11 Years of Dissolved Oxygen (DO) / Temperature Sampling at Little Sand Lake

In 2007, Big and Little Sand Lake Associations agreed to jointly purchase a high quality meter and a probe with 100 feet of cable to measure dissolved oxygen (DO) and temperature from the surface to bottom of the lakes. In 2007, sampling didn't get started until the equipment arrived in mid-June. Since then, sampling has usually started in mid-May and DO and temperature are measured about every two weeks through mid to late-October or November.

One of the reasons for measuring DO and temperature is to determine how much of the lake is suitable habitat for Cisco (tullibee), throughout the open water season. Cisco is a coldwater fish species that generally requires temperatures cooler than about 68º Fahrenheit (F), and dissolved oxygen levels greater than 3 parts per million (ppm). Ciscos are important because they are a primary source of food for the lake's predators, particularly walleye. Since Cisco are not very tolerant of warm water or poor water quality, they can also serve as an early detection of degrading conditions, the proverbial "canary in a coal mine".

The attached chart shows the results of sampling from 2007 through 2017. The black shaded areas show the bottom layer of water with DO levels less than 3 ppm. The dark gray shaded areas show the upper layer of water with temperature exceeding 68º F. The light gray shaded areas show the middle layer of water with conditions suitable for Cisco because temperatures were lower than 68º and DO was higher than 3 ppm.

When sampling starts in May, the lake is still somewhat mixed from the spring "turnover", so temperatures are low and fairly uniform from top to bottom. As surface water warms during the summer, the layer of water exceeding 68º F gets deeper. 2008, 2012 and 2016 were warmer summers, when the layer exceeding 68º went down to over 25 feet deep in late August or early September. 2013 and 2014 were much cooler summers. Surface water exceeded 68º for a shorter period, and then only down to about 22 feet.

Similarly, when sampling starts in May, DO levels are high and fairly uniform from top to bottom. As the summer progresses, oxygen is consumed by organic matter decomposing on the lake bottom. As more oxygen is consumed, the bottom layer of water with DO levels less than 3 ppm increases and water with DO greater than 3 ppm gets shallower. 2009 was the worst year for low DO, when only the upper 28 feet of water had DO greater than 3 ppm in mid-September. 2013 was one of the best years, when water down to 34.5 feet deep had DO greater than 3 ppm at all times. Later in the season, as water temperature cools and the water column mixes, DO is distributed throughout the water column and DO levels increase again in the lower layer of water.

As the two layers of unsuitable habitat for Cisco increase in mid to late summer, the middle layer of suitable Cisco habitat, where temperatures are less than 68º F and DO is greater than 3 ppm,

gets narrower. If the layers of unsuitable Cisco habitat get too large and reach each other or overlap, and the layer of suitable habitat is depleted, a fish kill of Cisco will likely occur. So far, we haven't seen that type of situation in Little Sand during the years that have been monitored. 2009 was the worst year observed so far. Water temperatures exceeded 68º down to 24½ feet and DO was higher than 3 ppm only down to 28 feet, leaving less than 3½ feet of suitable Cisco habitat. That's cutting it pretty close.

It will be important to continue monitoring DO and temperature in Little Sand Lake to look for even more extreme situations or long term trends. As you can see, conditions can vary considerably from year to year. If we have a worse year than 2009, and Little Sand experiences a summer fish kill of Cisco, it will be good to understand why and document those conditions. Increasing oxygen consumption resulting from unregulated development or other poor land use practices, or increasing temperatures as a result of climate change, could lead to less habitat for Cisco and increased potential for fish kills. Monitoring will help look for those types of long term trends.

If there are questions about this information, you can contact:
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