WHAT TYPE OF FISH CAN YOUR LAKE SUPPORT?

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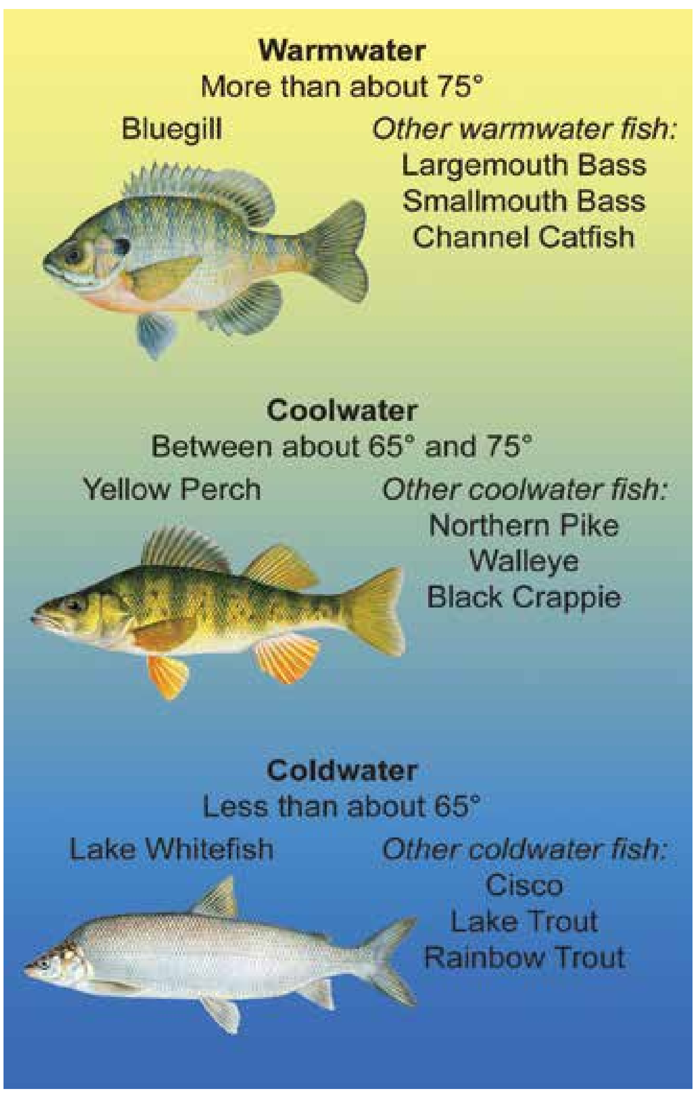
The type of fish your lake can support depends on several factors. Temperature, dissolved oxygen, depth, and lake productivity (the ability to support plant and animal life) can all influence whether certain fish species can thrive in a lake. This article examines some of these factors.

TEMPERATURE AND STRATIFICATION

Fish can be categorized by their summer temperature preferences, including warmwater, coolwater, and coldwater species (Figure 1).



Within a lake, especially in deep lakes, temperature can vary greatly from top to bottom, and different fish species inhabit different temperature zones.

Deeper lakes form temperature layers. As the ice cover breaks up in the spring, the water temperature becomes uniform from the surface to the bottom. This period is referred to as spring turnover because water mixes throughout the entire water column. As the surface waters warm, they are underlain by a colder, denser layer of water. This process is called temperature or thermal stratification. During summer there are three distinct layers. This is referred to as summer stratification. Once thermal stratification occurs, there is little mixing of the warm surface waters with the cold bottom waters. The transition layer that separates these layers is referred to as the thermocline. The thermocline is characterized as the zone where temperature drops rapidly with depth. As shown in Figure 2, warmwater fish tend to be found in the warm upper layer; cool- and coldwater fish prefer deeper waters where temperatures are cooler. As fall approaches, the warm surface waters begin to cool and become denser. Eventually, the surface temperature drops to a point that allows the lake to undergo complete mixing. This period is referred to as fall turnover. As the season progresses and ice begins to form on the lake, the lake stratifies again. However, during winter stratification, the surface waters (at or near 32°F) are underlain by slightly warmer water (about 39°F). This is sometimes referred to as inverse stratification and occurs because water is most dense at a temperature of about 39°F. As the lake ice melts in the spring, these stratification cycles are repeated. Stratification cycles do not occur in shallow lakes or may occur intermittently.

DISSOLVED OXYGEN

An important factor influencing fish is the quantity of dissolved oxygen in the water column. An oxygen level of about 5 parts per million is required to support warmwater

Figure 1. Cold-, cool-, and warmwater temperature ranges, and examples of fish species that prefer each range. Fish illustrations © Joseph R. Tomelleri (9537).

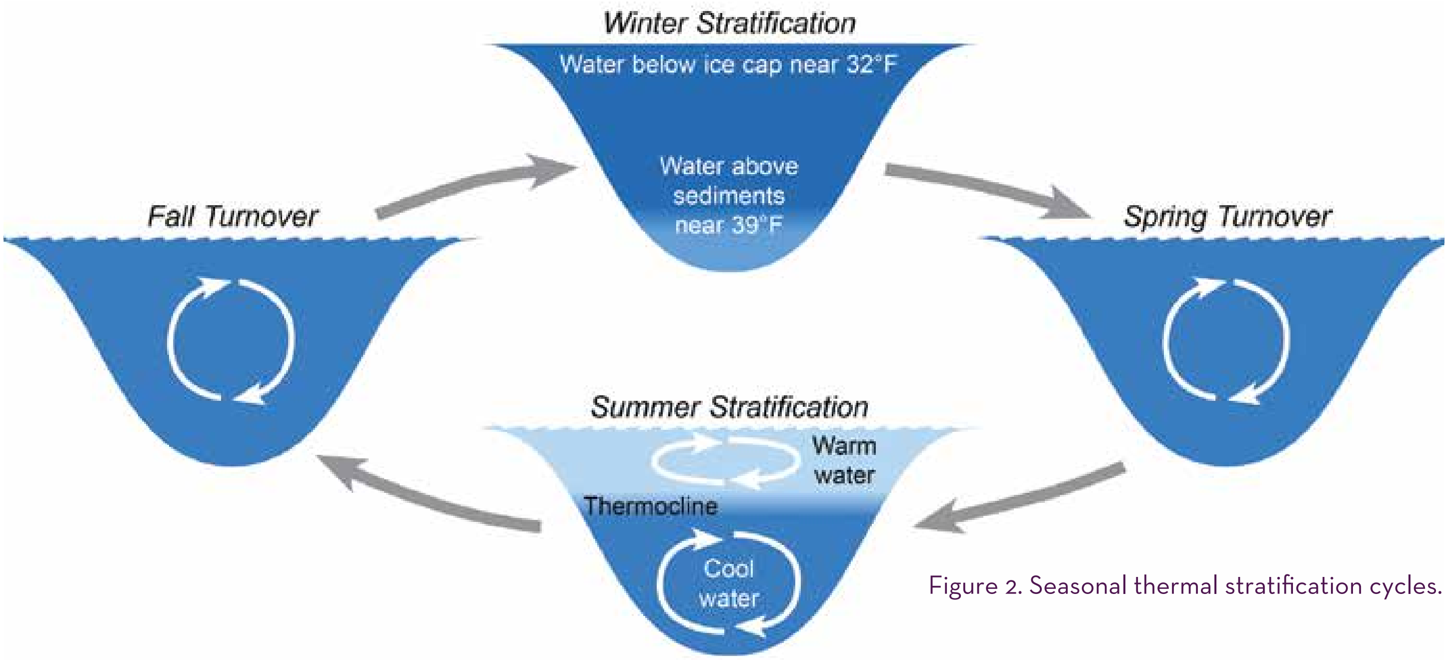


Figure 2. Seasonal thermal stratification cycles.

fish while coldwater fish require 6 to 7 parts per million. In general, cold water can hold more dissolved oxygen than warm water. The major inputs of dissolved oxygen to lakes are the atmosphere and photosynthetic activity by aquatic plants. In lakes deep enough to thermally stratify, oxygen levels are often reduced or depleted below the thermocline once the lake has stratified. This is because deep water is cut off from plant photosynthesis and the atmosphere, and oxygen is consumed by bacteria that use oxygen as they decompose organic matter (plant and animal remains) at the bottom of the lake. In nutrient-poor (oligotrophic) lakes, the cool, deep waters below the thermocline contain ample dissolved oxygen to support coldwater fish. However, in mesotrophic (moderately-enriched) lakes and eutrophic (highly nutrient-enriched) lakes, bottom-water oxygen depletion during summer is a common occurrence. These lakes lack a cold-water refuge for fish in summer. Thus, while warmwater fish can thrive in mesotrophic and eutrophic lakes, these lakes are not suitable for coldwater fish.

Houghton and Higgins Lakes provide a good illustration of how temperature and dissolved oxygen can impact fish. Located side- by-side in the north-central Lower Peninsula, these lakes are dramatically different. With a surface area over 20,000 acres, Houghton Lake is Michigan's largest inland lake by surface area, but has a maximum depth of only about 20 feet and an average depth of about 8 feet. By contrast, Higgins Lake has a surface area of nearly 10,000 acres, a maximum depth of 135 feet and a mean depth of about 44 feet. But the differences don't stop there.

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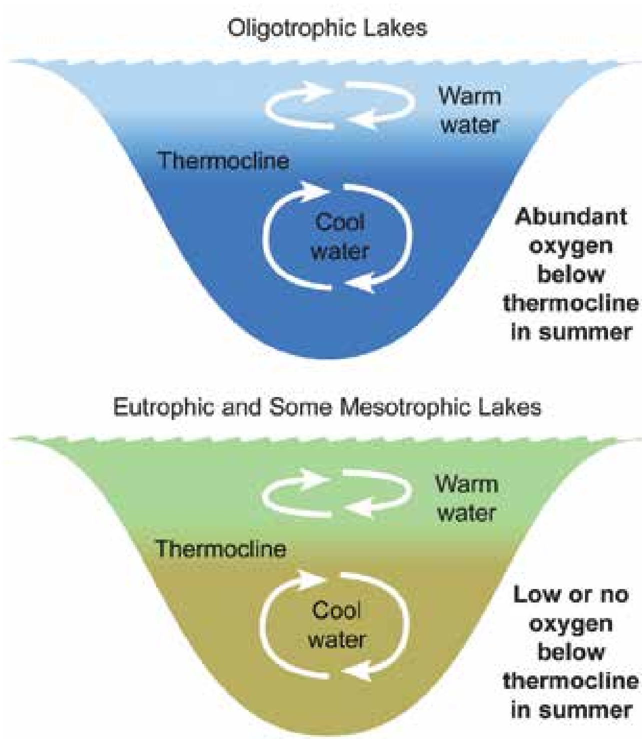

Figure 3. The relationship between trophic state and dissolved oxygen concentration.

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Houghton Lake is eutrophic with abundant aquatic plant growth. Because of its shallow depth, the lake rarely stratifies. During the summer months, it is generally warm and well-oxygenated from the surface to the bottom. Higgins Lake is oligotrophic with sparse aquatic plant growth. The lake is well-oxygenated from the surface to the deep waters during summer stratification. The cold, deep bottom waters in Higgins Lake provide excellent habitat for coldwater fish, and the lake supports both whitefish and trout. On the other hand, Houghton Lake is too warm during the summer to sustain trout, but the lake has good habitat for warm- and coolwater fish. Sunfish, bass, perch, crappie, northern pike and walleye are all found in the lake. If you are fishing for trout, Higgins Lake would be your choice. But if you are after warmwater and coolwater fish, you may have better luck fishing Houghton Lake.

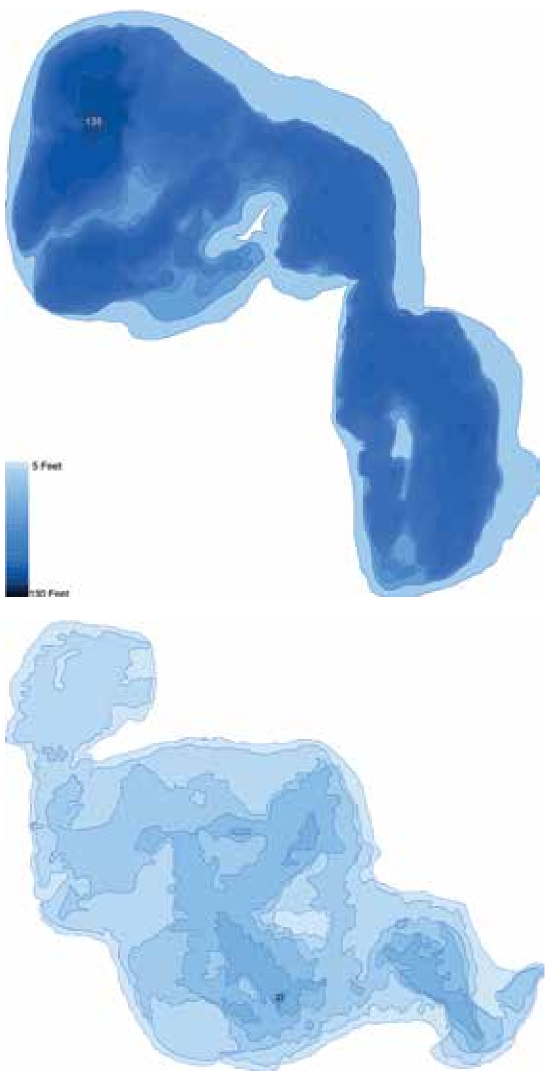

Figure 4. Depth contour maps of Higgins Lake (top) and Houghton Lake (bottom).

THE THERMOCLINE

The impacts of temperature and dissolved oxygen are often evident at the thermocline. In mesotrophic and eutrophic lakes during summer, coolwater fish such as pike and walleye will often suspend at or near the thermocline, where the water is cool and oxygenated. During prolonged periods of extremely hot, calm weather, dissolved oxygen decreases as lake waters warm. Coolwater fish can become stressed as shallow waters become too warm and deeper cooler waters lack oxygen. In extreme cases, a “summer kill” can occur. Pike and perch in particular are susceptible to these occurrences.

A highly prized coolwater fish, walleye are often chosen for stocking, but there are a couple things to consider. First, lakes that do not have natural populations of walleye often lack suitable spawning substrate—walleye need cool water and a rocky bottom to spawn successfully. In lakes lacking good spawning areas, walleye will not reproduce and will need to be constantly restocked to sustain the population. Another consideration is that walleye need a cool water refuge during the summer and, like pike, often suspend near the thermocline during the warm summer months. Stocking walleye could stress existing fish populations and disrupt the natural balance in the lake. In addition, walleye are considered a top predator; stocking the fish may disrupt normal predator-prey interactions to the detriment of native predator fish such as bass. A fisheries biologist should be consulted before arbitrarily stocking walleye.

CLIMATE CHANGE

The potential impacts of climate change on fish populations are beginning to emerge. These impacts are both subtle and profound. In some lakes, cool- and coldwater fish may well be extirpated. In the Great Lakes, climate scientists anticipate changes in both fish species abundance and distribution.

In a recent study of Wisconsin Lakes (Hansen et al. 2017), researchers noted that climate change may result in an increase in the range of warmwater fish such as largemouth bass and a concurrent decrease in coolwater species such as walleye. Given the variability in lake types, the impacts of climate change will likely vary with some lakes being more resistant to climate-influenced changes than others. The authors concluded that "Climate change undoubtedly will influence the species composition of temperate lakes, with many lakes becoming more suitable for warmwater species and less suitable for cool- and coldwater species."

Climate change appears to be impacting the freeze and thaw cycles in lakes by causing later dates of ice freeze-up and earlier dates of ice break-up (Vincent 2009). For nearly 100 years, freeze and thaw cycles on Gull Lake in Barry and Kalamazoo Counties have been monitored. During that timeframe, the duration of ice cover has decreased on average by about 20 days (Gull Lake Quality Organization). The data for Gull Lake are consistent with other mid-western lakes where long-term ice cover records are available. It is not clear how reduced ice cover will impact fisheries, but in some lakes reduced ice cover may reduce the occurrence of "winter kill" caused by dissolved oxygen depletion during periods of prolonged ice cover (Vincent 2009).

Scientists anticipate climate change will impact natural precipitation and evaporation rates, temperature and stratification cycles, dissolved oxygen levels, and increase watershed runoff which, in turn, may accelerate lake eutrophication (Vincent 2009, Stoddard et al. 2016). Various government agencies and the scientific community are working to develop long-term management strategies to address these threats.

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