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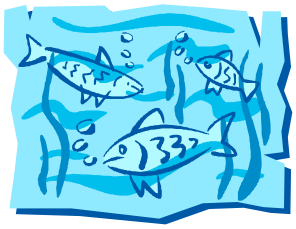

HARTWELL LAKE FISH EXPERIENCE YEARLY "TURNOVER"

Hartwell Lake is typical of most Southeastern U.S. lakes. These lakes go through many physical changes throughout the year. The changes occurring in Hartwell Lake that have the most affect on fish relate to water temperature and dissolved oxygen. Most species of fish have no trouble adjusting to these yearly changes but there are exceptions. The following information explains these changes and the influence water conditions have on the biology and behavior of fish.

Hartwell Lake forms distinct layers that change with the season and differ in water chemistry. This process, called stratification, greatly affects the location and condition of fish at different times of the year. Early in the spring the water temperature of Hartwell Lake is about the same from top to bottom. As the days get longer and warmer, the surface water warms faster than the water below it. The difference in water temperature with depth results in the formation of three distinct layers of water that is defined by their temperature differences. The first layer is called the *epilimnion.* During the summer stratification, this is the layer of water that represents the upper, warm, circulating water. Immediately below the epilimnion is a layer of water called the *thermocline.* This is the layer of water that shows a rapid rate of temperature decrease with depth. Because water in thermocline is much colder than water in the epilimnion, it is much denser. This denser water acts like a cover that keeps the warmer, lighter water in the epilimnion from mixing with the water below it. The third layer of water is called the *hypolimnion.* It is characterized by uniformly cold, relatively undisturbed water that extends from immediately below the thermocline to the bottom. Once the stratification pattern sets up in the spring, it remains until the fall. In the fall when the water in the epilimnion cools to about the same temperature and same density as water in the thermocline, the three layers of water mix. The process of the thermal layers mixing in the fall is often referred to as the lake *"turning over."* The chart below illustrates a typical summer temperature pattern.

When the epilimnion, thermocline, and hypolimnion develop in the late spring or early summer, there is an adequate supply of oxygen in all three layers of water. As the summer progresses, however, the amount of oxygen in the hypolimnion decreases. (Remember, the thermocline acts as a cover and keeps the water in the epilimnion from mixing with the water below it). Water in the epilimnion is in contact with the rich supply of oxygen

in the air so it is constantly supplied with oxygen. However, once the stratification process sets up in the summer, the thermocline acts as a barrier between the oxygen-rich water in the epilimnion and the hypolimnion. Oxygen used up by organisms in the cool hypolimnion cannot be replaced until the fall turnover.

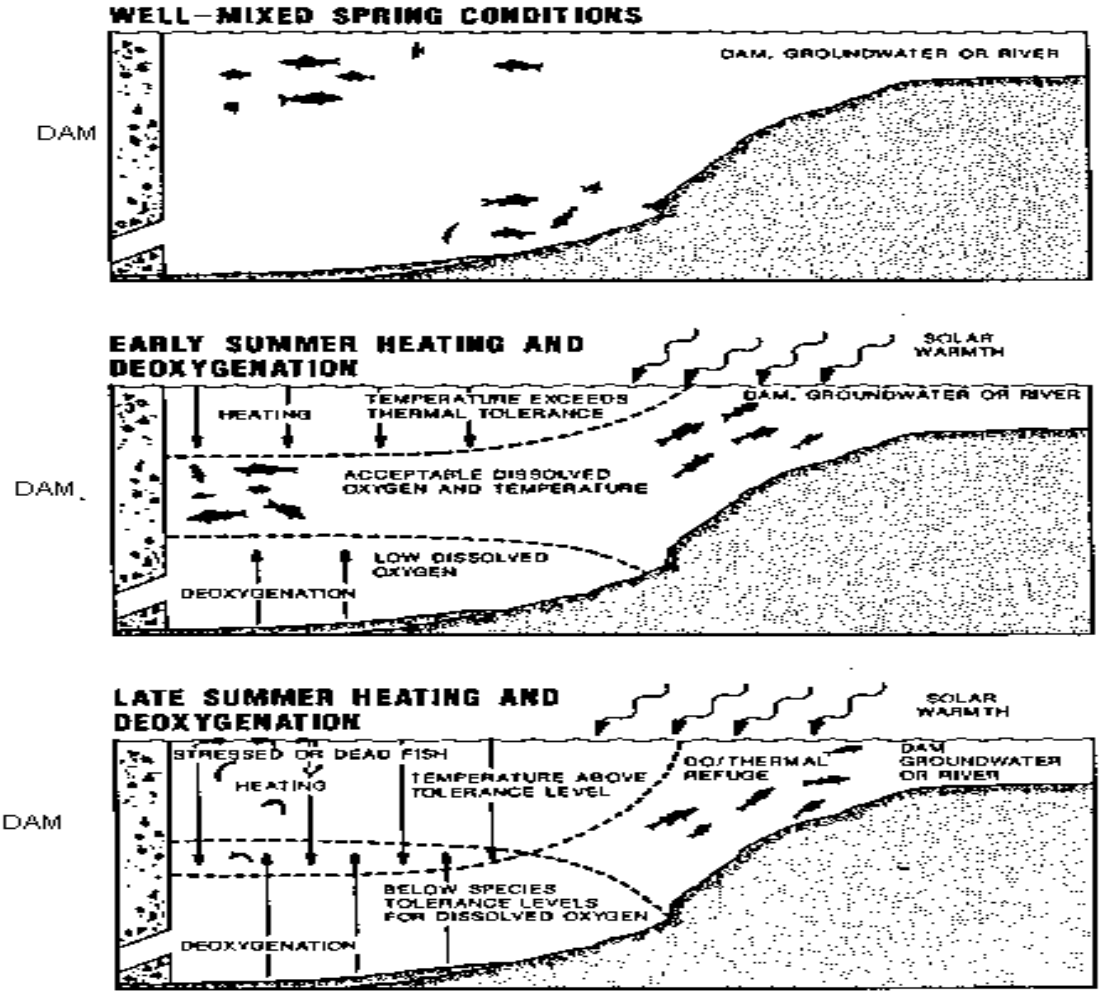

Figure 1. Adverse Conditions for Dissolved Oxygen and Temperature Developing in a Stratified Freshwater Reservoir during the Summer.

The decline in dissolved oxygen makes it impossible for most fish to live in the cool hypolimnion in Hartwell Lake during late summer and early fall. This is especially true of *anadromous* fish (fish which can live in salt and fresh water). These fish require cool, well-oxygenated water. Examples of anadromous fish in Hartwell Lake include blueback herring and striped bass. Although these fish species have become important forage and game fish, they are introduced marine species that are not compatible with the low hypolimnetic dissolved oxygen and high epilimnetic water temperature that occurs in Hartwell Lake each summer and fall. Striped bass found dead floating in late summer and early fall may be attributed to the stress of living in these water quality conditions. These conditions also cause several thousand blueback herring to school in the deep-water forebay of Hartwell Dam in late summer where they seek cool water with the highest concentration of oxygen remaining in the hypolimnion. This puts the fish in jeopardy of being entrained through the dam during hydroelectric power generation. Following water quality and fisheries studies, the U.S. Army Corps of Engineers implemented a monitoring plan in 1990 to minimize the number of blueback herring entrained each year.

Stratification is a natural process in southern lakes and is one of the prime factors that affect fish. This can be a problem for stocked or introduced cold-water fish. However, native species such as largemouth bass, crappie, and bream live quite successfully in the warm epilimnion. Understanding how this process works and affects fish will help you better understand the yearly changes taking place in Hartwell Lake.