

Land & Water

Conserving Natural Resources in Illinois

University of Illinois Extension • College of Agricultural, Consumer and Environmental Sciences

Pond Dynamics

Ponds and Temperature

Thousands of farm ponds dot the landscape across rural Illinois. These non-freeflowing bodies of water are considered to be ponds when they are less than 20 acres. What's more, they are scenic, functional, and deeply affected by the interplay of a host of environmental factors, such as temperature, oxygen content, nutrients, and biological activity.

For instance, take the case of changing temperatures within a pond...

Water reaches its maximum density, or weight, when its temperature is 39 F. As temperatures either drop below or rise above 39 F, water density lessens. This is important because water density has a major effect on the stratification, or layering, of water. And stratification can sometimes affect oxygen levels available for fish and other aquatic life.

To understand how this can happen, take a look at the seasonal stratification process.

Spring. In early spring, the different layers of water mix. But as surface water warms, it decreases in density or weight. A layer of warmer, less dense water forms on top, while the cooler, denser water forms a layer near the bottom of the pond. Stratification has begun.

Summer. As summer progresses, so does stratification. The warmer water remains on top, while the cooler water stays below. In between the two layers, a transition zone forms during the summer. This "thermocline" zone is characterized by a rapid change in temperature.

Fall. During fall, stratification disappears, allowing surface and deeper waters to mix. This is sometimes known as the "fall turnover" and may be characterized by a temporary change in water color or turbidity (cloudiness). As water mixes, sediment from the bottom is stirred up, causing the water to become a muddy brown.

Winter. Stratification returns in winter. A layer of colder water (near freezing) forms on top, just beneath the ice cover, while slightly warmer water (near 39 F) stays close to the bottom.

This pattern is the typical way in which stratification plays out over the seasons. But problems can arise if the pond's "turnover" occurs prematurely during the summer. If there is a heavy, cold rain, the cold, dense water sinks, causing oxygen-depleted water at the bottom to mix with the surface waters.

The result: There is less oxygen in the surface water. In some cases, "catastrophic oxygen depletion" can even lead to a large fish kill in the pond.

Ponds and Dissolved Oxygen

In addition to the problems posed by premature turnover, ponds can become oxygen-depleted for other reasons—such as when there is an overabundance of microscopic plants (which give the pond a green color) coupled with several cloudy days.

Photosynthesis by aquatic plants produces oxygen during the day. But at night, these plants consume a lot of the oxygen. Therefore, if you

have several cloudy days, the plants may not produce as much oxygen by day—and then they deplete the oxygen at night. This can lead to early morning fish kills. Other factors that affect oxygen levels include the following:

Temperature. Warmer water holds less dissolved oxygen than cold water.

Biological Oxygen Demand (BOD). This is the amount of oxygen required for microbes as they decompose organic materials. Large amounts of decomposing material create a high BOD, lowering dissolved oxygen levels for fish.

Time of year. If a pond is covered by ice and snow in winter, dissolved oxygen content can plummet, leading to winter fish kills. Seasonal turnover of water can also create low dissolved oxygen levels near the surface.

Ponds and Nutrients

Nutrients such as nitrogen and phosphorus are essential for aquatic plants and microbial activity. However, excessive levels of these nutrients can create an overabundance of plant growth. Surface runoff from nearby lawns or fields that have been fertilized can lead to excessive weed growth, including filamentous algae—better known as “pond scum.”

Ponds and Biological Activity

Depending on the depth of the pond, two or three biological zones may be present.

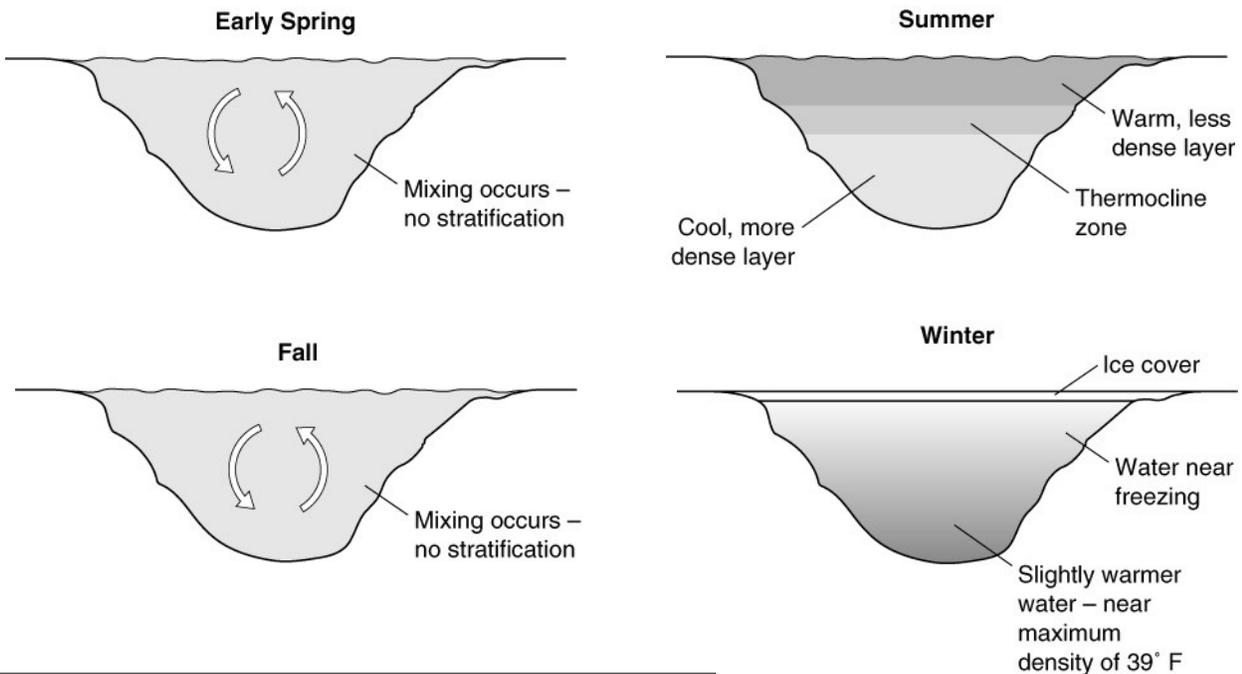
The Littoral Zone is close to shore. It has an abundance of rooted and floating plants, and it contains a diverse biological community.

The Limnetic Zone is found in deeper water away from the shore. It contains a large amount of microscopic organisms.

The Profundal Zone is the lowest zone, found only in deep ponds. It receives little or no sunlight, and organisms rely on the settlement of organic matter to the bottom for survival.

All ponds require some aquatic plants to be present for fish habitat and oxygen replenishment. Living trees along the shoreline provide shade, as well as organic matter for fish to feed on. Dead trees in ponds provide habitat for aquatic insects and cover for young fish.

Each pond, no matter how small, is a dynamic aquatic ecosystem. As with any ecosystem, a change in one part of the system will affect the other parts. So be sure to consider all aspects when managing your pond.



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Prepared by

Duane Friend, U of I Extension natural resources educator
 Dave Shiley, U of I Extension natural resources educator

