

# Managing Missouri Fish Ponds During an Extended Drought



*Figure 1. During a drought, water levels drop in watershed ponds, crowding fish and increasing the potential for aquatic vegetation and oxygen depletion problems.*

**M**any Missouri ponds are watershed ponds that rely on surface runoff to maintain proper water levels (Figure 1). Continued drought combined with high temperatures can have devastating effects on fish ponds. Drought conditions tend to reveal poor pond construction and magnify the potential for a fish kill. Even ponds that have been properly designed and constructed within a watershed can have problems.

Ponds that typically are the first to have problems are those in very small watersheds or on marginal soils. A small watershed is one where the area surrounding the pond is too small to provide enough runoff to maintain the pond's water level during years with average rainfall. In Missouri, the recommended watershed-to-pond acreage ratio is between 15-to-1 and 20-to-1, which means a watershed must be at least 15 acres to provide runoff for a 1-acre pond.

As pond levels decrease through seepage, evaporation and lack of runoff, several problems can occur:

- Fish may become stressed as the pond becomes more crowded and they are confined in smaller areas of water.

- Waste metabolites such as ammonia, carbon dioxide and nitrates become more concentrated, which can further stress and even kill fish.
- Less dissolved oxygen is available for the fish to breathe as they and other aquatic organisms are crowded into smaller volumes of water.
- Unwanted aquatic vegetation and algae begin to grow as nutrient levels in the pond become more concentrated.

## Pond water level

During drought, pond water levels will continue to drop, exposing the shoreline and further reducing pond volume. The combination of these events causes fish crowding and stress, and increased aquatic plant growth. Aquatic plants begin growth near the shoreline in shallow water that is less than 3 feet deep. Properly constructed ponds will have deeper shoreline areas. However, drought conditions will create shallow areas that expose plants to more sunlight and encourage their rapid growth. Plants grow quickly in warm water, so develop an aquatic plant management plan before a drought progresses very long. Aquatic plants can be reduced or controlled through several practices including use of recommended aquatic herbicides and stocking of grass carp. Excellent aquatic plant identification and control recommendations can be found on the Texas A&M University's Aquaplant website, <http://aquaplant.tamu.edu>.

This aquaculture guide is one in a series being developed jointly by MU Extension and Lincoln University.



Written by  
**Robert A. Pierce II**, Fisheries and Wildlife State Specialist, School of Natural Resources  
**Charles E. Hicks**, Aquaculture Specialist, Lincoln University



**Figure 2.** As a drought continues, pond waters can drop to dangerous levels, increasing aquatic plant growth, decreasing water quality and stressing fish, making them more vulnerable to disease and death.

## Aeration and pond oxygen

As a drought progresses, the danger of oxygen depletion in a pond greatly increases. Warm water holds less dissolved oxygen than cooler water. Dissolved oxygen (DO) is measured in a few different ways: parts per million (ppm), milligrams per liter (mg/L) or percent saturation. When measuring dissolved oxygen, concentrations range from 0 to 14 ppm or mg/L (both units of measure are the same; an oxygen test kit will use only one of them). Generally, fish become stressed when dissolved oxygen levels fall below 5 ppm, which is equivalent to 5 mg/L. The lower the concentration, the greater the stress. Dissolved oxygen levels that remain below 1 to 2 mg/L for a few hours can result in large fish kills.

The relationship of water temperature and the amount of dissolved oxygen available in the water is shown in the following example. At 77 degrees F, dissolved oxygen saturation in water is about 8 ppm; at 95 degrees F, it is about 7 ppm. Let's assume that a 3-acre pond with an average depth of 4 feet (3 acres  $\times$  4 feet = 12 acre-feet of water) at normal water levels last spring had 1,500 pounds of fish. If the water temperature was 77 degrees F and if the water was saturated with oxygen, 264 pounds of oxygen would have been available for the fish to use. Now let's assume that this summer the pond has a surface acreage of only 1.5 acres and an average depth of only 2 feet (3 acre-feet of water) and still supports 1,500 pounds of fish. If the water temperature was 95 degrees F and the water was saturated with oxygen, only 57 pounds of oxygen would be available to the fish. These differences will influence the survival of the fish in your pond.

In addition, algae and aquatic plants become more abundant in warm water and in ponds with lower water levels (Figure 2). Although plants produce oxygen during daylight hours, they consume oxygen at night and during extended periods of cloudy weather. Also, intense sunlight can cause algal blooms to die off, which further depletes oxygen. More abundant vegetation can also cause wide swings in pH levels because during the day when the plants

are carrying on photosynthesis they use carbon dioxide ( $\text{CO}_2$ ), which combined with water acts as a weak acid. As the  $\text{CO}_2$  is used up, the water becomes more alkaline and can reach pH levels above 10, an uncomfortable range for warm-water fish.

The use of supplemental aeration in ponds can protect fish during a drought. The simplest solution is to use an electric aerator that provides about  $\frac{3}{4}$  horsepower of efficient aeration per acre of pond area. Operate the aerator as needed or by a timer set to operate during the night. Other aeration solutions include pumps and outboard motors. Pumps can be used to circulate pond water, and the water can be splashed over a diffuser to increase the oxygen content. A drop of at least 2 feet, from the diffuser to the pond water, is needed to allow time for the water to absorb oxygen from the air. Pumps are efficient in moving water but usually move less water per horsepower than pond aerators. A pump can be used most efficiently to create a sanctuary area for fish to gather rather than to aerate an entire pond. Outboard motors can be carefully positioned to stir and splash pond water, but use this method only in dire emergency and be sure to follow safety precautions.

## Warning signs of oxygen depletion

Oxygen depletion is the most common cause of fish kills in ponds. Fish kills from oxygen depletion can occur from April through November but are most common during the months of July, August and September. The weather during these critical months can trigger oxygen depletion, so monitor local weather conditions and observe your pond on a frequent basis.

- Check the pond early in the morning; this is when dissolved oxygen levels will be at their lowest.
- Watch for any changes in pond water color. A change from green to brown, grey or black may indicate that the algae has died and oxygen depletion will occur in as little as 24 hours.

- Cloudy weather reduces the amount of sunlight available for plants to use in oxygen production. Oxygen may deplete rapidly after two or three days of cloudy weather.
- Windy weather may cause shallow ponds to “turn over” and mix water that has lower amounts of oxygen throughout the pond. This condition is particularly dangerous when dense blooms of algae are present on the water surface.
- When being fed a supplemental feed, fish eat less or stop feeding altogether. Carefully observe the feeding behavior of fish as a sign of low oxygen, and take preventive measures to provide supplemental oxygen.
- Fish will come to the surface in the morning and gulp air when oxygen levels are lower and as oxygen is being depleted in the water. When you see this behavior, aerate the pond immediately.

## Reducing the chance of a fish kill during a drought

In addition to watching for and treating for an oxygen depletion by providing supplemental aeration, pond owners can reduce the chance of a fish kill by taking preventive actions in the management of a drought-affected pond.

- Keep cows and other livestock from having direct access to the pond. Livestock wading in the pond will make the water muddy and further stress the fish. Also, manure in the pond will contribute to oxygen depletion.
- Do not apply aquatic herbicides to the pond during a drought. High temperatures and decreasing water volume will increase the chance of oxygen depletion as a result of increasing plant decay during decomposition.
- Take measures to thin the existing fish population, such as fishing the pond more.
- Increased fertility will influence the production of dissolved oxygen and consumption in a pond. The two primary sources of dissolved oxygen are photosynthesis from green plants and diffusion from the air. The green color of water in a pond is from a bloom of microscopic green plants known as phytoplankton. These microscopic aquatic plants, like other plants, produce oxygen in the presence of sunlight but use oxygen during periods of darkness. This activity results in wide daily fluctuations of dissolved oxygen, with very high concentrations in the late afternoon and low concentrations just after dawn. Under normal conditions, dissolved oxygen concentrations in the pond will reach a state of balance with the phytoplankton producing as much oxygen as they use. A problem is most likely to occur when the phytoplankton use more oxygen than they produce. This problem is compounded by reduced water levels and higher water temperatures. As discussed earlier, warmer water contains less dissolved oxygen; and if the same amount of nutrients are

present in this reduced volume of water, the nutrients become concentrated and will support a greater amount of phytoplankton. Thus, very fertile waters are more likely to experience oxygen depletions during an extended drought.

- Proper watershed management is key to maintaining a healthy pond. One frequent problem is over-use of fertilizers in the watershed, which compounds vegetation problems and oxygen depletions. Original placement, design and construction are also very important, especially during drought years. As stated earlier, a ratio of 15 acres of watershed to 1 acre of pond surface is recommended. Even in dry years, this ratio ensures adequate exchange of water and can help prevent a pond from drying up.

## Fish diseases and stress

Drought conditions may increase the prevalence of some fish diseases. Diseases that occur in warmer water temperatures include columnaris, aeromonas, enteric septicemia of catfish (ESC) and several viral infections. Any stressful condition increases the likelihood that these diseases will occur. Parasitic diseases including gill parasites and grubs may become a problem as fish are crowded into smaller volumes of water.

Columnaris is a bacterial disease that is more frequent in temperatures above 70 degrees F than at lower temperatures. This bacteria is present in the soils of most ponds and becomes pathogenic when fish are stressed or in crowded conditions. Pond water pH may be increased by liming during the winter months to make columnaris infections less likely.

Other soil-borne bacteria that are common belong to the genus *Aeromonas*. Aeromonas infections occur when fish populations are overcrowded and under increased stress. Partial oxygen depletion can cause increased infections. If aeromonas is observed in species such as channel catfish, feed Romet medicated feed immediately. For medicated feeds to be effective, feed them for the specified time at a quantity that will deliver the proper dose to the fish. If you are currently restricting feed to your fish, you should increase the feeding rate to the amount that fish will consume in 20 to 30 minutes when feeding medicated feed.

ESC is caused by a bacteria that is carried by most catfish in the U.S. Most ESC infections occur in water that is between 75 and 82 degrees F and are the result of fish being exposed to stressful conditions. Common stressors that encourage an outbreak of ESC are low dissolved oxygen or a rapid change in water temperatures.

Most catfish populations in the U.S. also carry channel catfish virus, though resistance to the disease has developed over time. However, if catfish develop swollen bellies and pop-eyes, you may suspect channel catfish virus. Water temperatures over 77 degrees F increase the frequency of this disease. Other viruses affect largemouth bass and catfish, but are not as prevalent as ESC and channel catfish virus.

Shallow water and crowded fish populations can attract wading birds and other wildlife that may carry diseases. Yellow grub infestations seem to have increased in Missouri the past few years and become more prevalent during drought conditions. Controlling snails in ponds may prevent severe infestations, but control measures may not be practical. Including red-ear sunfish as one of the bream species when stocking ponds may help reduce the danger of a grub infestation; these fish forage on snails and other invertebrates that spread diseases.

To prevent stress, avoid moving fish in hot weather. If fish must be moved, use calcium chloride, calcium carbonate or sodium chloride to harden the fish before transport.

Refer to MU Extension publication G9402, *Collection and Submission of Samples for Fish-Kill Investigation and Toxic-Substance Analysis*, for more information on preventing fish diseases and collecting fish for disease diagnosis. The Lincoln University Aquaculture Program conducts fisheries disease diagnostic services. For information on submitting fish and water samples for diagnosis, call 573-681-5452.

## Observe your pond and quickly react to changes

If possible, observe your pond daily during a drought. As discussed, a drought will cause a pond and its water quality

to change, which will impact the fish. Your quick reaction to these changes may save your fish or reduce treatment costs. Remember that the water will be hot and that increased temperatures accelerate the chemical and biological processes occurring in the pond. Make a plan for how you will treat various problems so that you will know what to do and can quickly take corrective action when a problem is identified.

In addition, contact the Missouri Department of Conservation (MDC) (<http://mdc.mo.gov/node/6>) or your local MU Extension center (<http://extension.missouri.edu/locations>) for additional recommendations on controlling nuisance aquatic plants, managing pond water quality and preventing a fish kill during a drought. The Department of Conservation's Missouri Pond Handbook and aquaguide series, <http://mdc.mo.gov/node/3117>, provide excellent information on pond management and techniques to prevent and solve pond problems.

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Portions of this publication were adapted from *Managing Fish Ponds During a Drought*, University of Georgia Cooperative Extension Special Bulletin 49, developed by Gary J. Burtle, Extension Aquaculture, Fisheries and Animal Sciences.

### ALSO FROM MU EXTENSION PUBLICATIONS

G9402 *Collection and Submission of Samples for Fish-Kill Investigation and Toxic-Substance Analysis*

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