

Understanding and Preventing Fish Kills in Your Pond

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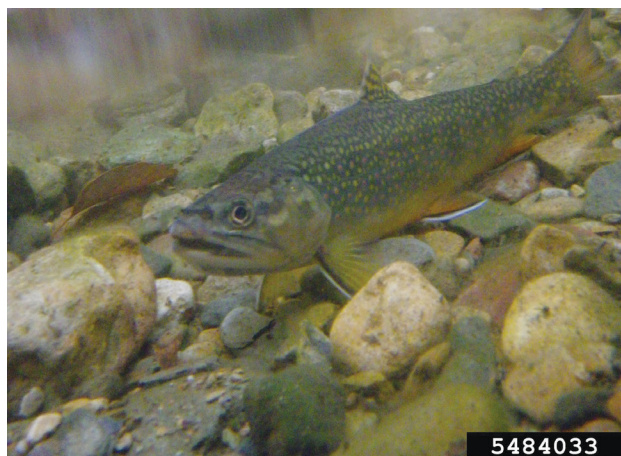
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INTRODUCTION

Fish mortality in ponds is a natural process, and noticing the occasional dead fish along shoreline areas is not unusual. Natural causes include predation, old age, minor disease outbreaks, handling, or spawning stress. However, when large numbers of dead fish are observed at one time, there is reason for concern. Unfortunately, by the time dying fish are observed, it is often too late to stop the fish kill; however, future fish kills can be prevented by understanding the causes.



(Trout photo by USDA Forest Service Southern Research Station Archive, USDA Forest Service, SRS, Bugwood.org.)

OXYGEN-RELATED FISH KILLS

The most common cause of fish kills is suffocation due to lack of dissolved oxygen. Most dissolved oxygen is produced by algae and aquatic plants through photosynthesis. A lesser but also important source of oxygen in water is diffusion from the atmosphere, which is enhanced by wind-induced surface water turbulence. During the night, oxygen is consumed for respiration by plants and animals, and by bacteria during decomposition of organic material. When more oxygen is consumed than is produced, oxygen levels can be depleted, which can lead to fish kills. Ponds suitable for supporting fish should have a minimum pre-dawn oxygen level that is close to optimal levels required by the fish. Warmwater fish require oxygen levels of 5 ppm (parts per million) and coldwater require levels of around 6.5 ppm to maintain good health. A sign of oxygen stress is fish gulping for air at the surface, particularly in early morning. Large fish will die first since they have greater oxygen demands. The following are scenarios that can lead to oxygen depletion and fish kills unless precautions are taken.

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(Bluegill photo courtesy of Dr. Michael Masser, Texas A&M University.)

Summer Fish Kills

Excessive vegetation. Summer fish kills are more common in shallow ponds that are heavily vegetated, in which 60 to 80% of the pond surface is covered with plants. Under these conditions, problems can arise after long periods of hot, cloudy, still (windless) weather conditions where water temperatures rise above 85°F (29°C). High temperatures allow less oxygen to dissolve into the water, cloudy skies prevent plants from producing sufficient oxygen through photosynthesis, and calm winds prevent turbulence and mixing of atmospheric oxygen into surface water. Ponds can usually withstand a number of consecutive hot days and nights, but if these conditions persist, oxygen levels may decline to levels harmful to fish. Larger fish usually die first because their oxygen requirements are greater than those of smaller fish.

Phytoplankton natural die-off. Nutrient-enriched ponds often produce dense blooms of microscopic algae (called phytoplankton), giving them a deep green colored appearance. Sudden phytoplankton die-offs can occur following consecutive days of cloudy, hot, windless conditions. When an algal bloom “crash” occurs, the water will appear to have turned black or clear overnight. The sudden die-off of algae will lead to a rapid decline in dissolved oxygen as bacteria decompose the dead algae. This can lead to dangerously low levels of dissolved oxygen, which can result in fish kills.

Herbicide overuse. Another cause of fish kills during summer months can be herbicide overuse leading to a massive die-off of either algae or aquatic weeds. Pond owners often wait until their ponds are overrun with aquatic plants or algae before initiating any con-

trol measures. If all the vegetation is treated simultaneously with an herbicide/algaecide, a massive die-off of the vegetation will occur shortly after the treatment. When this happens, bacteria will immediately begin to break down the dead plant material, and dissolved oxygen levels will decline rapidly. Not only will oxygen levels decline in response to increased bacterial activity needed to decompose all the dead plant material, but there is no longer oxygen being produced by the plants/algae that were killed by the herbicide/algaecide. Under these conditions, oxygen consumption far outpaces oxygen production, and levels will decline rapidly, leading to fish kills.

Premature turnover following heavy rains.

Many ponds deeper than 8 to 10 feet tend to stratify in the summer, resulting in a warmer, lighter, more oxygenated upper layer on top of a colder, denser bottom layer. This stratification will break down naturally in the fall when the pond undergoes a normal turnover as water temperatures decline and the increasingly cooler, denser water of the upper layer begins to sink, thereby mixing the entire water column.

Over the course of the summer, large amounts of organic matter can accumulate in the deeper areas of stratified ponds. By the latter part of the summer, oxygen in this bottom layer will be used up as this organic material decomposes. Premature mixing of these stratified layers can occur during the summer after a heavy cold rain. Oxygen-poor bottom layers mix with upper layers, resulting in critically low oxygen levels throughout the water column and possible fish kills.

Winter Fish Kills

Although winter fish kills may not be a common problem for many New Mexico pond owners, in northern, higher-elevation areas that receive snow and where ponds may ice over for extended periods of time, winter fish kills may occur. During the winter months, low water temperatures limit plant growth and photosynthesis, thus reducing the overall production of oxygen. This does not necessarily cause problems for fish since the reduced oxygen production is offset by their lower metabolic rate and oxygen requirements during winter months. However, this reduction of oxygen due to less photosynthesis can be further exacerbated when ponds are covered with ice, which prevents gas exchange, and snow, which blocks and prevents the penetration of sunlight into the water. Ice alone is not usually a problem because sunlight can penetrate, allowing photosynthesis to occur. However, ice combined with snow can deplete oxygen levels if they persist for a prolonged period of time, which can lead to fish kills.

PREVENTING OXYGEN-RELATED FISH KILLS

Preventing Summer Fish Kills

In all cases described above, oxygen depletion is the cause of fish kills. Preventing oxygen depletion is difficult, but proper pond management and construction can help prevent fish kills. The following suggestions will help.

Installing an aeration system to circulate and aerate oxygen-deficient water is recommended. Several types of aerators are available, including fountains and pump-operated bubblers or diffusers that sit on the bottom of ponds. To be effective, bubbler/diffuser systems must be turned on early in the spring and run nonstop all summer until temperatures begin to cool in the fall. If you opt for the diffuser-type of aerator, do not allow it to rest on the pond bottom since this will stir up organic materials, which will lead to increased oxygen consumption as the material is broken down by bacteria. Instead, place the diffuser on a pedestal or in a weighted 5-gallon bucket, or suspend it at least two feet off the bottom. Aeration also helps accelerate the decay of organic matter, which helps reduce buildup. In addition, aeration will help circulate and aerate oxygen-deficient bottom water, thus preventing stratification and potential fish kills due to summer inversions. Commercial aerators do an excellent job of aeration. The paddlewheel type is especially effective because it moves a large volume of water. During extremely hot weather, check your pond regularly at sunrise for signs of stressed fish. If you observe fish gulping at the surface during early morning hours, immediately stop feeding them and attempt to increase aeration.

Cultural methods, such as adding fresh water and deepening shallow areas of ponds (when possible) to limit vegetation growth and increase water volume, are also recommended. The recommended slope is 3:1 (for each 3 feet of distance from the shore there is a 1-foot drop). Limit animal waste from entering the pond to prevent excess organic matter buildup; excess organic matter can use up oxygen as it is broken down by bacteria. Do not allow livestock to wade in the pond. Creating and maintaining a buffer strip around the edge of the pond to prevent animal wastes and fertilizers, which contribute to algal blooms and aquatic weed infestations, from entering the water can be very effective at reducing nutrient loading to ponds. Buffer strip widths of anywhere from 20 to 50 feet are recommended.

Prevent aquatic weeds from accumulating to excessive levels since they will use up large amounts of oxygen when they decompose. This can be achieved by mechanical, cultural, and chemical methods. However, if you decide to use chemical means to control the weeds during the summer months, it is wise to consult a weed control specialist, fisheries biologist, or Extension agent (<https://aces.nmsu.edu/county/>). If an herbicide application is necessary, treat no more than one-fourth to one-third of

the pond at a time with 10 to 14 days in between treatments to prevent oxygen depletion and a resulting fish kill. In addition, do not wait until your pond is overrun with weeds before deciding to apply an herbicide. It is always better to treat the problem at its early stages when weeds can be more easily controlled. For more information on aquatic weed control, refer to NMSU Extension Circular 681, *Managing Aquatic Weeds* (https://aces.nmsu.edu/pubs/_circulars/CR681.pdf).

Preventing Winter Fish Kills

Aeration is also very effective at preventing winter fish kills, and can be achieved by maintaining an open water area during the winter and facilitating oxygen exchange from the atmosphere. The aeration system does not need to be run continuously all winter, only sparingly to minimize ice cover. Turn it on when ice is forming on the pond and leave it off when the pond is ice-free. If your pond is iced over but aeration is not an option, winterkills can often be prevented by removing snow covering the ice on frozen ponds. The snow blocks sunlight, thereby preventing submerged plants from oxygenating water through photosynthesis. Remove snow from 30 to 50% of the pond surface, but only if ice is thick enough to stand on safely. A good rule to follow is if ice is 4 inches thick, it is safe to stand on. If the ice is unsafe, remove the snow from the shoreline areas where submerged vegetation would be located beneath the ice.

FISH KILLS DUE TO PESTICIDE POISONING

Although fish kills caused by pesticides are not as common as those caused by oxygen depletion, some do occur. It is not easy to determine the cause of a fish kill, but fish that are affected by pesticides will generally show some of the following characteristics within 24 hours of a pesticide application:

1. **Sluggishness**
2. **Loss of equilibrium**
3. **Hypersensitivity and/or erratic, uncoordinated movements (when startled, fish will often swim in circles)**
4. **Tremors, convulsions, and “coughing”**
5. **Gross involuntary extension of pectoral fins and opercula (gill covers)**
6. **Spinal curves due to involuntary muscle contractions**
7. **Death**

Unlike fish kills related to oxygen deficits where larger fish die first, in a pesticide-caused fish kill the smaller fish will die first. Additionally, pesticide-related fish kills can occur any time of the day, and the water will appear normal. Other signs that can point to pesticide-related fish deaths are deaths of other aquatic species, such as frogs and turtles, and invertebrates, such as insects, shrimp, and crabs. You may also see signs of secondary poisoning of birds or other animals scavenging on the dead fish.

What To Do If You Suspect a Pesticide-Related Fish Kill

If you suspect that your fish were killed by a pesticide or other chemical, it is important to call the New Mexico Environment Department (NMED) immediately because many pesticides are not very persistent and will break down quickly, making it more difficult for them to be identified with every passing hour. Environmental samples will need to be taken quickly to test for pesticide residues; this will increase the likelihood that corrective measures can be taken to reduce further losses. Some of the information that is especially helpful to NMED inspectors is 1) the time of day when the kill started, 2) an estimate of the number of fish killed, 3) the type and size of fish killed, 4) whether fish kills have occurred in nearby bodies of water, and 5) whether you have observed any possible applications of pesticides near or in the body of water.

PREVENTING PESTICIDE-RELATED FISH KILLS

When applying any pesticide, it is important to read labels carefully and follow them correctly. Most pesticide labels contain very specific language about how a pesticide product should be mixed, what application equipment should be used, and where or when it can be applied. Phrases such as “do not apply to water” or “do not apply to areas bordering any bodies of water” provide clear guidance for determining how a pesticide should be used and when a violation has occurred. Be very careful when spraying herbicides or other pesticides near ponds since many are highly toxic to fish. Even herbicides that are registered for use in ponds, such as some algaecides, can be toxic to fish, so it is important to read the labels carefully to determine toxicity of the product to non-target organisms.

FISH KILLS CAUSED BY DISEASE

Fish kills caused by diseases usually occur when fish are already stressed by environmental factors such as poor water quality or overcrowding. Because the fish are already stressed, they are more susceptible to diseases. In most situations, there is little that can be done once the fish are affected by the disease other than to let it run its course. However, disease-related fish kills can be prevented by taking simple steps, such as fishing the pond properly to prevent overcrowding, maintaining good water quality in your pond, and watching for signs of

problems, such as poor fish growth, thin fish, and excessive numbers of small fish.

SUMMARY

- **Fish mortality in ponds is a natural process, but when large numbers of fish die at one time, there is reason for concern.** By understanding the main causes of fish kills, future losses can be prevented.
- **The most common cause of fish kills is suffocation due to lack of sufficient oxygen.** This occurs when more oxygen is consumed than is produced. Scenarios that can lead to oxygen deficits in pond water include 1) ponds with excessive vegetation (60 to 80% of pond surface covered with aquatic plants), 2) ponds that have experienced a sudden algal bloom crash, 3) extensive plant or algal die-off following herbicide overuse, 4) premature pond turnovers following heavy summer rains, and 5) extended periods of snow and ice cover during winter months.
- **To prevent fish kills related to oxygen deficiency, keep ponds aerated** and prevent excessive buildup of vegetation and organic matter.
- **Although less common, fish kills can also occur due to pesticide-related poisoning.** To prevent these, read pesticide labels carefully and follow instructions correctly. If pesticide-related fish kills are suspected, the New Mexico Environment Department should be contacted immediately because pesticides break down quickly, making them increasingly difficult to identify with each passing hour.
- **Fish kills caused by disease occur when fish are stressed by harmful environmental conditions,** such as poor water quality or overcrowding, making them more susceptible to diseases. By monitoring water quality and preventing overcrowding, disease-related deaths can be prevented.



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