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Fish Kills: Their Causes and Prevention

L. A. Helfrich, Extension Specialist and Professor, Department of Fisheries and Wildlife Sciences, Virginia Tech
Stephen A. Smith, Associate Professor, Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech

Fish die as a result of a wide variety of natural and unnatural causes. Fish may die of old age, starvation, body injury, stress, suffocation, water pollution, diseases, parasites, predation, toxic algae, severe weather, and other reasons.

A few dead fish floating on the surface of a pond or lake is not necessarily cause for alarm. Expect some fish to die of old age, injury, winter starvation, or even post-spawning stress in the springtime. However, when large numbers of fish of all sizes are found dead and dying over a long period of time, it is necessary to investigate and determine the cause.

Sudden, large fish kills in ponds are often the result of fish suffocation caused by nightime oxygen depletion in the summer. Fish kills from oxygen depletion usually occur in the early morning hours (at dawn) in very rich (green water) ponds following: (1) the die-off of a large algae bloom, (2) the decay of water weeds after treatment with a herbicide, (3) the turnover of oxygen-poor bottom waters following a thunderstorm, (4) the runoff of livestock waste and other organics after a heavy rain.

Symptoms of oxygen depletion may include an abnormal distribution of fish gulping at the water surface or at the pond inlet or edges. Large fish may die first, but all sizes of fish are usually affected. The color and clarity of pond water may change and a foul odor may be released. Fish kills from pesticides, chlorine, gasoline, fuel oil, ammonia fertilizer, acids, and other toxic chemicals are not as common in private ponds, but can occur.

In order to prevent fish suffocation in fertile ponds:

- ***Do not overfertilize ponds.***
- ***Do not overstock fish.***
- ***Do not feed ducks or sportfish.***
- ***Fence livestock from the pond and upstream waters.***
- ***Prevent manure and animal waste runoff into the pond.***
- ***Use herbicides only in the Spring and Fall.***
- ***Treat only one-third of the pond surface each time with herbicide.***
- ***Install emergency surface aerators or pump-sprays.***

Water quality tests

Water quality tests are usually expensive, complicated, and may be inconclusive. A number of water samples from the surface and bottom waters and from the pond entrance and exit waters are usually required to identify a problem. Moreover, because pond water quality may change rapidly (within hours), just determining that oxygen levels in the afternoon are adequate for fish following a nightime fish kill may be meaningless. Fish farmers usually conduct water quality tests daily to establish the pattern of conditions in their ponds, but most private pond owners do not monitor their pond water quality.

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Fish Diseases and Parasites

Fish are constantly exposed to a wide variety of diseases and parasites that occur in surface waters. Fish are subject to infection by disease-causing viruses, bacteria, and fungi. Fish are also parasitized by tapeworms, trematodes (grubs), nematodes (roundworms), leeches, and lice. Most of these organisms normally occur at low levels in farm ponds and in limited numbers on the fish. Some parasitized fish in a pond are not unusual. However, large numbers of infected fish are cause for concern since slow growth, sterility, stunted populations, and massive fish kills may result from extensive diseases and parasite infestations.

Fortunately, fish diseases and parasites seldom reach epidemic levels, and sudden, large fish kills in farm ponds are rarely caused by diseases or parasites. Fish suffering from diseases or parasites usually die slowly, a few fish each day. Only in severe cases when fish are in poor condition, starving, crowded, injured, mixed with wild fish, or stressed by rough handling, low oxygen levels, high temperatures or chemical toxins, do diseases and parasites become a serious problem.

Some early warning symptoms of fish suffering from disease or parasite infections are:

- ***Discoloration, open sores, reddening of the skin, bleeding, black or white spots on the skin***
- ***Abnormal shape, swollen areas, abnormal lumps, or popeyes***
- ***Abnormal distribution of the fish such as crowding at the surface, inlet, or pond edges***
- ***Abnormal activity such as flashing, twisting, whirling, convulsions, loss of buoyancy***
- ***Listlessness, weakness, sluggishness, lack of activity***
- ***Loss of appetite or refusal to feed***

Fish exhibiting any unusual form of behavior should be closely examined for external signs of disease or parasites. Infected fish usually show visible sores, discoloration, bleeding, swollen areas, lumps, popeyes, small black or white spots, or other abnormal growths on the head, body, and fins. Sick fish look and act abnormal.

There are few practical methods for treating diseased or parasitized fish in natural pond, lake, or stream waters. Sick fish can be effectively treated in hatcheries and aquariums under controlled conditions. However, in natural waters it is almost impossible to eradicate a disease or parasite without draining, drying, and disinfecting the pond bottom soil and destroying all the fish. Therefore, pond owners should make every attempt to prevent fish diseases and parasites from becoming a problem by:

- ***stocking only healthy fish from disease-free commercial hatchery stocks***
- ***excluding all wild fish from the pond***
- ***preventing the transfer of fish from other ponds, lakes, or streams***
- ***following the stocking recommendations to avoid overcrowding***
- ***preventing fertilizer, animal waste, or pesticide runoff into ponds***
- ***not overfeeding pond fish***

Collecting and Submitting Fish Samples:

Accurate fish disease diagnosis, like water quality testing, is expensive and complex. It often requires lengthy tissue culture preparations, blood chemistry analyses, bacterial culturing, and microscopic analysis. Diagnosis is further complicated by:

- ***the fact that fish cannot talk, so the symptoms must be visible,***
- ***hundreds of diseases and parasites can infect fish,***
- ***many different sources of stress can contribute to fish disease and death (Rottman et. al. 1992),***
- ***fish may be suffering from more than one disease simultaneously,***
- ***rapid tissue decomposition in dying fish can mask symptoms, and***
- ***environmental factors, including water pollution, poor nutrition, rough handling, and other stresses may be the source of the problem. Often, it is impossible to arrive at an exact diagnosis.***

For the best chance of determining the correct cause of a fish kill, fish farmers generally need to submit 5 to 10 live, dying (but not dead) fish that exhibit the signs of the disease, along with several water samples from the pond (Rottmann et al. 1992). Do not combine fish and water samples in the same container. Recent (fresh) dead fish may or may not be useful for diagnosis. Day-old dead fish that are bloated and floating at the surface are useless for diagnosis.

Use a dip net to collect dying fish exhibiting abnormal behavior at the water surface or pond edges. Dying fish should be transported immediately to the diagnostic lab in a cooler of water or a large plastic bag with water and oxygen (if possible) and kept as cool as possible. Freshly dead fish can be shipped wrapped with wet paper towels in plastic bags on ice in a styrofoam box. Samples should be hand delivered to the diagnostic lab or shipped by overnight carrier service. Always call the diagnostic lab before submitting any samples to insure that specimens are able to be accepted and rapidly processed.

In Virginia, fish samples can be submitted for disease diagnosis (at a nominal cost) to either the:

State Veterinary Diagnostic Laboratory
116 Reservoir Street
Harrisonburg, VA 22801
(540) 434-3897

Aquatic Medicine Laboratory
Virginia-Maryland Regional College of Veterinary Medicine
Phase II, Duck Pond Drive
Virginia Tech, Blacksburg, Virginia 24061
(540) 231-7666

If a toxic chemical is suspected and legal action is contemplated, special handling instructions apply (request these procedures from the disease diagnostic laboratory in your state prior to submission of samples). Microbiology results should be available within 48-72 hours, whereas histopathology may require as much as a week to complete.

Emergency Actions:

- ***Increase water flows***
- ***Flush the pond with clean, fresh water***
- ***Pump out stale, bottom water***
- ***Aerate surface waters***
- ***Remove dead and dying fish***
- ***Remove decomposing weeds and organics***
- ***Stop feeding the fish and fertilizing the pond***

Drug and Chemical Treatments:

Once a disease or parasite has been confirmed, successful treatment depends on selecting the most effective therapeutic drug or chemical and applying it in the most appropriate legal manner. In using drugs and chemicals that could potentially kill fish, proper dosage levels must be carefully calculated. Environmental factors such as water temperature, hardness, and salinity that may reduce the efficacy of the chemical or drug also need to be considered.

The three most commonly used methods of applying therapeutic drugs and chemicals are:

- ***Feeding medicated fish feeds (Durborow and Francis-Floyd l996).***
- ***Collecting and dipping fish into strong chemical baths for a short time period***
- ***Adding chemicals directly into pond waters, raceways, tanks, and aquaria***

Of these methods, feeding medicated fish foods may be particularly effective for certain bacterial diseases. Commercially prepared medicated feeds are available. The primary problem with this type of treatment is that sick fish may not eat. The dip method requires that sick fish be captured and treated. The dip method involves immersing infected fish into a chemical bath for a short time period. The final method, whole pond treatment, is usually impractical, expensive, and ineffective. Calculating the volume of the pond, the amount of chemical to add, and insuring that it is evenly applied and uniformly distributed complicates this type of treatment. It may be much easier and less expensive to drain the pond, kill all fish, and restock the pond with healthy fish. Treating sick fish in hatchery raceways, tanks and aquariums where water volume, flows, and environmental conditions can be controlled is more practical.

Many drugs have not been approved by the U.S. Food and Drug Administration for use in food fish and the application of chemicals into surface waters is regulated by the Environmental Protection Agency to prevent their introduction into drinking water supply reservoirs. Because certain drugs and chemicals used to treat fish diseases and parasites are not safe for human consumption, the applicator must use only approved drugs and chemicals. It is not worth the human health risk and liability to try to save a few fish with potentially harmful chemicals.

Fish Kill Investigation Information and Questions:

- ***Where and when was the fish kill discovered?***
- ***Size and depth of the pond?***
- ***Source of water?***
- ***What is the water temperature?***
- ***What type and how many aquatic plants?***
- ***Any recent agricultural spraying or animal waste runoff?***
- ***Any recent thunderstorm or hot, cloudy weather?***
- ***What species of fish were killed?***
- ***Was just one species of fish killed?***
- ***What species are in the pond?***
- ***What sizes of fish were killed?***
- ***Were both large and small fish killed?***
- ***Estimate how many fish were killed.***
- ***Where were the fish found (surface, bottom, sides, inlet)?***
- ***Are fish still dying?***
- ***Are the fish gulping at the surface?***
- ***Are the fish swimming erratically or behaving abnormally?***
- ***Any visible body sores, hemorrhage, growths, tumors?***
- ***Any dead fish upstream or downstream?***

References

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Federal Joint Subcommittee on Aquaculture. 1994. Guide to Drug, Vaccine, and Pesticide Use in Aquaculture. Texas Agriculture Extension Service, College Station, TX.

Disclaimer

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Table 1. Chemicals and drugs generally used in treating fish diseases and parasites. Application dosage will vary with the fish species, type of application, water temperature, and water chemistry. Consult your fish disease specialist or Extension agent for proper dosage and use.

Product/Chemical	Fishery Use	Regulatory Agency
Salt (sodium chloride)	Parasites/fungus	FDA
Vinegar (acetic acid)	Parasites	FDA
Chelated copper compounds	Algae control	EPA
Foramalin (37% formaldehyde)	Parasites/fungus	FDA, approved for all fin fish
Potassium Permanganate	Water quality	EPA
Terramycin (oxytetracycline)	Bacteria	FDA, approved only for catfish and salmonids
Romet (sulfadimethoxine)	Bacteria	FDA, approved only for catfish and salmonids

Reviewed by Michelle Davis, research associate, Fisheries and Wildlife