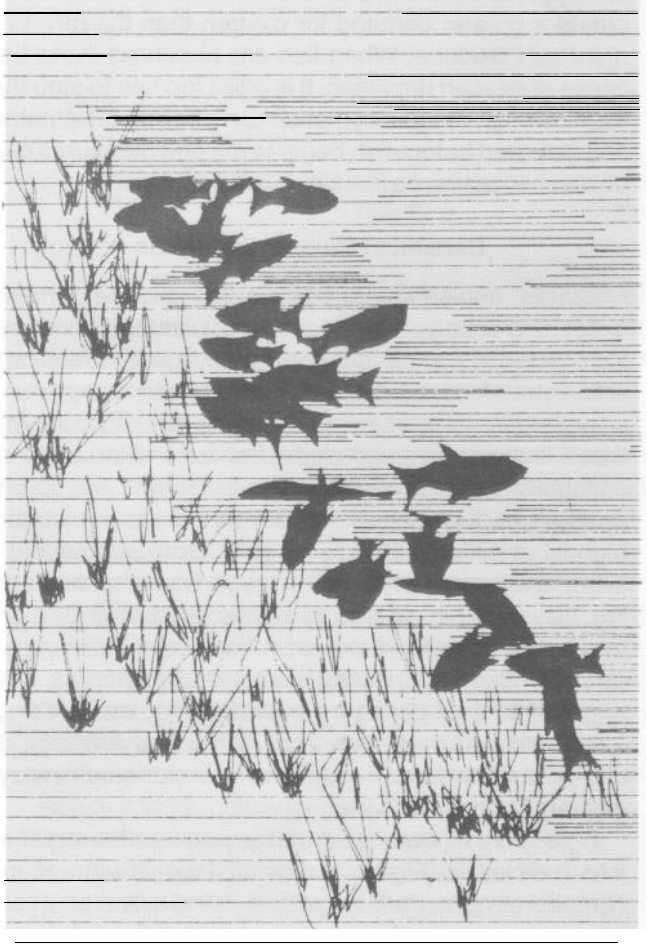
OXYGEN DEPLETION IN PONDS



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OXYGEN DEPLETION IN PONDS

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From June to October, oxygen depletion is the most common cause of fish kills in Georgia ponds. Depletion of oxygen in pond water will occur when conditions create a greater demand for oxygen than the environment can produce. When fish are observed dying because of oxygen depletion, it is often too late to stop the kill. However, oxygen depletion can often be anticipated and detected before fish begin to die and measures can be taken to prevent a fish kill.

Causes of Oxygen Depletion

Oxygen depletion in a pond is the result of demand exceeding supply. Aquatic animals, plants, and decaying organic matter consume oxygen. Aquatic plants are primary producers of oxygen. Plants produce oxygen as a by-product of photosynthesis. The rate of photosynthesis is dependent upon light. Because of the effect of sunlight on photosynthesis, the amount of oxygen in pond water fluctuates daily. Oxygen levels are usually highest at midday and lowest just before sunrise. Fish kills usually occur when more oxygen is consumed during the night hours than is produced during daylight hours. Warm water does not contain as much oxygen as cold water. Thus. during warm weather months, mismanagement of ponds by overstocking. overfeeding. overfertilization, pollution from barns and feedlots. or chemical treatment of aquatic weeds can result in oxygen depletion and fish kills.

During warm weather months. pond water stratifies into three layers (Figure 1). The top layer is warmer and contains oxygen producing algae. Wind action also contributes oxygen to the top layer. Most of the fish are in

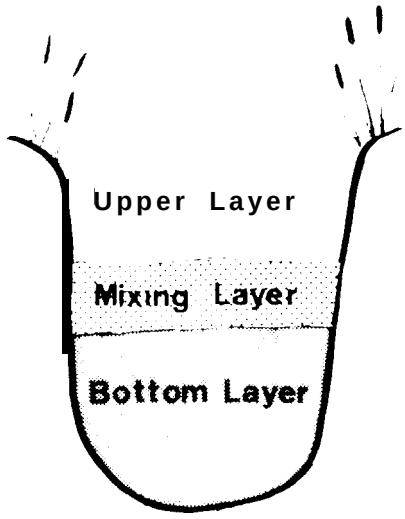

Figure 1.

the top layer. The middle layer is a relatively thin layer characterized by a rapid drop in temperature and oxygen levels The bottom layer is stagnant. cool water with little or no oxygen. It does not mix with the upper level during warm weather. Fish rarely enter this area.

Oxygen depletion can occur when these layers mix during a "turnover." Fish kills will occur if oxygen demand in the stagnant bottom layer of water exceeds the oxygen available in the top layer. Turnover can be triggered by heavy rains, strong winds blowing for long periods in one direction, and rapid cooling in the fall

Several calm, cloudy days during warm weather can also result in oxygen depletion and fish kiils This is because the rate of photosynthesis and subsequent oxygen production is dependent on the intensity of light In a pond with an excessive bloom of algae several days of reduced light and calm weather car result in not enough oxygen being produced to meet the demands of respiration and decay.

The pond owner should be alert to possibility of oxygen depletion if one or more of the following conditions exist:

(1) After a heavy rain:
(2) During periods of strong winds:
(3) During periods of calm. cloudy days:
(4) During the fall when air temperatures are rapidly cooling:

(5) After chemical treatment of aquatic weeds.

If one of these conditions exist, a pond owner should inspect his pond daily for signs of oxygen depletion.

Signs of an Oxygen Depletion

There are several signs of oxygen depletion:

(1) Large numbers of fish swimming to the top and gulping air at night or early in the morning. If disturbed they dive but quickly return to the surface.

(2) If oxygen depletion has not reached a lethal level, fish are at the surface in the early morning but return to deeper water as oxygen builds up during the day. This may continue for several days. The pond owner should take corrective action immediately.

(3) Fish being fed suddenly stop eating.

Testing the oxygen level in a pond is an excellent way to detect a developing problem. Oxygen test kits and meters are available for this purpose. Tests of oxygen levels in ponds should be made at dawn or shortly thereafter. If oxygen is less than three parts per million (ppm) in the top three feet of water, immediate action should be taken.

This may be impractical for a farmer with a large number of ponds. One can estimate the possibility of an oxygen depletion by measuring oxygen in the early evening and again two or three hours later. Since the rate of oxygen depletion is somewhat linear. these two values can be used to extrapolate oxygen content versus time during the remaining hours of darkness. Figure 2 illustrates this method.

The needs of fish for oxygen vary according to species. age and culture conditions. Most warm water fish need oxygen dissolved in water at a rate of at least one ppm for survival and more than three ppm for comfort Oxygen at five or more ppm provides the best growing conditions

Emergency Treatments

If signs of oxygen depletion are observed, emergency treatment must be undertaken immediately to prevent loss The following physical and chemical emergency treatments are effective.

Physical Treatments:

The most effective emergency treatment is mechanical aeration of the water. There are a number of ways

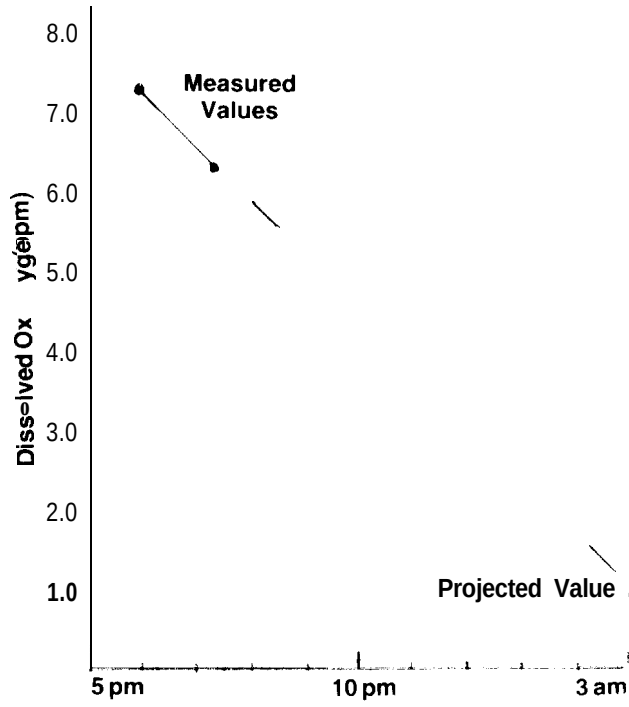

Figure 2.

the water can be aerated mechanically Whichever method is used, the sooner it is applied and the larger the volume of water sprayed or agitated per unit time and the sooner a current is established the more effective the method will be. If mechanical aeration is used it is important not to disturb the bottom mud. Bottom mud contains a large amount of organic material and decomposing bacteria that will contribute to oxygen depletion problems if mixed with water.

1. Paddle Wheel Aerator. There are various designs for a paddle wheel aerator Essentially. it is constructed by mounting a used car or truck differential on a trailer frame, constructing a paddle wheel on each end of the differential, and attaching a power-take-off linkage to the differential. The hub of the paddle whael can be an 18-inch diameter metal cylinder. Paddle blades are usually 8 to 12 inches long and the width of the drum Figure 3 is an example of the paddle wheel design.

Ideally, the paddle wheel should be backed into a pond until the bottom blades are just under the water surface. The differential should be level with respect

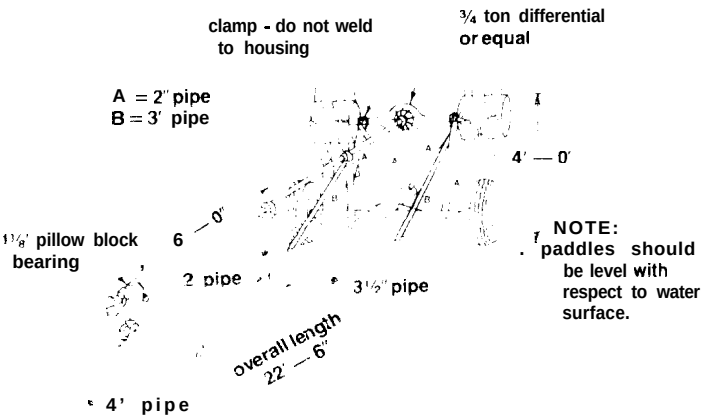

Figure 3. POND PADDLEWHEEL AERATOR

to the water surface The paddle wheel is efficiently operated at 1.500 to 1.800 rpm in large ponds; a reduced speed may be necessary in small ponds Paddle wheels should turn toward open water.

2 Large Volume Pumps. Any large volume water pump can be used to aerate a pond. Ideally. the pump should set up so that it creates a current and at the same time blows or sprays water across the pond surface.

3. Bushhog Mower. Bushhog mowers can also be used to aerate a pond. Essentially. they are backed into the water and the mower blade is used to circulate the water

4. Outboard Motors. Outboard motors also produce current if run in a fixed position. However, driving a boat in the pond with an outboard in order to stir the water is practically useless.

5. Water Replacement. Water replacement is also very effective. Unfortunately, most pond owners do not have an alternative water source with enough volume to be effective.

Chemical Treatments:

1. Add six to eight pounds of potassium permanganate per acre-foot. This oxidizes organic material in the water and reduces the demand for oxygen. The water will become a purple color. If the color disappears within one hour, repeat treatment at one-half the rate This material can be toxic to fish, so avoid over-treatment.
2. Add 50 to 100 pounds of triple superphosphate per surface acre. This increases the production of oxygen by plants.
3. Add 50 pounds of builders or hydrated lime per surface acre This reduces carbon dioxide in the water and makes the remaining oxygen more available to fish. This material can be toxic to fish so avoid over treatment.

Any one of the chemical treatments can be used alone, but the most effective way is to use all three Use potassium permanganate in the morning as soon as signs of a depletion are observed. Treat with triple superphosphate during midday and follow with builders or hydrated lime at dusk I? is advisable to purchase the required amounts of these chemicals before oxygen depletion problems are detected, Once oxygen depletion is a problem, immediate treatment is essential In some areas these chemicals are not readily available and a fish kill can happen in a matter of hours. Storing these chemicals near the pond will save time and help prevent a fish kill.

The key to preventing oxygen depletion is proper pond management. After the emergency has passed. find and eliminate the cause of oxygen depletion. Oxygen depletion can weaken and stress surviving fish making them more susceptible to diseases and parasites. Surviving fish should be watched closely during the few weeks following oxygen depletion to determine if treatment is necessary.

If a high percentage of the fish have died as a result of oxygen depletion, it may be necessary to drain and restock the pond. If there is any question about the severity of a kill, have the population checked by a Department of Natural Resources biologist the following summer. Biologists can be contacted through your County Extension Agent or Conservation Ranger

Supplemental Aeration

There are a number of aerators on the market designed to provide supplemental aeration to a pond. Supplemental and emergency aeration methods should not be confused. Supplemental methods are used to prevent oxygen depletion from occurring while emergency methods are used to correct oxygen depletion once it has occurred. Although emergency methods are effective, they are usually too difficult and expensive to use continuously. Emergency methods include adding chemicals to a pond such as potassiurn permanganate and hydrated lime, pumping or agitating large volumes of water, or flushing the pond with aerated water

Most supplemental aerators pump or agitate water to oxygenate it or inject air directly into the water Supplemental aerators can be used in emergency situations but most of them do not reoxygenate water as rapidly as emergency aerators

For a commercial fish farmer, the use of supplemental aeration can improve water quality and production and decrease losses. This is especially true if adequate amounts of water are not available to periodically flush !he pond during the hot summer months. For the sportfishing pond owner, the positive benefits of supplemental aeration are more questionable. Most oxygen depletions in sportfishing ponds are the result of a management error by the owner. Usually oxygen depletion in a sportfishing pond is the result of overstocking, overfeeding, over-fertilization, chemical treatment of aquatic weeds or pollution from barns and feedlots. These management problems coupled with hot summer weather, summer storms, cloudy weather or strong winds can cause oxygen depletion. In the long run, it is probably more economical for the sportfishing pond owner to correct the management problem rather than compensate for the problem with supplemental aeration.

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