Managing Water Quality to Prevent Fish Kill in Northeast Florida

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Northeast Florida is characterized by small fish ponds measuring approximately one-quarter to one acre in surface area and usually located near the owners' house. One of the major problems that can occur is fish kill especially during late spring and summer when the temperatures in ponds rise. The intent of this factsheet is to provide information that can help pond owners manage their ponds properly by highlighting several conditions that contribute to fish kill. The most important condition is the level of dissolved oxygen.

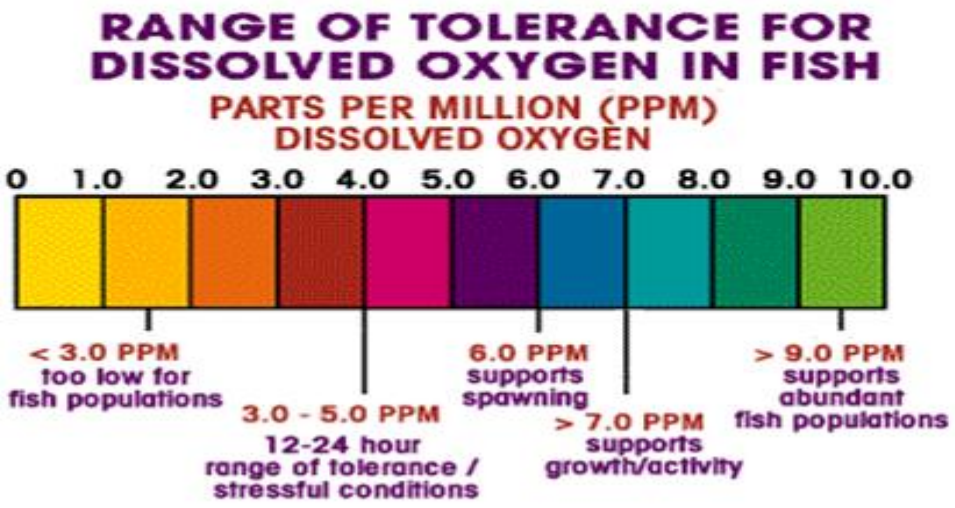
Dissolved Oxygen: Fish requires oxygen to respire and convert their food into energy. If there is an inadequate concentration of dissolved oxygen in the pond, fish health would decline and can be followed by death. The required concentrations of dissolved oxygen for fish depend on whether they are warm water or cold water species. Warm water species require at least 5mg/liter of dissolved oxygen compared to cold water species which require at least 7mg/liter of dissolved oxygen. Please note that mg/liter is the same as parts per million (PPM). Oxygen enters ponds by diffusion from the environment such as wind and wave actions as well as by photosynthesis. Photosynthesis is the main source of dissolved oxygen in ponds. It is the process by which plants manufacture their food in the presence of light. Very small aquatic plants called phytoplankton use carbon dioxide to manufacture their food. During this biological process oxygen is produced. Fish, aquatic organisms and microorganisms use this oxygen to fuel their biological processes. However, there is no photosynthesis taking place at night even though the organisms in the pond are continually using the oxygen. Consequently, the levels of dissolved oxygen decline during the night and are lowest at dawn. This is the recommended time to take a water sample for analysis of dissolved oxygen. Most of the time there is a balance on how much oxygen is produced and how much is used. However, this balance can be disturbed under some conditions in which oxygen concentration reaches a minimum level whereby some species of fish are unable to survive. You may refer to Figure 4.10 below which shows typical dissolved oxygen ranges for fish.

There are several factors that may reduce the levels of dissolved oxygen in ponds. These include:

- Long periods of hot weather can reduce the levels of oxygen concentrations in ponds. The solubility of oxygen in ponds declines with increasing environmental temperatures.

- Run-off from water sheds and agricultural areas can bring turbid water to your pond. Turbid water reduces the amount of light reaching aquatic plants. These plants require light for photosynthesis, and so if photosynthesis is adversely affected then the amount of oxygen generated may be reduced in a pond.
- Generally, ponds have upper layers with more dissolved oxygen and lower layers which are deeper and denser and characterized by lower oxygen concentrations. Heavy rains or storms can suddenly mix these two layers thereby reducing oxygen concentration which becomes inadequate for fish survival.
- Furthermore, the amount of fish a pond can support is limited by the level of dissolved oxygen. Increasing in stocking rate in ponds can deplete the oxygen levels in ponds to critical limits that can kill fish. It is important to follow the recommended stocking rates which vary with the species of fish. http://edis.ifas.ufl.edu/topic_a32783890 . You cannot control the weather, but we can use aerators to increase the levels of dissolved oxygen in your pond.

Figure 4.10: Typical dissolved oxygen ranges for fish populations.
Image from URL:
http://islandwood.org/kids/stream_health/Data/DOchart.gif



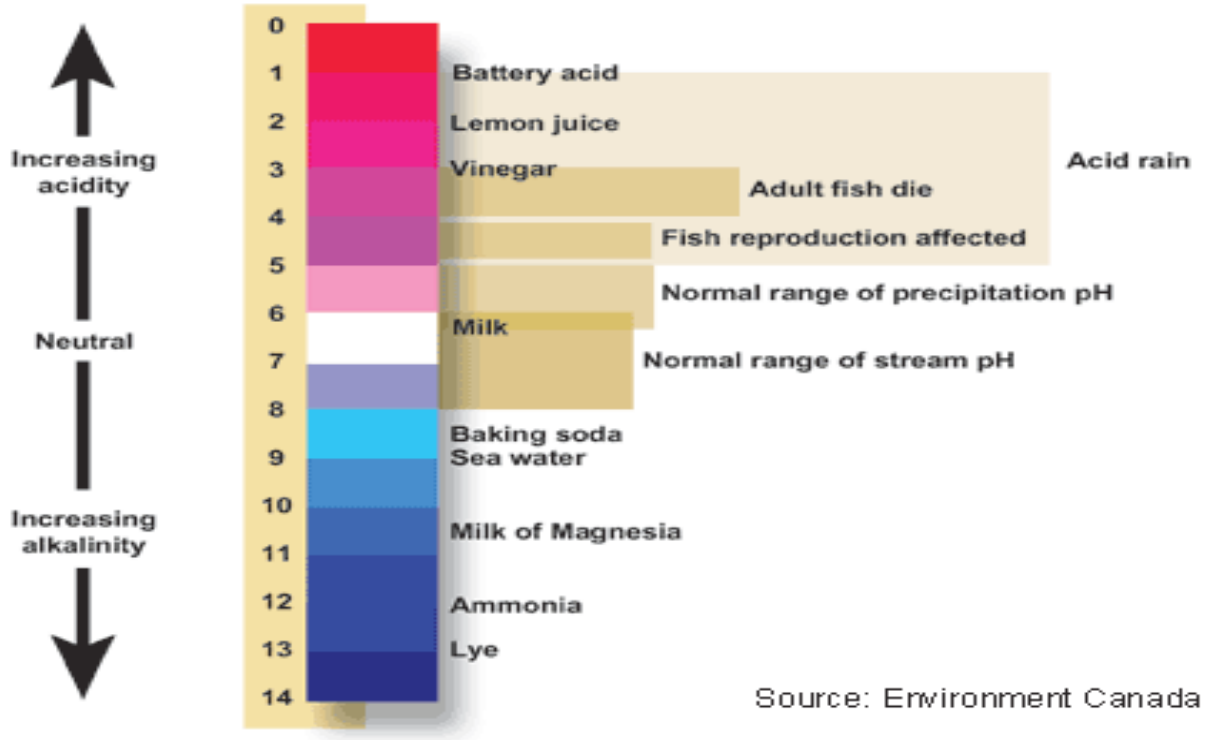
4

Ammonia: Rising levels of ammonia in a pond can lead to fish kill. Ammonia in fish ponds exist either as unionized (NH_3) or as ammonium (NH_4). Unionized ammonia is toxic to fish. The pH and temperature of the water in the pond determine the proportion of each form. As the pH and temperature increase the toxicity of ammonia increases because the relative proportion of the unionized ammonia increases. Unionized ammonia (NH_3) levels beyond 0.05 mg/liter can be toxic to fish. In trace amounts, it is

odorless and colorless. Water analysis is needed to determine if it is present in your pond. Ammonia is derived from the waste products of fish after feeding. Uneaten feed, dead algae and zoo planktons (small animal life) produce ammonia during decomposition. It is gradually removed from the pond by a natural process involving bacteria. They convert ammonia to nitrite, then to nitrate on the surface of mud or plants. Nitrate is relatively harmless to fish. The bacteria need oxygen to do this conversion provided the alkalinity of the pond is adequate (More information on alkalinity below). If oxygen is insufficient, the process breaks down and the ammonia levels in the ponds may increase. One of the objectives in good pond management is to reduce the levels of ammonia in ponds. To this effect, it is necessary to follow recommended stocking rates and avoid over-feeding your fish. Regular harvesting of fish as they reach maturity can reduce both the stocking rates and the level of ammonia in ponds. In addition, it is advisable to remove debris and dead vegetation. Remember chemical weed control during hot summer months can produce additional dead vegetation that may worsen the situation. This additional debris requires oxygen from your pond during its decomposition thereby further reducing the levels of dissolved oxygen available to fish.

pH and Alkalinity: The pH in ponds is influenced by its age, discharge from the environment and residential areas. Most ponds and lakes are basic or alkaline when they were first formed. They eventually become acidic due in part to the accumulation of organic materials. These materials decompose and produce carbon dioxide (CO_2). When it combines with water, the end product is a weak acid called carbonic acid.

Diagram Showing pH Scale.



The scale for measuring the degree of acidity is called the pH scale. The diagram above shows the pH of some common household products. The pH scale ranges from 1 to 14. A value of 7 is considered neutral, above 7 is basic and below 7 is acidic. The range of pH acceptable to fish health is pH 6.5 to pH 9. Aquatic plants use oxygen for respiration at night, and produce carbon dioxide which lowers the pH of the pond. The pH is expected to be at its lowest at dawn. It is advisable to take water samples at this time of the day if analysis has to be done for pH. Generally, pH is not a problem, but if it falls below the requirement for fish survival, the application of agriculture lime may be necessary. The application of lime increases the alkalinity of the pond. Alkalinity is a measure of the acid neutralizing or buffering capacity of water. Analysis for alkalinity involves a total measure of carbonates and bicarbonates in water samples. Total alkalinity is reported as equivalent calcium carbonate ($CaCO_3$) as has been traditionally expressed as milligrams per liter (mg/l). If alkalinity of your pond falls below 20 mg/liter, the process of converting ammonia to nitrate breaks down. Water test determines if you need to add agricultural lime to increase the alkalinity of your pond. Please check with your Extension Agent for more help in analyzing the water samples from your pond.

Summary

1. Avoid over-feeding.
2. Follow recommended stocking rates.
3. If possible harvest your fish as they reach maturity.
4. Consider using an aerator to increase the levels of dissolved oxygen in your pond.
5. Avoid run-off from watershed and farming areas that bring debris to your pond.
6. If possible, avoid controlling weeds in and on the edges of your pond when the environmental temperatures are high. Killing weeds increase the amount of debris in your pond.