SUMMERTIME FISH KILLS

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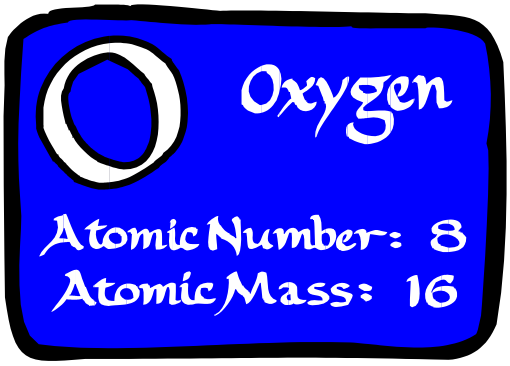
Each summer, fish kills occur in freshwater and saltwater environments. They occur in natural systems, retention ponds and aquaculture production facilities. Such kills often occur seemingly unexpectedly, and many times result in emotional and/or economic loss.

There are a number of reason for fish kills, but during the summer months, the most common cause is low dissolved oxygen.

What is Dissolved Oxygen and Where Does it Come From?



Dissolved oxygen (DO) refers to oxygen which is dissolved in water. Oxygen enters water from the atmosphere and through photosynthesis by aquatic plants and algae.

Diffusion of oxygen from the atmosphere occurs across the air-water interface and may be enhanced by turbulent mixing caused by winds and waves. This happens because wind and waves increase the surface area of water that is in contact with the atmosphere. A greater surface area to water volume ratio provides more opportunity for oxygen transfer.

Aquatic plants and algae also play a role in contributing dissolved oxygen to aquatic systems by converting sunlight energy into usable energy required for supporting aquatic life. This process, known as photosynthesis occurs during daylight hours. Photosynthesis is conducted by submerged and emergent plants as well as macro and micro algae.

What Factors Affect Dissolved Oxygen Levels in the Water?

While plants and algae contribute dissolved oxygen, they also use it, and they do so 24/7. Because photosynthesis occurs only during daylight hours and respiration (or use of oxygen) occurs day and night, dissolved oxygen levels are typically highest in the mid to late afternoons and lowest right before sun up in the morning.

In addition to the oxygen demands of photosynthesizing plants and algae — fish, crabs and other aquatic organisms also consume oxygen through aerobic respiration, and bacteria and fungi use oxygen during the process of breaking down dead plants and animals.

Other factors that affect dissolved oxygen include temperature, the amount of dissolved salts and atmospheric pressure.

How Much Dissolved Oxygen is Needed for Happy Fish?

Dissolved oxygen is typically measured as a concentration using milligrams (mg) of DO per one liter (L) of water. It may also be reported as the percent saturation. A DO of 5 mg/L is recommended for optimal fish health. Between 2-4 mg/L fish become stressed. Stressed fish that can move will seek out new areas with better DO conditions. DO below 2 mg/L becomes lethal.

The number of fish that are killed as a result of low dissolved oxygen is a function of how low the dissolved oxygen got and for how long it remained

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low. Typically, larger fish are going to be more impacted by low dissolved oxygen than are smaller fish. This is because the smaller fish can often take advantage of what little oxygen is available at the air/water interface, particularly near the edges of a water body.

What Causes Dissolved Oxygen to Rapidly Drop?

Simply put, when consumption exceeds production, dissolved oxygen becomes depleted. Increases in consumption may occur as the result of too many plants or algae (remember respiration occurs 24/7, but photosynthesis only occurs during the day), stratification or turnover, high water temperature, increased levels of organic material entering the water (e.g. septic tanks or manure), decomposition of organic mater (e.g. plant or algae death) or by certain chemicals that remove oxygen directly. Although oxygen levels can drop at any time of the year, they are more prone to drop in the summer time. Reasons include:

Temperature: Cold water is able to retain oxygen much better than warm water. This is because oxygen molecules in cold water are much closer together thus creating a strong bond. The molecules in warm water are unstable and vibrate. As a result warm water is less able to hold oxygen gas in solution. This creates a double edged sword for fish because when water warms their metabolic rate increases and therefore their need for oxygen increases.

Stratification or turnover: When surface waters heat up a thermocline (physical barrier) between the warm surface waters and colder bottom waters may develop. When thermoclines are present, no mixing between the surface and bottom waters take place. As a result oxygen created through diffusion and photosynthesis remain in the surface water layer and the bottom water layer becomes oxygen depleted. Stratification may also occur as a result of density differences caused by dissolved salts. Saltwater is heavier than freshwater. During the summertime when rain is abundant a freshwater layer may develop above the denser saltwater, again creating a physical barrier to mixing. These barriers may be broken by heavy wind or cold rain, both typical with summertime thunderstorms. When the barrier is broke, oxygen rich surface waters mix with oxygen poor bottom waters resulting in less than optimal or stressed oxygen conditions. If the demand for oxygen is great enough, it will quickly be depleted resulting in a fish kill.

The Doldrums of Summer: The lack of wind and cloudy or overcast skies also contribute to an oxygen depletion because the lack of sun limits photosynthesis and the lack of wind minimizes surface area for atmospheric diffusion to occur.

How do I Know if Low DO Caused a Fish Kill?

The following signs point to low DO fish kills:

- All of the fish die suddenly, frequently at night or in the early morning
- Large fish affected more than small ones
- Survivors gasping (piping) for oxygen at surface
- The weather has been hot, still and overcast.
- Heavy summer wind and/or a thunderstorm occurred
- A algae bloom or heavy aquatic plant growth is present

Dissolved oxygen can be measured using a portable meter or test kit. In lakes or ponds that support fish populations, when levels drop below 4 mg/L emergency aeration measures may be warranted.

Sources: Water Quality Notes: Dissolved Oxygen—EDIS SL313 and Dissolved Oxygen for Fish Production—EDIS FA27

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