

### **What causes fish kills and why are some fish affected while others are not?**

There are many factors that can account for a sudden fish die-off in a water body. Excluding toxic discharges, **low dissolved oxygen (DO) levels are usually the major contributor to fish kills.** However temperature, salinity, pH, ammonia, nitrite, carbon dioxide, turbidity, dissolved oxygen, pesticides, toxins, and diseases all must be considered when determining the cause of fish mortalities. Water chemistry and species biology (metabolic rates and tolerances, etc.) make some fish species more vulnerable to environmental stress and low DO than others. Often a relatively minor change in environmental conditions can lead to increased stress on one aquatic species without outwardly affecting others.

There are many factors that reduce water's ability to hold oxygen. The amount of oxygen held depends greatly on the temperature of the water. As temperatures rise, the amount of DO the water can hold lessens. The other factor which influences the DO levels of water is the amount of other compounds the water is already holding. These compounds may be solids, chemicals, or even other gasses, all of which can reduce the amount of DO the water can hold.

The DO in our local water bodies typically ranges between 0 and 13 milligrams per liter (mg/L) depending on the season (temperature) and water chemistry. Most fish do well in water that contains at least 5 mg/L of DO. At levels below 5 mg/L, some game fish become stressed. They will often move to areas which have high DO, if at all able to do so. As the oxygen levels drop lower, more species of aquatic organisms are adversely affected. Different fish have specific requirements for particular DO levels, below which they will not reproduce, feed, or survive. Larger fish usually have a greater need for oxygen than a smaller fish of the same species. Creatures that are active often require more oxygen than fish that are less active (for instance bottom dwellers), and most organisms need more oxygen while digesting food.

Some fish have adapted to waters that are chronically low in DO. Some of these adaptations include the development of rudimentary "lungs," more efficient oxygen carrying blood, and lower oxygen demands. These fish, mullet being a prime example, will often be sporting about while their cousins gasp at the surface. However, even they cannot survive long when the DO levels drop below 1 mg/L.

## **When is this most likely to occur?**

At levels below 3 mg/L, most fish will not feed and will show signs of distress. They will often be at the surface of the water and appear to be pushing their noses out of the water. Actually, they are trying to coat their gills with the thin layer of higher DO water at the surface. This is called piping and is most visible in the **early dawn when D.O. tends to be the lowest of the day due to reduced production of oxygen by aquatic plants** (inhibition of photosynthesis during the dark night) and less wind mixing. In shallow, confined water systems (like the Indian River Lagoon) it may be difficult for the fish to escape. If the dawn does not come soon enough, or if the day is not sunny or windy enough, some of the fish will die.

## **How does the oxygen get into the water in the first place?**

**Most of the dissolved oxygen gets into the water by mixing through the surface and as a byproduct of photosynthesis from the submerged aquatic vegetation (SAV).** SAV includes the large seaweeds and grasses, as well as the phytoplankton (usually single-celled, free swimming algae) that color the water but are too small to be seen with the naked eye. Unless the wind is blowing the deeper waters are usually lower in DO than near the surface. The sunnier it is, the more photosynthesis can occur; however, the warmer the water is, the less dissolved oxygen it can hold.

## **Where does the oxygen go?**

**Some of the oxygen is "tied-up," or used to build chemical or physical bonds with compounds dissolved in the water. At night, most plants and other organisms require oxygen and withdraw it from the system.**

It is important to remember that growth and decay cycles are occurring all the time, in all ecosystems. Normally, nutrients enter the system from many sources. Some of the most common sources of nutrients are compounds carried in by water currents and stormwater runoff, underlying sediments, particulates blown in as dust, or the result of the death and decay of resident organisms. The faster the nutrients enter the system and the slower they are removed, the quicker the water body eutrophies, or ages and dies. Normally, as nutrients become available they are quickly incorporated into sediments, other compounds, or into living tissue, and the system maintains a balance. Then, if the balance tilts towards a decrease in optimum conditions, (cloudy days, little wind, high temperatures) there may be a partial or complete die-off. If this balance tilts towards an improvement in some aspect of environmental requirements, (windy sunny days, high nutrients) there may be a bloom of algae, aquatic vegetation, fish, and other less noticeable organisms. The balance is tipped constantly by naturally occurring influences, but the frequency and degree of this tipping are often increased through the actions of human beings.

Some of the most common locations for fish kills are stormwater retention ponds and golf course water traps. These areas are usually highly nutrified and not usually designed to support aquatic life.

When a period of sunny days with windy nights is followed by a series of still, cloudy days and nights, the system gets out of balance. If the weather becomes warmer and there are local thunderstorms, carrying more nutrients, fish kills increase. A typical case is initiated when photosynthesis is reduced by cloudy skies, when the plants cannot replenish the "oxygen bank" of the water body. The plants, including algae, continue to use oxygen as they remain in the dark cycle of photosynthesis. These algae can live in waters with a lower DO than fish require and often rob the fish of their needed oxygen. The still surface waters

are no longer mixed and aerated by the wind, and can hold less oxygen because of the increased temperature. The warmer waters also increase the oxygen required for chemical reactions, which also removes available oxygen from the water. The stormwater runoff brings in many more chemicals to compete for the same DO as the fish, as well as suspended solids that block the penetration of sunlight into the water.

### **Could there be a complete die-off of a lake, stormwater pond, river or lagoon?**

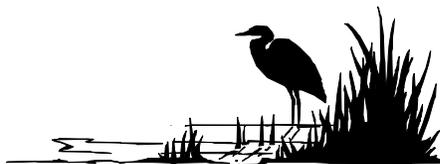
When this process occurs in a closed system such as a lake, it may become eutrophic (or dead). It could happen in the lagoon, but there is some flushing at the inlets, and it is so much bigger; however, if we keep adding more nutrients and pollution, it can get much worse. Usually in the lagoon the worst areas are the isolated dead-end canals and coves.

### **Is there always a complete die-off?**

In more open systems such as the Indian River Lagoon or St. Johns River, usually a small, isolated pocket of water ends up going through partial or complete oxygen depletion. **In most open water bodies, DO-caused die-offs are considered to be only temporary conditions. It might appear that all the fish in a particular open system are killed by low DO levels but this is rarely the case.** Small fish are usually able to obtain sufficient oxygen from the top inch or so of water, which is usually saturated with oxygen. This, combined with lesser oxygen demands associated with smaller body size and individual species tolerance, allows some fish to survive. Once the water conditions return to normal, fish will also migrate back to the area.

### **We had a fish kill. Will the City come test the water?**

Where there is a large fish kill in the Lagoon or St. Johns River, frequently the State will have water and fish samples collected to help determine the cause. Fish kills can be reported to the Florida Department of Environmental Protection, Florida Marine Research Institute ***FISH KILL HOTLINE at 1-800-636-0511***. In Stormwater ponds, the City does not typically sample unless there is some indication that there has been a sewage spill or someone has dumped something that may have been toxic. If there is something strange reported, we can inspect the site; however, over the years, and many, many fish kills, they are almost always caused by low DO. We must also remember that while stormwater ponds can be aesthetically pleasing, they were designed and built to collect pollutants not to support fish populations, even though many do. Fish kills can be expected, though as discussed in the following pages, there are things you can do to reduce the likelihood and frequency of their occurrence.



### **Will the City cleanup dead fish?**

Unless it becomes a public health issue, typically no, the City does not clean up fish kills. Maintenance of private stormwater ponds is the responsibility of the Homeowners Association, including dead fish in those ponds. Homeowners, if they wish, can bury the fish under plants, as they make good fertilizer, or dispose of them in the garbage. However, usually scavenger birds/animals eat the fish over a couple days. Fish kills in the Indian River Lagoon and St. Johns River are fairly frequent and, as stated above, natural scavengers usually provide the cleanup in a few days.

## **What can I do about it?**

There are several things that can be done to prevent or reduce the effects of a dissolved oxygen-related fish kill. If the low DO levels occur in a pond or a particular segment of a larger water body, it may be possible to add oxygen. The most often used methods include air and water pumps, or mechanical water movement.

Emergency aeration should be considered temporary first aid for the aquatic system. It is extremely important to determine the cause(s) of the DO drop and remedy it, if possible. The cycling of the oxygen levels in aquatic ecosystems is normal, natural, and usually follows some seasonal pattern. Fish kills have been recorded in the Indian River Lagoon since the first fishermen, hunters, and pioneers settled in this area. However, the frequency and severity of fish kills is increasing. This is due largely to the alteration of aquatic ecosystems and adjacent development. Increased influx of nutrient and sediment laden stormwater from near shoreline (watershed) development contributes greatly to the problem. These sources include stormwater runoff and groundwater, both of which may carry waste from septic tanks, fertilizers, pathogenic organisms, and toxic materials.

The most effective means of reducing fish kills is to prevent those nutrient and chemical constituents that result in lowering of the oxygen levels from entering surface waters.

**There are many common sense things that each resident can do or not do in their daily activities that can also result in a significant reduction of pollutants.** Avoid blowing lawn clippings into the street or dumping them down the storm drain. Once it rains, those leaves and grass clippings will be washed into the Indian River Lagoon. The nutrients they contain could then cause algae blooms, which decrease the amount of light and oxygen in the water, resulting in fish and sea grass kills.



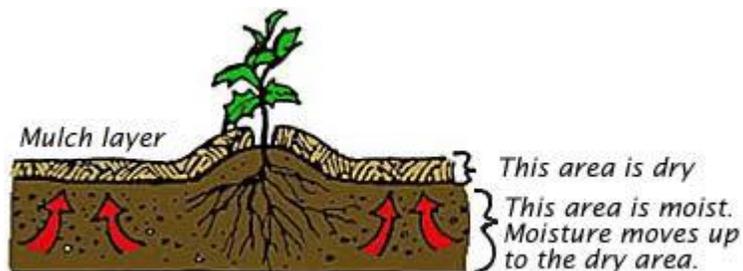
Do not pile yard clippings and tree branches on a storm drain. If possible, wait to put them out until the night before your yard trash pick up and make sure that they are placed on your grass, not any impervious surfaces. Instead, place them on a grassy area or in plastic garbage cans used only for yard waste. If you do use the plastic bins, remember that we still do not want to place them on the storm drains because in a rainstorm, they can still be washed out.

## Fertilizers & Pesticides



If using a fertilizer, choose one that contains at least 30 percent slow-release nitrogen. Also, check the three numbers on the front of the bag to select the right mixture for the type of plant you are fertilizing. The numbers represent the fertilizer's nitrogen (first number), phosphorus (second number) and potassium (third number) contents. High nitrogen fertilizers on a plant that does not need it is a waste of money and will eventually be washed away by stormwater. When possible, use environmentally friendly alternatives to pesticides. These include insecticidal soaps and horticultural oils, which can both be made easily at your home. To make insecticidal soap, simply mix 2½ tablespoons of liquid dishwashing soap and a gallon of water. These soaps can be used to combat whiteflies, aphids and spider mites. Horticultural oils can be made by combining 2 tablespoons of vegetable oil with 2 tablespoons of liquid dishwashing soap and a gallon of water. This alternative helps to eliminate problems with mealy bugs and thrips. The City web site has additional information at [www.brevardstorm.org](http://www.brevardstorm.org). If you must use fertilizers with higher chemical contents, weed killers or pesticides. Make sure to use only the amount and frequency directed on the label, and only on the affected areas. Remember, in this case, more is not better.

## Mulching



Mulching is another method of reducing stormwater runoff in your yards. Because mulch is porous, it allows rainwater to seep into the ground and forms a firm ground cover, filtering pollutants and holding soil in its place. You can get free mulch at the county landfills in Cocoa, Titusville and Melbourne. It is recommended that you call first to see if there is any available. The phone numbers are 633-1888 for the Cocoa and Titusville landfills and 255-4365 for the Sarno Road complex in Melbourne.

## Sprinklers & Downspouts



Turn downspouts of rain gutters into planted areas instead of toward paved surfaces such as driveways. The rain will wash pollutants off the driveways and into the storm drains. The same applies to sprinklers. Make sure they are not watering the streets and driveways instead of the plants. This is particularly important if you have reuse water that is high in nutrients. For more information on mulching, fertilizers and pesticides, please call the University of Florida/Brevard County Extension Service at 633-1702. Ask them how to obtain a free copy of the Florida Yardstick Workbook, which gives you tips on how to have a beautiful yard and still protect the lagoon from harmful chemicals and nutrients. You can also log on to their website at <http://brevard.ifas.ufl.edu>

## Car Care



Dispose of used oil at designated collection centers. Do not pour them down storm drains or into the streets. These toxic materials will flow into the lagoon and kill the wildlife. You can call the Brevard County Solid Waste Department at 635-7954 for information on proper disposal methods and the nearest collection site.



Have fluid leaks repaired promptly. Motor oil, gasoline, antifreeze, transmission fluids, battery acid, degreasers, radiator flushes and rust preventatives left on streets, driveways and parking lots will eventually end up in the lagoon after a rainstorm. Car drippings can be wiped up or absorbed and disposed of at the county landfill, which is lined to prevent these materials from getting into the water.



Wash your car on the lawn and let the nutrient rich, soapy water fertilize your grass while you are washing the car. Avoid washing your car in the driveway or street. Car wash water adds excess nutrients to the lagoon and can cause algae blooms.

### **Household Waste and Chemicals**



Dispose of household waste such as household cleaners, batteries and paints at designated collection centers. Avoid pouring these chemicals down the storm drains or into the streets. These materials are toxic and will kill both wildlife and plant life. Again, the Solid Waste Department can advise you as to proper disposal methods and the collection site closest to your home.

Solid Waste also offers a "Drop and Swap" program at the Central location in Cocoa for useable products brought in by residents. Residents are allowed to browse and pickup products including usable household chemicals, automotive fluids and paint products free of charge. For more information on this program and others offered to Brevard County residents, please visit the web site at [www.brevardcounty.us/swr/hazwaste.htm](http://www.brevardcounty.us/swr/hazwaste.htm) or call them at 635-7954.

## Pet Waste



Clean up after your pets. Pet waste left on paved surfaces or around storm drains and water bodies will eventually end up in the surface waters or the lagoon after a rainstorm. Pet waste can be a significant source of nutrients and fecal coliform, bacteria that can potentially harm the thriving shellfish industry the lagoon supports by making them unsafe to eat. When discarding of pet waste, flush it down the toilet or bury it in a hole about six inches deep.



**For more information about reducing stormwater pollution or to schedule a meeting with your homeowners association, please feel free to call the City of Palm Bay, Public Works Department, Stormwater Program at 321-953-8996. A healthy future for the Indian River Lagoon and St. John's River depends on your support.**

