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TEXAS A&M AGRILIFE EXTENSION

My Fish Are Dying!

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Fisheries biologists and county Extension agents will hear these words countless times throughout the year, especially during the summer months. As a general rule, small ponds intensively managed for catfish are the most susceptible to die-off problems. Other common scenarios for summer die-off problems are ponds with large quantities of aquatic vegetation, ponds that are heavily or frequently fed with commercial fish diets, ponds that were stocked heavily or excessively and biomass now exceeds carrying capacity, or ponds that experience phytoplankton die-offs caused by a multitude of different reasons. How do you determine the cause of a fish die-off? In most cases, asking the right questions will lead you to the cause or causes. Here are the questions I ask and the assessments made based on answers received to help a frantic pond owner:

1) ***When did the fish start dying and for how long have they been dying?*** The reason for this question is to determine if there is acute (very rapid) or chronic (slow and prolonged) mortality. The rate of fish mortality helps provide clues as to the cause. Oxygen depletions are typically acute mortality events in which the fish die quickly, within a few to several hours, and then the mortality ends. Chronic mortality spanning several days or even weeks is typically associated with disease or parasite issues where portions of the fish population die over prolonged periods. Exposure to lethal concentrations of pesticides or herbicides can cause either acute or chronic mortality, dependent upon the dose of the chemical the fish were exposed to, although mortality tends to be more acute as toxic pesticides tend to dilute and degrade quickly in the aquatic environment by simple dilution, oxidation, microbial deterioration, or UV exposure.

2) ***How many fish have died and what size are they?*** Agents often receive calls about a 'fish kill' in a pond, and after a lengthy discussion, discover that it was a single or a few large fish or perhaps 3-15 small fish. A few dead fish does not equate to a fish kill. Fish kills result when a major chemical or environmental event has occurred in a pond, that results in mass mortalities (10% or more of the **entire** fish population) of a single or multiple species.

   a. ***Large fish. -*** It is disheartening to lose a 5-10 pound largemouth bass or a 8-15 pound channel catfish, but believe it or not, some large fish do simply die of natural causes or old age in small impoundments. *Larger* fish tend to experience mortality during or immediately after the extremely stressful and body depleting spawning season. This means during the spring for largemouth bass and the late spring to mid-summer for channel catfish, it is not unusual to see a dead large fish or two every couple of days during or immediately after the spawning season. Large fish that are past their prime are also more vulnerable during the hot summer months, when their large body size and deteriorating body make them more vulnerable to low dissolved oxygen that may not be low enough to cause mortality in other fish in the pond.

b. ***Small fish. -*** Small quantities (3-12 or more) of dead *small* fish, such as largemouth bass fry or fingerlings, small bluegill, redear sunfish, or other baitfish, often trigger pond owners to call about fish kills. Be sure to ask about environmental conditions prior to the discovery of dead fish, such as prolonged cloud cover and/or heavy rains, rapid or prolonged severe temperature changes, and shallow habitat cover (areas of heavy aquatic vegetation). Small fish are more susceptible to localized, rapidly changing environmental conditions than larger fish. The reason for this is that they less mobile spatially in the pond environment and more restricted to shallow shoreline habitat. Their small size does not allow them to quickly navigate large distances, and their small size typically restricts them to shallow or heavy cover environs, or else they become food for predatory species. Localized mortality of small fish tends to occur due to temperature or pH shock after a heavy rain event, rapid temperature changes in the shallows, or localized oxygen depletions, especially in areas of heavy aquatic vegetation. Heavy rains can cause large amounts of runoff that differs in pH and other chemical properties or temperature. The effects of these chemical changes are greatest in shallow shoreline environments where small fish cannot seek the deep or open water environments available to large fish. Rapid air temperature changes such as sudden and prolonged cold fronts or extreme heat spells also effect shoreline environments as shallow water is the is subject to the most extreme temperature change due to the interface between surface area and water depth. Small fish cannot escape to the more stable deep water environs that larger fish can. Small fish are also often associated with heavy cover for protection, and the foremost cover in ponds is aquatic vegetation. Oxygen concentrations are not always uniform in a pond, and areas of heavy aquatic vegetation can produce localized oxygen depletions at night in heavily vegetated areas of a pond. Small fish require less total oxygen than large fish, but they are much more sensitive to oxygen depletions which can result in localized mortalities.

3) ***How many different species are dying?*** What you are trying to determine with this question is that if more than one species of fish is dying, you probably are faced with a water quality problem (i.e., oxygen, ammonia, nitrites). If only one species of several species present are dying, it *<u>may</u>* be a disease/parasite problem, but not always because different species may have different tolerance levels for water quality parameters. If only one species of fish is in the pond and a die-off is occurring, you need more information.

4) ***Have any pesticides or herbicides been used recently that were introduced into the pond?*** This could include pasture insecticides washing into ponds or even cattle that were treated with an insecticide standing in the pond to escape the summer heat. Determine if any herbicides, aquatic or terrestrial, have been recently (within 4 days) applied within 250 feet

of the pond or has there been any herbicides applied between 250 and 500 feet of the pond prior to (within 7 days) a rain event. Many terrestrial herbicide formulations are toxic to aquatic life including fish. Even non-toxic or low toxicity herbicides washing into a pond *may* lead to untimely vegetation die-offs. If herbicide is suspected in a fish die-off, be sure to inquire about aquatic vegetation die-offs as well to determine if oxygen depletion from plant decomposition is the culprit.

5) ***How big is the pond?*** The pond owner usually thinks the pond is 2x to 3x larger than it really is! Walk them through the process of estimating surface area in acres by dividing square footage by 43,560. Many pond owners find it difficult to estimate area in acreage or square footage, but satellite imagery, on-line tools, and GIS programs, such as Google Earth™, can be used to easily and accurately determine the square footage of a pond remotely by either the owner or Extension agent using the distance, mapping, or area tools. Remember, excessive depth *does* *not* make up for lack of surface area when it comes to fish production! Excessive water depth itself can periodically be the cause of fish die-offs in the spring or fall due to rapid destratification or turnover events leading to mixing of low dissolved oxygen waters. However, these turnover events require specific weather conditions, such as heavy cold rain or major cold front, in order to occur.

6) ***How many pounds of fish are present?*** Once you know the surface acreage, try to determine the pounds of fish present by asking: (1) ***for an estimate of fish stocked*** (minus those caught out) and (2) ***the average weight of the fish present.*** Be sure to ask if the owner notices or has caught any small fish and the number of those small fish in order to include an estimation of fish weight for offspring if the pond is more than a few years past stocking. This will help you estimate the total poundage of fish present.

STOP RIGHT HERE — if the total estimated pounds of fish exceed 1,000 pounds per surface acre (that's only 100 pounds in a 0.10 acre pond), you are probably dealing with oxygen depletion. This accounts for about 85% of all fish die-offs in Texas farm ponds!!!

7) ***Was there a water color change***? A color change associated with oxygen depletion is common. Typically ponds can go from a light green or clear color to a brown or coffee color signifying the loss of phytoplankton and a corresponding drop in oxygen. This is often occurs when persistent cloud cover prevents direct sunlight from reaching the pond.

8) ***Was there an aquatic herbicide or algaecide applied to the pond within the last 2 weeks?*** Did a fish die-off occur 5 days or more after applying herbicide to aquatic vegetation? If so, don't blame the herbicide, the culprit is likely the decaying vegetation. Determine what percentage of the pond was treated, with which herbicide, and what was/is the temperature of the water. A pond can contain 8-14 tons of aquatic vegetation per surface acre in water 4-6 feet deep. Decaying vegetation causes oxygen depletion, and therefore it is recommended that no more than 20-25% of a pond be treated with herbicide at a time to avoid low dissolved oxygen. Temperature is critical in this matter as the warmer the water, the less oxygen it holds. A pond owner will be able to treat more area or volume of the pond in the spring than in the summer, and aquatic vegetation should not be treated with

herbicide if the water temperature is above 90ºF. Also, "fragile" plants such as planktonic algae, filamentous algae, and submerged macrophytes will decompose much more quickly (and thus be more likely to cause oxygen debt) compared to emergent plants such as lily pads or cattails.

Oxygen Depletions

When the fish standing crop (total pounds of fish) exceeds the 1,000 lbs/acre carrying capacity during the hot months, the stage is set for a die-off. Why the summer months? Because again, warm water cannot hold as much oxygen as cool water, yet the fish need more because their metabolism (and therefore their oxygen requirements) increases as water temperature increases. A farm pond that could easily carry 2,000 to 3,000 pounds of fish per surface acre through the winter months won't stand a chance once the dog days of summer arrive. Remember, oxygen is usually lowest right at daylight, so that's a good time to check and see if fish are piping (gulping air and water at the surface) or swimming at or near the surface. In many cases, the larger fish will be the first to exhibit signs of oxygen stress. Now that the "hammer is cocked", additional events that could "pull the trigger" and further contribute to oxygen depletion include:

1) A couple of hot, still, cloudy days in succession that reduce photosynthesis and therefore oxygen production;

2) Aquatic herbicide treatments in hot weather that kill too much vegetation in too short a period of time resulting in an oxygen debt; or

3) Overfeeding/overfertilization resulting in nutrient decomposition or phytoplankton die-off.

So, how do you correct for low oxygen?

1) Reduce the fish load present to well below 1,000 lbs of fish/acre;

2) Emergency aerate by backing a boat on a trailer into the pond and running the motor in a fixed position to circulate the water and increase oxygen;

3) Add fresh well water, but aerate it well before it enters the pond;

4) Circulate water with a pump, but set the intake near the pond surface (pumping water off the pond bottom and spraying it back over the surface only compounds the problem!), and spray the outflow out over the water surface; or

5) Add aeration or destratification systems to the pond *before* an oxygen depletion occurs.

Other Common Water Quality Problems

Golden algae are microscopic flagellated alga about the same size as red blood cells (10 microns). Under favorable conditions, the algae are capable of producing toxins referred to as prymnesins with multiple effects including toxicity to fish. If the algal population is undergoing a substantial or rapid population increase, referred to as a "bloom", the toxin may lead to fish kills. Golden algae's impacts on fish populations are most likely to occur in waters that contain a high salinity or mineral content with a neutral (7) or higher pH. Most fish kills attributable to golden algae blooms have occurred during the winter and spring months when water temperatures are below 55°F. It is important for landowners to be able to differentiate between a fish kill caused by oxygen depletion, which is responsible for the vast majority of fish die-offs in Texas private waters. The best clue is the seasonality factor. If a fish kill is occurring during the hot months of May through September when the water temperature is above 70ºF, it is not likely to be related to the presence of golden alga. Conversely, fish kills due to low dissolved oxygen rarely occur in the cool months when golden alga blooms are most likely to kill fish.

Early detection of a golden algae bloom is essential to preventing a fish kill. Visible signs include water with a distinctive golden-yellow to rust color. However, this may not be evident during the early stages of a bloom. Early detection may only be possible through regular water sampling during the typical outbreak season when the temperature, pH and salinity levels are in the range conducive to supporting a bloom (water temperature below 55°F, pH greater than 7.0, and salinity 2 ppt or greater). Foam on the water surface may accompany the bloom when the water is agitated or subject to wave action. Dying fish may attempt to jump out of the water, swim slowly and sometimes congregate near the shore or sources of freshwater, such as inlets or near springs. If the bloom progresses and results in a fish kill, dead fish may have extremely red and/or bloody gills and fins and scales covered in mucous.

Upon observing visible signs of a golden algae bloom, water samples should be immediately sent to an organization or agency that has the capability of confirming its presence. Copper-based algaecides are effective at controlling golden algae blooms. Either the use of a chelated copper compound or copper sulfate should help reduce golden algae populations. A complete list of algaecides and their labels can be found at http://aquaplant.tamu.edu/management-options/golden-alga/. Potassium permanganate can be added to the pond to damage golden algae cells and to help limit toxicity by oxidation of prymnesins. If possible, the addition of supplemental aeration for a few days following the treatment will help maintain oxygen levels as organic matter in the pond is oxidized. In certain cases (e.g., where the cell count is already high), potassium permanganate applications may be recommended prior to the use of a copper-based algaecide. For more information on golden algae, visit the Texas Parks and Wildlife website http://tpwd.state.tx.us/landwater/water/environconcerns/hab/ga/.

The following is a partial list of sources that have offered golden algae diagnostic services:

PBS&J	Dave Buzan,	512-372-1207	DLBUZAN@pbsj.com
Estes, Inc.	Chris Smith	713-464-3391	csmith@estesinc.com
PhycoTech		269-983-3654	info@phycotech.com
Texas Veterinary &Medical Diagnostic Lab		888-646-5623	http://tvmdl.tamu.edu
Florida Fish & Wildlife Research Institute		727-896-8626	

Ammonia is a chemical compound used as a fertilizer, excreted by fish as part of protein metabolism, and is a byproduct of normal decomposition in a pond environment. Ammonia can build to concentrations toxic to fish and is most problematic in ponds with heavy loads of fish (near or over 1,000 lbs/acre), ponds that are over fertilized, or when fish are feed heavily, especially to excess. Heavy fertilization, including the use of chicken litter, in the watershed followed by run-off rains washing into the ponds can cause toxic levels of ammonia. Ammonia becomes more toxic as pH and temperature increase. A water test is required to determine if ammonia is present. The only cure is to add fresh water, aerate heavily to increase bacterial nitrification, remove stagnant, 'dead' water from the bottom and reduce the load of fish present.

Nitrites are converted from ammonia by *Nitrosomonas* spp bacteria. Nitrites can cause brown blood disease, so called because the fish affected have chocolate colored blood. If nitrite poisoning is suspected, cut open an affected fish and observe the blood color—instead of the normal bright red color, the blood appears dark or brownish. Nitrites bind to the blood's hemoglobin and form methemaglobin, which is ineffective at removing oxygen from the water - resulting in the fish's inability to breathe. The fish exhibit the same signs as when an oxygen depletion occur by swimming lethargically at the surface—but this may be observed even during mid-day when oxygen production should have improved. Ponds suffering from nitrite poisoning are usually heavily fed catfish ponds, and nitrites usually don't show up until late summer or early fall. Heavy pasture fertilization with run-off into a pond can also cause elevated levels of nitrites. Nitrites can be "neutralized" by adding un-iodized stock salt. The amount to add varies with the level of nitrites, but 200 ppm of chlorides is effective at mitigating the effects of nitrites in all but the most heavily stocked and fed commercial catfish ponds. Typically 200 pounds per surface acre is sufficient to adequately increase the chloride concentrations in most ponds and negate the impacts of nitrites. A simple recommendation of "add salt to the pond," without the benefit of a water (chloride and nitrite) test tends to give pond owners a false sense of security.

Diseases/Parasites

So, what if it's not a water quality problem killing my fish? Well, then your pond owner is in the vast *minority*. Even many disease problems are triggered by stress brought on by poor water quality. Diseases and parasites *normally* only affect one species, even if there are many species present. Common signs of parasites and diseases are not always realized until fish are inspected closely, and most often observations must be made of fresh dead (within an hour or two) or infected and dying fish. Parasites will begin to flee a carcass within fifteen minutes and bacteria will begin to die on the host within hours of death, so speed is of the essence. Additionally, gills are often inspected for parasites, color, mucus production, clubbing, and inflammation, but the gills will turn from bright red to light pink to grey in a few hours in warm water, rendering them useless for disease or parasite diagnosis. Indications of disease or parasite issues include prolonged or chronic mortality over several days to weeks, death of only one or two species, lesions, ulcers, hemorrhaging of the fins, belly, or around the gills, bulging 'pop' eyes, distended or fluid filled abdomen, cottony growth, dull patches or 'saddleback', deteriorating or missing fins, distended scales with localized scale loss and areas of skin that look like they have been 'rubbed with sandpaper'. Proper identification is a must, but typically the most common disease and parasite issues are:

1) **Protozoans** - The protozoa *Ichthyopthirius multifiliis* causes a disease commonly known as white spot disease or ich. Ich is one of the most common and persistent diseases. The protozoan produces white nodules on the body, fins, and gills that look like white grains up to 1 mm in diameter. Each white spot is an encysted parasite. Ich is very damaging to the gills and skin. In heavily infected fish it can cause a rapid loss of condition, considerable distress and death. Infected fish have small white spots on the skin and gills and produce excess mucus, due to irritation. Damage caused to the gill tissue of infected fish reduces respiratory efficiency.

2) **Bacteria** – Bacterial infections occur most frequently during periods of transition (summer to fall or winter to spring) when water temperatures are changing or any time fish may be subject to stress (high temperatures, low water, low dissolved oxygen). Fish may display lesions, ulcers, hemorrhaging of the fins, belly, or around the gills, bulging 'pop' eyes, distended or fluid filled abdomen, cottony growth, dull patches or 'saddleback', deteriorating or missing fins, or distended scales with localized scale loss. Consult a specialist for verification and control options.

   a. Motile Aeromonas Septicemia (MAS) - This is the most common bacterial disease of freshwater fish and is cause by several members of the genus *Aeromonas.* Signs of MAS range from sudden death to skin lesions. Skin lesions include variously sized areas of hemorrhaging and necrosis at the base of the fins. These lesions may progress to reddish to gray ulcerations with necrotic areas of tissue.
   b. Enteric Septicemia of Catfish (ESC) - This is the most important bacterial disease of catfish and occurs most frequently in catfish only ponds or ponds with large quantities of channel catfish. ESC is caused by the bacterium *Edwardsiella ictaluri*, and is *normally* a seasonal disease, with outbreaks occurring when water temperatures are in the range of 75-83ºF. Very high mortality is common and in some cases, very few clinical signs are observed. Symptoms include corkscrew spiral swimming, abdominal distention, 'pop-eye', or pale gills. Small white or red pin-head sized hemorrhages appear on the skin and a small hole can form in the top of the head.
   c. Edwardsiellosis (EPD) - This disease is caused by *Edwardsiella tarda* and is less common than ESC, but infects a wider variety of fish including channel catfish, bluegill, and largemouth bass. Small lesions are initially observed on the flanks and caudal peduncle of channel catfish. Unlike with ESC, catfish affected with this disease will continue to eat even if they are severely affected.
   d. Columnaris Disease - Columnaris, is a common bacterial disease that affects the skin or gills of freshwater fish and is caused by *Flexibacter columnare.* This bacterium is usually pathogenic at temperatures greater than 59ºF, although it can cause heavy infections in channel catfish during cold winter months. Mortality and severity of the disease increase at higher water temperatures. Common symptoms include erosions and necrosis of the skin and gills. It is often visible as a whitish 'dull looking patch' that may have a red peripheral zone on the head or back (saddleback) and/or the fins (fin rot).

3) **Viruses** – Viruses can occur at any time of year under any conditions, but major outbreaks tend to occur during crowding, poor water quality, and stress. Most common viruses cause severe mortality, seemingly without cause, and can strike quickly. Often times there are no visible or discernable symptoms. Viruses are not typically a problem in balanced ponds in which the fish population is below the natural carrying capacity.

   a. Largemouth Bass Virus (LMBV) – Largemouth bass virus is a naturally occurring virus that is carried by other fish species, but has produced disease in only largemouth bass. LMBV is often found in bass that show no signs of disease suggesting some fish might be infected but do not become ill. LMBV caused die-offs tend to occur from June through September, and warm water temperatures might be a factor. Most bass infected with LMBV will appear completely normal. In those cases where the virus has triggered disease, however, dying fish will be near the surface and have trouble swimming and remaining upright because LMBV appears to attack the swim bladder. LMBV may not be a major problem in ponds, but is suspected to be the cause of many largemouth bass die-offs that are blamed on oxygen depletions due to the similarity in symptoms.
   b. Channel catfish virus (CCVD)- Channel catfish virus disease was first recognized as a disease problem during the early days of commercial catfish farming with high mortalities reported in channel catfish fingerlings and fry. Today the virus is present in all catfish growing regions of the United States. The disease is strongly influenced by environmental stressors. CCVD occurs in fry and fingerlings less than a year old and less than 6 inches long. It is only a problem in ponds where there is catfish reproduction and when stocking channel catfish fingerlings or fry into new ponds.

4) **Parasites** – Parasites, both internal and external, are *always present* in pond populations of fish. However, they are more of a curiosity to fishermen who find them on fish they catch rather than a common cause of fish kills. When parasites multiply within a fish population to the point where they cause mortalities, then there is another problem already present in the pond that has allowed parasites to reach critical numbers. The factors that allow parasites to increase to critical numbers often include poor water quality (too many nutrients entering the pond), periodic low dissolved oxygen concentrations that stress the fish and weaken the immune systems, or a previous or ongoing disease issue that weakens the immune system or creates openings (lesions, external hemorrhages, scale loss, gill damage) that allow the parasites to better colonize the fish.

   a. **'Grubs' (nematodes)** - Once fishing season arrives, anglers catch a few fish and during cleaning (normally filleting) notice white, yellow or black "worms" encysted in the skin or flesh and are often found at the base of the fins. These 'grubs' are actually various nematodes, and have an interesting yet complex life cycle involving fish, snails and wading birds, but seldom kill fish by themselves. Breaking the cycle can be difficult, although some pond owners achieve success by controlling aquatic plants (food for snails), or stocking redear sunfish to control the snails.

b. **<u>Contracaecum</u>** - This roundworm looks like a watch spring and is often found attached to the membranes outside various internal organs. It's more of a curiosity to anglers cleaning fish than anything else.

c. **<u>'Flukes' (trematodes)</u> -** There are two families of trematodes: gill flukes and skin flukes. Fish infected with flukes often "flash" or rub against hard objects, yet no visible parasites are seen due to their small size. Gill flukes (*Dactylogyrus*) or body flukes (*Gyrodactylus*) are among the likely suspects when flashing is observed. Other, more advanced symptoms of flukes are clamped fins, inactivity, and rocking motions. **Gill Flukes** live as external parasites attached to the gills with hooks, and are less than a millimeter long. Gill flukes can become numerous and open the gills to bacterial infections leading to death. Part of the fishes' response to gill flukes is to secrete additional mucus. In bad infestations mucus can be seen trailing off the gills. If flukes become numerous, they can damage the gill lamellae, making them swell or even fuse together. **Body flukes** attach to the skin of the fish with hooks, burrowing under the scales. Body flukes can increase quickly and a fish can infect another through casual contact, or the free swimming larvae can find a new host. Bacterial infections commonly follow bad infestations.

d. **<u>Protozoans</u> -** *Trichodina spp.* are a group of protozoan parasites of fish. *Trichodina* have a prominent "tooth-like" internal cytoskeleton ring. While small numbers of *Trichodina* on a fish generally do not cause much of a health problem, large numbers can cause serious damage and ultimately, death. Unlike many parasites, *Trichodina* can cause significant mortality. Small fish are especially susceptible, and mortality can occur quickly if undiagnosed. *Trichodina* are often the cause of die-offs of small bluegill in the spring when temperatures begin to warm. *Trichodina* cause irritation by feeding on the cells covering the surface of the gills and skin. This can result in excessive growth of the epithelial cells, clubbing of the gill filaments and even fusion of the gill filaments. This reduces the ability of the fish to breathe and excrete ammonia.

For more detailed information on diseases/parasites, consult a copy of the "Inland Aquaculture Handbook" issued to each county office. You can also refer pond owners to the TVMDL at the TAMU-Vet School by calling 1-888-646-5623. They no longer offer fish disease services to pond owners but they can provide a list of alternate aquatic disease laboratories. As always, you can also contact one of the Extension Fisheries Specialists for advice.