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Algal Blooms, Scums and Mats in Ponds

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Each year Cooperative Extension personnel receive numerous calls regarding ponds with odd-looking scums, unusual colors or mats of filamentous algae ("moss") (Figure 1). These natural phenomena result from the addition of plant nutrients (principally phosphorus and nitrogen) to water. Understanding the nature and causes of blooms, scums and mats will help explain why their control is so difficult and why long-term, preventative measures are essential to reducing problematic algal growths.

Nutrients may be added to waters intentionally, as in the case of ponds that are fertilized or where fish are fed to augment fish production. Algae serve as the base of the food chain for sportfish, and a fertilized pond typically will support two to three times the weight of fish present in infertile ponds. In addition, algae cells suspended in the water shade the pond bottom, reducing the potential for growth of rooted aquatic weeds. However, in many cases, algal blooms, mats and scums are the unwanted results of unintentional nutrient additions. Nutrients reach ponds through runoff from fertilized lawns or pastures and from the wastes of livestock or poultry, including ducks and geese (Figures 2 and 3). Poorly functioning septic systems are another common source. Nutrients are recycled in ponds, so that even after the inflow is reduced, it often takes years for ponds to recover. Once pond water becomes clearer, rooted aquatic plants (which obtain their nutrients from the soil) may replace the algae.

Not all algae problems result from human actions. Some soils and waters, especially in the delta area of Arkansas, are naturally rich in plant nutrients. But in many areas, human activities result in nutrients reaching ponds, and watershed protection is the key to reducing nuisance algae problems.

What Are They and Why Do They Form?

Combine water, sunlight and nutrients, and some form of plant growth will result. Whether it is algae, rooted aquatic plants, floating plants or some combination of these forms, something will grow in the water. Perfectly clear water in a pond, with no plant growth of any type, occurs only under rare or unnatural conditions. Various types of algae and bacteria quickly develop populations in fertile water (Figure 4).

Algae in the form of microscopic plants are called "phytoplankton" and come in a wide variety of shapes and forms. Some forms of phytoplankton can actually move, using active propulsion methods such as whip-like tails (flagella) or through regulating the amount of gas in their cells. Diatoms, golden-brown and green algae, are common during the winter and spring. Blue-green algae often become the dominant type of algae in nutrient-enriched waters during warmer months. While commonly referred to as "blue-green algae," members of this group are actually bacteria that contain plant pigments, the Cyanobacteria. Blue-greens are generally considered undesirable for a variety of reasons. Certain blue-greens form unsightly surface films or scums, which are prone to sudden die-offs, and some species release compounds that give fish a muddy or musty flavor. In addition, a number of species of blue-green algae can produce toxins.

Blooms

When dense algae populations develop, they turn water a green or greenish brown color referred to as a "bloom." Blooms are simply high concentrations of algal cells that give the water a "pea soup" appearance (Figure 5). Dense blooms near the surface may resemble a layer of green paint. Problem blooms occur in the summer months and are more frequent in times of drought. As the number of algal cells in water increases, the chances for problems are also increased. The World Health Organization (WHO) standard for problem blooms is when the population of algal cells exceeds 100,000 cells/milliliter, or the equivalent of 24 million algal cells in an 8-ounce cup of water. Individual states may have different standards, and health agencies may test for specific toxins as well.

Bloom density in pond water is often measured using a Secchi disk. A Secchi disk is nothing more than a circular flat disk, typically 8 inches in diameter, made from wood or plastic and painted white or with black and white quadrants (Figure 6). The disk is mounted on a yardstick. The cut-off bottom of a plastic bleach bottle works well, and the yardstick can be fastened to the handle. To use the disk, insert it upright in the water and lower until the circular disk just disappears from view. Read the water depth on the yardstick. Slowly raise the disk until it can be seen again, and read the depth again. The average of the two readings is the "Secchi depth." Infertile water bodies should have Secchi depths of greater than 3 feet, and in these waters, Secchi disks must be weighted and suspended from calibrated ropes in order to obtain readings. In fertilized farm ponds for sportfish production, a Secchi depth in the range of 18 to 24 inches (during the summer months) is ideal. Blooms are considered to be too dense when the Secchi depth is less than 12 inches.

Scums

Under certain conditions, algae cells float at the surface of water and form a layer, or "scum." Scums typically form during still weather after a period of warm and windy conditions. This layer can be pushed to one side by the wind, forming a thick mass of algae (Figure 7). Scums come in a variety of colors – yellow, green, bluish green or even red. Exposure to intense sunlight will kill algae, turning some cells white, so that scums may also develop mottled colors. Red euglenoids are often responsible for red scums on freshwater ponds (Figure 8). Recent research has shown that two *Euglena* species, *Euglena sanguinea* and *E. granulata*, are capable of producing toxins that can kill fish. Apparently, this occurs only rarely. Another type of freshwater red algae (*Planktothrix* spp.) is known to produce toxins, and it does not form a scum. It is found infrequently at mid-depths in large lakes in early spring. A commonly found genus of freshwater red algae is called "*Haematococcus*," and it grows in bird baths (Figure 9).

Surface layers are not always caused by algae. In the spring, enough pollen may fall into ponds to form a layer on the water surface, especially in ponds around pine trees. Plants such as water meal (Figures 10 and 11), duckweed (Figures 12 and 13) and *Azolla* (Figures 14 and 15) also form surface scums. These tiny plants form a layer over the surface of a pond, blocking sunlight from entering the water. By keeping light from reaching algae in the water, dissolved oxygen concentrations are reduced, leading to the potential for fish kills. Water meal is a tiny, rootless green plant that reproduces quickly. The plants look like tiny "microbeads" floating on top of the water and, when rubbed between the fingers, feel like cornmeal. Duckweed, a bigger plant than water meal, is a small plant with fine root hairs. The two plants are often found together. There are several common species of *Azolla*. One is known by the common name of "mosquito fern," as the leaves resemble fern leaves. *Azolla* also can have a red color, resembling at a distance a red algae bloom.

Mats

Algae can also grow in long strands or chains of cells called filaments. Some forms of filamentous algae grow in a submerged mat over the pond bottom, especially in shallow areas (Figures 16 and 17). As bubbles of oxygen from photosynthesis accumulate in these submerged mats, clumps of algae will break loose and float to the surface. Algae mats and floating clumps are unsightly and create problems for anglers by fouling hooks. Filamentous algae mats are more common in ponds during the spring, but they can persist throughout the year. For some reason, infestations of filamentous algae appear to be more common in ponds receiving organic forms of fertilizer, such as septic system leakage. There are a number of species of mat-forming algae, and some types are more easily controlled than others. Algal filaments may feel slimy, cottony or like steel wool, depending on the species. Dark-colored mats can result from a type of algae called *Lyngbya*.

Bubbles, Dark Streaks and Colors

Ponds receiving nutrients are an organic "soup" and may exhibit a variety of characteristics resulting from natural processes. Organic matter from leaves and other plant material often accumulates in ponds, staining the water a dark color. Bubbles from gasses released by photosynthesis of plants in the water or from bottom sediments may also collect in surface scums at the pond surface (Figure 18). Dark streaks in irregular shapes may also appear in water, possibly formed by concentrations of motile algae (dinoflagellates).

Figure 1. Ponds often develop mats of filamentous algae.

Figure 2. Nutrients from livestock wastes can result in algae problems.

Figure 3. Organic fertilization is often linked to filamentous algae problems.

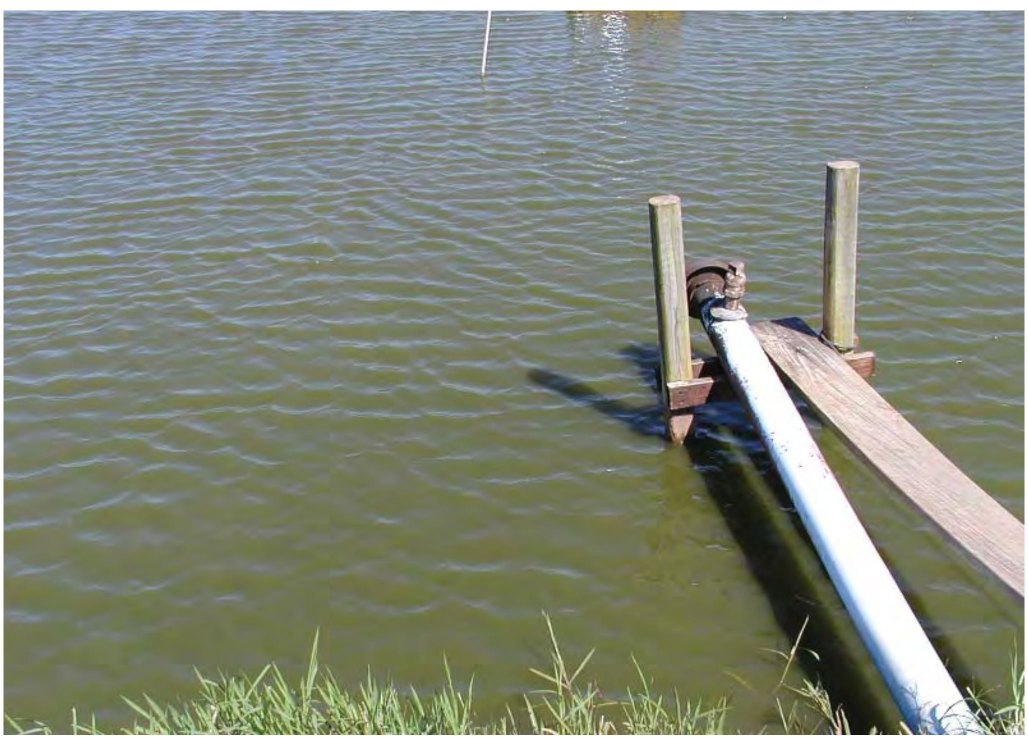

Figure 4. Microscopic algae, or phytoplankton, color water in various shades of green.

Figure 5. Dense algae blooms can give ponds a "pea soup" color.

Figure 6. A Secchi disk is used to estimate the concentration of algae in water.

Figure 7. Blue-green algae may form dense scums on the pond surface.

Figure 8. Red scums sometimes form on freshwater ponds.

Figure 9. A red algae is commonly found growing in bird baths.

Figure 10. Water meal is tiny but can form a film on top of ponds.

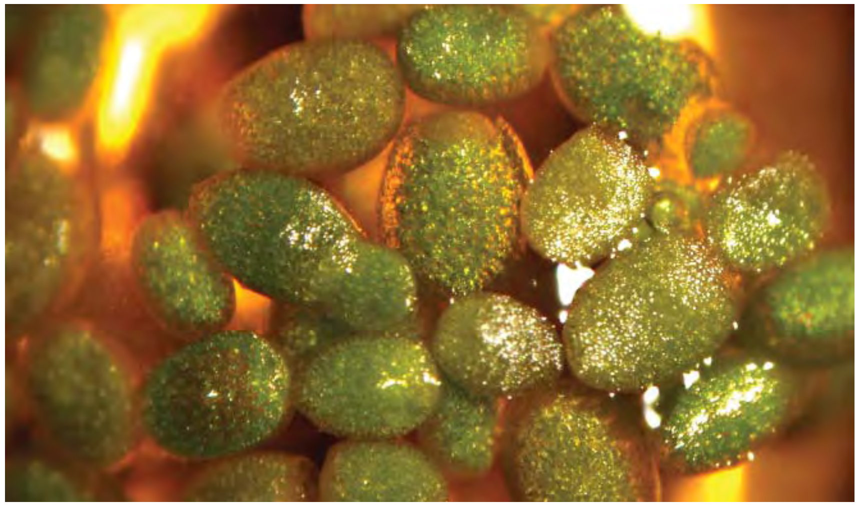

Figure 11. Under magnification, water meal is revealed as a tiny, rootless plant. ***(****Photo by Andy Goodwin****)***

Figure 12. Duckweed forms a green cover over the surface of ponds.

Figure 13. Duckweed has tiny hair-like roots.

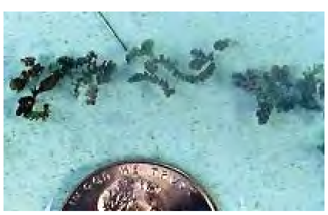

Figure 14. Azolla has tiny, fern-like leaves.

Figure 15. Azolla may also have a red color and is found in wetlands.

Figure 16. Filamentous algae can form dense mats on the pond bottom and at the surface.

Figure 17. Strands of filamentous algae.

Figure 18. Scum filled with bubbles along a pond edge.

Are They Harmful?

In sportfish ponds and commercial aquaculture ponds, moderate levels of algae are beneficial. They serve as the base of the food chain and also take up ammonia, a waste product of fish. However, algae also change the appearance of water bodies, and the filamentous forms can interfere with swimming, fishing or other recreational activities. The various forms and types of algae are rarely directly harmful. Although in rare cases, some types can produce toxins as discussed below.

In general, the major negative effects of algae occur indirectly. Excessive algae growth can lead to a lack of dissolved oxygen in the water. As plants, algae produce oxygen through photosynthesis, but they also consume oxygen through the process of respiration. Respiration of heavy blooms of algae on warm summer nights or during prolonged periods of cloudy weather can reduce dissolved oxygen levels to dangerously low levels, low enough to kill fish. Dense algae blooms or scums may also die suddenly, again resulting in low dissolved oxygen concentrations. Decomposition of blooms can reduce dissolved oxygen levels and result in fish kills. Blooms may be considered unsightly and may stink upon decay. A 1953 publication by Rose put it more eloquently: “Upon decomposition of these heavy scums, or “bloom” as they are commonly termed, terrifically foul, pig-pen odors issue therefrom, making human living conditions in the vicinity intolerable, and limiting to a large degree all aquatic recreation.”

Human Health

For unknown reasons, some common algae can produce toxins under unusual circumstances, and a few species of algae are capable of producing toxins continuously. Presently, algal toxins are considered to only rarely pose a human health hazard. People usually do not drink water containing algae, and ingestion is the primary pathway for entry of toxins.

However, there is increasing concern and a considerable amount of research is being conducted on the human health aspects of algal blooms. Skin and mucus membrane irritation has been reported from surface contact with algal blooms. Children should be kept from playing or swimming in dense algae blooms or scums, and adults should avoid contact as well. Wash affected areas with fresh water. Keep pets and other animals from drinking water in heavy algae bloom areas. In public waters affected by dense blooms, public health advisories will be issued, closing the water to recreational activities. In rare cases, reservoirs serving as water sources have developed dense blooms, and deliberate killing of the algae to remove it from the water has resulted in the release of toxins from within the cells. These cases highlight the importance of preventing nutrient enrichment of drinking water reservoirs!

Livestock Watering

Although rare, it is possible for livestock to be poisoned by drinking water in scummy areas with high concentrations of certain algae, by drinking water containing toxins (after an algae die-off) or from eating clumps of algae. Reported symptoms include muscle weakness, lethargy, reduced appetite, diarrhea and paleness. Keep livestock from water with heavy algae blooms, especially from areas with dense surface scums. Rarely, fish can also die from algal toxins, as well as birds and other animals. In August 2004, blooms of a species of toxic algae were blamed for fish kills in Arizona reservoirs. Saline waters in Texas have experienced fish kills resulting from blooms of a species of golden algae.

What Can Be Done?

Short-term control of problem algae may be obtained by use of chemicals (see Cooperative Extension Service publication MP44, *Recommended Chemicals for Weed and Brush Control*, for specifics), but this is not a long-term solution. It is instructive to remember that many problem algae are really bacteria, capable of fast growth and reproduction. Nutrients released on the death of treated algae may only serve to grow more of the same problem species. Decaying algae also consume oxygen from the water, and care must be taken to avoid oxygen problems and resulting fish kills. The least expensive chemical, copper sulfate, is toxic to fish in waters with low alkalinities, and it is ineffective for control of certain algae species. Young grass carp consume filamentous algae, but unless stocked at very high densities, it may take months for control to be realized.

The key to reducing problem algae (and problem floating weeds such as water meal and duckweed) over the long term is to reduce the quantity of nutrients (phosphorus and nitrogen) that enter the pond. Use soil testing (available through your county Cooperative Extension Service office) to avoid excessive nutrient applications on the watershed. Leave a buffer strip of undisturbed grassy vegetation, at least 25 to 50 feet wide, around the edge of the pond. Avoid applying nutrients within this buffer zone. Without buffer strips, pond banks can be denuded of vegetation, which can lead to soil erosion. Sediment muddies the pond, and nutrients that can be utilized by algae are bound to sediment.

Only a portion of the nutrients applied to the watershed of a pond will end up in the water. Poultry litter applied to a field at a typical rate of 2 tons per acre adds an average of 116 pounds of phosphorus per acre. Fertilizer losses in runoff may result in only 5 percent of nutrients reaching a pond. However, ponds require only relatively low concentrations of nutrients to develop a plankton bloom. A typical fertilization rate for ponds is 3 to 4 pounds of phosphorus per acre. It is easy to see that if even a fraction of the phosphorus in the litter makes its way into the pond, it could result in an algae bloom. For guidance on the proper rate of animal manure applications for use as fertilizer, obtain a nutrient management plan from your local conservation district office.

Livestock waste is a major source of nutrients for many ponds. Preventing livestock from loafing in and around ponds will reduce the nutrient loading. Ideally, livestock should be watered from a trough installed below the pond dam. Alternatively, control their access to a few areas where the livestock can water but not loiter. A floating, U-shaped PVC pipe boom topped with an electric fence wire has been suggested as a way to restrict access.

Encouraging the growth of rooted aquatic plants, which compete for nutrients, has been suggested as a means of reducing algae problems. However, rooted aquatic weeds can be problematic as well, and their widespread growth could preclude the use of a pond for other uses, such as swimming, boating and fishing. Rooted plants typically do not grow well in fertile water because the dense algae growth shades the pond bottom. In waters with low nutrient levels, they can become established by extracting nutrients from the bottom sediments. Ironically, some rooted aquatic plants have been shown to serve as "pumps," releasing nutrients obtained from the soil into the water.

If the pond is located near a home or housing addition using septic systems, make sure the systems are working properly. Human sewage contains appreciable amounts of nitrogen and phosphorus. Make sure the sewage effluent is not surfacing and flowing directly into the pond or entering during runoff events.

If ponds are located near lawns, make sure the fertilizer is not inadvertently applied to the pond. Soil test your lawn for proper fertilizer rates, and do not apply fertilizer immediately before storms. Also, avoid using the pond as a means of cleaning fertilizer applicator equipment. Clean equipment in an area where the rinse water can be contained from moving into the pond.

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