Golf course ponds are complete ecosystems

A complete food chain ensures healthier, more pleasant aquatic features on the golf course.

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When skies are cloudy on warm summer days, "turnover" often occurs in golf course ponds: Aquatic plants (from large to microscopic) receive insufficient sunlight for normal photosynthesis, and dissolved oxygen becomes deficient in the system.

At the same time, the upper levels of the pond may become much warmer than the bottom layer. The split in water temperatures at a given depth is called a thermocline, and it acts as a curtain preventing circulation, thereby depriving the lower levels of oxygen.

After the oxygen is depleted, a cold rain may mix the warm and cold layer, breaking down the thermocline and depleting the pond of what little dissolved oxygen remained in the upper levels. Without oxygen, microorganisms, invertebrates and, most noticeably, fish die.

Photo courtesy of Jamie Ennis

The golf course pond's ecosystem might be enhanced by providing subsurface structures for beneficial organisms to colonize.

KEY POINTS

- Ponds require monitoring and careful attention to avoid severe declines in water quality.
- Oxygen is important in ensuring pond health.
- Diversity of plant and microbial species helps reduce excess populations of undesirable organisms.
- Healthy pond ecosystems start at the bottom of the food chain with green algae and plants.

Like all ecosystems, a pond can be seen as simply a set of relationships among all the organisms of a closed system. By establishing a healthy pond ecosystem, you can alleviate many problems of ponds.

Eutrophication, nitrogen and phosphorus

Nutrients such as nitrogen and phosphorus are rarely found in natural ponds at destructive levels. However, sewage disposal, land drainage and fertilization may result in excess nutrient enrichment, known as cultural eutrophication.

When nitrates and phosphates occur in excess, algal blooms and aquatic weeds are sure to follow. Water-quality indicators such as turbidity, pH, alkalinity and dissolved oxygen are also adversely affected in a eutrophic pond. As the pond becomes unattractive and malodorous, it may also become less able to digest excess nutrients, so toxins (such as ammonia and nitrite) and metals (such as aluminum and iron) become potentially lethal to the entire ecosystem (1,3,7,8,9).

Oxygen depletion warning signs

Ponds with low levels of oxygen will exhibit the following:

- fish swimming at or near the surface or gulping for air during late night or early morning
- rapid changes in water color to brown, black or gray
- a putrid odor
- sudden algal die off

These conditions are most likely after an extended period of hot, cloudy weather is interrupted by a summer wind and rainstorm.

Primary producers

A healthy pond ecosystem starts at the bottom of the food chain with green algae and plants. Plants use the nutrients supplied by the microbial community to grow and in turn become food for herbivorous fish and other small animals. Thus, you need aquatic plants to build an ecosystem. The right plants help the ecosystem balance itself.

Pond weeds fulfill the primary producer niche and grow faster and more efficiently than anything else in your pond. The goal in balancing a pond's ecosystem is to provide it with less-destructive primary producers such as periphytic algae and manageable aquatic vegetation (1,2,7,8,9).

Fish

A diverse fish population is vital to any aquatic ecosystem. Smaller fish eat small animals and algae. Larger fish eat smaller fish and plants and algae. The top of the pond ecosystem is usually held by big fish that eat only other fish, although the occasional turtle, bird or alligator may make a strong argument.

The idea is to occupy as many levels of the food chain as possible, a concept known as biodiversity. Completing the food chain, the fish die, decompose, or are released through excretion back into nutrients. Then the cycle starts all over again (1,10).

State or federal fish and game agencies can suggest which fish to use and how to maintain their numbers, and they can inform you of any stocking laws in your area.

Attitude

Patience is absolutely essential in successful ecosystem establishment. It will not happen overnight, but in six months, or a year, or five years, you will see the advantages of proactive problem solving and letting nature take its course.

Superintendents and their staffs must be willing to learn about their water. Appoint an "environmental steward" to take classes and read books

on pond management and monitoring. Most regions have volunteer lake-management programs offered by universities or private groups that teach the ins and outs of responsible water management.

Finally, a leap of faith is required. There are activities that you will abandon and new ones that you will need to adopt. A willingness to change and the patience to allow success to happen make all the difference in the world (1,6).

Chemicals

It's difficult to make general statements about the use of chemicals in aquatic environments because of the many products on the market. Herbicides and algaecides are designed to kill or inhibit plants and algae. They are licensed and extensively studied by the EPA to ensure they are not toxic to organisms other than those targeted.

When a chemical kills a plant, the dead plant breaks down and adds to the nutrient load of the pond, feeding the next "bloom." An endless cycle of chemical application is too often the result.

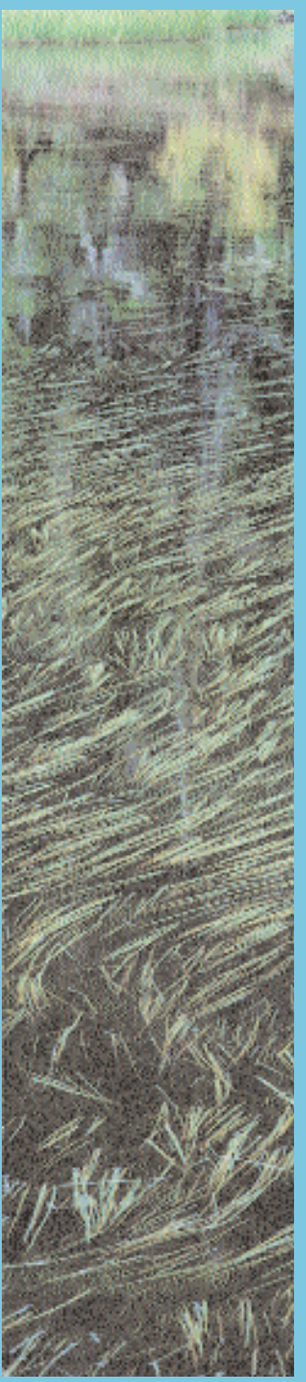
Chemicals offer a short-term fix. The best advice for the use of chemicals of any kind is to understand them. Know what they do to the plant, how they work, and how that is going to affect the communities that you are trying to establish. When you can answer those questions, you can effectively decide the most responsible chemical application. Just be sure you are not recycling your problem (2,6).

Monitoring

The best way to maintain a pond ecosystem is to constantly monitor it. Measuring turbidity, total ammonia-nitrogen, phosphorus, temperature, pH and dissolved oxygen takes the guesswork out of your evaluations of the effectiveness of your plan.

Several companies produce portable meters that give reliable readings quickly and easily. Further, the EPA and the North American Lake Management Society both produce manuals that

Pond glossary



Aeration: To add air or oxygen into a liquid.

Biodiversity: Describes all aspects of biological diversity, including species richness, ecosystem complexity and genetic variation.

Dissolved oxygen: The concentration of oxygen dissolved in water.

Dissolved oxygen crash: A severe decline in measured dissolved oxygen over a matter of hours or days.

Flow: Movement of water.

Periphytic algae: A general category of predominantly green algae found growing on or attached to submerged structures in fresh water. Periphytic algae are used in innovative programs for the remediation of water because of their extraordinary nutrient uptake capabilities.

Primary producer: Green plants, which convert energy from sunlight to chemical energy, thereby providing food for those above them on the food chain.

Thermocline: The zone of rapid temperature change between warm surface waters and cooler deep waters in a thermally stratified lake in summer.

Turbidity: The amount of suspended particles or sediment present in water; relative water clarity.

can teach you what to measure as well as provide responsible ways to solve problems (6).

Aeration

Aerators and oxygen diffusers are important for two reasons: They add to the amount of dissolved oxygen in your pond while providing flow. Nearly every animal and plant requires oxygen at some level. Dissolved oxygen crashes are not uncommon in eutrophic water and can be dangerous if not lethal to your ecosystem. By providing a constant oxygen source, you may also avoid the putrid smell and algal blooms that result when oxygen is absent. Aerators and diffusers are relatively cost-effective buffers. They also provide flow that is usually deficient in ponds, and the rule is, the more stagnant the water, the more trouble you can expect (4,5,10).

Structure

Every animal or plant needs a home. Fish require protection from predation, a place to spawn and space for the development of juveniles. Bacteria populations are limited by the amount of surface area on which they can live.

Beneficial algae (periphytic) that can starve out problematic blue-green and filamentous algae require submerged surface area and structure to grow on. This end of the food chain will dictate most of your failures and successes, and yet, it is the easiest to modify. All you have to do is supply it with surface area.

Rocks and rooted plants provide structure and surface area. Christmas trees, straw bales and other organic materials do the same, but may leach undesirable compounds and will eventually decompose and add to the nutrient load of your pond.

A synthetic product, AquaMats for Ponds, provides a high surface area on a grass-like structure. The mats offer 280 square yards of surface on just a square yard of product. That's roughly the area of a tennis court in a small area of your pond bottom. The product acts as an in-pond biological filter for improved water quality while providing structure required for successful biodiversity in the pond by offering surface area exceeding that found on a conventional structure (1,3,7,8,9).

Building and maintaining a thriving pond ecosystem require responsible problem solving. Remember to consider nutrient levels, biodiversity and long-term environmental implications and, of course, cost effectiveness. Better understanding of aquatic ecosystems will help you understand the implications of everything you do to your ponds. ■

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