







# IN AT THE DEEP END

**Mike Spencer takes you to the murky depths of the lake and pond and gives some excellent advice on maintenance**

Lakes and ponds, both man made and natural, have a life cycle. They start balanced, clean, fresh and clear. Eventually, with increasing levels of nutrient that overwhelm the natural clean up mechanisms, algae and weed growth appear, and without the correct supervision they pass into 'old age' as shallow bogs or marsh land.

This process used to take hundreds of years, but now can take only decades. Why? Because until recently, water was one of our least understood resources. This lack of understanding has led to some significant problems eg Algae blooms, aquatic vegetation growth, foul smelling odours, clogged sprinklers, valves and pumps. A better understanding of the causes of these problems leads to a clear long-term solution, which addresses the causes and is preventative in nature.

A pond in balance is a healthy, dynamic ecosystem that is ageing at a very slow rate. Fish and other aquatic life are present. There is an absence of odours, foul smell and algae blooms. As nutrients enter the ecosystem they are either absorbed by the plant life or metabolised by aerobic bacteria. There are safe levels of oxygen in the lake - at least 2-3 PPM or mg/l. Oxygen is added to the lake from wave and wind action, the light side of the photosynthesis process and rain. It's a healthy, balanced ecosystem. Mother Nature has provided the necessary clean up tools to deal with the problems.

Because this is a finely balanced situation it does not take much to throw it out of balance. Typically there is an influx of nutrients. The aerobic bacteria consume oxygen as they metabolise nutrient. Everything is fine until the first hot cloudy day when the planktonic algae doesn't photosynthesise and create oxygen or the first long hot night when oxygen demand soars.

It is in these scenarios when there are no oxygen producers and the demand for oxygen cannot be met. The result of this lack of oxygen appears in the form of algae, foul smells, insect infestation and eventually fish kills.

As any manager of water will tell you, the three most important factors that impact the balance of a lake or pond are temperature, nutrients and oxygen.

#### **Thermal stratification or layers of temperature**

The summer sun will warm the surface water. This water becomes less dense than the cooler waters that are trapped at the pond's bottom. As the summer progresses the surface water gets warmer and warmer in comparison with the cooler water at the bottom and the water eventually becomes stratified or separated into layers. The warmer water, which has a diminished capacity to hold oxygen - water at 40 degrees Fahrenheit can hold 40% more oxygen than water at 72 degrees Fahrenheit - encourages algae growth.

#### **Nutrients**

In pond ecology we talk specifically of those compounds that contain phosphorous and nitrogen. In fact, phosphorous has been identified as the single greatest contributor to aquatic plant growth. As the nutrient level in the pond increases, so does the plant and weed growth, which leads to severe problems from an environmental and aesthetic viewpoint.

The most common sources of nutrient are bottom silt; plant life and run off water from surrounding turf areas and inlet water.

Vegetative life in the pond and sediment are the number one source of nutrient. Blue green algae can divide as often as every 20 minutes with a two-week life cycle. At the end of the cycle the plants simply die and fall to the bottom adding to the biological material in the pond. This dead plant material acts as nutrient for future growths which in turn adds more demands on the little available oxygen.

'Run-off' is the second most common source of nutrient. Research shows that up to 4% of the fertilisers applied to areas adjacent to the ponds and lakes will eventually leach off into the water, placing additional burden on the lake's natural clean-up process.

Nutrient loading tends to be very high in waters adjacent to green areas or turf grass. Sludge build up can accumulate at 1-5 inches per year. This build up can rob your lake, or irriga-







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tion basin of its capacity to store water. The pond will work to break down and get rid of this nutrient load. This is a process called organic digestion. There are 2 types of digestion, aerobic and anaerobic. Aerobic bacteria are the most effective. They metabolise or break down the nutrients, respiring or consuming oxygen, much like we do. They are efficient, breaking down organic nutrients into elemental form, creating no noxious by-products.

The second type is anaerobic bacteria. They exist in water that is oxygen deficient. They are not as efficient and allow soluble organic nutrients to recycle into the water column. By products such as methane, ammonia and hydrogen sulphide are created by anaerobic decomposition. Aerobic bacteria work roughly 7 times faster than anaerobic bacteria.

## Oxygen

The third role is oxygen. Oxygen is important to both the life in the pond and is used by the pond itself to clean itself of excess nutrient. Oxygen supports the food chain. A healthy ecosystem in a pond is not just a nice thing to have. It provides for a natural way to consume organic nutrients.

The bottom of the food chain are the microscopic algae which are consumed by the slightly larger zooplankton. Each level of consumers transfers only a small fraction of the energy it receives up the chain to the next level. This means that a few sports fish depend on a much larger base of plants and algae. Therefore a healthy food chain can pull a tremendous amount of nutrient out of the water. Oxygen supports this entire system.

## Putting it all together

As a pond gets older the level of nutrient rises. This is due to an increase in run off, organic bottom sediment or fertiliser use in the surrounding area, and in the amount of algae and aquatic weed growth. As these weeds die they sink to the bottom. This will result in a sudden increase of aerobic bacteria due to the large food supply. This bacteria will use large amounts of oxygen as they digest organic waste. Due to thermal stratification, the top and bottom layers of the pond will not mix which means that the oxygen cannot get to the bottom to support the aerobic digestion.

Balance is critical to the aquatic ecosystem. A healthy lake contains balanced amounts of oxygen, nutrients and temperature.

## Solutions

Several methods are available to help solve the problems.

**Mechanical control** - This is the oldest method of management. Dredges, weed harvesters, rakes, are used to remove algae and aquatic plants. These methods can be an effective short to medium term solution - treating the symptoms of poor water quality rather than treating the causes. Disposal of aquatic plant material and dredged materials is quickly becoming more regulated and expensive.

**Chemical control** - This is probably the most popular method. Herbicides are applied to the pond to kill the algae and plants. They are fairly quick, however since herbicides kill the plants and algae which then sink to the bottom, oxygen depletion, odours and fish kills can be a by product. Chemical control does not improve water quality, but the symptom of poor water quality, algae and aquatic weed blooms.

**Biological control** - The most popular of these is the introduction of weed eating fish or grass carp. These fish can be quite effective in keeping excessive weed growth under control, are inexpensive and require no labour, however they are indiscriminate feeders with their preferred food being aquatic plants and they will only eat algae if their preferred plants are not available.

**Aeration** - This is the addition of oxygen to the water. It is still used today as a vital part of the treatment of industrial and domestic waste. By putting large amounts of oxygen into the water, an aerator encourages aerobic bacteria which, in turn, work to clean the pond of organic nutrients and waste. The high pumping rate of an aerator also prevents thermal stratification, distributing oxygen to all parts.

Aeration helps to keep the three contributing factors, temperature, nutrients and oxygen in balance.

For more information on 'Aeration' and Otterbine aeration units please contact Mike Spencer, of Aquatic Control Ltd, Tel: 01342 325389, H/o 01477 500406, or email mike.spencer@ukf.net

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