A Pond Water-Quality Primer

By Jim Morris, Contributor

In my previous article, I provided a brief discussion of the concepts for sound pond management, as well as briefly introducing and defining the term eutrophication. (To recap, eutrophication is the process by which a pond accumulates significant quantities of nutrients, organic matter and sediments, causing high photosynthetic activity and low transparency.) Having put the cart in front of the horse by starting with management concepts rather than the basic underlying science, I would like to now go back and provide a very brief summary of pond water-quality dynamics.

Probably the most fundamental truth in pond management is that *phosphorus* as a nutrient is the principal determinant of pond water quality, barring situations involving direct chemical contamination and/or very unusual natural settings related to geology or landscape position. The overriding importance of phosphorus to pond water quality stems from its role as the "limiting", or least available, nutrient in aquatic environments. Other nutrients are usually readily available in aquatic environments. Blue-green algae and certain strains of bacteria are able to "fix" nitrogen directly from the air and convert it to nitrate, nitrite and/or ammonia, while potassium and the various micro-nutrients required for plant growth are relatively abundant in soluble form.

While many of you may understand that phosphorus plays a pivotal role in pond water quality, you may not appreciate just how sensitive ponds are to inputs of this nutrient. In the Mid-Atlantic region, ponds with total phosphorus concentrations of ≥25 parts per billion (ppb) are extremely likely to be eutrophic and exhibit unacceptable water-quality conditions, and lower concentrations may result in undesirable conditions in some ponds. To more clearly illustrate this sensitivity, consider a pond with an average depth of eight feet. This pond would hold ±2.6 million gallons of water per acre of pond surface. Therefore, it only takes 0.55 pounds of phosphorus per acre of pond surface, at a given point in time, for this pond to exceed the 25 ppb eutrophic threshold and become an aesthetic embarassment.

For those of you used to dealing with fertilizers (which is to say all of you), this is clearly a very small amount of phosphorus. To make matters even more challenging for golf course superintendents, a large fraction of this tiny concentration of phosphorus will end up in your pond from natural sources, including rain, runoff from non-play areas, leaves and other organic matter, and internal cycling of phosphorus stored in pond sediments. Similarly, phosphorus can leave the pond through discharges to streams, irrigation withdrawals, and long-term storage in pond sediments. A detailed summary of the various phosphorus inflows, outflows, and in-pond concentrations is called a "phosphorus budget"; such a budget is derived from regular monitoring, and serves as the cornerstone for evaluation and remediateion of pond eutrophication problems.

There are several other principal factors that affect pond water quality that deal with the morphology and hydrology of the pond. These factors can be expressed in several ways, but are most easily discussed in terms of average depth and flushing rate. Average depth bears no explanation; flushing rate refers to the average volume of water that cycles through the pond per year divided by the pond's average volume. Although the processes are dynamic, in simple terms, the deeper the pond or the higher the flushing rate, the better the pond water quality.

There are also certain site-specific conditions that may adversely affect pond water quality, such as turbidity caused by inorganic suspended sediments frc natural or man-made sources, or high acidity stemming from underlying soils, human sources or acid depositon. However, probiems of these types are relatively uncommon in this region, and are usually far easier to address through changes in watershed practices and implementation of various Best Management Practices.

And that is that. The myriad of general pond water-quality and aesthetic problems encountered by superintendents, ranging form over-abundant algae ot noxious odors to decreased pond volume through sedimentation, are symptoms of the eutrophication process, which is driven by excessive phosphorus loading. Granted, certain specific pond management goals, especially maintaining a desirable and productive fishery, require successful management of numerous variables to achieve the desired effect. However, control of the basic pond water-quality problems which arise from eutrophication can be achieved simply through management of a pond's phosphorus budget.

Note: It has come to my attention that the rather glib reference to purveyors of pond management devices and their products contained in the opening of my first article may have piqued some of our fellow associate members. It was not my intention to pick on "salesmen", but simply to point out the general lack of site-specific information and assessment as a basis for pond management decision-making and product selection. The point would have been better made through the following analogy: distributors of pond management products are like pharmacists; they offer a variety of remedies for specific ills, and are quite knowledgeable of the symptoms their treatments alleviate. However, most of us would not turn to a pharmacist until we were sure of a diagnosis and had a prescription specific to our need. -- JBM

This is the second in a series of articles addressing pond management concepts, methodologies and resources and other water-quality issues.

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