Overview of Pond Ecology and Biological Building Blocks

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Ecology describes the interactions between organisms and their environment. For ponds, examples include: interactions between dissolved oxygen in the atmosphere and water, nutrients and primary producers, detrital contributions from the surrounding landscape, and fish and zooplankton. A healthy pond will balance these interactions, expanding its lifespan and enjoyment by pond owners.

Most of our enjoyment from ponds comes from looking at the surface. However, to understand how they function, we must understand the relationships within the pond. Sunlight, along with carbon dioxide, provides the energy necessary for photosynthesis by algae and higher plants. This important function is referred to as primary production because all life is directly or indirectly dependant upon it. Sunlight also strongly influences water temperature, which in turn controls the rate of biological processes such as decomposition of plant and animal debris, photosynthesis, and reproduction by plants and animals.

Dissolved oxygen in a pond is required for fish and invertebrates. It enters ponds directly via wind mixing at the water surface, through aeration systems and pumps and by photosynthetic release by algae and higher plants. In the sediment, the presence (oxic) or absence (anoxic) of oxygen determines the efficiency that decomposers (i.e. bacteria) function and the availability of nutrients for uptake by rooted plants.

Nutrients such as phosphorus and nitrogen cycle through ponds via geochemical and biogeochemical process, respectively. Phosphorus is considered a *geo*chemical process because it enters ponds through fertilizers and the weathering of phosphate from rocks. In the water column, phosphorus is taken up by algae and floating aquatic plants for growth. Algae are either consumed by zooplankton or die. In the latter case, phosphorus is either released back to the water or deposited in the pond sediment where rooted

plants absorb it for growth. Zooplankton that feed on algae are similarly either eaten by fish or die, and the phosphorus is released back to the water or deposited in the sediment for uptake by rooted plants. Nitrogen is considered a *bio*geochemical process because nitrogen must be transformed by bacteria prior to uptake by algae or higher plants. Without these organisms, nitrogen could not be converted for plant assimilation.

Algae blooms, or excessive algal biomass, wreak havoc on pond ecosystems. Blooms are caused by sufficient nutrient supply in combination with high sunlight, imparting the observed pea soup color. Not only are blooms aesthetically displeasing, they can even be harmful to zooplankton, fish, pets and humans if the bloom is caused by toxin producing cyanobacteria species. Once thought to be algae, cyanobacteria are photosynthetic bacteria capable of "fixing" nitrogen (converting nitrogen gas to organic nitrogen usable to plants).

More commonly, blooms limit light penetration to submersed plants and alter the day/night fluctuation of dissolved oxygen and pH. During the day, algae and higher plants *produce* oxygen, however, during the evening, they *use* dissolve oxygen and release carbon dioxide in a process called respiration, much like mammals. Similarly, pH increases during the day and decreases at night. Reduced pH (or acidic conditions) can be harmful to many invertebrates and fish. While slight fluctuations in dissolved oxygen and pH are natural, they are accentuated during blooms and are stressful to species that require sufficient dissolved oxygen and balanced pH for growth.

Over time, excess plant debris, sediment and nutrients from the surrounding landscape, and decaying organisms within the pond build up. This build up results in reduced water capacity, increased water temperature, and reduced dissolved oxygen levels. Submersed plants are replaced by emergent species, followed by wetland species and eventually terrestrial ones. This process is called pond succession. Eventually, the pond will fill and resemble the neighboring landscape. By maintaining a healthy pond ecosystem, the pond's lifespan may be increased.