Farm Pond Ecology

By Ken Cox

VERMONT FISH & WILDLIFE DEPARTMENT
1 National Life Drive, Montpelier VT 05620-3702 (802) 828-1000
www.vtfishandwildlife.com

The majority of small private ponds in Vermont fall into a category of waters commonly referred to as "farm ponds." These are generally artificial ponds or impoundments having a surface area between one quarter and five acres. Farm ponds are typically shallow water bodies having a maximum depth which rarely exceeds 12 feet. These dimensions are important distinctions that set farm ponds apart from large ponds and lakes with respect to the physical, chemical and biological processes that take place and the ecological characteristics of these waters.

Physical and Chemical Characteristics

The shallowness of most farm ponds has a profound influence on their seasonal temperature and chemical makeup. Large, deep ponds and lakes typically undergo thermal layering or stratification during the summer. During this time of year deep ponds develop layers of water which differ in character. An upper or surface layer is made up of warm water directly influenced by sunlight and air temperatures. Below this warm layer is a transitionary zone, where water temperature decreases as depth increases. The deepest region of ponds is a layer of uniformly cold water.

Stratification is a seasonal phenomenon. During the fall the layering effect characteristic of summer is broken down as the air temperature cools and wind action over the water surface causes a mixing of the three zones. This event is commonly referred to as fall overturn. Once winter has set in and the pond becomes ice capped, the temperature profile of the water body typically consists of a thin surface layer of very cold water underlain by slightly warmer water extending uniformally to the bottom. With ice breakup in the spring another period of mixing (spring overturn) occurs before stratification takes place in summer.

The thermal stratification process has a prominent effect on the distribution and concentration of dissolved gases and other compounds in ponds and lakes. Even though dissolved oxygen is critical to all aquatic life, individual species may have different oxygen and temperature requirements. These two physical factors are critical to determining whether a particular pond is capable of providing suitable habitat conditions for aquatic organisms. For example, ponds which are either uniformly warm from top to bottom or have low oxygen concentrations will not provide habitat capable of supporting fish species, such as trout, that require cold, well oxygenated water.

Photosynthesis by aquatic green plants, particularly algae, is an important source of dissolved oxygen and nutrients in ponds and lakes. Photosynthesis is typically confined to the upper water layer where light penetration is least affected by such factors as water clarity, color and depth. Consequently, dissolved oxygen levels in the upper water layer are generally higher than those found at greater depths, where oxygen consumption by respiring organisms and decomposition place a high demand

on oxygen being generated above. Occasionally situations arise in some ponds where oxygen consumption exceeds oxygen generation or replenishment, resulting in high mortality of aquatic life, including fish. Such events typically occur during summer and winter seasons.

Nutrients, whether produced from within the pond or originating from outside sources, also have a bearing on oxygen availability in aquatic systems. While nutrients are essential to sustaining life and promoting good growth, these substances directly and indirectly affect respiration and decomposition rates in the water. Excessive concentrations of many nutrients in the aquatic environment can lead to the over-production of organic matter, both living and dead. These consume dissolved oxygen through respiration and decomposition to the point of reducing oxygen levels below that needed to support many aquatic life forms.

For example, severe oxygen depletion can occur if a small pond receives a heavy dose of nutrients, such as livestock manure runoff, following an intense rain and period of prolonged cloudy weather. Photosynthetic activity is depressed by the lack of bright sunlight. Consequently, green plants in the pond are unable to replace oxygen being used up, which results in fish and possibly other aquatic life dying of suffocation.

Biological Interactions

Farm ponds can be complicated aquatic communities made up of a large variety of interacting plants and animal species, not unlike many natural lakes and ponds, or they may support a simple complex of relatively few species, such as monoculture fish ponds. Generally newly constructed farm ponds start out as simple communities which, if left to nature's own devices, become increasingly more complex over time. To illustrate this succession, a newly created pond is quickly colonized by a variety of aquatic insects capable of dispersal through flight. Amphibians of one kind or another (e.g. frogs, toads, newts) are soon attracted to the new habitat and food supply. The pond may become populated with one or more fish species if the impoundment is located on a stream or has as its water source a nearby stream or if the pond owner deliberately introduces fish into it.

After one or more growing seasons, plant life becomes more apparent in shallow shoreline areas as well as deeper areas of the pond if adequate sunlight can penetrate the water column to the pond bottom. Many plants, including algae and complex vascular plants, enter the pond through aerial dispersal of spores and seeds or through the pond's water supply. Once aquatic vegetation takes hold and flourishes, pond productivity increases and habitat becomes more diversified. The increased productivity means more food available to support greater numbers of aquatic organisms, and the habitat diversity attracts a greater variety of animals, both aquatic and terrestrial.

These organisms form communities within which there exist many inter-

relationships and dependencies. Foremost is the food web, a composite of many connected food chains. A food chain maps the conversion of solar energy and nutrients into plant and animal matter. All plant and animal life generate waste by-products and eventually die, and this matter is consumed by scavenging organisms and decomposing bacteria. Eventually much of the energy fed into the system at the beginning of the food chain is released back to the pond in the form of nutrients and minerals to be taken up again by the food web.

Management Considerations

The landowner with a farm pond or someone contemplating the construction of one, may consider its use in one or more ways: recreational fishing, other water recreation (e.g. swimming, ice skating), water supply for fire protection or livestock watering, wildlife habitat, commercial fish production or simply for the general aesthetic appeal of having water and pond life near the home. Pond siting and constructing requires a thorough consideration of the effects it will have on other habitats and wildlife. Wetlands and streams are complex communities and are permanently changed if a pond is built in their place. In terms of wildlife diversity, wetlands provide more suitable habitat than artificial ponds. Construction of ponds in place of these valuable habitats is strongly discouraged.

Before the landowner begins pond construction, it is advisable to identify what State, federal or local laws and regulations may apply and what permits are needed. Several regulations specifically address habitat and other environmental alteration issues.

Whether the landowner has an existing well-established farm pond or a newly constructed one, its primary use has a bearing on the aquatic community that will be supported. It is important to understand some uses are incompatible with others, and the landowner should identify what use is of greatest importance. For example, a pond maintained primarily for swimming and encircled with a well-manicured lawn probably will not attract much wildlife activity. Or, a pond to which livestock has direct access for drinking water or receives runoff from surrounding pasture land or a paddock can be expected to develop a rich algae bloom and unsatisfactory water quality. These conditions may not be conducive to swimming, aesthetics or raising fish.

The raising of fish is very popular with many farm pond owners. However, because not all ponds provide the best habitat conditions to support a particular fish species, it is important to understand basic physical and chemical characteristics of the water body, how these change through the seasons and the habitat requirements of the fish. While a pond may provide suitable habitat for trout during the cooler months of the year, summer warm water temperatures and low pond inflow may be limiting factors. Under these conditions the pond may not be suitable for trout. The stocking of any variety of warmwater fish species is often considered by the private pond owner.

Unfortunately, the stocking of warmwater species in small farm ponds frequently does not produce the desirable outcome. Such fish as bass, yellow perch, sunfish, bullhead, and minnows or shiners are often released into such waters with the hope of providing sport fishing. But in small productive waters these species are prone to reproducing too freely, becoming overabundant, and eventually stunting to the point that few, if any, fish attain a size worth fishing for. When such a situation develops, it is difficult to control and expensive to correct.

Fish overpopulation is not a problem for farm ponds stocked with trout, since these waters rarely have habitat to support spawning. Consequently, the pond owner exerts direct control over the size of the population by limiting the number of fish stocked initially and the frequency that restocking occurs.

Here are some recommendations for private pond owners, who wish to manage their pond primarily for fish, wildlife, and/or a natural aquatic habitat.

•Keep shoreline disturbance to a minimum, especially removal of shoreline vegetation which function as natural filters of nutrients, sediments, and other pollutants transported to the pond by overland runoff. A 100-foot wide buffer of undisturbed vegetation around the pool is recommended.

•While grassy lawn surrounding a pond can serve as an effective buffer for filtering pollutants, lawn is a poor attactor of wildlife and does not give the "pondscape" a natural appearance. The pond can be improved for wildlife by planting a variety of native trees, shrubs and herbaceous plants around the shoreline. Some nurseries are sources for native plants that can be planted to enhance wetlands and ponds for wildlife.

•Do not allow livestock, including ducks and geese, direct access to the pond. Livestock excrement in pond pond water can result in excessive algae and poor water quality, and it detracts from pond aesthetics. It is better to pump or siphon water to a drinking trough away from the pond. Locate manure storage areas and horse paddocks away from the pond and separate with a vegetated buffer strip.

•Regularly inspect and maintain your septic system. Drainage from a failed system into the pond can cause excessive algae growth, unhealthy water quality and poor aesthetics.

•Avoid the overuse of pesticides and fertilizers on lawns and gardens. Many of these products are toxic to aquatic life or encourage excessive algae growth.

•Consult the Vermont Agency of Natural Resources before treating your pond with pesticides or other chemical materials,or draining or dredging a pond. A permit may be required before any of these activities

can be carried out.

•It is not advisable and may be illegal to introduce or stock fish species other than trout (e.g. bass,perch, bullhead, pickerel, goldfish, grass carp) into your pond. Some fishes become a management problem in farm ponds or pose a threat to fish populations in nearby waters. Before stocking fish other than trout contact the Vermont Department of Fish and Wildlife office in your area.

•Before undertaking construction of a new pond, whether on-stream or off-stream, know what State, federal or local laws and regulations may apply. The Regional Environmental Office serving the town in which the pond site is located can assist you.

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Suggested Readings

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