MARYLAND COOPERATIVE EXTENSION
UNIVERSITY OF MARYLAND
COLLEGE PARK•EASTERN SHORE

Fact Sheet

Fact Sheet 766

Integrated Pond Management for Maryland

A pond edge with clumps of cattails.

This fact sheet is intended to be an introduction to integrated pond management principles. The information contained within will provide a broad overview of pond management principles.

The integrated pest management approach, or IPM, is an established environmentally friendly method for the control of pests in terrestrial systems. With increasing concern over water quality in the 10,000 ponds in Maryland used for irrigation, livestock watering, aquaculture production, and recreation, and the consequences of chemical use in the Chesapeake Bay, there is a need to develop alternative methods for management of aquatic pests, particularly weeds. Although aquatic management methods are in their infancy compared with terrestrial techniques, methods are available including chemical, mechanical, and biological approaches, which when

A bale of barley straw is being placed in a pond with a serious algae problem. The bale is contained in a chicken wire basket and held in place with a nylon rope tied to a cinder block.

combined create an "integrated" approach to pond management.

Ponds are complex ecosystems and it is important to be aware that many treatments can have adverse impacts on nontarget organisms. Integrated management approaches seek to minimize these impacts while considering the management goals for a specific pond. For example, in ponds used for irrigating horticultural crops or watering livestock, avoid herbicidal treatments or time them to not interfere with production needs.

Management of aquatic systems has several challenges compared with similar management approaches in terrestrial settings. First, because of the nature of aqueous environments, everything that dissolves in water will diffuse fairly quickly throughout the pond. This is advantageous in some treatments, e.g., fertilization and liming, but a concern in others, e.g., herbicidal treatment of a bed of submersed weeds. Second, because of the limited solubility of oxygen in water, treatments that lead to oxygen consumption, e.g., herbicides that create large amounts of decaying vegetation, can lead to fish stress and mortality.

Preventive Maintenance

A regular schedule and good pond management practices can help prevent development of serious weed problems. These methods all enhance water chemistry and fertility to maintain healthy stocks of phytoplankton (algae) —the aquatic "pasture" that supports the entire food web and may directly or indirectly influence the well-being of other aquatic organisms from aquatic insects to fish.

Fertilization

Phytoplankton generally require the same nutrients as land-based plants. In freshwater ponds phosphorous is the nutrient that is most likely in short supply, and therefore limits the growth of phytoplank-

Hydrodictyon or "water net" is a common mat-forming alga in Maryland ponds.

ton. Fertilization is often recommended in the spring when water temperatures will support rapid phytoplankton growth.

Fertilization will accomplish two things: first, research has demonstrated that fertilized ponds produce more fish. That is, increased production at the base of the food web is eventually transferred to the level of fish. This can mean improved recreational fishing. Second, increased phytoplankton abundance, or blooms as they are commonly called, in the spring will create shading that can prevent or delay the establishment of nuisance plant growth on the sediment surface. However, fertilization can contribute to weed problems since nutrients can be quickly released from phytoplankton as they die or are consumed by microscopic animals called zooplankton.

Ponds can be fertilized using a complete commercial formulation containing nitrogen, phosphorus, and potassium in various proportions. However, with the knowledge that most freshwater systems are limited by a lack of phosphorous, additions of polyphosphate or phosphoric acid are sometimes made. Various organic fertilizers are also employed including hay, cottonseed, or soy meal, and even manure. All of these fertilizers add organic materials including decaying particles called detritus, which are valuable as food for some pond organisms.

Commercial fertilizers have recently become available that have nitrogen and phosphorous ratios reflecting phytoplankton needs in freshwater in a time-release formulation that ensures a steady supply of nutrient to maintain phytoplankton blooms without the "boom-bust" pattern of regular fertilizers.

Liming

Liming a pond provides an important buffering capacity, which helps to prevent large changes in pH (acid or basic condition). With

pH stabilized at a point near neutral (pH 7), factors necessary for phytoplankton growth, as well as phosphate, trace elements, and carbon dioxide availability, are maximized. Increased phytoplankton growth provides food for the rest of the food web, ties up nutrients that might otherwise be used by aquatic weeds, and shades the sediments of the pond to prevent growth of rooted aquatic plants and mat algae. This growth will often begin on sediment surfaces.

Lime can be applied any time it is determined that alkalinity levels are below about 50 parts per million (ppm). Alkalinity can be determined directly by using chemical test kits. In selecting a test kit it is important to remember that you will want to determine total alkalinity with a range from 10 ppm to 300 ppm. Pond sediments can be tested like other soils for lime requirements (see Harrell and Bandel's fact sheet under "Further Reading"). In Central Maryland areas without limestone-based soils a 1-acre pond will require 1,000 to 2,000 pounds of agricultural lime. Application frequency varies significantly depending on flow-through rate, etc.

Aeration

The limited solubility of oxygen in water creates one of the greatest challenges aquatic organisms face. It is difficult for aquatic organisms to get enough oxygen because their environment may not provide enough on a seasonal or daily basis. Ironically, the atmosphere contains 20% oxygen while the water in a pond may contain only .002% or less. Aeration enables a pond manager to "force" additional oxygen into the water during shortages to prevent fish mortalities.

Aeration is also useful in preventing stratification, a process involving formation of layers of cool, low-oxygen water on the bottom of a pond. During the summer, upper pond layers increase in temperature as a result of the absorption of light while the bottom layers stay cool. Stratification creates zones on the bottom of a pond that may not support respiration of fish and other pond life. Also, the metabolism of bacteria and the types of bacteria present under low-oxygen conditions may lead to the formation of harmful chemicals like hydrogen sulfide and to the skunk-like odor associated with swamp mud and other oxygen-limited systems. Nutrients tend to accumulate at the bottom of stratified ponds. An additional benefit of aeration is that nutrients from the bottom are brought to the illuminated surface and can be used by phytoplankton.

This photograph illustrates a pond edge with an algal mat forming around decaying cattails.

Aeration adds oxygen and breaks stratification while ensuring nutrients necessary for phytoplankton growth are available. Aeration is often necessary during the summer because warmer water cannot absorb as much oxygen as cold water. In addition, high phytoplankton densities can lead to oxygen depletion because although phyto-

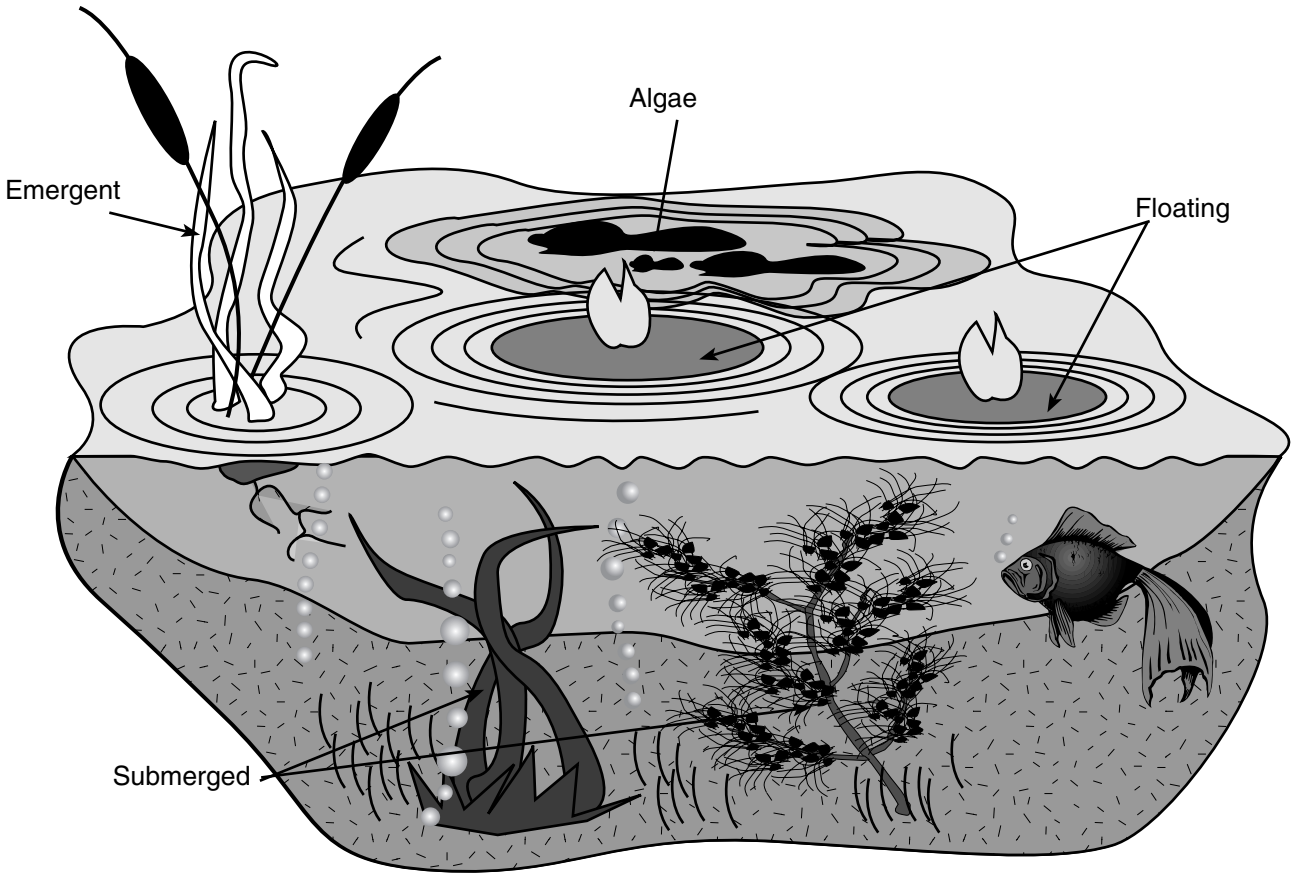

Figure 1. Cutaway of a pond.

plankton release oxygen through photosynthesis during the day, they respire at night, which uses oxygen. Aeration is also beneficial in winter by preventing ice formation. Although oxygen is more soluble in cool water, ice cover can prevent water contact with atmospheric oxygen, leading to depletion.

Various commercial aerators are available, ranging from fountains to floating impellers and diffusers that release compressed air into the water. Prices run from several hundred to several thousand dollars.

Chemical Weed Control

There are times when the use of a chemical to control aquatic weeds is the only practical solution. Once the problem has been identified the selection of a control product can be made. This selection should be based on the type of plant, mode of action of the pesticide, use of the water in the pond, time of year, cost, and availability. See Figure 1.

Understanding how these products work will allow the applicator to make better decisions based on timing and growth stage of the plants. For example, glyphosate must directly contact the plant and translocates best when the plant is actively growing or is moving reserves to the root system in preparation for winter. The formulation of a product may be better suited to certain circumstances; for example, the chemical 2,4-D is available in liquid or granular form.

Many of these products can cause damage to desirable plants. Aquashade is basically a dye that blocks light penetration into the water; it will not harm plants that are floating or emerged. However, this product will have to be re-applied during the season to maintain control of underwater plants. Table 1 is a summary of the performance for par-

Table 1. Performance of Weed-Control Products on Various Types of Plants

Chemical	Emergent	Submersed	Floating	Algae
Chelated copper				E
Copper sulfate				E
Aquashade		F		E
2,4-D	E	F	F	
Diquat dibromide	F	G	G	G
Fluridone	G	E	E	
Endothall		E		
Glyphosate	E			

E = excellent, G = good, F = fair.

ticular aquatic weed-control products for use on plants with particular growth patterns, i.e., flowering plants and algae. Some species within a growth pattern group may respond differently, so accurate plant identification is necessary for selecting an appropriate treatment.

Whenever using a pesticide consult the label for information on protective clothing, methods of mixing, application rates, and application procedures. Many of the chemicals used to control aquatic weeds have restrictions regarding the uses of the water for a number of days. Be sure to be aware of these restrictions prior to application. Specimen labels with this information can be requested from your local pesticide supplier.

Biological Control

Biological controls are an integral part of an integrated pond management program. The concept of biological control in aquatic systems for control of aquatic weeds is not new. For example, alligatorweed has been controlled in the U.S. since the early 1960s, with introduced insects that feed on the plant, keeping it at a manageable level. Snails have also been used to control aquatic weeds.

Although grass carp are excellent foragers, they are not specific in their feeding behavior and can damage desirable vegetation. Fish such as grass carp and Israeli carp are widely used for controlling aquatic vegetation. Grass carp control vegetation by directly feeding on aquatic vegetation. Although they are efficient herbivores, they are not selective feeders and can eliminate desirable vegetation. Israeli carp are primarily insect feeders but do consume some aquatic vegetation. Because of their bottom-feeding behavior they can increase turbidity of ponds which might also reduce aquatic vegetation by shading.

Introducing fish, or any other organisms, into a pond should be evaluated carefully because there are numerous examples of animals introduced for the control of other unwanted species that become problems themselves. Because of these concerns and the risk of escape into the Chesapeake Bay, grass carp are not allowed in Maryland. Israeli carp are permitted and have been reported effective by some users, but their use should be carefully considered. Only largemouth bass, bluegill sunfish, golden shiners, fathead minnows, and channel catfish are permitted to be stocked without prior written approval from the Maryland Department of Natural Resources.

Since the first reports from Britain that decomposing barley straw is effective in the control of nuisance algae, a growing number of reports in Maryland and the mid-Atlantic

region have been supporting the use of barley straw. The mechanism of control is unclear; however, research underway in Britain suggests the inhibitor is a phenolic compound. Studies underway suggest that the answer to the question of how barley straw extract inhibits algae growth is more complicated than previously thought. Barley straw has been used as part of an integrated approach to algae control in experiments conducted in Maryland with some success, but may not always provide adequate control on its own. Methods of application are still under trial in Maryland.

One method that shows great promise is to contain the bale of straw in a sort of cage with the strings cut to loosen the bale to allow water to move through. This will promote aerobic decomposition of the straw, which appears to be a consistently important point in the success of the application. The bales should be placed in the pond in early spring, kept close to the surface, and secured to allow removal prior to winter. As a rule of thumb 100 to 300 pounds of straw should be used per surface acre.

Further Reading:

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