CHAPTER 6

NONCHEMICAL AQUATIC VEGETATION MANAGEMENT TECHNIQUES

As mentioned in Chapter 3, "Integrated Pest Management," careful site evaluations are important information-gathering activities for pest managers. A successful management program for a body of water includes an accurate assessment of the types and numbers of plant species found in the area. Various plants serve different purposes and may or may not be nuisances.

Identifying the components within an aquatic plant community is necessary for short- and long-range planning. How each type of plant will fit into the long-range goal must be considered. Plant groups may be contained, eradicated, encouraged or restored. The management strategies that you use influence the composition among plant communities. This influence is often called selectivity.

Using a particular method will favor the production of some plant species or species groupings because it gives these species a competitive advantage over other species. Other species may be contained or eradicated by the application of a certain method or strategy. Some plant species will show little response to certain strategies. The selectivity issue is complicated by many interactions that influence the outcome of a particular management strategy in a particular lake.

Ideally, the aquatic pest manager has discussed short- and long-range expectations of the site with persons and associations responsible for the lake environment. Management plans should specify what plants will be maintained and those that will be contained, and establish priorities to achieve the stated goals. Not only is it possible to integrate several methods or strategies into the short- and long-range management plans, but it is usually necessary.

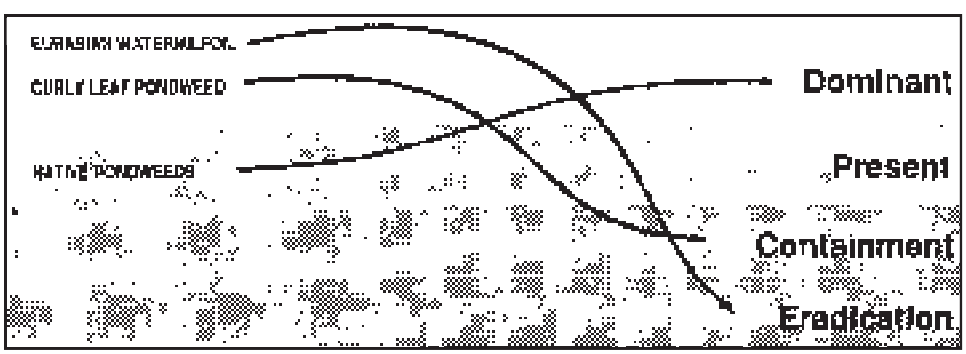
When evaluating aquatic weed problems, consider all methods of control: preventive, mechanical, cultural, biological and chemical.

Preventive Control

Preventive control of aquatic weeds has three major objectives: preventing weed spread, eliminating nutrient sources that support growth, and deepening or increasing the slope of shallow areas where plants can grow.

Preventing Aquatic Weed Spread

Aquatic plants seem to appear quickly in new ponds or lakes, even though they may be isolated from other bodies of water. Algal spores can be carried by wind. Plant propagules — spores, seeds, turions, tubers— and plant fragments can be carried on the feet or feathers of waterfowl or the fur of mammals. People are also primary movers of aquatic weeds, transporting plant



A diagramatic representation of how a species selective vegetation management strategy might be applied to contain or eradicate some species and restore other species to a predominant position in the lake flora.

propagules on boats and boat trailers. Using aquatic plants to provide packing or shade for bait minnows or worms, and disposing of aquarium plants through sewer systems are also believed to contribute to the spread of aquatic plants. It is nearly impossible to prevent the spread of aquatic weeds by animals, wind or water but many human activities that spread weeds can be prevented.

If a small clump of a particularly objectionable aquatic weed species appears in a pond or lake channel, it should be removed immediately, either by hand or with chemical spot treatments. Control these plants before they flower and form seeds. This is particularly important with exotic species such as Eurasian watermilfoil and curly-leaf pondweed.

Nutrient Management

A major emphasis during recent years has been placed on the management of nutrient loading to streams and larger water bodies such as lakes and reservoirs. The addition of nutrients increases production of plants and algae and causes the lake's ecosystem to age and deteriorate. This process is called **eutrophication**. Phosphorus is the nutrient of most concern, though nitrogen loading has also received significant attention and abatement measures largely because of public health concerns over nitrate levels in drinking water. Carbon also enhances aquatic plant production. Carbon supplies sufficient to support extensive plant growth can enter water from the atmosphere in the form of carbon dioxide or in water as dissolved bicarbonate (HCO_3) compounds.

Nitrogen is available from many sources, including rain, lightning, groundwater, the fixation of atmospheric nitrogen by blue-green algae, agricultural practices and lawn fertilization. For many lakes and streams, however, the major inputs of nitrogen and phosphorus are from **point sources** (single location of discharge or release) such as sewage treatment plants, septic tanks, and feedlots. Most of these sources can be identified and appropriate steps initiated to control their release of nutrients. For example, phosphorus can be partially removed through tertiary treatment at sewage treatment facilities, drainage from feedlots can be controlled, sewer systems can be installed in place of inadequate septic systems and the use of phosphate detergents can be minimized.

Not all water bodies obtain nutrients from point sources. When nutrient inputs or other contaminants are from **non-point sources,** control is much more difficult. Non-point-source pollution results from land runoff, precipitation, acid rain or percolation rather than from a discharge or release at a specific, single location. Watershed alterations and management practices to reduce nutrient and other contaminating inflows include:

1. Installing vegetation or grass sod along drainage areas and around receiving waters to prevent runoff and absorb nutrients (wetlands play a key role in this type of nutrient filtering).

On waterfront properties, avoid the use of fertilizers containing phosphorus, and do not fertilize close to water bodies; leave a 10-20 foot buffer strip.

2. Discontinuing turfgrass fertilization in a 10- to 20-foot strip around the body of water or, if this area requires fertilization, using only fertilizers **without** phosphorus on a limited basis. Fertilization of high maintenance lawns and golf courses can be a major source of nutrients in ponds and lakes.
3. Preventing livestock from entering the body of water. Animals not only fertilize the water but tear down banks and increase soil erosion.
4. Practicing conservation tillage methods in areas that are subject to severe soil erosion.
5. Constructing a settling pond to receive nutrients before the flow reaches the main body of water (in cases where nutrients may be entering by means of sediments in an inflowing stream).
6. Constructing wetlands. These may be a series of small ponds and areas planted with emergent wetland vegetation. When properly engineered, constructed wetlands can effectively remove nutrients, such as phosphorus, from inflowing water.
7. Avoiding adding fertilizers to a body of water. In fact, except in certain commercial fish production operations, fertilizers should

never be added to a body of water. In Michigan, the waters are usually sufficiently rich in plankton and other food organisms to support large fish.

8. Checking for hidden sources of nutrients such as septic fields and drainage tiles. Septic systems can be checked using dyes available from state or local health boards.
9. Planting deciduous trees far enough from water bodies so leaves will not fall into the water and accumulate.

Techniques to reduce nutrients in a body of water have been most effective for controlling organisms, such as phytoplankton, that receive nutrients from the water. Even though every effort should be made to reduce nutrient inputs into water, most evidence suggests that these efforts are unlikely to decrease the growth of established rooted plants. Reducing nutrient inputs to control rooted plants may be helpful in the long term for older lakes but is probably most effective in lakes where sediments have not become heavily loaded with nutrients.

Engineering Shallow Areas

New ponds and lakes should be constructed to avoid extensive areas less than 3 feet deep. Shoreline edges should be deepened to at least 3 feet to reduce sites for rapid establishment of plants. The only exception should be swimming areas, in which sharp drop-offs may be hazardous to small children.

Dredging shallow areas can be part of a pest management program.

Shallow areas in existing ponds or lakes can be deepened with dredges or draglines to create a slope of 3:1 to a depth of 6 to 8 feet. Removing sediment also removes nutrients and plants. A dumping site away from the water's edge must be available for the removed hydrosoils. Be sure you have all permits required for these activities.

Mechanical Control

Mechanical methods to remove existing stands of aquatic weeds include:

- Hand pulling.
- Raking.
- Using mechanized equipment.

Hand removal can be effective, but it is extremely time consuming and laborious. Regrowth from seeds and underground plant parts can be expected.

Mechanized equipment includes a variety of dredging machinery and weed cutters. Draglines are commonly used to remove vegetation and sediments from irrigation and drainage ditches. Draglining is an effective weed control method, but it is expensive and usually needs to be repeated every three to four years. Permits are required to perform dredging.

Weed cutters cut underwater rooted vegetation 4 to 6 feet below the water surface. They are used primarily on large lakes or rivers. Most machines

Mechanical harvesters are one option for managing aquatic weed populations.

also remove, or harvest, the cut material from the water body. Cutting/harvesting has several advantages. All types of aquatic vegetation, including filamentous algae and vascular plants, can usually be removed. The technique can be practiced under most non-windy conditions, and there are no restrictions on the amount of area to be cut or the use of the water following treatment.

Weed cutters that do not harvest the plants are not recommended because cut plant fragments can live for long periods of time floating in water. These plant fragments develop roots and can invade other areas. The cut fragments may also collect along shorelines and create a considerable mess along lakefronts and in swimming areas.

Aquatic weed cutters that harvest the cut plant material prevent it from decomposing in the water. Removing plant material reduces the risk of fish kills due to suffocation caused by decomposing plant material and resulting oxygen depletion and, to some degree, removes nutrients.

Only a small portion (2 to 3 percent in some cases) of a lake's total nutrient content is contained in the aquatic weeds. Over a long period of time, harvesting may lower the nutrient content of a body of water, if new nutrient inputs are prevented from entering the lake and nutrients are not recycled from the sediments.

Several factors should be considered before you invest in a mechanical harvester. Purchase and maintenance costs can make these machines an expensive form of weed control. Mechanical harvesting is like mowing a lawn — plants continue growing from the uncut portions, so harvesting must be done several times during the season to maintain open water.

Mechanical harvesters are not suitable for removing vegetation in water less than 1 to 3 feet deep, so many bodies of water will be too small for the large commercial equipment currently manufactured. Some aquatic managers in Michigan construct their own equipment to harvest plants from small lakes and ponds. Harvesting equipment may be classified as heavy equipment and can be dangerous if operated improperly. Most machines are operated hydraulically. Hoses, fittings and valves must be properly maintained to prevent leakage or loss of hydraulic fluid and pollution of lakes. Permits may be required to transport harvesters on public roads and to launch them from public access sites.

Another consideration with mechanical harvesting of aquatic weeds is vegetation disposal. A dumping area must be available from which vegetation cannot wash back into the lake. Harvested aquatic weeds can be used as mulches or fertilizers in gardens and fields. Considerable research is being conducted to determine other potential uses. Some possibilities include using the harvested aquatic plants as livestock feed or as sources of methane gas. Fines may be levied if harvested plant material falls off transport trucks en route to disposal sites.

A disadvantage to weed cutting and harvesting is that the initial process is **nonselective**. All plant types growing among the weeds, both nuisance and desirable species, are removed. When harvesting is used over several years, some highly undesirable plants such as Eurasian watermilfoil may become the predominant species and more desirable plants may be excluded. Fish and small organisms that live in the weeds are also commonly victims of harvesting. Wise use of several management techniques will avoid this nontarget impact and long-range selectivity of potentially undesirable species.

Finally, the plant stubble that remains after harvesting may relaese nutrients into the water. It is not uncommon for water clarity to decline immediately following a harvesting operation because of sediment suspension or algae blooms. This condition is usually temporary and water quality is typically restored within a few days.

Cultural Control

Cultural weed control can also be used at aquatic sites. It involves altering the environment in which the weeds are found. Altering the habitat where weeds prefer to grow will discourage their establishment or reproduction. Examples include the following:

1. The shoreline can be lined with rocks or other types of rip-rap to prevent both erosion and establishment of aquatic weeds. Public Health Code Act 346 of 1972, also known as the Inland Lakes and Streams Act, requires a permit for this type of activity.
2. Winter drawdowns are effective for controlling many submersed and rooted floating weeds. This technique involves exposing the shallow areas to drying and freezing conditions. Drawdown can be achieved with structures built to control water flow into the pond, lake or ditch, the installation of siphoning systems to lower the water level, or naturally as a result of receding shorelines during periods of low rainfall.

   One of the benefits of a partial drawdown is to concentrate the fish in a small, deep area away from the shallow weed zone.

Concentration enables more effective predation of small fish by large fish, which may result in an improvement in fish quality. Another benefit is the drying and consolidation of the sediments, which slightly deepens the water body. Drawdowns may also restructure the species composition of the lake flora. Naiads and milfoil may become dominant as a result. Table 6-1 outlines the effect of winter drawdowns on a variety of aquatic plant species. Act 346 permits are required to perform drawdowns.

3. Covering bottom sediments with black plastic, landscape fabric or other light prevention materials can be useful on a small scale for controlling submersed weeds. Several bottom-covering materials are commercially available. They are all called **benthic barriers.** The best benthic barrier is gas permeable and opaque and cannot be penetrated by plant roots or vegetation.

   Areas suited for this technique include boat dock areas and swimming beaches. The material may be installed during impoundment construction, drawdown or ice cover and weighted with sand or gravel. Benthic barriers must be securely fastened to a substrate to prevent their being buoyed upward by the gases naturally produced in the underlying sediments.

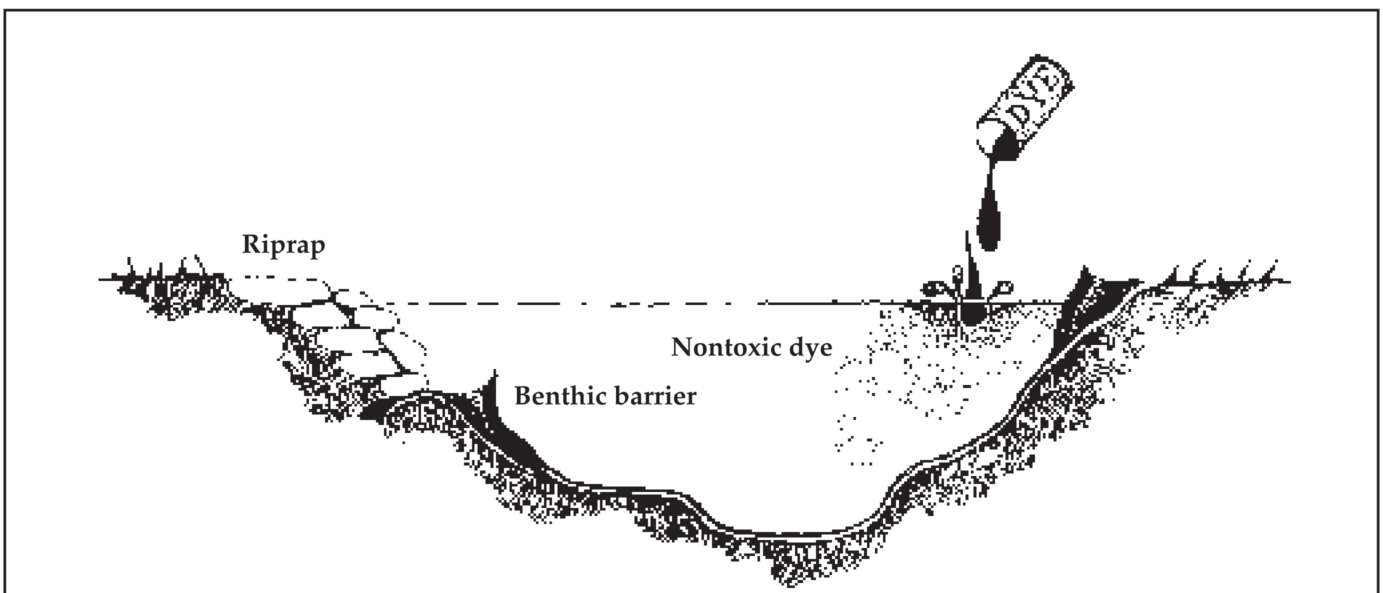
   Recognize that plastic becomes brittle over time and may break apart and float to the water surface. These pieces of plastic or other benthic barrier material are unsightly, may create a swimming hazard and can damage boat motors if they become entangled in the propellers. Aquascreen is a window screen-like material that resists tearing and is anchored to the sediment with spikes. Act 346 permits are required for installing benthic barriers.

4. Nontoxic dyes, which act as light screens, can be used to inhibit submersed plant growth. An example is a blue dye that absorbs light that plants would otherwise use for photosynthesis. This dye can be applied easily, disperses readily in a body of water and reduces plant growth. The dye concentration must be maintained throughout the growing season, so its use is limited to ponds with no outflow.

   Also, dyes must be applied before weeds emerge in the spring. Once weeds reach the water surface, the dye has little effect. In the Midwest, an initial application and a mid-season application are suggested.

   Some dyes are registered as pesticides: others are not. Only dyes approved for use in ponds should be used. Act 368 requires permits to use dyes.

5. Aeration may control algae but does not affect macrophytes. If this process is not done correctly or thoroughly, the aquatic algae problem may increase. Aeration can increase aquatic plant problems by bringing nutrients that were trapped in the colder, deeper water to the surface, causing an algae bloom. To date, the benefits derived from controlling aquatic weeds or algal blooms by this technique in small ponds and lakes have not adequately been demonstrated. The primary benefit of aeration may be to prevent oxygen



Types of cultural control.

depletion during the summer or winter and thus, to prevent fish kills.

The effectiveness of aeration techniques for reducing algae popluations is disputed.

In deep, thermally stratified lakes, aeration/destratification methods and devices have reduced phytoplanktonic algae production and shifted the species dominance from blue-green algae to more desirable species. Destratification techniques can alter nutrient and gas concentrations in the water column.

Susceptible to drawdown:

- Large-leaf pondweed *(Potamogeton amplifolius)*
- Waterlily *(Nymphaea tuberosa)*
- Watershield *(Brasenia schreberi)*

Moderately tolerant to drawdown:

- Leafy pondweed *(Potamogeton foliosus)*
- Richardson's pondweed *(Potamogeton richardsonii)*
- Water smartweed *(Polygonum natans)*

Tolerant to drawdown:

- Bulrush *(Scirpus validus)*
- Cattail *(Typha latifolia)*
- Coontail *(Ceratophyllum demursum)*
- Sago pondweed *(Potamogeton pectinatus)*

Predominance enhanced by drawdown:

- Naiads *(Najas* spp.*)*
- Milfoils *(Myriophyllum* spp.*)*
- Curly-leaf pondweed *(Potamogeton crispus)*

Effect of winter drawdown on some aquatic plant species.

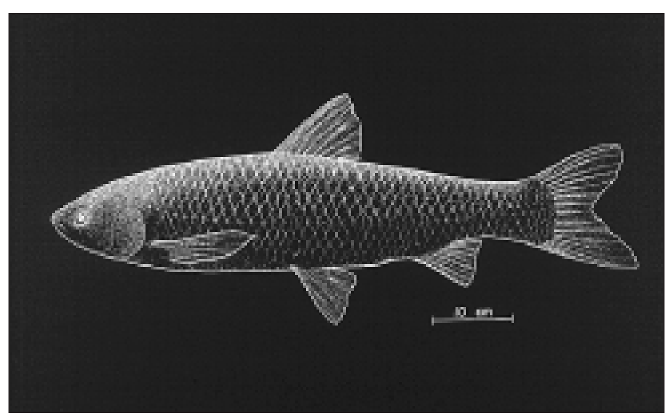
Biological Control/Biomanipulation

Biological controls include strategies that introduce or enhance the production of organisms that restrict pest species.

Biological controls may be introduced to encourage and/or artificially increase plants and animals that are parasites or predators of a pest. Biological controls are most commonly used to manage insects, mites and some weeds in terrestrial settings. Aquatic pest managers in Florida have been successful introducing several insects that provide varying levels of control of aquatic weeds such as alligatorweed, water hyacinth, hydrilla and water lettuce. Florida's pest managers have also attempted to use snails, manatees, ducks, crayfish and water buffalo to biologically control aquatic weeds. Most of these practices are not practical in Michigan.

Herbivorous (plant feeding) fish have also been used as a biological control for aquatic weeds. Fish species native to the United States do not normally feed on rooted vegetation, so strictly vegetarian species have been introduced. The two most notable species introduced include the tilapia *(Tilapia* or *Sarotherodon)* and the grass carp or white amur *(Ctenopharyngodon idella)*. The use of these fish is strictly **prohibited in Michigan** at this time because of many disadvantages described below.

The grass carp is a strict vegetarian, feeding on filamentous algae, *Chara*, submersed weeds and the duckweeds. It may also eat vegetation just above the water line, although it is not generally considered an effective control for emergent vegetation or large free-floating weeds. These wild-type grass carp are nonselective, eating all plant types, and have no limits to the quantity of vegetation they consume as their population grows. Because of this, it has been difficult to establish appropriate stocking rates. A limited number of grass carp can devastate an aquatic environment by eating too much vegetation. These fish tend to



Grass carp.

prefer, and therefore eat, the more desirable native Michigan plant species before consuming the exotic species that cause the greatest nuisance. The use of grass carp is inconsistent with management practices that are intended to provide a balanced plant community. When too much vegetation is consumed, the plant species found in that community may ultimately be replaced by planktonic algae, which these fish cannot eat.

Many states have laws banning the importation of the grass carp, but the triploid (sterile) grass carp is now allowed in some states (not in Michigan) under strict permit rule and supervision.

Biomanipulation of an aquatic site is the alteration of the food web to improve water clarity by enhancing biological activities. The following strategy for managing nuisance planktonic algae illustrates biomanipulation. If the effectiveness or the number of organisms that feed on nuisance planktonic algae is increased, the levels of planktonic algae will decrease. This can be accomplished by manipulating the food web so that zooplankton are able to increase in numbers and feed on the suspended algae. This may require removing fish from the lake and then restocking it with an appropriate fish species.

Sites that would be good candidates for the application of this biomanipulative strategy are small lakes or ponds that are filled with stunted sunfish and characterized by high turbidity. Results are not always predictable. It is highly recommended that this strategy be applied only with the assistance of a biologist knowledgeable and experienced in the use of biomanipulative planktonic algae management strategies. More research is needed to bring this technique into common practice.

Chapter 6 – Nonchemical Aquatic Vegetation Management Techniques Review Questions

Write the answers to the following questions, and then check your answers with those in the back of this manual.

1. The three major objectives of preventive aquatic weed control are:

2. It is possible to prevent the spread of aquatic weeds by animals, wind or water. True or False?

3. Describe the process of eutrophication.

4. The major inputs of nitrogen and phosphorus from single locations of discharge or release are called_____________________________________.

5. Control of contaminants is much more difficult if they are from:

   a. Point sources.

   b. Non-point sources.

   c. Sewage treatment plants.

   d. Feedlots.

6. List five of the eight methods for reducing nutrient and other contaminating inflows to water sources.

   1.

   2.

   3.

   4.

   5.

7. Which is not true about draglining as a means of mechanical control?

   a. It is an effective weed control method.

   b. It removes vegetation and sediments from irrigation and drainage ditches.

   c. It is inexpensive and needs only to be preformed once.

   d. Permits are required to perform dredging.

8. Mechanical harvesting is like mowing a lawn — plants continue growing from the uncut portions — so harvesting must be done several times during the season to maintain open water.

   True or False?

9. Which of these statements about cultural weed control is true?
   a. Lining the shore with rocks to prevent erosion and establishment of weeds does not require a permit.
   b. One of the benefits of a partial drawdown is to concentrate the fish in a larger, shallow area away from the weed zone.
   c. The best benthic barriers are gas permeable and opaque and cannot be penetrated by plant roots or vegetation.
   d. Aeration controls algae and macrophytes.

10. Which statement concerning aeration is false?
   a. If not done correctly or thoroughly, the aquatic algae problem may increase.
   b. Aeration can bring nutrients that were trapped in the colder, deeper water to the surface, causing algae bloom.
   c. The benefits derived from aeration to control aquatic weeds or algal blooms outweigh the potential problems.
   d. The primary benefit of aeration may be to prevent oxygen depletion during the summer or winter to prevent fish kills.

11. Which species is(are) susceptible to drawdown?
   a. Water smartweed (Polygonum natans)
   b. Large-leaf pondweed (Potamogeton amplifolius)
   c. Watershield (Brasenia schreberi)
   d. Sago pondweed (Potamogeton pectinatus)
   e. Both a and b.
   f. Both b and c.

12. ___________________controls include strategies that introduce or enhance the production of organisms that restrict pest species.

13. The grass carp:
   a. Is not considered an effective control for emergent vegetation or large free-floating weeds.
   b. Is selective in the plants types it feeds on.
   c. Has stable consumption habits, which makes stocking rates easy to establish.
   d. Is allowed in Michigan if it is sterile.

14. _____________________________________ is the alteration of the food web to improve water clarity by enhancing biological activities of an aquatic site.