3.4 Cultural and Physical Control of Aquatic Weeds

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Introduction

Methods for cultural and physical control of aquatic weeds are often viewed as strategies that can be readily employed by lake users as well as lake managers. Cultural control typically focuses on education and preventing invasive species introductions from occurring in the first place. Physical control methods are usually non-chemical, non-motorized techniques that are employed to control aquatic weeds and range from hand-pulling to water-level drawdowns, or efforts to alter water or sediment characteristics where weeds are found. As awareness of aquatic nuisance species has grown in recent years, so have efforts to incorporate cultural and physical control methods as important elements of Integrated Weed Management Programs.

Prevention

Many states have prepared official lists of invasive aquatic species and some have even passed legislation to ban their transport or introduction. However, there are often limited resources or mechanisms to enforce rules and prevention efforts are often left to individual lake associations or other volunteer groups. The first step in prevention is regular monitoring to look for new or pioneer infestations. Volunteers can be trained to participate in lake monitoring or "weed-watcher" programs to accurately identify invasive species. In many cases a step-by-step reporting protocol is provided if a new "find" is discovered.

Education is a key component of prevention. Educating lake users and the general public about the threat of invasive species is necessary to prevent new infestations and to sustain effective aquatic plant management programs. Education involves creating public awareness of the problem and familiarizing people with possible solutions. Volunteer labor and public participation are paramount to successful education efforts.

Boat ramp monitoring programs are used to inspect boats and trailers for the presence of invasive species. These are largely volunteer or summer intern positions that try to staff boat ramps during peak use periods. Inspections can either be mandatory or voluntary and usually only take a matter of minutes. Several northeastern states provide annual reports about the number of "saves", which occur when an invasive species is found on a boat or trailer and is removed before the boat is launched. The interaction with boat ramp monitors also provides an opportunity to distribute educational material and conduct surveys about boating habitats and other water bodies that were recently visited.

Boat washing stations are also used at some locations as an aggressive education and prevention measure. Boats and trailers are washed prior to entering and sometimes after leaving a lake. Most aquatic plant fragments capable of surviving out of water are easily seen and can be removed by hand. Washing stations are probably better suited to removing microscopic threats such as zebra mussel veligers, didymo or spiny water flea. Primary considerations for boat washing stations are whether space and utilities for a station are available, the cost of installation, staffing and how wash water is captured and treated. Boaters are sometimes reluctant to utilize volunteer boat washing stations or those where a fee is charged and this is another hurdle that must be overcome for wash stations to be effective.

Assessment and monitoring

The accurate identification of aquatic weed infestations and their associated problems are the first steps toward developing and implementing an aquatic plant management program. Once a program is implemented, monitoring is usually warranted to evaluate the effectiveness of techniques used and to make adjustments in future years. Compliance monitoring and reporting are often a permit requirement and may focus on changes to nontarget species and water quality. The basic protocol that is recommended when initiating an aquatic plant management program is outlined in detail in Section 3.2.

Physical control practices

Aeration or artificial circulation uses electric or solar powered mixers, fountains or compressed air diffuser systems to circulate and add oxygen to the water. The premise is that the addition of oxygen will reduce the amount of available phosphorus and result in less algae growth. The physical circulation or destratification (mixing) of water can also prevent noxious algal blooms from developing (Section 2.18). Benefits of aeration have been clearly documented in all types of water bodies from small, shallow ponds to large, thermally stratified lakes that are using hypolimnetic (deep water) aeration systems. Growth of some aquatic plants appears to be limited by disturbance of the physical water surface and may prevent canopy formation by floating plants such as duckweed or watermeal (Section 2.14). Claims that water circulators control invasive submersed species are unsubstantiated.

Benthic barriers or bottom weed barriers are used for localized control of aquatic plants through compression and by blocking sunlight. Barriers specifically manufactured for aquatic weed control are usually made from materials that are heavier than water such as PVC, fiberglass and nylon. Other fabrics used in landscaping and construction have also been tried. Barriers are usually anchored in place with a variety of fastening pins or anchoring devices. Some of the most common anchors being used are lengths of steel rebar encased in capped PVC pipes, which eliminates any sharp edges that could tear the barriers or be hazardous to swimmers. Sand bags, bricks and steel pins are also commonly used as anchors. Larger panels that are installed in water depths of greater than 4 feet usually require SCUBA divers for proper installation. Several different mechanisms have been devised to unroll the barriers in place during the installation process. Solid fabric barriers often need to be cut or vented to allow gasses to escape and to prevent billowing.

Benthic barriers are usually used to control dense, pioneer infestations of an invasive species or as a maintenance weed control strategy around boat docks and swimming areas. Large installations (greater than one acre) are often impractical due to the high cost associated with purchasing, installing and maintaining the barrier. Benthic barriers should be left in place for a minimum of 1 to 2 months to ensure that target plants are controlled, but barriers must be regularly removed and cleaned of silt; otherwise plants may begin to root on top of or through the barriers. Removal, cleaning and re-deployment is usually required every 1 to 3 years depending on the rate of silt accumulation. Some lakes with volunteer divers have attached barriers to lightweight frames that facilitate rapid deployment and retrieval. Barriers non-selectively control aquatic vegetation and may impact fish and other benthic organisms, which is another reason they are usually used for small localized areas. Many states require permits for the use of benthic barriers.

Drawdown or the lowering of the water level can be used to effectively control a number of invasive submersed species. This technique is used mostly in the northern US to expose targeted plants to freezing and drying conditions. Water is either gravity drained using a low-level gate valve or through a removable flashboard system on a dam. Siphoning or pumping can also be performed in lakes with insufficient outlet structures. A principal attraction of drawdown is that it is typically an inexpensive weed control strategy for lakes with a suitable outlet structure. Annual drawdown programs can result in sediment compaction and changes in substrate composition. Drawdowns are also utilized to provide protection from ice damage to docks and other shoreline structures and to allow for shoreline clean-up and repairs by lake residents.

Plants that are usually controlled by drawdowns include many submersed species that reproduce primarily through vegetative means such as root structures and vegetative fragmentation. Some invasive submersed species most commonly targeted by drawdown include Eurasian watermilfoil (Section 2.3), variable watermilfoil (*Myriophyllum heterophyllum*), fanwort (Section 2.6), egeria or Brazilian elodea (Section 2.5) and native coontail (*Ceratophyllum demersum*).

Waterlilies (*Nymphaea* sp.) can also be effectively controlled, provided sediments can be sufficiently dewatered to allow for the freezing and drying conditions required to control this species. Seeds and other non-vegetative propagules such as turions or winter buds are not controlled by drawdown; in fact, species that reproduce by these means may actually increase following drawdown programs. Many species of pondweed (*Potamogeton* spp.) have increased following drawdown programs and highly opportunistic species like hydrilla (Section 2.2) may expand rapidly following drawdown.

A general rule of thumb is to maintain drawdown conditions for 6 to 8 weeks to ensure sufficient exposure to freezing and drying conditions. Excessive snow cover or precipitation can limit the effectiveness of this technique. Drawdowns are usually timed to begin during the fall months to avoid stranding amphibians, molluscs and other benthic organisms with limited mobility. Care must also be taken to leave enough water to support fish populations and avoid impacts during key spawning periods. Drawdowns can have negative impacts on desirable aquatic plant species. Drawdowns can also impact adjacent wells and wetlands, so it is important to know the downstream channel configuration, capacity and flow requirements. When properly utilized, drawdowns can be a low-cost or no-cost strategy to incorporate into an integrated management program. Many states require permits for drawdown programs.

Hand pulling or hand harvesting is one of the simplest and most widely used methods to control aquatic weed growth and can be performed by wading or from a small boat in shallow water. Snorkeling equipment, surface supplied air systems or SCUBA divers are often used in water greater than 4 to 5 feet deep and for more intensive hand pulling programs. Boat or barge mounted suction pumps fitted with straining systems are often used to increase removal efficiency and are commonly referred to as Diver Assisted Suction Harvesting or DASH. Hand pulling can be a highly selective technique, provided the target species can be easily identified, and is usually used as a component of invasive species management programs to target new infestations with low plant density (generally less than 500 stems per acre). Hand pulling can be used to remove more dense plant growth over small areas, but benthic barriers or suction harvesting may be more effective approaches in these situations. It is often an important follow-up strategy to a herbicide treatment program to extend the duration of plant control.

When hand pulling a plant like Eurasian watermilfoil, the roots should be carefully dislodged from the bottom substrate so that the entire plant can be collected and removed to prevent vegetative regrowth. Once the bottom substrate is disturbed, suspended sediment often greatly reduces visibility, which results in the need to make multiple passes over the same area. In larger hand pulling programs that use multiple divers or DASH equipment, it is often advantageous to have people in boats that can collect dive bags full of weeds and can try to capture escaping plant fragments using pool skimmers. Waterchestnut (Section 2.10) is a noxious invasive species that has been effectively managed in several locations by hand pulling programs. This floating-leaved plant is easily identified and is a true annual plant that usually drops its seeds in late summer. Hand pulling efforts are usually performed for several weeks during the summer months before seed drop occurs. Several successful volunteer waterchestnut hand pulling programs have been organized and implemented in the Northeast.

Hand rakes of varying sizes and configurations are manufactured and sold for aquatic weed control. Many of these hand rakes are lightweight aluminum, with rope tethers that are designed to be thrown out into a swim area and dragged back onto shore. Some are designed to cut the weeds instead of raking them back to shore. While these may be cost-effective strategies to manage individual swim areas, there is a risk that these rakes will make the problem worse by creating weed fragments that can escape and infest other portions of the lake.

Nutrient inactivation involves the application of aluminum (as aluminum sulfate), iron salts, calcium compounds (lime) or rare-earth metals like lanthanum to remove phosphorus from the water column and to inactivate phosphorus in the sediment. Removing and inactivating phosphorus can effectively discourage algal blooms from developing, but the growth of most rooted vascular plants is usually limited by nitrogen and there are no compounds readily available that bind with nitrogen in the sediment. Injecting sediments with alum and lime has been attempted, but suppression of vascular plant growth was not significant. Nutrient inactivation remains best suited for water quality improvement and algal control. In fact, reducing water column nutrients and algae may encourage even more dense infestations of nuisance rooted plants due to improved water clarity and light penetration, which may allow weeds to grow in deeper areas.

Shading through the use of EPA-registered dyes or surface covers attempts to limit light penetration and restrict the depth at which rooted plants can grow. Dyes are usually considered non-toxic solutions that give the water a blue or black color. The use of dyes is often limited to smaller golf courses or ornamental ponds because they make the water appear artificial. Dyes have little use in larger water bodies; in addition, if the pond or lake has a flowing outlet, multiple treatments will likely be required and state or local permitting may be required. Surface covers made from various fabrics or plastic materials can be used to prevent light penetration and control rooted plant growth. This approach is generally not used in recreational ponds and lakes since they would impair access to or use of the lake. Recent studies have shown that this can be an effective means of controlling plants that do not produce seeds or other vegetative reproductive propagules, but its application is usually limited to small, highly controlled areas.

Weed rollers consist of a roller on the lake bottom that is powered by an electric motor and travels forward and reverse in up to a 270-degree arc around a pivot point. Rollers can be up to 30 feet long and are typically installed at the end of a dock. Plants initially become wrapped around the roller and are dislodged from the sediment; the constant motion of the rollers then disrupts and compresses the bottom sediments, which prevents plants from becoming reestablished. Because the rollers travel along a pivot point, they reportedly can be used in several different substrate types. Weed rollers are only practical for managing small areas. They may disrupt fish spawning or other benthic organisms, but these impacts would likely be minimal or highly localized. Many states require permits for the use of weed rollers.

Summary

There are a number of cultural or physical methods that can be employed by lake associations or individual lakefront owners to control aquatic weeds, but the most important function of stakeholders is to develop a prevention plan. The vast majority of new weed infestations are found near boat ramps, so these areas should be surveyed on a regular basis. Residents that regularly spend time on the lake should obtain plant identification materials from state agencies or other information sources so that exotic plants can be accurately identified and targeted for treatment. Management plans should be developed for rapid response; in other words, plans should be developed proactively and stakeholders shouldn't wait for an invasive species to appear before creating a plan. Prevention and rapid response should be top priorities among lake associations because these are the most cost-effective and ecologically sound means of protecting aquatic resources from invasive species.

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