Control Methods

METHODS TO CONTROL AQUATIC NUISANCE VEGETATION

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SUBMERSED PLANTS	CONTROL METHOD	DESCRIPTION	CONCERNS/ISSUES	COST
▪ **Eurasian Water milfoil** ▪ **Variable or Broadleaf Water milfoil** ▪ **Fanwort**	**Chemical Treatment** **Fluridone (Sonar & Avast)**	Formulation: Liquid & pellet formulations Comments: Systemic – selective control of Eurasian water milfoil & fanwort at low application rates. Most effective on contiguous areas ❼5 ac. Duration of Control: 2-3 years or longer	▪ 30 day irrigation precaution/restriction ▪ May not be effective for shoreline or partial waterbody treatments	$200-$600 per acre
	2,4-D (Navigate & Aqua-Kleen)	Formulation: Granular Comments: Systemic – effective for both species of milfoil. Used for both spot and whole-lake treatments Duration of Control: 1-2 years or longer.	▪ Currently not approved for use in Zone II – Wellhead Protection Areas. ▪ Extended use restrictions for irrigation, watering livestock or drinking/domestic purposes.	$300-$400 per acre
	Diquat (Reward)	Formulation: Liquid Comments: Contact – fast acting herbicide effective on both species of milfoil and curly leaf pondweed. Used for both spot and whole-lake treatments. Duration of Control: Typically 1 year.	▪ Seasonal control ▪ May impact more non-target species	$175-$400 per acre
	Cutting / Harvesting	Mechanized cutting to depth of 5-7 feet. Two cuttings per year desirable. Used for maintenance control of larger, established plant infestations.	▪ Non-selective ▪ Typically two or more cuttings required annually. ▪ Care must be taken to contain fragments. ▪ Shoreline disposal operation required.	$350-$600 per acre per cutting
	Hydro-Raking	Mechanical raking of plant and root material to depths of 12 feet. Used for smaller beach/swim areas < 1 acre. Once raking per year is generally adequate. Maintenance technique for	▪ Seasonal control ▪ Temporary disruption of bottom sediments and increases in turbidity.	$1,500-$2,500 per acre

		established milfoil infestations.	▪ Care must be taken to contain fragments. ▪ Shoreline disposal operation required.	
	Bottom/Benthic Weed Barriers	PVC sheeting or PVC coated fiberglass screening. Used for small, dense infestations and beach/swim areas < 1 acre.	▪ Barriers must be removed, cleaned, repaired and reinstalled every 1-3 years ▪ May require SCUBA divers for installations in waters > 4 feet deep. ▪ Cuts off bottom to other aquatic organisms	~$40,000 per acre installed
	Diver Operated Suction Harvesting	Effective in removing sparse growth or beds of rooted plants over smaller areas. Control is generally 1 year or longer.	▪ Seasonal control ▪ Labor intensive ▪ Equipment and operator availability	~$8,000 per acre
	Hand Pulling	Limited to depths of < 5 feet without SCUBA divers. Most effective where plants are widely scattered over small areas. Control is 1 year or longer depending on site.	▪ Seasonal control ▪ Labor intensive	Varies
	Dredging	Control by deepening beyond the plant's photic zone – typically 10 feet or more. Rare to control milfoil by change in substrate type alone.	▪ Considerable short-term disruption ▪ Complex permitting	$5-$10 per cu. yd. or $16,000-$32,000 to remove 2 ft. of sediment over a 1 acre area
	Drawdown	Lower water level in fall and winter to expose plants to freezing and drying conditions. Generally requires 6-8 weeks of sustained freezing/drying for effective control. Control usually 1 year or longer.	▪ Weather conditions and sediment composition may influence effectiveness. ▪ Potential for numerous impacts and constraints.	Varies
	Herbivorous Insects (Weevils)	Specific to Eurasian water milfoil. Weevils & Moths. Weevils are native to North America and have the potential for long term control. Naturally occurring weevil populations have generally yielded better results than new introductions. Extensive research in process	▪ Slow response ▪ Duration of control variable and cyclical. ▪ Milfoil remains viable	Varies

The next few pages consist of weed control methods that have been used in other lakes and ponds. Two categories of control methods are explained in greater detail:

1) Those deemed possibly feasible for Lake Boon based on previous studies and/ or

2) Those that have been contemplated by residents over the past few years. Due to cost

considerations of publishing the Gazette, it was prudent to keep the details of each to a minimum.

These methods and any others about which you may have questions will be more fully explained and discussed at the public information meeting held on May 1, 2002.

There are four major categories of aquatic plant control methods:

1. Manual/ Physical
2. Mechanical
3. Biological
4. Aquatic Herbicides

1) Manual/Physical

A.) Hand-pulling

B.) Cutting —Water Weed Cutter (lightweight, hand-operated, underwater weed cutter)

C.) Harvesting —Water Weed Rake (lightweight, extended handle rake with rigid aluminum teeth)

D.) Bottom barrier application (sediment covers/ bottom screens)

E.) Weed Rolling

F.) Water level drawdown

Lake-level drawdown can be an effective and inexpensive way to manage nuisance growths of aquatic plants, but only those sediments that are exposed to the disruptive activities during the fall and winter will produce negative effects on the aquatic plant growth. Due to the dam÷s construction, the maximum exposure of the lake÷s bottom is only about 21%

Water level management or "draw down" may have some future applicability and effectiveness for Lake Boon as it also offers local residents an opportunity to rehabilitate near-shore areas and docks, (residents can clean out their shoreline areas by raking, etc.) as well as helping to reverse the eutrophication of a lake.

There are the other issues that need to be addressed if drawdown is being done for weed control vs. shoreline restoration such as:

- Adverse effects on shallow wells with 2 —4 foot drawdown
- Associated wetlands must be evaluated and mitigated

- Shorter boating season
- Aesthetically, the bottom of the pond/ lake, especially during the fall, is not very pleasing.
- Odors, such as hydrogen sulfide, can be produced during the drying out of the sediments in the fall.

How does drawdown work?

Management of weeds is accomplished by disrupting the sediments, and not by freezing. Disruption of the sediments through the following actions precludes most aquatic vegetative growth.

The pond/ lake's water level should start to be restored during early January. If the sediments are frozen at this time, they will be severely disrupted if the water level rises quickly. Since ice floats, the frozen sediment layer is often literally torn from the bottom as the water rises. These sediments will drop back to the bottom in a matter of two to three days due to the absorption of sun light. Due to the record-high temperatures this past winter, drawdown would not have been effective.

G.) Implementing watershed controls to reduce nutrient inputs

The principle involves reducing sources of external (outside) nutrient and sediment inputs by implementing watershed best management practices (BMPs). The idea is to shut off entry of growth-stimulating nutrients (phosphorus and nitrogen) to the water body by using prudent household and yard care practices, as well as employing agricultural, forestry, construction and road maintenance practices that minimize pollutant loadings in the watershed. Common examples of homeowner BMP's include: maintaining septic systems, using prudent lawn and garden fertilizing practices, and disposing of yard litter by shredding or composting well away from water's edge. Use of watershed controls is often implemented as part of a whole lake/ watershed management effort, which may involve other in-lake aquatic weed control and/ or nutrient control measures.

In 2002, ÀA DEP 319 Nonpoint Source grant has been awarded to the Town of Stow formulated to address the phosphates and other nutrients entering the Lake . Some of the items that are being evaluated for feasibility are:

1. Storm-water catch basins
2. Septic pumping program
3. Develop an educational program
4. Perform a nonpoint source watershed survey *(Performed November 2002 (before grant contract was executed).*

5. Develop a Quality Assurance Planning Program (QAPP)

6. Native Plant Replacement Project

H.) Dilution

I.) Water column dyes

2) Mechanical

A.) Mechanical Cutting - for example: electric lake mowers (battery powered, boat mounted, underwater weed cutters)

B.) Mechanical Harvesting

Mechanical harvesters are large machines which both cut and collect aquatic plants. Cut plants are removed from the water by a conveyor belt system and stored on the harvester until disposal. A barge may be stationed near the harvesting site for temporary plant storage or the harvester carries the cut weeds to shore. The shore station equipment is usually a shore conveyor that mates to the harvester and lifts the cut plants into a dump truck. Harvested weeds are disposed of in landfills, used as compost, or in reclaiming spent gravel pits or similar sites.À

Harvesting is usually performed in late spring, summer, and early fall when aquatic plants have reached or are close to the water÷s surface. Harvesters can cut and collect several acres per day depending on weed type, plant density, and storage capacity of the equipment. Harvesting speeds for typical machines range from 0.5 to 1.5 acres per hour. Depending on the equipment used, the plants are cut from five to ten feet below the water÷s surface in a swath 6 to 20 feet wide. Some modern harvesters can cut plants in a range of water depths. Because of machine size and high costs, harvesting is most efficient in lakes larger than a few acres.

At the December 2001 TMDL Public Meeting, staff from DEP recognized that mechanical harvesting may not be a feasible management strategy for Lake Boon , given the high density of the plant growth along with the very difficult operating conditions (stumps) found there for mechanical equipment.

C.) Rotovation/ cultivation (underwater bottom tillage)

D.) Diver-operated suction dredging

3) Biological

Control of aquatic plants remains a desirable but elusive goal. No bio-control techniques are ready for immediate application in Massachusetts .

A.) Triploid (Sterile) Grass Carp (illegal in Massachusetts)

Grass carp are an exotic herbivorous fish native to China . These fish are widely used in aquaculture and as bio-control agents for aquatic plants. They eat a wide variety of aquatic plants but prefer certain types of plants. Milfoil is not high on their list.

Benefits

These fish will effectively eat almost any aquatic plant.

These fish are long-lived - 5 to 20 years - so control can also be long-lived.

Cost per acre, over a number of years, is relatively inexpensive.

Detriments

Grass carp will first eat the plants that they prefer. They may eliminate or severely reduce beneficial native plants before affecting nuisance species. State agencies must first approve stocking of exotic fish; currently Massachusetts does not allow stocking of the carp. If too few are stocked, control is ineffective. If too many are stocked, the fish can completely eliminate weed beds which are an important part of the aquatic ecosystem. The carp may disrupt reproduction activities and survival of native fish and fauna. In practice, grass carp often fail to control the plants or all the submersed plants are eliminated from the waterbody.À

Long-Term Effects

Aquatic vegetation can be effectively eradicated by these fish for a number of years.

Total eradication of weed beds, however, can negatively affect native fish that rely on some vegetation.

B.) Insect Pests - have been successful in controlling some aquatic weeds in the southern U.S. , but no insect pests are currently available to control aquatic weeds that grow in the Northeast. Some current work focuses on the use of a moth caterpillar on milfoil. This work is in initial stages, and data on the moth's effects are just too scanty to estimate its probable effect on milfoil, much less to guide a successful application.

1.) **The Milfoil Weevil (Euhrychiopsis lecontei)**

The milfoil weevil is native to North America and is a specialist herbivore of water milfoils. Once exposed to the exotic Eurasian water milfoil, the weevil prefers Eurasian over its native host northern water milfoil (*M. sibiricum*) The milfoil weevil is a small, herbivorous aquatic beetle, belonging to the family Curculionidae. It is a milfoil (*Myriophyllum spp.*) specialist, meaning that it feeds and develops only on plants in this genus. The weevil completes all life stages fully submersed and the larvae are stem miners. These characteristics make it very unique, as specialist herbivores are very rare among aquatic insects (Solarz and Newman 1996). These characteristics are precisely why the milfoil weevil has shown the most promise as a

potential biocontrol agent for Eurasian water milfoil (*Myriophyllum spicatum*) and why it has been the subject of much research.

Although the weevil has been quite effective at some sites, it has not been effective at other sites. Currently, we cannot predict when, where and how the weevils will or will not be effective.

4) Aquatic Herbicides

Aquatic herbicides are chemicals specifically formulated for use in water to kill or control aquatic plants. They are sprayed directly onto floating aquatic plants or are applied to the water in either a liquid or pellet form. **Systemic herbicides** kill the entire plant. **Contact herbicides** cause the parts of the plant in contact with the herbicide to die back. ÀAquatic herbicide application can be less expensive than other aquatic plant control methods and are easily applied around docks and underwater obstructions. The U.S. Environmental Protection Agency (USEPA), following careful evaluation, has registered these specific herbicide formulations for use on plants in aquatic and wetland environments.

The commonly available herbicide compounds for use on macrophytes and algae in aquatic and wetland sites include these commercial formulations:

Copper	Clearigate ||-; Cutrine ||-Plus; Komeen ||-; Nautique ||-
2,4-D	Aqua-Kleen ||-; Navigate ||-; Weed AR® IVM 44
Diquat	Reward® ;Weedtrine® -D
Endothall	Aquathol® ; Aquathol® Super K; Hydrothol® 191
Fluridone	Sonar® A.S.; Sonar® SRP
Glyphosate	Rodeo®

These herbicides are formulated as liquid soluble concentrates, suspensions in water, as granules, or as slow-release pellets.

Safety and Toxicity Issues for Aquatic Herbicides

Herbicide compounds are tested rigorously before being approved by the USEPA for use in aquatic and wetland sites. That is why only a limited range of compounds is available for application to water. When used correctly and according to the directions stated on the label, these formulations do not pose an unreasonable risk to human health and the environment. Therefore, the state of Massachusetts requires aquatic herbicides to be used only by trained and licensed applicators.

Once these herbicides are applied to water, they are diluted thousands to millions of times, and they no longer present the same safety or toxicity problems to humans and animals. In order to add an extra margin of safety, the USEPA has mandated restrictions on the use of water treated with certain herbicides.

Aquatic herbicides are tested on a wide variety of terrestrial and aquatic species,

including invertebrates, fish, birds, and mammals, before they can be registered. These studies establish concentrations of the compounds at which no effect is seen (No observed effect level = NOEL), as well as the higher concentrations that produce toxic effects.

Aquatic herbicides are diluted many times in water, and are quickly broken down or adsorbed to sediment or organic matter following application. They do not accumulate in animal tissues. The chance that a person could be affected by ingesting herbicide from treated water is extremely low. Consider this example:

If a 150-lb adult daily drank 1,000 gal of water containing 150 parts per billion (ppb) of Fluridone (the maximum rate allowed to be applied to water), he would still ingest less than the 9.4 mg/ kg body weight/ day that had no observable effect on rats that were fed this dose for a year (Weed Science Society of America 1994).

The specifications in the Invitation for Bid to the contractor only allow a maximum of 50ppb.

FLURIDONE –(SONAR® A.S., SONAR® SRP)

Fluridone, 1-methyl-3-phenyl-5-[3-trifluoromethyl)phenyl]-4(1H)-pyridinone, is a slow-acting, systemic type herbicide. Fluridone is available as the EPA-registered herbicide SONAR® (SePro) for use in the management of aquatic plants in freshwater ponds, lakes, reservoirs, and irrigation canals. It is formulated as a liquid (SONAR 4AS) sprayed above or below surface, and in controlled release pellets (SONAR SRP) spread on the water surface. Fluridone is effectively absorbed and translocated by both plant roots and shoots.

Fluridone demonstrates good control of submersed and emergent aquatic plants, especially where there is little water movement. Its use is most applicable for lake-wide or isolated bay treatments to control a variety of exotic and native species. Eurasian water milfoil is particularly susceptible to the effects of Fluridone. Typical Fluridone injury symptoms include retarded growth, "whitened" leaves and plant death. Effects of Fluridone treatment become noticeable 7-10 days after application, with control of target plants often requiring 60-90 days to become evident. Because of the delayed nature of toxicity, the herbicide is best applied during the early growth phase of the target plant, usually spring-early summer.

As a systemic herbicide, Fluridone is capable of killing roots and shoots of aquatic plants, thus producing a more long-lasting effect. A variety of emergent and submersed aquatic plants are susceptible to Fluridone treatment. As a result of extensive human health risk studies, it has been determined that use of Fluridone according to label instructions does not pose any affect to human health. Fluridone also has a very low order of toxicity to zooplankton, benthic invertebrates, fish, and wildlife.

DIQUAT –(REWARD® Landscape and Aquatic Herbicide, WEEDTRINE®-D)

Diquat (6,7-dihydrodipyrido[1,2-2',1'-c] pyrazinediium ion) is a broad spectrum contact herbicide that controls many submersed and free-floating aquatic macrophyte weeds and some types of filamentous algae in static and low-turbidity water. The Diquat formulations for aquatic use are liquid bromine salts and are not harmful to most fish at the application rates recommended by the herbicide manufacturers. Turbid or muddy water substantially reduces the effectiveness of Diquat by tightly adsorbing this herbicide to suspended clay particles, and Diquat is not considered bioavailable when bound. Therefore, Diquat should not be used, diluted, or mixed in muddy or turbid water.

Diquat is removed rapidly from aquatic systems, principally by adsorption. If adsorption is initially to weeds, biodegradation to soluble or volatile products occurs in several weeks. When sorbed to sediment, little or no degradation probably occurs. In any case, the Diquat disappears from the water in 2-4 weeks. Diquat will photo degrade in surface layers of water in 1-3 or more weeks when not adsorbed to particulate matter.

Per specifications in the IFB, Diquat will only be used after Sonar has maximized it÷s effectiveness on the Variable leaf milfoil and only after consultation and permission with the Lake Boon Quality Assurance Team (LBQAT).