

Standard Operating Procedures:

Using Hand Pulling and Benthic Barriers to Control Pioneer Populations of Non-Native Aquatic Species

A guide for volunteers



Foreword

The purpose of this document is to provide guidance on two different types of manual control techniques for pioneer infestations of aquatic non-native species. These techniques are suitable for volunteers who wish to implement a rapid response to a small infestation of non-native aquatic species, but usually are not considered feasible techniques for large scale infestations.

If a population of a non-native species is detected early, and responded to rapidly, there is a good chance the species can be eradicated. However, once a species has become well established throughout the water body, other options including herbicides, draw-downs, harvesting, and bio-controls may need to be considered. Information on other large scale techniques is available in the Generic Environmental Impact Report (GEIR), *Eutrophication and Aquatic Plant Management in Massachusetts*. Both this document and the accompanying *The Practical Guide to Aquatic Plant Management in Massachusetts*, are available online at www.mass.gov/lakesandponds. Those carrying out control techniques also should consult the website of the Department of Environmental Protection at www.mass.gov/dep/water/laws/alkguide.pdf for guidance on aquatic plant management in lakes and ponds.

Remember, all control efforts must first be approved by the local conservation commission.



Hand pulling Purple Loosestrife non-native plant.



Installing a benthic barrier emergent for submerged plants.



Hand pulling Water Chestnut, a non-native floating-leaved plant.



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I. Introduction

Non-native Invasive Species

Our lakes contain a wide variety of native plants and animals that are essential to a healthy lake ecosystem. These native species originated here in New England and are well adapted to our climate and to the other species that live here. However, several non-native or exotic species have been brought here from other parts of the country and the world. When these species enter a lake or pond they can have a devastating impact. Since the local ecosystem did not develop natural controls for them (animals or other plants to limit their growth and spread) populations of exotic species may increase very rapidly. When any species, native or non-native, is able to dominate or significantly alter an area's ecology, it is considered an invasive species.

Why They Are Harmful

- Many invasive non-native plants grow rapidly, and the dense mats of vegetation they form can restrict boating, fishing and swimming, and in some cases, may make the waterway entirely impassable.
- Many native plants cannot compete for space or food with non-native species, and are crowded out or eliminated from the area.
- The spread of invasive non-native species also can cause a decline in some native animal species and in some cases, eliminate them all together. This reduces the lake's natural biological diversity and disrupts the basic ecological relationships that sustain a healthy and balanced lake ecosystem.
- The aesthetic appeal, recreational value and surrounding property values of a lake or pond may quickly decline as the non-native invasive species takes over.
- Once non-native plants are established, they are almost impossible to eradicate and can be very expensive to control. The United States spends millions of dollars annually to control non-native species.

How They Are Spread

Non-native invasive species are introduced to new regions in a variety of ways including hitchhiking in ship ballast water, escaping from aquariums or water gardens or in intentionally introduced as ornamentals. Although many non-native species are not able to survive in the new climate, some species adapt, and due to a lack of natural controls, become invasive. Once established, they continue to spread to new locations.

Many species spread by fragmentation. Boat propellers, waves or currents break the plants into fragments which are then transported to new locations on trailers, anchors, fishing gear, engines or in currents. The sharp barbed nuts of water chestnut have been observed attached to migrating geese and waterfowl. Several animal species, including the Asian Clam and Zebra Mussels, have a microscopic larval form that can be transported undetected in bait buckets, live well water and cooling water.

Prevention, Early Detection and Rapid Response

Once a non-native invasive species becomes established in a water body, it is very difficult or impossible to eradicate and very expensive to control. Therefore, preventing an introduction is the first priority. Even if a water body already is plagued by one non-native invasive species, steps must be taken to prevent the introduction of additional non-native species. Listed below are several steps that citizens can take to protect their lake or pond. The keys to success are prevention, early detection and rapid response.

1. Prevention

Raise Aquatic Invasive Species (AIS) Awareness

- [Boat Ramp Signs/Posters](#): Request free boat ramp signs and posters from the DCR Lakes and Ponds Program to place at the boat ramps, in kiosks and at all other access points. Posting a ramp sign reminds boaters to check for plant fragments and to empty bait bucket water and live well water on dry land away from shore.
- [Lake Association](#): If your lake does not already have an association you can form one. There is strength in numbers and the dues collected can be applied towards restoration and protection projects. Meetings provide a forum for presenting information on invasive species and other lake issues. For information contact the Massachusetts Congress of Lakes and Ponds at www.macolap.org.
- [Press releases](#): Contact your local newspaper or cable access channel to interest them in running a story on invasive species.
- [Brochures](#): Educational brochures can be distributed to all lakefront home owners. The DCR Lakes and Ponds Program can provide a template of examples.

Monitor Boat Ramps

- Volunteers at the boat ramp can educate visitors and perform courtesy boat inspections to prevent a new invasive species from being introduced. Contact the DCR Lakes and Ponds Program for information.

2. Early Detection

Weed Watchers

- The DCR Weed Watcher Program teaches volunteers how to identify aquatic plants, with an emphasis placed on non-native species. Monitors routinely check key areas, including boat ramps, fishing piers and inlets/outlets, where non-native species are likely to appear first. Monitors also perform annual surveys to collect baseline data on the health and diversity of aquatic vegetation in their water body.

3. Rapid Response

Standard Operating Procedures (SOP's)

- Once detected, it is important to remove the pioneer populations of non-native species before they become established or spread further. These Standard Operating Procedures were developed to provide guidance for citizens who wish to eradicate new infestations of non-native aquatic species.

II. How to tell if your lake has invasive species

IDENTIFICATION

As a first step, it is important to determine if the plants in question are native or non-native. Collect a plant sample, including all parts of the plant (floating leaves, submerged leaves, flowers, fruits, stems etc), and use the review list below to determine if the plant is non-native. Then, if you suspect that the plant is not native, the identification needs to be confirmed by a professional (see the Confirmation Section on page 9).

Non-native aquatic plants are separated into three categories; submerged, floating-leaved and emergent. (For a free *Guide to Common Aquatic Plants in Massachusetts* or *A Guide to Selected Non-native Aquatic Species* go to the DCR Lakes and Ponds Program web site.)

1. Submerged plants

Submerged plants lie beneath the water's surface, however, at certain times of the year a flowering portion of the plant, called an emergent bract, may appear above the surface. In general, the plants are limp since they are supported by the water column.

2. Floating-leaved plants

Floating-leaved species float on the surface of the water; however, they may have roots that hang down into the water column.

3. Emergent

Emergent plants grow at or near the water's edge. Since they do not have the water column to provide support, they generally have a more woody structure.

1. Submerged Non-native Aquatic Species



Variable Milfoil (*Myriophyllum heterophyllum*)

This plant has a pipe-cleaner appearance. The feathery leaves are 2" long and 1" wide with slightly rounded tips. Leaves are arranged in closely spaced whorls of 4-6 on a thick reddish stem, giving the plant a "shaggy" appearance. The rigid emergent bract that forms in late summer has two distinct leaf types; one with smooth margins, one with serrated margins. This plant is very similar to native Low Water Milfoil and the presence of the emergent bract is necessary to make a determination.



Eurasian Milfoil (*Myriophyllum spicatum*)

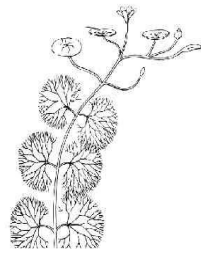
The olive green feathery leaves are less than 2" long with distinctively blunt leaf tips. Leaves occasionally have a reddish tinge. Leaves are arranged in whorls of 4 (occasionally 3-6) around the stem and the whorls are spaced approximately 3/8" apart. The stems are red/brown or white/pink and can reach lengths of over 20 feet. Reddish flowers form during July and August in whorls of 4, on an 8" emergent bract.





Fanwort (*Cabomba caroliniana*)

The bright green fan-shaped leaves are arranged in opposite pairs along the stem. In late summer the plant produces tiny white/cream flowers and small oval and diamond shaped floating leaves. This plant may be confused with Water Marigold, but Water Marigold lacks a petiole (a small stalk that connects the leaf to the stem.) The plant is also similar to Water Buttercup, but Water Buttercup has alternate leaves, not opposite pairs.



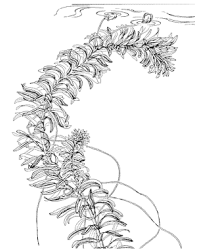
Curly Leaved Pondweed (*Potamogeton crispus*)

The 3" long undulating (wavy) thin leaves are arranged alternately along the stem. The leaves are rippled (curly) and the leaf margin (edge) is visibly serrated. When the leaf is held up to the light, a distinct ladder-like vein pattern is visible. Additionally, the mid-vein is dark and prominent.



South American Waterweed (*Egeria densa*)

This species is very robust, with 1" long narrow bright green strap-shaped leaves, arranged in whorls of 3-6 around the stem. If flowers are present they are 1" wide and white. This species is easily confused with the native waterweed (which has shorter leaves in whorls of 3) and exotic Hydrilla (which has whorls of 4-8, very serrated leaf margins and a midrib).



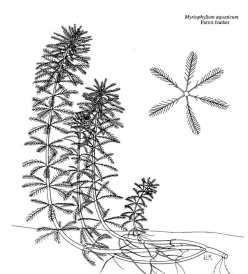
Hydrilla (*Hydrilla verticillata*)

The green leaves are 5/8" long and strap-shaped with distinct pointed tips, serrated leaf margins and a midrib. The leaves are arranged in whorls of 4-8. This species is often confused with native waterweed (*Elodea* sp) and South American Waterweed. Currently, this species only found in one water body in Massachusetts. If found, please report it to DRC Lakes & Ponds Program immediately (617-626-1411).



Parrot Feather (*Myriophyllum aquaticum*)

The emergent leaves are bright blue green, 1-2" long, rigid, deeply serrated and profuse. Emergent leaves often look like miniature fir trees and can extend up to 5 feet onto the shore, becoming "woody". The submerged leaves are feathery, often reddish and arranged in whorls of 4-6 around the stem. Submerged leaves are easily confused with Eurasian Milfoil leaves. In the spring, pink/white flowers may develop.



European Naiad (*Najas minor*)

This species has 6-15 deep serrations on the leaf margins that can be seen with a hand lens. The leaf base is clearly lobed and the tip of the leaf is tapered. The lime green leaves are 1" long, brittle and re-curved, giving the plant a busy appearance.

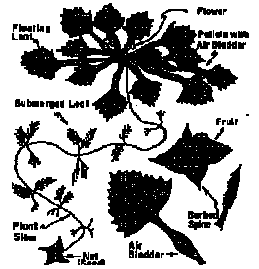


2. Floating-leaved Non-native Aquatic Species



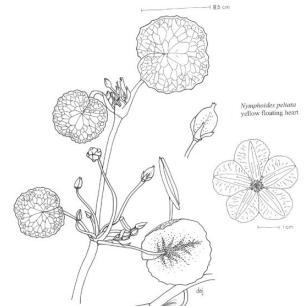
Water Chestnut (*Trapa natans*)

Floating diamond shaped leaves have deep margins and form rosettes that float on the surface. The upper side of the leaf is shiny and the underside is covered with fine hairs. Submerged leaves are feather-like and whorled around the stem. A 1" fruit (chestnut) with four sharp barbs may be attached. When present, flowers are white with four petals.



Yellow Floating Heart (*Nymphoides peltata*)

Shiny heart-shaped leaves are approximately the size of a silver dollar and have a deep V at the base of the leaf. The leaf lobes are rounded, the margins are rippled and the underside is often tinted purple. Showy yellow flowers develop on a rigid stalk. The leaf margins on the flower appear "frayed". Unlike the native Little Floating Heart, this species lacks root bunches on the stem at the base of the leaves.

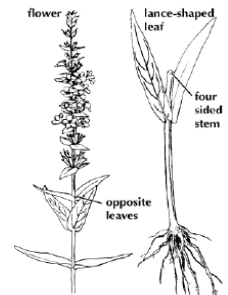


3. Emergent Non-native Aquatic Species



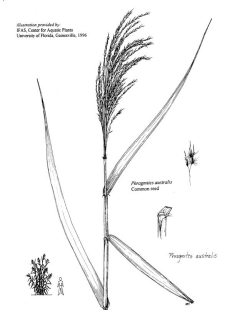
Purple Loosestrife (*Lythrum salicaria*)

Leaves are four inches long, covered in fine hairs and are lance-shaped with a heart shaped base. Leaves are arranged in opposite pairs and the pairs are located at 90-degree angles to each other on a rigid square stem. This species grows over four feet tall in late summer produces vibrant purple/pink flowers on a six inch stalk.



Phragmites (*Phragmites australis*)

The leaves are green/gray in color, strap-like and taper to a point. Leaves are up to 2" wide and 24" long and are located alternately along the stem. An appendage (ligule) is present where the base of the leaf "clasps" the stem. A silvery beige flower is present, often drooping. These plants frequently form dense stands and grow over 6 feet tall.



To key out plants using an interactive online dichotomous key visit:
<http://www.mass.gov/dcr/waterSupply/lakepond/exotics/exotic1.htm>

4. Additional Non-native Species to Watch For



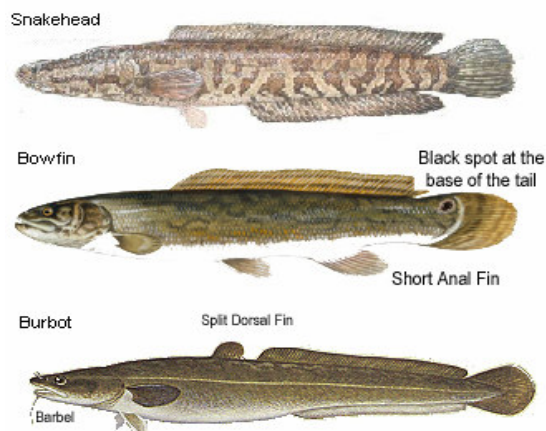
Asian Clams (*Corbicula*)

There are 4 known populations in MA. Asian Clams out-compete native bi-valves for resources and can clog intakes and engines. They are usually less than 1.5" wide and are dark beige to brown in color. The outside of the shell is lined with concentric ridges and the inside of the shell has three cardinal and two lateral teeth. The microscopic larval stage of this species can be unintentionally transported in bait buckets, live wells and engine cooling water.



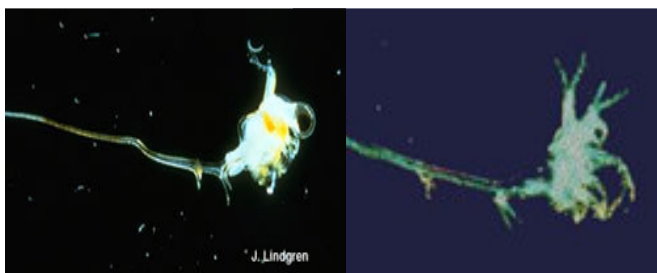
Zebra Mussel (*Dreissena polymorpha*)

Zebra Mussels are not known to be in MA yet, but are along our borders. They out-compete native bi-valves for resources and may clog intake pipes and engines. The yellowish D-shaped shells are usually 2" long, with alternating brown bands. The microscopic larval stage of this species can be unintentionally transported in bait buckets, live wells and engine cooling water.



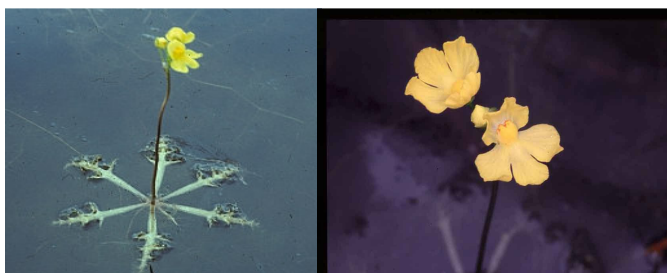
Northern Snakehead Fish (*Chana argus*)

There are no known populations in MA. Snakeheads can breathe out of water for several days and can move across land using their pectoral fins. Due to their sharp teeth and voracious appetites, they may out-compete native fish for food. They are tan with mottling and grow 3' long. Snakeheads may be confused with native Bowfins and Burbots; however, Bowfins have a dark tail spot and short anal fin, and Burbots have a split dorsal fin and a barbel. If you catch a snakehead, do not return it to the water. Contact DCR immediately. 617-626-1411



Spiny Water Flea & Fish Hook Flea

(*Bythotrephes cederstroemi*) & (*Cercopagis pengoi*)
These microscopic crustaceans are not yet in MA, but have had a detrimental impact on the Great Lakes ecosystem. They reproduce rapidly and form mats that can destroy fishing gear. Due to the presence of sharp barbs, they are not readily eaten by other animals, and compete with juvenile fish for food. They are transported on fishing gear and in bait buckets live wells and in engine cooling water.



Swollen Bladderwort (*Utricularia inflata*)

This non-native bladderwort has been documented in several ponds in MA. It produces bright yellow "snap dragon-like" flowers that are supported on a floating "pontoon". Underwater leaves are branched and have bladders. This species may be confused with native Floating Bladderwort, however, Floating Bladderwort has pale yellow flowers and is less robust.



Flowering Rush (*Butomus umbellatus*)

This emergent perennial species has not been confirmed in MA yet, but is established in our neighboring states. The emergent form of this plant produces flowers with three pink petals arranged on an umbrella-like stalk. Plants grow up to three feet tall, and the leaves are triangular and often confused with native Bulrushes. This plant can also produce limp submerged leaves.



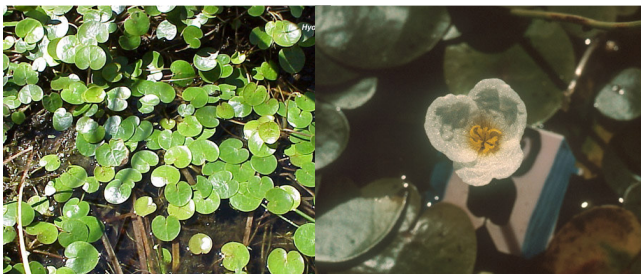
Water Hyacinth (*Eichhornia azurea*)

This non-native floating plant reproduces very quickly and can take over a water body. Water Hyacinth has elliptical leaves over eight inches long, and swollen leaf stalks that contain air to help the plant float. Showy white, blue or purple tinted flowers grow in a cluster on an emergent stalk.



East Indian Swampweed, Miramar Weed (*Hygrophila polysperma*)

This species is native to India and is currently on both the Federal and Massachusetts Noxious Weed Lists. *H. polysperma* can completely choke waterways. Leaves are opposite, pointed, slightly hairy and range from bright green to brownish red in color. Emergent stems can be square and brittle. Flowers are bluish-white, and lack stalks.



Frogs-bit (*Hydrochara morsus-ranae*)

The leaves may be floating or emersed, are heart-shaped leaves and are on long stems. The single flowers are white, with three petals. This plant may be confused with native American frog-bit.



Great Yellowcress (*Rorippa amphibia*)

This non-native species is currently in the Blackstone River, forming dense stands that can crowd out native species.

CONFIRMATION

If you suspect the plant is not native, it is important to confirm the species by contacting a member of the rapid response team:

Jim Straub 617-626-1411
Michelle Robinson 508-792-7423 x 304

Mail

Enclose damp plants in a sealed zip lock bag and ship in a padded envelope to:
DCR Lakes & Ponds Program 251 Causeway St. Suite 800 Boston MA 02114 or
DCR Lakes and Ponds Program 180 Beaman St. West Boylston MA 01583
Be sure to include several plants, all the flowers, fruits, submerged leaves, floating leaves and emergent leaves. Send the plant quickly so it that does not decay.

Digital Photo

Float the plant sample out in clean water in a white dish, with the leaves and stems clearly separated. Also attach an overall photograph of the plant growing in the water.
Note: Please keep photo file size under 1 MB. (see good examples below)

Digital photos can be emailed to michelle.robinson@state.ma.us



Parrot Feather



Parrot Feather infestation



Native Fern Pondweed close up



Curly-leaved Pondweed in pond



Water Starwort floated
out in dish



Photo showing size



Base of Burreed

III. SURVEY THE WATER BODY

METHODOLOGY

Once you have confirmed the species, a survey is necessary to evaluate the extent of the infestation, and to make certain that additional non-native species are not present. Survey results will help you determine which technique is best suited to manage the non-native species in your pond and also provides an opportunity to document the native species and the diversity. This information will provide both an overall picture of the health of the water body, and baseline data for comparing, detecting and monitoring any changes in the future. It is best to conduct a survey during mid-summer when vegetation in the water has peaked.

Select a survey technique

Determine what type of complete plant survey is best for your lake. Remember, plants can only grow to the depth that light can reach the bottom, so rooted plant growth is limited to this "photic" zone (approximately 15 ft deep, depending on water clarity).

Submerged and Floating-leaved species:

- If your lake is deeper than 15 ft perform a perimeter survey. *See Figure 1*
- If your lake has a shallow basin, where plants grow throughout the water body, a transect survey is ideal. *See Figure 2.*

Emergent species:

- If the plants are emergent species (on the perimeter) *See Figure 3.*

Safety First

- Check the local forecast and choose a day that has appropriate weather. Do not monitor your water body if bad weather is predicted.
- Choose a day when the water is calm, as ripples on the surface can make it difficult to see through the water column to the plants beneath.
- Always monitor in pairs or groups and wear life vests when boating.

Equipment

For all control techniques:

- Small boat with a short shaft motor, canoe, kayak, or row boat
- Plant identification books, sheets or cards
- Outline map of the lake with high priority areas¹ marked
- Pens or pencils
- Water, sun screen, hat with brim
- GPS to obtain data on AIS locations or treatment areas (optional)
- Waders (optional)

Additional equipment for submerged and floating leaved species:

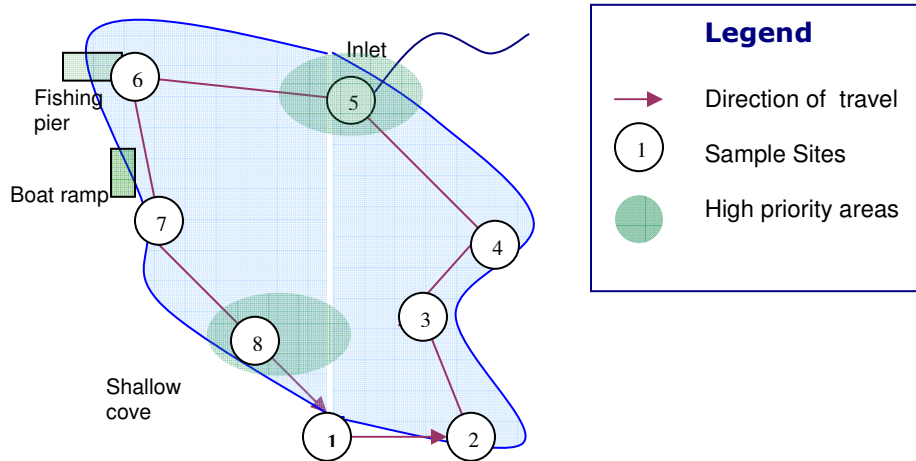
- Small rake with 30 foot rope attached to the end (drill a hole in the handle)
- Zip lock bags
- Polarized glasses or view scope (optional)
- Buoys to mark areas of submerged species (optional)

Additional equipment for the emergent species:

- Appropriate clothing: long sleeves, pants and gloves
- Flagging tape for marking areas of emergent species

¹ High priority areas are locations where non-native plants are likely to occur first. These include boat ramps, inlets, outlets, shallow coves, fishing piers and other high use areas.

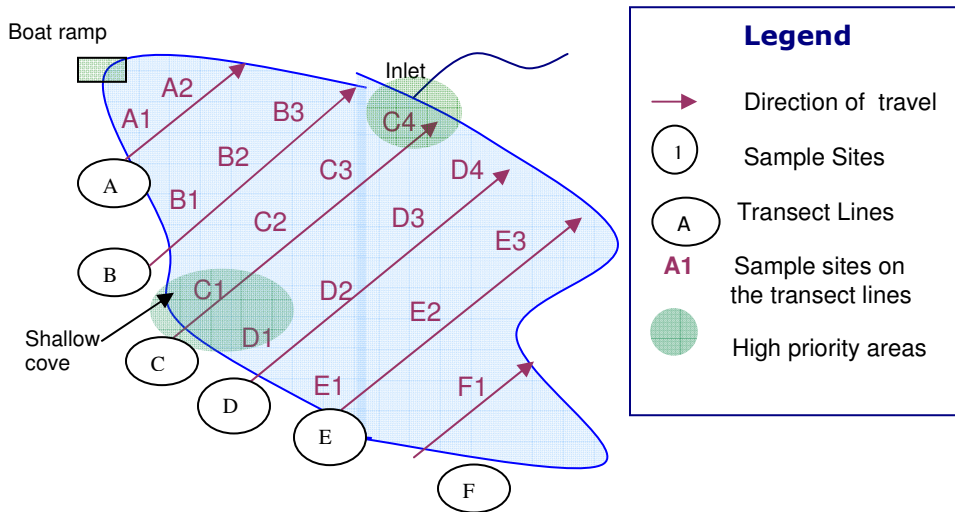
Figure 1. Perimeter Survey (deep water bodies)



Directions

- Move in a zigzag pattern around the perimeter of the lake. Include the entire photic zone (usually up to 15 ft deep).
- At even intervals, collect three rake throws² of vegetation and take notes to describe the site.
- Secure the samples in a zip lock bag and mark both the bag and the map with the date and sample site number.
- Return to shore to identify and record the samples.

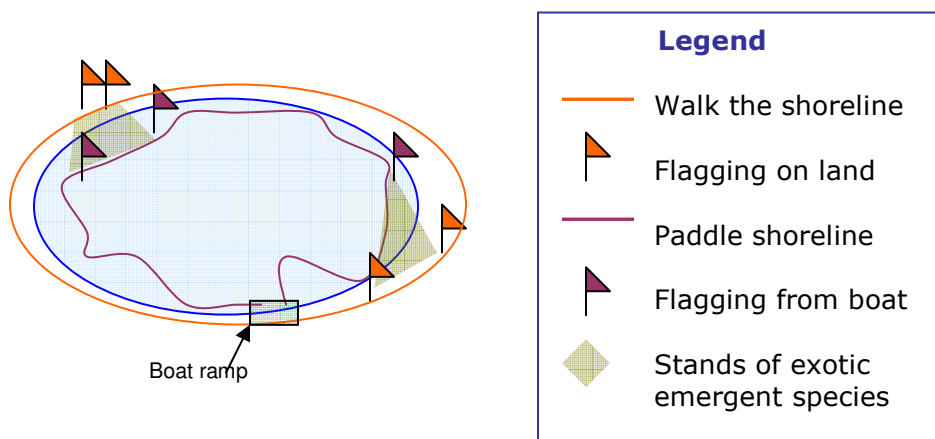
Figure 2. Transect Survey (shallow water bodies)



Directions

- On the pond map draw evenly spaced transects and label them.
- In your boat, follow the transects across the lake, and collect samples at evenly spaced sites along each transect. It is helpful to identify landmarks or use GPS to locate the transect end points.
- Mark sample sites on the map.
- Use three rake throws² at each site to obtain a thorough sample.
- Label the bags and return to shore to identify the plants.

Figure 3. Surveys for Emergent Aquatic Species



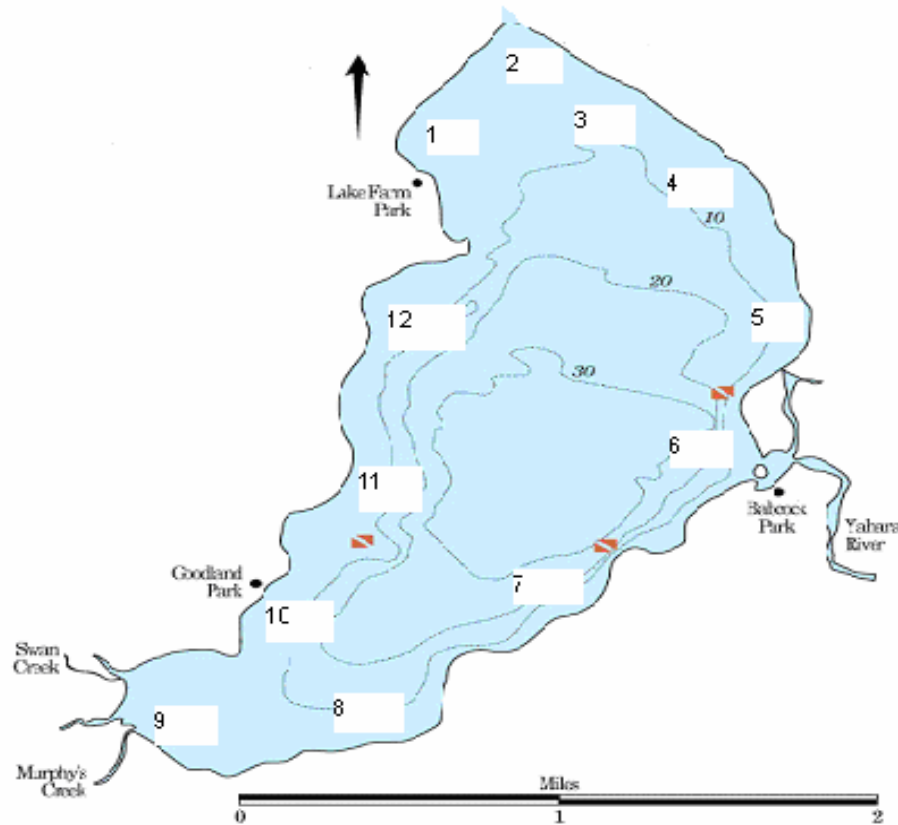
Directions

- Walk the shoreline and flag the perimeters of any patches of non-native emergent plants. Mark these areas on the map.
- Paddle along the shoreline. Flag (and mark on the map) the edges of any patches of non native emergent species.
- Then use a tape measure (or GPS coordinates) to estimate the size of the stands.
- Take notes on the density of the stand and presence of any native emergent species.

Rake throw²: Toss the plant rake into the water and let it sink to the bottom. Drag it gently along the bottom to retrieve it. Remove all the plants and place them in a labeled bag. When doing multiple rake throws, toss the rake off different sides of the boat.

WATERBODY PERIMETER SURVEY EXAMPLE

Move along the shoreline in a zig-zag movement, collecting and bagging samples at evenly spaced intervals. Using numbers, mark each sample location on both the map and the bag. Return to shore and record the results. For example, at site #1, Variable Milfoil, Fern Pondweed and Common Bladderwort were documented. In the row for sample site #1, place X marks in the columns beneath those three species.



Species								
	Variable Milfoil	Panwort	Fern Pondweed	White Water Lily	Hedge Hyssop	Wild Celery	Common Bladderwort	Yellow Water Lily
Sample Site #	1	2	3	4	5	6	7	8
1	x		x				x	
2	x	x	x	x	x	x	x	x
3		x	x			x	x	x
4	x							
5		x		x		x		
6	x	x	x	x	x	x	x	x
7			x		x			x
8	x							
9	x	x	x	x		x	x	x
10		x			x			
11		x	x	x		x		x
12	x		x					x

IV. SELECT A CONTROL TECHNIQUE

There are numerous techniques for controlling non-native aquatic plants including (but not limited to) hand pulling, diver-assisted harvesting, mechanical harvesting, benthic barriers, bio-controls, draw-downs and herbicide applications. Herbicides can only be applied by a licensed herbicide applicator. Since this guide was developed as a resource for volunteers, only hand pulling and benthic barriers are covered. For an extensive list of all the approved aquatic plant control techniques in Massachusetts refer to *The Practical Guide to Lake Management in Massachusetts*. Copies of this resource are available at www.mass.gov/lakesandponds or from the DCR Lakes and Ponds Program.

Hand pulling

Harvesting non-native invasive aquatic species by hand pulling is ideal for small infestations where there are volunteers willing to participate. Hand pulling projects are easy to plan and implement, and are often the best way to control small infestations or to respond to the initial detection of a small population of non-native plants. Hand pulling often is a good alternative in sites where herbicides or other methods cannot be used. This technique is extremely species specific and can target the invasive non-native plants with little or no damage to non-target species. The advantages of hand pulling are its limited ecological impact and low (or no) cost for supplies. In cases where the water is too deep, SCUBA divers can be utilized; however, number of divers and the amount of time required will affect the cost of the hand pulling technique.

The disadvantages of hand pulling include the intensive time and labor required, and stirring up the sediments which reduces water clarity and limits the time of a hand pulling session. Effectiveness also is limited on plants with deep, underground stems and roots which, if left behind, can re-sprout. Many plants spread by fragmentation, so it is important to catch any fragments that are created. Plants should be harvested before they produce seeds. If the plants have already produced seeds, the seeds may germinate in the future, so continual monitoring is necessary to insure success.

Benthic Barriers

Benthic barriers are mesh mats, that when placed over a patch of plants, limit plant development by restricting light and upward growth. They are most suitable for use in smaller areas around docks, beaches and in boating lanes. The benthic barriers are easily controlled and can be removed at any time. In addition to restricting plant growth, they reduce turbidity in areas with soft sediments and can improve breeding habitat for some fish species. The cost of barrier material is between \$0.22 and \$1.25 per square foot. In addition to long-term control, barriers can be used to control pioneer infestations of submerged species.

Benthic barriers have potential negative impacts, including the impact to non-target species and the potential for anoxia in the sediments immediately beneath the barrier. Benthic vertebrates and the spawning of some fish also may be affected. The mats need to be cleaned occasionally or sediments may accumulate allowing plants to colonize.

It is important to properly anchor the barriers as decomposing plant matter can create gases that may cause the barrier to float to the surface and create a boating/ swimming hazard. To prevent damage to the barriers from anchors and fishing hooks, the location of barriers should be clearly marked with buoys.

V. NEXT STEPS

APPROVAL

Obtain approval under the Wetlands Protection Act from your local conservation commission. A negative determination of applicability (NDA) may be appropriate if the area to be treated affects less than 5,000 square feet. An Order of Conditions (OOC) may be required for areas greater than 5,000 square feet of native vegetation. Non-native vegetation identified on the Rapid Response List usually can be removed without restriction on areal extent. (see attached DEP letter)

VOLUNTEERS

Define the number of volunteers required and organize accordingly. It is helpful to have a pre-meeting to brief the volunteers on non-native species in general, what to bring the day of the project, and how to identify the target species. Inform the public, boating and swimming communities and lakeshore homeowners about the project by distributing a flier or posting an article in the local newspaper.

TIMING

Review the selected standard operating procedures to determine the best time of year to implement the technique. Timing is both species specific and technique specific, as noted.

- For benthic barrier installation, early spring is the best time. Less plant matter present beneath the barrier reduces the amount of gases created during decomposition, decreasing the chance that the barrier will float. Additionally, fewer plants present during installation means that there is less chance of fragmentation and spread.
- For hand pulling, it is best to remove the plants early in the season while they are smaller, less dense and/or have not developed seeds. However, cold water temperature should be considered when recruiting volunteers.

POST- PROJECT MONITORING

The key to any successful control technique is post-project monitoring. It is important to revisit the site routinely and remove any of the target species that withstood the control treatment, regenerated from roots or germinated from seeds remaining in the soil. Additionally, by regularly monitoring the site and the entire water body, any new invasive non-native species can be detected early, before they become established. Training on invasive species monitoring is offered through the DCR Weed Watcher Program.

Visit www.mass.gov/lakesandpond or call 508-792-7423 x 304

VI. Standard Operating Procedures

A. CONTROL OF SUBMERGED AQUATIC PLANTS

HANDPULLING SUBMERGED SPECIES

SUMMARY

This inexpensive technique is favored for controlling small pioneer infestations or where a large pool of volunteer labor is available. Although this technique is very species specific and causes minimal damage to non-target species or other biota, many submerged non-native species spread by fragmentation, so extreme caution must be exercised when hand pulling to prevent additional spread. Although hand pulling is an inexpensive management technique, the use of SCUBA divers may increase the cost, and post monitoring is essential.

SAFETY CONSIDERATIONS

It is essential to carry out this technique with a partner, rather than alone, and to take into consideration weather conditions, such as extreme heat or approaching storms. Life jackets are strongly recommended, and always follow the boating/water rules and regulations. If SCUBA divers are required, the divers will follow the safety guidelines outline by PADI, SCUBA or the certifying company.

MATERIALS

- Plant bags & nets
- Spotter boat (if needed)
- Scuba divers (if needed)
- Plant guide, note pad and markers (permanent ink)
- Life vests
- Water, sunscreen, polarized glasses, hat with a brim

PROCEDURE

- 1 If plants are in deep water, arrange for a spotter boat and two volunteers: one to drive and one to net any fragments that may float up. If the plants are confined to shallow waters, waders and view scopes (or mask/snorkel) may suffice.
- 2 Have a volunteer on shore keep notes on the amount of plants removed, the time spent on removal, names of participants etc. It is important to have volunteers sign in and out so that they are accounted for.
- 3 Begin at the furthest boundary of the defined area and line up the volunteers along the boundary. Work towards the shore with the volunteers maintaining the line formation. Volunteers should go no more than chest deep, depending on the slope of the shore and type of bottom.
- 4 Remove target plants from the base, removing the entire root while disturbing the sediment as little as possible. Place the removed plants carefully in a collecting bag, and take care not to fragment the plants or leave any fragments in the water. The spotter boat should remain nearby, down wind/current, and have a volunteer with a net collect any fragments and place

them in a storage bag. The boat operator needs to be very cautious of the volunteers in the water.

- 5 Repeat steps 3 and 4 until all the target plants have been removed. Depending on the number of volunteers, type of sediment, depth of water and other factors, expect this project to take a few days since the removal of the plants can create turbidity and make visibility very difficult.
- 6 Once the removal is complete, dispose of the contents of the storage bags far from the water so that they cannot cause a re-infestation.
- 7 Record the final details of the procedure and include date, time, site, town, volunteers involved, size of area pulled, approximate volume of plants removed, how they were disposed of and other relevant notes.
- 8 To ensure effectiveness of treatment, monitor the site monthly during the growing season for reappearance of the non-native species. Remove any surviving plants.

BENTHIC BARRIERS FOR SUBMERGED SPECIES

SUMMARY

The installation of benthic barriers can be used to control the growth of aquatic submerged and floating-leaved plants. Benthic barriers are most suitable for small areas such as around docks and swim beaches. This technique can be repeated over a long period of time if the mats are maintained and cleaned.

SAFETY CONSIDERATIONS

The barrier needs to be securely anchored to the lake bottom or gases from decaying plants can build up beneath the barrier, causing it to rise off the bottom where it may create a hazard for boaters and swimmers. Caution must be used in selecting anchors so that they do not pose a hazard for swimmers, and will not roll as gases build up. Installation should be done on a day with appropriate weather conditions (calm and with no predicted storms). Use the buddy system when performing routine maintenance or inspection of the barrier.

APPARATUS / MATERIALS

- Anchors (sand bags, rocks, concrete blocks, flat weight discs)
- Durable material (resistant to decay, limits light and is less likely to float)
- Area markers (anchored buoys/floating milk jugs) and rope
- Life vests
- Sunscreen, hat with brim, polarized glasses, water (optional)
- Note pad and pen

PROCEDURE

1. If possible select a date in early spring for installation.
2. Purchase project materials including benthic barriers, area markers, and weights. Note that there are many companies that both sell and install the benthic barriers.
3. If the barrier is not being professionally installed, identify an adequate number of volunteers who will install the barrier. Notify boaters, swimmers and home owners.
4. Define the area of barrier installation and mark area very clearly with visible, durable markers or buoys. Fishing lures and anchors can tear the fabric so it is very important to forewarn boaters and fishermen of the barriers presence.
5. Record the details of the procedure and include date, time, site, town, number of volunteers (or name professional company involved), size of area covered, and other relevant notes.
6. One of the easier ways to install, maintain and move a benthic barrier is to create a frame of marine plywood or rebar and PVC pipes for the barrier. Slits in the benthic material will allow gasses to escape and sand bags can be used to secure the frame. Another option is to roll the material outward over the treatment area, anchoring as you proceed. Weights should then be placed along the edges, corners and in the center of the barrier to anchor it down. Select weights that will not roll (such as cinder blocks).
7. Monitor the site monthly during the growing season to ensure that the mat remains well anchored and free of sediments, and to assess effectiveness of treatment. Also monitor the area on a routine basis to check for reappearance of invasive species. Keep accurate records of the monitoring visits.

B. Control of Floating-leaved Non-native Plants

HAND PULLING FLOATING LEAVED SPECIES

SUMMARY

This inexpensive technique is favored for small to medium sized infestations or where a large pool of volunteer labor is available. Since the floating-leaved plants do not spread by fragmentation, this technique is very species specific with minimal risk of additional spread. Although hand pulling is an inexpensive management technique, post monitoring for re-growth and new plants is essential because many plants drop seeds that remain viable for years.

SAFETY CONSIDERATIONS

It is essential to carry out this technique with a partner and to take into consideration weather conditions. Life jackets are recommended and always follow the boating regulations.

MATERIALS

- Laundry baskets/Leaf Tip bags (or other containers to transport plants)
- Kayak/canoe
- Pontoon boat (optional)
- Plant guide, note pad and pens
- Life vests
- Water, sunscreen, polarized glasses, hat with a brim
- Waders, mask/snorkel, view scope (optional)
- 100 lb limit hanging scale (optional)

PROCEDURE

1. Timing: Mid-June is the best time to pull floating-leaved plants since they are visible at the water's surface, are still small, and have not produced seeds. Water Chestnut must be pulled prior to August, before the nuts have formed. If hand pulling after August is inevitable, then take care to pull plants very carefully and to turn them upside down during retrieval to prevent the seeds from dropping into the water.
2. Boats: Kayaks and canoes are ideal vessels for hand pulling floating-leaved species. Kayaks are easier to transport to remote locations, and are more maneuverable, especially in shallow water and dense plant growth. Since kayaks only require one person to paddle, their use maximizes the use of available volunteers. Canoes have the advantage of being able to carry a greater quantity of pulled plants, but generally require two volunteers to paddle and steer. Pontoon boats increase the efficiency of the hand pulling project in several ways. They can carry all the supplies, volunteers and kayaks/canoes to the location and then once unloaded, can be used to store and transport the plants. (ex. An average pontoon boat can carry around 1000 pounds of water chestnut plants.) Kayakers and canoes can save time and energy by trading full laundry baskets for empty ones at the pontoon boat, instead to traveling to and from shore each time.
3. If plants are confined to shallow waters near shore, then volunteers with waders may suffice.

4. Plastic laundry baskets are ideal collection containers because they are inexpensive, light weight, can be secured to the kayak with bungee cords and drain excess water. Two handled plastic tubs also work well in canoes. For hand pulling projects near shore, Leaf Tip bags will suffice.
5. Prior to beginning a hand pulling event, give volunteers a brief history of the species, its impacts, and emphasize species identification.
7. Keep a list of the names of participants and have volunteers sign in and out so that they can be accounted.
6. Remove target plants from the base, removing the entire root and stem. Place the removed plants carefully in the collecting basket/bag.
7. Once the basket is full return to shore (or a stationary pontoon boat) and turn in the basket to be weighed (or plants counted). Assign a volunteer to keep notes on the weight or number of plants removed. This data is helpful for tracking population decreases year to year as a result of the hand pulling effort. If uniform bags or baskets are used, 10 loads can be averaged to determine the approximate weight and plant count per load. This will eliminate the need to weigh or count plants for every load collected. Plants should be disposed of on dry land, far above the high water mark. Some towns or local companies may be willing to haul away and compost or incinerate the removed plants.
8. Record the final details including date, weather, beginning and end time, site, town, number of volunteers, size of area pulled, number (or weight) of plants removed, how they were disposed of and other relevant notes.
9. Return to the site in one month and hand pull any new growth. Continue to monitor the site monthly (if possible) during the growing season.

C. Control of Emergent Non-native Plants

HAND PULLING EMERGENT SPECIES

SUMMARY

This inexpensive, labor intensive technique is suitable for small pioneer infestations but is not feasible on a large scale. Although this technique is very species specific and creates minimal damage to non-target species or other biota, it does require a long term commitment. Both Purple Loosestrife and Phragmites have deep underground root systems and can re-grow if any sections remain in the soil. Seeds already present in the soil rapidly germinate when the site has been disturbed, and therefore, continual monitoring and removal are necessary. These species need to be pulled prior to the formation of seeds, otherwise the disturbance that occurs during hand pulling will only aid in their dispersal. Also, covering the area with black plastic or other light barrier may thwart new growth, and/or mowing the dry areas prevents returning plants from storing nutrients or developing seeds/flowers. Additional success may be achieved by planting native species in the disturbed area. (See additional techniques on page 20)

SAFETY CONSIDERATIONS

It is essential to carry out this technique with a partner or group and to take into consideration weather conditions, such as extreme heat or approaching storms. Dress appropriately by wearing long sleeves, long pants and gloves. While working, volunteers should keep a 10 foot distance from each other to avoid accidental injury from rakes and other tools.

MATERIALS

- Shovels, rakes, trowels, clippers
- Plant guide, note pad and permanent markers
- Water, sunscreen, polarized glasses, hat with a brim
- Long sleeve shirts, pants and gloves
- Waders (optional)

PROCEDURE

1. If plants are in deep water a boat can be used, if they are confined to shallow water and the shoreline, chest waders are ideal.
2. Have a volunteer keep notes on the amount of plants removed, the time spent on removal, names of participants etc. It is important to have volunteers sign in and out so that they can remain accounted.
3. Timing for the removal of emergent plants is species specific, however it is best to hand pull the plants in the spring when they are smaller, less established and have not produced seeds. Although it is easier to identify Purple Loosestrife when it is in bloom, the plants need to be removed before they have formed seeds (usually mid-July). Pulling plants when they are in seed will only aid in distributing the 1-2 million seeds per plant. However, if the plants must be pulled after they have bloomed, place a plastic bag carefully over the flowering portion of the plant and secure it around the stem. This will minimize seed dispersal.
4. Begin on shore and slowly work outwards into the stand.
5. Remove target plants and try to extract the entire root. Place the removed plants carefully in a collecting bag, and take care not to fragment the plants or leave any fragments in the water.

6. Proper disposal of the removed plants is very important. Do not compost Phragmites or Purple Loosestrife. The plants should be incinerated or burned. If this is not feasible, the plants should remain in plastic bags and allowed to rot.

ADDITIONAL TECHNIQUES (to maximize emergent hand pulling success)

- Mowing:
If the majority of the stand is located on dry land, the hand pulled area can be repeatedly mowed. The mowing prevents any surviving or new plants from storing nutrients or maturing and producing seeds.
- Barriers:
Landscaping fabric, benthic barriers or heavy black plastic can be placed over the hand pulled (or mowed) area to smother any returning plants. The heat, lack of sunlight and restriction of upward growth from the plastic helps to retard any new plants from maturing.
- Re-planting with Native Species:
Once a hand pulling technique has been used, the area is considered a “disturbed site” which favors the re-growth of invasive species. To maximize the success of a hand pulling project, it is recommended that the disturbed area be re-planted with native species (ex. Cattails or Bull Rush).
- Bio-control Options:
The Massachusetts Office of Coastal Zone Management’s Wetlands Restoration Program currently is assisting local sponsors with bio-control projects to help combat the Purple Loosestrife invasion in Massachusetts’ freshwater wetlands. The projects involve the propagation and monitored release of a beetle native to Asia (*Galerucella californiensis*). This beetle forages on Purple Loosestrife plants, and although they do not entirely eliminate Purple Loosestrife from an area, they even the playing field, giving native species to compete with Purple Loosestrife. For more information on Purple Loosestrife Bio-control project visit:
www.mass.gov/czm/wrp/projects_pages/project_types.htm

VII. Additional Resources

USEFULL WEB LINKS

Lakes and Ponds Program (DCR)

www.mass.gov/lakesandponds (main webpage)

<http://www.mass.gov/dcr/waterSupply/lakepond/publications.htm> (GEIR)

<http://www.mass.gov/dcr/waterSupply/lakepond/weedwatch.htm> (Weed Watcher)

MA Department of Environmental Protection (MassDEP)

<http://www.mass.gov/dep/water/waterres.htm>

Invasive Plant Atlas of New England (IPANE)

www.ipane.org

North East Aquatic Nuisance Species Panel (NEANS)

www.neans.org

The Nature Conservancy (TNC)

<http://tncweeds.ucdavis.edu/handbook.html> (Invasive Species Control Handbook)

<http://tncweeds.ucdavis.edu/tool.html> (Hand-pulling Tool Review)

The Coastal Zone Wetlands Restoration Program

<http://www.mass.gov/czm/wrp/index.htm>

Water Chestnut Hand Pulling Brochure

<http://www.northeastans.org/docs/waterchestnutpull.pdf>

Florida Center for Aquatic & Invasive Plants

<http://aquat1.ifas.ufl.edu/> (collection of plant photos)

USDA Plants

<http://plants.usda.gov/>

Congress of Lakes and Ponds (COLAP)

www.macolap.org (assistance with forming a lake association)

Massachusetts Water Watch Partnership (MWWP)

www.umass.edu/tei/mwwp/index.html (provides monitoring guidance)

Sea Grant Non-indigenous Species Site (SGNIS)

www.sgnis.org (library of invasive species articles)

Massachusetts Invasive Plant Advisory Group (MIPAG)

www.nature.org/wherewework/northamerica/states/massachusetts/press/press1917.html
(temporary site until the MIPAG site is launched)

New England Wildflower Society (NEWFS)

<http://www.newfs.org/conserv/invasive.htm> (guidance on removing plants)

<http://www.newfs.org/conserv/docs/wfn98.pdf> (pdf guide on invasive plant identification)

PLANT SURVEY FORM

[illegible]

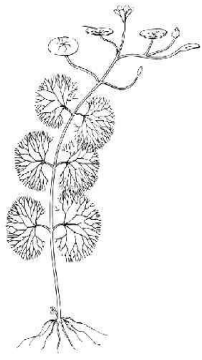
TIPS FOR RECRUITING AND RETAINING VOLUNTEERS

RECRUITING: outreach, messaging, and timing

1. It is important to reach out to potential volunteers by posting fliers in the library and other locations, but diversifying outreach efforts will likely yield a greater response.
 - Consider contacting a variety of local groups and organizations including Rod & Gun clubs, local fishing clubs, 4-H Clubs, Girl Scouts, Boy Scouts, Senior Centers, high school environmental clubs, science teachers, community service organizations (Rotary, Elks etc.) and churches.
 - Talk to local businesses to see if they would be willing to participate or sponsor a volunteer lake monitoring project. Kayak/canoe rental shops may be willing to rent boats for free or at a discounted rate for participants. They may also be willing to advertise the event in their store. Bait & Tackle Stores, outdoor equipment stores and local marinas may consider participating or promoting the event through their stores.
 - Even unrelated local businesses can be targeted as potential sponsors.
 - Coffee shops might offer free coffee to participants
 - Ice cream shops may provide free ice cream for volunteers if the weather is hot
 - Local farms or the DPW might be willing to haul and compost pulled plants
 - Local chain stores might be willing to provide free soda, note books, laundry baskets etc
 - If possible spread your message in local newspapers, lake association bulletins, on the radio, on television and town web page.
2. Developing a recruitment message for potential volunteers is very important. Every message should include:
 - A short, clear mission or purpose. What is this project and why is important?
 - A clear statement on what is expected of the volunteer in terms of the time commitment, amount of labor, location, deadlines etc.
 - Highlight the benefits for the potential volunteer. The project should be far more appealing and rewarding than spending the day at home. Ex. Free training, free kayak rental, interesting lectures on wildlife from local biologists, free meals etc.
 - The message should be enticing and descriptive, such as, “Here’s a chance to spend a day on the water while participating in an effort to protect Lake Wyola from invasive plants. Bring your boat or use one loaned by Jack’s Boat Shop and kayak/canoe to hand-pull invasive plants”.
3. Timing is important. The recruiting process takes time and patience, so recruitment should begin at least six weeks ahead of time. If the recruitment effort is started too close to the day of the project, many potential volunteers may have already made alternate plans.

RETAINING: Keep them happy, interested and engaged

1. Try to make the day as stress-free and comfortable as possible for the volunteers. The day needs to run smoothly and efficiently and the basic needs of the volunteers (food, drink, rest) must be addressed. Either find a way to provide drinks or other goodies or make sure they know they need to bring what's not provided.
2. The volunteers need to have a job and feel useful. If they have dedicated their day and they are left standing idly around, they will be hesitant to volunteer for future projects.
3. It helps to assign volunteers official titles such as "leader" and "coordinator". These provide the volunteer with a sense of responsibility and importance. It helps them to have a defined role to and to realize that they are valuable to the project. Keep an eye out for potential leaders and get them involved early.
4. It is very important that the volunteers feel appreciated. Recognition is one method of showing appreciation, and it can be delivered through speeches, articles, certificates etc. Additionally, after the conclusion of the project, sending a sincere thank you letter that highlights the success of event can help remind the volunteer of their valuable contribution. Ex. "Thanks to your support, 3000 pounds of water chestnut were removed from Lake Wyola. This restored over 30 acres of open water for both recreation and migrating birds. We could not have done this with out you!"
5. Freebies! Giving participants t-shirts, water bottles and other gifts is a tangible way of saying thank you.



Massachusetts Weed Watchers

Non-native Aquatic Species Monitoring Program

Department of Conservation & Recreation Lakes and Ponds Program



By monitoring your lake or pond you are taking an active role in ensuring the protection of your lake for the future!

Program Description

A key goal of the Department of Conservation and Recreation's Lakes and Ponds Program is to prevent further infestation of Massachusetts's lakes and ponds by exotic invasive aquatic plants, and to work toward controlling and removing existing populations of exotic invasive plants. To meet this goal, we have developed a program to train local lake groups to monitor their ponds for the presence of exotic invasive species and to develop a removal plan if an infestation is found. If a pioneer infestation of invasive exotic species is identified early, there is a greater chance that the plant can be eradicated before it becomes established in the lake or pond. Once invasive species are established they are almost impossible to remove and very expensive to control. Invasive species spread rapidly and form dense mats that can make boating, fishing and swimming impossible. As the recreational and aesthetic value of the lake declines, property values around the lake also decrease.



Class Description

Each spring and summer the Lakes and Ponds Program schedules Weed Watcher training for any interested lake groups or associations. The 2 hour class begins with an introduction to the non-native species issue, how exotic species are introduced into our waterways, methods of dispersal, basic terminology, and guidance on performing bi-weekly monitoring and completing plant surveys. The remaining 3/4 of the class will engage volunteers in hands-on identification. A variety of non-native and native plant species are provided, and people are encouraged to bring in their own samples. Volunteers will become familiar with using a dichotomous key and, although the emphasis is on exotic species, the goal is to teach volunteers to understand how to *use* the key so that they will be able to identify the majority of common aquatic plants in their lake or pond (native or otherwise).

The group will receive a Weed Watcher Packet that contains: reporting forms, Standard Operating Procedures (for Hand Pulling and Benthic Barriers), A Guide to Aquatic Plants in Massachusetts (Aquarium Guide), Guide to Selected Invasive Non-native Plants in Massachusetts, Massachusetts Lake & Pond Guide, Invasive Species brochure and poster, boat ramp signs, and other useful information. The Lakes & Ponds Program requests that participating groups return the reporting forms each summer, so that the aquatic invasive species data base can be updated. Contact Michelle Robinson 508-792-7423 x 304 or visit <http://www.mass.gov/dcr/waterSupply/lakepond/weedwatch.htm>

