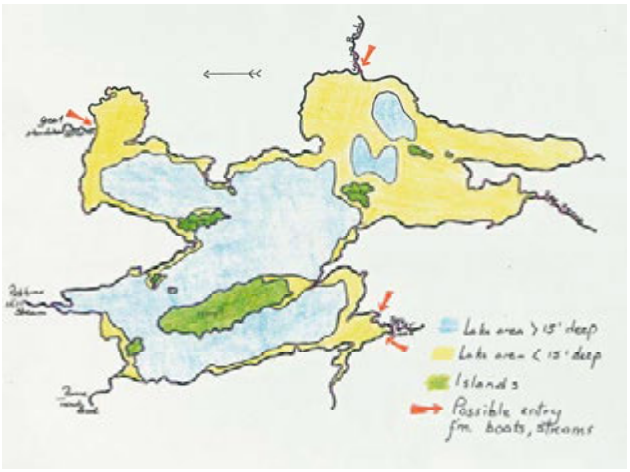
Invasive Aquatic Plant Screening Survey and Mapping Procedures

Overview

The primary goal of your mapping survey project is to 1) visually scan as much of the existing aquatic plant habitat as possible, looking for the particular invader that has been confirmed in the waterbody, and 2) to record the location of any suspicious plant (or plant patches) in a way that will ensure timely and effective follow-up action.



Invasive aquatic plant surveys may be conducted at various levels of detail, depending on the amount of time and effort volunteers are able to spend on the project. In the case of the confirmed presence of an invasive aquatic plant in a waterbody, it is recommended that the entire *littoral zone* of the infested waterbody be surveyed. (The *littoral zone* includes all areas in the waterbody where sunlight reaches the bottom and rooted aquatic plants may grow.) The purpose of this comprehensive "Level 3" survey is to screen the entire waterbody for the target invasive plant species in order to determine the extent of the infestation. The earlier the detection of all invasive plant populations in the waterbody, the better the chances for successful control, and the greater the potential to prevent spread of the plant to other, non-infested regions of the water body.

Volunteers may perform effective screening surveys with a minimum amount of training if basic procedures are followed carefully and suspicious plants are sent to professionals for

identification. *It is highly recommended that all those participating directly in the survey attend an Invasive Plant Patrol training workshop, offered free of charge to volunteers though VLMP Center for Invasive Aquatic Plants.*

Survey and Mapping Equipment

With the exception of the boat (or boats), the equipment needed to conduct an invasive aquatic plant survey and mapping project is fairly simple, inexpensive, and easy to come by and/or fabricate.

Here is what you will need:

- ☐ **Small shallow-draft boat, canoe or kayak** - Large boats and motors are not recommended as they actually make the process more difficult and can destroy sensitive aquatic vegetation. Surveys are accomplished most easily, and are safer, with at least two persons in the boat: one to paddle and/or steer, and one to watch for obstacles, observe plants and record findings.
- ☐ **Personal flotation device** - Always practice safe boating during surveys.
- ☐ **Documentation forms** - (available on line at www.MaineVolunteerLakeMonitors.org under *publications and resources*)
- ☐ **Pencil and clipboard**
- ☐ **Map of the survey area** - Can be copied or traced from lake depth map available from VLMP (www.mainevolunteerlakemonitors.org/lakes), or PEARL website (www.pearl.maine.edu)
- ☐ **Pocket knife or snips** - for obtaining specimens
- ☐ **Wide angle viewing scope** - Available commercially, or constructed from 5 gallon plastic bucket and Plexiglas. (Construction plans are available online at www.MaineVolunteerLakeMonitors.org under *publications and resources*.)
- ☐ **Weighted measuring tape**, **Secchi disk, or marked anchor line -** to determine plant observation depths
- ☐ **Ziploc bags (various sizes) and cooler** - for storing plant specimens. Bags should contain enough water to float the specimens.
- ☐ **Anchor**

- ☐ **Plant identification guides and keys** - available through VLMP
- ☐ **Buoys -** to mark the location of suspicious plants; commercially available or fabricated from empty plastic jugs, pieces of floating noodles, tied to bags of stones, cored bricks, etc.
- ☐ **Permanent marker pens** - to mark specimen containers
- ☐ **Magnifying glass or hand lens** – for examining plant specimen structure. 5X to 10X pocket magnifiers are recommended.
- ☐ **Small white tray or shallow plastic container** (such as margarine tub) - for floating and observing specimens in the field
- ☐ **Polarized sun glasses** - greatly improves visibility under most conditions.

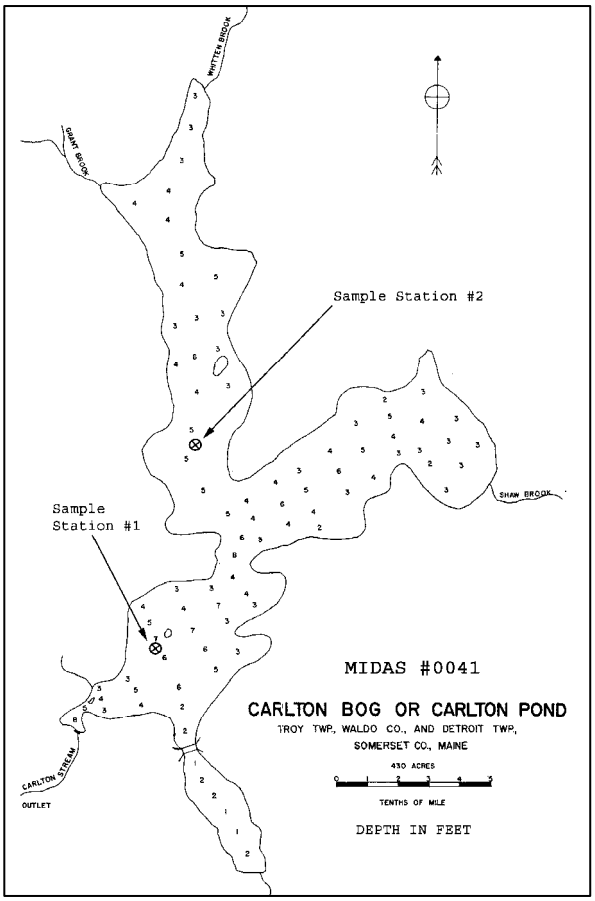
The following items are not essential, but may be very helpful under certain circumstances:

- ☐ **Colored pencils or highlighter pens** - useful for tracking the progress of the survey on the map.
- ☐ **Long-handled net** - for catching stray fragments. In most cases the leaf rake can perform this task sufficiently.
- ☐ **Long-handled cultivator** - useful for collecting specimens from the bottom in shallow areas.
- ☐ **Weed weasel** - a tined tool on a rope, used in deeper water for obtaining samples of plants that are not visible from the boat. (Construction plans are available from VLMP.)
- ☐ **Hand-held depth finder** - a flashlight-like device that provides a quick, efficient way to determine water depth; especially useful when spiking out (heading out perpendicular to shore) to check for the outside edge of the littoral zone.
- ☐ **GPS (geographic positioning system) receiver** - a useful tool for mapping the general locations of individual invasive plants or small patches, and showing the general extent of larger infested areas. Keep in mind that unless you have access to one of the higher-end GPS units, the accuracy of your marked waypoints may be off by 15 feet or more. All GPS waypoints marking individual plants or small patches should correspond to actual marks (buoys) deployed next to the plants in the waterbody.
- ☐ **SCUBA divers** - can be helpful members of the survey team, especially in areas where the water is deeper and the visibility from the surface is low. (In shallower depths, SCUBA divers may stir up bottom sediments, reducing visibility.)

- ☐ **Underwater video camera** - used in deeper water to see plants that are not visible from the boat. (Available from fishing supply dealers.)
- ☐ **Small gas powered or electric motor** - facilitates travel to survey locations and through plant-free sections of the littoral zone. *Motors should not be used in areas where there is significant plant growth.*

Getting Ready

1. It is best to start of with a reality check. What resources are available for this project? Resources include personnel, expertise, funds, survey equipment, etc. Given your resources, who will be responsible for conducting the survey and mapping project? Options include: professionals, student researchers, trained volunteers, or a combination of these.



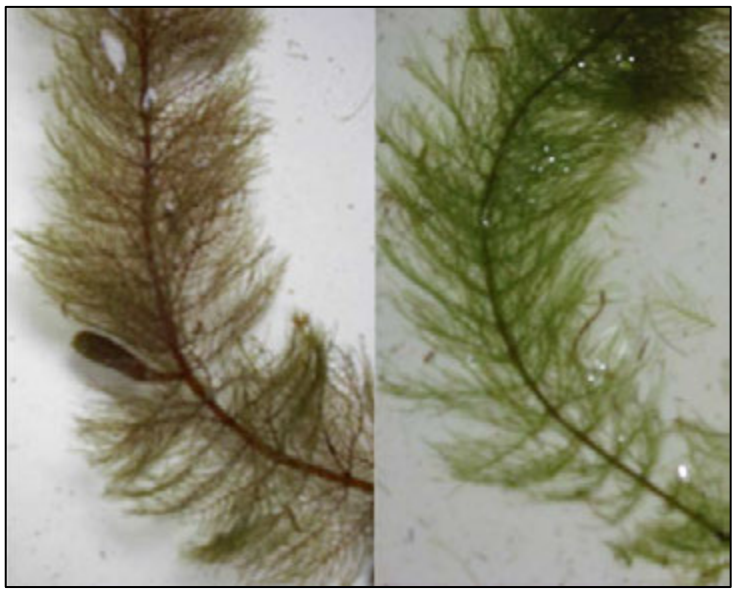
2. Obtain a depth map for your waterbody (Depth maps are available from VLMP and the PEARL website). Study the map. Determine and mark (using highlighters, colored pencils, marking pens, etc.) the approximate extent of the littoral zone (areas with depths equal to or less than 15 feet). It is also helpful to mark the location of the "known" infestation, protected areas that are likely to provide good plant habitat, inlets, outlets, and high-use areas (such as public and private boat launches, marinas, etc.). Make "field" copies of the map for all survey teams.

3. Spend time getting very familiar with the appearance and growth habit of the target invader. Visit the "known" infested site in your waterbody to observe the plants as they appear from the boat, and carefully collect a sample for closer inspection.

4. The goal of your survey and mapping project is to visually scan as much of the littoral area as possible, looking for suspicious plants, and recording their location. Primarily you are looking for the "confirmed" invader. But since you are going through the process of conducting a comprehensive survey of the waterbody you may wish to expand the scope of your screening survey to include "being on the lookout" for the other invasive plant species on Maine's watch list as well. Study your plant identification guides and keys so you will also be familiar with all eleven invasive aquatic plants on Maine's watch list. Some groups also use this "opportunity" as a chance to inventory the dominant native plant species growing in the waterbody. Consideration of the resources you have available for this project should help you to determine an appropriate "scope" for your survey before you set out.

5. If you will be screening for all eleven invaders on Maine's watch list, remember, a number of native plants look very much like the eleven listed invasive species. Some examples of these native "look-alikes" are coontail, water marigold, some bladderworts, the waterweeds, etc. Maine is also home to six native milfoil species. All milfoils exhibit a wide degree of vegetative variability, often making it difficult to distinguish between native and invasive species of milfoil without assistance.

   Learning the structural characteristics of the look-alike plants before beginning the survey may save a great deal of time. *It is highly recommended that all those*



Comparison of native comb water-milfoil (left), with invasive variable water-rmlfoil (right).

participating directly in the survey attend an Invasive Plant Patrol training workshop, offered free of charge to volunteers though VLMP Center for Invasive Aquatic Plants.

6. Surveys should be conducted when there is adequate light and conditions are relatively calm. Early morning conditions are often ideal because the water is calm and reflection on the water surface is minimal. It will be difficult to conduct an effective survey during windy conditions. Weekends may be problematic because of heavy powerboat activity on some lakes and ponds.

7. The survey may be conducted over a period of time. Level 3 surveys on large lakes may require several weeks or longer (up to 3 years) to complete.

8. Mid-July through September is generally the best time of year to conduct IAP screening surveys. Prior to July, many aquatic plants are not fully developed. Emergent flowering structures are sometimes needed for plant identification and for many species, variable milfoil for example, flowers do not typically start to develop until July. One of the plants on Maine's watch list, curly leaf pondweed (*Potamogeton crispus),* is an exception to this rule, usually reaching maturity by late spring to early summer.

Conducting the Survey

1. Fill out "Section I" of IAP Screening Survey Form and begin the survey.

2. The survey area extends from the shoreline to the outer depth of the littoral zone--the point at which it is no longer possible to see the lake bottom with a viewing scope. The depth of the littoral zone will vary, depending on the clarity of the water. Very clear lakes may support rooted plants at depths of 15-20 feet. Shallow ponds may support rooted plants from

shore to shore. The course your boat travels will vary in accordance with the natural variability of the littoral zone and, to a lesser extent, occasional human placed obstacles. (If you are using SCUBA divers, an underwater video camera, or a weed weasel your survey area may extend slightly beyond the "visible" zone.)

3. In areas where the lake bottom drops relatively steeply from the shore, plotting a straight course roughly parallel to the shore generally allows adequate screening of the area from both sides of the boat. Working in teams of two, one surveyor scans the area from the boat toward the shore, the other from the boat toward the outward extent of the littoral zone. "Scanning" will involve looking through the glass-like surface of the water when weather and light conditions are optimum or through the view scope when they are not.

4. The distance from shore the boat travels will be determined by the width of the littoral zone and various conditions including: water clarity, wind and wave activity, cloud cover, the angle of the sun, plant density, etc. The "straight" line of travel along the shore may wiggle and contort from time to time to conform to and accommodate shoreline features, docks, moored boats, floats, etc. The assumed width of the littoral zone should be verified from time to time by "spiking out" (heading out perpendicular to shore) and visually checking the depth.

5. Remember, the surveyor in the bow must also watch for hazards and the surveyor in the stern must steer the boat! Watch out for submersed mooring lines!

6. In areas where the littoral zone is wider (in shallow coves, inlets and outlets, and where the plant community is dense and complex) other course patterns including point-to-point transects should be employed (figure

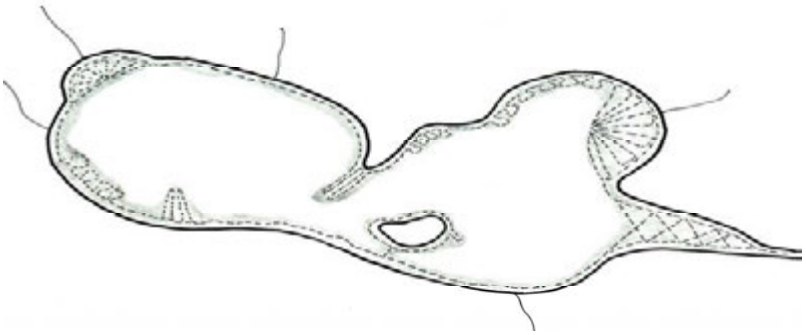


Figure 1: The gray area represents the lake littoral zone. The dotted line represents the various patterns of travel used to optimize direct observation of this area.

1). The configuration and spacing of the patterns and transects will vary in accordance with the observation conditions, density of the plant communities, etc. The overall goal in selecting a proper course pattern is to optimize direct observation of the littoral zone.

7. Use a highlighter pen or colored pencils to track the progress of your survey on your field map.

8. Obtain specimens when a closer look is needed to distinguish "friend" from "foe." Snip a small section of the plant in question and float it in clean water in a white tray or container. Use a hand lens to view minute features. Consult your plant identification guides and keys.

9. If you are certain that you have found the target invader (or patch of invasive plants), mark the location using a weighted buoy and plot it on the field map. Indicate local landmarks (shoreline cottages, unusual rocks or trees, etc) to help others re-locate the site. Use a consistent marking code on the survey form, the plant specimen bag, the map, and the marking buoy. Mark GPS waypoint or record longitude/latitude coordinates if you are using this technology. (But remember, unless you have a very "high-end" GPS unit, the accuracy may be off by 15 feet or more.)

10. If you encounter larger infested areas, where plants and plant clusters are sparsely distributed and too numerous to mark individually, shade the entire infested area on your map.

11. Mark the perimeter of the infested areas with a series of buoys and/or GPS way points. Marking may also be done with small-diameter,

Homemade buoy marker using cored brick and empty, thoroughly rinsed plastic jug

2 foot-long PVC pipes driven into the sediment. This allows observers to find plant locations the next year to ensure that re-growth hasn't occurred. The pipe should be painted fluorescent orange for better underwater visibility, since the white will disappear under algal growth after several months. Be sure to install the pipes far enough into the sediments so that they do not interfere with boat traffic or recreational use of the waterbody. Install the pipes around the perimeter of the plant bed.

12. Characterize all of your invasive aquatic plant (IAP) observations on the map and/or documentation form. Here is an example of a simple code system for characterizing each IAP observation.

CODE	OBSERVATION CHARACTERIZATION
IN	Individual IAP
CL	Cluster of IAP; 2 – 6 plants growing in close proximity to one another
SDP	Small Dense Patch of IAP; covering an area less than 100 square feet
MDP	Medium-sized Dense Patch of IAP; covering an area 100 to 500 square feet
LDP	Large Dense Patch of IAP; covering an area over 500 square feet (Provide an estimate of the area coverage for LDP if possible.)
IA	Infested Area; plants and plant clusters sparsely distributed over a wide area, too numerous to mark individually (Shade IA on the map &/or mark outer boundaries with series of GPS way points)
MXN	IAP Mixed in among dense colony of Native plants

To keep the field map as "clean" as possible, simply number each observation on the map, and then record each number and its corresponding characterization code on the documentation form. In some cases it may be appropriate to use more than one code. For example IA/MXN would indicate an infested area where plants are sparsely scattered among a dense colony of native plants.

13. If you are *not* certain, but *suspect* you may have found an invasive plant, it is very important to follow the proper protocol, discussed in the next section: **If You Find a Suspicious Plant** (pg 3.1.10).

14. Remember that many aquatic plants (native and invasive) can spread through fragmentation. Avoid disturbing plants unless a specimen is required. Specimens should be obtained by a clean cut, if possible. Scoop up any and all fragments with the leaf rake or a net.

15. If you are noting dominant native plants observed in your survey (this is optional), be sure to record these as you go, using the checklist on the back of the survey documentation form.

16. When the survey is complete, organize your findings. Consider how you are going to use the "infestation" data. Data may be organized simply by copying and collating the documentation forms and field maps. However, to share your findings with the public, you will want to present the information in more user-friendly formats. Options include a narrative report, a poster sized infestation map, a PowerPoint presentation, etc. Be sure to submit copies of all survey and mapping data to MDEP and VLMP-CIAP to ensure that this important information will be included in the Maine's statewide database.

If You Find a Suspicious Plant

1. Mark the location of the suspicious plant or patch of plants as described in item 9 of **Conducting the Survey** (above)**.**

2. Obtain a specimen. Great care must be taken when collecting a plant specimen, as the creation of fragments could result in an invasive plant spreading to other areas of the waterbody.

3. If possible, collect several (3-5) healthy stems of the plant in question. The flower, fruits and winter buds of many aquatic plants are helpful in the identification process. If these structures are present be sure to include them in your sample. Gently snip or break off stem section about 6-8" long from the top portion of the plant. For rooted floating leaved plants be sure to include as much of the stem as possible.

4. DO NOT attempt to pull the plant out by its roots. (This is *very* important!)

5. If the plant is covered with algae or tangled in debris, remove as much of the unwanted material as possible, without damaging the specimens.

6. Specimens may be kept alive in a container full of water in the refrigerator until you are ready to mail them to VLMP for species confirmation. When you are ready to ship, place wet specimens in a Ziploc bag. If the plant is delicate or flimsy, add enough water to the bag to cushion the plant and keep it wet. If the plant is relatively sturdy, remove all the air from the bag and seal. DO NOT wrap the plant in a wet paper towel or other absorbent material. Make sure the bag is sealed tight and place it in a small box with enough packing material to prevent movement. Cardboard mailing envelopes are fine for sturdy specimens that are not packed in water. *Padded envelopes do not work well for plant specimens.*

7. Include a Suspicious Plant Form in the box with the specimen(s). The form can be obtained from VLMP or downloaded online at www.MaineVolunteerLakeMonitors.org/mciap/ipp. This information is critical to tracking plants sent in for identification and ensuring a timely response.

Delicate Wet Sample (above)
Sturdy Dry Sample (below)

8. Mail the specimen on a Monday or Tuesday, to minimize the possibility of weekend delays. Please contact VLMP~CIAP at (207) 783-7733 or mciap@mainevlmp.org to give them a heads up that the specimen is on its way.

9. Send packaged specimens to:
VLMP Center for Invasive Aquatic Plants
24 Maple Hill Road, Auburn, Maine 04210
You will be contacted with information pertaining to the identification of your specimen(s) within 72 hours of our receiving them.

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Make Your Own Bucket Scope

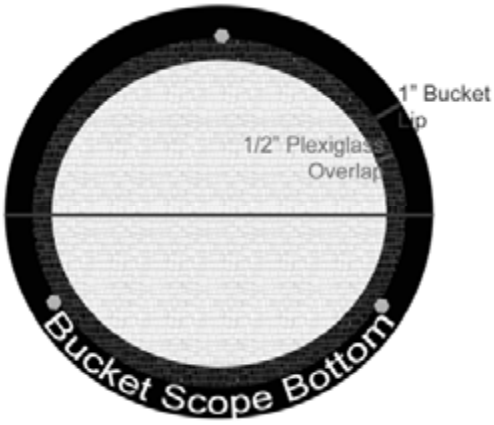
You Will Need:

- clean 5 gallon black bucket (OR black flat spray paint)
- 1/8" plexiglass, pre-cut to proper size (see step two)
- 100% silicone sealant (clear)
- three stainless steel, ¼" bolts (½" long) with nuts
- six stainless steel washers
- saber saw
- electric drill and ¼" drill bit

Directions

1. If your bucket is not already black, paint the inside of the bucket black to prevent glare. Let dry.

2. Find the diameter of the bottom of the bucket. The plexiglass, when placed over the bottom of the bucket, should allow for a 1" flat edge (or lip) around the bottom of the bucket. Therefore the diameter of the plexiglass should be 2" less than the diameter of the bucket bottom. Make sure this 1" lip extends beyond any tabs or protrusions present on the bottom of the bucket.



3. Draw a circle on the bottom of the bucket that has a diameter that is 1" less than the diameter of the plexiglass (3" less than the diameter of the bottom of the bucket). This is the circle that will be cut out of the bottom of the bucket. The flat lip of the bucket will be a total of 1 ½" – the plexiglass will overlap the bucket lip by ½" all around.

4. Use the electric drill to drill a starting hole just inside the drawn circle. With the saber saw, cut the circle out of the bottom of the bucket (Figure 1).

Figure 1

5. Center the plexiglass over the hole in the bucket – the hole should be completely covered, with the plexiglass overlapping the lip of the bucket by ½".

6. Holding the plexiglass in place, mark 3 dots of equal distance from each other around the edge of the plexiglass circle. Use an electric drill to make a hole in the bucket at one of these dots (Figure 2). The hole should lie right at the edge of the plexiglass. Place a bolt in the hole – the head of the bolt should lie partly on top of the plexiglass, but the bolt should still be able to sit straight and fit snugly in the hole.

Figure 2

7. Use the first bolt to hold the plexiglass in place – the plexiglass should be pressed up against the bolt. Drill the second hole. Drilling the holes one at a time and using the seated bolts as guidelines ensures that all the bolts will fit properly and hold the plexiglass in place. Place the second bolt in its hole. Again, be sure that the bolt sits straight but secures the edge of the plexiglass. Now with the first and second bolt to hold the plexiglass in place, repeat the procedure for the third bolt.

8. If there is still protective plastic on the plexiglass, peel it off.

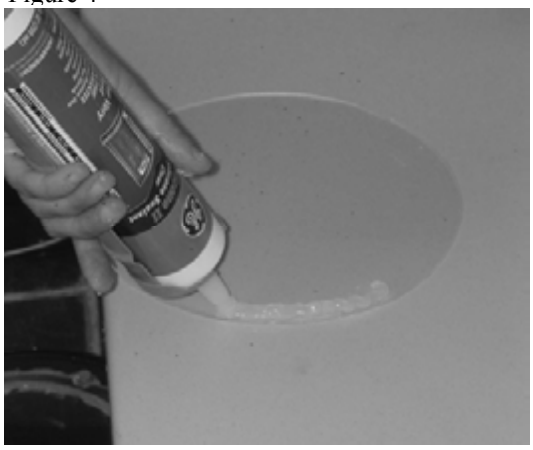
9. Take the bolts out of the bucket and the plexiglass off. Make a continuous ring of silicone – roughly ¼" wide - along the edge of the bucket's lip (Figures 3A and 3B).

Figure 3A

Figure 3B

10. Make another ¼" wide silicone bead along the edge of the Plexiglas circle (Figure 4). Press the plexiglass onto the bucket lip – silicone ring onto silicone ring. Be sure to place the plexiglass carefully – don't cover any bolt holes! Rotate the plexiglass slightly to get rid of any air bubbles.

Figure 4



11. Use the silicone to make a bead over each bolt hole (Figure 5A)– the bead should cover the hole completely. Slide a washer onto a bolt and slide the bolt through the bead of silicone and into the hole (Figure 5B). The bead should distribute fairly evenly underneath the washer and bolt. Repeat for the other two bolts.

Figure 5A

Figure 5B

12. Turn the bucket over. Place another bead of silicone around the end of each bolt, inside the bucket. Slide the second washer into place – again, the silicone should distribute evenly under the washer. Repeat for the other bolts.

Figure 6

13. Screw the nuts tightly into place (two wrenches may be necessary to do this). Do not overtighten the nuts – this causes the plexiglass to crack.

14. Allow the silicone to cure for the amount of time directed (usually 24-48 hours). Check for leaks (Figure 7). The bucket scope is now ready for use!

Figure 7

Buffy's Bucket Scope Cover

Materials:

36 inches of 3/16" bungee cord
18 inch circle of dark, washable fabric

1. Cut one 18" circle of dark fabric. Turn under at a 1½ inch hem. Clip edges and sew to create a channel for the bungee cord, leaving about a 1½ inch opening.
2. Cut a 5 inch hole in the center of the fabric and bind the inner edge to keep it from stretching while being used.
3. Cut a 36 inch piece of 3/16" bungee cord. Tie a knot at each end. Thread bungee through channel and tie ends together so the cover fits snugly over the top of the bucket scope.

How to make a Weed Weasel

This homemade double-sided throwing rake (affectionately dubbed the weed weasel) is a handy tool for sampling a plant community. The weed weasel is made from two sawed-off garden rakes bolted together back-to-back. The tines are tied together with "quick-connect" ties, and a 20 to 30 foot length of rope is attached by means of an eyebolt. *Note that the weasle is for sampling only—NOT for "cleaning up" the lake bottom*. Also, when using any sampling rake, be sure to remove all plant fragments generated during the process from the water.

Here are the instructions for building your own weed weasel.

Materials Needed:

- 2 garden rakes
- 2 regular bolts
- 1 eyebolt
- 3 nuts
- several tie-wraps
- 20-30 feet of line (clothesline is OK)
- duct tape

Tools needed:

- drill
- saw

- Saw off the rake handles at 3 feet.
- Place the rakes back to back (tape them together with duct tape to hold them tight).
- Drill a hole through both handles near the top of the handles, at the middle, and near the bottom.
- Place bolts through two lower holes and secure with nuts. Use the eyebolt in the top hole.
- Tie the rakes together with tie-wraps between tines.
- Tie the line to the yoke part of the weasel and thread through the eyebolt.

Adapted from Massachusettes Water Watch Partnership web site which is supported in part by Executive Office of Environmental Affairs Watershed Initiative and the Massachusetts Environmental Trust

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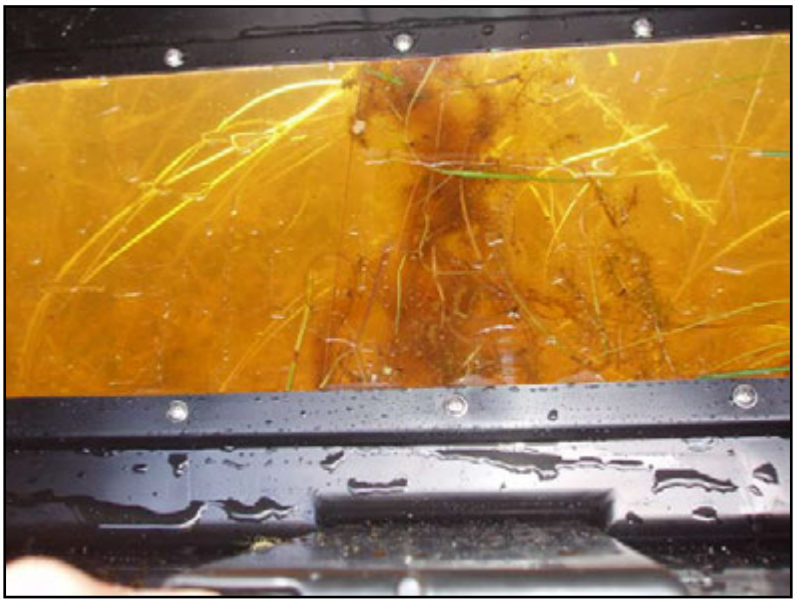
Introducing… the Trunk Scope

(or as we here at the VLMP are inclined to call it: "Ross's Rolls Royce")



Invasive Plant Patroller Ross Wescott, dissatisfied with the limitations of the bucket scope (e.g., not well shielded from backlighting; limited view area) set out to make improvements. By the time Ross completed his self-imposed redesign project; Maine had its first "trunk scope." The trunk scope is crafted from a large heavy-duty plastic trunk. It floats on the surface and may be lashed to the front, back, or side of the boat. A Plexiglas window in the bottom of the trunk provides three times the view area of the typical bucket scope, while the hinged top and black-curtain sides shield out unwanted light. The scope is ergonomic and easy to use; just sit back and observe the wonders passing before you!

We predict Ross's ingenious viewing device will not only soon be used by many other Plant Patrollers here in Maine; it will be sweeping the nation! Ross is also moving forward on a new scope designed specifically for lone-kayakers. So stay tuned!

Ross Wescott's detailed step-by-step instructions on how to construct your own trunk scope are now available on line at www.MaineVolunteerLakeMonitors.org/publications/TrunkScope.pdf

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Building a View-Canoe or Kayak

by George Lewis, Certified Invasive Plant Patroller, Branch Lake

Placing a viewing window in the bottom of a canoe or kayak involves three operations:

- Cutting an opening in the bottom of the canoe and covering it with a piece of clear plastic.
- Providing a covering so sunlight does not hit the top side of the plastic window.
- Adding a seat for the person viewing the area under the canoe.

If you are using a kayak the third step is unnecessary because the normal kayak seat works fine.

In selecting a canoe, try to find one with a wide center section without a keel. We used an Old Town Guide canoe. The center section is wide and relatively flat with a thwart across the canoe near the center. If you are working with a kayak it is unlikely that you will have a flat space large enough to fit a window. Don't be discouraged. It is possible to build up the front and back section of the opening to provide a flat surface to mount the plastic window.

Install the flat plastic window

In our canoe we cut a 10" x 13" opening in the center, just forward of the thwart using a saber saw. We obtained a section of Lexan polycarbonate resin thermoplastic intended to replace glass where higher strength is needed. A piece 13"x16" x 1/4" was used to allow 1 1/2" overlap on all four sides. Lexan is a registered trademark of GE but there are other companies that make similar materials that are as good.

A row of holes were drilled around the edge of the opening in the canoe about 3/4" in from each edge. These holes in the canoe are slightly larger than the diameter of a #6 machine screw. We used #6 machine screws and mating T nuts with the screw heads on the bottom of the canoe. Using the holes in the canoe as a template, drill a similar set of holes in the plastic sheet. The holes in the plastic must be slightly larger than the holes in the canoe to accept the T nuts. The holes in both the plastic and the canoe should not be too snug to allow for some movement between the plastic sheet and the canoe surface.

Then using 3M Marine Adhesive/Sealant make two beads of the material around the plastic sheet. One bead should be just inside the row of holes and one just outside the row of holes. Be sure to use sufficient material so that when the plastic sheet with the adhesive on it is placed against the bottom of the canoe the adhesive will fill

the screw holes and provide a water tight seal. As soon as the adhesive is spread, place the plastic sheet over the holes in bottom of the canoe with the adhesive in contact with the inside of the canoe.

Hold the plastic sheet in place by putting a machine screw and T nut in the center of each side. The T-nut is placed in the hole in the plastic and the machine screw is put in the hole in the canoe with the head on the bottom of the canoe. When the screws are tightened the threaded part should be flush with the top of the nut or just below the top. Add screws and nuts to the corners. Complete the operation by installing the remaining screws and nuts. When all screws and nuts are in place, tighten them just enough to spread the adhesive across the overlapping area. Do not over tighten these screws. This operation will require at least two people - one holding the nuts on the inside of the canoe and one installing the screws from the outside of the canoe. Support the canoe on its side so both people can work comfortably.

If you are installing the view window in the bottom of a kayak, the procedure is similar, but the bottoms of most kayaks are sloped. To provide a flat surface for the window it will probably be necessary to build up an area just forward and behind the opening in the kayak. This can be done using the fiberglass material from the opening cut in the kayak or a commercial material like Marine-Tex. The opening in our kayak was 8”x10” and the plastic sheet was 10”x 12”-allowing a 1” overlap on each side.

Provide a covering to shield the surface of the view window from the light

In the canoe we installed a 1’’x 6” board just ahead of the existing thwart. A piece of plywood was placed across the canoe covering the thwart and the added 1x6 board and the space between them. Then a hole was cut in the plywood that would accept a short piece of 6” plastic pipe. The pipe is installed at an angle so the viewer can look down the pipe easily. A section of soft plastic material is mounted around the upper section of the pipe that can be adjusted up or down by the viewer.

A rectangular box under the shelf is provided to block out most of the light. Our box was made using 1/8” Masonite. If Masonite is used it must be coated with something to keep it from getting wet.

When using a kayak a similar rectangular box was made as a separate unit so it can be placed in position over the view window after getting in the kayak.

Add a seat for the person viewing the area under the canoe

The final step is to provide a comfortable seat that can be adjusted to suit the viewer. For our canoe we found a commercial seat in the Overton Catalog at a reasonable price. Two padded strips of wood were added to the bottom to provide a seat that can be moved around the canoe without damaging the surface.