Native Water-milfoil Weevil

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Monitoring Protocol

Protocol drafted by Aubrey Maccoux, 2007. Modified by Laura Herman, 2009.

Background/Overview

Eurasian Water-milfoil

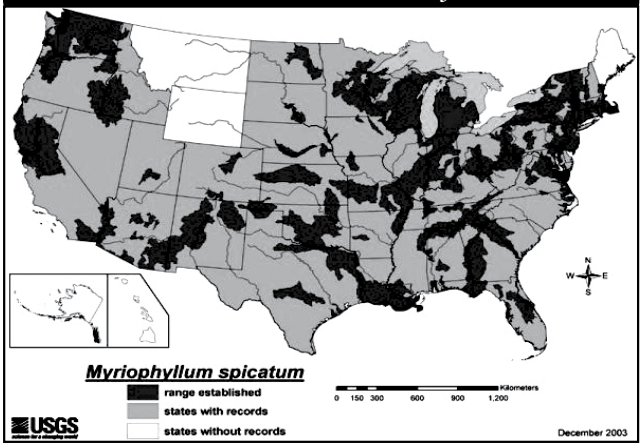
Eurasian water-milfoil (EWM) is a submerged aquatic plant that poses a serious threat to a lake's native aquatic plants and the animals that depend on these diverse ecosystems. Since it is not native to Wisconsin or the United States, it has very few natural predators. EWM can form thick underwater stands of tangled stems and vast mats of vegetation at the water's surface. It can crowd out native plants and become so thick that the larger fish cannot swim through the tangled mats. When EWM mats get well established, channels are needed to allow access from the shoreline out into deeper water areas. EWM is now one of the most troublesome submerged aquatic plants in Wisconsin.

There are 11 native water-milfoil species in North America. Of these 11 native species, seven are native to Wisconsin. The native water-milfoils are not as aggressive as the exotic water-milfoil and they have natural predators. Some Wisconsin species of water-milfoil are quite rare and are on the Wisconsin Threatened and Endangered species list.

EWM is native to Europe, Asia and northern Africa. It may have been brought in to the United States via aquaculture and the aquarium trade. The first authenticated record of EWM in the United States was in 1942 in a Washington D.C. pond. In 2007 it was found in 48 of the 50 states. EWM was first documented in Wisconsin in the 1960's. The list of waterbodies in Wisconsin where EWM has been verified can be found at http://dnr.wi.gov/lakes/invasives/.

Volunteers play an integral part in learning to recognize the plant and checking local lakes for the presence of EWM. Early identification of the plant makes control much easier, and can help prevent the spread into other waterbodies. If you detect the invasives early enough, you may be able to prevent them from spreading throughout your lake system. It is cheaper to control small patches of invasives than to control invasives that have taken over an entire lake system. Once invasives are established in a lake, they are nearly impossible to eradicate.

Eurasian Water-milfoil Distribution



USGS - December 2003

Shoreline of EWM-Infested Lake

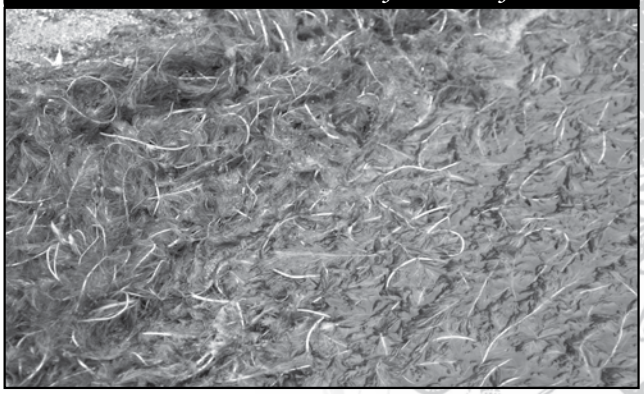


Photo by Robert Korth

Life Cycle
Eurasian Water-milfoil

EWM is an evergreen plant. The plant remains alive over the winter and starts growing when water temperatures reach 50° F (Bode, J. et al. 1992). EWM begins growing earlier in the season than the native water-milfoils. This makes early spring chemical treatment an option for control of EWM as it is more selective for EWM than late spring or summer treatments. In spring and summer, EWM can grow up to two inches a day. If EWM plant growth reaches the surface of the lake, the plant will continue to grow and can form a canopy over the surface of the lake often making the area nearly impassable with a motor boat. This canopy can also shade out native plants. Excessive growth affects recreational use by interfering with swimming, fishing, and boating and reducing the aesthetics of the lake. EWM grows in water depths ranging from less than one-foot to over 20-feet. Thick beds can form in water depths from 3 to 20 feet deep (Smith, C and J. Barko, 1990), but most commonly reach nuisance levels in water depths of 6-15 feet. It has the capability to survive in the cleanest lakes to lakes with very high nutrient levels, but does best in moderately fertile lakes.

EWM produces seeds and runners, but the main method of spread is through plant fragmentation (vegetative propagation) by boats and wave action. In the late summer and early fall, auto fragmentation may occur. Auto fragmentation is when the plant "breaks itself into smaller pieces". Plant cells at leaf nodes and side-branch connections become weak, die and break off. These newly formed fragments float to new locations where they fall to the substrate, root and establish new beds of EWM.

What Insects Are Known to Eat Eurasian Water-milfoil?

Euhrychiopsis lecontei: Eggs are laid in the tips of the plants; larvae feed on the tips of the stem and burrow into the stem eating the vascular material; pupae chambers are inside the stem; and adults eat the leaves of the water-milfoil. The weevil monitoring through CLMN will focus on *Euhrychiopsis lecontei*.

Phytobius species: *Phytobius* is a weevil that looks a lot like *Euhrychiopsis* and the two are often confused. One needs to look at the leg characteristics as well as the "bumps" on the back of the insect to distinguish these two species. Eggs are laid on the flowers; larvae feed on the flowers; pupae chambers are "wart-like" bubbles on the outside of the stem; and adults feed on the flowers. *Phytobius* has been documented in Wisconsin (Amy Thorstenson, personal contact 2008). If weevils are found on your lake, the samples will be collected and research folks will identify and determine which weevil is found. *Phytobius* does not seem to be as successful in controlling EWM as *Euhrychiopsis*.

Acentria species: There is a moth species in which the larvae lives in the water and eats Eurasian water-milfoil. Not a lot is documented about this moth as it does not "control" Eurasian water-milfoil as well as *Euhrychiopsis* and *Phytobius*. There are native *Acentria* species in Wisconsin.

Cricotopus species: This chironomid midge larvae will feed on Eurasian water-milfoil. Not a lot of documentation has taken place on *Cricotopus* as this midge does not "control" Eurasian water-milfoil. There are native *Cricotopus* species in Wisconsin.

Overview and Life Cycle

Euhrychiopsis lecontei (water-milfoil weevil)

Euhrychiopsis lecontei, an aquatic water-milfoil weevil, is a water-milfoil specialist native to northeastern US, upper Midwestern US, and western Canada/northwestern US. The weevil feeds solely on water-milfoil with northern water-milfoil being its primary native food base. The weevils have also been found to eat Eurasian water-milfoil. The weevils over-winter in organic matter (leaves and debris) on the shore and fly or swim back out to water-milfoil beds in spring. Adults feed on water-milfoil leaves and spend the majority of their lives clinging to plants in water. Weevils have wings but do not fly or swim well (Jester 1998). It's believed that weevils fly only at the end of the summer to overwinter on shoreline habitat. Because in the fall there are no water-milfoil flowers above water to climb on and dry wings, it is more probable that weevils swim/crawl along the water-milfoil mats to the shore. The weevil's overwintering habitat consists of natural vegetation near the water. It seems most plants will do, but weevil populations are higher where the shoreline includes more that five feet of bushes and trees creating a natural buffer zone to human development.

After flying back to the water in spring, a female weevil lays 1-2 eggs per day on the leafy apical meristem (tips) of water-milfoil (about 562 eggs in lifetime in captivity). Adults can live up to 162 days (Cofrancesco and Crosson 1999). The eggs are cream-colored ellipses about 0.5mm long (a pencil tip or half the size of a BB) and are difficult to see with the naked eye. Eggs hatch in 3-6 days in temperatures of 20-25°C (68-77°F) (Cofrancesco and Crosson 1999). Eggs are found in higher percentages in warmer summer temperatures (Jester 1999). When eggs hatch into larvae, the larvae feed on the tips of EWM and work their way down the stem feeding on vascular tissues. The larvae look like little grubs. They are only 1/8 inch long and cream colored with a dark head (some may also have a dark body). Weevil larvae will eat the EWM and burrow in and out of top meter (3-feet) of the stem. Larvae will make pin holes in the stem while entering and exiting during feeding. Development of the larvae takes 8-15 days in 20-25°C (68-77°F) (Cofrancesco and Crosson 1999). Weevil feeding behavior makes the stems less buoyant and they eventually wither and collapse (Cofrancesco and Crosson 1999). Pupae cannot be seen directly because they are in the lower stem of EWM (where the stem is thicker). The stem will have a dark chamber with something inside. When held up to light, the pupa chamber may seem to contain a dark little worm. This is the pupa. A fingernail or safety pin can be gently pushed down to feel if something firmer is inside. Be careful not to injure the pupa! Development in this stage takes 9-12 days at 20-25°C (68-77°F) (Cofrancesco and Crosson 1999). The pupa develops into the adult and the adult emerges from the pupa

chamber through a "blast hole." Blast holes are much larger than the larval entrance holes (Skawinski). The complete life cycle of a weevil takes 23-27 days, so three generations may be produced in one summer (Cofrancesco and Crosson 1999).

Identification

Euhrychiopsis lecontei (water-milfoil weevil)

In your packet is a laminate with pictures of *Euhrychiopsis* eggs, larvae, adults, pupae chamber and weevil damage. *Refer to pictures below, and on the next page, as well as the laminates in your packet to see the characteristics listed below:*

- Adult weevils grow to only 2-3mm. They have long, distinguishing snouts that other aquatic insects lack. They may have yellow and black stripes along their backs or be a solid color with a light ventral side.
- The eggs are cream-colored ellipses about 0.5mm long (a pencil tip or half the size of a BB) and are difficult to see with the naked eye.
- The larvae look like little grubs. They are only 1/8 inch long and cream colored with a dark head, (some may also have a dark body).
- When held up to light, the pupa chamber may seem to contain a dark little worm. This is the pupa.
- The pupa develops into the adult and the adult emerges from the pupa chamber through a "blast hole." Blast holes are much larger than the larval entrance holes (Skawinski).

Weevils

Photo by Laura Herman

Weevil Eggs

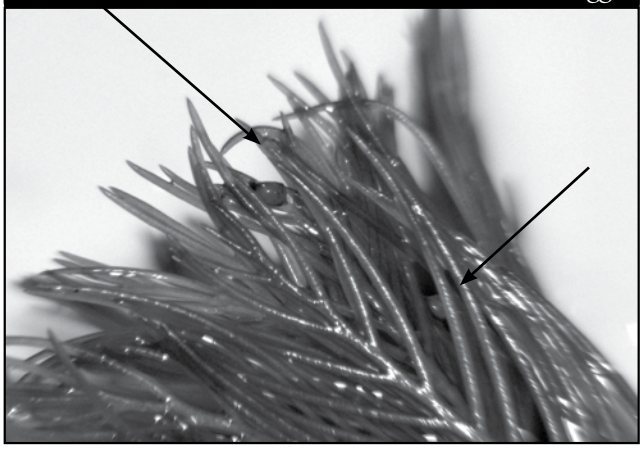


Photo by Paul Skawinski

Weevil larvae

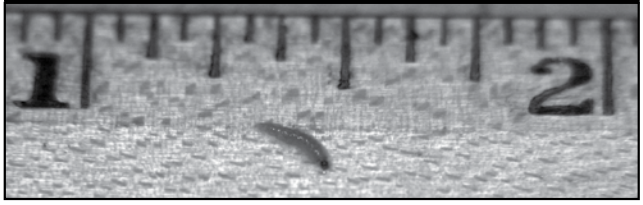


Photo by Paul Skawinski

Weevil larvae on water-milfoil stem

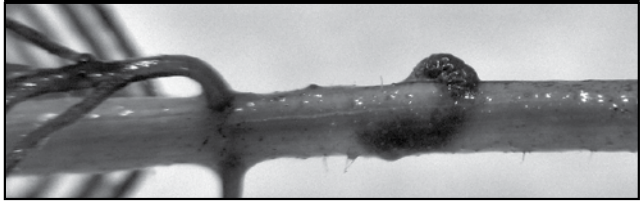


Photo by Paul Skawinski

Pupa chamber of Euhrychiopsis

Photo by Paul Skawinski

Pupa chamber of Phytobius

Photo by Paul Skawinski

Weevil damaged plants will have a darkened and hollowed stem contrasting with healthy light or green stems (see photo below). Occasional small holes should also be present in the darkened stems. The larvae will mine from the tip of the plant downward. Sometimes only the tip of the plant is affected or several feet can be affected.

Weevil damage

Photo by Robert Korth

Broken EWM stem - NOT weevil damage

Photo by Robert Korth

Compare this photo at the left of weevil damage (darkened stem) to the photo on the right, which shows a broken Eurasian water-milfoil stem (healed-over scar, stem is still green).

Why Study Weevils and How Can They Impact EWM Densities?

This weevil study is being conducted to obtain a better understanding of the ecology of weevil populations and when water-milfoil populations are susceptible to weevil damage. Some lake groups will monitor for the weevil even though their lake does not have EWM. They want to know if the weevil is present "in case" EWM is introduced into their lake. These folks will also monitor the shoreline of the lake to ensure that weevil overwintering habitat is present and maintained on their shorelines. Other lake groups will monitor for the weevil "because" their lake has EWM. They want to know if the weevil is present and what impact the weevil is having on the EWM.

Early research by the Wisconsin Cooperative Fishery Research Unit showed weevil populations are negatively affected by cold water temperatures, fish predation, calcium carbonate deposits, some nutrients/chemicals, and a lack of natural shorelines. The

weevils burrow into water-milfoil stems and eat the water-milfoil leaves and vascular tissue (depending on the weevil life cycle stage). Most of the feeding is confined to the upper portions of the water-milfoil, so it doesn't completely collapse in the water column but does lose buoyancy (Jester 1999). Shorter EWM would allow native plants to compete. Damage also prevents water-milfoil from flowering (Jester 1999). Under ideal conditions, weevils have been know to decrease native and non-native water-milfoil populations to the extent that they do not spread further and do not reach the surface of the lake.

As for the use of *Euhrychiopsis lecontei* weevils as a biological control against EWM, not enough research has been done to determine the effects of stocked populations. For now, Laura Jester and Michael Bozek of the Wisconsin Milfoil Weevil Project predict more weevils can be found in "large, shallow water-milfoil beds and areas of natural shoreline," and these water bodies may have the greatest vulnerability to weevil control in addition to those experiencing large-scale decline. Currently, it's unknown if weevil densities will remain high enough to keep EWM at bay, or whether natural fluctuations in the weevil populations will allow EWM to rebound. Perhaps, weevil stocking can be best used in conjunction with mechanical and chemical controls.

Monitoring

Euhrychiopsis lecontei (water-milfoil weevil)

The timing for the monitoring will vary from year to year. In a normal year, you would begin seeing signs of the larvae and pupae in June. The weevils begin to get quite active when the water reaches 20°C (68°F). By September the weevils stop laying eggs and are fattening up to head to the shoreline thus monitoring in September will be more difficult. For presence/absence monitoring of these weevils, you can monitor once during late July to early August. If you are monitoring to learn more about the densities of the weevils, you would want to monitor twice a month in July and August.

Equipment Needed

- ☐ Boat (canoe, kayak, fishing boat, paddle boat, etc.)
- ☐ Personal Floatation Device (PFD)
- ☐ Long handled rake with attached rope (see description and pictures on page 275)
- ☐ Lake map for marking EWM beds and sample sites within the bed.
- ☐ Pencil for marking on map
- ☐ Clip board or other hard surface for writing
- ☐ Ziploc® bags
- ☐ Waterproof sharpie pen (to write on Ziploc® bags)
- ☐ Cooler to keep plants and weevils in
- ☐ GPS unit (optional)
- ☐ Polarized sunglasses (optional)
- ☐ Aqua-View Scope (optional). To build your own Aqua-View Scope, see construction directions at the end of this section.
- ☐ A copy of appropriate report form (found at the end of this section)

NOTE

Monitoring Methods:

If your lake group is augmenting weevil populations, return adults and larvae back to the lake.

Setting up a Monitoring Team

Often it is easier to "divide" up the work than to rely on one volunteer to monitor an entire lake for water-milfoil weevils. Designate a team leader (and maybe an assistant) who is willing to keep track of what areas are being monitored and who is doing monitoring. The team leader can also be the person who maintains the data and enters the monitoring results on the CLMN website http://dnr.wi.gov/lakes/CLMN (once the form is on-line) and the person to whom other volunteers can bring suspect weevil species. If assistance in identification is needed, the team leader can take the species to DNR, UW-Extension, or the County Land and Water Conservation staff for vouchering.

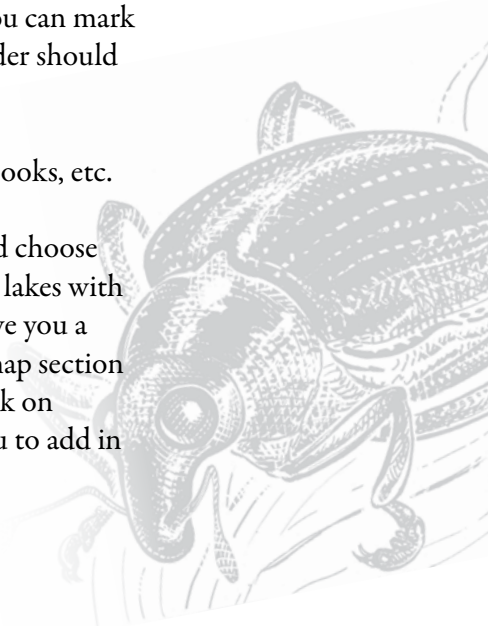
Consider having a mini-Eurasian water-milfoil weevil training session for your team. The Citizen Lake Monitoring Network Coordinator or the Aquatic Plant Management Coordinator for your area (refer front of manual and http://dnr.wi.gov/lakes/contacts) may be able to assist you with a training session. If not, contact your local CLMN contact to see if an Aquatic Invasive Species training session will be scheduled for your area. These sessions are often set up in conjunction with local lake fairs and conventions. AIS workshops/training sessions are also listed at http://www.uwsp.edu/cnr/uwexlakes/CLMN/training.asp.

Mapping

A map is a very quick and reliable way to assure that everyone knows the place you are talking about when you describe a certain point on your lake. A map will assist you in locating Eurasian water-milfoil beds, weevil monitoring sites and shoreline weevil overwintering areas. At the end of the season, you can map all of the sites visited.

If you have a team of weevil monitors, a map will also assist your team in deciding who will monitor where. Once you have your "team" together, print out a map so that you can mark which Eurasian water-milfoil beds each volunteer is monitoring. Your team leader should keep the master copy of the map.

You can get maps from your local DNR office, Fishing Hot Spots, fishing map books, etc. Basic lake maps can also be generated through the DNR web site: http://dnr.wi.gov/lakes/lakepages/search.aspx. Type in the name of the lake and choose the county, then click "search." Click on the lake name (if there are two or more lakes with the same name in the same county, select the lake you are after). This site will give you a plethora of information about your lake, but to find a map, scroll down to the map section and either click on "Contour (Bathymetric) Map" for a printable version, or click on "Interactive Map." The interactive map (in the Surface Water Viewer) allows you to add in "layers" such as invasive species or monitoring sites.



Use a map source that is most convenient for you. Make sure the following information is on your lake map: lake name, county, sites monitored, date(s), volunteer(s), and any additional observations.

Water body ID numbers can be found at http://dnr.wi.gov/lakes/lakepages/results.aspx. Choose your county, click on the lake name, then click on the "Facts and Figures" tab.

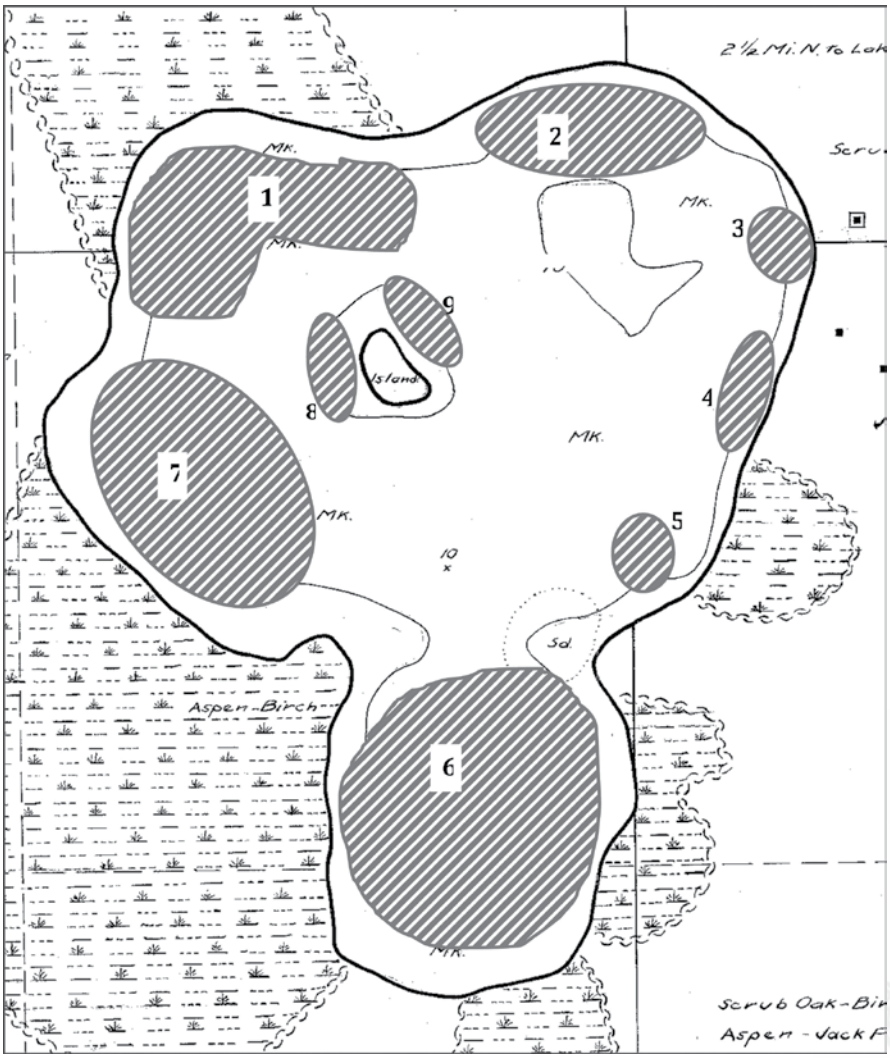
Water body types may be defined as man-made ponds, harbors, reservoirs, rivers, or lakes. Categorize to the best of your knowledge.

Photo by Paul Skawinski

Monitoring Protocols

If you are only interested in presence/absence of the weevil, you can look for weevil damage on the plants and not do the actual counts. If you are only after presence/absence data, it is best to look for damage in water depths of 3-8 feet near shorelines (this is where the weevils will most often be found). Look on the non-flowering tips to see the most damage. Please use a map to mark where you found the weevil damage. The University of Minnesota Department of Fisheries and Wildlife website (http://fwcb.cfans.umn.edu/research/milfoil/milfoilbc/Doyouhaveweevils.html) states that searching for weevils is easiest by snorkeling, followed by wading and lastly by boat. We use the boat method as we are following methods that can be done by any volunteer – whether they can snorkel or not and we are looking at densities of weevils on a lake. If you are interested in weevil densities continue with the following steps.

Before sampling weevil populations, the entire lake must be mapped for Eurasian water-milfoil beds. Label the beds with numbers: 1, 2, 3 ... etc. (see example below).



Mapped EWM beds

On another copy of the map (see example below), label the beds you will sample. These beds should be the largest EWM beds where EWM populations are stable and not expanding much. These are the locations where weevils are likely to establish. Choose a minimum of 4 beds and a maximum of 10 beds in each water body to sample. The beds within 20 feet of the shoreline are the most important beds to monitor as they are more likely to have weevils (researchers have found weevils in beds hundreds of yards from shore, but that is not common and if the EWM has not top out the bed may not be viable for the weevils). Next, plot and label three points (sites) on a transect running through bed #1. Go from shallow to deep when marking these sites. Bed 1, site A is the shallowest site in the bed; Bed 1, site B is in the middle of the water-milfoil bed; and Bed 1, site C is on the deepest edge of the bed. Repeat this process for the 4-10 beds you want to study. The maps you make are extremely important to compare data collected in other years and by other volunteers.

EWM beds with transects and sample points

NOTE

Some folks may want to combine samples A, B & C when analyzing the data. This will work, but will not give you as much detail as when the samples are kept separate. It appears that the weevils will be found in the shallower portions of the EWM bed earlier in the season. As the season progresses, the weevils will be found further out in the EWM bed. This may be due to the water depths the EWM tops out at as it grows.

Canoe or boat to the first sample site. If using a motorboat, head towards the sampling site and turn off the motor before reaching the site so as to drift into the EWM bed. Paddle the rest of the way to the sample sites. This will prevent any stems from being broken by the motor and throwing off the "broken stems" counts. You can anchor at the site if you wish. Monitor that site, then let out the anchor line and float or paddle till you reach the next sample point in the bed. Tie off the rope and monitor at the second site, release rope and paddle or drift to the third site and monitor there. Pontoon use is limited as it is hard to anchor in one spot and/or paddling to the correct site within a bed without breakage of the plants – this may throw off your sampling if you are not careful. If you have a GPS unit, take readings at each site. Exactly 10 stems will be pulled from each of the three sites (A, B & C) in the EWM bed. That means 30 stems total from the bed.

- When collecting stems, carefully reach over one side of the boat and pull 5 stems out of the water; then go to the other side of the boat and collect 5 more stems. This allows for better coverage of the area. This way you are less likely to be bumping stems and knocking off adult beetles. If the bed is small you will have to pick all 10 plants from one side of the boat.

- Pull gently to get as much of the stem as possible (try to get the top two feet of the plant). Once you have the sample back in the boat, cut off the top 20-24 inches of the plant, and save that top portion in a Ziploc® bag. Toss the bottom portion of the plant into a bucket to be composted when you return to shore. If the entire stem is saved until you look for weevils, the stems can get twisted and break when you try to separate them, thus you will not know if the fragments are from the top portion of the plant or the bottom portion of the plant. By only saving the top 20-24 inches of the plant, you know that all fragments in the Ziploc® bag must be looked at.

Collecting EWM Stems

Photo by Laura Herman

- You may want to put each site's (site A, B, & C) weevils into a separate bag to give you a better idea of where the weevils are at in the bed – this is often helpful in the early summer as the weevils move deeper in the bed as the milfoil tops out in deeper water. So shallow vs. middle vs. deep site counts may vary. If the data is kept separate, trends can be run on the data). Or you can combine the sites into one bag if you are only looking at weevil presence/absence.

- Repeat process for each of the three sites (A, B & C) in the EWM bed.

- Be conscientious about visual bias. It is easy to follow our natural tendency to reject a raggedy looking stem, but this can throw off your results and give you a much lower weevil count. Those raggedy stems are the stems mostly likely to contain weevils. It is important to collect the FIRST stem your hand touches, regardless of appearance, so long as it is rooted (floaters are rejected), AND make sure you collect the top two feet of that stem. If a piece breaks off, you need to make an effort to grab that piece as well. Collect ONLY the number of stems you need. Do not grab extras as this will cause confusion later at the lab. Weevils seem to prefer laying their eggs on a nice bushy leaf bud, not flowering tips. If you are just looking for presence/absence data, you can just look at non-flowering stems. If you are after densities, you should collect 10 stems no matter if they have flowers or not. Weevils live in the top three feet (more typically

the top 12 inches) of healthy EWM. Counting of the weevils can be done right on the lake or in a lab. If your lake group is augmenting weevil populations, count the weevils on the lake and return adults and larvae back to the lake.

- If you are counting in the lab, add water and label your Ziploc® bag with the bed and site number (For example, the bag with EWM from Bed 1, Site A would be labeled 1-A. If you are lumping all three sites into one bag, the bag would just be labeled Bed 1). If the EWM is not to the surface of the lake, you can use a rake to reach and pull up the plants. Again, try to collect the top two feet of the plant. The rake method is often needed in the early growing season.

Water temperatures and dissolved oxygen (DO) vary from day to day, but may be important when tracking where weevils reproduce. Warmer summer site temperatures have been correlated with higher percentages of weevil eggs in lab studies. Dissolved oxygen is being recorded in this study because it is somewhat lacking in other studies. Laura Jester found no correlation between dissolved oxygen and weevil populations in her 1998 study, but her dissolved oxygen readings were taken from the middle of the lake, not from the surface of every site. Because we know dense EWM makes dissolved oxygen fluctuate greatly between night and day, developing eggs and adults should be affected by the lack of oxygen near the surface at night. Your dissolved oxygen readings in the EWM bed will help us better understand the correlation with dissolved oxygen levels and weevil success. Water temperature may be taken with any kind of thermometer available. If you have the equipment, please record temperatures and dissolved oxygen surface levels.

Water depth can be measured with a Secchi disk (normally used to measure transparency in lakes) or a calibrated rake/rope. Lower the measuring tool into the water at sampling site and record depth in feet. Remember to collect the depth at each of the three sites in the EWM bed. Before pulling the rake (or other depth-measuring device), "feel" the bottom by bouncing the depth-measuring device on the lake bed. Substrates may be recorded as muck (soft, squishy, false bottom); sand (feels firm); gravel (pebbles and small stones – you will feel these bounce the device and often hear the clinking); or rock (either solid or boulders – you will feel the bounce of the device and hear the clinking). Estimate the substrate type. If the EWM bed is too dense, a record of the substrate surrounding the bed will suffice. Next, the EWM stand density should be observed. Plant density may indicate intensity of weevil feeding. Theoretically, as weevil feeding increases, plant density should decrease and vice versa.

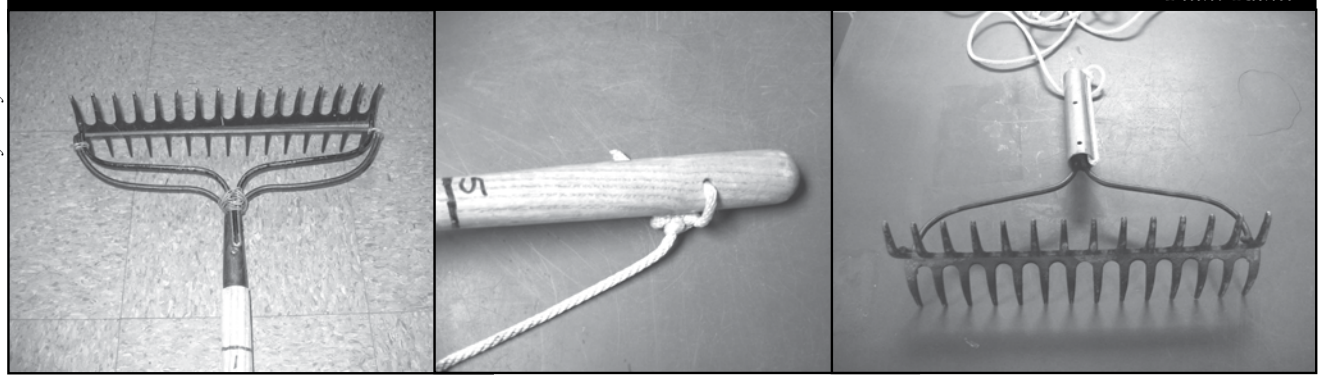
The substrate type and EWM density data are collected after the weevil monitoring takes place. This way you will not be knocking the weevils off of your study plants.

Plant Rakes

Since it is difficult to collect plants that have not reached the lake's surface, volunteers use rakes to sample plants. When the rake is thrown into the water, it settles to the bottom of the lake. When the rake is hauled back into the boat, aquatic plants come with it making for easier identification. A thatching rake can be used, or you can make a "2-headed" garden rake by purchasing two garden rakes (try looking at garage sales). Disconnect the head from one rake and wire or weld the rake heads together (teeth facing out). To monitor in deeper water, drill a hole in the end of the handle and tie a rope to it. With the two heads, no matter which way the rake falls to the lake bed, the teeth will catch the roots of the plants making plant collection a lot easier. If you need to make the rake heavier, you can use cable ties to attach duck decoy weights, a small brick or other weights. Some volunteers do not like to deal with a rake handle in deeper water or in a canoe, so they cut off the rake handle and attach the rope directly to the rake heads. If you use this type of rake, it is essential that you weigh the rake by using the decoy weights, a small brick, hand weights, etc. No matter which rake is used, please be sure to tie the loose end of the rope to the boat. This way you will not lose your sampling rake.

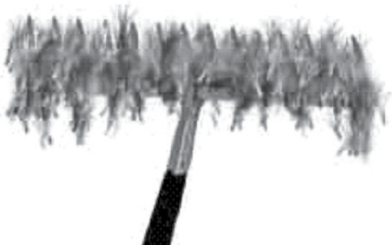
Plant Rakes

Photos by Sandy Wickman



A rope is tied to the handle of this "2-headed" garden rake, so it can be used in deep water.

To determine EWM stand density, tie a rope to a garden rake and extend the rake so that the rake head is roughly 3.0 feet from the gunwale of the boat, then lower the rake to the lake bottom. Pull the rake toward the boat until the head of the rake is still resting on the bottom and the handle is roughly perpendicular to the water's surface. The rake head should be pulled approximately 2.5 feet along the substrate (bottom), then be pulled to the surface and into the boat. Once in the boat, rank the EWM stand density 1-3. One for only a few plants on the rake head; two for half full, the top of the rake can be easily seen; and three for overflowing where the rake head cannot be seen.

Rating	Coverage	Description
1		A few plants on rake head
2		Rake head is about ½ full Can easily see top of rake head
3		Overflowing Cannot see top of rake head

Available wintering habitat plays a major role in the location of weevil populations. When recording the shoreline vegetation type near the EWM bed, observe the nearest shoreline. Only natural shorelines are included as buffer zones; mown lawns, rip-rap (any amount), and sand beaches do not count and will be recorded as zero-foot buffer zone. If there is vegetation, record whether the vegetation is mostly grasses, bushes, or trees and how wide this shoreline buffer zone stretches from the water's edge (0ft, 1-10ft, 10-20ft, or 20+ ft). This information will be useful if you are looking at possible weevil augmentation. Some lake groups will ask landowners with lawns to not mow right up to the water's edge. If possible, please include photos of the shoreline buffer zone to verify the width of the zone. Add in additional observations in the comment section. Survey the entire shoreline for overwintering habitat as your EWM may spread over the years.

Repeat the above processes for each EWM bed you are monitoring.

The remaining steps can be done on the lake or in your garage.
It is hard to find the eggs and small larvae in the EWM plants. Volunteers can choose to only look for adults and weevil damage and record this information. Please note on your Monitoring Data Sheet if you only looked for the adults and damage. For those looking for all stages of the weevil's life cycle, it is helpful to count the number of weevils in each stage. There are up to three generations of weevils born in a single summer. We can then follow the survival rate of weevils in each water body. If you are after rough counts, you may want to record the number of eggs, larvae, pupae, and adult weevils you find while you are still on the lake and then return the weevils back to the lake. Eggs are small and cream colored, larvae look like little grubs, pupae are dark shapes in the stems, and adults possess a distinctive snout. Refer to lifecycle information for tips on weevil identification.

- If you are going to look for all stages of weevils you will want to check for eggs first as eggs are easy to knock off with just a little handling. Eggs can be found in leafy tips of the water-milfoil. Tips may be floated in a pan of water to see between the leaves better. **Tip for looking for eggs: If you use a clear pan, place the pan over a dark background (black paper or plastic bag). This makes the eggs and young larvae (the hardest and tiniest life stages to see) pop out – they nearly glow. Pick the bud up so that you are looking straight down at the top of it usually made the eggs stand out more readily.** Sometimes tiny algae blobs looked a lot like eggs but the algae have a fuzzy appearance around the edges and don't look as solid as an egg. Recognizing that the algae had a fuzzy appearance makes it easier to eliminate them without needing closer examination. Also if algae blobs are down lower on the stem and not on the apical bud, you can assume they are not eggs as the eggs are laid in the tip of the plant. Once you have looked for the eggs in the plant tips, continue examining down the stem for the larvae/pupae/adults.


Looking for Water-milfoil Weevils

Photo by Laura Herman

- Larvae may be feeding inside or outside the stems of the water-milfoil.

- Pupae are difficult to see under any circumstance; hold the stem up to the sunlight and look for a dark crescent shape. For this reason, identification is best done on a sunny day. If you're unsure, poke the suspect with a pin or thumb nail.

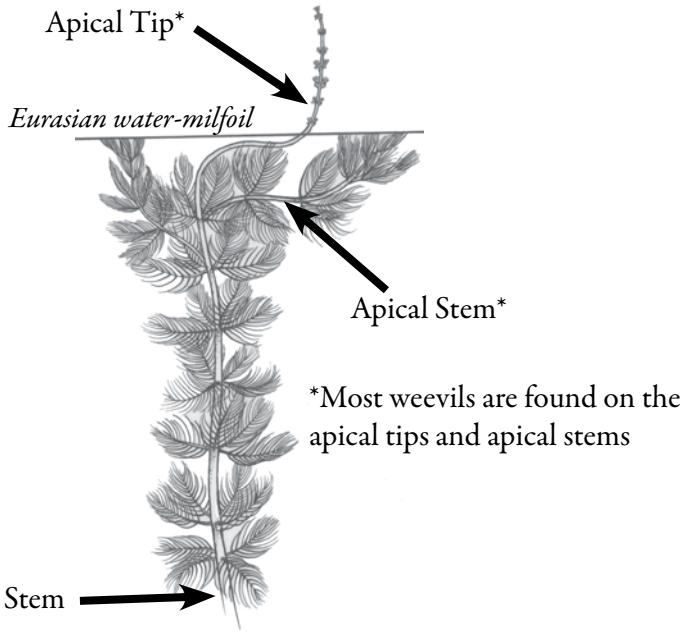
- Adult weevils will likely be clinging to the stem just about anywhere on the plant – make sure to flip the plants over as the adults will "hide" on the back side of the plants.

- Record the total number of weevils (all stages) in the data sheet. You can place the weevils back into the lake. If you are augmenting weevil populations on your lake you do not want to hinder your efforts by killing the weevils.

- Please note on the Data Sheet if the counts were done on the lake or back at your lab.

Sometimes fragmentation and autofragmentation scars can be found on the water-milfoil stems. These scars tend to have a black "scab" look as compared to weevil damage which tends to have a longer blackened stem. Fragmentation (from boats, etc) and autofragmentation scars "heal / scab" over. Weevil damage is brown to black and often has a tattered appearance. Refer to the pictures provided on your laminates to see the difference in the two appearances. Adventitious root bud look a lot like eggs except they are on the lower part of the plant. Healthy stems (no weevil damage) from the lower part of the plant are a white color with a red streak down the center of the stem. Weevil larvae hollow out the red streak portion of the plant.

Weevils spend different stages of their lives on different parts of water-milfoil. This information can tell researchers where the weevils are feeding on the plant. Imagine the water-milfoil stem as a tree trunk, the apical stems would be the branches, and the apical tips would be the tips of twigs. The information about weevil location on the plant can be recorded on the Monitoring Data Sheet.



The feeding behavior of weevils has a tendency to break off the tips off of water-milfoil stems and the plant stem often breaks where the larvae burrow into and out of the stem. The stem will also break when the adults emerge from the pupa chambers. Heavy feeding by the weevils inhibits the growth of water-milfoil. Weevil-damaged stems have blackened tips as compared to other breaks. Record the number of broken EWM stems/tips and the total number of EWM stems/tips.

Algae may become thick in some EWM beds. The warm, still surface water provides perfect growing conditions for algae but may reduce the amount of oxygen available for weevils. Record if algae are absent, present, or abundant under "stems algae-covered" section.

When sampling is finished, you can pour/place the counted weevils and EWM stems (with the eggs and larvae) back into the water-milfoil bed. Do this so you do not to spread EWM further in the water body but yet you are returning the weevils back to the water body. If you find what you suspect to be weevils in your lake and wish to be certain, you should preserve several adults in alcohol (rubbing alcohol will work). Include a label with your lake's name and county in the bottle (use a pencil as ink will dissolve in alcohol). Fill out your data form and deliver that to your weevil contact so that they can verify your information and make sure the weevil data is added to the proper files and data bases. If you do not find any weevil damage/sign, please dispose of the EWM on land (in your compost pile) so that you are not spreading EWM on your lake.

Reporting

What would all the work that goes into gathering accurate information be worth if others could not read, review and act it? Reporting is one of the most important parts of monitoring for invasive species and their biological control insects. Knowing where species or potential control organisms are not, as well as where they are, is extremely important in being able to track and understand the spread of invasives. Knowing how often monitors are looking for species and what they are finding is very important information.

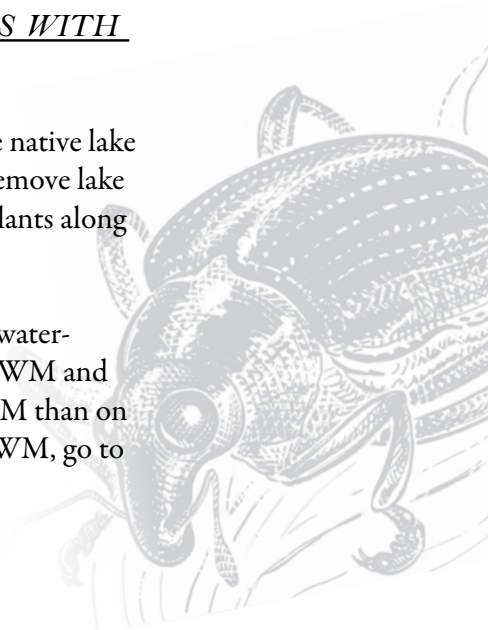
DNR staff, lake managers, researchers, and others use the information that is reported through the Citizen Lake Monitoring Network to study lakes and better understand aquatic invasive species. The information reported by volunteers is also provided to the state legislature, federal, tribal and local agencies/organizations who in turn may use this data to help determine funding for invasive species grants and programs.

We do not have a website on-line weevil reporting form for 2009. For 2009, please send your completed Water-milfoil Weevil (*Euhrychiopsis lecontei*) Monitoring Data Sheet to your local Citizen Lake Monitoring Coordinator (page vii) and they will share the information with the local Lake Coordinator and the Aquatic Plant Coordinator. They will also save the data for when it can be reported on-line.

How to Improve Your Lake's Chances of Success with the Water-milfoil Weevils

Even if your lake does not have Eurasian water-milfoil, you will want to keep the native lake plants healthy so that EWM does not get a foot-hold if it is introduced. Only remove lake plants where absolutely necessary to gain access to your lake. The more native plants along your shoreline, the less chance EWM will get a foot-hold.

The water-milfoil weevil is native to Wisconsin and normally lives on northern water-milfoil, but once EWM comes into the lake, the weevil will switch over to the EWM and eat and reproduce on the EWM. Egg and larvae survival is often greater on EWM than on northern water-milfoil. For more information on the weevil success rates on EWM, go to http://fwcb.cfans.umn.edu/research/milfoil/milfoilbc.html.



The weevil will overwinter on the shoreline of your lake. It overwinters in leaf litter. Some studies indicate that the success of the weevil is greater where the native plants remain along the shoreline. By keeping a natural shoreline (as compared to a lawn shoreline) you may be increasing the chances of success of the weevil. If you would like to switch from a lawn setting to a natural shoreline area, work with your local Land and Water Conservation Department on shoreline restoration projects. They have lists of plants that will grow in your area and will know if there is financial assistance available for you. The following links will assist you in the process. http://dnr.wi.gov/org/water/wm/dsfm/shore/restoration.htm contains information on the shoreline restoration processes. http://dnr.wi.gov/org/water/wm/dsfm/shore/buffers.htm gives your information on shoreline buffers. Langlade County created a good interactive site that helps to choose plants that fit certain criteria http://lrrd.co.langlade.wi.us/shoreland/customize.asp. Again, your local Land and Water Conservation Department should be one of your first contacts if you decide to modify your shoreline.

The weevil does not overwinter in rip-rap areas. If you have erosion along your shoreline, work with your local DNR or Land and Water Conservation Department to add in natural shoreline.
Refer to http://dnr.wi.gov/waterways/shoreline_habitat/erosioncontrol-biological.html for more information on erosion control methods.

Photo by Laura Herman

Additional Materials and Supporting Documentation

Eurasian water-milfoil and Euhrychiopsis lecontei Information Sources

Biological Control of Eurasian Watermilfoil
http://fwcb.cfans.umn.edu/research/milfoil/milfoilbc.html

Do You Have Milfoil Weevils in Your Lake?
http://fwcb.cfans.umn.edu/research/milfoil/milfoilbc/Doyouhaveweevils.html

References

Bode, J. et al. 1992. Eurasian Water Milfoil in Wisconsin: A Report to the Legislature.

Cofrancesco, Alfred F. and H. Crosson. August 1999. Euchiopsis lecontei as a potential biocontrol agent of Eurasian watermilfoil (Myriophyllum spicatum). Aquatic Plant Control Research Program. US Army Corps of Engineers. Volume A-99-3.

Jester, Laura L. October 1998. The geographic distribution of the aquatic milfoil weevil (Euchryiopsis lecontei) and factors influencing its density on Wisconsin lakes. Masters Thesis. University of Wisconsin. Stevens Point, WI.

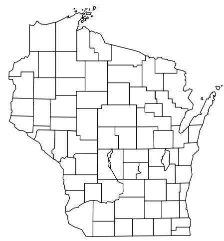
Jester, L.L., M.A. Bozek and D.R. Helsel. 1999. Wisconsin Milfoil Weevil Project. WI Cooperative Fishery Research Unit.

Smith, C.S. and J.W. Barko. 1990. Ecology of Eurasian watermilfoil. J. Aquat. Plant Manage. 28:55-64.

Plant Labels

Project Name: Citizen Lake Monitoring Network

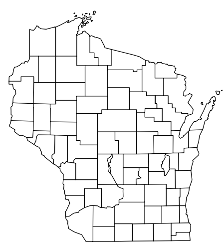
(Scientific Name & authority)



Common Name:
Lake Name:
Water Body ID code#:
County:
Collected by:
Date:
Depth:
Location and Habitat:

Project Name: Citizen Lake Monitoring Network

(Scientific Name & authority)



Common Name:
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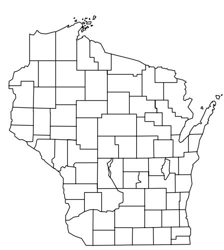


Common Name:
Lake Name:
Water Body ID code#:
County:
Collected by:
Date:
Depth:
Location and Habitat:

Aqua-View Scope Construction Directions

- 1 - 3 foot section of 4" diameter plastic pipe. We use ABS pipe because it is black and because it is lighter than PVC pipe. If you are unable to find ABS pipe, PVC pipe will work just fine. Your hardware store may have a short piece of pipe they will sell you. We bought a 10-foot piece of pipe and cut it.
- 1 or 2 - 5 ½" pull handles (we used one, it was easier to hold and guide)
- Screws if not supplied with handle
- 1 - 4" ABS coupler
- 1 - 4 3/8" diameter lexan disk – Lexan is non-breakable plexiglass that we had cut at our local glass repair shop. You can use plexiglass for the disk but it is difficult to cut the plexiglass in a circle.
- Clear silicone rubber sealant
- Drill and screw driver
- Weatherstripping for around the top of the aqua-view scope. Marine and automotive weatherstrip tape works well.

How to Make an Aqua-view scope (picture on next page)

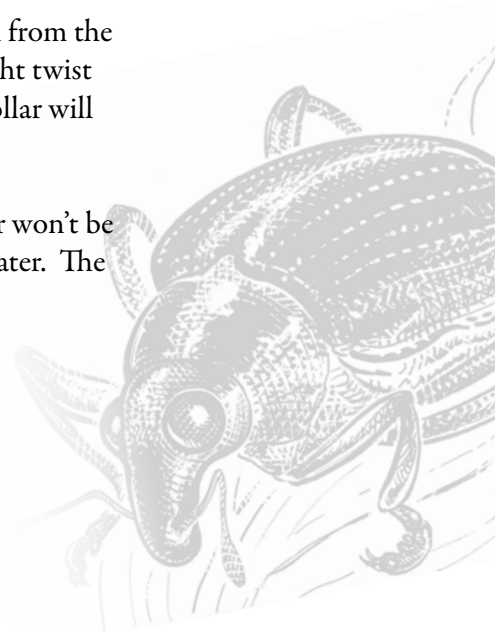
Cut a 3 foot section of 4" diameter ABS or PVC pipe. The cut must be straight and square to the pipe. If you can't find pipe with a black interior, you can paint the inside a flat black. If the pipe is shiny on the inside, rough it up using sandpaper or steel wool so that there won't be any glare inside the tube. **If you are going to rough it up on the inside, make sure to do that before you attach the screws so you don't scratch your hand!**

Attach one or two handles on either side of the pipe about four inches from one end. ABS pipe is fairly soft, you can use a screw driver to put the screws in or you can drill pilot holes and put the screws in. If you are using a drill, make sure to make the hole smaller than the screw so the screw will hold. If using PVC pipe, you will need to drill the holes.

Run a bead of clear silicone rubber sealant on the bottom of the squared off end of pipe. Place the lexan disk on the bead of sealant.

Smear a small amount of silicon sealant on the outside of the pipe one half inch from the end of the pipe with the lexan. Slide the coupling over the end and give it a slight twist to distribute the sealant evenly. Slide the coupling on as far as it will go. The collar will extend out beyond the lexan disk protecting it from scratching.

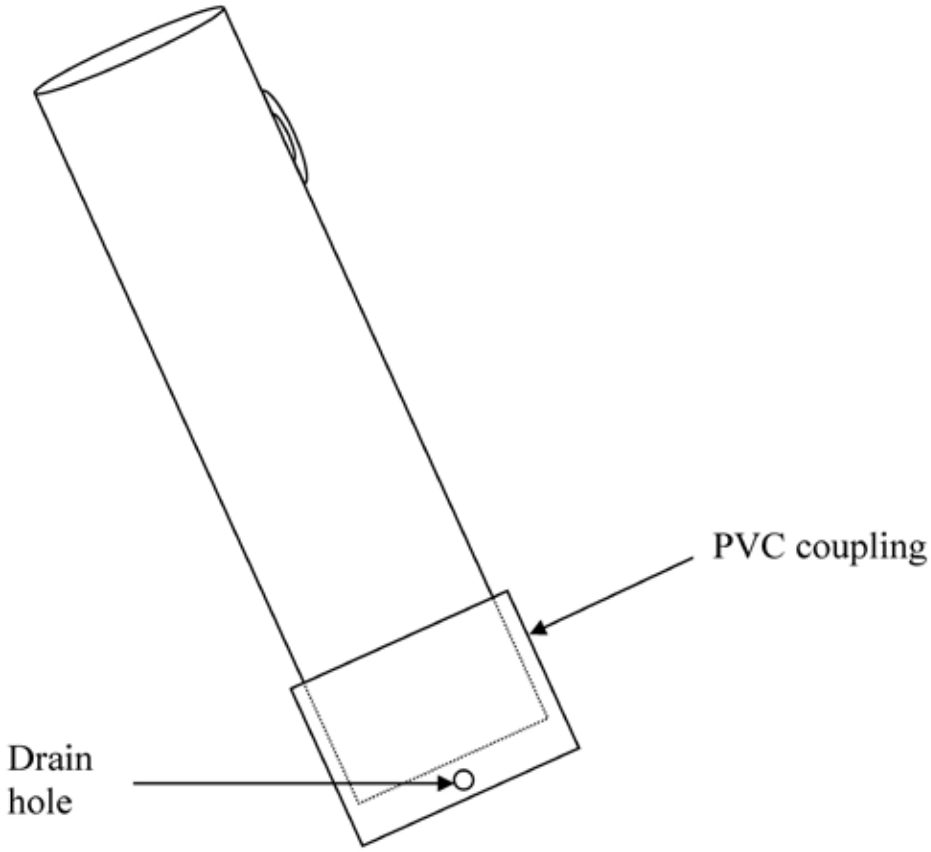
Drill two small (1/4") holes in the side of the collar close to the lexan so that air won't be trapped in the open end of the coupler when you put the view scope into the water. The holes should be drilled on opposite sides of the pipe.



Weatherstripping is placed around the top of the open end of the scope (the side you look into). Weatherstripping has a sticky side that sticks to the plastic and the foam makes it a little more comfortable for your face to rest against.

Aqua-view scope instructions adapted from those designed by Jeff Schloss, coordinator of New Hampshire Lakes Lay Monitoring Program (603) 862-3848.

Aqua-view scope drawing



State of Wisconsin
Department of Natural Resources
Wisconsin Lakes Partnership

Water-milfoil Weevil Monitoring Report

Form 3200-134 (R 03/10)

The purpose of this form is to track the abundance of the Water-milfoil weevil (Euhrychiopsis lecontei) and the amount of weevil damage in individual beds of EWM in Wisconsin lakes.

Use one datasheet for each EWM bed surveyed. When collecting stems for weevil counts, collect the TOP 50 centimeters (20 inches). Collect 10 stems/site for a total of 30 stems/bed.

Notice: Information on this voluntary form is collected under ss. 33.02 and 281.11, Wis. Stats. Personally identifiable information collected on this form will be incorporated into the DNR Surface Water Integrated Monitoring System (SWIMS) Database. Personally identifiable information collected on this form will be incorporated into the DNR aquatic invasive species database. It is not intended to be used for any other purposes, but may be made available to requesters under Wisconsin's Open Records laws, ss. 19.32 - 19.39, Wis. Stats.

Primary Data Collector		
Name	Phone Number	Email

Monitoring Location		
Waterbody Name	Township Name	County
Latitude of center of EWM bed (optional)	Longitude of center of EWM bed (optional)	

Date and Time of Monitoring		
Monitoring Date	Start Time	End Time

EWM Bed Habitat Information

Shoreline Vegetation Type: ☐ Natural Herbaceous (non-woody plants) ☐ Natural Woody Shrubs ☐ Trees ☐ Manicured Lawn

Distance of Natural Shoreline Buffer from Lakeshore to Manicured Lawn (If there is any rip-rap along the shoreline, record this as 0 ft of buffer) ☐ 0 feet ☐ 1-10 feet ☐ 10-20 feet ☐ 20+ feet

Site Habitat Characteristics	Site A	Site B	Site C
Surface Water Temperature inside bed (optional)	° F	° F	° F
Surface Dissolved Oxygen inside bed (optional)	mg/L	mg/L	mg/L
Substrate (muck, sand, gravel, boulders)			
Water Depth at Site	feet	feet	feet
Substrate (muck, sand, gravel, boulders)			

Site EWM Characteristics			
EWM Rake Density (see "rake density" on pg 2)			
Stems Algae-Covered (none, present, abundant)			
Weevil Damage Count (number of pin-holes, pupa chambers and broken stems)			
Number of Weevil Eggs for 10 Stems			
Number of Weevil Larvae for 10 Stems			
Number of Weevil Pupae for 10 Stems			
Number of Weevil Adults for 10 Stems			
Total Number of Weevils			

Comments

For DNR or UW-Ext Lakes Staff to fill out

Have you entered the results of the voucher in SWIMS? ☐ Yes ☐ No

Name of person or museum who identified the voucher specimen

Was the specimen confirmed as….?

Euhrychiopsis lecontei ? ☐ Yes ☐ No *Phytobius* species? ☐ Yes ☐ No

DNR or UW-Ext Lakes Staff: Please enter this report in SWIMS under the Weevil project for the appropriate county. Then, keep the paper copy for your records.

State of Wisconsin
Department of Natural Resources
Wisconsin Lakes Partnership

Water-milfoil Weevil Monitoring Report

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Latitude of center of EWM bed (optional)		Longitude of center of EWM bed (optional)	
Date and Time of Monitoring			
Monitoring Date	Start Time	End Time	
EWM Bed Habitat Information			
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Distance of Natural Shoreline Buffer from Lakeshore to Manicured Lawn (If there is any rip-rap along the shoreline, record this as 0 ft of buffer) ☐ 0 feet ☐ 1-10 feet ☐ 10-20 feet ☐ 20+ feet			
Site Habitat Characteristics			
	Site A	Site B	Site C
Surface Water Temperature inside bed (optional)	° F	° F	° F
Surface Dissolved Oxygen inside bed (optional)	mg/L	mg/L	mg/L
Substrate (muck, sand, gravel, boulders)			
Water Depth at Site	feet	feet	feet
Substrate (muck, sand, gravel, boulders)			
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Stems Algae-Covered (none, present, abundant)			
Weevil Damage Count (number of pin-holes, pupa chambers and broken stems)			
Number of Weevil Eggs for 10 Stems			
Number of Weevil Larvae for 10 Stems			
Number of Weevil Pupae for 10 Stems			
Number of Weevil Adults for 10 Stems			
Total Number of Weevils			
Comments			
For DNR or UW-Ext Lakes Staff to fill out			
Have you entered the results of the voucher in SWIMS? ☐ Yes ☐ No			
Name of person or museum who identified the voucher specimen			
Was the specimen confirmed as....?			
Euhrychiopsis lecontei ? ☐ Yes ☐ No	*Phytobius* species? ☐ Yes ☐ No		
DNR or UW-Ext Lakes Staff: Please enter this report in SWIMS under the Weevil project for the appropriate county. Then, keep the paper copy for your records.			