Aquatic Invasive Species Monitoring Procedures

Citizen Lake Monitoring Network Training Manual

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Laura Herman

University of Wisconsin Extension

Manual prepared by:

Laura Herman
Citizen Lake Monitoring Network Lake Monitoring
UWEX
University of Wisconsin-Stevens Point
800 Reserve Street
Stevens Point, WI 54481
715-346-3989 (Stevens Point)
715-365-8998 (Rhinelander)

This manual is a work in progress. This is the second year of the AIS monitoring project and we (UWEX and DNR) want to learn from the training sessions and from the volunteers. We will incorporate comments / changes that we receive at the training sessions. We will update the protocols as we learn more about the aquatic invasives being monitored and will add in new sections as new invasives move into Wisconsin.

Contributors: Sandy Wickman, Sandy Engel, Dr. Terry Peard, Jeff Maxted, Pieter Johnson, Chris Solomon, Brock Woods, Susan Knight, Scott Provost, Deb Konkel, Dick Sachs, Kris Stepenuck, Steve Galarneau, Frank Koshere, Laura Felda-Marquardt, Cathy Cleland, Meg Marshall, Jen Hauxwell, and Kelly Wagner.

Acknowledgements
Aquatic Invasive Species Monitoring Procedures is a guide for Citizens who are interested in monitoring for aquatic invasive species in the lakes they live on and on the lakes they recreate on. The Citizen Monitoring Network is sponsored and promoted by the Wisconsin Department of Natural Resources, the UW Extension and the Wisconsin Association of Lakes.

Table of Contents

Appendices

Citizen Lake Monitoring Network & Aquatic Invasive Species Statewide Contacts

CLMN Educator
Laura Herman
UW-Extension
College of Natural Resources
800 Reserve Street
Stevens Point, WI 54481
715-346-3989 Stevens Point
715-365-8998 Rhinelander
laura.herman@uwsp.edu

Water Resource Management Specialist
Tim Asplund
WI-DNR
PO Box 7921
Madison, WI 53707-7921
608-267-7602
tim.asplund@Wisconsin.gov

Data Services Professional
Jennifer Filbert
WI-DNR
PO Box 7921
Madison, WI 53707-7921
608-264-8533
jennifer.filbert@Wisconsin.gov

Lakes Team Leader
Carroll Schaal
WI-DNR
PO Box 7921
Madison, WI 53707-7921
608-261-6423
carroll.schaal@Wisconsin.gov

Aquatic Invasive Species Coordinator
Ron Martin
WI-DNR
PO Box 7921
Madison, WI 53707-7921
608-266-9270
ronald.martin@Wisconsin.gov

Aquatic Invasive Species Educator
Julia Solomon WI-DNR
PO Box 7921
Madison, WI 53707-7921
608-267-3531
julia.solomon@Wisconsin.gov

Clean Boats, Clean Waters Coordinator
Laura Felda-Marquardt
107 Sutliff Ave.
Rhinelander, WI 54501
715-365-2659
laura.felda@Wisconsin.gov

Phil Moy
Non-indigenous Species Specialist
UW Sea Grant
706 Viebahn St.
Manitowoc, WI 54220
pmoy@uwc.edu
920-683-4697

WI Purple Loosestrife Control Coordinator
Brock Woods WI-DNR
2801 Progress Road
Madison, WI 53716-3339
608-221-6349
brock.woods@Wisconsin.gov

Rusty Crayfish Research Specialist
Jeff Maxted
UW-Madison Center for Limnology
Madison, WI
(608) 262-3088
jtmaxted@wisc.edu

Wisconsin Department of Natural Resources
Regional Citizen Lake Monitoring Network Coordinators

These folks are your primary contacts for the Citizen Lake Monitoring Network. The coordinators provide assistance with:

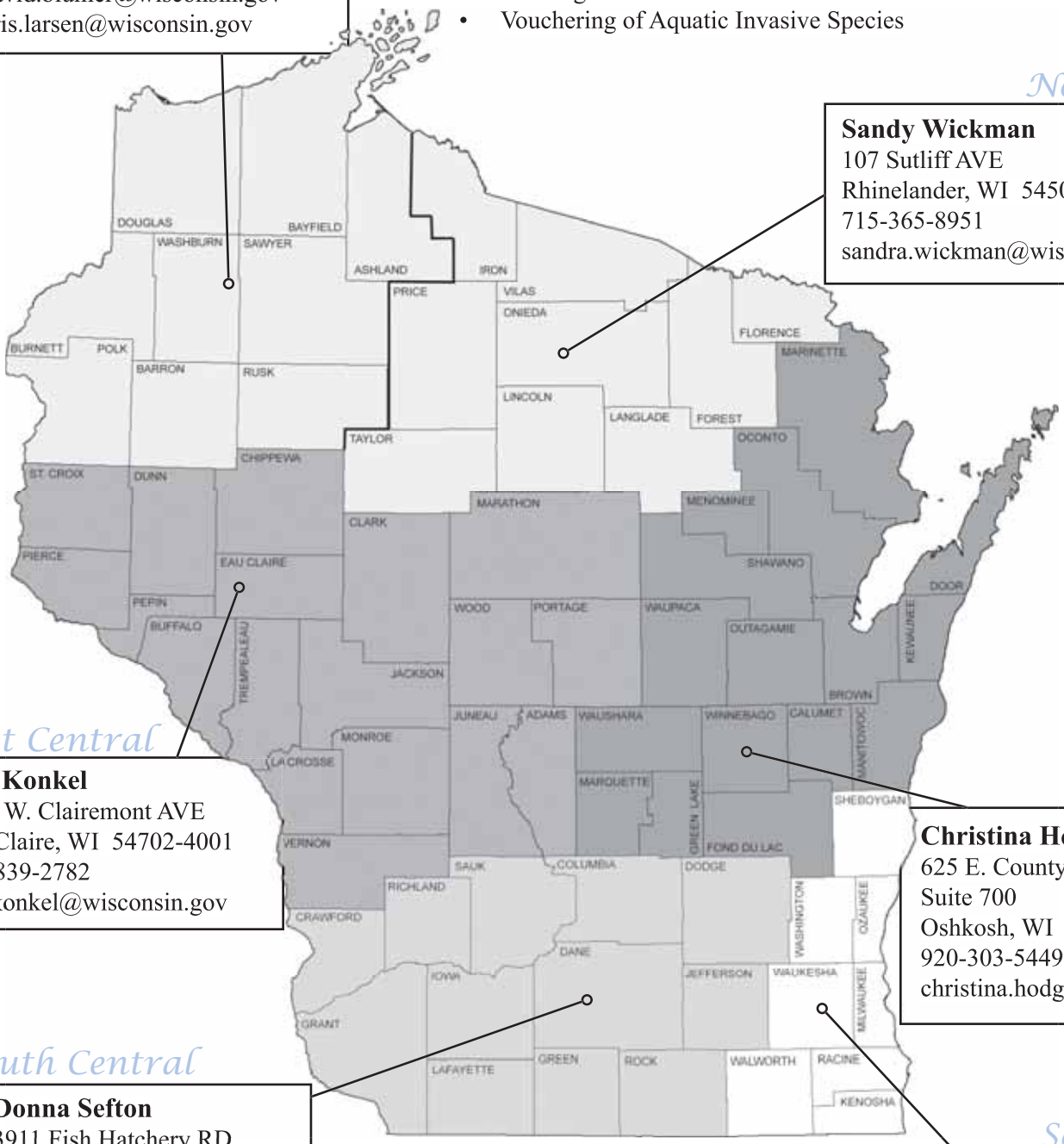
- Education on lake issues
- Supplies, reporting forms, mailings and awards
- Data entry into the Surface Water Integrated Monitoring System (SWIMS)
- Equipment repairs and replacement
- Trainings
- Vouchering of Aquatic Invasive Species

Northern

Dave Blumer and Kris Larsen
810 W. Maple ST
Spooner, WI 54801
715-635-4078
david.blumer@wisconsin.gov
kris.larsen@wisconsin.gov

Northern

Sandy Wickman
107 Sutliff AVE
Rhinelander, WI 54501
715-365-8951
sandra.wickman@wisconsin.gov



West Central

Deb Konkel
1300 W. Clairemont AVE
Eau Claire, WI 54702-4001
715-839-2782
deb.konkel@wisconsin.gov

Northeast

Christina Hodge
625 E. County Road Y
Suite 700
Oshkosh, WI 54901
920-303-5449
christina.hodge@wisconsin.gov

South Central

Donna Sefton
3911 Fish Hatchery RD
Fitchburg, WI 53711
608-275-3330
donna.sefton@wisconsin.gov

Southeast

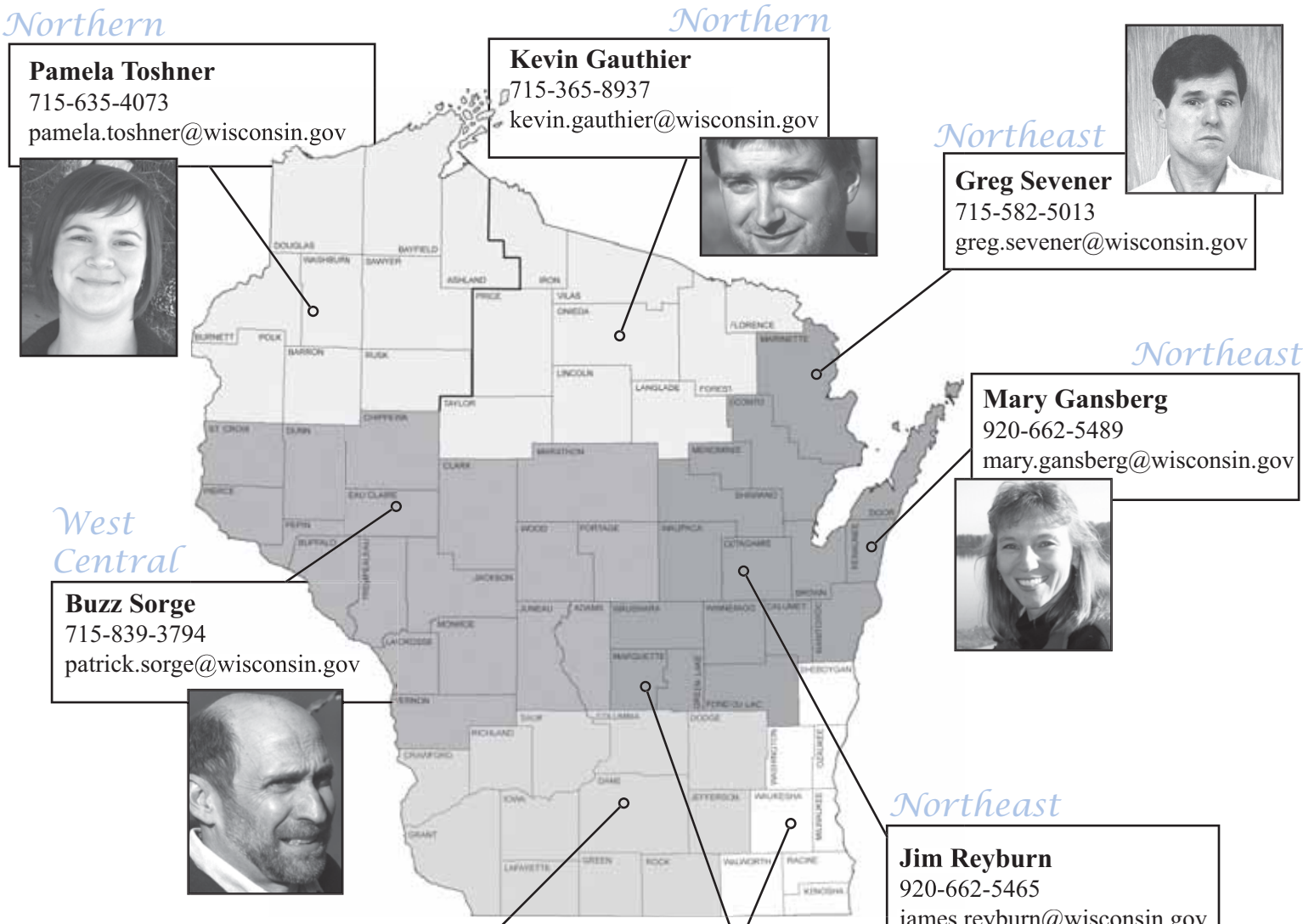
Heidi Bunk
141 NW Barstow ST, Rm 108
Waukesha, WI 53188
262-574-2130
heidi.bunk@wisconsin.gov

Wisconsin Department of Natural Resources
Lake Coordinators

These folks have responsibility for administering the DNR's lake programs. While exact duties vary depending on regional staffing arrangements and priorities, the coordinators can help provide assistance with:

- Lake management education, technical and information assistance
- Grants: Lake Planning, Aquatic Invasive Species, Lake Protection & Classification, and other project funding
- Citizen Lake Monitoring Network
- Aquatic Plant Management

In addition, they may be involved in River Protection Grants and Water Action Volunteer stream monitoring.



Northern

Pamela Toshner
715-635-4073
pamela.toshner@wisconsin.gov

Northern

Kevin Gauthier
715-365-8937
kevin.gauthier@wisconsin.gov

Northeast

Greg Sevener
715-582-5013
greg.sevener@wisconsin.gov

Northeast

Mary Gansberg
920-662-5489
mary.gansberg@wisconsin.gov

West Central

Buzz Sorge
715-839-3794
patrick.sorge@wisconsin.gov

Northeast

Jim Reyburn
920-662-5465
james.reyburn@wisconsin.gov

South Central

Susan Graham
608-275-3329
susan.graham@wisconsin.gov

Southeast

Heidi Bunk
262-574-2130
heidi.bunk@wisconsin.gov

Northeast

Mark Sesing
920-485-3023
mark.sesing@wisconsin.gov

Section 1

Aquatic Invasive Species Monitoring: Getting Started

Citizen Lake Monitoring Network

Welcome to the Aquatic Invasive Species portion of the Citizen Lake Monitoring Network.

Aquatic Invasive Species (AIS) are one threat to Wisconsin lakes. Wisconsin residents spend several million dollars each year trying to control AIS, and these costs are increasing every year. With early detection of most AIS, the costs to control the AIS are greatly reduced. Each year that many of the AIS are left unchecked, they continue to spread and get a stronger hold on the lake.

Wisconsin's 15,081 lakes are fortunate to have volunteers who monitor water clarity, water chemistry, aquatic plants and AIS. Since 1986, these volunteers have been the eyes and ears for the lake biologists. They have provided data to local and state agencies on what is happening on their lakes. Without the volunteers, we would not have lake data which is necessary to help make decisions to protect the health of our lakes.

Through the AIS monitoring network, volunteers are trained to monitor the "entire" lake for Eurasian water-milfoil, curly-leaf pondweed, purple loosestrife, rusty crayfish, adult zebra mussels, Chinese and banded mystery snails and freshwater jellyfish. They will also learn how to assist the DNR staff in monitoring for the veliger stage of zebra mussels as well as water-fleas.

See Appendix A for a list of common terms used around the lake.

Why do Aquatic Invasive Species Monitoring?

Monitoring for and mapping aquatic invasive species is essential to the future of our inland lakes. Early detection is the best and cheapest route in the control of invasives. 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 pay to control invasives that have taken over an entire lake system. Once invasives are established in your lake, they are nearly impossible to eradicate.

Watch for changes in species diversity or changes in abundance of native species and not just for the presence or absence of exotics. A decrease in diversity or an increase of one particular species may be an early-warning sign of changing water quality. We know that some plants do better in lakes with increased nutrients – so by monitoring these indicator species we can tell when the lakes are becoming more nutrient rich.

Shoreline and lake bottom disturbances that remove native plants eliminate these benefits and make it easier for non-native species, such as Eurasian water-milfoil to become established in our lakes. Excess nutrients carried to a lake by runoff can lead to algal blooms, and overgrowth of some plant species and can result in a decrease of recreational and aesthetic value. Preserving the natural aquatic plant community helps maintain a balance that ultimately protects the lake.

Luckily, with some invasives, water and sediment characteristics may help to prevent the spread and nuisance growth of these Aquatic Invasive Species. We believe this is happening on some lakes with Eurasian water-milfoil and curly-leaf pondweed. On some lakes we think that the hardness and calcium content may not be conducive to zebra mussel invasions while on other lakes we know that if zebra mussels get established, we will have serious problems. We also know that rusty crayfish populations do not do very well on lakes with muck bottoms.

Eurasian water-milfoil starts growing in the early spring before the native plants begin growing. It often reaches nuisance levels in late June and remains at these levels until fall. On some lakes, Eurasian water-milfoil has taken over hundreds of acres of the shallow water areas. It becomes so dense that it makes boating and fishing almost impossible. Swimming in these areas is out of the question. When Eurasian water-milfoil gets so thick, it hinders feeding of larger fish. Small fish are able to "hide" in the Eurasian water-milfoil and the larger fish cannot swim through it easily. This imbalance can change the entire fish community of the lake.

Curly-leaf pondweed is an invasive plant that came to the US from Europe. Once the ice goes off, the plant growth increases. Nuisance levels will be reached in May and June. When the plants die in mid-summer they rot. This rotting process will increase the amount of nutrients in the lake and may promote algal blooms. We still have a lot to learn about curly-leaf pondweed. Some lakes have had curly-leaf pondweed for decades and the levels of curly-leaf never reach nuisance levels. Curly-leaf pondweed is essentially becoming a part of a "balanced" aquatic plant community. In other lakes, the curly-leaf pondweed reaches nuisance levels every year or every few years. We still do not know enough about this plant to determine why the nuisance levels vary. Minnesota DNR has determined that "nuisance growth of curly-leaf pondweed often

occurs in shallow, eutrophic basins, where native submerged aquatic vegetation has been lost due to the loss of water clarity and the presence of carp".

Purple loosestrife is a beautiful, but aggressive, plant that can grow in upland, wetland and shallow water areas. Each plant has the capability to produce over 2 million seeds each year, making it easy for this plant to take over disturbed areas. Seeds can be moved by wind, water, animals and humans. If excavation is taking place in a purple loosestrife bed, the seeds can be dragged over the excavated site and the plants will grow throughout this area.

Rusty crayfish were introduced from the Ohio River Basin and the states of Ohio, Tennessee and Kentucky. They are considered opportunistic feeders. They feed on aquatic plants, insects, snails, leeches, clams and fish eggs. Rusties have a higher metabolic rate and grow larger than native crayfish. Some studies show that they can consume more than four times the food of a native crayfish, thus they do more damage to the plant community than native crayfish. Rusty crayfish are also messy eaters. They often cut a plant off, then nibble on the plant and let the rest of the plant float away. This can spread plants such as Eurasian water-milfoil.

Zebra mussels' spread and abundance can be linked to their reproductive cycle. A mature female can lay up to 1 million eggs per year. Of these, roughly 20,000 – 40,000 make it to adulthood (within 1 year). Zebra mussels have a tuft of fibers called byssal threads which allows the zebra mussel to attach to aquatic plants, rocks, docks, native clams, native mussels, snails, or any hard surface. An adult mussel is capable of filtering over a liter of water a day, feeding on the phytoplankton and small zooplankton. Phytoplankton is normally eaten by zooplankton which, in turn, is eaten by small fish. It is speculated that the zebra mussels may impact the fishery on the lake because there is less food for forage fish. Zebra mussels do not eat attached blue-green algae, so lakes with zebra mussel often have the slimy masses of algae attached to plants and other hard surfaces. There is concern about the increases in blue green algae on lakes, as the blue green algae can become toxic when they die off.

The **Chinese mystery snail** is native to Asia. The **banded mystery snail** is native to the southeastern US. One of the main identification features of the mystery snails are their size. Adult sails are often over 1 ½ inches in length. Mystery snails have opercula (singular operculum) which are a "trap door" when they are closed. This operculum is darkly colored, solid in consistency with concentric rings. Most native snails do not have opercula. Mystery snails thrive in silt and mud areas although they can be found in lesser numbers in areas with sand or rock substrates. They are found in lakes, ponds, irrigation ditches, and slower portions of streams and rivers. They are tolerant of pollution and often thrive in stagnant water areas.

There are two types of non-native waterfleas, the **spiny waterflea** and **fishhook waterflea**. Both may impact the fisheries of the body of water where these waterfleas are found. The waterfleas are up to ¾ inch in length. Both the spiny and the fishhook waterfleas have sharp spines on their tails. Some small fish have difficulty swallowing these waterfleas. It may take a small fish 8-10% more time to eat a spiny waterflea than other prey. This is energy wasted. Both waterfleas eat small zooplankton, which normally would have been consumed by native zooplankton and fish. An impact on the fisheries is expected, but not well documented.

The **freshwater jellyfish** found in Wisconsin are one of several species of *Craspedacusta* native to China. In some years, especially hot summers in Wisconsin, you will see the medusa form of the jellyfish. The medusa has a nearly transparent body, often called a bell, which dangles long, hairlike tentacles we associate with jellyfish. At this stage, the jellyfish is about the size of a quarter. Jellyfish eat zooplankton and even small fish. Not a lot is known about the life history of jellyfish in Wisconsin lakes.

The future – we know that more than 180 non-native plants and animals have a foot hold in the Great Lakes – The aquatic invasive species monitored through the Citizen Lake Monitoring Network may be only the first of many species that will impact Wisconsin lakes. Getting a plan in place for monitoring will help to prepare for lake users of the future.

Citizen Lake Monitoring Network and Aquatic Invasive Species Monitoring

The Citizen Lake Monitoring Network (CLMN) aquatic invasive species monitoring protocol will help you design a monitoring plan for your lake and set up a monitoring schedule.

You do not need to know how to identify invasive species when you join the program. Training sessions will be held periodically, or you can contact your local Citizen Lake Monitoring Network representative for help setting up a training session.

Goals of the Citizen Lake Monitoring Network aquatic invasive species monitoring are to

- Help you become familiar with some of the more common native aquatic plants in your lake**.**
- Help you monitor for the more common aquatic invasive species.
- Help you to communicate information to others.

We will discuss each invasive species separately. You may select the Aquatic Invasive Species (AIS) you would like to monitor for. Since each lake is unique, you can tailor the monitoring to fit your individual lake. Your regional Citizen Lake Monitoring Network Coordinator can offer assistance.

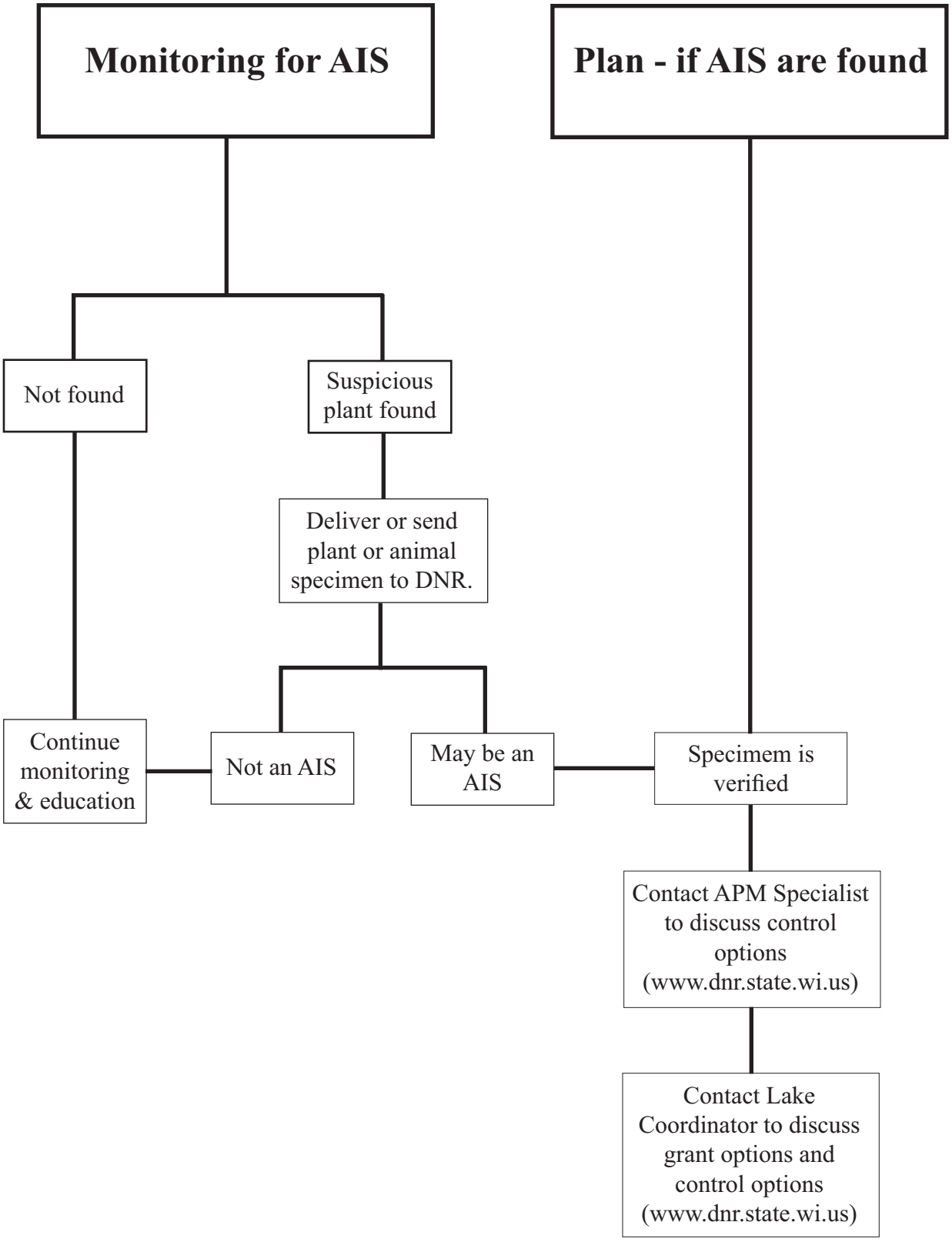
Some volunteers in the CLMN will:

- Collect "suspect" aquatic invasive plants and animals from their lake. If the organism is determined to be an invasive, then further monitoring should be initiated.
- Collect "suspect" aquatic invasive plants and animals from their lake. If the organism is determined to be an invasive, map the beds of the aquatic invasive plant(s) and track the spread of the invasive animals. This will help you to determine the extent of the lake's surface area covered by this invasive.
- Collect "suspect" aquatic invasive plants and animals from their lake. If the organism is determined to be an invasive, map and track the location of the beds of the aquatic invasive plant(s) or spread of the invasive animals through use of GPS. This will help you to determine the extent of the lake's surface area covered by this invasive. By

using the GPS information, you can more accurately track the spread and better display the data.

Please refer to the flow chart on page 7 for information on what to do if you do not find an invasive species while monitoring as well as what to do if you do find an invasive species.

You should consider contacting the DNR Aquatic Plant Management and Protection Coordinator to see if there is background aquatic plant data on your lake. Aquatic plant surveys may have already taken place on your lake. This data may help you in the identification of the plants that you find as well as give you background data on what plant species were present in the past. To determine your aquatic plant contact, go to http://dnr.wi.gov/org/water/wm/dsfm/shore/county.htm and click on the county of interest.


Monitoring for AIS
Plan - if AIS are found
Not found
Suspicious plant found
Deliver or send plant or animal specimen to DNR.
Continue monitoring & education
Not an AIS
May be an AIS
Specimem is verified
Contact APM Specialist to discuss control options (www.dnr.state.wi.us)
Contact Lake Coordinator to discuss grant options and control options (www.dnr.state.wi.us)

How to Set 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 invasives. Some volunteers may want to monitor for specific invasives while others may want to monitor specific areas of the lake. The first thing to do is find volunteers to assist you in your monitoring effort and find out what their interests and constraints are. Some may not have access to boats, but are willing to look for AIS at beaches or boat landings or some may only have a day a month to give – these folks would work great for Eurasian water-milfoil monitoring. Others will have more time available – these folks can map plant beds and / or monitor for rusty crayfish. Others may have an interest, but not a lot of time. Ask these folks to look for zebra mussels when they pull in their docks. Just remember, the more people who know about aquatic invasive species, the better your chances of finding the invasives early in the infestation cycle.

You may want to **designate a point person** that can keep track of who is monitoring and what areas are being monitored. This person can also be the person the other volunteers can bring suspect organisms to. If assistance in identification is needed, the point person can take the organims to the DNR, UW-Extension, or the County Land and Water Conservation staff for vouchering. By having the point person take in suspect plants, you will not have every team member tracking down staff to verify the identification of the plant(s), and you will be able to keep a list of what plants have been taken in and identified. By the end of the summer, your point person will be quite familiar with the native plants and will not have to take all plants to be vouchered. Some groups have asked bait dealers to "hold" suspect plants that were bought in by residents. Then the point person would collect the plants from the bait dealers and take them in for identification when necessary. Be creative and most importantly, do not burn out your point person!

Once you have your "team" together, you will want to **print out a map** so that you can mark which areas each volunteer is monitoring. Your team leader / point person should keep a master copy of the map. It may be easiest to have volunteers monitor the areas by their homes or where they fish. Assigning smaller (1/2 or 1-mile) stretches of shoreline per volunteer will be less overwhelming than monitoring 30 miles of shoreline.

You can get maps from your local DNR office, Fishing Hot Spots, etc. or basic lake maps can be found at http://maps.dnr.state.wi.us/imf/dnrimf.jsp?site=SurfaceWaterViewer. The easiest way to get where you want to go is to use the Zoom To button. Here is an example. Say you want a map of Bearskin Lake in Oneida County. Use the drop down button at the left of the screen (right now it will say city or village) click on the down arrow and click on County. Then go to the drop down arrow in the next line and click on Oneida. Then click on [Go!]. The Oneida County map will appear on the right. If you move your cursor / mouse on the map and left click, the map will zoom to the area under the curser. Keep zooming in until you have the lake you want (you can zoom out if you overshoot your target lake). Once you have your lake in the box, click on the purple print button near the top of your screen and then click on ok. To see what you will be printing, click on [open map]. Once you try this a few times, it will get easier. Also, via the Layers tab, you can select what you want to show. Or you might want to consider obtaining a surveyed contour or bathymetric map of the water body. Go to http://dnr.wi.gov/org/water/fhp/lakes/lakemap/ for these maps. Here is an example of

how to print out a Bearskin Lake, Oneida County map. Click on the down arrow key next to Counties. Select Oneida County. Then page down to Bearskin Lake. Left click on Bearskin Lake. Click on "For a More Detailed Lake Map". Now just follow the directions. To print this to a letter size paper, right click on the map and "save picture as" a file on your computer. Start Word, then click on the tabs: "File" "Page Setup" "Paper Size" "Landscape" "ok" and "insert" "picture" "from file" and pick the lake map file and then print it. Either map will work. Use the web site that is most convenient for you.

Consider having a **mini-plant training session** for your team. The Citizen Lake Monitoring Network or the Aquatic Plant Management Coordinators for your area may be able to assist with this training. If not, group Aquatic Invasive Species Training sessions will be set up annually. Contact your local Citizen Lake Monitoring Network contact to see if such a session is scheduled for your area. These sessions are often set up in conjunction with Lake Fairs and Conventions.

When to Monitor

- **Native aquatic plant** monitoring normally takes place **mid-June through the end of August** with the earlier months used in the southern part of the state and the later months used in the northern part of the state. These dates are impacted by ice out dates and how hot the spring and summer are.
- Many groups will monitor for **Eurasian water-milfoil** several times a season from **May – October** as Eurasian water-milfoil begins growing early and keeps growing late into the fall. For lakes with known Eurasian water-milfoil this allows you to look for new beds so that these beds can be treated (scuba diving, hand pulling, chemical, etc.) while the beds are still small. Chemical treatment is conducted in the spring, so beds need to be located early. An aquatic plant management plan is often required as a part of a permit for chemical treatment of Eurasian water-milfoil.
- **Curly-leaf pondweed** is often at peak densities in May and June and begins to die back in late June to July. You would want to conduct your monitoring in **May or June**. An aquatic plant management plan is often required as a part of a permit for chemical treatment of Curly-leaf pondweed.
- **Purple Loosestrife** monitoring takes place **mid-July through August** when the plants are in bloom.
- **Rusty crayfish** trapping normally **begins in June and ends in August**.
- **Zebra mussel** monitoring can be done from **ice out to ice on**. One of the best times to look for zebra mussels is when you pull out your dock or even in the spring when you put your dock back in – the zebra mussels can be seen on the pipes and/or they feel like sandpaper. Consider placing an article in your newsletter asking all of your residents to do the same, or mention it at your annual meeting. Think of the shoreline area you can cover by having everyone check their docks and piers for zebra mussels.
- **Chinese and Banded Mystery snail** monitoring can take place anytime from **ice out to ice on.**
- **Waterflea** monitoring normally takes place **June through September**.
- **Freshwater jellyfish** monitoring normally takes place **early August – mid September**.

Refer to the specific aquatic invasive species section for more detailed information on monitoring.

Aquatic Invasive Species – A Guide for Proactive and Reactive Management is excellent resource for planning what to do before an invasive is found in your lake. It also is an excellent guide on what to do if an invasive species is found. This publication can be downloaded at http://www.uwsp.edu/cnr/uwexlakes.

If an invasive plant is suspected or found, you should contact your local DNR Aquatic Plant Management Specialist. To determine your Aquatic Plant Management Specialist, go to http://dnr.wi.gov/org/water/wm/dsfm/shore/county.htm and click on the county of interest. Your lake organization may want to consider control efforts for these invasives. Your DNR Lake Coordinator can go over grant options at this point. If you find an aquatic invasive animal (rusty crayfish, zebra mussel, etc.) contact your local CLMN Contact (page vii).

Section 2

Eurasian water-milfoil Monitoring Protocol

Citizen Lake Monitoring Network

Eurasian water-milfoil

Eurasian water-milfoil Overview

Education is the best defense against Eurasian water-milfoil. It is estimated that human carelessness accounts for 95-97% of the spread of Eurasian water-milfoil. Eurasian water-milfoil only needs a 2-3 inch plant fragment to start a new colony on a "clean" lake. If you recreate on a lake with Eurasian water-milfoil and pick up a piece of plant material on your boat, trailer, jet ski, fishing equipment, etc., you could haul that plant material to an un-infested lake. That piece of Eurasian water-milfoil has the potential to grow roots and settle to the bottom of the lake starting a new colony of Eurasian water-milfoil. Be sure to remove all aquatic plants from boating equipment, including your trailer, boat, motor/propeller and anchor before launching and after leaving the water. By removing aquatic plants from boating equipment and encouraging others to do the same, you can help protect Wisconsin lakes from exotic invasives. Another way to protect your lake from invasives is to protect native plants beds. "Research has shown that abundance of Eurasian water-milfoil is inversely related to cumulative native plant cover. It is important to maintain aquatic plant communities as a buffer against non-native plants." Madsen, 1998 Predicting Invasion Success of Eurasian water-milfoil, US Army Corps. of Engineers.

If Eurasian water-milfoil is suspected, deliver a specimen to your local DNR Aquatic Plant Management Specialist http://dnr.wi.gov/org/water/wm/dsfm/shore/county.htm. If EWM is confirmed, your lake organization will want to consider control efforts. Your DNR Lake Coordinator (page viii) can go over grant options and control methods at this point. It is easiest to control and potentially eradicate an invasive plant if the invasive is found in the pioneer stage when only a few plants are present. In the pioneer stage, the plants can be hand pulled. For shallow water areas, a rake can be used to remove the roots. In deeper areas, you may want to consider hiring a SCUBA diver to hand pull the plants and roots. Dispose of the plants well away from the lake so that they do not wash back into the lake during the next rain event. If caught early enough, hand removal may eradicate the invasive from the lake. When the plant beds get larger, you may want to consider chemical control followed up by hand pulling. Chemical control is not 100% effective, so a second control method is often used to increase the control rate. Once Eurasian water-milfoil becomes well established in your lake, it may be impossible to fully eradicate it. Early detection gives you the best chance of eradicating the invasive and will save you money in the long run.

Eurasian Water-milfoil Background

There are 11 native water-milfoil species in North America. Of these 11 native species, 7 are native to Wisconsin. Eurasian water-milfoil (EWM) is a plant introduced to the United States from Europe, Asia and northern Africa. EWM may have been brought in to the United States via aquaculture and the aquarium trade. Since it is not native to Wisconsin or the United States it has very few natural predators. The first authenticated record of EWM in the United States was in 1942 in a Washington D.C. pond. It is currently be found in 48 of the 50 states. EWM was first documented in Wisconsin in the 1960's. As of December 2006, EWM has been verified in 475 water bodies in Wisconsin (appendix 6). EWM poses a serious threat to the lake's native aquatic plant communities and the animals that depend on these diverse ecosystems. EWM can form thick underwater stands of tangled stems and vast mats of vegetation at the water's surface and can crowd out native plants and can become so thick that the larger fish cannot swim through the

tangled mats. Under severe conditions, channels are needed to allow access from the shoreline out into deeper water areas. EWM is now one of the most troublesome of submerged aquatic plants in Wisconsin. 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.

Eurasian Water-milfoil Identification
In your packet is a card that shows you a picture of Eurasian water-milfoil on one side of the card and northern water-milfoil on the other side. Northern water-milfoil is a Wisconsin native that is sometimes confused with EWM. In your packet, you will also find a laminated example of EWM as well as a Water-milfoil Turion fact sheet that shows several of the native water-milfoil overwintering turions and the early spring leaves that form from these turions. EWM does not for these turions, so if you see turions in the fall or the spring turion leaves, you do not have EWM. Please use the references for identification purposes.

The native water-milfoils are not as aggressive as the exotic water-milfoil and the natives have natural predators. Some Wisconsin species of water-milfoil are quite rare and on the Threatened and Endangered list. Eurasian water-milfoil has been known to hybridize with northern water-milfoil (*Myriophyllum sibiricum*). The hybrids cannot be distinguished by visual characteristics, but rather has to be identified through DNA analysis. If you suspect that you have the hybrid, please contact your local Aquatic Plant Management staff http://dnr.wi.gov/org/water/wm/dsfm/shore/county.htm for assistance.

Eurasian water-milfoil (Refer to pictures below as well as reference materials in your packet as these materials show the characteristics listed below):

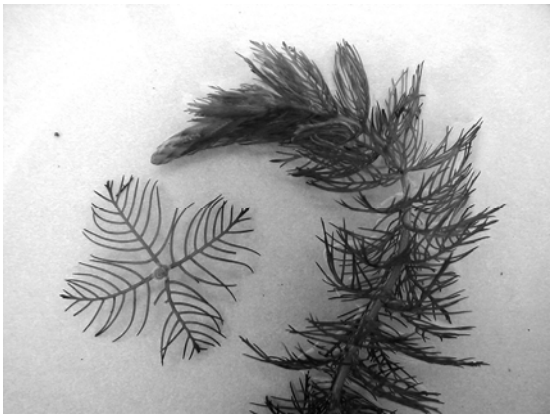
- EWM has delicate feather-like leaves.
- The thread-like leaflets, on the lower part of the leaf, are mostly the same length.
- Leaves are fairly limp when pulled out of the water.
- Leaves are arranged in whorls (circles) of 3 to 5 around the stem.
- Usually there are 12-21 leaflet pairs per leaf.
- In the summer, the plants can be 20 feet tall.
- In the summer, the distance between the leaf whorls can be several inches.
- Upper part of the plant stem often has a pink or reddish color. Some native species of water-milfoils may also have pink stems.
- EWM does not produce turions (overwintering buds).

Northern water-milfoil is native to Wisconsin. This is the water-milfoil that is most often confused with EWM. (Refer to pictures below as well as reference materials in your packet as these materials show the characteristics listed below):

- Northern water-milfoil has rigid feather-like leaves.
- The thread-like leaflets, on the lower part of the leaf, are not the same length. The lower leaflets are usually longer than the upper leaflets. When looking at an individual leaf, you may notice a Christmas tree shape.
- Leaves are usually stiff when the plant is removed from the water.
- Leaves are arranged in whorls (circles) around the stem.
- Usually there are 7-10 leaflet pairs per leaf.

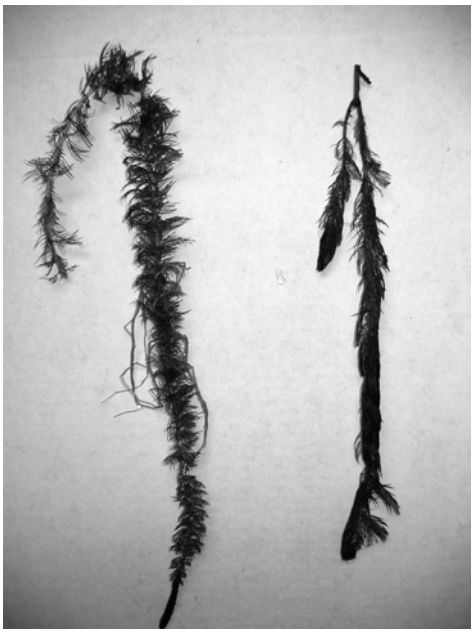
- In the summer, the distance between the leaf whorls is quite short.
- Stems are often whitish or whitish green in color.
- Most native water-milfoils produce turions (overwintering buds) while EWM does not.

EWM whorl showing 4 leaves with leaflets. WI DNR photo.

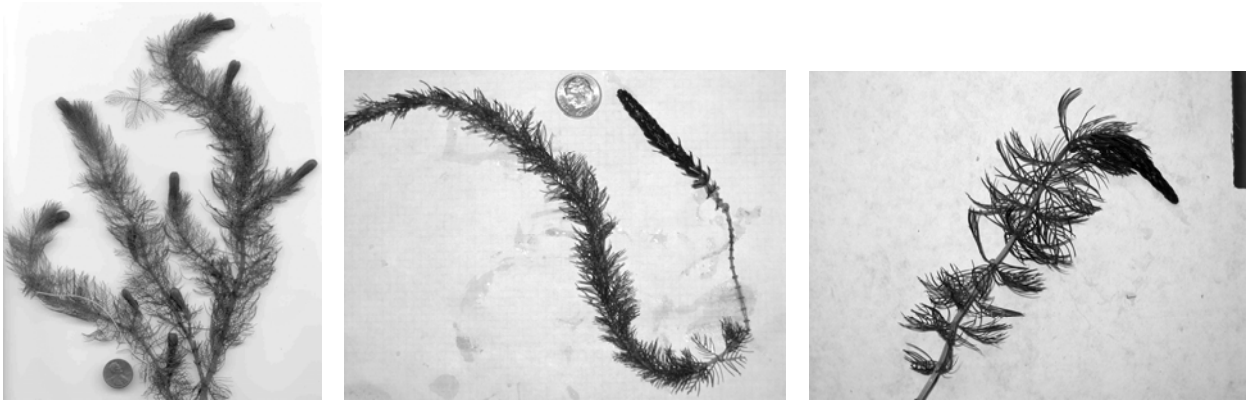


Northern water-milfoil whorl showing 4 leaves with leaflets. WI DNR photo.

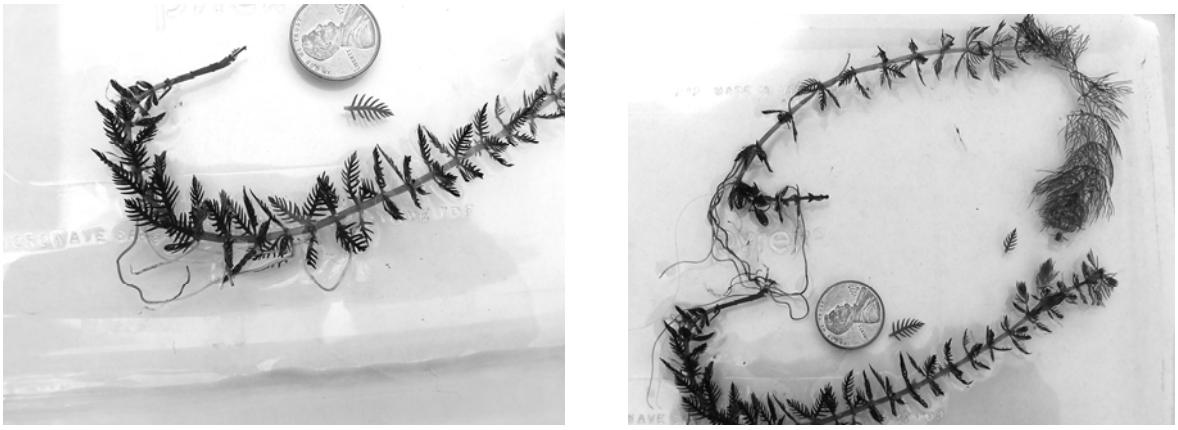
EWM often develops adventitious roots along its stem. Ted Ritter photo.



Northern water-milfoil on the left. EWM on the right. Northern water-milfoil leaves are stiff when pulled out of water. EWM leaves are limp when pulled out of water.



Several native species of water-milfoil form turions (winter buds). Shown above are turions on whorled water-milfoil and northern water-milfoil. Eurasian water-milfoil does **not** form turions.



Northern water-milfoil turion leaves. Eurasian water-milfoil does **not** produce turions, thus you will not find turion leaves on Eurasian water-milfoil.

Eurasian Water-milfoil Life Cycle

Eurasian water-milfoil is an evergreen plant. The plant remains alive over the winter and starts growing when water temperatures reach 50^{o} F (Bode, J. et al. 1992). Eurasian water-milfoil begins growing earlier in the season than the native water-milfoils. This makes early spring chemical treatment an option in the control of Eurasian water-milfoil as it is more selective for Eurasian water-milfoil than late spring or summer treatments. In spring and summer, Eurasian water-milfoil can grow up to 2 inches a day. If EWM plant growth reaches the surface of the lake, the plant will continue to grow and can for a canopy over the surface of the lake often making this area almost impassable with a motor boat. This canopy can also shade out native plants. Excessive growth affects recreational use of lakes by interfering with swimming, fishing, and boating and reduces the aesthetics of the lake. EWM grows in water depths of less than a foot to water depths of a little 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. Eurasian water-milfoil 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.

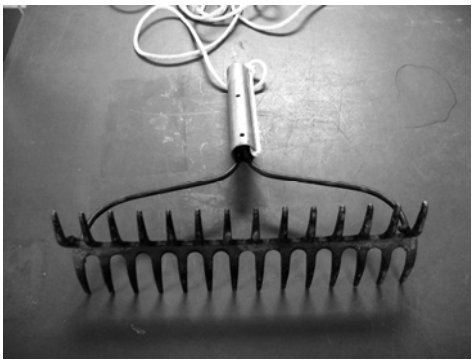
Eurasian Water-milfoil Surveys

Equipment

- Boat (canoe, kayak, fishing boat, paddle boat, etc.)
- Personal Floatation Device (PFD)
- Long-handled rake with attached rope (see pictures)
- Lake map for marking suspect EWM beds and keeping track of where you have been.
- Pencil for marking on map
- Data forms (appendix 5)
- Clip board or other hard surface for writing
- Ziploc bags
- Waterproof sharpie pen (to write on Ziploc bags)
- Cooler to keep plants in
- Plant density data sheet (optional)
- GPS unit (optional)
- Polarized sunglasses (optional)
- Aqua-View Scope (optional). Construction directions in Appendix 3.

The "2-headed" garden rake.

A rope is tied to the handle of the "2-headed" rake



This "2-headed" rake is used in deep water.

Since it is sometimes difficult to identify plants under water, volunteers rake up plant samples. A thatching rake can be used, or you can make a "2-headed" garden rake by purchasing 2 garden rakes (try looking at garage sales for broken rakes). Disconnect the head from one rake and wire or weld the rake heads together (teeth facing out). Drill a hole in the handle end of the rake. Tie a rope on the handle, and you can sample in deeper water. 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. 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 attach duck decoy weights. Some volunteers do not like to mess with the rake handle in deeper water, 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. No matter which rake is used in deeper water, please make sure you tie the loose end of the rope to the boat. This way you will not lose your sampling rake.

Make sure the weather will allow for successful and safe sampling. Clear, calm weather is the best for sampling. Sunny skies make it easier to see into the water. Polarized sunglasses or Aqua-View Scope (Appendix 3) will help you to see the plant beds. Check your lake from ice off until mid-September. If you notice water-milfoils growing in the spring when the water temperature is cold, it could be EWM.

Please complete and return one of the enclosed reporting forms each time you sample, whether or not you find EWM. **Please mail the EWM reporting forms to your local Citizen Lake Monitoring Network contact (page vii). In the near future, you will be able to enter your data on line. Contact your local Citizen Lake Monitoring Network contact if you are interested in this option. They can let you know when the process is up and running.**

Minnesota research has shown that the most susceptible lakes to invasives are those that are close to lakes with established aquatic invasive species (especially if the nearby lake has had the invasive for years). These will be lakes you want to target in your monitoring effort.

Setting up a Monitoring Team
Refer back to Section 1, pages 8-9 for suggestions on how to set up a monitoring team and how to divide up the workload.

When to Conduct Surveys
Many groups monitor for Eurasian water-milfoil several times a season, as Eurasian water-milfoil is an evergreen plant and begins growing early (when water temperature is about 50 degrees F) and keeps growing late into the fall. For lakes with known Eurasian water-milfoil look for new beds early in the season so that these beds can be treated (scuba diving, hand pulling, chemical, etc.) while the beds are still small. For lakes not known to have EWM, you may want to conduct your monitoring late spring to mid summer when the Eurasian water-milfoil biomass is at its greatest. Some teams monitor from ice out to ice on. Monitor several times throughout the open-water season so that you catch the beds as early as possible. Most groups monitor on a 3-4 week interval. Please note that spring drought conditions cause high

growth in EWM during the early growing season so you will want to monitor earlier in drought years.

Where do I Look?

Eurasian Water-milfoil Habitat Background
EWM probably has the capability to survive in all lakes in Wisconsin if it gets established. It can tolerate a wide range of conditions. EWM can grow in water depths of less than 1-foot to water depths of a little over 20-feet. In Wisconsin, EWM gets the most dense in water depths of 6-15 feet, but can reach nuisance levels in as little as 2 feet. EWM can grow in the clearest of lakes to some of the most turbid lakes, but it does best in moderate to fertile lakes. EWM can grow in rocky areas to sandy areas to mucky areas, but does best in areas with silt and sediment. EWM even has the ability to survive in wetland areas, although it will not grow to be dense in these areas. Please remember, EWM will grow throughout the entire lake where water depths are less than 20 feet, so do not just rely on monitoring "prime habitat" areas.

Where to Start Monitoring
Even before looking for the beds of EWM, you will want to look for floating plants. Think about your lake. Which way does the wind blow from and where does the wind blow the plants and floating debris to. Go to the areas where you have seen the piles of plants and debris. Look in these piles to see if you can find any EWM plant fragments. It is especially important to visit these areas **after storms and high boat traffic times** as this is when the plant fragments will be the heaviest. If you find any EWM fragments here, you know that the invasive is in your lake. Check **beach areas, inlets, boat launches, high use areas and the perimeter of the lake**. In mid-summer, EWM may start to break up into smaller pieces and these pieces often wash up along shorelines. These smaller fragments may establish new populations.

Whole Lake Monitoring
Boat or walk around the shoreline of your lake and look for the invasives in the shallow water areas. Look for EWM in both sand areas and in mucky areas. EWM will grow in a variety of sediment conditions, but will do the best in areas with a mucky bottom. Once you have monitored a variety of near shore areas, go out in your boat and begin to collect plants in the deeper water areas. It will be easiest to see the plants if you are wearing polarized sunglasses and/or using an Aqua-View Scope. Use the rake and the rake on a rope to collect plants that are hard to reach or difficult to identify. You can lower the rake to the bottom of the lake and drag the rake along. Pull the rope so that the rake pulls along several feet of the lake bed. This makes for relatively easy monitoring of deep water areas. This method will also help you pull up roots and collect plants that are not readily visible from the lakes surface. Be sure to monitor over sand as well as muck areas.

NOTE: Please do not throw plants that you collect back into the lake. Instead, dispose of them on shore or take them for mulch or compost for your garden. If you toss back plants, you may inadvertently spread plants to different locations on the lake. Since many do not know which plants are native and which are non-native, it is best not to throw any plants back into the lake.

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 plant communities, recreational and habitat use areas, and more. A map will also assist your team in deciding who will monitor where. At the end of the season, you can map all of the sites visited. Refer to Section 1, pages 8-9 on websites where you can download maps. Mark the following information on your lake map: lake name, county, date, volunteer(s), and any additional observations.

GPS
If you have a GPS unit, you may want to mark in the edges of the beds, and then you can load this data into a mapping program and print out maps of the beds.

What to do with Suspect Plants
Even if your lake group is controlling EWM, you still want to monitor for EWM. You want to know if they have spread to any new locations, so that you can begin control of these new beds ASAP. The earlier you find a new invasive, the easier it will be to control.

- Note the "suspect" plant's location on your map, making sure you can find the spot(s) again. Use report form in Appendix 5.
- You will need to take a fresh sample to your local contact. To collect a specimen of the plant, gently pull the plant from the lake bottom. Be sure to collect as much of the plant as possible, paying special attention to getting the leafy and flowering portion, if present. Try not to break up or rip the plant as the pieces of the plant that float away can form roots and start new plants.
- Use a permanent marker and record the following information on the plastic bag:
    a. Date
    b. Water body
    c. Description of where the sample was found.
- Put the sample in a plastic bag and keep it in a cool place (a cooler in your car or refrigerator at home). Take the specimen to your team's point person, your local Land and Water Conservation District personnel, UW-Extension office or the local DNR contact for identification. You will want to get these plants vouchered ASAP, so that control can take place in a timely manner. **NOTE – if your lake has been verified to have EWM, samples do not need to go to the DNR for vouchering – you can just take the plants to your point person.**
- If you cannot bring the plant in for vouchering, rinse the plant under running tap water or in a large pan. This will slow the rotting process.
- Blot the plant dry with a paper towel.
- Spread the plant out on a dry paper towel or newspaper. For water-milfoil, try to spread the leaflets apart to help with identification.
- Cover with a dry paper towel and press in a catalog or phone book for about a week.
- Complete the label (Appendix 2) and reporting form (Appendix 5)
- When the plant is dry, place it between sheets of thin cardboard (like a cereal box). Mail the plant, map and the reporting form to your local Citizen Lake Monitoring Network Contact.
- Remember to make a copy of your map and data sheets for your records.

Remember if you find "something," don't give up; there are a variety of control and management options to address invasive species on your lake. Early detection is the key to controlling the situation!

If you find beds of EWM, you may want to determine how dense the beds are. This information will be very useful when determining the proper control method for your invasive.

PLANT DENSITY

Use the following numbers to denote the plant density for each invasive aquatic plant bed found: Rake fullness ratings are given from 1-3. Conditions of the ratings are described below:

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

NOTE: Please do not throw plants that you collect back into the water. Instead, dispose of them in the trash or take them for mulch or compost for your garden.

Other Data You may want to collect

Sample Location: Record the sample GPS position.

Depth: Measure depth at each sampling site regardless of whether vegetation is present. A variety of options exist for taking depth measurements, including SONAR guns, depth finders that attach to the boat, or an anchor attached to a line with depth increments.

Dominant Sediment Type: Record sediment type (based on how the rake feels when in contact with the bottom) at each site where plants are sampled as: (a) mucky, (b) sandy, or (c) rocky.

Here are a few plant identification sources you may find helpful:

Through the Looking Glass. 1997. Susan Borman, Robert Korth, Jo Temte. Wisconsin Lakes Partnership. DNR publication # FH-207-97.

Common Aquatic Plants of Wisconsin list prepared by Stan Nichols, Wisconsin Geological and Natural History Survey, Madison, WI. (This is not a true key, but it is easy for all to use)

Aquatic and Wetland Plants of Northeastern North America. Garrett E. Crow and C. Barre Hellquist. The University of Wisconsin Press.

A Manual of Aquatic Plants by Norman C. Fassett. 1957. University of Wisconsin Press.

Aquatic Plants of Illinois by Glen S. Winterringer and Alvin C. Lopinot. 1966. Department of Registration and Education, Illinois State Museum Division and the Department of Conservation, Division of Fisheries.

Michigan Flora by Edward G. Voss. 1985. University of Michigan Press.

Section 3

Curly-leaf Pondweed Monitoring Protocol

Citizen Lake Monitoring Network

Curly-leaf pondweed

Curly-leaf Pondweed Overview

Education is the best defense against curly-leaf pondweed. Curly-leaf pondweed turions (specialized reproductive structure) are sometimes carried in muck attached to an anchor or dropped in the bottom of your boat. These turions can sprout and grow new curly-leaf pondweed colonies. Be sure to remove all aquatic plants from boating equipment, including your trailer, boat, motor/propeller and anchor before launching and after leaving the water. By removing aquatic plants from boating equipment and encouraging others to do the same, you can help protect Wisconsin lakes from exotic invasives. Another way to protect your lake from invasives is to protect native plants beds. It is important to maintain aquatic plant communities as a buffer against non-native plants

If Curly-leaf pondweed is suspected deliver a specimen to your local DNR Aquatic Plant Management Specialist http://dnr.wi.gov/org/water/wm/dsfm/shore/county.htm. Your lake organization will want to consider control efforts for these invasives. Your DNR Lake Coordinator (page viii) can go over grant options and control methods at this point. It is easiest to control and potentially eradicate an invasive plant if the invasive is found in the pioneer stage when only a few plants are present. In the pioneer stage, the plants can be hand pulled. For shallow water areas, a rake can be used to remove the roots. In deeper areas, you may want to consider hiring a SCUBA diver to hand pull the plants and roots. Dispose of the plants well away from the lake so that they do not wash back into the lake during the next rain event. If caught early enough, hand removal may eradicate the invasive from the lake. When the plant beds get larger, you may want to consider chemical control followed up by hand pulling. Chemical control is not 100% effective, so a second control method is often used to increase the control. Once curly-leaf pondweed becomes well established in your lake, it may be impossible to fully eradicate it. Early detection gives you the best chance of eradicating the invasive and will save you money in the long run.

Curly-leaf Pondweed Background

Curly-leaf pondweed (*Potamogeton crispus*) is native to the fresh waters of Eurasia, Africa and Australia. This aquatic plant was accidentally introduced into the United States when the common carp was brought in during the mid 1800's. It is thought to have made its way to Wisconsin in 1905 along with fish imported from Europe. Agency staff has just begun tracking lakes that have Curly-leaf pondweed, so there is not a complete list of lakes with Curly-leaf pondweed. The information we do have is located in Appendix 7. **We need your help to discern which additional lakes have this invasive.**

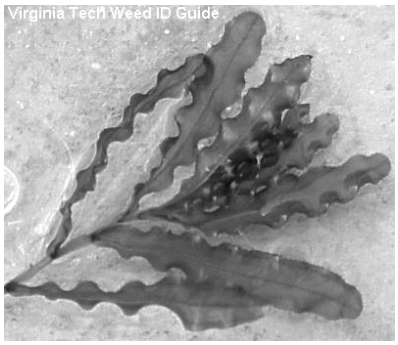
Curly-leaf pondweed has a unique life cycle. The plant normally begins growing in the fall, grows very slowly under the ice and has a large growth spurt from ice out to early spring. Plants die in June – July and can form dense mats of dying vegetation on the surface. When these die-offs take place, nutrients such as phosphorus are released and these nutrients fuel algal blooms. Turions and seeds are formed on the plants before the plants die. A turion is a compacted vegetative bud that is produced along the stem. Turions lie dormant on the lake bed until fall when many sprout and produce a new plant. Some turions will actually sprout in the spring and some will lie dormant in the sediment until environmental conditions are favorable to sprouting.

Curly-leaf pondweed (CLP) is one of 80 pondweed species found throughout the world. In some situations, native vegetation can be displaced by CLP. CLP is tolerant of disturbance and can grow in most water conditions.

Curly-leaf Pondweed Identification (Please refer to the laminate in the back of the binder for a detailed picture of Curly-leaf pondweed).

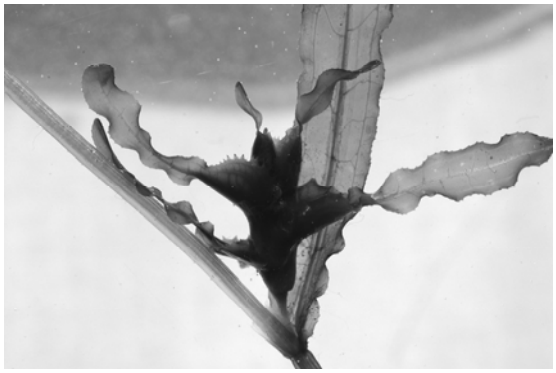
Curly-leaf pondweed:

- CLP is recognized by alternate leaves that are minutely toothed (you may need a magnifying glass to see the teeth).
- The leaf edges are also wavy and they have a crispy appearance – hence the name. The leaves are often described as mini "lasagna noodle" looking leaves.
- Most leaves have a prominent red-tinged mid-vein.
- The stem is slightly flattened.
- A short flower stalk rises above the water's surface, though the rest of the plant is submersed.
- CLP does not form specialized floating leaves. Some native pondweeds produce these specialized floating leaves. The floating leaves are thicker than the submerged leaves and often have a waxy feel to these leaves.
- CLP produces turions, vegetative reproductive buds, which sprout in late summer and produce new plants. Turions are very rigid and resemble small pinecones.



CLP leaves are often light green and fairly transparent. www.ppws.vt.edu/ photo

Note the "lasagna" wavy leaves of CLP. S. Knight photo



CLP turion with leaves still attached. The leaves will rot and fall off of the turion. Frank Koshere photo

Curly-leaf pondweed can be confused with Clasping-leaf pondweed (*Potamogeton richardsonii*). Clasping-leaf pondweed does not have toothed leaf edges.

Potamogeton richardsonii (Clasping-leaf pondweed) www.mlswa.org photo

Curly-leaf Pondweed Life Cycle

Most of our native aquatic plants come out of dormancy in spring and reach their maximum growth in late summer or early fall. Curly-leaf is different and has a natural inclination for low water temperatures, which helps it to avoid competition with other plant species. Seeds are produced that may be fertile but vegetative reproduction tends to be more important for the dispersal of this plant. Turions are probably the most reliable form of reproduction. A turion is a dormant shoot segment (vegetative bud) that can form most anywhere on the plant. It is a hard structure that looks a little bit like a burr or pinecone.

In northern Wisconsin, curly-leaf plants usually complete their life cycle by late June or early July. The turion, which has developed on the plant, falls to the bottom of the lake as the plant dies. Most of the turions begin to sprout in late summer, responding either to the shortening day length or to water temperature. The new growth continues even under the ice of winter. The leaves on the plant in winter and very early spring are quite narrow and lack the wavy edges. A few days after ice off, CLP begins to grow more rapidly and attains its spring foliage (lasagna noodle wavy edges with the crispy appearance). The fast growth allows the stems to reach the water's surface before any other plant. By late spring, a dense canopy of curly-leaf may have formed blocking sun light from reaching other plants. At this time, the curly-leaf pondweed

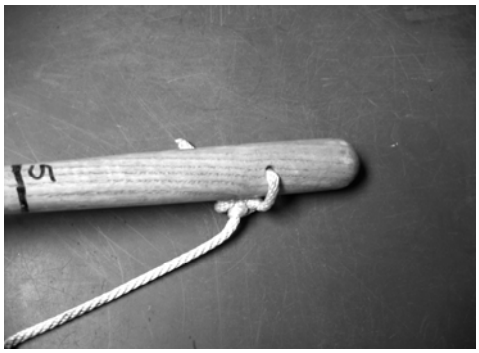
develops turions which drop to the bed of the lake and the plant itself dies and begins to decay. If you notice that plants on your lake are dying back in late June or early July, you will want to check to see if it is Curly-leaf pondweed. Please note, some turions will sprout in the spring and some will lie dormant in the sediment until environmental conditions are favorable to sprouting. The turions can remain dormant for years.

Curly-leaf Pondweed Surveys

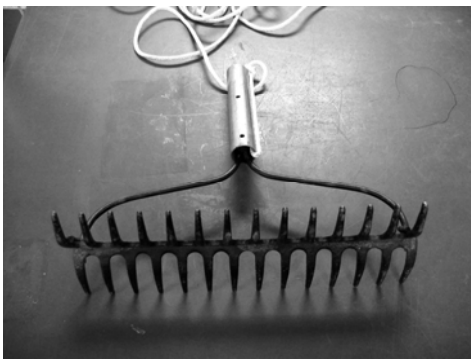
Equipment

- Boat (canoe, kayak, fishing boat, paddle boat, etc.)
- Personal Floatation Device (PFD)
- Long-handled rake with attached rope (see pictures)
- Lake map for marking suspect CLP beds and keeping track of where you have been.
- Pencil for marking on map
- Data forms (appendix 5)
- Clip board or other hard surface for writing
- Ziploc bags
- Waterproof sharpie pen (to write on Ziploc bags)
- Cooler to keep plants in
- Plant density data sheet (optional)
- GPS unit (optional)
- Polarized sunglasses (optional)
- Aqua-View Scope (optional). Construction directions in Appendix 3.

The "2-headed" garden rake



A rope is tied to the handle of the "2-headed" rake



This "2-headed" rake is used in deep water.

Since it is sometimes difficult to identify plants under water, volunteers rake up plant samples. A thatching rake can be used or you can make a "2-headed" garden rake by purchasing 2 garden rakes (try looking at garage sales for broken rakes). Disconnect the head from one rake and wire or weld the rake heads together (teeth facing out). Drill a hole in the handle end of the rake. Tie a rope on the handle, and you can sample in deeper water. 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. 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 attach duck decoy weights. Some volunteers do not like to mess with the rake handle in deeper water, 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. No matter which rake is used in deeper water, please make sure you tie the loose end of the rope to the boat. This way you will not lose your sampling rake.

Make sure the weather will allow for successful and safe sampling. Clear, calm weather is the best for sampling. Sunny skies make it easier to see into the water. Polarized sunglasses or Aqua-View Scope (Appendix 3) will help you to see the plant beds. Check your lake from ice off until mid-September. If you notice that plants suddenly disappear in late June, it may be CLP.

Please complete and return one of the enclosed reporting forms each time you sample, whether or not you find CLP. **Please mail the CLP reporting forms to your local Citizen Lake Monitoring Network contact (page vii). In the near future, you will be able to enter your data on line. Contact your local Citizen Lake Monitoring Network contact if you are interested in this option. They can let you know when the process is up and running.**

Minnesota research has shown that the most susceptible lakes to invasives are those that are close to lakes with established aquatic invasive species (especially if the nearby lake has had the invasive for years). These will be lakes you want to target in your monitoring.

Setting up a Monitoring Team
Refer back to Section 1, pages 8-9 for suggestions on how to set up a monitoring team and how to divide up the workload.

When to Conduct Surveys
Curly leaf pondweed is often at peak densities in May and June and begins to die in July, thus you would want to conduct your monitoring in May or June. Since CLP is normally only dense for a few months, most groups monitor every 2-3 weeks. Some groups also check for Curly-leaf pondweed in the late fall, as the new plants will be growing at this time and the native pondweeds are dying back. This way they can treat those beds as early in the spring as possible. This will increase the chances for control of CLP.

Where do I Look?

Curly-leaf Pondweed Habitat Background
Curly-leaf pondweed can survive in a wide range of lake conditions. It grows in water depths of less than 1-foot to water depths of about 15-feet. In Wisconsin, CLP gets the most dense in

water depths of 3-10 feet, but can reach nuisance levels in as little as 1-foot to as deep as 15-feet. CLP does best in moderate to fertile lakes and does well in turbid water conditions. CLP is often associated with degraded water quality. CLP can live in sandy soils, but prefers soft substrates. Please remember, CLP will grow throughout the entire lake where water depths are less than 15 feet, so do not just rely on monitoring "prime habitat" areas.

Where to Start Monitoring
Even before looking for beds of CLP, you will want to look for floating plants. Think about your lake. What is the direction of the prevailing winds and where are plants and floating debris likely to be? Go to the areas where you have seen the piles of plants and debris. Look in these piles to see if you can find any CLP plant fragments. It is especially important to visit these areas **after storms and high boat traffic times,** as this is when the plant fragments will be the heaviest. If you find any CLP fragments here, you know that the invasive is in your lake. Check **beach areas, inlets, boat launches, high use areas and the perimeter of the lake**.

Whole Lake Monitoring
Boat or walk around the shoreline of your lake and look for the invasives in the shallow water areas. Look for CLP in both sand areas and in mucky areas. CLP will grow in a variety of sediment conditions, but will do the best in areas with a mucky bottom. Once you have monitored a variety of near shore areas, go out in your boat and begin to collect plants in the deeper water areas. It will be easiest to see the plants if you are wearing polarized sunglasses and/or using an Aqua-View Scope. Use the rake and the rake on a rope to collect plants that are hard to reach or difficult to identify. You can lower the rake to the bottom of the lake and drag the rake along. Pull the rope so that the rake pulls along several feet of the lake bed. This makes for relatively easy monitoring of deep water areas. This method will also help you pull up roots and collect plants that are not readily visible from the lakes surface. Be sure to monitor over sand as well as muck areas.

NOTE: Please do not throw plants that you collect back into the lake. Instead, dispose of them on shore or take them for mulch or compost for your garden. If you toss back plants, you may inadvertently spread plants to different locations on the lake. Since many do not know which plants are native and which are non-native, it is best not to throw any plants back into the lake.

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 plant communities, recreational and habitat use areas, and more. A map will also assist your team in deciding who will monitor where. At the end of the season, you can map all of the sites visited. Refer to Section 1, pages 8-9 on websites where you can download maps. Mark the following information on your lake map: lake name, county, date, volunteer(s), and any additional observations.

GPS
If you have a GPS unit, you may want to mark in the edges of the beds, and then you can load this data into a mapping program and print out maps of the beds.

What to do with Suspect Plants

Even if your lake group is controlling CLP, you still want to monitor for these plants. You want to know if they have spread to any new locations, so that you can begin control of these new beds ASAP. The earlier you find a new invasive, the easier it will be to control.

- Note the "suspect" plant's location on your map, making sure you can find the spot(s) again. Use report form in Appendix 5.
- You will need to take a fresh sample to your local contact. To collect a specimen of the plant, gently pull the plant from the lake bottom. Be sure to collect as much of the plant as possible, paying special attention to getting the leafy and flowering portion, if present. Try not to break up or rip the plant as the pieces of the plant that float away can form roots and start new plants.
- Use a permanent marker and record the following information on the plastic bag:
    a. Date
    b. Water body
    c. Description of where the sample was found.
- Put the sample in a plastic bag and keep it in a cool place (a cooler in your car or refrigerator at home). Take the specimen to your team's point person, your local Land and Water Conservation District personnel, UW-Extension office or the local DNR contact for identification. You will want to get these plants vouchered ASAP, so that control can take place in a timely manner. **NOTE – if your lake has been verified to have CLP, samples do not need to go to the DNR for vouchering – you can just take the plants to your point person.**
- If you cannot bring the plant in for vouchering, rinse the plant under running tap water or in a large pan. This will slow the rotting process.
- Blot the plant dry with a paper towel.
- Spread the plant out on a dry paper towel or newspaper. For water-milfoil, try to spread the leaflets apart to help with identification.
- Cover with a dry paper towel and press in a catalog or phone book for about a week.
- Complete the label (Appendix 2) and reporting form (Appendix 5)
- When the plant is dry, place it between sheets of thin cardboard (like a cereal box). Mail the plant, map and the reporting form to your local Citizen Lake Monitoring Network Contact.
- Remember to make a copy of your map and data sheets for your records.

Remember if you find "something," don't give up; there are a variety of control and management options to address invasive species on your lake. Early detection is the key to controlling the situation!

If you find beds of CLP, you may want to determine how dense the beds are. This information will be very useful when determining the proper control method for your invasive.

PLANT DENSITY

Use the following numbers to denote the plant density for each invasive aquatic plant bed found: Rake fullness ratings are given from 1-3. Conditions of the ratings are described below:

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

NOTE: Please do not throw plants that you collect back into the water. Instead, dispose of them in the trash or take them for mulch or compost for your garden.

Other Data You may want to collect:

Sample Location: Record the sample GPS position.

Depth: Measure depth at each sampling site regardless of whether vegetation is present. A variety of options exist for taking depth measurements, including SONAR guns, depth finders that attach to the boat, or an anchor attached to a line with depth increments.

Dominant Sediment Type: Record sediment type (based on how the rake feels when in contact with the bottom) at each site where plants are sampled as: (a) mucky, (b) sandy, or (c) rocky.

Here are a few plant identification sources you may find helpful:

Through the Looking Glass. 1997. Susan Borman, Robert Korth, Jo Temte. Wisconsin Lakes Partnership. DNR publication # FH-207-97.

Common Aquatic Plants of Wisconsin list prepared by Stan Nichols, Wisconsin Geological and Natural History Survey, Madison, WI. (This is not a true key, but it is easy for all to use)

Aquatic and Wetland Plants of Northeastern North America. Garrett E. Crow and C. Barre Hellquist. The University of Wisconsin Press.

A Manual of Aquatic Plants by Norman C. Fassett. 1957. University of Wisconsin Press.

Aquatic Plants of Illinois by Glen S. Winterringer and Alvin C. Lopinot. 1966. Department of Registration and Education, Illinois State Museum Division and the Department of Conservation, Division of Fisheries.

Michigan Flora by Edward G. Voss. 1985. University of Michigan Press.

Section 4

Purple Loosestrife Monitoring Protocol And Control Information

Citizen Lake Monitoring Network

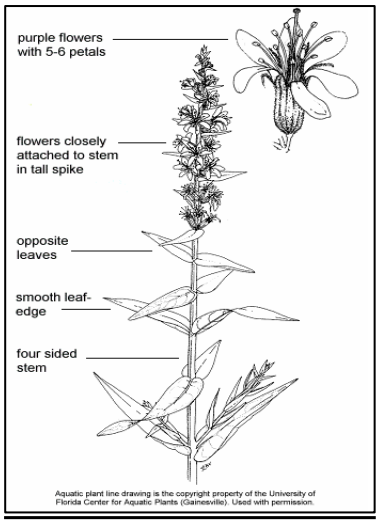
Purple Loosestrife Overview

You may not have paid much attention to the vegetation growing along the shores of your lake in the past. You may have fished the lake or boated for years vaguely remembering the greenery along the shoreline as a pleasing array of grass-like plants, water lilies, or any of a number of common shoreline plants. Have you noticed any changes lately? Are there plants you don't recall seeing in the past? Or maybe you've noticed there is more of one certain type of plant.

If you haven't looked for these changes, you should since they may be signs of invasive plants moving in. Not knowing friend from foe, you should be concerned whenever you see a new face or a dramatic increase in any plant. You should definitely sound the alarm if lake edges that were once green with cattails or other plants have suddenly erupted in massive amounts of pink-purple in mid to late summer; almost a sure sign that purple loosestrife has established. It would be even better to recognize and remove the first of these plants before they bloom…and set seed.

Purple loosestrife (*Lythrum salicaria;* PL) is an attractive wetland perennial plant originating in Europe and Asia that has become a real threat to wetland communities across temperate North America. It was introduced without the specialized insects and diseases that help control it at home. Freed from its natural controls, it grows faster and taller than most of our native wetland plants. Once established on a lake shore or adjacent wetland, it often shades out all but the tallest of its competitors, and can replace large numbers of native plants where it becomes established. This should concern you since it can dramatically change the health of your lake's edge—and how you and wildlife are able to use the lake system. As native plants decline, so do the other species that depend on them!

The plant's habit and vigor also result in large numbers of small seeds that are easily dispersed to wetlands everywhere via moving water, on the feet of migrating birds, or in the cleats of muddy boots or tires. The seeds germinate on open, moist soil, creating first year flowering plants that produce many more thousands of seeds! Thus, loosestrife quickly creates large seed banks that make the plant virtually impossible to eliminate (so remove those young plants before flowering, if you can!) Lots of easily dispersed seeds also virtually ensure its spread.



Purple Loosestrife Identification (please refer to the laminate in the back of your binder for a detailed picture of purple loosestrife).

- Semi-woody, hardy perennial with a dense bushy growth of 1 – 50 stems.
- Square to many sided stems grow 3-9 feet tall. Stems are said to have "edges".
- Flowers are purple to pink in color; have 5-6 petals; and form on spikes. Flowers bloom from the bottom of the spike to the top of the spike.
- Leaves are usually opposite, but can be found whorled or even alternate.
- Stemless leaves are lance shaped and 3-10 cm long with smooth edges.
- Purple Loosestrife blooms July – September with plants blooming earlier in southern Wisconsin than in northern Wisconsin.

Surveys and Mapping

It's very important to know where purple loosestrife is growing in order to determine the best method(s) to control it. Purple loosestrife is found in wetlands, along the shorelines of lakes and streams, and along roadsides and trails. In order to discover it, especially before blooming, you need to be able to correctly identify it and distinguish it from native plants. Please refer to the drawing, identification card and/or the identification criteria above. (The state loosestrife brochure also has a guide to native look-a-like plants.) The best time of year to identify purple loosestrife and conduct surveys is when it's in bloom from mid July through August.

Surveying for purple loosestrife is most easily done while riding in a car, boat or canoe, or while, biking or hiking. It is best to have a map available to mark locations. County maps are great to use as they have the roads clearly marked. County maps are available at Visitor Information Centers or the Department of Transportation offices. Plat books are another option and may be purchased from your county government or Extension offices. Another option is to report purple loosestrife on the *Purple Loosestrife Watch: Reporting Procedures*, Form 3200-119, located in the back of your binder (appendix 5). Estimate the size of the infestation and/or number of plants and indicate this on the map, a separate piece of paper or on the reporting form itself. A GPS is ideal for correctly identifying locations. Photos are also a wonderful tool. Make sure you mark the location on the back of the photo. Please send all maps to Brock Woods, Purple Loosestrife Control Coordinator (pages vi). To see which sites have reported purple loosestrife, go to www.glifwc-maps.org and click on infested sites for that species. The Information that is provided to the state will be incorporated into a statewide data base maintained by Great Lakes Indian Fish and Wildlife Commission (GLIFWC).

Control

Control methods are included in this chapter since these methods are better defined than control methods for other AIS.

Effective long-term control of purple loosestrife in Wisconsin may require the use of both traditional control methods as well as biological control. Each has advantages and you must carefully decide which to use on any site. The most important thing is to start controlling the purple loosestrife now. Use traditional methods (see below) on all sites on which you need quick and effective control and have adequate resources to be successful. These measures are labor intensive and expensive on large sites, so small or low-density sites are most often controlled this way. These techniques will require additional vigilance. Even if all purple loosestrife is

accessible, missed plants and seeds in the soil that germinate up to a decade later result in more purple loosestrife plants. Thus, you must annually check for and treat these plants. You should also destroy any purple loosestrife in surrounding areas to stop new seed dissemination to your site. In fact, if your site is in an area surrounded by other loosestrife infestations, traditional control methods may not be worth the effort. These methods can also be very disruptive to wetlands and, in addition to cost and possible unwanted chemical effects, suggest a serious consideration of alternative biological control.

Traditional controls and biocontrol may be used together on the same site as long as insects have foliage to eat and are not killed by other methods. One combination is to cut the stems just beneath the flower head to prevent seed production, but leave lower foliage for the beetles. Another is to put beetles in the center of an infestation while using other controls on its edge to prevent the infestation from growing larger or spreading. Integrating control methods may be the best plan because there is some immediate purple loosestrife control while biocontrol insect numbers increase--perhaps eventually replacing the need for any traditional controls!

Traditional Control Methods

- **Preventing purple loosestrife from infesting new sites is the best and easiest way to control it.** In addition to where loosestrife is found in the wild, it may also be found in local gardens or near outlets to local storm sewers. Prior to 1987 purple loosestrife and hybrids of it were sold in nurseries in Wisconsin as a favorite garden plant. It's now illegal to sell or plant purple loosestrife because seeds from these plants often start new wild infestations. Please remove and destroy these--and any new plants--whenever you see them (get the landowner's permission first). At a minimum cut off their blooms. Do all this before they drop seed (which begins before blooming is complete). Dispose of plant parts in garbage bags and take them to the landfill. Purple loosestrife is exempt from yard waste regulations. Composting is not an option since compost piles do not reach temperatures sufficient to destroy the seeds and hardy roots. Also be careful to inspect clothing and equipment to keep them seed-free and prevent further spread. Once you remove purple loosestrife from a site, you need to monitor the site for any new seedlings which may emerge.

- **Mechanical Control** includes cutting, pulling or digging. Cutting is best done just before plants begin flowering. Cutting too early encourages more flowers to grow. If done too late, seed may have already fallen. Since lower pods can drop seed while upper flowers are blooming, check for seed. If none, simply bag and landfill all cuttings. Do not leave the cut plants at the site as fragments will root and establish new plants. If there is seed, cut off each top while holding it upright, then carefully place it into the bag to catch any dropping seeds. Watch for holes in your bags so you don't spread seed while moving the bags. While cutting does not destroy the plant, it can prevent more seeds from entering the environment until you can destroy the plant.

- **Pulling and digging** can be effective, but can also be disruptive by creating disturbed bare spots, which are good sites for purple loosestrife seeds to germinate. They may also leave root fragments behind. These root fragments can grow new plants. Use pulling and digging primarily with small plants in loose soils, since they do not usually leave behind

large soil gaps or root tips. Digging large plants with multiple stems and brittle roots often leaves root tips behind. Dispose of dug plants as listed above.

Chemical Control

This is usually the best way to eliminate purple loosestrife quickly, especially if you have mature plants with extensive root systems. Timing is important: treat before flowering to prevent seed set. Dispose of plant parts as listed above. Always back away from sprayed areas as you go to prevent getting herbicide on your clothes.

The best chemical method is to cut stems and paint the stumps with herbicide. Cut low on the stem (about knee level) and apply the herbicide, while carefully stuffing the plant top into a plastic bag. The herbicide can be applied with a small drip bottle or spray bottle, which can be adjusted to release only a small amount. Cover the entire cut portion of the stem, but don't let the herbicide drip since it may kill other plants it touches. On dryer sites, use non-selective glyphosate herbicides such as Roundup and Glyfosate. For wet areas use Rodeo (a glyphosate formulated for use over water) or equivalent **(WDNR permit is required**). These have a short soil life. Stem applied glyphosate should be mixed to 20 to 40% active ingredient, depending on effects on your specific area's plants (always test). For sites with many native grasses, sedges, cattails, rushes, etc. consider using triclopyr herbicide marketed as Renovate since it does not kill these monocots, though it does breakdown slower. Check Renovate's label for its correct usage. Since you must treat at least some stems of each plant and the plants often grow together in a clump, all stems in a clump should be treated to ensure all plants are killed. Bag cuttings since they can root if they come in contact with water or moist soil. Dispose of as mentioned above.

Another chemical method is using very carefully targeted foliar applications of herbicide (NOT broadcast spraying). This may be acceptable and reduce costs for sites with very high densities of purple loosestrife, since fewer non-loosestrife plants will be hit. Use a glyphosate formulated for use over water and in a weaker solution (around 1% active ingredient; always test first). You may need to wet only 25% of the leaves of each plant to kill it. Triclopyr can be used as a foliar spray, too; check its label for instructions. Wet most of the foliage if using Triclopyr.

You must obtain a permit from WDNR before applying any chemical over or near standing water. The process has been streamlined for control of purple loosestrife and **there is no cost**. The appropriate person to contact is your regional WDNR Aquatic Plant Management Coordinator: http://dnr.wi.gov/org/water/wm/dsfm/shore/county.htm. S/he will want to know about your site and plan, may make further suggestions and will issue your permit.

Biocontrol

One of the cheapest, most effective control methods for purple loosestrife is biocontrol - using one organism to control another. One hundred species of insects that feed on purple loosestrife in Europe were tested on North American agricultural, wetland, and loosestrife-related plants to be sure there were little or no cross-over feeding. The selected insect species were then shipped to this continent and tested in quarantine on more species of North American plants before release. Four species passed all safety tests: two flower and root weevil species, and two types of "Cella" foliage beetles. No one has reported any substantive problems with the insects being used, nor has WDNR seen any real problems in over ten years of field monitoring.

A citizen biocontrol program uses the two safe Galerucella beetle species in combination with traditional methods. You can acquire these beetles by rearing a small number of starter beetles that you receive from WDNR. You may also be able to collect or buy beetles for rearing or release. Biocontrol is beginning to reduce the purple loosestrife in many areas around the state, and yours should be included. Along with prevention efforts, we still need to put out many more beetles to reduce purple loosestrife statewide. Success in this endeavor depends on YOU!

Please read any of the following items for a better understanding of the purple loosestrife problem and its solutions. All are available on the Internet and at many WDNR and UW Extension offices. Start with the WDNR/UWEX Purple Loosestrife Brochures: in color, WDNR publication # PUB-WT-799 2004 at http://clean-water.uwex.edu/pubs/purple.pdf, and in black/white, PUB-WT-829 2006. More details are found in "*Purple Loosestrife: What You Should Know, What You Can Do*," PUB WT-276-2003. Specific biological control information and forms are found in the appendices of "*See Cella Chow!--A Purple Loosestrife Biocontrol Manual for Educators.*" Down load the Manual or selected activities and appendices mentioned here, on line at http://dnr.wi.gov/org/es/science/publications/ss981_2003.htm, PUB-SS-981 2003). Additional purple loosestrife and biocontrol information is also on the WDNR web site; http://dnr.wi.gov/invasives/fact/loosestrife.htm.

Most cooperators initiate biocontrol by rearing large numbers of beetles. This is the best way to ensure successful beetle establishment. WDNR supplies starter beetles for rearing, most needed supplies, and the know-how. The volunteer supplies purple loosestrife roots and a sunny location. Rearing is easy and cheap ($50 or less for several sites), though it requires a little gardening skill. A small sunny area is needed and the hours of labor required are few. The beetle starter population for rearing is free if picked up at the DNR office in Madison, or they can be mailed to you for a program donation to cover shipping.

You may also be able to collect free beetles in the field yourself for propagation or simple dispersal, or buy ready-to-release beetles (private sellers). Call/write Brock Woods (608-221-6349) for details, including the current year's schedule of free field trips. No special permit is needed if beetles are purchased in-state for release, though you still need to send in Release Site Forms (appendix 5) so WDNR knows when and where you have put your beetles.

Rearing is easy. (Details are on page 40.)

1) Send in your signed "Application/Authorization Form" (appendix 5);
2) Sew sleeve cages from fabric mailed to you.
3) Transplant the 10 biggest purple loosestrife rootstocks (from a local area) into pots. Do this first thing in the spring.
4) Immediately place sleeve cages on the pots.
5) Place all the pots into kids' wading pools or similar containers.
6) Maintain several inches of water in the pools to re-create wetland habitat.
7) In May, when plants are 2+ feet tall, put ten starter beetles into each of the cages. Secure the bags at the top so that the beetles do not escape.
8) When new beetles start appearing in June or July, simply move the potted plants to local purple loosestrife-infested wetlands and remove the sleeve cages so beetles can disperse.

That's all there is to rearing your own beetles! Plus, if you pick a good local spot for first beetle releases, you can develop your own local insectary site for collecting free future beetles for rearing or immediate release!

After your release(s), report your site details to WDNR with an easy-to-fill-in Release Site Form (appendix 5). Since beetle damage to purple loosestrife flowers is typical after a couple years, an easy way to see the decline in your purple loosestrife is to photograph your site's purple loosestrife blooms annually. You'll see sites change from purple to green by comparing the first year photo with ensuing years.

Try to team up with others to share in the work, costs, fun, and learning. Consider friends, or organizations such as Lake Districts, schools or conservation groups. This can be a great school project, but it usually needs to be finished in summer school or by a non-school tag team partner since a project's typical field time runs from April to July. (Rearing earlier, entirely within the school year, is possible, as well. Inquire if interested.) Also, the first half of "See Cella Chow!" includes 15 curricular activities centered on purple loosestrife and biological control, specifically to encourage use of the project for teaching!

To reserve your beetles from WDNR and get authorization to grow purple loosestrife for beetle production, fill out and send in your signed "Authorization/Application Form" (appendix 5), along with the donation check if you want beetles delivered by mail. (Make your check payable to 'Wisconsin DNR' and note that it's for 'Purple Loosestrife Bio-Control'. To legally cultivate purple loosestrife plants to rear beetles, you must return the authorization form whether or not you need beetles from DNR. Send everything to the addresses below. 100 beetles is a typical starting number, but you can start with fewer or more. If you decide to purchase ready-to-release beetles or collect for immediate distribution you must still send in release site form(s).

If you cannot rear or acquire beetles for local release, the state purple loosestrife brochure lists many other ways you can help! One great way is to report new purple loosestrife sites on our "Watch Form," downloaded at www.dnr.state.wi.us/org/caer/ce/news/on/3200119.pdf. Describe the sites, and send the form to us at the address below. Also, please share this information with interested others--especially teachers.

We hope you can join us in controlling Purple loosestrife in Wisconsin. This will require a long-term effort involving many citizens. WDNR and UWEX will do everything possible to work cooperatively with all interested citizens and organizations in this work. If you have any questions or comments about the program, please contact Brock Woods, Purple Loosestrife Project Coordinator, DNR Science Operation Center, 2801 Progress Road, Madison, WI 53716. Brock can be reached at brock.woods@wisconsin.gov or by calling 608/221-6349.

Materials for Rearing 100 *Galerucella* Beetles

This is an exhaustive list and you may not need, or need to purchase, all items. Some may be available for free from the Wisconsin Purple Loosestrife Biological Control Project (WPLBCP). Those items are followed by an asterisk *. Other items, such as pots, you may be able to get from landscape businesses or buckets [that need holes drilled] from school lunch programs.

Getting Ready and Collecting Roots

1. Wetland plant identification book(s)
2. Map(s) to location of loosestrife roots and beetle release sites – Use a good local map after consulting the Great Lakes Indian Fish and Wildlife Commission's web site at www.glifwc-maps.org.
3. Colored flagging in a roll or on metal stakes
4. Filled out, signed, copied, and mailed Wisconsin DNR permit letter (see appendix 5)
5. Shovel or fork for digging and cutting roots
6. Plastic tubs (Rubbermaid® type) or plastic bags for hauling roots and waste
7. Pruning shears to cut off old dead stem tops and root tips, if necessary
8. Gloves, eye protection, rubber boots, and old clothes

Potting Roots

9. 12-15 large purple loosestrife roots from a local wetland
10. 12-15 plastic pots, 10-14 in. diameter *
11. About 2.5 cubic feet of high peat content potting soil (Fafard or a similar mix) *
12. 1 lb. fertilizer, slow release type like Osmocote 18-6-12, unless in the soil *
13. Hose and water source for rinsing roots, wetting soil, and filling pools
14. Two 4-foot child's wading pools, one 5-foot pool, or other suitable containers *

Pool Set-up and Plant Care

15. 24 yd. of 48+ in. wide, no-see-um insect netting, thread, and sewing machine to make 11 net sleeve cages about 78 in. long. Fold each piece of fabric along its short side and sew down the open 78-in. seam, tapering the cage at one end to match the diameter of your pots. *
16. Duct tape (and perhaps bungi type cords) to attach cages firmly to pots *
17. Wire or string to tie cage tops shut and to supports: also for guy wires
18. 4 X 8 foot space in full sun or at south facing windows
19. 7-foot high cage support system for suspending net cages-clotheslines or conduit posts or a design of your own!
20. Dependable watering system

Raising Beetles

21. 100+ over-wintered beetles from the WPLBCP, field collected, or from other suppliers *
22. Aspirator for catching and moving beetles *

Releasing Beetles and Follow-up

23. Heavy-duty transportation for taking potted plants into the field.
24. Site release form (filled out and mailed to the WPLBCP on the day of release)

25. 3-11 PVC posts – for marking release site and photo point
26. Camera and film

Outlets for Had to Find Materials and Videos

Beetles for rearing or filed release in July-August (Call for details):

- Cornell University, (607) 275-3786 (from New York Stat – minimum # to order)
- Beetles Unlimited, (608) 831-5601 (from Wisconsin – no minimums)

Insect netting (need approximately 78 inches of fabric/cage)
(WPLBCP supplies free with 3 year rearing):

- Venture Textiles
  115 Messina Drive
  Baintree, MA 02185
  (781) 794-1400

  56 inches of white or slate; 500 yd. bolt $1.10/yard; lesser yardage is $1.10/yard pluis $10 cut charge

Miscellaneous other supplies:

Aspirators (a small jar with hoses for collecting/moving beetles; about $7)

- BioQuip
  17803 La Salle Avenue
  Gardena, CA 90248
  (310)324-7931
  Fax: (310)324-7931

Videos:

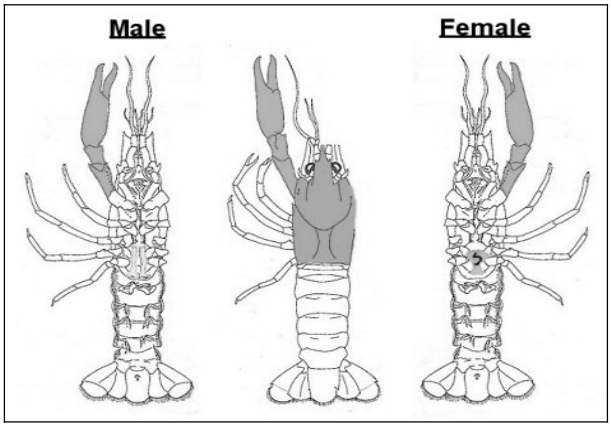
- "Restoring the Balance: Biological Control of Purple Loosestrife" – a summary of the problem, traditional and biological solutions and biological control safety.
- "Rearing of Biological Control Agents for Purple Loosestrife" – more rearing details.
  $25 each (but volume discounts apply)
  - Resource Center
    7 Business & Technology Park
    Cornell University
    Ithaca, NY 14850
    (607) 255-7660, ext. 2090
    Fax: (607) 255-9946

  (Your local and school libraries can also get these on inter-library loan from the Wisconsin DNR library in Madison for free!)

Section 5

Rusty Crayfish Monitoring Protocol

Citizen Lake Monitoring Network Version



Crayfish Introduction

Native crayfish are important members of aquatic ecosystems in Wisconsin. They perform many functions, including processing detritus and serving as food for game fish (Hobbs and Jass, 1988). There are 330 native crayfish species in the United States, of which 111 species are in periled or extinct.

In recent years, there have been changes in the distribution of crayfish species throughout Wisconsin. To gain a better understanding of these trends, the Wisconsin DNR has provided funding to the University of Wisconsin – Madison to conduct research, including a state-wide crayfish survey. This protocol outlines the methods for this survey. These surveys are to monitor the **native crayfish** populations as well as **rusty crayfish** (Orconectes rusticus) populations. Ideally the monitoring would take place over several years so that we can track what is happening on an individual lake basis.

The methods used in this manual are crayfish collection in lakes. Stream and river sampling have different sampling protocols and trap restrictions. Please refer to the current WI fishing regulations for these restrictions.

Changes in Protocol may be made in the near future. To keep current on protocols, please refer to http://limnology.wisc.edu/personnel/jakevz/ais.asp . (This site should become active spring of 2007).

Background on rusty Crayfish

Rusty crayfish are native to streams in the Ohio River Basin states of Ohio, Kentucky, Illinois, Indiana and Tennessee. They were likely introduced to Wisconsin waters primarily by anglers who used them as live bait. Rusty crayfish are aggressive and will "chase" native crayfish from prime habitat. When the native crayfish are chased out into the open, they are more susceptible to predation by larger fish. Rusty crayfish eat about 4 times the amount of food a native crayfish eats and will eat small fish, insects, fish eggs and aquatic plants. Rusty crayfish are messy eaters. When they snip off a plant to eat, they often only eat small pieces of the plant and the remainder of the plant floats away. If the rusty crayfish are eating Eurasian water-milfoil, they will actually be spreading the water-milfoil with their eating habits. Appendix 8 lists lakes with Rusty crayfish.

Hobbs, H.H. and J. P. Jass. 1988. The crayfishes and shrimp of Wisconsin. Milwaukee Public Museum: Milwaukee, Wisconsin.

Legal information about crayfish harvesting

2006-7 Crayfish Fishing Regulations
(from Guide to Wisconsin Hook and Line Fishing Regulations)

- A fishing or small game license is required to take crayfish.
- No person may possess live crayfish and angling equipment simultaneously on any inland water except the Mississippi River
- No person may place, deposit, throw or otherwise introduce live crayfish or crabs into any water of the state unless a permit authorizing introduction has been issued.
- Crayfish traps placed in trout streams shall conform to the dimensions of minnow traps.*

There are no bag or size limits on crayfish and no closed season except on the Wisconsin/Minnesota boundary waters where the open season is from May 1 to the following March 1, both dates inclusive.

Crayfish scoops may be used in the Wisconsin/Minnesota boundary waters provided the scoops do not exceed 4 feet in length, 3 feet in width and 18 inches in depth attached to a handle not to exceed 4 feet in length.

Crayfish may be taken in all waters by the following means only: By hand, by use of minnow seines and minnow dip nets, where the same are permitted for the taking of minnows, and by crayfish traps (other than in trout streams) with the entrance of the trap not to exceed 2-1/2 inches at the greatest diagonal measurement. Traps must bear the name and address of the owner and must be raised and emptied at least once each day following the day set.

Only parts of fish or fish by-products including fish meal or prepared parts of such fish may be used for bait.

Floats or markers used to locate traps may not exceed 5 inches in size, may not extend more than 4 inches above the water surface and cannot be orange or fluorescent in color.

***Minnow Regulations** *(*Guide to Wisconsin Hook and Line Fishing Regulations)

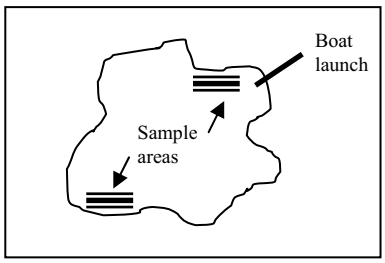
Bait minnows may be taken, where allowed, by the following methods only:

(*relevant excerpt*) With traps no more than 24 inches long and 16 inches in diameter or square with a throat measuring one and a half inches or less. All traps must bear their owner's name and address and be emptied at least once every 48 hours (once every 24 hours on trout streams). On Minnesota and Iowa boundary waters, minnows must be removed from traps at least once a day from one hour before sunrise to one hour after sunset.

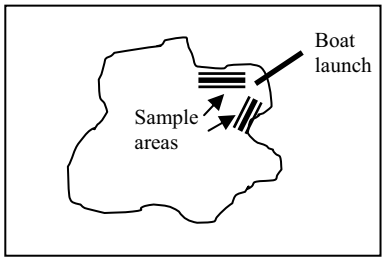
Site Selection

- **Crayfish reside in a variety of habitats including rocky substrates, sand flats and aquatic plant beds, so please sample a variety of ecosystem types**.

Lakes: The preferred method of sampling in lakes is to collect crayfish along two transects on opposite sides of the lake:



For large lakes, this may be unrealistic, so collect crayfish along the shoreline in each direction from the boat launch:



If the sites you used did not produce crayfish, you may want to sample several other locations on the lake – focus the additional monitoring efforts on areas with cobble. If your sampling did produce crayfish, no further monitoring is necessary. The goal of our program is to find out which lakes have rusties. If your group is interested in monitoring for densities and removal, you should refer to http://limnology.wisc.edu/personnel/jakevz/ais.asp for more details on this type of trapping. (This site should become active spring of 2007).

- **Crayfish are less active (and less trappable) when water temperatures are below 12 °C (54 °F).** Make sure that the water temperature is >12 °C (54 °F) before you sample. In Wisconsin, crayfish are most active from late June through mid-August. **Only sample your lake one time / summer.** There are rare crayfish in Wisconsin and they can be trapped out of a lake quite easily.

Equipment

Methods	Minnow or crayfish traps
Data sheets (appendix 5)	Buoys
Pencil	Rope
Whirl-Pak bags	Bait
Whirl Pak labels	Sharpie marker
Dip nets	Preservation alcohol (optional)

Traps used in this pilot were purchased through FRABILL.com. Other companies also sell traps. You can locate vendors by conducting a Google search on crayfish traps. For presence / absence monitoring, the trap style is not important. Trap style is more important when looking at population estimates and trapping for removal. Future presence / absence monitoring protocols may be modified to mesh with these other sampling designs.

Collection

In Wisconsin, crayfish are most active from late June through mid-August, so this is the best time to trap crayfish. **Only sample your lake one time / summer.** There are rare crayfish in Wisconsin and they can be trapped out of a lake quite easily.

Before initiating any monitoring, verify that your fishing license or small game license is valid. Please remember, no person may possess live crayfish and angling equipment simultaneously on any inland water except the Mississippi River, so please do **not** take your fishing equipment with you when doing the crayfish monitoring. It is beneficial to mark on a map where you collected your samples. This will help you and the research team document where the samples were taken. Make sure the site numbers on your map match with the site numbers on the data forms.

A combination of trapping AND hand/net collection provides the best information on crayfish distributions. Minnow traps are an effective way to collect crayfish, but trapping requires a visit to the sampling site on two consecutive days. Hand or net sampling can be done in one visit to the site. If sampling over a two day period is not possible, please collect the crayfish using only the net and hand collection described below. Feel free to use the hand / net collection techniques in addition to using the traps. The minnow trap style of trap is best for catching adult crayfish – especially adult males. The adult males are more aggressive and defensive of food and will also eat the juvenile crayfish in the trap. Hand netting is best for sampling juvenile crayfish.

Acceptable collection methods include:

- Modified minnow traps
- Hand collection
- Nets: Seines and Dip nets

Regardless of sampling method, be sure to **precisely** follow the **preservation**, **labeling** and **data recording** protocols.

Do NOT try to target one crayfish species. Be sure to collect and preserve individuals from **ALL crayfish species** present. The Center for Limnology is tracking native crayfish species and the impact of rusties on the native species; also other invasive crayfish have been found in Wisconsin lakes in the past.

For all types of active sampling, collect until you have retrieved 30 crayfish or when 40 minutes of "total search time" has elapsed, whichever comes first.

Minnow Trap Notes:

- Traps must not be longer than 24" in a designated trout stream.
- Traps must not be wider than 16" in any stream.
- The use of non-fish bait is prohibited without a collector's permit. Sardines and tuna are good bait.

1. Expand the trap opening to 4-5 cm. (1.5 – 2 inches) in diameter. This can be done by pushing an oar handle into the opening. Please note that traps may not have an opening larger than 1.5 inches in a designated trout stream. Since we are only sampling lakes, we do not have to worry about this restriction. Also note that if the holes are too large, you may trap and kill mink which swim in to eat the bait.

2. Put bait (about 1/4 pound) into a standard wire-caged minnow trap. Dead fish and/or sardines are good bait. Please note that the use of non-fish bait is prohibited unless you have a collector's permit.

3. Label and tag the trap. Floats and markers used to locate the traps must be less than 5 inches in diameter and cannot be orange or fluorescent. Traps must be tagged or marked with a contact name, street address, city, and phone number.

4. If you have minnow traps at home, it is ideal to set more than one trap at each site. If you only have one trap, you can sample 5- 10 days in one site and then move the trap from site to site. Ideally you would set 5-10 traps at each sample site. Traps should be at least 10 meters (30 ft.) apart from each other at water depths of 0.5 to 3.0 meters (2-10 feet). Select your sample sites so that you are monitoring both rocky areas (preferred) and other habitats (as available).

5. Leave the trap(s) overnight and remove it/them the next day. If you only have one trap, you can reset the trap in the same location. If overnight sets are not possible, please use the hand/net collection techniques described below.

6. If you do not catch any crayfish at your original sample sites, please feel free to trap in other areas around the lake. Crayfish tend to hold on cobble areas as it offers a hiding place for the crayfish. You may want to focus your monitoring on these sites if the original sites are not productive.

Dip Net, Hand Collection, and Seine Net:

This technique should be used *in combination* with trapping. When it is not possible to return the following day to pick up crayfish traps, use hand/dip net/seine net alone. For crayfish trapping, the dip nets can be the umbrella style (vertical lift net often used in sucker and smelt fishing). If the dip net has a handle, the net has to be at a 90 degree angle to the handle so that the net is raised vertically in the water. There is not minimum net size restriction, but the maximum net size is 8 feet in diameter for the umbrella style.


Umbrella style net


Dip net with 90 degree bend to handle

1. **Use a collection technique that suits the conditions**. In conditions of reduced water clarity, a seine net works best. Crayfish can also be collected by hand (mask and snorkel) or with a dip net, this method works well in lakes.

2. **Distribute your collection efforts over a variety of habitats, including rocks, vegetation, and sand.** Try not to concentrate your sampling effort in one small area.

3. **Collect until you have retrieved 30 crayfish or when 40 minutes of "total search time" has elapsed, whichever comes first.**

Water characteristics:
If you have a dissolved oxygen kit or meter and/or a thermometer, measure the dissolved oxygen (DO) and temperature of the water approximately one foot from the bottom and record the results on the data sheet. Estimate the substrate/habitat characteristics of the area you sampled and record them as percent cover (see data sheet Appendix 5 for listing of substrate type).

Preservation

All crayfish are to be preserved and later identified by employees of the UW-Madison Center for Limnology. Please follow these guidelines when preserving crayfish:

1. **Place the collected crayfish into Whirl-Paks.** Preserve up to 30 total crayfish for the site; using approximately 1-3 whirl-paks. Include a variety of sizes and crayfish from both nets *and* minnow traps. If less than 30 crayfish were collected, preserve all of them.

   Do not overfill the pack with crayfish – to prevent decay, each Whirl-Pak should only be ¼ full of crayfish.

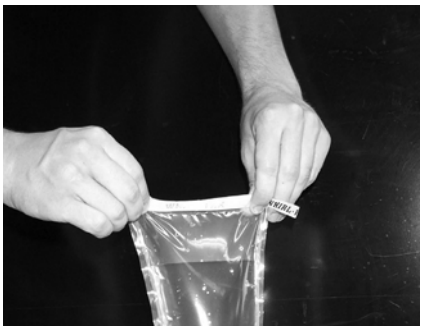
   Use new Whirl-Paks at each site and be sure they are **well labeled**. Do not mix crayfish from different sites.

2. **Fill the pack with minimum 70% alcohol (rubbing alcohol) if you have it.** Larger size bottles of alcohol can be purchased at hardware stores in the paint / refinishing sections of the stores. If you do not have alcohol, you can place the crayfish in a cooler that contains ice and

then take the crayfish back to you house where you can freeze the Whirl-Paks and crayfish (see step 5). If using alcohol, there should be approximately three parts alcohol to one part crayfish.

3. Liquid-proof labels have been provided for your use. **Be sure to USE A PENCIL to fill out the labels**, and place them *inside* the Whirl-Paks. DO NOT label the outside of Whirl-Paks with a permanent marker; alcohol leakage makes the ink disappear!!! ***SAMPLES WITH UNCLEAR LABELS CANNOT BE USED IN THIS STUDY!!!*** **Place a label *inside* the whirl-pak with**:
    a. Date
    b. Site # (*Use the same number as the data sheet)*
    c. Lake name
    d. Water Body Identification Number (WBIC)
    e. County
    f. Whirl-Pak # of total.

4. **Seal the Whirl-Pak.**



Step 1: Fold the top of the Whirl-Pak 4-5 times.

Step 2: Fold the wire tabs in front and twist together 4-5 times to seal the pack.

5. **Store the samples in freezer.** Even if you have alcohol in the bags, freezing will help slow the rotting process even further. If you cannot freeze the sample(s), finish the reporting and deliver the crayfish to your local DNR office. They can place the samples in their freezer.

Recording the Results

A data sheet (appendix 5) must be completed for each sampling site.

A sampling site is defined as one lake site/location. Water characteristics only need to be measured at only one site.

Please try to fill in all information on the data sheets.

Site # – Record a site # that can be matched to the preserved samples. Make sure to have the site numbers also match with the site numbers marked on your map.

Date – The date that the traps are pulled out and/or collection by dip net, hand, or seine net is conducted. Record the format as **DD/MM/YYYY**. For example: 20/06/2004 (June 20, 2004)

Time – Time of day that the traps are pulled out and/or collection by dip net, hand, or seine net begins.

Water Body – Official name of the lake or flowage.

Water Body Identification Code - The WBIC is important if your county has several lakes with the same name. The WBIC distinguishes which lake the sample is from. The WBIC can be found at the following DNR web site: http://dnr.wi.gov/org/water/fhp/lakes/alpha/lakes_a.htm. Please contact your local CLMN staff (page vii) if you need further assistance on the WBIC.

Type – Circle the most appropriate choice.

Location – Include a precise description of the sample site location. Use township, range, and section descriptions (a Gazetteer may be useful) and attach a map if possible.
For example: "Left of boat launch on east side of Clam Lake"

County – The name of the county.

If you have a GPS Unit – Record the latitude and longitude of the sample site as it appears on the GPS receiver. Please circle DD if the units are decimal degrees or DMS if the units are in degrees, minutes, seconds.
Decimal degrees look like this:

46.043056° N
89.670556° W

Degrees, minutes, seconds looks like this:

46° 02' 35" N
80° 40' 14" W

Collector Names – List the names of each person at the sampling site.

Organization – Indicate which group/organization you are affiliated with. For example, DNR or CLMN. Research uses this information in their data analysis.

Optional - Water temperature – Record water temperature in **°Fahrenheit**.

Optional - Dissolved oxygen (DO) – Record DO in **mg/L**.

Substrate – Give a general description of the habitat in the sampled area – see monitoring data sheet for substrate types. Example, "3 traps in 80% cobble and 20% sand"; or "2 traps in 100% muck with some weeds" or "40 minutes of search time on cobble." Include details and special characteristics in the comment section at the bottom of the data sheet.

Number of traps – The total number of traps for this site.

Duration of trap set – Record the total number of hours that the traps were in place.

Average water depth – Record the average water depth of the traps at this sample site.

Total search time – Record the number of person-minutes spent collecting (should not be more than 40 person-minutes). For example: 2 people searching for 20 minutes each = 40 person-minutes

Equipment – Place a check by each type of equipment used.

Number of crayfish collected at this site – Count and record the total number crayfish caught at this site (regardless of method).

Number of Whirl-Paks used for preservation – Record the number of packs associated with this site.

Other comments – Record any additional notes that may be relevant for this site.

Transportation

At the end of the summer sampling season, all of the preserved crayfish will be cataloged by the UW-Madison Center for Limnology. Take your samples to your **local CLMN staff (page vii). Please phone your contact ahead of time to ensure they are in the office on the day you plan deliver the samples.** Regions will arrange for transport to Center for Limnology. **Please try to get your crayfish to your DNR contact by early September.**

Contact Information

If you have questions or concerns during your sampling efforts, please contact:

Jeff Maxted (jtmaxted@wisc.edu)
Research Specialist
UW-Madison Center for Limnology
(608) 262-3088

Section 6

Zebra Mussel Monitoring Protocol

Citizen Lake Monitoring Network

Zebra Mussel Background

Zebra mussels are native to the Ponto-Caspian region of western Russia. The Zebra mussels were first found in Lake St. Claire in 1988. They were accidentally introduced to North America in ballast water from a boat that traveled across the ocean. Zebra mussels first arrived in the Wisconsin waters of Lake Michigan in the Racine harbor in 1990. Since that time they have "hitched rides" on boats and become established in more than 70 inland waters. Zebra mussels are most frequently transported from an infested lake to other lakes as mature mussels attached to aquatic plants. Be sure to remove all aquatic plants from boating equipment, including your trailer, boat, motor/propeller and anchor before launching and after leaving the water. By removing aquatic plants from boating equipment and encouraging others to do the same, you can help protect Wisconsin lakes from zebra mussels.

Zebra mussels come in many colors. Most are white or cream-colored with jagged brown or black stripes. However, some individual mussels have been found that are all-white, all-black, or have stripes going the other direction. Mussels and clams are bivalve mollusks. Bivalves have two shells that are held together by a strong ligament. Many of the mollusks we call clams are in fact mussels.

Zebra mussels reproduce when the water temperature gets above 54 degrees Fahrenheit. Male zebras release a cloud of sperm into the water. Female zebras release a cloud of eggs. A female zebra mussel can produce 30,000 to 1,000,000 eggs in one year. The fertilized eggs quickly develop into microscopic free-swimming larvae called veligers (VEL-i-jers). Veligers feed on tiny phytoplankton and begin to grow shells. The water currents can cause veligers to travel great distances. At 3 - 5 weeks, the veligers' shells weigh enough to cause them to sink. They must find something to attach to or they will die. Some of the veligers attach to hard surfaces with their sticky byssal threads. Hard surfaces include rocks, wood, glass, metal, native mussels, aquatic plants, and each other. They now change from free-swimming larvae to anchored mussels. Luckily, only 2-3% of the veligers survive to this stage (that is still 6,000 – 30,000 per female mussel, so that is a lot). Zebra mussels form dense clusters that attach to hard surfaces. The young zebra mussels reach sexual maturity during their first year and are ready to continue the cycle. These mussels are normally small, about 1 ½ inches in length, but sometimes grow larger (2 inches).

When zebra mussels feed on plankton, they remove incredible amounts of food from the water. Zebra mussels take in water; filter food from it and expel excess water and unwanted particles such as blue-green algae. A single mussel can filter about 1 quart of water each day. They leave the water clear, sometimes too clear. With plankton removed from the water, more sunshine reaches the bottom. Plants living here grow rapidly. Light sensitive fish such as walleye may move to deeper waters. Zooplankton and small fish which feed on plankton have less to eat. Their numbers decrease. Larger fish which feed on the small fish decrease in number. The zebra mussels take food, space, and oxygen, causing the death of native mussels. Zebra mussels do not eat filamentous algae or blue-green algae, thus these slimy algal populations will increase. This will cause unsightly algal blooms. Some of the blue-green algae become toxic when they die off.

In addition, zebra mussels can clog the intakes on boat engines, and intake pipes for utilities and industrial facilities; and their sharp shells can cut the feet of beach walkers. When they die they

wash up on the shore and begin to decay. These shells pile up on beaches, in some cases there will be "windrows" several feet thick of these shells.

Refer to appendix 9 for a list of lakes with zebra mussels.

Zebra Mussel Monitoring

Veliger Monitoring
DNR staff annually selects water bodies to sample for zebra mussel veligers (larvae). The veliger monitoring equipment is too expensive to distribute to individual lake volunteers, thus the goal of our network is to have the volunteers provide a boat and assistance to DNR staff. Since the volunteer's boat stays on the lake, the DNR staff does not have to disinfect boats before and after the collection and they do not have to trailer boats to the lakes they are monitoring. Since the volunteer would be assisting in the monitoring, only one DNR staff would be required to do the sampling safely and efficiently. If you have an interest in assisting with veliger monitoring, contact your local DNR staff (page vii).

Adult Mussel Monitoring
Adult zebra mussel monitoring serves several purposes: (1) to track the spread by collecting additional data on lakes where veliger monitoring is not being conducted, (2) to verify a reproducing population if veligers have been identified as being present in a water sample, and (3) to determine the population densities of mussels after an infestation has occurred.

Adult zebra mussel monitoring on inland waters is accomplished using one of two methods:
A. Shoreline surveys and regular inspections of structures in the water to determine the presence/absence of zebra mussels. <u>This method is normally used on lakes that are not known to have zebra mussels. This method is more productive than using a substrate sampler as it covers a larger area on the lake.</u>
B. Substrate sampler monitoring (substrate refers to any substance in the water that zebra mussels may attach to) to estimate population densities. <u>This method is most often used when zebra mussels have been found on a lake and DNR is trying to determine the densities of the mussels.</u>

Method A: Shoreline Surveys

<u>Sampling Equipment:</u>
Rubbing alcohol
Zebra mussel data sheets
Hand lens 30X

Shoreline surveys and inspections of structures in the water are conducted to identify the presence or absence of adult zebra mussels. A single observer can monitor thousands of square meters of substrate at a given location in a short period of time – covering a larger surface area than a set of substrate samplers (see Method B).

Shoreline survey:

- Conduct shoreline surveys about once every two weeks from ice out to ice on. More or less frequent observations may be conducted if desired.
- Target areas around public boat ramps or areas that are likely to have a lot of boating traffic in the vicinity (for example, fishing hot spots, resorts, campgrounds, etc.).
- A survey may be conducted while swimming, taking a casual stroll along the shoreline, or fishing.
- Any solid surface is a suitable substrate to observe. Rub your hands along some of the submerged surfaces. Zebra mussels on the surface will feel like sandpaper. Divers can monitor in deeper water, or small rock (from deeper water) can be lifted through use of a net.
- In the fall, check your dock, piers, buoys and boats when you are removing them from the lake. Some residents prefer to do this monitoring in the spring prior to placing their equipment back in the water. In spring, the algae will have dried, leaving just the zebra mussels behind. Also, residents are often rushed when the equipment is pulled out in the fall. There may be more time to check in the spring.
- Zebra mussels do not like direct sunlight and are more often found on the underside of rocks and in cracks and crevices of rocks and structures. Small zebra mussels can be attached to plants as well.

Zebra mussels attached to native water-milfoil.

Reporting Zebra Mussel Monitoring Results:
A negative report can be as important as finding zebra mussels at a location. It is important to know where people are looking for zebra mussels in order to make decisions about whether zebra mussels are present at a given location. One cannot confidently state that zebra mussels are not present in an area if no one has looked. All monitoring efforts should be reported on the zebra mussel datasheets and submitted to your local Citizen Lake Monitoring Network (page vii) or Ron Martin at 101 South Webster St., Madison, WI 53707. Complete the zebra mussels reporting form Method A, electronically available as form 3200-122 A at http://intranet.dnr.state.wi.us/itworks/forms/eforms.asp or a paper copy in appendix 5.

Collect any mussels that you believe are zebra mussels. Place them in rubbing alcohol and deliver them to your local CLMN contact (page vii). **It is illegal to mail alcohol through the Postal Service.**

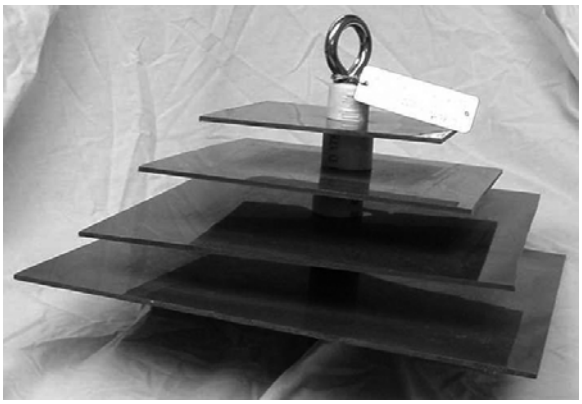
Method B: Substrate Sampler Monitoring

This method is often used once zebra mussels have been found on a waterbody or upstream waterbody. Some DNR regions also use this method on lakes not known to have zebra mussels. Contact your local CLMN contact (page vii) to see if substrate sampling is an appropriate monitoring technique for your lake. Plate samplers and hand lens will be provided to you by this staff.

Sampling Equipment:
Substrate samplers (figure 2 and appendix 4)
Rope or chain (rope may get chewed on by muskrats etc.)
Anchor (e.g. concrete block)
Rubbing alcohol
Zebra mussel data sheets
Hand lens 30X

The substrate sampler is a series of four square-plates that are 6, 8, 10 and 12 inches in size, pyramiding from smaller plates at the top down to larger plates at the bottom. The plates are made of 1/8 inch grey plastic PVC stock with ¾-inch PVC pipe for spacers (1-inch sections) between the plates. The sampler is held together with an 8 inch long 3/8 inch diameter stainless steel eyebolt, plus washers and a wing nut. Each sampler has a DNR tag attached that provides a phone number for further information. Samplers will be provided by your local CLMN contact. Detailed directions to build a substrate sampler are found in appendix 4. Note - the substrate samplers are easily disassembled and cleaned for the next sampling season.

Substrate sampler for zebra mussel monitoring.



Substrate samplers are analyzed on a regular basis to determine if zebra mussels are present. Substrate sampler monitoring documents the arrival of zebra mussels, tracks the spread of zebra mussels, and determines zebra mussel population growth and seasonal abundance. Using a 30x-hand lens, mussels should be counted and the lengths recorded. This level of monitoring will provide estimates of population density and help determine when zebra mussels are settling in an area.

Placement of Substrate Samplers

- Place the substrate sampler in an area where there will be little chance of vandalism.
- Hang the substrate sampler from a dock, pier or other structure found in the water. An existing float or buoy may be used to suspend the sampler in the water column. If you plan to use a new float / buoy, a waterway marker application and permit form is necessary.
- Place samplers in areas where zebra mussels are most likely to be found. Pay special attention to areas in which zebra mussels may have been transported from infested waterways (for example, public and private boat landings, water access sites, fishing hot spots, resorts, campgrounds, etc.).
- Avoid placing substrate samplers in areas where there is strong current.
- Put two samplers at each location chosen for monitoring. Place the samplers one above the other (one higher in the water column than the other). The top sampler is removed and analyzed every four weeks, then placed back into the lake for the next sampling period. The second (bottom) sampler remains in the water for the entire monitoring season (May-September). Securing the two samplers on the same line with clips makes it easy to replace the top one every four weeks. A small concrete block anchor works to hold the sampler(s) in place (and provides an additional substrate sampler to examine). Rope can be used to suspend the sampler, but sometimes wildlife will sever the rope. Chains work well to better secure the samplers in those locations.
- Suspend substrate samplers at mid-depth in water.

Analysis of Samples for Quantitative Monitoring of Adults

1. Place samplers in small, white or clear garbage bags before removing it from the water.
2. At home, disassemble the sampler and examine each plate with a 30x-hand lens. Scan all four plates, top and bottom, looking for zebra mussels.
3. Recently settled post-veligers can be very small. If you were to rub your hands along the plate, the surface will feel like sandpaper. If you believe that you have detected post-veligers, please hand deliver these to your local CLMN contact (page vii).
4. Count the number of zebra mussels found on the top and bottom of each plate and record these numbers separately (use zebra mussel Method B forms, appendix 5).
5. Report the lengths of the smallest and largest mussels on the plate to the nearest millimeter (1/16-inch). Measure the longest axis of the shell. See diagram below.

6. For an initial discovery, all zebra mussels collected should be placed in rubbing alcohol for expert verification. Complete the zebra mussel reporting form and hand deliver the form and the specimens to your CLMN contact. **It is illegal to mail alcohol through the Postal Service.**

7. Note: Sampler plates can be thoroughly scrubbed, dried, reassembled and reused next year.

Reporting

Complete the zebra mussels reporting form Method B, electronically available as form 3200-122 B at http://intranet.dnr.state.wi.us/itworks/forms/eforms.asp or a paper copy in appendix 5 below. Send the completed form to your local CLMN contact (page vii) or Ron Martin, 101 South Webster Street, Madison, WI, 53707.

Samples should be clearly labeled with all requested information. Both field staff and volunteers that monitor for adults use the same data sheets. For tracking the movement of zebra mussel infestations, a negative report is as important as finding zebra mussels at a location. All monitoring efforts should be reported on the zebra mussel reporting form and submitted to DNR.

Volunteers should also provide DNR with a lake map showing the location of the monitoring sites. The zebra mussel monitoring sites, along with the names and addresses of the monitors, are maintained and updated periodically. Maps showing all the sampling locations (for adults and veligers) are recorded on the GIS network and are available on the DNR web page: http://dnr.wi.gov/org/water/wm/GLWSP/exotics/zebra.html.

Section 7

Mystery Snail Monitoring Protocol

Citizen Lake Monitoring Network

Mystery Snail Background.
There are three species of mystery snails in Wisconsin. Only one of these species, the brown mystery snail (*Campeloma decisum*), is native to Wisconsin. The Chinese mystery snail (*Bellamya japonica*) is also called the Japanese mystery snail as well as the Oriental mystery snail. The Chinese mystery snail is native to Asia. The banded mystery snail (*Viviparus georgianus*) is native to the southeastern US.

Mystery snails thrive in silt and mud areas although they can be found in lesser numbers in areas with sand or rock substrates. They are found in lakes, ponds, irrigation ditches, and slower portions of streams and rivers. They are tolerant of pollution and often thrive in stagnant water areas. Mystery snails can be found in water depths of 0.5 m to 5 m (1.5 to 15 feet). They tend to reach their maximum population densities around 1-2 m (3-6 feet) of water depth. Mystery snails do not seem to eat plants (macrophytes). Instead, they feed on detritus; and in lesser amounts algae on the mud and phytoplankton. Thus removal of plants in your shoreline area will not reduce the abundance of mystery snails.

Lakes with high densities of mystery snails often see large die-offs of the snails. These die-offs are probably related to the lakes warming coupled with low oxygen (related to algal blooms). Mystery snails cannot tolerate low oxygen levels. High temperatures by themselves seem insufficient to kill the snails as the snails could move into deeper water.

The female mystery snail gives birth to live, crawling young.

Chinese Mystery snails are a source of food in Asia. They were first imported into the US in 1892, and sold in a Chinese market in San Francisco (Wood 1892). Some communities still harvest the Chinese Mystery Snail and use them as a food base.

Monitoring Background
In 2006, the Center for Limnology has intensively surveyed 45 Wisconsin lakes for Chinese and banded mystery snails. These snails were present in nearly 40% of the sampled lakes! This way beyond what they had expected. They are now analyzing the data now to see how the snail's presence correlates with native snail abundance, water chemistry, etc. The Center for Limnology has also completed a large, outdoor experiment examining how Chinese mystery snails and rusty crayfish affect native snails. The preliminary results are clear-cut -- both invaders have strong negative effects on the natives. The Chinese mystery snail, owing to its larger size, is relatively immune from rusty crayfish attack while other snails are often fed on by the rusty crayfish.

The Center for Limnology is interested in any and all records of the mystery snails and their densities in Wisconsin lakes. They are also interested in lakes that do not have these mystery snails as they are beginning to assemble a database of invaded lakes in WI. The Center for Limnology is still learning about differences in densities through out a lake. Often we see areas of the lake with higher snail densities than other areas on the same lake. This may be related to calcium levels (higher is better) and food levels of that area.

Many lake residents are worried about mystery snails being carriers of the Swimmer's Itch parasite. In theory, they are potential carriers. However, as an invasive snail, they are less likely to harbor parasites because of a lack of evolutionary relationships. This remains an open and important question that warrants more research. The Chinese mystery snails that the Center for Limnology dissected (they were looking for parasites) did not have swimmer's itch parasites.

Control Options

There is no legal chemical control method for mystery snails in Wisconsin. Any chemical that have the potential to control Chinese and banded mystery snails would impact the native snails, clams and other organisms and is illegal. Some residents have raked the mystery snails out of their lake. This is legal. The lake residents then took the snails and buried them so that the snails did not stink when rotting. Some have also added lime to the hole to deter raccoons and skunks from digging up the snails. If you do bury the snails removed from your lake frontage; please bury them away from the lake so that you are not impacting your shoreline area.

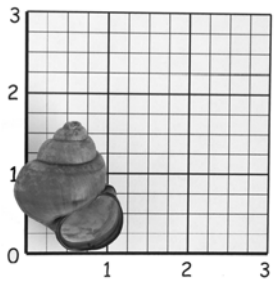
Identification

One of the main identification features of the mystery snails is their size. Adult sails of some species are over 1 ½ inches in length. Snail shell length is measured from the lip of the shell to the tip of the whorl. All mystery snail species will show corrosion ("chipping" and "weathering") on the top of the whorl of the shell. This is particularly true in soft-water lakes. Mystery snails have opercula (singular operculum) which are "trap doors" that can be closed. This operculum is darkly colored, solid in consistency with concentric rings. Most native snails do not have opercula. Since mystery snails give birth to live young, you may find these small snails "inside" of the adults.

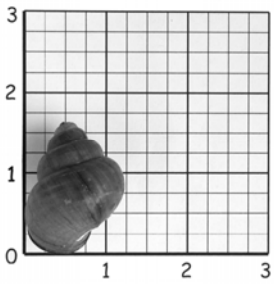
Chinese Mystery Snail – non-native

Identifying features Chinese mystery snail (see photos below):

- Adult snails are often over 1.5 inches in length.
- Operculum (trap door) present
- Typically light to dark olive green
- Uniform coloring on the shell (no banding)
- Chinese mystery snail is often wider than the brown mystery snail.



Ventral view (scale is inches)



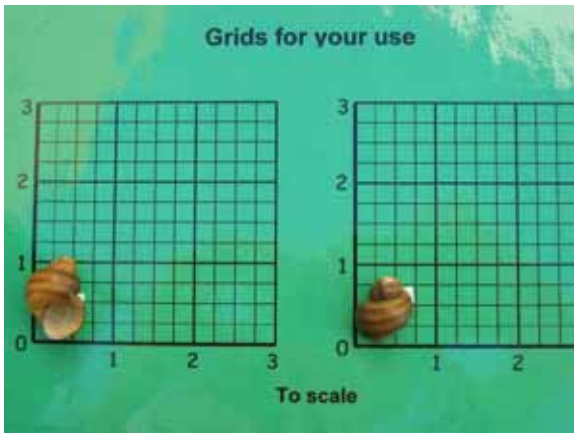
Dorsal view (scale is inches)

Ventral view and operculum

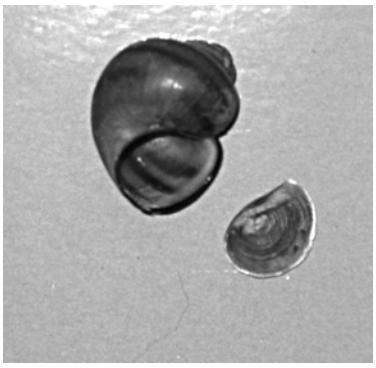
Banded Mystery Snail – non-native

Identifying features of the banded mystery snail:

- Can get up to 1.5 inches in length
- Distinct reddish-brown bands along the shell. This feature is VERY obvious in bleached shells, but a little more subtle among living snails.



Ventral view Dorsal view

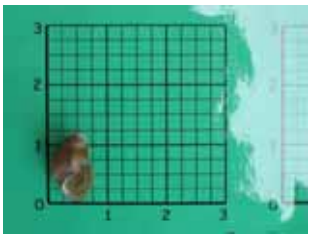


Ventral view with operculum

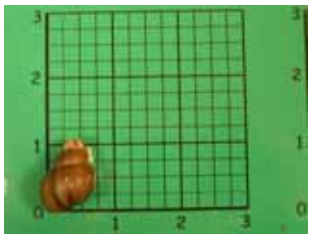
Brown Mystery Snail - native

Identifying features of the Brown Mystery snail (see photo below):

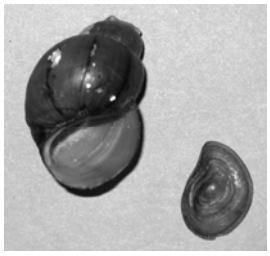
- Rarely reaches 1.5 inches in length.
- Operculum (trap door) present
- Typically olive green
- The width to height ratio is smaller in the brown mystery snail than in the Chinese mystery snail (the brown mystery snail is narrower than is Chinese mystery snail - which tends to be very wide).



Ventral view (scale is inches)



Dorsal view (scale is inches)



Ventral view with operculum

Monitoring Protocol:

- The best time of the year to monitor for the mystery snails is late summer, but monitoring can take place anytime you are on the water.
- Look for the "large" snails along the shoreline. Shells of dead snails are often found near the high water mark of the lake, particularly on the downwind side of the lake.

- Mystery snails can be found in the shallows out into the lake where the water depth reaches 15 feet. You may want to look for them while boating. Take a landing net to collect snails in deeper water.
- Mystery snails are often found in areas with mud and / or sand. They seldom are found in rocky areas or areas with a lot of plants.
- Collect the largest snails present. Small snails are hard to differentiate by picture alone. If you only find small snails, preserve them as directed in (2) below. Banded snails are often smaller than Chinese mystery snails, but careful inspection will usually reveal the telltale stripes without a problem.
- Conduct a 10 minute "rapid assessment" of lakes near the boat landing, walking the shore looking for shells on the shoreline and in the shallow water area. If you find snails, there is no need to continue monitoring for the full 10 minutes. Fill out the data form and keep this record with the snails. Stop monitoring if you do not find snails after 10 minutes of looking and send in the data form letting us know that you monitored but did not see any mystery snails.

If you find what you suspect is a mystery snail you can do one of two things.

(1). Take digital pictures of the snail next to a ruler or on the green paper grid system provided and email that pictures as well as the information requested on the mystery snail reporting form (appendix 5) to Dr. Pieter Johnson (pieter.johnson@colorado.edu) with the heading "MYSTERY SNAIL".

TIPS:

- To reduce glare, take pictures of dry shells;
- The marking of the shells shows up better in pictures if you take the pictures of shells without the bodies inside. You can freeze the snails to kill them. Defrost the snail, and the snail bodies can be pulled from the shell quite easily (a lot easier than if you kill the snails with alcohol).
- The camera flash will cause glare - take several pictures to get glare off of shell or leave the flash off (take pictures outside for more light).
- Take ventral and dorsal pictures.
- You will want to keep the shells until Dr. Johnson lets you know what species you have. If the pictures do not work out, the Center for Limnology may need to see the shell.

(2). Place several snail shells in a ziplock bag and deliver them and the data reporting form (appendix 5) to your local CLMN contact (page vii). If there are still live snails in the shells, you can freeze the snails and then deliver the frozen snails to the staff. By freezing the snails, the snail bodies can be pulled from the shell. If the snails are killed by placing them in alcohol, the snail bodies cannot be pulled from the shells easily.

For more information on Chinese mystery snails, please refer to: Wood, W.M. 1892. Paludina japonica Mart. For sale in the San Francisco Chinese markets. Nautilus 5:114-115. http://nis.gsmfc.org/nis_factsheet2.php?toc_id=125.

Section 8
Waterflea Monitoring Protocol

Citizen Lake Monitoring Network

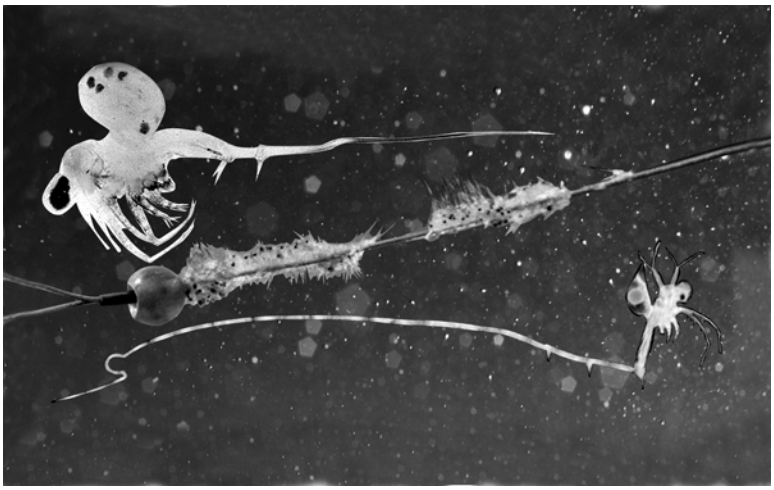


Photo from: University of Minnesota Sea Grant Program.
Spiny waterflea - upper left, actual size on downrigger cable - center, fishhook waterflea - bottom right

Waterflea Background
Spiny waterfleas (*Bythotrephes longimanus*) and fish hook waterfleas (*Cercopagis* sp.) are large (up to ¾ inch), predatory crustacean zooplankton native to parts of Europe and Asia. Both species of waterfleas entered the Great Lakes in ship ballast water from Europe. The spiny waterflea arrived in the 1980's, followed in the 1990's by the fishhook waterflea. One or both species are now found in all of the Great Lakes. Spiny Waterfleas were found in the Gile Flowage, a lake in Iron County near Lake Superior, in September 2003. This is the only invasive waterflea that has been found in an inland Wisconsin Lake. Both the spiny and fish hook waterfleas can be transported from an infested waterbody to another lake if they are attached to fishing gear and boating equipment.

Outside of *Mysis* shrimp, spiny waterfleas are considerably larger than any naturally occurring lake zooplankton. Spiny waterfleas are readily distinguished by their long tail spines, which generally support between one and three barbs. Fishhook waterfleas have smaller barbs on their tails and the end of tail has a "fishhook" shape. Both spiny and fish hook waterfleas are often first noticed by anglers and recreational lake users. These invasive waterfleas have a tendency to become entangled on fish lines, anchors, downrigger cables, and other types of gear used in boating activities. Masses of waterfleas can clog the first eyelet of rods, damaging a reel's drag system. Extreme care should be exercised to avoid transporting these organisms between lakes.

Spiny and fishhook waterfleas are predators – they eat smaller zooplankton (planktonic animals), including Daphnia (native waterfleas). This puts them in direct competition with juvenile fish for food. Additionally, young fish have trouble eating these waterfleas due to their long, spiny tails. Therefore, invasive waterfleas have the potential to disrupt food webs.

The spiny and fishhook waterfleas reproduce rapidly sexually and asexually. This means that no males are required and a single female can start a new population. Fishing, boating and other water recreational equipment can transport waterfleas and their eggs to new water bodies. Their resting eggs can survive long after the adults are dead, so care must be taken not to transport water between an infested lake and a non-infested lake. Drain all water from the boat and equipment to make sure all waterfleas and eggs are removed.

Monitoring Background
Spiny waterfleas (*Bythotrephes longimanus*) and fish hook waterfleas (*Cercopagis* sp.) are large (up to ¾ inch) and can be seen by the naked eye. Lake residents could be the first ones to find the waterfleas on a lake. It all depends upon how close you look at your lake and the water in your lake. Some lake groups collect algae and zooplankton samples on their lakes. These folks will probably be the ones that find the waterfleas in their lake tows.

DNR staff annually selects water bodies to sample for waterfleas. The monitoring equipment (zooplankton tow net) is too expensive to distribute to individual lake volunteers. One of the goals of our network is to have the volunteers provide a boat and assistance to DNR staff. Since the volunteer's boat stays on the lake, the DNR staff does not have to disinfect boats before and after the collection and they do not have to trailer boats to the lakes they are

monitoring. Since the volunteer would be assisting in the monitoring, only one DNR staff would be required to do the sampling safely and efficiently.

Volunteer Monitoring

Some lake groups are monitoring algae and zooplankton on their lakes. These folks could look for spiny and fish hook waterfleas in the samples they collect. For groups that have monies for monitoring equipment, zooplankton nets can be used to sample the lake water column for these waterfleas. These nets do not have to be the same net size (circumference or length) that the DNR uses; you can use a smaller version. For those without a net, you can Google search on "make your own plankton net" to find directions to making a plankton net. One site that seemed to be detailed yet easy to understand is http://archive.orr.noaa.gov/living/watercolumn/plankton.html. You should follow the other protocols that the DNR uses (listed below). Please note on your data sheet what type of net you used in the collection. By using the smaller net size, you will not be sampling as much water volume as the DNR staff. You may want to take additional samples to increase the amount of water sampled.

Agency Monitoring

Monitoring protocols may be modified once we learn more about the life cycle of waterfleas and infestation rates of inland lakes. **These protocols are included so that you know what will be expected of you and what the DNR staff will be doing on the lake.**

Agency Sampling equipment (other than the boat & anchor, equipment will be provided by DNR)
Boat/Anchor
0.5-1 meter diameter, 250-micron mesh plankton net
Rope on net with the meter increments marked
Vinegar/Large container to hold plankton net for vinegar bath
250 ml plastic bottles
1-liter plastic bottles
Alcohol, 95% alcohol (190 proof ethyl alcohol)
Lake Maps
Water flea data collection sheet (appendix 5)
Cooler with ice
GPS unit – *optional*

Target Sampling

- **Frequency**
  Ideally, three samples should be collected from a particular lake on three dates between June and September (for a total of nine samples per lake). Samples should be collected at monthly intervals after the water temperatures reach 54 degrees. The first collection dates will vary from early to late June.

  When time and staff constraints exist, sampling can be downsized to three samples per lake for one sample period during mid-summer.

- **Sample Location**
  On each sampling date, Waterflea samples should be collected from three different locations in a lake. The sites should be in different bays or basins or at several of the more heavily used lake sites. The three sampling sites should be deep enough to sample, so 15 to 20 feet of water is a good rule of thumb. The deepest point of the lake and areas near boat landings (sites of boat traffic) or lake's outlet are the best locations to sample. Mark on the lake map where samples were collected. These same sites should be used for each of the sample periods – if not, then submit a revised map with subsequent samples.

- **Collection**
  1. Collect sample with a large diameter (0.5-1 meter opening) zooplankton net with a mesh size of 250 microns. Smaller nets can easily clog with small forms of phytoplankton and zooplankton and can allow spiny waterfleas to elude capture.

  2. A 100 meter horizontal tow is best suited for capturing Waterfleas. You can use a GPS unit to measure distance and/or rate of travel or you can tow the net for 120 seconds at a low boat speed (~3 km hr^{-1}) that prevents the net from surfacing (horizontal tows are facilitated by adding weight to the zooplankton net; tie a loop in the rope approximately 0.5-1 meter in front of the net and attach a weight [e.g., a brick with a hole in it] using an additional piece of rope or cable tie). Ideally, horizontal tows should be oblique, sampling from the top of the thermocline to just below the water's surface. Care must be given that the net does not hit the lake bottom. When the net hits the lake bottom, the sample is of muddy water, which is very difficult or impossible to analyze. If you hit the lake bottom, rinse out the sampling equipment and go to a different area of the lake that will provide enough depth for a good tow.

  3. Be sure to rinse the net from the outside of the net so that all of the material washes into the plankton collection cup. Since waterfleas are large, you will likely, but not always, see them in the collection cup if they are present.

  4. Record sampling information on the waterflea collection data sheet (appendix 5).

  5. Condense the size of the sample by filtering out as much water as possible in the field. You should "swirl" the sample, so that the excess water drains out the screens. <u>If you plan to look through the sample yourself, please skip to #9</u>. Swirling the sample helps reduce the amount of alcohol that needs to be added and aids in the analyses as well.

  6. Preserve the sample using 95% alcohol. Rubbing alcohol can be used if you have it. Larger size bottles of alcohol can be purchased at hardware stores in the paint / refinishing sections of the stores. The ratio should be 4 parts alcohol to 1 part sample. Note: If the prescribed alcohol to sample ratio (4:1) can not be achieved after repeated

condensing and decanting, then the sample should be split between two sample bottles. Label each with the same information (as specified under "Processing the Sample – Field"), and label one as "Split 1 of 2" and the other as "Split 2 of 2".

7. Repeat the process at the other two pre-selected sites. Composite the samples from the three sites into one 250-ml or larger (1-liter) bottle and receive a single enumeration for the lake.

8. Transport the sample bottle(s) on ice in a cooler.

9. Identification of waterfleas can be conducted by the region water quality biologist or you can look through the sample yourself. Place sample in a white cake pan style dish. Make sure there is enough water so the sample floats. Then look for the waterfleas. Spiny and Fishhook Waterflea Watch and Wild cards are excellent resources for identification. If you find anything that you think are spiny or fish hook waterfleas, the samples should be preserved in alcohol and driven to your local CLMN contact (page vii). **It is illegal to mail samples that contain alcohol**. Make sure you fill out the data form and bring it with the sample. Be sure to write legibly and with indelible ink (e.g. Sharpie) – do not use a ball point pen, as the ink is soluble in alcohol. If no spiny or fish hook waterfleas are found, please send in your data form showing that you sampled and no waterfleas were found.

Label sample bottles with the following information:

- Sampler's name
- Sampler's phone number - lab may need to contact you regarding the sample
- Lake name
- WBIC
- County
- TRS
- *optional* - Sample site Latitude/Longitude locational data using a GPS unit
- Site number
- Net opening diameter
- Sample date
- Number of tows
- Depth of the tows
- Preservatives added

Shipping Samples

Waterflea samples will not be shipped by volunteers as ethanol (4 parts ethanol: 1 part sample), is a hazardous materials because of its flammability (the flash point of a 4:1 ethanol/water solution is approximately 72º F). **Any staff preparing specimens for shipment MUST attend a hazardous training workshop and ship through certified carriers.**

Decontamination Procedures

When sampling multiple lakes on the same day, the net, boat and all other sampling equipment must be decontaminated between lakes**.** Decontaminating will eliminate cross contamination and reduce the risk of transporting invasive species from lake to lake. You do not have to decontaminate equipment between sample sites on the same lake. If multiple lakes are sampled in one day, it is recommended to sample any lakes that are not on the watch or infestation lists before sampling lakes on those lists, to minimize the potential for transport.

- The net and sample equipment can be decontaminated using regular household vinegar. The acidity of the vinegar may kill living adults; but it is not known if it will kill resting eggs, which could remain viable within dead adults. If waterfleas are observed, extreme care should be taken to avoid transporting individuals to a "clean" lake. For cleaning the net, an easy method of vinegar decontamination is to use a large, round rubber storage container that will fit the outside diameter of the net. Put in enough vinegar to cover the net. Keep the storage container in the truck rather than in the boat. Every time you take your boat out of a lake, place the net in the vinegar. Dip equipment into 100% vinegar for at least 20 minutes. Take the net out at the next lake and let it rinse in the water a minute or so before taking your first sample. Rinse the net without dipping the ring below the surface, so that the vinegar is rinsed from the outside of the net. There is no need to change vinegar between lakes, just add more vinegar when the level gets low. Be aware that vinegar attracts wasps, bees and hornets. It is a good idea to rinse your equipment in hot water and let the net and cup dry thoroughly for at least 24-48 hrs after a day of sampling, both to preserve the integrity of the net and reduce the risk of any resting eggs remaining viable.

Section 9

Freshwater Jellyfish Monitoring Protocol

Citizen Lake Monitoring Network

Several adult freshwater jellyfish (*Craspedacusta sowerbii*) in the medusa stage.
Photo by Sharon Milstead

Much of the information for this chapter was compiled by Sandy Engel.
Additional data is from: http://www.jellyfish.iup.edu/index.html

Freshwater Jellyfish in Wisconsin: Biology and Spread

The freshwater jellyfish found in Wisconsin are one of several species of *Craspedacusta* native to China. Two species (*C. sowerbii* and *C. sinensis*) live in the Yangtze River—the world's third longest river and one so vast it makes the Wisconsin River seem like a trout stream! In China, male and female medusae form from spring until fall and congregate in quiet reaches of the river. The frequent occurrences of these bisexual swarms are one reason why these jellyfish are thought to be native to China. Freshwater jellyfish were first reported in North America as early as 1884. Sightings in Wisconsin date to 1969. Much more remains to be learned about these fascinating creatures. Although they probably evolved from estuarine species, themselves descendents of ocean jellyfish, almost nothing is known about the evolution of freshwater jellyfish. That's because jellyfish leave no fossil records.

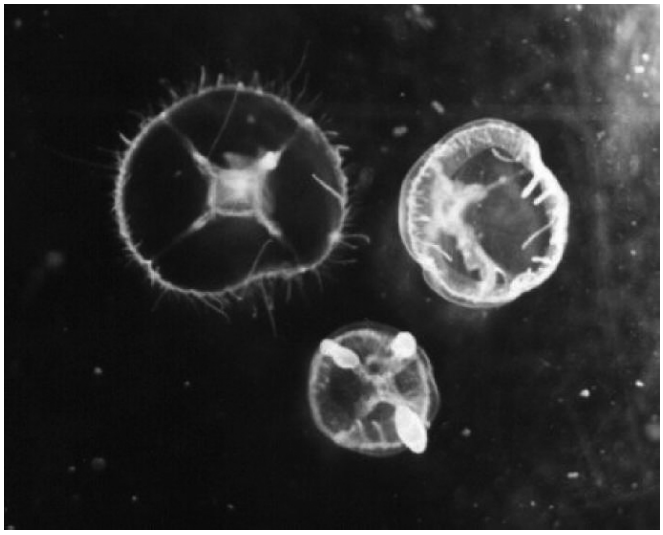
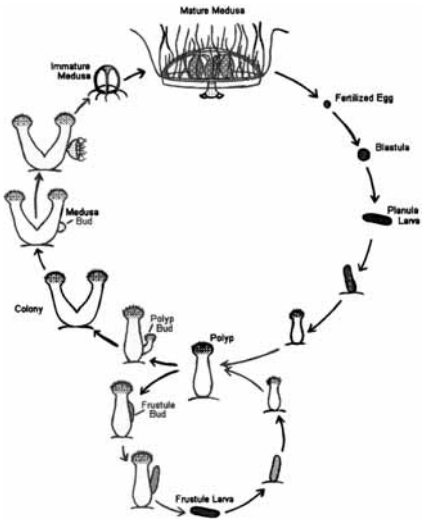


Photo from www.jellyfish.iup.edu/

Freshwater Jellyfish Biology

Freshwater jellyfish exhibit a varied life cycle. It comprises three primary stages: egg, polyp, and medusa. Two kinds of larvae and a cyst stage also form.



Female Medusae (top) produces **Eggs** (arrow, top right). These are fertilized by the sperm of a male medusa (not shown), each egg hatches into a tiny, flat larva called a **planula**. It swims for a few days before settling down on an underwater plant, log, rock, or piece of sediment. The planula then becomes a **polyp**. The polyp looks like a miniature hydra without tentacles. Like hydra, the polyp does bear stinging cells (nematocysts) to stun prey. The tiny polyp soon forms a bud (bottom left) near its base that stays attached and develops into a second polyp, forming a polyp colony. The two polyps are identical twins, having formed asexually. Soon, the twins form yet more fixed buds, which become polyps that also stay attached and expand the polyp colony. After a few weeks, the colony has as many as 2-10 (sometimes 12) polyps—all so small you'd need a hand lens or, better yet, a microscope to study them. Now and then, jellyfish polyps form a second kind of bud (bottom): a detachable bud. Each of these side buds develops into a tiny, cigar-shaped larva called frustule larvae. The larva frees itself from its parent polyp and either crawls a few inches away or is carried off by water flow. It then settles down to become itself a polyp . . . one that forms fixed buds to produce a new colony of polyps. So far, our life cycle involves asexual reproduction: polyps forming buds that become either attached polyps or larvae that detach to become a new polyp colony.

In some years, especially during hot summers in Wisconsin, the polyp colony produces medusa buds (left, middle). Each of these top buds becomes either a male or female **medusa**. The developing medusa grows from nutrition supplied by the parent polyp. After a week or two, and still quite small, the medusa leaves home to become free swimming. Another five weeks are needed for the medusa to mature. When full grown, the medusa has a nearly transparent body called a bell that dangles long, hair like tentacles we all associate with jellyfish.

Sometimes just female medusae form. Sometimes just males form. Why jellyfish would produce swarms of same-sex medusae, a seeming waste of energy, still remains a mystery. Only rarely in North America and Europe do both male and female medusae appear together. The female medusae produce eggs. When fertilized externally by male medusae, the eggs hatch into planula larvae. These sexually derived juveniles then swim away and eventually settle on sediments, plants, or other objects. Here, each larva turns upright and becomes a polyp . . . the start of a new polyp colony.

So completes the jellyfish life-cycle. Although sometimes called an "alternation of generations'—asexual generations (polyps and frustules) alternating with sexual generations (medusae and planulae)—most of the time only asexual polyps are produced.

Both polyps and medusae feed on zooplankton. The polyps, hardly more than $1/8^{th}$ -inch long, eat protozoans, rotifers, copepods, and water fleas. The medusae, pushing an inch across the bell, can use their tentacles to sting these same critters and capture even larger prey, such as water mites and insect midge larvae. Only rarely do they stun newly hatched fish fry.

The medusae live but a few weeks, release eggs, and die. The polyps can live from spring until fall, when they may roundup into **cysts**. Covered with a chitinous "skin" that encloses fairly dry cells, the cysts are able to survive drought and cold. In Wisconsin, the cysts survive on the bottoms of ice-covered ponds, lakes, and quiet river pools where the water is slightly above freezing. But the cysts are more than a winter resting stage. They are a vehicle for jellyfish to spread north of their home range and invade new waters.

Spread

Freshwater jellyfish were found outside of China in the 1500s. William Sowerby (1827-1906) found jellyfish medusae swimming in a large, water-lily tank at the Royal Botanic Gardens in Regent's Park--then just outside London, England. Sowerby was the director of these private botanical gardens and thus in charge of their indoor and outdoor exhibits. He found the medusae, all males, among sediment and the root crowns of pickerelweeds--only three weeks after filling the water tank. Thinking they came from South America with the plants, he dubbed them Amazon jellyfish. The discovery came with much publicity and fanfare. Then, six weeks later, a curator's worst nightmare struck: all jellyfish medusae vanished! (They did reappear in the same tank, though not every year.)

But where were the polyps? In 1884, mature jellyfish polyps were found in a water tank at Regent's Park. That same year, immature polyps were found in a stream in Pennsylvania. More than forty years would pass before the two polyps—the bigger ones from England and the newly budded ones from America—would be united into one species.

How did these freshwater jellyfish get to London and Pennsylvania? The jellyfish probably landed at both locations as polyps or cysts attached to sediments, water plants, or fishes. The 1880s were the heyday of water gardens and carp stocking. Garden clubs

and aquarium societies in this Victorian Era were busy gathering the world's exotic plants and fishes for proud display and study. Soon the jellyfish made their way to other botanical societies, as well as to public and private aquariums in England, Europe, North America, South America, and Australia. Once again, plants and fishes provided a vehicle for polyps and cysts. Other jellyfish were flushed into lakes and rivers when aquariums were emptied, perhaps for cleaning or restocking with fish. Polyps and cysts, attached to river sediments, were swept downstream to new waters. Others may have arrived on the backs of turtles or the feet of water birds. Perhaps they even stuck to boats and boat motors.

After Pennsylvania, jellyfish progressively appeared in other states and provinces (appendix 11). By the time they were first sighted in Wisconsin, jellyfish had already been reported from 33 states, Hawaii (then a U.S. territory), and Washington DC. Their distribution in the United States now stretches to 47^{o} N. latitude—well north of the Yangtze River, between 27^{o} and 37^{o} N. latitudes.

In Wisconsin, jellyfish were first reported from a farm pond near Baraboo, in Sauk County. Wood ducks rather than fish or plants were thought to have carried the polyps or cysts to the pond. By October 2006, 26 years later, jellyfish had been reported from 40 water basins: 37 natural lakes, 2 dugout ponds, and 1 creek (appendix 11). These "jellyfish waters" vary in size from tiny ponds to lakes 9,842 acres (Lake Mendota) and 236 feet deep (Big Green Lake). Of the 40 basins, 70% are seepage lakes, lacking any surface inlet or outlet. More than 25% (10 drainage basins and 1 drained basin) do have a surface outflow, allowing jellyfish to escape downstream to other waters. The freshwater jellyfish has been found in a variety of water types. They have observed in waters ranging from crystal clear rock quarries to soupy green farm ponds. Preliminary research indicates that waters high in chloride do not favor the appearance of the freshwater jellyfish.

Unlike a list of Eurasian water-milfoil lakes, these 40 Wisconsin water bodies may no longer have jellyfish! Almost all of the sightings have been of medusae, which are sporadic and soon disappear, sometimes never to be seen again. On the other hand, polyps tend to be more widespread than medusae, so Wisconsin could have more "jellyfish waters" than these tables indicate.

Monitoring

Agency staff does not have a formal monitoring program for Freshwater Jellyfish. If they see Freshwater Jellyfish while conducting lake monitoring, they send in the data to a central location for documentation. In 2007, we will be asking volunteers to look for the presence of Freshwater Jellyfish while they are recreating on Wisconsin Lakes.

Finding jellyfish in a pond, lake, or river slough can be an unforgettable experience! But keeping a "jellyfish watch" can become boring. That's because medusae--not to mention the microscopic polyps--occur sporadically and unexpectedly. Still, here are some tips for limiting your search.

In Wisconsin, look for jellyfish medusae during dry and hot summers. The sedentary polyps can form medusa buds in late May or early June, if the shallows warm rapidly during spring. The medusae emerge from these buds after a week or two and swim toward the water surface. Yet, the medusae are so tiny and transparent that hardly anyone--even a dedicated jellyfish watcher--would notice them. Only when fully grown, densely packed on the water surface, and perhaps yellowed with eggs do they draw attention. That typically happens, in Wisconsin, from early August to mid-September. The jellyfish will gently float or swim just below the surface of the water. They are easily seen by the naked eye. They often surface in large numbers called "blooms". Sunny days are especially good for spotting jellyfish. The medusae are restricted to a narrow band of 65-75 F. If the water surface of a lake becomes warmer than 75 F, as many of our lakes have during recent afternoons (and evenings), the medusae congregate in the lower epilimnion where they can find their preferred temperature range. Even with cooler weather, the medusae should stay around through August and even into September . . . but then only in certain lakes

Although medusae can swim in almost any type of water--big or little, shallow or deep, hardwater or softwater--they are not found everywhere. They have rarely been reported from bogs or marshes. Nor are they easy to spot in swift-flowing streams and rivers. Look for them in ponds and lakes with a mix of hard bottoms and soft sediments: places where polyps can attach yet not become smothered, and where the polyps have access to rotifers and other small prey. In large lakes, medusae may mob ("swarm") certain bays or shorelines. These are areas where their parent polyps are most common.

What should you do when you or someone else comes upon a swarm of medusae? Grab a jar or plastic bag and collect a small sample of the medusae. You can keep them alive for a few days in your refrigerator. They may live a bit longer in an aerated aquarium. You can also preserve a few medusae for later study and identification. Spoon-out some medusae from your jar or bag and place them in a small jar, such as a glass or plastic vial, containing 70% rubbing (isopropyl) alcohol. You can purchase the alcohol ready-made from pet shops, hardware stores, and department stores. Label the jar with the date, waterbody name, and specific site on the water where the medusae were collected. If you find what you suspect is a freshwater jellyfish, you should take the sample to a local DNR office for verification. See page vii for local contacts.

One word of caution. If you do find jellyfish medusae, you may become hooked into a life of jellyfish watching! You may even start searching lake beds in shallow water for the tiny polyps and their cysts, though you would need a dissecting microscope to search among samples of bottom gravel, sticks, plants, and sediments.