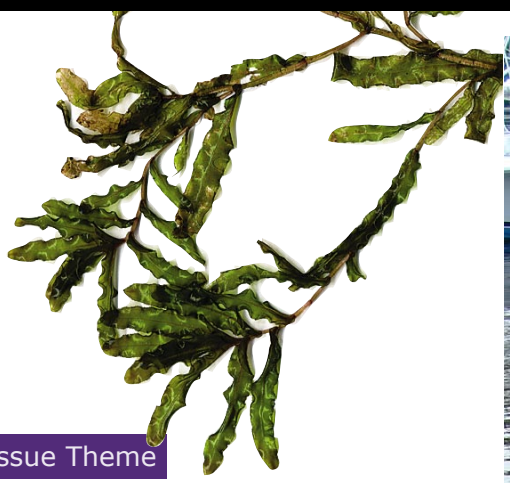
THE
Volunteer Monitor

THE NATIONAL NEWSLETTER OF VOLUNTEER WATERSHED MONITORING Volume 20, Number 1 • Spring 2009



Issue Theme

Aquatic Invasive Species

INSIDE

THE Volunteer Monitor

The Volunteer Monitor is a national newsletter, published twice yearly, that facilitates the exchange of ideas, monitoring methods, and practical advice among volunteer monitoring groups.

Contacting the editor
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Subscriptions & address changes
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***The Volunteer Monitor* online**
The newsletter website contains back issues from Spring 1993 and a comprehensive subject index of newsletter articles. See: www.epa.gov/owow/volunteer/vm_index.html

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For print copies of back issues, use the order form on page 23.

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Printer: Alonzo Printing, Hayward, CA

This project has been partially funded by the U.S. Environmental Protection Agency. The contents of this document do not necessarily reflect the views and policies of EPA, nor does mention of trade names or commercial products constitute endorsement or recommendation of use.

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Printed on 20% minimum post-consumer recycled paper

Next Issue: Bragging Time!

The first issue of *The Volunteer Monitor* was published in Fall 1989—which means that the upcoming Fall 2009 issue marks the newsletter's 20th anniversary! In honor of the occasion, the issue will celebrate volunteer monitoring with a theme of "Accomplishments, Innovations, and Great Ideas."

Please send story ideas to the editor at ellieely@earthlink.net. Stories about finding and fixing problems are always inspiring and always welcome. There are also other kinds of success. What are you most proud of? What's the most valuable lesson you've learned? What are the top one or two ideas you would share with someone starting a monitoring project?

Here are just a few possibilities for stories:
- Discovery of a significant problem (e.g., first detection of an invasive species)
- How your monitoring project made a difference in the community or to an individual
- Brilliant idea for fundraising or community outreach
- How to get more bang for the buck (e.g., homemade monitoring equipment)
- Innovative uses of volunteer monitoring data

With so many volunteer monitoring groups out there doing amazing work, competition for space in the issue could be tough! *Note:* Please start by sending the editor a "pitch" describing your idea, rather than a full-blown article.

new option Electronic Subscription

Would you like to have *The Volunteer Monitor* in PDF format delivered to your e-mail inbox? Advantages: The issue will arrive sooner than a mailed hardcopy, the photos will be in color, and you can easily forward copies to colleagues. Plus you will be helping the newsletter save on postage costs, which have increased substantially.

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Citizen Science Project Gateway

The Citizen Science Central website (www.birds.cornell.edu/citscitoolkit) has a new feature called Project Gateway. The Gateway is an international catalog of projects involving public participation in research—from water quality monitoring to wildlife inventories to astronomy. Volunteer monitoring groups can use the Gateway to post information about their own program and to network with other projects.

Congratulations SOS!

The Izaak Walton League of America's Save Our Streams program is celebrating the 40th anniversary of its founding in 1969. Visit www.iwla.org/sos for commemorative activities.

Aquatic Plant Website

The Center for Aquatic and Invasive Plants at the University of Florida maintains a comprehensive website (http://plants.ifas.ufl.edu) with information and color photos for more than 500 aquatic plants, as well as short identification videos for many species. The site also contains 175 botanical drawings and numerous other resources.

Parrot feather, *Myriophyllum aquaticum*

from SECCHI DISK to BUCKET SCOPE

MAINE'S INVASIVE PLANT PATROLLERS

by Roberta Hill

The challenge is this: How does an organization go about the task of motivating hundreds, if not thousands, of individuals from all walks of life to engage in a search of unprecedented proportions, using new skills and meticulous care, scanning the broadest possible areas repeatedly, with dedication, year after year, all the while hoping that the object of the search will *never* be found?

MAINE VLMP

Homemade bucket scope gives Invasive Plant Patrollers a good view of underwater plants.

The Maine Volunteer Lake Monitoring Program (VLMP) took up this challenge with enthusiasm in 2002, when we launched our Invasive Plant Patrol (IPP) program. Since that time, we have trained nearly 2,000 Invasive Plant Patrollers. The majority of all invasive aquatic plant screening reported in Maine is now conducted by IPP volunteers.

Though the VLMP is the oldest and one of the largest citizen-based lake monitoring programs in the nation, invasive plant monitoring is a relatively new activity for us. When the decision was made to take on the challenge of creating a statewide early detection team made up largely of citizen volunteers, it was only natural that we would turn to our tested and proven model.

The model

The VLMP was founded in 1971 by the Maine Department of Environmental Protection (DEP). In 1992 it became a stand-alone nonprofit organization, while still maintaining a strong cooperative relationship with the DEP. Volunteers take Secchi readings twice monthly during the sampling season, and may elect to engage in more advanced training to monitor additional water quality indicators.

The VLMP model is based on straightforward, common-sense principles: If you want a job done right, you must provide training that is sufficient in both quality and quantity. If you want the people you have so carefully trained to *stay* with the job, you need to offer more: technical (and moral) support; ongoing education; connectivity to community; a sense of ownership in the overall endeavor; and, importantly, the assurance that one's work is not only of significant value, but also properly appreciated.

The key elements of the VLMP model are:

1. A comprehensive multilevel hands-on training program offered at no cost to participants
2. A strong emphasis on quality assurance and quality control
3. Ongoing education and technical support
4. Active engagement of volunteers in all aspects of the program

What's different about monitoring invasives?

Before we could apply the VLMP model to the new IPP program, we had to think about how monitoring for invasive aquatic plants differs from water quality monitoring.

1. More volunteers

Our lake water quality monitors usually sample at a single discrete point (or, at most, several discrete points) on the water body. For consistency and quality control, one well-trained volunteer, or perhaps a team of two, is generally considered optimal.

Invasive aquatic plants, on the other hand, may occur anywhere in a lake's littoral zone (those portions of the lake where sunlight penetrates to the bottom and aquatic plants grow). Therefore, the more trained eyes on the water, the better.

2. Flexible protocols

In the case of water quality monitoring, strict protocols must be rigorously adhered to in order to ensure the quality of the data. If the boat from which a Secchi disk reading is taken is not anchored properly, or the light is not sufficient, the value of the data cannot be assured.

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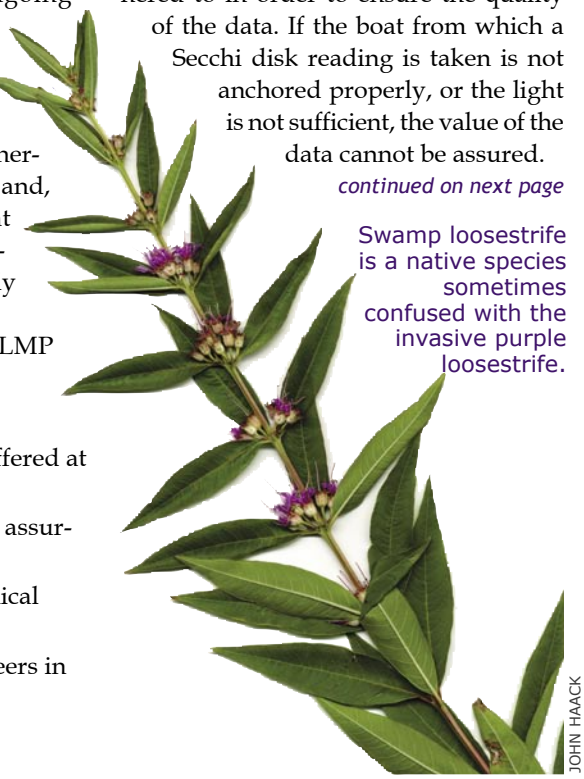


Swamp loosestrife is a native species sometimes confused with the invasive purple loosestrife.

JOHN HAACK

BUCKET SCOPE, continued

When it comes to monitoring for invasive aquatic plants, even a person with the most limited familiarity with one or more target organisms is capable of being the first to detect an invader. The value of this contribution is significant, whether or not the person follows suggested protocols or submits a formal datasheet.

3. More water bodies

Many aquatic invaders may just as easily become established in rivers and streams as in lakes.

Taking and tweaking

Once we identified these key differences, we were able to decide which pieces of our water quality monitoring model could be taken and transferred intact to the IPP program, and which needed to be modified, or tweaked. One area that required a substantial amount of modification was volunteer training. We had been accustomed to training a small cadre of highly committed volunteers. Now we needed a workshop structure that would allow for (and encourage!) widespread participation by individuals with varying amounts of time and expertise to commit to the endeavor.

Things we tweaked

Workshop location and coordination

Most water quality monitors travel to our centrally located education center on Lake Auburn to receive their initial training. Our office directly coordinates workshop planning, recruitment, and registration.

We wanted to make introductory IPP training available all over the state. The only way to do this was to work with local partners such as lake associations, soil and water conservation districts, schools, or municipalities, who serve as "workshop hosts." Workshop hosts line up the workshop site, help get the word out to their local communities, and assist with workshop coordination.

Nearly all IPP workshops are held "away." And indeed a number of them are held "way away," as every year it is our goal to assure that our IPP workshop schedule reflects the greatest possible geographic distribution.

MAINE VLMP

Maine's only known *Hydrilla* infestation, on Pickerel Pond in southern Maine.

MAINE VLMP

Plant Patrollers float through native vegetation, keeping a sharp lookout for potential invaders.

> Even a person with the most limited familiarity with one or more target organisms is capable of being the first to detect an invader.

Volunteer certification and quality assurance

One required component of the water quality monitoring training is volunteer certification. To become certified, each trainee must attend the half-day training session and then be individually checked, using his or her new Secchi disk and view scope, out on the water. In other words, a volunteer does not attend the workshop unless he or she intends to become certified.

For the IPP program, on the other hand, the doors are swung wide open: All are welcome, from the casually curious to the seriously committed. Certification is strictly optional. This is not to say that certification for Invasive Plant Patrollers is not taken as seriously as certification of water quality monitors. IPP certification, in fact, is seen as a vital part of the IPP quality assurance program. However, if the goal is to get as many trained eyes out on the water as possible in a state as water-rich as Maine, we needed to

An Action Plan for Maine

Maine is in the enviable position of still having a chance to prevent introductions of invasive aquatic species. To date, only 30 Maine water bodies are known to be infested. In most cases the invading species is variable water-milfoil.

Because Maine has been fortunate so far in avoiding the numbers of invasions other states have seen, it is highly motivated and proactive about taking steps to hold the line against invasives. Beginning in 2001, Maine adopted a series of laws prohibiting the sale, transport, and propagation of 11 invasive aquatic plant species and establishing a dedicated funding mechanism to support the state's prevention efforts. The funding is generated through the sale of mandatory boat stickers. An interagency task force developed Maine's Invasive Aquatic Species Action Plan, a strategy based on the three prongs of prevention, early detection, and rapid response and management.

structure the program such that IPP certification would be strongly encouraged and supported, but *voluntary*.

To become a certified plant patroller, an individual must (1) attend the introductory IPP training and (2) make a formal commitment to regular monitoring and reporting using standardized protocols and data sheets. Like our water quality monitors, certified patrollers receive a certification card with a discrete identification number. In lieu of the Secchi disk and 4-inch view scope that are provided to water quality monitors, certified plant patrollers receive a free bucket scope.

Training season

The training season for new water quality monitors is short and intense since workshops need to be sandwiched in between ice-off (early April in the southern part of the state, early May in the north) and the beginning of the monitoring season, which is generally early May through mid-June.

The IPP workshop season is somewhat more flexible and generally takes place over a longer timeframe. The primary scheduling considerations are the availability of live plant material for workshops and the best time for conducting surveys. There is an ample window of time beginning when the aquatic plants are mature and ending when the plants begin to die back in the fall. Here in Maine, this is typically from late June through September. The benefit of this longer timeframe is obvious: We can do more IPP workshops!

Invasive Plant Patrol Workshops

The VLMP conducts about 20 introductory IPP workshops across the state of Maine each year, training from 250 to 300 individuals annually. Citizen volunteers, including lake association members, students, teachers, municipal officials, civic groups, anglers, float plane pilots, and others, are the primary target audience. State agency personnel and professional lake managers are also trained through the program.

MAINE VLMP

A key component of the introductory workshop is hands-on practice with live plants, emphasizing Maine's "Eleven Most Unwanted" species and their native look-alikes. The 5½-hour workshop also offers a comprehensive overview of the problem of invasive aquatic species and instruction on how to conduct an invasive aquatic plant screening survey. Participants receive the *Invasive Plant Patroller's Handbook* (a three-ring binder of reference materials, data forms, etc.) and our new *Maine Field Guide to Invasive Aquatic Plants.*

Ongoing technical assistance

Once water quality monitors are properly trained, they generally don't take long to settle into the monitoring routine. Invasive Plant Patrollers, in contrast, have a steeper learning curve. Even though the IPP workshops are specifically designed to familiarize volunteers with both the target invaders and their native look-alikes, and detailed identification keys are provided, much of what the novice patroller encounters that first time out on the water is a total mystery. It takes time and effort to become acquainted with the local flora.

MAINE VLMP

Volunteers hone their plant identification skills at an advanced training workshop.

Therefore we added a new technical service: Volunteers (and anyone for that matter) can send plant samples to our office for identification.

Things we took

Many components of the VLMP could be taken and incorporated into the IPP program with little or no tweaking.

Advanced training options

Thirty-seven years of experience in working with volunteer monitors in Maine has taught us that ongoing education through a variety of means, including advanced training options, is key to keeping volunteers engaged over time. This idea has been fully integrated into the IPP program.

IPP volunteers may elect to participate in one or both of the currently offered advanced training workshops. "Advanced Plant ID" focuses on the identification of common native aquatic plants. The more familiar one becomes with the plants that are native to a given water body, the greater the likelihood that an unfamiliar intruder will be noticed in a timely manner. "Screening Survey

continued on next page

Homemade Viewing Devices from Maine VLMP

Vie
by w


MAINE VLMP

Bucket scope

The bucket scope is a view scope made from a dark-colored 5-gallon bucket. It is constructed by cutting out a large hole in the bottom of the bucket, then securing in an appropriately sized piece of Plexiglas using some kind of mechanical fasteners, such as small bolts, and a layer of waterproof sealant. Depending upon the angle of the sun, additional modifications may be needed to cut out backlighting. The simple solution is to toss a dark towel over your head. A more refined innovation is the elasticized Naugahyde cover with view hole designed by IPP volunteer Buffy DeMatteis. *[Editor's note: For a variation on the bucket scope design see* The Volunteer Monitor *Fall 2000, page 9.]*

Trunk scope

Invasive Plant Patroller Ross Wescott, dissatisfied with the limitations of the bucket scope (e.g., not well shielded from backlighting; limited view area) set out to make improvements. By the time Ross completed his self-imposed redesign project, Maine had its first "trunk scope" (or, as we here at the VLMP are inclined to call it, "Ross's Rolls Royce"). The trunk scope is crafted from a large heavy-duty plastic trunk. It floats on the surface and may be lashed to the front, back, or side of the boat. A Plexiglas "window" installed in the bottom of the trunk provides three times the view area of the typical bucket scope, while the hinged top and black-curtain sides shield out unwanted light.


MAINE VLMP

Plant Patrollers Sibyl and Bob French demonstrate the trunk scope.


DONALD HAYES

View canoe

Branch Lake, an 11-mile-long lake with many public access points, is currently patrolled by 35 Milfoil Rangers. Among them is George Lewis, the designer of what we believe is Maine's first-ever "view canoe." With George's invention, the boat and the viewing window are one elegant unit.

For instructions for making all three viewing devices, see the "publications and resources" page of the VLMP website at www.mainevolunteerlakemonitors.org/publications/#IAP.

BUCKET SCOPE, continued

Field Methods" builds on the classroom introduction offered in the introductory workshop by providing on-lake instruction and practice.

Central role of volunteers

The VLMP is structured to optimize volunteer engagement at all levels. The VLMP Board of Directors is entirely made up of volunteers. Each of Maine's 16 counties has its own volunteer Regional Coordinator and Data Coordinator. These volunteer coordinators assist with such tasks as organizing training workshops, collecting and checking data forms, entering data into the database, and responding to volunteer requests for equipment.

A similar structure is steadily coming together on the IPP side, much of it overlapping with, and enhancing, the existing regional structure.

Valuing the voices of volunteers

Volunteer feedback is actively solicited and purposefully integrated into all aspects of the VLMP. Volunteers are encouraged to provide candid feedback through workshop evaluations, roundtable discussions, end-of-year surveys, and telephone interviews. All volunteers are strongly urged to contribute directly to VLMP publications and website content.

Time and again, the simple act of welcoming the insights, knowledge, and experience of our volunteers has resulted in significant tangible benefit for the VLMP. The same is true for the IPP program. Two ingenious devices to improve viewing of underwater plants—the "trunk scope," and the "view canoe"—were invented by our IPP volunteers (see box at left). And the newly revised *Maine Field Guide to Invasive Aquatic Plants* benefited tremendously from the experience-based suggestions of volunteers who field-tested the original version: "We need a dichotomous key, but keep it *simple*." "If the book is spiral-bound it will be easier to set it down in the bottom of the boat while keeping it open to the page of interest." "It would be great if you could include more image… more descriptive narrative… an expanded glossary… species comparison charts." We did our best to include them all. The resulting publication has been enormously successful here in Maine, and widely acclaimed well beyond Maine's borders. (For ordering information, see "Resources," below.)

Time and again, the simple act of welcoming the insights, knowledge, and experience of our volunteers has resulted in significant tangible benefit for the program.

Diversified support

The VLMP has long been funded through a wide array of sources, including state and federal funds, foundation grants, and financial contributions from lake and watershed associations, volunteers, businesses, and others. Following on this model, IPP program support is now similarly diversified.

It is important to note, however, that without a substantial up-front infusion of support from a single source, the IPP program might have never risen off the ground. As noted in the box on page 4, Maine has adopted a dedicated funding mechanism for invasive aquatic species prevention. A portion of this "sticker revenue" supports the VLMP's invasives program, through a grant administered by the Maine DEP. Initially, the DEP/sticker funding accounted for nearly 100 percent of the VLMP's invasives program budget. Now, after several years of operation and a concerted effort to attract matching support from private sources, sticker funds account for closer to one-third of the budget. This greatly increased "bang for the buck" is one of the many upsides of the VLMP's unique public-private partnership with the DEP.

Holistic approach

So there you have it. To build a strong statewide early detection team, you need to engage volunteers. To engage individuals with no previous experience in a task that requires a substantial amount of know-how and skill, you must provide high-quality training. To *keep* volunteers engaged, you must do more. The approach that has worked well here in Maine might best be described as a holistic approach, one that combines quality training with ongoing education, direct access to technical resources and expertise, and plentiful opportunities for active engagement, collaborative relationship, and the realization of shared and personal goals. Then you will not only have a properly organized team; you will have a thriving, sustainable, and forward-leaning community.

DON CAMERON

Trainee uses the IPP field guide to identify specimens.

MAINE VLMP

European naiad (*Najas minor*) is one of Maine's "Eleven Most Unwanted."

Roberta Hill is the Program Director for Maine Volunteer Lake Monitoring Program Center for Invasive Aquatic Plants. For more information: 207-783-7733; mciap@mainevlmp.org; www.mainevolunteerlakemonitors.org/.

Resources

Maine Field Guide to Invasive Aquatic Plants. Focuses on the 11 invasive aquatic plants currently listed by Maine law as imminent threats to Maine waters, and the native plants commonly confused with them. Includes more than 100 photographs and illustrations, as well as instructions for conducting a survey. 146 pages. The Field Guide may be downloaded or ordered at www.mainevolunteerlakemonitors.org/publications/#IAP, or ordered from the VLMP at vlmp@mainevlmp.org or 207-783-7733.

Maine Volunteer Lake Monitoring Program Website (www.mainevolunteerlakemonitors.org). Multiple resources for water quality monitoring and invasive aquatic plant surveys. Coming soon: online Interactive Field Guide to Aquatic Invaders and Virtual IPP Workshop.

Riverine **E**arly **D**etectors
a new frontier in the fight against invasive species

by Laura MacFarland

Aquatic invasive species (AIS) threaten all aquatic ecosystems. However, the vast majority of state funding (nearly $9 million) and human resources in Wisconsin have gone toward protecting lakes. Until recently, many eligible applicants did not even realize that Wisconsin Department of Natural Resources (WDNR) AIS grant funding could be used to protect rivers; they associated the program exclusively with lakes. Meanwhile invasive species spread undetected through riverine corridors. These invasives not only degrade the health of our rivers, they use the rivers as dispersal corridors.

Slipping through the cracks

River systems present unique challenges in terms of battling AIS. We suspect this is why the necessary resources have not been spent to protect rivers, not only in Wisconsin but nationwide.

- The impacts of invasive species to rivers are not well understood and certainly not as apparent as the impacts to lakes. With thousands of homes on the shores of Wisconsin's lakes, the impact of an invasive plant like Eurasian water-milfoil is highly visible from kitchen windows and private docks.

- Control and eradication of AIS in flowing waters is difficult, and in some cases impossible. Chemical treatments that are commonly used to control invasive plants in lakes are less effective in rivers due to the short contact time. In addition, once an invasive is established in a river it quickly disseminates downstream. Even accessing a river system for monitoring and treatment can be a challenge because of private lands or difficult terrain.

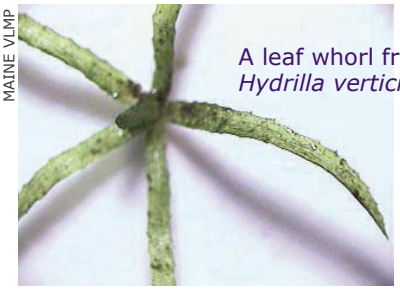
- Landowners along river corridors are rarely, if ever, organized into a membership organization like a lake association. AIS management is difficult when there are a large number of landowners with varying degrees of interest and resources.

Whatever the reasons, one thing is for certain. Aquatic invasive species such as the New Zealand mudsnail, zebra mussel, purple loosestrife, and others are slipping undetected through the blue cracks in our maps.

Project RED: A paddle with a purpose

In 2007, the River Alliance of Wisconsin, a statewide nonprofit organization that has been the voice for Wisconsin's rivers for over 15 years, began working to overcome these challenges. We obtained funding from the WDNR AIS grant program and spent a year exploring the potential roles of the River Alliance and our over 130 member organizations throughout the state. In speaking with a subset of these member organizations it became evident that there was a volunteer base out there that was concerned about invasives in their rivers; however, few were aware of what was encroaching on their rivers and how they could help.

Our first step was a one-year pilot project to test how well paddlers in canoes and kayaks could detect four easily identified invasive plant species along the banks of a river. The four pilot species were all wetland plants: purple loosestrife, Japanese hops, Japanese knotweed, and common reed grass. We worked with several volunteer groups such as the Sheboygan County Master Gardeners and the Friends of Badfish Creek. The volunteers monitored over 50 miles of streambank. They detected several new infestations, and as a result two groups have applied for WDNR AIS funding to eradicate isolated stands of knotweed.



MAINE VLMP

A leaf whorl from *Hydrilla verticillata*.

Curly leaf pondweed (*Potamogeton crispus*)

JOHN HAACK

From this successful pilot, Project RED (Riverine Early Detectors) emerged, with the rallying cry of "Early Detection, Rapid Response." We have expanded the number of invasive species to 15, including both plants and animals, both along the streambank and in the water. In partnership with WDNR and the National Institute for Invasive Species Science (NIISS), River Alliance has begun offering free workshops to train volunteers throughout the state to identify and report these invasives that threaten our rivers.

We believe that with Project RED the River Alliance is breaking new ground. While several existing river monitoring groups include invasive plant surveys as part of general riparian vegetation mapping efforts, Project RED is taking a different approach, focusing specifically on AIS early detection and rapid response.


RIVER ALLIANCE OF WISCONSIN

Sheboygan Master Gardener Terri Lyon records invasive plant locations on the Sheboygan River.

The goal is to cover a lot of area longitudinally, beginning at the headwaters, in an effort to stop the spread of invasives at the source.

Plan of attack

During the pilot project, we quickly discovered that timing is everything. A small patch of knotweed that could easily go undetected in June was hard to miss in late August while blooming. Project RED teams of volunteers will be encouraged to float their river at different times throughout the paddling season to monitor for select species, based upon the timeline shown at right.

Volunteers will use GPS units that are stored at technology libraries throughout the state. These are provided by the Citizen Based Monitoring Network of Wisconsin and are available for checkout by citizen monitors. The species name, geographical coordinates, and estimated size of the infestation will be recorded on a field data sheet printed on Rite in the Rain paper provided by Project RED.

Sharing the data

The volunteers will receive training from NIISS on entering their data into the CitSci.org website (www.citsci.org), an online tool created by NIISS. The website allows volunteer organizations to tailor online data reporting sheets and maps to their specific needs. Through the site, Project RED data will be shared with other project members, the Wisconsin DNR, the River Alliance, and anyone else who wants to view it.

Foreseen challenges and limitations

Project RED is intentionally designed to be simple, not to serve as a census. It is anticipated that there will not be a 100 percent detection rate. In the pilot project, with four species that were relatively easy to identify from a distance, the volunteers were as efficient as the quality control teams. The expanded list of species of concern includes some that will be harder to find, such as the mussels and snails.

Misidentification is a concern as well. Volunteers will be given a list of experts who can verify their findings the first time they detect a species in their watershed. We will also provide volunteers with numerous descriptions and photographs, both in print and online. However, there will likely be a few false positives.

Monitoring Timeline

Common name	Scientific name	May	June	July	Aug	Sept
purple loosestrife	*Lythrum salicaria*			•	•	•
Japanese knotweed	*Polygonum cuspidatum*				•	•
Japanese hops	*Humulus japonicus*		•	•	•	•
common reed	*Phragmites australis*			•	•	•
flowering rush	*Butomus umbellatus*		•	•	•	
hydrilla	*Hydrilla verticillata*			•	•	•
curly-leaf pondweed	*Potamogeton crispus*	•	•			
Eurasian water-milfoil	*Myriophyllum spicatum*		•	•	•	
Brazilian waterweed	*Egeria densa*			•	•	•
didymo	*Didymosphenia geminata*	•	•	•	•	•
zebra mussel	*Dreissena polymorpha*	•	•	•	•	•
quagga mussel	*Dreissena rostriformis bugensis*	•	•	•	•	•
New Zealand mudsnail	*Potamopyrgus antipodarum*	•	•	•	•	•
Chinese mystery snail	*Cipangopaludina chinensis*	•	•	•	•	•
banded mystery snail	*Viviparus georgianus*	•	•	•	•	•

Nipping it in the bud

There are two possible endings to each monitoring season. Project RED monitors either (1) do not find what they are looking for or (2) find that their river is under invasion.

Although the happier ending of the two, the first scenario presents a challenge with volunteer retention. It remains to be seen whether the combination of not finding anything and having a great excuse to be on the water is rewarding enough to keep monitors returning year after year. With each year there will likely be new threats on the horizon to keep things interesting.

The objective of Project RED, of course, is that if an invasion is detected, volunteers—in partnership with the WDNR and local resource managers—will work to contain or eradicate it. After all, our aim is early detection AND rapid response. The Friends of Badfish Creek in southern Wisconsin offer a great example of what we hope to see more of. Last fall, during a pilot paddle, the group found a pioneer stand of Japanese knotweed in Badfish Creek. The plant was apparently introduced in fill used during the building of a bridge abutment. Since the discovery, the Friends have taken steps to protect their riparian habitat from certain invasion. They have obtained the landowners' consent and the necessary volunteer labor and are seeking support from the WDNR AIS grant program for chemical treatment to eradicate the stand.

There is still plenty of opportunity to detect invasive species in our rivers before it is too late to contain or eradicate them. The River Alliance of Wisconsin is depending on volunteer monitors to grab their paddles and hit the water!

Laura MacFarland is AIS Project Coordinator for River Alliance of Wisconsin. For more information: 608-257-2424, ext. 110; lmacfarland@wisconsinrivers.org; www.wisconsinrivers.org.

Boat Inspection Programs:
Halting Invaders at the Gate

ANDREA LAMOREAUX

A Lake Host volunteer talks to a boater in New Hampshire.

UW-EXTENSION LAKES

Aprons for Wisconsin's Clean Boats Clean Waters program are modeled by Manitowoc County Lakes Council members.

by Eleanor Ely

When dealing with aquatic invasive species, an ounce of prevention is worth far more than a pound of cure. Efforts to control invasions are enormously costly, but that isn't the worst news. The worst is that in many cases eradication cannot be achieved at any price once the invader becomes established.

In lakes, recreational boats are a prime transport route for invasive plants and animals. This means that getting rid of hitchhikers before a boat enters another water body is key to preventing or slowing the spread of invasive species. Surveys in Minnesota showed that most boaters want to take action to prevent spreading invasives; the main barrier is uncertainty about what they should do.

Posting signs asking people to inspect and clean their boat and trailer is a good start, but it's not enough. A more effective approach is to staff boat ramps with paid or volunteer boat inspectors.

Boat inspection programs

The Minnesota Department of Natural Resources instituted the nation's first statewide watercraft inspection program in the early 1990s. Since then, a number of other states have followed suit. Some programs rely mainly or entirely on paid inspectors while others utilize a mix of paid and volunteer inspectors. Three long-standing watercraft inspection programs with a significant volunteer component are Maine's Courtesy Boat Inspection Program (started in 2001), New Hampshire's Lake Host program (2002), and Wisconsin's Clean Boats Clean Waters program (2003).

What inspectors do

Watercraft inspectors check all boats entering and leaving a water body and remove any plant material or animals that they find. Educating boaters is an equally important part of their job. Inspectors invite boaters to participate in the inspection, and as they examine the boat and trailer the inspector points out favorite hiding spots for invasive species. Inspectors also give boaters informational brochures and explain basic prevention steps: inspect, remove , drain, wash, dry for five days.

> Most boaters want to take action to prevent spreading invasives; the main barrier is uncertainty about what they should do.

In most programs, inspectors complete a brief survey with each boater (sample questions: Was the boat used on a different water body in the last five days? Have you heard of Eurasian water-milfoil?).

Friendly approach, positive response

Newly trained inspectors sometimes feel a little trepidation about going up to strangers and asking to check their boat. And occasionally a boater *is* uncooperative. A guidance document for Maine's Courtesy Boat Inspection Program describes the problem delicately: "Some people are very sensitive to implications that they should do things differently." Volunteers are instructed to avoid confrontation, and never to insist on performing an inspection.

Fortunately, negative responses are very rare. "Our inspectors can happily state that they are routinely thanked for what they are doing," reports Linda Schier, who coordinates boat inspection on Great East Lake in New Hampshire and Maine.

Boat inspection programs take several steps to ensure good relations with the

public. Inspectors generally wear distinctive T-shirts, caps, or even (in the case of Wisconsin) aprons, with the program logo clearly displayed. Training materials give step-by-step instructions: be friendly, introduce yourself, briefly explain your purpose, ask permission to do the inspection, reassure boaters that it won't take much time. Training workshops often include a role-playing exercise.

David Potter, a volunteer Courtesy Boat Inspector, holds the water chestnut fruit he pulled from a boat about to launch into a Maine pond. Although water chestnut infests several nearby states, it is not yet known to occur in Maine.

MAINE VLMP

Paying inspectors

Even in states such as Wisconsin and New Hampshire where the majority of watercraft inspectors are volunteers, paid inspectors make up an important part of the program. Typically the paid inspectors are high school or college students for whom this may be their first paid employment or their first environment-related job. Paid inspectors tend to be more willing than volunteers to work on weekends or holidays, and generally put in a greater number of hours over the season. This is not to discount the commitment and dedication of the volunteer inspectors, many of whom take on the 6 to 8 a.m. shift (a popular time for fishers to launch).

Paying boat inspectors brings up the issue of who handles hiring and payroll. In some cases the state environmental agency directly hires summer interns to work as inspectors. Another possibility is for state funding to be distributed in the form of grants to local lake organizations, which then use the funds to hire and pay inspectors. However, this arrangement requires the local organization to function as an employer, with responsibility for withholding and reporting taxes, providing liability insurance and workers compensation, and other administrative tasks.

New Hampshire's Lake Host program, coordinated by the nonprofit New Hampshire Lakes Association (NH LAKES), has a unique arrangement that relieves participating organizations of payroll-associated paperwork. NH LAKES receives state and federal funding which it passes on to local groups in the form of "payroll grants." Local groups apply annually to NH LAKES for the grants, and NH LAKES applies each group's grant amount to paying that group's boat inspectors. This means that NH LAKES, rather than the small local groups, performs the administrative duties of an employer.

continued on next page

Realistic Plant ID Sheets

The images on the plant identification sheets used by Wisconsin volunteers are so realistic that at first glance they look like herbarium specimens. Actually, they're better. John Haack, a University of Wisconsin-Extension natural resource educator who manufacturers the sheets as a side business to help pay his kids' college tuition, says he got the idea several years ago when he noticed that the pressed plant specimens the volunteers were using "did not look good by the end of the season."

JOHN HAACK

The native plant water marigold (*Megalodonta beckii)* may be confused with invasive watermilfoil species.

Haack believed he could create high-quality images that would last much longer than actual plants. After some disappointing experiments using a typical desktop flatbed scanner, Haack found a local printshop with a high-end digital scanner. Persuading the staff to place wet plants on their expensive scanner was not easy, but the lifelike images were just what Haack had hoped for.

Haack uses a layout program to add diagnostic labels and arrows to the digitized image, then prints it out on a digital laser color copier and laminates the sheet.

Wisconsin volunteer lake monitors and boat inspectors with the Clean Boats Clean Waters program receive a spiral-bound book of laminated ID sheets, including both native and non-native plants. Most of the images are lifesize. Trainers use large-format (11 x 17) sheets for teaching. Sheets can also be posted at boat launching sites, information booths, and other public places.

Haack welcomes inquiries at vhaack@dishmail.net. Producing ID sheets for out-of-state clients is not a problem since plant specimens can be shipped.

BOAT INSPECTIONS, continued

Measuring success

Many facts and figures attest to the success of boat inspection programs. For example:

- Since 2002, New Hampshire Lake Hosts have conducted almost 244,000 inspections and intercepted 516 exotic plant fragments.
- In 2008, about 56,000 boat inspections were conducted in New Hampshire, and about 50,000 each in Wisconsin and Maine.
- Niney-two percent of Wisconsin boaters surveyed in 2008 said they inspect their boat and equipment and remove any plants (up from 12 percent in 2004).

For Andrea Lamoreaux, who coordinates the Lake Host program statewide, the best proof of the program's success was this comment written by a local coordinator on her end-of-season survey form:

> *I have talked to boaters all summer, and by the end of the summer they would get involved in conversations with other boaters while I was inspecting a boat, and they would educate the people on what I had taught them earlier.*

Resources

Clean Boats Clean Waters website: www.uwsp.edu/cnr/uwexlakes/CBCW/.

Courtesy Boat Inspection Program website: www.mainevolunteerlakemonitors.org/mciap/cbi.php. Includes training video.

Lake Host website: www.nhlakes.org/. Includes training video.

Felda-Marquardt, L. and E. Henegar. 2008. *Volunteer Watercraft Inspection Guidelines for Aquatic Invasive Species*. Wisconsin Lakes Partnership, Clean Boats Clean Waters Program, PUB-WT-780 2008. This comprehensive handbook offers detailed guidance. Available in PDF at the CBCW website (see above). To purchase a hard copy, call 715-346-2116 or email uwexlakes@uwsp.edu.

Stop Aquatic Hitchhikers website. www.protectyourwaters.net/. Lots of useful information about controlling the spread of aquatic invasive species.

monitoring methods

by Eleanor Ely

No other invasive aquatic animal is the target of as much detection and monitoring effort by citizen volunteers as the zebra mussel (and its close relative, the quagga mussel). Methods used by volunteer monitoring programs include looking for attached mussels on natural surfaces, deploying artificial substrates, and capturing the free-floating larval stage with plankton nets.

So, which method is most effective? Probably the best answer comes from Steve Wells, coordinator of the Zebra Mussel Monitoring Network at Portland State University's Center for Lakes and Reservoirs, who advises, "Use as many different methods as you can." Wells points out that every method, including accidental discovery by the informed public, has been the first to detect a zebra or quagga mussel invasion in a water body where other methods were also being used.

Detecting attached mussels

Like marine mussels, but unlike any native freshwater bivalve species, juvenile and adult zebra and quagga mussels attach tightly to hard surfaces by means of sticky byssal threads. This characteristic accounts for the biofouling damage these mussels cause—clogging industrial and municipal water intake pipes and covering boat hulls, engines, and propellers; buoys; ladders; and virtually any object submerged in the water.

An essential part of any zebra and quagga mussel detection effort is to carefully examine submerged hard surfaces for attached mussels. Even if volunteer monitors are also deploying artificial substrates or using plankton tow nets, they should always be sure to inspect existing natural and man-made surfaces.

Efforts to enlist the general public (as opposed to specifically trained volunteers) in detecting new infestations hinge on encouraging people to keep a careful eye out for mussels on any submerged surface. The importance of such outreach efforts is underscored by Minnesota's experience: Of the first four zebra mussel infestations found in the state, three were discovered by the general public.

Search tips

The following tips on searching for zebra mussels are based on the instruction manual for the Pennsylvania Zebra and Quagga Monitoring Network:

- Wearing polarized sunglasses improves vision into the water.
- New infestations are likely to be found near boat ramps, docks, and marinas.
- Surfaces that should be examined include natural substrates such as rocks, logs, and vegetation, and man-made substrates such as dock floats, pilings, boats, buoys, cables, and any

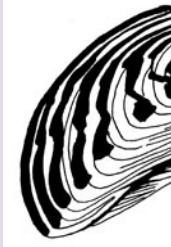
Zebra and Quagga Mussels

Zebra mussels and quagga mussels are closely related species within the genus *Dreissena*. Both species are native to Eurasia. Both are usually 1 inch or less in length, although quagga mussels may be slightly larger.

Zebra mussels (*Dreissena polymorpha*) were discovered in the United States in 1988, in Michigan's Lake St. Clair, which connects Lake Huron and Lake Erie. Quagga mussels (*Dreissena bugensis*) were discovered the following year in Lake Erie. These invasive mussels have spread through much of the eastern United States and have recently been found in some Western states as well.

The microscopic larvae, or veligers, are free-floating for about three or four weeks. Then they settle and attach to hard surfaces with sticky secretions called byssal threads. Juvenile

Zebra mussel



for Zebra Mussels

100TH MERIDIAN INITIATIVE

Zebra mussel. The striped pattern on the shell is quite variable, and sometimes absent.

object that has been in the water for a long time.

- Zebra and quagga mussels avoid light, so look especially in shaded areas, crevices, on the underside of objects such as docks or boats, and under bridges.

Mussels too small to be seen may sometimes be felt. Newly settled mussels feel like grains of sand. Culver et al. (2009) point out that it can be hard to distinguish these tiny mussels from other organisms or substances. They advise pushing lightly on any suspicious bump. Because of their byssal threads, mussels will rotate and stay attached. In contrast, most other animals or objects will either fall off or else stay fixed without any rotation.

Zebra and quagga mussels prefer areas with low flow. When monitoring in a stream, it's a good idea to pay particular attention to the edges of pools or runs.

mussels can resuspend in the water column and attach to another substrate. The mussels generally reach sexual maturity within the first year of life. For more information on the life cycle, see the U.S. Army Corps of Engineers Zebra Mussel Information System, http://el.erdc.usace.army.mil/zebra/zmis/.

Artificial substrates

Compared to docks, boat hulls, submerged logs, and the like, artificial substrates present a relatively small surface area for settlement and attachment. If volunteers focus too narrowly on checking artificial substrates, they risk missing the forest for the trees.

On the plus side, artificial substrates allow sampling at depth. They should be suspended as deep as possible, as long as there is at least 6 inches between the substrate and the bottom. Artificial substrates also function as a "memory jog"—retrieving and examining them becomes part of the monitoring routine and serves as a reminder to also check other surfaces.

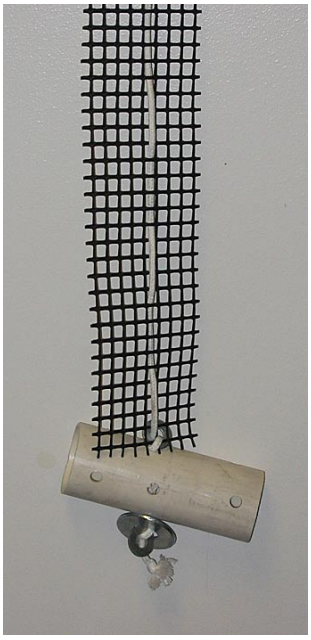
Artificial substrates come in a variety of materials, shapes, and sizes. The various volunteer monitoring programs contacted for this article reported using concrete blocks, bricks, stacked PVC plates, lengths of PVC or ABS pipe, and construction mesh. All of these are effective for mussel settlement and attachment.

One of the simplest artificial substrates is a concrete block tied to a rope. A lightweight, easy-to-ship alternative is a length of 4-inch-diameter PVC pipe with drilled holes (to allow easy passage of food and water). Some people like to use white PVC pipe because small juvenile mussels can be more easily seen; on the other hand, the Army Corps of Engineers website states that the mussels seem to prefer darker PVC, perhaps due to their avoidance of light.

A stacked plate sampler with standard surface area is useful for quantifying mussel density, but few if any volunteer programs attempt to quantify density.

Whatever the design, the artificial substrate is generally suspended from a pier, dock, or buoy. A single rope can hold several pieces of PVC or ABS pipe, or a combination of different substrates. Because of the mussels' preference for dark places, artificial substrates should be deployed in shaded areas. They should be set out at least two weeks prior to the spawning season to allow for the buildup of a biofilm, which encourages settlement.

A very thorough discussion of artificial substrates in Culver et al. (2009) describes many materials and designs and provides instructions for selecting sites and deploying and examining the substrates.



STEVE WELLS

This combination of two settling substrates, plastic mesh and PVC pipe, is used in Portland State University's Zebra Mussel Monitoring Network.

(Note: The mesh is Landware/Tenax polypropylene hardware net, product no. 751397.)

Plankton net for detecting veligers

In contrast to the other methods volunteer programs use, which are aimed at finding attached juvenile and adult mussels, the plankton net method detects veligers (the microscopic free-floating larval stage) in the water column. This is the least widely used approach among volunteer monitoring programs, probably due in part to the cost of the net (around $200) and the time involved. However, at least one North American program—Invading Species Watch, in Ontario—has used the plankton net method extensively with

continued on next page

hundreds of volunteers. This province-wide program is a joint project of the nonprofit Ontario Federation of Anglers and Hunters (OFAH) and the Ontario Ministry of Natural Resources.

Since the program's inception in 1998, Invading Species Watch volunteers have monitored a total of 482 Ontario lakes and detected 85 zebra mussel first occurrences. In 2007, 193 lakes were monitored and veligers were found in six lakes where they had not been found before.

Lakes are monitored once per summer in the OFAH program. Using a boat or canoe, volunteers sample at least three different locations in their lake. To minimize costs, OFAH owns just 22 nets, which are loaned out on a rotating basis throughout the summer. Each lake association has a scheduled date for receiving the net and other equipment.

The plankton net is hauled vertically in water depths greater than 29 feet, and horizontally in shallower waters. Mussel veligers, along with other small planktonic organisms, are caught on the inside of the net and rinsed down into the cod end (bottom). The contents of the cod end are emptied into a sampling bottle and preserved with alcohol.

The veligers are too small to be seen with the naked eye. OFAH contracts with a consultant to examine the samples microscopically under cross-polarized light, a technique that makes the veligers easy to identify.

The plankton net method is a bit more involved than other methods for monitoring zebra mussels, but Francine MacDonald, the Invading Species Awareness Program coordinator for OFAH, reports that volunteers are easily able to follow the step-by-step instructions in the manual.

MacDonald says that OFAH chose the plankton net method because it is the main method used by Ontario Ministry of Natural Resources biologists, and it is more likely than other methods to catch an invasion early on. Earlier detection means that lakeshore residents have more time to take steps to protect their property from the mussels—for example, they may want to build a lift to get their boat out of the water when it's not in use.

ONTARIO FEDERATION OF ANGLERS

Invading Species Watch volunteers with plankton tow net.

MacDonald points out other advantages as well. "We always know exactly which lakes are being monitored, and we get a 100 percent response rate from the participants," she says. "Also, people really enjoy it—they are amazed to see all the different zooplankton in the sample bottle."

Soon after the volunteers began using the plankton nets, the program discovered an unexpected bonus—the spiny water flea, another invasive species, was also being captured.

One note of caution about the method: It is sometimes possible to find veligers even when an established adult population is not present. For example, veligers can wash into a lake from an upstream source but they will not necessarily be successful in attaching and surviving. Finding attached juveniles or adults confirms that the lake is infested.

Zebra mussel and spiny water flea data from the Invading Species Watch program are entered in the Ontario Ministry of Natural Resources invasive species database and shared with municipalities and marinas.

"For the majority of lakes that we monitor, our data is the only data for zebra mussels and spiny water fleas," says MacDonald. "If we didn't have the information, it would not exist."

DEBORAH ROSE, MN DNR

Zebra mussel.

Resources

Culver, C.S., S.L. Drill, M.R. Myers, and V.T. Borel. 2009. *Early Detection Monitoring Manual for Quagga and Zebra Mussels*. California Sea Grant. Comprehensive, well-illustrated guidebook with detailed instructions for volunteer monitors. 40 pages. Order from http://anrcatalog.ucdavis.edu or 800-994-8849. $10.

Invading Species Watch Program volunteer instruction manual. www.invadingspecies.com/.

"Pennsylvania Aquatic Invasive Species Monitoring Squad." Training manual for Pennsylvania Zebra and Quagga Mussel Monitoring Network. http://seagrant.psu.edu/zm/monitor/MonitoringManual2008.pdf.

"Stemming the Tide: A Guide to Monitoring Zebra and Quagga Mussels in Pennsylvania" (DVD). Available from Pennsylvania Sea Grant; contact Sarah Whitney at swhitney@psu.edu.

U.S. Army Corps of Engineers Zebra Mussel Information System: http://el.erdc.usace.army.mil/zebra/zmis/. Information on life cycle, detection and monitoring, and more.

U.S. Geological Survey Nonindigenous Aquatic Species website, Zebra and Quagga Mussel Information Resource Page. http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/. Distribution maps, fact sheets.

Salem Sound Volunteers Track Marine Invaders

by Eleanor Ely

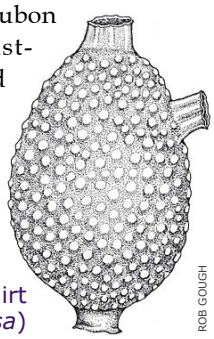

BARBARA WARREN

When the Adopt-A-Tidepool volunteers she was working with started finding more invasive species, Barbara Warren decided it was time to design a program for detecting and tracking invasives in Salem Sound. Estuaries (such as Salem Sound) are especially vulnerable to invasion because they are typically centers for such activities as aquaculture, international shipping, and fishing with fresh bait, all of which are important vectors for transporting and spreading invasive species.

Warren, who is the Executive Director of the nonprofit Salem Sound Coastwatch in Salem, Massachusetts, didn't know of any other volunteer-based marine invasive species monitoring programs to use as a model. She did know that she wanted a program in which volunteers would monitor sites regularly for both invasive and native species, using random sampling and semi-quantitative methods, as opposed to a simpler "early detection" approach focusing exclusively on screening for invasives. This comprehensive, quantitative approach would generate long-term data that could be used for trend analysis.

"People around here often comment that 'things are so different than they used to be,' but without data no one really knows for sure," says Warren.

Warren also felt the comprehensive approach would be more interesting for volunteers. She had seen the enthusiasm generated by Adopt-A-Tidepool, a Massachusetts Audubon program that Coastwatch participated in. "The volunteers I work with want to know what's in their world—the world of the tidepool," says Warren. "I didn't want to just ask them to look for something that may not even be there."


ROB GOUGH

European sea squirt (*Ascidiella aspersa*)

Designing the protocols

So Warren set about developing protocols. For monitoring the rocky shoreline, she adapted a quadrat method described in a 2002 report by Murray et al. For floating docks, she worked with Massachusetts Audubon scientist Robert Buchsbaum to design a transect method appropriate for volunteers. (See box on next page for details on methods.)

Lessons from the pilot study

In the summer of 2004, 42 volunteers took part in a pilot project, performing monthly monitoring at 13 sites.

At the end of the summer, two things were clear. First, volunteers were willing and able to perform the tasks. Second, identifying the organisms was a bigger challenge than anticipated. The volunteers needed more training, more assistance in the field, and—most important—better identification materials for nonnative species than the generic field guides they were using.

With financial support and technical assistance from Massachusetts Coastal Zone Management, Salem Sound Coastwatch produced identification cards for 13 marine invasive species already established in Massachusetts and seven potential invaders. The sturdy laminated cards, inspired by similar cards used in New Zealand, measure approximately 5" x 8" and are convenient for field use. The front of each card contains drawings, photographs, and descriptive information, while the back gives information about the invasion history of the species and tips for distinguishing it from similar-looking species.

Adaptation

Since its official launch in 2005, Salem Sound Coastwatch's Coastal Habitat Invasives Monitoring Program has continued to evolve. The biggest change was

continued on next page

Rocky shorelines: Random quadrat method

In the Salem Sound Coastwatch invasive species monitoring program, rocky shorelines are sampled at low tide by placing a 1-square-meter quadrat made from PVC pipe at several randomly selected locations. Volunteers count some species, including crabs, sea stars, and sea urchins, and make abundance estimates for others. Two invasive crab species, the Asian shore crab and the European green crab, are important targets of rocky shoreline monitoring.


ANDREW MARTINEZ

European green crab *(Carcinus maenus)* female carrying eggs.

The Coastwatch invasive species manual stresses the difference between truly random quadrat placement, which is accomplished with the help of a random number table, and "haphazard" placement, an informal method in which the monitor simply attempts to place the quadrat in an unbiased manner. Inevitably, the manual explains, haphazard placement will be unconsciously influenced by the size of the rocks, the amount of water, the glimpse of an organism, or other factors.


BARBARA WARREN

Floating docks: Transect method

The submerged floats beneath floating docks provide excellent attachment surfaces for marine plants and organisms. Volunteer monitors lie facedown at the edge of the dock and gaze into an underwater world of algae, tunicates, mussels, barnacles, anemones, sponges, sea stars, crabs, and others. Many of these are sessile (nonmotile) organisms attached to the floats, while others are visitors who come to feed on the permanent residents.


ADRIENNE PAPPAL

Line transects are marked on the edge of the dock so that repeat sampling takes place at the same location. Initially the volunteer protocol called for 18-inch lines, but that quickly proved to be too wide an area. The novice monitor is confronted with a rich and crowded three-dimensional mass of living, pulsing, plant and animal life—waving tentacles, colorful slime, bulb-shaped sea squirts, tiny crawling crabs, and assorted blobs and crusts of every shape and description. In order to be able to make accurate identifications and abundance estimates, volunteers needed a more manageable area. It was found that 20 cm (8 inches), which is just about the width of a human face, worked well.

Another issue that arose was how closely to estimate abundance. During the pilot project, the volunteers only recorded presence or absence. "But then we thought, 'We can do better,'" says Warren. So the protocol was revised to include three abundance categories: none, 1-10, and greater than 10. Recently the program experimented with using five categories (none/rare/few/common/abundant), but this proved confusing for volunteers.

Detailed instructions for methods can be found in Salem Sound Coastwatch's *A Citizen's Guide to Monitoring Invasive Species* (see "Resources" section on next page).

SALEM SOUND, continued

the incorporation, in 2006, of a nonquantitative visual survey in which volunteers visually "sweep" docks or shorelines looking for new invasions or dramatic changes in species distribution.

Currently, the program monitors nine sites monthly throughout the summer. Visual surveys are conducted at all sites. In addition, a cadre of dedicated volunteers carries out the original quantitative monitoring at six of the sites.

This new hybrid approach combining quantitative and qualitative monitoring fulfills several objectives. The visual survey covers more ground more quickly, improving the chances of catching a new species. It also suits the needs of volunteers with less time to commit, and allows more volunteers to participate in the program. At the same time, a long-term dataset continues to be built for the six sites that receive consistent quantitative monitoring.

Training and support

Coastwatch provides both classroom and field training sessions. Trainers stress that a finding of "absence" is just as significant as "presence"—in fact absence is the desired finding when it comes to invasive species.

The Coastwatch program schedules specific dates for monitoring each site and makes an effort to send a staff member or trained college intern out with the volunteers to help identify organisms and answer questions.

A timely catch

Warren's favorite invasive species story is about the day in August 2007 when a volunteer doing a dock transect called her and said, "You've got to come down—there's something here." When Warren got to the site she found the invasive species *Didemnum*, a type of tunicate, covering all the submerged hard substrates. It was hanging from the floats under the floating docks and covering the underwater portions of the pilings on stationary docks. Warren and the volunteer proceeded on to a nearby marina and then a yacht club, and found *Didemnum* on every piling.


BARBARA WARREN

Didemnum forms gloppy-looking colonies composed of thousands of individuals.

This was the first time *Didemnum* had been seen in Salem Sound.

"We'd been monitoring the dock regularly since 2004," says Warren. "It had just been monitored in July 2007. That's how monitoring goes—you don't see anything, you don't see anything, and then all of a sudden you see something. If that volunteer hadn't been out there, we wouldn't have made this discovery."

For more information, contact Salem Sound Coastwatch Executive Director Barbara Warren, barbara.warren@salemsound.org; 978-741-7900; or visit www.salemsound.org.

Resources

Murray, S.N., R.F. Ambrose, and M.N. Dethier. 2002. Methods for Performing Monitoring, Impact, and Ecological Studies on Rocky Shores. MMS OCS Study 2001-070. Marine Science Institute, University of California, Santa Barbara. www.coastalresearchcenter.ucsb.edu/scei/Files/2001-070.pdf.

Salem Sound Coastwatch Marine Introduced Species Monitoring Resource Center. www.salemsound.org/mis/miscenter.htm.

Warren, Barbara. 2005. *A Citizen's Guide to Monitoring Marine Invasive Species*. Salem Sound Coastwatch. 27 pages. Available at Salem Sound Coastwatch Coastal Habitat Invasives Monitoring Program website, www.salemsound.org/chimp.htm.

Invasives Monitoring in Puget Sound

At sites throughout Puget Sound and the inland marine waters of Washington State, trained volunteers with the Marine Invasive Species Monitoring program (motto: "MISM – Don't miss 'em!") regularly look for 32 exotic marine and estuarine species, 24 already present in the Sound and eight potential invaders.

Like their counterparts in Massachusetts, MISM monitors survey marinas, docks, and shorelines for a variety of invasive species. They also set out baited traps for European green crabs, an activity that would be completely superfluous in New England where the crabs are all too easy to find. But not one European green crab has yet been found in Puget Sound, although the Sound is imminently threatened by well-established populations on nearby Vancouver Island in British Columbia. MISM hopes to quickly detect any crabs invading from the north before they have a chance to spread throughout the Sound. Trapping is a significant commitment for volunteers, since traps need to be checked every 24 hours to ensure there is no accidental catch of endangered species.

MARY JO ADAMS

The Asian mud snail (*Batillaria attramentaria*) and the seaweed *Sargassum muticum* are on MISM's target list.

ANN EISSINGER

MISM volunteer Melissa Roberts sets trap for European green crab.

Ann Eissinger, who coordinates MISM, is especially proud of the program's online reporting system that allows volunteers to enter their data directly, thereby conserving precious staff time.

MISM is a joint project of the Washington Department of Fish and Wildlife and the nonprofit group Nahkeeta Northwest. For more information see the program website, http://vmp.bioe.orst.edu, which includes the volunteer training manual, invasive species identification guide, and data entry portal.

MIMIC: A Broad Effort in New England

Inspired by the Salem Sound Coastwatch invasive species monitoring activities, the Massachusetts Office of Coastal Zone Management (CZM) decided to initiate an early detection network for marine invasive species. The network, termed the Marine Invader Monitoring and Information Collaborative, or MIMIC, was launched in 2006 and expanded beyond Massachusetts' borders in 2008.

MIMIC currently includes seven participating Massachusetts organizations, including Salem Sound Coastwatch, as well as several groups in Maine, New Hampshire, and Rhode Island. In 2008, about 100 volunteers participated at about 50 sites.

CZM trains MIMIC volunteers in a visual survey protocol very similar to that used by Salem Sound Coastwatch. However, MIMIC does not include a quantitative monitoring component.

"It's more of an early detection focus, designed to cover a wide area," says Adrienne Pappal, who coordinates the MIMIC program. "We try to make it easy for folks to participate."

The survey takes about an hour, and volunteers are asked to monitor four times during the summer. Volunteers enter their data into the Marine Invader Tracking Information System (MITIS) database maintained by MIT Sea Grant (http://massbay.mit.edu/mitis/).

For more information, and to download the MIMIC protocol manual and invasive species ID cards, please visit www.mass.gov/czm/invasives/.

WES SHAW

With the help of laminated identification cards, MIMIC volunteers identify tunicates covering a kelp blade that they pulled from the side of a dock.

Attention

Volunteer Monitors: Don't Spread Invasives!

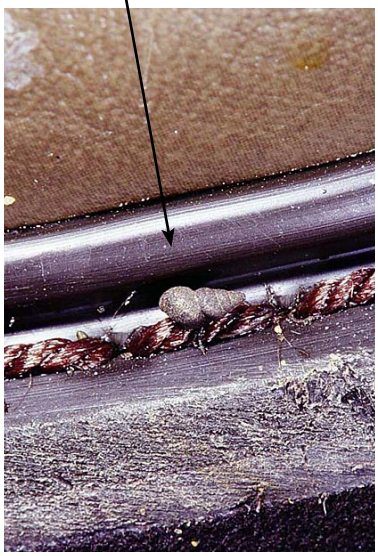
by Eleanor Ely

The last thing volunteer monitors want to do is spread aquatic invasive species. But they risk doing just that if they monitor more than one water body.

"The world has changed," says Joe Starinchak, Outreach Coordinator for the U.S. Fish and Wildlife Service's Branch of Invasive Species. "An unintended consequence of the global economy is that we have many more invasive species to worry about. We need to take precautions now that we didn't have to in the past."

Invasive aquatic plants and animals can hitchhike on volunteer monitors' personal gear, especially boots and waders; on boats and trailers; and on monitoring equipment such as nets, water samplers, thermometers, turbidity tubes, plant rakes, Secchi disks and ropes, macroinvertebrate sorting trays, and electronic meters.

Basically, anything that comes in contact with the water can become a vector for carrying unwanted passengers. If monitors don't thoroughly clean, dry, and/or disinfect their gear between water bodies, they could unwittingly infect the very waters they are trying to protect.



JANE AND MICHAEL LIU

A New Zealand mudsnail hitching a ride in a boot seam. This tiny invader (usually less than 0.2 inches long at maturity) can easily go undetected on clothing or equipment.

The idea that volunteer water monitors (or professionals, for that matter) need to take precautions to avoid spreading invasive species is fairly new. The critical first step is awareness, followed by a conscious effort to identify every activity that could potentially transport invasives.

Thinking about risks

Many volunteer monitoring programs probably haven't even thought about the risks involved in the following situations:

- Training sessions, workshops, or demonstrations in which the same equipment or footwear is used in quick succession in two or more water bodies
- One-day monitoring events or "blitzes" during which volunteers visit several sites
- Sharing of equipment among volunteers monitoring different waters

Even when all the sites being monitored are free of known infestation, some risk still exists. "Nondetect is not the same as absent," notes Steve Wells, an invasive species biologist at Portland State University. And even a volunteer who monitors only a single site could introduce an invasive species by using a boat or waders that were recently used for some other activity (e.g., fishing) in an infested water body.

Avoiding problems

Monitors can avoid problems if they either

(a) Monitor only one site (and don't use the same footwear or gear in any other water body), or

(b) Maintain a separate set of gear for each water body monitored.

However, when monitors are using the same gear in more than one water body, they need to take steps to avoid transporting invasive species to new locations. These steps can be broken down into **prevention**, **removal**, and **decontamination**.

1. Prevention

If the same equipment or footwear is being used in more than one water body, the following precautions are helpful:

- Don't use felt-soled waders. Felt can

MINNESOTA VOLUNTEER STREAM MONITORING PROGRAM

What does this picture show?

From a human perspective:

Volunteers with waders, dipnet, rope, and pan.

From an invasive species perspective:

Lots of ways to catch a free ride to a new home.

easily pick up and transport invasives, especially the nuisance alga didymo (*Didymosphenia geminata*) and the New Zealand mudsnail, and it holds moisture for a long time, which allows the organisms to survive. Trout Unlimited recently issued a call to fishing gear manufacturers to stop producing felt-soled waders and boots by 2011.

• When monitoring several sites in the same day, visit those that are believed to be free of infestation before those known to be infested.

• When equipment is shared among volunteers, maintain a log of dates, water bodies monitored, and decontamination steps taken.

2. Cleaning and removal

Gear and equipment should be carefully inspected and cleaned before leaving the site. The techniques are fairly straightforward. Remove any visible plants, animals, and debris from boats and gear. Remember that even a small plant fragment can start a new infestation. Scrub boots or waders, gloves, and other gear or equipment that won't be damaged with a stiff brush and (if possible) warm soapy water or one of the disinfectant solutions listed below. Rinse everything with clean water (not water from the water body).

Boats and trailers should be washed with hot and/or high-pressure water.

Remember that some invasives (e.g., invertebrate larvae and juveniles, fungal spores, viruses) are too small to be visible, so cleaning procedures should be carefully followed whether or not equipment "looks dirty."

FRANK KOSHERE

Curly-leaf pondweed (*Potamogeton crispus*)

DAN GUSTAFSON

New Zealand mudsnail (*Potamopyrgus antipodarum*) shells

3. Decontamination

The aim of decontamination is to kill any invasive organisms, including spores or seeds, that remain after the cleaning and removal process. Easier said than done! Unfortunately, information about the efficacy of various treatments against different invasive species is incomplete; much more research needs to be done.

Some invasives are too small to be visible, so cleaning procedures should be carefully followed whether or not equipment "looks dirty."

One thing is clear—there is no single treatment that works against every invasive aquatic species ("unless maybe a flame thrower and some napalm," quips David Britton, Assistant Aquatic Invasive Species Coordinator for U.S. Fish and Wildlife Service).

The choice of method depends partly on which species are known or suspected to be present in a given region. A few major species of concern are zebra and quagga mussels, New Zealand mudsnails, the alga didymo, and various invasive plants.

Decontamination methods fall into two categories: physical and chemical. The following discussion provides general information, mainly drawn from the sources in the reference list. These sources do not always agree with each other, and a number of different protocols are currently in use by different agencies.

Volunteer monitoring groups are strongly advised to consult with local biologists for advice on disinfection methods appropriate to their particular situation (i.e., type of equipment being used, invasive species of particular concern in the region, etc.).

Physical decontamination methods

When feasible, physical decontamination methods (drying, freezing, or heat) are preferable to chemical treatments. The physical methods are much less damaging to gear and equipment, and are nontoxic to humans and the environment. Also, the physical methods are more effective than chemical methods for killing adult zebra and quagga mussels and New Zealand mudsnails, which are able to sense the presence of noxious chemicals and defend themselves by closing their shells (in the case of mussels) or opercula (mudsnails).

Drying

Thorough drying is a simple, no-cost, broadly effective method. The critical word is *thorough*, and the catch is that thorough drying can take a long time. Some sources recommend drying an additional 48 hours after items are dry to the touch. Drying in sunlight is best. Total drying time can be three to five days, or even longer, depending on weather conditions. Nets take an especially long time to dry.

Freezing

For items that fit into a freezer, freezing for 24 hours is a simple and effective method for killing invasives. This method can also be used for larger items when outside temperatures are below freezing.

continued on next page

Hot water

Exposure to water above 140°F (60°C) for 10 minutes is a very effective method for a wide range of invasive species, including zebra and quagga mussels and New Zealand mudsnails. This temperature is much hotter than hot tap water. It's also hotter than the water used at a typical carwash facility. In spite of the less-than-optimal water temperature, power washing at a carwash is widely recommended for cleaning boats and trailers and is a valuable and practical approach.

Chemical decontamination methods

Important notes:

1. Probes from instruments such as DO or pH meters should never be put into a chemical solution. The outer cases and cables of meters can be treated with chemicals, but the only safe treatment for probes is thorough rinsing with clean water.

2. Never mix bleach with any ammonia-containing product, or with any acid. This produces poisonous gases.

A major drawback of chemical treatments is that they are all, to a greater or lesser extent, corrosive to equipment and clothing and toxic to aquatic life. Clothing or equipment containing adhesives (nets and boots, for example) is particularly susceptible to damage.

On the plus side, chemical treatments provide a relatively quick and convenient method that can (if necessary) be used in the field. Chemical methods and hot water are the only decontamination options that work quickly enough to be used when monitoring several water bodies in one day using the same equipment.

Chemical decontamination is best done at home in a large sink, tub, or shower. If done at the monitoring site, make sure the chemical solution doesn't get into the water body. After treatment, rinse items with clean water (tap water). Protective goggles and gloves should be worn when using chemicals.

Chemical decontamination protocols often differ from agency to agency and region to region, not only in the chemicals used but in the recommended concentrations and treatment times. The resources listed at the end of this article illustrate the variability in protocols. These differences are sometimes related to which invasive species are the primary targets.

The four chemicals discussed below—chlorine bleach, vinegar, salt, and quaternary ammonium compounds—seem to be the most commonly used at present. Volunteer monitoring groups should be sure to consult with local biologists before adopting a chemical treatment protocol.

Chlorine bleach

A very important caveat about bleach is that, while it is effective against a number of invasive species, it is NOT effective against adult New Zealand mudsnails.

For zebra and quagga mussels, a solution of 1 tablespoon Clorox per gallon of water is often recommended (see for example the U.S. Army Corps of Engineers (USACE) ZMIS website and Hosea and Finlayson 2005). Higher concentrations may be advisable in some situations. For example, the Wisconsin Department of Natural Resources uses 5 ounces (about 0.6 cup) bleach per gallon of water, largely because of concerns about the yellow perch parasite *Heterosporis*.

Soak items in the bleach solution for the recommended contact time (some sources suggest 10 minutes). Alternatively, use a spray bottle to completely saturate the items with the solution, then allow to sit for the recommended time. Immediately after treatment, rinse items thoroughly with clean water.

Vinegar

Several sources consulted for this article suggested undiluted vinegar as a treatment for zebra and quagga mussels but did not mention whether vinegar is effective against other invasive species. This may be an area where more research is needed.

As part of a study comparing different chemical treatments (Hosea and Finlayson 2005), the neoprene bootie on the right was exposed to undiluted bleach, which caused cracking, color loss, and other damage. In practice, a diluted bleach solution would be used and the damage would not be as extreme.

ROBERT HOSEA

> Chemical treatments are all, to a greater or lesser extent, corrosive to equipment and clothing and toxic to aquatic life.

Vinegar is not as damaging as bleach to equipment and footwear. Undiluted white vinegar may be used as a soak or spray. A 20-minute contact time is recommended for killing zebra mussels (USACE ZMIS website).

According to Steve Wells, one advantage of vinegar is that it physically dissolves zebra and quagga mussel veligers, whereas bleach or hot water will kill the veligers but not dissolve them. In situations where plankton nets are being used to monitor for veligers, Wells advises submerging the nets in vinegar for two hours to dissolve veligers before using the nets in another water body. Otherwise, microscopic examination of the sample may detect killed veligers from a previous water body, leading to a false positive result.

DON CAMERON

Eurasian water-milfoil (*Myriophyllum spicatum*)

Salt

Of all the chemical methods, salt is probably the least corrosive to equipment and the least toxic to the environment. It's also very cheap.

As is the case with vinegar, salt is a frequently mentioned treatment for zebra mussels but not much information is available about its effectiveness against other invasive aquatic species.

Some protocols (Wisconsin DNR; Stop Aquatic Hitchhikers) call for submerging items for 24 hours in a 1% salt solution (about 1/8 cup of salt per gallon of water). However, the USACE ZMIS website recommends a saturated solution (about 26% salt) for 30 minutes.

Quaternary ammonium compounds

Quaternary ammonium compounds are a type of disinfectant commonly used in public places such as gyms, restrooms, and hospitals. Example brands are Quat 128 (Buckeye International) and Sparquat (Spartan Chemical Company). Reminder: Never mix these compounds with bleach (see note on page 20).

Quaternary ammonium compounds are effective against a broad range of invasive species, including zebra and quagga mussels and New Zealand mudsnails. They are also relatively nontoxic, and not too hard on fabric or metal. However, they are more expensive than bleach, vinegar, or salt.

For recommended concentrations against specific species, see the U.S. Forest Service Intermountain Region's 2008 guidance document.

QwikLite: A New Toxicity Testing Method

A new bioassay for detecting toxicity in water and sediment offers a quick and simple alternative to current toxicity bioassays that are based on *Daphnia* (water fleas), mysid shrimp, fathead minnows, and other indicator organisms.

The new method, called QwikLite, uses the bioluminescent marine dinoflagellate *Pyrocystis lunula* to detect the presence and severity of toxic contamination. The higher the level of toxicity, the greater the reduction in bioluminescence.

The QwikLite system. The white cartridge holds cuvettes (small tubes) that contain the bioluminescent dinoflagellate *Pyrocystis* mixed with the sample to be tested.

No laboratory is required, and results are available in 24 hours. Like other toxicity bioassays, QwikLite is nonspecific—that is, it does not provide any information about which specific contaminants are present.

QwikLite is being marketed by a Southern California startup company, Assure Controls, that has an active interest in working with nonprofit volunteer monitoring groups. Although the sophisticated QwikLite equipment designed for industry or agency use costs upward of $5,000, the company also has available a simpler version (shown in the photo) that can be rented to volunteer monitoring groups.

The Stevens & Permanente Creeks Watershed Council in San Jose, California, recently began using the simple version of the QwikLite system for testing Stevens and Permanente creeks, which are on California's 303(d) list for toxicity. "We got excited about the method because it's faster and easier than using *Daphnia* and it takes up a lot less space," says Mondy Lariz, the Council's Executive Director. "We've been able to produce credible results with minimal training. And the company is very responsive to the needs of community groups like ours."

For more information, contact Assure Controls at 760-505-3000; info@assurecontrols.com; www.assurecontrols.com; or Mondy Lariz at execdir@spcwc.org.

Conclusion

The treatment of gear and equipment to prevent spreading invasives is an evolving science. A number of other chemical disinfectants besides those mentioned above have been investigated or are being used. For details, interested readers are referred to the reports and websites listed at the end of this article.

The number of different invasive species and treatment protocols can seem overwhelming. Volunteer monitoring programs need to carefully evaluate the risks of their particular situations and decide on realistic precautions, in consultation with local experts.

Some of the methods described above are too burdensome for volunteers except in high-risk situations. Simple actions like inspecting gear and equipment, cleaning with a good scrub brush, and trying to avoid using the same gear in more than one water body are important first lines of defense. As Steve Wells points out, "Something is better than nothing."

The assistance of Steve Wells in the preparation of this article is greatly appreciated.

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Wisconsin Department of Natural Resources boat and gear disinfection protocol. http://dnr.wi.gov/fish/documents/disinfection_protocols.pdf.

SUCCESS STORY

A Volunteer Saves the Day

NH VLAP

George Fitzgerald (left) and a fellow volunteer monitor water quality on Halfmoon Pond. The long tube is for collecting an integrated sample for chlorophyll testing.

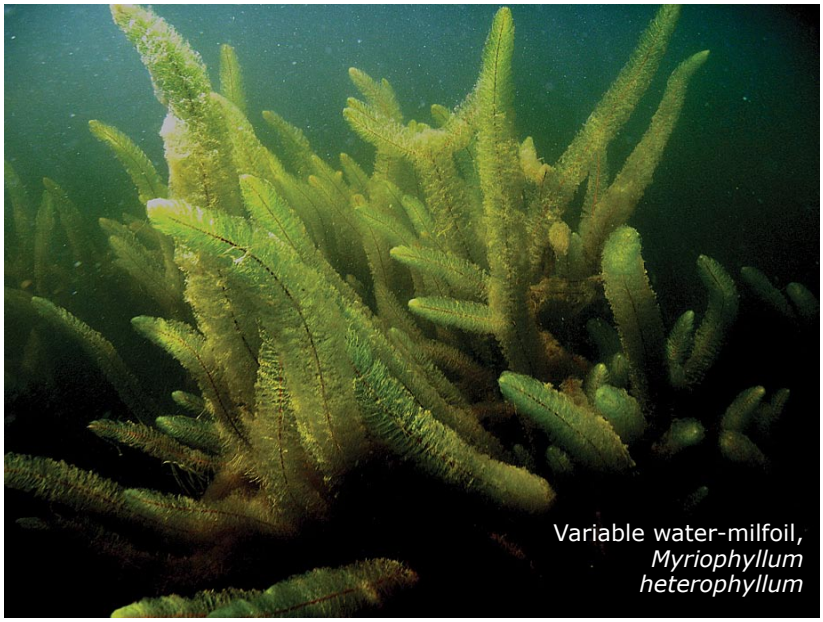
by Amy P. Smagula

Residents on Halfmoon Pond in Alton, New Hampshire, have a great deal to be happy about. One day in July 2006 when George Fitzpatrick was doing his routine water quality monitoring, he noticed something unusual.

George, a volunteer for nearly 20 years with the New Hampshire Department of Environmental Services (DES) Volunteer Lake Assessment Program (VLAP), was on his way back from sampling the deep spot on Halfmoon Pond. He was slowly driving his pontoon boat through his shallow cove to his dock, keeping a close eye out for the couple of big boulders that were just below the surface, when he spotted something bright green in the water. Looking closer, he saw small patches of the same type of plant here and there on the bottom.

Concerned, George headed up the bow, leaned over, and grabbed a handful of the vivid green plant. With his history on the lake, he was pretty certain he hadn't seen it before. He had heard of some plants that were taking over water bodies in the area, but didn't exactly know what to look for.

Back on shore, George packed up his samples and drove to the DES lab with a sense of unease. At the lab he unloaded big white bottles, big brown bottles, and small brown bottles. The last thing to come out of the cooler was the bright green plant in a small container.



DENNIS ROBERGE

Variable water-milfoil, *Myriophyllum heterophyllum*

As Exotic Species Program Coordinator for DES, I was called down to the lab to take a look. The plant was definitely a milfoil species, and it had all the characteristics of New Hampshire's most problematic aquatic plant, variable milfoil—bright green leaves in whorls around the main stem, a thick red stem, and lush hardy-looking growth. However, since the specimen lacked fruit or flowers I would need to get genetic confirmation of the species (milfoils are notoriously hard to identify when only in the vegetative form). Meanwhile, I asked George to keep an eye out for more plants and to alert his fellow lake residents about the possible problem.

The following weekend was the annual Halfmoon Pond Lake Association meeting. George wanted to make sure no one was left unaware of the potential problem in the lake. He collected more specimens from Halfmoon Pond, and also from other water bodies in town that had a known problem, and brought a bucketful of plants to the meeting. He also invited a state biologist to attend the meeting to provide information about exotic plants and answer questions.

In anticipation that the plant was in

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fact an invasive, I went out with George and two other volunteer monitors to do a brief preliminary survey. All except the initial location turned up free of anything resembling variable milfoil. Soon afterward we got the DNA results confirming variable milfoil, and I took an intern out with me to do a full assessment of the littoral zone of the lake.

We found no variable milfoil outside George's cove, but the survey was an amazing experience for me, unlike anything I've encountered in 10 years working with the Exotic Species Program. It was a hot sunny day with lots of lake residents on the shoreline and in the water. As we drove around the lake in the state boat, one person after another called out and asked if we were looking for "that weed" or "that milfoil." Many added that they had seen George's bucket of plants at the meeting and had already checked their shoreline. To see such lakewide awareness of an issue, in a short period of time, and to know that one of our volunteers was responsible for raising that level of awareness speaks volumes about how important volunteers can be to a cause.

For management of the variable milfoil in George's cove, DES divers hand-pulled the plants. The following summer (2007), DES continued with monitoring and some additional pulling. In 2008, our surveys found no variable milfoil at all in the lake.

The Halfmoon Pond story is a great example of how early detection and rapid response can head off a full-lake infestation. Our VLAP monitors continue to keep an eye on the cove and lake, and I'm sure the shoreline residents take a look around their beaches and shallows every time they are out there, thanks to the bucket of milfoil and some encouraging words from George and other monitors about protecting the lake from a menacing green plant called variable milfoil.

Amy P. Smagula is a Limnologist and the Exotic Species Program Coordinator with New Hampshire Department of Environmental Services. For further information: amy.smagula@des.nh.gov.

Invasive Eel in New Jersey

Matt Kail, a volunteer with Delaware Riverkeeper Network, and his friend Zack Russo made an important discovery last year when they captured unusual-looking eel-like creatures in a New Jersey lake. The specimens were identified by state biologists as the invasive nonnative Asian swamp eel (*Monopterus albus*), not previously seen in New Jersey. Kail, a college student and amateur naturalist, says he first caught a glimpse of the eels in in 2004, but didn't catch the slippery invader until 2008.

The Asian swamp eel is able to breathe air, travel over land on moist ground, tolerate a wide range of temperatures, and survive for weeks or even months without food. These qualities, combined with its voracious appetite, make it a formidable invader.


MATT KAIL

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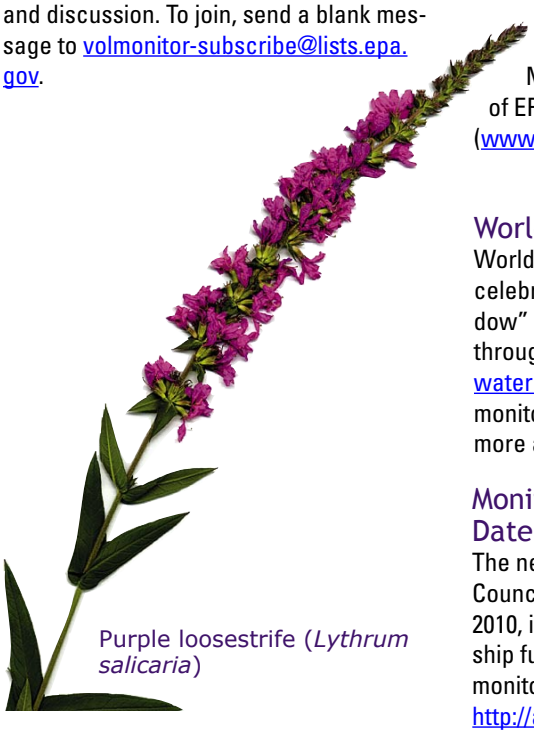
Resources and Events

Resources from EPA

The U. S. Environmental Protection Agency's volunteer monitoring website, www.epa.gov/volunteer/, includes methods manuals, a national directory of volunteer monitoring programs, conference proceedings, guidance for quality assurance plans, back issues of this newsletter, and more.

EPA's volunteer monitoring listserv is an open forum for announcements, questions, and discussion. To join, send a blank message to volmonitor-subscribe@lists.epa.gov.



JOHN HAACK

Purple loosestrife (*Lythrum salicaria*)

Mud Meter

Roger Clapp, Executive Director of the Watershed Association of the Tuckasegee River, was attending a high school football game when he got a brainstorm—why not use something like a football scoreboard to display water quality information? The end result was a billboard mounted on a bridge over a North Carolina creek. The billboard's electronic display shows current turbidity in the creek as well as a two-day average. Read more about the "Mud Meter" in the November 2008 issue of EPA's *Nonpoint Source News-Notes* (www.epa.gov/owow/info/NewsNotes).

World Water Monitoring Day

World Water Monitoring Day is officially celebrated on September 18, but the "window" for monitoring extends from March 22 through December 31. See www.worldwatermonitoringday.org/ to order simple monitoring kits, register a site, or learn more about the event.

Monitoring Conference—Save the Date

The next National Water Quality Monitoring Council conference will be held April 25-30, 2010, in Denver, Colorado. Some scholarship funding will be available for volunteer monitoring program coordinators. Watch http://acwi.gov/monitoring/ for updates.

Fundraising, Presentations, & Outreach

Fact sheets on three topics—fundraising, presentations, and outreach—have recently been added to the "Guide for Growing Programs" series on Cooperative Extension's Volunteer Monitoring Network website (www.usawaterquality.org/volunteer/). Like their predecessors in the series, the new fact sheets bring together useful information from multiple sources and are packed with references and links. The website also contains a wealth of other resources for volunteer monitoring programs.

ANDREW MARTINEZ

Codium fragile (dead man's fingers)