DEFINITION OF EXOTIC NUISANCE ALIEN INVASIVE SPECIES AND NATIVE INDIGENOUS SPECIES

From Maine DEP website http://www.maine.gov/dep/water/invasives/invmaterial.html

Discussions of Invasive Aquatic Plants include many words we all recognize, but the context can be unfamiliar and confusing when applied to plants. In addition to the common usage, biologists use these terms to describe the ecological status of plant or animal populations and how they fit into a particular geographical region. Some terms are used interchangeably, such as nuisance and invasive, both with a negative connotation. Four categories (Binggeli 1994) serve to cover the concepts used to describe the status and the distribution of a particular species.

1. **Native, Indigenous:** species naturally occurring or originating in a geographical region since prehistoric time;
2. **Introduced, Alien, Exotic:** deliberate or accidental release of a species into an area in which it has not occurred in historical times;
3. **Invasive:** the establishment of self-regenerating and spreading populations of a naturalized species in a free-living state in the wild, takes possession and may affect injuriously;
4. **Nuisance, Noxious, Weed:** any plant, either native or introduced, with a harmful or destructive influence on existing natural communities, interfering with the objectives or requirements of people.

These categories apply to biological communities, which are always evolving or changing due to fluctuating environmental conditions. Some species may be considered invasive if they occur in Maine but have been transported between watersheds and their introduction has caused detrimental effects to existing populations (e.g. introduction of white perch to brook trout waters has severely curtailed the beneficial values of brook trout in the affected waters). Some species in Maine fit into one or several of these categories, for example:

- Variable milfoil: a common plant in its native range, is invasive and a nuisance when spread to new waterbodies
- Bladderwort: a common native aquatic plant that is occasionally considered a nuisance
- Purple Loosestrife: a rapidly spreading exotic invasive in wetland habitat
- Brook Trout: a desirable native that is not a nuisance
- Brown Trout: an introduced species that is not invasive or considered a nuisance
- Gold Fish or Carp: exotics that are also considered noxious invasives

Binggeli, P. (1994) Misuse of terminology and anthropomorphic concepts in the description of introduced species. Bull. Brit. ecol. Soc. 25, 10-13.

DEFINING THE TERM "INVASIVE SPECIES"

Excerpted with permission from a letter to Lori Williams, Executive Director, National Invasive Species Council, U.S. Department of the Interior, from E. Shippen Bright, Interim Chairman, Invasive Species Advisory Committee, dated April 23, 2004

At a number of recent policy forums, the ambiguity of the term "invasive species" has been cited as a reason for delaying new federal programs to combat the problem. Confusion over this particular term is understandable, given the globally diverse terms used in describing the issue. However, the use of the term "invasive species" and its meaning pertaining to U.S. federal programs within the Invasive Species Advisory Committee (ISAC) and the 2001 National Management Plan for Invasive Species (NMP) has been debated and agreed upon. While some areas remain unclear or "gray", they need not hinder action to prevent and control those organisms that clearly fall within the boundaries of the NMP definitions. This letter is to summarize these important distinctions, hoping that the member agencies of the National Invasive Species Council (NISC) can quickly and decisively respond to programmatic criticisms stemming from definitional concerns, allowing discussion to proceed on more important questions of policy.

Executive Order 13112, which established NISC, utilizes the terms "alien," "invasive" and "native" species. It defines the term ***"alien species"*** as:

> *"any species, including its seeds, eggs, spores or other biological material capable of propagating that species, that is not native to that [particular] ecosystem."*

The order defines ***"invasive species"*** as:

> *"an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health."*

It further defines ***"native species"*** as:

> *"a species that, other than as a result of an introduction, historically occurred or currently occurs in that [particular] ecosystem."*

In continuing this convention, the NMP clarifies the difference between "alien" and "invasive" by stating that the latter are those that cause or are likely to cause harm to the nation's economy, environment, or public health. It provides a set of examples to illustrate the distinctions between these concepts, and calls for a clear set of screening criteria which will consider potential societal benefits, as well as risks associated with organisms that fall into the gray area.

The consistency between these documents was hard won, but highly worthwhile. To counteract any continuing uncertainty, NISC should actively and clearly reaffirm that actions to manage invasives will focus only on those alien species that cause or are likely to cause economic or environmental harm, or harm to human health. NISC agencies should also ensure that this information is widely disseminated to all relevant field personnel.

In conclusion, the challenges posed by invasive species are already daunting. Eliminating the vagueness associated with the issue's terminology will contribute greatly to developing new policies and management strategies to protect the economy, environment, and public health of the United States.

Demystifying Milfoil

By
Scott Williams and Roberta Hill
Lake Stewards of Maine - Volunteer Lake Monitoring Program

Almost everyone has now heard of milfoil, that nasty invasive plant that threatens to ruin Maine's lakes, but there seems to be some confusion. How many types of milfoil are there? Is milfoil native to Maine? If not, how long has it been here? If so, why are we so worried about it? Is milfoil the only aquatic plant that threatens Maine's lakes? Much of the confusion may come from the way the term "milfoil" has been used in recent years.

"Milfoil" has been used as a catchword to get the message out about the threat of invasive aquatic plants in Maine. There are the "Maine Milfoil Summits," the "Milfoil Bill," and the formation of the "Maine Milfoil Coalition", etc. Having a word that people can easily identify with has been helpful in raising awareness. *But the practice of reducing a complex problem to a single generic term always has its down side. It fails to provide an accurate and complete picture. The term "milfoil," when used to describe the current threat of invasive aquatic plants to Maine's lakes, is limited and potentially misleading for a number of reasons.*

First, several milfoil species are native to Maine lakes. These plants are not harmful or threatening. In fact, like all of our native aquatic plants, they provide many benefits to the lake ecosystem. Native plants provide essential habitat for wildlife and protect water quality by taking up nutrients and protecting the shoreline from wave and wake action. Native aquatic plants are good for our lakes and ponds. *It would be most unfortunate if the public were to think that all members of the milfoil family were undesirable, and that they should be removed.*

Secondly, there are several non-milfoil plants that are just as likely to invade Maine's lakes in the coming years as the invasive milfoils. The current list of "Maine's most unwanted aquatic plants" (determined by the Maine Department of Environmental Protection (DEP), and included in the laws passed by the Maine Legislature in 2000 and 2001) includes the following eleven: Brazilian elodea, Curly leaf pondweed, European naiad, Fanwort, Frogbit, Hydrilla, Water chestnut, Yellow floating heart, Parrot feather, Variable-leaf milfoil and Eurasian watermilfoil. *Only the last three of these are actually milfoils. But all of these plants have been identified as imminent threats to Maine lakes. Indeed, hydrilla, considered by many experts to be one of the most aggressive and persistent invaders on the list, has now been found in two waterbodies in Maine.*

Here is an example of how generic language can be confusing. A Sebago Lake website posts the following Sebago Lake "fact."

> "Water plants native to the lake include pipewort, bur reed, water lobelia, spikerush, pondweeds, water celery, coontail, water milfoil."

Though the statement above is very likely accurate, in light of the recent attention focused on non-native invasive milfoils, the listing of "water milfoil," without further explanation, has caused some confusion, to say the least. Some have taken the statement to mean that the milfoil that has appeared in the tributaries and coves of Sebago Lake over the last forty years, Variable watermilfoil (*M. heterophyllum*), is native to Sebago Lake and therefore nothing to worry about.

Variable watermilfoil is *not* native to Sebago, to Maine, or even to New England. According to biologist C. Barre Hellquist, coauthor of *Aquatic and Wetland Plants for Northeastern North America,* the plant migrated, by way of human activity, to New England from the south and west (e.g., Michigan and Oklahoma) some time in the 1940s.

According to Biologist David Cortemanch, former manager of the Environmental Assessment Division at the Maine DEP, variable watermilfoil (*M. heterophyllum*) was first identified in Sebago Lake in the late 70s, and it was likely present in the lake for a few decades before it was identified.

There are many species of watermilfoil (genus *Myriophyllum*) worldwide. The *National List of Plants Species that Occur in Wetlands* lists six milfoils that are native to Maine. This is why the website fact is likely accurate. It would not be surprising to find one or more of these native milfoils in Sebago Lake. Indeed, over the last few years, the Lake Stewards of Maine (LSM-VLMP), Portland Water District (PWD), and the DEP have received requests to identify many aquatic plant specimens that have turned out to be native milfoils.

So variable milfoil is not native to Maine. Yet, it has been here for years, and it *hasn't* taken over Sebago Lake. What's the fuss?

Here's the fuss: Variable watermilfoil, which grows to a maximum depth of ~12 feet, will never overtake a lake like Sebago that is dominated by deep water habitat (often exceeding 100 feet), but it can become a significant nuisance in coves and near shore areas, interfering with boating and swimming and causing property values to decline. Variable milfoil can take over shoreline areas previously inhabited by native plants and negatively impact an important habitat. This is, of course, true for other Maine lakes that are infested with Variable watermilfoil.

Having no baseline data to work with, it is impossible to know how fast the plant is spreading in the lake and how many new colonies are forming each year. The Portland Water District began mapping milfoil sightings on the lake in 2000 and is currently working to organize a comprehensive screening of the lake's shoreline. The LSM-VLMP "Invasive Plant Patrol" screening project, a volunteer training program that is open to the general pubic, will be implemented through public workshops on lakes throughout Maine during the next several years. Having baseline data is essential to determining an appropriate action plan for Sebago Lake, and an effective prevention and identification plan for other lakes throughout the state.

Sebago Lake is one of the most popular boating lakes in Maine and in New England. Given that boats are the primary ways these plants get from lake to lake, the invasive milfoil found in Sebago is a potential threat to every other lake in the region.

Make no mistake – the three species of milfoil listed as "unwanted" in Maine lakes are aggressive and invasive. Every effort should be taken to keep them out of Maine lakes. But other invasive species are also present in Maine and more are on the horizon.

A great slogan for this issue has been: "Spread the Word, Not the Plant." *We should make sure that the words we are "spreading" are clear and accurate.* Perhaps it is time to adopt more accurate terminology. When speaking about the issue (and not about a specific plant), the term "invasive aquatic plants" or "lake invaders" works better than "milfoil" in almost all cases. It may not form a nice alliteration with the name of our state and lend itself to such catchy headlines as "Milfoil Makes Mess of Maine Lakes!" but give it time. It may grow on you.

For more information on invasive plants in Maine please visit the following websites:

Lake Stewards of Maine - Volunteer Lake Monitoring Program
www.lakestewardsme.org

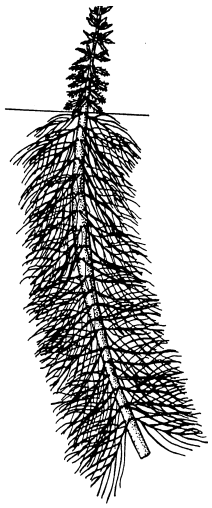
Maine Department of Environmental Protection
http://www.maine.gov/dep/water/invasives/index.html

Portland Water District
www.pwd.org

Lakes Environmental Association
www.mainelakes.org

INVASIVE SPECIES Q & A

With all the attention being paid to invasive plants like milfoil, people are asking a lot of questions. You can obtain additional information from the Dept. of Environmental Protection at 1-800-452-1942 or by visiting their website at http://www.maine.gov/dep/, or by calling the Dept. of Inland Fisheries & Wildlife at 287-8000.



- **What are invasive species?**

  Invasive species are plants, animals, and even microbes that are introduced from other regions and aggressively out-compete native species.

- **How are invasive species spread?**

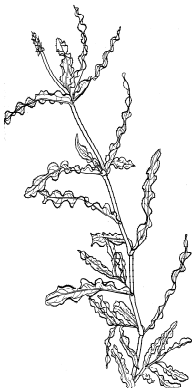
  Invasive species are usually spread as a result of human activity. Examples include carp from illegal fish stocking, Eurasian water-milfoil from boat and gear transport, and zebra mussels from engine cooling water and live wells.

- **What harm do these critters do?**

  It varies with each species. For example, invasive aquatic plants can grow densely, crowd out native plants, reduce fish movement and stunt growth. In dense beds, invasive aquatic plants can shade out the bottom, reduce the number of snails and other useful animals, and change water chemistry.

- **What's at stake?**

  Every year in the United States, government agencies and private citizens spend over $100 million to combat invasive aquatic plants. Closer to home, Vermont has spent over six million dollars since 1980 to control these plants, and in 2009 received over $1,080,000 in requests from municipalities for help in dealing with the problem. In addition, invasive species cost billions of dollars in lost recreation and property values, and ruin habitat for native species.



- **Does Maine have a lot of invasive species?**

  There are at least 49 invasive aquatic species--ranging from green crab in ocean waters to white carp in a number of rivers--known to occur in Maine. Scores of other invasive species that have spread into other New England states in the last few decades will increasingly pose a threat to Maine waters. Currently thirty-one lakes and ponds, and fourteen stream or river segments are known to be infested with one or more invasive aquatic species. Variable water-milfoil is still the most widespread of the known invasive aquatic plants in Maine. Other invasive aquatic plants present in Maine include curly-leaf pondweed, Eurasian water-milfoil, spiny (European) naiad, hydrilla and European frogbit. Five additional invasive aquatic plant species (not yet known to occur in Maine) have been listed by Maine law as imminent threats to our State.

Continued…

- Aren't all plants good for fish like bass?

  Plant life in lakes and streams is essential for good fisheries. In moderate densities, aquatic plants provide just the right blend of cover and edge for successful fish growth as well as places to produce forage for smaller fish. The very dense plant growth often seen with invasive species like variable leaf milfoil and water chestnut has the opposite effect.

- What is Maine doing about the problem?

  In 2000, Maine launched an effort to prevent the spread of invasive species, starting with aquatic plants, the most obvious problem. This includes educating people on how to recognize invasive aquatic plants, avoid spreading them, and what to do if they find them. The effort also includes thousands of voluntary boat inspections by wardens and volunteers, information given to incoming motorists, and projects to eradicate new infestations where possible. We are also cooperating with other states in our region along with federal agencies.

- Why bother to do all this if the plants are going to get here anyway?

  We know from other states' experiences that we can slow down the spread (and even prevent introductions) in some instances. The longer we keep these pests out, the more time we have to develop better control methods and the more recreation people can enjoy without these species in their favorite lakes.

- When is a sticker required?

  A Lake and River Protection Sticker is required to be posted on the bow of all motorized watercraft when operating on inland waters. This sticker requirement applies to both motorboats registered in Maine and motorboats from other states operating in Maine. For residents, the sticker has been combined with the registration sticker. No sticker is required for watercraft on tidal waters or for canoes and other boats not requiring registration. Contact your regional warden service headquarters for the exact boundary between tidal and inland waters on specific rivers.

- Where do I get the sticker?

  The current cost is $10 for Maine registered boats (which is included in the watercraft registration fee), and $20 for those registered in other states while operating on Maine's inland waters. Nonresidents can purchase stickers wherever boats are registered, fishing licenses are sold, and through the Inland Fisheries and Wildlife online store. In May of 2019 a bill to increase the sticker fee for both residents and non-residents passed in both houses of the Maine Legislature. New stickers must be purchased annually.

- What does this sticker pay for?

  100% of the funds raised go towards efforts to prevent spread of invasive aquatic species. None of this money is used for other DIFW or DEP work. Along with new warden staff and DEP specialists, much of the money is going to volunteer work and education efforts along with the boat inspections.

INVASIVE LAKE PLANTS: WHAT ARE THE COSTS?

Maine is the only New England state that has not experienced serious infestations of invasive aquatic plants. Unless real efforts are made to prevent these plants from finding their way into our lakes and ponds, we will have to pay the high cost that other states have faced, including:

RECREATIONAL LOSSES: Heavy Plant Growth = Less Enjoyment for Everyone!

- Entanglement of boats and motors in thick weed beds
- Problems for fishermen
  - Stunted growth of some species due to high plant densities
  - Difficulty navigating
  - Impact on fisheries resulting from plant control measures;
  - Higher lake association fees
- Reduced shore front property values on lakes that are infested
- Reduced tax, retail and tourism revenues to communities with affected lakes
- A nuisance and potential danger to swimmers
- Revenues from tourism may decline

METHODS USED TO CONTROL AQUATIC PLANTS: Very Costly and Potentially Damaging to the Environment!

- **Mechanical Plant Harvesting (cutting/mowing):** $350-$1500 per acre. Does not remove rooting systems and ensuing plant fragments could spread plant infestation. Ongoing maintenance generally requires two to three cuttings per season to obtain acceptable control.
- **Herbicide Application:** $300-$1000 per acre. Costs vary depending on treatment rate, chemical used and water depth. Generally needs to be repeated every two years. Negative effects include the loss of beneficial plants, nutrient release, water use restrictions, questions concerning long-term impacts to the ecosystem, and social acceptability.
- **Bottom Barriers:** $10,000-20,000 per acre (Professional installation). Limited application due to cost, difficulty in stabilizing large areas, and impacts on the lake ecosystem.

REAL DOLLAR COSTS TO OTHER STATES:

- **VERMONT:** Since 1980, the state has spent over six million dollars in federal, state, and local funds to prevent and control the spread of invasive aquatic plants. The state currently spends $200,000 annually just to staff invasive plant control programs for only 46 of its 285 larger lakes.
- **NEW HAMPSHIRE:** $100,000 in state and local operating funds is used annually to support 7-9 invasive plant control projects. This amount does not even come close to the public demand for programs for New Hampshire's 55 infested lakes.
- **MASSACHUSETTS:** Massachusetts spends over $290,000 annually on grants for local lake projects, most of which is used to battle invasives in its 298 infested lakes. For state properties alone, $95,000 a year is spent on operations to control invasive aquatic plants.
- **CONNECTICUT:** More than $150,000 a year in state funds is spent to cost share local projects for invasives control.
- Many states have had to hire full time coordinators just to manage invasive plant issues!

Everyone Agrees on the Most Cost Effective Solution: PREVENTION, PREVENTION, PREVENTION!

Frightening Factoids

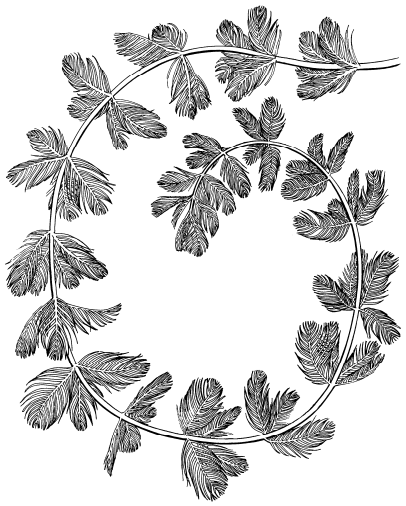
About Aquatic Invaders

~ A tiny plant fragment or a single seed carried on a boat or trailer can begin the infestation of an entire lake. Invasive species, unlike other forms of pollution, are self-sustaining.

~ An invasive plant population in a lake can double or triple in size every year.

~ Invasive plants are forever! There are very few documented cases of successful eradications.

~ Some of the control measures used to fight invasive aquatic plants are nearly as destructive to lakes as the plants themselves. Control measures may threaten rare or endangered species in a water body.



~ Lake associations and towns in other states have been battling Eurasian milfoil (EWM) for decades! Approximately 8-10 million dollars in public money is spent fighting this plant every year.

~ Invasive aquatic plants can compete with and eliminate beneficial native aquatic plants.

~ The introduction of a single invasive species to a lake can virtually ruin recreational opportunities, alter fish and wildlife habitat, affect water quality and lower shoreline property values.

~ Recent research in Vermont shows that invasive plants can cost shore line landowners on infested lakes over $12,000 each in lost property values! Vermont property values have been seen to decrease by up to 16% due to milfoil infestations alone.

~ Maine's neighboring states spend hundreds of thousands of dollars each year to prevent and control the spread of IAS.

~ All of the New England States, as well as 42 other states and seven Canadian provinces are battling Eurasian milfoil, water chestnut, and a broad group of other invasive species.

~ A total of $100 million is invested annually in the U.S. to control invasive aquatic plants.

~ Hydrilla can be even worse than Eurasian milfoil! This aquatic invader can completely overtake a population of EWM! From $20-$30 million in public money is spent every year battling Hydrilla in the US.

~ Massachusetts spends over $290,000 annually on grants for local lake projects, most of which is spent on battling invasives in their 298 infested lakes.

~ The US Coast Guard estimates that economic losses and control efforts cost the United States about $5 billion each year.

~ Zebra mussels can clog water pipes so severely that city water supplies can be cut-off. This happened in 1989 in the town of Monroe, MI for three days. Zebra mussels also crowd out some fish species and deposit sharp shells on beaches.

The most effective and inexpensive approach to the problem of invasive aquatic species is PREVENTION.

Lake Stewards of Maine ~ 24 Maple Hill Rd., Auburn, ME 04210 ~ 207-783-7733 ~ stewards@lakestewardsme.org ~ www.lakestewardsme.org

INVASIVE SPECIES AND THE ENVIRONMENTAL ETHIC

From a talk delivered at the 6th Annual Milfoil Summit, 2/25/05

by
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Adm. Horatio Nelson, the famous British naval commander, once wrote: "But in case signals can neither be seen or perfectly understood, no captain can do very wrong if he places his ship alongside that of the enemy."

Not being a ship's captain, I don't know exactly what that means, but whether in politics or government or business, I have taken this as a metaphor – a piece of good advice to get as close as possible to an enemy, or a problem, or a disagreement and learn about its character and what is driving it as best you can, so that you can try to take it to a satisfactory resolution. The advice seems good, in any case, when it comes to invasive species, some of which are clothed in great beauty and false hope, others of which slip in as hideaways, and a very high percentage of which arrive with the complicity, witting or unwitting, of human beings who did not take the time to get to know what they were dealing with. It is a good idea to take the measure of exotic species, to determine what kinds of problem they are, to determine which may or may not be enemies, and, though they may not be seen and may not be perfectly understood, take the necessary actions to prevent or contain the spread of those that earn the label, invasive.

Here is what I think we know about exotic species in the U.S. in general:

-- Approximately 4,000 species of exotic plants and 500 species of exotic animals have established free-living populations in the U.S. (Alien Plant Working Group, undated) Some were purposeful introductions, brought into their new habitats for economic reasons or for pleasure. Many others were accidental introductions.

-- Of these, nearly 700 are known to cause severe harm to agriculture, and more than 1,000 have been identified as a threat to native flora and fauna as a result of their aggressive characteristics, earning them the label of invasive.

-- This also means that 75% to 85% of exotics are not known to be invasive. Many have cautioned not to paint all exotics with the same brush; many have been incorporated into our gardens, our recreation, and our economy. But those that are invasive have wide-spread, damaging effects: reduced biodiversity, disruption of existing ecosystems, and impacts on the food supplies, recreation, and other resources of human communities.

Beyond these facts, in the interest of getting to know these species, it is useful to ask: is the problem of invasives primarily biological? Or is it primarily economic? And is there an ethical component to the problem—that is, if there were not a direct economic component to the problem, would we care? The answers frame both our public and private responses to invasives: how much we are willing to invest in solving the problem, how much we are willing to regulate ourselves, how much effort we are going to put into education.

BIOLOGICAL

The problem obviously has a biological component, and knowledge of the biology of invasives is central to preventing their arrival, to their eradication if they do arrive, and to their containment if eradication is impossible.

Exotics that are invasive succeed in their invasion for inherent biological reasons. As noted in a recent issue of *Conservation Biology* (Allendorf and Lundquist, 2003), they may be intrinsically better competitors because they evolved in a more competitive environment. They may find themselves relatively free of enemies, parasites and disease, which means that they end up with more resources and

opportunities for growth and reproduction than native species that have co-evolved with a community of species, both cooperators and competitors. And they may gain biological advantage in another way. Native populations may have evolved adaptations for their particular habitats that give them an advantage in extreme events, such as storms, drought, or fire that may come into play every 50 or 100 years. But these same advantages may carry a small price in efficiencies in the short term, which may be constraining when compared to an introduced species that has not been burdened by such adaptations. In these cases, the introduced species will pay in the long run, but may cause havoc in the short run.

If the problem of invasive species were only a biological issue, one could be neutral toward them, even admiring of them. We would battle them, because we, too, are biological beings that compete for space and habitat. But we would know that these species are doing what all species are designed to do – disperse, secure a position in a community that allows them to thrive, and from that position to reproduce and widen its territory as much as possible. Human beings could be particularly admiring, since we excel at these things ourselves. And we would understand that nature has a way of evening things out over the very long term: species come and go; ecological communities are structured and re-structured; and nature lives on.

ECONOMIC

But for anyone who might, in some intellectual way, be admiring of the biological capabilities and achievements of successful invasives, the economic component of the problem dampens our enthusiasm immediately. This is a matter of self-interest, a direct harm or threat of a harm that moves us to action. The costs are documented to be high.

For example, Kevin Boyle, Steve Kahl, Roy Bouchard, and others have documented the importance of great ponds to Maine's economy and tax base; and, in turn, have quantified the impact of water clarity on the value of properties around lakes. For example, the loss of 1 meter of clarity in a great pond such as Thompson Lake or Pushaw Lake can cumulatively depress property values by $6 million to $10 million dollars. (Boyle et. al. 1998) And that does not account for the spin-off impacts on tourism and the outdoor recreation industries that rely on healthy lakes and marine systems.

Nationally each year, invasive plants cause economic losses and expenditures in farming, forestry, and rangelands measured in the billions of dollars. The Office of Technology Assessment estimates that invasive species of weeds cost crop and livestock production more than $5 billion per year, plus the direct and indirect costs of using herbicides to try to control the weeds. The National Park Service and the Fish and Wildlife Service alone spend an estimated $12 million per year to control exotic plants.

And all of this apparently is just a fraction of total costs. When everything is accounted for, from lost production, to environmental costs, to the costs of containment, to the costs of anti-fouling measures in utility lines, writers in the journal *BioScience* in 2000 estimated the total cost of invasive species in the U.S. at an eye-popping $125 billion per year.

This, certainly, is what brings all of you here. According to an examination of the role of great ponds in Maine's economy, conducted for the Great Ponds Task Force in 1997, the economic activity associated with lakes and ponds leads to $1.2 billion in annual income for Maine residents and 50,000 jobs. (Boyle et. al., 1997). The economic consequences of milfoil and other invasives in Maine's lakes and ponds are too great to ignore.

ETHICAL

But is there also an ethical component? If so, our reaction takes on a different dimension. By definition, an ethical component requires us to act *contrary* to economic self-interest – to take action, or to refuse an opportunity, out of concern about something bigger than we, or out of obligation to a community or a generation that is not ours.

The ethical component of invasives has at least two parts to it. The first is only partly ethical; arguably it is really another aspect of the economic problem, because it has to do with who pays. The question is whether those who cause the problem appropriately bear the cost of solving it. We know that, while species invasions are a natural biological event, the rate of their occurrence and the distances traversed by species now exceed by orders of magnitude the invasions of a few hundred years ago. They are directly the result of human movement and trade. Some, like carp and European starlings, have been introduced on purpose. But far more often, they are introduced accidentally—such as Eurasian water milfoil by recreational boaters and anglers and zebra mussels via ballast water. Did you know that it is estimated that between 3,000 and 10,000 species of protists, animals, and plants are in motion around the world on any given day, in the ballast of ocean-going ships? The Japanese shore crab, now colonizing Atlantic North America, is one of them.

This is a question of fair distribution of costs and benefits, and that is why it is at least partly an ethical question. Those who have been responsible for inadvertently introducing species into new habitats may not have been willing to make the investment to prevent such accidents from occurring. They may not have realized the dangers, and in any case the dangers would be unlikely to have much economic impact on their own welfare. Rather, the costs of such accidents are borne by people other than those who have catalyzed the accidents. As Jeffrey McNeely, Chief Scientist of The World Conservation Union, has pointed out, the costs are in this way externalized. (Undated)

There is also a more purely ethical component to the invasives problem. The raw, ethical question is this: would we care about invasives if it were not for the direct economic harm to property values, to livelihoods, and to the enjoyment of resources we regard as placed on earth for our use? For that matter, *should* we care?

The non-economic problem associated with invasives is the homogenization of nature: taking a complex, resilient ecosystem that has evolved over thousands of years and simplifying and homogenizing and weakening it. As species invasions have accelerated in numbers and space well beyond background levels, ecosystems are less and less able to absorb their impacts. As a result, they are another manifestation of homogenization that comes with human colonization of local, regional, and global ecosystems. A recent article in the respected journal *Conservation Biology* asserts that the impact of invasive events on biodiversity is widespread – that invasive species are at least partially responsible for the extinction or imperiled status of 49% of the extinct or imperiled species in the United States. (Lodge & Shrader-Frechette, 2003)

If there were no economic consequences to this, I wonder if we would care. A little more than 30 years ago the U.S. passed the first federal statute, the Endangered Species Act, to grant de facto existence rights to species of plants and animals. In concept, at least, the Act recognizes existence rights of other species apart from their potential value as instrumentalities of human beings.

Yet, there is a great deal of evidence that our ethical values—that is, our willingness to act contrary to economic self-interest for a purpose greater than ourselves—do not extend to the homogenization of nature. The best evidence arises from the way in which we have chosen to spread ourselves across the landscape over the last half-century. Sprawl, as this pattern of settlement has become known, is one of the great homogenizers of nature. Even at low densities of one unit per 5 to 10 acres, sprawl reduces or eliminates the interior habitats required for biodiversity. The diversity of life quickly halves, and halves again, as large blocks of open space are reduced to 1,000-acres, 500-acres, and 50-acres, or are punctuated with house lots on 2, 5, or 10 acres. Yet, this is precisely what most suburban zoning ordinances now require.

Suburban sprawl, so far, has been impervious to ethical arguments dealing with pollution of the commons, reduction of wildlife habitat, and the homogenization of nature. Economic arguments simply trump ethical arguments. As a result, those of us who are trying to slow down or reverse sprawl must

resort to economic arguments of our own. There are plenty – including tax burdens, loss of the competitive advantage that is our quality of life, inordinate transportation costs, and so forth. And right now, the statewide organization GrowSmart Maine, led by its president Alan Caron, is launching a major analysis of the relationship between sprawl and Maine's economy—an analysis that we believe will definitively link the need to defuse sprawl to the future economic well-being of the state.

But the point is that, when it comes to common resources, like wildlife, the air, the great ponds, and so forth, we must rely on economic rather than ethical considerations if we are to protect them.

This is not exactly what Aldo Leopold had in mind, when he wrote in *A Sand County Almanac*: "Examine each question in terms of what is ethically and aesthetically right, as well as economically expedient. A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."

Fortunately or unfortunately, we need not rely on the ethical component to stir interest in invasives. The economic imperatives are strong enough to engage public policy, and, thanks to your efforts, public awareness of the problem is growing. The volunteer efforts and the public service mounted by the people in this room, and many others, around the control of milfoil and other lake invasives are remarkable. And, economically driven or not, it is a testament to Mainers' feelings for nature.

Let me conclude by saying that when I hear or read about invasives, a little poem by Ogden Nash comes to mind. It is about one of the most prolific introduced species in North America, the Rock Dove (now officially known as the common pigeon):

> "Toward a better world I contribute my modest smidgin;
> I eat the squab, lest it become a pigeon." – Ogden Nash

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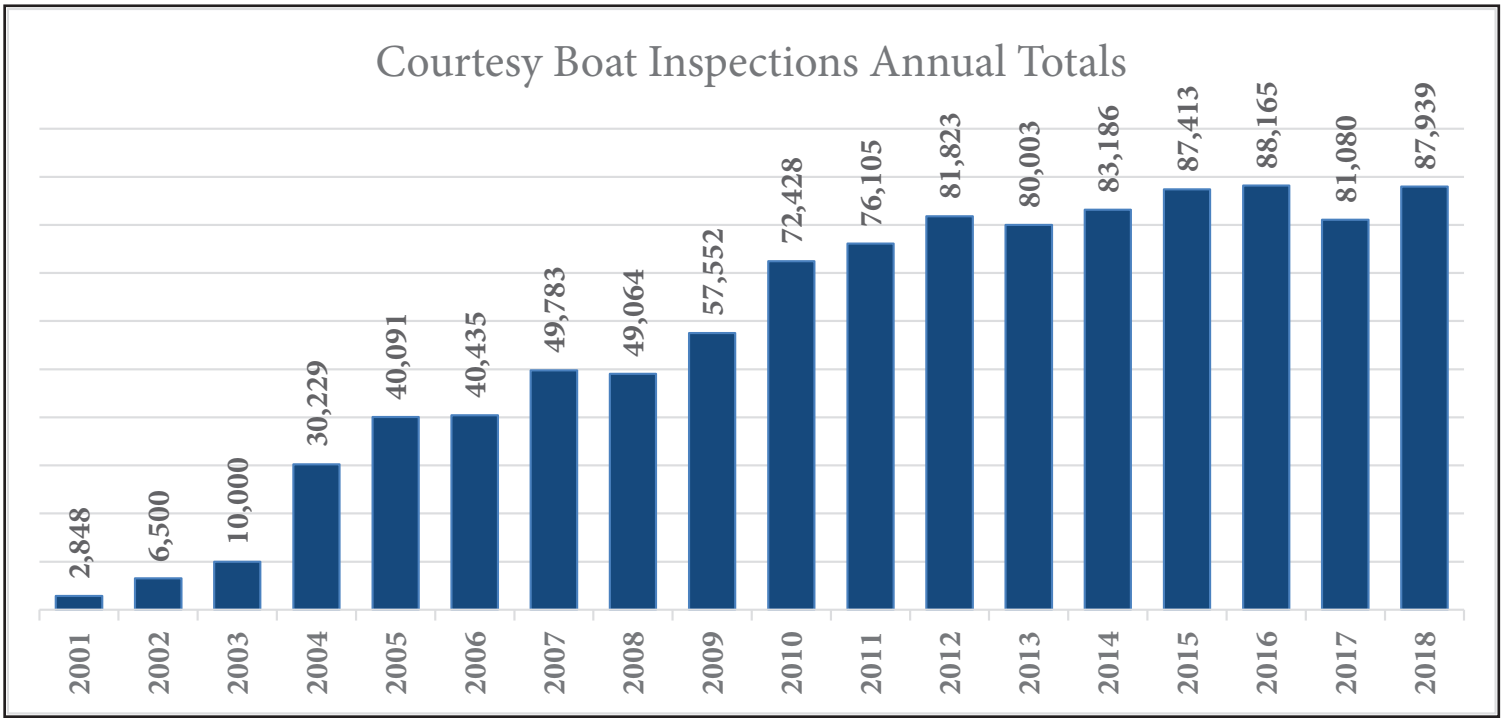


CBI statistics	2017	2018
Infested lakes with inspections	15	16
Water bodies with inspections	122	123
Total plants found	3622	3532
Total invasive plants found	77	95
Invasive plants on entering boats	6	18
Invasive plants on leaving boats	71	77
Total inspectors	653	592
Inspection hours	44,415	43,406
Boats with sticker	56,222	61,484
Participating lake association organizations	50	53
Participating Bass Clubs	48	41

Source: Maine Department of Environmental Protection

Confirmed 'saves' 2018	Boat direction	Invasive plant
Panther Pond, Raymond	1 entering	Variable milfoil
Sebago Cove, Naples	7 leaving	Variable milfoil
Lake Arrowhead, Waterboro	3 entering 54 leaving	Variable milfoil
Messalonskee Lake, Oakland	1 entering 6 leaving	Variable milfoil
Messalonskee Lake, Oakland	1 entering	Eurasian milfoil
Messalonskee Lake, Sidney	1 entering 7 leaving	Variable milfoil
Pleasant Pond, Litchfield	1 leaving	Variable milfoil
Pennessewassee Lake	3 entering	Eurasian milfoil, Zebra Mussel, and Variable milfoil
Trickey Pond, Naples	1 entering	Eurasian milfoil
Thompson Lake, Oxford	1 entering	Variable milfoil
Songo River, Naples	4 entering 3 leaving	Variable milfoil
Sebago Lake, State Park	3 leaving	Variable milfoil
Toddy Pond,	1 entering	Eurasian milfoil
Great East Lake, Acton	1 entering	Variable milfoil
Long Lake, Harrison	1 entering	Eurasian milfoil

Maine DEP News from the 2018 Season

Invasive Aquatic Plants Report Card

Prior to 2018, no invasive plants were known to be in 5,500-acre Cobbosseecontee (Cobbossee) Lake. Unfortunately, Cobbossee now has not one but two invasive aquatic plant species. Surveyors from the Friends of the Cobbossee Watershed (FOCW) discovered an incipient population of Eurasian water-milfoil (Myriophyllum spicatum, EWM) in July 2018. During removal of EWM in August 2018, DEP staff found European frog's-bit (Hydrocharis morsus-ranae), the first known population of this plant in Maine.

At the time, the discovery of EWM in Cobbossee became only the second known EWM population in the state (see below for mention of the third). With staff assistance from the FOCW and the Cobbossee Watershed District, DEP conducted weekly dives into the fall to survey for and manually remove scattered EWM plants. Based on results of 2018 plant surveys of the lake by FOCW, the EWM infestation is confined to a small cove in the north end of the lake. DEP and the lake groups resume the rapid response in 2019.

The European frog's-bit is more widely established than EWM in Cobbossee, found along several protected shorelines including islands. Surveys in 2018 suggest that the most extensive growth of frog's-bit is in a tributary at the northeast end of the lake. DEP is grateful to a dozen lake residents who mobilized for three days of manual removal in this area of dense growth. Their catch: nine pickup loads of European frog's bit deposited high and dry away from the lake, an outstanding start toward managing this infestation.

The third new infestation in 2018 is EWM in a small pond with no public access in south-coastal Maine. Unfortunately, the EWM is well-established in this new location. DEP has discussed spread prevention and plant management with shorefront residents.

Courtesy Boat Inspectors Make Notable Saves

A save occurs when a Maine boat inspector finds an invasive plant on a boat or associated equipment and removes the plant prior to launching into or after removal from a water body. Maine boat inspectors make saves each year but 2018 provided four Eurasian water-milfoil saves of note.

The previous water bodies recorded by the boat inspector for these four saves were Lake Champlain, Candlewood Lake (CT), Lake Mendota (Madison, WI!) and the St. Lawrence River.

The Champlain save was on a boat returning home to Long Lake in Harrison. An experienced Lakes Environmental Association inspector was fortunately working that day and identified the plant. It's not surprising that a fragment could remain viable from the Champlain Valley or, for that matter, a Connecticut Lake to Maine. But the Lake Mendota, Wisconsin save proves that plants (and other organisms) can move longer distances than we might expect. The Mendota EWM was partly dried, mixed with other species, and caught up in a sailboat trailer. After immersing the plant material in water, the EWM fragment was easily identified and appeared to be viable.

Finally, the discovery of EWM on a boat entering Pennesseewassee Lake in Norway reminds us of the threat of hitchhiking organisms. The plant was intercepted by a Lakes Association of Norway (LAON) inspector. Upon close inspection of the intercepted plant, DEP staff made an additional alarming discovery: an attached zebra mussel. The inspection information collected by LAON indicated the boat had been in the St. Lawrence River – host to non-native mussels. While the water chemistry of western Maine lakes is generally not favorable to zebra mussel, the hitchhiking mussel raises the stakes for Courtesy Boat Inspection Programs like the one run by LAON.

These saves highlight the continued potential for infestation from waters far beyond Maine's border in addition to the spread threat from infested waters within Maine.

Some Good News

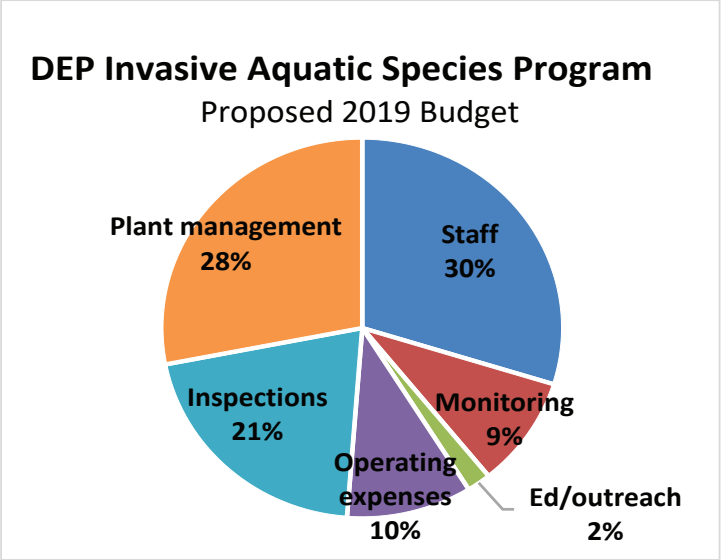
The DEP can report encouraging management results on two infested waterbodies: Damariscotta Lake in Jefferson (Hydrilla verticillata, hydrilla) and West Pond in Parsonsfield (Potamogeton crispus, curly-leaf pondweed).

Hydrilla was discovered in 4,686-acre Damariscotta Lake in 2009. Maine DEP's initial response included manual

removal, deployment of benthic barriers and herbicide treatment to knock-back the population. Over the last several years, the local group Midcoast Conservancy and DEP have teamed-up to monitor and manually remove any remnant hydrilla found. For the second year, biweekly surveys in 2018 found no hydrilla in Damariscotta Lake.

Curly-leaf pondweed was confirmed in 167-acre West Pond in 2004. Much of the pond is suitable habitat for this invasive plant and there were several large, dense patches when first discovered. Under the dedicated management of one West Pond Association (WPA) member, the infestation has been managed using Diver Assisted Suction Harvesting (DASH). In addition to their own DASH, the WPA used an outside DASH contractor past the last three seasons. This combined approach has significantly reduced the volume of plant material harvested. A dive tow survey in October 2018 to assess new growth showed promised for continued reduction of the plant in 2019.

FMI: email milfoil@maine.gov or visit http://www.maine.gov/dep/water/invasives/



Total milfoil sticker sales and revenue, 2002-2018

Calendar Year	Resident	Amount	Non-resident	Amount	Grand Total	DIFW Share	DEP Share
2002	100,049	$900,441	9,814	$186,466	$1,086,907	$434,763	$652,144
2003	94,451	$850,059	9,135	$173,565	$1,023,624	$409,450	$614,174
2004	96,713	$870,417	9,260	$175,940	$1,046,357	$418,543	$627,814
2005	98,393	$885,537	10,239	$194,541	$1,080,078	$432,031	$648,047
2006	99,947	$899,523	10,449	$198,531	$1,098,054	$439,222	$658,832
2007	98,255	$884,295	11,666	$221,654	$1,105,949	$442,380	$663,569
2008	94,451	$944,510	11,190	$212,610	$1,157,120	$462,848	$694,272
2009	94,568	$945,680	11,052	$209,988	$1,155,668	$462,267	$693,401
2010	97,250	$972,500	11,096	$210,824	$1,183,324	$473,330	$709,994
2011	92,675	$926,750	10,203	$193,857	$1,120,607	$448,243	$672,364
2012	93,477	$934,770	10,108	$192,052	$1,126,822	$450,729	$676,093
2013	93,945	$939,450	9,402	$178,638	$1,118,088	$447,235	$670,853
*2014	92,764	$927,640	10,171	$193,249	$1,120,889	$251,142	$869,747
2015	93,887	$938,870	10,017	$190,323	$1,129,193	$225,839	$903,354
2016	97,243	$972,430	10,121	$192,299	$1,164,729	$232,946	$931,783
2017	95,926	$959,260	9,574	$181,906	$1,141,166	$228,233	$912,933
2018	97,530	$975,300	9,548	$181,412	$1,156,712	$231,342	$925,370
Totals	**1,631,525**	**$15,727,442**	**173,045**	**$3,287,855**	**$19,015,297**	**$6,490,545**	**$12,524,752**

Source: Maine Natural Resources Services Center. Revenues collected January 1 - December 31.

**DEP's share increased and DIFW's decreased in 2014 due to the revenue distribution change approved by the Maine Legislature*

DIFW's invasive species program

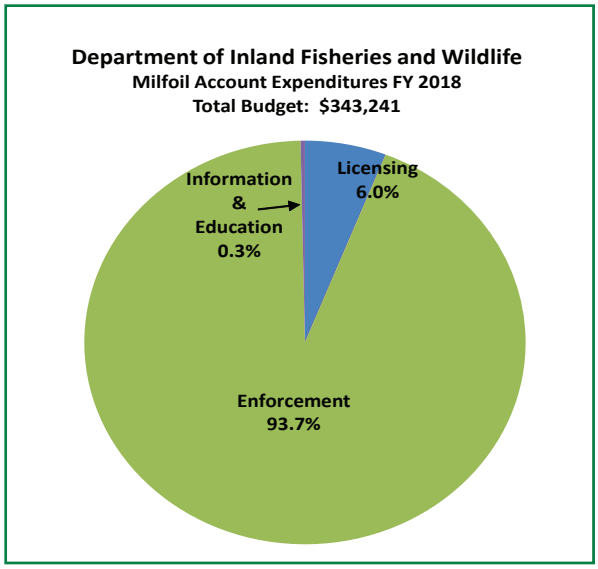
In 2018, Maine Game Wardens worked approximately 20,000 hours doing recreational boating enforcement. These hours included education, maintenance, court time preparation, ramp checks and actual hours on the water checking boats. Game wardens reported almost 9,000 hours on the water enforcing boating rules and regulations. Game Wardens checked approximately 19,500 boats.

For milfoil, the stats break down to 322 registration violations and 134 milfoil sticker violations. This year wardens recorded how many times that they worked with courtesy boat inspectors (CBI). In our records management system, we had almost 40 recorded details where a warden intentionally set out that day to work with a CBI. Of course, this does not count the times a warden just stopped by or spent time with a courtesy boat inspector.

Education remains a large part of how the enforcement branch of Inland Fisheries and Wildlife works to stop the spread of invasive aquatic plants. Warden Pete Herring who is assigned to patrol Sebago Lake, has spent many hours and many different times working with the CBI program in and around the Sebago Lake area. "People still are learning about milfoil", Herring went on to say. Warden Herring talked about attending a recent out-of-state fishing and outdoor sports show in Suffern, New York. Warden Herring seized the opportunity to speak directly with several professional bass anglers. One of the topics at the sports show was the large bass tournament on Sebago Lake scheduled for September 2019. Warden Herring spoke with them at length regarding Maine law requiring them to purchase a lake and river protection sticker prior to launching their boats. Warden Herring was surprised when many of them questioned him regarding the need for the sticker and what milfoil was. Warden Herring stated, "This is also true on a local level when dealing with offenders". "First the offenders, who claim not to know about it, become very upset after receiving a summons for not having the sticker after doing what they felt was "everything by the book". Warden Herring went on to talk about our ongoing education efforts with the court systems as well. "We need to continue to push the education piece with not only the boaters but the court systems also".

Adam Gormely is a Lieutenant with the Maine Warden Service and oversees the operations of Division A Warden Service, centered around Sebago Lake extending up into Oxford County. Lt. Gormely stated that the Maine Warden Service will again be partnering with the CBI program for this upcoming season and encourages members of the CBI program to reach out to the wardens in his or her area. Any of the regional offices listed on our web site can let members of the CBI program know which warden is assigned to the lake they are protecting.

CBI Steve Eisenberg and Sam King with Warden Deputy Sarah Miller at Kezar Lake



WHAT CAN WE DO TO PREVENT INVASIVE PLANTS?

Here are some things that can be done locally to prevent the introduction and spread of invasive aquatic species, in particular, exotic plants. There are also a few notes about what cannot or should not be done.

The first thing to understand is that the threat of invasive aquatic species is not going to go away at any time in the foreseeable future. As long as people travel from one waterbody to another, the potential for the spread of unwanted aquatic organisms will persist. For any prevention effort to be effective it must be sustainable "over the long haul." It is important, therefore, to choose the strategies that are most suited to the particular circumstances and needs of your community, and that can be adapted over time. The best way to do this is to organize a committee, with members representing a broad spectrum of community interests, to collect information and develop a comprehensive plan for addressing the invasives issue locally.

Many of the most effective strategies are very simple and inexpensive. Others will require more time, effort and funding. Volunteers can do much of the work, but there may be instances when the assistance of professionals may be warranted. For each project, there should be a designated individual who takes on the job of monitoring things over time, e.g., checking periodically that signs are still up, brochures are still being given out, etc.

1. Make sure that all public launch ramps have warning signs

Use the signs developed by the LSM and the DEP or make your own. Whichever you choose, remember that visual clutter can be an issue. Think about placement to increase the likelihood that boaters will actually see the signs. When placing signs, make sure to identify who owns the ramp and talk with them about sign placement etc.

Kiosks at landings are a good way to offer more information, but again, the best information is not useful if it is not seen. Sometimes the shorter, simpler, and more attention-getting the message is, the stronger its effect. Be sure to avoid alarmist rhetoric – that turns many people off.

2. Post informational posters and flyers

Look for key areas in your community where boaters (especially those from away) are likely to see public notices, such as community bulletin boards, local stores, sportsmen's clubs, etc. Post the LSM flyer material, both sides of the color brochure, or develop your own posters and flyers. The use of color and keeping the message simple increases the chances that the information will be read. (Electronic files of the LSM brochure graphics are available upon request. Also, please feel free to take illustrations off our website.)

3. Ask your town office to hand out brochures

Contact your town office and ask if they will hand out brochures (your own brochure and/or those developed by the DEP, LSM or others) whenever boat and boat trailers are registered and when fishing licenses or the new "Protect Maine Waters" boat stickers are purchased. Non-resident fishing licenses and the boat stickers are also sold through local stores and agents, so they should be contacted as well. Be sure to ask stores, tourist information locations, town offices etc. to put up posters (in effective locations) and stock brochures.

4. Distribute flyers and/or brochures at ramps

a) Organize volunteers to stop by public boat ramps a few times each day and place flyers on vehicles with trailers. To reduce the chances of "reflyering" frequent ramp users, keep records of which vehicles have been "flyered" and avoid repeats when possible.

b) Put flyers in a box at the ramp for people to pick up.

One problem with both of these distribution methods is the potential for litter, so be prepared to pick up a few flyers from time to time. As with placing signs, it's good to discuss the project with the ramp owner before hand.

5. Create a portable display of posters, signs and brochures

A portable display can be a terrific way to reach a wide audience. Move the display around the community – place it in schools and libraries, or set it up at public meetings and events, etc.

6. Inventory all places where boats are launched and contact the owners

Keep a list of who has ramps likely to be used by boats from other lakes, including the contact person and when last contacted. It's good to renew these contacts in May and July each year.

a) Private ramps open to others (such as marinas and sporting camps): When someone launches at a commercial facility, the staff there can use the opportunity to hand out brochures and may be willing to check boat trailers for plants. If you get this kind of cooperation, please make sure to acknowledge the owner and staff in your newsletter or newspaper article. The owner can also post a sign/poster for you.

b) Other private ramps: Alert owners to potential problems. If they have guests use their boat launch, ask them to check the boat before launching.

7. Boat inspection at ramps

Having boat inspectors at ramps is perhaps the single most effective way to prevent the spread of invasive plants. It is imperative that the owner of the ramp (IF&W, DOC, Town, Sporting Club, etc.) knows and agrees with what you are doing. Above all, avoid conflicts with boaters by observing a few simple rules:

a) Boater participation in your inspections is completely voluntary. View it as an opportunity to educate them. If they object to an inspection, or are "too busy", simply offer them a brochure.

b) Try to talk with boaters before launch; preferably while they are preparing their boat, and not while it is on the ramp if the facility is busy.

c) Keep your message short. Boaters are often impatient to be off, and they will be more receptive to a few sentences (and maybe let you quickly show them the inspection process) if you are brief.

d) Never "expect" boaters to accept your message. Some people are very sensitive to implications that they should do things differently. If they are resistant or show signs of wanting to argue, it is best to thank them for their time and let them continue on their way.

You may want a mixture of volunteer help and paid interns, depending on your resources and the amount of time you think you can arrange for coverage at the landing. Obviously, you want to cover the highest use times -- weekends, vacation times (Memorial Day, July 4th), fishing tournaments, etc.

Lake Stewards of Maine (LSM) offers boat inspection training for volunteer groups. Please contact LSM at 207-783-7733 or stewards@lakestewardsme.org for more information.

8. Boat Washing Stations

Boat washing stations can be effective, but are generally quite costly to set up and operate. They may not be much more effective than careful inspections at preventing plant infestations. However, zebra mussels may be transported in engine cooling water and any container with lake water from another area. If an engine has not been flushed out with clean water before launching, at least run it "dry" for a few seconds so most of the cooling water will be expelled, preferably away from the ramp so it soaks into the ground. A few seconds should do it, and will not overheat the engine. Some boat owners will not agree to that. A better alternative would be to have a "boot" and clean water source for flushing the cooling system completely.

9. Incentives to cooperate

Getting people to cooperate can be helped if something useful comes along with the education (key chain, water bottle, etc.). This can also carry your message: association logo or whatever take-home message you want.

10. Survey the ramp area and other likely sites for invasive plants

The LSM offers Invasive Plant Patrol training to help volunteers in your community conduct invasive plant surveys of lakes, ponds or streams. Please contact the LSM for upcoming workshop dates and locations.

11. Using local media to put out the word

Many areas have free advertisers or seasonal papers that will print short articles if you provide the information and especially a selection of clear pictures or graphics. The papers are often looking for content, and reviewing a few past issues will give you an idea for length, style etc. of what they may print.

The message might vary depending on the time of year and the project you choose. While you want to avoid sensational statements, your story should be presented in a way that will be of interest to the public. Any time you can put your issue in a local perspective, especially how the issue affects people, it makes for a better read. Some of these papers will print articles for you several times a year, particularly if you offer something a bit different each time. Media exposure works best if the message is short, positive and repeated in different ways.

Explore other outlets such as newsletters from organizations (besides lake associations) that make regular mailings and may be receptive to including your information. These can include local service groups, churches or clubs.

Some other things you should know:

State law, or other considerations may limit what can or should be done in some instances.

Restricting Public Access: Unless the town or private club etc. owns a launch ramp and has the right to close it, it will not be possible to close the lake to boats and gear coming "from away". Campaigns to do this can cause bad feelings among local people who rely on these access points to use lakes.

Restricting Surface Use (such as allowing only non-motorized craft)**:** Only IF&W can set restrictions on surface use, such as maximum horsepower and the like, and they are limited by law as to what they can limit (horsepower size, use by personal watercraft) and for what reasons (public safety). There is a process to restrict surface use by petition for these reasons, but limitations apply to everyone using the lake (including camp owners). In the case of restricting personal watercraft, it also requires municipalities involved to agree to identical standards. For more information, call IF&W at 207-287-8000 or see their website at http://www.maine.gov/ifw/laws_rules/boatlaws.htm.

Use of Herbicides: Except in private ponds with no outlets, herbicide application to water requires a discharge permit from the DEP and in many cases, application by a licensed pesticide applicator. Pesticides themselves and professional applicators are regulated by the Department of Agriculture, Pesticides Control Board. For more information, please call 207-287-2731 or check the web at www.maine.gov/agriculture/pesticides/index.htm.

Discharge licenses for pesticides to lakes are not allowed by DEP: Under current law, DEP can apply herbicides for the sole purpose of restoring a water body. Repeated applications or the use of herbicides to simply suppress or manage, but not eliminate a plant population is not allowed.

There is growing anecdotal evidence that property owners are buying herbicides from local suppliers, through the mail, or over the Internet and using them illegally in lakes. Herbicides have been used on native populations of plants to eliminate them in front of camps. People may have the misimpression that because the chemicals are EPA registered, they are safe and benign. The suppliers rarely tell a person that applying them without proper permission is a serious legal offense and is hazardous to the environment (and to themselves if not done properly).

Physical Control Methods: Methods such as dredging, bottom barriers and weed harvesting require an "NRPA" permit. DEP can apply control methods without getting a permit provided it is for the *immediate eradication* of an infestation. If such physical control methods are to be done by parties other than the DEP or for management/suppression (without the prospect of eradication) then a regular NRPA permit is required.

Homeowners are allowed to *hand-remove* a swath of vegetation 10 feet wide perpendicular from their shoreline out into the lake. This will allow a place to swim and passage for boats. To do this, an owner needs to get a "Permit by Rule" from the DEP. Although a quick and simple process, PBR carries clear standards, which must be met. For information on NRPA and PBR standards, call a DEP agent at 207-287-3901 or 1-800-452-1942 or visit the web: http://www.maine.gov/dep/land/nrpa/index.html.

Maine State Invasive Aquatic Plant Laws

The State of Maine enacted Title 38, Chapter 3, Section §419-C *Prevention of the spread of invasive aquatic plants* in 1999. This statute provides the following prohibitions:

A person may not:

A. Transport any aquatic plant or parts of any aquatic plant, including roots, rhizomes, stems, leaves or seeds, on the outside of a vehicle, boat, personal watercraft, boat trailer or other equipment on a public road;
B. Possess, import, cultivate, transport or distribute any invasive aquatic plant or parts of any invasive aquatic plant, including roots, rhizomes, stems, leaves or seeds, in a manner that could cause the plant to get into any state waters; or
C. After September 1, 2000, sell or offer for sale in this State any invasive aquatic plant.

Title 38 chapter 3 http://legislature.maine.gov/statutes/38/title38sec410-N.html and http://legislature.maine.gov/statutes/38/title38sec419-C.html

Further laws were passed in Title 38, Chapter 20-A to create a dedicated funding mechanism for prevention and control programs and to outline those programs and their goals. It also includes a mechanism for restricting surface use on infested waterbodies.

Title 38 chapter 20-A http://legislature.maine.gov/statutes/38/title38ch20-Asec0.html and http://legislature.maine.gov/statutes/38/title38ch20-Bsec0.html.

Title 12, chapter 935, Section §13068-A, contains prohibitions against launching contaminated boats and failure to display a lakes and rivers protection sticker (the funding mechanism created in Title 38, Chapter 20-A). A person violating all of these prohibitions could face a combined maximum penalty nearly $13,000.

Title 12, chapter 935, Section §13068-A
http://legislature.maine.gov/statutes/12/title12sec13058.html and
http://legislature.maine.gov/statutes/12/title12sec13068-A.html

Additional Invasive Aquatic Plant provisions are codified in the following statues:

5 MRSA 12004-D(6) – Interagency task force expenses
http://legislature.maine.gov/statutes/5/title5sec12006.html

12 MRSA 13001(6) -- "aquatic plant" and (14) "invasive aquatic plant"
http://legislature.maine.gov/statutes/12/title12sec13001.html

12 MRSA 13068(1) -- Launching contaminated watercraft
http://legislature.maine.gov/statutes/12/title12sec13068-a.html

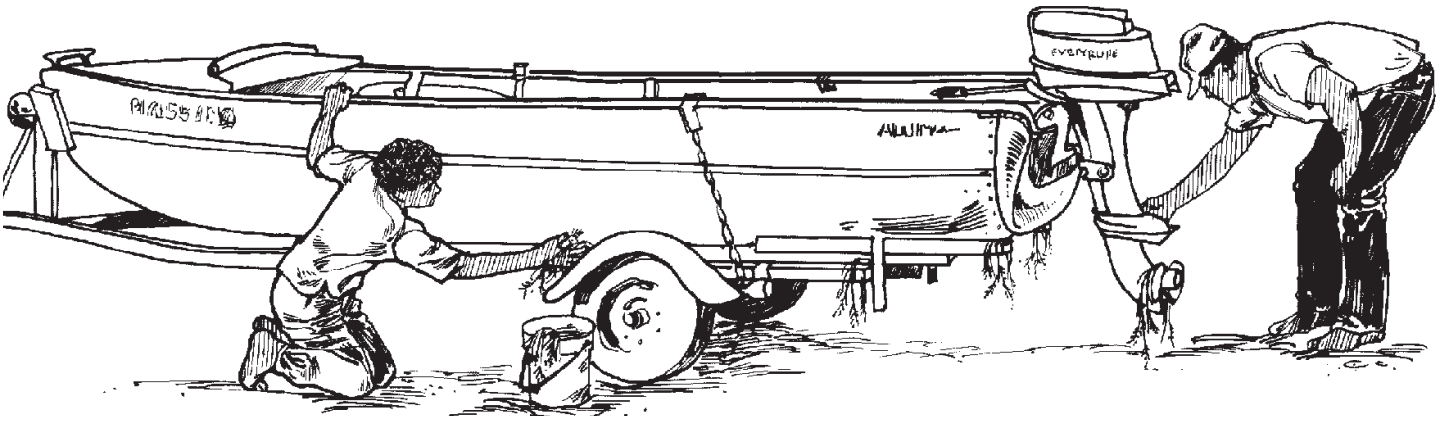
12 MRSA 10257-- Lake and river protection fund
http://legislature.maine.gov/statutes/12/title12sec10257.html

38 MRSA 1864 -- Emergency authority to regulate surface use
http://legislature.maine.gov/statutes/38/title38sec1864.html

BEYOND CLEAN, DRAIN & DRY:

ADVANCED DECONTAMINATION PROTOCOLS for boats, trailers, and gear

adapted from Wisconsin Department of Natural Resources



Are you a lake steward who participates (with your boat and survey gear) in 'away' workshops and/or screening survey projects? If yes, the last thing you will want to do is inadvertently become a vector for less-visible aquatic hitchhikers, such as young Chinese mystery snails. When your good work takes you and your boat away from home, we recommend the following advanced decontamination protocols.

In a location, distant from (and not draining directly to) a waterbody, please **CLEAN**, and **DRAIN** your boats, trailers, and all survey gear and **DRY** for at least 5 days in advance of launching into a new waterbody. If the 5-day drying period is not possible, please decontaminate your gear using the following three steps:

Step 1. Make sure all gear to be disinfected is clean and free of algae and/or debris.

Scrubbing with detergent at a high-power wash facility may be needed to properly clean all gear.

Step 2. Spray and/or wipe down all gear with freshly mixed chlorine solution; let stand at least 10 minutes.

Create a ~0.5% bleach solution by mixing 1.5 tablespoons of fresh household bleach with one gallon of clean potable water. (The use of lake water may greatly reduce efficacy.) Chlorine solution in the form of household bleach (8.25% sodium hypochlorite) can be purchased from most grocery stores. (Use only bleach that is labeled: 'disinfectant'.)

Bleach solutions begin to lose disinfecting properties after 24 hours, and the more diluted the chlorine solution, the quicker it will deteriorate. It is important to use 0.5% bleach solutions that are less than 24 hours old. Chlorine solutions also deteriorate with exposure to light, heat, contact with air, metals, metallic ions and organic materials. *Bleach and bleach solutions are best stored out of heat and sun.* If stored at a temperature between 50 and 70°F, household bleach retains its disinfection properties for about six months, after which, it begins to degrade. If bleach is stored in locations with higher temperatures, such as a garage or the back of a truck, it will lose its disinfection properties at a faster pace. Therefore, new bleach should be purchased for purposes of decontamination at the beginning of each field season. If using bleach year-round for decontamination, new bleach should be purchased every 6 months.

Label the container holding the diluted bleach solution with the words "Bleach Solution" and record the date and time of dilution on the label. The solution should be used within 2 months.

Small amounts of bleach solution may be disposed of in the sink, provided you follow with plenty of water.

Step 3. Rinse everything with fresh water.

Caution must be taken to not mix chlorine bleach with other chemicals (e.g., vinegar). After using bleach, it is important to carefully rinse all contaminated gear with water.

Step 3. Spray and/or wipe down all gear with white vinegar.

There have been no peer-reviewed studies investigating vinegar as a disinfectant for invasive species; therefore, it must be used in tandem with other disinfection, such as chlorine bleach. While bleach is effective in killing most invasive species, it may not kill all of them, especially some mollusks. Vinegar will dissolve mollusk shells, including those of zebra and quagga mussel veligers. Vinegar should definitely be used on nets or gear that are used to collect samples for zebra/quagga mussel analysis after sampling to prevent false positive detections in uninfected lakes.

Use white distilled vinegar without dilution. Apply by spraying, or use a sponge, so surface is thoroughly exposed to the vinegar. Contact time should be at least 10 minutes.

Store in a cool, dry area. Shelf life is indefinite if stored properly. Dispose of small amounts of unused vinegar in the sink; follow with plenty of water.

Can Volunteers Make a Difference? You Bet!

Volunteer Early Detectors Help Local Authorities Nip New Infestation in the Bud

The Great East Lake Improvement Association (GELIA) in Wakefield, New Hampshire and Acton, Maine has an active Weed Watcher program. (Weed Watchers is the New Hampshire corollary to Maine's Invasive Plant Patrol.) GEILA's early detection program has grown steadily every year since its inception, and the association now has over 60 volunteer "watchers" on the lake, covering nearly all of Great East's eighteen miles of shoreline. On July 11, 2006 Great East Lake resident and volunteer weed watcher, Carol LaFond, was surveying her assigned sector near the public boat launch on the Maine side of the lake, when she noticed a suspicious plant "standing out like a neon sign" among the native plants. She collected a specimen and brought it to local authorities. The plant was not in flower at the time and species identification was only possible through DNA analysis. (The flowering parts are needed to positively identify most milfoils.) DNA test results confirmed what had been suspected: the suspicious plant was variable water-milfoil (*Myriophyllum heterophyllum*). The response was swift and carefully executed. Once the invasive plant and its roots were removed, Carol continued to revisit the plant removal site, as well as the surrounding cove area, on a weekly basis for the remainder of the open water season. No additional invasive plants were found. Additional surveys of Great East Lake beyond the cove seem to confirm that the introduced invader was detected and removed before it had a chance to become well-established or to spread to other areas of the lake. Having successfully averted what could have become an ecological and economic disaster for the lake and the region, GELIA has provided us with a compelling example of the enormous--and ultimately incalculable--value of volunteer early detection efforts.

IPP Training on Echo Lake

To learn more about Maine's early detection effort, please contact
Lake Stewards of Maine
207-783-7733 or stewards@lakestewardsme.org

Littorally Speaking

by Roberta Hill
Program Director
VLMP's Center for Invasive Aquatic Plants

When it Comes to Invasive Aquatic Plants, Time is of the Essence
Enter . . . VLMP's Invasive Plant Patrol First Responders

What did YOU do over the Fourth-of-July weekend? Could be you headed for your favorite lake, launched your boat, and dangled your hook (or toes) in the water? You weren't the only one heading for a lake, but for a dozen of your fellow Maine lake lovers, the mission to be accomplished over the holiday was be a bit more serious. For these VLMP "Invasive Plant Patrol First Responders," the job at hand is to scour the entire shoreline and shallows of Tripp Lake in Poland, looking carefully, methodically, with trained eyes, for something they hoped they would not find.

On June 14th a Courtesy Boat Inspector (CBI) on Kezar Lake in Lovell removed a plant fragment from a boat preparing to launch. The suspicious plant specimen was subsequently submitted to VLMP for identification. Though the condition of the fragment was such that species ID could not immediately be confirmed, photos of the fragment were quickly disseminated to the Maine Department of Environmental Protection's on-call expert "peer group." Within a day, consensus was reached, qualifying this CBI intervention as one more official CBI "save." Since the CBI program began, hundreds of invasive plant fragments have been removed from boats and boating gear here in Maine, greatly reducing the potential for spread of these destructive organisms.

But the story does not end there. According to the records of the CBI in Lovell, the boat that carried the Eurasian water-milfoil had last been in Tripp Lake in Poland. Tripp Lake is not currently known to be infested with any aquatic invader. The situation begged a host of questions. What was Eurasian milfoil doing in Tripp Lake? Was it quietly gaining ground there in some back cove, as yet unnoticed? Could the Eurasian milfoil fragment have been deposited in the area of the public boat landing by yet another boat, one that had just recently come from an infested lake? Lacking the full registration identification number needed to find the Kezar Lake boater, and information that might help trace the plant's origin, there was only one course of action to be taken: All of the shallow areas in Tripp Lake capable of supporting rooted plants had to be immediately screened, in order to rule out the presence of Eurasian water milfoil.

IPP First Responders assemble to formulate their plan of action.

The VLMP put out an urgent call to its Invasive Plant Patrol First Responders, a team of highly trained and experienced volunteer lake monitors that have signed up for special duty: responding to newly identified (or suspected) infestations by conducting a comprehensive invasive aquatic plant survey on the waterbody of concern, as rapidly as possible. When it comes to effectively controlling invasive aquatic plants, early detection and rapid response are critical.

Within two days of the Eurasian water-milfoil confirmation, a strategic meeting was held at VLMP headquarters. Members of the Tripp Lake Improvement Association were present to lend their intimate knowledge of the lake and possible points of private access for efficient deployment of the team. "I am so impressed." commented former Tripp Lake Improvement Association president Barbara Shapiro at the meeting. "You all have dropped what you are doing and come from all over Maine to help us here on Tripp Lake. Thank you from the bottom of our collective hearts for moving so quickly."

And quickly the team did move. Within two weeks, the IPP First Responder's Level 3 survey on Tripp Lake was complete. No Eurasian water milfoil was detected, nor was any of the other invasive aquatic plants on Maine's prohibited list; the team screened for all eleven. They also collected native plant data during the survey; a full

IPP First Responders, Sibyl French (L) and Jackey Bailey (R) scour the littoral zone in search of aquatic invaders.

inventory of native plants observed will be available as soon as all the paperwork is in, and posted later in the season on the VLMP's Tripp Lake webpage. A small population of Chinese mystery snails was observed in area of the public boat landing. It is possible that this is a relatively new introduction to Tripp Lake. One small floating fragment
of milfoil was spotted and collected by team Member Marsha Letourneau (great eye, Marsha!); it was sent to a lab for DNA species confirmation, and proved to be a native milfoil species.

With the help of the Tripp Lake Improvement Association, the volunteer monitoring effort on Tripp Lake will continue. Plans are already underway for an Invasive Plant Patrol workshop in that area next summer, and we look forward to providing the training and technical support needed to help our friends on Tripp Lake launch an effective, locally sustainable IPP team on their lake.

Many capable hands (and eyes!) came together during this incident; some working behind the scenes, others on the front lines. Each acted swiftly, skillfully, and cohesively—playing their role in Maine's ever growing, largely volunteer-powered system; working together to protect Maine's lakes, ponds, rivers and streams from the treat of invasive aquatic species. All of us here at the VLMP are very proud to be part of such an impressive endeavor.

For more information on VLMP's IPP First Responders and/or to learn how you can get involved, please contact Roberta Hill at Roberta@mainevlmp.org or 207-783-7733.

The IPP First Responders was first activated in 2009 when hydrilla was found in a small cove on Damariscotta Lake. Team members include: Jackey Bailey, Bob and Sibyl French, Marsha Letourneau, Elin Haugen, Dennis Roberge, Bev Smith, Ross and Bunny Wescott, Keith Williams and Pixie Williams. This year the team had special assistance from David Coyne, Roger Lariviere, Gordon Smith, and VLMP staff.

Littorally Speaking

Moosehead Lake Survey Complete:
No Aquatic Invaders Found!

by Roberta Hill
VLMP Invasive Species Program Director

The first-ever, volunteer-powered aquatic plant survey of Maine's largest lake, Moosehead, is complete! The entire shoreline of the 74,000-acre-plus lake has been methodically screened for aquatic invaders. We are very pleased to report that **no invasive species** have been detected.

In 2008, the Maine Volunteer Lake Monitoring Program launched an ambitious program to help promote and support citizen-based early detection efforts in areas of the state where such activities are currently lacking. The objectives of VLMP's Invasive Plant Patrol Jump Start are to: 1) organize a survey team (comprised primarily of seasoned volunteer Invasive Plant Patrollers, supported by VLMP staff) to conduct a comprehensive invasive aquatic plant screening survey and native plant inventory on the target waterbody; and 2) to help "jump-start" a locally sustainable citizen-based monitoring program in the region through outreach, training, and more spontaneous forms of interaction between team members and the host community.

The VLMP decided to pilot its new concept on one of the most highly-valued and more vulnerable lakes in Maine: Moosehead. If such a project could succeed on this grand scale, we surmised, it could succeed anywhere in the state!

A high percentage of the volunteers who participated in this project over its six year timespan remained active throughout, which helped to create a cohesive, highly-competent team. The logistics of surveying a lake the size of Moosehead are challenging to say the least—challenges range from where the team will make base camp, how meals will be organized, to the more critical issues of access, on-lake communication, and safety. Each challenge was deftly handled by the team, with volunteer team members taking on key roles in all phases of the project: planning, facilitation, technical support, training, outreach, survey activity, plant identification, reporting, and documentation, follow-up, etc.

Can volunteers be effective and efficient monitors of Maine Lakes? Please consider the following project outcomes and decide for yourself.

• The shoreline of Moosehead Lake, including the islands, measures 281 miles. If one takes into account deployment of boats over significant distances (often with larger motorized boats towing smaller paddle craft) and the methodical travel back and forth along transects that is required to survey fertile coves and extensive shallows, the actual scope of the survey was substantially greater. The survey was done in short annual increments, taking six years to complete. Actual time on the water however was remarkably short: 23 days!

• During this time the team carefully screened the littoral zone of Moosehead Lake for all eleven invasive aquatic plants legally listed as imminent threats to Maine lakes, as well as other potential aquatic invaders such as Chinese mystery snails and zebra mussels. No invasives were detected. Moosehead Lake now has a "clean bill of health" from which future monitoring efforts can proceed.[1]

• During the course of the survey, the team also documented all the native plants found growing in the lake. A whopping 110 plant species have been documented. Thirty plant specimens of note have been submitted to the Maine State herbarium.

• Work on the second Jump-Start goal— assisting with the development of a locally sustainable citizen-based monitoring program in the region—is off to a promising start and continues to gather momentum. Through outreach conducted by team members, the VLMP has formed a broad coalition of local partners who will be meeting next spring onboard the *Katahdin* in Greenville to discuss next steps for the region.

The Hunt for Aquatic Invaders, a video documentary featuring this Moosehead Jump-Start project, will have its regional premiere at this event. (For more on *The Hunt*, see page 11, and please stay tuned for more on the *Katahdin Citizen Lake Monitoring Forum*.)

> Volunteer engagement not only enabled this project to happen, it showed that a high-quality survey could be done, efficiently and effectively, by volunteers.

A project of this scale, were it to have been done by professionals, would have been extremely costly, with a price tag in the tens of thousands of dollars—a cost prohibitive to most state agencies, municipalities and non-profit lake conservation groups. Volunteer engagement not only enabled this project to happen, it showed that a high-quality survey could be done, efficiently and effectively, by volunteers.

A number of studies conducted throughout the country have consistently shown that information collected by trained citizen scientists is equivalent to, and indistinguishable from, that of professional scientists, at a fraction of the cost. This groundbreaking project on Maine's largest lake serves as a powerful case in point!

1. The VLMP survey team did not monitor the lake for invasive fish. Two non-native fish species are known to be established in Moosehead Lake: small mouth bass (Micropterus dolomieu), and white perch (Morone americana). Both were the result of illegal introductions.

Moosehead Lake Survey Project Contributors

Moosehead Lake Survey Team Members

(2008 – 2013) Followed by number of years each member participated in the survey (no survey activity was conducted in 2010).

Volunteers

Curtis Breen (1)
Sally Breen (4)
Mary Jane Dillingham (1)
Robert French (5)
Sibyl French (5)
Gabriel Gunning (1)
Elin Haugen (4)
David Lamon (1)
Marsha Letourneau (1)
Randy Richardson (1)
Dennis Roberge (3)
Matthew Vachon (2)
Eduardo Van den berg (1)
Bunny Wescott (5)
Ross Wescott (5)
Ellie White (4)
Willis White (4)
Mark Whiting (4)
Keith Williams (4)

VLMP Interns

Libby Davis (1)
Jamey Epstein (2)
Ilse Pukinskis (1)
Kelly Stewart (1)

VLMP Staff

Jacolyn Bailey* (2)
Christine Guerette* (5)
Roberta Hill* (4)
Jonnie Maloney (1)

*Indicates staff participation in the survey at least one season as a volunteer.

Moosehead Survey Supporters

The Moosehead Lake Invasive Plant Patrol Jump-Start Project has been made possible through the generous support of:

Beaver Cove Marina
The Betterment Fund
The Birches Resort
Boater Participation in the Maine Lake and River Protection Sticker Program
Friends of Wilson Ponds Area
Maine Department of Environmental Protection
Maine Outdoor Heritage Fund
Maine Water Company
Patagonia
Plum Creek Foundation
Ram Island Conservation Fund of the Maine Community Foundation
Underwood Productions
Wilsons on Moosehead Lake
Private donations from VLMP business sponsors, lake and watershed associations, and individuals

We also wish to thank many new friends and partners in the Moosehead region who have generously welcomed us to their community and provided numerous in-kind goods and services, with special thanks to Liz Cannel (Katahdin Cruises), Joe DeFelice, David Grant, Kay Johnson, Scott Snell (Wilsons on Moosehead Lake), and John Willard (The Birches Resort) for their support of the project documentary: *The Hunt for Aquatic Invaders*, and to Kay and Ralph Johnson for their support, gracious hospitality, and enthusiasm.

Littorally Speaking

Milfoil in Annabessacook Lake

a cautionary yet hopeful tale of prevention, early detection, and rapid response

by Roberta Hill
VLMP Invasive Species Program Director

Late in the summer of 2013, a vigilant Courtesy Boat Inspector (CBI) stationed on Annabessacook Lake spotted a single milfoil fragment floating near the public boat landing. DNA testing confirmed the plant to be variable water-milfoil (VWM, scientific name: *Myriophyllum heterophyllum*), the most prevalent invasive aquatic plant in Maine. Though Annabessacook Lake was not known to be infested, it *is* in fairly close proximity to several waterbodies that *do* have known VWM infestations. Were the wayward fragments left behind by a visiting boat, or did they originate from a new—as yet undetected—infestation in Annabessacook Lake?

The only way to answer this question with certainty was to conduct a comprehensive "level-3" survey of the lake's entire littoral zone (all shallow areas of the lake, anywhere that sunlight reaches the bottom and rooted plants may grow). Conducting a level-3 survey on a lake that is nearly 1500 acres in size, with over 17 miles of shoreline, can be challenging in the best of circumstances. In the case of Annabessacook Lake, the challenge was intensified by several factors: 1) DNA analysis of the milfoil fragment found by the CBI took longer than usual. When the results finally arrived in December 2013, it was too late to conduct even a cursory survey. This delay would significantly cut into greatly needed planning and preparation time. 2) Though invasive aquatic plant (IAP) screening survey activity was being done regularly on Annabessacook Lake, these surveys were generally limited in scope. Conducting a full level-3 survey would require a significant increase in survey capacity. The community elected to accomplish this by building a locally-sustainable volunteer Invasive Plant Patrol (IPP) team, an undertaking that would require a good deal of local outreach, and the development of a comprehensive training program. 3) Most

Is this invasive milfoil? Lacking the vibrant red stem that is often associated with this invader, none of the milfoil plants found in Annabessacook Lake looked glaringly suspicious; but neither did they present the features needed to confidently rule out the target invader. This "plain-Jane" milfoil specimen was indeed confirmed as VWM.

lake plants in Maine are fully mature and easiest to view and identify from mid to late summer. But in Annabessacook Lake, the growth of planktonic algae in late August can significantly reduce water clarity, and potentially impede survey visibility, thus shrinking the survey window of opportunity. In a nutshell, the local community had barely half a year to plan, gather the resources, and build the volunteer capacity needed to accomplish a high-quality, comprehensive survey within a very short (one-to-two-week) timeframe.

A coalition of project partners quickly assembled and mobilized. The VLMP's role in the alliance, which included Annabessacook Lake Improvement Association (ALIA), Friends of Cobbossee Watershed (FOCW), Cobbossee Watershed District (CWD) and the Maine Department of Environmental Protection (DEP), was primarily to assist in informing, engaging, training, and activating a local team of trained citizen Invasive Plant Patrollers.

With Annabessacook Lake Improvement Association playing the vital role of workshop host—securing workshop venues, organizing food, publicizing the workshops locally, etc., the IPP training program was rolled out through the summer of 2014. The program was launched in June with an IPP Plant Paddle led by Friends of Cobbossee Watershed staff. This engagement-level event helped to spur local interest in the Annabessacook survey project and to encourage participation in the more extensive trainings to follow. The IPP Intro Workshop and IPP Survey Field Methods Workshops, which took place in July, were both well-attended, resulting in a formidable cadre of well-trained, certified, locally-based patrollers. The Annabessacook IPP team was born!

While VLMP and ALIA were busy with the trainings, Maine DEP staff began conducting preliminary surveys of the areas closest to the public boat landing. A local leadership team was formed, comprised of one representative from each of the local partners: CWD, FOCW and ALIA. This group took on the task of organizing the full, lake-wide survey, and working out the various logistics needed to ensure its success. The necessary survey equipment was gathered and/or constructed. A series of public and private launch sites were identified around the lake; in the case of the private launches, permission to launch was sought and obtained. Nine survey regions were delineated, each with its own launch site. Each region was divided into several smaller sectors, with

VLMP's Roberta Hill teaches Annabessacook Lake volunteers how to recognize an aquatic invader when they see it.

most sectors covering roughly 1000-feet of shoreline. As surveyors signed on to the new Annabessacook IPP Team, they either adopted, or were assigned, one or more survey sectors.

The preliminary survey activity by the DEP revealed yet another challenge. Annabessacook Lake was home to three native milfoil species, all similar in appearance to VWM. The presence of these and other native look-alikes would certainly complicate things, especially for novice patrollers. Survey planners addressed this challenge by teaming more experienced patrollers—acting as "region leaders"—with the novice patrollers in their assigned areas. The team had now grown to thirty-six members, the majority of whom were trained and certified IPP volunteers.

Training of the Annabessacook Lake IPP Team continued with on-the-water instruction and guided practice.

This story cannot be properly told without mentioning the vital role played by Maine's IPP Rapid Response Team: certified IPP volunteers who have agreed to be on-call should a new infestation be identified in Maine. Not only did many of these seasoned "IPPs from away" travel across the State to attend trainings and support the novice patrollers, they also signed on as volunteer region leaders, lending their considerable expertise, experience and mentorship skills to the survey effort. When members of Maine's IPP Rapid Response Team were introduced at the survey kick-off meeting, they were met with a resounding standing ovation. A palpable sigh of relief spread across the room and someone cheered, "The cavalry has arrived!"

Over the course of the next two weeks—thankfully, with full cooperation from the weather—the level-3 survey of Annabessacook Lake was completed without a hitch. Several significant patches of milfoil were indeed encountered by surveyors. Was this invasive milfoil? None of the specimens looked glaringly suspicious; but neither did they present the features needed to confidently rule out the target invader. The patches were properly marked and mapped, and specimens were collected. Once again, we would have to rely upon DNA analysis.

A few weeks later, the DNA results arrived: two of the twelve specimens came back with a positive identification of *Myriophyllum heterophyllum*, invasive variable water-milfoil. One specimen had been taken from a growing patch in the northern inlet cove; the other was a floating fragment found near the boat landing, at the other end of the lake. Sadly, Annabessacook Lake was now to be added to the list of Maine lakes with known infestations.

The Maine DEP mobilized immediately upon receiving the DNA results, and on September 24 they deployed SCUBA divers who carefully removed the known VWM patch in the northern cove. They also investigated suspicious milfoil plants in the shallows beyond the public boat

The Maine DEP mobilized immediately upon receiving the DNA results, deploying SCUBA divers who carefully removed several large patches of VWM from the lake.

Maine's IPP Rapid Response Team played a vital role in the survey. Team Members participating in the Annabessacook survey included: Diane Clay, Bob and Sibyl French, Carol Fuller, Susie Wilding-Hartford, Marsha Letourneau, Dennis Roberge, Lea Stabinski, and Ross and Bunny Wescott. Pictured above are Diane (L) and Susie (R).

landing channel, a patch recently discovered by alert CWD staff during routine water-quality monitoring. DNA analysis later confirmed VWM in this area, as well. DEP and CWD returned to the boat-landing area on October 17, and a number of additional, well-established milfoil patches were found. The characteristics of these newly-discovered plants precisely matching those of confirmed VWM, they were also removed.

Despite this disconcerting result, it is important to note the good news here. The level-3 survey findings suggest that the rooted VWM population may very well be limited to two discrete areas in the lake. With luck, the process that began when the CBI spotted a suspicious plant floating near the boat launch in 2013, and continued with the activation of ALIA's Invasive Plant Patrol team, has resulted in a timely, early-detection of the infestation. We know from experience that early detection has been key to the successful management of variable milfoil in a number of cases in Maine. If the infestation in Annabessacook Lake proves to be as limited in scope as these early findings suggest; if actions are taken swiftly and deliberately; if the successful collaboration that began in 2013 continues, the prospects for successfully addressing the Annabessacook infestation are very good indeed. ◔

Photos for this article were provided by The Cobbossee Watershed District.

Littorally Speaking

When the Hunt for Aquatic Invaders Results in a 'Find'

Maine's latest confirmed infestation

by Roberta Hill
VLMP Invasive Species Program Director

VLMP Certified Invasive Plant Patroller, Dennis Roberge, who many of you may know through his superb underwater photos, was starting to wrap up his busiest survey season ever. Dennis surveys his home lake—Mousam Lake in York County—on a regular basis; he also holds the record for the most waterbodies surveyed by an Invasive Plant Patroller in a single season. Beating his own record by conducting surveys on forty waterbodies this year, it was on the occasion of lake number thirty-three that Dennis turned his highly-trained eyes toward a portion of nearby Salmon Falls River. In this area, along the boundary of Milton, New Hampshire and Lebanon, Maine, the impounded river settles into three distinct, but interconnected, ponds, locally known as Milton Three Ponds. Northeast Pond, at 685 acres, is the largest of the three and flows into smaller Milton Pond (395 acres) to the south. Both straddle the ME/NH border. Townhouse Pond, similar in size to Milton Pond, is situated west of Northeast Pond and North of Milton Pond, and is entirely in New Hampshire.

Dennis began his survey at the public boat landing. Water clarity was not the best this day, but as a snorkeler, Dennis was able to dip down below the surface and could see to depths ranging from 5 – 8 feet. He was a couple hundred yards from the boat landing when he spotted a plant that did not "look quite right." It was a naiad, of that he was sure, but there was something about it which triggered his plant patroller instincts. He bagged the plant for closer examination back home. The rest of the session went smoothly; several more of these odd looking naiads were observed, but they were few and far between. The plants were not large—about 18 inches tall—and neither the size of the plants nor the sparse growth sent off any serious alarm bells. Still, a nagging feeling persisted.

Beating his own record set in 2007, Dennis Roberge conducted invasive aquatic plant screening surveys on forty different waterbodies in 2015. *Photo credit: Roberta Hill, VLMP.*

Later that evening, Dennis sat down in a pool of excellent light, at a table on his porch organized for just this activity. Surrounded by his plant identification books, his hand lens, microscope, and other implements of examination, he poured the Salmon Falls River naiad out into a tray. He was on the phone with fellow VLMP Certified Plant Patroller Marsha Letourneau, at the time. As soon as the specimen dropped out of the bag and unfurled itself in the tray of water, Dennis knew exactly what he was looking at. The leaves were slender and strongly recurved; serrations along the leaf edges were plainly visible, even without magnification. The leaf bases were blocky and serrated. "Uh oh Marsha," he said, "this is a *bad* plant." And he was right.

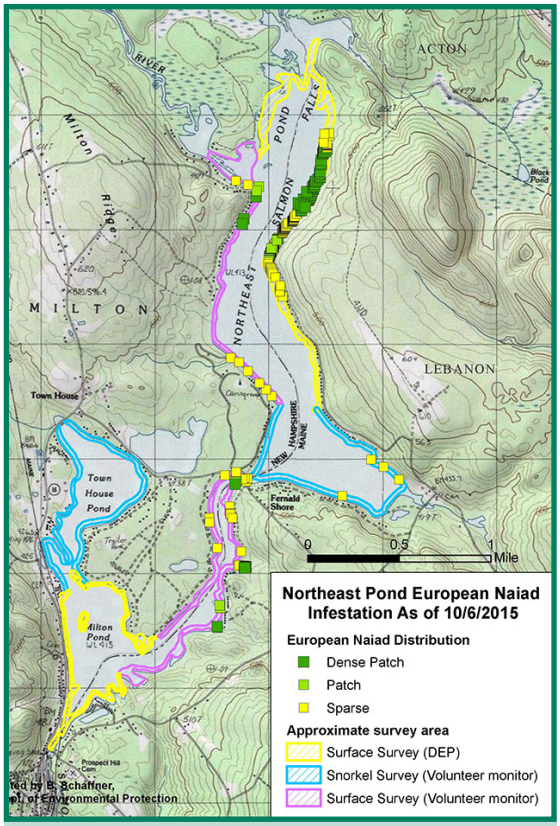
Following IPP protocol to a tee, Dennis immediately reported his find to the VLMP by email, attaching several clear, crisp photos of the plant spread out in the tray of water. A day or so later, at the request of the VLMP staff, he returned to the original survey area to collect additional live specimens, which he packaged and sent in for a confirmed identification. Seeing that the survey season was swiftly coming to an end, and not wanting to lose any time, Dennis used the collection visit as an opportunity to survey an additional 400 yards of shoreline of Northeast Pond. During that survey he saw about 50 suspicious plants, but no dense or extensive growth. Most of what he observed was a diverse, dense community of native plants. Overall, he thought, it could be worse. But there was still much uncertainty. To know the full extent of the infestation, all three ponds and their connecting streams would need to be surveyed. Accomplishing this before cold temperatures brought the survey season to an abrupt halt would require swift mobilization and a major collaborative effort.

In the meantime, the VLMP sent micrographs of key features—leaves, leaf base, seeds—by email to Maine's panel of aquatic plant experts. Consensus came back within several days—there was no question about it: the plant was European naiad, *Najas minor*. This find means that Maine has another infested waterway, bringing the total number of known infested water systems to twenty-five, encompassing 46 distinct waterbodies. (To learn more about how to identify European naiad, please see page 7.)

Confirmation of European naiad in Salmon Falls River system set off a flurry of activity at the state and local level. Laurie Callahan, founder and coordinator of York County Invasive Aquatic Species Project (YCIASP) took the lead on the response, coordinating an extensive survey of Milton Three Ponds and connecting waterways, to determine the extent to which the invader had spread. In addition to Laurie, who serves as IPP Regional Coordinator for York County,

the response team was comprised of VLMP/YCIASP Invasive Plant Patrollers: Dennis Roberge, Marsha Letourneau, Jeanne Achille, and Melissa (Missy) Brandt, Three Ponds Protective Association volunteers, and personnel from both the Maine Department of Environmental Protection (DEP) and New Hampshire Department of Environmental Services (DES).

The survey took place over a period of several weeks, starting in early September. It covered most of the littoral zone of all three ponds and their connecting streams (please see map). With Laurie Callahan coordinating schedules, communications, and documentation of the survey, the survey team set to work scouring assigned sections of the shoreline, recording the locations of any invasive naiad plants encountered, and—in areas where plants were sparse—removing the offending plants in accordance with established protocol.



This map shows the portions of Milton Three Ponds that have been surveyed in response to Dennis's find. *Map source: Maine DEP.*

As the survey proceeded, it became clear that European naiad plants were scattered lightly (with a few dense patches) over an extensive area in Northeast Pond and the stream segment locally known as "the river" that connects Northeast to Milton Pond. Even more discouraging news came on September 27 when DEP's John McPhedran reported that an extensive, well-established "mother-lode" of European naiad had been found growing densely along the northeast (Lebanon, Maine) shore of Northeast Pond, just east of where the Salmon Falls River flows in. Additional large dense patches were found near the Branch River confluence (on the New Hampshire side). A more comprehensive management strategy will be needed to address these more extensive areas. There was some good news, too: to date, no invasive naiad plants have been found in either Milton Pond or Townhouse Pond.

In addition to assisting with the survey, ME DEP and NH DES have distributed invasive species warning signs to be posted at boat ramps, urging boaters to inspect for, and remove, plant debris before and after boating in the area. Boat ramp and other land owners, fishing tournament organizers, and fisheries and warden services from both states were also notified.

Officials from Maine and New Hampshire will be meeting with local stakeholders over the winter to come up with the best strategy for controlling the infestation. The strategy will no doubt include ramping up the Courtesy Boat Inspection program at area public boat landings. A targeted control effort—likely employing one or more manual control methods—will be organized and activated. Careful monitoring will need to be ongoing in the area for the foreseeable future. The VLMP stands by to assist with IPP training.

Whatever the determined plan of action, two things are certain: 1) trained volunteers will have an important role to play in all of these efforts; and 2) Dennis's vigilance as an Invasive Plant Patroller has greatly increased the chances that efforts will ultimately be effective. Who can say how much further this invader would have spread within Milton Three Ponds, or to nearby waterbodies, if it had remained undetected for another year, or two, or even longer?

There is another important take away here: while much of the focus has been on 'milfoil' here in Maine, invasive milfoils are not the only threat to Maine waters. The State of Maine has officially listed eleven invasive aquatic plants that pose an imminent threat to Maine waters; only three of the eleven are milfoils. Norman Turgeon, a board member of the Three Ponds Protective Association, put it succinctly, "Unfortunately, this one was off our radar."

Dennis admits that he has been somewhat conflicted about his find. Though while he is out surveying he is always aware that he is hunting for something he hopes never to find, most of the time he just gets caught up in the sheer joy of the work—being on and in the water on the finest days of the season, observing the plants and the wildlife, tallying up native plant species found in each lake, discovering new lakes, spending time with fellow plant patrollers, and continually learning something new. "After seven years of surveying, however, it suddenly got real. I had a moment when I started thinking . . . I'm not sure if I want to do this anymore. I don't want to find any more bad plants."

Luckily for us and Maine lakes, that moment passed. Dennis says he is now "more determined than ever" to keep doing what he does, because he knows now, firsthand, just how important this work is. "Plant Patrollers really are making a difference here in Maine. We can all be proud of that." Dennis is right about this as well. Informed and alert citizens are responsible for finding nearly all of Maine's known aquatic infestations. Early detection of a new infestation provides the best hope of eradication. In cases where eradication is not possible, the earlier an infestation is detected, the greater the chance that the invasive plants can be managed effectively, and with the least amount of collateral damage to the native ecosystem.

To learn more about how you can get involved in Maine's Invasive Plant Patrol, please contact the VLMP today!

Littorally Speaking

The Wonders of the Littoral Zone

And how citizen scientists are enhancing our understanding of these vital near-shore areas

by Roberta Hill
VLMP Invasive Species Program Director

Imagine... the last ice age in North America is giving way to warmer times, and the geological processes associated with the retreat of Maine's ice sheets are yet hard at work--carving, scraping, impounding, and otherwise molding the depth contours and meandering shorelines of the 6000 or so lakes and ponds that we know and love in Maine today. Fast forward over the next 12,000 years or so, as the seasons turn again and again, bringing the meltwater and rainwater that flows over the land, eroding the scarred earth, carrying mineral particles, organic debris, and dissolved nutrients into the receiving lake basins. These processes in turn fuel the natural cycles of growth and decay, set in motion the successional colonization of a dazzling array of flora and fauna, ranging from the single celled planktonic organisms to the mighty moose, and animate the intricate ecological web of life that connects them all. Through this natural process of eutrophication, Maine's rocky, barren, crystal-clear lakes slowly but steadily become more enriched, more productive, more biologically active and diverse, especially the sun-filled near-shore areas, the 'fertile fringe,' (or littoral zone) where vascular aquatic plants (macrophytes) reside.

Since the days of Thoreau, naturalists and scientists have been drawn to the sun-filled nearshore portions of Maine's lakes, to study plant taxonomy, species diversity, the role aquatic plants play in lake ecosystems, and more. These earlier scientific pioneers and their contemporary counterparts have provided us with a fairly thorough account of the macrophyte species native to Maine, a sense of their general relative abundance, and an understanding of the inherently dynamic nature of aquatic plant communities. But the littoral zones of most lakes in Maine have never been thoroughly surveyed in this way, and there are still many questions left unanswered, for example: How do species diversity and community composition differ from lake to lake, and from location to location within a single waterbody? . . . What are the physical, biological, chemical, and cultural factors at play? . . . Are all aquatic plants currently listed as 'rare' really rare? . . . Are Maine's macrophyte communities changing in response to climate change? If so, which species will likely do better, and which will do worse? How will these changes affect other members of the lake community? And, of course, the perennial (indefinitely ongoing) question: *Have any invasive plants become established here?*

The VLMP Invasive Plant Patrol (IPP) program started with this last question. Through this program we have worked to help build the statewide early detection system needed to answer this question on a lake by lake, year by year basis. Since our first workshop in 2001, we have now trained over 4,200 people through the program. Engagement at every level of this early detection system is encouraged, from those who are keeping a casual eye out for anything suspicious while they are out recreating on the water, to those who are conducting high-quality professional-caliber invasive species screening surveys on an annual basis, or leading lake-wide IPP teams, or coordinating IPP efforts at the regional level.

One of the outcomes of engaging in the careful, methodical search for possible aquatic invaders in a State where less than 1% of our lakes are known to be infested, is that one becomes naturally curious about the plants that one does encounter. For some, this curiosity grows into a great passion; in others, the desire to learn grows into something more resembling obsession! Thus, the VLMP have somewhat accidentally set off a whole new wave of serious interest in aquatic botany here in Maine. I actually think it quite safe to say that there has never been a time in the history of our State when there have been so many amateur botanists exploring Maine's lakes, ponds, streams and rivers.

IPP Plant Paddles are 3-hour guided explorations that takes place on shore and on the water. Participants learn about the threat of aquatic invaders how they can get involved in the early detection effort.

IPP 101 is a comprehensive 6-hour classroom experience that prepares attendees for conducting or leading invasive aquatic plant screening surveys, and satisfies the quality assurance requirement for IPP certification.

With the help and input of this growing cadre of citizen aquatic botanists we are continually finding new ways to keep this unique interest, energy, and momentum alive. In addition to our Invasive Plant Patrol workshop offerings *(IPP Plant Paddle, IPP 101,* and *IPP Field Methods)* the VLMP has for several years offered an *Advanced Plant ID* course that essentially picks up where IPP 101 leaves off, delving into the ecology and the distinctive physical characteristics of the native plants that inhabit Maine's lakes and ponds. Attendees hone their identification skills with live specimens, and have the option of participating in an Aquatic Plant ID Proficiency Certification exam.

We also provide a number of opportunities for volunteers to expand their IPP horizons geographically while getting valuable in-lake experience. The goal of the *IPP Jump-Start* is to promote and support citizen-based early detection efforts in areas of the state where such activities are currently lacking. We work to accomplish this through: 1) organizing a survey team—comprised primarily of seasoned volunteer Invasive Plant Patrollers, supported by VLMP staff—to conduct a comprehensive invasive aquatic plant screening survey; and 2) helping to "jump-start" a locally sustainable citizen-based monitoring program in the region through outreach, training, and direct interaction with the host community. Our first major project took place on Moosehead Lake and is featured in the short documentary, *The Hunt for Aquatic Invaders*. We are currently partnering with **Acadia National Park** and **Somes-Meynell Wildlife Sanctuary** on a similar project on the waters of Mount Desert Island.

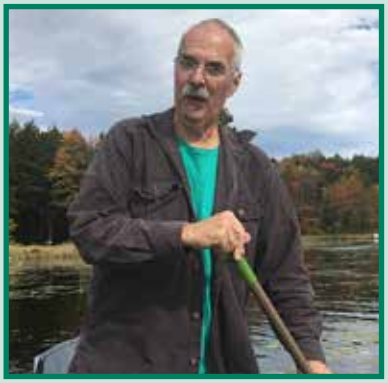
IPP Rapid Responders work in partnership with Maine DEP and VLMP staff to survey areas that need immediate attention. This citizen-powered rapid response team has been officially deployed six times now, in most cases in response to a newly-identified infestation. As with the Jump-Start surveys, the entire littoral zone of the target waterbody is gone over with a fine-tooth comb. Given the inherent thoroughness of these surveys, Jump-Start and Rapid Response actions provide excellent opportunities to gather detailed information on the native aquatic plants that are observed. Specimens are collected during the course of the survey and are later examined in 'extreme-botanizing' sessions; the best specimens are pressed, dried, and mounted for the VLMP herbarium.

At the beginning of 2016, a small group of dedicated volunteers, with extensive collective experience in aquatic plant identification, plant systematics, specimen collection and preservation, decided to adopt the *VLMP Herbarium Project* and apply their zeal for lakes and lake plants to the task of bringing the it to full fruition.

Thanks to all of you who participate in this important work, native plant data has now been collected on close to 300 Maine waterbodies! Each year the data set becomes more robust, more revealing, and more scientifically useful. And because it is now readily available on the VLMP Lakes of Maine website, it is increasingly being used by researchers, students, lake associations, lake managers, and many others. Toddy Pond Association and East Pond Association, for example, have now both used their native plant inventory data to create customized field guides for their lakes. (Please see the Fall 2016 *Water Column* on our website for more on the Toddy Pond project.)

We may not yet be able to answer all of the pressing questions now emerging from the littoral zones of Maine, but thanks to VLMP Invasive Plant Patrollers, we are starting to gather the kind of data needed to do so.

Volunteers Helping to Answer Important Questions About Maine Lakes



When the call for help went out, IPP Rapid Response Team members Nick Cody, Bob French, Sibyl French, Marsha Letourneau, Dennis Roberge *(pictured)*, Bunny Wescott and Ross Wescott dropped what they were doing to help determine the extent of the variable water-milfoil infestation in Long Lake, Bridgton.

The VLMP Jump-Start Team continue the hunt for aquatic invaders on the waters of Acadia. The 2017 team was powered by the following IPP volunteers: Unn Bourcher, Sue Carrington, Bob French, Sibyl French, Janene Gorham, Ellie Hopkins, Sandy Larned, Tom Larned, Marsha Letourneau, Toni Pied, Sherry Pettyjohn, Dennis Roberge, Lea Stabinski, Steve Underwood, Keith Williams, Ellie White and Willis White.

Our Acadia Jump-Start partners and hosts: Jesse Wheeler (Acadia National Park) and Billy Helprin (Somes-Meynell Wildlife Sanctuary). Jesse and Billy are working with the VLMP to build a volunteer IPP team on Mount Desert Island. For more information, contact Billy Helprin at somesmeynell@gmail.com.

Article reprinted from the LSM (previously VLMP) newsletter archives

Invasive Plant Patrol Leaders

Invasive Plant Patrol Leadership Opportunities

Are you looking for opportunities to expand your horizons as a Plant Patroller? Hone your survey techniques and plant identification skills while exploring new regions of the State with other lake-minded volunteers? Be part of Maine's growing IPP Rapid Response Survey Team? Expand volunteer participation in your own local early detection effort? If so, please read on and consider becoming involved in one or more of these exciting new leadership opportunities:

IPP First Responders are trained IPP volunteers who are willing to be on call should a new infestation be identified anywhere in the State of Maine (limits on distances one is willing to travel may be specified of course). This mobile, ready-to-go team is able to move confidently and swiftly when the need arises. With LSM coordinating with the local lake community, trained Plant Patrollers may be paired up with members of the local community who may have great familiarity with the lake of concern, but limited knowledge of invasive plants, thus enhancing not only the quality of the survey, but the quality of the survey experience for everyone involved.

The First Responder concept was successfully tested on Damariscotta Lake in 2009 when twenty-seven trained invasive plant patrollers (many traveling from distant corners of the state) participated in the intense search that followed the discovery of hydrilla in a small cove along the western shore of Damariscotta Lake. To date, no additional hydrilla has been detected in the lake.

The purpose of ***IPP Jump-Start*** is to conserve native ecosystems now threatened by a wide array of invasive aquatic organisms, by "jump-starting" locally-sustainable citizen-based invasive aquatic species monitoring in areas of the state where such activities are currently lacking. At the core of this program is the IPP Jump Start team: comprised of trained IPP volunteers, state agency personnel, LSM staff and other professionals working alongside of—and mentoring—novice plant patrollers and other members of the target community.

Engaging and leading by example, the IPP Jump-Start team conducts an invasive aquatic plant screening survey and baseline native aquatic plant inventory on the waters of the target region while providing one-on-one outreach to the community. IPP Jump-Start got its start in the Moosehead Lake Region in 2008.

Invasive Plant Patrol Leaders - When the LSM achieves its *ultimate* goal as an organization, virtually every lake in the State of Maine will have one or more water quality monitors and an active team of trained Invasive Plant Patrollers routinely monitoring the health of the waterbody. This statewide cadre of dedicated volunteers, trained and certified by LSM, will be supported and sustained by a well-organized, integrated, collaborative system involving LSM, local, county and State agencies, trained volunteer coordinators, local lake associations, and regional lake conservation groups.

LSM has had such a structure in place on for its water quality monitoring program for decades. It is now working to put the necessary elements in place for its Invasive Plant Patrol as well. The emerging structure provides opportunities for volunteer leadership at every level: trained Invasive Plant Patrollers, IPP Lake Team Leaders, IPP Regional Coordinators, etc. As is the case with the water quality system, the benefits include: technical assistance and quality assurance checks at each level; enhanced volunteer involvement and contribution; improved program efficiency and sustainability.

Much progress is being made, including, to our great delight, the activation (or active formation) of many

IPP First Responder Dennis Roberge surveys the shallows of Damariscotta Lake from dockside, while taking a well deserved break from the numbing fall water temperatures

new IPP Teams across the State of Maine. (An IPP Team is defined as "four or more trained Invasive Plant Patrollers working in concert to conduct an invasive aquatic plant screening survey.") The number of waterbodies being surveyed by an active (or actively forming) team jumped from a small handful in 2009 to over 60 waterbodies in 2011 and is somewhere in the vicinity of 80 teams today. In addition, roundtable meetings of current IPP Leaders are held in the spring for the purpose of refining and enhancing IPP program goals and objectives; more clearly defining volunteer leadership roles; identifying needs; and brainstorming next steps. Two train-the-trainer workshops (*How to Lead an IPP Plant Paddle* and the *View Scope Clinic*) have now been added to the list of LSM training opportunities. A host of new resources for IPP Leaders are available on the *Invasive Plant Patrol Leaders Resource Page* on the LSM website.

To learn more about any of LSM's volunteer leadership opportunities, please contact us at vlmp@mainevlmp.org or 207-783-7733.

Does Your Lake Have an IPP Team?

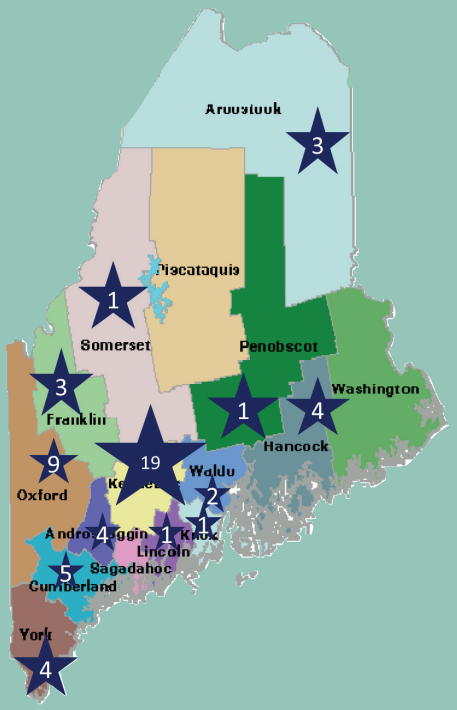
When it comes to monitoring aquatic invaders, the more eyes on the water, the better. The creation of strong, active *Invasive Plant Patrol Lake Teams* is seen as essential, not only to ensuring the quality of invasive aquatic plant surveys, but also to the long term sustainability of Maine's early detection effort. As part of a larger team, each patroller can focus more comprehensively on a smaller survey area; no one's survey area is too onerous. Teams are formed by dividing the shoreline of a waterbody into appropriately scaled sectors (e.g. 500-1,000 foot sections), and recruiting and training volunteers to conduct a survey in each sector.

The *Lake Team Leader* plays a key role in energizing, organizing and providing local technical support to members of the Lake Team. *Lake Associations* also play an important role in sustaining the team: helping to recruit team members, raising funds for supplies and equipment, providing recognition of the team's work, etc.

An active, well trained, fully equipped survey team benefits your lake community in many ways. The team can rule out presence of invasive aquatic plants annually, help educate and engage the lake community (friendly face-to-face encounters, dockside, are commonplace during plant surveys) and provide a better understanding of your lake's unique native plant communities.

Maine now has several successful *Regional* IPP Teams. In this situation, one or more trained Plant Patrollers from each waterbody in the local system (e.g., Five Kezars, Tacoma Lakes, Belgrade Lakes) form a composite team and work together to collectively monitor each lake in the system. Possible strategies for accomplishing goals include: monitoring all high risk areas on every waterbody in the region, annually, over the course of several days; conducting a complete (Level 3) survey on each lake in the system in rotation, with the goal of monitoring each lake once every two or three years; or some combination of the above. This is a great way to stretch the effectiveness of an IPP effort in water rich areas where there are currently only one or two trained patrollers on each waterbody.

Whatever the size and scope of your team…working as part of a team is, safer, more effective, more efficient, more engaging, and *more fun*! For more information on IPP Lake Teams, please contact us at 207-783-7733 or vlmp@mainevlmp.org.



Battling the Invaders

As of January 2019, thirty-one lakes and ponds, and fourteen stream or river segments are known to be infested with one or more invasive aquatic species. Variable water-milfoil is still the most widespread of the known invasive aquatic plants in Maine. Other invasive aquatic plants present in Maine include curly-leaf pondweed, Eurasian water-milfoil, spiny (European) naiad, hydrilla and European frogbit. Five additional invasive aquatic plant species (not yet known to occur in Maine) have been listed by Maine law as imminent threats to our State.

Once an infestation has been confirmed, rapid response is crucial. The prospects for eradication (or barring that, effective management at minimum risk to the aquatic ecosystem), are greatly increased by swift, well-planned, and properly executed controls. In developing an invasive aquatic plant management plan, one of the most important questions to be answered is "How, exactly, is the invasive plant infestation to be controlled?" The principal approach in Maine—used primarily by groups currently involved in battling variable milfoil (or its invasive hybrid)—is "manual control". Manual control methods may alternately be referred to as "non-chemical," "physical" or "mechanical" methods. The three primary manual control methods currently being used in Maine are: manual harvesting, benthic barriers, and suction-assisted harvesting.

Variable water-milfoil infestation

Maine has taken a cautious approach to the use of aquatic herbicides to control invasive aquatic plants. Herbicides, like all pesticides, pose a definite degree of risk for people, for fish, and for the integrity of the aquatic ecosystem which depends on that body of water. Though aquatic herbicides are seen by state officials as an "effective tool," it is the state's position that the "benefits of using herbicides rarely exceed the risks of very real adverse ecological impacts." Therefore, "it is only in extraordinary circumstances that the Maine Department of Environmental Protection (DEP) will support the use of herbicides."[1] In recent years, the DEP has approved and overseen the use of aquatic herbicides in four specific instances--the Hydrilla infestations in Pickerel Pond in Limerick and Damariscotta Lake in Jefferson, and the Eurasian water-milfoil infestations in the unnamed gravel pit in Scarborough and Salmon Lake in Belgrade.

IMPORTANT! – All invasive aquatic plant control projects are subject to regulation under Maine's Natural Resources Protection Act. Before planning any control project, contact the Maine Department of Environmental Protection for specific permit requirements. All native aquatic plants are strictly protected by Maine law.

Manual Control Methods

Below is a brief overview of the three primary manual control methods currently being used in Maine: manual harvesting, benthic barriers, and suction-assisted harvesting. More detailed information on each method is located online at www.mainevlmp.org/aquatic-invaders/.

Manual Harvesting (or Manual Removal)

Most of the variable milfoil management efforts currently underway in Maine involve a combination of manual control methods. Nearly all of these projects involve at least some use of the method known as manual harvesting. Manual harvesting is a useful technique for removing scattered individual plants and controlling small, infested patches. With manual harvesting, plants and their root systems are individually removed from the infested area, collected, and transported away from the waterbody for disposal. As even tiny plant fragments can generate new plants, it is very important when using manual harvesting that every attempt is made to remove all plant and root fragments from the project site.

Jim Chandler, using manual harvesting to control variable milfoil in Lily Brook, surfacing with a bag of milfoil.

The means by which the plants are approached, handled, and even the way in which they are disposed of may vary, but the basic concept remains the same. Think "weeding the garden by hand (or with hand tools)." Now think "weeding the garden under several feet of water." This should give you a pretty good sense of the work. Depending on the water depth, the work is done by waders, boaters, snorkelers and/or SCUBA divers. Though manual harvesting is a labor-intensive process, if done with care it is a "species selective" technique that causes minimal impact to other native species in the vicinity of the control activity. However, despite the level of care and thoroughness, it is nearly impossible to see and remove every stem and root fragment in the infested area. For this reason, ongoing monitoring of management sites and routine control activity is essential.

Benthic Barriers (also called Benthic Mats or Bottom Barriers)

Placement of benthic barriers is another labor-intensive, but effective, method for controlling invasive aquatic plants. Benthic mats are particularly useful in treating small to moderate sized patches of dense growth. They are used to suppress invasive plant growth in high use areas such as public swimming areas. If depths are sufficient, benthic barriers may also be used to clear and define plant-free boating channels through infested areas, reducing plant-boat contact and thereby minimizing the potential for boats to spread the infestation. Controlling larger infestations with benthic barriers is possible, but given the labor and materials involved, larger control projects are generally done incrementally in stages, and in some cases may take several years to reach the desired result.

Benthic barriers may be constructed in various shapes and sizes, using a variety of materials and systems for weighting the mats down. Their basic function, however, is to lay "flat" on the bottom of the lake, pond, or stream, covering the infested area, preventing plants underneath from receiving sunlight, thereby killing them. (Returning to the garden analogy . . . think mulch). The mats are left in place long enough to kill the plants (generally four to six weeks, though in some cases, the mats may be left in place for longer periods). Manual harvesting is often used in tandem with the placement of benthic barriers to control any "outliers" and plants that find their way out from under the mats around the edges. One significant advantage with the use of benthic barriers is that the plants in the treated area are, by and large, killed. The "almost impossible" challenge of extracting

Photo by Nikki Leam
Team installing benthic barriers to control variable milfoil in Lily Brook.

every root hair from the substrate (as is necessary to completely kill a plant through manual harvesting) is largely eliminated when this method is properly employed. One disadvantage is that benthic mats are not "species selective" and may cause "collateral damage" to any native flora and fauna that do not have the means to escape out from under the mats.

Diver Assisted Suction Harvesting (DASH)

Suction harvesting is the least frequently used, of the three manual control methods now employed in Maine. It is a relatively expensive and cumbersome control option. However in certain circumstances such as large, widespread infestations, suction assisted harvesting is proving to be an important management tool. Groups in Maine utilizing this method have shown enormous industry and innovation in developing the required technology and techniques. As the fine-tuning of the process proceeds and more "rigs" come on line, it is likely that the use of suction-assisted harvesting in Maine will expand.

Little Sebago Lake Association has developed two floating work stations (dubbed HIPPO I and HIPPO II) to support their suction assisted harvesting activity

Suction harvesting is 'manual harvesting' (see above) with the added advantage of a highly efficient way to get the plants to the surface where they are collected for disposal. Rather than swimming the plants to the surface in mesh bags, divers extract plants by hand as above, and then feed the plant material directly into a suction tube for rapid transport to the work platform at the surface (generally a pontoon boat or barge). From the hoses, the plants and any sediments clinging to the plants, are pumped through some form of strainer system, then piled or bagged. The sediment-laden water that comes along with the plants is either returned directly to the waterbody, or (better) is put though another system that removes sediment particles or allows them to settle out.

Plant fragmentation is a concern with all of these manual control methods, but with diver-operated suction harvesting the potential for fragmentation is moderately high. Use of careful technique and fragment barriers can significantly reduce the creation and escape of fragments from the work area.

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1. Keynote Presentation at the Seventh Annual Maine Milfoil Summit by Commissioner David P. Littell, Maine Department of Environmental Protection.

The Use of Herbicides to Control Invasive Aquatic Plants: Questions and ~~Answers~~ *More Questions…*

Roberta Hill, Invasive Aquatic Species Program Director, LSM

As of January 2019, thirty-one lakes and ponds, and fourteen stream or river segments are known to be infested with one or more invasive aquatic species. Variable water-milfoil is still the most widespread of the known invasive aquatic plants in Maine. Other invasive aquatic plants present in Maine include curly-leaf pondweed, Eurasian water-milfoil, spiny (European) naiad, hydrilla and European frogbit. Five additional invasive aquatic plant species (not yet known to occur in Maine) have been listed by Maine law as imminent threats to our State.

The increased awareness of existing or new infestations, the alarming rate of advance of some invasive populations, and the significant challenges that arise when one takes on the task of controlling aquatic invaders have all contributed to a growing sense of urgency, perhaps even something more akin to panic. It is not surprising that, in the midst of this deepening climate of concern, the hunt should intensify for the proverbial "silver bullet" that will, if not kill the offending invader once and for all, at least diminish it to the point that it no longer poses a significant threat. It is in this context that some are now asking about the possibility of expanding the use of aquatic herbicides to control the invaders. Some commonly asked questions are "Why can't we just kill the plants with herbicides?" or "Other states routinely use aquatic herbicides to control invasive aquatic plants: Why aren't herbicides more widely used in Maine?".

The purpose of this article is to take a careful look at the prospect of expanding the use of aquatic herbicides in Maine—and to ask some of the questions that will surely arise as we, the citizens of Maine, begin to consider the pros and cons of such a course of action. How are aquatic herbicides currently being used in our state? What is the rationale behind Maine's current "cautious" approach to the use of aquatic herbicides? Are aquatic herbicides safe? Are they effective?

The intention here is not to attempt to provide *answers* to these questions, because to some extent there are no clear answers. Rather, it is to illuminate some of the complexities inherent in the questions themselves, and to suggest the types of questions that should be asked if we wish to ensure the best decisions moving forward. The primary goal of this article, in other words, is to simply get the ball rolling on a critically important public discussion; one that ultimately may impact all of us who have a special place in our hearts for Maine's lakes, ponds and rivers.

Question 1: How are aquatic herbicides currently being used in Maine? What is the rationale behind Maine's current "cautious" approach to the use of aquatic herbicides?

Controlling hydrilla in Pickerel Pond with aquatic herbicides (Photo courtesy of MDEP)

To treat waters of the State with an herbicide one must apply for, and receive, a waste discharge license from the Maine Department of Environmental Protection. License applications are reviewed on a case-by-case basis. The risks and benefits of using a particular herbicide are weighed against the risks and benefits of not doing so. The risks and benefits associated with alternative methods of controlling the particular infestation must also be considered.

The rationale behind Maine's measured and cautious approach to regulating the use of aquatic herbicides was stated succinctly by then Maine Department of Environmental Protection Commissioner, David Littell, in his keynote address at the 2006 Milfoil Summit: "Herbicides, and all other pesticides for that matter, pose a definite degree of risk for people, for fish, and for the integrity of the aquatic ecosystem which depends on that body of water." Though state officials are currently using aquatic herbicides to control invasive plants in two instances as described below, it is the state's position that the "benefits of using herbicides rarely exceed the risks of very real adverse ecological impacts." Therefore "it is only in extraordinary circumstances that DEP will support the use of herbicides."[1]

Since 2003, Maine DEP has approved and overseen the use of aquatic herbicides in four specific instances—the Hydrilla infestation in Pickerel Pond in Limerick, the Eurasian water-milfoil infestation in the unnamed gravel pit in Scarborough, the Eurasian water-milfoil infestation in Salmon Lake in Belgrade, and the Hydrilla infestation in Damariscotta Lake in Jefferson. According to former Commissioner Littell, all four of the infestations are seen as unique. All occur in small ponds less than 50 acres in size or small coves, "small enough to manage effectively." Both species are considered extremely serious invaders, widely recognized by biologists as among the "most tenacious, most costly, and most environmentally damaging plant species in North America." Containing these two particular invaders and "preventing any opportunity for them to take hold elsewhere in Maine"— is, according to the DEP, "…the primary benefit of using herbicide on these four ponds."[2]

Maine DEP's Paul Gregory has explained that the decision to apply herbicides in these four unique situations was something like deciding to treat an aggressive [and in this case highly infectious] disease with chemotherapy, a toxic regimen that interacts with the whole system being treated, not just those parts you are attempting to destroy. It is a "very serious medicine to be used only when all other, less risky treatments have been ruled out as inadequate to the task".

Question 2: Are aquatic herbicides safe?

All herbicides legally used in the United States for controlling aquatic plants must be "registered for use" by the US Environmental Protection Agency (EPA). According to the EPA's own definition, pesticide registration is the "process through which EPA examines the ingredients of a pesticide; the site or crop on which it is to be used; the amount, frequency and timing of its use; and storage and disposal practices. EPA evaluates the pesticide to ensure that it will not have unreasonable adverse effects on humans, the environment and non-target species."[3] It should be noted that the EPA definition does *not* say there will be "no adverse effects." It says that any possible adverse effects will not be "*unreasonable*." So here is one of those niggling complexities that gives rise to more questions…Who gets to define the term "unreasonable?" Under what conditions is an *adverse* effect deemed "reasonable?"

Although pesticide registration is scientifically rigorous it does not guarantee that a product is completely safe. Significant gaps in the research remain. Roy Bouchard, biologist with the Maine Department of Environmental Protection, points to one of the gaps. "I know of very few long-term studies of the effects of herbicide use on ecosystems. Repeated use of herbicides for long term management of aquatic vegetation can fundamentally shift how the system operates, and how the rest of the plant and animal community that depend on aquatic vegetation responds in the long term. Herbicides may not kill organisms such as invertebrates or fish directly, but little is known about what will happen to [these organisms] and their habitat over time."

Part of the problem lies in the fact that for organisms other than humans, the registration process is primarily concerned with "acute toxicity," the study of how much of the product in question it takes to kill this life form or that. When it comes to "sub-lethal effects," especially on creatures other than mammals, very little is known. And what *is* known is not entirely reassuring. Recent studies on endangered Pacific salmon, for example, have suggested there may be sub-lethal or behavioral effects from pesticides. Another problem comes from the way the data is generated. Most of the "effects" are extrapolated from short term, high dose tests conducted on a small number of

species. A number of epidemiological studies suggest that the short term animal studies tend to underestimate the effects on humans, and the same studies support the notion that many sub-lethal effects aren't being predicted at all.

Another area where knowledge is scarce surrounds the question of how different compounds interact with each other in the environment. What are the risks to the environment and human health when herbicides applied directly into our water resources are combined with other toxic materials released into the watershed from forestry, agriculture, and home lawn and garden activities? The EPA estimates that there are currently about 87,000 "chemicals in commerce" in the US. Do the math and you will soon understand the complexity inherent in properly assessing all possible interactions between all possible combinations of these chemicals in the environment.

Which begs another question…do we even know which chemicals are already present in our lakes and rivers, and at what concentrations? Following a ten-year national study of rivers and aquifer systems conducted by the EPA and the US Geological Survey (USGS), a report was recently released describing the occurrence of pesticides in our nation's waters. The report concludes that pesticides (a broad group of chemicals that includes herbicides) are "typically present throughout the year in most streams in [developed] areas of the Nation…at concentrations that may affect aquatic life or fish-eating wildlife."[4]

The EPA/USGS study also discovered that detected pesticides seldom occur alone; rather they almost always occur as complex "mixtures." Acknowledging that very little is known about the potential toxicity of such mixtures, the researchers ultimately conclude that "the study of mixtures should be a high priority."

Most stream samples and about half of the well samples contained two or more pesticides and frequently more. The potential effects of contaminant mixtures on people, aquatic life, and fish-eating wildlife are still poorly understood and most toxicity information, as well as water-quality benchmarks used in the study, has been developed for individual chemicals. The common occurrence of pesticide mixtures, particularly in streams, means that the total combined toxicity of pesticides in water, sediment, and fish may be greater than that on any single pesticide compound that is present. Studies of the effects of mixtures\ are still in early stages, and it may take years for researchers to attain major advances in understanding the actual potential for effects. Our results indicate, however, that studies of mixtures should be a high priority.[5]

This call for a better understanding of the "potential effects" of herbicides—and in particular the potential effects of herbicides on public health—has been voiced here in Maine as well. Roughly one third of Maine's citizens get their drinking water from "surface waters" of the State (lakes, ponds and rivers). What impact, if any, would loosening the restrictions on the use of aquatic herbicides have upon Maine's drinking water supply? Echoing some of the concerns described above, the Maine Water Utilities Association (MWUA) has taken a clear position on the issue.

Like all surface waters in the state, [those that serve as] water supplies are threatened by the spread of invasive aquatic plants. As drinking water suppliers, our primary concern is for potential impacts that the spread of these organisms could have upon human health and the long-term safety of the drinking water supply. . . The use of aquatic herbicides to control invasive plant infestations has become common [in the United States]. Despite advertisements that claim these products leave "no residue" and have shown "no adverse effects," there are still many questions left unanswered about the long-term health risks associated with these agents, for both humans and wildlife.[6]

In making its case, MWUA points to another outstanding gap in the research concerning the safety of aquatic herbicides.

One significant question yet to be answered is whether or not the chemicals currently used to control aquatic plants are endocrine disruptors. Endocrine disruptors are synthetic chemicals that interfere with the operation of the endocrine system, the system of hormones that regulates an organism's development, growth, reproduction and

behavior. Because they may interfere with reproductive function, the adverse affects of these compounds may not be immediate but, instead, passed from one generation to the next . . . At present, the research focused on the effects of these compounds on human endocrine systems is incomplete and inconclusive. According to the EPA, "there currently is not enough scientific data available on most of the estimated 87,000 chemicals in commerce to allow us to evaluate all potential risks.[7]

After consideration of the potential, as yet unknown risks associated with the use of aquatic herbicides, MWUA argues for erring on the side of caution, taking the position that "No herbicides should be used in a public drinking water supply."[8] And if aquatic herbicides are to be used in the *watershed* of a public drinking water supply, MWUA suggests the following conditions should apply:

1. The compound to be used has undergone adequate testing to determine the short and long-term health effects on human health, including the compound's potential to disrupt endocrine systems.
2. The chances for total eradication by this method are excellent, reducing the need for repeated applications.
3. All water utility customers are properly notified of the intended action, given an opportunity to comment, and concerns can be adequately addressed.[9]

Question 3: Are aquatic herbicides effective?

There is a good deal of research and numerous case studies supporting the claim that aquatic herbicides are effective tools in controlling or "knocking back" aquatic plants. But *eradication* of invasive aquatic plant species by *any* means, including by the use of herbicides, is rare indeed.

Case in point: Hydrilla in the state of Florida. Hydrilla, now in more than 43% of Florida's public waters, is reported to be the most abundant submersed aquatic plant in the state. Despite one of the most aggressive (and expensive) invasive plant management programs in the country, involving an extensive use of aquatic herbicides, this "worst of the worst" invader appears in more Florida waterbodies every year.

Hydrilla infestation in Pickerel Pond, 2002

One of the challenges of Hydrilla, is that the herbicides commonly used to control it do not affect Hydrilla seeds, tubers and turions (small vegetative buds capable of reproduction) and repeated applications are needed to control regrowth. The Hydrilla in Pickerel Pond, for example, has been treated with fluridone (the herbicide of choice for this invader) every year since 2003. It is not yet known how many additional treatments may be needed before the "tuber bank" in the sediment will be depleted to the point that regrowth can be handled by manual control methods alone.

Another problem with respect to the efficacy of herbicides appears to be the result of a phenomenon known as "herbicide resistance." When a plant loses its sensitivity to an herbicide over time through the process of genetic selection, it is said to have become "resistant" to that herbicide. We have been aware of this phenomenon for decades in agricultural systems, so it is not really surprising to learn that evidence is now mounting to show that some aquatic plant species are developing a similar resistance.

An article in the spring 2006 issue of *Aquatics,*[10] the journal of the Florida Aquatic Plant Management Society, reports that some Hydrilla populations in Florida have developed resistance to fluridone; meaning that the herbicide is no longer effective in controlling Hydrilla in these lakes. The authors suggest various strategies for minimizing the potential for resistance, including: avoiding the repeated use of herbicides that kill plants by way of the same "mode of action," alternating the types of herbicides used, and using other non-herbicide methods, such as mechanical and/or manual control, when feasible.

What is the extent of aquatic herbicide resistance nation wide? What are the possible implications of this resistance over time? As for the suggestion that “alternating herbicides” may be one solution to the resistance problem, how does this strategy square with the USGS/EPA caution regarding "herbicide mixtures"? Again, there are many questions to be asked, and limited data with which to answer them.

There seems little doubt that the discussion and debate concerning the question of the "proper" use of aquatic herbicides in Maine will be with us for some time. It is a discussion worthy of careful attention, thoughtful consideration and widespread involvement.

When you come to a difficult crossroad, it is always a good idea to take a few steps back where you can ponder the longer and broader view. Maine proudly claims that ours is the state where life is "as it should be." One assumption inherent in that claim is that we have an environmental condition that sets us apart from other states, and our unique environmental heritage is something to be valued and protected. The shorelines of most of Maine’s lakes and streams are vastly different, aesthetically and ecologically, from shorelines in most other states in our country. This is in part due to the fact that we have had less development pressure. But it also stems from having the advantage of learning from the experiences of others who have already borne those higher pressures. Maine’s Shoreland Zoning codes, almost unique in the nation, are a prime example of benefits reaped from lessons gleaned from "away." Maine’s cautious approach to the use of aquatic herbicides is another example.

Which brings us back full circle to one of the original questions asked here, “Other states routinely use aquatic herbicides to control invasive aquatic plants. Why aren’t herbicides more widely used in Maine?” Perhaps the best way to answer this question is to pose another… Just because other states allow the widespread use of herbicides (as well as significant alterations of shoreline and wetland habitat etc.) *is* that a good reason for Maine to follow suit?

Notes:

1. *Keynote Presentation at the Seventh Annual Maine Milfoil Summit* by Commissioner David P. Littell, Maine Department of Environmental Protection. Text of the commissioner’s speech is available on the Maine DEP website at http://mainegov-images.informe.org/dep/pubs/2006%20milfoil%20summit.pdf
2. Ibid.
3. EPA website www.epa.gov/pesticides/regulating/registering
4. *Pesticides in the Nation’s Streams and Ground Water*, 1992-2001,” Circular is available at http://pubs.usgs.gov/circ/2005/1291 or by calling 1-888-ASK-USGS.
5. Ibid.
6. *Maine Water Utilities Position Paper on Invasive Aquatic Plants*, January 2002.
7. Ibid.
8. Based on MWUA recommendations, Maine law now states that “Chemical control agents may not be used on a water body that is a public water supply without the prior written consent of each public water supplier using that water body” (38 MSRA section 1865) http://janus.state.me.us/legis/statutes/38/title38sec1865.html
9. *Maine Water Utilities Position Paper on Invasive Aquatic Plants*, January 2002.
10. *Aquatic Plant Resistance to Herbicides*, Tyler J. Koschnick, W.T. Haller and M.D. Netherland, Aquatics, Spring 2006/Vol. 28, No. 1, p. 4-9. For additional information on Hydrilla resistance, see *Pegging a Troublesome Change in Hydrilla*, available on the United States Department of Agriculture (USDA) website at www.ars.usda.gov/is/AR/archive/nov05/hydrilla1105.htm.

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