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

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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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