Aquatic Herbicides in the Wood-Pawcatuck Watershed

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Introduction:

The application of aquatic herbicides to control pond vegetation was first identified as a potential problem by a member of the Wood-Pawcatuck Watershed Association. As part of an environmental studies class at Brown University, we studied this issue from a variety of angles throughout this past semester. To study the Rhode Island permitting process for aquatic herbicides, we constructed a database of all of the permits from 1997-2001. The permits are held in the Fish and Wildlife office at the Steadman Building in Wakefield. They are destroyed after five years, so we were only able to obtain data going back to 1997, although the permitting process has existed for longer. A digital copy of the database has been supplied to the Wood-Pawcatuck Watershed Association.

The Current Permitting Process in Rhode Island

In Rhode Island, anyone can apply for a permit to apply aquatic herbicide to a pond. From the permits we reviewed, it is clear that there are three primary types of applicants: individuals, pond associations, and licensed applicators applying on behalf of individuals or groups.

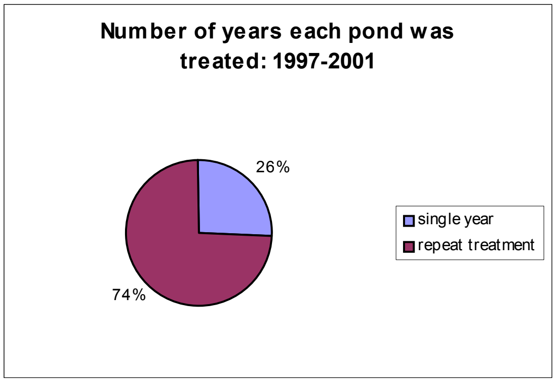
There are two companies, both operating out of Massachusetts, that are licensed to apply aquatic herbicides: Aquatic Control Technologies Incorporated, and Lycott Environmental. Rhode Island has no program to license applicators, nor does it have applicators operating in Rhode Island that are licensed in other states.Use of licensed companies is entirely voluntary.

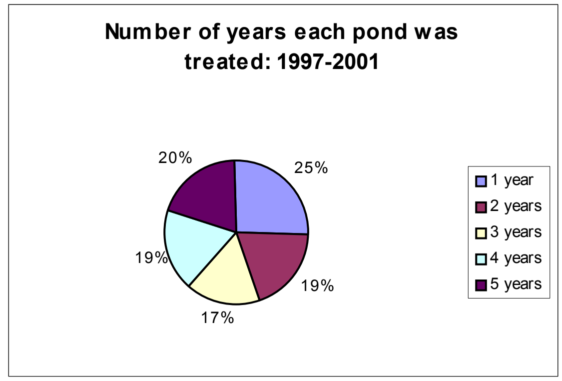
The permit application is one page long and asks for information about the pond to be treated (including pond area and water depth), target species, chemicals to be used, and the amounts of those chemicals. Applicants are also requested to indicate neighboring wells and public water sources on a map.

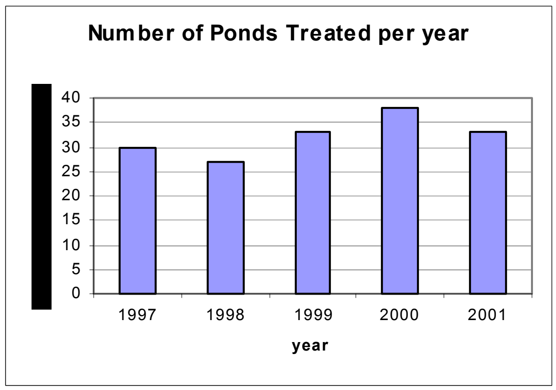
The completed application is submitted to the Division of Fish and Wildlife (F&W) where it is date stamped, numbered to indicate the year and order received, and immediately sent to the Division of Agriculture (DoA) for further review by their Environmental Scientist, Elizabeth Lopes-Duguay. At the DoA, Lopes-Duguay reviews the application's chemical use and dosage amount for compliance with the herbicides' EPA label restrictions. Assuming the application is in compliance, DoA sends the application back to F&W with a memo outlining the approval, or conditional approval of the permit. Often, Lopes-Duguay highlights conditional use requirements such as public notification or water use restriction during the time of application. Next, John O'Brien at F&W signs and dates the application and returns it with the Lopes-Duguay memo to the applicant. There is no record of further follow-up or monitoring to assure that the conditions of approval are followed. F&W receives twenty to thirty applications per year and of the five years of permit applications we reviewed, we did not see an application request ever denied. O'Brien indicated that when permits are rejected for a specific reason, they are often sent back to the applicant for revision and then approved. We never saw a file containing a record of any rejections and revisions; it seems this important data and information is being lost in the process.

There is a separate permitting process for all non-chemical methods of aquatic plant control in Rhode Island. Applications for permits to alter pond or wetland ecosystems using mechanical or biological techniques go through the Wetlands department of the Office of Water Resources. This application process is more extensive and appears to have a longer review period. We were told that there have been only one or two of these types of permits granted in the last ten years[1]. Coastal Resource Management Council (CRMC) also has to approve chemical herbicide applications for waters that fall under their jurisdiction ; in these cases, Lopes-Duguay grants approval for the herbicide permit conditioned on CRMC's approval. We found that there were a total of 56 ponds treated in the last five years, of which 42 ponds (74%) were treated miltiple times. Eleven of the ponds (20%) were treated all five years. There is little change in the number of ponds treated each year because so many of the ponds are treated multiple times. These statistics are summarized in the graphs below.

[1] Faneuf, Brandon. Personal communication. April 18, 2002.


Number of years each pond was treated: 1997-2001
26%
74%
single year
repeat treatment


Number of years each pond was treated: 1997-2001
20%
25%
19%
19%
17%
1 year
2 years
3 years
4 years
5 years


Number of Ponds Treated per year
[redacted]
40
35
30
25
20
15
10
5
0
1997
1998
1999
2000
2001
year

Potential Issues

Several issues with the permitting process have been identified. These are first and most importantly questions that need to be answered, not necessarily outright criticisms of the process.

The first issue deals with the outcome of the situation. The application of aquatic herbicides is an annual method to deal with pond weeds, not a long-term solution to reduce weed growth. Since the problem of overabundance of growth is being merely symptomatically treated year after year, the cycle is perpetuated without a true solution. There is no consideration of the land use surrounding the pond that leads to this unwanted plant growth, nor is there any consideration of what the historical status of the pond is. The permit is approved without any indication of whether the plants currently considered nuisance weeds are, in fact, native to the pond and part of its historic ecology. This historic point does not apply as much to man-made ponds, but is still an important factor in considering the reasons for plant growth. Regarding land use, the inclusion of this factor into the treatment of a pond could help to explain the plant growth and perhaps help to create a preventative solution.

The second issue is the application itself. The brevity of the one-page document excludes many questions of potential value. In addition, the existence of different permitting processes for the different methods of weed control leaves room for discrepancies and could act to deter applicants from employing alternatives to herbicides. Also, there is no monitoring to ensure that the conditions imposed by Lopes-Duguay at DoA are followed. There also seems to be a conflict of interest with regard to ponds managed by DEM; on more than one permit, O'Brien at F&W applied for the permit and then approved it. In these instances, a licensed commercial applicator actually treated the pond, but these situations are still problematic.

The third issue is of scientific uncertainty. While there are documented studies about these aquatic herbicides and their effects on fish and some other aquatic life, there are still some unanswered questions. In addition, the overall potential of anoxia or pond eutrophication due to the amount of decaying matter on the bottom year after year has not been investigated thoroughly. Other issues, which we were not able to investigate but we believe are very important, are the possibility of interaction between the various combinations of herbicides applied, and also the effects of the herbicides' breakdown products that do not degrade entirely.

Examples from the Wood-Pawcatuck Watershed

Currently there are five ponds in the Wood-Pawcatuck watershed that regularly receive aquatic herbicide treatment: Locustville Pond, Larkin Pond, Meadowbrook Pond, Wyoming Pond, and a section of the Wood River that lies near the intersection of Skunk Hill Road and Route 3 in Hope Valley, RI.

Locustville Pond is abutted by many landowners, and overseen by the Locustville Pond Association. Each year that association requests a permit to apply 700 lbs. of AquaKleen (2,4-D) on the pond in order to control populations of the invasive plant species Eurasian watermilfoil. Although the Locustville Pond Association requests permission to apply 700 lbs. of AquaKleen each year, there are some years where herbicide application is unnecessary. Therefore, even though the pond association may not need to apply the herbicide every year, they apply for the permit in early spring so that if there is an outbreak of milfoil in late summer, they will be able to treat it. There is no follow-up from the Division of Fish and Wildlife to track when herbicide is actually being applied on the ponds. A homeowner who lives on the pond first alerted the Wood-Pawcatuck Watershed Association to a potential problem after seeing the herbicide powder applied on a windy day, which subsequently blew the herbicide onto her property. Another potential issue is a nearby gravel-packed well that was pointed out to the Locustville Pond Association by Lopes-Duguay in her memo attached to the application. She recommended that the applicants be aware of it.

Meadowbrook Pond is treated with Reward (diquat dibromide) and Navigate (2,4-D, same as AquaKleen) to treat Eurasian watermilfoil and pondweeds. John O'Brien, who, as previously stated, approves all permits, submitted the application to treat this pond. We see a major conflict of interest here—the reviewing authority should not be the same as the applicant.

Even if this pond is under DEM management, this conflict still exists. In addition, it was brought to our attention by a homeowner on Meadowbrook Pond that even though a licensed applicator treated the pond, canisters of herbicides were left on her property afterwards.

Larkin Pond is used as a swimming area for the Hoffman Girl Scout Camp. It is treated with Reward, Aquathol K, and Rodeo (glyphosate). Some of our concerns for Larkin are the possible interactions that might result from three chemicals being applied at once, the drinking water well pointed out by DoA situated near Cookie Pond, and the swimming restrictions associated with using Reward.

Wyoming Pond does not have a pond association. Judith G. Mendelsohn, a homeowner who lives on the pond, applied for a permit to use AquaKleen to treat "vegetation." Although the permit application requires the species name, this particular permit was approved despite the lack of specificity. In addition, the DoA advised Ms. Mendelsohn to avoid applying heavy concentrations in certain areas, in order to prevent fish kills.

A homeowner named T. St. Clair applied for a permit to use AquaKleen on the Wood River near Skunk Hill road and Route 3. The AquaKleen was used to treat pond weeds. The DoA recommended that when applying the chemical, water flow should be restricted, as per label instructions. This does not seem possible on a flowing river.

Aquatic Herbicides Being Used in the Wood-Pawcatuck

AquaKleen and Navigate, both comprised primarily of the chemical 2,4-D, are used specifically to treat Eurasian watermilfoil, an invasive species that is rapidly becoming one of the most problematic pondweeds throughout the country. In aquatic environments, the fate of the chemical appears to be rather benign. While most of the chemical is absorbed into plants, some of it is taken in by other aquatic organisms. There is no bioaccumulation in the organisms, as the half-life for 2,4-D in these animals is approximately 48 hours. If not absorbed by plants or animals, 2,4-D is readily broken down by microorganisms in the water, and is completely degraded in one to several weeks. Toxicity tests performed with 2,4-D on human and animal subjects showed effects such as coughing, dizziness, and lack of coordination, but only after prolonged or acute exposure to the chemical. Given the short period of degradation, it is unlikely that AquaKleen or Navigate applied to aquatic weeds would pose a threat to human health. However, the carcinogenicity of 2,4-D is controversial. Rats exposed to 2,4-D over a period of two years began to develop malignant tumors. Studies of the possibly carcinogenic effects of 2,4-D on humans have generated varying results, and have been very limited.[2]

Reward, whose primary ingredient is diquat dibromide, treats watermilfoil, pond weeds, and filamentous algae. Once absorbed into plants, it takes several weeks to degrade. Furthermore, the residue chemical that is not taken up by plants eventually settles to the lake bottom, where it is absorbed by soil particles. Once bonded to sediment, the chemical degrades very little or not at all. Another concern with diquat dibromide is that in the limited studies that have been conducted, it has shown a low toxicity to aquatic organisms.[3]

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[2] http://ace.orst.edu/info/extoxnet/pips/24-D.htm accessed on May 1, 2002.
[3] http://ace.orst.edu/info/extoxnet/pips/diquatdi.htm accessed on May 1, 2002.

Aquathol K (primary ingredient dipotassium endothall), treats pondweeds and watermilfoil. It degrades in water in less than a week (4-7 days). On a range of low, medium, or high toxicity, Aquathol K exhibits a "medium" toxicity to aquatic insects.[4]

Rodeo, the aquatic version of Roundup, uses the same primary ingredient, glyphosate, to treat emergent plants, like cattails, and water lilies. The half-life of glyphosate in aquatic environments is 12 days to ten weeks. Like the other chemicals, only limited studies have been performed concerning its toxicity to aquatic life. It has been found in these studies that glyphosate may be slightly toxic to aquatic invertebrates.[5]

More information about the amounts of these herbicides and their use on these five ponds can be found in our database. The following table summarizes herbicides used in the Wood-Pawcatuck watershed.

Herbicide	**Target Species**	**Fate after application**
Aquakleen, Navigate (2,4-D)	Watermilfoil	⅄ ~48 hour half-life in aquatic organisms, 1 week to several weeks in water ⅄ Carcinogenic effects uncertain
Reward (diquat dibromide)	Watermilfoil, pond weeds, filamentous algae	⅄ Several weeks to degrade in plants, little or no degradation in soil ⅄ Low toxicity to aquatic life
Aquatholl K	Pondweeds, watermilfoil	⅄ 4-7 day degradation in water ⅄ "medium" toxicity to aquatic insects
Rodeo	Water-lilies, emergent plants (cattails)	⅄ Half-life is 12 days - 10 weeks ⅄ "may be slightly toxic to aquatic invertebrates"

[4] http://ace.orst.edu/info/extoxnet/pips/endothal.htm accessed on May 2, 2002.
[5] http://ace.orst.edu/info/extoxnet/pips/glyphosa.htm accessed on May 1, 2002.

Questions About the Effects of Aquatic Herbicides on Water Quality

Because we are aware that plant decomposition can lead to reduced dissolved oxygen levels at the bottom of the pond, as well as the possibility of long-term additions of nutrients due to the decomposing plant matter, we investigated data collected by URI's volunteer monitoring program, Watershed Watch.

After examining water quality data for the four treated ponds in the Wood-Pawcatuck watershed, we were not able to come to any firm conclusion about the effects of aquatic herbicides on water quality. We encountered many difficulties.

First, we did not have dissolved oxygen data for many of the ponds because they were too shallow for the measurement to be accurate. In addition, the data only had measurements once every two months or so, and there were often gaps in the data, which made it difficult to see what had happened to each parameter over time. It is possible that we did not obtain all of the available data, and we will continue to look for the full set of measurements.

Also, it is difficult to separate the effects of plants dying naturally in autumn and winter from the effects of decomposition of plants killed by herbicides. Comparing the dates of herbicide application with the dates of changes in dissolved oxygen and nutrient levels would tell us whether the changes were due to seasonal plant death or herbicides, but the low resolution on the time series made it difficult to tell when changes in parameters occurred. We attempted to address this problem by comparing treatment and non-treatment years for each of the four ponds.

Furthermore, according to anecdotal evidence, even when permits are granted for herbicide applications, sometimes the chemicals are not applied. As far as we know, no confirmation of actual application exists. Therefore, any observations about "treated" ponds have the potential to actually be about ponds that were not treated in that year.

Despite these limitations, we were able to make the following observations:

Dissolved oxygen:

A Watershed Watch volunteer reported that the dissolved oxygen level in Locustville Pond dropped to zero ppm after treatment with AquaKleen in summer 2001. This observation initiated our investigation of the effects of herbicides on water quality. By itself, the observation does not tell us whether the drop in DO was caused by herbicides, but it suggests the possibility.

Dissolved oxygen dropped sharply in Larkin Pond to around 2 mg/l in early July 1999. The dissolved oxygen level did not drop as low in 1993, and did not drop until September in 1994, suggesting that summer treatment with herbicides may have caused the drop in dissolved oxygen in 1999. We do not know the exact date of treatment in 1999, or whether the pond was treated in 1993 or 1994, and we would need additional years of data to prove a strong correlation between herbicides and the drop in dissolved oxygen. Therefore, this is only an observation, and would need to be integrated with further monitoring of dissolved oxygen before and after treatment to reach any sort of conclusion.

Nutrients:

The only pond in the Wood-Pawcatuck watershed that shows any difference in nutrient levels between treatment and non-treatment years is Meadowbrook Pond. In 1997 and 1998, the two years before treatment began, Meadowbrook Pond showed significantly higher levels of nitrate than in the treatment years or the years before 1997. The level of phosphorus in the pond appears to be slightly higher in treatment years. Higher levels of phosphorus are consistent with our hypothesis that the plants killed by the herbicide release nutrients as they decompose. However, the changes in the level of nitrate appear to contradict this hypothesis.

It is possible that the high nitrate levels in 1997 and 1998 came from an external source, such as a leaking septic system or fertilizer runoff. An external input of nitrate in 1997 and 1998 could have led to eutrophication, which might have led the pond owners to treat the pond for excessive plant growth in the following years. It might seem counterintuitive that nitrate levels would decrease in treatment years if there was plant matter decomposing, but it is possible that denitrifying bacteria played a role. If the bottom of the pond became anoxic, as we would expect it to if there was a large amount of plant matter decomposing, bacteria that are able to utilize nitrate instead of oxygen in their metabolism would gain a competitive advantage and be likely to become more prevalent. A larger proportion of denitrifying bacteria would decrease the amount of nitrate in the water relative to the amount of phosphate, which could explain the changes in nutrient levels that we observed. In order to determine whether an increase in total phosphorus and a decreased ratio of nitrate to phosphate in the water is a consistent consequence of herbicide use, other ponds should be examined, and dissolved oxygen measurements should be incorporated into the analysis.

None of the treated ponds in the Wood-Pawcatuck watershed showed increasing nutrient levels over five years. Therefore, we found no evidence of increased long-term eutrophication as a result of herbicide use. However, this hypothesis should not be discarded. Five years is not a long enough time horizon to draw a firm conclusion about the long-term effects of herbicides on nutrient levels.

Graphs of the Watershed Watch data from which we made these observations are included in the appendix.

Alternatives to Herbicides

There are many non-chemical aquatic plant management methods currently being used around the country, and there are more under research and development. Social concern over the use of chemicals and uncertainty about long term human and eco-system effects urge us to consider the alternatives. These can be broadly grouped into biological and physical management techniques.

Biological or biomanipulation examples include herbivorous fish and insects, fungal pathogens, and native plant community restoration. Physical or mechanical techniques include hand cutting or pulling, harvesting (cutting and removing), grinding or juicing, suction harvesting, and rotavating. Dredging, water level drawdowns, physical benthic level barriers (such as dark plastic or organic sediment layers), light attenuation and shading, and nutrient inactivation (often using alum), are other physical control methods.

An extremely important consideration often overlooked while discussing treatment is identifying and eliminating factors contributing to the growth of these plants in the first place. Increased nutrient inputs (especially phosphorus) often lead to overgrowth. Efforts to rid ponds of this overgrowth without lessening nutrient inputs can be futile.

It is not feasible to elaborate on all of these alternative techniques in this paper. Often these methods are species specific and all have long lists of advantages and disadvantages. A few examples:

Mechanical harvesting of certain species can be extremely effective in long term management, while harvesting other species in this way can spread the growth of the undesirable plants through reproduction due to fragmentation. Grass carp has been used effectively to manage hydrilla and other preferred species in isolated water bodies, but in larger water bodies the fish may prove impossible to control or contain. In the appendix of this paper we include resources examining each management method in further depth.

The watershed councils, perhaps in partnership with the local pond associations, can play an important role in understanding the local pond ecosystems and drafting pond-specific management plans. As listed above, there is a large range of management tools, but as Tom Davenport and Susan Kaynor point out, "effective lake restoration strategies must directly address the dominant plant community in the lake."[6]

In the Wood-Pawcatuck watershed, permits for herbicides have been granted to control curly leaf pondweed (*Potamogeton crispus*), phragmites, and watermilfoil (*myriophyllum*). There is a growing body of research addressing control of water milfoil, a species that has spread quickly throughout the US. The development of new methods such as fungal pathogens (*Mycoleptodiscus terrestris*) and weevils (*Euhrychiopsis lecontei*) to treat milfoil holds promise, and WPWA and DEM should follow this research closely.

In the Wyoming Pond and Wood River permits, it is not specified which species are being targeted. This highlights a shortcoming with the current permitting process. Without identifying specific target species (or enforcing the completion of this question on the current application), the success of both chemical treatments and alternative ones are brought into question.

No technique, including the use of chemical herbicides, provides a magic solution for managing nuisance plants. After a fourteen-page document outlining different biological, chemical, and physical methods, John D. Madsen, Ph.D. research biologist for the US Army Engineer Research and Development Center's Environmental Laboratory, concludes that

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[6] Davenport, Tom and Susan Kaynor. "In-Lake Treatment to Restore Urban Lakes." Urban Lake Management.

> "several ... techniques can be made to work for most aquatic plant problems, given enough time and money. None of these techniques are evil or inherently unacceptable; likewise, none of these techniques are without flaws or potential environmental impacts. Rather, it is up to each management group to select the most appropriate techniques for their situation given a set of social, political, economic, and environmental conditions." ("Advantages and Disadvantages")[7]

We see great potential for WPWA to play an informed role in urging Rhode Island to move towards incorporating alternative aquatic plant control methods into this type of pond specific aquatic plant management strategy. Hopefully by employing some of these alternative control methods, at a watershed and state level, we can move away from reliance on annual herbicide treatments, and work toward long-term management solutions for our ponds.

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7 Madsen, John D. "Advantages and Disadvantages of Aquatic Plant Management Techniques" obtained online http://www.aquatics.org/pubs/madsen.htm. April 8, 2002.

Approaches to Aquatic Weed Management in Other States

One of the possibilities we encountered as an alternative to the current system of permitting in Rhode Island is the Integrated Management Approach. This model is currently being used in Washington State as well as being considered in Wisconsin. The guidelines for developing one of these plans are outlined in a Citizen's Manual issued by the Washington State Department of Ecology. Ultimately, the goal of the integrated aquatic vegetation management plan is to find a solution to nuisance aquatic weeds that is "effective, ecologically sensitive, and economically feasible."[8] The Washington model separates the plan into two separate phases, the first being problem/site description and the second being control strategy development. The first phase begins with a definition of why the aquatic plants are creating a nuisance and what management of these plants hopes to accomplish (essentially, the reason why they are being eradicated). Next, the plan requires a consideration of the ecology of the water body. This would include taking into account certain features that the particular water body at hand might have, different beneficial uses that the water body currently supports, and also creating a map that delineates exactly where the aquatic plants in question are located in the pond. The control strategy development phase starts with an investigation of alternatives. Because the specifics of the site have already been mapped out in the first phase, it is easier to determine which alternatives would be most appropriate to the water body and to what intensity that strategy must be employed. The methods of control most appropriate to a water body may very well include the use of aquatic herbicides. However, because the integrated plan stresses a "long-view" outlook (preventing the problem by eliminating or treating the causes of nuisance plant growth), there will almost invariably be a combination of strategies to treat plant growth in the action

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[8] A Citizen's Manual for Developing Integrated Aquatic Vegetation Management Plans, 1st Ed., Washington State Dept. of Ecology, January 1994, p. vii.

plan. The action plan that is produced at the end of this process will include these components as well as indicators to monitor the progress of the treatment and measures to inform and educate the public as to how they can contribute to the future development of the plan.[9]

This model appeals to us because it addresses the issues of long-term planning and also site specificity. The requirements for monitoring and community outreach measures before the plan is approved are also useful in assessing the progress and success of the action plan.

Most importantly for the WPWA, the holistic nature of the integrated plan is consistent with the watershed approach-- to preserve water quality by looking at the ecosystem of the area as a whole, through strategies employed by local expertise and through focusing solutions that recognize the unique characteristics of the area.

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[9] A Citizen's Manual for Developing Integrated Aquatic Vegetation Management Plans, 1st Ed., Washington State Dept. of Ecology, January 1994.

Recommendations

Based on our research and on our interviews with various people involved with the permitting process, we have several recommendations. Overall, our general recommendation is that Rhode Island should move to a more integrated management approach, as is used in other states (see appendices). Below are outlined some more specific recommendations.

Recommendations: The Role of the Watershed Councils:

There are two main ways in which the watershed councils can play a role in aquatic weed management. One way they can participate is by coordinating and conducting scientific research. Watershed councils can work in partnership with Watershed Watch and/or the Department of Environmental Management to measure the effects of herbicides on water quality. The most important water quality parameters are likely to be dissolved oxygen, in order to assess the likelihood of anoxia caused by decomposing plants; and nutrients, particularly nitrogen and phosphorus, in order to determine whether decomposition of plants is contributing to long-term eutrophication (which could aggravate the problem of excessive plant growth). Based on the data we currently have, there is a particular need for dissolved oxygen data, higher time series resolution for all parameters, and monitoring of water quality before and after herbicide applications. Transient water quality monitoring of ponds during the period before, during, and after treatment would be a particularly effective way to address this need. WPWA, in collaboration with Watershed Watch and DEM, is planning to begin this research this summer. Other watershed associations that are concerned about aquatic herbicides could also conduct similar research in their watersheds.

The watershed councils can also assist with general and site-specific research on the causes of excessive plant growth. By measuring water quality parameters and examining the area around the body of water, watershed councils can help determine whether the plant growth resulted from eutrophication (perhaps a result of a failing septic system nearby), standard inter-annual variation, or some other cause. Assessing the causes of plant growth would allow preventative and long-term strategies for weed management.

The second way the watershed councils can participate in addressing the issue of aquatic herbicides is by taking an advisory role with pond associations and the Department of Environmental Management. Watershed councils can form cooperative partnerships with pond associations in order to help them assess the specific situation in their pond, determine the causes of plant growth, and choose an appropriate management strategy. They can also advise and assist pond associations with public education about the effects and appropriateness of various weed management strategies.

Watershed councils can assist the Department of Environmental Management with a review and revision of the aquatic herbicide permitting process. Because watershed councils have knowledge of the way the permitting process plays out on a local scale, they have information that is potentially useful to DEM in revising the process. Additionally, although watershed councils are not enforcement agencies, they can play a "watchdog" role in herbicide applications, keeping their eyes open for any violations of DEM rules.

Recommendations: Permitting

The permit application should be more substantial. There needs to be a long-term approach to pond management rather than a yearly eradication of plants. For this to happen, a management plan for each pond needs to be developed in order for the permit to be approved. In addition, there needs to be some consideration of alternatives to herbicides and also the reason why the applicant desires treatment. The inclusion of these last two elements (included in the permitting process of other states) will help to stop what appears to be the simple rubber-stamp approval of herbicide permits currently occurring.

In order for the permitting process to be meaningful, there also needs to be monitoring of approved herbicide applications. Monitoring would ensure that the conditions written to the applicant by Lopes-Duguay at the Division of Agriculture are followed. Since some of these conditions impose water use restrictions so as not to pose a health threat from the chemicals, the enforcement of these restrictions is very important.

As previously stated, the only monitoring that currently exists is the occasional check-up on licensed applicators. Individual pond owners are never monitored. This brings to light another problem: Rhode Island does not have a licensing process. We recommend, following the model of other states, that Rhode Island create a licensing process. One potential way to create a streamlined monitoring system would be to license applicators, and then allow only these applicators to apply for permits to treat ponds. As these licensed commercial applicators are reported to charge fairly high fees, this may create a situation where the ponds with large or very active pond associations are more able to use herbicides while private or smaller ponds are more likely to seek cheaper alternatives, but it does seem that at least some sort of licensing process and preference for licensed applicators is warranted.

Recommendations: Authority

Authority over all types of pond management needs to be centralized. The three different divisions currently overseeing the different processes for plant management all have different missions. F&W and DoA are divisions within the Bureau of Natural Resources, while the Wetlands department of the Office of Water Resources (which is charged with ensuring water quality in the state) falls within the Bureau of Environmental Protection. These conflicting missions help explain why the divisions have such different permitting processes, and also show the discrepancies occurring between these processes.

One agency, whether in the Office of Water Resources or an entirely new group charged with surface water management, should handle the entire process. This solution would be more efficient—not sending the applications from agency to agency would save time and money. In addition, with one authority approving applications, that office is more likely to have specific information about that pond and its treatment history, making it more likely to have the ability to create a long-term plan and also to choose the most effective treatment based on the plants present and the characteristics of the pond.

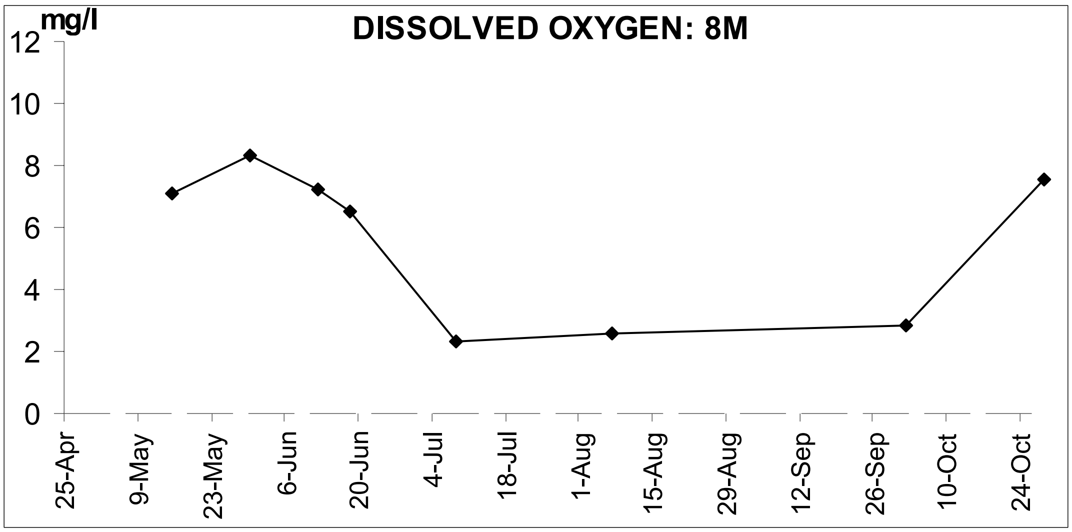
Moving all permitting to one office would also remove the discrepancies between the herbicide permitting process and the process for other methods of weed control. As previously mentioned, the Wetlands permitting process for non-herbicide weed control is more time-consuming and more difficult, whereas the herbicide permitting process is fairly simple and almost guaranteed to be approved. This sets up an incentive to control aquatic vegetation by chemical means, favoring one method without examining the others to see if any are more appropriate. This incentive for herbicides needs to be removed to ensure that all types of pond management methods can be considered equally.

In addition, there are no current regulations governing the permitting process. The General Laws of Rhode Island provide for a permitting process and mandate that F&W has jurisdiction over it, but there are no regulations as to what that process needs to include. Regulations of this type were proposed in 1993 but were never promulgated. Creating regulations would necessitate a careful review of the process and would put the weight of an investigation behind it; this is necessary to create a more efficient and legitimate process.

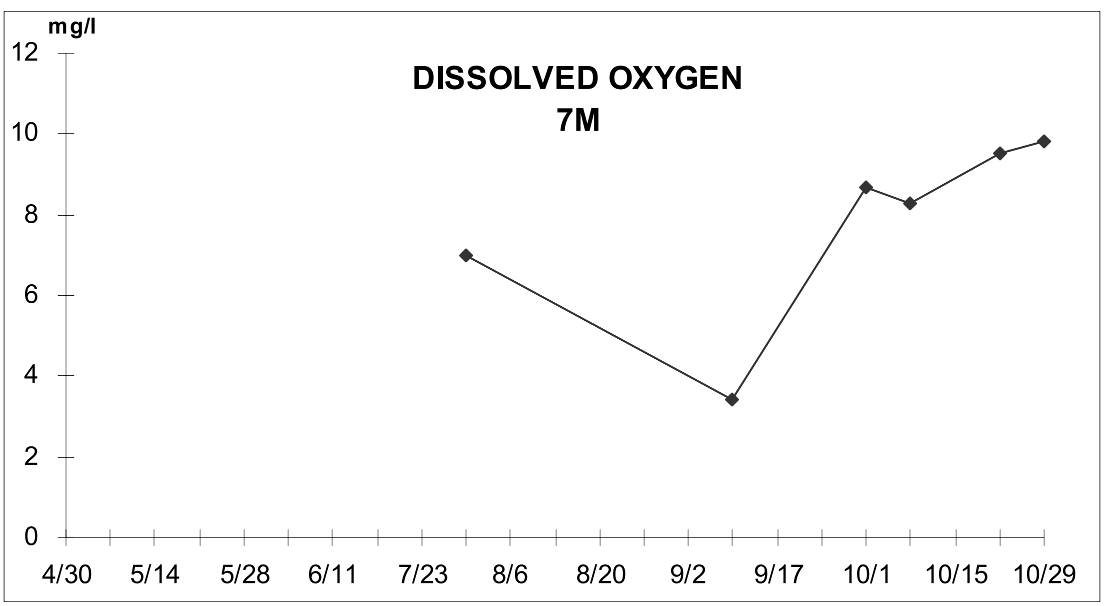
Appendix A

Dissolved Oxygen

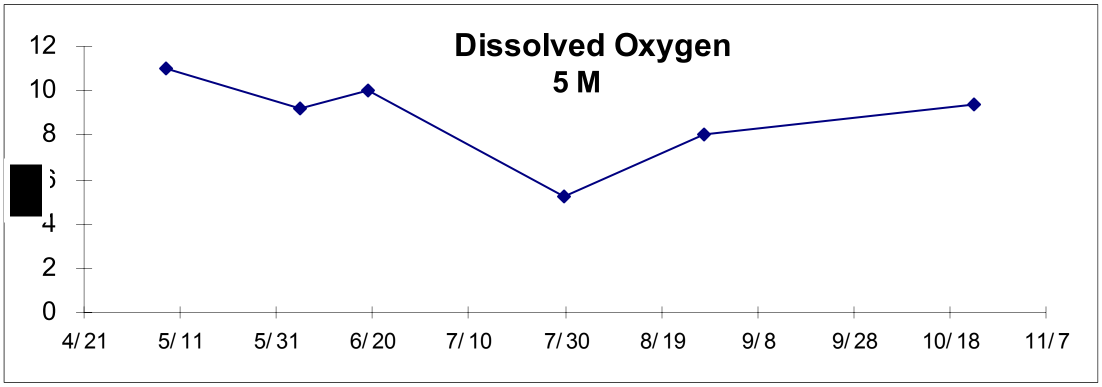
Dissolved Oxygen: Larkin Pond 1999



Dissolved Oxygen: Larkin Pond 1994



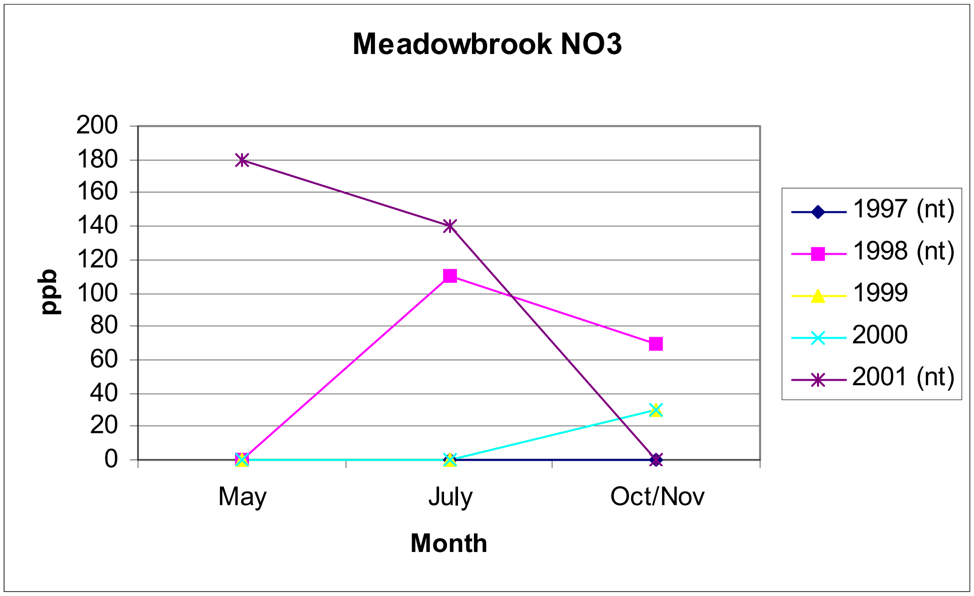
Dissolved Oxygen: Larkin Pond 1993



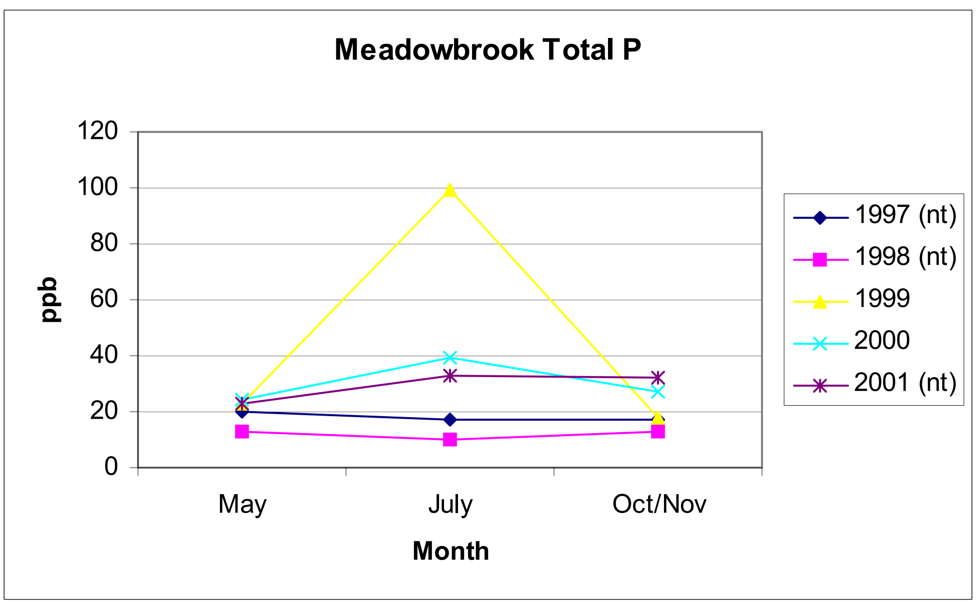
Graphs courtesy of Watershed Watch, URI.

Nutrients

Nitrate: Meadowbrook Pond



Total Phosphorus: Meadowbrook Pond



Based on data from Watershed Watch, URI.

Appendix B:

A Summary of Eurasian Watermilfoil Control Technologies

published by the Vermont Department of Environmental Conservation

(see hardcopy)