

## CHALLENGES AND SUCCESSES MANAGING EURASIAN WATERMILFOIL IN LAKE LUZERNE: A 25-YEAR CITIZEN-GOVERNMENT PARTNERSHIP

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### ABSTRACT

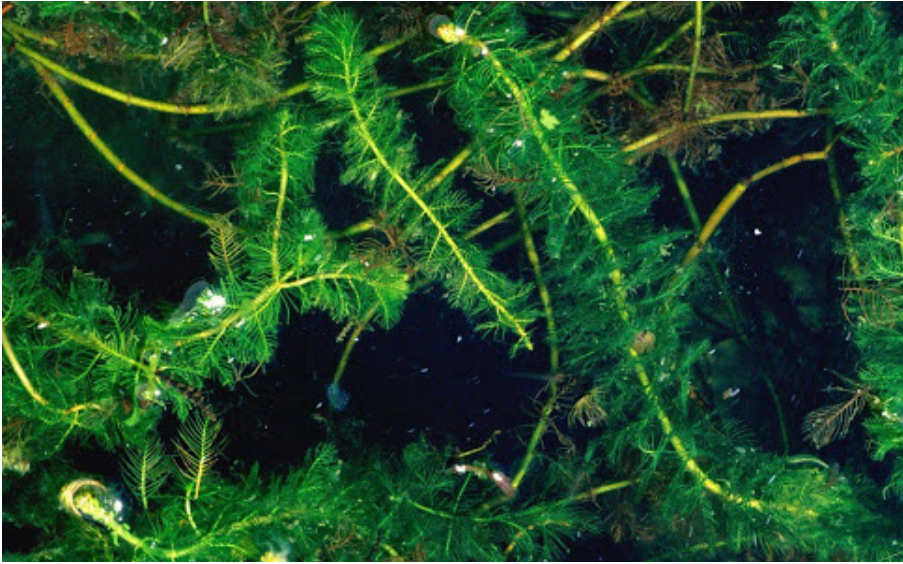
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A 25-year, grassroots initiative to manage the spread of Eurasian watermilfoil, an invasive aquatic plant, in a Southern Adirondack lake is described. A dedicated group of long-term volunteers, together with local government and lake association support, employed a variety of management methods to control the Eurasian watermilfoil, keeping the lake attractive for recreational use. The management methods, volunteer effort, funding, and outcome for each epoch are included, along with keys to success, lessons learned, and future challenges.

### INTRODUCTION

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Eurasian watermilfoil (*Myriophyllum spicatum*), hereafter referred to as “milfoil”, is a rooted aquatic perennial (Figure 1) that grows up to three meters in length with feather-like leaves around the stem. Milfoil was first observed in the United States in 1880 in Dryden Lake, NY. Since then, milfoil has spread to all other states with the exceptions of Hawaii and Wyoming, as well as the Canadian provinces of British Columbia, Ontario, and Quebec (“Eurasian watermilfoil (*Myriophyllum spicatum*)—Species Profile”, Eiswerth et al., 2000).



**Figure 1.** Eurasian watermilfoil (Source: New York Invasive Species Information Clearinghouse).

Milfoil spreads in a lake primarily by stolons (horizontal roots) and fragments that drift, settle, and re-root (Martin et al., 2020). It reduces the water quality of the bodies of water it invades by increasing nutrient loading, reducing oxygen content, and altering water temperatures. Furthermore, milfoil can lead to significantly decreased numbers and coverage of native plant species. Milfoil forms a canopy over the water, blocking sunlight from reaching plants underneath it, as well as sheltering undesirable insects such as mosquitos (Eiswerth et al., 2000). Within two years, milfoil can overtake the littoral areas of a lake rendering it unusable for swimming, boating, and fishing.

Aquatic invasive species, such as milfoil, can negatively impact the economic prosperity of the surrounding regions. The Adirondack Park generates annual revenue of over 1.2 billion dollars and employs over 25,000 people both directly and indirectly through recreation and hospitality industries (Kelting and Laxson, 2010). Greater than 80% of Adirondack tourists cite aquatic activities as the motivation to stay on or near the water and the presence of milfoil has a negative effect on lakefront residence prices (Zhang and Boyle, 2010, Horsch and Lewis, 2009). Milfoil that grows to within a few inches of the water's surface inhibits boat navigation, fishing, water skiing, swimming, and other forms of aquatic recreation (Evans et al., 2013).

Starting in the early 1960s, herbicides were field tested to control milfoil growth. However, this has been met with controversy as it adversely affected drinking water, as well as food animals such as finfish and shellfish (Rawls, 1975, Marko and White, 2018). Researchers have also investigated the use of benthic mats which are installed at the bottom of a body of water in order to decrease the amount of sunlight that reaches the bottom. Although these mats have been shown to be successful in preventing the spread of milfoil (Kelting and Laxson, 2010), they can also permit milfoil growth in sediment which settles on top of the mats. In addition, when the mats are removed,

milfoil can aggressively reestablish. Lastly, another mitigation approach used by volunteers and environmentalists is to hand or suction harvest the milfoil and other invasive aquatic plants (Eichler et al., 1993). A combination of control methods are often utilized to reduce the spread of milfoil.

As we will see below, many approaches have been attempted to reduce the spread of milfoil starting in the 1960s. Some of these attempts were effective but had unacceptable side effects, some were ineffective, and none succeeded in removing milfoil completely. But we have, in Lake Luzerne, managed to reach an acceptable equilibrium with the milfoil. This happy state of affairs is the end result of an ongoing collaborative effort by volunteers and government.

## A Brief Introduction to Our Lake

One lake that has been affected by milfoil is Lake Luzerne, located in the Town of Lake Luzerne, Warren County, NY within the Adirondack Park. The town has a population of approximately 3,500, with an average age of 48, median income of \$49,500, and a poverty rate of approximately 10% (US Census Bureau). There is also a local association open to anyone interested in the lake, the Lake Luzerne Association (LLA), which holds community events and communicates about topics of interest to its members. Tourism is an important driver for the local economy with summer visitors choosing Lake Luzerne for aquatic recreation. There are two small public beaches and a municipal cartop boat launch; the 7.5 hp limit for boat motors along with the above average water clarity makes this an attractive destination for kayaking, canoeing, fishing, and swimming (“2012 LCI Report Lake Luzerne”). The lake has nearly three miles of waterfront property surrounding it, and covers nearly 400,000 square meters: about 111 acres (US Census Bureau). Milfoil is present throughout the littoral and shallow portions of the lake in depths up to approximately 13 feet (See Figure 2). The entire South Cove has been fully infested with milfoil due to its relatively shallow depth.



**Figure 2.** Location of Vinyl Curtain as Indicated by Thick Black Line (Source: New York State Department of Environmental Conservation)

The lake is considered to be at “high vulnerability” for threats from invasive species (“2012 LCI Report Lake Luzerne”). Rapid milfoil growth has the potential to inhibit recreation and public watersport use as its dense growth blocks not only aquatic organisms that swim through it, but also human swimmers, boats, and other aquatic activities (“Eurasian Water Milfoil”, 2009). Here we describe the community efforts to manage the spread of milfoil with the hope that our experiences and lessons learned benefit other lakes in addressing the challenges presented by invasive species.

## **Individual and First Organized Efforts in Milfoil Control (1990-2005)**

Beginning the 1990s, lake users and town residents became aware of the growth of an unidentified aquatic plant. Although initially appearing harmless, it spread rapidly and began to affect aquatic life and recreation. Some waterfront property owners removed milfoil directly in front of their shoreline by hand harvesting within the Adirondack Park Agency (APA) guidelines, allowing shoreline owners to control plants within a limited area. However, large areas of the lake still had uncontrolled milfoil growth.

As it became clear that the sporadic and uncoordinated efforts of individual owners of lakefront property would not slow the spread of the then-unidentified aquatic plant, some residents decided to better understand the nature of this invasive and how to address it. With initial funding from individuals and the lake association and the support of local government, a group of volunteers began a more organized effort to address the problem. A core group of four volunteers, of varied backgrounds but with a strong passion for lake conservation, met regularly with a goal of learning as much as possible about how milfoil propagates and how to effectively manage its spread. They attended conferences dealing with environmental issues affecting the Adirondacks, commissioned lake studies, visited other regional lakes infested with milfoil to observe their remediation techniques, made numerous visits to the Darrin Fresh Water Institute in Bolton Landing, NY, and evaluated the available management methods. It was through interactions with other concerned citizens and scientists at a lake association conference that the invasive weed was identified as Eurasian watermilfoil. Realizing that once milfoil has established itself in a lake, eradication was not a realistic option and a long-term management strategy was needed. The group established a long-term goal of hiring a permanent lake manager and as an interim step, engaged a lake consultant supported by local government funding.

The first organized efforts in milfoil management focused on outreach, education, and community involvement. The group made regular presentations to the town board on their progress and secured initial funding from the town. Government officials were often taken out in boats to observe the milfoil firsthand, which had much greater impact than a textbook photo on a presentation slide. The local press was also engaged, and feature newspaper articles were published at key project milestones.

Additional volunteers would also need to be recruited to assist with a variety of projects. The core group recognized the importance of building a spirit of camaraderie. Hence, they dubbed the volunteers the “Milfoil Pirates” to engender esprit de corps and attract newcomers. Boats participating in the lake project flew Jolly Roger flags and participants were given decals, as shown in Figure 3, to advertise their participation and build community awareness.



**Figure 3.** *Milfoil Pirate Decal*

The work done by the dedicated volunteers during this period formed a solid foundation of technical knowledge and community awareness that positioned the project to undertake the next phase of milfoil management.

### **Management by Benthic Mats and Herbicide Treatment (2006-2010)**

By 2006, the milfoil was more widespread and a coordinated lakewide initiative was needed. The preliminary research had revealed two important facts. First, the options available were limited: herbicides were nearly impossible to get approved and hand harvesting was beyond the available budget. Work continued on the effort to get approval for the application of herbicides while the group simultaneously organized to deploy the only practical method available, benthic mats. The Milfoil Pirates opted to proceed with benthic mats in the belief that the demonstrated commitment of time and energy would increase the chance of getting approval from state and park agencies to use more effective control methods.

The necessary town approval and APA permit were obtained, followed by enlisting volunteers to fabricate the mats. A local paper manufacturer donated obsolete paper-making mats. Rebar was hand sewn into the edges of the 10 square foot mats, which proved to be time consuming and labor intensive. Forty mats were constructed allowing 4,000 square feet to be covered, representing approximately 0.1% of the lake bottom. In June, the mats were strategically placed at recreational use locations and areas exhibiting dense milfoil growth. The mats were loaded onto a unique vessel belonging to one of the property owners, a floating 12'x 30' wooden raft powered by an electric outboard motor (See Figure 4).



**Figure 4.** Installation of Herbicide Barrier Curtain

Volunteers lowered the mats into the water where they were placed on the lake bottom and secured with two cinder blocks per mat by two divers. The APA required that any milfoil fragments released to the surface be collected; this was done with nets by a team of volunteers in small boats. After 60 days, the mats were moved to new locations, allowing 8,000 square feet to be matted annually. These mats were used for two summers. Availability of volunteers was an important consideration in determining when the mats were removed for winter storage. Subsequently, the Town of Lake Luzerne purchased 50 additional 10' x 40' mats that were lighter in weight, could be folded for easy transport, and did not require the use of cinder blocks. Despite the increased coverage and improvement in the moving and placement process, this labor intensive way of managing the milfoil growth was not sustainable. As the mats proved to be ineffective, dirty, and hard work, volunteer interest flagged. As one long-time volunteer said, "The grass was growing faster than we could mow it."

Although no active control management was conducted in 2008-2009, other control options (Madsen, 2005) were investigated through literature review, consultation with local experts, and benchmarking other regional lakes. Natural predators such as grass carp (*Ctenopharyngodon idella*) and an aquatic weevil (*Euhrychiopsis lecontei*) had previously been demonstrated as successful at controlling milfoil (Van Dyke et al., 1984, Sheldon and O'Bryan, 1996). The introduction of weevils in a nearby Vermont lake, together with mechanical harvesting, reduced milfoil and allowed native species to return. Biological and mechanical controls were rejected for Lake Luzerne due to cost and other practical considerations.

Herbicides were another viable alternative (Wersal et al., 2010) and the regional APA representative encouraged us to pursue this option for a portion of the lake that was badly infested. Herbicides to control milfoil had not previously been used within the Adirondack Park. At this point, the Milfoil Pirates joined with the Town of Lake Luzerne to form the Aquatic Conservation Task Force. Volunteers spent nearly a year researching and preparing the information needed to obtain the APA permit. This included a detailed history of prior milfoil control activities, a bathymetric lake map, two benthic surveys identifying underwater plant life with special attention to endangered species, a method to sequester the treatment zone, and a post-treatment water testing plan. In addition, approval was needed (by non-objection) from all lakefront property owners. Approval from the town supervisor was granted despite some concerns raised by community members, particularly those who fish. After several iterations with the APA, the permit was granted for the first use of an herbicide (triclopyr) in the Adirondack Park to control milfoil. The permit specified restrictions on swimming, fishing, and use of lake water on plants for a period of time after application.

Lake Luzerne has an outflow to the Hudson River at the northwest end which requires that the treatment area at the south end be isolated. This was accomplished using a 500 foot vinyl curtain that was extended across the narrowest part of the south end of the lake, as shown in Figure 2. The curtain was donated by a local business with volunteers performing the installation. Figure 4 shows the curtain, which was supported at the surface by floats and secured to the lake bottom by cinder blocks. Volunteers marveled as they watched fish swim up to the curtain and find no way to proceed forward.

Sixteen hundred pounds of triclopyr, which selectively targets milfoil, were applied to the lake surface in under 30 minutes by a private company using an airboat, with the press, volunteers, town officials, the APA, and other onlookers observing. The application date was chosen to minimize the impact on recreational use of the lake and before milfoil began growing. The curtain remained in place for six weeks. Water quality sampling was conducted weekly on both sides of the curtain by volunteers; the results were within the prescribed limits. The only adverse effects reported were that a larger number of small dead snails were seen along the shoreline than in previous years. By the fall of 2010, much of the milfoil in the south end of the lake was gone with no noticeable impact on native plants and the herbicide treatment was deemed successful.

During this period, volunteers were very active in raising funds and awareness for the project. A community auction raised approximately \$2,000 with donations from over 50 area businesses. The herbicide treatment was funded through both volunteer fundraising and town and lake association support. Volunteers made contact with local media outlets and a number of articles were published detailing the various aspects of the project. A booth at the annual summer festival raised awareness of the harm caused by invasive aquatic species and the technologies employed to control milfoil in Lake Luzerne. Government officials and citizens were regularly updated on the milfoil control at monthly town board meetings.

## Return to Hand Harvesting (2011-2020)

With the milfoil greatly reduced in the south end of the lake, attention turned to the remainder of the lake where milfoil was removed through hand harvesting. A private company was hired and divers performed the hand harvesting with primary funding provided by the town. Initially eight to ten tons of milfoil were removed each year with town employees responsible for safe disposal of the harvested weeds. The cost of hand harvesting increased each year and four years after herbicide treatment, milfoil reestablished in the southern end of the lake. As the town sought to contain costs and increase milfoil removal, another company was engaged to remove milfoil through suction harvesting. At the peak, approximately 18-22 tons of milfoil were removed in a season, but as native vegetation began to return, yields dropped to 10-12 tons annually. This decrease occurred because it took divers longer to remove milfoil from among native plants. Since 2016, Warren County has contributed funding for these milfoil control activities. To further control cost, the town invested in a pontoon boat and now hires only the divers through the private company. This investment indicates recognition of the long-term need to manage milfoil growth and the town's commitment to maintain Lake Luzerne as a recreational and aesthetic asset.

Throughout this period, lake studies and surveys have continued, culminating in a 2019 lake management plan funded through the NYS Department of Environmental Conservation (NYSDEC) Invasive Species Grant Program (Clothier, 2020). The plan was developed by private consultants, the Darrin Fresh Water Institute, and the Warren County Soil and Water Conservation District and will guide the town, lake association, and community volunteers in future invasive aquatic species control efforts. One plan recommendation called for the LLA to participate in the NYSDEC Citizen's Statewide Lake Assessment Program where volunteers regularly collect water samples to establish a record of the lake's water quality. Funding for the necessary equipment was provided by the LLA and sampling began in the summer of 2020.

With the town and professionals conducting the milfoil removal, volunteers have been focused on raising community awareness and conducting water sampling. During this period, the town installed signage at its two town beaches to educate the public and prevent milfoil spread in the region. Boat inspection and removal of invasive species is important in preventing inter-lake spread. Volunteers have also been engaged with organizations such as the New York Federation of Lake Associations to learn best practices in invasive species management from experts and other lake associations. The town has provided funding for volunteers to attend regional lake conferences.

## Lessons Learned

After 25 years, much has been learned about invasive species management, positioning Lake Luzerne to effectively manage milfoil into the future and to prepare for the possibility of a new invasive entering the ecosystem. However, it is recognized that many other factors can affect a lake's environmental outcomes including the lake's ecology, the impact of tourists and transient recreational users, and global factors such as climate change (Fitchett and Henson, 2020). Our experience has shown that success relies on collaboration among property owners, concerned citizens, local and state government, and lake management professionals. The lake management plan helps coordinate the actions of all stakeholders. The level of effort applied by the different stakeholders is dynamic over time with different entities



better suited to different tasks. The herbicide application would not have been possible without the involvement of local government officials as they are best positioned to interact with county and state agencies. Frequent communication is key to successful collaboration to achieve common goals. Volunteers regularly take government officials out on the lake in their boats to observe the extent of the milfoil infestation and the impact of control actions. Similarly, the town supervisor addresses the annual meeting of the Lake Luzerne Association each summer to update property owners on town government involvement in lake conservation.

Maintaining a volunteer workforce is essential to support the various elements of long-term milfoil control, as eradication is not achievable. It is important to consider volunteer motivation, such as sustaining a clean environment for themselves and future generations (McCannon and Han, 2016). Over the years, a core group of four to five individuals has organized the volunteer efforts. These leaders have demonstrated a sustained commitment to lake preservation and they have created an atmosphere of camaraderie that volunteers find engaging. A variety of skills are needed such as physical labor, research and writing, and fundraising; individuals can make a contribution on a one-time or an ongoing basis. In the future, volunteer recruitment will become more challenging in light of an aging local, regional, and national demographic. We are heartened by the recent participation of some new, younger volunteers in the water sampling program.

Since the community became aware of milfoil in Lake Luzerne, volunteers and local government officials have sought to learn about invasive species and lake management by attending regional conferences, consulting professionals and state agencies, and visiting other affected lakes to observe their management practices. Maintaining awareness of the latest scientific advances and government regulations is essential to efficient and cost effective lake management. NYS DEC's eight Partnerships for Regional Invasive Species Management coordinate detection and control activities, provide training for volunteers, and supply outreach resources. The New York Federation of Lake Associations is a non-profit that offers a number of resources, including *Diet for a Small Lake*, a comprehensive guide to lake management that can be downloaded from their website ("*Diet for a Small Lake*, 2nd edition", 2009).

## Future Challenges

Research has shown the easiest way to mitigate the spread of invasive species is to prevent them from entering native ecosystems. Removal of a troublesome invasive species is likely to require the expenditure of considerable resources once it is widespread, even for a small lake. Prevention is the preferred approach. It is recommended that annual lake monitoring be conducted to assess the status of existing invasive species (Keltling and Laxson, 2010). Water testing can detect excess nutrients, which can lead to accelerated invasive species growth. An informed citizenry can assist in early detection of changes in the lake ecosystem and prevent practices that unknowingly introduce or spread invasive species. One of the recommendations in the lake management plan is for the lake association to increase community education, particularly related to boat self-inspection and to dispel the myth that all aquatic plants cause damage. Plans to increase community engagement in 2020 by the addition of monthly meetings of lake association members and presentations at local community education venues were thwarted by the gathering restrictions imposed during the COVID-19 pandemic.

Funding for lake management presents an ongoing challenge. Regular communication with local government officials and the community highlights the success and importance of our milfoil management efforts which is essential to sustain government and private financial and in-kind support. Securing adequate funding levels will be more challenging amid the ongoing COVID-19 pandemic with the associated unanticipated expenditures and continuing budgetary pressures from competing priorities for public funds such as infrastructure repairs and healthcare costs. Diversifying our funding stream will protect us from the possibility of future reductions from existing sources. This can be achieved by pursuing new funding sources such as lake association memberships, grants, and fundraising events. The volunteers have committed to continuing the Citizen Statewide Lake Assessment Program for the next five years which positions Lake Luzerne with the data necessary to pursue grant funding opportunities.

There are strong incentives for individuals to contribute to environmental causes, such as helping protect local habitats for future generations, realizing health benefits due to cleaner air and water, and maintaining property value and tourism revenue. Over 25 years we have successfully adapted to changes in the volunteer, scientific, funding, and governmental landscape and with concerted effort have kept Lake Luzerne a desirable recreational destination. Many uncertainties lie ahead and further complications have arisen from the COVID-19 pandemic. In 2020, residents observed that the lake experienced increased recreational use, likely due to the pandemic restrictions and favorable weather conditions. A new appreciation for outdoor recreation and environmental conservation may be an unanticipated benefit of the pandemic. We are confident in our ability to work together as a community to continue the milfoil management, maintaining the lake's aesthetic beauty and recreational value.

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