2010 Progress Report for Moshawquit Lake, Menominee County, Wisconsin

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Introduction

Eurasian watermilfoil (*Myriophyllum spicatum*) is an aquatic invasive species which is native to Europe and Asia and has caused significant ecological and economic problems in the U.S. This plant has the ability to form dense, impenetrable beds that inhibit boating, swimming and fishing. Eurasian watermilfoil begins growing earlier than native plants, which can give it a competitive advantage. The dense surface mats formed by the plant block sunlight and can displace native submergent plants. Eurasian watermilfoil has also been found to reduce water quality in lakes by several means.

In early 2007, Eurasian watermilfoil was discovered in Moshawquit Lake. Moshawquit Lake is located downstream of the Legend Lake system in Menominee County/Menominee Reservation. Because of the concerns with milfoil growth and the possibility of other invasive species, the Moshawquit Lake Association quickly implemented a program to monitor and manage invasive species, namely Eurasian watermilfoil.

Recent Management Activities

On June 25, 2007, Moshawquit Lake was surveyed for Eurasian watermilfoil and other exotic species. Using surface observations and rake tows, Cason & Associates, LLC staff along with Tim Ebben, an Association volunteer, surveyed the littoral zone of the lake. At the time of this survey approximately one acre of Eurasian watermilfoil was found. A majority of the milfoil plants were found growing in deeper water than expected. A fall herbicide treatment was planned in an attempt to control the plant. On September 24, 2007, the lake was again surveyed to determine if the extent and locations of Eurasian watermilfoil had changed. At that time no changes in the distribution of milfoil were noted. On October 16, 2007, the areas identified in the surveys were treated with Navigate® (granular 2,4-D) at a rate of 150 lbs/acre.

On June 5, 2008, a post-treatment survey of Moshawquit Lake was completed. Results of this survey suggested that although the fall treatment was able to decrease the density of plants in the treated areas, survival occurred in each location and retreatment would be required. In addition, the treatment area expanded to 3 acres in 2008 which included four newly identified areas of milfoil. These changes were communicated to the Wisconsin Department of Natural Resources (WDNR) and the Menominee Indian Tribe of Wisconsin (MITW). Approval was given by both agencies to proceed with the treatment as planned. Using the updated acreages, these areas were again treated with 2,4-D on June 17, 2008. In total, 760 lbs of Navigate® were applied.

On May 22, 2009 three acres of Eurasian watermilfoil (*Myriophyllum spicatum*) were again treated in the same manner. At the time of this treatment, zebra mussels (*Dreissena polymorpha*), another aquatic invasive species in Wisconsin, were found clinging to plants in the lake. It is likely the zebra mussels were transported from Legend Lake, immediately upstream of Moshawquit Lake. A post-treatment survey of Moshawquit Lake was conducted on August 11, 2009 to assess the effectiveness of the treatment. This survey was also used to document additional areas of milfoil growth identified by

Association members. This survey utilized a point-intercept map provided by the Wisconsin DNR (**Figure 1**). At each location the presence or absence of exotic species, namely Eurasian watermilfoil, was determined using surface observations and rake tows. This technique has been referred to as a focused point intercept survey. Areas of milfoil identified between sample points were also noted and used to delineate larger beds of milfoil where appropriate. Zebra mussels were again found clinging to many of the plant samples collected during the survey. Zebra mussels appeared to have spread throughout Moshawquit Lake. No other exotic species were identified during this survey.

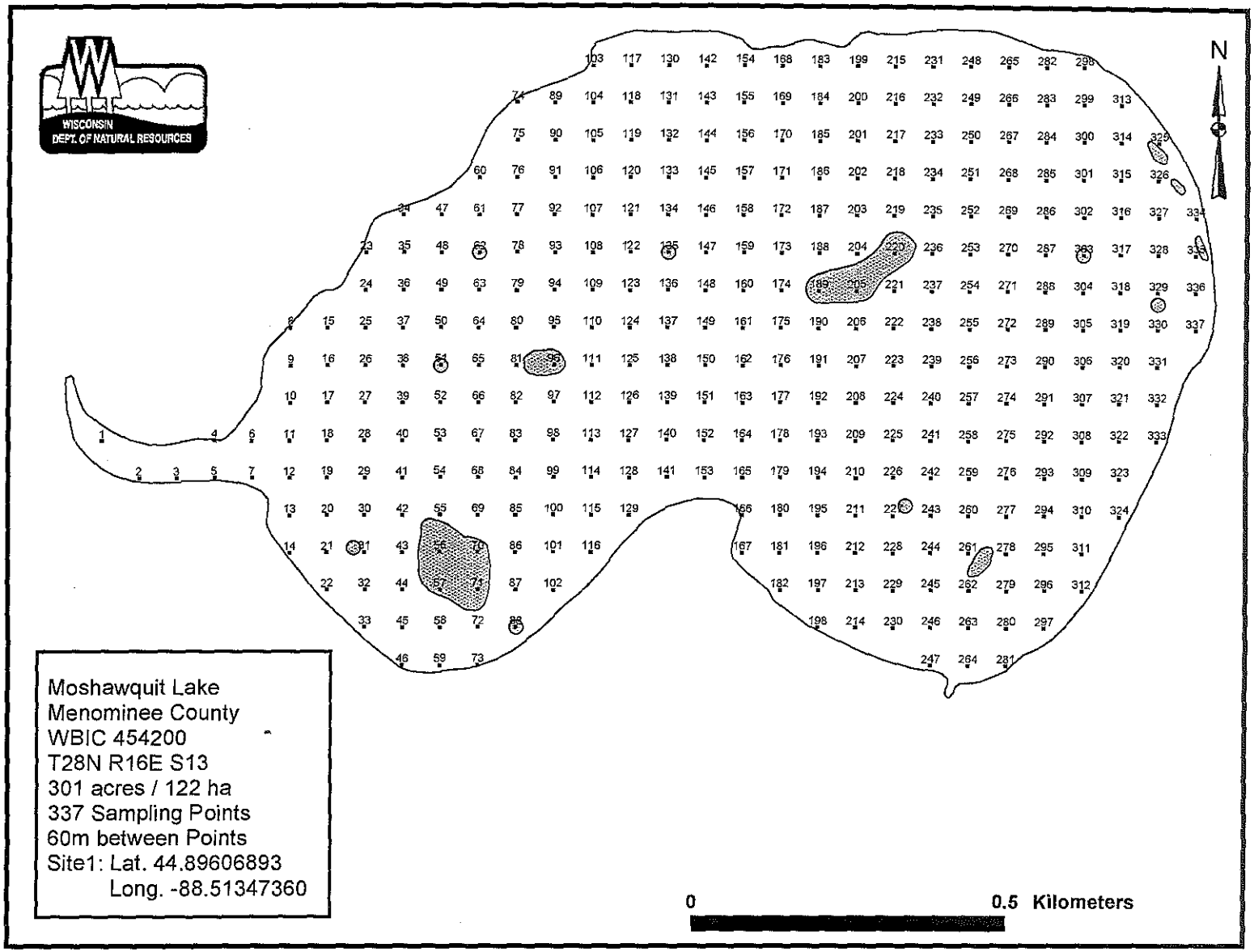
The locations of Eurasian watermilfoil on Moshawquit Lake in August 2009 are shown in **Figure 1**. New milfoil growth was documented in previously undocumented areas. The locations of milfoil were drawn on the point-intercept map to facilitate locating and treating these areas the following spring. The locations of milfoil in **Figure 1** represent a total of 9.0 acres. Although milfoil was more widespread than previously thought, the results of this survey indicated that all areas on the map had sparse distributions of milfoil. Milfoil was not found growing at nuisance levels (i.e. interfering with recreational use of the lake).

On May 17, 2010, the nine acres mapped the previous fall were treated with Navigate® at a rate of 200 lbs/acre. This elevated rate was chosen because previous treatment attempts were unable to stop the spread of milfoil through the lake. At the time of the treatment, an area of curly-leaf pondweed (*Potamogeton crispus*) was identified in the west end of the lake. This area was not treated nor was the remainder of the lake surveyed due to time and budgetary restraints.

In February 2010, the Moshawquit Lake Association applied for and received an Aquatic Invasive Species grant through the WDNR. This grant has covered 75% of the management and survey costs associated with Eurasian watermilfoil on Moshawquit Lake in 2010. This grant will continue to cover costs into 2011.

The remainder of this report focuses on survey results following this treatment and recommendations for further lake management.

Figure 1. Locations of Eurasian watermilfoil (*Myriophyllum spicatum*) found in Moshawquit Lake on August 11, 2009.



Methods

Submergent Aquatic Plant Survey

On August 5, 2010, a submergent aquatic plant survey was conducted. The goal of this survey was to establish baseline data regarding the aquatic plant community in Moshawquit Lake and to assess the results of the spring treatment for Eurasian watermilfoil.

The Wisconsin DNR's Bureau of Research developed a plant survey map for Moshawquit Lake (**Figure 1**). A series of 337 grid points were plotted across the lake. At each of these locations, aquatic plant samples were collected from a boat with a single rake tow. The rake used consisted of two short-toothed garden rake heads welded together and attached to a rope. All plant samples collected were identified to *genus* and *species* whenever possible, and the information was recorded. An abundance rating was also given for each species. In addition to the plant data, depth and bottom substrate composition were recorded for each location. Data collected was used to determine species composition, percent frequency and relative abundance.

Exotic Plant Distribution Mapping

On October 11, 2010 a survey for exotic species, namely Eurasian watermilfoil, was conducted on Moshawquit Lake. This survey again utilized the point intercept approach employed during the August 2009 survey.

Results and Discussion

Aquatic Plant Community

Of the 337 points mapped across Moshawquit Lake, 326 samples were navigable at the time of the August 5th survey with 242 points containing vegetation. Those without vegetation were largely in the deepest areas of the lake or in the shallow near-shore sandy areas. A total of 25 aquatic plant species and filamentous algae were found during the survey (**Table 1**). This is well above the state-wide average of 13 species. Moshawquit Lake lies within the Northern Lakes and Forests region of Wisconsin[1]. The average number of species found in lakes in this region is also 13 species. The most abundant plant species encountered in Moshawquit Lake were bushy pondweed (*Najas flexilis*), wild celery (*Vallisneria americana*) and muskgrass (*Chara* sp.) Each of these species was found at approximately one third of the points sampled.

Table 1. Results of the submergent aquatic plant survey conducted on Moshawquit Lake on August 5, 2010.

		2010	
Species common name	**scientific name**	**Percent Frequency**	**Relative Frequency**
Bushy pondweed	*Najas flexilis*	36.24	15.6
Wild celery	*Vallisneria americana*	35.23	15.2
Muskgrasses	*Chara* sp.	30.20	13.0
Nitella	*Nitella* sp.	20.13	8.7
Small pondweed	*Potamogeton pusillus*	14.09	6.1
Common waterweed	*Elodea canadensis*	13.76	5.9
Flat-stem pondweed	*Potamogeton zosteriformis*	9.40	4.0
Fern pondweed	*Potamogeton robbinsii*	9.06	3.9
Variable pondweed	*Potamogeton gramineus*	8.72	3.8
Common bladderwort	*Utricularia vulgaris*	7.72	3.3
Clasping-leaf pondweed	*Potamogeton richardsonii*	7.05	3.0
Illinois pondweed	*Potamogeton illinoensis*	7.05	3.0
Northern water milfoil	*Myriophyllum sibiricum*	6.71	2.9
moss	--	5.37	2.3
Water marigold	*Megalodonta beckii*	5.37	2.3
Coontail	*Ceratophyllum demersum*	4.03	1.7
Creeping bladderwort	*Utricularia gibba*	3.36	1.4
Frie's pondweed	*Potamogeton friesii*	3.02	1.3
filamentous algae	--	2.68	1.2
Sago pondweed	*Stuckenia pectinata*	2.35	1.0
White-stem pondweed	*Potamogeton praelongus*	2.01	0.9
Large-leaf pondweed	*Potamogeton amplifolius*	1.68	0.7
Spatterdock	*Nuphar variegata*	1.01	0.4
Eurasian water milfoil	*Myriophyllum spicatum*	0.67	0.3
Small bladderwort	*Utricularia minor*	0.34	0.1
Spikerush	*Eleocharis* sp.	0.34	0.1

[1] Nichols. 1999. *Floristic quality assessment of Wisconsin lake plant communities with example applications.* Journal of Lake and Reservoir Management. 15(2):133-141.

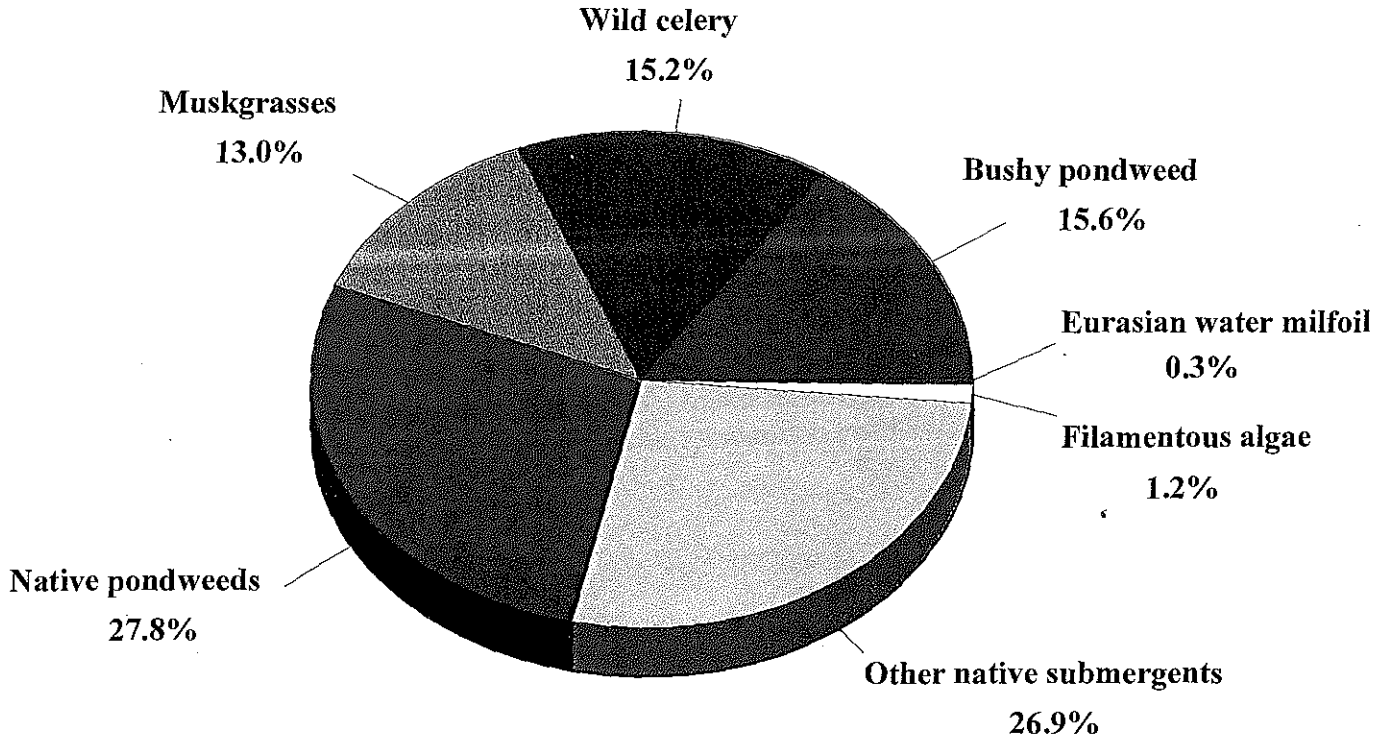
Percent frequency values reflect the relationship between the number of locations where a particular species was found versus the total number of locations sampled. Relative frequency values reflect the abundance of a particular species in relation to all other species found.

A number of floating-leafed and emergent plant species were identified during the plant survey but were not sampled as part of the survey. They include floating-leaf pondweed (*Potamogeton natans*), pickerelweed (*Pontederia cordata*), water smartweed (*Polygonum amphibium*), watershield (*Brasenia schreberi*) and white water lily (*Nymphaea odorata*). These species were not directly sampled by the rake, were found growing between sample points or in areas not navigable by boat.

The raw data for the 2010 submergent aquatic plant survey can be found in **Appendix A.**

Figure 2 presents the relative frequency (abundance) of submergent aquatic plant species found in Moshawquit Lake at the time of the 2010 survey.

Figure 2. Submergent aquatic plant community composition for Moshawquit Lake, on August 5, 2010 in Moshawquit Lake, Menominee County, WI.



Simpson Diversity Index

In order to estimate the diversity of the aquatic plant community, the Simpson Diversity Index takes into account both the number of species identified (richness) and the distribution or relative abundance of each species. With the Simpson Diversity Index (D), 1 represents infinite diversity and 0, no diversity. That is, the bigger the value of D, the higher the diversity. The value of D calculated for Moshawquit Lake based on the 2010 data was 0.91. Although State-wide or region averages for D are not available, data from lakes surveyed in neighboring counties have yielded values of 0.75 or greater.

Assessment of Floristic Quality

The plant data collected for Moshawquit Lake were used to assess the *floristic quality* of the lake. The method used assigns a value to each native plant species called a *Coefficient of Conservatism.* Values are not given for exotic species, moss of filamentous algae. Coefficient values range from 0-10 and reflect a particular species' likelihood of occurring in a relatively undisturbed landscape. Species with low coefficient values, such as sago pondweed, are likely to be found in a variety of habitat types and can tolerate high levels of human disturbance. On the other hand, species with higher coefficient values, such as small bladderwort, are much more likely to be restricted to high quality natural areas. By averaging the coefficient values available for the submergent and emergent species found in Moshawquit Lake, a lake-wide value of 6.5 was calculated (see **Table 2**). The average value for lakes in Wisconsin is 6.0 while the combined average for lakes in the Northern Lakes and Forests region of Wisconsin, which includes Menominee County, is 6.7 [(1)].

By utilizing the Coefficients of Conservatism for the plant species of Moshawquit Lake, further assessment of floristic quality can be made. By multiplying the average coefficient values for Moshawquit Lake by the square root of the number of plant species found, a Floristic Quality Index (FQI) was calculated to be 34.2 (see **Table 2**). In general, higher FQI values reflect higher lake quality. The average for Wisconsin lakes is 22.2. The average for lakes in the Northern Lakes and Forests region is 24.3 [(1)].

Species diversity and floristic quality assessment indicate that the quality of Moshawquit Lake specifically in terms of the plant community, is above average.

Table 2. Moshawquit Lake Floristic Quality Index (FQI) analysis table.

Common Name	Species	C
Watershield	Brasenia schreberi	7
Muskgrasses	Chara	7
Ceratophyllum demersum	Coontail	3
Needle spikerush	Eleocharis acicularis	5
Common waterweed	Elodea canadensis	3
Water marigold	Megalodonta beckii	8
Northern water-milfoil	Myriophyllum sibericum	7
Bushy pondweed	Najas flexilis	6
Nitella	Nitella	7
Spatterdock	Nuphar variegata	6
White water lily	Nymphaea odorata	6
Water smartweed	Polygonum amphibium	5
Pickerelweed	Pontederia cordata	9
Large-leaf pondweed	Potamogeton amplifolius	7
Frie's pondweed	Potamogeton friesii	8
Variable pondweed	Potamogeton gramineus	7
Illinois pondweed	Potamogeton illinoensis	6
Floating-leaf	Potamogeton natans	5
White-stem pondweed	Potamogeton praelongis	8
Small pondweed	Potamogeton pusillus	7
Clasping-leaf pondweed	Potamogeton richardsonii	5
Robbins pondweed	Potamogeton robbinsii	8
Flat-stem pondweed	Potamogeton zosteriformis	6
Sogo pondweed	Stuckenia pectinata	3
Creeping bladderwort	Utricularia gibba	9
Small bladderwort	Utricularia minor	10
Common bladderwort	Utricularia vulgaris	7
Wild celery	Vallisneria americana	6
	N	28
	mean C	6.5
	FQI	34.2

Exotic Plant Distribution Mapping

Eurasian watermilfoil was identified during both the August 5th and October 11th surveys. In both instances, the milfoil was found at low occurrences and growing sparsely. **Figures 3 and 4** show the distribution of milfoil for these two dates. In total there is approximately 1.0 acre of milfoil remaining in the lake.

At the time of these surveys, zebra mussels were again identified growing on aquatic plants. Their abundance appeared to have decreased since the previous year. However, no data was collected to quantify the populations of zebra mussels.

Figure 3. Locations of Eurasian watermilfoil (*Myriophyllum spicatum*) found in Moshawquit Lake on August 5, 2010.

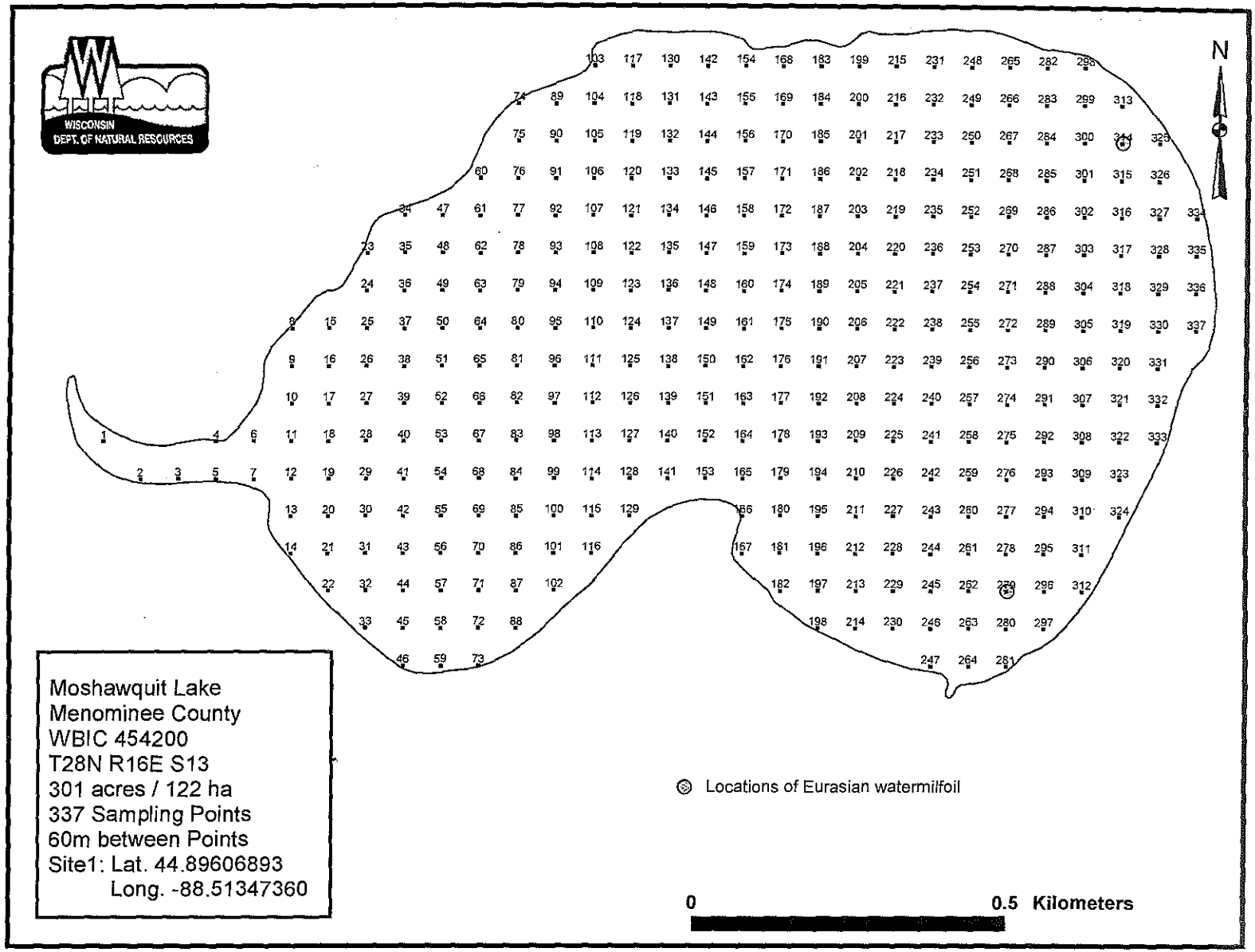
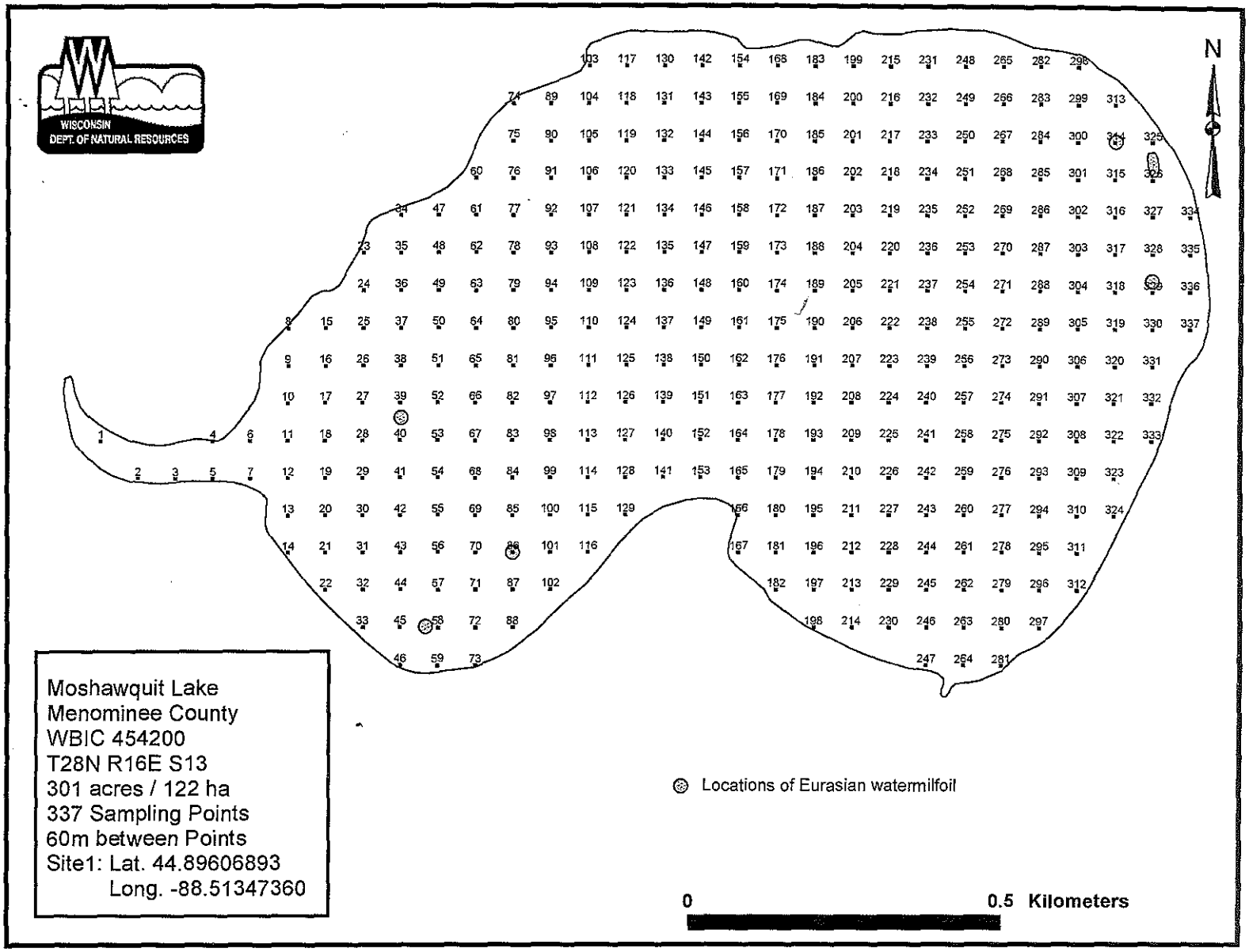


Figure 4. Locations of Eurasian watermilfoil (*Myriophyllum spicatum*) found in Moshawquit Lake on October 11, 2010.



Curly-leaf pondweed was not identified during either survey. This is to be expected given the life cycle of this species. curly-leaf pondweed is a cold water species that can begin growing under the ice giving it a competitive advantage over native plants, As water temperatures increase into the 60's (°F), curly-leaf pondweed plants begin producing vegetative reproductive structures called turions. By mid-summer when water temperatures reach the upper 70's range, the plants begin to dies off and drop their turions. The turions remain dormant in the upper sediment layer until the spring when they sprout new curly-leaf pondweed plants. Turions can remain viable in the sediment for five or more years. This can complicate treatment efforts since this typically warrants repeated treatments to kill not only the standing crop of curly-leaf pondweed but also the growth in subsequent years.

Since the first identification of curly-leaf pondweed in Moshawquit Lake, the Association has applied for and received a second Aquatic Invasive Species grant from the Wisconsin DNR to cover monitoring and management costs associated with this species.

Conclusions and Recommendations

Maintaining control of Eurasian watermilfoil has been a challenging process. Because it has grown mostly in small, deep locations, initial treatment effectiveness was been less than desired. For the first two years, treatments were able to minimize the spread of milfoil in the lake. In 2009, milfoil appeared to spread. As a result, an increased rate of application was used to target milfoil in 2010. This approach appears to have worked well. Nine acres of milfoil were reduced to one acre, and some locations where milfoil persisted from year to year were eliminated. By increasing the rate of application, the effects of dilution from the surrounding untreated waters can be reduced. It is recommended that annual treatments for Eurasian watermilfoil continue with Navigate® at the increased rate of 200 lbs/ac. As with any milfoil treatment, it is recommended that the full extent of Eurasian watermilfoil be treated.

There will always be the threat of reintroduction or survival of milfoil in Moshawquit Lake. Going forward, it would be in the Association's best interest to continue sponsoring annual surveys to stay proactive in the management of Eurasian watermilfoil. The focused point intercept approach to surveys appears to be the most thorough method employed on Moshawquit Lake. It is recommended this approach continue to be utilized. For this technique to be most effective, special attention should be made to historic locations of Eurasian watermilfoil growth, particularly those areas that fall between sampling locations.

Regardless of the outcome of surveys and treatments, continued monitoring will be essential for the foreseeable future. Surveys should take place at least once a year, preferably once in the spring and once in the fall. Spring surveys are best at identifying the true distribution of curly-leaf pondweed, while fall surveys are ideal for identifying and mapping Eurasian watermilfoil.

If milfoil is found to have survived treatment or is reintroduced into the lake, it would benefit the lake and the Association to implement further management options. Fragmentation is the primary mode of spread for Eurasian watermilfoil. Individuals should remove floating fragments of milfoil and hand-pull individual plants if they are found growing in the lake. When hand-pulling, it is very important to properly identify the plant as Eurasian watermilfoil, and to remove the entire plant, including the roots, whenever possible.

As previously discussed with Association members, there is unfortunately little, if anything, the Association can do at this point to manage the zebra mussels currently in the lake. The focus now should be reducing the chance of exotic species from spreading to other lakes. This includes draining all water from boats and motors, removing plants from boats and trailers and whenever feasible, disinfecting the hulls of boats that travel from Moshawquit Lake to neighboring lakes. More information can be found on the Wisconsin DNR website (dnr.wi.gov).