FILED ELECTRONICALLY
December 15, 2009

Office of the Secretary
Federal Energy Regulatory Commission
888 1st Street, NE
Washington, DC 20426

Re: Little Quinnesec Falls Hydroelectric Project, FERC No. 2536
Article 409 - 2010 Exotic Species Reports

Dear Secretary:

In accordance with the Commission order approving the monitoring plan for purple loosestrife and Eurasian watermilfoil at the Little Quinnesec Hydroelectric Project, and the *Milfoil Weevil Monitoring and Eurasian Watermilfoil Adaptive Management Plan*, dated April 2010, enclosed are the following annual reports prepared by White Water Associates, Inc:

1. *Monitoring the Little Quinnesec Falls Hydroelectric Project for Eurasian Watermilfoil and Purple Loosestrife*, dated September 2010; and

2. *Annual Report of Milfoil Weevil Monitoring and Eurasian Watermilfoil Management for the Little Quinnesec Falls Hydroelectric Project*, dated September 2010.

Eurasian Watermilfoil & Purple Loosestrife Monitoring

In the 2010 survey, a single purple loosestrife plant was observed in the project area, and was subsequently removed. Twenty-five sites were identified with Eurasian watermilfoil. Although ten of these sites were new, most had few plants. In spite of the 2010 increase in number of sites, the estimated number of plants and coverage actually decreased slightly from the previous year. In 2009, Site D and Site K had increased in Eurasian watermilfoil density and dominance from the previous year and each could be reasonably labeled a "bed." In 2010, the subpopulation at Site D had significantly decreased whereas the subpopulation at Site K remains large. The actual surface area coverage of Eurasian watermilfoil (about 0.03 acre) relative to the size of the impoundment (349 acres) is very small. In most of the sites where it is found, the numbers are few. With the possible exception of Site K, Eurasian watermilfoil is not "taking over" the locations in which it is found. The finding of

Milfoil Weevil Monitoring

The 2010 survey found the existence of a natural population of the native watermilfoil weevil (*Euhrychiopsis lecontei*) in the Eurasian watermilfoil at Site K.

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Scottsdale, Arizona 85260
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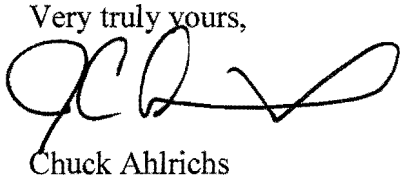
2011 Activities

Based on the results of the monitoring programs, Northbrook proposes another year of monitoring under both programs in 2011.

Very truly yours,

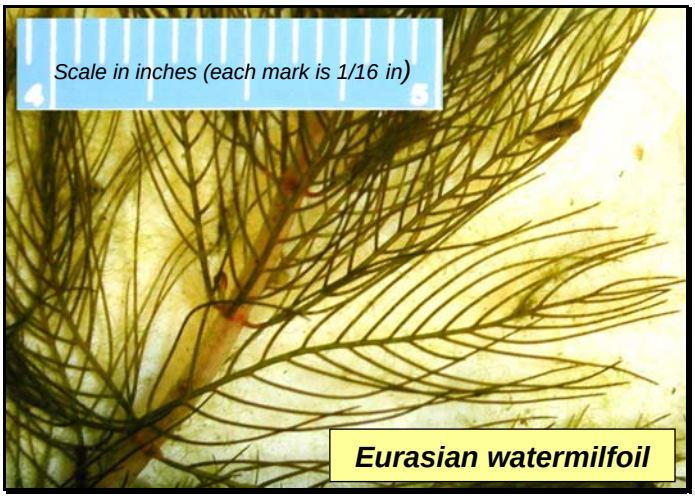


Chuck Ahlrichs
President

PROJECT REPORT

Monitoring The Little Quinnesec Falls Hydroelectric Project for Eurasian Watermilfoil and Purple Loosestrife

FERC Hydro Project No. 2536, Little Quinnesec Falls



Prepared for:

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September 2010

PROJECT REPORT

Monitoring The Little Quinnesec Falls Hydroelectric Project for Eurasian Watermilfoil and Purple Loosestrife

FERC Hydro Project No. 2536, Little Quinnesec Falls

Fieldwork:	Bill Artwich, B.S., Field Biologist Susan, Fawcett, B.S., Field Biologist Dean Premo, Ph.D., Senior Ecologist
Data Analysis And Report	Dean Premo, Ph.D., Senior Ecologist Kent Premo, M.S. Technical Support Scientist Bill Artwich, B.S., Field Biologist

Cite as: Premo, Dean and Kent Premo. 2010. Monitoring The Little Quinnesec Falls Hydroelectric Project for Eurasian Watermilfoil and Purple Loosestrife (FERC Hydro Project No. 2536, Little Quinnesec Falls). Report to Northbrook Energy, LLC by White Water Associates, Inc.

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SUMMARY

Monitoring for Eurasian watermilfoil (*Myriophyllum spicatum*) and purple loosestrife (*Lythrum salicaria*) was conducted on the Little Quinnesec Falls Project (FERC Hydro Project No. 2536) in 2010 as required by Article 409 of the FERC order issuing a project license. Annual monitoring for these species has occurred at this project since 1998. Both plants have been reported in the Menominee River basin since 1990 although none in the project area before 2002. Scientists from White Water Associates (an independent consulting firm) conducted fieldwork from a boat and on foot on July 26 and 27, 2010. Additional observations were taken on July 28, 2010 when a survey for the watermilfoil weevil (*Euhrychiopsis lecontei*) was conducted.

The project area has a robust diversity of native aquatic plants including native watermilfoils. In the 2010 survey, twenty-five sites were identified with Eurasian watermilfoil (an increase from 2009). Although ten of these sites were new, most had few plants. In spite of the 2010 increase in number of sites, the estimated number of plants and coverage actually decreased slightly from the previous year. In 2009, Site D and Site K had increased in Eurasian watermilfoil density and dominance from the previous year and each could be reasonably labeled a "bed." In 2010, the subpopulation at Site D had significantly decreased whereas the subpopulation at Site K remained large.

Over the years of monitoring at the Little Quinnesec Falls Project we have noted that small sub-populations of Eurasian watermilfoil come and go. We continued that observation in 2010. The reasons for this are unknown, but may indicate the difficulty of invading a thriving native plant community.

The actual surface area coverage of Eurasian watermilfoil (about 0.03 acre) relative to the size of the impoundment (349 acres) is very small. In most of the sites where it is found, the numbers are few. With the possible exception of Site K, Eurasian watermilfoil is not "taking over" the locations in which it is found. The finding of a natural population of the native watermilfoil weevil (*Euhrychiopsis lecontei*) in the Eurasian watermilfoil at Site K deserves careful monitoring in the future. The watermilfoil weevil is a biological control agent of Eurasian water milfoil. The presence of the weevil is documented in a separate report.

A single purple loosestrife plant was observed in the project area in 2010. It was removed. A number of purple loosestrife plants exist immediately downstream of the project area on private and public land.

INTRODUCTION AND BACKGROUND

In 2010, monitoring for Eurasian watermilfoil (*Myriophyllum spicatum*) and purple loosestrife (*Lythrum salicaria*) was conducted on the Little Quinnesec Falls Project (FERC Hydro Project No. 2536) as required by Article 409 of the FERC order issuing a project license. Annual monitoring for these non-native species has occurred at this project since 1998. There have been reports of both Eurasian watermilfoil and purple loosestrife within the Menominee River basin since 1990 although none from the project area prior to 2002. Eurasian watermilfoil has been reported since 1995 from the Twin Falls Flowage about ten miles upstream of the project area.

Neither Eurasian watermilfoil nor purple loosestrife were reported from the Little Quinnesec Falls project during surveys conducted for the license application process (1990) and neither species was found in the project area during monitoring in 1998, 1999, 2000, or 2001. Eurasian watermilfoil was first documented in 2002 by observation of a few plants at two locations. In 2002, several specimens of Eurasian watermilfoil and both native watermilfoil species (*M. sibiricum* and *M. heterophyllum*) were collected from the project area and sent to experts Drs. Donald Les and Michael Moody of the University of Connecticut for further identification by genetic analysis. Their analysis of these specimens indicated that no hybrids were present, only the pure forms of each of the three species. Most locations where Eurasian watermilfoil has been found since 2002 have been small areas containing small numbers of individual plants mixed within a diverse community of native aquatic plants. Since 2006, a couple of relatively small areas hosted larger numbers of Eurasian watermilfoil (one to two hundred individual plants). “Beds” or “colonies” where Eurasian watermilfoil is the dominant plant were not observed in the project area through 2008. In 2009, we reported two areas where Eurasian watermilfoil numbers were such that they could legitimately be referred to as “beds.”

Purple loosestrife was first found in 1998 growing along the Wisconsin shoreline of the river below the Little Quinnesec Dam (about 100 feet below the public access site). This area is within the one-quarter mile project survey area. Each year White Water Associates staff removed these plants by hand pulling, but they persisted until 2005 when they were absent. In 2005 a single non-flowering plant and two flowering plants were found near the first private property residence about 30 feet downstream of the original patch. White Water staff pulled these plants in 2005 and they were absent in 2006. In 2007, six flowering purple loosestrife plants were observed along the Wisconsin shoreline downstream of the rafter’s boat launch. These were removed by NewPage staff. Downstream from this area, and outside the project survey area, there were

numerous flowering purple loosestrife plants in 2007. The City of Niagara was contacted by NewPage and agreed to dispose of these plants; however, the plants remained in 2008 and 2009.

This document reports 2010 monitoring results and presents information in five sections: (1) Summary, (2) Introduction and Background, (3) Methods, (4) Findings, and (5) Conclusions. Appendix A contains a figure and two tables.

METHODS

The fieldwork for the 2010 monitoring was completed on July 26 and 27, 2010. Additional observations were taken on July 28, 2010 when a survey for the watermilfoil weevil (*Euhrychiopsis lecontei*) was conducted. Bill Artwich and Susan Fawcett of White Water Associates conducted the work on the reservoir and the river downstream of the dam. Dean Premo joined them on July 28 for the weevil survey. A 14-foot boat and 9.9 HP engine was used to survey the shoreline and numerous backwater wetlands from the Little Quinnesec Falls Dam upstream to the Big Quinnesec Falls Dam. Most of the backwater wetlands are shallow and densely vegetated with a diversity of aquatic plants making motor use difficult. Water levels encountered during the 2010 survey allowed access into some of these backwater wetlands.

We visually surveyed for Eurasian watermilfoil in aquatic plant beds and took samples by hand and garden rake. We closely examined the leaves of suspect plants, counting leaflets (average number of leaflets is the main morphological trait used to separate the native northern watermilfoil (*Myriophyllum sibiricum*) from Eurasian watermilfoil, although there is considerable variability within each species. Generally, the average number of leaflets for northern watermilfoil is 5-11 with a reported maximum of 13. The average number for Eurasian watermilfoil is 14-17 with a maximum of 20. Also useful later in the season is the presence of winter buds (turions) on northern watermilfoil, structures not found on Eurasian watermilfoil.

Purple loosestrife when flowering is showy and easily identified. Peak blossoming extends from late July through August in northern Michigan. Wetlands and backwaters connected to the project area reservoir were visually inspected. Binoculars were used to scan the shore and less accessible backwaters. The project area downstream of the Little Quinnesec Falls dam was surveyed on foot on July 27.

FINDINGS

This report section presents the finding from the 2010 survey and integrates information from past surveys to provide insight into population dynamics of Eurasian watermilfoil and purple loosestrife in the Little Quinnesec Falls project area.

Eurasian watermilfoil

The project area continues to have a robust diversity and dominance of native aquatic plants. Native watermilfoils in the flowage include *Myriophyllum heterophyllum* and *M. sibiricum*. *Vallisneria americana* and *Potamogeton richardsonii* continue to be some of the most abundant species throughout the flowage. Other species comprising the aquatic plant community include *Elodea canadensis, Elodea nuttallii, Potamogeton spirillus, P. epihydrus, P. diversifolius, P. zosterformis, P. robbinsii, Zosterella dubia, Ceratophyllum demersum, Ranunculus longirostris, Utricularia vulgaris,* and *Bidens (Megalodonta) beckii*.

The aerial photo shown in Figure 1 shows all sites where Eurasian watermilfoil has been detected in the Little Quinnesec Falls project area since 2002. Table 1 presents additional information about these areas, including the latitude/longitude, estimated number of plants observed, and plant surface area involved. Table 2 summarizes the data over all monitoring years (2002 to present).

As in past years of monitoring at the Little Quinnesec Falls project area, the plants identified as Eurasian watermilfoil exhibit considerable morphological variation. The numbers of leaflets are sometimes intermediate between the northern watermilfoil and the Eurasian watermilfoil.

In the 2010 survey, we detected twenty-five sites in the project area with rooted Eurasian watermilfoil. This represents an increase of overall number of sites (sixteen sites were detected in 2009). Ten new sites were recorded in 2010, but each of these new sites had relatively small numbers of plants (most less than ten plants; one area had fifty plants scattered over 400 yards of near-shore habitat). Each of the other fifteen 2010 Eurasian watermilfoil sites had a history of the species in the past. Twelve of the fifteen sites had twenty or fewer Eurasian watermilfoil plants. In spite of the increase in number of sites, the estimated number of plants and surface area of coverage actually decreased slightly from 2009.

Considering the Little Quinnesec Falls population of Eurasian watermilfoil from an historical perspective, we have seen some sub-populations increase in number, some stay the same, and some decrease or disappear. Of the twenty-four sites that have two or more years of observations, 2010 observations at nine sites saw the numbers increase, another nine sites saw the conditions remain the same, and six sites saw Eurasian watermilfoil numbers decrease (in four of these sites, Eurasian watermilfoil disappeared altogether). In all cases in 2010 (as in the past) the Eurasian watermilfoil existed among native aquatic plants.

In 2009, Site D had an estimated two hundred Eurasian watermilfoil plants representing an increase from previous years. In 2010, we estimated only about twenty Eurasian watermilfoil plants existed among other natives in this area. These Eurasian watermilfoil did not appear healthy and were covered by algae. We observed possible evidence of weevil herbivory, but the plants were not in good enough shape to verify this evidence. No weevil life stages were observed.

In 2009, Eurasian watermilfoil numbers at Site K had grown to what could reasonably be labeled a "bed." This remained the case in 2010. The Eurasian watermilfoil at this site are part of a multispecies aquatic plant bed. This site was selected as subject of an intensive survey for the watermilfoil weevil (*Euhrychiopsis lecontei*) in 2010. The weevil was found at this site in fairly robust numbers and this will be covered in a separate report. Despite the presence of the weevil, the Eurasian watermilfoil at Site K appeared healthy. We suspect that Site K is a source of propagules for downstream establishments of Eurasian watermilfoil, especially those that occur for a mile or so along the south shore of the impoundment. We observed a fairly large number of Eurasian watermilfoil fragments floating in the relatively strong current along the south shore especially in the vicinity of Site AE (where there seems to be a convergence of current and floating material).

Site I (see Figure 1) is the original location for Eurasian watermilfoil on the Little Quinnesec Falls project area. It consistently had a few rooted plants in 2002, 2003, 2004, and 2005. We did not detect any plants in 2006 or 2007. In 2008, we found nine Eurasian watermilfoil plants at Site I in the area between the north and south arms of this bay. In 2009 we observed eighteen plants in the same area. In 2010, we observed no Eurasian watermilfoil at this site.

As exemplified by Site I, over the years of monitoring at the Little Quinnesec Falls Project we have noted that small sub-populations of Eurasian watermilfoil come and go and (sometimes) come back again. This phenomenon is documented in Table 1. The reasons for this rather tenuous hold of these small sub-populations of Eurasian watermilfoil are unknown, but may indicate the

relative difficulty of invading a thriving native plant community. At Sites D and L where native plants were apparently reduced by previous herbicide treatments, the Eurasian watermilfoil rebounded in 2009. As previously mentioned 2010 observations at Site D indicated a decline in Eurasian watermilfoil. Site L remained the same in 2010 as was reported in 2009.

The actual surface area coverage of Eurasian watermilfoil relative to the size of the impoundment remains very small (see Table 2 for summary). We used 349 acres as the size of the project area when calculating percentages. Clearly not all of the impoundment is suitable to Eurasian watermilfoil because of depth or water current. Using aerial photo interpretation and in-the-field ground-truthing, we roughly estimate that between 100 and 150 acres of the project area might be suitable Eurasian watermilfoil habitat (primarily consisting of shoreline areas and quiet backwaters). Even if this more conservative estimate of habitat is used the relative amount of coverage of existing Eurasian watermilfoil is miniscule. The sites where Eurasian watermilfoil has been found in the Little Quinnesec Fall project have been fairly shallow backwaters and areas with little current. In all cases, the species is part of a diverse and healthy community of native aquatic plants including *Potamogeton foliosus, Ranunculus longirostris, Utricularia vulgaris, Ceratophyllum demersum* and the native milfoil, *Myriophyllum sibiricum*. In most of the sites where it is found as a rooted plant, the number of plants is very low.

Purple Loosestrife

In past years of the survey, no purple loosestrife was found within the portion of the project area, lying between the Little Quinnesec Dam and the Big Quinnesec Dam. In 2010, however, a single plant was located on an island along the north shore and about 150 yards downstream of the US 141 Bridge (latitude: 45.7934; longitude: -088.0458; see Figure 1). White Water staff carefully bagged the flower head and dug this plant up being careful to extract the entire root mass. The plant was bagged and disposed of in a sanitary landfill. This area will be checked in subsequent years for possible regrowth. No other purple loosestrife plants were observed in the vicinity.

Purple loosestrife has been found each year starting in 1998 until present growing along the Wisconsin shoreline of the river downstream of the Little Quinnesec Dam about 100 feet downstream of the public access site. This area is within the one-quarter mile project survey area. Each year, White Water Associates staff removed these plants by hand pulling, but the plants

persisted until 2005 when they were absent. In 2005, a single non-flowering plant and two flowering plants were found near the first private property residence about 30 feet downstream of the original patch. White Water Associates staff pulled these three plants in 2005 and this site was absent of plants in 2006 and 2007. In 2007, we observed no purple loosestrife on the Michigan side of the river below the Little Quinnesec Falls Dam. In 2007, six purple loosestrife plants were located on the Wisconsin side of the river, downstream of the rafter's boat launch. NewPage staff removed, bagged, and disposed of these plants. Additional purple loosestrife plants were observed on the Wisconsin shoreline outside of the project survey area along the Niagara City Park. The City of Niagara was contacted by NewPage staff and agreed to dispose of these plants.

In 2008, we observed no purple loosestrife plants on corporate property downstream of the Little Quinnesec Dam. There were, however, cut or broken plants on private property (residences) on the Wisconsin side of the river. We also observed more purple loosestrife on the Niagara City Park. Purple loosestrife was again present in 2009.

In 2010 purple loosestrife plants exist downstream of the Little Quinnesec Falls Dam on the Wisconsin side of the river from about 50 yards downstream of the boat landing parking area to a point approximately one-half mile below the boat landing parking area.

CONCLUSIONS

Eurasian watermilfoil is known for spreading rapidly, usurping space, and dominating the aquatic plant community. Over the years at the Little Quinnesec Falls Project area, the Eurasian watermilfoil has been quite limited in occurrence and numbers. It may be that the robust populations of native plants help keep this invasive species in check. Although the number of Eurasian watermilfoil sites actually increased in 2010, the estimated number of plants and area of coverage actually decreased slightly. The largest subpopulation of Eurasian watermilfoil is Site K in the upstream-most part of the project area and the colony may be the source of propagules for some of the downstream Eurasian watermilfoil sites that have been detect in the last two years. On the more hopeful side, we have documented a population of the watermilfoil weevil (a biological control agent of Eursian watermiofoil i) in Site K and will monitor its effects.

In 2006, we attempted to hand-pull individual Eurasian watermilfoil plants, but found this to be an impractical means of control in this setting. First of all there is uncertainty about getting the underground portion of the plant and a danger of fragmenting the upper portions and setting

some adrift to possibly colonize other areas. The process of wading or swimming and pulling the plants muddies the water making for difficult visibility. We also tried using a rake to pull the plants but the same difficulties exist as with the hand pulling. The attempt at herbicide control of Eurasian watermilfoil at three project area sites showed little or no effect in 2007. In 2008, increased chemical dosage at these same sites appears to have been very effective in reducing Eurasian watermilfoil in the 2008 season, but the plant made a strong comeback at two of these sites in 2009. In 2010, the population of Eurasian watermilfoil at one of these two sites (Site D) was greatly reduced. The reason for this decline is unknown. As documented in a separate report, the watermilfoil weevil was found to be present in the large subpopulation of Eurasian watermilfoil at Site K. The biological control effects of this Eurasian watermilfoil herbivore will be monitored.

In 2010 (and for the first time), a single purple loosestrife plant was observed in the project area upstream of the Little Quinnesec Falls dam. It was removed and the site will be carefully monitored in the future. As in the past, a number of plants exist immediately downstream of the project area on private and public land.

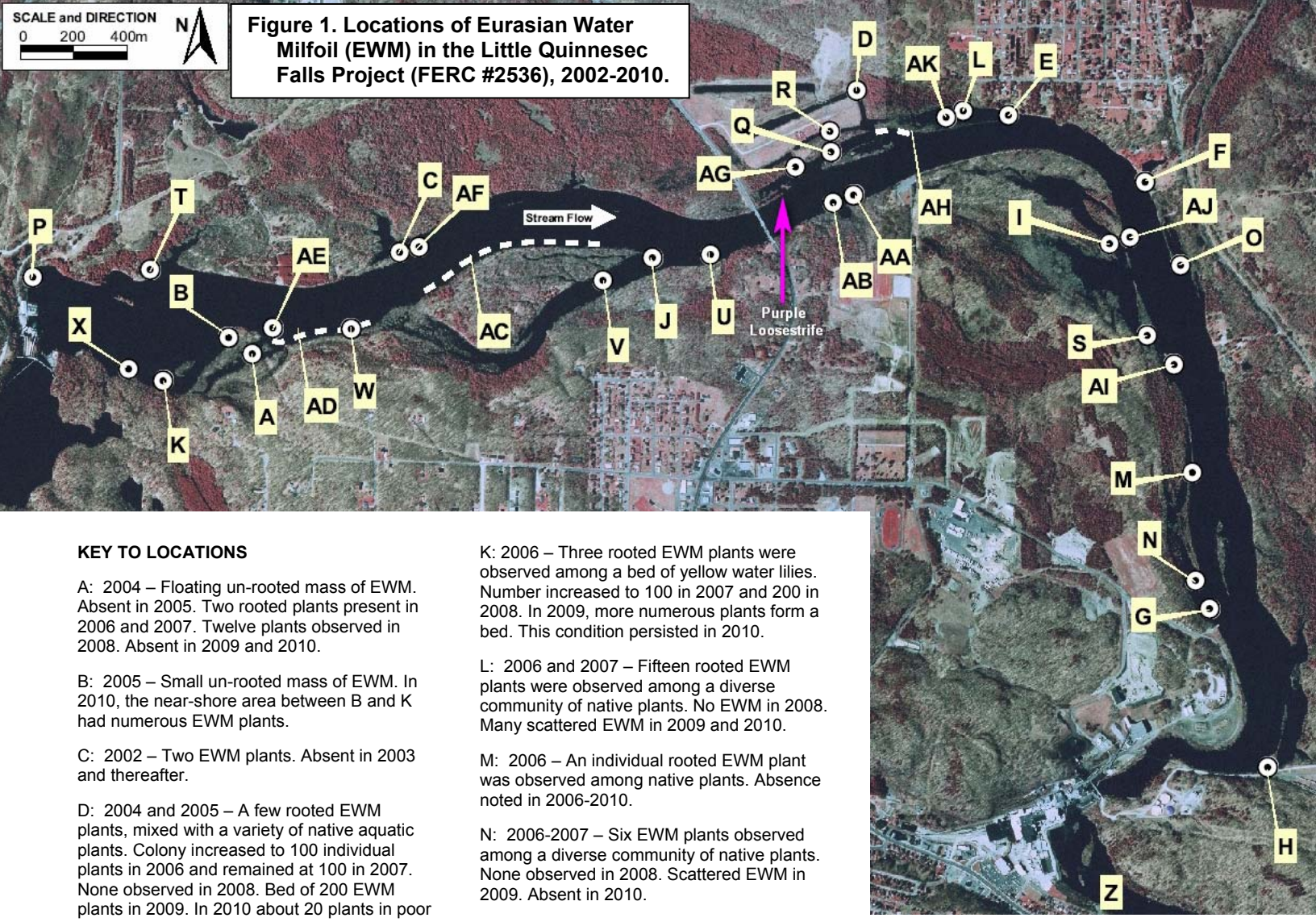

Figure 1. Locations of Eurasian Water Milfoil (EWM) in the Little Quinnesec Falls Project (FERC #2536), 2002-2010.

KEY TO LOCATIONS

A: 2004 – Floating un-rooted mass of EWM. Absent in 2005. Two rooted plants present in 2006 and 2007. Twelve plants observed in 2008. Absent in 2009 and 2010.

B: 2005 – Small un-rooted mass of EWM. In 2010, the near-shore area between B and K had numerous EWM plants.

C: 2002 – Two EWM plants. Absent in 2003 and thereafter.

D: 2004 and 2005 – A few rooted EWM plants, mixed with a variety of native aquatic plants. Colony increased to 100 individual plants in 2006 and remained at 100 in 2007. None observed in 2008. Bed of 200 EWM plants in 2009. In 2010 about 20 plants in poor condition.

E: 2004 – Floating un-rooted mass of EWM caught along edge. Absent in 2005, but 4 rooted plants present in 2006 and 3 plants present in 2007. None observed in 2008. Scattered plants in 2009 and 2010.

F: 2004 – Floating un-rooted mass of EWM along edge. Absent in 2005, but 2 rooted plants present in 2006 and 2007. None observed in 2008, 2009, and 2010.

G: 2004 – Floating un-rooted mass of EWM along edge. EWM absent in 2005, 2006, 2007, and 2008. Scattered plants at bay mouth in 2009. None observed in 2010.

H: 2004 – Floating un-rooted mass of EWM along edge. EWM absent in 2005 and 2006. EWM present in 2007, but not observed in 2008. Several plants in 2009 and 2010.

I: 2002, 2003, 2004, and 2005 – This was the original location for EWM in the LQF Project. The few rooted plants were scattered within a species-rich community of native plants. No change in coverage observed from 2002 to 2005. All EWM absent in 2006. In 2007, shallow water prevented survey. In 2008, nine rooted plants present. In 2009, eighteen plants were observed. In 2010, none were observed.

J: 2006 – Floating un-rooted EWM mass in an area of diverse native plants. Three un-rooted plants present in 2007. None observed in 2008. A few plants in 2009 and 2010.

K: 2006 – Three rooted EWM plants were observed among a bed of yellow water lilies. Number increased to 100 in 2007 and 200 in 2008. In 2009, more numerous plants form a bed. This condition persisted in 2010.

L: 2006 and 2007 – Fifteen rooted EWM plants were observed among a diverse community of native plants. No EWM in 2008. Many scattered EWM in 2009 and 2010.

M: 2006 – An individual rooted EWM plant was observed among native plants. Absence noted in 2006-2010.

N: 2006-2007 – Six EWM plants observed among a diverse community of native plants. None observed in 2008. Scattered EWM in 2009. Absent in 2010.

O: 2006 – Seven individual rooted EWM plants observed among a diverse community of native plants. Six present in 2007. EWM absent from 2008-2010.

P: 2007 – Fifteen EWM in a small quiet backwater below Big Quinnesec Dam. Not observed in 2008. Two plants in 2009. Eight observed in 2010.

Q: 2007 – Fifteen EWM in a natural riverine side channel. Not observed in 2008 or 2009. Fifteen observed in 2010.

R: 2007 – Two EWM in the area of man-made canals. Not observed in 2008. Two plants in 2009 and eight in 2010.

S: 2007 – Six EWM along quiet water at river's edge among native plants. Not observed in 2008 or 2009. Eight observed in 2010.

T: 2008 – Six EWM observed at river's edge among native plants. Same in 2009. No EWM seen in 2010.

U: 2009 – Twenty EWM scattered along shore with native vegetation. The same in 2010.

V: 2009 – Fifteen EWM scattered among native vegetation. The same in 2010.

W: 2009 – A single EWM plant in native plants. In 2010, eight EWM were observed.

X: 2009 – Five scattered EWM in native plants. Ten observed in 2010.

Z: 2008-2009 – Survey area. No EWM observed.

AA: 2010 – A single EWM among native plants.

AB: 2010 – A single EWM among native plants.

AC: 2010 – Five EWM among native plants in this half mile of near-shore habitat.

AD: 2010 – About fifty EWM scattered among native aquatic plants in this quarter mile stretch of near-shore habitat.

AE: 2010 – Observed quite a few fragments of EWM floating in the strong current that breaks around this point.

AF: 2010 – Observed three EWM plants among native plants.

AG: 2010 – Observed fifteen EWM among dense Elodea and other native plants.

AH: 2010 – Observed nine EWM plants along this 200 yard long shore among native plants.

AI: 2010 – A single EWM among native plants.

AJ: 2010 – Observed six EWM among native plants.

AK: 2010 – A single EWM among native plants.

Table 1. History of Eurasian Watermilfoil (*Myriophyllum spicatum* L.) in the Little Quinnesec Falls Project (FERC #2536)

Site Code	Year	Latitude & Longitude Coordinates	Present (Y/N)	Rooted (Y/N)	Number of Plants	Surface Area (sq. ft).	Surface Area (acres)	% Project boundary acres (349 acres)	Weevil evidence (Y/N)[1]	Comments
A	2004	45.78759 -88.03029	Y	N	1	2	0.00005	0.000000		Floating un-rooted mass (ca. 4 square feet) of *M. spicatum* at entrance to small bay.
A	2006		Y	Y	2	4	0.00009	0.000000	N	After absence in 2005, two rooted *M. spicatum* in 2006.
A	2007		Y	Y	2	4	0.00009	0.000000	N	Two rooted *M. spicatum* plants among abundant native milfoil and bladderwort.
A	2008		Y	Y	12	24	0.00028	0.000001	N	Twelve rooted *M. spicatum* plants among abundant native milfoil and bladderwort.
A	2009		N							Thorough search revealed not a single plant.
A	2010		N							Thorough search revealed not a single plant.
B	2005	45.78848 -88.03040	Y	N	1	2	0.00005	0.000000		Small un-rooted mass (ca. 2 square feet) of *M. spicatum* floating downstream.
B	2010		Y	Y	40	80	0.00184	0.000004		The shoreline from B southwest to K has these scattered *M. spicatum* among natives.
C	2002	45.79125 -88.02352	Y	Y	2	4	0.00009	0.000000		Two rooted plants present in 2002, but absent in subsequent years.
D	2004	45.79701 -88.00139	Y	Y	6	12	0.00028	0.000001		A few rooted plants of *M. spicatum* , mixed with a variety of native aquatic plants.
D	2005		Y	Y	10	20	0.00046	0.000001		A few rooted plants of *M. spicatum* , mixed with a variety of native aquatic plants.
D	2006		Y	Y	100	200	0.00459	0.000013	N	Rooted plants have increased in number to ca. 100 rooted plants approximately 150 feet in either direction from the GPS point.
D	2007		Y	Y	100	200	0.00459	0.000013	N	Rooted plants at about the same number and dispersion as in 2006.
D	2008		N							Chemically treated area with no *M. spicatum* and few other macrophytes observed.

Table 1. History of Eurasian Watermilfoil (*Myriophyllum spicatum* L.) in the Little Quinnesec Falls Project (FERC #2536)

Site Code	Year	Latitude & Longitude Coordinates	Present (Y/N)	Rooted (Y/N)	Number of Plants	Surface Area (sq. ft).	Surface Area (acres)	% Project boundary acres (349 acres)	Weevil evidence (Y/N)[1]	Comments
D	2009		Y	Y	200	400	0.00918	0.000026	N	A dense bed of *M. spicatum* observed in 2009 with few other macrophytes.
D	2010		Y	Y	20	40	0.00092	0.000002		Many fewer plants and in poorer condition than in 2009. Other native plants present.
E	2004	45.7963 -87.99399	Y	N	1	2	0.00005	0.000000		Floating un-rooted mass (ca. 2 square feet) of *M. spicatum* found along river's edge.
E	2006		Y	Y	4	8	0.00018	0.000001	N	After an absence in 2005, 4 rooted plants were present in 2006. These are downslope from several houses on the bank and docks that accommodate boats and pontoon boats.
E	2007		Y	Y	3	6	0.00014	0.000000		Three rooted plants observed in 2007 in conditions similar to 2006.
E	2008		N							None were present in the 2008 survey. Few aquatic macrophytes present; significant filamentous algae present.
E	2009		Y	Y	25	50	0.00148	0.000000	N	*M. spicatum* scattered through the area.
E	2010		Y	Y	15	30	0.00069	0.000002		*M. spicatum* scattered through the area.
F	2004	45.7921 -87.98744	Y	N	1	2	0.00005	0.000000		Floating un-rooted mass (ca. 2 square feet) of *M. spicatum* found along river's edge right at the mouth of Fumee Creek.
F	2006		Y	Y	2	4	0.00009	0.000000	N	Two rooted *M. spicatum* found along river's edge right at the mouth of Fumee Creek.
F	2007		Y	Y	2	4	0.00009	0.000000	N	Two rooted *M. spicatum* found along river's edge right at the mouth of Fumee Creek.
F	2008		N							No *M. spicatum* observed (only native milfoil)
F	2009		N							
F	2010		N							
G	2004	45.77982	Y	N	1	2	0.00005	0.000000		Floating un-rooted mass (ca. 2 square feet) of *M. spicatum* caught along river's edge

Table 1. History of Eurasian Watermilfoil (*Myriophyllum spicatum* L.) in the Little Quinnesec Falls Project (FERC #2536)

Site Code	Year	Latitude & Longitude Coordinates	Present (Y/N)	Rooted (Y/N)	Number of Plants	Surface Area (sq. ft).	Surface Area (acres)	% Project boundary acres (349 acres)	Weevil evidence (Y/N)[1]	Comments
		-87.98366								upstream of fire dock.
G	2009		Y	Y	30	60	0.00034	0.000001	N	*M. spicatum* distributed around entry of bay.
G	2010		N	N						No *M. spicatum* noted in area seen in 2009
H	2004	45.77453 -87.98065	Y	N	1	2	0.00005	0.000000		Floating un-rooted mass (ca. 2 square feet) caught along river's edge.
H	2007		Y	Y	15	30	0.00069	0.000002	N	Fifteen rooted *M. spicatum* (each ca. 2 sq ft) were observed among a diverse community of native aquatic plants. Eight of these plants were just upstream of the downstream tip of the island on the west side (river side) of the island and seven were just upstream of the downstream tip of the island on east side of the island.
H	2008		N	N						No *M. spicatum* observed in 2008.
H	2009		Y	Y	6	12	0.00028	0.000001	N	*M. spicatum* among native aquatic plants.
H	2010		Y	Y	8	16	0.00028	0.000001		*M. spicatum* among native aquatic plants.
I	2002	45.79204 -87.98893	Y	Y	3	6	0.00014	0.000000		A few rooted plants scattered within a species-rich community of native aquatic plants. This was original site for *M. spicatum* in the Little Quinnesec Falls Project area.
I	2003		Y	Y	4	12	0.00028	0.000001		A few rooted plants scattered within a species-rich community of native plants.
I	2004		Y	Y	4	12	0.00028	0.000001		A few rooted plants scattered within a species-rich community of native plants.
I	2005		Y	Y	4	12	0.00028	0.000001		A few rooted plants scattered within a species-rich community of native plants.
I	2006		N							All *M. spicatum* were absent.
I	2007		N							The low water prevented entry into this bay in 2007. We assume no change since 2006.

Table 1. History of Eurasian Watermilfoil (*Myriophyllum spicatum* L.) in the Little Quinnesec Falls Project (FERC #2536)

Site Code	Year	Latitude & Longitude Coordinates	Present (Y/N)	Rooted (Y/N)	Number of Plants	Surface Area (sq. ft).	Surface Area (acres)	% Project boundary acres (349 acres)	Weevil evidence (Y/N)[1]	Comments
I	2008		Y	Y	9	18	0.00021	0.000001	N	Nine plants scattered in channel between long bay and short bay.
I	2009		Y	Y	18	36	0.00084	0.000003	N	*M. spicatum* scattered in this bay among native aquatic plants.
I	2010		N	N						No *M. spicatum* observed in this area, in fact much less aquatic vegetation than in past.
J	2006	45.79119 -88.01104	Y	N	1	2	0.00005	0.000000	N	Floating un-rooted mass (ca. 2 sq. feet) of *M. spicatum* in area of diverse native plants.
J	2007		Y	N	3	6	0.00014	0.000000	N	Floating un-rooted plant fragments (ca. 6 sq. feet) of *M. spicatum* in area of diverse native plants.
J	2008		N							No *M. spicatum* observed in 2008.
J	2009		Y	Y	5	10	0.00023	0.000000	N	A few *M. spicatum* among native plants.
J	2010		Y	Y	12	24	0.00028	0.000001		Several *M. spicatum* among native plants.
K	2006	45.78674 -88.034822	Y	Y	3	6	0.00014	0.000000	N	Three rooted *M. spicatum* (each ca. 2 sq ft) observed in a bed of yellow water lilies.
K	2007		Y	Y	100	200	0.00459	0.000013	N	Rooted plants have increased in number to ca. 100 rooted plants in an area approximately 100x300 feet. These plants are mixed in with *Nuphar, Valisineria*, and *Potamogeton richardsonii*
K	2008		Y	Y	200	400	0.00918	0.000026	N	Rooted plants have increased in number to ca. 200 rooted plants in an area approximately 100x300 feet. These plants are mixed in with *Nuphar, Valisineria*, and *Potamogeton richardsonii*
K	2009		Y	Y	~400	~800	0.01836	0.000052	N	Similar area as in 2008, but denser and excluding other plants. It is accurate to characterize this as a bed. Difficult to estimate number of plants

Table 1. History of Eurasian Watermilfoil (*Myriophyllum spicatum* L.) in the Little Quinnesec Falls Project (FERC #2536)

Site Code	Year	Latitude & Longitude Coordinates	Present (Y/N)	Rooted (Y/N)	Number of Plants	Surface Area (sq. ft).	Surface Area (acres)	% Project boundary acres (349 acres)	Weevil evidence (Y/N)[1]	Comments
K	2010		Y	Y	~400	~800	0.01836	0.000052	Y	Similar area as in 2009. Weevil survey here showed all life stages present and plant damage occurring.
L	2006	45.796423 -87.996198	Y	Y	15	30	0.00069	0.000002	N	Fifteen rooted *M. spicatum* (each ca. 2 sq ft) were observed among a diverse community of native aquatic plants.
L	2007		Y	Y	15	30	0.00069	0.000002	N	Low water in 2007 prevented access into all parts of this bay, so it was estimated that the same number of rooted *M. spicatum* were present as in 2006 (among a diverse community of native aquatic plants).
L	2008		N							This area was chemically treated in 2007 and 2008.
L	2009		Y	Y	60	120	0.00276	0.000008	N	Numerous *M. spicatum* throughout the bay.
L	2010		Y	Y	60	120	0.00276	0.000008		Numerous *M. spicatum* throughout the bay among native aquatic plants.
M	2006	45.78440 -87.984675	Y	Y	1	2	0.00005	0.000000	N	An individual rooted plant of *M. spicatum* (ca. 2 square feet) was observed among native plants at the mouth of a small bay.
M	2007		N							No *M. spicatum* were observed from 2007 through 2010.
M	2008		N							
M	2009		N							
M	2010		N							
N	2006	45.780751 -87.984406	Y	Y	6	12	0.00028	0.000001	N	Six individual rooted *M. spicatum* (each ca. 2 sq ft) observed among a community of native plants at the mouth of a small bay.
N	2007		Y	Y	6	12	0.00028	0.000001	N	Low water conditions during the 2007 survey prevented access to this shallow bay; we therefore assume conditions to be the same as in 2006.

Table 1. History of Eurasian Watermilfoil (*Myriophyllum spicatum* L.) in the Little Quinnesec Falls Project (FERC #2536)

Site Code	Year	Latitude & Longitude Coordinates	Present (Y/N)	Rooted (Y/N)	Number of Plants	Surface Area (sq. ft).	Surface Area (acres)	% Project boundary acres (349 acres)	Weevil evidence (Y/N)[1]	Comments
N	2008		N	N						Low backwater conditions during the 2008 survey prevented thorough access to this shallow bay.
N	2009		Y	Y	6	12	0.00028	0.000001	N	*M. spicatum* scattered in small bay.
N	2010		N	N						No *M. spicatum* observed in 2010.
O	2006	45.791406 -87.985502	Y	Y	7	14	0.00032	0.000001	N	Seven individual rooted *M. spicatum* (each ca. 2 sq ft) observed among a diverse community of native plants in a bay upstream of Verso park.
O	2007		Y	Y	6	12	0.00028	0.000001	N	Six individual rooted *M. spicatum* (each ca. 2 sq ft) observed among a community of native plants in bay upstream of Verso park.
O	2008		N							No *M. spicatum* were observed in 2008. This area was chemically treated.
O	2009		N							No *M. spicatum* were observed in 2009.
O	2010		N							No *M. spicatum* were observed in 2010.
P	2007	45.790 -88.041	Y	Y	15	30	0.00069	0.000002	N	This was a new find in 2007 in an area just below the Big Quinnesec Dam on the north side of the river in a bay with little or no current. Distributed in an area of 10x20 feet.
P	2008		N	N						No *M. spicatum* were observed in 2008.
P	2009		Y	Y	2	4	0.00009	0.000000		Two *M. spicatum* were observed in 2009.
P	2010		Y	Y	8	16	0.00028	0.000001		Eight *M. spicatum* were observed in 2010.
Q	2007	45.7949 -88.0025	Y	Y	15	30	0.00069	0.000002	N	This new area was in the area where old man-made excavations (canals) were made. These plants were scattered throughout the backwater channel just outside of the created channels.
Q	2008		N							No *M. spicatum* were observed in 2008 or 2009.
Q	2009		N							

Table 1. History of Eurasian Watermilfoil (*Myriophyllum spicatum* L.) in the Little Quinnesec Falls Project (FERC #2536)

Site Code	Year	Latitude & Longitude Coordinates	Present (Y/N)	Rooted (Y/N)	Number of Plants	Surface Area (sq. ft).	Surface Area (acres)	% Project boundary acres (349 acres)	Weevil evidence (Y/N)[1]	Comments
Q	2010		Y	Y	15	30	0.00069	0.000002		*M. spicatum* among native plants.
R	2007	45.7956 -88.0026	Y	Y	2	4	0.00009	0.000000	N	Two rooted plants present in 2007 among native plants.
R	2008		N							No *M. spicatum* were observed in 2008.
R	2009		Y	Y	2	4	0.00009	0.000000		Two *M. spicatum* among native vegetation.
R	2010		Y	Y	8	16	0.00028	0.000001		Eight *M. spicatum* among native vegetation.
S	2007	45.789 -87.987	Y	Y	6	12	0.00028	0.000001	N	Six rooted *M. spicatum* (each ca. 2 sq ft) were observed among a community of native plants in quiet water along the river's edge.
S	2008		N							No *M. spicatum* were observed in 2008 or 2009.
S	2009		N							
S	2010		Y	Y	8	16	0.00028	0.000001		*M. spicatum* seen in 2010 among natives.
T	2008	45.79036 -88.03532	Y	Y	6	12	0.00028	0.000001	N	*M. spicatum* observed among native plants in quiet water along the river's edge in 2008 and 2009.
T	2009		Y	Y	6	12	0.00028	0.000001	N	
T	2010		N	N						*M. spicatum* absent in 2010
U	2009	45.79145 -88.00748	Y	Y	20	40	0.00092	0.000002	N	*M. spicatum* were scattered along the shore with native aquatic plants
U	2010		Y	Y	20	40	0.00092	0.000002		*M. spicatum* were scattered along the shore with native aquatic plants
V	2009	45.79090 -88.01153	Y	Y	15	30	0.00069	0.000002	N	*M. spicatum* were scattered along the shore with native aquatic plants
V	2010		Y	Y	15	30	0.00069	0.000002		*M. spicatum* were scattered among native aquatic plants
W	2009	45.78946 -88.02341	Y	Y	1	2	0.00005	0.000000	N	One *M. spicatum* on edge of current among native plants.
W	2010		Y	Y	8	16	0.00028	0.000001		Eight *M. spicatum* on edge of current among native plants.

Table 1. History of Eurasian Watermilfoil (*Myriophyllum spicatum* L.) in the Little Quinnesec Falls Project (FERC #2536)

Site Code	Year	Latitude & Longitude Coordinates	Present (Y/N)	Rooted (Y/N)	Number of Plants	Surface Area (sq. ft).	Surface Area (acres)	% Project boundary acres (349 acres)	Weevil evidence (Y/N)[1]	Comments
X	2009	45.78698 -88.04108	Y	Y	5	10	0.00023	0.000000	N	*M. spicatum* plants distributed among native plants.
X	2010		Y	Y	10	20	0.00046	0.000001		*M. spicatum* distributed among native plants.
Z	2008	The area downstream of LQF Dam	N							*M. spicatum* was not observed in the portion of the project area that is downstream of the Little Quinnesec Falls Dam.
Z	2009		N							
Z	2010		N							
AA	2010	45.79349 -88.00136	Y	Y	1	2	0.00005	0.000000		A single *M. spicatum* among native plants.
AB	2010	45.79320 -88.00238	Y	Y	1	2	0.00005	0.000000		A single *M. spicatum* among native plants.
AC	2010	0.5 mile of shore between 45.79160 -88.01309 and 45.78988 -88.02192	Y	Y	5	10	0.00023	0.000000		Five *M. spicatum* scattered among native aquatic plants.
AD	2010	0.25 mile of shore between 45.78894 -88.02438 and 45.78807 -88.02931	Y	Y	50	100	0.00230	0.000007		About fifty *M. spicatum* scattered among native aquatic plants in this stretch of shoreline. It seems as though the bed of *M. spicatum* at Site K may be the source of these plants. Fragments observed along the shore here as well as rooted plants.
AE	2010	45.78848 -88.02931	N	N						Observed quite a few fragments of *M. spicatum* in the strong current that breaks around this point. Likely source is Site K.
AF	2010	45.79136 -88.02235	Y	Y	3	6	0.00014	0.000000		Observed three plants of *M. spicatum* among *M. sibiricum* and other native plants.
AG	2010	45.79438 -88.00425	Y	Y	15	30	0.00069	0.000002		Observed fifteen plants of *M. spicatum* among dense *Elodea* and some *M. sibiricum* and other native plants.

Table 1. History of Eurasian Watermilfoil (*Myriophyllum spicatum* L.) in the Little Quinnesec Falls Project (FERC #2536)

Site Code	Year	Latitude & Longitude Coordinates	Present (Y/N)	Rooted (Y/N)	Number of Plants	Surface Area (sq. ft).	Surface Area (acres)	% Project boundary acres (349 acres)	Weevil evidence (Y/N)[1]	Comments
AH	2010	200 yard long shore between 45.79535 -88.00065 and 45.79566 -87.99983	Y	Y	9	18	0.00021	0.000001		Observed nine plants of *M. spicatum* among native plants.
AI	2010	45.78804 -8798569	Y	Y	1	2	0.00005	0.000000		Observed one *M. spicatum* among natives.
AJ	2010	45.79227 -87.98797	Y	Y	6	12	0.00028	0.000001		Observed six *M. spicatum* among natives.
AK	2010	45.796168 -87.99699	Y	Y	1	2	0.00005	0.000000		Observed one *M. spicatum* among natives.

[1]*Field staff began checking for evidence of weevil herbivory on M. spicatum in 2006. In 2010, field staff did not check generally for weevil herbivory since a specific weevil survey was for targeted areas.*

Table 2. Summary of Total Plant Observations of Eurasian Watermilfoil (EWM) in the Little Quinnesec Falls Project (FERC #2536)

Year of Survey	Number of Sites Observed with EWM	Estimated Number of Plants	Surface Area (square feet)[1]	Surface Area (acres)[1]	Percent Project Boundary Acres[2]
2002	2	5	10	0.00023	0.0001
2003	1	4	12	0.00028	0.0001
2004	2	15	34	0.00078	0.0002
2005	2	14	32	0.00073	0.0002
2006	8	139	278	0.00638	0.0018
2007	13	290	580	0.01331	0.0038
2008	7	265	542	0.01244	0.0037
2009	16	801	1602	0.0361	0.0103
2010	25	739	1478	0.0331	0.0095

[1] *The surface area is based on the total number of plants (rooted and un-rooted) and assumes two square feet of surface area coverage (as viewed from above) for each plant.*

[2] *Calculation of percent project boundary acres assumes 349 acres for the project area.*

Annual Report of Milfoil Weevil Monitoring and Eurasian Watermilfoil Management for the Little Quinnesec Falls Hydroelectric Project

FERC Hydro Project No. 2536, Little Quinnesec Falls


Susan Fawcett photo

Specimens from the Menominee River on the Little Quinnesec Falls Hydroelectric Project.

On left: Adult and larval Milfoil Weevil *(Euhrychiopsis lecontei*
Below: Eurasian water milfoil (*Myriophyllum spicatum*)


Dean Premo photo

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Date: September 2010

Annual Report of Milfoil Weevil Monitoring and Eurasian Watermilfoil Management for the Little Quinnesec Falls Hydroelectric Project

FERC Hydro Project No. 2536, Little Quinnesec Falls

September 2010

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INTRODUCTION AND BACKGROUND

Monitoring for Eurasian watermilfoil (*Myriophyllum spicatum*) has been conducted on the Little Quinnesec Falls Project (FERC Hydro Project No. 2536) from 1998 through 2010 as required by Article 409 of the FERC order issuing a project license. This monitoring has revealed that small sub-populations (consisting of several plants) of Eurasian watermilfoil come and go. The reasons for this are unknown, but may be because Eurasian watermilfoil finds it difficult to invade the thriving native plant community in the impoundment. No large beds of Eurasian watermilfoil exist in the project area. The 2009 survey revealed that two Eurasian watermilfoil sites in the impoundment had increased in number of plant stems and surface area coverage. One of these "beds" resulted from the rebound of Eurasian watermilfoil after two years of herbicide treatments had depressed native vegetation. The other bed was untreated, but had increased in size from previous years. The total surface area coverage of Eurasian watermilfoil in 2009 and 2010 in the 349 acre project area was less than 0.04 acre (Premo and Premo 2010).

Eurasian watermilfoil occurs in much larger populations in the Menominee River watershed in reservoirs upstream and downstream of the Little Quinnesec Falls Project and in lakes. These multi-acre areas of Eurasian watermilfoil have been treated by several methods. The Michigan Department of Natural Resources and Environment (MDNRE) is concerned with the management of Eurasian watermilfoil in Michigan's waters. It is further interested in potential use of biological control agents, specifically the milfoil weevil (*Euhrychiopsis lecontei*) in managing Eurasian watermilfoil. Because of this interest, the MDNRE requested that Northbrook Wisconsin, LLC (the FERC licensee for the Little Quinnesec Falls Project) prepare a milfoil weevil monitoring and treatment plan for the Little Quinnesec Falls Hydroelectric Project. This plan was completed and submitted to the responsible agencies in April 2010.

At the recommendation of the MDNRE, Northbrook Wisconsin, LLC (the licensee) has adopted an ***adaptive management*** (Walters, 1986) approach to Eurasian watermilfoil in the Little Quinnesec Falls Hydroelectric Project. Simply stated, it uses findings from planned monitoring activities to inform management actions and periodic refinement of the plan. This is the first annual report on milfoil weevil monitoring and Eurasian watermilfoil management and is presented in six sections: (1) Introduction and Background, (2) Study Area, (3) Milfoil Weevil Ecology, (4) Survey for Milfoil Weevil, (5) Eurasian Watermilfoil Management at the Little Quinnesec Falls Project, and (6) Literature Cited.

STUDY AREA

The Little Quinnesec Falls Hydroelectric Project is located on the Menominee River approximately ninety miles upstream from where it flows into Lake Michigan (in Menominee, Michigan). The Menominee River is a border stream between Michigan and Wisconsin. The study area of interest to this plan is the impounded area from the Little Quinnesec Falls Dam upstream approximately 4.4 miles to the Big Quinnesec Falls Dam. The surface area of this riverine impoundment is 349 acres. The shoreline is about 15 miles long and nearly all is vegetated in forested riparian area. Just a little more than one-half mile of the shoreline is developed (principally manifested by the Big Quinnesec Falls Dam and the Little Quinnesec Falls Dam and mill site). Very little residential development exists along the river in the study area.

In this section, we describe two components of the biota in the study area. In the first subsection, we discuss the aquatic plant community with emphasis on Eurasian watermilfoil. In the second subsection, we discuss the fish community of the study area since some fish have particular importance as predators of the milfoil weevil.

The study area has consistently displayed a robust diversity of native aquatic plants. Native watermilfoils in the flowage include *Myriophyllum heterophyllum* and *M. sibiricum*. The most abundant species throughout the flowage are *Vallisneria americana* and *Potamogeton richardsonii*. Other species comprising the aquatic plant community include *Elodea canadensis, Elodea nuttallii, Potamogeton spirillus, P. epihydrus, P. diversifolius, P. zosterformis, P. robbinsii, Zosterella dubia, Ceratophyllum demersum, Ranunculus longirostris*, *Utricularia vulgaris,* and *Megalodonta beckii*.

Eurasian watermilfoil was first documented in 2002 by observation of a few plants at two locations. Most locations where the plant has been found since 2002 have been small areas containing small numbers of individual plants mixed within a diverse community of native aquatic plants. In 2009, we documented an increase in Eurasian watermilfoil density and dominance at Site D (estimated 200 plants) and Site K (400 plants). This was the first time that we referred to a "bed" of Eurasian watermilfoil in the study area. These two sites were identified as sites to monitor for milfoil weevils in 2010.

The study area offers a large diversity of aquatic habitat. This ranges from quiet shallow backwaters with dense beds of native aquatic vegetation to deep river pools with significant current and cobble bottom. The natural shoreline of the study area continuously contributes large woody material to the river edges forming good habitat for invertebrates and fish. A variety of

fish spawning habitat is also present in the study area. For these reasons, the fish community in the study area is also diverse. It includes species that are known predators of the milfoil weevil. Game fish species present in the study area include: Northern Pike (*Esox lucius*), Muskellunge (*Esox masquinongy*), Smallmouth Bass (*Micropterus dolomieui*), Largemouth Bass (*Micropterus salmoides*), Pumpkinseed (*Lepomis gibbosus*), Bluegill (*Lepomis macrochirus*), Rock Bass (*Ambloplites rupestris*), Black Crappie (*Pomoxis nigromaculatus*), Walleye (*Stizostedion vitreum*), and Yellow Perch (*Perca flavescens*). Pumpkinseed and Bluegill are known to be significant predators of the milfoil weevil (Newman 2004; Sutter and Newman 1997). A large variety of cyprinid and other minnows and darters exist in the study area (Becker 1983). Some of these are potential, but not yet documented, predators of the milfoil weevil.

MILFOIL WEEVIL

Eurasian watermilfoil is one of North America's most noxious and aggressive weeds. It represents an ecological threat to native aquatic plants and the animals that use these native plants as habitat. As a result, tremendous effort has been applied to control and management of Eurasian watermilfoil. Three North American insect species have been considered as agents of biological control for Eurasian watermilfoil. Of these, the milfoil weevil (*Euhrychiopsis lectontei*) has shown the greatest promise (Newman 2004). For this reason it is under consideration as a biological control agent in the study area.

Euhrychiopsis lectontei specializes in using water milfoil as its host plant and food. This native weevil feeds solely on native and Eurasian watermilfoils with the native Northern watermilfoil comprising its principal food source (Newman 2004; Herman 2009). Milfoil weevils over-winter in the organic material (leaves and other organic debris) in the vegetation of the near-shore riparian area. Weevil populations are reported to be higher where natural riparian zone exists (Herman 2009). They crawl, swim, or fly to this overwintering habitat and return to milfoil beds by the same means in spring (Creed and Sheldon 1994). Adults feed on watermilfoil leaves and spend their time clinging to plants underwater (Newman et al. 2001). Female milfoil weevil lays one or two eggs per day on the tips of water milfoil plants and may lay more than a hundred eggs over the course of a season. The eggs hatch in a few days and the grub-like larvae feed on the tips of the milfoil plant working their way down the stem feeding on vascular tissues. The larvae use the upper three feet of the milfoil plant and burrow (by chewing) in and out of the

plant, leaving small pin-holes. At the end of their development, the larvae burrow into the lower and thicker part of the milfoil stem and pupate. The adult emerges from the pupa and exits the stem through a "blast hole" (larger than the pin hole entrances of the larvae). The complete life cycle is completed in a little less than four weeks and three or four generations are possible during the summer (Cofrancesco and Crosson 1999; Newman 2004). In late August to mid-September (in Minnesota and Vermont) adults stop laying eggs and move to shore to overwinter (Sheldon and O'Bryan 1996; Newman et al. 2001).

Adult milfoil weevils feed on the meristems (the growing tips of the plant), leaves, and stems of the milfoil plant and can suppress growth (Creed and Sheldon 1993). The larvae, however, have the greater impact on the milfoil plant. Young larvae feeding on the meristem suppress plant growth and elongation (Creed and Sheldon 1993). Older larvae mine the stems and consume vascular tissue thus inhibiting transport of nutrients (Newman et al. 1996) which may affect root carbohydrate stores and reduce vigor and ability to overwinter (Creed and Sheldon 1995). Larval mining of stems can cause the plants to leak gasses and become less buoyant and sink out of the upper water column (Creed et al. 1992).

Although milfoil weevil has been associated with numerous milfoil declines in the field, many are poorly documented. Newman (2004) summarizes the literature and states that "densities of 1 or more weevils per stem can control milfoil and densities of <0.1 per stem are not likely to control the plant." Since most of this reported work has been done on very large and dense populations of Eurasian watermilfoil, it is not known what dynamic is in play between weevils and milfoil in small Eurasian watermilfoil populations. In fact, R.M. Newman indicated (pers. com. 2010) that no one has looked at the minimum water milfoil bed size needed to maintain a viable weevil population and stated that if the overall plant density is less than a few stems per square meter it would probably be hard to support a significant weevil population.

Successful biological control results in a suppression of the pest plant, not its elimination (Gettsinger et al. 2002; Newman 2004). Because this control is potentially cyclical, it is more useful for long term control in lower priority sites and over large areas. If biological control is implemented, at least several years must be provided to determine if suppression will take place (Newman 2004).

MILFOIL WEEVIL MONITORING

The *Milfoil Weevil Monitoring and Eurasian Watermilfoil Adaptive Management Plan for the Little Quinnesec Falls Hydroelectric Project* (Premo 2010) called for investigating presence and abundance of the milfoil weevil in the study area. The milfoil weevil is common and can be abundant in lakes of the Great Lakes states (Newman 2004). Its distribution in riverine systems is less well known, but it has been found as a native in Menominee River impoundments upstream of the study area (Grisar, pers. com, 2010). In this section, we describe monitoring methods used and present 2010 monitoring results.

Methods

We developed the survey protocol for the study area by researching scientific literature and contacting experts (outlined in Premo 2010). The plan called for us to monitor for weevils at Eurasian watermilfoil beds of size similar to the two "beds" identified in the study area in 2009 (Sites D and K). In 2010, only a single bed in the study area (Site K) met this criterion (Premo and Premo 2010). We mapped the aquatic plant at Site K bed using a hand-held GPS unit. Three parallel transects were established in the bed that were oriented along the long axis of the bed. One transect was established through the center of the bed and the flanking transects were positioned half-way between the middle transect and the edges of the bed (the three transects divide the bed into parallel quarters). Five collection points were established equidistant along each transect with one located at the shoreward edge of the bed, one at the outside edge, one in the middle, one between the middle and outside edge, and one between the middle and shoreward edge. Exhibit 1 is a generalized layout of transects and sampling points. Exhibit 2 shows an aerial photograph with the actual size and shape of the plant bed at Site K.

The water depth and substrate required the use of a boat to sample the fifteen collection points at Site K. At each point, we collected one rooted Eurasian watermilfoil stem from each side of the boat (randomly selected by collecting the first rooted stem contacted with the hand). On a few occasions a rake was used to collect stems. With the two stems in the boat, we collected the top 24 inches of each and placed both in a plastic sample bag marked with transect letter and point number. The plant samples thus collected were stored in a cooler on wet ice. The unused portion of the Eurasian watermilfoil stems were placed in a plastic bag and retained for proper

disposal (composting). After all fifteen points were sampled, a total of 30 plant stems were collected and transported back to the White Water Associates' laboratory for examination.

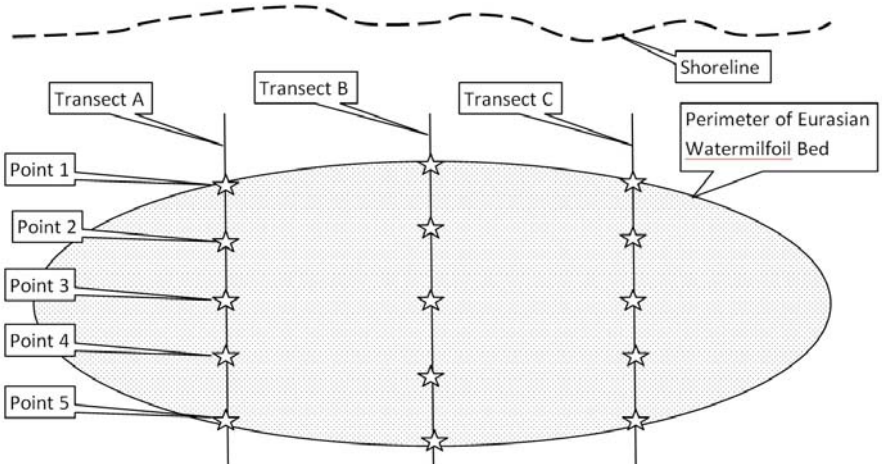


Exhibit 1. Generalized layout of sampling transects.

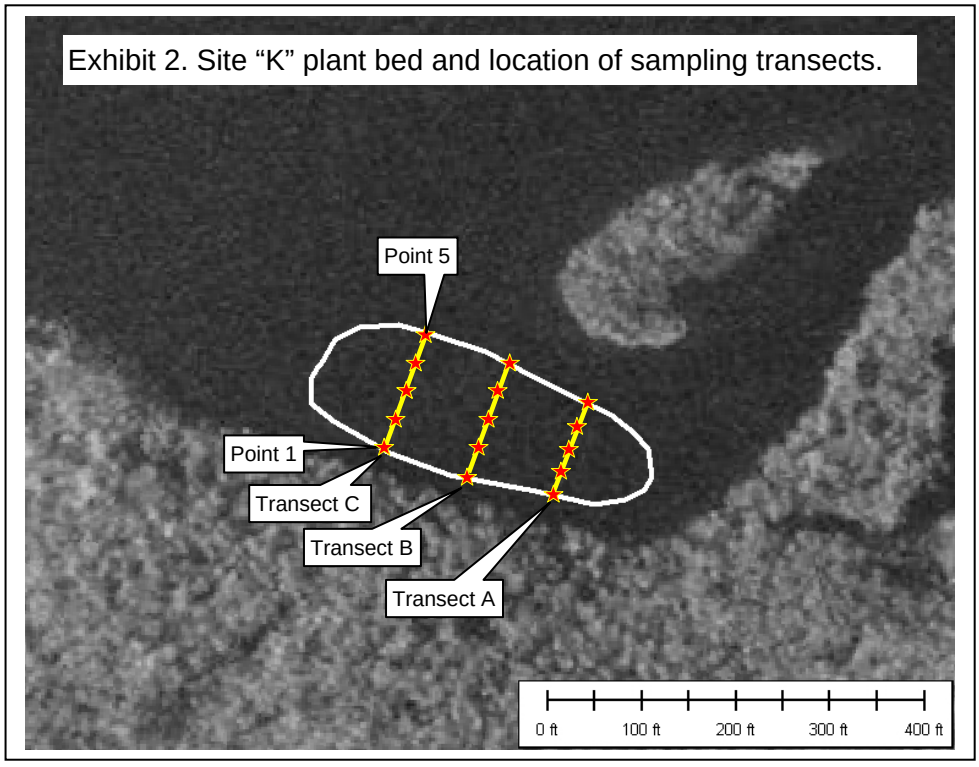


Exhibit 2. Site "K" plant bed and location of sampling transects.

We measured a Secchi transparency depth at the subject Eurasian watermilfoil bed. We also measured temperature, dissolved oxygen, pH, and conductivity at the water surface. We recorded substrate type in the bed. We used a lazer range-finder to measure distance to the nearest shore from the shoreward edge of the bed. We recorded a description of the shoreline and riparian area vegetative cover. We also recorded qualitative observations regarding the overall health of the Eurasian watermilfoil, presence of weevils or weevil damage, and native plants present.

At sampling Point 3 of each transect (A, B, and C) we used a double-sided fourteen-tine rake to make a one meter tow to collect vegetation. All plants on the rake were identified and a rake fullness rating was applied for each species. The rake fullness values were based on the Wisconsin Department of Natural Resources Point-Intercept Protocol for aquatic plant surveys as follows: (1) rake fullness rating 1 is given when plant is present and occupies less than one-half of tine space, (2) rating 2 is given when plant is present and occupies more than one-half of tine space, (3) rating 3 is given when plant is present and occupies all or more than tine space. This approach provides a baseline estimate of Eurasian watermilfoil density in the bed.

In order to compare to other Eurasian watermilfoil stands in the Menominee River basin, we will also applied the "estimated density rating" used by We Energies in their annual monitoring (We Energies 2009 Annual Report – Nuisance Plant Control). The ratings are: (1) Sparse: 0-5% cover; (2) Moderately Sparse: >5-25% cover; (3) Moderate: >25-75% cover; (4) Moderately dense: >75-95% cover; and (5) Dense: >95% cover.

In the laboratory, Eurasian watermilfoil samples were examined for presence of all milfoil weevil life stages using magnification. Quantitative data are reported as number of weevils per stem. Voucher specimens were sent to Wisconsin scientist Amy Thortenson to verify identification.

Field work for the weevil monitoring was conducted on July 28, 2010. We predicted that Eurasian water milfoil (and potentially milfoil weevils) would be at maximum population size at this time because of the warm weather experienced during July.

Results

We planned to monitor for weevils at the two Eurasian watermilfoil subpopulations identified as "beds" in the study area in 2009 (Sites D and K) and any other subpopulations that were recognized in 2010 to have reached a similar size. The 2010 Eurasian watermilfoil monitoring revealed that only one site (Site K) still met this size criterion (Premo and Premo 2010). At Site D, in 2010, we estimated only about twenty Eurasian watermilfoil plants (down from 200 in 2009) existed among other native plants. These Eurasian watermilfoil did not appear healthy and were covered by algae. The plants were not in good enough shape to verify possible evidence of weevil herbivory. No weevil life stages were observed.

Exhibit 2 shows an aerial photograph of the portion of the study area that contains Site K. The aquatic macrophyte bed that constitutes Site K is outlined on this exhibit. The bed's dimensions are 370 feet by 134 feet and the surface area is 0.94 acre. Exhibit 2 also illustrates that the bed is in a bay and has fairly close proximity to naturally vegetated shorelines on three sides (one of these shorelines is a forested island situated immediately northeast of the bed. The nearest shoreline is about 50 feet away from the bed. The natural riparian area in the vicinity of this bed is forested with mixed hardwoods and white pine (the island has a younger forest stand). A shrub layer exists in the riparian area as well as significant amounts of dead woody material and leaf litter. We judge good quality overwintering habitat for weevils is present.

Water depth of the entire plant bed ranges from four to six feet. The substrate throughout the bed consists of sand, gravel, and some clay sediment. The bed is comprised of a diverse mix of native aquatic plants along with the Eurasian watermilfoil. We estimated the "stand density rating" as "moderate" (>25%-75% Eurasian watermilfoil cover). Exhibit 3 summarizes water quality measures taken at the sampling site.

Exhibit 3. Water quality measures at the Site K weevil monitoring site (July 28, 2010)

Secchi transparency: 3 feet	Conductivity (surface): 181	pH (surface): 7.47	
Dissolved Oxygen/Temperature Profile	Surface	1 meter	2 meter
Dissolved oxygen (mg/L):	6.64	6.59	6.60
Temperature (°C):	24.0	23.8	23.8

The plant bed at Site K is comprised of a diverse assemblage of mostly native plant species. Eurasian watermilfoil has recently become a bigger component of the bed (Premo and Premo 2010) but it is not a monoculture. Among other plants, *Nuphar variegata* (bull-head pond-lily) is an evident constituent of the bed. Exhibit 4 presents the species identified in one meter rake tows at three points in the bed and the rake fullness scores for each. As can be seen, Eurasian watermilfoil (*Miriophyllum spicatum*) is present in two of the three samples and its rake fullness rating is only a "1" in these two samples. The Eurasian watermilfoil appeared healthy in this bed on the sampling day.

Exhibit 4. Plant species identified and rake fullness scores for Site K plant bed.

	Plant species identified (1 meter tow)	**Fullness Score**
Transect A - Point 3	*Elodea Canadensis*	2
	Miriophyllum spicatum	1
	Valisneria Americana	1
	Total Rake Fullness (all species)	3
	Plant species identified (1 meter tow)	**Fullness Score**
Transect B - Point 3	*Elodea Canadensis*	2
	Bidens (Megalodonta) beckii	1
	Miriophyllum spicatum	1
	Valisneria Americana	1
	Total Rake Fullness (all species)	3
	Plant species identified (1 meter tow)	**Fullness Score**
Transect C - Point 3	*Elodea Canadensis*	1
	Bidens (Megalodonta) beckii	1
	Miriophyllum sibiricum	1
	Valisneria Americana	2
	Total Rake Fullness (all species)	3

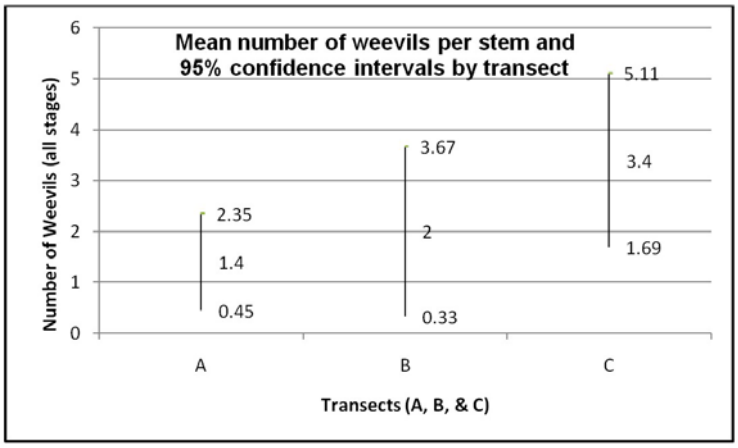
During the field sampling, we observed one adult milfoil weevil **(***Euhrychiopsis lecontei***)** and one larva on Eurasian watermilfoil stems. Back at the laboratory and under better magnification we found a total of twelve adults, seventeen eggs, and thirty-nine larvae. Exhibit 5 summarizes the distribution of these life stages at the various transects and points.

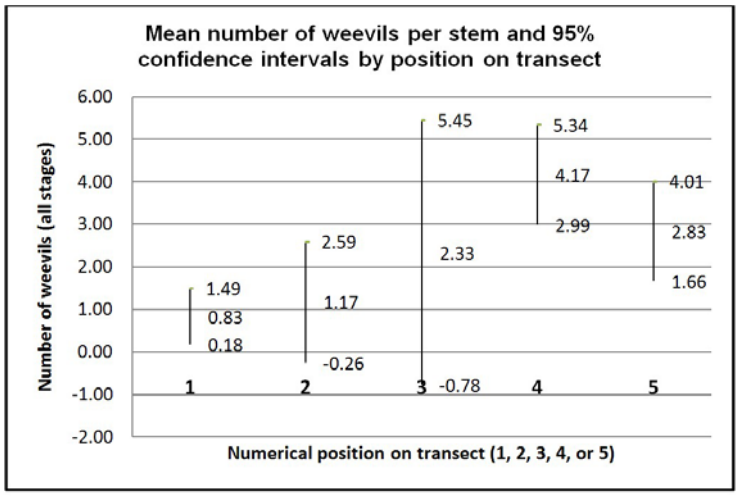
Exhibit 5. Milfoil weevils in Eurasian watermilfoil sampled at Site K.					
Transect	Point	# Adults	# Eggs	# Larvae	Notes
A	1	1	0	0	Stem damage and blast holes
A	2	1	0	1	Larva still in the stem
A	3	0	0	1	Stem damage and blast holes
A	4	2	2	2	Stem damage
A	5	0	4	0	
B	1	2	0	1	Stem damage and blast holes
B	2	0	0	0	Stem damage
B	3	0	2	0	
B	4	1	3	6	Stem damage and blast holes
B	5	1	2	2	
C	1	0	0	1	Stem damage and blast holes
C	2	2	0	3	
C	3	0	1	10	Stem damage and blast holes
C	4	1	3	5	
C	5	1	0	7	
TOTALS		12	17	39	
SUMMARY OF WEEVILS ACROSS ENTIRE PLANT BED					
Mean number of adult weevils per stem				***0.40***	Note: Two 24 inch Eurasian watermilfoil stems were collected at each of the 15 sampling points (total of 30 stems).
Mean number of larval weevils per stem				***0.57***	
Mean number of weevil eggs per stem				***1.30***	
Mean # of weevils per stem (all life stages)				***2.27***	

We analyzed weevil distribution within the bed and found that mean weevil number per stem increased from one transect to the next (Transect C had significantly greater weevils per stem then Transect A). We also analyzed weevil distribution with regard to site numbers along transects. In this case, Sites A1 through C1 and Sites A2 through C2 are significantly different (lower mean number per stem) than A4 through C4 and A5 through C5. Exhibit 6 presents these data and Exhibit 7 is a graphical representation. Simply stated, the weevils were more abundant on the northwest end and northeast side of the plant bed.

Exhibit 6. Distribution of milfoil weevils across points and transects.						
Weevils (all stages)	Total Number on all stems	Mean Number per stem	Standard Deviation	95% C.I. (+/-)	C.I. lower limit	C.I upper limit
At all points "1"	5	0.83	0.58	0.65	0.18	1.49
At all points "2"	7	1.17	1.26	1.42	-0.26	2.59
At all points "3"	14	2.33	2.75	3.12	-0.78	5.45
At all points "4"	25	4.17	1.04	1.18	2.99	5.34
At all points "5"	17	2.83	1.04	1.18	1.66	4.01
For all points on A	14	1.40	1.08	0.95	0.45	2.35
For all points on B	20	2.00	1.90	1.67	0.33	3.67
For all points on C	34	3.40	1.95	1.71	1.69	5.11

Exhibit 7. Graphical representation of distribution of weevils across points and transects within the plant bed.





BIOLOGICAL CONTROL AT LITTLE QUINNESEC FALLS PROJECT

After reviewing the extensive literature on Eurasian watermilfoil and speaking with experts on the subject, we recognize that the relatively small population of the invasive plant in the Little Quinnesec Falls study area is "under control" by most standards. Nevertheless, it is present and, except for 2010, has shown some increase in the past several years. At least one area of increase occurred in a subpopulation previously treated with an herbicide. We have focused on the potential for biological control in our adaptive management of the Eurasian watermilfoil in the study area.

Part of the adaptive management approach involves increasing the ecological knowledge base for the system being managed. The Little Quinnesec Falls study area provides a potential opportunity to test the efficacy of biological control in very small populations of Eurasian watermilfoil. Laura Herman (University of Wisconsin Extension Lakes program) expressed that a bed of at least four or five acres was needed before weevil treatment was warranted (pers. com 2010). Raymond Newman (Professor, Fisheries, Wildlife and Conservation Biology, University of Minnesota) offered the opinion that the Eurasian watermilfoil population at the Little Quinnesec Falls study area might be too small to support milfoil weevils, but indicated that no one has researched this topic (pers. com. 2010). In our 2010 study, we did find a native population of milfoil weevils in fairly high numbers at Site K despite the fairly small size of the Site K bed (about one acre).

The adaptive management plan call for augmentation of biological control of Eurasian watermilfoil by introducing milfoil weevils in the Little Quinnesec Falls study area if two criteria are met:

1. The Eurasian watermilfoil population increases in size for two consecutive years (2010 and 2011) in areas that constitute beds; and
2. The population of milfoil weevils in these beds is less than 0.1/stem, the lower threshold for likely effective control according to Newman (2004).

In 2010, neither of these criteria was met. In general, the overall surface area coverage of Eurasian watermilfoil in the study area decreased slightly. More specifically, a 2009 "bed" (Site D), decreased dramatically in size in 2010. The other Eurasian water milfoil area characterized as

a “bed” in 2009 remained of similar size in 2010, and contained numerous healthy-appearing Eurasian watermilfoil in a diverse native aquatic plant bed. Site K Eurasian watermilfoil harbored a good population of milfoil weevils in all life stages. The per-stem density of weevils was such that biological control is a strong possibility in this bed. Future monitoring will follow the status of both the Eurasian watermilfoil and the milfoil weevil at this location, as well as subpopulations in other parts of the study area.

In his review paper, Newman (2004) states that although the milfoil weevil can be effective control agents if adequate densities can persist (through summers and years), many sites investigated have failed to sustain this density. In spite of significant research, it is not yet possible to predict when suppression of Eurasian watermilfoil will occur.

Follow-up monitoring will track the success of the adaptive management process. Part of this adaptive process will be to communicate with other ecosystem managers in the region, resource agency technical staff, and scientists with expertise in Eurasian watermilfoil management.

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