Paul Smith's College
Adirondack Watershed Institute

Technical Report

Limnology and Water Quality Program

4-15-2016

Upper Saranac Lake Milfoil Monitoring Program: Project Update, Year 2015

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Recommended Citation
Laxson, C.L. and D.L. Kelting. 2016. Upper Saranac Lake Milfoil Monitoring Program: Project Update, Year 2015. Report No: PSCAWI 2016-07,

Table of Contents

Executive Summary

This report provides an update of the aquatic plant monitoring study that was initiated by the Adirondack Watershed Institute in 2004. The objectives of this project are to provide data on the efficacy of the Eurasian water milfoil management strategy being employed on Upper Saranac Lake. This year's report highlights the following:

1. Eurasian water milfoil was only detected at 6 of the 16 monitoring locations in 2015. The greatest amount encountered was in Fish Creek Pond, followed by Little Square Bay, South Gull Bay, Gilpin Bay, Saginaw Bay, and the Saginaw Bay benthic barrier site

2. Overall very few milfoil stems were detected in Upper Saranac Lake. The greatest number of stems encountered in any one measurement cycle was the 5 stems enumerated in Little Square Bay during the month of June. Milfoil stems encountered each month in Little Square Bay appeared to be new growth, demonstrating the productivity of this site for milfoil.

3. The average milfoil density across all locations on Upper Saranac Lake was 10.2 stems/acre, substantially lower than the 600 stems per acre that existed in 2004, the first year of the intensive management effort. The management strategy employed on the lake has been highly successful at maintaining low milfoil densities, especially over the last three years.

4. Eurasian water milfoil can be considered a rare plant in Upper Saranac, it was found to occur on only 1% of the 588 study segments in the lake (ranked #17 out of 19 plant species encountered).

5. Eurasian water milfoil density in Fish Creek Pond has been on the rise since 2010. However, stem density in 2015 exhibited a decrease over previous years.

6. Variable-leaf milfoil, a similar nuisance plant species, was first detected in Fish Creek Pond in 2009. Since that time it has exhibited a significant increase in occurrence. In 2015 we observed variable-leaf milfoil on 25% of the study segments in Fish Creek Pond.

List of Figures

List of Tables

Introduction

Management of Eurasian water milfoil (*Myriophyllum spicatum*) has been a priority for the Upper Saranac Lake community for the past 17 years. Milfoil was first detected in the head of Saginaw Bay during the summer of 1996. The plant was positively identified as part of comprehensive lake study that occurred between 1995-1996, know colloquially as the "state of the lake study" (Martin et al 1998[i]). Limited control efforts in the form of hand harvesting and supplemental benthic matting began in 1999 and continued through 2003. The initial removal effort was successful at reducing milfoil cover within the managed areas, but the lakes 47 miles of shoreline made lake wide control unattainable, and the plant continued to expand through the untreated areas of the lake.

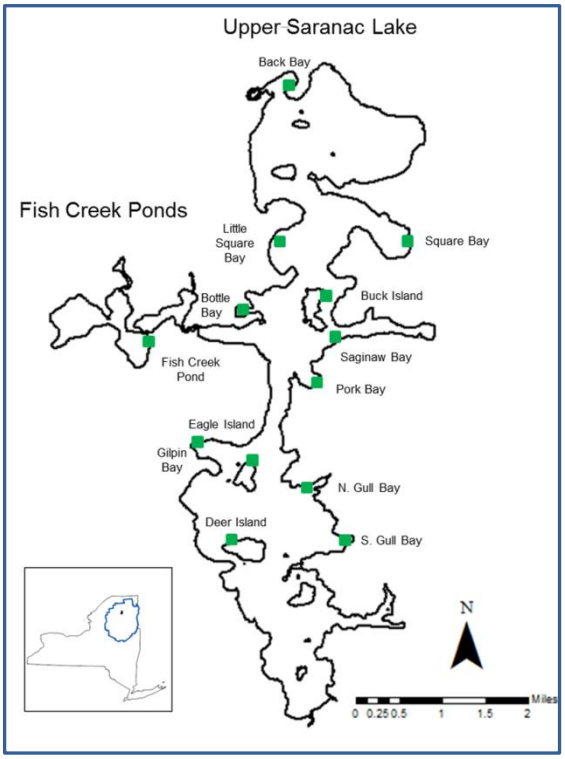

Figure 1. Underwater transect locations on Upper Saranac Lake and Fish Creek Pond.

Recognizing the partial success of the limited control effort and the documented expansion of Eurasian water milfoil in other parts of Upper Saranac Lake, members of the lake community developed a new management approach in 2004 (reviewed by Kelting and Laxson 2010[ii]). The intensified approach to milfoil removal called for the selective removal of the plant through hand harvesting of the entire littoral zone of the lake at least twice each summer for three years, supplemented by limited benthic matting of dense beds. The intensive management effort employed 32 divers during the period of 2004-2006. The effort was reduced by approximately 50% in 2007, and again in 2008 as the lake entered into the 'maintenance period' that it continues to operate in to this day.

In an effort to monitor the success of the management strategy, the Paul Smith's College Adirondack Watershed Institute established 15 underwater monitoring sites across the lake in 2004, and one location in Fish Creek Pond in 2006. This report serves as an update on the project for the year 2015. The objectives of this report are to summarize the 2015 data and analyze the historical milfoil abundance at the study sites.

Methods

Detailed descriptions of the methods are presented in previous annual reports, as well as Kelting and Laxson (2010). In general, fifteen sites on Upper Saranac and one on Fish Creek Pond with historically high Eurasian water milfoil densities were selected (Figure 1). At each site a transect line method was used to monitor the presence and abundance of Eurasian water milfoil. At each site four permanent underwater transect lines (nylon rope) were installed, with the exception of the Gull Bay sites and Deer Island which had two and three transects respectively. The transects ran from approximately 3 feet of depth to 15 feet of depth. At several locations the lake bottom had very little slope, in which case 150 foot long transects were established. Once a month during the summer (June-Sep) a SCUBA diver swam each transect at the 16 locations and recorded aquatic plant species presence as well as the number of milfoil stems in 6 feet wide by 10 feet long segments for the entire length of each transects line (Figure 2). There are a total of 588 segments in Upper Saranac and 36 in Fish Creek Pond.

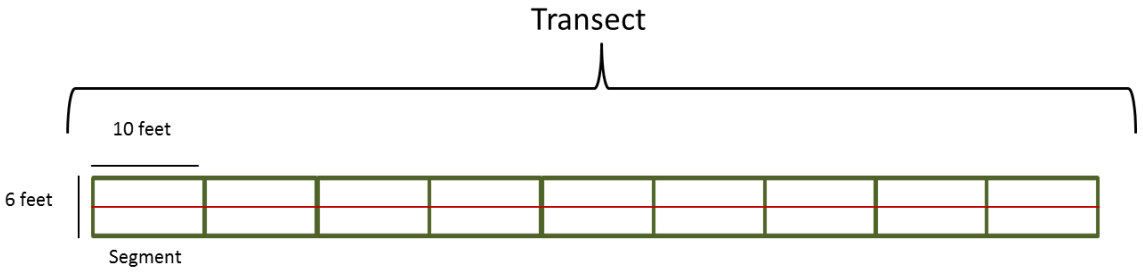

Figure 2. Detailed view of the underwater transects used in the study. The transects consist of a nylon rope that is anchored to the lake bottom between depths of 3 and 15 feet (red line). Each transect is divided into a number of 10' x 6' study segments. In each segment species occurrence is recorded and milfoil stems are enumerated.

Update of Results

During the summer of 2015 we encountered relatively few Eurasian water milfoil stems, and the plant was only detected in 6 of the 16 monitoring locations (Table 1). Greatest rate of milfoil detection occurred during the month of August, followed by September and July, with the least amount of plants detected in the month of June.

Fish Creek Pond

The milfoil stem count at the unmanaged Fish Creek Pond location ranged from a low of 10 stems in June to as high as 21 stems in July. In general, milfoil density (stems/acre) has been on the rise in Fish Creek Pond since 2010 (Figure 3). However, in 2015 milfoil density exhibited a

decrease. For example, stem density was estimated to be 453 stem/acre in August of 2015, which is over 200 stems/ acre lower than August of the previous two years. This type of variation is not uncommon, as aquatic plant growth is affected by numerous environmental variables.

The aquatic plant species found to occur most frequently at the Fish Creek location was stonewort (*Nitella species*), which occurred on 70% of the study segments (Figure 4). Other common plants were Robbin's pondweed (*Potamogeton robbinsii*), eel grass (*Vallisneria americana*). Eurasian water milfoil was ranked number 10 in terms of frequency of occurrence, and was found to occur on 13% of the study segments in August of 2015. Interestingly, a different species of invasive milfoil, variable-leaf milfoil (*Myriophyllum heterophyllum*), is more common in Fish Creek Pond, occurring on 25% of the study segments. Variable-leaf milfoil was first detected at the Fish Creek Pond location in 2009, and since that time has exhibited a significant increase in its frequency of occurrence by approximately 3% per year ($P < 0.001$, $R^2 = 0.89$). We observed no significant trend in the frequency of occurrence of Eurasian water milfoil ($P = 0.38$, Figure 5).

Table 1. Milfoil stem count at each of the transect locations during the summer of 2015. Dashed line indicates that milfoil was not detected at the location

Location	June	July	August	September
Fish Creek Pond	10	15	21	17
Little Square Bay	5	3	2	1
South Gull Bay	2	2	2	0
Gilpin Bay	1	1	1	1
Saginaw Bay	-	1	1	1
Saginaw Bay Mat	-	1	1	-
Deer Island	-	-	-	-
Buck Island	-	-	-	-
Back Bay	-	-	-	-
Bottle Bay	-	-	-	-
Eagle Island	-	-	-	-
Fish Creek Bay	-	-	-	-
North Gull Bay	-	-	-	-
Pork Bay	-	-	-	-
Square Bay	-	-	-	-
Square Bay Mat	-	-	-	-

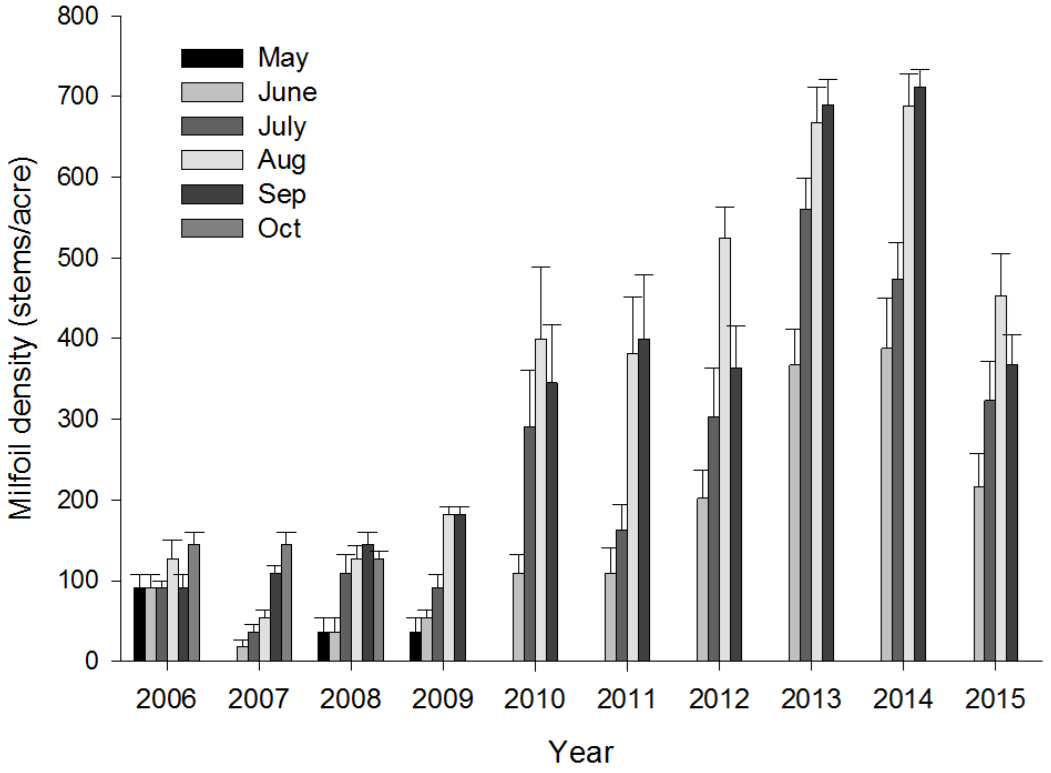

Figure 3. The average density of Eurasian water-milfoil at the Fish Creek Pond site 2006-2015. Vertical bars represent standard error (SE) of the mean, n=4.

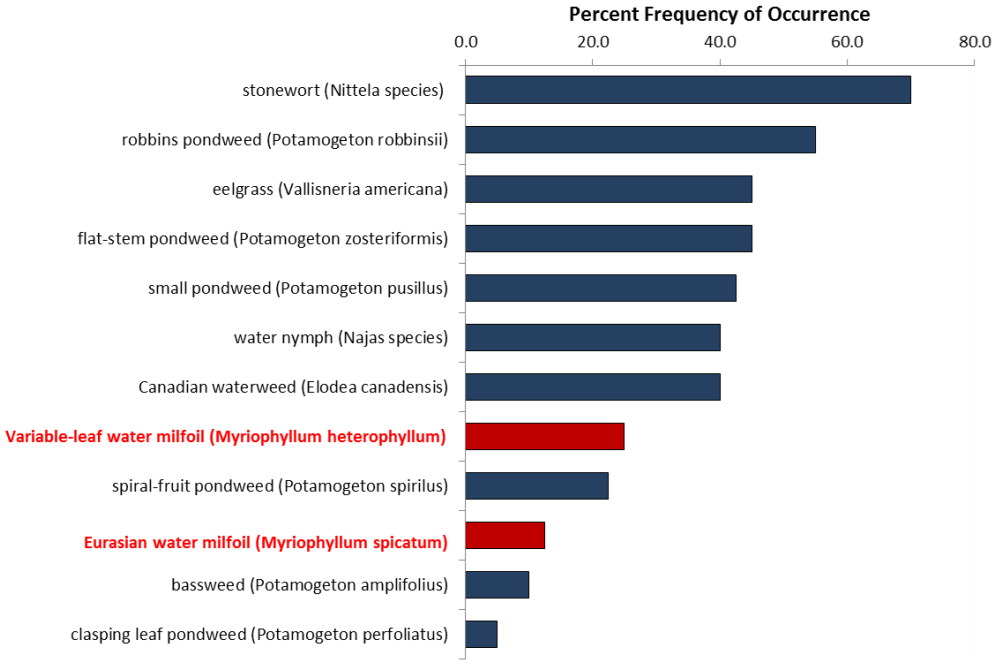

Figure 4. Percent frequency of occurrence of aquatic plant species on the study segments of the Fish Creek Pond location, August 2015. Red indicates invasive or non-indigenous species.

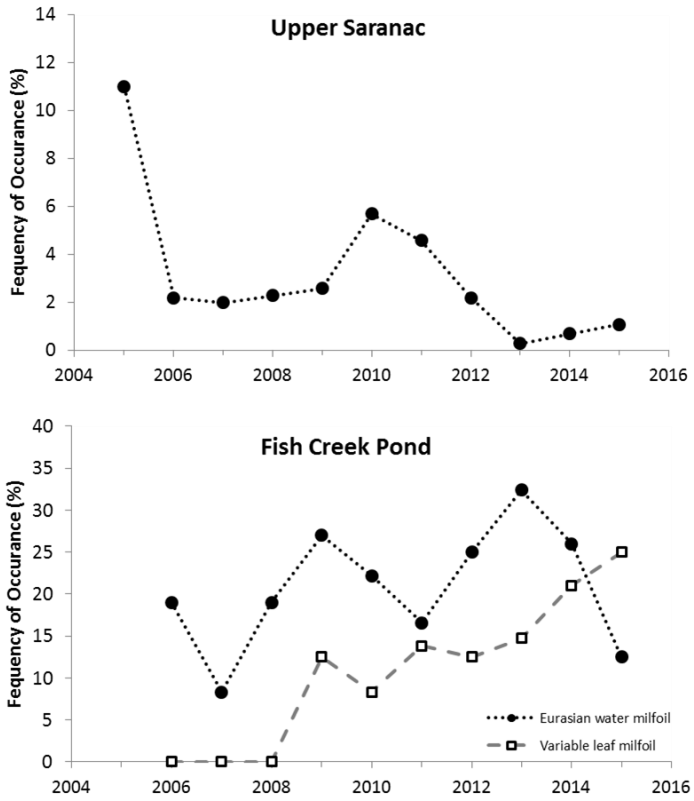

Figure 5. Annual changes in the frequency of occurrence of Eurasian water milfoil and variable-leaf milfoil in Upper Saranac Lake and Fish Creek Pond.

Upper Saranac Lake

In Upper Saranac Lake the greatest amount of milfoil occurred at the Little Square Bay location and ranged from 5 stems detected in the month of June to 1 stem in the month of September. It is important to note that we observed different individual plants in Little Square Bay during each monthly measurement. The harvesting crew typically cleared the milfoil from our study area several times a month, with new plants appearing between measurements. This observation further demonstrates the productivity of milfoil in Little Square Bay. We detected between 1 and 2 milfoil stems at other locations on Upper Saranac Lake, including Gilpin, Gull, and Saginaw Bays. The plants enumerated at these sites appeared to be same plant each month. Overall, stem density (stems/acre) has remained low through the entire maintenance period, and particularly low during the last three years (Figure 5). Average stem density across all locations in 2015 was 10.2 stems/acre. To put this number in perspective, average stem density during the first year of the intensive management period was sixty times greater at 600 stems/acre.

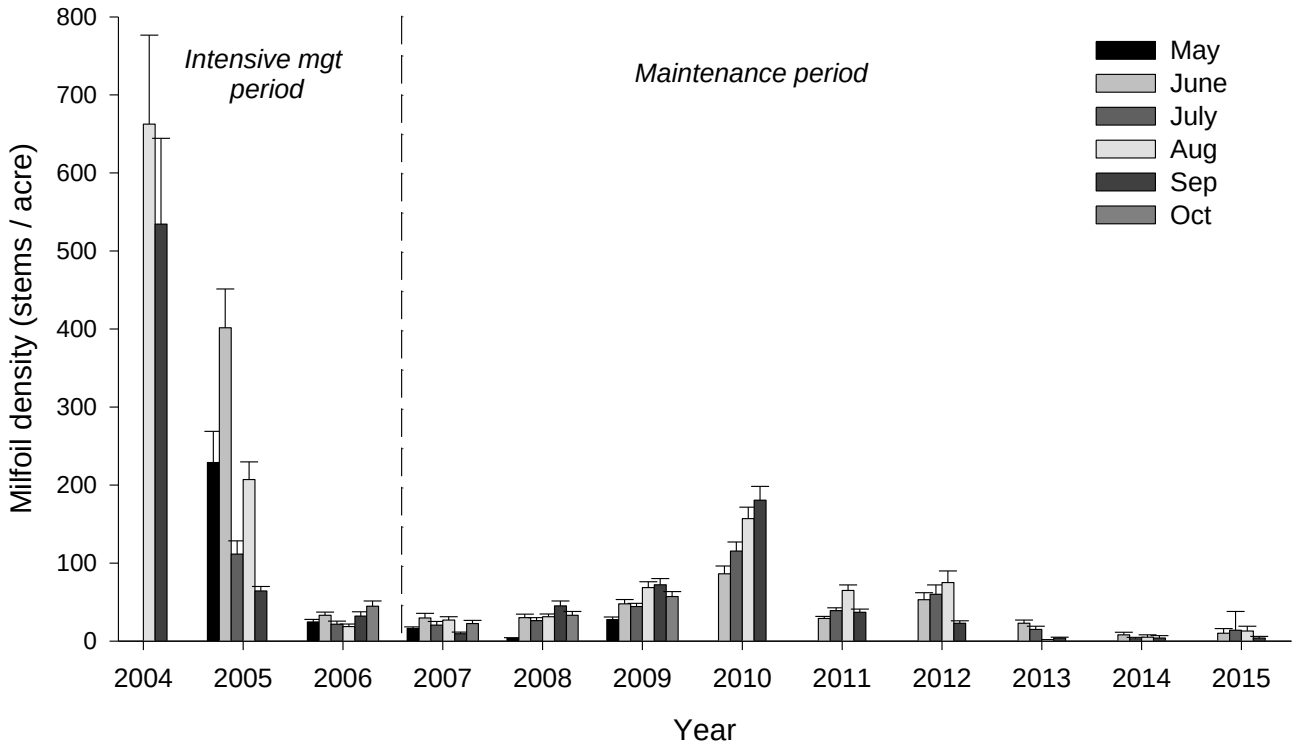

Figure 6. The average density of Eurasian water-milfoil at the 13 underwater monitoring sites in Upper Saranac Lake 2004-2015. Vertical bars represent standard error (SE) of the mean, n=15.

The aquatic plant found to occur most frequently in Upper Saranac Lake was Robbins pondweed, which occurred on 68% of the study segments (Figure 6). Other common species encountered were water nymph (Najas species), eelgrass (*Vallisneria americana*), spiral fruit pondweed (*Potamogeton spirillus*), stonewort, (*Nitella species*), and Canada water weed (*Elodea canadensis*). Eurasian water milfoil was ranked 17th in terms of frequency of occurrence and is considered to be a rare plant in the lake. In August of 2015 Eurasian water milfoil was found on only 1% of the 588 study segments, down from a high of 11% of study segments in 2004, a marginally significant down ward trend (P = 0.06). Since 2006 the frequency of occurrence of milfoil has fluctuated between 0.7 and 5.7% of study segments, with most plants being encountered in Little Square Bay, Gull Bay, Gilpin Bay, and Square Bay.

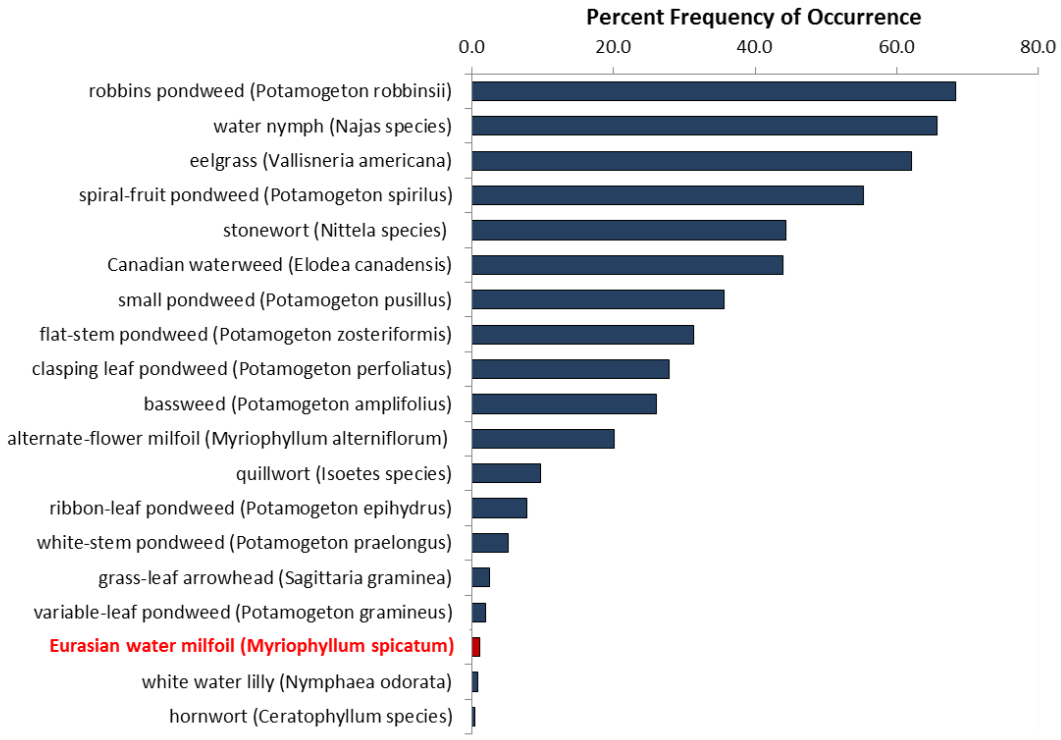

Figure 7. Percent frequency of occurrence of aquatic plant species on the study segments of Upper Saranac Lake, August 2015. Red indicates invasive or non-indigenous species.

Conclusions

Our study of the underwater transect data further demonstrates that the 12 year management effort on Upper Saranac has been successful at reducing the lake wide abundance of Eurasian water milfoil. The removal effort, has resulted in a reduction of milfoil density from over 600 stems/acre in 2004, to 10.3 stems/acre in 2015. Over the last three year, the density of the plant has been particularly low, and ranged from 5 to 11 stems per acre. Milfoil density in Upper Saranac is substantially lower than other lakes in the Adirondacks with established milfoil populations. For example, in Chateaugay Lakes the average August milfoil density across similar underwater transects has ranged from 5,200 to 11,000 stems/acre over the last 5 years (AWI unpublished data 2015). Similarly, milfoil density at the unmanaged Fish Creek Pond location was 30 times greater than the average density at the Upper Saranac locations in 2015.

The management effort has also been successful at reducing the frequency at which milfoil beds are encountered on Upper Saranac. At this time we consider Eurasian water milfoil to be a rare plant in Upper Saranac Lake as it occurred on only 1% of the 588 study segments during August, the month of greatest aquatic plant cover. We were 10 times more likely to encounter milfoil on the study segments in 2005. Milfoil encounter rates are much greater in Fish Creek Pond and are highly variable between years, suggesting that the milfoil bed being studied in Fish Creek is unstable.

We have observed that the abundance of variable – leaf milfoil is increasing in Fish Creek Pond. First detected in 2009, the species now occurs on 25% of the study segments. Surface water observations confirm that the species can be found throughout Fish Creek Pond, and it has also been encountered sporadically in Upper Saranac Lake. Although its native status is unclear, variable-leaf milfoil is a species of concern throughout the northeast. Like Eurasian water milfoil, variable-leaf milfoil is capable of forming dense beds, congesting waterways, and reducing plant species richness.

Appendix 1. Tabular Data

	Upper Saranac Lake - Average Stems per acre plus SE of the mean											
	MAY	***May SE***	**JUNE**	***June SE***	**JULY**	***July SE***	**AUG**	***Aug SE***	**SEP**	***Sep SE***	**OCT**	***Oct SE***
2004							663	*114*	534	*110*		
2005	229	*40*	402	*50*	111	*17*	207	*23*	64	*6*		
2006	25	*3*	33	*4*	22	*4*	19	*3*	32	*5*	45	*7*
2007	16	*2*	30	*6*	20	*5*	27	*4*	9	*2*	23	*4*
2008	3	*1*	30	*5*	26	*4*	31	*3*	45	*6*	33	*5*
2009	28	*3*	48	*5*	44	*4*	69	*8*	72	*8*	57	*6*
2010			86	*10*	115	*12*	157	*15*	181	*18*		
2011			29	*3*	39	*4*	65	*7*	37	*4*		
2012			53	*9*	60	*12*	75	*15*	23	*3*		
2013			23	*4*	15	*4*	2	*0*	4	*1*		
2014			8	*0.9*	3	*0.6*	5	*0.9*	4	*0.9*		
2015			10	*6*	14	*24*	13	*6*	4	*2*		

	Fish Creek Pond - Average Stems per acre plus SE of the mean											
	MAY	*May SE*	JUNE	*June SE*	JULY	*July SE*	AUG	*Aug SE*	SEP	*Sep SE*	OCT	*Oct SE*
2006	91	*17*	91	*17*	91	*9*	127	*23*	91	*17*	145	*15*
2007	0	*0*	18	*9*	36	*10*	54	*9*	109	*10*	145	*15*
2008	36	*18*	36	*18*	109	*23*	127	*17*	145	*15*	127	*9*
2009	36	*18*	54	*9*	91	*17*	182	*10*	182	*10*		
2010			109	*23*	290	*71*	399	*90*	345	*72*		
2011			109	*31*	163	*31*	381	*70*	399	*80*		
2012			202	*35*	303	*60*	524	*39*	363	*53*		
2013			367	*44*	561	*38*	668	*44*	690	*31*		
2014			388	*62*	474	*45*	688	*40*	712	*22*		

[i] Martin, M., Deangelo, M., Hyde, J., Southerland, J., Bonham, R., Bloomfield, J., Gallinger, G., Siegfried, C., Eichler, L., and C. Boyle. 1998. The State of Upper Saranac Lake, NY. Adirondack Watershed Institue of Paul Smiths College.

[ii] Kelting, D.L. and C.L. Laxson. 2010. Cost and effectiveness of hand harvesting to control the Eurasian water milfoil population in Upper Saranac Lake, New York. *Journal of Aquatic Plant Management*. 48:1-5.