Loon Lake Integrated Aquatic Plant Management Program

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Background
A complete littoral survey and subsequent physical plant management of Eurasian watermilfoil (*Myriophyllum spicatum*) was undertaken in Loon Lake, Warren County, NY from May-August 2010 by Lycott Environmental Inc. This work follows the work conducted by volunteers dating to 2000, and a contracted firm in the previous four years. Management techniques are solely physical including hand harvesting and benthic barrier installations. This program is operated under a permit from the Adirondack Park Agency. The survey was designed to confirm previously mapped milfoil sites as well as to locate any unmapped beds or areas of growth.

Waterbody Description

Loon Lake is a mesotrohic lake situated in the Town of Chester. It is classified as Type AA and therefore useable as potable water. Loon Lake has a surface area of 586 acres and lies within a watershed of 8,204 acres. The maximum depth is 32 feet with an average depth of 15 feet.Aquatic plant survey data is sparse for this water body, but the invasive, non-native *M. spicatum* was first documented in 2000 (Eichler, 2001) and has since spread to most of the littoral zone (Figure 1). The largest bed is in northeast bay and in general most sites are found along the eastern shore and outlet bays (although 8 of the 37 sites are on the western shore).

Ecology of Eurasian Watermilfoil

Eurasian watermilfoil (hereafter milfoil) was unintentionally introduced to the United States from Eurasia, and was first identified in Washington, D.C., in 1942 (Remaley 2009). The species is a perennial dicot of the family Haloragaceae, and is typically found in greatest abundance in mesotrophic or slightly eutrophic lakes at depths less than five meters. However, the species can tolerate low alkalinity systems to hard-water lakes, and trophic states from eutrophic to oligotrophic (Madsen 1998). Plant growth is nitrogen limited (Smith and Barko 1990). Milfoil presence is influenced by turbidity, and is limited to the photic zone of water bodies (Smith and Barko 1990). Stems can grow to the water surface from depths of 10 meters if water clarity is high enough. Stems of milfoil are long, slender, branching, hairless, and become leafless toward the base. The grayish-green leaves of milfoil are finely dissected and occur in whorls of three or four along the lighter colored stem, with 14-24 pairs of fine, thin leaflets about .5 inch long (Madsen 2005, Remaley 2009).

These leaflets give milfoil a feathery appearance that is a distinguishing feature of the plant (Remaley 2009). Milfoil can live in fresh to brackish water of rivers, reservoirs, natural lakes, and estuaries (Smith and Barko 1990, Madsen 2005). The species can reproduce sexually by seed production through the formation of a short inflorescence above the water surface composed of both pollen-forming and seed-bearing flowers that are wind pollinated (Smith and Barko 1990, Madsen 2005). However, the plant more commonly reproduces through vegetative production of rhizomes and stem fragmentation (Madsen et al 1988, Smith and Barko 1990). Rhizomes can spread the species a few meters by extending the root system in the sediment, but stem fragments can be transported long distances because they can survive for long periods of time before establishment (Madsen 2005). Stem fragmentation is the most important means by which the species spreads both within and across water bodies. Fragments are created through abscission of the stem through autofragmentation, which typically occurs after plants reach the surface (Madsen et al 1988, Smith and Barko 1990).

In Adirondack lakes the highest fragmentation rates have been observed in late September (Madsen et al 1988). Within lakes and river systems, currents are thought to be the primary mode of transport within and across water bodies (Kimbel 1982). Recreational boat traffic is thought to be a mechanism of intra-lake dispersal, as weeds are often tangled in anchors and propellers. This is considered mechanical fragmentation, and humans can unintentionally transport mechanically fragmented segments between water bodies in bilge water, fish buckets, or even on shoes and clothing. Vegetative reproduction alone likely accounts for most milfoil spread within North America (Smith and Barko 1990). Reproduction and growth strategies make the species a threat in many water bodies (Remaley 2009). The plants have shoots that branch profusely when they reach the surface, and can form large, floating mats of vegetation that prevent light penetration for native plants (Madsen et al 1991, Boylen et al 1996). This occurs in areas of high turbidity, where reaching the surface would dramatically increase photosynthetic capacity. Plants in clear waters do not generally extend to the surface (Nichols and Shaw 1986). The species is evergreen and maintains a large biomass throughout the winter, which combined with rapid spring growth once the water temperature reaches 15°C allows the species to reach dominance early in the growing season (Nichols and Shaw 1986). The species has also been shown to increase water temperatures, lower dissolved oxygen levels, and increase nutrient loading from the sediment (Smith and Adams 1986, Unmuth et al 2000). These changes in resources can effectively alter the diversity and richness of plant, macroinvertebrate, and fish assemblages (Valley and Bregiman 2001, Cheruvelil et al 2002). Monotypic beds may decrease the diversity of native aquatic plants and can drive local extinctions (Madsen et al 1991, Boylen et al 1999). This will impact food web structure and ecological stability of an invaded water body.

In addition to altering ecosystem function, milfoil affects recreation by interfering with swimming and boating and reducing the aesthetic appeal of water bodies. Alterations to fish populations may also impact the value of sport fisheries. Dense populations may alter discharge, sedimentation, and impart an unwanted taste and odor to the water, (Smith and Barko 1990, Madsen 2005), which may specifically affect water intake for local residents. Therefore, the ecological alterations caused by a milfoil invasion could have negative economic impacts on the local tourism industry and for the residents of the lake.

Milfoil Management History in Loon Lake

Management History in Loon Lake
Volunteer efforts began immediately upon discovery in 2000. By 2006 the services of an independent contractor was obtained and was supplemented by significant volunteer effort including volunteer divers coordinated by LLPDA. While it is difficult to completely retrace the management history in this lake, available annual reports seem to indicate that harvested plants counts for the years 2006-2009 were 414 (AE); 4,671 (combined AE+LLPDA); 33,524 (combined AE+LLPDA); 32,015 (18,018 by AE, and 13,997 by LLPDA) respectively. Additionally, 10'x10' benthic barrier panels have been installed in various locations.

2010 Management in Loon Lake
Record keeping early on in a new aquatic plant management program often takes second place to actual in-lake management efforts. Despite honest efforts to keep track of management and results, the evolving organizational structure around such programs can lead to a difficult reconstruction of such programs after the fact. As such, the current report attempts to document past efforts as well as establish comprehensive site history and current status of milfoil growth and management within Loon Lake. We have discarded prior site numbering systems but will maintain site names/descriptions (where available).

Initially, a complete littoral survey was conducted by snorkeling and using a waterproof, handheld gps unit. Water clarity and wind conditions can limit the efficacy of topside survey methods especially for individual plants and sparsely invaded areas. Thus a complete in-water survey is suggested for newly invaded lakes if the management plan includes or is limited to physical techniques. In this case, the diver was assisted by topside help who documented waypoint-specific notes. Individual waypoints were dropped for individual plants as well as sparse distributions of plants as encountered. Dense beds and moderately dense areas were mapped in detail by dropping waypoints ca. every meter around the milfoil bed (so as to get accurate estimates of bed sizes and best management plan for any given site). A total of 37 milfoil sites were mapped (Figure 1) and density estimates were obtained (Table 1).

Twenty-eight of the 37 sites were cleared by hand harvesting, five sites were reduced using hand harvesting and/or benthic barriers and four sites were not managed at all in 2010 due to time constraints (Figure 2). Lycott and LLPDA removed 26,947 and 1,703 plants respectively by hand harvesting. A total of 58 (375 sf) barrier panels were installed across sites 5, 11, 18 and 34 (two installations of 29 panels each) and 10, (100 sf) panels were installed at site 32 by LLPDA. Twenty-nine panels remain in place at site 11 and the LLPDA panels remain at site 32. Panels used by Lycott are 7.5'x50,' those installed by LLPDA were 10'x10.' Thus a total of 21,750 sf of barrier material was installed by Lycott and 500 sf by LLPDA. Due to necessary overlap of panels, actual combined coverage was ca. 19,250 sf. Average plant density at install sites was calculated to be 1.7/sf. Thus, Lycott and LLPDA barrier coverage removed an estimated 32,045 and 680 plants respectively. The combined total number of plants removed from Loon Lake in 2010 from hand harvesting and benthic barrier placement was 58,992 by Lycott and an additional 2,383 by LLPDA; for a total of 61,375 plants. Site 11 and most of the outlet sites will require significant management in 2011 (Figure 2).

Table 1. Progress and status by site number. Action column codes= 'C' cleared, 'O' observed, 'R' reduced.

Site	Zone	Name	Density	Lycott	LLPD A	Action	Panels installed (sf)	Panels installed (#)
1	n/a	Van Guilder Lane	Sparse	36	-	C	-	-
2	n/a	Van Guilder Lane North	Sparse	42	-	C	-	-
3	19	Burke's Cottages	Scat.	58	-	C	-	-
4	n/a	Bonnie Belle	Scat.	73	-	C	-	-
5	16	Water's Edge Pt (Wh. Dock)	Mod.	2683	-	C	3375	9
6	n/a	Birchwood Motel (South)	Mod.	771	-	C	-	-
7	21	Birchwood Motel (North)	Mod.	1727	-	C	-	-
8	n/a	Vista View Shoreline	Scat.	144	-	C	-	-
9	2	Northeast Bay Point	Mod.	382	-	C	-	-
10	2	Northeast Bay Cove	Scat.	228	-	C	-	-
11	20	North East Shore Drive	Bed	2746	223	R	10875	29
12	20	Middle East Shore Drive	Mod.	754	-	C	-	-
13	20	South East Shore Drive	Mod.	1212	-	C	-	-
14	15	Blythewood Is. (West)	Scat.	389	-	C	-	-
15	4	Blythewood Is. (South Bay)	Bed	3928	-	R	-	-
16	23	Island	Bed	531	-	C	-	-
17	6	Height's Beach	Mod.	653	528	C	-	-
18	22	North of Martin's Bay	Bed	1265	48	C	5625	15
19	8	Kingsley's Extention	Scat.	331	-	C	-	-
20	9	Martin's Bay (Shoreline)	Scat.	-	577	R	-	-
21	n/a	Martin's Bay (Midbay)	Bed	-	-	O	-	-
22	9	Martin's Bay (East Cove)	Scat.	-	11	R	-	-
23	n/a	Conway's Shore	Scat.	-	-	O	-	-
24	11	Chester Shore East	Scat.	-	31	R	-	-
25	11	Chester Shore Middle	Mod.	-	-	O	-	-
26	n/a	Chester Shore West	Sparse	8	-	C	-	-
27	7	Blue Bay	Scat.	679	-	C	-	-
28	n/a	Birchwood South	Scat.	546	-	C	-	-
29	n/a	Birchwood North	Scat.	77	-	C	-	-
30	5	Frego's Rock	Bed	3546	-	C	-	-
31	18	North of Marina	Scat.	9	-	C	-	-
32	4a	Blythewood Is. S. (Midbay)	Scat.	203	275	C	500	5
33	3	Vista View	Mod.	241	-	C	-	-
34	17	Three Sisters	Bed	3615	-	C	1875	5

35	1	Stump City	Scat.	13	-	C	-	-
36	n/a	Blythewood Is. North	Scat.	57	-	C	-	-
37	10	Cole's Bay	Scat.	-	-	O	-	-
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			Totals:	**26,947**	**1,703**		**22,250**	**63**

Future directions

Even though most sites were cleared through 2010 efforts, a large milfoil bed remains in place at site 11 and moderate to dense growth remains at several locations near the outlet. Moreover, physical management can generate plant fragmentation. Therefore it is anticipated that most of the cleared sites will have some level of milfoil regrowth in 2011.

It is suggested that 2011 milfoil management occurs in the following sequence:

1) panels are removed and reinstalled at site 11
2) all sites cleared or reduced in 2010 are visited and cleared by hand harvesting
3) outlet sites are managed
4) complete shoreline survey/removal to insure any new sites are found and managed
5) remove and install panels at site 11 to complete bed coverage (30---45 days after step 1) 6) any remaining management effort to be directed at follow---up harvesting at large sites and all outlet sites.

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Figure 1. Site locations, numbers, boundaries and density pre---management, May 2010.

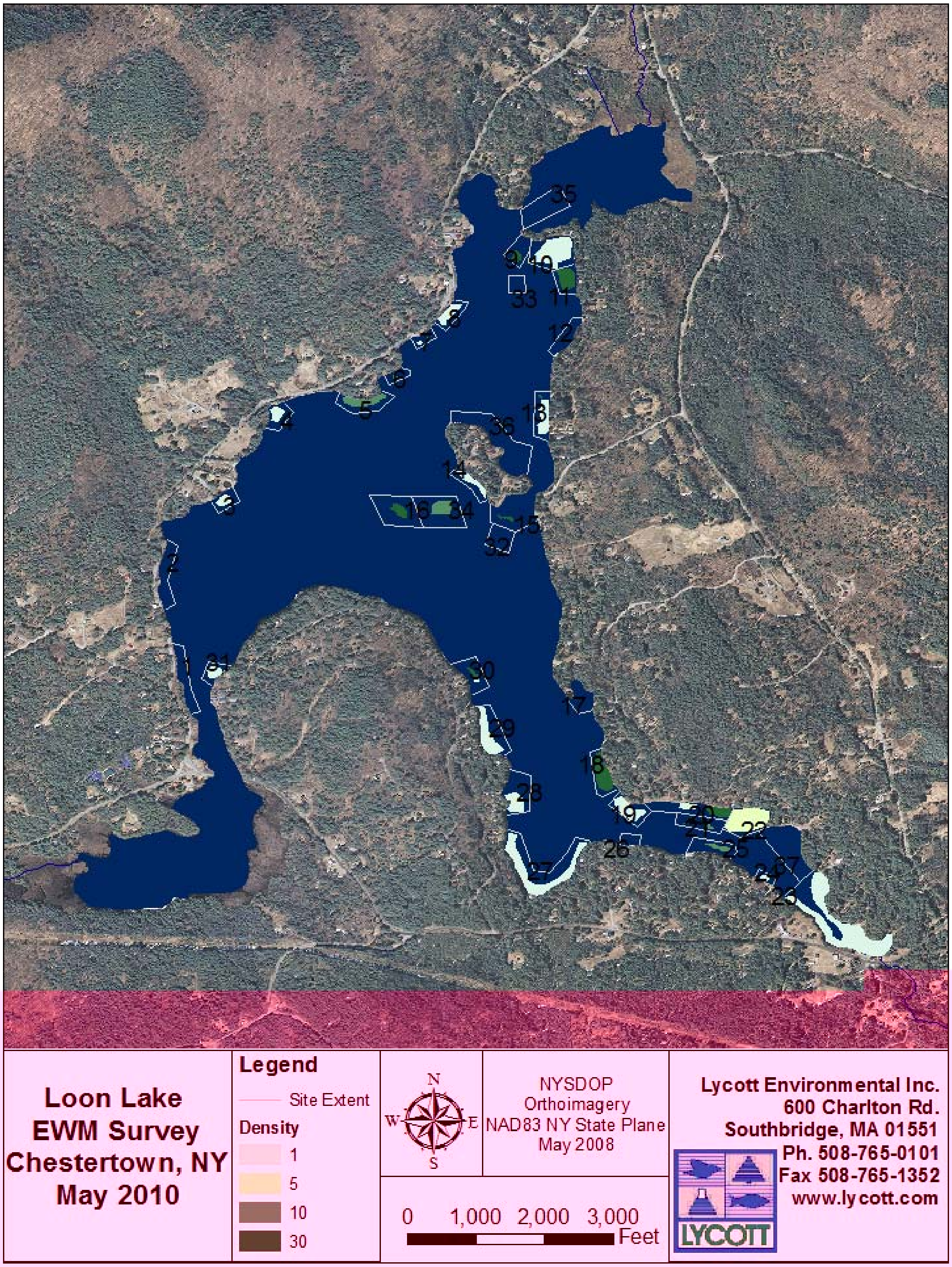

Figure 2. Site locations, numbers, boundaries and density post---management, August 2010.