Interim Report on Vegetation of Saratoga Lake, New York
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Background.

Quantitative aquatic plant surveys were undertaken for Saratoga Lake, New York as part of a cooperative effort between Solitude Lake Management and the Darrin Fresh Water Institute, and supported by the Saratoga Lake Protection and Improvement District (SLPID). The aquatic plant survey was designed to be comparable to pre-treatment and post-treatment data collected by the author in 2004, and 2007 thru 2016 (Eichler & Boylen 2016) to evaluate a treatment program based on application of the herbicide fluridone (SONAR^{TM}) in 2007 and the herbicide triclopyr (Renovate) in 2008 thru 2013 and a combination of triclopyr and Aquathol K in 2014 (Figure 1) to control Eurasian watermilfoil (*Myriophyllum spicatum*). In 2011, hand harvesting of Eurasian watermilfoil by SCUBA divers was also conducted by Adirondack Invasives Management (AIM) in an area south of Mannings Cove. No treatment was conducted in 2015. The Point-Intercept Rake Toss method presently required by NYS DEC for Tier III Lakes was employed.

The project was designed to obtain data to evaluate current aquatic plant management efforts and review potential new strategies. The assessment will generate the information necessary to: 1) review effectiveness of aquatic plant management efforts, 2) meet all permit requirements and 3) provide data for comparison of post-treatment conditions to prior survey information.

Methods

1. Species List and Herbarium Specimens. As the lake was surveyed, the occurrence of each aquatic plant species observed was recorded and adequate herbarium specimens collected. Herbarium specimens were pressed, dried, and mounted (Hellquist 1993) at the Darrin Fresh Water Institute Laboratory in Bolton Landing, NY, where they became part of the permanent collection.

2. Point Intercept. The frequency and richness of aquatic plant species were evaluated using a point intercept (rake toss) method (Madsen 1999). At each grid point intersection, all species located at that point were recorded, as well as water depth. Species were located by a visual inspection of the point and by deploying a rake to the bottom, and examining the plants retrieved. A differential global positioning system (DGPS) was used to navigate to each point for the survey observation. Point intercept plant frequencies were surveyed on August 22 and 24 of 2017, at the time of maximum aquatic plant abundance. Based on an 80 m grid and excluding the majority of points outside the littoral zone, we surveyed a total of 308 points on Saratoga Lake (Figure 2). The point intercept method allows a large number of discrete observations in a

short period of time facilitating statistical analysis and comparisons. Point intercept methods also allow for production of distribution maps for all species listed.

Figure 1. Aquatic plant management plan for Saratoga Lake prepared by Aquatic Control Technologies, Inc.

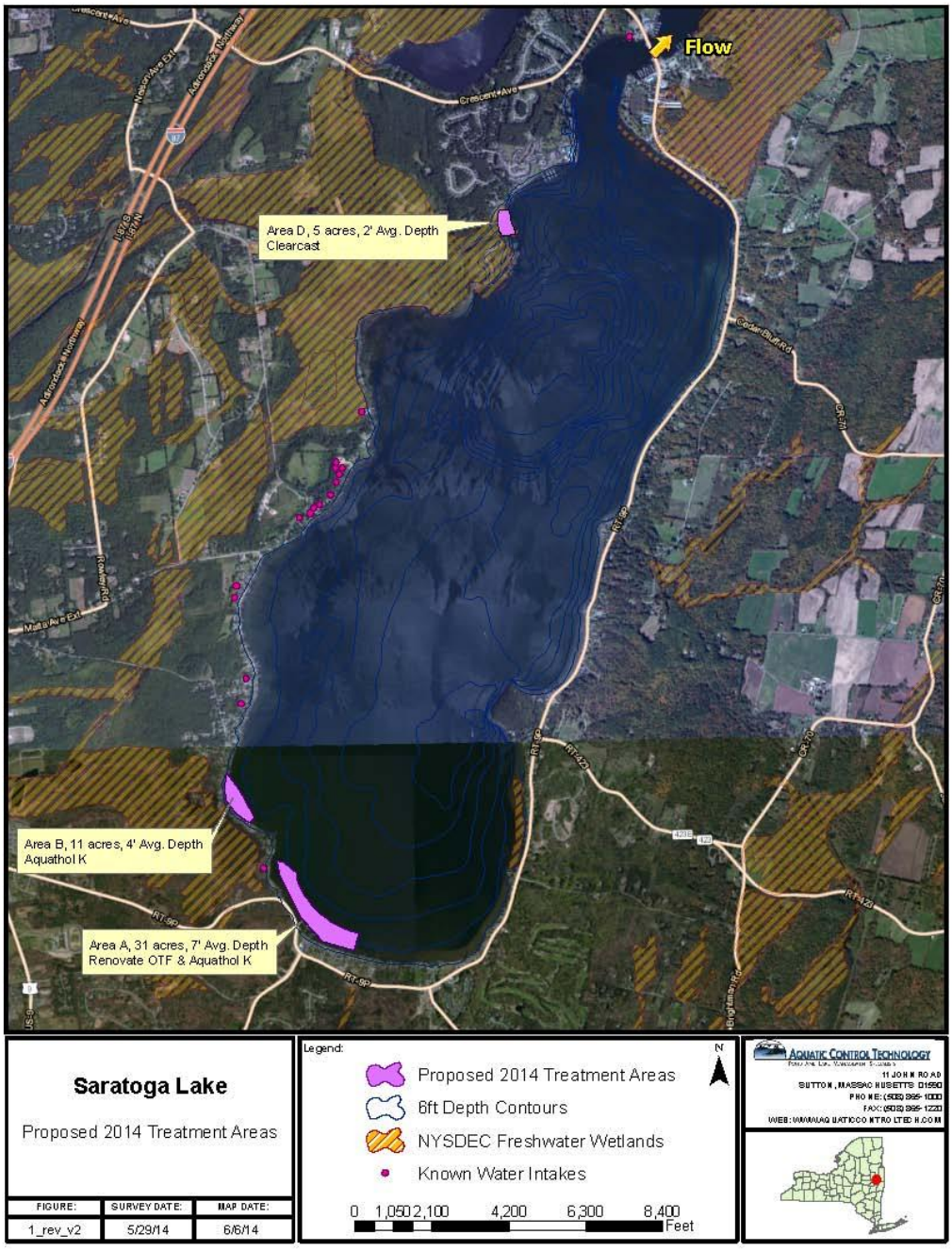
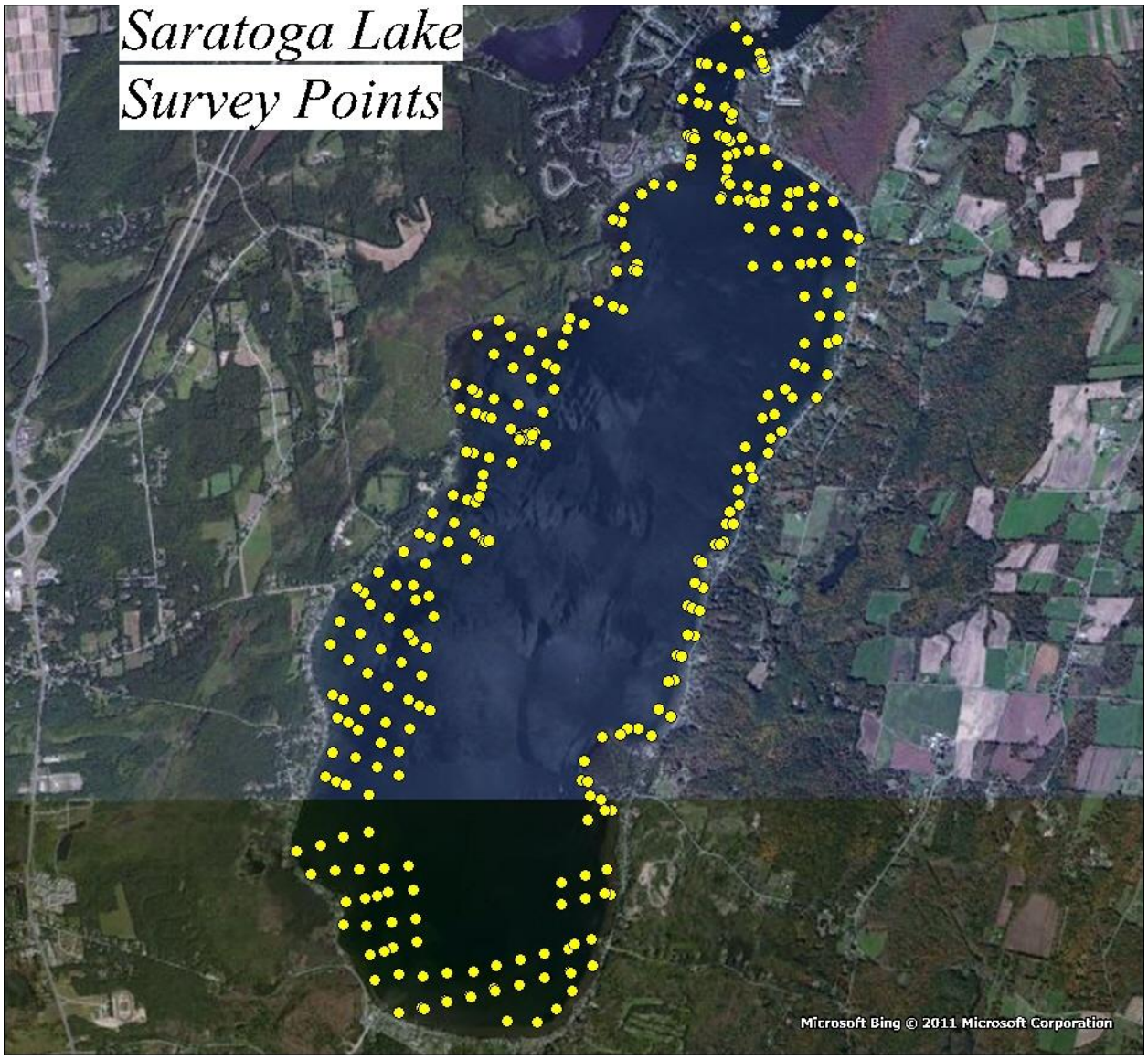


Figure 2. Sampling points for 2017 Saratoga Lake aquatic plant survey.



Results

1. Species List. A preliminary list of species observed for Saratoga Lake is provided in Table 1. A total of 26 species were collected in the point intercept portion of the survey and 28 species were observed in Saratoga Lake in 2017. These results are comparable to previous surveys in 2015 (27 species, Eichler 2015; 2016), 2010 and 2012 (24 species, Eichler and Boylen 2010; 2012), 2009 (29 species, Eichler and Boylen 2009), 2007 - 2008 (25 species, Eichler and Boylen 2008), 2004 (21 species, Eichler and Boylen 2004), 1994 (22 species, Eichler and Boylen 1995), 1982 (21 species, Hardt et al. 1983) and 1969 (20 species, Dean 1969). None of the species encountered in Saratoga Lake are on the New York State Rare Species List (Young, 2010).

2. Species Frequency. Species richness in Saratoga Lake was quite high, with a large number of species occurring in more than 5% of survey points (Table 2). Eurasian watermilfoil was the fourth most widely distributed plant (29% of survey points, Figure 3), an increase from fifth in 2016, fourth in 2015 and third in 2014, but an increase from fifth in 2011 and 2012, seventh in 2010 and ninth in 2009 (Figure 3). Common native species included *Vallisneria americana* (41%), *Ceratophyllum demersum* (46%), *Potamogeton richardsonii* (21%), *Najas guadalupensis* (26%), *Zosterella dubia* (31%), *Elodea canadensis* (11%), and *Najas flexilis* (9%). *Potamogeton richardsonii* has increased dramatically in frequency of occurrence over the past few years. Average number of species per sample point was 2.48 ± 0.10, similar to 2016 (2.35 ± 0.11), 2015 (2.46 ± 0.11), 2014 (2.89 ± 0.12), 2013 (2.63 ± 0.13), 2012 (2.59 ± 0.12), 2011 (2.79 ± 0.11), 2009 (2.74 ± 0.12) and 2008 (2.47 ± 0.12), but less than in 2010 (3.47 ± 0.12). Exclusion of all survey points outside the littoral zone in 2010 may account for this change.

Figure 3. Distribution of Eurasian watermilfoil (*Myriophyllum spicatum*) in surveyed areas of Saratoga Lake in 2017.

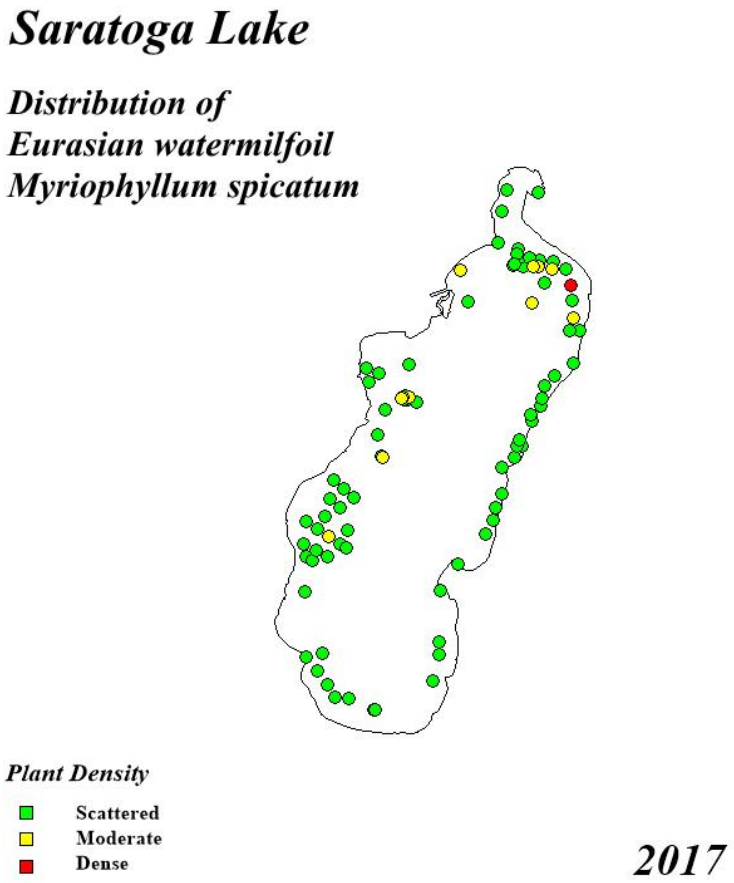


Table 1. Aquatic plant species present in Saratoga Lake in recent surveys.

Species	**Common Name**	**2013**	**2014**	**2015**	**2016**	**2017**
Ceratophyllum demersum L.	coontail	x	x	x	x	x
Chara/Nitella sp.	muskgrass, chara	x	x	x	x	x
Elodea canadensis Michx.	elodea	x	x	x	x	x
Lemna minor L.	duckweed	x	x	x		
Lemna trisulca L.	duckweed	x	x	x	x	x
Megalodonta beckii Torr.	water marigold	x	x	x	x	x
Myriophyllum spicatum L.	Eurasian watermilfoil	x	x	x	x	x
Najas flexilis (Willd.) Rostk. & Schmidt.	bushy pondweed	x	x	x	x	x
Najas minor All.	Minor Naiad	x	x	x		x
Najas guadalupensis (Spreng.) Magnus	Southern naiad	x	x	x	x	x
Nuphar variegata Engelm. ex Durand	yellow pondlily	x	x	x	x	x
Nymphaea odorata Ait.	white pondlily	x	x	x	x	x
Pontederia cordata L.	pickerelweed	x	x	x	x	x
Potamogeton amplifolius Tuckerm.	largeleaf pondweed	x	x	x	x	x
Potamogeton crispus L.	curlyleaf pondweed	x	x	x	x	x
Potamogeton foliosus Raf.	leafy pondweed	x				
Potamogeton gramineus L.	variable-leaf pondweed	x	x		x	x
Potamogeton illinoensis L.	Illinois pondweed	x	x	x	x	x
Potamogeton perfoliatus L	clasping-leaved Pondweed	x	x	x	x	x
Potamogeton praelongus Wulfen	white-stem pondweed	x	x	x	x	x
Potamogeton pusillus L.	small pondweed		x	x		
Potamogeton richardsonii (Ar. Benn.) Rydb.	Richardsons' pondweed	x	x	x	x	x
Potamogeton robbinsii Oakes	Robbins' pondweed	x	x	x		
Potamogeton vaseyi Robbins	Vasey's pondweed	x	x			
Potamogeton zosteriformis Fern.	flat-stem pondweed	x	x	x	x	x
Ranunculus longirostris Godron	white watercrowfoot	x		x		x
Sparganium sp.	burreed	x	x	x	x	x
Spirodela polyrhiza	giant duckweed				x	x
Stuckenia pectinata L.	sago pondweed	x	x	x	x	x
Trapa natans L.	waterchestnut	x	x	x	x	x
Typha	cattail	x	x	x	x	x
Utricularia vulgaris L.	great bladderwort	x		x		x
Vallisneria americana L.	wild celery	x	x	x	x	x
Wolffia sp.	Water meal				x	x
Zosterella dubia Jacq.	water stargrass	x	x	x	x	x

Table 2. Percent frequency of occurrence of aquatic plant species in Saratoga Lake. Invasive species are in bold.

Species	Common Name	2013	2014	2015	2016	2017
Ceratophyllum demersum	coontail	53.5%	47.5%	36.7%	32.8%	45.6%
Chara/Nitella	muskgrass, chara	11.6%	10.2%	12.0%	10.4%	8.1%
Elodea canadensis	elodea	14.5%	16.9%	13.6%	10.4%	11.3%
Lemna minor	duckweed	0.3%	0.3%	0.3%		
Lemna trisulca	duckweed	3.3%	1.7%	1.3%	1.3%	0.6%
Megalodonta beckii	water marigold	0.3%	1.0%	1.6%	1.9%	1.6%
Myriophyllum spicatum	**Eurasian watermilfoil**	**23.1%**	**37.3%**	26.9%	26.0%	29.4%
Najas flexilis	bushy pondweed	6.9%	8.5%	8.1%	8.4%	8.7%
Najas guadalupensis	Southern naiad	30.0%	34.2%	24.7%	23.7%	25.6%
Najas minor	**brittle naiad**	**0.7%**	**0.3%**	0.6%	1.0%	1.0%
Nuphar variegata	yellow pondlily	0.7%	1.0%	1.0%	0.6%	1.0%
Nymphaea odorata	white pondlily	0.7%	0.7%	0.3%	0.6%	0.3%
Potamogeton amplifolius	largeleaf pondweed	1.3%	1.4%	1.0%	2.3%	1.6%
Potamogeton crispus	**curlyleaf pondweed**	**2.3%**	**3.4%**	3.2%	1.0%	1.6%
Potamogeton foliosus	leafy pondweed	1.7%				
Potamogeton gramineus	variable-leaf pondweed	0.3%	1.0%		0.3%	
Potamogeton illinoensis	Illinois pondweed	6.9%	6.1%	5.2%	4.2%	6.5%
Potamogeton perfoliatus	Clasping-leaved Pondweed	0.3%	0.3%	1.3%	1.0%	2.3%
Potamogeton praelongus	white-stem pondweed	2.3%	3.4%	3.9%	2.6%	1.9%
Potamogeton pusillus	small pondweed		0.3%	0.3%		
Potamogeton richardsonii	Richardsons' Pondweed	33.3%	33.9%	31.5%	30.8%	21.4%
Potamogeton robbinsii	Robbins' pondweed			0.3%		
Potamogeton vaseyii	Vasey's pondweed		1.0%			
Potamogeton zosteriformes	flat-stem pondweed	9.9%	6.1%	2.6%	2.9%	1.9%
Ranunculus longirostris	white watercrowfoot	1.0%		0.3%		0.3%
Spirodela polyrhiza	Giant duckweed				0.3%	0.3%
Stuckenia pectinata	sago pondweed	2.0%	0.3%	0.3%	1.0%	1.3%
Trapa natans	**waterchestnut**	**0.3%**	**0.3%**	0.6%	1.3%	1.0%
Utricularia vulgaris	giant bladderwort			0.3%		0.6%
Vallisneria americana	wild celery	35.3%	44.1%	42.2%	40.9%	41.4%
Wolffia sp.	Water meal				1.0%	1.0%
Zosterella dubia	water stargrass	17.5%	27.5%	25.3%	28.9%	31.1%

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