

Chautauqua Lake Plant Monitoring Program

2019 Delineation of Aquatic Vegetation in Chautauqua Lake



Image: Blogspot.com

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Table of Contents

Introduction, Methodology3
Survey Results5
Central & South Basin6
 Town of Chautauqua.....9
 Town of North Harmony10
 Towns of Busti & Lakewood11
 Town of Ellery & Village of Bemus Point.....12
North Basin.....13
 Town of Chautauqua-West16
 Town of Chautauqua – East17
 Village of Mayville18
 Town of Ellery.....19
Discussion19
Summary of Findings.....22

Appendix: Central & South Basin Plant Maps
 Central & South Basin Data files (electronic only)
 North Basin Plant Maps
 North Basin Data files (electronic only)
 Macrophyte Descriptions

2019 Delineation of Aquatic Vegetation in Chautauqua Lake

Introduction

Chautauqua Lake supports an abundance of aquatic plant growth, including extensive beds of the non-native submersed species Eurasian Watermilfoil (*Myriophyllum spicatum*) and Curly-leaf Pondweed (*Potamogeton crispus*). Both are highly invasive submersed aquatic plants that can result in significant negative ecological, recreational, and economic impacts. This survey and the maps generated herein are crucial for the preparation of future submersed aquatic plant management at Chautauqua Lake. The survey was designed to provide support for on-going aquatic plant management activities in Chautauqua Lake, and specifically to enable herbicide application planning and permitting for 2020. Due to the observed lack of aquatic plant growth in the lake's south end in August 2019, that portion of the survey (Ellicott, Celeron, Lakewood) is being conducted in Spring 2020.

System Characteristics

Chautauqua Lake is a 13,000-acre waterbody, the largest inland lake in western New York, and is comprised of two basins of nearly equal size. The South Basin is generally shallower than the North Basin, with mean depths of 11 and 25 feet, respectively. While geographically located on the southeastern shore of Lake Erie, Chautauqua Lake shares a separate watershed. Water flows into the lake via small tributaries along the two basins and flows out the South Basin into the Chadakoin River. The Chautauqua Lake basin acts as the northeastern-most portion of the Ohio River basin and therefore the Mississippi River basin. Historically, the lake has been used by various industries which has transitioned into supporting the most grape farming/production in New York in addition to a tourism-based economy.

Methodology

Point Intercept Submersed Aquatic Plant Mapping

The Point Intercept Method (PIM) of sampling macrophytes is designed to determine the extent of submersed aquatic plant growth within an area of concern. Point-intercept locations were determined throughout the delegated littoral zone, where one sample station was established for ~every 2.5 surface acres in the North Basin, and ~every 4 acres in the Central and South basins and randomly assigned on a grid pattern overlay of the section.

A total of 863 sample sites were established for the 2019 Fall monitoring event. For monitoring purposes, the survey area was broken into the North and South basins. Below is a summary of municipal locations (Table 1).

Section/Town	# Sites	Notes
North Harmony	153	Southcentral shoreline of survey area. Included in South Basin area.
Busti/Lakewood	98	Southwestern shoreline of survey area in South Basin
Mayville	109	Northwestern shoreline of North Basin survey area
Chautauqua	277	Northern-most portion of western and eastern shorelines within the North and South basin survey areas.
Ellery	226	Northeastern shoreline of the survey area, spanning between the North and South Basins. Includes Bemus Bay.

During the survey, each predetermined georeferenced point was accessed by boat in a feasible order based on general lake and weather conditions. At each point, the real-time GPS location was recorded using a Trimble Geo 7X, a handheld GNSS system. The accuracy of this unit is sub-decimeter and suitable to track changes in plant growth over time following aquatic plant control. **One rake toss** was conducted at each site.

The Rake Toss Methodology, developed by the US Army Corps of Engineers and modified by Cornell University was used for this survey (Lord and Johnson 2006). SLM has further modified these survey protocols for large-scale submersed aquatic plant mapping projects. The following data was collected for each rake toss: depth (when possible), overall abundance of macrophyte growth, relative abundance of each species, and any other pertinent field notes regarding the site location. The abundance scale defined by this methodology was used to categorize the observed macrophyte growth for each rake toss (Table 2).

Abundance	Dry Weight (g/m ²)	Mean Weight (g/m ²)	Description
No Plants (Z)	0.0	0.0	No plants on rake
Trace (T)	0.0001-0.9999	0.5	Fingerful on rake
Sparse (S)	1.0000-24.9999	13.0	Handful on rake
Medium (M)	25.0000-99.9999	62.5	Rakeful of plants
Dense (D)	100.0000-400.0000+	250.0	Difficult to bring into boat

The dry weight and mean weight are equivalent to the abundance scale – determined by Cornell University (Lord and Johnson 2006). The dry weights can be used to calculate the biomass produced, but are not included as part of this study.

Water depth was recorded during the survey at each sample location as appropriate to the conditions. An on-board depth finder calibrated instrument was used to obtain depth readings. In-field conditions are referenced in the Survey Results section.

Macrophyte specimens not readily identifiable in the field were collected and associated with corresponding site information. The collected vegetation samples were then placed in a cooler and inspected post-survey section for positive identification. Regionally appropriate taxonomic keys were used to identify the aquatic macrophytes to the lowest practical taxa – typically to species. Documentation of each species was not a required part of the contracted scope of work, but was collected and is presented in table format, although not in plant maps. Since the assessment of native plant growth was planned and contracted as a “general” assessment, only the most dominant native species have been mapped for the Central and South Basin in this report.

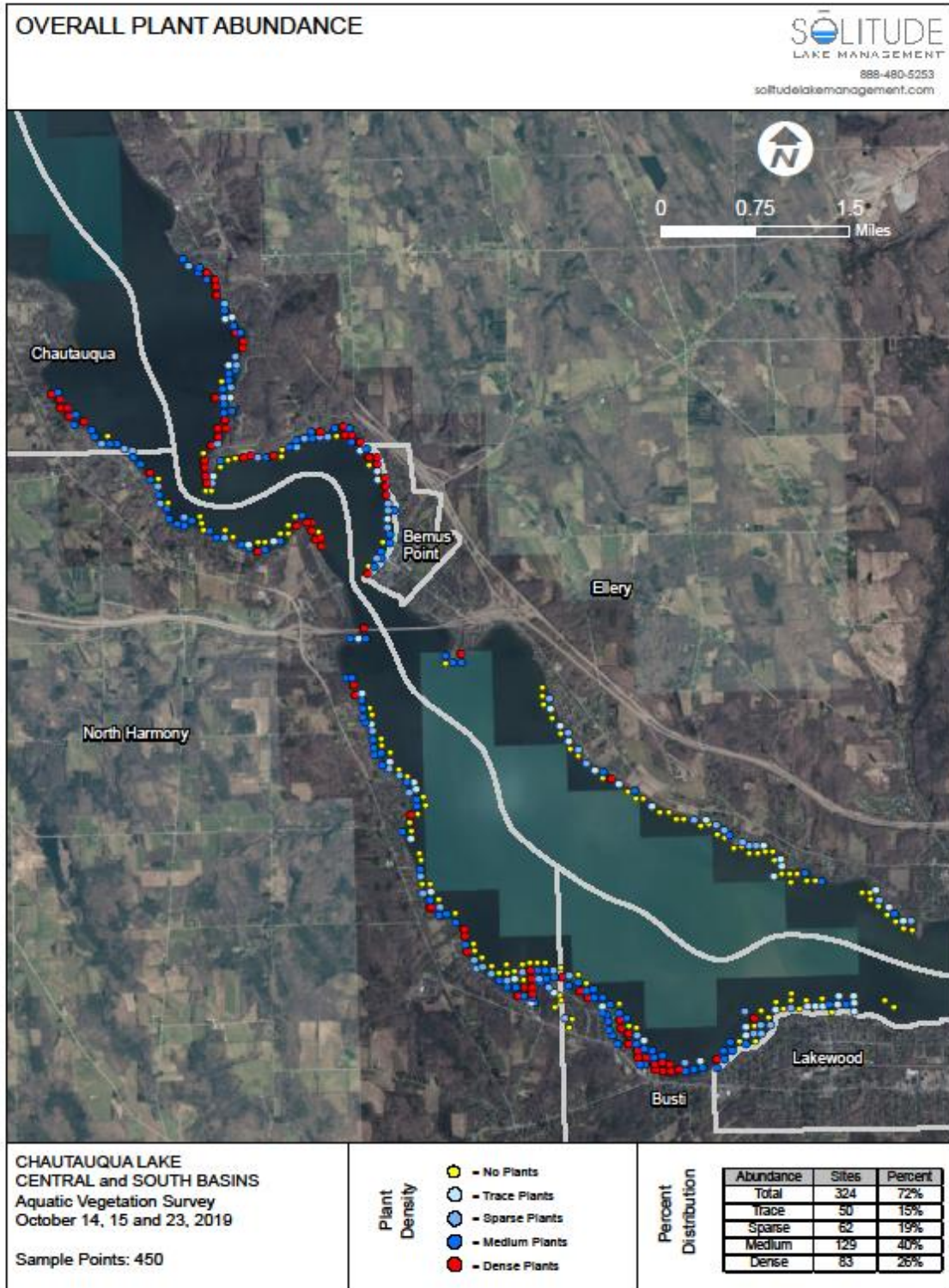
Survey Results

For the 2019 monitoring survey, the Central and South Basin monitoring area extended north to Maple Springs and Whitney Bay, as had been surveyed in the 2018 Fall plant monitoring. The 2019 Central and South Basin fall survey did not include Ellicott, Celoron and part of Lakewood, which will be surveyed in Spring 2020. Areas further north that were newly monitored by Solitude Lake Management in 2019, including the Town of Chautauqua and Village of Mayville, and the balance of Ellery are referred to as the North Basin. While this break between our Central and South, and North Basin reporting does not mirror the language in the Chautauqua County MOA, it allows some comparison between portions of the 2018 & 2019 plant surveys, particularly in the Town of Ellery and Village of Bemus Point.

The results are presented below for the Central and South Basins first, followed by the North Basin. For each Basin, a breakdown of plant diversity in each Town or Village is shown, with the exception of the Busti and Lakewood data. Given the small amount of Lakewood area in the Central and South Basin fall survey, and the fact that both municipalities were grouped together in the 2018 survey, Lakewood was incorporated with the Busti data again. At the end of the report, all data, as well as all maps prepared are included in Appendix.

Central and South Basin

Figure 1



Central and South Basin

The 2019 survey documented 21 macrophytes in the Central and South Basin section – two of which are considered non-native and invasive within the state of New York. Of the 19 native macrophytes, thirteen are submersed species, three are floating-leaf species, two are considered algae, and one is emergent. (The 2018 survey documented 25 macrophytes, however this was in a larger area with almost 3X as many sample sites.)

Submersed aquatic vegetation was documented at 324 of the 450 sites, representing 72% of the sample area. Of the sites supporting vegetation growth, 212 (66%) were categorized as Medium or Dense. The most widely distributed species at the time of the survey was Eurasian Watermilfoil at 218 of the 324 vegetated sites. Native Coontail, Water Celery and Water Stargrass were also prominent throughout the survey area, at 42%, 30% and 29% respectively. Eleven of the 21 species found occurred in less than 5% of the sample sites.

Table 3

Chautauqua Lake - Central and South Basin
Aquatic Macrophyte Abundance Distribution
October 14, 15 and 23, 2019

	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
TOTAL SITES	450									
OVERALL	324	72%	50	15%	62	19%	129	40%	83	26%
EURASIAN WATER MILFOIL	218	48%	130	60%	67	31%	18	8%	3	1%
COONTAIL	188	42%	93	49%	52	28%	29	15%	14	7%
WILD CELERY	135	30%	50	37%	54	40%	25	19%	6	4%
WATER STARGRASS	129	29%	56	43%	41	32%	22	17%	10	8%
COMMON WATERWEED	128	28%	53	41%	40	31%	22	17%	13	10%
SOUTHERN NAIAD	65	14%	38	58%	22	34%	5	8%	0	0%
BENTHIC FILAMENTOUS ALGAE	57	13%	20	35%	30	53%	5	9%	2	4%
IVY-LEAVED DUCKWEED	43	10%	29	67%	13	30%	1	2%	0	0%
SLENDER NAIAD	26	6%	23	88%	3	12%	0	0%	0	0%
WHITE WATER LILY	25	6%	8	32%	16	64%	1	4%	0	0%
CLASPING-LEAF PONDWEED	15	3%	13	87%	2	13%	0	0%	0	0%
CURLY-LEAF PONDWEED	12	3%	11	92%	0	0%	1	8%	0	0%
ILLINOIS PONDWEED	12	3%	10	83%	2	17%	0	0%	0	0%
SMALL DUCKWEED	11	2%	2	18%	9	82%	0	0%	0	0%
WESTERN WATERWEED	10	2%	5	50%	4	40%	1	10%	0	0%
MACROALGAE	5	1%	3	60%	1	20%	1	20%	0	0%
WHITE STEM PONDWEED	5	1%	5	100%	0	0%	0	0%	0	0%
SMALL PONDWEED	2	0%	2	100%	0	0%	0	0%	0	0%
SAGO PONDWEED	1	0%	1	100%	0	0%	0	0%	0	0%
SPIKERUSH	1	0%	1	100%	0	0%	0	0%	0	0%
COMMON BLADDERWORT	1	0%	1	100%	0	0%	0	0%	0	0%

Red entries indicate invasive species; n = 450

Table 4: Distribution of plant density – Central and South Basin

	All Survey Area	Chautauqua	North Harmony	Busti/Lakewood	Ellery/Bemus Point
Total Sites	450	16	107	76	125
Total (%)	48%	82%	44%	54%	46%
Trace-Sparse (%)	34%	86%	97%	81%	92%
Medium-Dense (%)	66%	14%	3%	19%	8%

Curlyleaf Pondweed was the only other non-native species documented at the time of the survey, with a low distribution at 3% (12/450). Single plants were typically documented. However, Curlyleaf Pondweed has a much earlier life cycle from typical northern species, and usually dies back by early June-July in its northern region. A wider distribution across the lake likely occurs earlier in the season, and large surface mats of this plant were reported by lake users and the application team during the May herbicide application. The distribution of curly-leaf pondweed during the Fall survey is expected to be sporadic and inconsistent with the actual distribution due to the late nature of the survey.

The water in the South Basin was visually green and turbid from extremely dense algae growth. Throughout the course of the survey, the algae population appeared to increase from Bemus Bay down to the Ellicott end of the lake. This algae bloom was similar to what was observed during the 2018 survey and referenced in that report. The image below from the 2019 plant survey in the Town of Ellery shows the visible accumulation of algae in the water column.

Figure 2



The specific identifications of Wild Celery (*Vallisneria americana*) and Macroalgae (*Chara/Nitella*) are reasoned as follows. The *Vallisneria* genus is entirely comprised native species, of which *V. americana* is commonly known and identified throughout the northeast, and particularly in New York State. While *V. americana* was identified at Chautauqua Lake, other species were not keyed out considering the multiple growth stages and lack of identifying features on portions of the *Vallisneria* population within Chautauqua Lake. Regarding macroalgae, and considering the presence of starry stonewort (*Nitellopsis obtusa*) within New York state, no starry stonewort was observed within the survey area of Chautauqua Lake. The *Chara* and *Nitella* genera were combined based on the native status and similar ecological influences.

The following section breaks down the individual species found in each Town/Village area of the lake. This breakdown was not part of the accepted contract with the Chautauqua Lake Partnership, but is included since the fieldwork was conducted.

Town of Chautauqua

The 17 site locations within the Central Basin, Town of Chautauqua only cover a small, southern portion of the littoral zone located within the boundaries of the town. This area was included in the 2018 aquatic plant survey, therefore its data was collected and organized with the Central and South Basin data group. A fuller picture and description of aquatic plant growth along this shoreline is shown in the North Basin, Chautauqua West Table later in the report.

This survey area had one of the highest rates of Eurasian Watermilfoil at 82% of sample sites. All species in this area also were present in at least 24% of the sample sites. While the total number of sample sites here was small, the higher plant density and lack of less abundant species is unusual compared to other areas.

Table 5

Chautauqua Lake - Central Basin - Chautauqua										
Aquatic Macrophyte Abundance Distribution										
October 2019										
	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
OVERALL ABUNDANCE	16	94%	0	0%	3	19%	7	44%	6	38%
EURASIAN MILFOIL	14	82%	6	43%	6	43%	2	14%	0	0%
COONTAIL	13	76%	6	46%	3	23%	3	23%	1	8%
WILD CELERY	8	47%	2	25%	5	63%	1	13%	0	0%
COMMON WATERWEED	8	47%	2	25%	3	38%	2	25%	1	13%
SOUTHERN NAIAD	7	41%	4	57%	3	43%	0	0%	0	0%
CLASPING-LEAF PONDWEED	5	29%	4	80%	1	20%	0	0%	0	0%
IVY-LEAVED DUCKWEED	5	29%	3	60%	2	40%	0	0%	0	0%
BENTHIC FILAMENTOUS ALGAE	5	29%	2	40%	3	60%	0	0%	0	0%
WATER STARGRASS	4	24%	3	75%	0	0%	1	25%	0	0%
ILLINOIS PONDWEED	4	24%	4	100%	0	0%	0	0%	0	0%

Red entries indicate invasive species; n = 17

Town of North Harmony

The 153 site locations span the entire approximated littoral zone within the Town of North Harmony. A total of seventeen (17) macrophytes were identified along the Town shorelines. Eurasian Watermilfoil was the most abundant plant at 44% of sites, and the four dominant native plants (Coontail, Common Waterweed, Wild Celery and Water Stargrass) were well-represented at 32-42%. Of the 17 macrophytes, 10 species occurred at 5% or less of the sample sites. These species included all of the native pondweed species and two species of duckweed, a small floating plant. A species not encountered last year, Western Waterweed (*Elodea nuttallii*) was also found at 2 sites.

The 2019 herbicide application in North Harmony covered only ~ 15% of the Town's shoreline. That makes a comparison of the 2018 & 2019 plant survey data somewhat reasonable, since the influence of the herbicide treatment was limited to a small area. There were 153 sample sites in 2019, compared to 251 sites in 2018. The 2019 survey found 17 macrophytes, while the larger sample size in 2018 found 20 species.

The dominant species in 2018 was Coontail at 39% of sample sites, followed by Common waterweed at 32% and then Eurasian Watermilfoil at 29%. In the 2019 survey, all three of these plants increased in abundance, with the Eurasian Watermilfoil increase being the largest and becoming the dominant plant. The Bly Bay area of North Harmony showed the greatest increase in Eurasian Watermilfoil from 2018-2019.

Table 6

Chautauqua Lake - South Basin - North Harmony
Aquatic Macrophyte Abundance Distribution
October 2019

	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
OVERALL ABUNDANCE	107	70%	13	12%	20	19%	50	47%	24	22%
EURASIAN MILFOIL	68	44%	48	71%	18	26%	2	3%	0	0%
COONTAIL	65	42%	37	57%	20	31%	6	9%	2	3%
COMMON WATERWEED	53	35%	20	38%	14	26%	12	23%	7	13%
WATER STARGRASS	51	33%	17	33%	22	43%	10	20%	2	4%
WILD CELERY	49	32%	19	39%	16	33%	12	24%	2	4%
SOUTHERN NAIAD	18	12%	12	67%	5	28%	1	6%	0	0%
WHITE WATERLILY	14	9%	3	21%	10	71%	1	7%	0	0%
IVY-LEAVED DUCKWEED	8	5%	5	63%	3	38%	0	0%	0	0%
SLENDER NAIAD	7	5%	7	100%	0	0%	0	0%	0	0%
BENTHIC FILAMENTOUS ALGAE	5	3%	0	0%	5	100%	0	0%	0	0%
SMALL DUCKWEED	4	3%	1	25%	3	75%	0	0%	0	0%
CURLY-LEAF PONDWEED	3	2%	3	100%	0	0%	0	0%	0	0%
MACRO-ALGAE (NATIVE)	3	2%	1	33%	1	33%	1	33%	0	0%
CLASPING-LEAF PONDWEED	2	1%	2	100%	0	0%	0	0%	0	0%
ILLINOIS PONDWEED	2	1%	2	100%	0	0%	0	0%	0	0%
WESTERN WATERWEED	2	1%	0	0%	2	100%	0	0%	0	0%
WHITE-STEM PONDWEED	1	1%	1	100%	0	0%	0	0%	0	0%

Red entries indicate invasive species; n = 153

Towns of Busti & Village of Lakewood

The 98 site locations span the entire approximated littoral zone within the Town of Busti, and the northern portion of Lakewood. A total of sixteen (16) macrophytes were identified throughout the sampled shoreline. Eurasian Watermilfoil was the dominant species occurring at 54% of the sample sites, and was similar in abundance to Coontail with 49% of sample sites. Seven species were found at less than 10% of sites, including a pondweed, two duckweeds and Common Bladderwort. Bladderworts are more commonly found in softer waters, and would not be expected to thrive in Chautauqua Lake. Since the 2018 survey of Busti encompassed all of Lakewood, including part of Burtis Bay, comparison between 2018 and the current 2019 data are not useful.

The sample areas in Busti and Lakewood were not treated in 2019, however Busti's shoreline was treated in 2018. While Eurasian Watermilfoil is the most abundant species in this area, its interesting to note that Coontail, the second most abundant species, displays a higher density of Medium and Dense sites than does Eurasian Watermilfoil. Experience suggests that this may be due to the impact on Eurasian Watermilfoil from the 2018 application.

Table 7

Chautauqua Lake - South Basin - Busti / Lakewood										
Aquatic Macrophyte Abundance Distribution										
October 2019										
	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
OVERALL ABUNDANCE	76	78%	14	18%	10	13%	33	43%	19	25%
EURASIAN MILFOIL	53	54%	28	53%	15	28%	8	15%	2	4%
COONTAIL	48	49%	19	40%	12	25%	13	27%	4	8%
COMMON WATERWEED	31	32%	14	45%	12	39%	3	10%	2	6%
WATER STARGRASS	28	29%	19	68%	4	14%	5	18%	0	0%
WILD CELERY	25	26%	8	32%	12	48%	4	16%	1	4%
SOUTHERN NAIAD	16	16%	8	50%	6	38%	2	13%	0	0%
SLENDER NAIAD	14	14%	12	86%	2	14%	0	0%	0	0%
BENTHIC FILAMENTOUS ALGAE	13	13%	4	31%	7	54%	2	15%	0	0%
WHITE WATERLILY	11	11%	5	45%	6	55%	0	0%	0	0%
CURLY-LEAF PONDWEED	7	7%	6	86%	0	0%	1	14%	0	0%
SMALL DUCKWEED	7	7%	1	14%	6	86%	0	0%	0	0%
IVY-LEAVED DUCKWEED	4	4%	4	100%	0	0%	0	0%	0	0%
MACROALGAE (NATIVE)	2	2%	2	100%	0	0%	0	0%	0	0%
CLASPING-LEAF PONDWEED	2	2%	2	100%	0	0%	0	0%	0	0%
SMALL PONDWEED	2	2%	2	100%	0	0%	0	0%	0	0%
COMMON BLADDERWORT	1	1%	1	100%	0	0%	0	0%	0	0%

Red entries indicate invasive species; n = 98

Town of Ellery & Village of Bemus Point

The 179 site locations spans almost two-thirds of the approximate littoral zone along the Ellery and Bemus Point shoreline, and extends into the north basin proper to Maple Springs. Despite being recognized as part of the North Basin in the MOA, Long Point to Maple Springs is included in the Central and South Basin summary since this area was also included in the 2018 survey.

Eurasian watermilfoil was the dominant species in Ellery, found at 46% of the sample sites, followed by the four dominant native species at 20-35% of sample sites. Eight species were found at less than 5% of sample sites. Ellery contained the largest area of Western Waterweed, 8 sites, which was not found in 2018. The only locations of Spikerush and Sago Pondweed also occurred in Ellery.

The sample areas of the 2018 and 2019 plant surveys in Ellery and Bemus Point match up. Direct comparison of the data is challenged by the difference in sample point density (492 vs. 179), as well as the extent of herbicide application to the Bemus Point, Arnold Bay and Greenhurst shorelines. Nevertheless, both surveys found Eurasian Watermilfoil most abundant, followed closely by Coontail. One interesting note is that despite the herbicide treatment of four areas of Ellery, the overall abundance of macrophytes increased from 62% in 2018 to 70% in 2019.

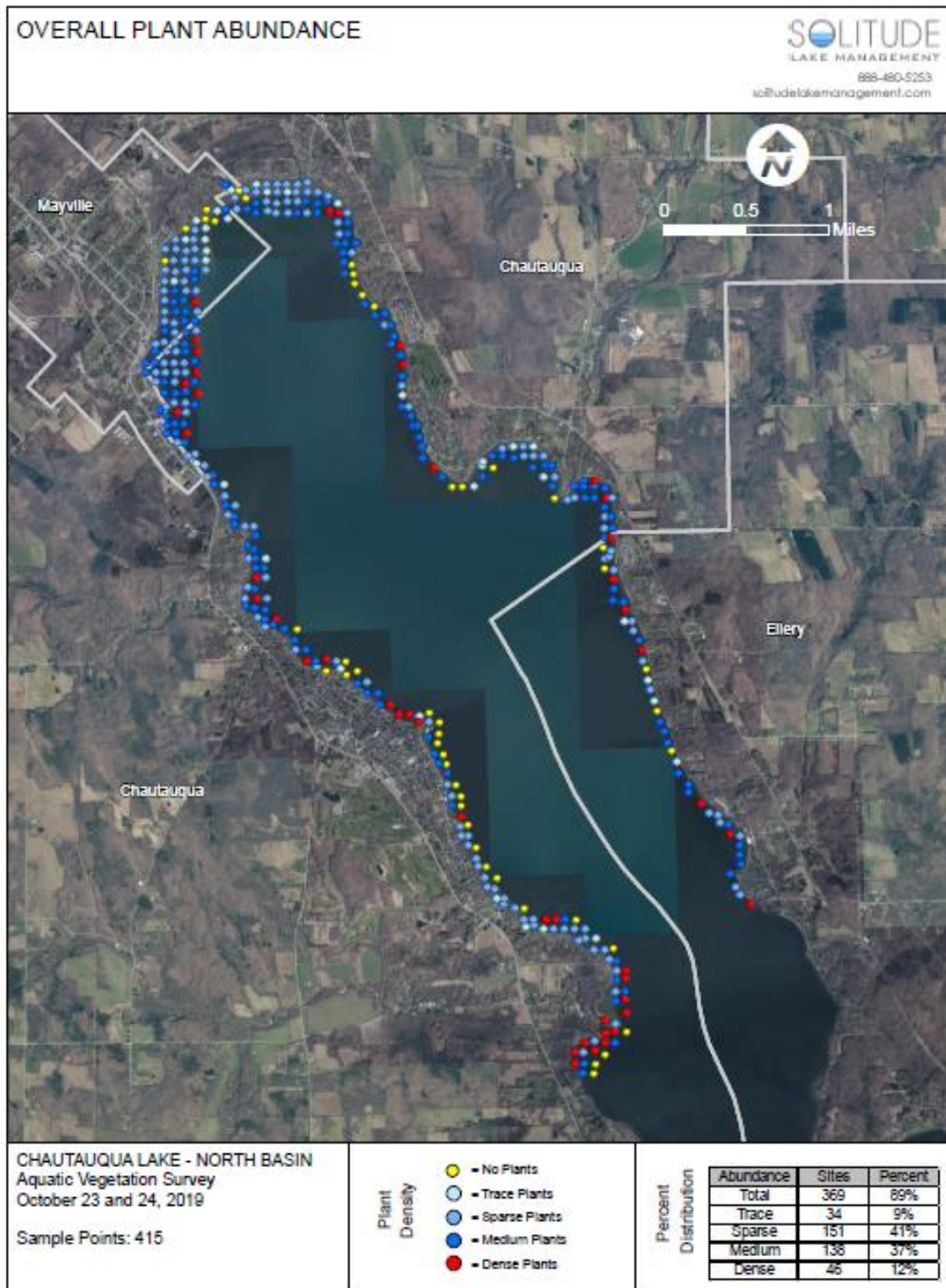
Table 8

Chautauqua Lake - Central and South Basin - Ellery										
Aquatic Macrophyte Abundance Distribution										
October 2019										
	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
OVERALL ABUNDANCE	125	70%	23	18%	29	23%	39	31%	34	27%
EURASIAN MILFOIL	83	46%	48	58%	28	34%	6	7%	1	1%
COONTAIL	62	35%	31	50%	17	27%	7	11%	7	11%
WILD CELERY	53	30%	21	40%	21	40%	8	15%	3	6%
WATER STARGRASS	46	26%	17	37%	15	33%	6	13%	8	17%
COMMON WATERWEED	36	20%	17	47%	11	31%	5	14%	3	8%
BENTHIC FILAMENTOUS ALGAE	34	19%	14	41%	15	44%	3	9%	2	6%
IVY-LEAVED DUCKWEED	26	15%	17	65%	8	31%	1	4%	0	0%
SOUTHERN NAIAD	24	13%	14	58%	8	33%	2	8%	0	0%
WESTERN WATERWEED	8	4%	5	63%	2	25%	1	13%	0	0%
CLASPING-LEAF PONDWEED	6	3%	5	83%	1	17%	0	0%	0	0%
ILLINOIS PONDWEED	6	3%	4	67%	2	33%	0	0%	0	0%
SLENDER NAIAD	5	3%	4	80%	1	20%	0	0%	0	0%
WHITE-STEM PONDWEED	4	2%	4	100%	0	0%	0	0%	0	0%
CURLY-LEAF PONDWEED	2	1%	2	100%	0	0%	0	0%	0	0%
SAGO PONDWEED	1	1%	1	100%	0	0%	0	0%	0	0%
SPIKERUSH	1	1%	1	100%	0	0%	0	0%	0	0%

Red entries indicate invasive species; n = 179

North Basin

Figure 3



North Basin

The North Basin of the lake exhibits better water quality and water clarity than the South Basin, and is considerably deeper. The majority of the North Basin's littoral zone hugs the lake shoreline, with the exception of the Mayville & Chautauqua north end of the lake, where the littoral zone extends almost 2,000 feet out into the lake at a maximum. Twenty three (23) aquatic macrophyte species were documented in the North Basin section of the survey, including two invasive species, Eurasian Watermilfoil and Curlyleaf Pondweed. As with the South Basin, the four dominant native species were Coontail, Water Celery, Common Waterweed and Water Stargrass, so despite the different morphology of the two basins, their plant composition is similar.

Site locations labeled Dense accounted for 12% of the sample sites. Dominant plants in these sites were Eurasian watermilfoil, and the native species Coontail and Wild Celery. The Dense sites were spread out throughout the North Basin sample area, with clusters in Snug Harbor and off the Mayville shoreline. Starting with the North Basin, Chautauqua West section we see a larger gap in abundance between the dominant Eurasian Watermilfoil (65%), and the next dominant species, in this case Coontail (42%). This 23% gap falls within the 20-29% gap range of North Basin, Chautauqua East and Mayville, and is considerably greater than the gap for Central and South Basin sites, which are 11% or less between Eurasian Watermilfoil and the next dominant plant.

Of the 23 species identified, 14 species were found in less than 5% of the sample sites. These species included most of the native pondweeds.

Table 9

Chautauqua Lake - North Basin										
Aquatic Macrophyte Abundance Distribution										
October 23 and 24, 2019										
	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
TOTAL SITES	413									
OVERALL	369	89%	34	9%	151	41%	138	37%	46	12%
EURASIAN WATER MILFOIL	283	68%	158	56%	82	29%	35	12%	8	3%
COONTAIL	176	42%	95	54%	54	31%	22	13%	5	3%
COMMON WATERWEED	147	35%	87	59%	46	31%	13	9%	1	1%
WILD CELERY	146	35%	59	40%	59	40%	24	16%	4	3%
WATER STARGRASS	125	30%	59	47%	56	45%	10	8%	0	0%
SOUTHERN NAIAD	64	15%	49	77%	14	22%	1	2%	0	0%
CLASPING LEAF PONDWEED	49	12%	36	73%	13	27%	0	0%	0	0%
BENTHIC FILAMENTOUS ALGAE	33	8%	17	52%	15	45%	1	3%	0	0%
IVY-LEAVED DUCKWEED	31	7%	23	74%	8	26%	0	0%	0	0%
CURLY-LEAF PONDWEED	12	3%	11	92%	1	8%	0	0%	0	0%
WHITE-STEM PONDWEED	12	3%	8	67%	4	33%	0	0%	0	0%
WATER PLANTAIN	12	3%	8	67%	3	25%	1	8%	0	0%
SPOTTED PONDWEED	7	2%	7	100%	0	0%	0	0%	0	0%
SMALL DUCKWEED	6	1%	2	33%	3	50%	1	17%	0	0%
WHITE WATER LILY	6	1%	3	50%	1	17%	2	33%	0	0%
ILLINOIS PONDWEED	5	1%	4	80%	1	20%	0	0%	0	0%
SMALL PONDWEED	5	1%	5	100%	0	0%	0	0%	0	0%
SLENDER NAIAD	4	1%	3	75%	1	25%	0	0%	0	0%
FLAT-STEM PONDWEED	3	1%	3	100%	0	0%	0	0%	0	0%
MACROALGAE	3	1%	2	67%	1	33%	0	0%	0	0%
FLOATING-LEAF PONDWEED	1	0%	0	0%	0	0%	1	100%	0	0%
LARGELEAF PONDWEED	1	0%	1	100%	0	0%	0	0%	0	0%
WHITE WATER CROWFOOT	1	0%	1	100%	0	0%	0	0%	0	0%

Red entries indicate invasive species; n = 413

Table 10: Distribution of Plant Density – North Basin

	All Survey Area	Chautauqua West	Mayville	Chautauqua East	Ellery
Total Sites	413	144	109	116	47
Total (%)	89%	83%	94%	91%	87%
Trace-Sparse (%)	50%	48%	59%	46%	44%
Medium-Dense (%)	50%	52%	41%	54%	56%

The following pages break down the individual species found in each Town/Village area of the lake. This breakdown was not part of the accepted contract with the Chautauqua Lake Partnership, but is included since the fieldwork was conducted.

Town of Chautauqua – West Section

The North Basin, Town of Chautauqua West section covers the area from Snug Harbor, where the Central Basin, Town of Chautauqua leaves off, and extends northward to the Mayville border. This section includes the Chautauqua Institute shoreline. As with all other areas of the survey, Eurasian Watermilfoil was the most abundant aquatic plant in this area.

The West section of the Town of Chautauqua supported the highest plant diversity of the Town/Village shoreline areas, with 21 species found. Eurasian Watermilfoil was the dominant species and was found at 65% of the sample sites. The next most abundant species was Coontail, which occurred at 42% of the sample sites. This section also exhibited the highest density of southern naiad (19%), a native but often nuisance annual plant that appears in late Spring or summer.

Of the 21 species, 12 occurred in 5% or less of the sample sites. These included all of the 8 pondweed species, a condition consistent with the South Basin sites as well.

North Basin, Chautauqua West shows a higher abundance of Medium and Dense plant density (52%, see Table 10) than other South Basin sites, which fall at 19% or below. This greater plant density is explained by a higher overall density of the 6 most abundant species, as compared to South Basin sites.

Table 11

Chautauqua Lake - North Basin - Chautauqua West										
Aquatic Macrophyte Abundance Distribution										
October 2019										
	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
OVERALL ABUNDANCE	119	83%	8	7%	49	41%	38	32%	24	20%
EURASAIN MILFOIL	94	65%	54	57%	21	22%	16	17%	3	3%
COONTAIL	60	42%	22	37%	25	42%	9	15%	4	7%
WILD CELERY	54	38%	23	43%	25	46%	6	11%	0	0%
COMMON WATERWEED	51	35%	27	53%	16	31%	7	14%	1	2%
SOUTHERN NAIAD	28	19%	20	71%	7	25%	1	4%	0	0%
WATER STARGRASS	27	19%	15	56%	12	44%	0	0%	0	0%
BENTHIC FILAMENTOUS ALGAE	23	16%	10	43%	13	57%	0	0%	0	0%
IVY-LEAVED DUCKWEED	13	9%	6	46%	7	54%	0	0%	0	0%
WATER PLANTAIN	11	8%	7	64%	3	27%	1	9%	0	0%
CLASPINGLEAF PONDWEED	7	5%	5	71%	2	29%	0	0%	0	0%
CURLY-LEAF PONDWEED	6	4%	5	83%	1	17%	0	0%	0	0%
WHITE WATERLILY	6	4%	3	50%	1	17%	2	33%	0	0%
SLENDER NAIAD	4	3%	3	75%	1	25%	0	0%	0	0%
ILLINOIS PONDWEED	4	3%	3	75%	1	25%	0	0%	0	0%
FLATSTEM PONDWEED	3	2%	3	100%	0	0%	0	0%	0	0%
SMALL DUCKWEED	3	2%	1	33%	2	67%	0	0%	0	0%
WHITE-STEM PONDWEED	3	2%	2	67%	1	33%	0	0%	0	0%
FLOATING-LEAF PONDWEED	1	1%	0	0%	0	0%	1	100%	0	0%
WHITE WATERCROWFOOT	1	1%	1	100%	0	0%	0	0%	0	0%
SPOTTED PONDWEED	1	1%	1	100%	0	0%	0	0%	0	0%
LARGE-LEAF PONDWEED	1	1%	1	100%	0	0%	0	0%	0	0%

Red entries indicate invasive species; n = 144

Town of Chautauqua – East Section

The North Basin, Town of Chautauqua East section covers the area from the Ellery border to the Mayville border. Since this section of Chautauqua is separated from the West shore of Chautauqua by more than 1.3 miles and some 1,500+ acres of water, it made sense to present data from the two areas separately. Although this section only sampled 14 species, the difference in plant composition between West and East was largely made up of less abundant species found at only a few sites. The average abundance of the top 6 species was similar: West – 36%, and East 37%.

Eurasian Watermilfoil was the dominant plant in the region at 62% of sampled sites, and its abundance was 20% greater than the next most abundant species, Coontail, at 42% of sites. This area also had a higher abundance of Claspig Leaf Pondweed (19%), although none of these 22 sites were characterized as Medium or Dense.

Table 12

Chautauqua Lake - North Basin - Chautauqua East										
Aquatic Macrophyte Abundance Distribution										
October 2019										
	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
OVERALL ABUNDANCE	106	91%	11	10%	38	36%	50	47%	7	7%
EURASIAN MILFOIL	72	62%	51	71%	15	21%	6	8%	0	0%
COONTAIL	49	42%	27	55%	12	24%	9	18%	1	2%
WATER STARGRASS	47	41%	17	36%	23	49%	7	15%	0	0%
COMMON WATERWEED	35	30%	22	63%	8	23%	5	14%	0	0%
WILD CELERY	34	29%	10	29%	14	41%	9	26%	1	3%
CLASPING-LEAF PONDWEED	22	19%	15	68%	7	32%	0	0%	0	0%
SOUTHERN NAIAD	14	12%	11	79%	3	21%	0	0%	0	0%
IVY-LEAVED DUCKWEED	6	5%	6	100%	0	0%	0	0%	0	0%
WHITE-STEM PONDWEED	6	5%	3	50%	3	50%	0	0%	0	0%
BENTHIC FILAMENTOUS	5	4%	5	100%	0	0%	0	0%	0	0%
SPOTTED PONDWEED	3	3%	3	100%	0	0%	0	0%	0	0%
CURLY-LEAF PONDWEED	3	3%	3	100%	0	0%	0	0%	0	0%
SMALL PONDWEED	2	2%	2	100%	0	0%	0	0%	0	0%
WATER PLANTAIN	1	1%	1	100%	0	0%	0	0%	0	0%

Red entries indicate invasive species; n = 116

Village of Mayville

The Village of Mayville, in the North Basin, is situated between the east and west shorelines of the Town of Chautauqua. The Mayville shoreline has the largest littoral zone in the North Basin of the lake, which extends out into the lake close to 2,000 feet at its maximum. Mayville supports one of the densest areas of Eurasian Watermilfoil in the North Basin (80%), and this infestation is most dense furthest into the lake. Observations during the survey indicated that additional Eurasian watermilfoil was present beyond the survey zone further into the lake. Unfortunately, in most of the Dense sites, an accurate depth measurement could not be obtained to the dense plant biomass.

Mayville supported the highest percentage of vegetated sample sites (94%) of all areas surveyed in 2019. Compared to other areas, it also supported the highest average abundance of the top 6 species, and average of 42%, and by far the highest average abundance of the top 3 species, 60%. This is consistent with field reports that suggest weed management is badly needed in this area.

Table 13

Chautauqua Lake - North Basin - Mayville										
Aquatic Macrophyte Abundance Distribution										
October 2019										
	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
OVERALL ABUNDANCE	103	94%	11	11%	50	49%	34	33%	8	8%
EURASIAN MILFOIL	87	80%	40	46%	32	37%	10	11%	5	6%
COMMON WATERWEED	56	51%	33	59%	22	39%	1	2%	0	0%
COONTAIL	55	50%	37	67%	15	27%	3	5%	0	0%
WATER STARGRASS	33	30%	21	64%	12	36%	0	0%	0	0%
TAPEGRASS	31	28%	19	61%	11	35%	1	3%	0	0%
SOUTHERN NAIAD	14	13%	11	79%	3	21%	0	0%	0	0%
CLASPING-LEAF PONDWEED	12	11%	9	75%	3	25%	0	0%	0	0%
IVY-LEAVED DUCKWEED	8	7%	8	100%	0	0%	0	0%	0	0%
BENTHIC FILAMENTOUS ALGAE	5	5%	2	40%	2	40%	1	20%	0	0%
SPOTTED PONDWEED	3	3%	3	100%	0	0%	0	0%	0	0%
MACROALGAE (NATIVE)	3	3%	2	67%	1	33%	0	0%	0	0%
SMALL DUCKWEED	3	3%	1	33%	1	33%	1	33%	0	0%
SMALL PONDWEED	3	3%	3	100%	0	0%	0	0%	0	0%
CURLY-LEAF PONDWEED	3	3%	3	100%	0	0%	0	0%	0	0%
WHITE-STEM PONDWEED	2	2%	2	100%	0	0%	0	0%	0	0%
ILLINOIS PONDWEED	1	1%	1	100%	0	0%	0	0%	0	0%

Red entries indicate invasive species; n = 109

Town of Ellery

The North Basin, Town of Ellery covers the northern third of the Ellery lakeshore, from Maple Springs, where the Central and South Basin, Town of Ellery data stops, to the border of Chautauqua. The 2019 survey only collected 9 species from this area. This was likely due in large part to the narrow littoral zone, where sample points formed a single row along the shoreline.

Eurasian Watermilfoil was the dominant plant, followed by Wild Celery and Water Stargrass. Of the 9 species, only 2 were found at less than 5%, Ivy-Leaved Duckweed and White Stem Pondweed.

Table 14

Chautauqua Lake - North Basin - Ellery										
Aquatic Macrophyte Abundance Distribution										
October 2019										
	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
OVERALL ABUNDANCE	41	87%	4	10%	14	34%	16	39%	7	17%
EURASIAN MILFOIL	30	64%	13	43%	14	47%	3	10%	0	0%
WILD CELERY	27	57%	7	26%	9	33%	8	30%	3	11%
WATER STARGRASS	18	38%	6	33%	9	50%	3	17%	0	0%
COONTAIL	12	26%	9	75%	2	17%	1	8%	0	0%
CLASPING-LEAF PONDWEED	8	17%	7	88%	1	13%	0	0%	0	0%
SOUTHERN NAIAD	8	17%	7	88%	1	13%	0	0%	0	0%
COMMON WATERWEED	5	11%	5	100%	0	0%	0	0%	0	0%
IVY-LEAVED DUCKWEED	4	9%	3	75%	1	25%	0	0%	0	0%
WHITE-STEM PONDWEED	1	2%	1	100%	0	0%	0	0%	0	0%

Red entries indicate invasive species; n =

Discussion

As a reminder, the purpose of this project was twofold:

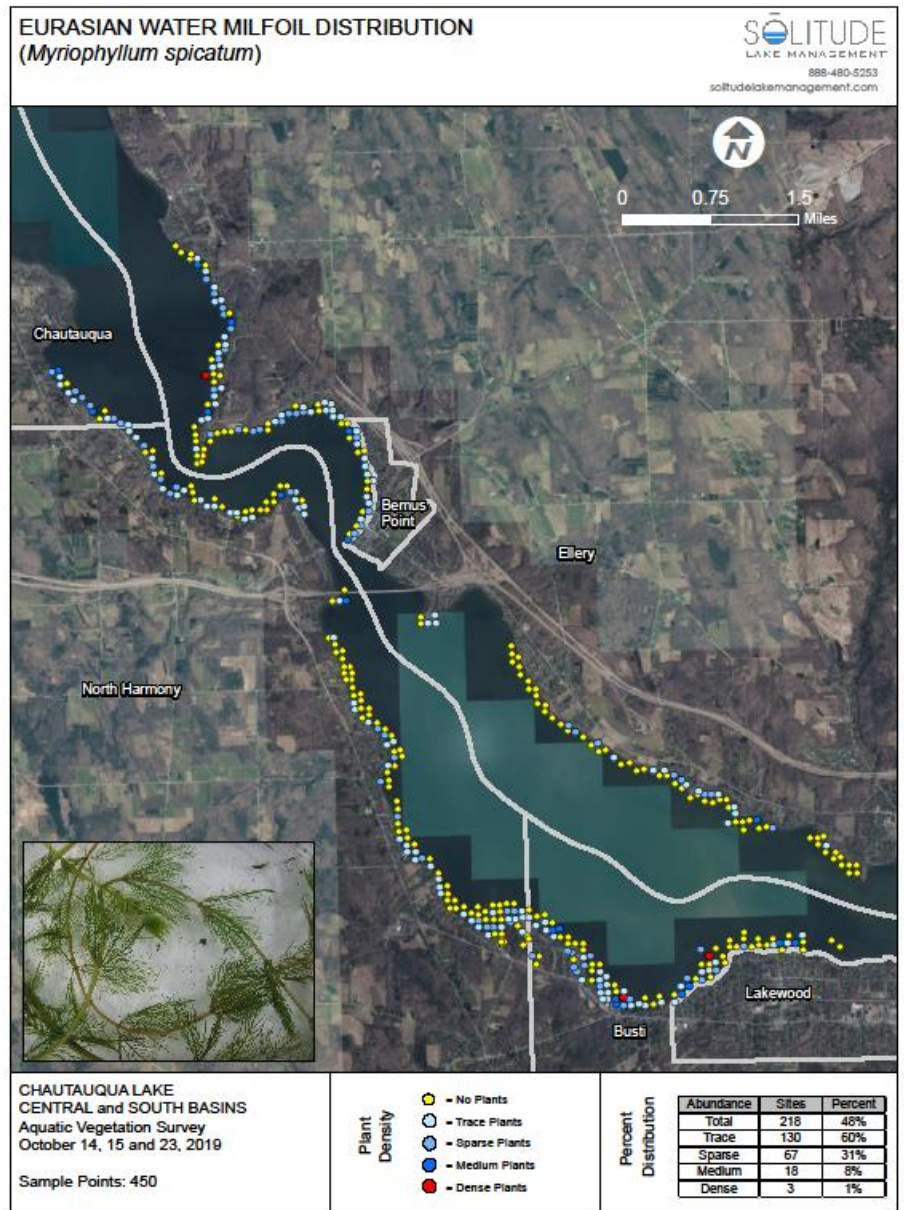
- To assess the aquatic plant community of the North Basin, which had not experienced any recent herbicide application, but may warrant such an integrated management approach of herbicides and harvesting in the immediate future.
- To assess the aquatic plant community of the survey area from 2018, referred to as the Central and South Basin, relative to preparation and support of plant management in 2020. With the knowledge that the NYSDEC would not permit re-treatment with herbicide of any areas in consecutive years, 2019 treatment areas were intentionally not surveyed as part of this project. Further, while the remainder of the South Basin, including the Town of Ellicott, Village of Celoron and part of the Town of Lakewood, and more broadly, Burtis Bay were meant to be included initially, their survey was intentionally delayed until Spring 2020 to provide a better assessment of plant coverage and re-appearance following the summer's dense algae bloom.

Given the disparity between the 2018 & 2019 South Basin plant surveys, a close comparison of data from similar areas was generally not valid. The 2019 herbicide application targeted the most dense

areas of Eurasian watermilfoil growth in the South Basin, therefore the 2019 data reflects a subset of 2018, focused on areas which previously supported less Eurasian watermilfoil growth.

What the 2019 Central and South Basin data does identify is those areas that would still benefit from herbicide control of Eurasian watermilfoil, such as Bemus Bay, the Town of Busti, and portions of the Lakewood, North Harmony and Ellery shorelines. These areas are shown in the map of Eurasian watermilfoil in the South Basin below.

Figure 4

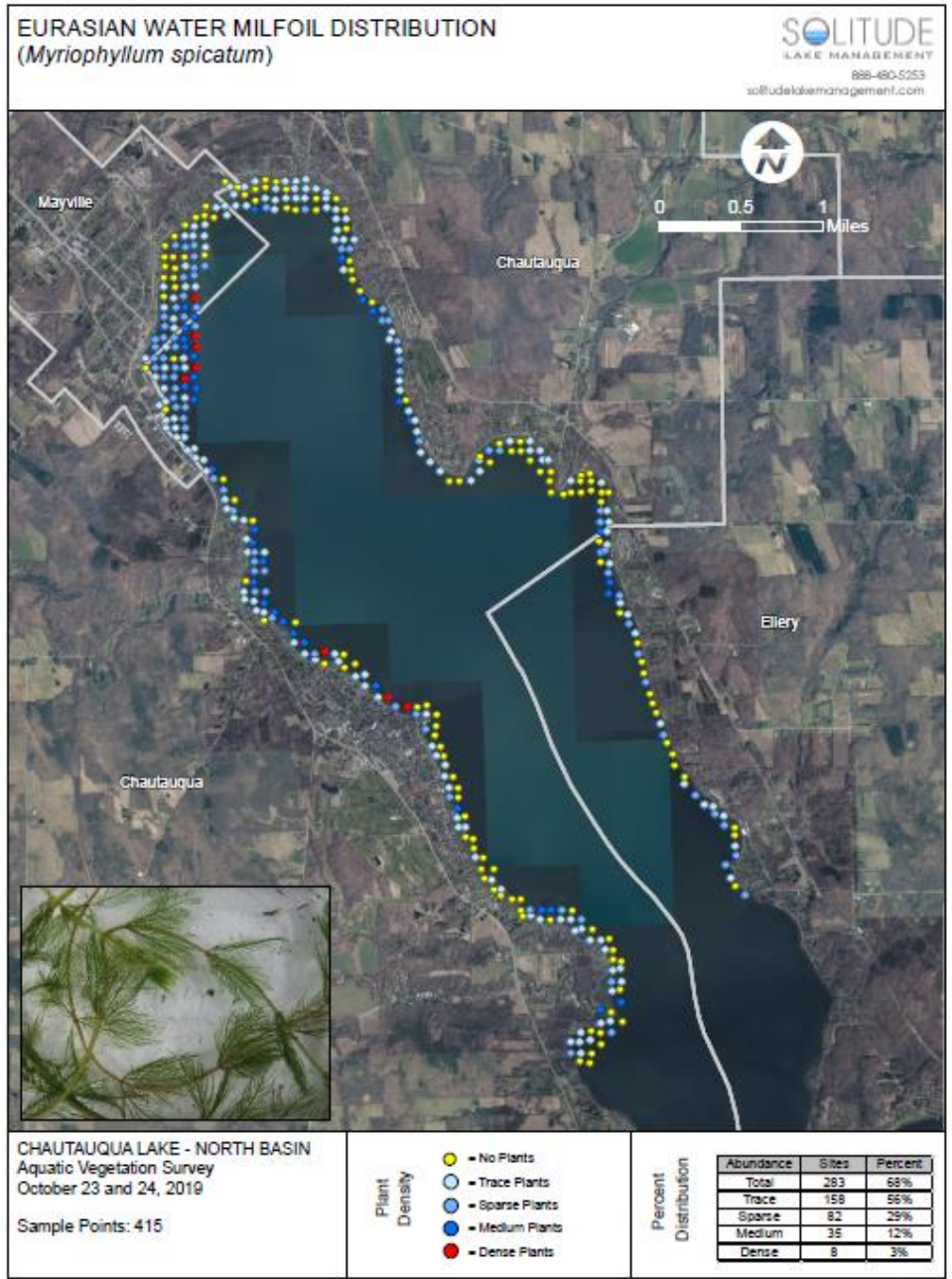


As the above map indicates, the proportion of Medium and Dense Eurasian watermilfoil sites in the Central and South Basin is limited (9%). It also illustrates that the more concentrated areas of Eurasian watermilfoil are found in areas treated in 2018. Experience with the growth and control of this plant over the past 25 years strongly support that if left unmanaged in 2020, areas of Trace

and Sparse Eurasian watermilfoil growth will increase in density, and replace reductions from the 2018 herbicide control.

Eurasian watermilfoil is more widespread in the North Basin, where it was found in 68% of the sample sites, 20% more than in the Central and South Basin. The Mayville shoreline, as well as the northern section of Chautauqua West shoreline support extensive beds, much of which are characterized as Medium or Dense.

Figure 5



Summary of Findings

- Based on 863 sample sites surveyed by SOLitude Lake Management, Eurasian Watermilfoil remains the most abundant plant in all surveyed areas of the lake, more than 85% of the lake's shoreline.
- The dominant native submersed aquatic plants (Coontail, Water Celery, Common Waterweed and Water Stargrass) are the same in both North and South Basins, and appear in similar relative abundance in most surveyed area.
- The overall abundance of Eurasian Watermilfoil is 26% greater than then next most abundant plant in the North Basin, and only 6% greater than the next most abundant plant in the Central and South Basins. This may be attributed to the focus of the 2019 herbicide treatment on areas of higher density Eurasian Watermilfoil in the Central and South Basins.
- The Village of Mayville area, and the Central Basin section of the Town of Chautauqua support the greatest relative abundance of Eurasian Watermilfoil, at 80% and 82% of sampled sites, respectively.
- As expected, the Fall survey does not accurately portray the extent of Curlyleaf Pondweed in the lake, since data only shows its presence at 24 of 863 sites.
- The wide-leaf pondweed species (Illinois, Flat-stem, White Stem, Large-leaf), which are generally most desirable for fish habitat, are all found in less than 10% of the North and Central and South Basins.
- A comparison between 2018 & 2019 survey results is only reasonably valid in North Harmony. This comparison shows an increase in abundance of the top three plant species, with Eurasian Watermilfoil increasing from 3rd to most abundant in 2019.
- Despite the herbicide treatment of four areas of Ellery (116.9 acres), the overall abundance of macrophytes increased from 62% - 70% of sample sites.
- Plant monitoring in Fall was once again impacted by an algae bloom in the South Basin. Moving the plant monitoring event to midsummer would provide less foresight to Eurasian watermilfoil growth in the following season, but would document a more accurate picture of the height of the plant community.
- While areas of herbicide applications were known and occasionally referenced in this report, no maps of harvested areas were available or used to contribute to any assessment of plant composition.
- Based on the survey results in the Central and South Basin areas, the 2019 herbicide treatment did not result in a significant impact to aquatic vegetation in untreated areas.

References

- Borman, et al. 1999. *Through the Looking Glass: A Field Guide to Aquatic Plants*. Wisconsin Lakes Partnership, University of Wisconsin-Extension. Reindl Printing, Inc. Merrill, WI.
- Fassett, Norman C. 1972. *A Manual of Aquatic Plants*. The University of Wisconsin Press, Milwaukee.
- Hill, R. and S. Williams. 2007. *Maine Field Guide to Invasive Aquatic Plants and their Common Native Look Alikes*. Maine Center for Invasive Aquatic Plants and the Maine Volunteer Lake Monitoring Program. J.S McCarthy Printers, Augusta Maine.
- Lord et al. 2005. *Effective Aquatic Plant Monitoring: Data and Issues from Waneta Lake* Presentation at the Northeast Aquatic Plant Management Society Annual Meeting. Saratoga Springs, NY.
- Madsen, J. D. 1999. *Point and Line Intercept Methods for Aquatic Plant Management*. APCRP Technical Notes Collection (TN APCRP-M1-02), US Army Engineer Research and Development center, Vicksburg, MS. pp 1-16.
- SŌLitude Lake Management. June 2017. *Aquatic Macrophyte Control at Bemus Bay, Chautauqua Lake*.
- SŌLitude Lake Management. January, 2019. *Chautauqua Lake Plant Monitoring Program Report*
- Young, S. M. 2010. *New York Rare Plant Status Lists*. New York Natural Heritage Program, Albany, NY. June 201. 111 pages.

[Appendix A: South Basin Plant Distribution Maps](#)

[Appendix B: South Basin Raw Data](#)

[Appendix C: North Basin Plant Distribution Maps](#)

[Appendix D: North Basin Raw Data](#)

[Appendix E: Macrophyte Descriptions](#)