

# Technical Memorandum

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**To:** Mrs. Jan Anderson, Three Lakes Council  
**From:** Alejandro Reyes  
**cc:** Luke Gervase, Lindsey Kollmer  
**Date:** May 7, 2026  
**Re:** Technical Memo  
Three Lakes Council  
Lake Waccabuc  
Lewisboro, New York

**Project No.:** 2501041

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Please see the narrative memo below detailing the 2025 full-lake aquatic plant survey effort on Lake Waccabuc, in Lewisboro, New York. GEI was contracted by the Three Lakes Council (TLC) to conduct an aquatic plant survey on Lake Waccabuc in 2025. This summary memo will discuss the results of that survey and provide recommendations for future management.

## Site Description

Lake Waccabuc is an approximately 128-acre lake located in the Town of Lewisboro, New York (Westchester County). The lake has a maximum depth of roughly 40 feet with a mean depth of 24 feet. The lake drains south into the Waccabuc River, draining eventually into the Cross River and into the Cross River Reservoir, a New York City Department of Environmental Protection (NYCDEP) drinking water supply reservoir. Lake Waccabuc is characterized by a moderately deep central basin with more gradual slopes in the eastern section of the lake, which is a shallow, wetland area that has a channel that connects to Lake Oscaleta. Much of the shoreline transitions gradually from upland to shallow water, particularly along the eastern and southern portions of the lake, where nearshore areas support aquatic vegetation growth. Several small coves and embayments extend from the main basin, and these areas tend to be shallower and more protected, providing favorable conditions for macrophyte (aquatic plant) growth. In these coves, the littoral zone often extends across much of the basin, with the shallowest back sections supporting emergent and floating-leaf vegetation such as water lilies. The main lake basin, while deeper, still supports patches of vegetation along its margins.

**Photo 1. Lake Waccabuc Lake Conditions on July 30, 2025**



## **Aquatic Plant Survey**

GEI staff visited Lake Waccabuc on July 30, 2025, to perform a full lake aquatic plant survey. The survey was designed to replicate past methods used by previous lake contractors.

### ***Methodology***

Aquatic plant survey methods involved a point-intercept style approach. Pre-determined waypoints from previous survey efforts were re-visited. A total of 120 waypoints were visited using a Trimble R1 unit with sub-meter accuracy to ensure location. At each waypoint, water depth was recorded using a commercially available fish finder with a down scanning transducer.

Plant coverage was determined using the rake fullness method. At each waypoint, two rake tosses were made in opposite directions. Each rake was thrown approximately 10 meters except for waypoints close to shore. For waypoints close to shore, GEI staff threw the rake to the underwater area right before the shoreline. The rakes were allowed to settle, then retrieved slowly to minimize plant loss. Once brought on board, rakes were assessed for total plant abundance and individual species percent cover. For total and individual plant abundance, GEI used a qualitative scale of rake fullness (Table 1).

**Table 1. Rake Fullness Categories used to Assign Categories to Rake Tosses**

<b>Fullness Category</b>	<b>Numerical Category</b>	<b>Description</b>
<b>Z</b>	0	No plants present on the rake
<b>T</b>	1	Fingerful of plants on the rake
<b>S</b>	2	Fistful of plants on the rake
<b>M</b>	3	Plants covering all tines on the rake
<b>D</b>	4	Difficult to bring into the boat

Rake fullness categories were converted into numerical categories for analysis (Table 1), then the two rake tosses were averaged to develop a mean numerical category per waypoint. Floating and submersed species were surveyed distinctly from each other and will be reported separately in the analysis.

Filamentous algae in 2025 was counted as both a floating species and a submersed species due to its variable growth form.

Previous survey results were integrated with 2025 results to provide a long-term analysis and perspective on the aquatic plant community. Analysis to determine frequency of occurrence, species abundance, and species richness was performed within R studio utilizing the tidyr and dplyr packages. Maps were made in ArcGIS Pro.

## ***Results***

Results are presented below in table/graphic format. Maps of species distributions are present in Appendix A for invasive species or select species with over 20% frequency of occurrence (Maps 1 to 10). Additional graphics describing long-term changes in species abundance are presented in Appendix B, Figure 1 and Appendix B, Figure 2.

When describing an aquatic plant community, ecologists utilize a number of metrics and parameters. For this report, GEI will focus on the following parameters to describe the Lake Waccabuc community:

**Frequency of Occurrence:** This metric describes how often a particular species was encountered in a given year. GEI staff sampled 120 waypoints, so the frequency of occurrence metric indicates how many points a specific plant was found out of that 120. This is a useful metric to describe how well distributed a species is across the lake, however it does not provide information on how abundant that species is at a given point or lake wide.

**Species Abundance:** This metric describes how abundant a particular species was during the survey. This was calculated by averaging the species abundance (derived from the rake fullness ratings; Table 1) at each sampling point for a particular plant species.

This metric does also account for the distribution of a species across the lake as does frequency of occurrence. The difference is that since “0” values are integrated into the species abundance values, there is not an outsized effect from locally abundant species. For example, if species “1” was present at 10 locations out of 120, but it was dense (D), numerical category 4, at those 10 locations, the species would not be as abundant as species “2” which was present at 70 locations, but it was only sparsely found, numerical category 2.

**Species Richness:** This metric describes how many species were found at a particular waypoint. Species richness is an indicator of aquatic plant diversity. In lakes, aquatic plant diversity is directly linked to ecosystem resilience. As the number of species increases, the lake gains increased capacity to resist incoming invasive species and resist a single species becoming increasingly dominant. A high number of species in the lake also indicates a diversity of habitats, which can be an indicator of the ecological state of the lake. High quality lakes often have a high diversity of aquatic plants and a high diversity of types of aquatic plants (i.e. submerged, floating, emergent).

## 2025 Survey Results

GEI documented a total of 19 taxa on Lake Waccabuc in 2025 (Table 2). Of the 19 species found, five are considered floating species, 13 are considered submersed species, and one is considered both floating and submersed (filamentous algae). Only two invasive taxa, Eurasian watermilfoil (*Myriophyllum spicatum* [EWM]) and curly leaf pondweed (*Potamogeton crispus*) were documented in 2025. EWM was the most frequently encountered species in 2025, followed by white water lily (*Nymphaea odorata*), coontail (*Ceratophyllum demersum*), and filamentous algae. EWM was also the most abundant species documented in 2025, followed by white water lily, coontail, and watershield (*Brasenia schreberi*) (Table 2).

**Table 2. Taxa Documented in 2025 on Lake Waccabuc. Percent occurrence represents the percentage of waypoints where a specific plant taxa was encountered. Species abundance is the average rake fullness rating of each species encountered at each waypoint in 2025.**

Scientific Name	Common Name	Growth Habit	Invasive/Native Status	Percent Occurrence	Average Species Abundance
<i>Brasenia schreberi</i>	Watershield	Floating	Native	32.5	0.403
<i>Ceratophyllum demersum</i>	Coontail	Submersed	Native	45.8	0.557
<i>Elodea nuttallii</i>	Western Waterweed	Submersed	Native	0.8	0.004
<i>Filamentous algae</i>	Filamentous Algae	Floating/Submersed	Native	44.2	0.256
<i>Heteranthera dubia</i>	Water Stargrass	Submersed	Native	5.8	0.052
<i>Lemna minor</i>	Common Duckweed	Floating	Native	6.7	0.083
<i>Lyngbya wolleii</i>	Lyngbya	Submersed	Native	18.3	0.265
<i>Myriophyllum spicatum</i>	Eurasian Watermilfoil	Submersed	Invasive	92.5	1.062
<i>Myriophyllum tenellum</i>	Slender Watermilfoil	Submersed	Native	0.8	0.004
<i>Nuphar variegata</i>	Yellow Water Lily	Floating	Native	24.2	0.335
<i>Nymphaea odorata</i>	White Water Lily	Floating	Native	68.3	1.012
<i>Potamogeton amplifolius</i>	Largeleaf Pondweed	Submersed	Native	22.5	0.233
<i>Potamogeton crispus</i>	Curly Leaf Pondweed	Submersed	Invasive	1.7	0.017
<i>Potamogeton epihydrus</i>	Ribbon Leaf Pondweed	Submersed	Native	0.8	0.004
<i>Potamogeton foliosus</i>	Leafy Pondweed	Submersed	Native	1.7	0.013
<i>Potamogeton robbinsii</i>	Robbin's Pondweed	Submersed	Native	6.7	0.078
<i>Sagittaria sp rosette</i>	Arrowhead Rosette	Submersed	Native	5	0.039
<i>Sparganium sp</i>	Bur-Reed	Floating	Native	2.5	0.009
<i>Utricularia gibba</i>	Humped Bladderwort	Submersed	Native	3.3	0.026

Distribution of aquatic plant species in Lake Waccabuc are presented in Appendix A, Maps 1 to 18. Specific notes on distribution for select species of note are presented below:

**Eurasian Watermilfoil:** Present and dense in most parts of the lake outside of the northern shoreline across from the island. Most cove areas have moderate or dense abundances of EWM. The island itself has high density of EWM on its shorelines. Most EWM was growing to the lake surface.

**Photo 2. Dense Eurasian Watermilfoil Growth in the Eastern Cove in Lake Waccabuc in 2025**



**Largeleaf Pondweed:** Mostly present on eastern side of the lake within the easternmost cove (lake inlet from Lake Oscaleta). There were only two locations documented west of the island.

**Curly Leaf Pondweed:** Only documented at two locations. This is likely a function of the survey timing, as curly leaf pondweed is an early season grower.

**Photo 3. Curly Leaf Pondweed (center, red) and Largeleaf Pondweed (bottom left, yellow) Growing in Lake Waccabuc in 2025**



**Coontail:** Most of the coontail was found in the eastern cove (lake inlet from Lake Oscaleta). There were other sporadic occurrences throughout the lake.

**White Water Lily:** Distributed lake-wide, with dense patches documented on the northwestern shoreline.

**Filamentous Algae:** Mostly located in the eastern cove (lake inlet from Lake Oscaleta). Algae was both growing as surface mats on top of submersed plants, attached to plants within the water column, and on the lake bottom.

**Photo 4. Surface Floating Filamentous Algae in the Foreground, and Duckweed (*Lemna minor*) in the Background on Top of Filamentous Algae, in Lake Waccabuc in 2025**



In general, there was dense aquatic plant growth across the lake with cove areas having plants growing to the surface (termed “topped out”). These topped out plant communities were often a mixture of species but did vary by depth. In shallow waters, specifically within cove areas, water lilies (white water lily, yellow water lily (*Nuphar variegata*), and watershield) along with emergent species (not documented during the survey) were dominant. As depth increased, there was an observed shift to largeleaf pondweed (*Potamogeton amplifolius*) and EWM. In deeper waters (~8 to 10 feet deep) EWM dominated the aquatic plant community. Robbin’s pondweed (*Potamogeton robbinsii*) and coontail were found on the lake bottom throughout multiple lake depths. While not specifically tracked during the aquatic plant survey, the maximum depth of aquatic plants seemed to be at approximately 12 feet deep.

### **Historical Aquatic Plant Community**

Examining the long-term aquatic plant community on Lake Waccabuc allows for contextualization of 2025 results into the broader ecosystem. Lake Waccabuc is unique when compared to lakes in this region as there is no active management of aquatic plants. Many other lakes actively or passively manage aquatic plants through drawdown, grass carp stocking, mechanical/diver harvesting and/or herbicide treatments. Long term changes in the aquatic plant community do not represent management impacts, but are likely the result of competition, predation by insect herbivores, annual weather variations, and other non-intentional human mediated interventions.

## Long Term Frequency of Occurrence

Changes in long term frequency of occurrence in Lake Waccabuc has been variable, with differing species becoming more and less frequent over time (Table 3).

**Table 3. Long Term Frequency of Occurrence of Species Encountered on Lake Waccabuc from 2008-2025**

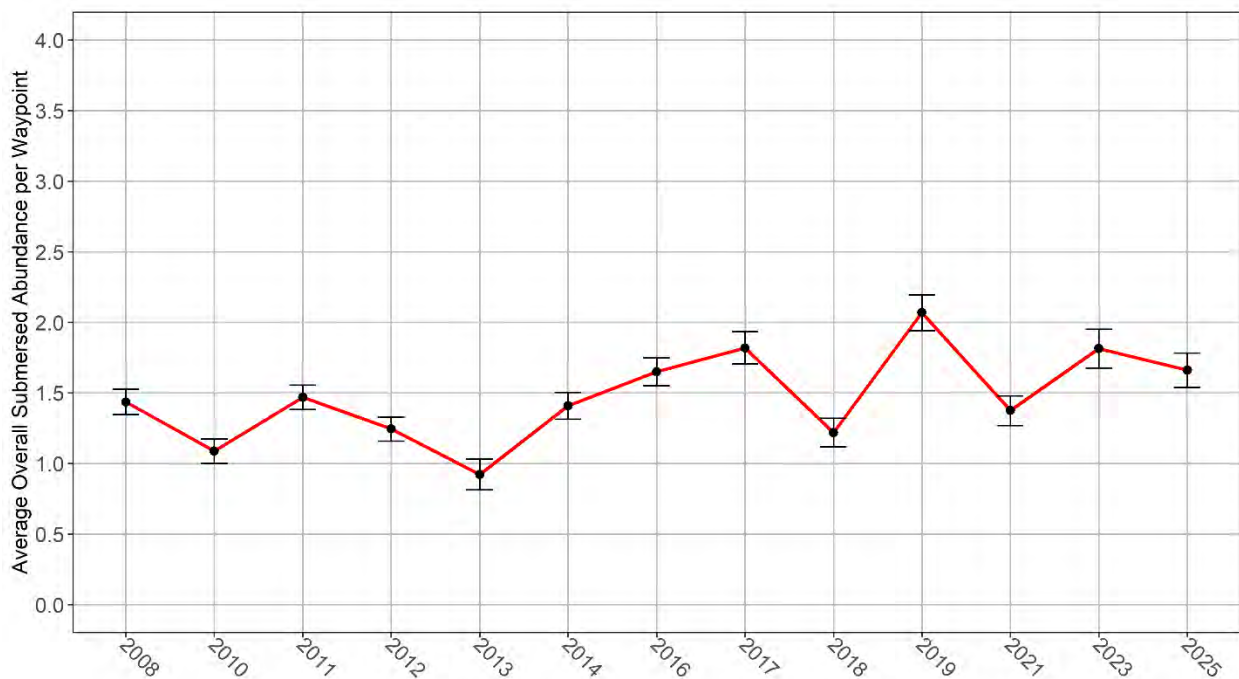
Scientific name	2008	2010	2011	2012	2013	2014	2016	2017	2018	2019	2021	2023	2025
<i>Brasenia schreberi</i>	32.5	34.2	34.2	30	27.5	31.7	37.5	30.8	30	27.5	32.5	30	20
<i>Carex sp.</i>	0	0	0	0	0	0	0	0.8	1.7	0	0	0	0
<i>Carex sp. floating</i>	0	0	0	0	0	0	0	0	0	1.7	0	0	0
<i>Carex sp. floating leaf</i>	0	0	0	0	0	0	0	0	0	0	3.3	0	0
<i>Ceratophyllum demersum</i>	14.2	25	31.7	36.7	35.8	38.3	37.5	35.8	44.2	48.3	34.2	20.8	29.2
<i>Egeria densa</i>	0.8	0.8	0	0	0	0	0	0	0	0	0	0	0
<i>Elodea canadensis</i>	2.5	12.5	15	11.7	10.8	15	15.8	9.2	3.3	3.3	0	3.3	0
<i>Elodea nuttallii</i>	0	0	0	0	0	0	0	0	0	0	0	0	0.8
Filamentous algae	45.8	22.5	92.5	59.2	75	77.5	73.3	59.2	46.7	56.7	49.2	60	37.5
<i>Fontinalis spp.</i>	0	0	0	0.8	1.7	0	0	0	0	0	0	0	0
<i>Heteranthera dubia</i>	0	9.2	11.7	11.7	12.5	16.7	35.8	25	25	30	0	0	5
<i>Isoetes sp.</i>	0	0	0	0	0	0	0	0.8	0	0	0	0	0
<i>Lemna minor</i>	0	1.7	0	4.2	1.7	5.8	5.8	2.5	9.2	9.2	0	0	5
<i>Lyngbya wolleii</i>	0	0	0	0	0	0	0	0	0	0	0	0	10
<i>Lythrum salicaria</i>	0	0	0	0	0	0	0	0	0	0	0	0.8	0
<i>Myriophyllum spicatum</i>	75.8	55.8	74.2	70	80	81.7	80	83.3	63.3	74.2	73.3	76.7	60
<i>Myriophyllum tenellum</i>	1.7	4.2	1.7	5	2.5	3.3	2.5	0.8	1.7	0.8	1.7	0	0.8
<i>Najas flexilis</i>	0	0	0.8	0	0	0	0	0.8	0	0	0	0	0
<i>Najas minor</i>	0	4.2	3.3	0	2.5	1.7	9.2	2.5	4.2	5	2.5	0	0
<i>Nuphar variegata</i>	10	17.5	18.3	15.8	18.3	16.7	17.5	18.3	17.5	19.2	25.8	15.8	16.7
<i>Nymphaea odorata</i>	25.8	33.3	34.2	38.3	40	43.3	49.2	40.8	43.3	31.7	43.3	45	43.3
<i>Pontederia cordata</i>	0	0	0	0	0	0	0	0	0	0	0	10	0
<i>Potamogeton amplifolius</i>	28.3	37.5	49.2	36.7	35.8	34.2	44.2	29.2	32.5	38.3	20.8	7.5	17.5
<i>Potamogeton crispus</i>	0.8	0	1.7	0	4.2	0.8	0	0.8	0	1.7	0	0	1.7

Scientific name	2008	2010	2011	2012	2013	2014	2016	2017	2018	2019	2021	2023	2025
<i>Potamogeton epihydrus</i>	0	2.5	1.7	3.3	3.3	4.2	5	3.3	6.7	9.2	0	0	0.8
<i>Potamogeton foliosus</i>	0.8	8.3	5.8	8.3	3.3	3.3	12.5	4.2	17.5	13.3	2.5	0	1.7
<i>Potamogeton robbinsii</i>	10	10	20	13.3	10	16.7	7.5	5.8	0	0	2.5	11.7	4.2
<i>Potamogeton sp.</i>	0	0	0	0	0	11.7	18.3	18.3	5	0	0	0	0
<i>Potamogeton spirillus</i>	0.8	0.8	3.3	2.5	10.8	0	0	0	0	0.8	0	0	0
<i>Potamogeton zosteriformis</i>	3.3	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sagittaria sp.</i>	0	0	0	0	0	0	0	5.8	0	0	9.2	3.3	0
<i>Sagittaria sp rosette</i>	3.3	5.8	11.7	11.7	11.7	13.3	6.7	0	10	10.8	0	0	4.2
<i>Sparganium sp</i>	0	0	0	0	0	0	0	0	0	0	0	0	1.7
<i>Spirodela polyrhiza</i>	0	0	0	3.3	1.7	2.5	1.7	0	5	5.8	20	1.7	0
<i>Trapa natans</i>	0	0	0	0	0	0.8	0	0	0	0	0	0	0
<i>Utricularia gibba</i>	6.7	1.7	2.5	1.7	8.3	5	5	0	3.3	6.7	0	0	2.5
<i>Utricularia macrorhiza</i>	0	0	0	0	0	0	0	5.8	0	0	0	0	0
<i>Utricularia minor</i>	0	0	0	0	0	0	0	0	0	0	0	2.5	0
<i>Wolffia spp.</i>	0	0	0	1.7	0	0	1.7	0	9.2	0.8	0	0	0

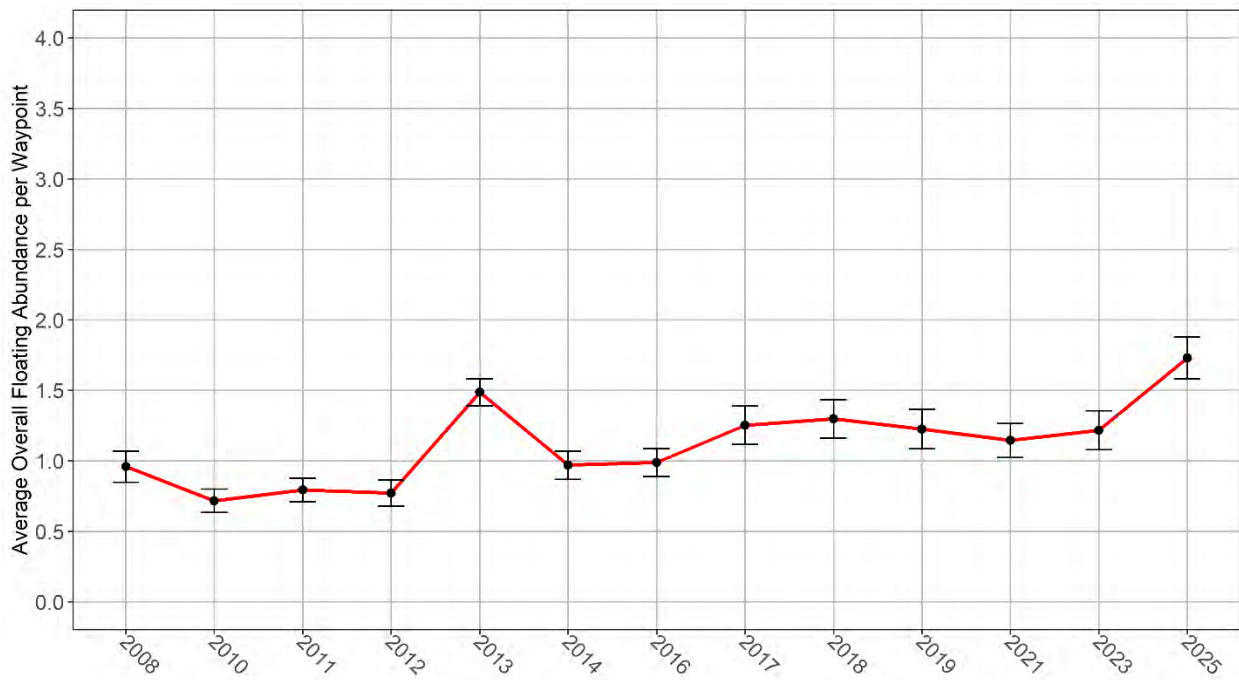
*Species Abundance Lakewide*

Both submersed (Figure 1) and floating (Figure 2) abundance per waypoint has increased over time in Lake Waccabuc. The increases are primarily driven by EWM and white water lily for submersed and floating species respectively. For species abundance, the scale goes from 0 to 4 with 0 representing no plants present in the lake and 4 representing plants being dense across all lake waypoints. There has been higher inter-year variability in recent years (2017-2025) as compared to previous years in submersed plant abundance, with floating species abundance being relatively consistent within the same time period.

**Figure 1. Average Submersed Plant Abundance per Waypoint from 2008 to 2025. The error bars represent standard error of the mean.**



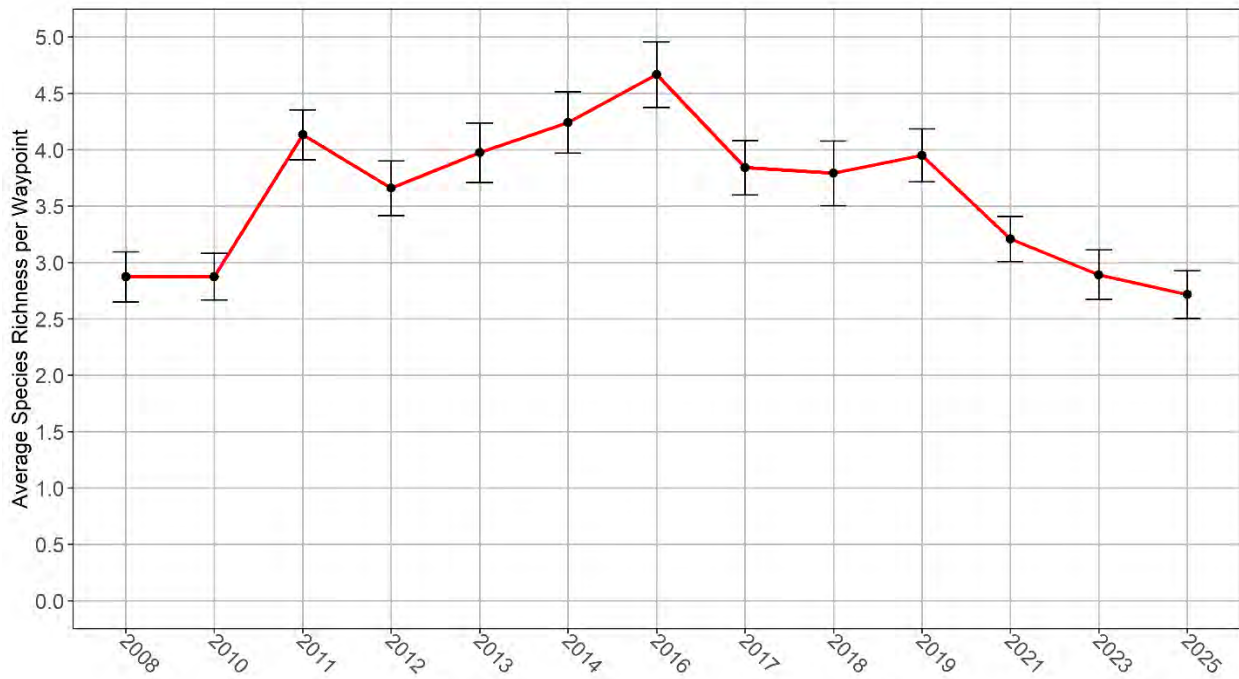
**Figure 2. Average Floating Plant Abundance per Waypoint from 2008 to 2025. The error bars represent standard error of the mean.**



### *Average Species Richness Lakewide*

Average species richness per waypoint has undergone large changes from 2008 to 2025 (Figure 3). Initially, species richness was low, with the average number of species detected per waypoint below 3 from 2008 to 2010. From 2010 to 2016, species richness increased to a peak of 4.7 species per waypoint in 2016. From 2016, species richness has declined steadily, to a total number of species per waypoint dipping below 3 for the first time since 2010.

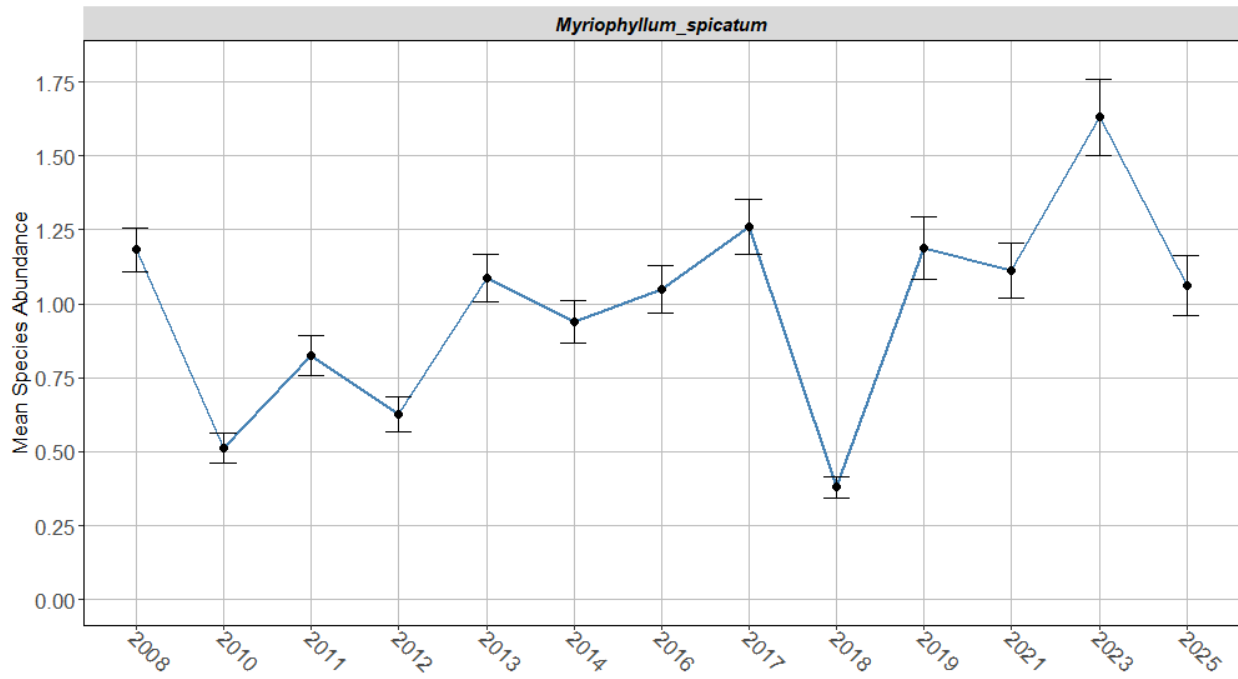
**Figure 3. Average Species Richness per Waypoint from 2008 to 2025 in Lake Waccabuc. The error bars represent standard error of the mean.**



### **Eurasian Watermilfoil**

EWM has historically been the most dominant submersed aquatic plant species in Lake Waccabuc. The species abundance has increased over time, especially post 2018 (Figure 4). There can be large inter-annual variation in EWM species abundance over time, which is expected. In any given year, the EWM population can face substantial boons and impediments to its growth including insect herbivory, weather patterns, competition from native plants etc.

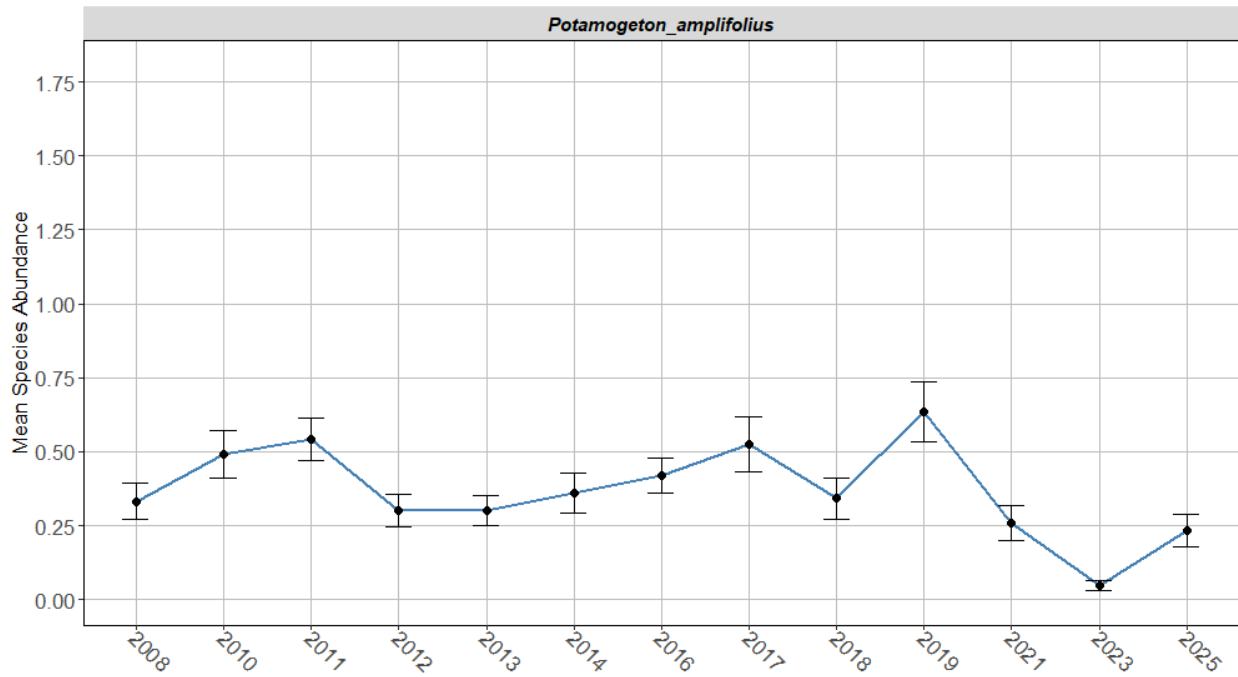
Figure 4. Average EWM Abundance per Waypoint from 2008 to 2025 in Lake Waccabuc



### Largeleaf Pondweed

Largeleaf pondweed species abundance was relatively stable for 2008-2019, however over the past few years, there is a decline (Figure 5). This may be due to competition with EWM, which has seen a similar increase in species abundance over the past few years.

Figure 5. Average Largeleaf Pondweed Abundance per Waypoint from 2008 to 2025 in Lake Waccabuc



### Floating Species

Yellow and white water lily have been increasing in species abundance since 2008, with white water lily increasing significantly throughout the years (Figures 6 and 7). All other floating species have been relatively consistent, with watershield having the largest fluctuations over time. Both species of duckweeds (*Lemna minor* and *Spirodela polyrhiza*) have been relatively low in abundance, however this is to be expected. These species are wind blown and have a tendency to have variable detection probabilities in any given year.

Figure 6. Average White Water Lily Abundance per Waypoint from 2008 to 2025 in Lake Waccabuc

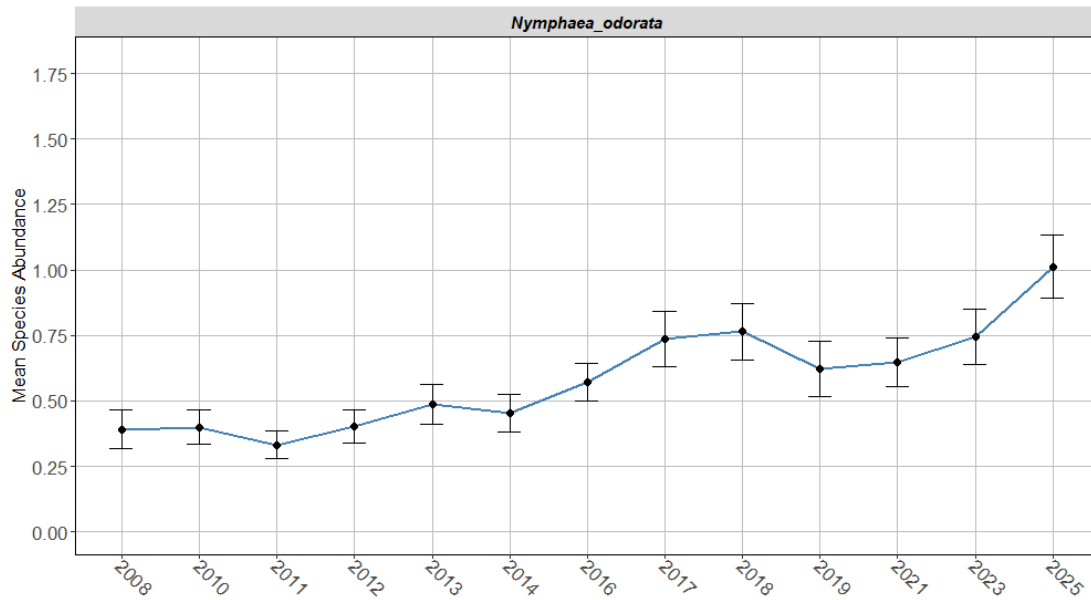
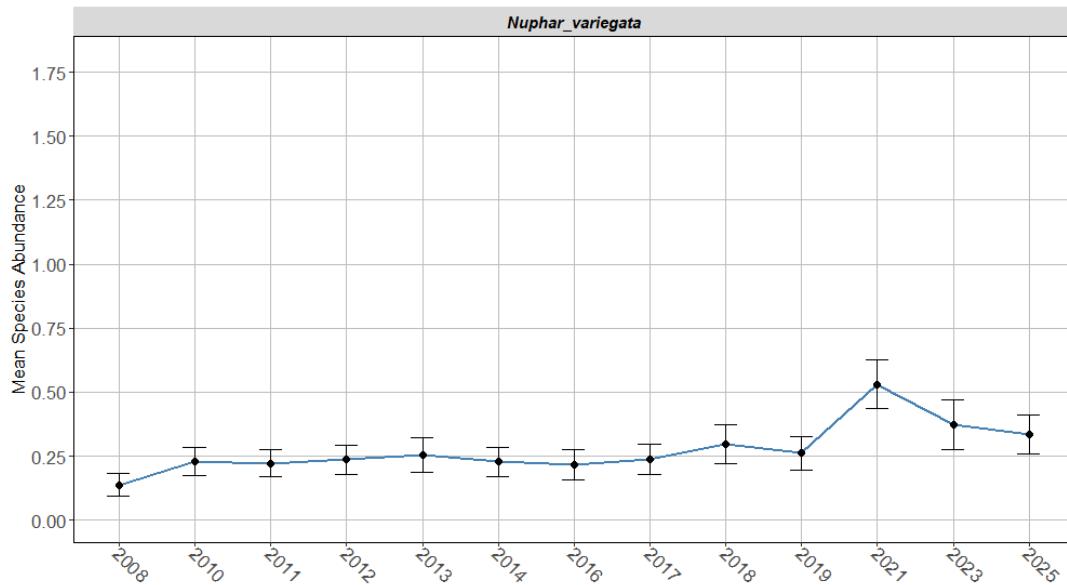


Figure 7. Average Yellow Water Lily Abundance per Waypoint from 2008 to 2025 in Lake Waccabuc



## Discussion

The aquatic plant community of Lake Waccabuc is characterized by dense submersed and floating leaf plant growth throughout the lake, with cove areas and shallow lake sections having increased growth. The primary submersed species in Lake Waccabuc is EWM, which is present lake wide in high densities and growing to the surface in most instances. White water lily is the most dominant floating leaved plant

and is present and dense in multiple lake areas. While there are dense areas of plant growth, the depth profile of the lake allows for a large amount of open water to be present, which provides natural access to water void of plants. Despite the deeper water, the shallow areas of the lake have significant vegetation growth which impacts recreational activities, such as boats getting to the aforementioned open water areas. This is especially true for residents living in the eastern most cove (inlet to Lake Oscaleta).

The value of having a long term dataset for the aquatic plant community cannot be understated. This level of detail allows for analysis to look back and contextualize changes in the lake that would otherwise be left to conjecture or speculation. Based on the analysis of the long term data there are a few broad conclusions can be drawn.

### ***Increase in Floating Vegetation Density***

There has been an increase in floating vegetation density lake wide from 2008 to 2025 (Figure 2), specifically driven by white water lily (Figure 6) and yellow water lily (Figure 7). Water lilies can cause recreational issues by clogging boat propellers and inhibiting non-motorized recreation. The increase over time is modest, likely due to the limitations of water lily growth (will not grow in water deeper than 8 feet and will likely not be dense in waters deeper than 6 feet). It is not known where geographically on the lake the water lily density increase is coming from. Understanding where the increased density is occurring within the lake could be an important next step to determining where to potentially prioritize management. This can be done via annual drone survey or advanced GIS analysis of past distribution maps. Long term satellite imagery can be useful as well to discern where lilies are becoming more dense over time (See Appendix C).

### ***Eurasian Watermilfoil Increase***

EWM density in Lake Waccabuc has been variable over time, especially since 2018. While the general trend indicates that there is an increase, the variable nature of the data warrants caution when interpreting how significant of a change actually exists. EWM populations can be highly variable in lakes and are subject to various environmental stressors. Changes in weather, insect herbivore populations, and/or survey timing and the individual surveyors themselves can all have impacts on the annual EWM abundance seen within the long-term dataset.

Despite the high variability, there is reason to believe the increase in EWM is an actual increase. The closest competitor to EWM currently in Lake Waccabuc is largeleaf pondweed which has had a decline in species abundance during the same time period of the increase in EWM. There is considerable overlap in the habitat preferences of both species, with only slight differences in water depth preference (largeleaf pondweed prefers to grow shallower than EWM). Both species grow vertically and form canopies in waters between 4 to 10 feet. EWM can overtake previously established largeleaf pondweed locations over time. Ecological competition between the two species is not resolved in a short time period absent of a large disturbance. The more likely mechanism is a slow colonization of EWM within largeleaf pondweed beds combined with infrequent bad growth years for largeleaf pondweed leading to lower density. This increase in EWM is a plausible cause for the recent decline in species richness per waypoint documented on the lake.

## ***Decline in Species Richness***

Since 2016, there has been a decline in species richness at Lake Waccabuc. Species richness is an important metric for understanding the community ecology of a lake, however caution should be exercised when drawing significant conclusions. Comparing the species lists from 2016 to 2025, The highest and lowest years of average species richness, there is only a two species difference (21 to 19 from 2016 to 2025). The two species found in 2016, but not in 2025 were brittle naiad and common watermeal. Brittle naiad was not common in 2016 and common watermeal can fluctuate in survey detection based on the time of year and wind patterns, since it is a small, floating plant. Therefore, the differences seen between the surveys more likely reflect a decline in local plant diversity (at the waypoint scale) as compared to large additions or subtractions of individual species.

This change in local species diversity indicates that other species are becoming more dense at particular waypoints. It can be inferred from GEI's site observations that there were not many sampling points in the lake that had low plant coverage overall, which would indicate that diversity loss may be more due to competition versus plant species just disappearing. The increases in Eurasian watermilfoil and water lily (white and yellow) density over time supports this assumption.

GEI also does not believe the decline in species richness would have been due to only using two rake tosses in 2025 as compared to three in previous years. The decline in species richness has been taking place well before the switch from three to two rake tosses took place

## ***Survey and Methodology Limitations***

Every aquatic plant survey is not designed to answer all the potential questions that lake associations and lake managers have for a particular lake. The point intercept rake toss methodology employed by TLC is an excellent all around survey methodology, allowing for lake wide comparisons of abundance of the dominant species. However, it is important to recognize the limitations of this survey methodology to better interpret and understand the results presented.

Point intercept surveys provide information on the species and densities present at the exact sample point but the distribution of points around the lake does not allow for all pertinent questions to be answered. For example, the maximum depth distribution of plants in Lake Waccabuc can only be inferred and not quantified because the set points exist within the littoral zone (area where plants grow). It may be important to know the maximum extent of plant growth to determine acreages of plants, which is important for management planning. Furthermore, estimates of plant area coverage are difficult to make with a point intercept design, as there has to be a lot of interpolation (estimates) of what the density of plants are between the points to develop accurate coverage estimates.

Survey timing also may influence results. While most surveys on Lake Waccabuc are done within the late July to early August timeframe, specific timing paired with weather may lead to altered plant communities based on lake conditions. For example, a cold June and July may lead to extended curly leaf pondweed growth later in the season, which may show up as more present in the lake than it would during more typical conditions. Conversely, a hot June and July with a later survey (August) may lead to later season species being more prevalent in the survey results.

The limitations presented above are not intended to pose that the current methodology is insufficient, rather to highlight that aquatic plant communities may need various survey approaches or multiple surveys per year to address various questions. Lake Waccabuc has not actively managed aquatic plants in the lake since managing Brazilian elodea (*Egeria densa*) on a small scale in the early 2010s, hence the point intercept methodology has been sufficient for tracking long term changes. However, if management priorities change over time, an alternate survey methodology may be warranted.

## **Management Recommendations**

Currently, there are a few impediments to recreation on Lake Waccabuc that can be remedied via management. The decision to undertake management needs to be underpinned by strong goals and objectives. While specific goals should be decided upon with the consultation of the entire lake community, GEI can provide a general framework for TLC to follow.

### ***Proposed Goal***

Management goals should be ecological and recreational in nature. GEI is proposing two overarching goals to address these factors.

The proposed goal for recreational management on Lake Waccabuc is to ensure that all residents on the lake should have access to all parts of the lake with minimal aquatic plant interference, while managing the least amount of aquatic plants practical to achieve this access. Various homeowners have various shoreline and depth characteristics on their property which influences how easily they can access the lake. Homeowners in the eastern cove areas have a lot of shallow water with dense plant growth to contend with accessing the rest of the lake. Homeowners on the northern and southern shoreline for comparison have limited aquatic plant interference issues comparatively, therefore management intensity should be reflected accordingly.

The ecological goal for the lake should be to maximize species richness so there are no dominant, monocultures of invasive species which crowd out native species. Increases in species richness allow for more niche habitats to be filled, which increases lake resilience to new invasive species. Invasive species that have to compete with multiple species for space in a lake have a much harder time becoming dominant and affecting the lake's ecology versus having to compete with a lower number of species. The general mechanism to increase species richness in a lake is to manage invasive plants that create dense monocultures, which includes EWM.

### ***Methods for Achieving Goals***

To achieve these goals, active management of aquatic plants would likely involve localized control of water lilies to improve access and larger-scale control of EWM. The water lily control can be done by prioritizing areas where water lilies are direct impediments to lake access. A few areas such as the eastern cove can have small access lanes (~10 to 20 foot wide) lanes initially cut from the back of the cove to the deeper water to allow boat passage for multiple homes. These lanes should be initially cut using a hydrorake, which removes the rhizomes of the water lilies and then can be maintained semi-annually using a small boat based cutter, herbicide application, or continued hydroraking. GEI would not recommend using a standard larger mechanical harvester, as the water depth in these areas is

too shallow and the cutter head may dig into the sediment, creating localized water quality issues and causing machine damage.

The EWM management should be done using an EPA and New York State Department of Environmental Conservation (NYSDEC) registered herbicide. While other management strategies such as Diver Assisted Suction Harvesting (DASH) can be used in localized areas, once the area for management increases, the price increases proportionally.

**Table 4. Management Strategies for Achieving Goals for Lake Waccabuc**

	<b>Goal 1. Water Lily Control and Access</b>	<b>Goal 2. Eurasian Watermilfoil Control</b>
<b>Recommended Management Techniques</b>	Hydroraking initially, following up with cutting/hydroraking/herbicides.	ProcellaCOR EC application
<b>Timing for Management</b>	Initial Management can take place at any time of the year, follow-ups should take place in the beginning of the season.	Initial application in early to mid-June.
<b>Longevity of Management</b>	Initial Management 1 to 2 years, follow up management will likely last the season depending on technique chosen.	Full-Lake Application – 2 to 4 years, partial lake applications 1 to 3 years
<b>Non-Target Impacts</b>	All management non-selective inside of management areas, herbicides and cutting may leave submersed plants in management area unimpacted.	No impacts on other submerged plants, possible impacts on watershed, but treatment would not happen in areas close to watershed locations.
<b>Area for Management</b>	Limited to less than 1 acre, multiple lanes with dimensions of 10 to 20 feet wide and ~100 feet long.	Full-Lake Application -- ~50 acres through littoral zone, partial treatments 2 to 5 acres per treatment.
<b>Cost Estimates</b>	Hydroraking: ~\$1,500 to \$3,000 per day, ~2 to 7 day per 1 acre. Follow up management costs will vary, but may range between \$1,500 to \$3,000 per day, however would take ~1 to 3 days to complete based on density of regrown plants in paths.	\$1,200 to \$2,000 per acre with combined mobilization and product cost for ProcellaCOR EC. There should not be any need for an herbicide treatment in year 2 or 3.
<b>Anticipated Permits Needed</b>	Article 15 excavation and fill, Article 24 Freshwater wetlands permit. Local permitting.	Article 15 pesticide permit, Article 24 Freshwater wetlands permit. Local permitting. DEP concurrence needed.

### ***Monitoring Recommendations***

The long term aquatic plant dataset for Lake Waccabuc is incredibly valuable and unique among New York lakes. Aquatic plant surveys spanning a decade using the same methodology on the same waterbody allow for greater insights into the functioning of the system as compared to other comparable lakes. The conclusions made in this report concerning the increase of EWM and floating

vegetation could not be made without the strong background dataset to reference. Continuing the long-term data collection should be prioritized.

If management actions are undertaken to control aquatic vegetation, it may be necessary to adopt a different monitoring strategy to adequately assess the impacts of that management. This may mean a point intercept survey with closely spaced points within a treatment area, or a drone survey to fly over areas where water lily management is taking place.

AR/LK:ag

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2026-05-07.docx

## Appendices

- Appendix A Project Maps
- Appendix B Additional Plant Graphics
- Appendix C Long Term Satellite Imagery Eastern Cove

Three Lakes Council  
Lake Waccabuc  
Lewisboro, New York  
May 7, 2026

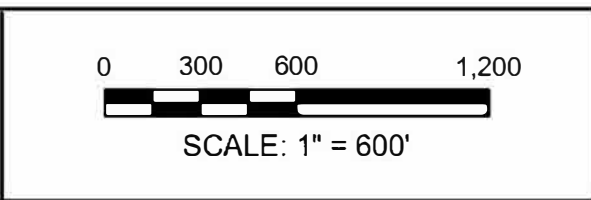
## Appendix A Project Maps

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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Watershield  
(*Brasenia schreberi*)



Plant Distribution Map  
July 30, 2025

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Project 2501041 May 2026

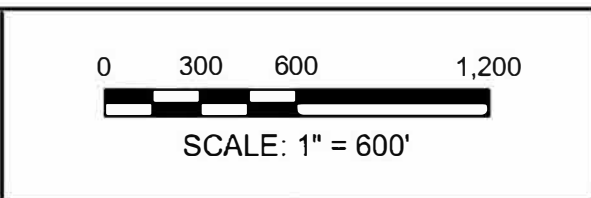
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Coontail  
(*Ceratophyllum demersum*)



Plant Distribution Map  
July 30, 2025

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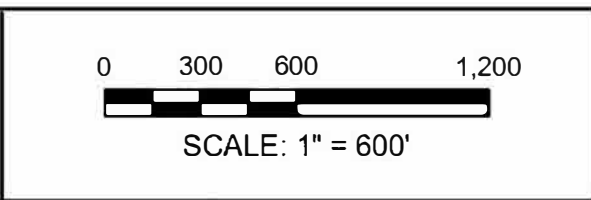
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Western Waterweed  
(*Elodea nuttallii*)



Plant Distribution Map  
July 30, 2025

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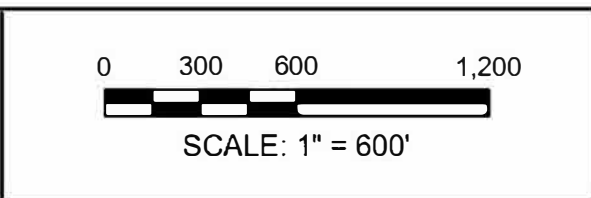
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Filamentous Algae



Plant Distribution Map  
July 30, 2025  
Project 2501041  
May 2026

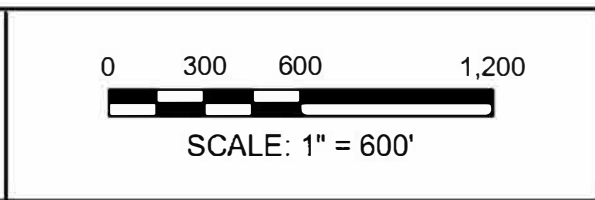
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Duckweed  
(*Lemna minor*)



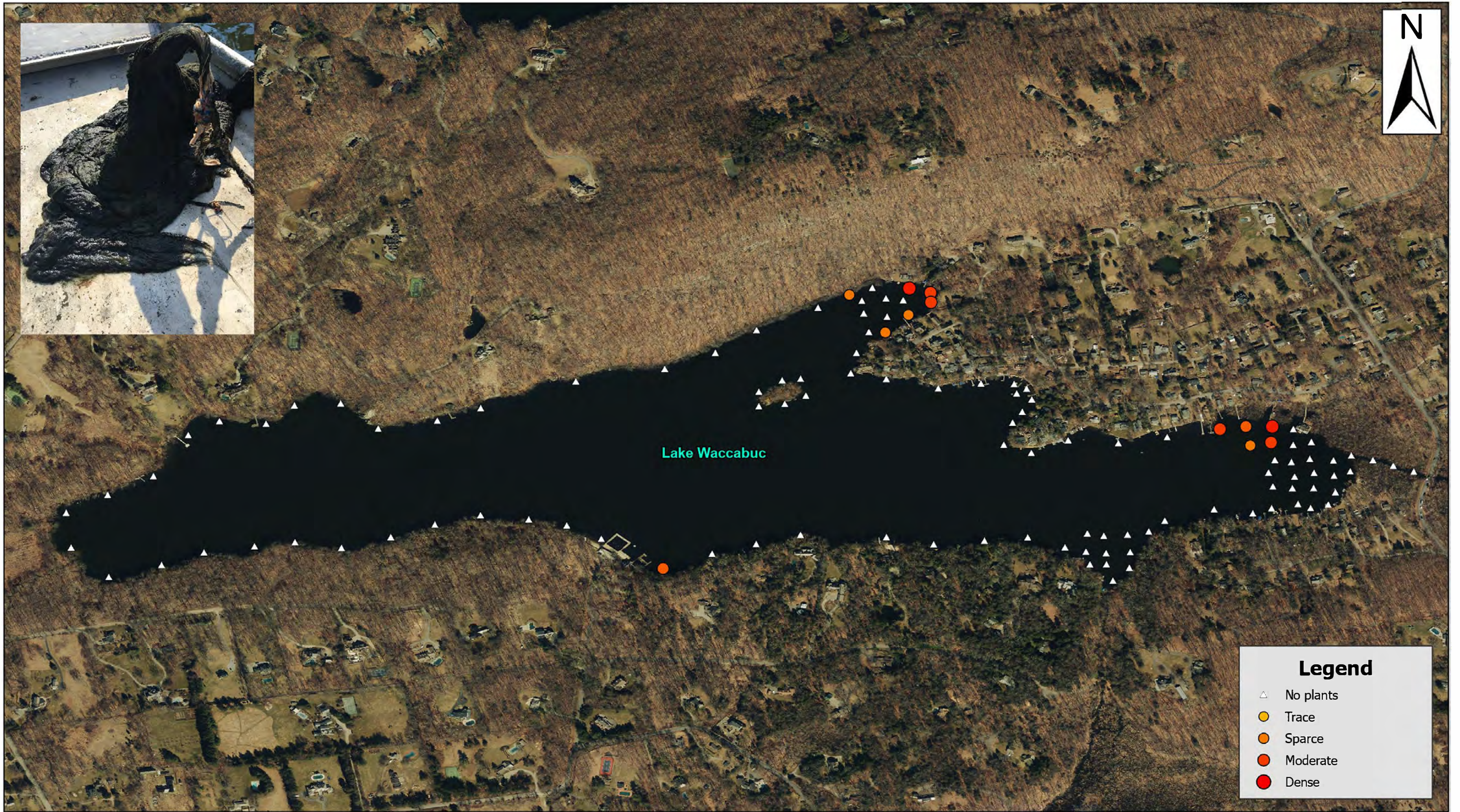
Plant Distribution Map  
July 30, 2025

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Project 2501041 May 2026

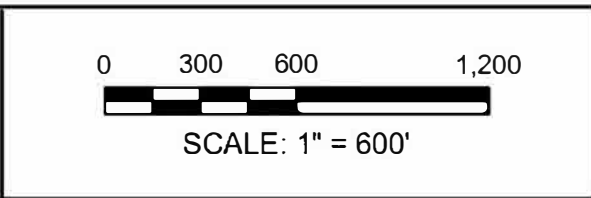
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

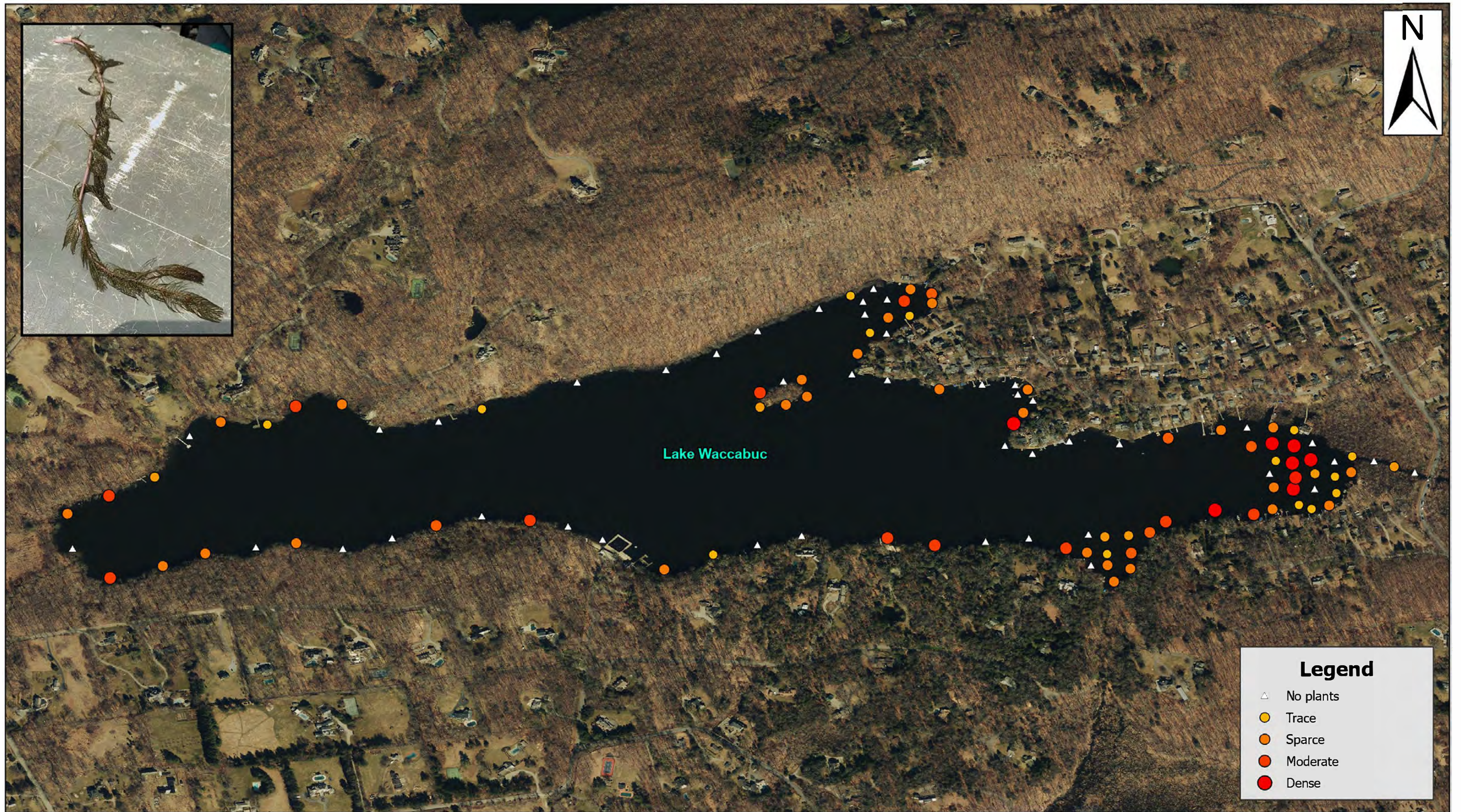
Horsehair Algae  
(*Lyngbya sp.*)



Plant Distribution Map  
July 30, 2025  
Project 2501041  
May 2026

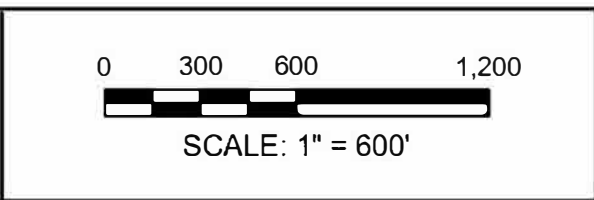
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

**Eurasian Watermilfoil**  
*(Myriophyllum spicatum)*



Plant Distribution Map  
July 30, 2025

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Project 2501041 May 2026

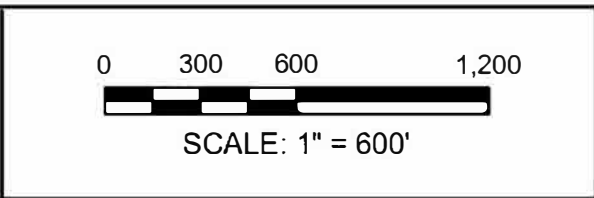
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Slender Watermilfoil  
(*Myriophyllum tennellum*)



Plant Distribution Map  
July 30, 2025

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Project 2501041 May 2026

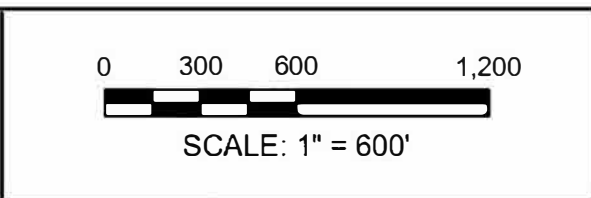
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Yellow Water Lily  
(*Nuphar variegata*)



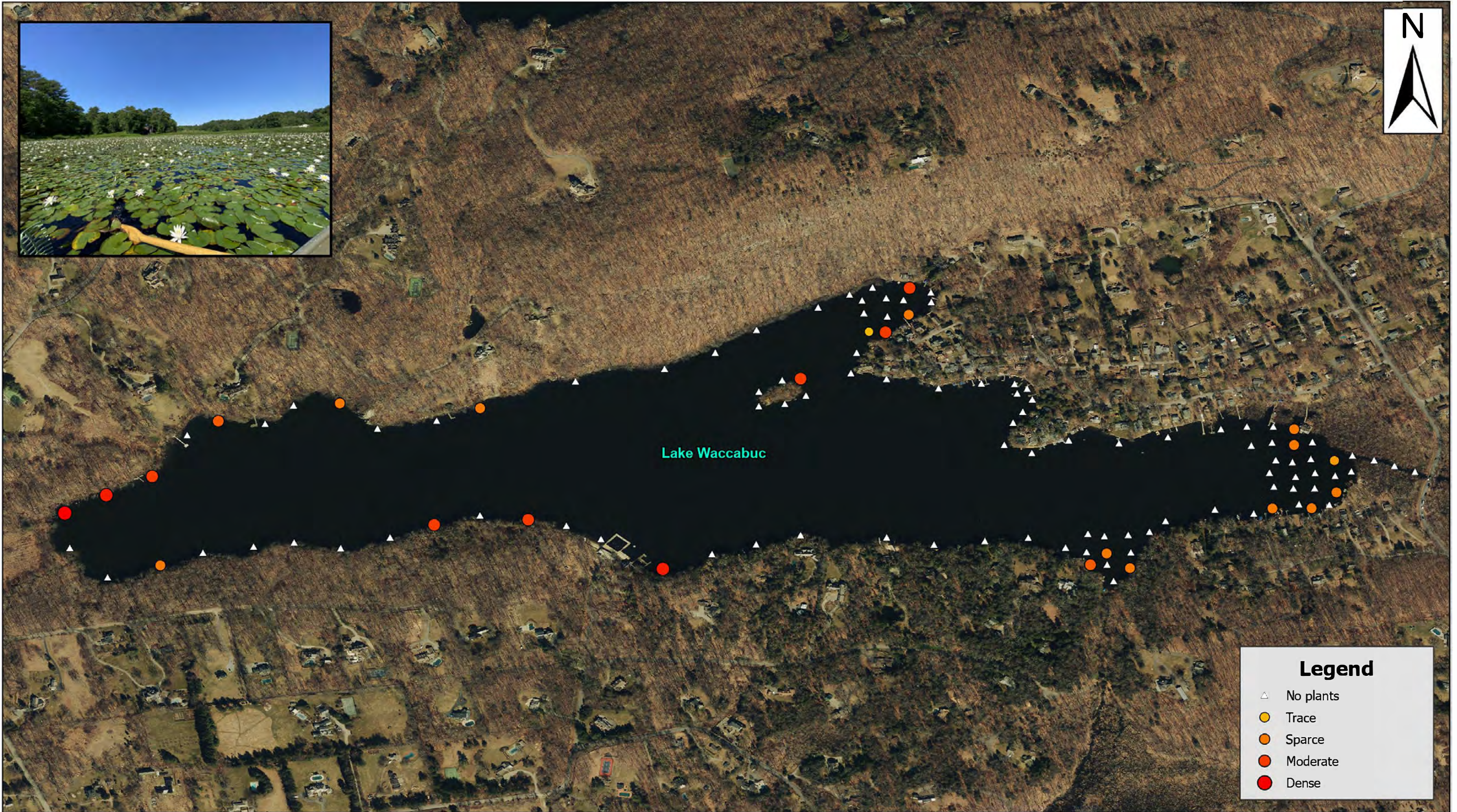
Plant Distribution Map  
July 30, 2025

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Project 2501041 May 2026

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Lake Waccabuc  
Lewisboro  
Westchester County, New York

White Water Lily  
(*Nymphaea odorata*)



Plant Distribution Map  
July 30, 2025

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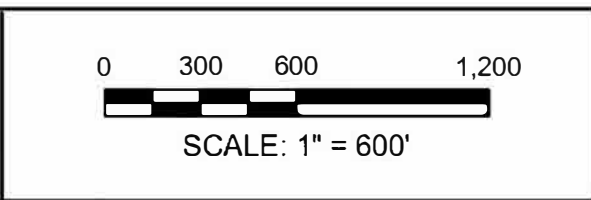
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Largeleaf Pondweed  
*(Potamogeton amplifolius)*



Plant Distribution Map  
July 30, 2025

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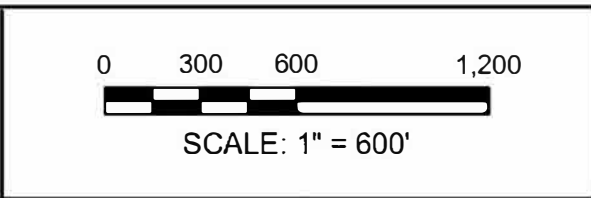
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

**Curly-Leaf Pondweed**  
*(Potamogeton crispus)*



Plant Distribution Map  
July 30, 2025

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Project 2501041 May 2026

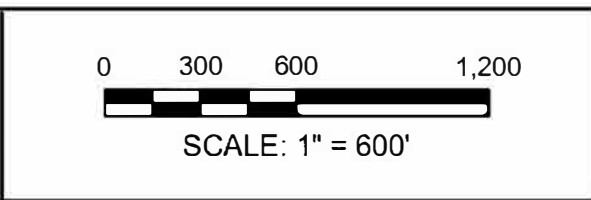
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Ribbonleaf Pondweed  
(*Potamogeton epihydrus*)



Plant Distribution Map  
July 30, 2025

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Project 2501041 May 2026

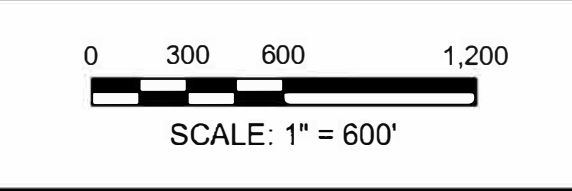
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Leafy Pondweed  
*(Potamogeton foliosus)*



Plant Distribution Map  
July 30, 2025

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Project 2501041 May 2026

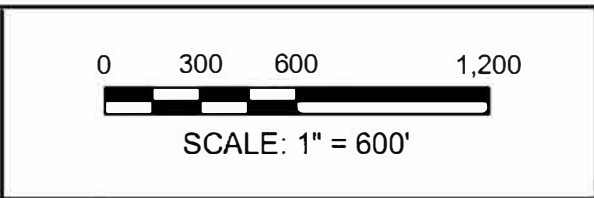
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Robinns' Pondweed  
(*Potamogeton robbinsii*)



Plant Distribution Map  
July 30, 2025  
Project 2501041  
May 2026

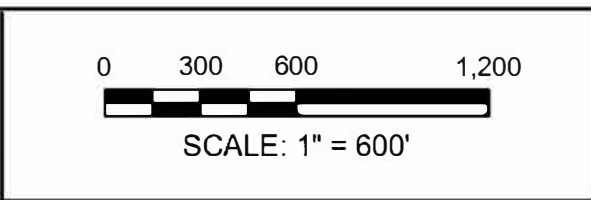
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Grassy Arrowhead  
(*Sagittaria graminea*)



Plant Distribution Map  
July 30, 2025

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Project 2501041 May 2026

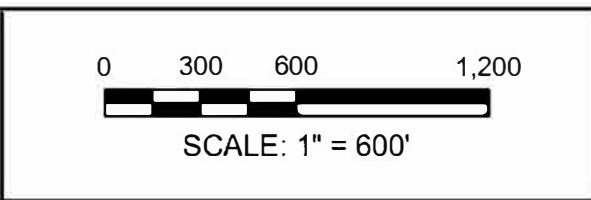
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Bur-reed  
(*Sparganium sp.*)



Plant Distribution Map  
July 30, 2025

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Project 2501041 May 2026

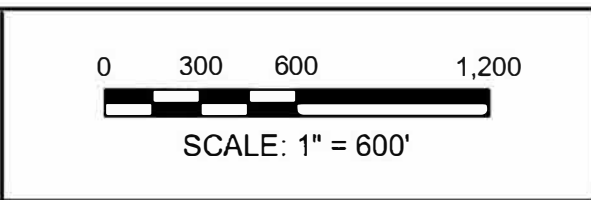
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Lake Waccabuc  
Lewisboro  
Westchester County, New York

Humped Bladderwort  
(*Utricularia gibba*)



Plant Distribution Map  
July 30, 2025

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Project 2501041 May 2026

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## **Appendix B Additional Plant Graphics**

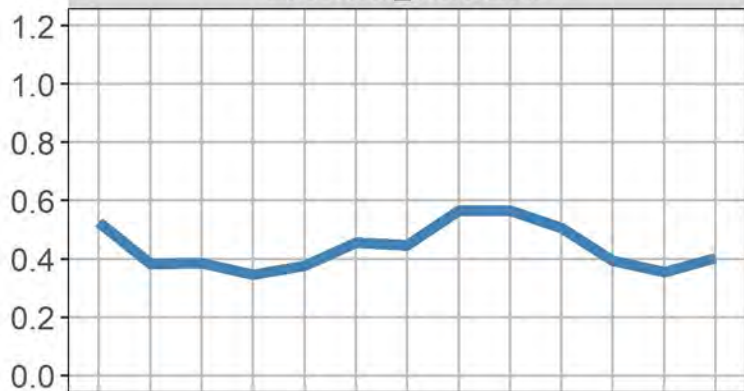
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**Appendix B - Figure 1. Lake Waccabuc Average Submersed Species Abundance 2008-2025**

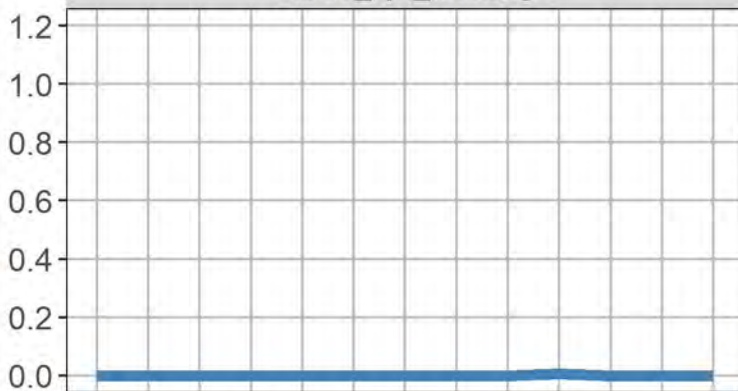
**Appendix B - Figure 2. Lake Waccabuc Average Floating Species Abundance 2008-2025**

Mean Species Abundance

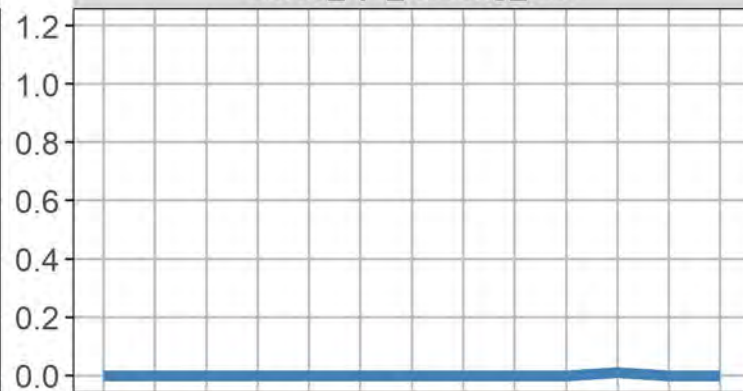
*Brasenia\_schreberi*



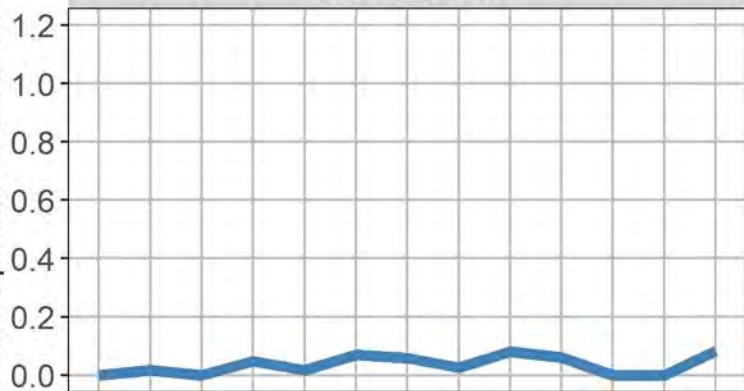
*Carex\_sp.\_floating*



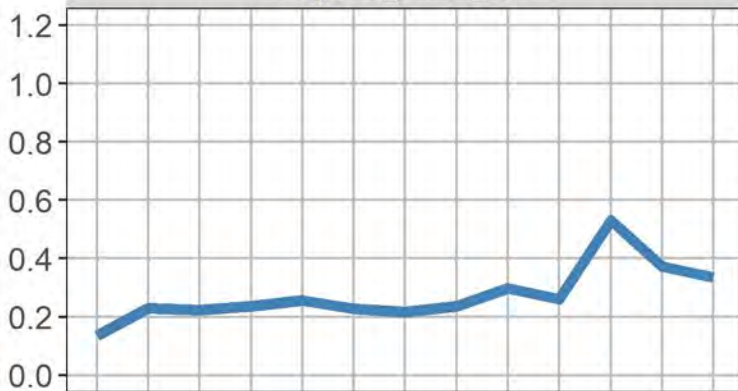
*Carex\_sp.\_floating\_leaf*



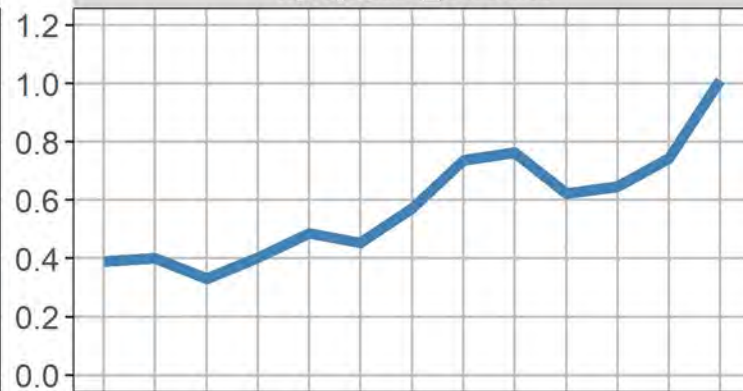
*Lemna\_minor*



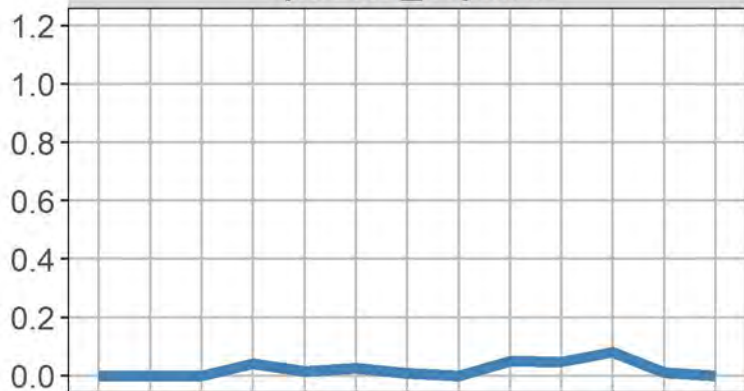
*Nuphar\_variegata*



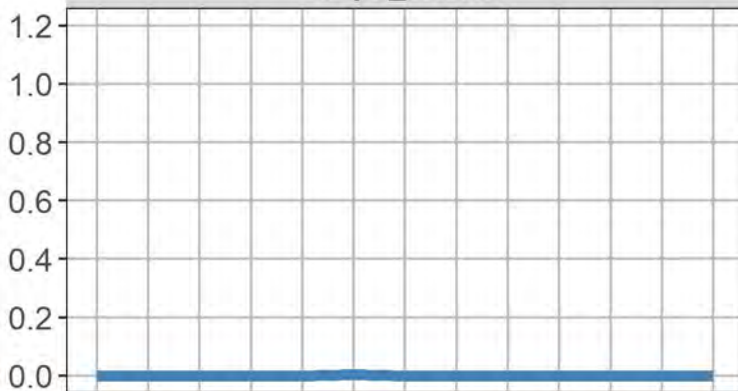
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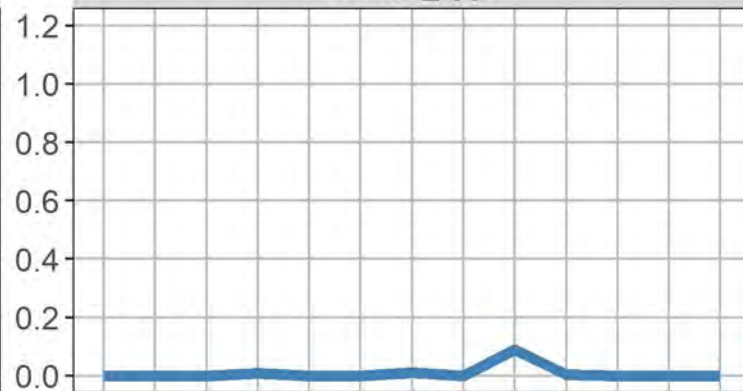
*Spirodela\_polyrhiza*

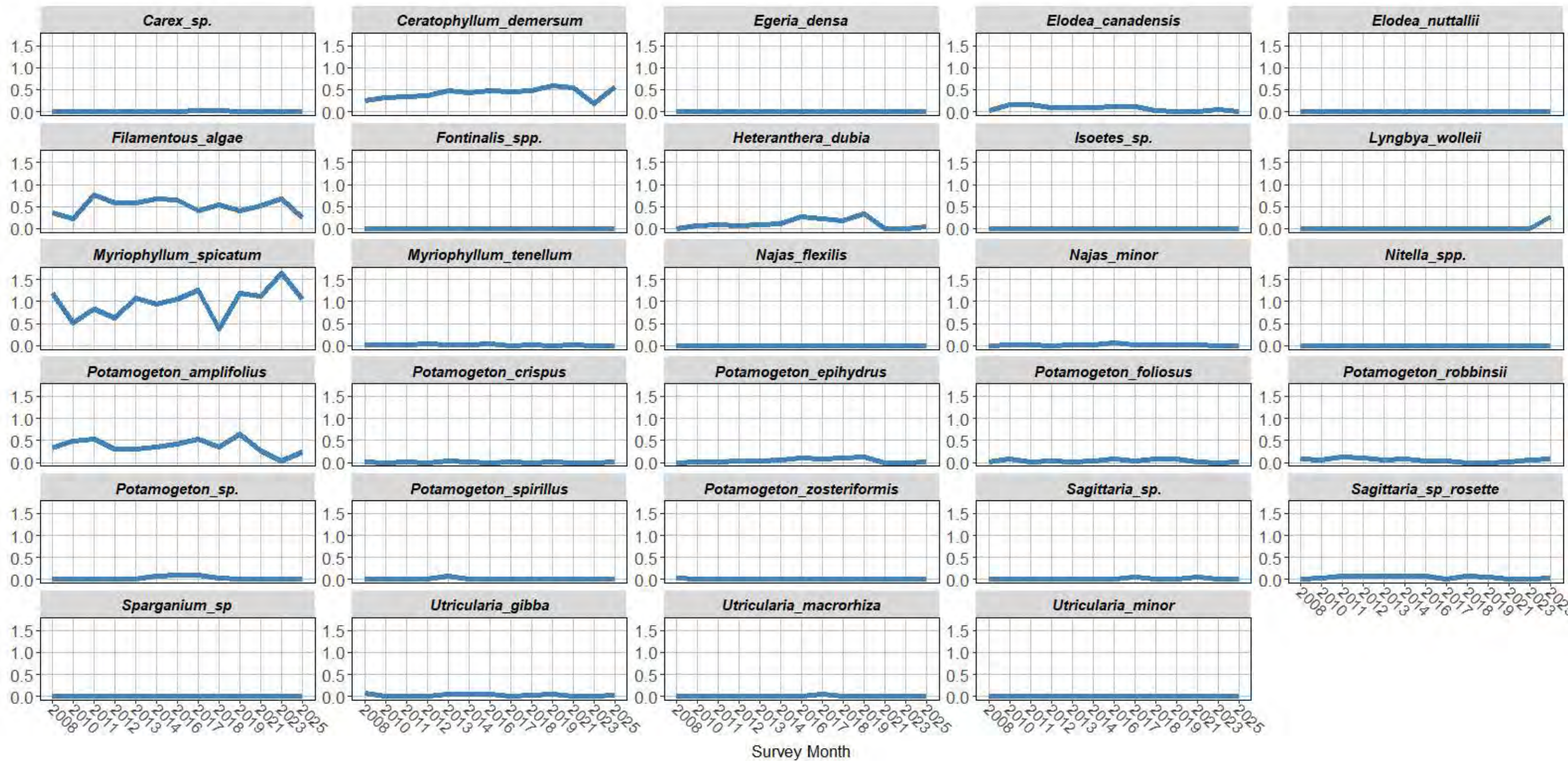


*Trapa\_natans*



*Wolffia\_spp.*





Three Lakes Council  
Lake Waccabuc  
Lewisboro, New York  
May 7, 2026

## **Appendix C Long Term Satellite Imagery Eastern Cove**

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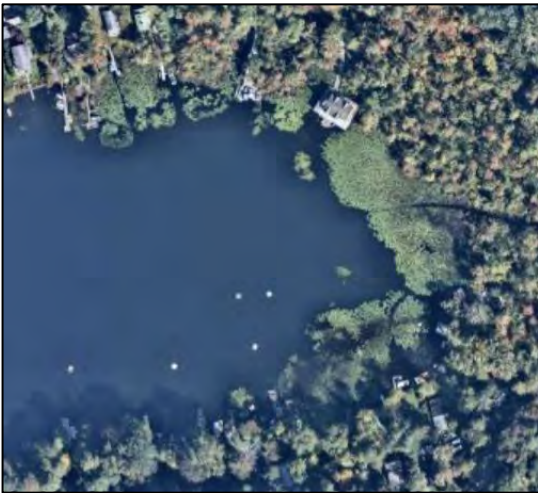
October 2<sup>nd</sup>, 2025



September 12<sup>th</sup>, 2025



October 1st, 2023



September 15<sup>th</sup>, 2022



September 29<sup>th</sup>, 2021



September 22<sup>nd</sup>, 2019

