DFWI

Darrin Fresh Water Institute at Rensselaer

Aquatic Vegetation of Lake Algonquin, New York

Prepared for

The Friends of Lake Algonquin
Wells, NY

Prepared By

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Acknowledgements

The author would like to acknowledge Mr. John Hoekstra of the Friends of Lake Algonquin for his assistance in coordinating the current survey project.

Background.

Quantitative aquatic plant surveys were undertaken for Lake Algonquin, Wells, New York as part of a cooperative effort between the Darrin Fresh Water Institute and the Friends of Lake Algonquin. The aquatic plant survey was designed to provide data on aquatic plant distribution and to develop information for a treatment program to control Eurasian watermilfoil (*Myriophyllum spicatum*). The Point-Intercept Rake Toss method presently required by NYS DEC for Tier III Lakes was employed. 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 future comparisons of post-treatment conditions to prior survey information.

Methods

Survey Site.

Lake Algonquin is located in Hamilton County in the Town of Wells, New York. Elevations within the watershed range from 988 feet at the surface of the lake to in excess of 1600 feet above sea level. The lake has a surface area of 249 acres and a watershed of 314,616 acres. Mikol and Polsinelli (1985) report a maximum depth of 19 feet and a mean depth of 9 feet. The hydraulic retention time for the lake is less than 0.1 years and the lake forms part of the Hudson River drainage. A number of native species of aquatic plants (Table 1) have been reported for Lake Algonquin (LCI 2017). Eurasian watermilfoil (*Myriophyllum spicatum*), an invasive (i.e. non-native) aquatic plant species was first reported in 2002 (APIPP 2002). In 2017, the NYS DEC Lake Classification and Inventory (LCI) identified Eurasian watermilfoil (*Myriophyllum spicatum* L) in Lake Algonquin and confirmed the presence of 12 other macrophyte species. Shoreline surveys by Adirondack Research as part of the APIPP in 2018 reported extensive growth of Eurasian watermilfoil throughout the lake, with dense growth at the south end of the lake and in one cove on the west side.

Table 1. Species List for Lake Algonquin, NY (LCI 2017)

Aquatic Plant Species	Common Name
Brasenia schreberi	Watershield
Chara sp.	Muskgrass
Dulichium arundinaceum	Three-way sedge
Eleocharis sp.	spike rush
Elodea canadensis	Waterweed
Myriophyllum spicatum	Eurasian watermilfoil
Nymphaea odorata	White water lily
Pontederia cordata	Pickerelweed
Potamogeton amplifolius	Largeleaf pondweed
Sagittaria	Arrowhead
Sparganium sp.	Burreed
Typha latifolia	Broad-leaved cattail, Common cattail
Vallisneria americana	Wild celery

Methods

Species List and Herbarium Specimens. As the lake was surveyed, the occurrence of each aquatic plant species observed was recorded and herbarium specimens collected where necessary. Plant specimens became part of the permanent collection at the Darrin Fresh Water Institute Laboratory in Bolton Landing, NY. All taxonomy is based on Crow & Hellquist, 2000.

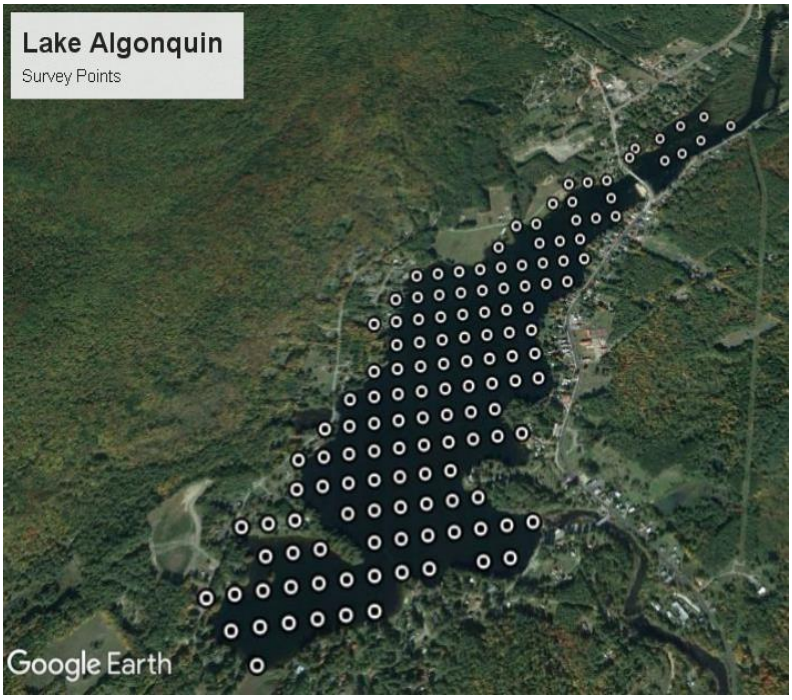


Figure 1. Sampling points for Lake Algonquin.

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 September 2nd, 2021 at the time of maximum aquatic plant abundance.

Based on a 100 meter grid and excluding some points outside the littoral zone, we surveyed a total of 136 points (Figure 1). 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.

Lake Algonquin Open-Lake Survey Results

In September of 2021, the aquatic plant community of Lake Algonquin included a total of 32 species, with 31 species collected in the point intercept survey (Table 1). Of these, one group are macroscopic alga, or charophytes (*Chara/Nitella*), three are floating-leafed species (*Nuphar, Nymphaea* and *Brasenia*), six are emergent species (*Eleocharis, Sparganium, Polygonum, Scirpus, Typha* and *Pontederia*) and the remaining 22 are submersed. This high diversity suggests a healthy aquatic plant population at the present time. None of these species is on the New York State Rare Plant list (Young, 2020). *Myriophyllum spicatum* was the only submersed, exotic species reported for Lake Algonquin.

Table 1. Aquatic plant species present in Lake Algonquin surveys.

Species	**Common Name**
Brasenia schreberi J.F. Gmel	Water Shield
Chara species	Musk Grass
Eleocharis acicularis (L.) Roemer & Schultes	Spike Rush
Elodea canadensis Michx.	Waterweed
Eriocaulon septangulare With.	Pipewort
Isoetes echinospora Dur.	Quillwort
Juncus pelocarpus	Rush
Megalodonta beckii	Water Marigold
Myriophyllum sibiricum L.	Northern Milfoil
Myriophyllum spicatum L.	Eurasian watermilfoil
Myriophyllum tenellum Kom.	Leafless Milfoil
Najas flexilis (Willd.) Rostk. & Schmidt.	Bushy Pondweed
Polygonum amphibium	Smartweed
Nuphar variegata Engem. Ex Durand	Yellow Water Lily
Nymphaea odorata Ait.	White Water Lily
Pontedaria cordata L.	Pickerelweed
Potamogeton amplifolius Tuckerm.	Broad leaf Pondweed
Potamogeton epihydrus Raf.	Ribbon leaf Pondweed
Potamogeton gramineus L.	Variable Pondweed
Potamogeton illinoensis Morong	Illinois Pondweed
Potamogeton praelongus Wulfen	White stem Pondweed
Potamogeton pusillus L.	Narrow leaf Pondweed
Potamogeton richardsonii (Ar. Benn) Rydb.	Richardsons Pondweed
Sagittaria graminea Michx.	Arrowhead
Scirpus spp.	Rush
Sparganium sp.	Bur Reed

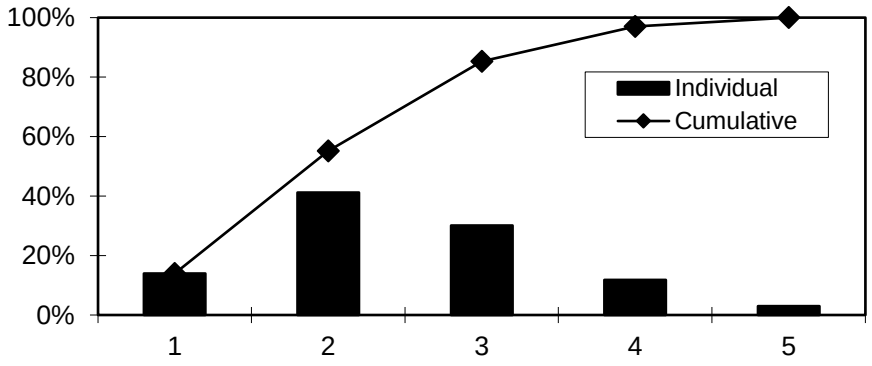
Species	Common Name
Typha latifolia L.	Cattail
Utricularia intermedia Hayne	Bladderwort
Utricularia gibba L.	Humped Bladderwort
Utricularia purpurea Hayne	Purple Bladderwort
Utricularia vulgaris L.	Great Bladderwort
Vallisneria americana L.	Duck Celery

Species richness in Lake Algonquin was quite high, with a large number of species occurring in more than 5% of survey points (Table 2). Macroalgae including *Chara* sp. and *Nitella* sp. were by far the most widely distributed plants. Eurasian watermilfoil (*Myriophyllum spicatum*) was the seventh most common macrophyte. Common native macrophytes species included waterweed (*Elodea canadensis*), purple bladderwort (*Utricularia purpurea*), rush (*Scirpus* sp.), burreed (*Sparganium sp.*), northern watermilfoil *(Myriophyllum sibiricum*), white waterlily (*Nymphaea odorata*), and broad-leaf pondweed (*Potamogeton amplifolius*). With this diversity and distribution of native species, the test for selectivity should be sensitive to a number of species, and the probability of native plant restoration in areas formerly inhabited by Eurasian watermilfoil should be high following management efforts.

Maximum Depth of Colonization

Rooted aquatic plants (macrophytes) were present from the waters' edge to a depth of 3.3 meters (11 feet) defining the littoral zone of Lake Algonquin. Point intercept samples were collected to a maximum depth of 5 meters, with equitable distribution throughout the littoral zone (Figure 3).

Figure 3. Distribution of Lake Algonquin Sampling Points in 1 meter depth classes.



Species Lists

Maps of the distribution of aquatic plant species for Lake Algonquin are included in Appendix A. These maps are based on the presence of individual species in point intercept samples. A total of 31 species were collected in the point intercept portion of the 2021 survey. Native species were clearly dominant, however Eurasian watermilfoil (*Myriophyllum spicatum*) was widely distributed; reported for 13% of survey points in 2021. Macroalgae including *Chara* sp. and *Nitella* sp. were by far the most widely distributed plants, reported in 54% of survey points.

A native macrophyte, waterweed (*Elodea canadensis),* was the most common rooted species (38% of survey points). Common native macrophyte species included purple bladderwort (*Utricularia purpurea,* 19%), rush (*Scirpus sp.,* 17%), burreed (*Sparganium sp.,* 17%), northern watermilfoil (*Myriophyllum sibiricum,* 14%), white waterlily (*Nymphaea odorata, 13%),* and broad-leaf pondweed (*Potamogeton amplifolius,* 10%).

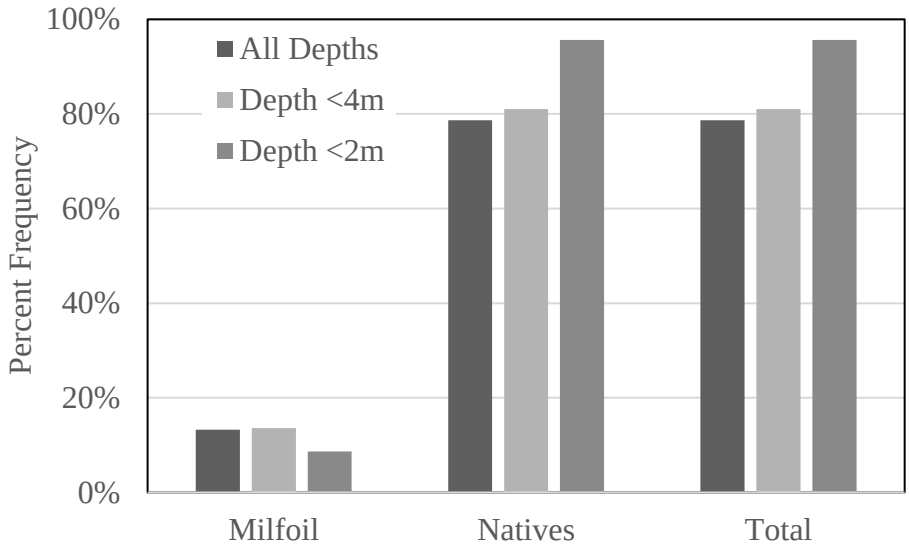
Table 2. Percent frequency of occurrence of aquatic plant species in Lake Algonquin, NY

Species	**Common Name**	**Percent frequency**
Brasenia schreberi J.F. Gmel	Water Shield	3.7%
Chara species	Musk Grass	53.7%
Eleocharis acicularis (L.) Roemer & Schultes	Spike Rush	2.2%
Elodea canadensis Michx.	Waterweed	37.5%
Eriocaulon septangulare With.	Pipewort	0.7%
Isoetes echinospora Dur.	Quillwort	0.7%
Juncus pelocarpus	Rush	0.7%
Megalodonta beckii	Water Marigold	2.2%
Myriophyllum sibiricum L.	Northern Milfoil	14.0%
Myriophyllum spicatum L.	Eurasian watermilfoil	13.2%
Myriophyllum tenellum Kom.	Leafless Milfoil	0.7%
Najas flexilis (Willd.) Rostk. & Schmidt.	Naiad	5.9%
Nuphar variegata Engem. Ex Durand	Yellow Water Lily	2.2%
Nymphaea odorata Ait.	White Water Lily	12.5%
Polygonum amphibium	Smartweed	1.5%
Pontedaria cordata L.	Pickerelweed	0.7%
Potamogeton amplifolius Tuckerm.	Broad leaf Pondweed	10.3%
Potamogeton epihydrus Raf.	Ribbon leaf Pondweed	7.4%
Potamogeton gramineus L.	Variable Pondweed	2.2%
Potamogeton illinoensis Morong	Illinois Pondweed	0.7%
Potamogeton praelongus Wulfen	White stem Pondweed	0.7%
Potamogeton pusillus L.	Narrow leaf Pondweed	5.9%
Potamogeton richardsonii (Ar. Benn) Rydb.	Richardsons Pondweed	1.5%
Sagittaria graminea Michx.	Arrowhead	0.7%
Scirpus spp.	Rush	16.9%
Sparganium sp.	Bur Reed	16.9%
Utricularia gibba L.	Humped Bladderwort	4.4%
Utricularia intermedia Hayne	Bladderwort	5.9%
Utricularia purpurea Hayne	Purple Bladderwort	19.1%
Utricularia vulgaris L.	Great Bladderwort	8.1%
Vallisneria americana L.	Duck Celery	5.1%

With a total of 32 species reported for Lake Algonquin, these results are similar to those of moderately productive (mesotrophic) regional lakes, including Lake Hortonia, Vermont (19 to 23 species; Gettsinger et al., 2002) and Lake Luzerne, New York (33 to 39 species; Eichler and Boylen, 2004). Whole lake species richness in moderately productive, low elevation lakes in New York State is also reported to average 15 species (Taggett et al. 1990).

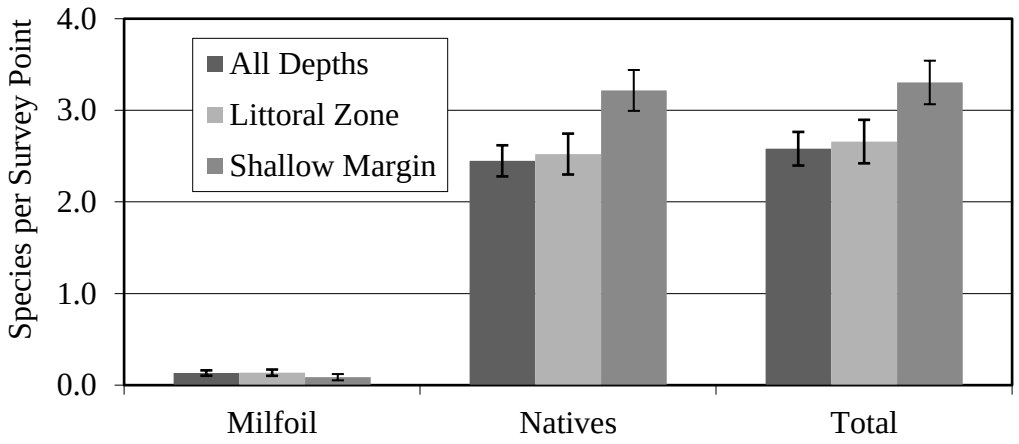
Seventy-nine percent of whole lake sampling points were vegetated by at least one native plant species (Figure 4), 81% of survey points with depths less than 4 m (Figure 5) and 96% of survey points less than 2 meters depth yielded native aquatic plants. Eurasian watermilfoil was present in 13% of whole lake survey points and 14% of survey points less than 4 m water depth, representing the littoral zone or zone of aquatic plant growth. In the shallow margin of the littoral zone, Eurasian watermilfoil was present in 8% of survey points.

Figure 4. Lake Algonquin frequency of occurrence summaries for 2021.



The number of plant species present per sample point, or species richness, is presented in Figure 5. Average number of species per sample point within the littoral zone was 2.66 ± 0.18 species. Within the shallow margin of the littoral zone, species richness averaged 3.30 ± 0.24. Species richness in the littoral zone of Lake Algonquin is comparable to other mesotrophic lakes in the northeast, which range between 2 and 3 species per sample point. Native plant species richness within the littoral zone is comparable to total species richness, reported at 2.52 ± 0.17 species per sample point. Declines in native species richness following expansive growth of *Myriophyllum spicatum* have been well documented (Madsen et al. 1989, 1991). Conversely, species richness increases in areas where Eurasian watermilfoil growth is reduced (Boylen et al., 1996). Given the limited growth of Eurasian watermilfoil in Lake Algonquin, current species richness information provides valuable baseline data.

Figure 5. Lake Algonquin species richness. Error bars are standard error.



Summary

Quantitative aquatic plant surveys were undertaken in September of 2021 for Lake Algonquin, New York, to obtain data for a Eurasian watermilfoil (*Myriophyllum spicatum* L.) management program. The project was designed to: characterize existing aquatic plant populations, obtain data to evaluate aquatic plant management efforts, and meet current and future permit requirements. The project consisted of point-intercept frequency and depth data for points distributed throughout the lake. Aquatic plant management in Lake Algonquin is coordinated by the Friends of Lake Algonquin and the Adirondack Park Agency.

Lake Algonquin supports a diverse native plant community with twenty-three submersed species, three rooted floating-leaf species and six native emergent species. One of the submersed species is an exotic, invasive aquatic plant, Eurasian watermilfoil (*Myriophyllum spicatum*), first confirmed in Lake Algonquin in 2002.

With a maximum depth of 19 feet (5.8 meters), nearly all of Lake Algonquin falls within the littoral zone or zone where rooted aquatic plants can grow, which was demonstrated to include depths to a maximum of 11 feet (3.3 meters). Within the littoral zone, aquatic plants were found in 81% of survey points.

Species richness was quite high, with a large number of species occurring in more than 5% of survey points. A total of 32 aquatic plant species were identified for Lake Algonquin, with 31 species collected in the point intercept survey. Native species were clearly dominant, however Eurasian watermilfoil was widely distributed (13% of survey points). Macroalgae including *Chara* sp. and *Nitella* sp. were by far the most widely distributed plants (54% of survey points). Common native species for Lake Algonquin included purple bladderwort (*Utricularia purpurea,* 19%), rush (*Scirpus sp.,* 17%), burreed (*Sparganium sp.,* 17%), northern watermilfoil (*Myriophyllum sibiricum,* 14%), white waterlily (*Nymphaea odorata, 13%),* and broad-leaf pondweed (*Potamogeton amplifolius,* 10%).

Average number of species per sample point within the littoral zone was 2.66 ± 0.18 species per sample point. Within the shallow margin of the littoral zone, species richness averaged 3.30± 0.24 species per sample point. Species richness in the littoral zone of Lake Algonquin is comparable to other mesotrophic lakes in the northeast, which range between 2 and 3 species per sample point. Native species richness in the littoral zone is similar to total species richness, reported at 2.52 species per sample point. Declines in native species richness following expansive growth of *Myriophyllum spicatum* have been well documented (Madsen et al. 1989, 1991). Conversely, species richness increases in areas where Eurasian watermilfoil growth is reduced (Boylen et al., 1996). Given the limited growth of Eurasian watermilfoil in Lake Algonquin, current species richness information provides valuable baseline data.

Eurasian watermilfoil growth was present throughout Lake Algonquin with the largest area of dense growth in a cove on the eastern side of the lake (Figure 7). Comparing the distribution of Eurasian watermilfoil in 2021 to that reported in 2018 (Figure 8), differences appear to include: 1) reduced Eurasian watermilfoil growth in the southwest cove and west side, 2) increased density of growth on the East side, and 3) increased scattered Eurasian watermilfoil on the

northwest shore. At this level of infestation, the impact of Eurasian watermilfoil on native species is limited, however left unchecked the potential exists for expansive growth. The current survey results should continue to provide a baseline from which to assess future impacts of both Eurasian watermilfoil growth and management activities.

Figure 7. Eurasian watermilfoil in Lake Algonquin in 2021.

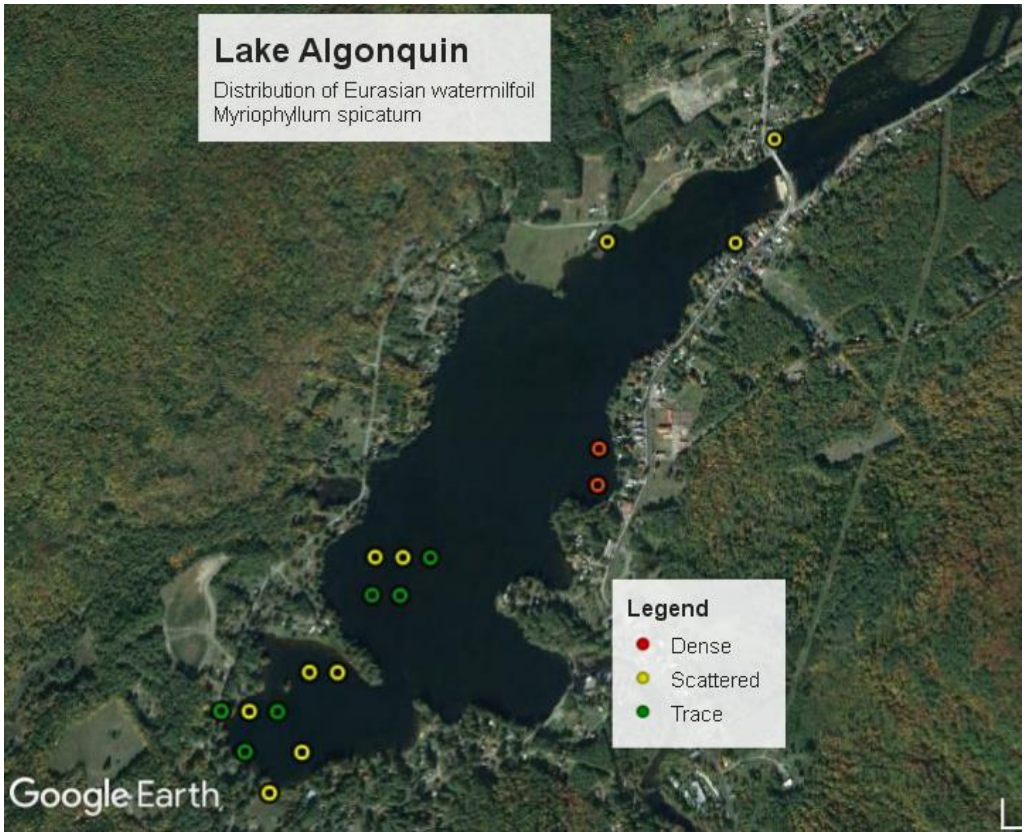
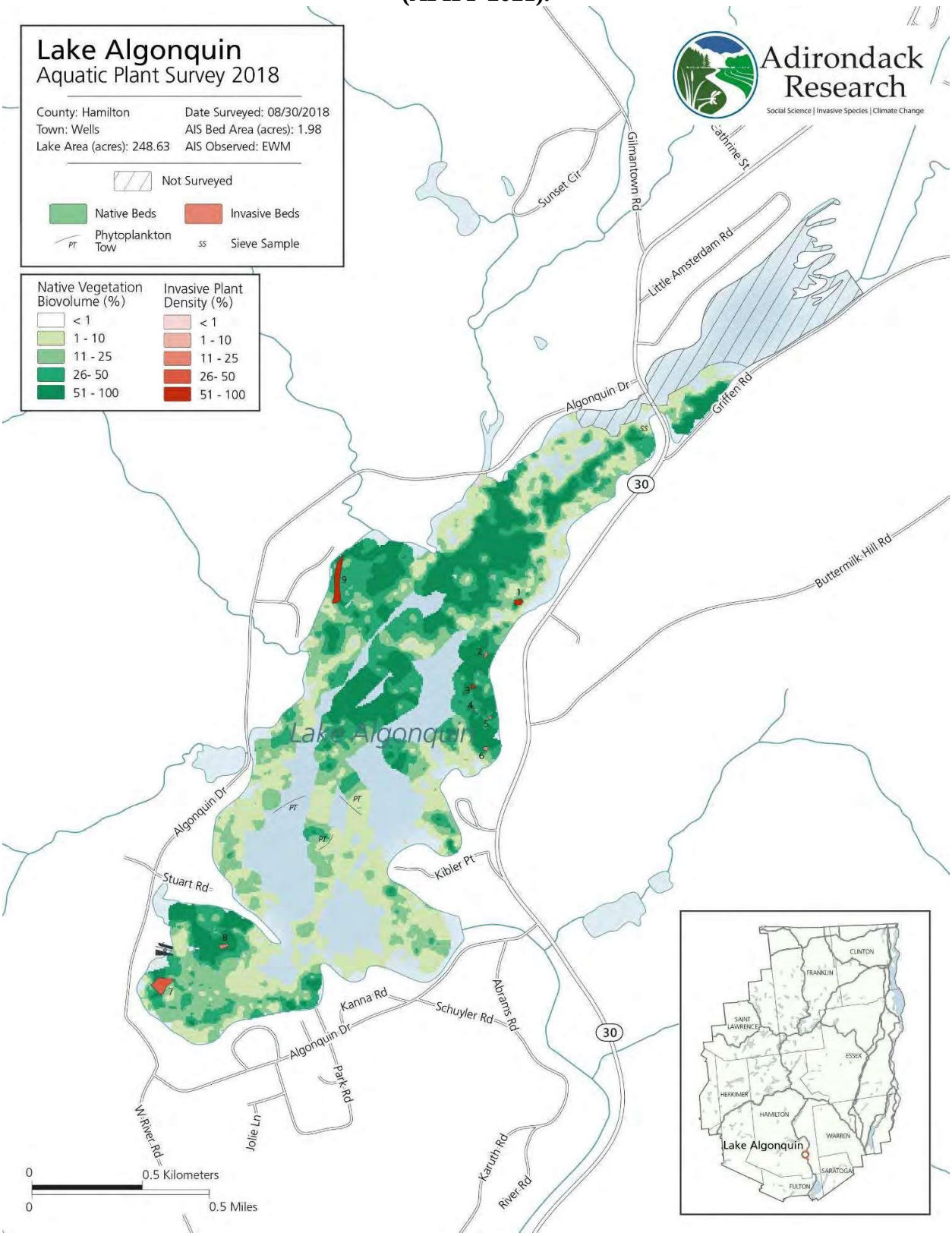


Figure 8. Eurasian watermilfoil distribution in 2018 mapped by Adirondack Research (APIPP 2021).



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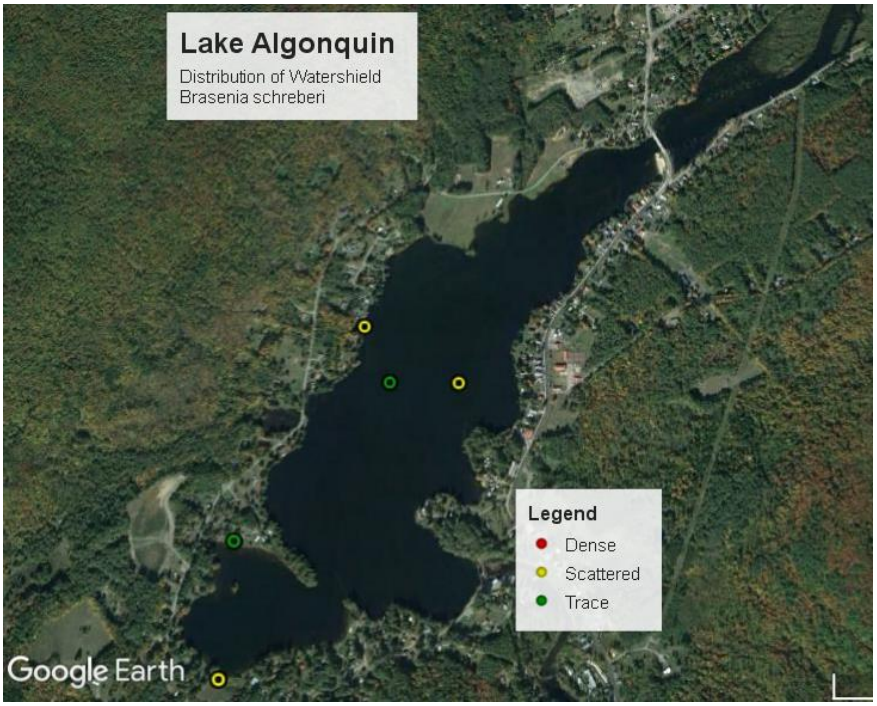
Appendix A.

Aquatic Plant Distribution Maps for Lake Algonquin Based on Point Intercept Survey Data


Lake Algonquin
Distribution of Watershield
Brasenia schreberi
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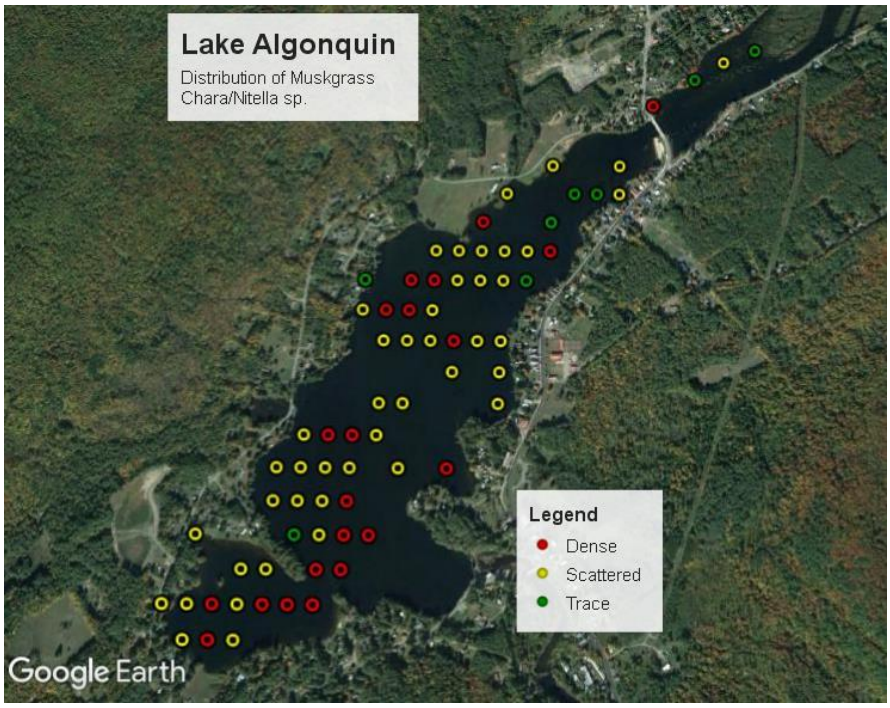
Scattered
Trace
Google Earth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Distribution of Muskgrass
Chara/Nitella sp.
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Lake Algonquin
Distribution of Spikerush
Eleocharis acicularis
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Dense
Scattered
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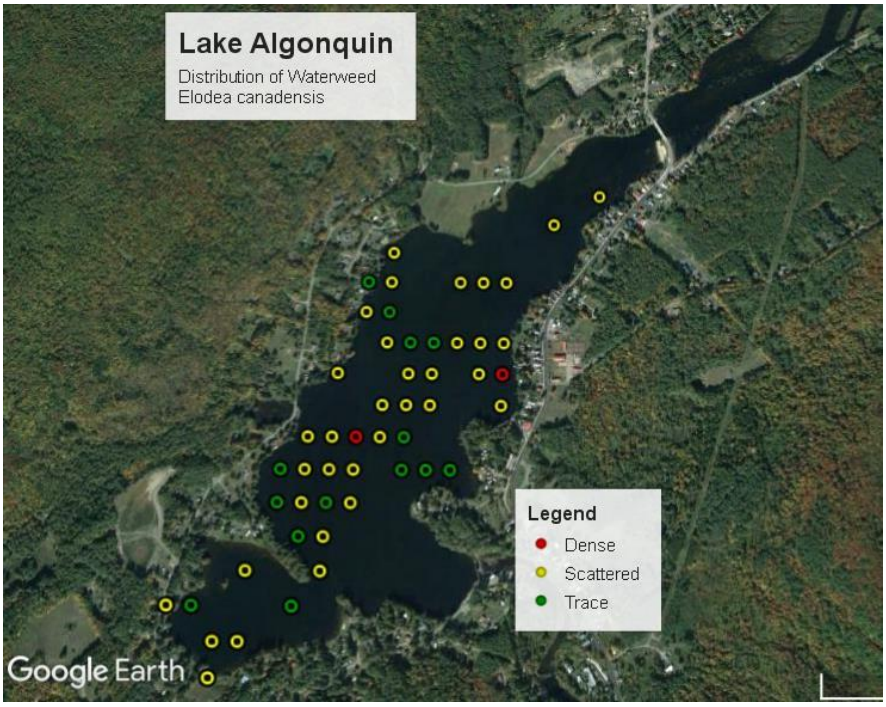
Lake Algonquin
Distribution of Waterweed
Elodea canadensis
Legend
Dense
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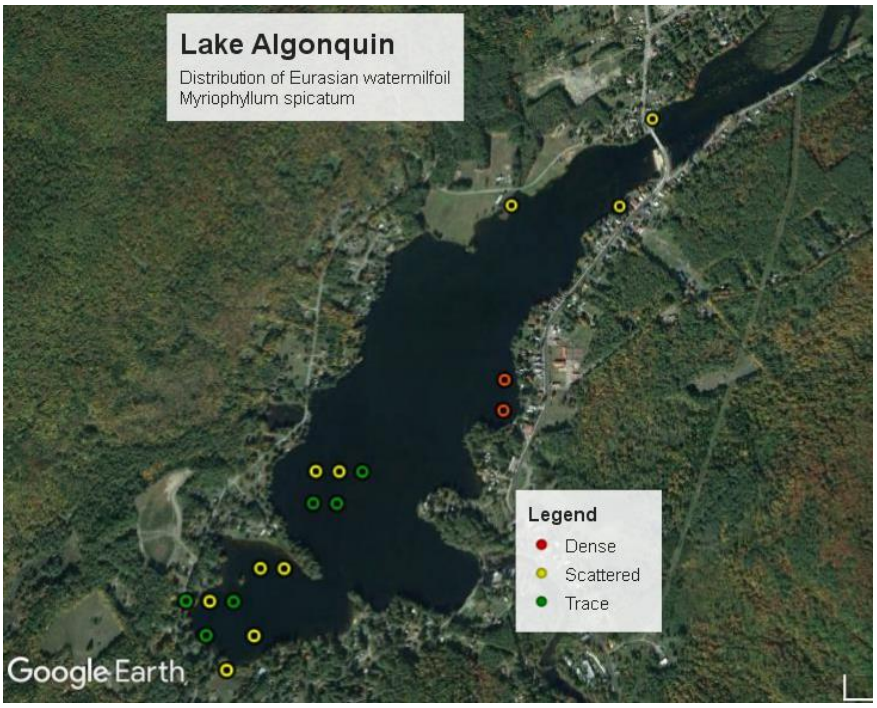
Trace
Google Earth


Lake Algonquin
Distribution of Pipewort
Eriocaulon septangulare
Legend
Dense
Scattered
Trace
Google Earth


Lake Algonquin
Distribution of Eurasian watermilfoil
Myriophyllum spicatum
Legend
Dense
Scattered
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Google Earth


Lake Algonquin
Distribution of Quillwort
Isoetes echinospora
Legend
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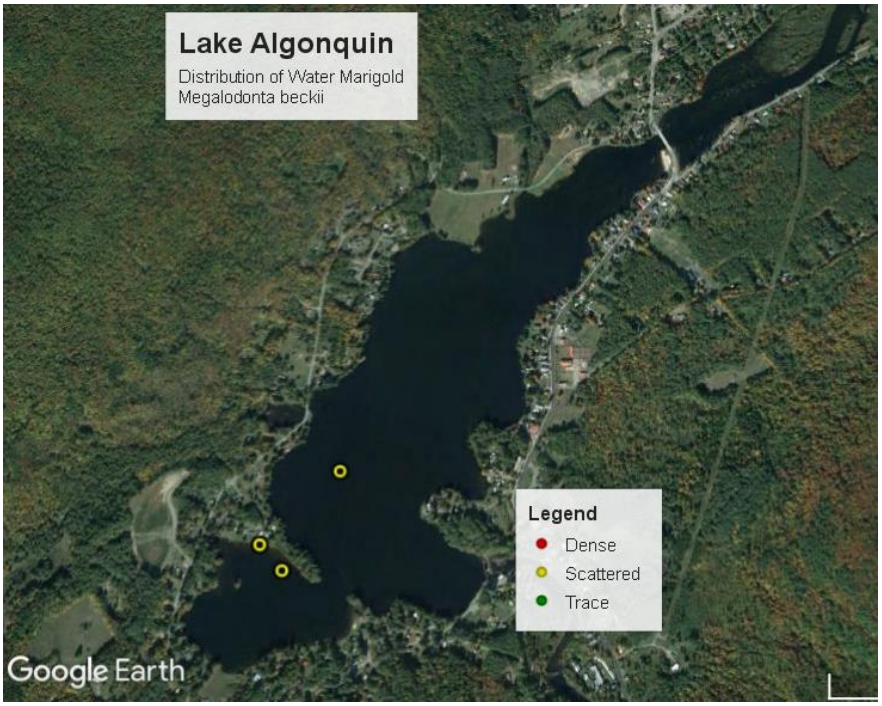
Trace
Google Earth


Lake Algonquin
Distribution of Rush
Juncus pelocarpus
Legend
Dense
Scattered
Trace
Google Earth


Lake Algonquin
Distribution of Water Marigold
Megalodonta beckii
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Dense
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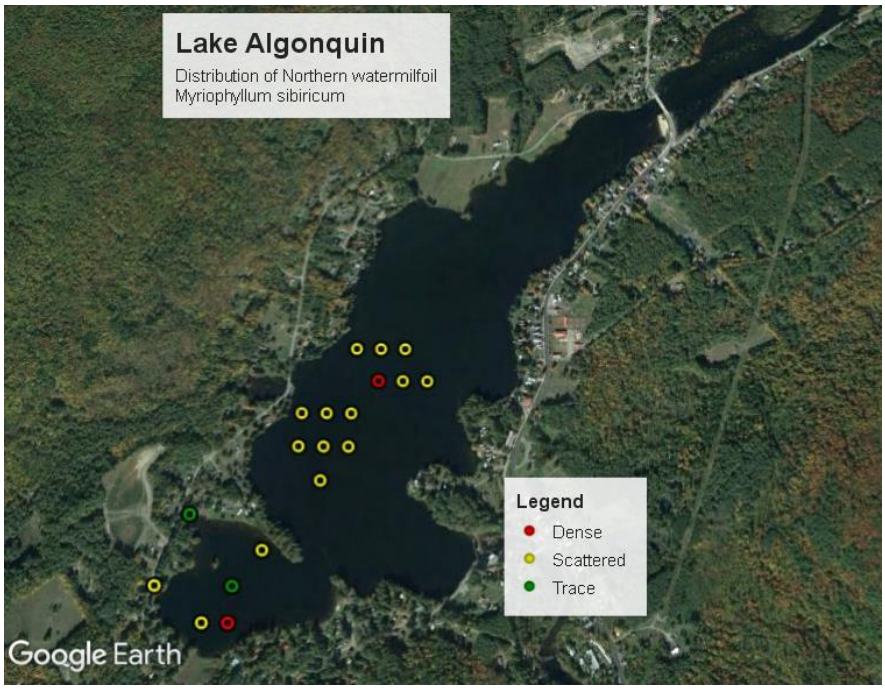
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Distribution of Northern watermilfoil
Myriophyllum sibiricum
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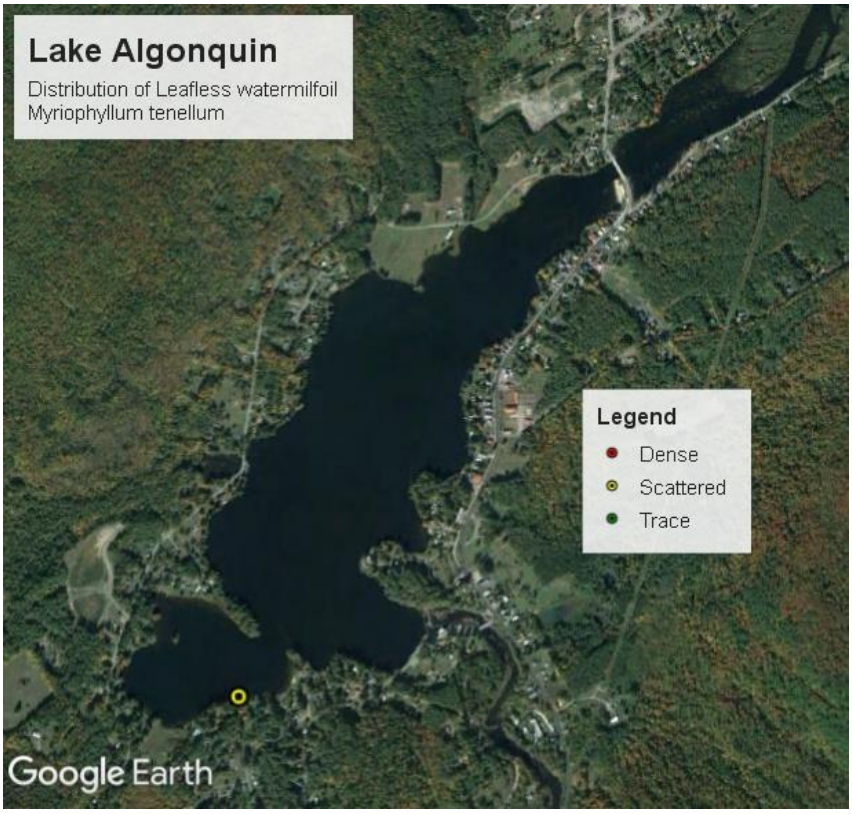
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Distribution of Leafless watermilfoil
Myriophyllum tenellum
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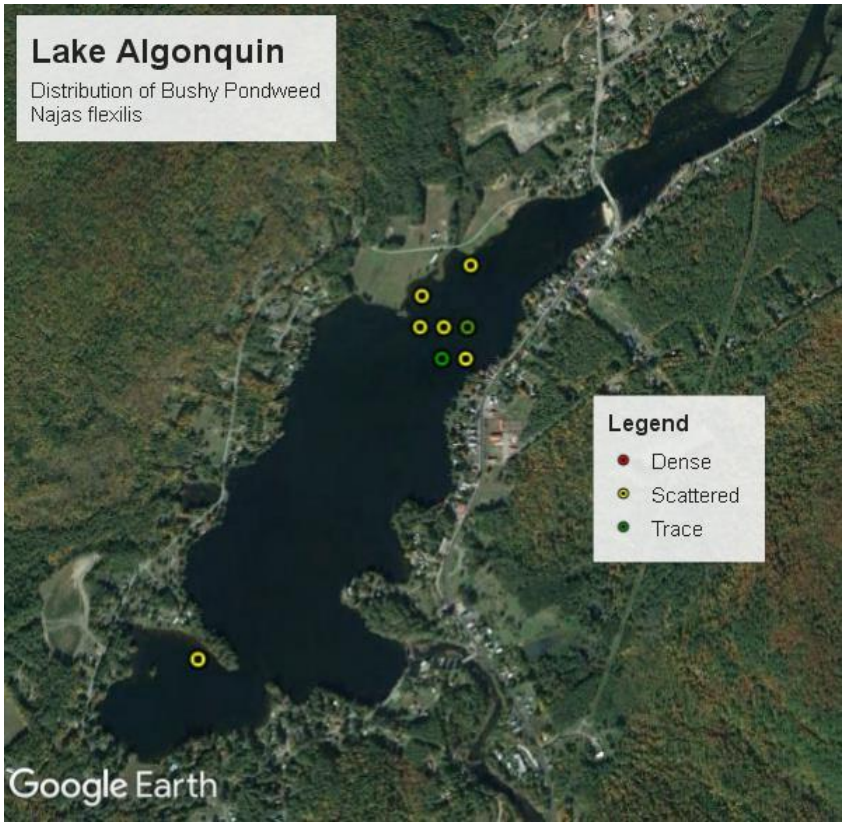
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Distribution of Bushy Pondweed
Najas flexilis
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Lake Algonquin
Distribution of Yellow Waterlily
Nuphar variegata
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Dense
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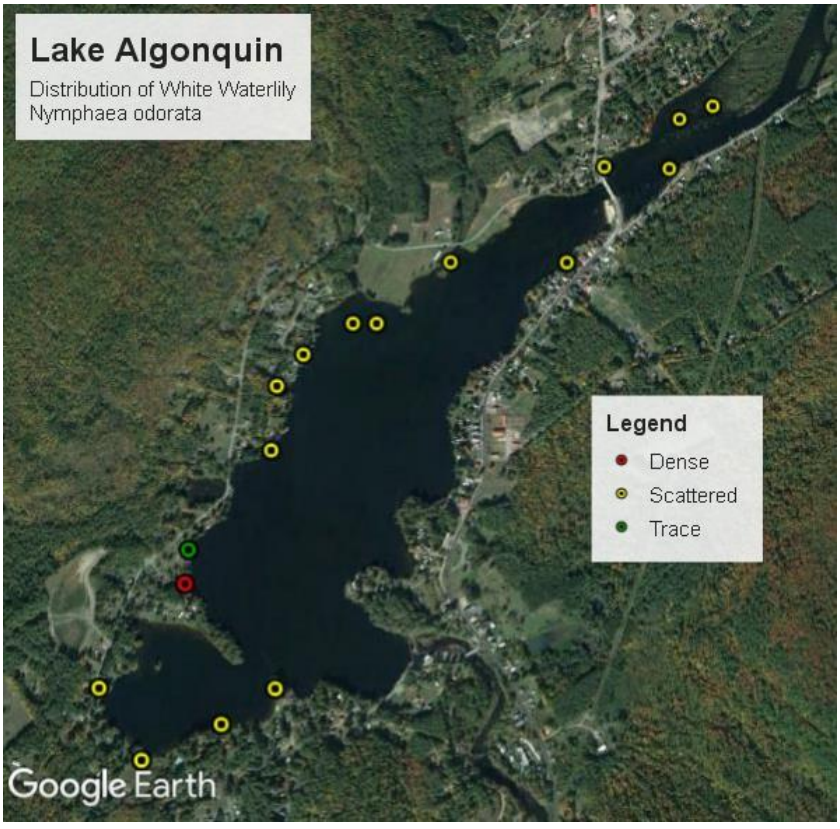
Lake Algonquin
Distribution of White Waterlily
Nymphaea odorata
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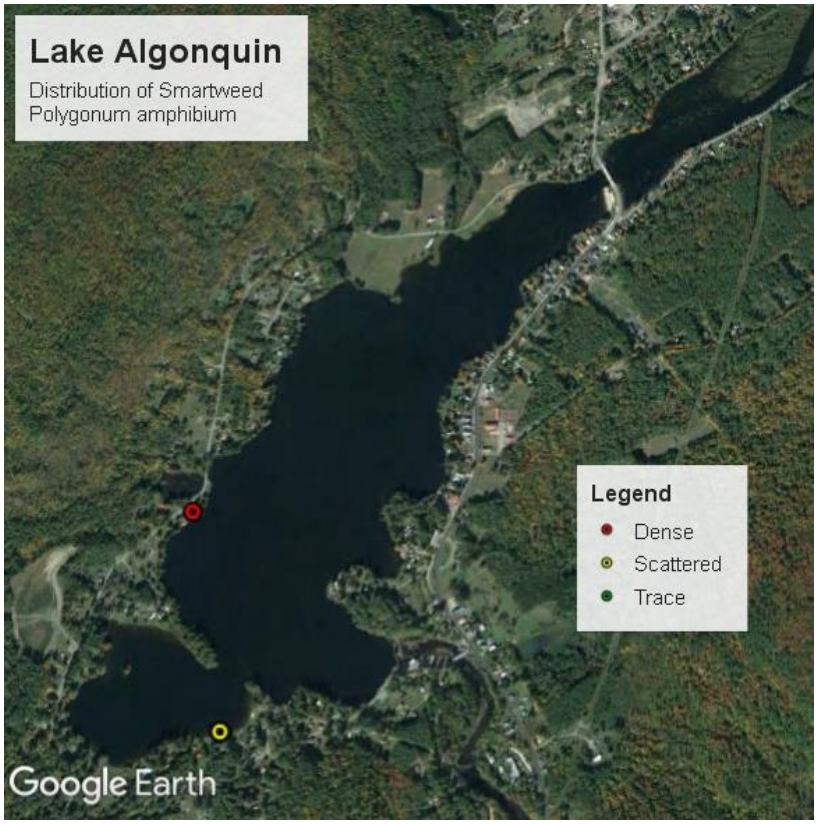
Dense
Scattered
Trace
Google Earth


Lake Algonquin
Distribution of Smartweed
Polygonum amphibium
Legend
Dense
Scattered
Trace
Google Earth


Lake Algonquin
Distribution of Pickerelweed
Pontedaria cordata
Legend
Dense
Scattered
Trace
Google Earth


Lake Algonquin
Distribution of Broad-leaf Pondweed
Potamogeton amplifolius
Legend
Dense
Scattered
Trace
Google Earth


Lake Algonquin
Distribution of Ribbon-leaf Pondweed
Potamogeton epihydrus
Legend
Dense
Scattered
Trace
Google Earth

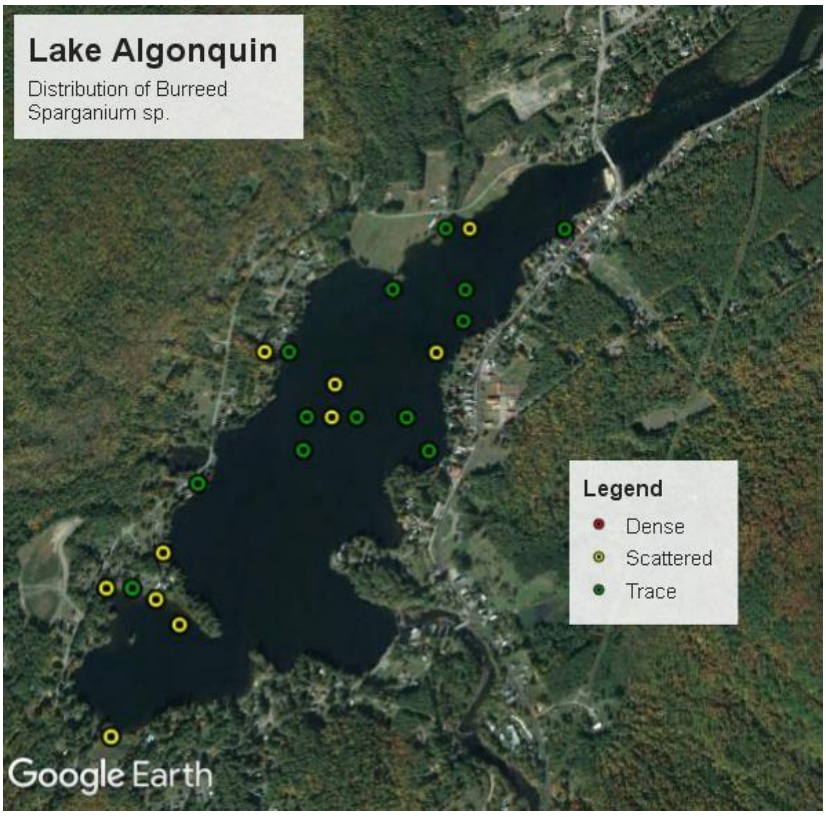

Lake Algonquin
Distribution of Variable-leaf Pondweed
Potamogeton grmineus
Legend
Dense
Scattered
Trace
Google Earth

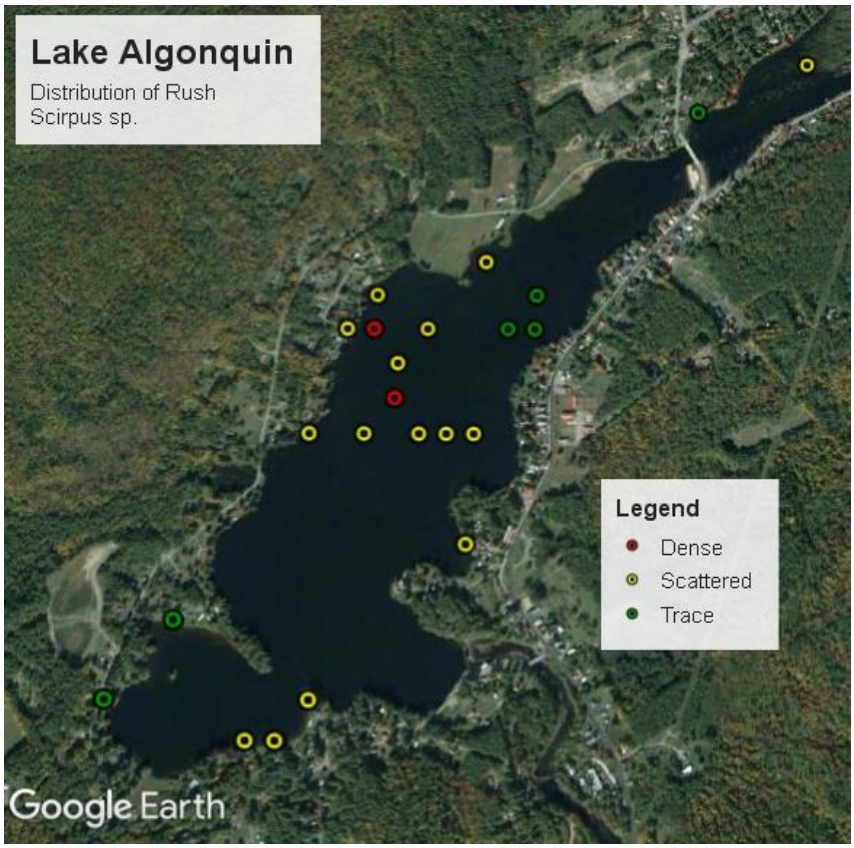

Lake Algonquin
Distribution of Illinois Pondweed
Potamogeton illinoensis
Legend
Dense
Scattered
Trace
Google Earth

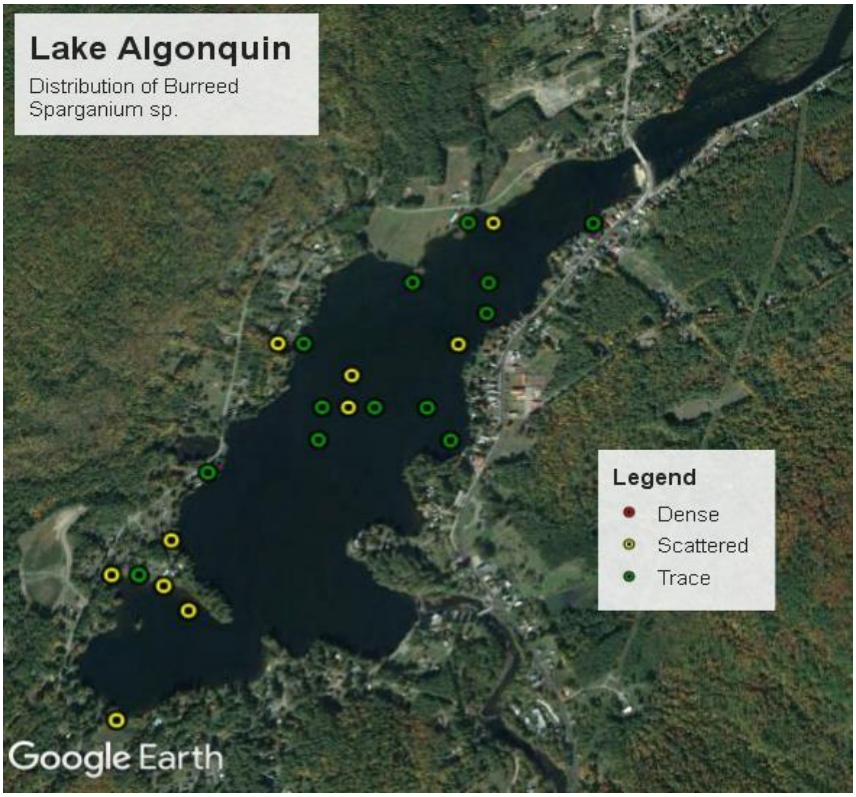

Lake Algonquin
Distribution of White-stem Pondweed
Potamogeton praelongus
Legend
Dense
Scattered
Trace
Google Earth

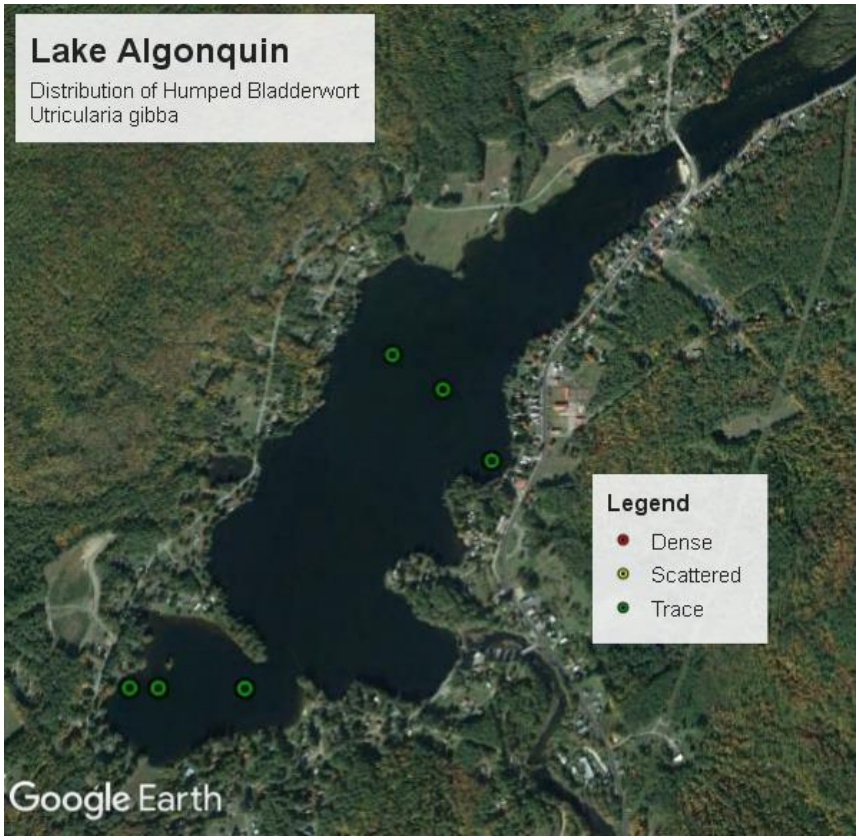

Lake Algonquin
Distribution of Narrow-leaf Pondweed
Potamogeton pusillus
Legend
Dense
Scattered
Trace
Google Earth

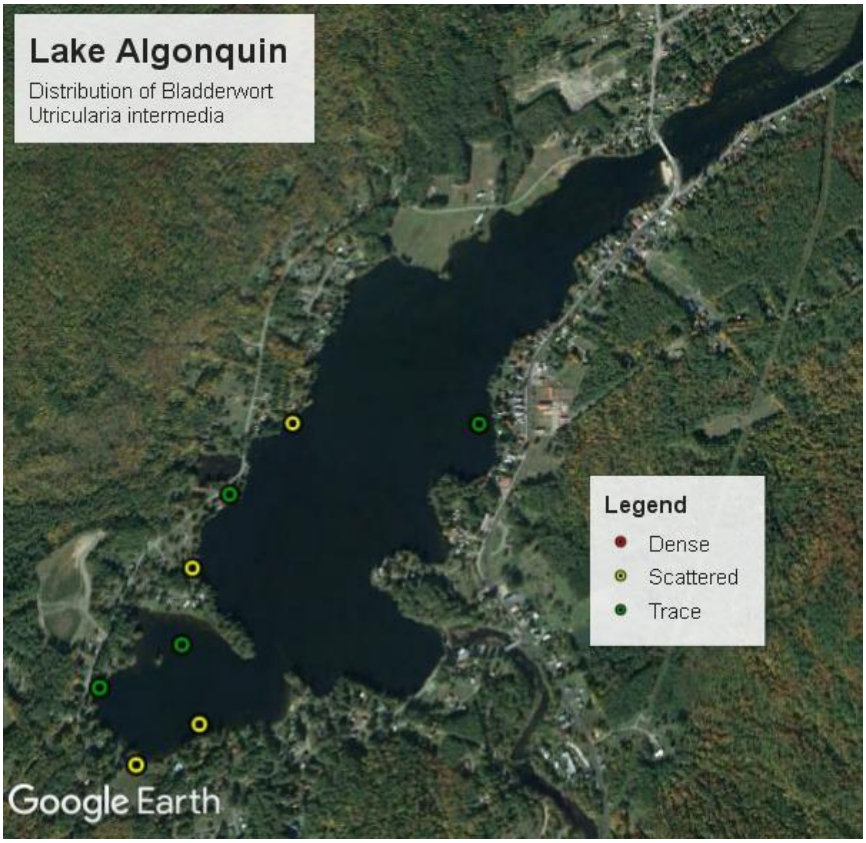

Lake Algonquin
Distribution of Richardsons' Pondweed
Potamogeton richardsonii
Legend
Dense
Scattered
Trace
Google Earth

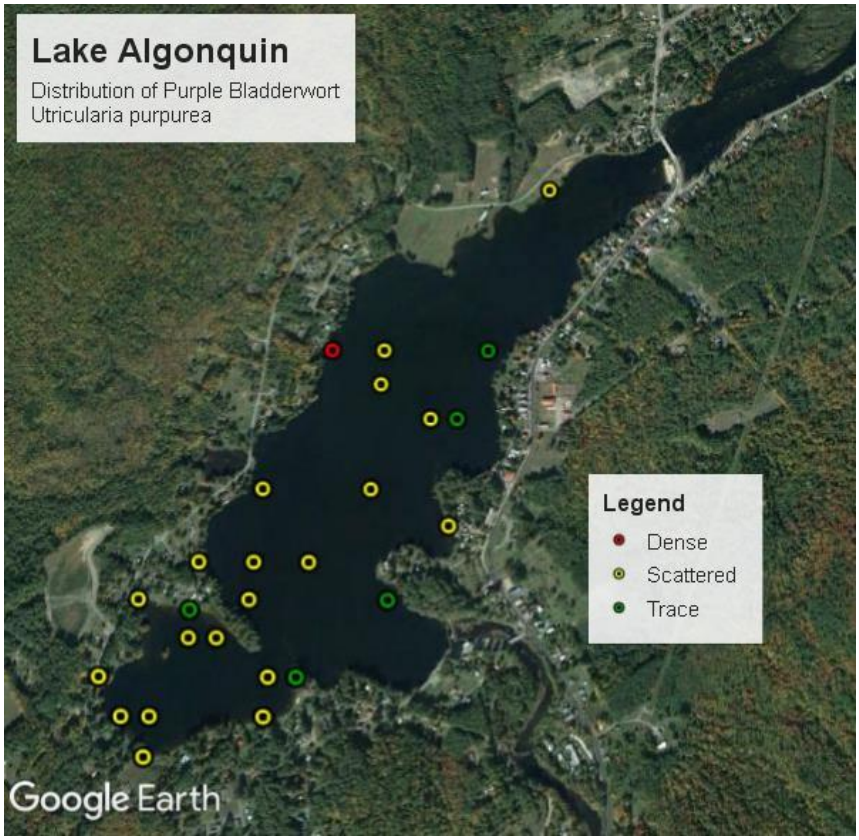

Lake Algonquin
Distribution of Burreed
Sparganium sp.
Legend
Dense
Scattered
Trace
Google Earth

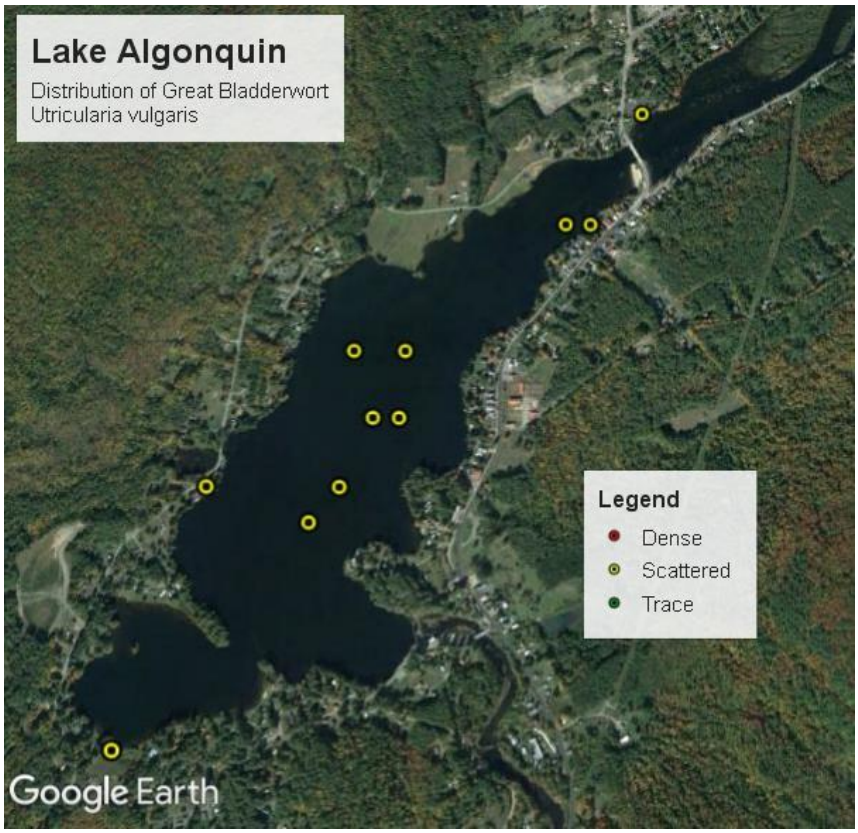

Lake Algonquin
Distribution of Rush
Scirpus sp.
Legend
Dense
Scattered
Trace
Google Earth

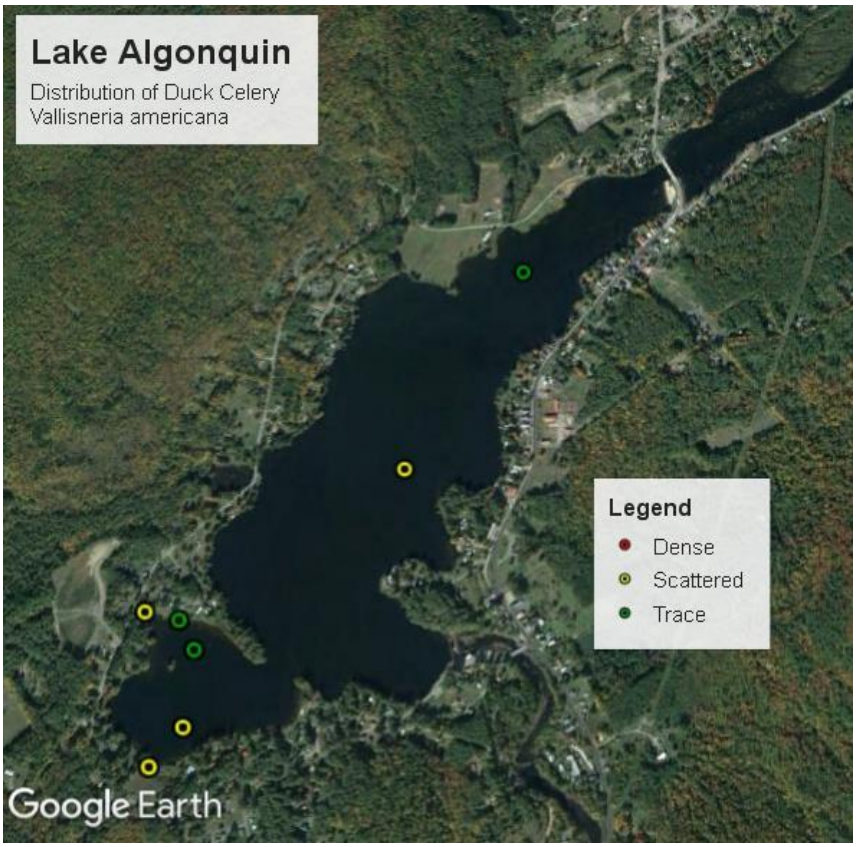

Lake Algonquin
Distribution of Burreed
Sparganium sp.
Legend
Dense
Scattered
Trace
Google Earth


Lake Algonquin
Distribution of Humped Bladderwort
Utricularia gibba
Legend
Dense
Scattered
Trace
Google Earth


Lake Algonquin
Distribution of Bladderwort
Utricularia intermedia
Legend
Dense
Scattered
Trace
Google Earth


Lake Algonquin
Distribution of Purple Bladderwort
Utricularia purpurea
Legend
Dense
Scattered
Trace
Google Earth


Lake Algonquin
Distribution of Great Bladderwort
Utricularia vulgaris
Legend
Dense
Scattered
Trace
Google Earth


Lake Algonquin
Distribution of Duck Celery
Vallisneria americana
Legend
Dense
Scattered
Trace
Google Earth