



Aquatic Vegetation of Lake Iroquois Chittenden County, Vermont

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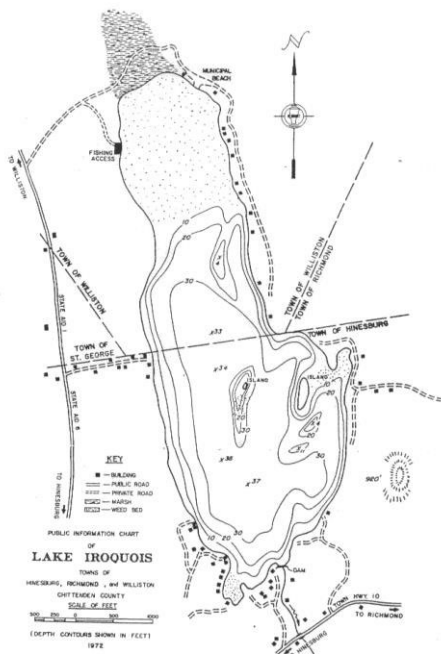
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Background.

At the request of Pat Suozzi and Jane Clifford of the Lake Iroquois Association, Spring and Fall 2024 quantitative aquatic plant surveys were undertaken for Lake Iroquois, Vermont. The surveys occurred pre- and post-treatment following aquatic plant management efforts employing the herbicide ProcellaCOR EC for Eurasian watermilfoil control. The surveys largely duplicated the 2017, 2019, 2021, 2022 and 2023 surveys conducted by the author (Eichler 2017, 2019, 2021, 2022 and 2023). The surveys consisted of frequency of occurrence and relative abundance data for all aquatic plant species present in points distributed throughout the lake. The Point-Intercept Rake Toss method presently used by the US Army Corps of Engineers and others was employed. The assessment includes the distribution and density of existing aquatic plant communities, the extent of exotic species infestation and a review of ongoing management efforts to control Eurasian watermilfoil (*Myriophyllum spicatum*). The Vermont Department of Environment Conservation (DEC) Aquatic Nuisance Control (ANC) Grant-in-Aid funds funded in part the Lake Iroquois 2024 Plant Surveys.

Methods

Survey Sites



Lake Iroquois. Lake Iroquois is located in Chittenden County, in the towns of Hinesburg, Richmond and Williston. The lake has a surface area of approximately 244 acres with a watershed area of 2198 acres. Lake Iroquois has a single outlet with a control structure to maintain lake level. Maximum water depth is reported to be 37 ft with average water depth of 19 feet (VTDEC 2016a). Secchi disk transparency in 2015 averaged 12 ft (3.8 m; VT DEC 2015). Lake Iroquois is classified as eutrophic based on phosphorous and chlorophyll concentrations, indicating that nutrient levels are sufficient to support dense growth of planktonic algae and aquatic plants. Two invasive aquatic plant species are reported for Lake Iroquois, Eurasian watermilfoil (*Myriophyllum spicatum*) and Curly-leaf Pondweed (*Potamogeton crispus*) (VT DEC 2016b). VT DEC records indicate that Eurasian watermilfoil was first confirmed in 1991 while curly-leaf pondweed was present in 1984. An aquatic plant survey of Lake Iroquois in September of 2014 reported over 70 acres

of dense Eurasian watermilfoil growth (Knoecklein 2015). A total of 45 aquatic plant species have been reported for Lake Iroquois in multiple surveys since 1984, however a 2014 survey only reported 23 species. Loss of native species is a commonly reported phenomenon in lakes with severe infestation by Eurasian watermilfoil and/or other invasive aquatic plant species (Madsen et al. 1991). In a survey conducted by the author in 2017, a total of 25 species of aquatic plants were observed in Lake Iroquois (Eichler 2017). The aquatic plant community

included sixteen submersed species, two floating-leaved species, and seven emergent species.

Duck celery (*Vallisneria americana*) and coontail (*Ceratophyllum demersum*) were the most common native plants. Eurasian watermilfoil (*Myriophyllum spicatum*) was present in 24% of survey points. Small declines in the frequency of occurrence of the majority of native species were observed in 2019 (19 of 23 species when compared to the 2017 survey), possibly as a result of the expansion of Eurasian watermilfoil to 43% of survey points. In the Spring of 2021 prior to herbicide treatment, Eurasian watermilfoil was present in 24% of survey points. In September post-treatment and again in June of 2022, Eurasian watermilfoil was absent from all survey points. In September of 2022, Eurasian watermilfoil was found at a single survey point at the south end of the lake. By June of 2023, Eurasian watermilfoil was reported at 2 survey points (3%) at the south end of the lake. By June of 2024, Eurasian watermilfoil had expanded to 28% of survey points. Dense growth of Eurasian watermilfoil was found along the west shore from the north end of the waterski course southward along the shoreline. Dense growth was also observed around the rocky island in the center of the lake, in the bay north of the large island and in the southeastern bay. Moderate and scattered Eurasian watermilfoil growth also occurred at the north end of the lake.

Hand harvesting efforts began on Lake Iroquois in 2008 to control dense growth of Eurasian watermilfoil. The aquatic weevil (*Euhrychiopsis lecontei*) population was supplemented in 2008 and 2009 to provide a biocontrol agent for Eurasian watermilfoil. Extensive growth of Eurasian

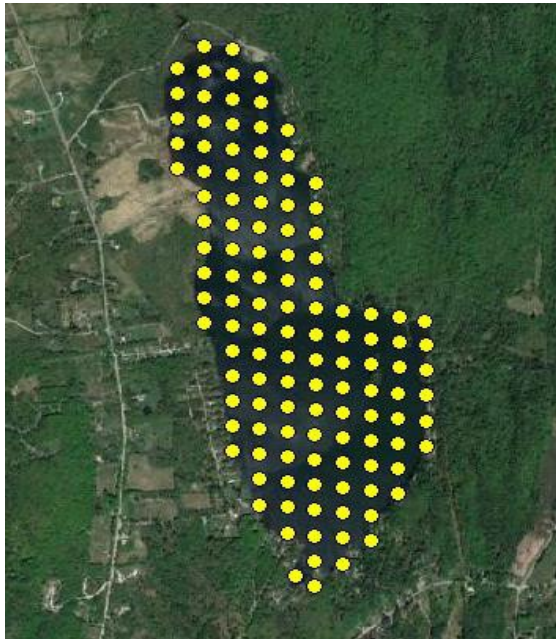


Figure 1. Map of Lake Iroquois with point intercept survey locations.

watermilfoil reported in 2014 suggested a more intensive management effort was necessary. In 2016, diver assisted suction harvesting (DASH) for Eurasian watermilfoil control was employed in the boat launch area and near the LIRD beach. Over a period of 2 weeks, divers harvested over 5000 gallons of Eurasian watermilfoil. Benthic barriers (mats) were installed in 2017 to maintain the areas harvested by DASH in 2016. In 2019, DASH collected approximately 2000 gallons of Eurasian watermilfoil, representing a fraction of Eurasian watermilfoil growth. Residents remained concerned that Eurasian watermilfoil growth was exceeding the capacity of the existing management effort. The management effort was expanded in 2021 to include an herbicide, with 40 acres at the north end of Lake Iroquois treated with ProcettaCOR EC. No organized management efforts occurred in 2022.

Species List and Herbarium Specimens. As the lake was surveyed, the occurrence of each aquatic plant species observed in the lake was recorded and herbarium specimens collected where necessary. Herbarium specimens were pressed, dried, and mounted (Hellquist 1993); and became part of the permanent collection at the Darrin Fresh Water Institute in Bolton Landing, NY. All taxonomy is based on Crow & Hellquist, 2000.

Point Intercept Surveys. The frequency and richness of aquatic plant species were evaluated

using a point intercept 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 total of 73 points were surveyed in the Spring, and 79 points were surveyed in the Fall for Lake Iroquois, based on a 100 m grid. Point intercept plant frequencies were surveyed on June 4, 2024 and September 6, 2024 to provide pre- and post-management data. A global positioning system (GPS) was used to navigate to each point for the survey observation.

Relative abundance in the Point Intercept surveys. To characterize relative abundance of each of the species identified in the point intercept survey, a scale developed by Cornell University and the US Army Corps of Engineers was employed. For each rake toss, the relative abundance of each plant species collected was recorded based on this rating scale. Maps of the distribution of each species by its relative abundance is included in Appendix A.

Relative abundance scale based on US Army Corp/Cornell methods.		
Code	Rating	Abundance
0	no plants	
1	trace growth of plants	fingerful on rake
2	sparse growth of plants	handful on rake
3	medium growth of plants	rakeful of plants
4	dense growth of plants	difficult to bring into boat

Results and Discussion

In September of 2024, the aquatic plant community of Lake Iroquois included twenty-four submersed species, three floating-leaved species, two floating species and five emergent species (Table 1), including some species observed but not collected in the point intercept survey. Twenty species were present in the point intercept portion of the 2024 survey, comparable to the 23, 24, 26, 25, 19 and 23 species reported in 2023, 2022, 2021, 2019, 2017 and 2014, even though a greater number of survey points were included in 2014. Combining the results of all surveys, a total of 45 aquatic plant species have been reported for Lake Iroquois, however many of these are classified as wetland species not typically captured by the current survey technique. This number of species greatly exceeds the 15 species typically reported for moderately productive lakes in our region and indicates good water quality and a variety of habitat types. Eurasian watermilfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*) were the only exotic species reported in Lake Iroquois. Species richness was quite high, with a number of species occurring in more than 5% of survey points (Table 2).

Table 1. Species list for Lake Iroquois. Species in red are invasive.

Species Name	Common Name	Habit
<i>Brasenia schreberi</i>	water shield	fl
<i>Ceratophyllum demersum</i> L.	coontail	s
<i>Chara</i> sp.	muskgrass, chara	s
<i>Eleocharis acicularis</i> (L.) Roemer & Schultes	needle spike-rush	e
<i>Elodea canadensis</i> Michx.	waterweed	s
<i>Fontinalis</i> sp.	moss	s
<i>Isoetes echinospora</i> Dur.	quillwort	s
<i>Lemna minor</i> L.	duckweed	f
<i>Lemna trisulca</i> L.	duckweed	f
<i>Megalodonta (Bidens) beckii</i> Torr.	water marigold	s
<i>Myriophyllum spicatum</i> L.	Eurasian watermilfoil	s
<i>Najas flexilis</i> (Willd.) Rostk. & Schmidt.	bushy pondweed	s
<i>Najas guadalupensis</i> L.	southern naiad	s
<i>Nuphar variegata</i>	yellow pondlily	fl
<i>Nymphaea odorata</i> Ait.	white waterlily	fl
<i>Polygonum amphibium</i>	smartweed	e
<i>Pontederia cordata</i> L.	pickerelweed	e
<i>Potamogeton amplifolius</i> Tuckerm.	large-leaf pondweed	s
<i>Potamogeton crispus</i> L.	curly-leaf pondweed	s
<i>Potamogeton foliosus</i> Raf.	pondweed	s
<i>Potamogeton natans</i> L.	floating-leaf pondweed	s
<i>Potamogeton perfoliatus</i> L.	clasping-leaf pondweed	s
<i>Potamogeton praelongus</i> Wulfen	white-stem pondweed	s

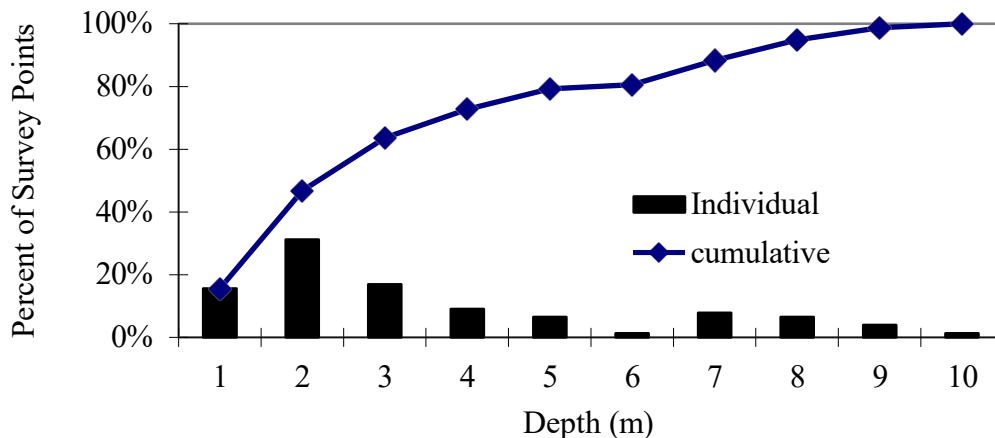
Species Name	Common Name	Habit
<i>Potamogeton pusillus</i> L.	small pondweed	s
<i>Potamogeton richardsonii</i> Oakes	Richardsons' pondweed	s
<i>Potamogeton spirillus</i> Tuckerm.	pondweed	s
<i>Potamogeton zosteriformis</i> Fern.	flat-stem pondweed	s
<i>Ranunculus longirostris</i> Godron	white watercrowfoot	s
<i>Sparganium</i> sp.	bur-reed	e
<i>Typha</i> sp.	cattail	e
<i>Utricularia gibba</i> L.	humped bladderwort	s
<i>Utricularia vulgaris</i> L.	great bladderwort	s
<i>Vallisneria americana</i> L.	wild celery	s
<i>Zosterella dubia</i> (Jacq.) Small	water stargrass	s

f=floating fl=floating leaved e=emergent s=submersed

Maximum Depth of Colonization

Maximum depth of rooted aquatic plant growth, termed the littoral zone, extended approximately 5.0 meters (16 feet). The majority of survey points were in the littoral zone (Figure 2), providing a reasonable representation of the plant population of Lake Iroquois.

Figure 2. Depth Distribution of Lake Iroquois Sampling Points in 1 meter depth classes.



Species Lists

Maps of the distribution of aquatic plant species for Lake Iroquois are included in Appendix A. Frequency of occurrence results are presented in Table 2. For the June 2024, three-year post-treatment survey, waterweed (*Elodea canadensis*) was the most common plant (45% of survey points). Eurasian watermilfoil (*Myriophyllum spicatum*) was present in 28% of the survey points. Curly-leaf Pondweed, another invasive species, was present in 22% of survey points. Common native species in the June 2024 survey for Lake Iroquois included *Chara* (37% of survey points), *Zosterella dubia* (25%), *Potamogeton zosteriformis* (15%), *Potamogeton amplifolius* (12%),

Potamogeton foliosus (11%), *Ceratophyllum demersum* (9%), *Potamogeton praelongus* (8%), *Nymphaea odorata* (8%), and *Eleocharis acicularis* (7%). While the Spring survey provides a confirmation of the distribution of Eurasian watermilfoil, a perennial species, the timing of the survey precludes determination of the distribution and relative abundance of most native species that have not started growing this early in the season. The remainder of this report will focus on comparison of the Fall survey results.

Table 2. Lake Iroquois percent frequency of occurrence data for Fall surveys only.

Species Name	Common Name	Fall 2022	Fall 2023	Fall 2024
<i>Ceratophyllum demersum</i> L.	Coontail	10.1%	11.4%	5.1%
<i>Chara</i> sp.	muskgrass, chara	44.3%	46.8%	39.2%
<i>Eleocharis acicularis</i> (L.) Roemer & Schultes	needle spike-rush	1.3%	3.8%	1.3%
<i>Elodea canadensis</i> Michx.	Elodea	44.3%	43.0%	51.9%
<i>Fontinalis</i> sp.	Moss			2.5%
<i>Lemna trisulca</i> L.	Duckweed	6.3%	1.3%	
<i>Myriophyllum spicatum</i> L.	Eurasian watermilfoil	1.3%	19.0%	
<i>Najas flexilis</i> (Willd.) Rostk. & Schmidt.	bushy pondweed	8.9%	13.9%	3.8%
<i>Nymphaea odorata</i> Ait.	white waterlily	17.7%	15.2%	10.1%
<i>Polygonum amphibium</i>	Smartweed		1.3%	1.3%
<i>Potamogeton amplifolius</i> Tuckerm.	largeleaf pondweed	17.7%	7.6%	17.7%
<i>Potamogeton foliosus</i> Raf.	Pondweed	6.9%	13.0%	
<i>Potamogeton gramineus</i>	variable pondweed	1.3%	1.3%	5.1%
<i>Potamogeton natans</i> L.	floating-leaf pondweed	2.5%		
<i>Potamogeton perfoliatus</i> L.	clasping-leaf pondweed	2.5%	2.5%	1.3%
<i>Potamogeton praelongus</i> Wulfen	white-stem pondweed	8.9%	13.9%	3.8%
<i>Potamogeton pusillus</i> L.	small pondweed	10.1%	13.9%	7.6%
<i>Potamogeton robbinsii</i>	Robbins' pondweed	3.8%		
<i>Potamogeton richardsonii</i> Oakes	Richardsons' pondweed		5.1%	
<i>Potamogeton zosteriformis</i> Fern.	flat-stem pondweed	21.5%	36.7%	29.1%
<i>Ranunculus longirostris</i> Godron	white watercrowfoot	6.3%	3.8%	7.6%
<i>Sparganium</i> sp.	burreed	2.5%	1.3%	1.3%
<i>Typha</i> sp.	cattail	1.3%	1.3%	
<i>Utricularia gibba</i> L.	humped bladderwort	1.3%	3.8%	1.3%
<i>Utricularia vulgaris</i> L.	great bladderwort	7.6%	11.4%	10.1%
<i>Vallisneria americana</i> L.	wild celery	41.8%	39.2%	43.0%
<i>Zosterella dubia</i> (Jacq.) Small	water stargrass	24.1%	27.8%	17.7%

For the September 2024 year of treatment sample, waterweed (*Elodea canadensis*) remained the most common species, present in 52% of survey points. Eurasian watermilfoil (*Myriophyllum spicatum*) was absent. Common native species included *Vallisneria americana* (43% of survey

points), *Chara* sp. (39%), *Potamogeton zosteriformis* (29%), *Zosterella dubia* (18%), *Potamogeton amplifolius* (18%), *Nymphaea odorata* (10%), *Utricularia vulgaris* (10%), *Potamogeton pusillus* (8%), *Ranunculus longirostris* (8%), *Ceratophyllum demersum* (5%), and *Potamogeton gramineus* (5%).

Native species results were generally comparable to those reported in prior surveys with a few exceptions. A common native species, *Ceratophyllum demersum*, was dominant in Lake Iroquois in 2017 but was observed at lower frequency of occurrence in 2019 through 2024. This species is known to be sensitive to ProcettaCOR. Pondweed species (*Potamogeton amplifolius*, *P. foliosus* and *P. zosteriformis*) were generally more abundant in September post-treatment surveys, particularly Broad-leaf Pondweed (*Potamogeton amplifolius*). Slight declines in the frequency of occurrence of the majority of native species were observed (19 of 23 species) between 2017 and 2019. The majority of these species increased in frequency of occurrence in 2021 through 2023 surveys. In 2024, 16 of the 19 native species declined in frequency of occurrence. Declines in most native species are observed as a result of invasion and canopy formation by Eurasian watermilfoil, with recovery generally fairly rapid after removal of the canopy.

Seventy-three percent of whole lake sampling points were vegetated by at least one native plant species (Figure 3), 95% of survey points with depths less than 5 m (Figure 4) and 97% of survey points with depths less than 2 meters depth yielded native aquatic plants in Fall of 2024. These results are comparable to 2023 and 2022, when 75% and 76% of whole lake sampling points

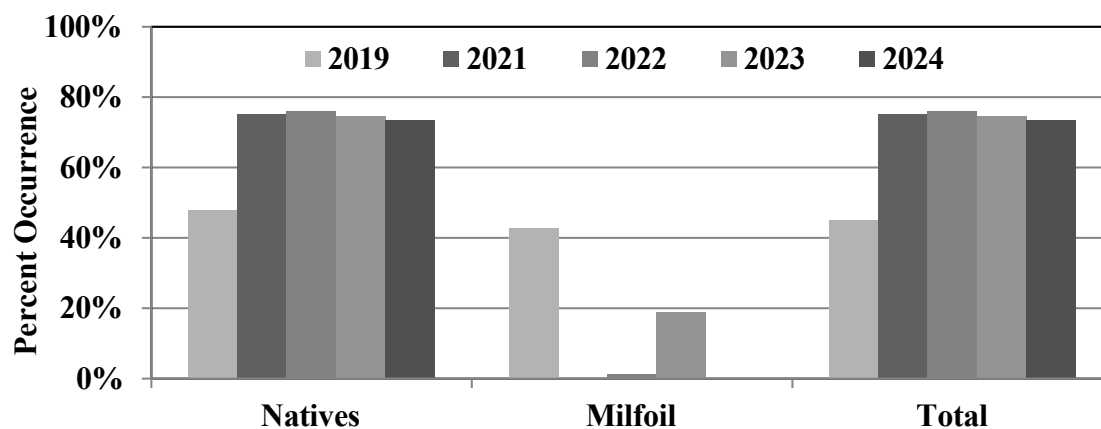


Figure 3. Lake Iroquois frequency of occurrence summaries.

were vegetated by native plants. In 2021, seventy-five percent of whole lake sampling points were vegetated by at least one native plant species, 94% of survey points with depths less than 5 m and 100% of survey points with depths less than 2 meters depth were vegetated by at least one native plant species. In 2019, forty-five percent of whole lake sampling points were vegetated by at least one native plant species, 91% of survey points with depths less than 5 m and 97% of survey points with whole lake sampling points were vegetated by at least one native plant species. Absent post-treatment in the Fall of 2024, Eurasian watermilfoil was present in 19% of survey points in the Fall of 2023 and 1% of survey points in the Fall of 2022. Absent in 2021, Eurasian watermilfoil was present in 43% of whole lake survey points, and 86% of survey points

less than 5 m water depth in 2019, representing the littoral zone or zone of aquatic plant growth. For survey points within the littoral zone, water depth less than 5 m, results similar to whole lake surveys are reported. The expected relationship of greater frequency of occurrence of aquatic plants with shallower water depth is consistent with that reported by other regional studies.

Littoral zone frequency of occurrence values for both survey years were dominated by native species and similar to nearby lakes (Getsinger et al. 2002). Species richness is presented in Table 3 and Figure 4. Whole lake native species richness in 2024 was 2.61 species per sample

Table 3. Lake Iroquois species richness comparison.

Plant Grouping	Water Depth Class	Summary Statistic	Survey Result				
			2019	2021	2022	2023	2024
Native plant species	Whole Lake (all depths)	Mean	1.50	2.65	2.94	3.06	2.61
		N	115	77	79	79	79
		Std. Error	0.12	0.26	0.25	0.27	0.24
	Points with depths <5m	Mean	3.02	3.33	3.75	4.03	3.38
		N	57	61	63	60	61
		Std. Error	0.27	0.26	0.22	0.24	0.23
	Points with depths <2m	Mean	3.86	4.11	4.35	4.23	4.08
		N	35	36	43	40	37
		Std. Error	0.31	0.32	0.22	0.31	0.28
All plant species	Whole Lake (all depths)	Mean	1.94	2.74	2.95	3.25	2.61
		N	115	77	79	79	79
		Std. Error	0.15	0.26	0.25	0.29	0.24
	Points with depths <4m	Mean	3.91	3.44	3.77	4.28	3.38
		N	57	61	63	60	61
		Std. Error	0.28	0.27	0.22	0.26	0.23
	Points with depths <2m	Mean	4.74	4.25	4.37	4.50	4.08
		N	35	36	43	40	37
		Std. Error	0.32	0.33	0.23	0.34	0.28

point similar to the 3.06, 2.94, 2.65, 1.50 and 2.13 reported in 2023, 2022, 2021, 2019 and 2017, respectively. Species richness in this range is comparable to nearby lakes (Eichler 2016). For survey points exclusively within the littoral zone (depths less than 5 meters), native species richness was 3.38, 4.03, 3.75, 3.33, 3.02 and 3.62 species per survey point (Figure 4) for 2024, 2023, 2022, 2021, 2019 and 2017, respectively. As expected, species richness in the littoral zone and its shallow fringe was higher than whole lake species richness and native species richness increased with the removal of Eurasian watermilfoil.

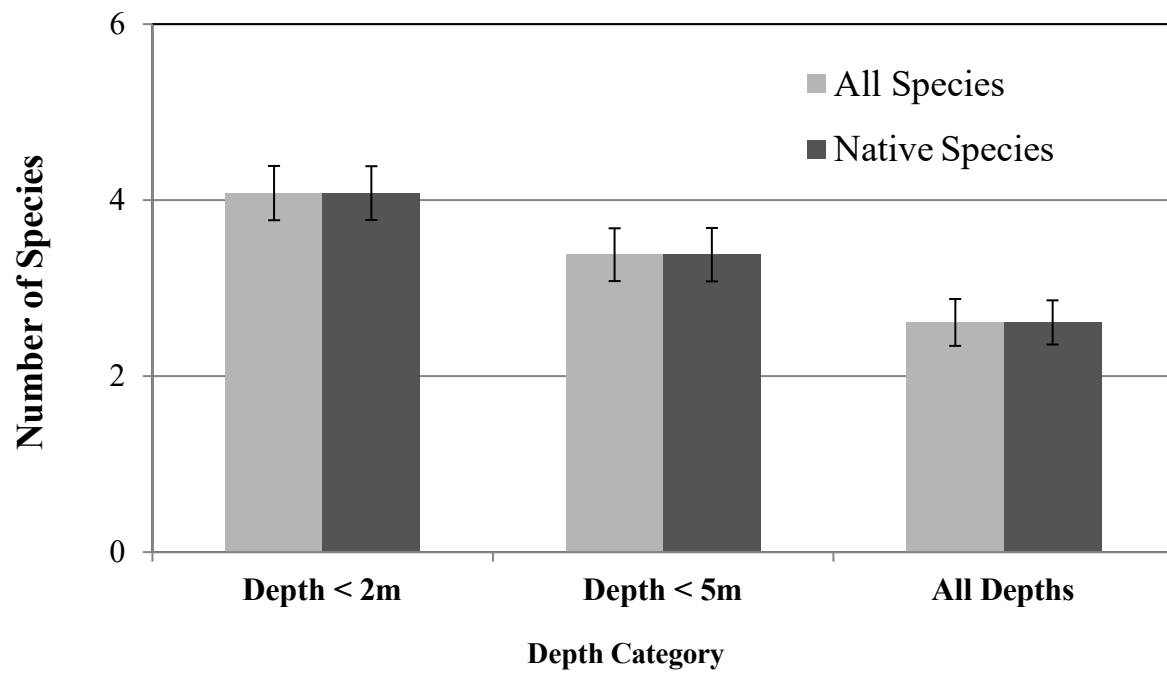


Figure 4. Lake Iroquois species richness.
Error bars are standard error of the mean

Summary

Spring and Fall quantitative aquatic plant surveys were undertaken for Lake Iroquois, Vermont in June and September 2024. The surveys occurred pre- and post-treatment for aquatic plant management efforts employing the herbicide ProcellaCOR EC for Eurasian watermilfoil control. The September component of the survey duplicated prior surveys conducted by the author (Eichler 2023). The surveys consisted of frequency of occurrence and relative abundance data for all aquatic plant species present in points distributed throughout the lake. The Point-Intercept Rake Toss method presently used by the US Army Corps of Engineers and others was employed. The assessment generated the information necessary to: 1) evaluate the effectiveness of the aquatic plant management efforts, 2) determine the impact of the management efforts on non-target aquatic plant species, and 3) provide data for comparison of post-treatment conditions to prior survey information.

Eurasian watermilfoil (*Myriophyllum spicatum*) populations were first reported in 1990 in Lake Iroquois and confirmed in 1991. Hand harvesting by skin and SCUBA divers has been the basis of the program since the formation of the lake association in 2007. The aquatic weevil (*Euhrychiopsis lecontei*) population of the lake was supplemented in 2008 and 2009 to provide a biocontrol agent for Eurasian watermilfoil. However, by 2014 approximately 70 acres of Lake Iroquois was reported to support dense growth of Eurasian watermilfoil. Benthic barrier and diver assisted suction harvesting (DASH) were included in 2016 through 2019. A more intensive management effort based on herbicide treatment occurred in the Spring of 2021. No organized management efforts occurred in 2022. Limited diver assisted suction harvesting (DASH) was employed in 2023, however a report of dense growth of Eurasian watermilfoil to the west of the water ski course suggested the need for a more intensive management strategy. Four areas of Lake Iroquois were treated with the herbicide ProcellaCOR EC in 2024.

The aquatic plant community of Lake Iroquois in 2024 included twenty-four submersed species, three floating-leaved species, two floating species and five emergent species. Twenty species were collected in the point intercept portion of the survey, comparable to the 23, 24, 26, 25, 19, and 23 species reported in 2023, 2022, 2021, 2019, 2017 and 2014, respectively. This number of species greatly exceeds the 15 species typically reported for moderately productive lakes in our region and indicates good water quality and a variety of habitat types. Two of the species present in Lake Iroquois, Humped Bladderwort (*Utricularia gibba*) and White Watercrowfoot (*Ranunculus longirostris*) are found on Vermont's rare plant list (VT DEC 2022).

Eurasian watermilfoil was absent post-treatment from the Fall 2024 survey of Lake Iroquois. Pre-treatment in June of 2024, Eurasian watermilfoil had expanded to 28% of survey points. Eurasian watermilfoil was reported for 3% of survey points in the Spring of 2023 and 19% of survey points in the Fall 2023 survey. Present in 1% of survey points in the Fall 2022 survey, Eurasian watermilfoil was absent in the Spring of 2022 and Fall, post-treatment survey of 2021. Eurasian watermilfoil was present in 24% of survey points in the Spring of 2021, 43% of survey points in the Fall of 2019 and 24% of survey points in the Fall of 2017, representing a decline from the dense growth reported for over 67% of the littoral zone in 2014. The density of Eurasian watermilfoil growth also varied, with most points described as dense growth in 2014 reduced to scattered or moderate growth in 2017 and 2019. Absent in the Fall 2021 and Spring

2022 surveys, Eurasian watermilfoil was reported as scattered growth at a single location in the Fall of 2022. By the Fall 2023 survey scattered growth of Eurasian watermilfoil was reported in several locations and dense growth was reported in the north end of the lake west of the water ski course. In the Spring of 2024, dense growth of Eurasian watermilfoil was found along the west shore from the north end of the waterski course southward along the shoreline. Dense growth was also observed around the rocky island in the center of the lake, in the bay north of the large island and in the southeastern bay. Moderate and scattered Eurasian watermilfoil growth also occurred at the north end of the lake. Eurasian watermilfoil was absent in the Fall 2024 survey, post-treatment with the herbicide ProcettaCOR EC.

Species richness in Lake Iroquois was quite high, with a number of species occurring in more than 5% of survey points. Seventy-three percent of sampling points were vegetated by at least one native plant species in the Fall 2024 survey. The large number of points supporting native plant species suggests that Lake Iroquois is a prime candidate for recovery of its native plant population following management of Eurasian watermilfoil. Native species richness in the littoral zone was 3.38, 4.03, 3.75, 3.33, 3.02 and 3.62 species per sample in 2024, 2023, 2022, 2021, 2019 and 2017, respectively; and at the high end of species richness values for other regional lakes, which ranged from 1.79 to 4.00 species per sample.

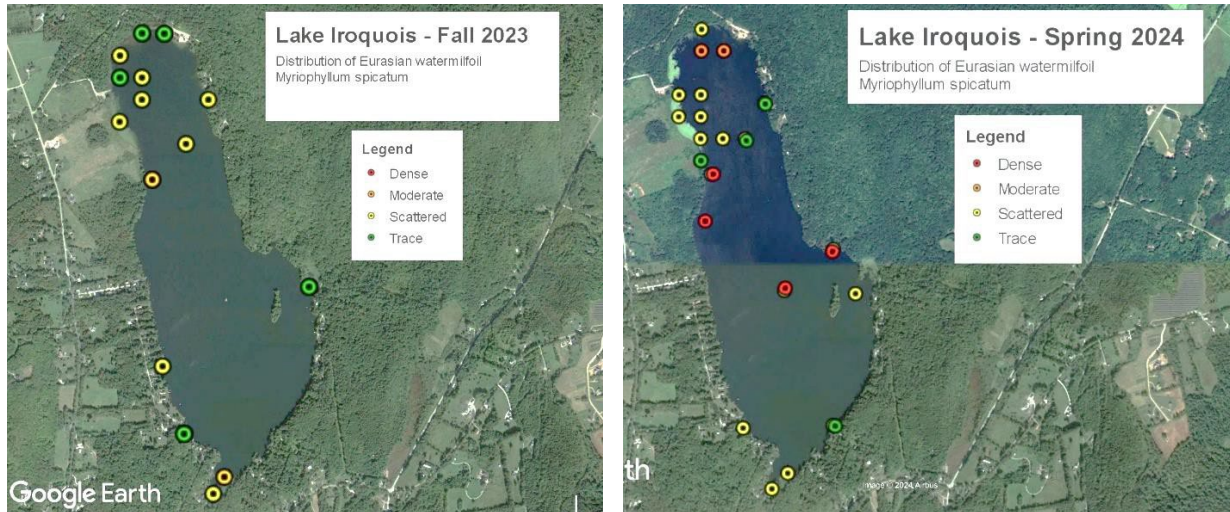
Common native species for Lake Iroquois in the Fall 2024 survey included waterweed (*Elodea canadensis*, 52% of survey points), wild celery (*Vallisneria spiralis*, 43%), muskgrass (*Chara/Nitella*, 39%), flat-stem pondweed (*Potamogeton zosteriformis*, 29%), water stargrass (*Zosterella dubia*, 18%), broad-leaf pondweed (*Potamogeton amplifolius*, 18%), white waterlily (*Nymphaea odorata*, 10%), giant bladderwort (*Utricularia vulgaris*, 10%), white watercress (*Ranunculus longirostris*, 8%), small pondweed (*Potamogeton pusillus*, 8%), coontail (*Ceratophyllum demersum*, 5%), and Variable pondweed (*Potamogeton gramineus*, 5%). Native species results are generally comparable to those reported in prior surveys with a few exceptions. A common native species, *Ceratophyllum demersum*, remains dominant in Lake Iroquois but at lower frequency of occurrence. This species is known to be sensitive to ProcettaCOR.

Pondweed species (*Potamogeton amplifolius*, *P. pusillus* and *P. zosteriformis*) were generally more abundant in September post-treatment surveys, particularly Broad-leaf Pondweed. Declines in most native species are observed as a result of invasion and canopy formation by Eurasian watermilfoil, with recovery generally fairly rapid after removal of the canopy. Shifts in plant growth from year to year are common, particularly with new invaders like Eurasian watermilfoil. These shifts are often attributed to changing weather patterns, plant disease outbreaks or differences in the abundance of plant predators.

Eurasian watermilfoil growth in Lake Iroquois was present primarily as scattered and moderate density growth in September of 2017, while native plant populations were robust and similar to other regional lakes. By the Fall 2019, moderate to dense growth of Eurasian watermilfoil was more typical and native plant populations had declined. In May of 2021 immediately prior to application of ProcettaCOR EC, Eurasian watermilfoil frequency of occurrence was similar to Fall 2017 and was most abundant at the north end of the lake, the area chosen for treatment with the herbicide. Eurasian watermilfoil was absent in post-treatment surveys in September of 2021 and June of 2022, most likely attributable to the use of the herbicide. In September of 2022, Eurasian watermilfoil was present in 1% of survey points. In June of 2023, Eurasian watermilfoil

was reported at 2 survey points (3%) at the south end of the lake, increasing to 19% of survey points by September of 2023 (Figure 5). In June of 2024 pre-treatment, Eurasian watermilfoil had expanded to 28% of survey points. Following the ProcellaCOR EC treatment, Eurasian watermilfoil was absent from the Fall 2024 survey.

**Figure 5. Distribution of Eurasian watermilfoil in Lake Iroquois.
Eurasian watermilfoil was absent from the 2024 Fall survey.**



References

- Crow, G.E. and C.B. Hellquist. 2000. Aquatic and wetland plants of northeastern North America. 2 Volumes. University of Wisconsin Press, Madison, WI.
- Eichler, L.W. 2016. Aquatic vegetation of Lake Dunmore and Fern Lake, Vermont - 2016. Prepared for Vermont DEC & the Lake Dunmore Association. DFWI Technical Report 2016-11. Darrin Fresh Water Institute, Bolton Landing, NY.
- Eichler, L.W. 2017. Aquatic vegetation of Lake Iroquois and Sunset Pond, Chittenden County, Vermont - 2017. Prepared for Vermont DEC & the Lake Iroquois Association. DFWI Technical Report 2017-6. Darrin Fresh Water Institute, Bolton Landing, NY.
- Eichler, L.W. 2019. Aquatic vegetation of Lake Iroquois, Chittenden County, Vermont - 2019. Prepared for Vermont DEC & the Lake Iroquois Association. DFWI Technical Report 2019-10. Darrin Fresh Water Institute, Bolton Landing, NY.
- Eichler, L.W. 2021. Aquatic vegetation of Lake Iroquois, Chittenden County, Vermont - 2021. Prepared for Vermont DEC & the Lake Iroquois Association. DFWI Technical Report 2021-2. Darrin Fresh Water Institute, Bolton Landing, NY.
- Eichler, L.W. 2022. Aquatic vegetation of Lake Iroquois, Chittenden County, Vermont - 2022. Prepared for Vermont DEC & the Lake Iroquois Association. Prepared by Lawrence Eichler, Scientific Consultant, Lake George, NY. September 2022.
- Eichler, L.W. 2023. Aquatic vegetation of Lake Iroquois, Chittenden County, Vermont - 2023. Prepared for Vermont DEC & the Lake Iroquois Association. Prepared by Lawrence Eichler, Scientific Consultant, Lake George, NY. September 2023.
- Getsinger et al., K.D., R.M. Stewart, J.D. Madsen, A.S. Way, C.S. Owens, H.A. Crosson, and A.J. Burns. 2002. Use of Whole-Lake Fluridone Treatments to Selectively Control Eurasian Watermilfoil in Burr Pond and Lake Hortonia, VT. US Army Corps of Engineers, Engineer Research and Development Ctr., Aquatic Plant Control Res. Program. ERDC/EL TR-02-39.
- Hellquist, C.B. 1993. Taxonomic considerations in aquatic vegetation assessments. *Lake and Reserv. Manage.* 7:175-183.
- Knoecklein, G. 2015. Lake Iroquois aquatic plant survey. Northeast Aquatic Research, LLC, Mansefield, CT. February 2015.
<http://www.lakeiroquois.org/home/announcements/milfoilreportnowavailable>
- Madsen, J.D. 1999. Point intercept and line intercept methods for aquatic plant management. US Army Engineer Waterways Experiment Station Aquatic Plant Control Research Program Technical Note CC-02, Vicksburg, MS.
- Madsen, J.D., L.W. Eichler, and C.W. Boylen. 1988. Vegetative spread of Eurasian watermilfoil in Lake George, New York. *J. Aquat. Plant Manage.* 26, 47-50.
- Madsen J.D., J.W. Sutherland, J.A. Bloomfield, L.W. Eichler and C.W. Boylen. 1991. Decline of native vegetation under a canopy of Eurasian watermilfoil. *J. Aquatic Plant Manage.* 29:94-99.
- VT DEC. 2010. Vermont Department of Environmental Conservation – Lay Monitoring Program.

- www.anr.state.vt.us/dec/waterq/cfm/lakerep/lakerep_details.cfm
- VT DEC. 2012. Rare and Uncommon Native Vascular Plants of Vermont. Vermont Natural Heritage Inventory. Vermont Fish & Wildlife Department. 21 November 2012.
www.vtfishandwildlife.com/.../List_of_Rare_and_Uncommon_Native_Plants_of_Vermont.pdf
- VT DEC. 2016. Vermont Department of Environmental Conservation – Lay Monitoring Program. Online, September 2017. www.anr.state.vt.us/dec/waterq/cfm/lakerep/lakerep_details.cfm
- VT DEC. 2016a. Vermont Department of Environmental Conservation webpage. Depth charts for Vermont lakes. Online, December 2016.
www.watershedmanagement.vt.gov/lakes/htm/lp_depthcharts.htm
- VT DEC. 2016b. Vermont Department of Environmental Conservation webpage. Waterbodies infested with aquatic invasive species. Online, December 2016.
http://dec.vermont.gov/sites/dec/files/wsm/lakes/ans/docs/lp_InfestedWaterBodiesList2016.pdf
- VT DEC. 2022. Rare and Uncommon Native Vascular Plants of Vermont. Vermont Natural Heritage Inventory. Vermont Fish & Wildlife Department. 4 May 2022.
www.vtfishandwildlife.com/.../List_of_Rare_and_Uncommon_Native_Plants_of_Vermont.pdf

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Appendix A

Lake Iroquois Aquatic Plant Distribution Maps

