LAKE ST. CATHERINE

Aquatic Vegetation Management Program

2022 Annual Report

November 2022

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1 INTRODUCTION

This report summarizes SŌLitude Lake Management's 2022 activities with herbicide treatment and comprehensive survey and offers 2023 season recommendations for Lake St. Catherine.

The 2022 season was SŌLitude Lake Management's 18th year of involvement with Lake St. Catherine's Integrated Management Plan addressing the control of non-native Eurasian watermilfoil (*Myriophyllum spicatum*) throughout the lake. Overall management continues to focus on herbicide treatments, diver assisted suction harvesting (DASH) and hand-pulling efforts, boat inspections, and community education. Treatment, hand-pulling, and diver assisted suction harvesting are actions that continue to be consistent with the current five-year Integrated Management Plan that is set to expire in 2023. Specific information on the 2022 diver hand-pulling and diver assisted suction harvesting efforts will be provided by the Lake St. Catherine Association (LSCA) under a separate cover.

Key Treatment Information

- 454.4 PDUs of ProcellaCOR™ EC (florpyrauxifen-benzyl) applied to Main Basin (8.7 acres) and Little Lake (35.4 acres).
- No regrowth in treatment areas within Little Lake and treatment area two of Main Basin.
- Sparse regrowth in treatment area three of Main Basin.

Key Survey Findings

- Overall decrease in Eurasian watermilfoil in Lily Pond, Little Lake, and the Main Basin.
- Trace-sparse regrowth within Horseshoe Bay treatment area.
    - Observed during interim survey and comprehensive survey.
- Overall decrease in percent plant cover, biomass index (BMI) and species richness.
    - Reflective of previous years' fluctuations and likely a natural cycle.
- Overall increase in Yellow waterlily (*Nuphar variegata*), Largeleaf pondweed (*Potamogeton amplifolius*), Thinleaf pondweed (*Potamogeton pusillus*), and Common bladderwort (*Utricularia vulgaris*).
- Frequency of Occurrence (FOO) increase in Brittle Naiad (Najas minor), an invasive species, by one percent.
- Mild cyanobacterial bloom observed and documented in appendix map three.

The remainder of this text contains the results of the 2022 Treatment Program and details findings from the late season comprehensive aquatic plant survey that has been performed annually to document in-lake plant conditions and help evaluate and refine management goals.

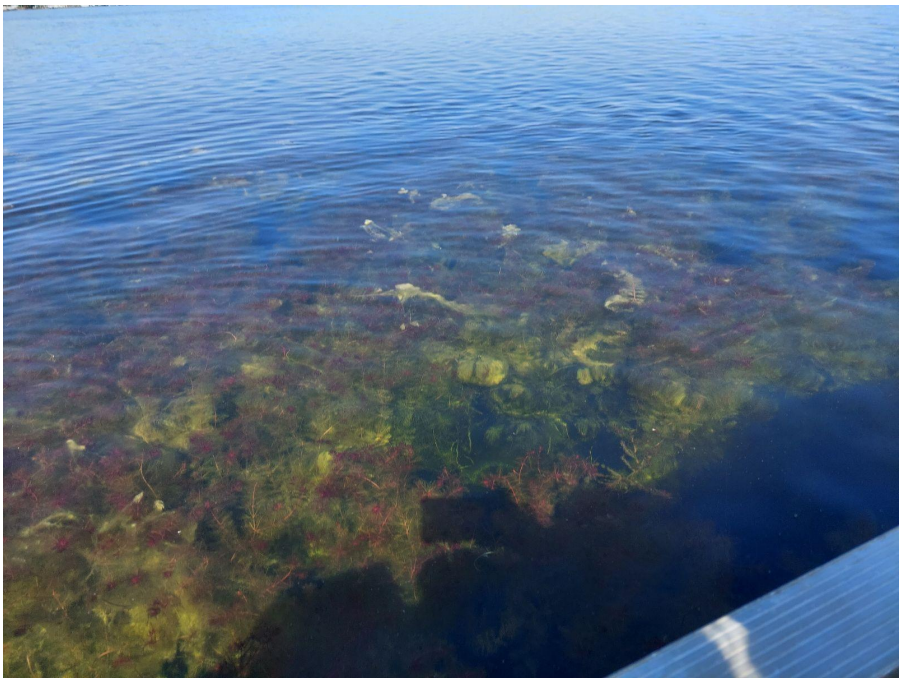
2 HERBICIDE TREATMENT PROGRAM - 2022

2.1 Program Chronology

The following chronology describes 2022 Treatment Program activities:

Pre-treatment inspection to finalize treatment areas	May 16
Treatment of 44.1 acres with ProcellaCOR™ EC	June 20
Herbicide residue monitoring	June 22
Interim post-treatment survey	July 28
Comprehensive aquatic plant survey	September 20 - 22

2.2 Pre-Treatment Inspection

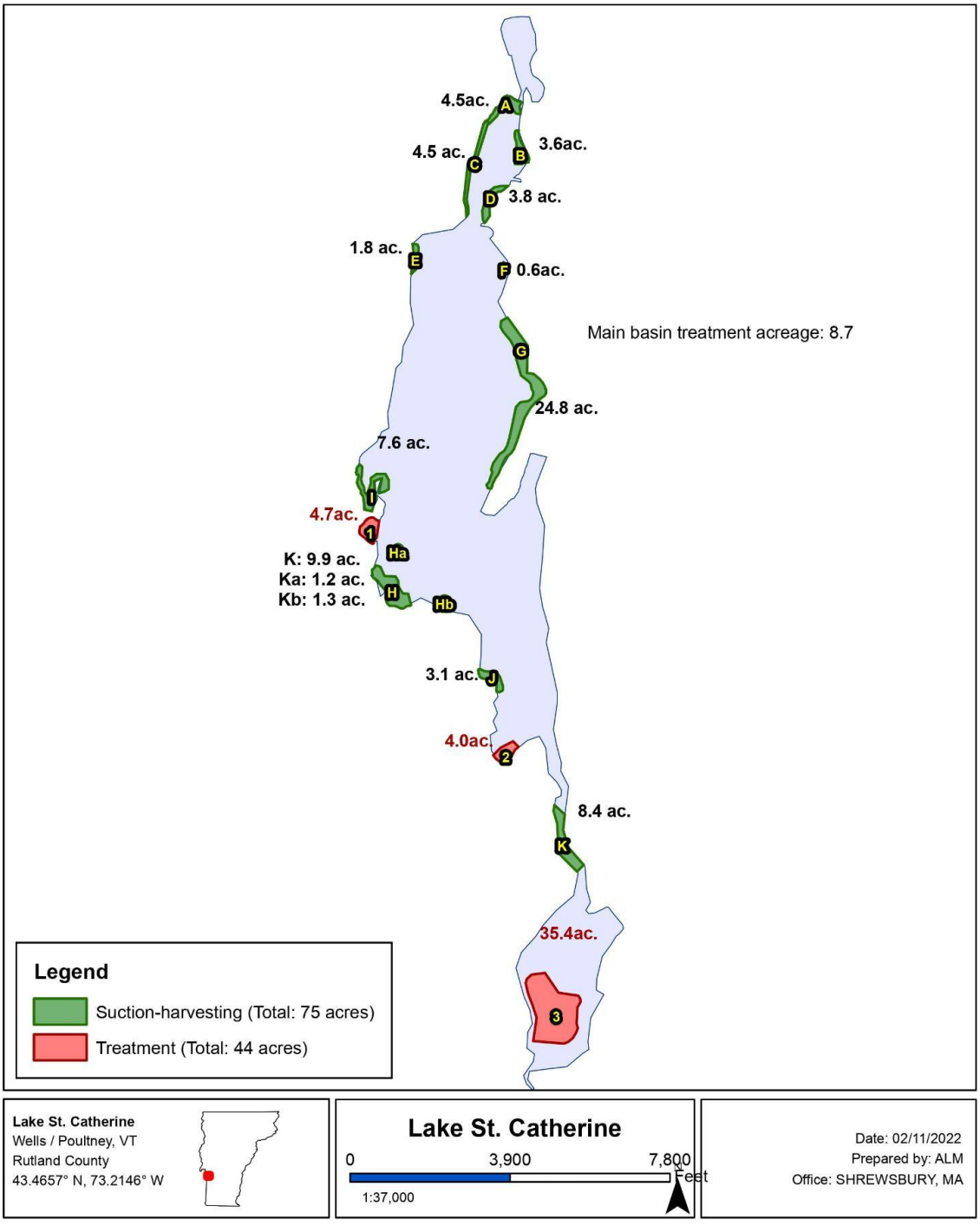


On May 16, 2022, potential treatment and management areas of Lake St. Catherine were surveyed by two SŌLitude biologists and a member of the DASH team. Weather was partly cloudy with good visibility into the water. Throughout the lake, new and old growth of Eursian watermilfoil was observed growing with a BMI of 1-2 in most areas. Some localized, shallow spots had growth with a BMI of 3-4. Stems were a healthy green with redding occurring at the apical meristems. Growth was more pronounced in Little lake as compared to the main basin, partly due to the depth at which milfoil was growing.

Consistent with previous years, each treatment area was evaluated with regards to Eurasian watermilfoil cover/distribution as well as several other factors including: potential for increased Eurasian watermilfoil spread; potential for effective treatment; and the overall benefit of milfoil control with respect to the lake, lake residents and other potential users.

Results of the survey were communicated to LSCA for their input and final determination on proposed treatment and DASH areas (Figure 1). Once final management areas were agreed upon, the required pre-treatment notification information was provided to the Vermont DEC, Lakes & Ponds Program and final approval to proceed was received on June 16, 2022.

Figure 1. 2022 Proposed Management Areas



2.3 ProcellaCOR™ EC Treatment

To comply with notifications requirements of ANC Permit #2770-ANC-C and to avoid weekend water use restrictions, treatment was conducted on Monday, June 20, 2022. A total of 44.1 acres amongst three areas were treated for Eurasian watermilfoil using ProcellaCOR™ EC (Figure 1).

The application rate for ProcellaCOR was 2-3 PDUs/ac-ft (3.86-5.79 ppb/ac-ft); a total of 454.4 PDUs were applied. The treatment took approximately three hours to complete between 1:00 and 4:00 pm.

Weather conditions on the day of treatment were favorable with mostly sunny skies, 75°F air temperature, and 5 MPH winds North/Northwest. The dissolved oxygen/temperature profile of the Main Basin was as followed:

Table #: Dissolved oxygen and temperature profile data in the Main Basin on June 20, 2022.

Depth (m)	Temperature °C	Dissolved Oxygen (mg/L)
Surface	21.3	9.13
1	21.5	9.15
2	21.5	9.15
3	20.8	9.33
4	20.5	9.39
5	20.5	9.44
6	20.3	9.49
7	20.1	9.56
8	18.0	9.77

The treatment was conducted using a 20-foot aluminum work skiff with a pump injection system. Diluted ProcellaCOR™ EC herbicide solution was injected at subsurface depths into the treatment areas. An onboard GPS unit was used to provide real-time guidance and ensure an even application in each of the treated areas. The State boat ramp located on the channel between the Main Lake and Little Lake was used as the base of operations.

2.4 Herbicide Residue Testing

In compliance with conditions of the ANC Permit #2770-ANC-C, water samples were collected from within and immediately downstream of Lake St. Catherine following treatment for analysis of ProcellaCOR concentrations. A total of four sample locations were chosen.

A map of the sampling locations is attached in Appendix A. Sampling instructions and sample bottles were provided to LSCA representatives by SŌLitude and SePRO. Collected samples were shipped via overnight delivery to SePRO's laboratory in Whittakers, North Carolina.

SePRO Results were obtained on Monday, June 27th. One sample at location three had a detection limit of 1.5 ppb, whereas all other locations were at or below the laboratory detection limit of 1.0 ppb. Thus, water-use restrictions were formally lifted. A copy of the results is attached in Appendix A.

2.5 Interim Post-Treatment Survey

An interim survey was conducted on July 28, 2022 to assess and monitor efficacy of treatment for Eurasian watermilfoil control.

Little Lake

No milfoil was found in the Little Lake treatment area. However, treatment did not appear to have a significant impact on milfoil outside of the treatment zone, as abundant and healthy stems were observed. Some injury (chlorosis) to water lily and watershield populations were realized outside of the treatment area. Native plant populations appeared healthy and abundant.

Main Basin

One multi-branched, healthy milfoil stand was observed in Horseshoe Bay. Part of the plant appeared injured, although new growth was observed. No other milfoil stems were found in the Main Basin treatment areas. Native plant populations in the treatment area appeared to be healthy and abundant. Some injury to waterlily populations was realized.

3 LATE SEASON COMPREHENSIVE AQUATIC VEGETATION SURVEY

3.1 Survey Methods

Consistent with methods employed in previous years of this management program, the late season comprehensive aquatic vegetation survey was conducted from September 20-22. All three lake basins were systematically toured by boat by SŌLitude biologists. Transect and data point locations established in 2001 were relocated using a Differential GPS system (Appendix B – Figure 1).

Weather conditions were rainy on all days, giving moderate to poor visibility into the water.

Recorded at each data point was the following information: aquatic plants present, dominant species, plant biomass, percent total plant cover and percent Eurasian watermilfoil cover. Water depths that were recorded during the pre-treatment survey were verified using a high-resolution depth finder. The plant community was assessed through visual inspection, use of a throw-rake and with an Aqua-Vu underwater camera system. Locations where Eurasian watermilfoil plants were observed were recorded with a GPS unit. Plants were identified to genus and species level when possible. Plant cover was given a percentage rank based on the aerial coverage of plants within an approximate 400 square foot area assessed at each data point. Generally, in areas with 100% cover, bottom sediments could not be seen through the vegetation; percentages less than 100% indicated the amount of bottom area covered by plant growth. The percentage of Eurasian watermilfoil was also recorded at each data point. In addition to cover percentage, a plant biomass index was assigned at each data point to document the amount of plant growth vertically through the water column. Plant biomass was estimated on a scale of 0-4, as follows:

0 No biomass; plants generally absent
1 Low biomass; plants growing only as a low layer on the sediment
2 Moderate biomass; plants protruding well into the water column but generally not reaching the water surface
3 High biomass; plants filling enough of the water column and/or covering enough of the water surface to be considered a possible recreational nuisance or habitat impairment
4 Extremely high biomass; water column filled and/or surface completely covered, obvious nuisance conditions and habitat impairment severe

3.2 Overall Results and Discussion

Table 1. Summary of Annual Survey Data, 2001-2022

LILY POND	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
# of Data Points	24																			
Total Plant Cover	90	80	98	88	91	98	94	98	93	94	96	94	90	78	60	99	99	88	92	95
Plant Biomass Index	3.1	2.5	3.3	2.5	2.8	3.3	2.7	2.3	2.9	3.1	3.5	3.4	3.5	3.2	2.9	3.9	3.7	4.0	4.0	3.4
Average Species Richness	5.67	3.58	5.17	3.59	4.54	5.58	4.83	5.46	4.13	4.21	4.46	5.04	4.8	5.5	5.54	7.75	7.04	5.38	5.63	5.13

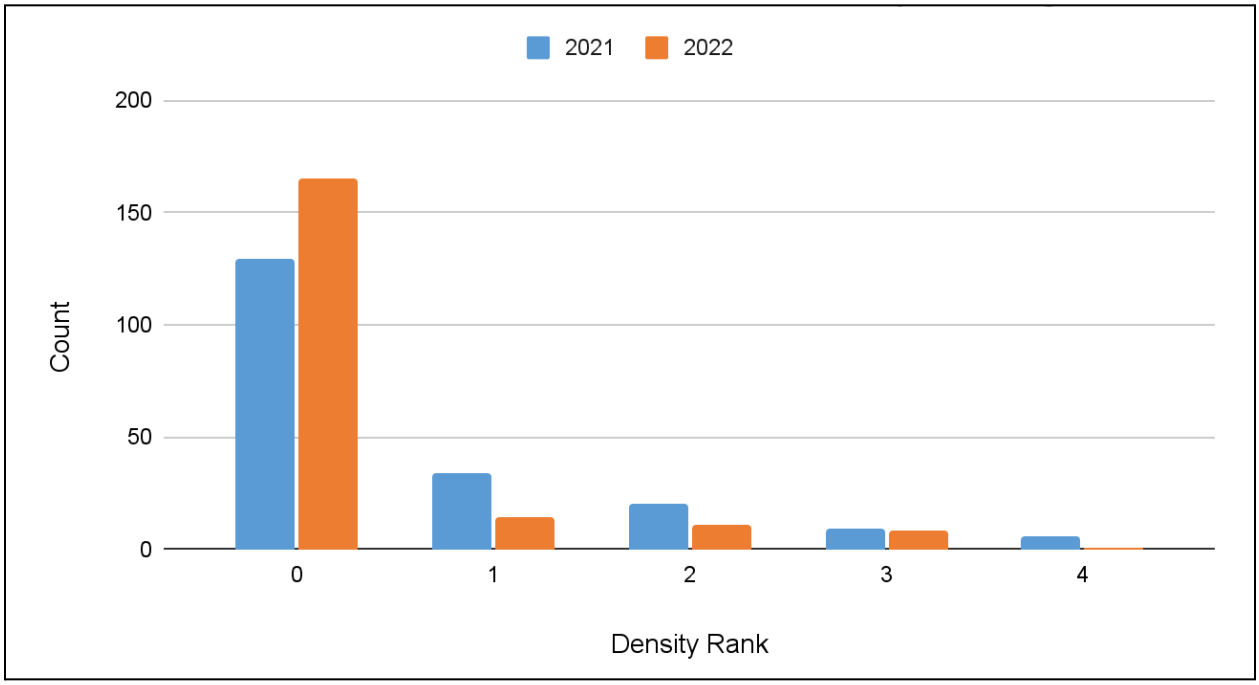
LAKE ST. CATHERINE (Main Basin)	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
# of Data Points	129																			
Total Plant Cover	66	46	51	57	58	66	58	63	59	56	63	63	63	37	43	60	47	51	55	37
Plant Biomass Index	1.9	1.5	1.6	1.8	2	2	2	1.3	1.8	1.5	2	2	2	2.6	1.6	2.9	2.7	2.9	3	1.9
Average Species Richness	2.96	2.39	2.85	3.5	3.75	4.09	3.68	3.06	2.88	2.88	2.85	2.87	3.2	3.1	3.35	4.59	3.98	4.26	4.73	2.49

LITTLE LAKE	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
# of Data Points	43																			
Total Plant Cover	72	66	78	83	83	77	56	62	76	81	80	86	96	54	49	84	90	80	71	53
Plant Biomass Index	2.3	2.1	2.4	2.9	2.8	2.7	2.2	2.7	3.3	2.5	3	3.2	3.8	3.8	2.3	3.9	3.9	3.7	3.5	2.9
Average Species Richness	5.62	3.23	3.3	3.81	4.58	4.3	4.23	4.65	3.84	4.42	4.63	4.77	4.4	4	5.49	6.79	6.26	6.40	5.56	3.19

Table 1. Summary of Annual Survey Data, 2001-2022

OVERALL	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
# of Data Points	199																			
Total Plant Cover (%)	70	54	63	66	67	73	63	67	67	66	70	72	-	45	46	70	63	61	63	47
Plant Biomass Index	2	2	2	2	2	2	2	2	2	2	2	2	-	3	2	3.2	3.1	3.2	3.2	2.3
Average Species Richness	-	-	-	3.57	4.03	4.32	3.94	3.7	3.23	3.38	3.44	3.56	3.71	3.52	4.08	5.45	4.84	4.85	5.08	3.80

Chart 1. Comparison between 2021 and 2022 Eurasian watermilfoil overall density ranks



Key		
Rank	**Abundance**	**Biomass estimation (g/m^2)**
0	No plants	0.000
1	Trace	0.0001 - 2.000
2	Sparse	2.001 to 140.000
3	Moderate	140.001 to 230.000
4	Dense	230.001 to 450.000+

Table 2. Entire System – Annual Species List and Frequency of Occurrence (%) 2001-2022

Macrophyte Species (Common Name / Scientific Name)	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Water marigold	3	0	0	0	0	0	0	0	1	0	0	0.5	0	0	0	0	0	<1	0	0
Bidens beckii																				
Watershield	4	8	7	7	7	6	5	5	5	3	4	4	3	3	3	5	5	3	1	<1
Brasenia schreberi																				
Coontail	20	8	11	12	21	18	17	22	10	21	15	17	15	14	21	24	17	4	6	3
Ceratophyllum demersum																				
Spineless hornwort																	3	0	<1	0
Ceratophyllum echinatum																				
Muskgrass / Stonewort	17	6	36	40	14	14	13	2	2	1	0	3	19	5	8	12	3	8	15	5
Char asp. / Nitella sp.																				
Spikerush	1	1	1	0	0	0	0	0	0	0	0	0	2	<1	0	0	0	1	<1	0
Eleocharis asicularia																				
Common waterweed	32	1	1	1	5	43	60	30	10	14	23	12	30	38	50	61	70	57	56	17
Elodea canadensis																				
Quillwort	2	6	2	5	2	3	1	0	1	1	0	0	1	<1	<1	<1	0	`	0	0
Isoetes sp.																				
Common duckweed	7	1	0	1	0	1	1	0	0	0	0	0	<1	<1	<1	0	0	0	0	0
Lemna minor																				
Eurasian watermilfoil	94	44	17	33	74	65	38	40	43	51	64	54	48	25	62	69	37	35	30	17
Myriophyllum spicatum																				
Whorled watermilfoil													1	0	5	0	<1	<1	0	0
Myriophyllum verticillatum																				
Slender naiad	22	0	8	39	34	22	15	16	14	8	4	7	10	9	20	19	17	22	17	15
Najas flexilis																				
Thread leaf naiad																5	1	1	2	0
Najas gracillima																				
Spiny naiad	0	0	0	0	0	0	0	0	0	0	0	0	<1	2	0	1	2	2	1	2
Najas minor																				
Yellow waterlily	5	5	5	2	2	1	2	1	2	1	1	0	2	<1	13	2	2	2	2	19
Nuphar variegata																				
White waterlily	16	5	11	10	11	11	10	7	7	12	12	14	13	8	1	24	21	20	24	10
Nymphaea odorata																				
Largeleaf pondweed	33	38	43	49	52	53	51	56	23	35	32	31	13	20	19	23	22	28	29	42
Potamogeton amplifolius																				
Berchtold's pondweed																	4	0	3	3
Potamogeton berchtoldii																				
Curlyleaf pondweed	2	1	7	5	3	1	0	0	1	1	0	1	0	<1	1	0	<1	2	1	1
Potamogeton crispus																				
Ribbonleaf pondweed	2	6	7	3	3	5	1	1	1	4	1	2	<1	1	2	8	7	7	4	0
Potamogeton epihydrus																				
Leafy Pondweed																12	3	3	1	0
Potamogeton foliosus																				
Variable leaf pondweed	23	1	6	6	2	4	4	4	11	8	3	3	4	3	4	14	9	8	8	5
Potamogeton gramineus																				
Illinois pondweed	4	1	2	9	23	39	29	36	35	53	56	57	44	47	50	43	57	66	70	42
Potamogeton illinoensis																				
Floating leaf pondweed	0	0	0	9	0	8	8	13	8	0	0	13	0	0	0	<1	0	<1	<1	0
Potamogeton natans																				

Table 2. Entire System – Annual Species List and Frequency of Occurrence (%) 2001-2022

Macrophyte Species (Common Name / Scientific Name)	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Whitestem pondweed	0	0	0	0	0	0	0	0	0	<1	<1	3	6	10	<1	5	10	0	0	0
Potamogeton praelongus																				
Thinleaf pondweed	0	0	0	5	12	6	5	12	12	5	4	0	14	2	0	12	0	20	21	60
Potamogeton pusillus																				
Robbins' pondweed	52	76	88	74	77	68	84	78	57	76	76	73	57	58	65	69	70	74	71	60
Potamogeton robbinsii																				
Vasey's pondweed																	6	0	0	0
Potamogeton vaseyi																				
Flatstem pondweed	28	3	29	29	23	19	16	26	22	20	23	36	15	16	15	31	20	26	28	2
Potamogeton zosteriformis																				
White water crowfoot															2	0	2	<1	0	0
Ranunculus aquatilis																				
Arrowhead																		<1	0	0
Sagittaria sp.																				
Sago pondweed																	2	1	1	0
Stuckenia pectinata																				
Humped bladderwort	2	0	1	5	1	1	4	1	0	0	0	0	2	5	5	5	2	5	4	5
Utricularia gibba																				
Flat leaf bladderwort																3	1	2	3	1
Utricularia intermedia																				
Purple bladderwort																8	0	0	0	0
Utricularia purpurea																				
Common bladderwort	8	9	2	6	7	7	11	8	2	4	4	7	7	4	10	13	13	15	13	45
Utricularia vulgaris																				
Tapegrass	29	13	2	4	9	8	15	15	14	15	18	19	26	21	24	34	34	35	39	7
Vallisneria americana																				
Watermeal	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wolffia sp.																				
Water stargrass	1	1	9	8	23	17	7	13	4	2	4	11	15	19	20	38	37	38	47	10
Zosterella dubia																				

Quantitative measures of the aquatic plant community documented in 2022 showed variation in metrics likely due to decreases in Eurasian watermilfoil, fluctuations in native plant species, and weather conditions during surveyance. Overall vegetation cover decreased by 16%, average species richness decreased by 1.28, and biomass index decreased by 0.9 (Table 1). Decreases in these metrics occurred in all portions of Lake St. Catherine.

Frequency of Occurrence (FOO) measures indicate an overall decline in Eurasian watermilfoil by 13% (Table 2). Compared to 2021, there were 37 less sites containing milfoil. Further, plant density decreased from an average of 1, equating to trace abundance or a biomass of 0.0001 to 2.000 g/m^2, to an average of 0 equating to no biomass (Chart 1). Comparable to last year, most milfoil sites had trace or sparse abundance.

The decision to include density ranks (Chart 1) in lieu of percent cover is to add standardization to metrics. Percent cover is often subjective to the surveyor, whereas density ranks are national

industry standards that remove some of the confounding factors underlying percent cover. Moving forward, density ranks will continue to hold the place of percent cover and annual data will be able to be compared to previous datasets.

Notable iIncreases in FOO occurred in Yellow waterlily (17%), Largeleaf pondweed (13%), Thinleaf pondweed (39%), and Common bladderwort (32%). Decreases in FOO occurred in Common waterweed (39%), Illinois pondweed (28%), Flatstem pondweed (26%), and Tapegrass (32%). Remaining species had minor shifts reflective of annual trends. These fluctuations are likely part of a natural competition regime where, for example, one pondweed species is outcompeting the other. The increases in macrophyte FOO further explain the overall decrease in diversity (25 species). In addition, survey methods only capture macrophytes at the exact coordinate of the sample point. Thus, additional plants may be unaccounted for.

3.3 Lily Pond Results and Discussion

Figure 2. Lily Pond – Fall 2022 Eurasian watermilfoil Distribution

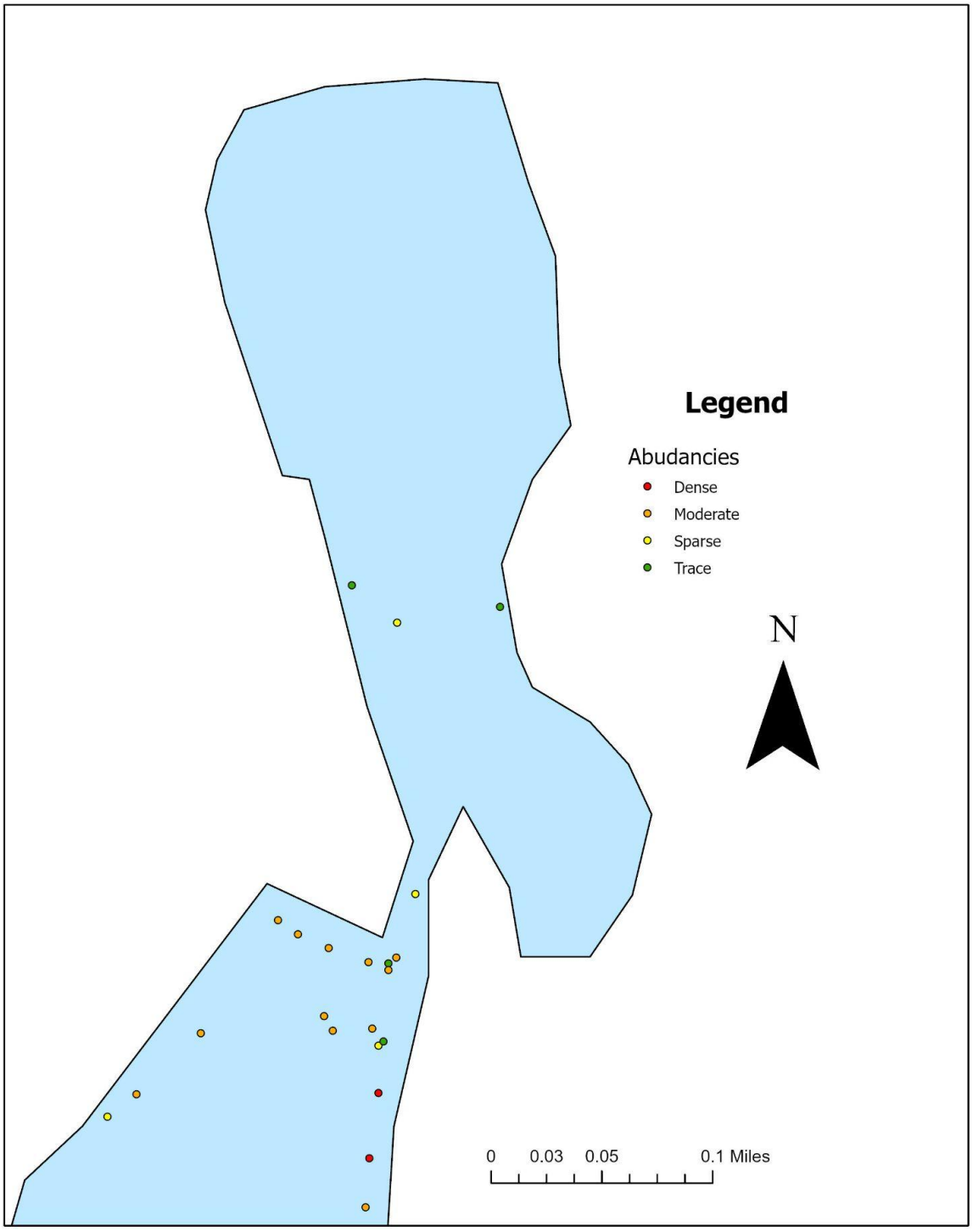


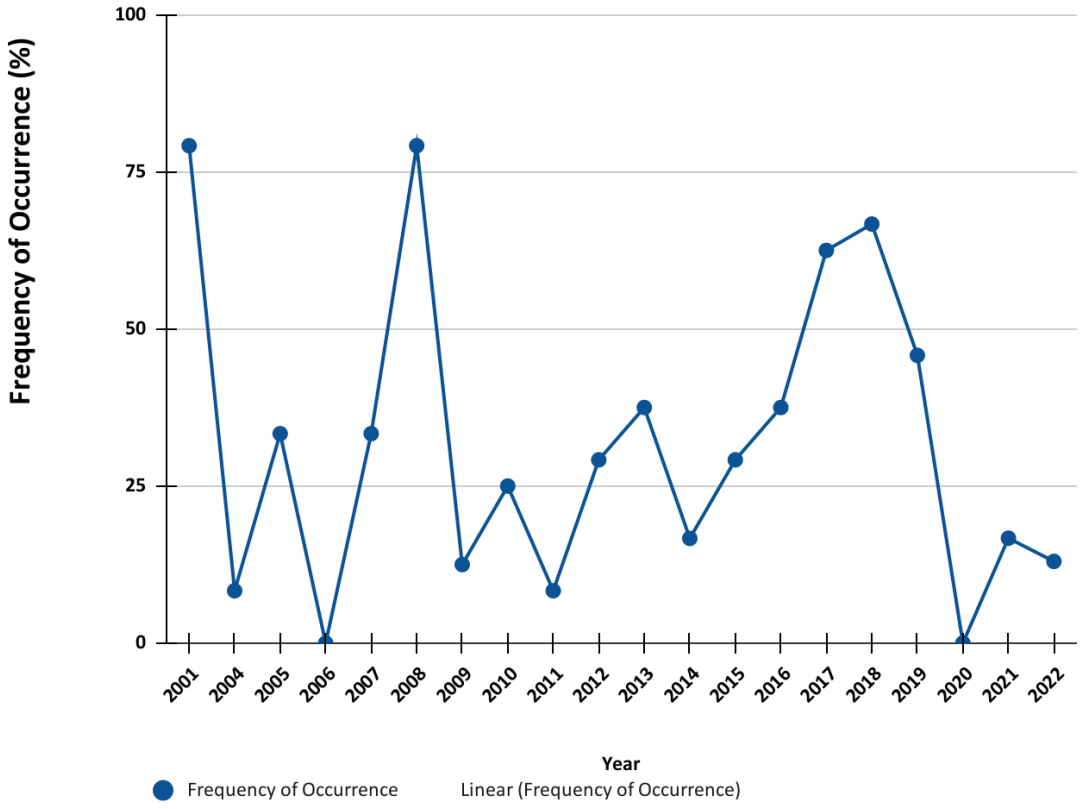
Table 3. Lily Pond – Annual Species List and Frequency of Occurrence (%), 2001-2022

Macrophyte Species (Common Name / Scientific Name)	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Watershield *Brasenia schreberi*	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Coontail *Ceratophyllum demersum*	71	4	50	46	83	83	83	79	75	63	67	54	64	67	67	92	75	0	8	13
Spineless hornwort *Ceratophyllum echinatum*																	13	0	0	0
Muskgrass / Stonewort *Chara sp. / Nitella sp.*	0	0	0	5	4	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4
Common waterweed *Elodea canadensis*	29	0	8	0	8	29	46	79	17	29	17	13	48	63	83	88	92	63	75	75
Quillwort *Isoetes sp.*	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common duckweed *Lemna minor*	46	8	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eurasian watermilfoil *Myriophyllum spicatum*	79	8	33	0	33	79	13	25	8	29	42	17	28	38	63	67	46	0	17	13
Whorled watermilfoil *Myriophyllum verticillatum*																	4	0	0	0
Slender naiad *Najas flexilis*	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thread leaf naiad *Najas gracillima*																				0
Spiny naiad *Najas minor*																				0
Yellow waterlily *Nuphar variegatum*	17	17	17	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	4	0
White waterlily *Nymphaea odorata*	63	17	29	9	21	25	33	17	25	29	38	38	28	33	42	71	67	67	67	63
Largeleaf pondweed *Potamogeton amplifolius*	33	100	92	77	79	88	92	88	38	46	75	75	24	50	38	54	42	54	38	17
Curlyleaf pondweed *Potamogeton crispus*	4	4	4	5	13	0	0	0	4	0	0	0	0	0	0	0	4	0	4	4
Ribbonleaf pondweed *Potamogeton epihydrus*	0	13	4	0	4	4	4	0	4	4	0	0	0	4	0	8	0	4	0	0
Leafy Pondweed *Potamogeton foliosus*																		8	0	0
Variable leaf pondweed *Potamogeton gramineus*	17	0	8	0	4	0	8	0	8	8	0	0	0	0	0	0	0	0	0	0
Illinois pondweed *Potamogeton illinoensis*	0	4	8	9	46	42	25	17	46	42	46	54	16	46	33	29	38	75	67	71
Floating leaf pondweed *Potamogeton natans*	0	0	0	9	0	8	8	13	8	0	0	13	0	0	0	4	0	4	4	0
Whitestem pondweed *Potamogeton praelongus*																17	46	0	0	0
Thinleaf pondweed *Potamogeton pusillus*																4	0	0	0	0

Table 3. Lily Pond – Annual Species List and Frequency of Occurrence (%), 2001-2022

Macrophyte Species (Common Name / Scientific Name)	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Robbins' pondweed *Potamogeton robbinsii*	96	92	96	96	92	88	96	96	86	96	100	100	68	71	92	100	96	92	96	88
Flatstem pondweed *Potamogeton zosteriformis*	58	8	63	0	25	46	13	67	46	33	29	67	48	46	33	79	54	88	15	17
Humped bladderwort *Utricularia gibba*	0	0	0	41	0	0	4	0	0	0	0	0	12	25	8	0	0	0	4	8
Purple bladderwort *Utricularia purpurea*																17	0	0	0	0
Common bladderwort *Utricularia vulgaris*	29	38	0	27	4	13	17	4	17	21	17	29	28	29	50	67	63	67	63	54
Tapegrass *Vallisneria americana*	33	46	0	0	0	0	8	4	4	0	0	0	4	38	0	8	4	4	4	0
Watermeal *Wolffia sp.*	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water stargrass *Zosterella dubia*	4	0	38	0	25	21	8	50	0	0	0	17	40	58	29	63	50	13	13	17

Chart 2. Lily Pond Annual Eurasian watermilfoil Frequency of Occurrence



Frequency of Occurrence (FOO) measures indicate an overall decline in Eurasian watermilfoil by 4%. (Table 3). Thus, the FOO for Eurasian watermilfoil is on par with previous years and but slightly decreasing in density (Chart 3).

A notable decrease occurred in Largeleaf pondweed (21%). Decreases in plant FOO and abundance can occur through natural selection processes. As minor FOO increases occurred in certain species (Table 3), it is expected that there would be decreases in other species.

All other species had minor fluctuations and were consistent with previous years. Robbins' pondweed remained the most abundant species with a FOO of 88%. Elodea and Illinois pondweed also had relatively high FOO percentages at 75% and 71%, respectively. Although species richness declined slightly (Table 1), metrics were generally on par with previous years' data.

3.4 Main Basin Results and Discussion

Figure 3. Main Basin – Fall 2022 Eurasian watermilfoil Distribution

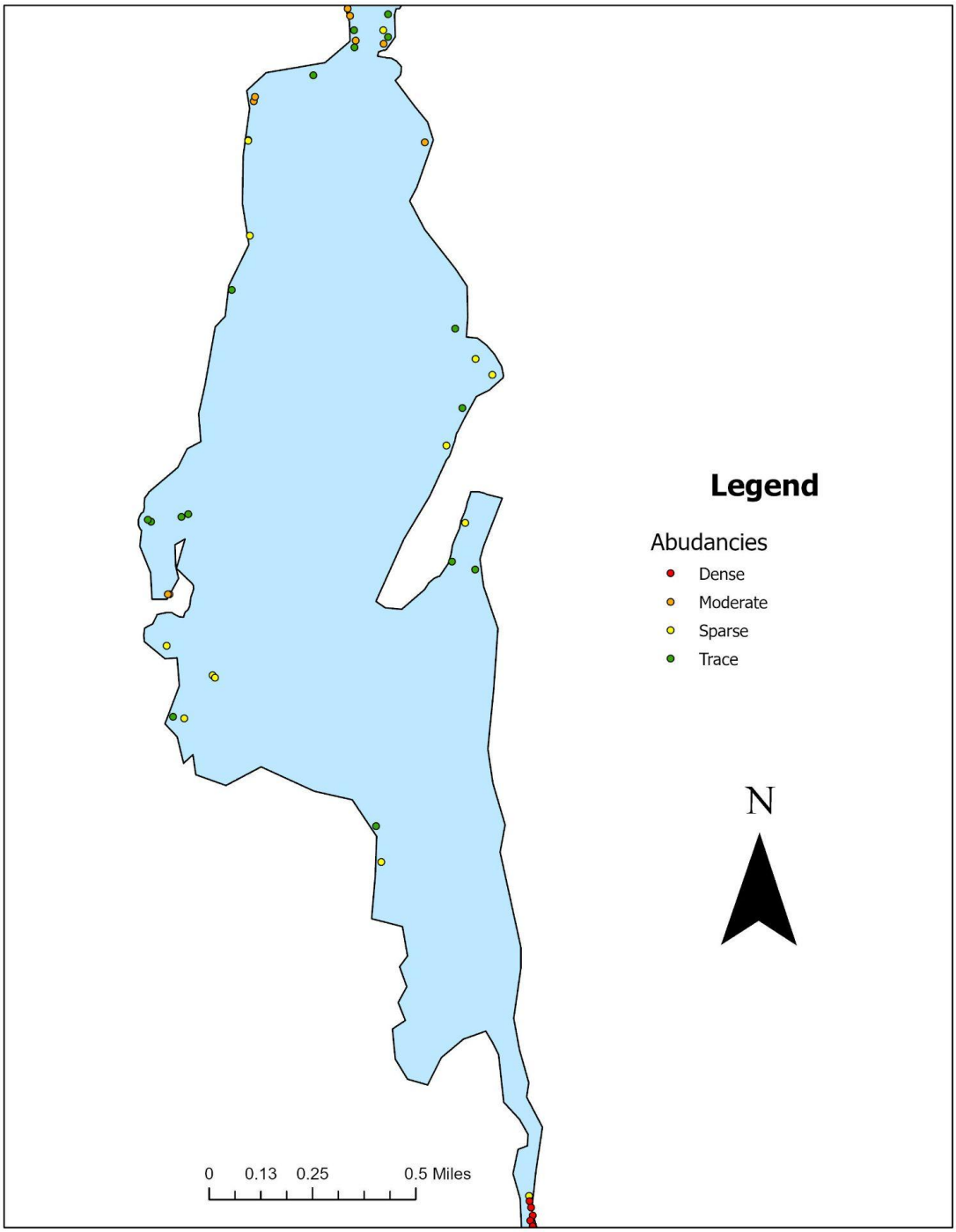


Table 4: Main Basin – Annual Species List and Frequency of Occurrence (%), 2001-2022

Macrophyte Species (Common Name / Scientific Name)	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Water marigold *Bidens beckii†*	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0
Watershield *Brasenia schreberi*	0	<1	<1	2	2	2	2	2	2	<1	<1	2	3	3	2	5	2	2	<1	0
Coontail *Ceratophyllum demersum*	11	11	6	7	11	10	8	14	6	11	2	5	3	5	5	6	2	<!	3	2
Spineless hornwort *Ceratophyllum echinatum*																	1	0	0	0
Muskgrass / Stonewort *Chara* sp. / *Nitella* sp.	2	17	62	57	21	22	19	2	<1	0	0	5	16	9	11	14	5	11	18	10
Spikerush *Eleocharis asicularia*																		<1	0	0
Common waterweed *Elodea canadensis*	28	0	0	<1	5	52	71	15	9	7	19	7	30	37	45	58	64	58	55	38
Quillwort *Isoetes* sp.	2	9	<1	6	2	5	0	0	<1	<1	0	0	2	0	<1	<1	0	<1	0	0
Common duckweed *Lemna minor*	2	0	0	0	0	<1	<1	0	0	0	0	0	<1	0	0	0	0	0	0	0
Eurasian watermilfoil *Myriophyllum spicatum*	98	65	15	36	77	59	44	28	50	47	66	56	39	34	46	62	15	21	33	19
Whorled watermilfoil *Myriophyllum verticillatum*																				0
Slender naiad *Najas flexilis*	19	0	12	57	50	34	22	25	20	12	6	6	16	2	28	25	24	29	20	8
Thread leaf naiad *Najas gracillima*																8	2	2	3	0

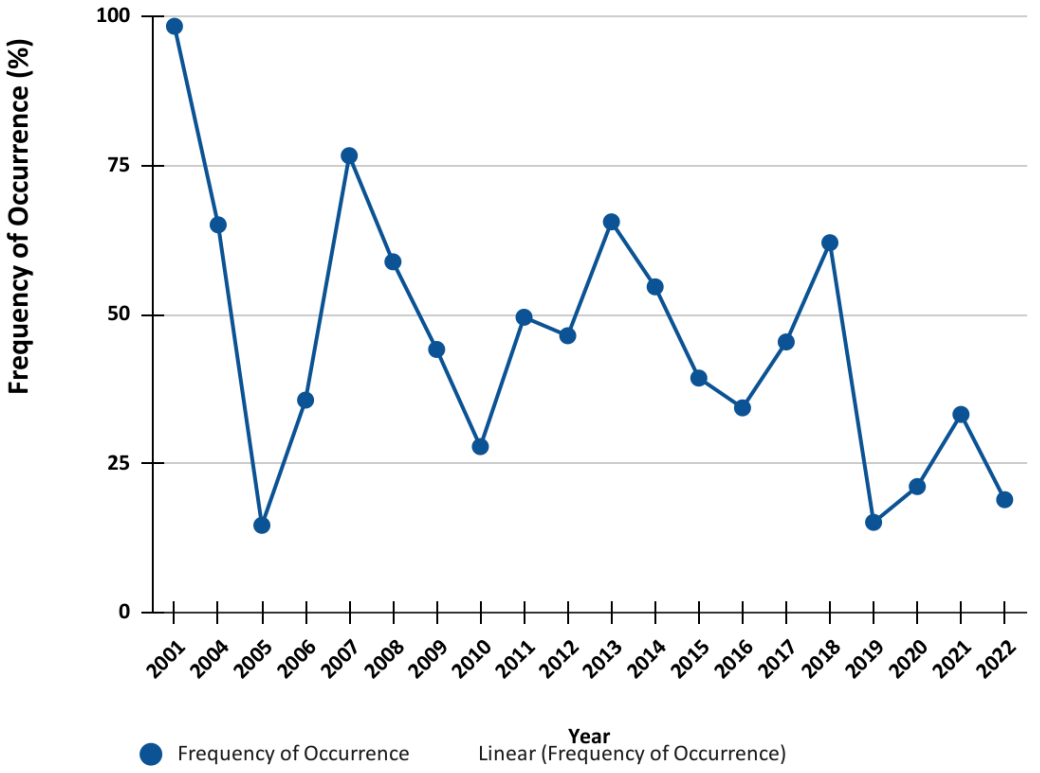
Table 4: Main Basin – Annual Species List and Frequency of Occurrence (%), 2001-2022

Macrophyte Species (Common Name / Scientific Name)	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Brittle naiad *Najas minor*																2	2	2	2	3
Yellow waterlily *Nuphar variegata*	<1	0	0	<1	<1	0	0	<1	<1	0	0	0	0	0	2	0	1	0	0	0
White waterlily *Nymphaea odorata*	3	2	2	3	3	3	3	2	2	2	<1	2	5	2	0	8	5	5	9	3
Largeleaf pondweed *Potamogeton amplifolius*	29	15	26	34	39	38	41	44	26	35	27	25	12	12	18	15	17	21	26	11
Berchtold's pondweed *Potamogeton berchtoldii*																	5	0	5	7
Curlyleaf pondweed *Potamogeton crispus*	2	0	9	5	2	<1	0	0	0	0	0	<1	0	0	<1	0	0	0	0	1
Ribbonleaf pondweed *Potamogeton epihydrus*	2	3	5	2	<1	4	<1	<1	<1	2	0	2	0	0	<1	4	5	<1	<1	0
Leafy pondweed *Potamogeton foliosus*																17	4	2	<1	0
Variable leaf pondweed *Potamogeton gramineus*	18	0	5	2	2	6	3	6	15	9	3	4	6	4	5	21	14	12	9	4
Illinois pondweed *Potamogeton illinoensis*	6	<1	<1	9	16	34	23	31	33	53	57	56	40	38	52	34	60	64	71	37
Whitestem pondweed *Potamogeton praelongus*																4	5	0	0	0
Thinleaf pondweed *Potamogeton pusillus*	0	0	0	5	12	6	5	12	12	5	4	0	14	2	0	17	0	29	30	9

Table 4: Main Basin – Annual Species List and Frequency of Occurrence (%), 2001-2022

Macrophyte Species (Common Name / Scientific Name)	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Robbins' pondweed *Potamogeton robbinsii*	31	65	82	62	67	58	78	73	58	67	66	61	49	47	44	58	57	58	57	46
Vasey's pondweed *Potamogeton vaseyi*																	8	0	5	0
Flatstem pondweed *Potamogeton zosteriformis*	24	2	31	42	28	19	19	23	30	20	20	32	10	4	10	23	11	14	19	11
White water crowfoot *Ranunculus aquatilis*																	2	<1	0	0
Arrowhead *Sagittaria sp.*																		<1	0	0
Sago pondweed *Stuckenia pectinata*																	3	<1	<1	0
Humped bladderwort *Utricularia gibba*																				0
Common bladderwort *Utricularia vulgaris*	<1	<1	<1	0	0	2	<1	3	0	<1	0	<1	<1	<1	2	2	3	2	2	2
Tapegrass *Vallisneria americana*	14	3	<1	3	9	9	13	13	10	9	15	14	23	20	19	31	33	33	39	16
Water stargrass *Zosterella dubia*		<3	5	12	28	22	8	9	5	2	2	13	13	24	21	32	42	47	57	18

Chart 3. Main Basin Annual Eurasian watermilfoil Frequency of Occurrence



Overall decreases in species richness (Table 1) and species FOO (Table 4) were observed in the Main Basin. Specific species decreases in FOO occurred in Common waterweed (17%), Eurasian watermilfoil (14%), Slender naiad (12%), Largeleaf pondweed (15%), Illinois pondweed (34%), Thinleaf pondweed (21%), Robbins' pondweed (11%), Tapegrass (23%), and Water stargrass (39%). All other increases and decreases in FOO were minor fluctuations. Robbins' pondweed was the most abundant species at 46% FOO followed by Common waterweed (38%) and Illinois pondweed (37%). Overall trends are in line with the historical dataset and are not outliers (Table 4).

Minor regrowth of Eurasian watermilfoil was observed in Horseshoe Bay during the interim survey and fall comprehensive survey despite the overall decrease in abundance (Chart 3). In addition to point-intercept survey locations, Eurasian watermilfoil was also documented by GPS and is reflected in Map 1.

3.5 Little Lake Results and Discussion

Figure 4. Little Lake – Fall 2022 Eurasian watermilfoil Distribution

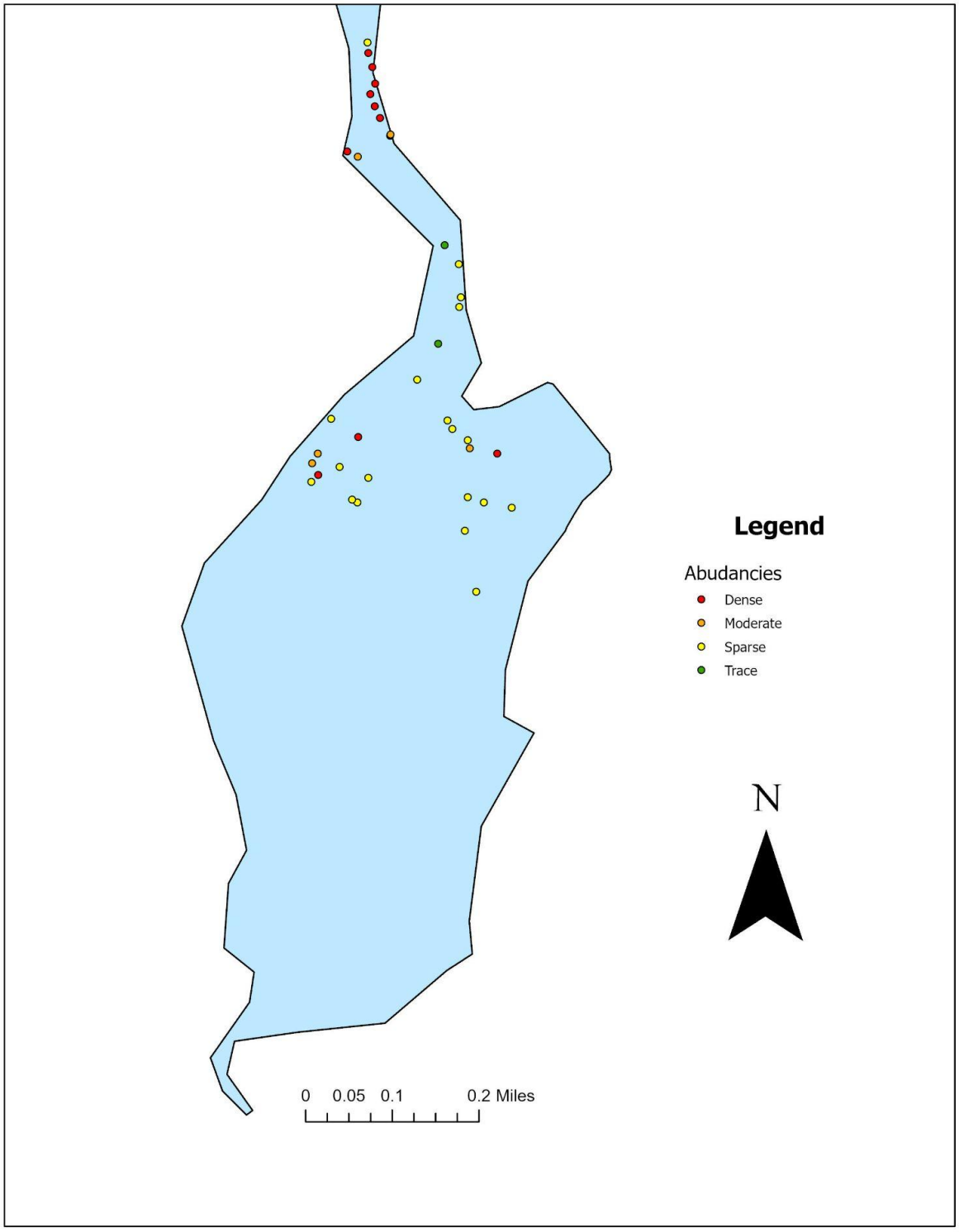


Table 5: Little Lake – Annual Species List and Frequency of Occurrence (%), 2001-2022

Macrophyte Species (Common Name / Scientific Name)	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Water marigold *Bidens beckii*	7	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Watershield *Brasenia schreberi*	14	30	30	23	26	21	14	12	14	12	14	12	2	2	5	7	21	7	0	2
Muskgrass / Stonewort *Chara sp. / Nitella sp.*	7	5	7	12	0	0	2	0	5	2	0	0	2	0	0	12	0	2	12	7
Coontail *Ceratophyllum demersum*	21	0	2	9	16	7	9	16	28	28	28	35	23	14	44	40	30	14	14	0
Spinless hornwort *Ceratophyllum echinatum*																	2	0	2	0
Spikerush *Eleocharis sp.*	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0
Common waterweed *Elodea canadensis*	47	5	0	0	2	23	40	47	21	28	40	26	28	28	74	54	74	51	47	51
Quillwort *Isoetes sp.*	0	0	5	2	0	0	2	0	0	2	0	0	0	0	0	0	0	2	0	0
Eurasian watermilfoil *Myriophyllum spicatum*	88	0	16	40	88	77	32	81	44	77	74	72	86	74	88	88	100	98	28	12
Whorled watermilfoil *Myriophyllum verticillatum*													4	0	5	0	0	2	0	0
Slender naiad *Najas flexilis*	40	0	0	5	2	0	5	0	5	0	2	14	0	2	7	9	5	14	16	0
Thread leaf naiad *Najas gracillima*																				0

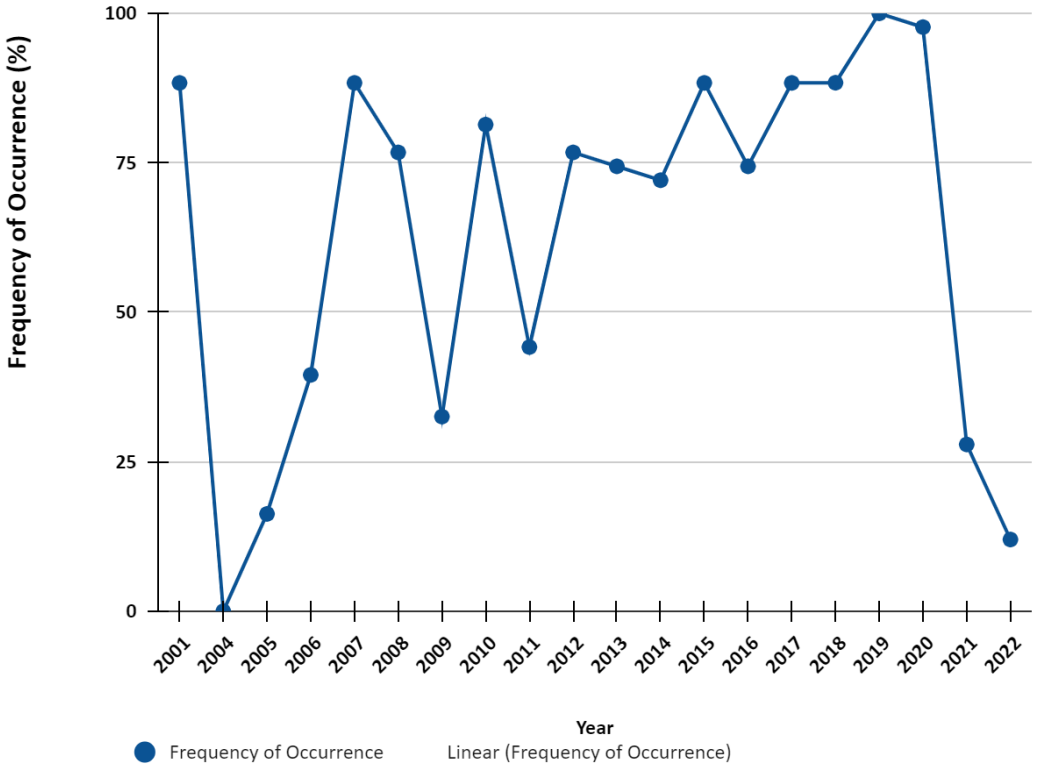
Table 5: Little Lake – Annual Species List and Frequency of Occurrence (%), 2001-2022

Macrophyte Species (Common Name / Scientific Name)	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Yellow waterlily *Nuphar variegata*	9	14	12	7	7	2	7	2	5	2	2	0	7	5	5	9	5	7	7	7
White waterlily *Nymphaea odorata*	30	9	26	30	28	10	19	19	23	32	30	37	27	12	42	44	44	40	47	40
Largeleaf pondweed *Potamogeton amplifolius*	44	72	70	77	74	77	56	72	28	30	21	23	14	28	12	26	28	35	32	9
Berchtold's pondweed *Potamogeton berchtoldii*																	2	0	0	2
Curlyleaf pondweed *Potamogeton crispus*	0	0	0	2	0	0	0	0	0	2	0	0	0	0	2	0	0	7	2	0
Ribbonleaf pondweed *Potamogeton epihydrus*	0	12	14	7	7	7	0	0	2	9	2	2	2	2	5	21	19	28	14	0
Leafy Pondweed *Potamogeton foliosus*																		2	2	0
Variable leaf pondweed *Potamogeton gramineus*	42	5	9	23	0	0	5	0	5	5	2	0	0	0	2	0	0	0	7	0
Illinois pondweed *Potamogeton illinoensis*	0	0	0	9	33	47	49	36	62	61	61	65	71	72	51	61	58	63	65	40
Floating leaf pondweed *Potamogeton natans*																				0
Whitestem pondweed *Potamogeton praelongus*																	5	0	0	0
Thinleaf pondweed *Potamogeton pusillus*	0	0	0	2	7	2	0	0	0	0	0	0	2	0	0	0	0	5	5	2

Table 5: Little Lake – Annual Species List and Frequency of Occurrence (%), 2001-2022

Macrophyte Species (Common Name / Scientific Name)	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Robbins' pondweed *Potamogeton robbinsii*	88	100	100	100	100	88	95	81	86	91	93	95	73	86	86	81	86	95	84	81
Flatstem pondweed *Potamogeton zosteriformi*	23	2	5	5	7	5	7	9	9	14	28	33	11	19	19	30	30	28	37	0
White water crowfoot *Ranunculus aquatilis*															2	0	0	0	0	0
Arrowhead *Sagittaria sp.*																				0
Sago Pondweed *Stuckenia pectinata*																		2	2	0
Humped bladderwort *Utricularia gibba*	7	0	2	0	5	2	14	5	0	0	0	0	2	7	16	21	9	21	14	19
Flat leaf bladderwort *Utricularia intermedia*																12	5	7	7	5
Purple bladderwort *Utricularia purpurea*																26	0	0	0	0
Floating Bladderwort *Utricularia radiata*																				2
Common bladderwort *Utricularia vulgaris*	16	19	7	12	30	19	35	26	5	2	9	14	14	0	11	14	14	28	16	9
Tapegrass *Vallisneria americana*	72	26	7	9	14	9	26	26	35	40	40	44	50	35	0	58	54	56	58	28
Water stargrass *Zosterella dubia*	2	2	5	0	7	2	5	5	2	5	14	2	9	9	9	42	14	23	26	0

Chart 4. Little Lake Annual Eurasian watermilfoil Frequency of Occurrence



Overall decreases in species richness (Table 1) and species FOO (Table 5) were observed in Little Lake. Decreases in FOO occurred in Coontail (14%), Eurasian watermilfoil (16%), Slender naiad (16%), Largeleaf pondweed (23%), Ribbonleaf pondweed (14%), Illinois pondweed (25%), Tapegrass (30%), and Water stargrass (26%). Although Coontail decreased, 2021 data reflected six locations outside of the 2022 treatment areas with only trace abundance. Some of these locations were inaccessible in 2022 due to dense White waterlily growth and regrowth. Thus, it is possible Coontail is still present in Little Lake and was not captured during the fall comprehensive survey. Because these locations were far outside the treatment area, it is unlikely the decrease was directly caused by treatment.

The most abundant species were Robbins' pondweed (81%), Common waterweed (51%), Illinois pondweed (40%), and White waterlily (40%). These values are in line with historical dataset trends. All other increases and decreases in species FOO were minor.

No treatment area regrowth was observed during the interim survey and fall comprehensive survey reflected in the overall decrease in abundance (Chart 4). Minor injury to White waterlily was observed inside and outside the treatment area during the interim survey, though the species remained one of the most abundant during the fall comprehensive survey.

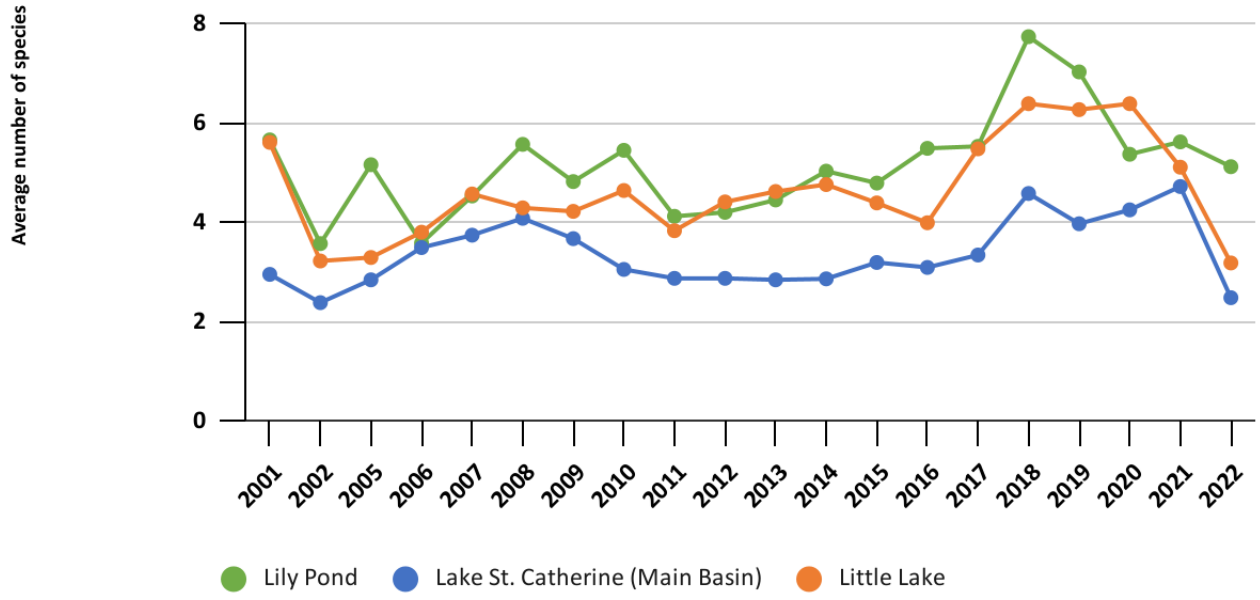
3.6 Species Richness

Species richness declined in the Main Basin, Little Lake, and Lily Pond (Chart 5). This may be due to natural competition, as increases in certain species were observed. Additionally, weather conditions could have impacted visibility. As previously mentioned, survey methods only capture macrophytes at the exact coordinate of the sample point. Thus, additional plants may be unaccounted for.

Although species richness declined in basins containing treatment areas, Lily Pond - an untreated basin - also saw a decline. If treatment impacted species richness, it would be expected that decreases would only be observed in basins that were treated. Further, many species on the annual species list had low FOO% values in 2021 which returned minor decreases in 2022 despite complete absence.

Monitoring should continue through the 2023 season to assess further changes in species richness.

Chart 5. Species richness by basin



4 SUMMARY OF 2021 AQUATIC VEGETATION MANAGEMENT PROGRAM

4.1 ProcellaCOR Herbicide Treatment

Results of the 2022 ProcellaCOR herbicide treatment program at Lake St. Catherine were favorable with little Eurasian watermilfoil regrowth observed in the treatment areas in the Main Basin and none observed in Little Lake. Approximately one-month after treatment, there was little Eurasian watermilfoil growth found in Little Lake and only one stem found in the Main Basin treatment areas. Partial or temporary Eurasian watermilfoil control was seen outside of the treatment areas, but Eurasian watermilfoil plants recovered by the time the late season survey was performed.

Species richness and frequency of occurrence indices have fluctuated within each basin over time. However, no major susceptible plant composition changes were observed as a result of this year's ProcellaCOR treatment; trends will continue to be monitored through future management years.

4.2 Spread Prevention and Non-Chemical Control Activities

As required by the ANC Permit, non-chemical milfoil control activities continued at Lake St. Catherine during the 2021 season. Efforts included volunteer monitoring, boat ramp greeter program, diver assisted suction harvesting and other educational efforts. Details of the non-chemical control efforts will be provided by LSCA under separate cover.

5 RECOMMENDATIONS FOR 2023 SEASON

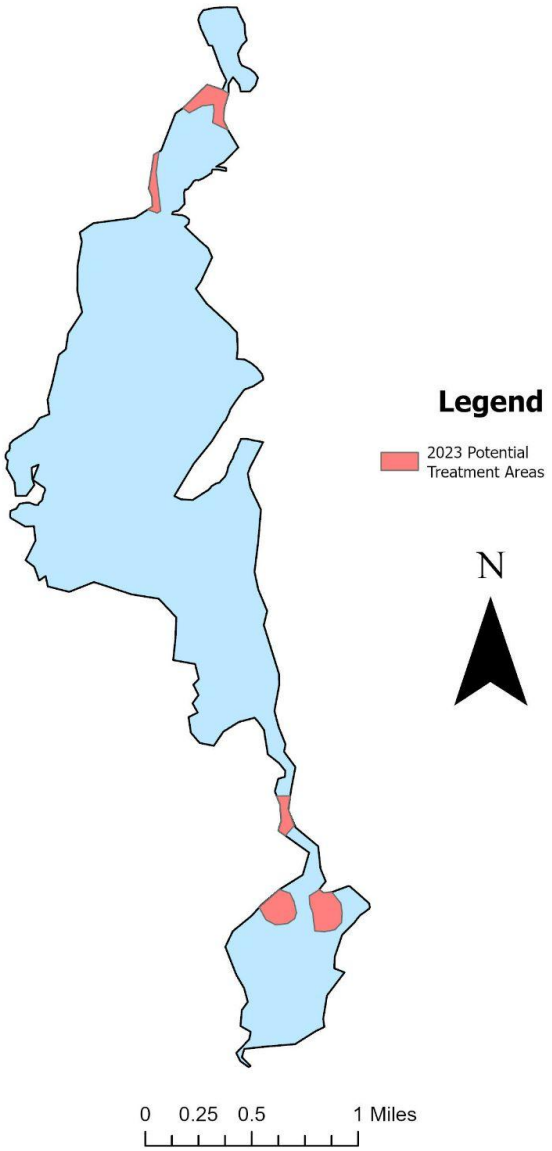
Continuation of an integrated management program utilizing the combination of DASH and spot-treatment with ProcellaCOR herbicide is recommended for the 2023 season. It continues to appear that the duration of Eurasian watermilfoil control following prior ProcellaCOR treatments at Lake St. Catherine is lasting 2-3 years. As Eurasian watermilfoil distribution and density continues to decrease, the size of spot-treatment areas will decrease. Thus, application rates of ProcellaCOR™ EC will likely need to be increased to help overcome the effects of dilution. Alternatively, electing for larger treatment areas requires less product. Overall, there is less regrowth and abundance of Eurasian watermilfoil with the use of ProcellaCOR™ EC versus past products. The focus of the program lies heavily on DASH with treatment as a necessary but supplementary management component.

We will continue to work closely with Lake St. Catherine Association and SePRO, the manufacturer of ProcellaCOR™ EC, to further refine treatment protocols in effort to maximize the duration of control and reduce the frequency and scope of maintenance treatments.

Potential treatment areas will be inspected in the early spring and treatment areas will be finalized in coordination with the LSCA and VT DEC prior to finalizing the 2023 management program. This time frame allows for more accurate estimations, based on distribution and density of Eurasian watermilfoil, of acreage that could be effectively managed by treatment versus DASH.

Based on the distribution and density of Eurasian watermilfoil observed during the late season survey, SŌLitude expects that spot-treatment areas may be warranted in the following areas:

Figure 5. Preliminary 2023 Spot-Treatment Areas



SŌLitude Lake Management thanks Lake St. Catherine Association for their continued partnership and looks forward to working with them in the 2023 season.

APPENDIX A

SePro FasTEST Sampling Results
Laboratory Results

SePRO Research & Technology Campus FasTEST*

16013 Watson Seed Farm Road, Whitakers, NC 27891

Chain of Custody: COC12795 **LABORATORY REPORT**

Customer Company **Customer Contact**

Company Name SOLitude Lake Management	Contact Person: Emily Vulgamore
Address: 1320 Brookwood Drive, Ste. H Little Rock, AR 72202	E-mail Address: emily.vulgamore@solitudelake.com
	Phone: 508.885.0101

Waterbody Information

Waterbody:	Lake St. Catherine - VT
Waterbody size:	1100
Depth Average:	25

Sample ID	Sample Location	Test	Method	Results	Sampling Date / Time
CTM35932-1	1	ProcellaCOR/florpyrauxifen-benzyl (ug/L)	FAST 16	<1	06/22/2022
		ProcellaCOR acid/florpyrauxifen (ug/L)	FAST 16	<1	
CTM35933-1	2	ProcellaCOR/florpyrauxifen-benzyl (ug/L)	FAST 16	<1	06/22/2022
		ProcellaCOR acid/florpyrauxifen (ug/L)	FAST 16	<1	
CTM35934-1	3	ProcellaCOR/florpyrauxifen-benzyl (ug/L)	FAST 16	<1	06/22/2022
		ProcellaCOR acid/florpyrauxifen (ug/L)	FAST 16	1.5	
CTM35935-1	4	ProcellaCOR/florpyrauxifen-benzyl (ug/L)	FAST 16	<1	06/22/2022
		ProcellaCOR acid/florpyrauxifen (ug/L)	FAST 16	<1	

ANALYSIS STATEMENTS:
SAMPLE RECEIPT /HOLDING TIMES: All samples arrived in an acceptable condition and were analyzed within prescribed holding times in accordance with the SRTC Laboratory Sample Receipt Policy unless otherwise noted in the report.
PRESERVATION: Samples requiring preservation were verified prior to sample analysis and any qualifiers will be noted
in the report.
QA/QC CRITERIA: All analyses met method criteria, except as noted in the report with data qualifiers.
COMMENTS: No significant observations were made unless noted in the report.
MEASUREMENT UNCERTAINTY: Uncertainty of measurement has been determined and is available upon request.

Laboratory Information
Date / Time Received: 06/23/22 11:30 AM
Date Results Sent: Monday, June 27, 2022

This entire report was reviewed and approved for release.

Reviewed By: Laboratory Supervisor

APPENDIX B

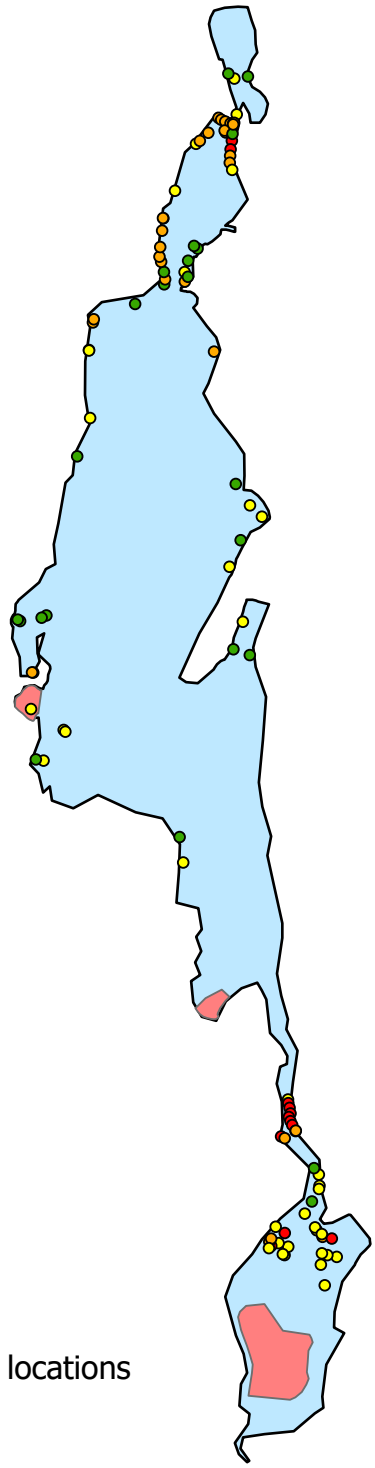
Comprehensive Aquatic Vegetation Survey Information

Fall 2022 Eurasian watermilfoil Distribution Map

Fall 2022 Comprehensive Survey Native Vegetation Maps

MAP 1: Fall 2022 Eurasian Watermilfoil Distribution

SOLITUDE LAKE MANAGEMENT
888.480.5253
solitudelakemanagement.com



Legend

Abudancies

- Dense (12)
- Moderate (23)
- Sparse (27)
- Trace (10)
- 2022 Treatment Areas (3)

Note: values indicate number of locations

Lake St. Catherine
Poultney and Wells, Vermont
Rutland County

Lake St. Catherine

0 1,250 2,500 5,000 Feet

1:41,529

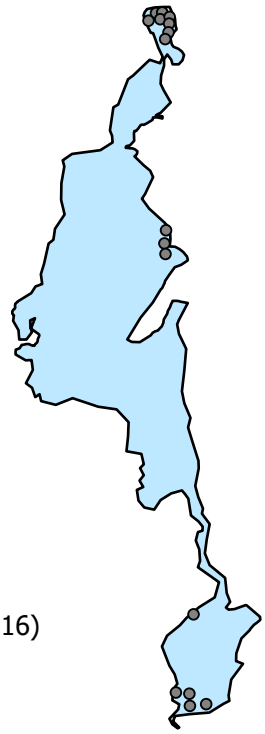
N

Survey Date: September 20-22, 2022
Map Date: November 1, 2022
Prepared by: E. Vulgamore
Office: Shrewsbury, Massachusetts

MAP 2: Fall 2022 Native Vegetation

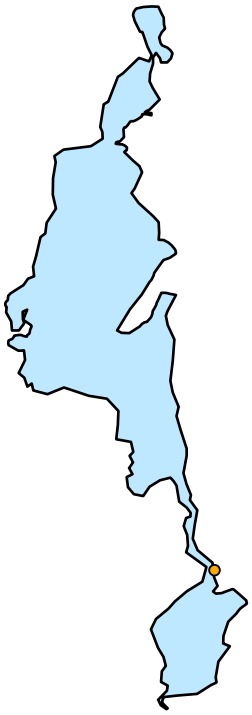
SOLITUDE LAKE MANAGEMENT
888.480.5253
solitudelakemanagement.com

Benthic Filamentous Algae



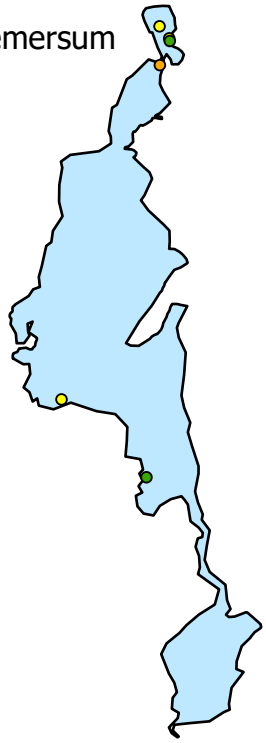
Abundance
- Present (16)

Brasenia schreberi



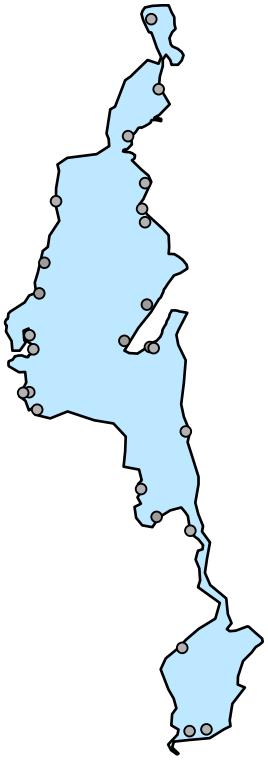
Abundance
- Moderate (1)

Ceratophyllum demersum



Abundancies
- Moderate (1)
- Sparse (3)
- Trace (2)

Chara/Nitella Macro-algae



Abundance
- Present (25)

Lake St. Catherine
Poultney and Wells, Vermont
Rutland County

Lake St. Catherine

0 4,000 8,000 Feet

N

Survey Date: September 20-22, 2022
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Prepared by: E. Vulgamore
Office: Shrewsbury, Massachusetts

MAP 3: Fall 2022 Native Vegetation

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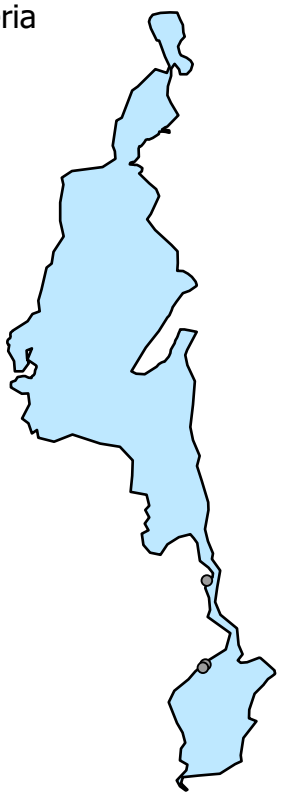
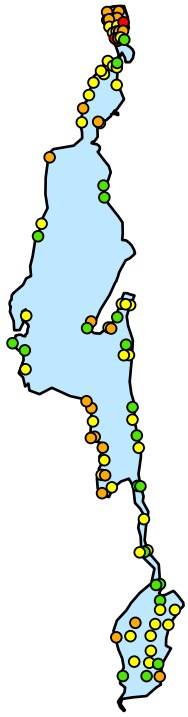
Cyanobacteria



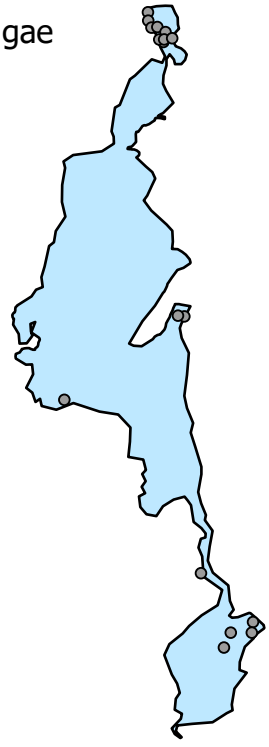
Abundance
- Present (3)

Elodea spp.



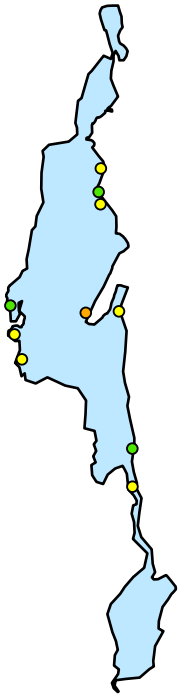
Abundance
- Dense (3)
- Moderate (24)
- Sparse (42)
- Trace (21)

Filamentous Algae



Abundance
- Present (17)

Najas flexilis



Abundancies
- Moderate
- Sparse
- Trace

Lake St. Catherine
Poultney and Wells, Vermont
Rutland County

Lake St. Catherine

0 4,000 8,000 Feet

N

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MAP 4: Fall 2022 Native Vegetation

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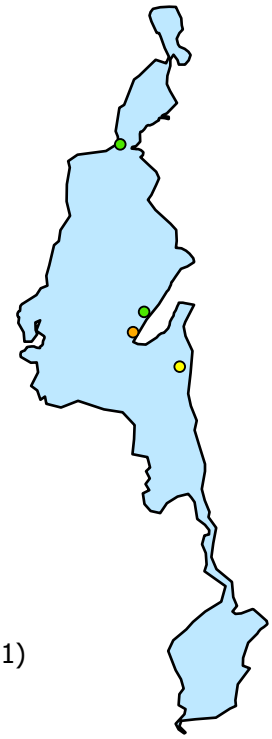
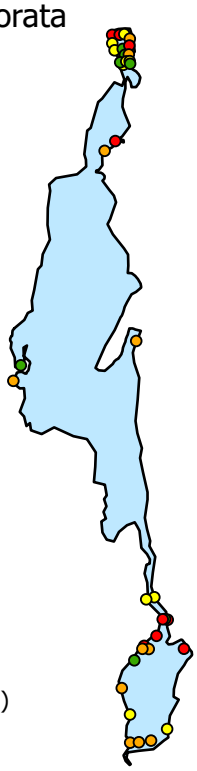
Najas minor



Abundancies
- Moderate (1)
- Sparse (1)
- Trace (2)

Nymphaea odorata

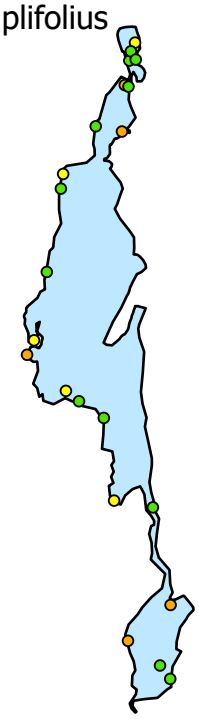


Abundancies
- Dense (9)
- Moderate (11)
- Sparse (10)
- Trace (7)

Nuphar variegata

Abundancies
- Moderate (5)
- Sparse (5)
- Trace (12)

Potamogeton amplifolius



Abundancies
- Moderate (5)
- Sparse (5)
- Trace (12)

Lake St. Catherine
Poultney and Wells, Vermont
Rutland County

Lake St. Catherine

0 4,000 8,000 Feet

N

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MAP 5: Fall 2022 Native Vegetation

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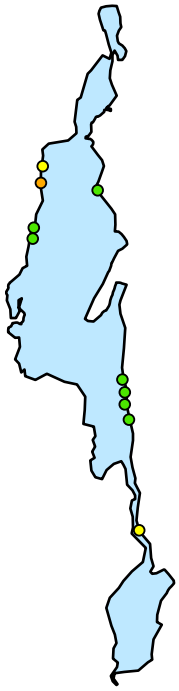
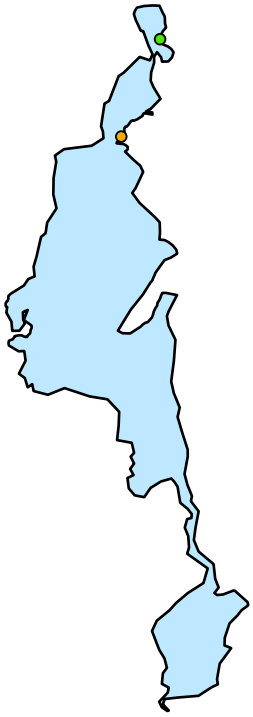
Potamogeton pusillus var berchtoldii



Abundancies
- Moderate (1)
- Sparse (2)
- Trace (7)

Potamogeton crispus

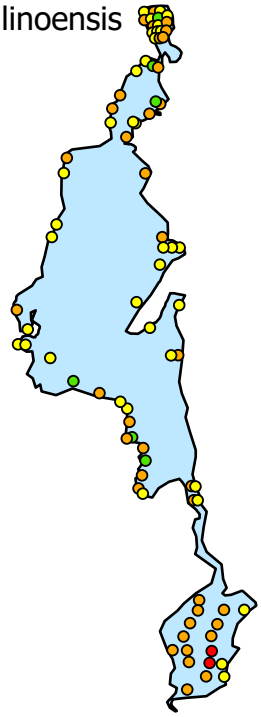


Abundancies
- Moderate (1)
- Trace (1)

Potamogeton gramineus

Abundancies
- Moderate (1)
- Sparse (3)
- Trace (1)

Potamogeton illinoensis



Abundancies
- Dense (2)
- Moderate (38)
- Sparse (37)
- Trace (6)

Lake St. Catherine
Poultney and Wells, Vermont
Rutland County

Lake St. Catherine

0 4,500 9,000 Feet

N

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MAP 6: Fall 2022 Native Vegetation

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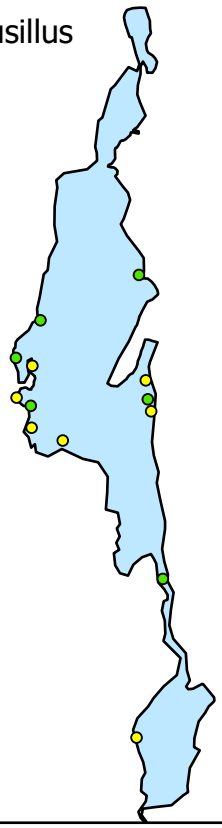
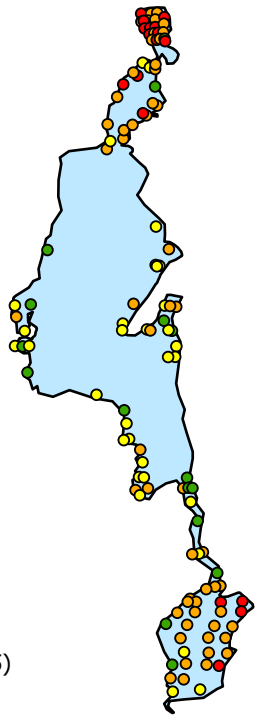
Potamogeton pusillus



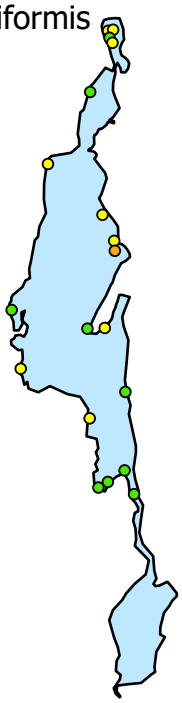
Abundancies
- Sparse (7)
- Trace (6)

Potamogeton robbinsii



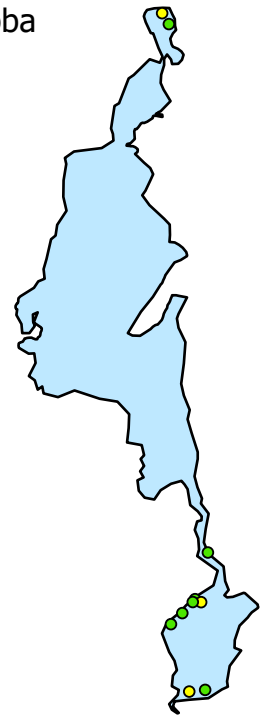
PROB
- Dense (17)
- Moderate (55)
- Sparse (31)
- Trace (17)

Potamogeton zosteriformis



Abundancies
- Moderate (1)
- Sparse (9)
- Trace (9)

Utricularia gibba



Abundancies
- Sparse (3)
- Trace (7)

Lake St. Catherine
Poultney and Wells, Vermont
Rutland County

Lake St. Catherine

0 3,750 7,500 Feet

N

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MAP 7: Fall 2022 Native Vegetation

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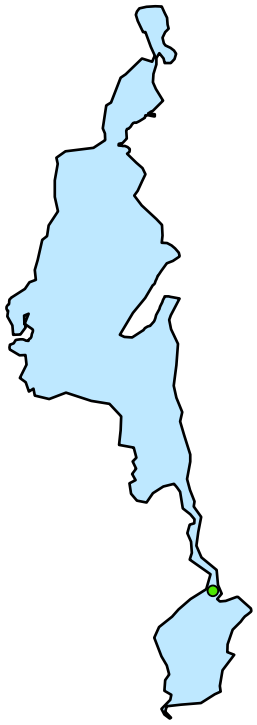
Utricularia intermedia

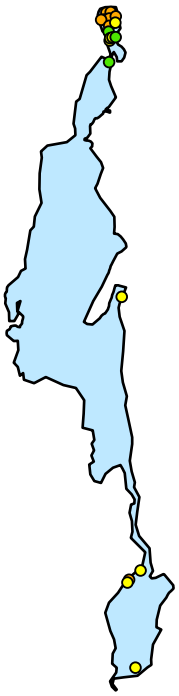
Abundancies
- Sparse (2)

Utricularia radiata



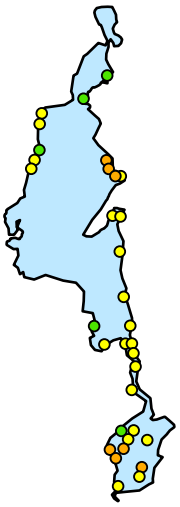
Abundancies
- Trace (1)

Utricularia vulgaris



Abundancies
- Moderate (8)
- Sparse (8)
- Trace (3)

Vallisneria americana



Abundancies
- Moderate (7)
- Sparse (21)
- Trace (5)

Lake St. Catherine
Poultney and Wells, Vermont
Rutland County

Lake St. Catherine

0 4,500 9,000 Feet

N

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MAP 8: Fall 2022 Native Vegetation

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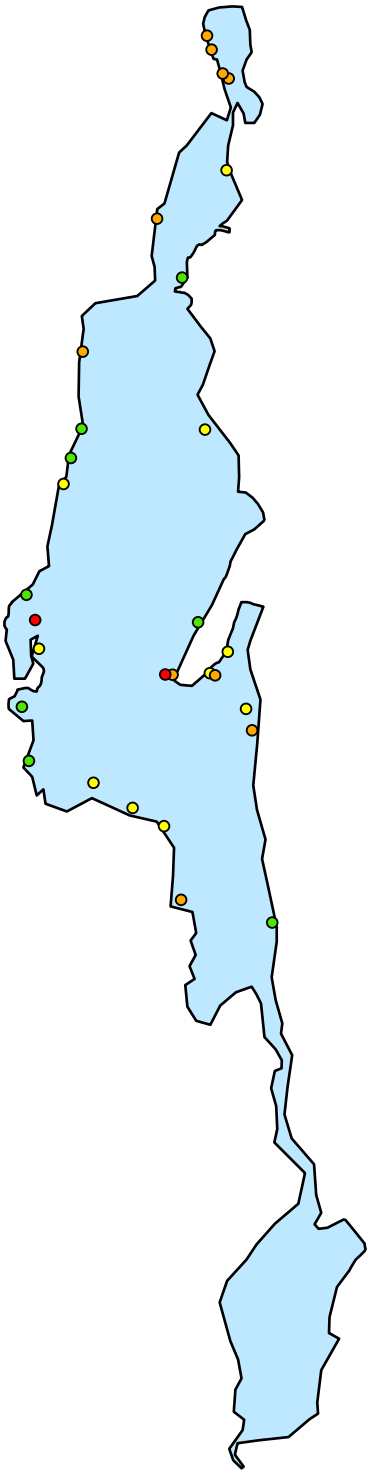
Zosterella dubia



Abundancies

- Dense (2)
- Moderate (10)
- Sparse (10)
- Trace (8)

Lake St. Catherine
Poultney and Wells, Vermont
Rutland County

Lake St. Catherine

0 4,000 8,000 Feet

N

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