



Native Aquatic Plants Dominated by Claspingleaf Pondweed in Spring Lake, August 16, 2023

Aquatic Plant Point Intercept Surveys for Spring Lake, Scott Co, Minnesota, 2023

Summer Point Intercept Plant Surveys:
June 6 and August 16 and 19, 2023

Prepared for:
Spring Lake Association
Prior Lake, Minnesota



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Aquatic Plant Point Intercept Surveys for Spring Lake, Scott Co, Minnesota, 2023

Summary

Two aquatic plant point intercept surveys were conducted on Spring Lake in 2023.

June 6, 2023 Point Intercept Survey Results: An early summer aquatic plant point intercept survey on a 50-meter grid was conducted on June 6, 2023 in Spring Lake. Aquatic plant growth was light to heavy and 10 submerged plant species were found growing to a depth of 11 feet. A total of 319 sites were sampled to a water depth of 11 feet. The number of species per site ranged from 0-4 with an average of 0.9 native species per point. Overall plant coverage in Spring Lake was 21% in the June 2023 survey (Figure 1).

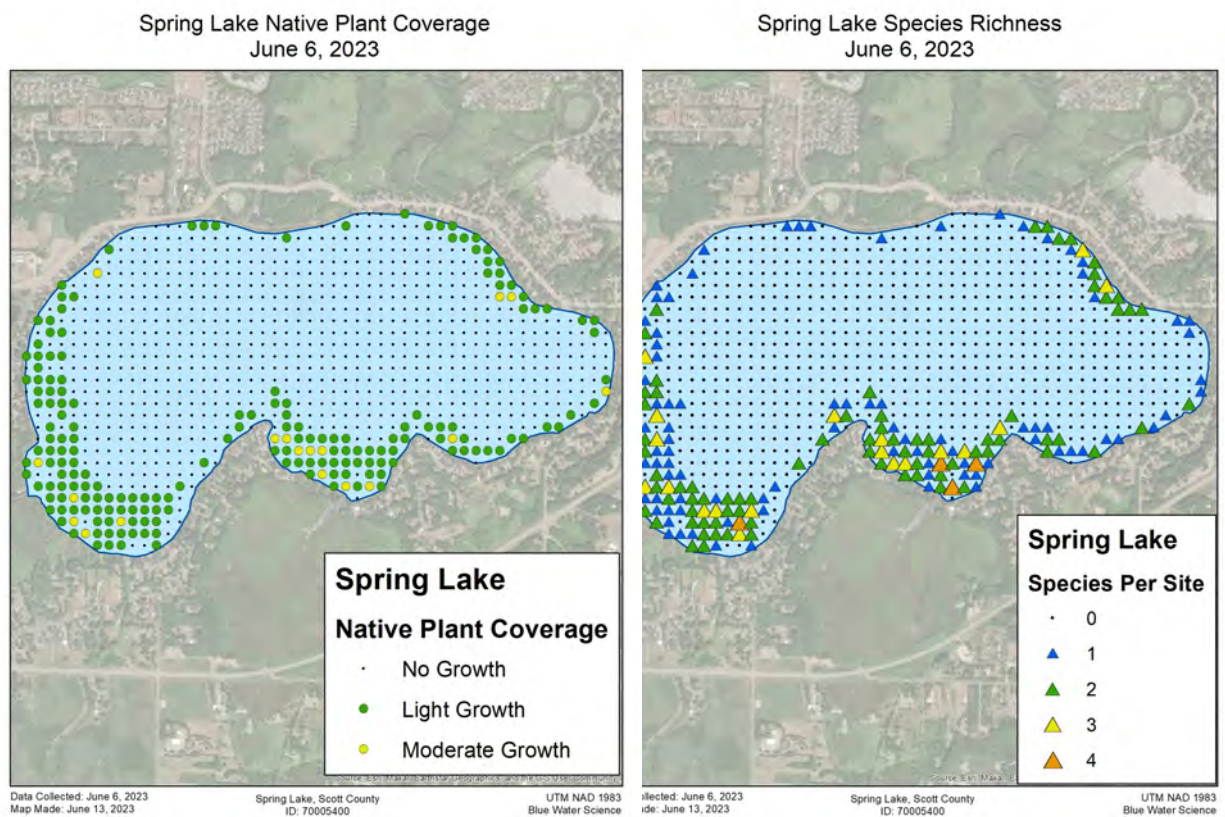


Figure 1. [left] Native plant coverage map showing all native plant growth and [right] species richness maps showing the number of species per site on June 6, 2023.

Claspingleaf pondweed and stringy pondweed were the dominant aquatic plants found at 94 and 92 sites respectively (29% each) and coontail was the third most common aquatic plant found at 50 sites (16%)(Figure 2). The non-native curlyleaf pondweed was found at 31 sites (10% occurrence) and no Eurasian watermilfoil was observed. The 12 aquatic plant species found in this survey represent good diversity for Spring Lake in summer.

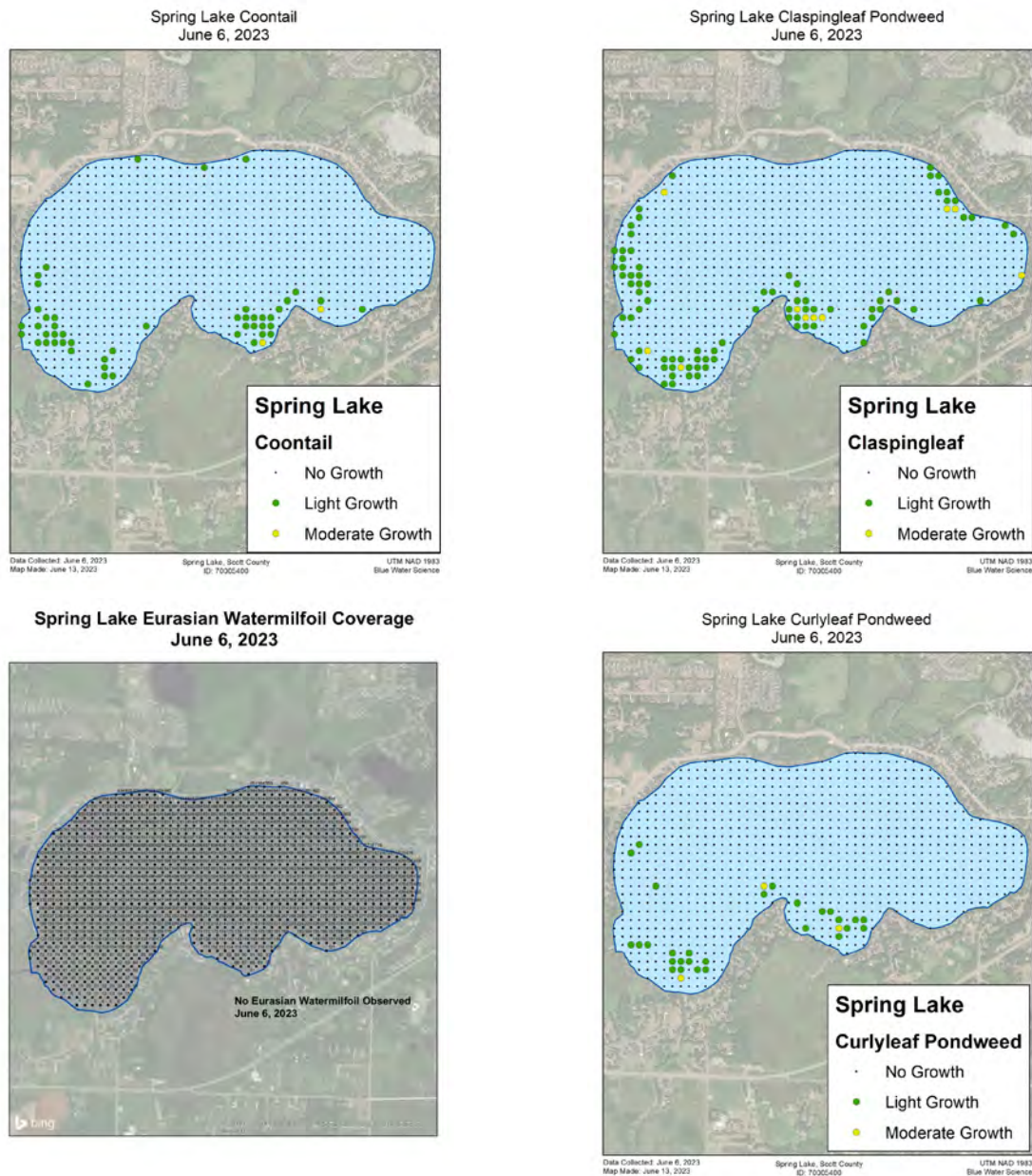


Figure 2. Growth and distribution of coontail (top-left), claspingleaf [top-right], EWM [bottom-left], and CLP [bottom-right]. Key: green = light growth, yellow = moderate growth, and black dot = no growth.

August 16 and 19, 2023 Point Intercept Survey Results: A late summer aquatic plant point intercept survey on a 50-meter grid was conducted on August 16 and 19, 2023 in Spring Lake. Aquatic plant growth was light to heavy and 17 submerged plant species were found growing to a depth of 12 feet. A total of 381 sites were sampled out to a depth of 12 feet. The number of species per site ranged from 0-6 with an average of 1.7 native species per point. Overall plant coverage in Spring Lake was 31% in the August 2023 survey (Figure 3).

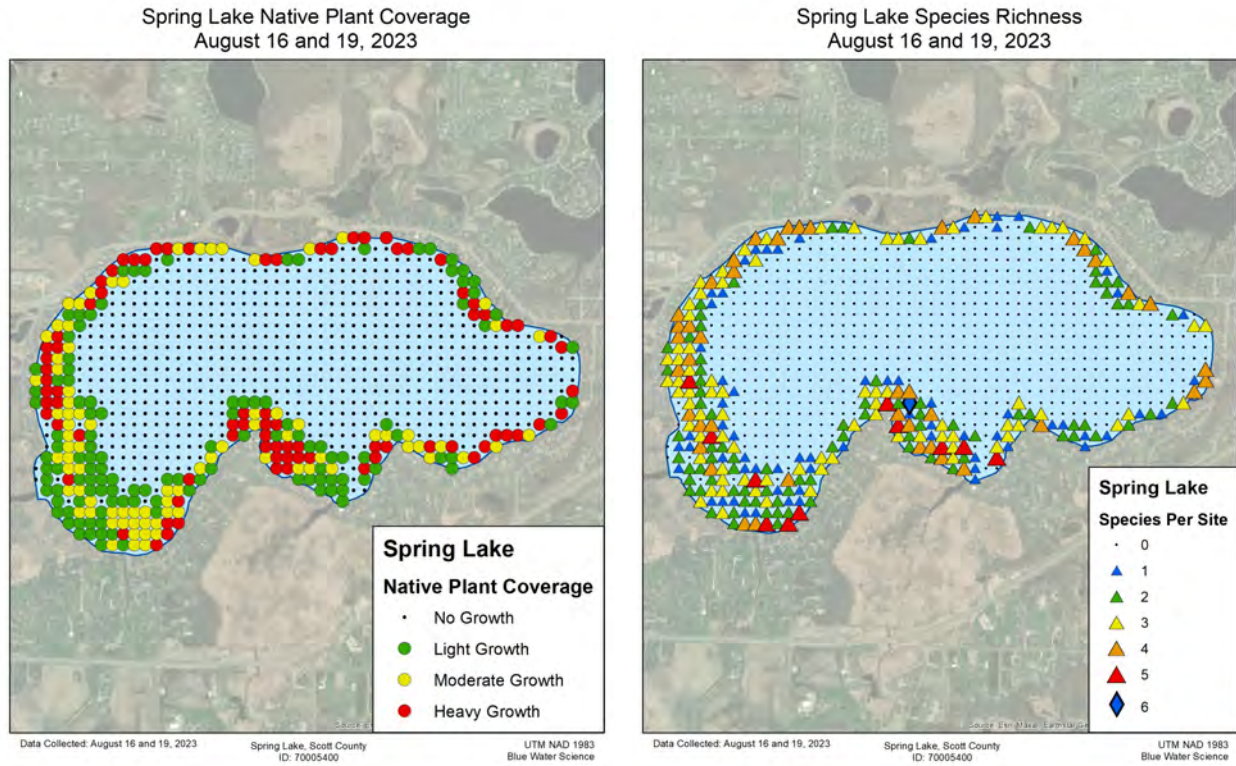


Figure 3. [left] Native plant coverage map showing all native plant growth and [right] species richness maps showing the number of species per site on August 16 and 19, 2023.

Claspingleaf pondweed was the dominant aquatic plants found at 189 sites (50%) and water celery was the third most common aquatic plant found at 142 sites (37%)(Figure 4). Curlyleaf pondweed was observed at 8 sites and Eurasian watermilfoil was found at 5 sites. The 17 submerged aquatic plant species found in this survey represent good diversity for Spring Lake in summer.

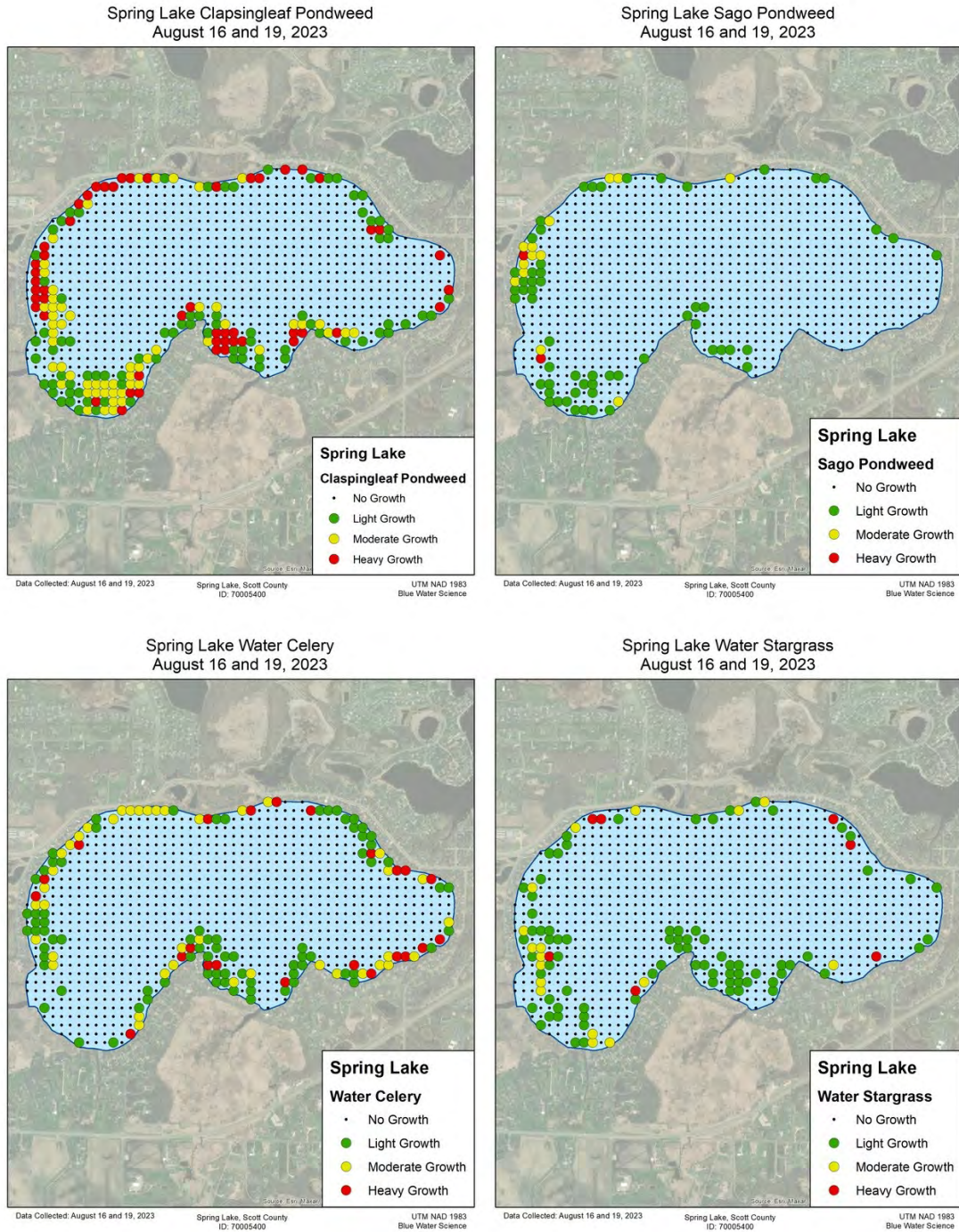


Figure 4. Growth and distribution of (top-left) claspingleaf, [top-right] sago pondweed, [bottom-left] water celery, and [bottom-right] water stargrass. Key: green = light growth, yellow = moderate growth, red = heavy growth, and black dot = no growth.

Comparison of 2015, and 2018- 2023 Point Intercept Surveys: Point intercept surveys were conducted on Spring Lake in 2015 and 2018 through 2023 and results are shown in Table 1. In 2015, elodea was the dominant plant but since then coontail has been dominant (Table 1). Several species increased in occurrence over the last few years including claspingleaf pondweed, water celery, and chara. Elodea and stringy pondweed have decreased (Table 1).

Table 1. Spring Lake aquatic plant occurrence for the point intercept surveys conducted in 2015 and 2018 through 2023. Number of sites is based on depth of maximum plant growth.

	2015 July 30 % Occur (113 sites)	2018 Aug 20 % Occur (248 sites)	2019 Aug 30 % Occur (214 sites)	2020 Aug 14 % Occur (298 sites)	2021 July 12 % Occur (377 Sites)	2022 Aug 1 & 2 % Occur (344 Sites)	2023 June 6 % Occur (319 Sites)	2023 Aug 16 & 19 % Occur (381 Sites)
Cattails (<i>Typha sp</i>)		1		1	1		1	
Watershield (<i>Brasenia Schreberi</i>)					1			
Duckweed (<i>Lemna sp</i>)		1		1				
White water lilies (<i>Nymphaea ordata</i>)		1	5	2	1		1	1
Coontail (<i>Ceratophyllum demersum</i>)	15	56	47	51	52	49	16	18
Chara (<i>Chara sp</i>)	4	2	2	1	14	12	7	12
Chara - 2 (<i>Chara sp</i>)		1						
Moss (<i>Drepanocladus sp</i>)		1	2	1		0.3		1
Elodea (<i>Elodea canadensis</i>)	42	36	3	5	6	3		1
Water stargrass (<i>Heteranthera dubia</i>)	5	12	10	19	21	11	5	27
Bearded stonewort (<i>Lychnothamnus barbatus</i>)								1
Northern watermilfoil (<i>Myriophyllum sibiricum</i>)				1	2	0.3		3
Eurasian watermilfoil (<i>M. spicatum</i>)					1	1		1
Naiads (<i>Najas flexilis</i>)	21	23	9	39	22	15		11
Nitella (<i>Nitella sp</i>)								1
Curlyleaf pondweed (<i>Potamogeton crispus</i>)	12	6		7	7	0.3	10	2
Fries pondweed (<i>P. Friesii</i>)					1		1	
Whitestem pondweed (<i>P. praelongus</i>)							1	
Claspingleaf pondweed (<i>P. richardsonii</i>)	4	10	10	20	23	42	29	50
Floatingleaf (<i>P. sp</i>)					1			1
Stringy pondweed (<i>P. sp</i>)	29	7	4	19	19	6	29	4
Flatstem pondweed (<i>P. zosteriformis</i>)				1	1	1		1
Sago pondweed (<i>Stuckenia pectinata</i>)	17	11	9	5	22	17	1	19
Bladderwort (<i>Utricularia vulgaris</i>)		1						
Water celery (<i>Vallisneria americana</i>)	9	20	23	21	23	33	7	37
Number of submerged species	10	13	10	14	15	15	10	17
Depth of plant growth (ft)	9	8	8	9	12	9	11	12
Percent coverage of plants (%)	29 (175 ac)	21 (122 ac)	17 (98 ac)	25 (145 ac)	34 (197 ac)	27 (164 ac)	21 (127 ac)	31 (184 ac)

Aquatic Plant Point Intercept Surveys for Spring Lake, Scott Co, Minnesota in 2023

Introduction

Spring Lake has an area of 592 acres with a littoral area (0-15 feet deep) of 290 acres (source: MnDNR). The objectives of the plant survey were to monitor the non-native and native plants in the summer.

An early summer aquatic plant point intercept survey was conducted on June 6, 2023 to check and inspect the aquatic plant community in Spring Lake.

A late summer aquatic plant point intercept survey was conducted on August 16 and 19, 2023 to check the plant growth at peak growth conditions.



Figure 5. Rake sample of native plants sampled on June 6, 2023 in Spring Lake.

Survey Methods for the Point Intercept Surveys: An aquatic plant point intercept survey of Spring Lake was conducted by Blue Water Science on June 6, 2023. A total of 319 points in the growing zone out to 11 feet were sampled. Another point intercept survey was conducted on August 16 and 19, 2023. A total of 381 points in the growing zone out to 12 feet were sampled. Sample points were spaced 50 meters apart on a grid that covered the lake (Figure 6). At each sample point, a sampling rake was lowered into the water and a plant sample was taken. The plant species were recorded and the density of each species was assigned. Densities were based on the coverage on the teeth of the rake. Density ratings ranged from 1 to 3 with 1 being sparse and 3 being heavy growth (Figure 7). Based on these sample sites, plant distribution maps were constructed.

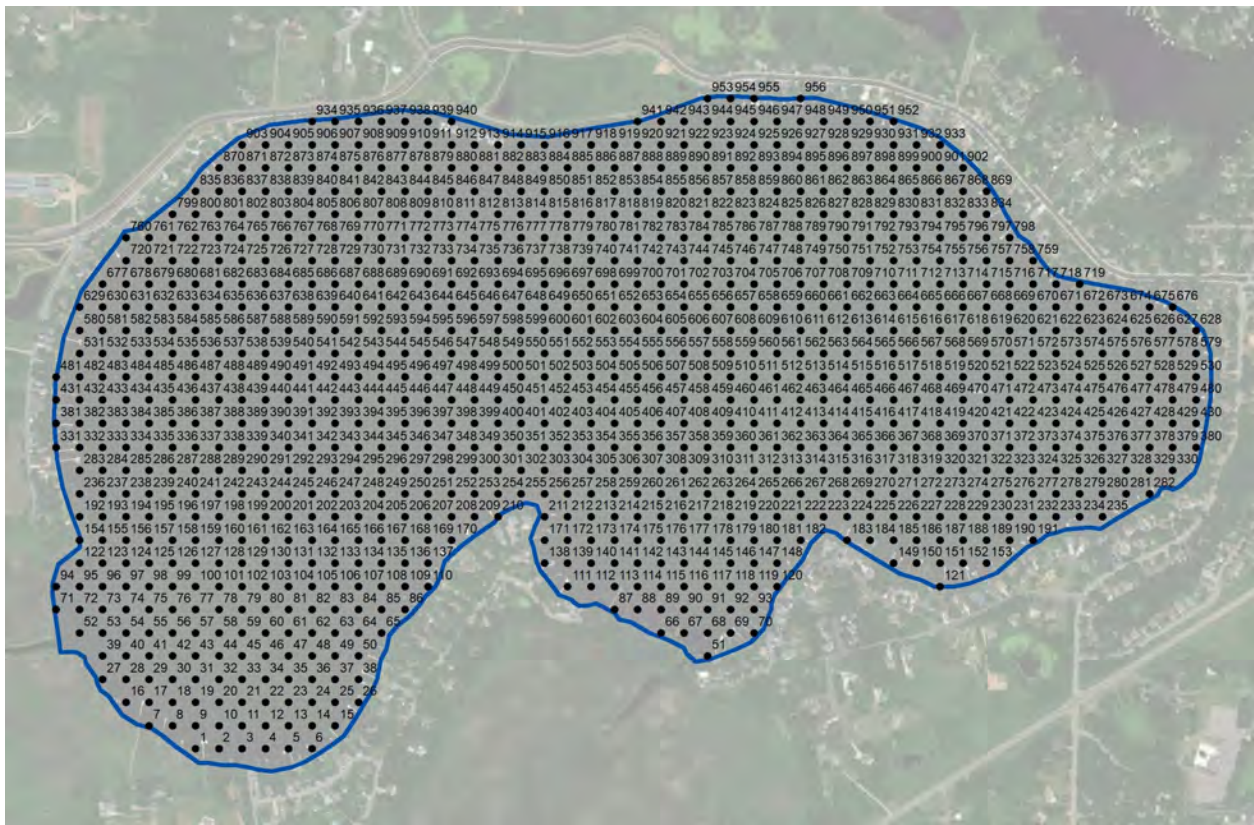


Figure 6. Point intercept sample sites for Spring Lake in 2023. Sample sites were spaced 50 meters apart.

Chart of Density Ratings for Rake Sampling



Figure 7. Eurasian watermilfoil rake density ratings from 1 to 3. Milfoil that was sampled on the rake was collected in the boat and not returned to the lake.

Results - Point Intercept Aquatic Plant Survey on June 6, 2023

Results of the summer aquatic plant survey conducted on June 6, 2023 found 10 submerged aquatic plant species, CLP was present in June and Eurasian watermilfoil was not observed. Plant growth was observed to water depths of 11 feet in Spring Lake. A list of species and their percent occurrence is shown in Table 2. Aquatic abundance and species diversity is shown in Figure 8 and plant distribution and abundance for other species are shown in Figure 9. Native plants were estimated to cover 21 % of the lake area.

Table 2. Spring Lake aquatic plant occurrence and density for the June 6, 2023 survey based on 319 sites which was the maximum depth of plant growth out to 11 feet. Density ratings are 1-3 with 1 being low and 3 being most dense.

	All Stations (n=319)		
	Occur	% Occur	Average Density
Cattails (<i>Typha sp</i>)	1	1	1.0
White water lilies (<i>Nymphaea ordata</i>)	2	1	1.0
Coontail (<i>Ceratophyllum demersum</i>)	50	29	1.1
Chara (<i>Chara sp</i>)	22	7	1.0
Elodea (<i>Elodea canadensis</i>)			
Water stargrass (<i>Heteranthera dubia</i>)	17	5	1.0
Curlyleaf pondweed (<i>Potamogeton crispus</i>)	31	10	1.1
Fries pondweed (<i>P. friesii</i>)	3	1	1.0
Whitestem pondweed (<i>P. praelongus</i>)	1	1	1.0
Claspingleaf pondweed (<i>P. Richardsonii</i>)	94	29	1.1
Stringy pondweed (<i>P. sp</i>)	92	29	1.2
Sago pondweed (<i>Stuckenia pectinata</i>)	4	1	1.0
Water celery (<i>Vallisneria americana</i>)	22	7	1.0
Filamentous algae	231	72	1.4

Spring Lake Species Richness June 6, 2023

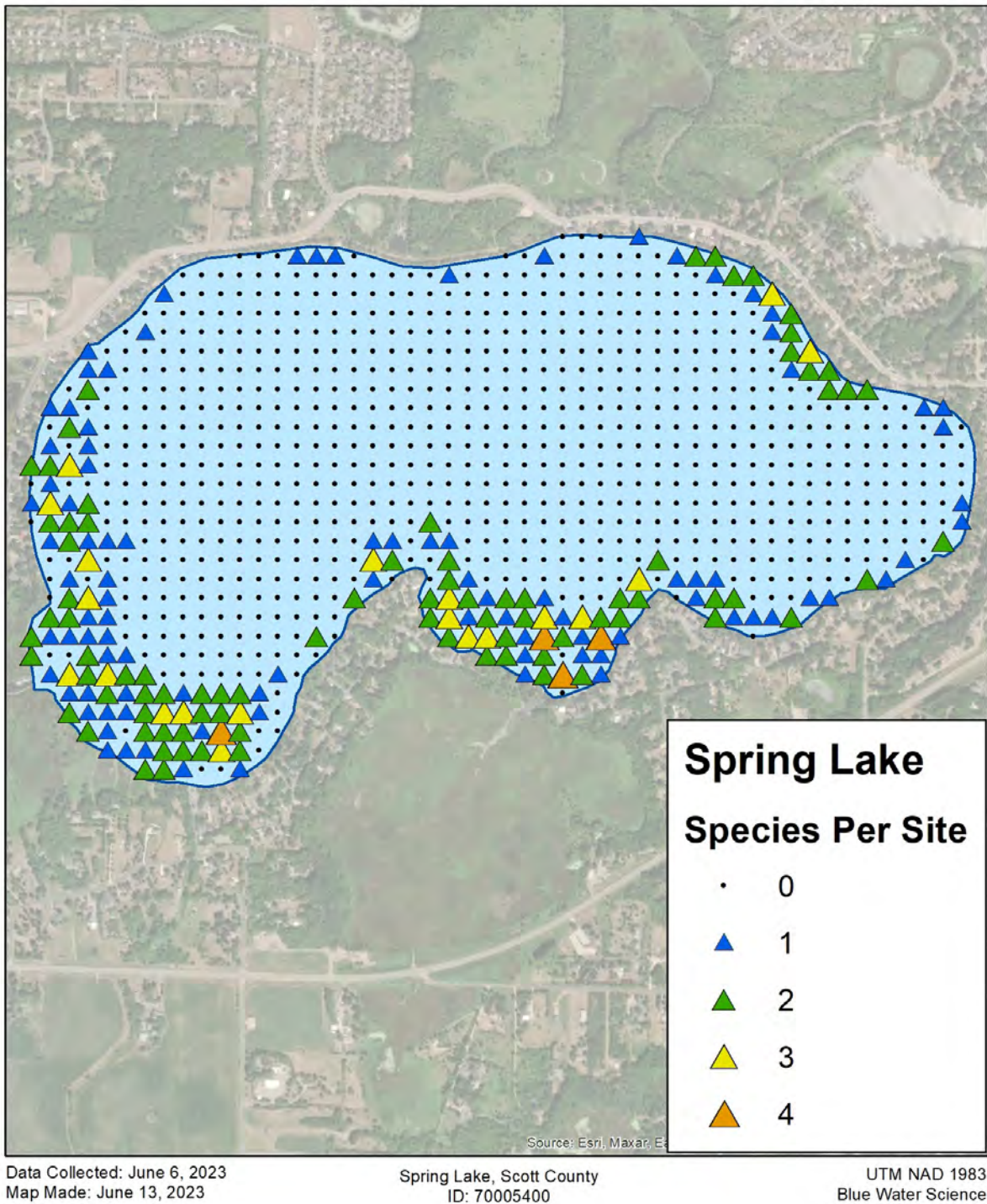


Figure 8. Species richness or the number of species per site for the point intercept survey on June 6, 2023.

Aquatic Plant Maps: Coverage of the aquatic plants species found in the June 2023 survey are shown in Figure 9.

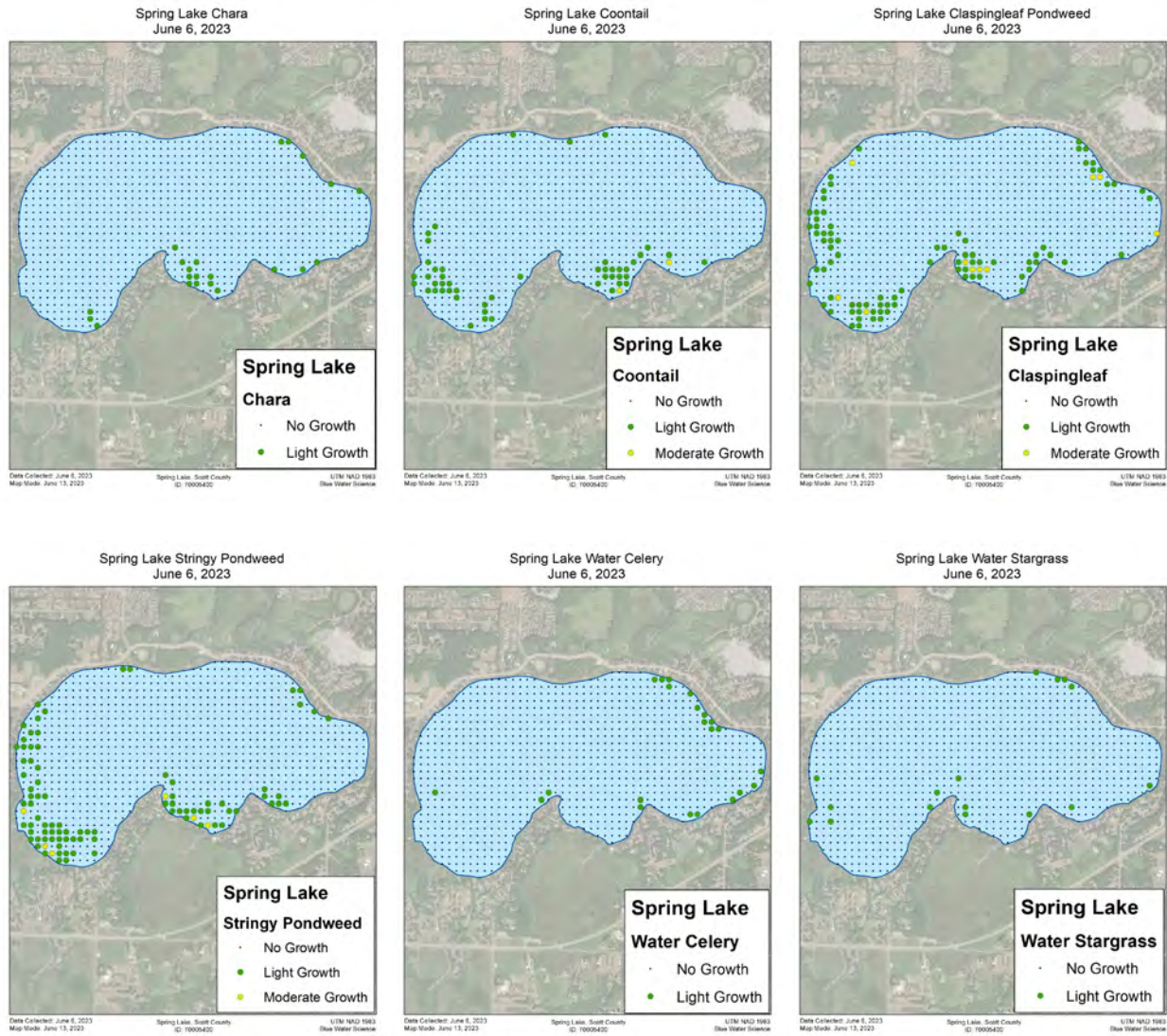


Figure 9. Distribution and abundance maps for common native submerged aquatic plant species in Spring Lake on June 6, 2023.

Spring Lake Point Intercept Survey Statistics: A summary of plant statistics from the June 6, 2023 point intercept survey is shown in Tables 3 and 4 and Figure 10. A total of 360 points were sampled out to a 20-foot depth and plants were found growing out to 11 feet of water depth. Plant occurrence and abundance for individual sites are shown in the Appendix.

Table 3. Statistics using the MnDNR template.

Total # Points Sampled	360
Depth Range of Rooted Veg	1-11 feet
Maximum Depth of Growth (95%) in feet	8
# Points in Max Depth Range	257
# Points in Littoral Zone (0-15 feet)	350
% Points w/ Submersed Native Taxa	57
Mean Submersed Native Taxa/Point	0.9
# Submersed Native Taxa	10
# Submersed Invasive Taxa	1
Max Depth of CLP in feet	9
% Frequency of CLP	9
Mode Rake Abundance of CLP	1

Table 4. Aquatic plants sampled by depth.

Depth Bin (Feet)	# points sampled (0-20 ft)	% Sampling points with submersed species observed
0	0	0
1	6	64
2	25	75
3	44	60
4	53	87
5	46	88
6	33	83
7	24	77
8	26	33
9	21	6
10	31	10
11	10	1
12	13	0
13	8	0
14	5	0
15	5	0
16	5	0
17	1	0
18	2	0
19	1	0
20	1	0
	360	

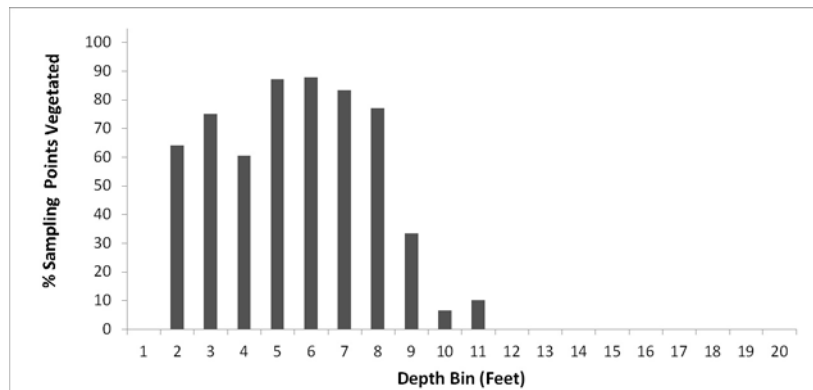


Figure 10. Depth of plant colonization (in feet).

Results - Point Intercept Aquatic Plant Survey on August 16 & 19, 2023

Results of the summer aquatic plant survey conducted on August 16 & 19, 2023 found 17 submerged aquatic plant species, including the non-native curlyleaf pondweed and Eurasian watermilfoil (Figures 11 and 12). Plant growth was observed to water depths of 12 feet in Spring Lake. A list of species and their percent occurrence is shown in Table 5. Plant distribution and species richness are shown in Figure 11. Native plants were estimated to cover 31 % of the lake area.

Table 5. Spring Lake aquatic plant occurrence and density for the August 16 & 19, 2023 survey based on 381 sites which is out to the depth of maximum plant growth. Density ratings are 1-3 with 1 being low and 3 being most dense.

	All Stations (n=381)		
	Occur	% Occur	Average Density
White water lilies (<i>Nymphaea odorata</i>)	1	1	1.0
Coontail (<i>Ceratophyllum demersum</i>)	67	18	1.1
Chara (<i>Chara sp</i>)	45	12	1.3
Moss (<i>Drepanocladus sp</i>)	5	1	1.0
Elodea (<i>Elodea canadensis</i>)	1	1	1.0
Water stargrass (<i>Heteranthera dubia</i>)	102	27	1.3
Bearded stonewort (<i>Lychnothamnus barbatus</i>)	1	1	1.0
Northern watermilfoil (<i>Myriophyllum sibiricum</i>)	12	3	1.0
Eurasian watermilfoil (<i>M. spicatum</i>)	5	1	1.0
Naiads (<i>Najas flexilis</i>)	43	11	1.0
Nitella (<i>Nitella sp</i>)	3	1	1.0
Curlyleaf pondweed (<i>Potamogeton crispus</i>)	8	2	1.0
Claspingleaf pondweed (<i>P. richardsonii</i>)	189	50	1.8
Floatingleaf (<i>P. sp</i>)	2	1	1.0
Stringy pondweed (<i>P. sp</i>)	15	4	1.1
Flatstem pondweed (<i>P. zosteriformis</i>)	2	1	1.0
Sago pondweed (<i>Stuckenia pectinata</i>)	74	19	1.3
Water celery (<i>Vallisneria americana</i>)	142	37	1.6
Filamentous algae	39	10	1.1

Spring Lake Species Richness August 16 and 19, 2023

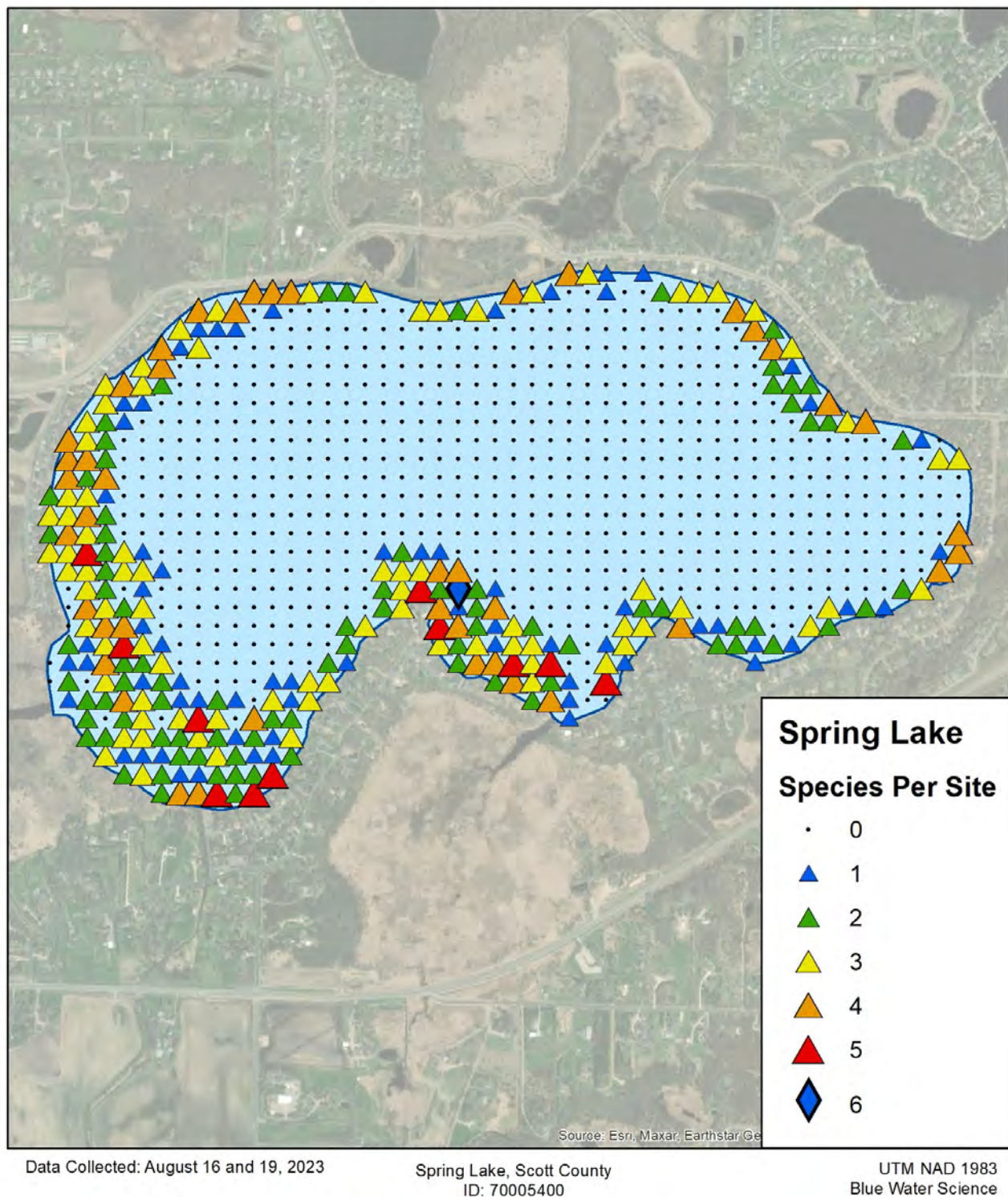


Figure 11. Species richness or the number of species per site for the point intercept survey on August 16 & 19, 2023.

Aquatic Plant Maps: Coverage of the aquatic plants species found in the August 2023 survey are shown in Figure 12.

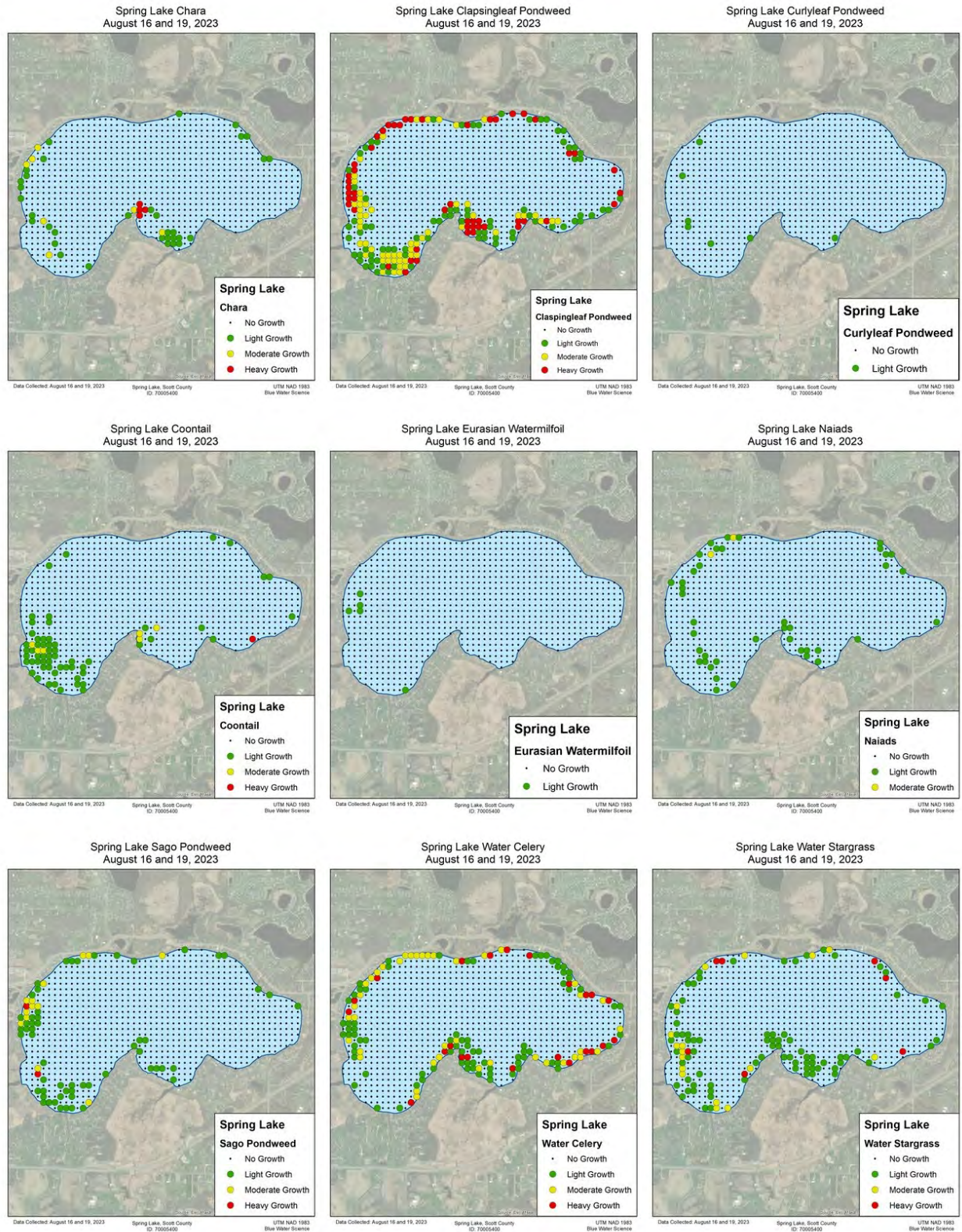


Figure 12. Distribution and abundance maps for common native submerged aquatic plant species in Spring Lake on August 16 and 19, 2023.

Spring Lake Point Intercept Survey Statistics: A summary of plant statistics from the point intercept survey is shown in Tables 6 and 7 and Figure 13. A total of 411 points were sampled out to a 20-foot depth and plants were found growing out to 12 feet of water depth. Plant occurrence and abundance for individual sites are shown in the Appendix.

Table 6. Statistics using the MnDNR template.

Total # Points Sampled	416
Depth Range of Rooted Veg	1-12 feet
Maximum Depth of Growth (95%) in feet	10
# Points in Max Depth Range	323
# Points in Littoral Zone (0-15 feet)	411
% Points w/ Submersed Native Taxa	70
Mean Submersed Native Taxa/Point	1.7
# Submersed Native Taxa	15
# Submersed Invasive Taxa	2
Max Depth of EWM in feet	8
% Frequency of EWM	1
Mode Rake Abundance of EWM	1
Max Depth of CLP in feet	10
% Frequency of CLP	2
Mode Rake Abundance of CLP	1

Table 7. Aquatic plants sampled by depth.

Depth Bin (Feet)	# points sampled (0-20 ft)	% Sampling points with submersed species observed
0	0	0
1	19	0
2	37	95
3	48	96
4	55	98
5	33	94
6	25	92
7	28	93
8	26	88
9	27	52
10	25	40
11	23	22
12	34	6
13	14	0
14	11	0
15	6	0
16	4	0
17	0	0
18	1	0
19	0	0
20	0	0
	416	

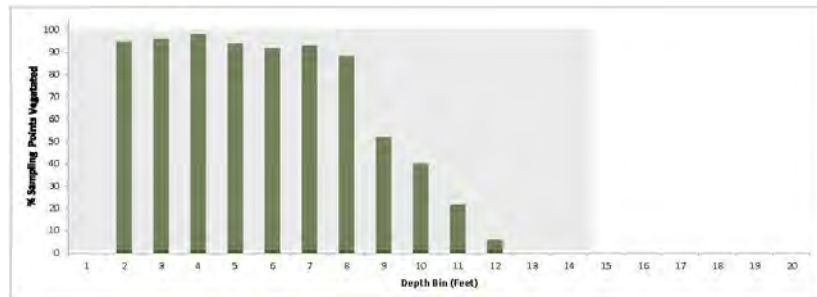


Figure 13. Depth of plant colonization (in feet).

Eurasian Watermilfoil Status in August 2023: Eurasian watermilfoil was surveyed using both a meander survey combined with a point intercept survey. EWM was found primarily in the western end of Spring Lake with several patches in the north side (Figure 14). EWM growth was mostly light.

Spring Lake Eurasian Watermilfoil PI Sites and GPS Sites
August 16 and 19, 2023

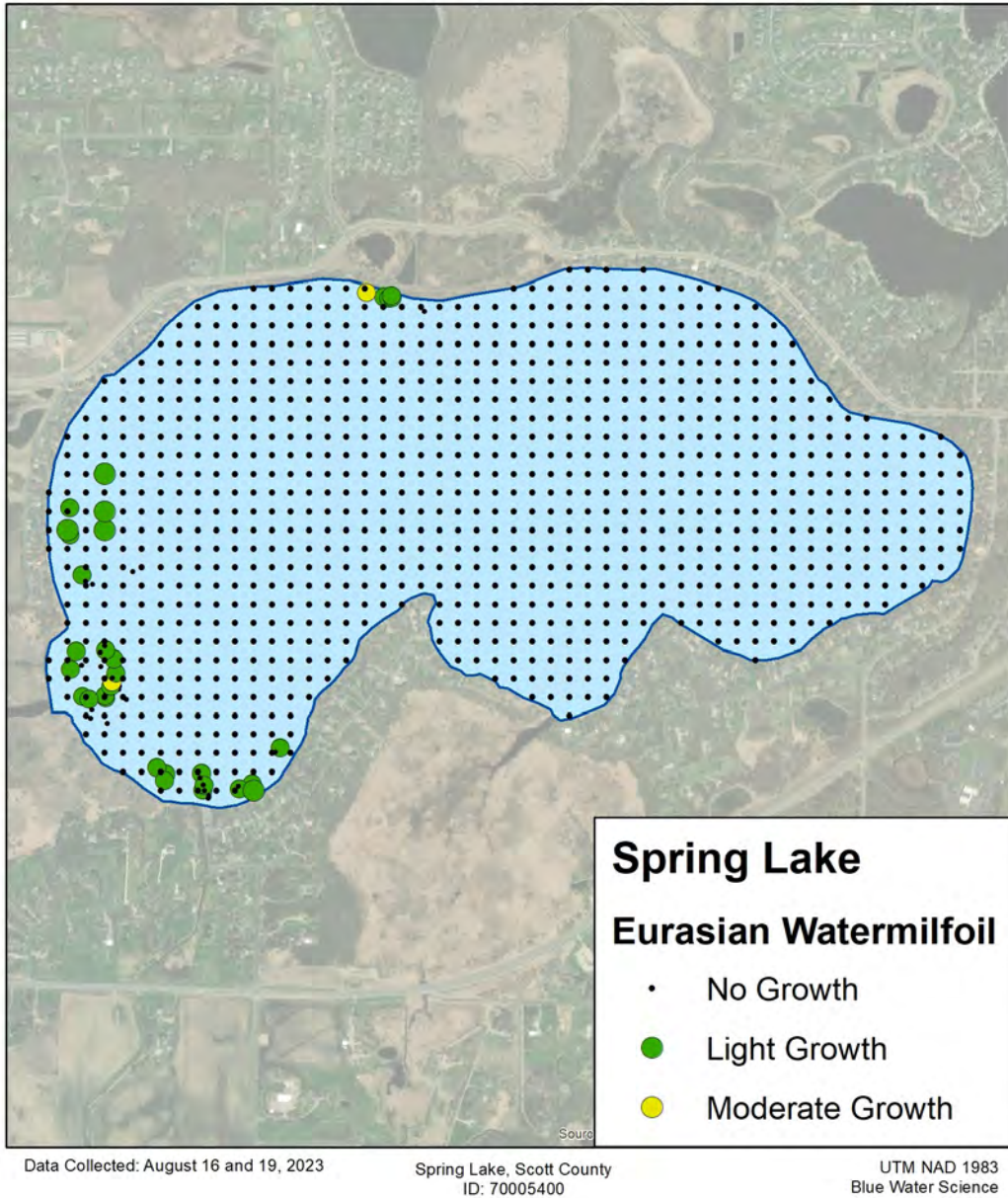


Figure 14. Eurasian watermilfoil observations using both the point intercept survey and a meandering survey conducted on August 16 and 19, 2023.

Comparison of 2015, 2018-2023 Point Intercept Surveys

Point intercept surveys were conducted on Spring Lake in 2015, and 2018 - 2023 and results are shown in Table 8. In 2015, elodea was the dominant plant but since then coontail has been dominant (Table 8). Several species increased in occurrence since 2015 including coontail, claspingleaf pondweed, and water celery. Elodea has significantly decreased over the years (Table 8).

Table 8. Spring Lake aquatic plant occurrence for the point intercept surveys conducted in 2015 and 2018 through 2023. Number of sites is based on maximum depth of plant growth.

	2015 July 30 % Occur (113 sites)	2018 Aug 20 % Occur (248 sites)	2019 Aug 30 % Occur (214 sites)	2020 Aug 14 % Occur (298 sites)	2021 July 12 % Occur (377 Sites)	2022 Aug 1 & 2 % Occur (344 Sites)	2023 June 6 % Occur (319 Sites)	2023 Aug 16 & 19 % Occur (381 Sites)
Cattails (<i>Typha sp</i>)		1		1	1		1	
Watershield (<i>Brasenia Schreberi</i>)					1			
Duckweed (<i>Lemna sp</i>)		1		1				
White water lilies (<i>Nymphaea oreada</i>)		1	5	2	1		1	1
Coontail (<i>Ceratophyllum demersum</i>)	15	56	47	51	52	49	16	18
Chara (<i>Chara sp</i>)	4	2	2	1	14	12	7	12
Chara - 2 (<i>Chara sp</i>)		1						
Moss (<i>Drepanocladus sp</i>)		1	2	1		0.3		1
Elodea (<i>Elodea canadensis</i>)	42	36	3	5	6	3		1
Water stargrass (<i>Heteranthera dubia</i>)	5	12	10	19	21	11	5	27
Bearded stonewort (<i>Lychnothamnus barbatus</i>)								1
Northern watermilfoil (<i>Myriophyllum sibiricum</i>)				1	2	0.3		3
Eurasian watermilfoil (<i>M. spicatum</i>)					1	1		1
Naiads (<i>Najas flexilis</i>)	21	23	9	39	22	15		11
Nitella (<i>Nitella sp</i>)								1
Curlyleaf pondweed (<i>Potamogeton crispus</i>)	12	6		7	7	0.3	10	2
Fries pondweed (<i>P. Friesii</i>)					1		1	
Whitestem pondweed (<i>P. praelongus</i>)							1	
Claspingleaf pondweed (<i>P. richardsonii</i>)	4	10	10	20	23	42	29	50
Floatingleaf (<i>P. sp</i>)					1			1
Stringy pondweed (<i>P. sp</i>)	29	7	4	19	19	6	29	4
Flatstem pondweed (<i>P. zosteriformis</i>)				1	1	1		1
Sago pondweed (<i>Stuckenia pectinata</i>)	17	11	9	5	22	17	1	19
Bladderwort (<i>Utricularia vulgaris</i>)		1						
Water celery (<i>Vallisneria americana</i>)	9	20	23	21	23	33	7	37
Number of submerged species	10	13	10	14	15	15	10	17
Depth of plant growth (ft)	9	8	8	9	12	9	11	12
Percent coverage of plants (%)	29 (175 ac)	21 (122 ac)	17 (98 ac)	25 (145 ac)	34 (197 ac)	27 (164 ac)	21 (127 ac)	31 (184 ac)

Aquatic Plant Coverage Comparisons: Aquatic plant distribution from 2015 to 2019 but then increased in 2020 and 2021 with a slight decrease in 2022 based on point intercept survey results (Figure 15). In 2015, plants grew to a depth of 9 feet and covered an estimated 175 acres of the lake (29%). In 2018, plants were found out to a depth of 8 feet and covered an estimated 122 acres of the lake (198 sites with plants 21%). In 2019, plant coverage was estimated at 98 acres or about 17% of the lake area (150 sites with plants). In 2020, plants grew out to 9 feet and covered approximately 25% of the lake bottom (Figure 15). In 2021, plants grew out to 12 feet and covered approximately 34% of the lake bottom (Figure 15) and in 2022, plants were observed growing to 9 feet and covered approximately 28% of the lake bottom.

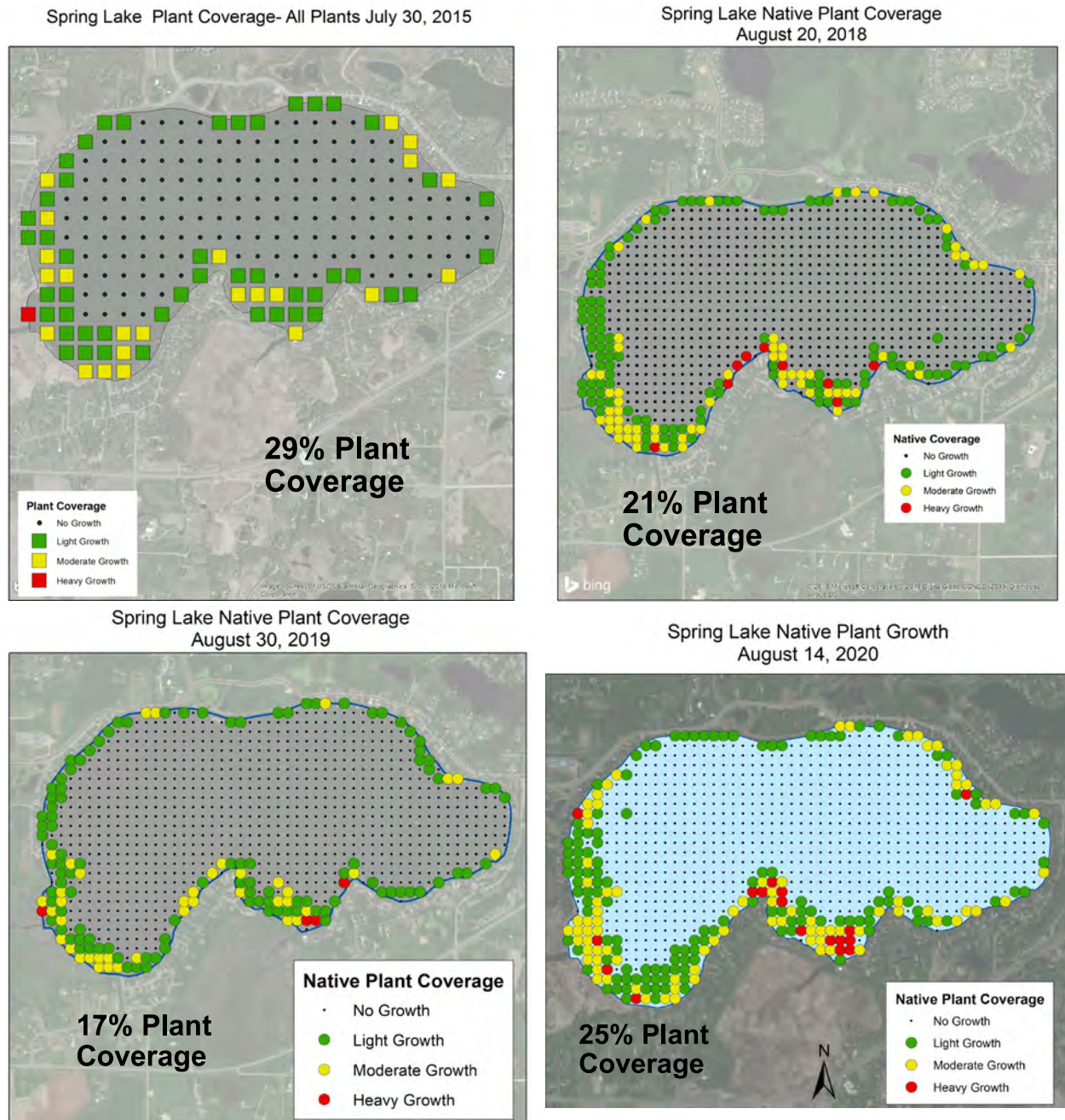


Figure 15. Aquatic plant distribution and abundance for the point intercept surveys in 2015, 2018, 2019, and 2020. Key: green = light growth, yellow = moderate growth, red = heavy growth, and black dot = no growth.

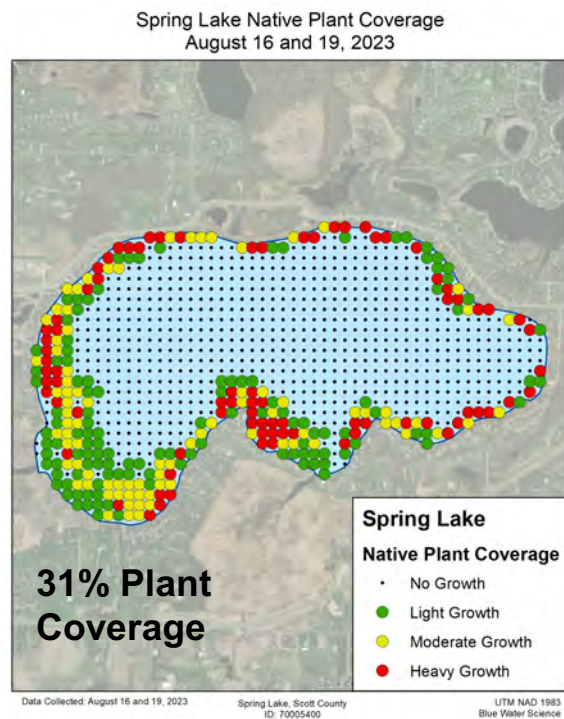
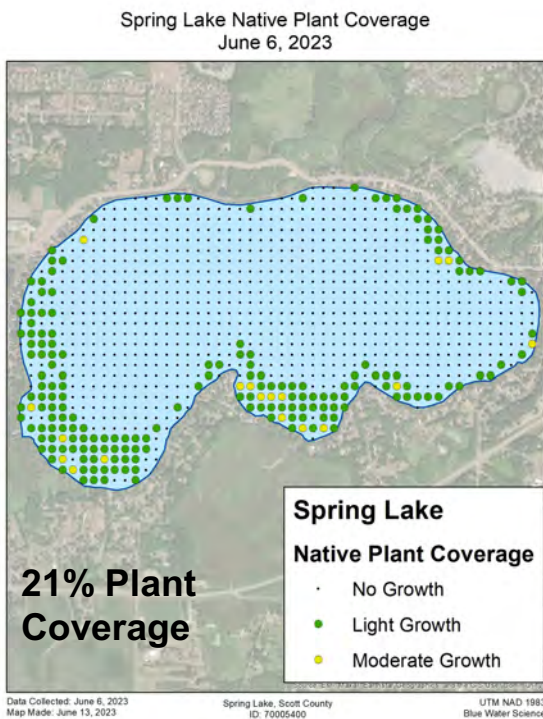
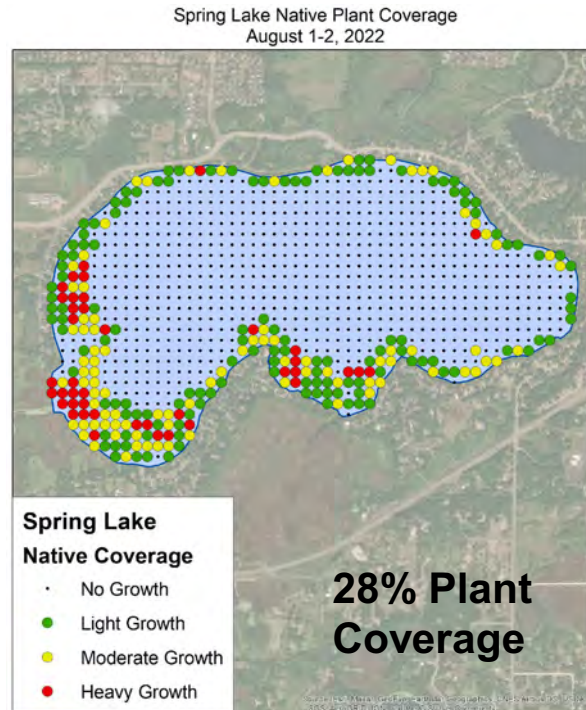
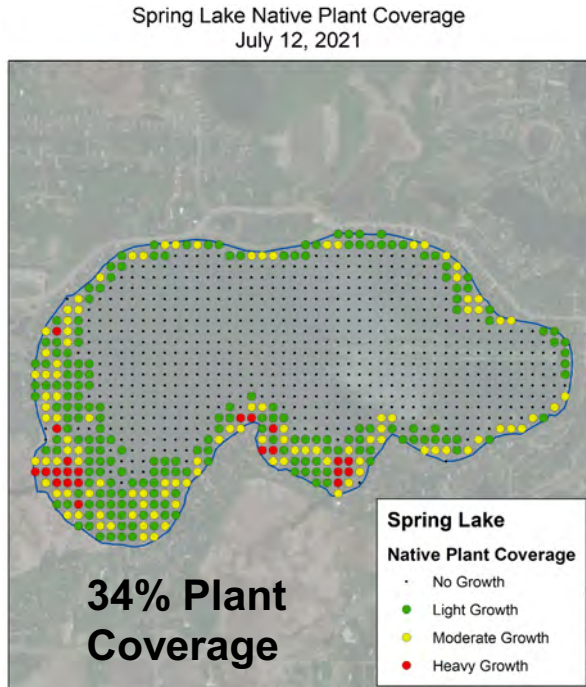


Figure 15 concluded. Aquatic plant distribution and abundance for the point intercept surveys in 2021, 2022, and 2023. Key: green = light growth, yellow = moderate growth, red = heavy growth, and black dot = no growth.

Summary of Aquatic Plant Surveys from 1948 - 2023

Since 1948, specific plant species in Spring Lake have appeared and disappeared. For a number of years, stringy pondweed, likely a *Potamogeton pusillus*, was the dominant plant species, from 2018 through 2022, coontail was the dominant plant. But on June 6, 2023, claspingleaf pondweed (*Potamogeton richardsonii*) was the dominant plant (Table 9).

The number of aquatic plant species has range from a low of 5 to a peak of 15 which was recorded in 2021 and 2022 (Table 9).

Table 9. Aquatic plant status for 1948 to 2023.

	Dominant Plant Occurrence (% occurrence of the dominant plant species based on surveys)	Dominant Species in Mid Summer Survey	Number of Plant Species	Observed Max Depth of Plant Colonization (ft)
1948	Rare (MnDNR)	All rare	7	
1973	Rare-Common (MnDNR)	5 - common	8	
1982	Rare-Common (MnDNR)	Coontail	8	
1986	Present (MnDNR)	3 species	5	
1988	Present-Occasional (MnDNR)	Sago + water stargrass	8	
2000	40	Curlyleaf	9	
2002	36	Sago	9	
2004	68	Elodea	9	
2005	76	Elodea	9	
2006	48	Coontail	8	8
2007	30	Coontail	6	7
2008	24	Stringy	9	6
2009	66	Stringy	9	7
2010	34	Stringy	7	
2011	64	Stringy	6	
2012	72	Stringy	4	7
2013	19	Stringy	5	7
2014	48	Stringy	5	10
2015	42 (PI survey)	Elodea	10	9
2016	38	Elodea	6	7
2017	86	Stringy	8	7
2018	56 (PI survey)	Coontail	13	8
2019	47 (PI survey)	Coontail	10	8
2020	52 (PI survey)	Coontail	14	9
2021	52 (PI survey)	Coontail	15	12
2022	49 (PI survey)	Coontail	15	9
2023	29 (PI survey)	Claspingleaf	10	11

Supplemental Data For Spring Lake

Common Aquatic Plants in Minnesota

Chara (*Chara sp*)



Claspingleaf pondweed (*Potamogeton richardsonii*)



Coontail (*Ceratophyllum demersum*)



Curlyleaf Pondweed (non-native)(*Potamogeton crispus*)



Eurasian watermilfoil (non-native)
(*Myriophyllum spicatum*)



Flatstem pondweed (*Potamogeton zosteriformis*)



Naiad (*Najas* sp)



Northern watermilfoil (*Myriophyllum sibiricum*)



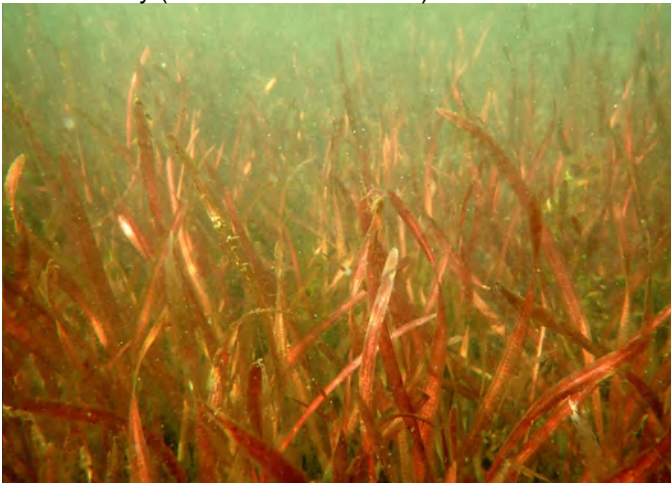
Sago pondweed (*Stuckenia pectinata*)



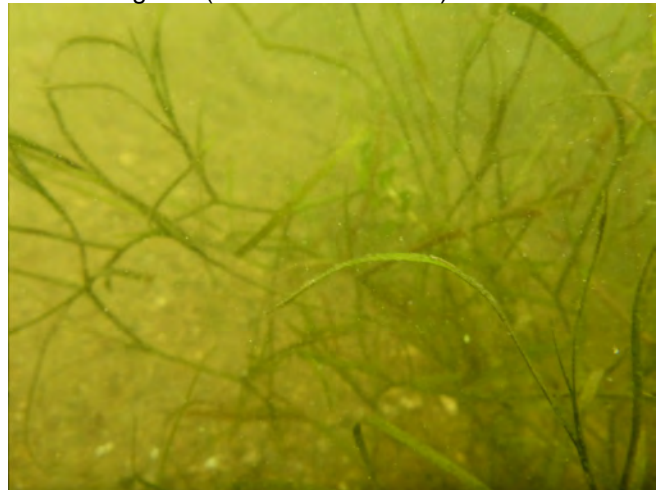
Stringy pondweed (*Potamogeton pusillus*)



Water celery (*Vallisneria americana*)



Water stargrass (*Heteranthera dubia*)



June 6, 2023: Individual sample site data.

Site	Depth (ft)	Cattails	White lilies	Chara	Clasping-leaf	Coontail	CLP	Fries	Sago	Stringy	Water celery	Water stargrass	White-stem	Fila algae	Zebra mussels	No plants
1	2				1					1				2		
2	3				1					1				1		
3	3					1								2		
3	4													2		1
4	4													1		1
5	4													1		1
6	2			1										2		
7	3									1				2		
8	3									2				2		
9	4									1				3		
10	4				1					1				2		
11	4						2			1				1		
12	5				1							1		1		
12	5				1							1		1		
13	5			1	1	1								1		
14	5					1								3		
15	2									1						1
16	3				1					1				2		
17	4									2				2		
18	4													3		1
19	4				1					1				3		
20	5				1		1							1		
21	6				2		1							1		
22	6				1											
23	6			1	1	1	1							2		
24	5				1		1							1		
26	2															1
27	2				1					1				3		
28	4									1				3		
29	4									1				3		
30	5									1				3		
31	6				1					1				1		
32	6				1		1			1				1		
33	7				1		1			1				1		
34	7						1			1				2		
35	7				1	1								2		
36	7				1		1			1						
37	6				1									2		
38	4													1		1
39	3									1				2		
40	5				1									3		
41	4				2					1				1		
42	6									1						
43	7					1				1				1		
44	8						1			1				1		
45	5							1								
46	9						1			1						
47	8				1					1				1		
48	8					1				1						
49	7				1									1		
50	4															1
51	1															1
52	3									1				2		
53	3					1	1			1				1		
54	5					1	1							2		
55	6					1	1			1				2		
56	8					1				1				1		
57	7					1				1				1		
58	10															1
59	10															1
62	10															1
63	9															1
64	7				1									1		
65	4															1
66	1									13				1		
67	3		1							2						
68	3		1	1		1				1						
69	4					2				1				1		
70	2				1									2		
71	3				1	1										
74	5					1				1					1	
75	8					1								1		
76	8					1								1		
77	10															1
84	9													1		1
85	5													1		1
86	5													2		1
87	1.5			1						1				1		
88	2			1						2				1		
89	2					1								1		
90	2			1			1							1		
91	4													2		1
92	4					1								2		
93	3					1								1		
94	3					1						1		1		

Site	Depth (ft)	Cattails	White lilies	Chara	Clasping-leaf	Coontail	CLP	Fries	Sago	Stringy	Water celery	Water stargrass	White-stem	Fila algae	Zebra mussels	No plants
95	4									2				2		
96	4					1								3		
97	6											1		2		
98	8					1								1		
99	9															1
100	11															1
108	10													1		1
109	5					1		1						1		
110	3															1
111	3				1					1				2		
112	4				1		1			1				1		
113	3			1	1					1						
114	3			1						1						
115	3									1				1		
116	5			1		1	2			1				1		
117	5					1	1							2		
118	6					1										
119	6				1	1	1							2		
120	2									1				2		
122	3				1					1				1		
123	3				1					1				1		
124	6					1								2		
125	8					1										
136	10													1		1
137	5															1
138	3				1					1						
139	4				1					1		1		1		
140	4				2							1		1		
141	5			1	2											
142	5				2											
143	4					1			1					1		
144	8					1	1			1				1		
145	9					1								1		
146	9					1	1			1				2		
147	8					1	1							2		
148	6				1							1		2		
149	2			1						1						
150	4									1				1		
151	4									1				1		
152	5										1			1		
153	4			1							1			1		
154	land															
155	3					1				1				2		
156	4				1					1		1		2		
157	8									1				1		
158	10													1		1
159	12													1		1
168	12															1
169	10													1		1
170	5				1							1				
171	3				1					2						
172	5				2					1		1				
173	6			1	1									2		
174	6				1									1		
175	8			1			1							1		
176	9				1		1									
177	11					1								1		
178	12															1
179	12															1
180	10													1		1
181	7				1	1								2		
182	4				1						1			1		
183	1															1
184	5									1						
185	6				1	2										
186	7									1		1		2		
186	12															1
187	9													2		1
188	10													1		1
189	9													2		1
190	8					1								1		
191	2			1										1		
192	2	1														
193	2									1				1		
194	4													2		1
195	5				1									1		
196	10													1		1
206	15															1
207	12															1
208	9													2		1
209	4										1					
210	1															1
211	2															1
212	3				1		1							1		
213	7				1									2		
214	10													1		1
215	11													1		1
216	13															1

Site	Depth (ft)	Cattails	White lilies	Chara	Clasping-leaf	Coontail	CLP	Fries	Sago	Stringy	Water celery	Water stargrass	White-stem	Fila algae	Zebra mussels	No plants
217	15															1
218	16															1
219	17															1
220	13															1
221	10													1		1
222	5				1	1					1			1		
223	1.5													2		1
224	7				1									1		
225	10									1				2		
226	10					1								2		
227	11													2		1
228	14															1
229	15															1
230	16															1
231	16															1
232	9													2		1
233	8													2		1
234	6				1				1					1		
235	3										1			1		
236	2													2		1
237	3													1		1
238	5				1					1	1			1		
239	3													1		1
240	4													1		1
241	8													1		1
252	13															1
253	8				1		1					1		1		
254	5				1						1					
255	2															1
256	2															1
257	4															1
258	10													2		1
259	13															1
266	12															1
267	8													2		1
268	5				1	1								1		
269	12															1
270	15															1
271	16															1
278	15															1
279	13															1
280	9													1		1
281	6										1			1		
282	2													1		1
283	3									1				1		
284	5				1	1								1		
285	6				1											
286	7				1											
287	9						1							1		
288	10															1
299	16															1
300	9						2									
301	8						1									
302	5													1		1
303	3									1						
304	7				1											
328	14															1
329	12															1
330	6										1	1		1		
331	3															1
332	5				1							1		1		
333	6				1	1								1	1	
334	7				1					1				2	1	
335	8													2		1
336	10													1		1
349	13															1
350	11													1		1
351	10													1		1
352	9				1							1		1		
357	3			1						1						
378	18															1
379	14															1
380	4				2									1		
381	2				1											
382	5				1			1		1						
383	6									1				1		
384	7				1	1								1		
385	9													1		
386	12															1
430	5										1			1		
431	2															1
432	4				1											
433	6													1		1
434	8													1		1
480	13															1
481	3				1					1				1		
482	5				1					1				1		
483	6				1		1			1				1		

Site	Depth (ft)	Cattails	White lilies	Chara	Clasping-leaf	Coontail	CLP	Fries	Sago	Stringy	Water celery	Water stargrass	White-stem	Fila algae	Zebra mussels	No plants
484	7									1				1		
485	10													1		1
530	14															1
531	4									1				1		
532	6															1
533	8						1									
534	12															1
579	12															1
580	4													2		1
581	5				1					1				1		
582	8									1						
583	11													1		1
627	8				1									2		
628	4													1		1
629	2									1				1		
630	4				1											
631	6															1
637	10															1
671	20															1
672	19															1
673	14															1
674	11													1		1
675	5				1									2		
676	3			1										1		
677	3													1		1
678	7				1					1				1		
679	10													1		1
717	5				1						1					
718	4				1						1			1		
719	2			1						1						
720	4				1									1		
721	6									1				1		
722	12															1
735	5													2		1
736	7													1		1
756	11															1
757	8				2											
758	5				2						1					
759	3									1	1					
760	2									1				1		
761	4															1
762	9													1		1
763	10															1
795	18															1
796	10													1		1
797	6				1					1						
798	3				1				1		1					
799	3													1	1	1
800	7				2									1		
833	7				1									1		
834	4				1						1					
837	10															1
868	5									1				1		
869	3			1						1				1		
870	5				1									1		
871	8													1		1
872	10															1
901	6				1											
902	4				1				1		1					
903	4													1		1
904	6													1		1
905	7													2		1
906	10															1
912	11													1		1
913	9													1		1
914	4													2		1
915	4													2		1
916	5													2		1
917	5					1								2		
918	7													1		1
919	9													2		1
920	10													1		1
930	13															1
931	8										1			1		
932	4			1								1			1	
933	4			1	1							1				
934	4													1		1
935	3													1		1
936	4													2		1
937	5					1								1		
938	5									1				2		
939	6									1				1		
940	3													1		1
941	3															1
942	4													1		1
943	6					1								1		
944	7													1		1
945	10													1		1

Site	Depth (ft)	Cattails	White lilies	Chara	Clasping-leaf	Coontail	CLP	Fries	Sago	Stringy	Water celery	Water stargrass	White-stem	Fila algae	Zebra mussels	No plants
946	10													1		1
946	11													1		1
947	9													1		1
948	10													2		1
949	9													1		1
950	6										1			1		
951	5										1	1		1		
952	3										1	1				
953	4															1
954	3													1		1
955	3													1		1
956	2											1				
Average		1.0	1.0	1.0	1.1	1.0	1.1	1.0	1.0	1.2	1.0	1.0	1.0	1.4		
Occur out to 11 ft (319 sites)		1	2	22	94	50	31	3	4	92	22	17	1	231	5	156
% occur		0	1	7	29	16	10	1	1	29	7	5	0	72		

August 16 and 19, 2023: Individual sample site data.

Site	Depth (ft)	White lilies	Beard stone-wort	Chara	Clasp-ingleaf	Coon-tail	CLP	Elodea	EWM	Flat-stem	Float-ingleaf	Moss	Naiad	Nitella	NWM	Sago	Stringy	Water celery	Water star-grass	FA - benthic	Zebra mussel	No plants
1	1				1													1		1		
2	2				2	1										1			1	1		
3	2				1			1								1			1			
4	3				2								1			1	1		2			
5	1.5				2													1		1		
6	3				3	1			1							1			2			
7	3				1											1						
8	2				1	1										1						
9	3					1										1						
10	3				1																	
11	4				3																1	
12	4				1														2			
13	5				2	1															1	
14	4				2	1																
15	2			1	1																	
16	1.5				1	1							1			2		3		1	1	
17	3															1				1	1	
18	4				1																	
19	4				1																	
20	4				2											1				1		
21	4				2														1			
22	6				2								1			1						
23	6				2	1														1		
24	4				2																1	
25	5				3																1	
26	3				3													2			1	
27	1				1	1																
28	3				1											1				1		
29	4				2											1			1			
30	6			2	1														1			
31	6					1									1							
32	6			1	2																	
33	7				2											1			1			
34	8				2											1						
35	7				2																1	
36	7				1	1																
37	7				2															1		
38	3				2													2				
39	2																	1	1	1		
40	3																			2	1	1
41	5				1	1																
42	6				2	1													1			
43	7																					
44	7				1	1										1						
45	8				1	1							1				1		1			
46	8				1	1										1					1	
47	8																			1		1
48	8				1	1									1	1						
49	7				2											1						
50	4				3													1				
51	2	1																				
52	2					1															2	
53	3					1										1				1		
54	4				2	1															1	
55	5				2	1										1			1		1	
56	8		1			1																
57	7			1									1				1					
58	9												1									
59	10						1													1		
60	9					1							1								1	
61	9																			1		
62	9																					1
63	7				2	1														1		
63	11					1																
64	6				2																	
65	3																1	1	1	1	1	
66	1			1													1	1				
67	1			1	1								1			1						
68	2			1																	1	
69	2																					1
70	1																					1
72	3				1	1														1		
74	4					1										3		1	2			
75	2					1												1		1		
75	5					1	1									2						
76	9					1																
77	9					1													1			
78	9												1									
79	11																					1
80	11																					1
81	11																					1
82	10																			1		1
83	9																	1			1	
84	8				1															1	1	

Site	Depth (ft)	White lilies	Beard stone-wort	Chara	Clasp-ingleaf	Coon-tail	CLP	Elodea	EWM	Flat-stem	Float-ingleaf	Moss	Naiad	Nitella	NWM	Sago	Stringy	Water celery	Water star-grass	FA - benthic	Zebra mussel	No plants	
85	6				2													1	3	1	1		
86	2				1		1									1							
87	1				1													1					
88	1			1	1								1					1	1				
89	2			1														1	1			1	
90	2			1	1																		
91	3			1																		1	
92	4																						1
93	3			1	1		1											1	1				
95	2					1															1		
96	3					1															1		
97	5				1	2										2			2			1	
98	6					2											1						
99	10					1									1							1	
100	10			1		1							1										
101	11																						1
102	12																						1
104	12																						1
105	12																						1
106	12																						1
106	12																						1
107	10																						1
108	9																				1		1
109	5				2														2				
110	3																	1				1	
111	2				3													1				1	
112	3				3											1		1	1			1	
113	2				1								1			1		2				1	
114	1			2	1								1			1		1	1				
115	2			1														1	1			1	
116	2			1	2								1			1		1	1			1	
117	6																						1
118	6																						1
119	4				1														3	1		1	
120	2																	1					
121	2																	1					
122	2				1	1												1					1
123	1					2																	
124	4				2	1													1			1	
125	7				1	1	1								1	1							
126	9			1	1	1																	
127	10					1																1	
128	12																						1
129	12																						1
131	12																						1
132	12																						1
133	12																						1
134	12																						1
135	11																						1
136	9																			1			1
137	4																	2	1				
138	2				2	1												1				1	
139	3				3													1					
140	4				3													1	1				
141	4				3																	1	
142	4				3													1	1			1	
143	3				1													2	1			1	
144	8																1					1	
145	8																1					1	
146	9																		1				1
147	9											1										1	
148	5				3													1	1			1	
149	3																	2	1				
150	2				1													1				1	
151	3																	1				1	
152	5				1													2				1	
153	5																	3				1	
155	1			1	1													1					
156	4				2	1												2	2			1	
157	7			2		1	1												1				
158	10					1																	
159	11																						1
159	12																						1
161	12																						1
166	13																						1
167	14																						1
168	10																						1
169	10				1								1										
170	3				1													2	1			1	
171	3				1	2												3	1			1	
172	3				3								1					3	1			1	
173	4				3	1																	
174	5				3																		
175	7																						
176	8				1							1		1					1			1	
177	11																		1				1
178	12																						1

Site	Depth (ft)	White lilies	Beard stone-wort	Chara	Clasp-ingleaf	Coon-tail	CLP	Elodea	EWM	Flat-stem	Float-ingleaf	Moss	Naiad	Nitella	NWM	Sago	Stringy	Water celery	Water star-grass	FA - benthic	Zebra mussel	No plants
179	11																					1
181	7				3													1	1		1	
182	4				3													1	1		1	
183	3				1	1							1					2			1	
184	6				2																1	
185	6				3																1	
186	4				2														2		1	
187	5				2													3			1	
188	10																					1
189	9																					1
190	7				1	3												2			1	
191	4				1													2			1	
193	1			1		1												1	1			
194	3				2													2	2		1	
195	5				2														3		1	
196	8												1		1				1		1	
197	11																					1
199	13																					1
206	13																					1
207	12																					1
208	9																					1
209	4				1													3				
210	2			1	1													1			1	
211	1			3		2										1		1			1	
212	4				1																1	
213	6				2													1			1	
214	8			1										1				1	1		1	
215	11																					1
216	13																					1
219	15																					1
220	14																					1
221	8				2																1	
222	2				2													1			1	
223	2				1													1			1	
224	7				2					1									1		1	
226	11																		1		1	
232	7				1													2	3		1	
233	5																	3			1	
234	6				1													3			1	
235	4																	2			1	
237	3				3													1	2		1	
238	4				2														2			
239	3																					1
240	4				2																	
241	10																					1
243	13																					1
250	14																					1
251	14																					1
252	12																					1
253	6				3													2			1	
254	4				1													3	1		1	
255	2			2	1											1		1	1		1	
256	2			3																		
257	2			3	1	1							1					1			1	
258	8			1								1									1	
259	12					2																
266	10																					1
267	5				1	1												1			1	
268	9																					1
269	10																					1
270	12																					1
271	15																					1
277	14																					1
278	15																					1
279	11																					1
280	9																					1
281	6				1													3			1	
282	3				1													1	1			
283	2				3													2	1		1	
284	3				2	1									1						1	
285	5				2													1			1	
286	5				2													1	1		1	
287	8					1							1						1	1	1	
288	10																		1			
300	8									1		1							1		1	
301	6				3													1	1		1	
302	4				2													2	1		1	
303	2			3									1			1		1			1	
304	4				2											1		1	1			
305	13																					1
313	18																					1
314	10																					1
315	13																					1
329	9																					1
330	5				3								1					3	1		1	
331	1			1												1		1			1	
332	3				3													1	2		1	

Site	Depth (ft)	White lilies	Beard stone-wort	Chara	Clasp-ingleaf	Coon-tail	CLP	Elodea	EWM	Flat-stem	Float-ingleaf	Moss	Naiad	Nitella	NWM	Sago	Stringy	Water celery	Water star-grass	FA - benthic	Zebra mussel	No plants	
333	4				3	1										1		1	1		1		
334	5				2														1	1	1		
335	7				1											1			1	1	1		
336	10					1																1	
337	12																						1
338	13																						1
349	11																		1				
350	10											1							1		1		
351	8																	1					
352	8																		1		1		
353	13																						1
354	16																						1
379	11					1																	
380	4				1						1					1		1			1		
381	1															1	1				1		
382	4				3				1							1		1			1		
383	5				3											1		1		1	1		
384	6				2				1											1	1		
385	9																			1	1		1
386	11																						1
401	15																						1
402	16																						1
430	7				3						1					1		2			1		
431	1			1												2		1					
432	4				3											1		1			1		
433	5				1											1		1	1		1		
434	7								1							1							
434	10																						1
435																							1
436	12																						1
481	1			1												1							
482	3				3											2		2			1		
483	5				2											1		2			1		
484	7															1				1	1		
485	10																						1
486	12																						1
530	14																						1
531	3			1	3											2		3			1		
532	5				2														1		1		
533	8						1		1				1			1					1		
534	10																						1
535	12																						1
579	10																						1
580	2			1	1											3		1			1		
581	4				3											2		2	2		1		
582	7												1			2				1	1		
583	10																						1
584	13																						1
627	7				3											1		1			1		
628	4															1		1	1		1		
629	1.5			2									1			2		1			1		
629	2			1	2											2					1		
630	3				3											2		3			1		
631	7												1						1		1		
632	11																						1
633	12																						1
672	14																						1
673	10																						1
674	9																	2	1		1		
675	8																	3			1		
677	2			2												1		1			1		
678	4				2													2			1		
679	9			1																	1		
680	12																						1
681	16																						1
716	8				1														1		1		
717	4				1													2			1		
718	3			1		1												3			1		
719	3			1		1										1		3			1		
720	2				1											1		1			1		
721	7																	1					
722	11												1										
723	14																						1
756	9																						1
757	7				3													1			1		
758	5				3																1		
759	2				1								1			1		1			1		
760	2															1		1			1		
761	3				1											2		2	1		1		
762	6				3	1													1		1		
763	12												1				1						
764	14																						1
796	9												1					1			1		
797	4				1													3			1		
798	3				1													2			1		
799	4			1	1													2			1		
800	5				1		1											3	1		1		

Site	Depth (ft)	White lilies	Beard stone-wort	Chara	Clasp-ingleaf	Coon-tail	CLP	Elodea	EWM	Flat-stem	Float-ingleaf	Moss	Naiad	Nitella	NWM	Sago	Stringy	Water celery	Water star-grass	FA - benthic	Zebra mussel	No plants	
801	11																					1	
802	13																						1
833	5				1														3		1		
834	3																	1			1		
835	4				3								1					2	1		1		
836	6				2																1		
837	8					1							2				1				1		
838	12																						1
839	15																						1
840	16																						1
867	11																						1
868	4			1									1					1	1		1		
869	4			1									1					1			1		
870	4				3													2	2		1		
871	7																	1			1		
872	9												1										
873	11												1								1		
874	13																						1
882	12																						1
883	13																						1
884	11																						1
900	14																						1
901	3				1								1					1	1		1		
902	3				1													1			1		
903	4				3								1			1		1			1		
904	5				3										1				3		1		
905	6				3										1			2	3		1		
906	8																						
907	10																		1	1	1		
907	12																						1
908	12																						1
908	12																						1
909	12																						1
910	14																						1
911	12																						1
912	12																						1
913	9																						1
914	9																						1
915	4				2											1		2			1		
916	5				1													3	1		1		
917	8				3													1			1		
918	8				1													1	1				
919	6				1																		1
920	8																			1	1		1
921	10																			1	1		1
922	13																						1
928	15																						1
931	12																						1
932	4					1									1			1	3		1		
933	3			1									1					1			1		
934	4				3								1			2		2			1		
935	3				3								2			2		2			1		
936	3				2								1			1		2			1		
936	5																						1
937	4				3													2	2		1		
938	5				2													2			1		
939	4				1													2			1		
940	3				2										1			1			1		
941	3				2										2			2	1		1		
942	4				3													3	2		1		
943	6				3																1		
944	7																			1	1		1
945	5																						1
946	9																		1		1		
948	11																						1
949	6				1													3			1		
950	7				3	1												1			1		
951	4				1										1			1			1		
952	4				1										1			1			1		
953	3			1	1													2	1				
954	3														1			3	2				
955	5				3																		1
956	5				3																		1
Average		1.0	1.0	1.3	1.8	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.1	1.6	1.3	1.1			
Occur out to 12 ft (381 sites)		1	1	45	189	67	8	1	5	2	2	5	43	3	12	74	15	142	102	39	184	128	
% occur		0	0	12	50	18	2	0	1	1	1	1	11	1	3	19	4	37	27	10			