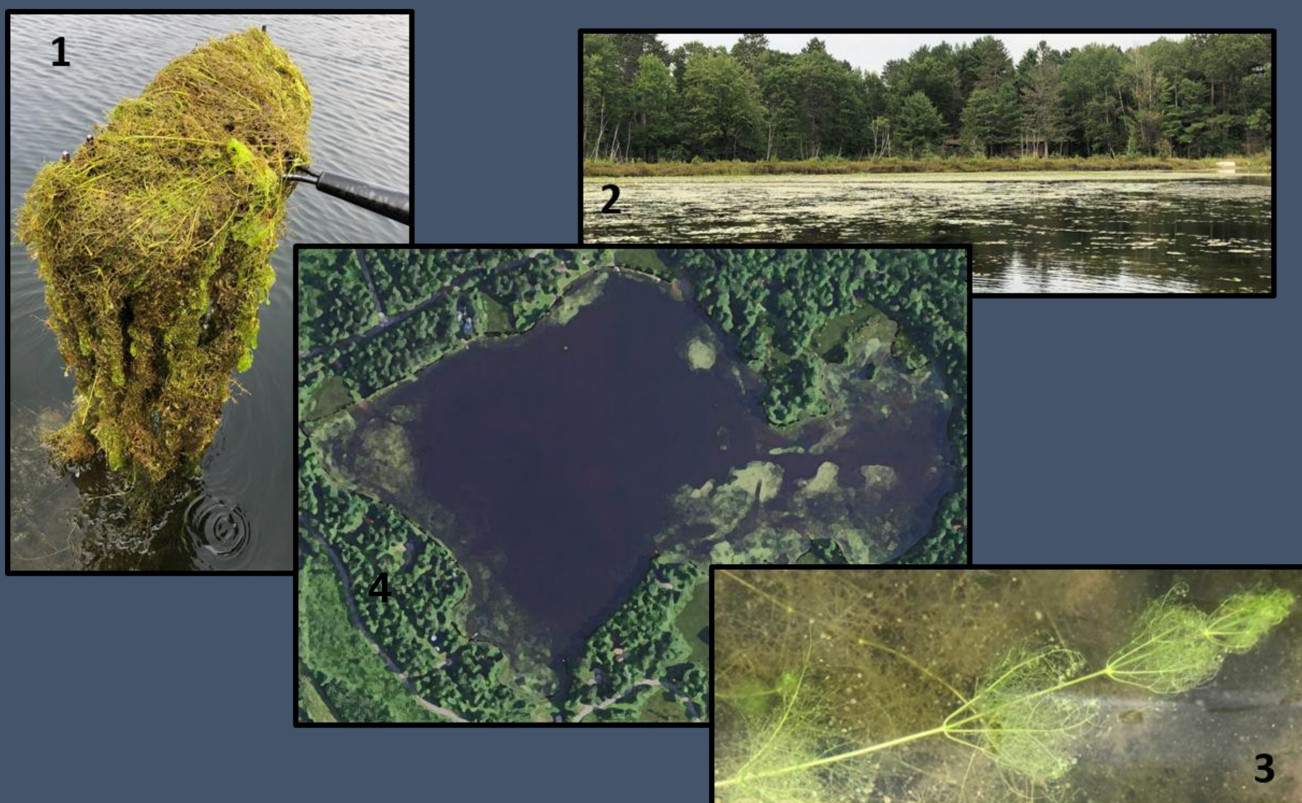
Aquatic Plant Survey of Beaver Lake

Washburn County, Wisconsin
July 2021



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Photos from Cover Page

1. **Rake sample of large purple bladderwort from Beaver Lake in 2021.**
2. **Northwest bay and boggy shoreline of Beaver Lake.**
3. **Large purple bladderwort was the most commonly occurring plant in Beaver Lake.**
4. **Aerial imagery and shoreline illustration of Beaver Lake.**

ABSTRACT

An aquatic plant survey was conducted on Beaver Lake (WBIC 2452600) on July 29-30th, 2021. A total of 280 points were sampled using methods from Hauxwell (2010). Aquatic plants were found at 226 points. The maximum rooting depth was 16 feet, which is also the maximum depth of Beaver Lake. Overall, the aquatic plant community of Beaver Lake was of high abundance on a lake-wide scale but relatively low species richness and high homogeneity. A total of 20 species of aquatic plants were found, eight of which were “visual only” (i.e., within 6 feet of the survey point but not found on the rake) and one that was documented as part of the boat survey (> 6 feet from any survey point). Therefore, 11 species of native plants total were found at sample points. **There were no aquatic invasive species found during the survey.** Large purple bladderwort (*Utricularia purpurea)*, creeping bladderwort (*Utricularia gibba),* and fern pondweed (*Potamogeton robbinsii*) were the most common species found with relative frequencies of 51%, 16%, and 7%, respectively. Their high combined relative frequency of 76% indicates the aquatic plant community is homogeneous. The Simpson Diversity Index was low at 0.69 on a scale from 0 to 1. The floristic quality index was 24.7 and was slightly higher than average for the eco-region (24.3), which suggests the aquatic plant community is reflective of a lake with low-to-moderate human perturbations. Recommendations for aquatic plant management in Beaver Lake are as follows: 1) Protect native aquatic plants as they provide important structural habitat and contribute to a healthy lake system. 2) Conduct watercraft inspections and early detection efforts to prevent the introduction of new aquatic invasive species. Apply for a Clean Boats Clean Waters grant in 2022 to help fund this effort. 3) Revive volunteer water chemistry and clarity monitoring, which was suspended after 2007. 4) Initiate citizen-based aquatic invasive species monitoring through the Citizen Lake Monitoring Network, especially around the public boat landing. 5) Use outreach and education to make residents aware of aquatic invasive species, better understand the nature of large purple bladderwort, and recruit volunteers for important monitoring work.

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INTRODUCTION

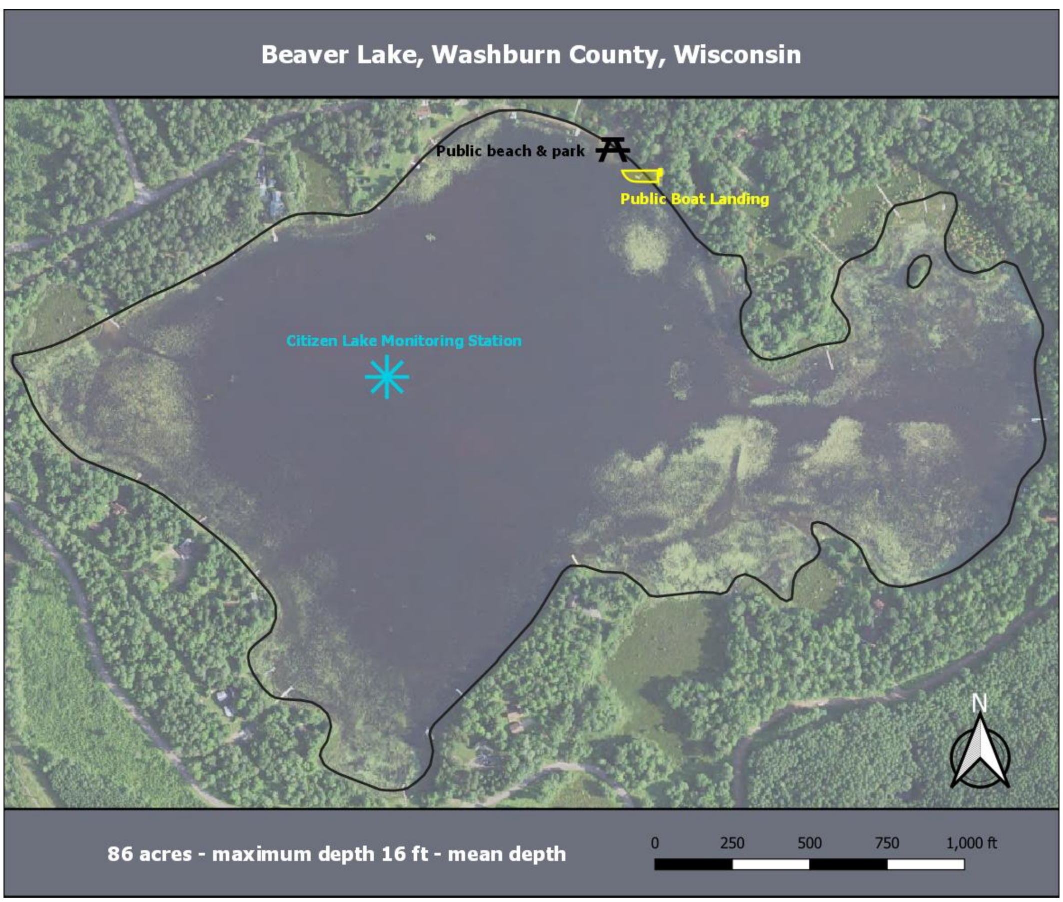
Project Background

The Beaver Lake Association (BLA) was awarded a grant from the DNR in 2021 to complete the first aquatic plant survey of the lake that same year. BLA partnered with Aquatic Plant and Habitat (APHS) services to complete a point-intercept aquatic plant survey of all species in 2021.

Study Site

Beaver Lake (WBIC 2452600) is an 86-acre lake in Washburn County, Wisconsin with a maximum depth of 16 feet and mean depth of 8 feet. The lake is classified as a shallow (<18ft), soft-water, seepage lake (no surface water inlet or outlet). Beaver Lake is also classified as oligotrophic based on levels of chlorophyll in 2007. The lake also has a mean summer secchi depth of 10 feet and mean phosphorus of 15 µg/l based on water sampling by volunteers in 2007 (WDNR, 2021). Lakes that have more than 20 µg/l of phosphorus may experience noticeable algae blooms, but this is not the case in Beaver Lake where water clarity is high.

Figure 1 – Beaver Lake Map

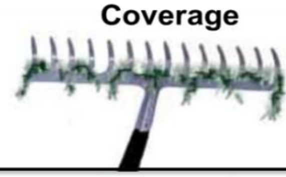
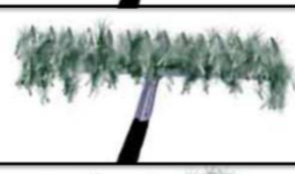
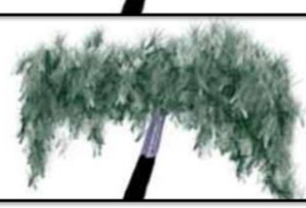


METHODS

Field Methods

Field methods followed the standardized protocol developed by the Wisconsin Department of Natural Resources (WDNR) in Hauxwell et. al (2010) and the survey was completed July 29-30th, 2021. A grid of survey points that were 35 meters apart was provided by the DNR (Appendix A). Since Beaver Lake has a relatively shallow maximum depth of 16 feet, all points were sampled. The survey coordinates were uploaded to an iPhone using Avenza Maps application, allowing navigation to each survey point on the lake. A double-sided rake head on a telescopic pole was used to sample each point ≤15 feet deep for aquatic plants, depth, and dominant sediment type (muck, rock, or sand). Sonar was used to gauge depth at points that were greather than 15 feet deep and a weighted double-sided rake attached to a rope was used to sample aquatic plants at those points. The rake fullness rating for total coverage of plants on the rake and a separate rake fullness rating for each species present were recorded (Figure 2). One sample point was inaccessible due to shallow water and abundant vegetation, so no sample was taken at that single location, which is illustrated at the northeast bay in Figure 4. Aquatic plants found within 6 feet of the sample point but not found on the rake were counted as visual observations. Occurrence of species greater than 6 feet from any survey point were recorded to note their presence as part of a boat survey, but were not counted in statistical calculations. Plant identification was verified using Skawinski (2018) and by mailing selected voucher specimens (bright green spikerush & Robbins' spikerush) to Dr. Robert Freckmann at the University of Wisconsin-Stevens Point.

Figure 2 - Rake Fullness Rating Illustration

Rating	Coverage	Description
1		Few plants
2		Plants cover length of the rake but not tines
3		Rake completely covered, tines not visible

Data Analysis Methods
Survey data were used to calculate statistics including Simpson Diversity Index, species richness, Nichols (1999) Floristic Quality Index, frequencies, rake fullness, number of visual sightings, and other summary statistics. The "Aquatic Plant Survey Data Workbook" was downloaded from the UW-Extension Lakes webpage and the spreadsheet was populated with data collected from Beaver Lake. Species that were recorded as visuals (i.e., within 6 feet of a survey point but not sampled with the rake) were not included in Simpson Diversity Index and FQI calculations.

Lake-wide Plant Statistics
Lake-wide plant statistics provide a general overview of the plant community and can be used to compare Beaver Lake to itself in future surveys or to other lakes in the region or state. Floristic Quality Index (FQI) is summarized in Table 1, but elaborating on this metric developed by Nichols (1999) is worthwhile. Aquatic plant species native to Wisconsin have a Coefficient of Conservatism (C) ranging from 0 to 10. The C value estimates the likelihood of that plant species occurring in an environment that is relatively unaltered from pre-settlement conditions. As human disturbance increases, species with a lower C value occur more frequently while more sensitive species with a higher C value occur less frequently. To calculate floristic quality, the mean C value of all species found in the lake is multiplied by the square root of the total number of plant species in the lake. Only plants found on the rake are included in the calculations. Overall, the FQI metric helps us understand how close the aquatic plant community is to one of undisturbed conditions. A higher FQI value assumes a healthier aquatic plant community. Floristic quality values can be compared on a statewide value, but Nichols (1999) recommends comparing values within one of the four ecoregional-lake types. Beaver Lake falls within the "Northern Lakes and Forests" eco-regional lake type.

Individual Plant Species Statistics
Individual species statistics assess the plant species composition in Beaver Lake and allow for comparisons of the plant community within the lake (Table 1). Relative frequency values are helpful because they consider the number of times a particular species is found divided by the total number of times vegetation occurred. Frequency of occurrence at sites shallower than the maximum rooting depth, or littoral frequency, is a helpful metric in comparing plant occurrence among different survey years.

Map Development
Aquatic plant survey data were uploaded to an open source geographic information systems (GIS) program known as QGIS (QGIS, 2021). Maps were created to illustrate depth ranges, sediment type, total rake fullness for all species, and individual plant species distribution. Some maps are part of the Results Section while the remainder are compiled in Appendix B.

Table 1 – Statistics Explanation Tables

Summary Statistics Explanations

	Statistic	Explanation
1	Total number of sites visited	The total number of sites sampled, which is not necessarily equal to the number of survey points because some sites may not be accessible.
2	Total number of sites with vegetation	Number of sites where at least one plant was found on the rake (does not include moss, sponges, filamentous algae, or liverworts).
3	Maximum depth of plants	Depth of deepest site where at least one plant was found on the rake (does not include moss, sponges, filamentous algae, or liverworts).
4	Total number of sites shallower than maximum depth of plants	Number of sites where depth was less than or equal to the maximum depth where at least one plant was found on the rake.
5	Frequency of occurrence at sites shallower than maximum depth of plants (Littoral FOO)	Total number of sites with vegetation (2) / Total number of sites shallower than maximum depth of plants (4).
6	Average number of species per site (split into four subcategories)	a) Shallower than maximum depth – the average number of species found per site at sites less than or equal to the maximum depth where at least one plant was found on the rake (4).
		b) Vegetated sites only – the average number of species found per site at sites where at least one plant was found on the rake (2).
		c) Native species shallower than maximum depth – Same explanation as 6(a), non-native species excluded from average.
		d) Native species at vegetated sites only – Same explanation as 6(b), non-native species excluded from average.
7	Species Richness (split into two subcategories)	a) Total number of species found on the rake at all sites (does not include moss, sponges, filamentous algae, or liverworts
		b) Including visuals – Same explanation as 7(a) and including visual observations within 6 feet of the sample sight
8	Simpson Diversity Index	Estimates the heterogeneity of a community by calculating the probability that two individuals randomly selected from the data set will be different species. The index ranges from 0-1, and the closer the value is to one, the more diverse the community. Visual observations (within 6 feet of sample point) are not included in calculation of index.
9	Coefficient of Conservatism (C)	This is not a statistical calculation, but rather a value assigned to each plant species based on how sensitive that species is to disturbance. C values range from 1 to 10 with higher values assigned to species that are more sensitive to disturbance (Nichols, 1999).
10	Floristic Quality Index	How similar the aquatic plant community is to one that is undisturbed (Nichols, 1999). This index only factors species raked at survey points and does not include non-native species. The FQI is calculated using coefficient of conservatism values (9).

Individual Species Statistics Explanations

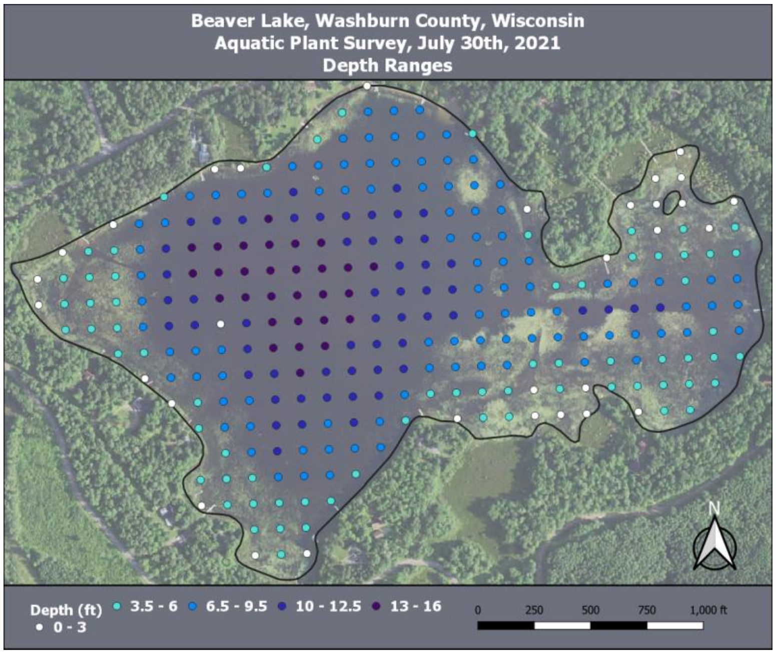
Individual Statistic	Explanation
Average Rake Fullness	Mean rake fullness rating ranging from 1 to 3. See Rake Fullness Illustration.
# Sites	The total number of survey points where a particular species was found on the rake.
# Visual	The total number of times a particular species was visually observed within 6 feet of a sampling point, but not collected on the rake.
Frequency of Occurrence "FOO" (split into two subcategories	a) FOO in vegetated areas only – The number of sites at which a particular species is found on the rake divided by the total number of vegetated sites (Table 2, #2).
	b) Littoral FOO – The number of sites at which a particular species is found on the rake divided by the total number of sites less than or equal to the maximum depth of plants (Table 2, #4). Also known as littoral frequency.
Relative frequency (%)	This value represents the degree to which a particular species contributes to the total of all observations. The sum of all relative frequencies is 100%.

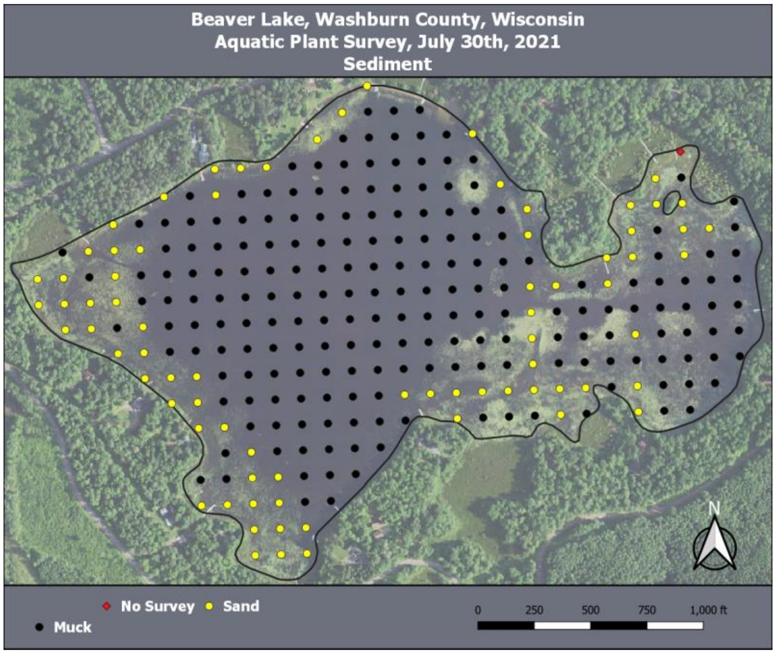
RESULTS

Depth, & Sediment

Due to the shallow maximum depth of Beaver Lake (16 ft), all sample points were surveyed and none were too deep for aquatic plant growth. As illustrated in Figure 3, the majority of sample points were 12.5 feet or shallower. The sediment type was recorded as muck, sand, or rock. There were no sample points with rocky sediment while some near-shore areas had more firm and sandy sediment. The majority of sample sites had a soft bottom and were recorded as muck.

Figure 3 – Depth & Sediment Maps





Lake-wide Plant Survey Results

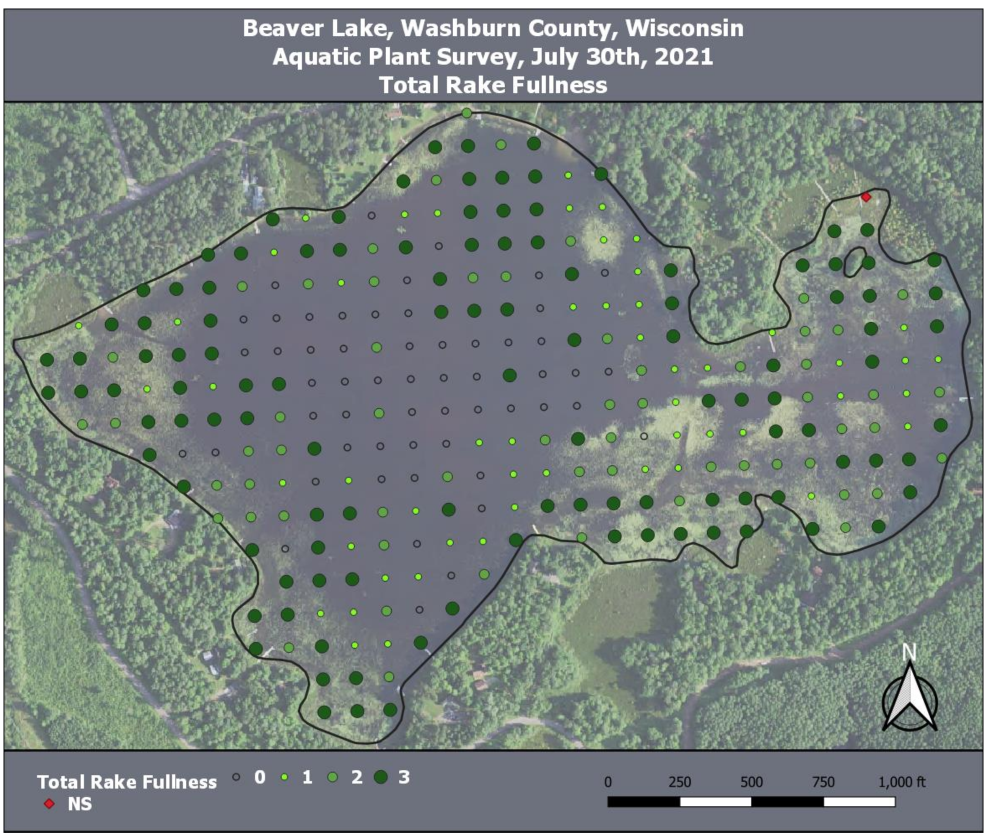
A total of 280 points were sampled with the rake in Beaver Lake. Of the 280 points that were sampled with the rake, 226 had vegetation present and the maximum depth of plants was 16 feet, which was also the maximum depth of the lake (Table 2, Figure 4).

A total of 20 species of aquatic plants were found, 8 of which were "visual only" (i.e., within 6 feet of the survey point but not found on the rake) and one of which was documented as part of the boat survey (> 6 feet from any survey point, not counted in Table 2). A complete list of species is in Table 3. The Simpson Diversity Index was 0.69 on a scale from 0 to 1 (See Table 1, #8 for explanation).

Table 2 – Summary Statistics Results

Summary Statistic			July 30, 2021
1	Total # of sites visited		280
2	Total # of sites with vegetation		226
3	Max. depth of plants (feet)		16 ft
4	Total # of sites shallower than max. depth of plants		280
5	Frequency of occurrence (FOO) at sites shallower than max. depth of plants. AKA Littoral frequency		80.71
6	Average # of species per site	a) Shallower than max. depth	1.44
		b) Vegetated sites only	1.79
		c) Native shallower than max. depth	1.44
		d) Native species at vegetated sites only	1.79
7	Species Richness	a) Total # species on rake at all sites	11
		b) Including visuals	19
8	Simpson's Diversity Index		0.69
9	Mean Coefficient of Conservatism		7.45
10	Floristic Quality Index		24.72

Figure 4 – Total Rake Fullness Map



Individual Plant Species Results

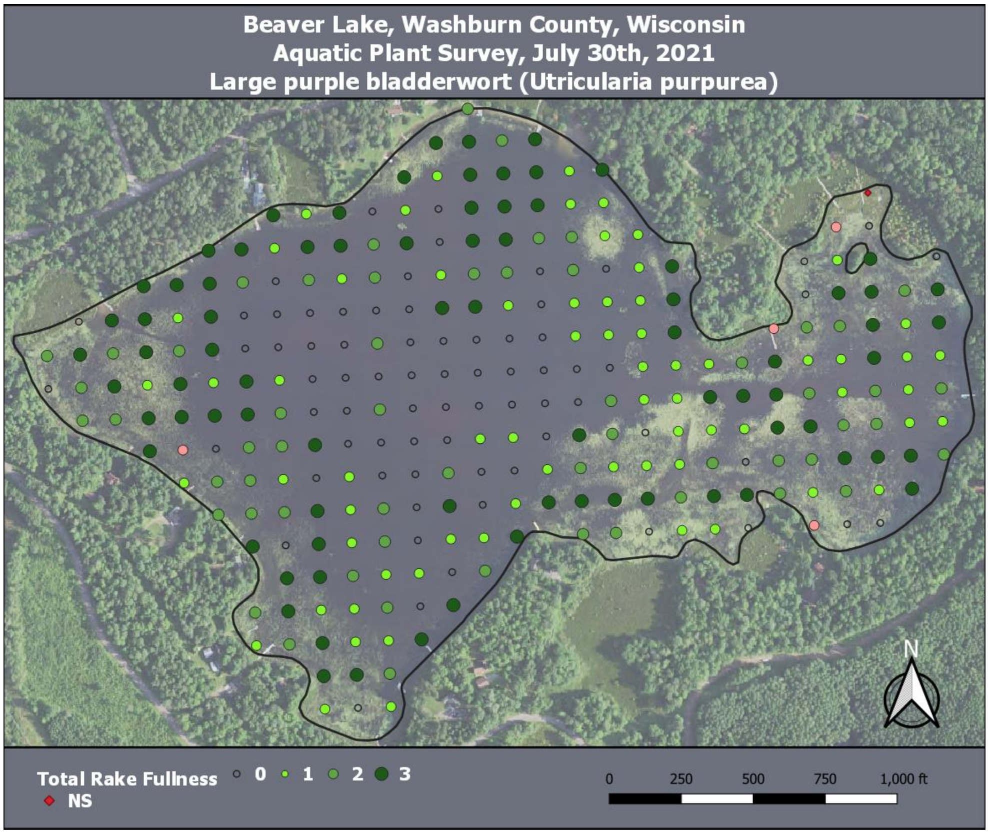
There were 20 aquatic plant species found during the plant survey (Table 3). No non-native aquatic invasive species were found. Eleven (11) native plant species were found on the sampling rake. Large purple bladderwort was the most commonly found species in the lake with occurrence at 205 sites and relative frequency of 51%. The next most common plant species was creeping bladderwort at 66 sites and a relative frequency of 16%. The third most common plant was fern pondweed at 35 sites and relative frequency of 9%. Distributions of these species are illustrated in Figure 5 and Figure 6. The total relative frequency of the three plants combined is 76%, which suggests a homogeneous plant community in the lake (i.e., the same species are often found at different sample points). This homogeneity contributed to a low Simpson Diversity Index score of 0.69.

Table 3 – Individual Plant Species Results

Common Name	Scientific Name	# Sites	Littoral Frequency	FOO in Veg. Areas	Relative Frequency	Avg. Rake Fullness	# Visual
Large purple bladderwort	*Utricularia purpurea*	205	73.21	90.71	50.74	2.06	4
Creeping bladderwort	*Utricularia gibba*	66	23.57	29.20	16.34	1.00	0
Fern pondweed	*Potamogeton robbinsii*	35	12.50	15.49	8.66	1.83	0
Watershield	*Brasenia schreberi*	33	11.79	14.60	8.17	1.94	13
Water bulrush	*Schoenoplectus subterminalis*	24	8.57	10.62	5.94	1.21	0
White water lily	*Nymphaea odorata*	21	7.50	9.29	5.20	1.95	14
Floating-leaf pondweed	*Potamogeton natans*	10	3.57	4.42	2.48	1.00	2
Spatterdock	*Nuphar variegata*	6	2.14	2.65	1.49	1.00	18
Dwarf water-milfoil	*Myriophyllum tenellum*	2	0.71	0.88	0.50	1.00	0
Water smartweed	*Polygonum amphibium*	1	0.36	0.44	0.25	1.00	0
Three-way sedge	*Dulichium arundinaceum*	1	0.36	0.44	0.25	1.00	1
Robbins' spikerush	*Eleocharis robbinsii*	*	*	*	*	*	3
Creeping spikerush	*Eleocharis palustris*	*	*	*	*	*	2
Water horsetail	*Equisetum fluviatile*	*	*	*	*	*	1
Pipewort	*Eriocaulon aquaticum*	*	*	*	*	*	1
Vasey's pondweed	*Potamogeton vaseyi*	*	*	*	*	*	1
Common bladderwort	*Utricularia vulgaris*	*	*	*	*	*	1
Bright green spikerush	*Eleocharis flavescens var. olivacea*	*	*	*	*	*	1
Marsh cinquefoil	*Potentilla palustris*	*	*	*	*	*	1
Arrowhead	*Sagittaria sp.*	**	**	**	**	**	**

**Not found on the rake sampler, but found within 6 feet of sample point(s)*
***Species in the lake but greater than 6 feet from any sample point.*

Figure 5 – Maps of Large Purple Bladderwort & Creeping Bladderwort



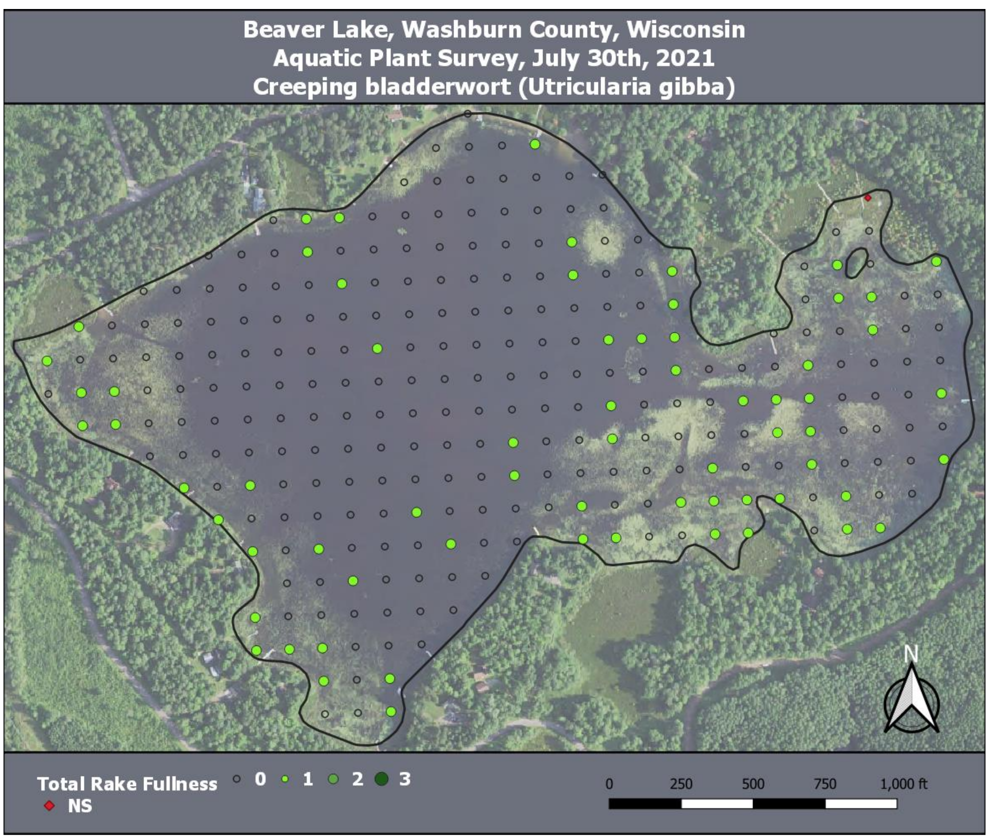
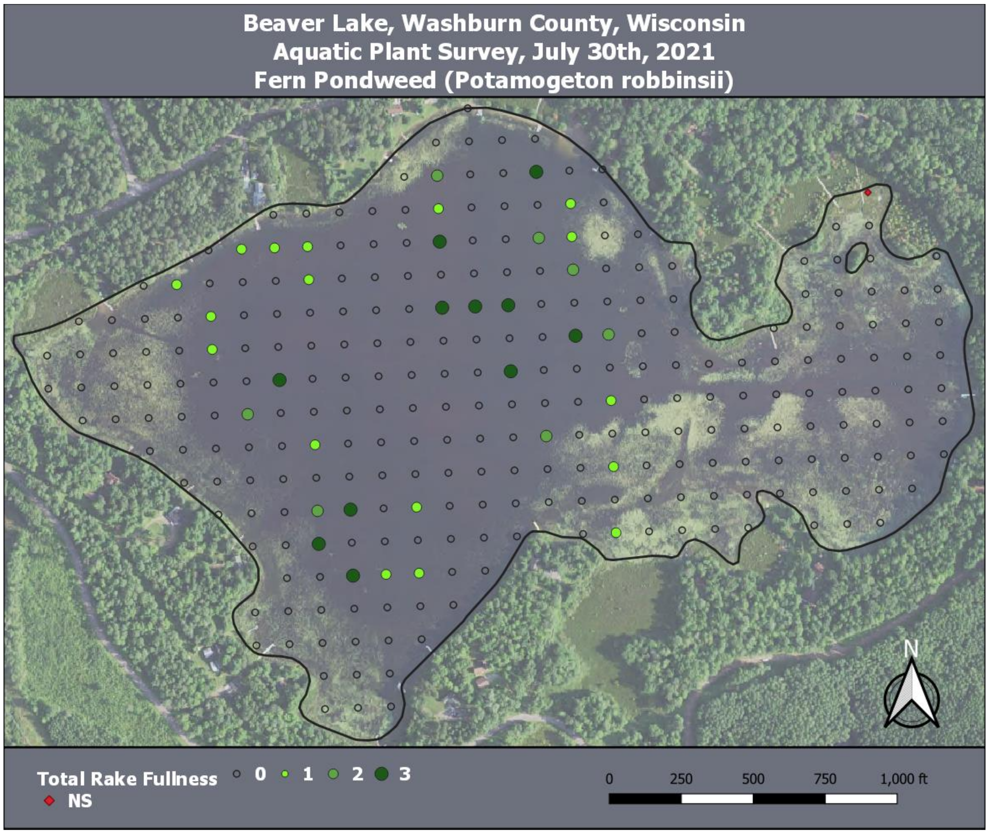


Figure 6 – Map of Fern Pondweed



Floristic Quality

Beaver Lake is located within the Northern Lakes and Forests eco-region. The Floristic Quality Index (FQI) only factors native species raked at survey points. Therefore, 11 species were included in the calculation, which is lower than the average number of species found in lakes in the same eco-region (13) and lower than the statewide average (also 13) (Table 4). The overall floristic quality of Beaver Lake was 24.7 compared to the slightly lower eco-region average of 24.3 and lower state average (22.2). The average C value for Beaver Lake (7.5) was also higher than the state and eco-region averages (Nichols, 1999).

In summary, the species richness for Beaver Lake is lower than the average for lakes in the same eco-region and compared to other lakes in Wisconsin. However, 4 species found in the lake have high C-values of 9 or 10, therefore the average conservatism and floristic quality are higher because of these species.

Table 4 – Floristic Quality Results

<table>
<tr><th colspan="2">Common Name</th><th colspan="2">Scientific Name</th><th>C Value</th></tr>
<tr><td colspan="2">Large purple bladderwort</td><td colspan="2">Utricularia purpurea</td><td>9</td></tr>
<tr><td colspan="2">Creeping bladderwort</td><td colspan="2">Utricularia gibba</td><td>9</td></tr>
<tr><td colspan="2">Fern pondweed</td><td colspan="2">Potamogeton robbinsii</td><td>8</td></tr>
<tr><td colspan="2">Watershield</td><td colspan="2">Brasenia schreberi</td><td>6</td></tr>
<tr><td colspan="2">Water bulrush</td><td colspan="2">Schoenoplectus subterminalis</td><td>4</td></tr>
<tr><td colspan="2">White water lily</td><td colspan="2">Nymphaea odorata</td><td>6</td></tr>
<tr><td colspan="2">Floating-leaf pondweed</td><td colspan="2">Potamogeton natans</td><td>5</td></tr>
<tr><td colspan="2">Spatterdock</td><td colspan="2">Nuphar variegate</td><td>6</td></tr>
<tr><td colspan="2">Dwarf water-milfoil</td><td colspan="2">Myriophyllum tenellum</td><td>10</td></tr>
<tr><td colspan="2">Water smartweed</td><td colspan="2">Polygonum amphibium</td><td>5</td></tr>
<tr><td colspan="2">Three-way sedge</td><td colspan="2">Dulichium arundinaceum</td><td>9</td></tr>
<tr><td>N</td><td>Statewide 13</td><td>Region 13</td><td>Beaver Lake</td><td>11</td></tr>
<tr><td>Mean C</td><td>Statewide 6.0</td><td>Region 6.7</td><td>Beaver Lake</td><td>7.5</td></tr>
<tr><td>FQI</td><td>Statewide 22.2</td><td>Region 24.3</td><td>Beaver Lake</td><td>24.7</td></tr>
</table>

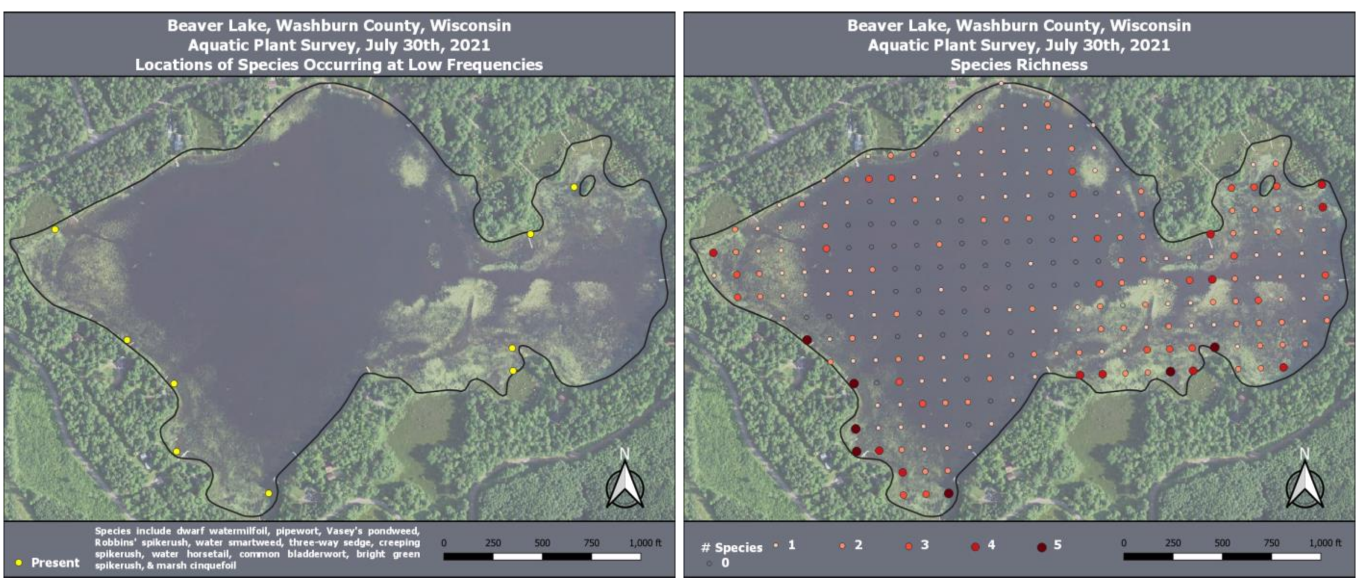
High Value, Sensitive, Low Frequency, & Species Richness

There were four species with a high conservatism (C) value of 9 or 10 documented at sample points in Beaver Lake including large purple bladderwort, creeping bladderwort, dwarf watermilfoil, and three-way sedge. These species contributed to a higher-than-average floristic quality despite the relatively low species richness in Beaver Lake. In addition, but not included in FQI calculations, there were four more species with a high C value within 6 feet of sample points but not on the sample rake including Robbins' spikerush, pipewort, Vasey's pondweed, and bright green spikerush. C value estimates the likelihood of that plant species occurring in an environment that is relatively unaltered from pre-settlement conditions. As human disturbance occurs, species with a low C value are considered less sensitive and more likely to dominate a lake.

Eleven (11) native species occurred with low frequency (fewer than 10 occurrences, including visual observations). The locations of these species is illustrated in Figure 7 and includes dwarf watermilfoil, water smartweed, three-way sedge, Robbins' spikerush, creeping spikerush, water horsetail, pipewort, Vasey's pondweed, common bladderwort, bright green spikerush, and marsh cinquefoil. Specimens of Robbins' spikerush and bright green spikerush were mailed to Dr. Robert Freckmann at UW-Stevens Point for vouchering. The bright green spikerush identification was made by Dr. Freckmann. The Robbins' spikerush specimens were lacking spikelets (flowering parts) and therefore uncertain. However, the presence of numerous slender, thread-like shoots among the stouter, 3-sided, emergent stems suggests the determination as Robbins' spikerush to be correct.

The number of species found at vegetated sites ranged from 1 to 5 with a low average of 1.79. This is illustrated in the Native Species Richness map (Figure 7), which reveals the sites with highest species richness are mainly scattered along the southern shore.

Figure 7 – Maps of Species Richness & Low Frequency Species

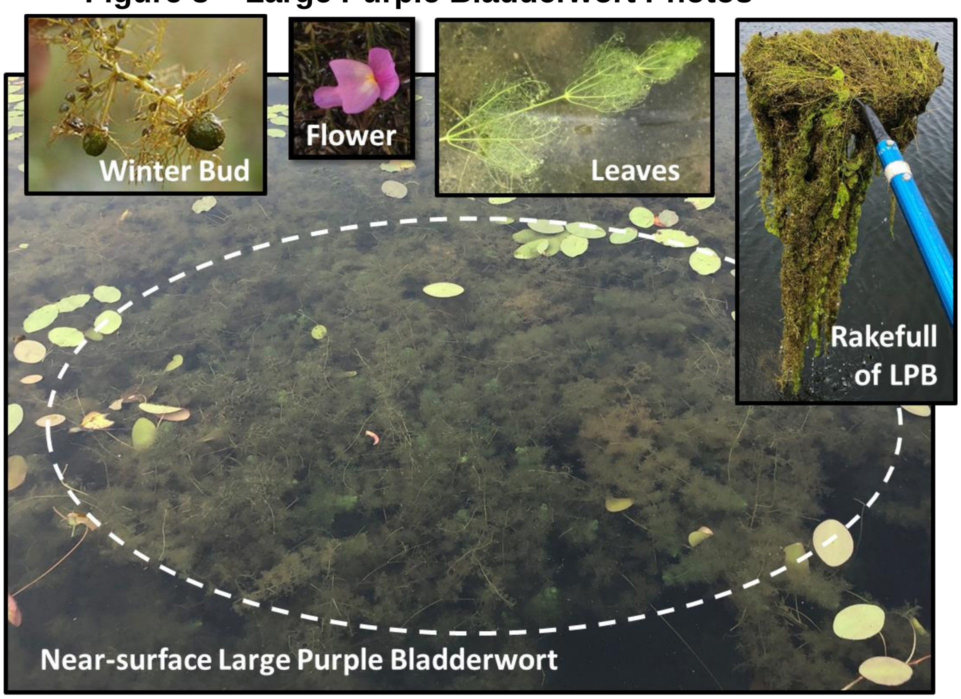


Large Purple Bladderwort

Large purple bladderwort (LPB) was the most commonly occurring plant species found throughout the lake at 73% of sampling points as shown in Figure 5. Some lake residents perceived navigation impairment caused by clumps of dense, free-floating LPB that grew near or at the water's surface in recent years, prompting the aquatic plant survey in 2021.

Although LPB is a native plant species with a high conservatism value of 9 and generally thought of as a desirable plant, it can sometimes grow abundantly and cause frustration for lake residents. Populations can often fluctuate from one year to the next. High abundance and subsequent nuisance conditions created by LPB is a relatively new phenomenon (15 years) in northwest Wisconsin in seepage lakes similar to Beaver Lake. As a member of the bladderwort family, LPB lacks roots and is generally free-floating but is sometimes anchored to the bottom sediment by plant parts. The finely divided leaves have bladder-like carnivorous traps, believed to be for capturing and digesting microorganisms that provide the plant with nutrients. Recent information suggests that bladders are more often observed to contain bacteria, algae, and diatoms living in the bladders, not as prey, suggesting that the bladders perform mutually beneficial relationships with some organisms[1]. If the plant flowers, purple flowers are held on stalks above the lake surface. LPB reproduces by seed and winter buds (turions), which are structures that forms at the tip of each branch at the end of summer, drop to the lake bottom, and grow the following spring. A single "stem" of bladderwort has a growing end where new growth and branching occurs. The opposite end of that "stem" is the dying end where decay occurs. This suggests the plant does not necessarily fragment but one "stem" (actually a stolon) can branch many times yielding many plants as the stolon decays from the dying end.

Figure 8 – Large Purple Bladderwort Photos



[1] https://www.minnesotawildflowers.info/flower/purple-flowered-bladderwort. 11 Nov. 2021

DISCUSSION AND MANAGEMENT RECOMMENDATIONS

Aquatic Plants are Necessary for Healthy Lakes

Aquatic plants serve important functions in lake systems. They provide structural habitat for small invertebrates that are an important food source for juvenile game fish and adult panfish. Plants provide structural habitat for small fish to hide from predators and vice versa as larger predators lurk amongst plants in wait of forage. They offer foraging and/or hiding structure for reptiles, amphibians, and waterfowl. The shorelines of lakes are buffered from wave action when aquatic plants absorb some of the wave energy. Aquatic plants are important consumers of nutrients that would otherwise be available for nuisance algal growth. For these reasons, native aquatic plants should be protected in lakes and a healthy aquatic plant community should be promoted.

There are times when native aquatic plants grow to nuisance levels that hinder the aforementioned functions. Overabundance can lead to dissolved oxygen depletion during respiration (aquatic plants actually USE oxygen at night) and as plants decompose, thereby reducing oxygen available to aquatic organisms. Although the natural growth and senescence of aquatic plants is an important part of the cycling of nutrients in lakes, an overabundance of vegetation can be associated with nutrient issues, poor fishing, decline in water quality, and general impairment to recreation. Protecting healthy plant communities like that found in Beaver Lake can help avoid these issues.

The Aquatic Plant Community in Beaver Lake

The aquatic plant community in Beaver Lake is lower in species richness but higher in floristic quality compared to other lakes in the Northern Lakes & Forests eco-region and statewide. The native plant species found in the lake have a higher average conservatism (C) value compared to other lakes statewide and in the eco-region. In other words, the lake has low diversity but the species present are those more likely to be found in lakes with low human disturbance (i.e., those species are more "sensitive"). The aquatic plant community is highly homogeneous with the three most common species accounting for 76% of the relative frequency and low Simpson's Diversity of 0.69. This means you are likely to find the same plant species among sample points. Furthermore, the species richness at sample points was low. Protecting biotic diversity is important for any lake and can be achieved, in part, by carefully managing the areas where high diversity and low frequency species occur. According to Figure 7, these areas are scattered but appear most often very near the shoreline.

Aquatic Invasive Species

It is particularly noteworthy that ***no aquatic invasive species were found during the survey***. Protecting the native aquatic plant community from the introduction of invasive plants, especially Eurasian watermilfoil (EWM, *Myriophyllum spicatum),* is important. The nearest verified occurrences of EWM are in Lake Hayward and Lac Courte Oreilles (Sawyer Co.), both of which are approximately 6 miles from Beaver Lake. Curly-leaf pondweed (*Potamogeton crispus)* is also found in Lake Hayward and Lac Courte Oreilles. Initiating a Clean Boats Clean Waters program and citizen-based monitoring for aquatic invasive species are ways to prevent their introduction and provide early detection if a new infestation were to occur.

Large Purple Bladderwort in Beaver Lake

Impetus for the aquatic plant survey in 2021 was largely due to the high occurrence of purple bladderwort (LPB) throughout the lake and concerns about LPB causing recreational impairment. Although LPB is native, it is growing in very high abundance and often at the lake surface in near-shore areas. Management options for controlling LPB are limited and funding through the DNR Surface Water Grant Program would be limited, if not unavailable, for mitigation of native plant species.

Per Chapter NR 109, native plants may be manually removed from a 30-foot wide section perpendicular to shore without a permit. This can only occur in a single area and all piers, boatlifts, swim rafts, or other recreational or other water use devices must be within that 30-foot zone. This method can only be employed where other plant control methods are not being used, cannot be used in designated sensitive areas, cannot be used in an area with floating bogs, and all plants must be removed from the lake. At the time of writing this report, there are no designated sensitive areas in Beaver Lake. Property owners considering this method for recreational purposes are encouraged to contact their local WDNR Lakes Coordinator[2] or Aquatic Plant Management specialist[3] if they have any questions or need clarification on native plant removal at their particular site. Additionally, there are no limits on raking loose plant material that accumulates along the waterline. Aquatic invasive species (which are not currently present in Beaver Lake) can be selectively removed by manual means anywhere along shore or in open water area without a permit. Regulations require that the native plant community is not harmed during manual removal of AIS.

Benefits of manual removal include little damage to the lake and plant community, the removal can be highly selective and very effective, and there is no cost. On the other hand, this method is labor intensive and only appropriate for small-scale removal.

Table 5 - Management Recommendations

1. Protect native aquatic plants as they provide important structural habitat and contribute to a healthy lake system. If manual removal is necessary in near shore areas, follow regulations listed in NR 109 (referenced on pg 18 of this report).
2. Conduct watercraft inspections and early detection efforts to prevent the introduction of new aquatic invasive species, particularly Eurasian watermilfoil and curly-leaf pondweed. Apply for a Clean Boats Clean Waters grant in 2022 to help fund this effort.
3. Revive volunteer water chemistry and clarity monitoring.
4. Initiate citizen-based aquatic invasive species monitoring through the Citizen Lake Monitoring Network.
5. Use outreach and education to make residents aware of aquatic invasive species, better understand large purple bladderwort, and recruit volunteers for important monitoring work.

[2] In 2021, this is Pamela Toshner, WDNR Lakes Coordinator, 715-635-4073, pamela.toshner@wisconsin.gov

[3] In 2021, this is Tyler Mesalk, Aquatic Plant Management, 715-635-4227, tyler.mesalk@wisconsin.gov

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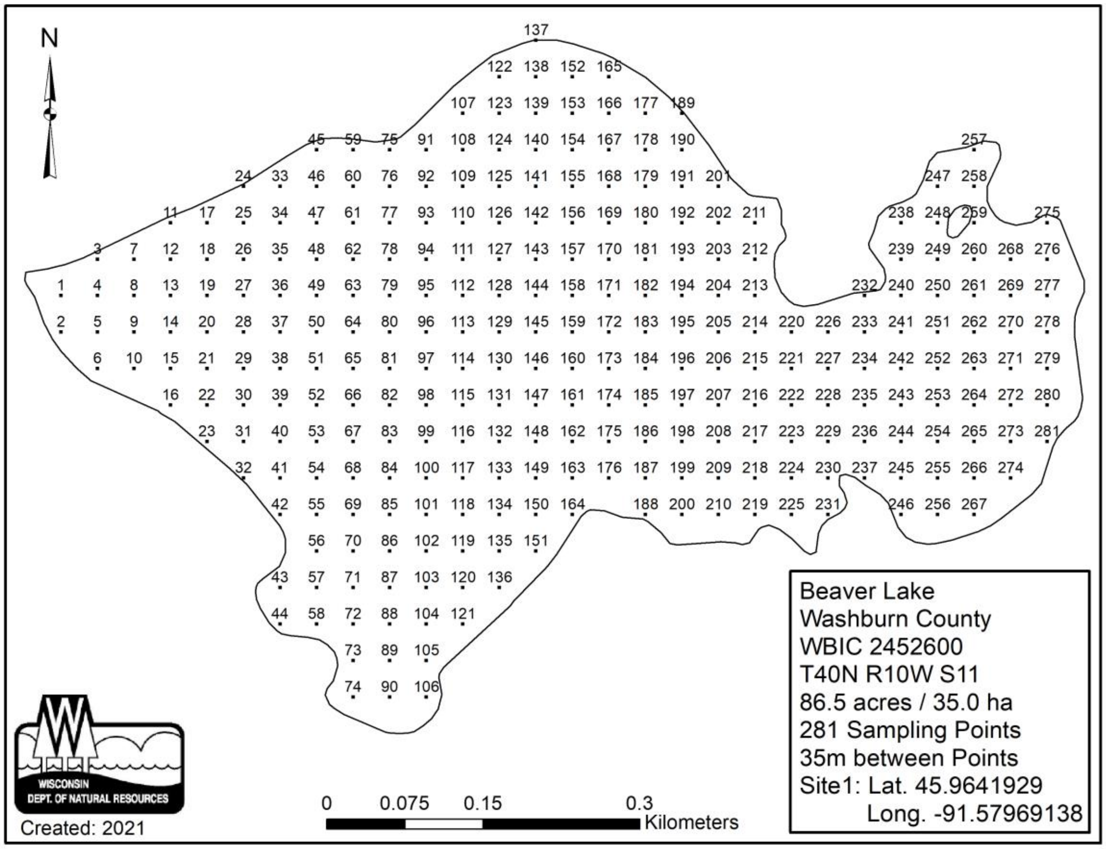
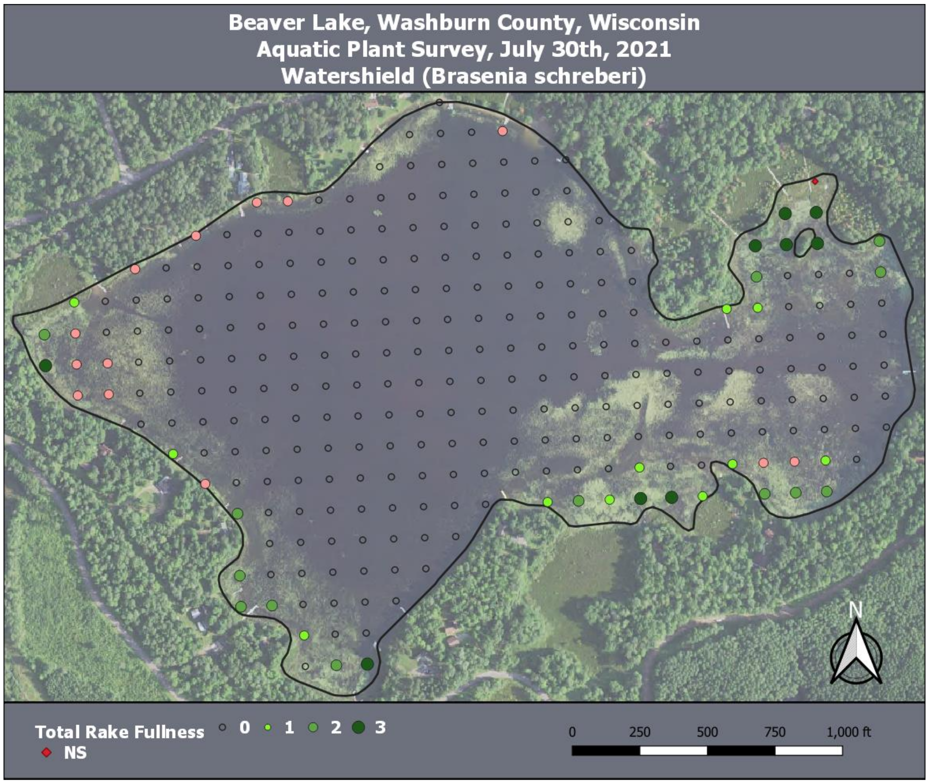
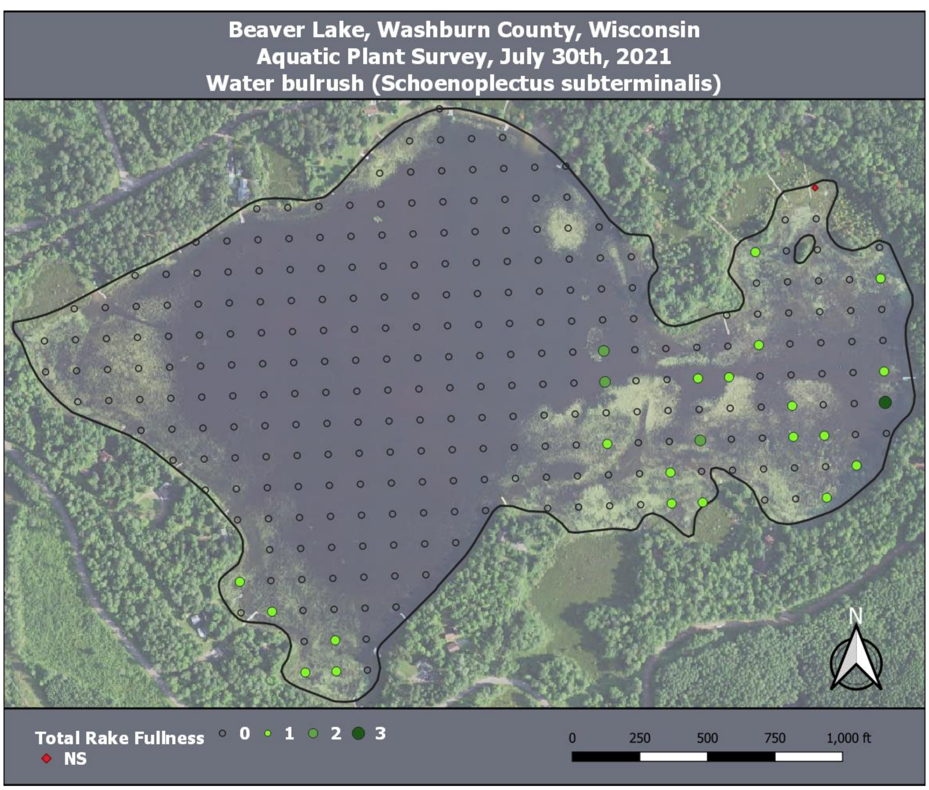
APPENDIX A – POINT INTERCEPT SURVEY MAP

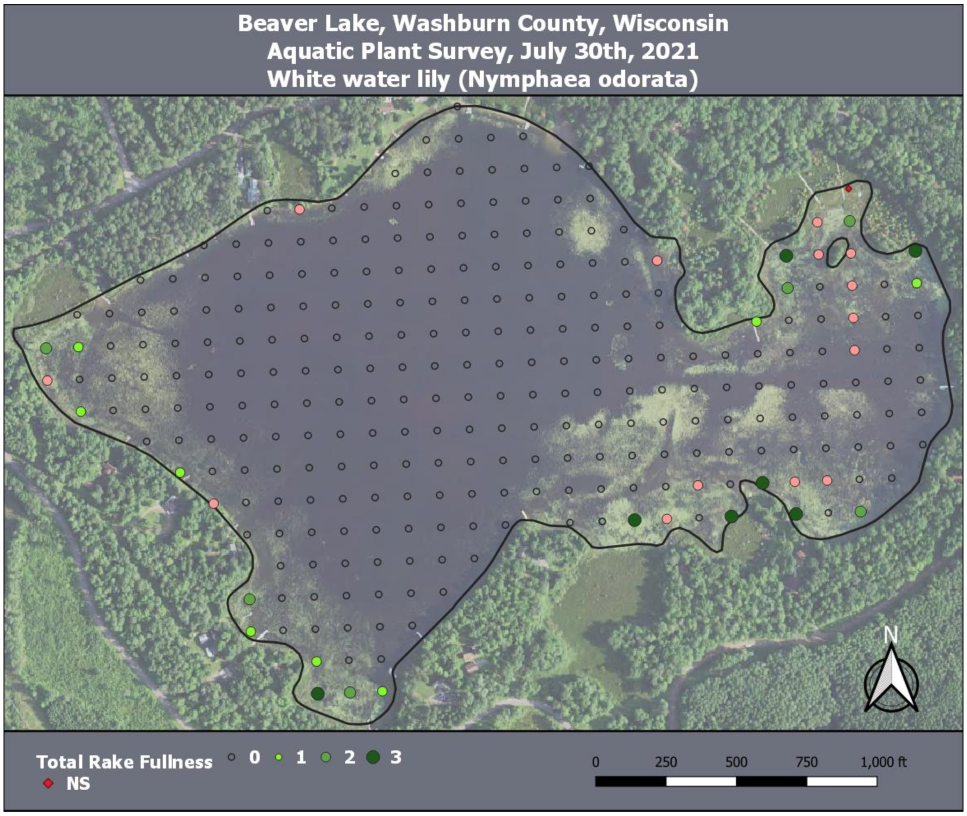


APPENDIX B – AQUATIC PLANT SURVEY MAPS

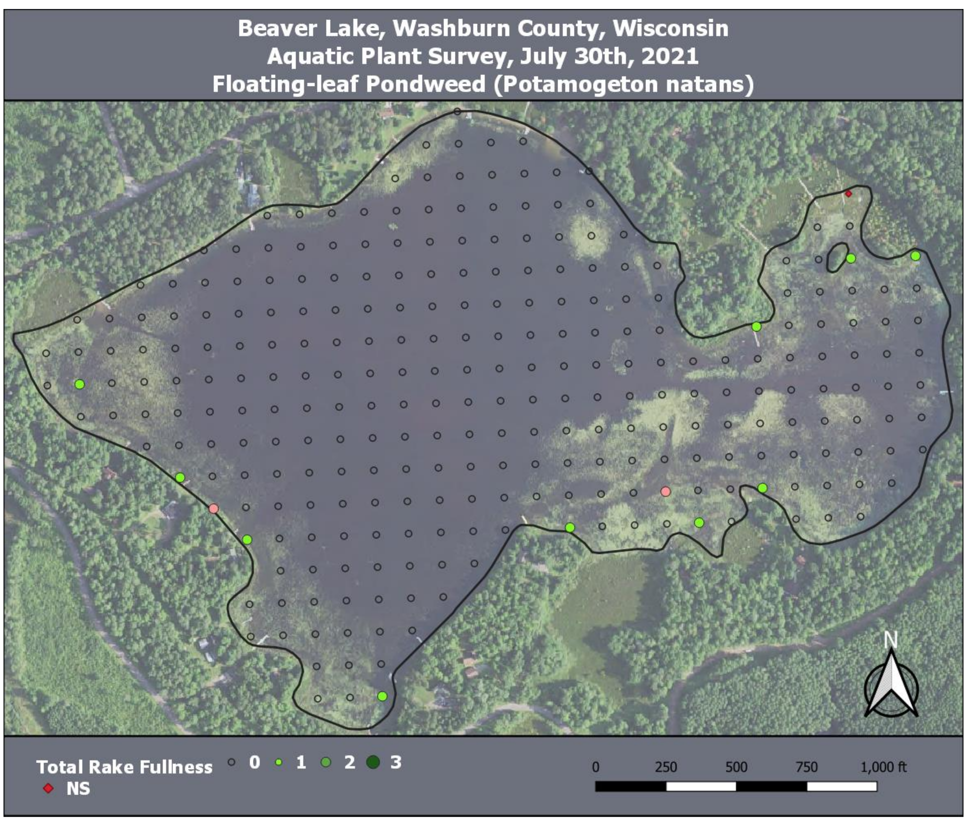
Includes maps not already in the main body. Species maps are in order of relative frequency values in Table 3.



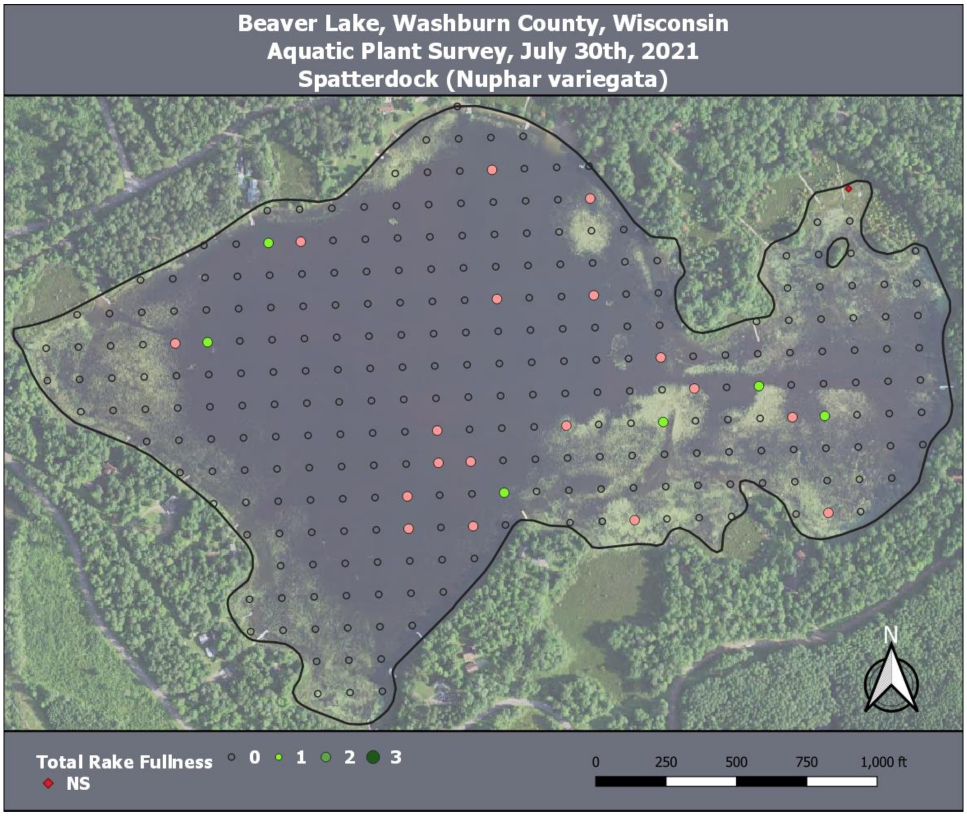


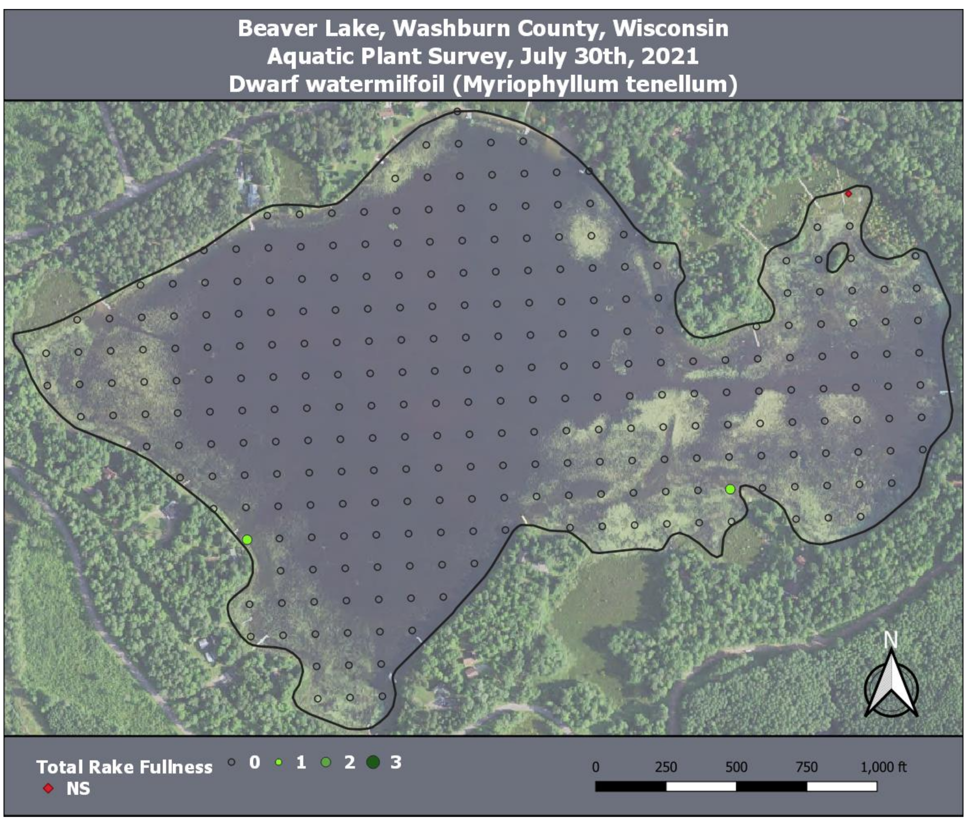


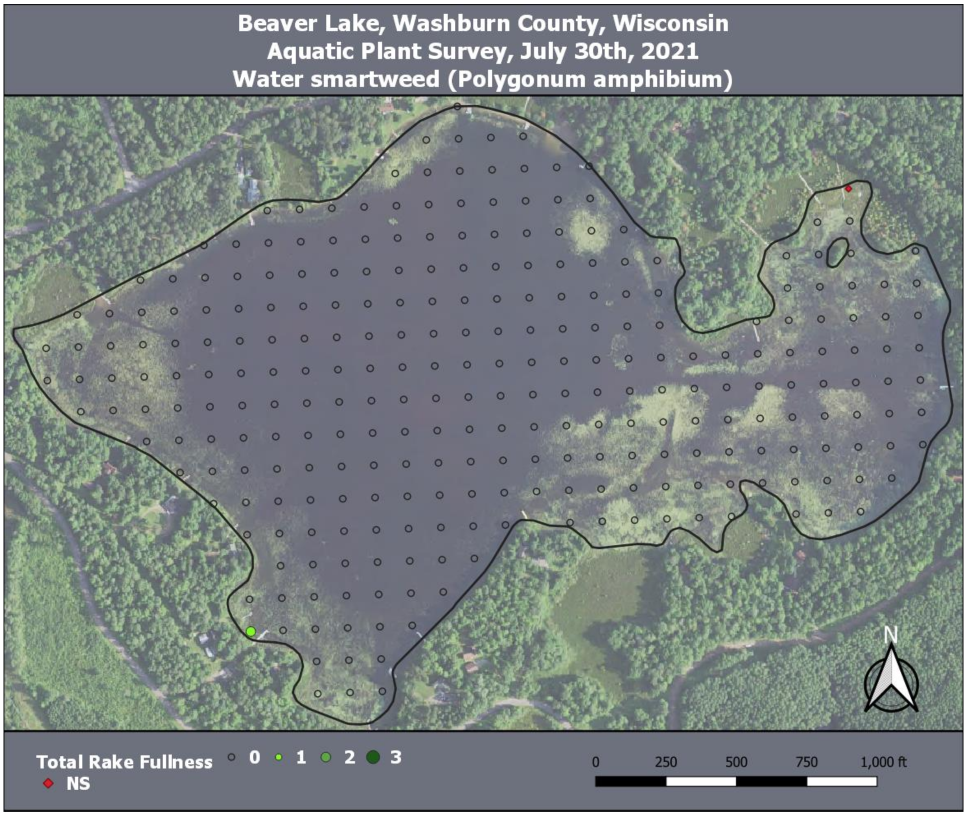
Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
White water lily (Nymphaea odorata)
N
Total Rake Fullness
0
1
2
3
NS
0
250
500
750
1,000 ft

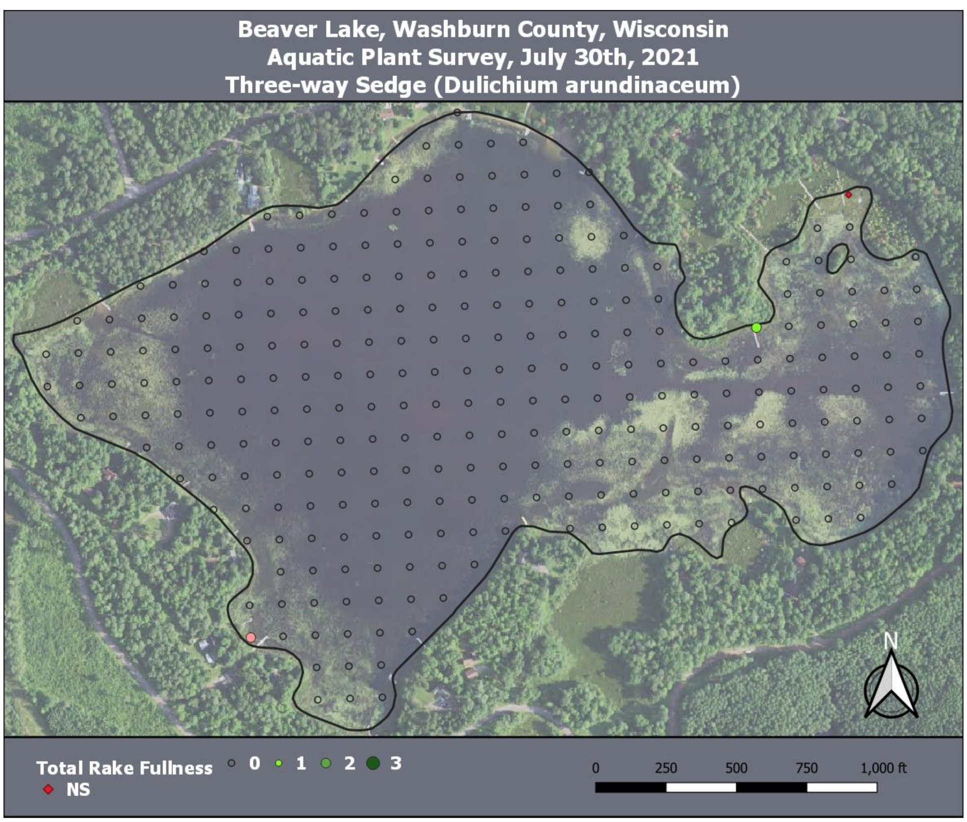


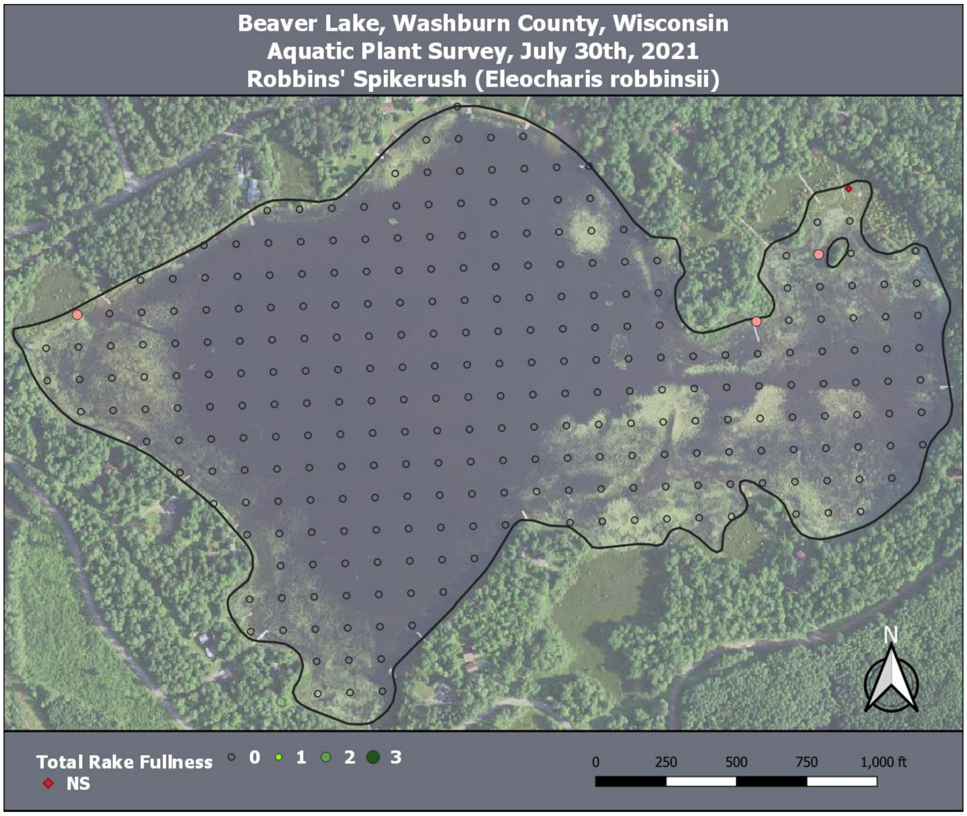
Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
Floating-leaf Pondweed (Potamogeton natans)
N
Total Rake Fullness
0
1
2
3
NS
0
250
500
750
1,000 ft

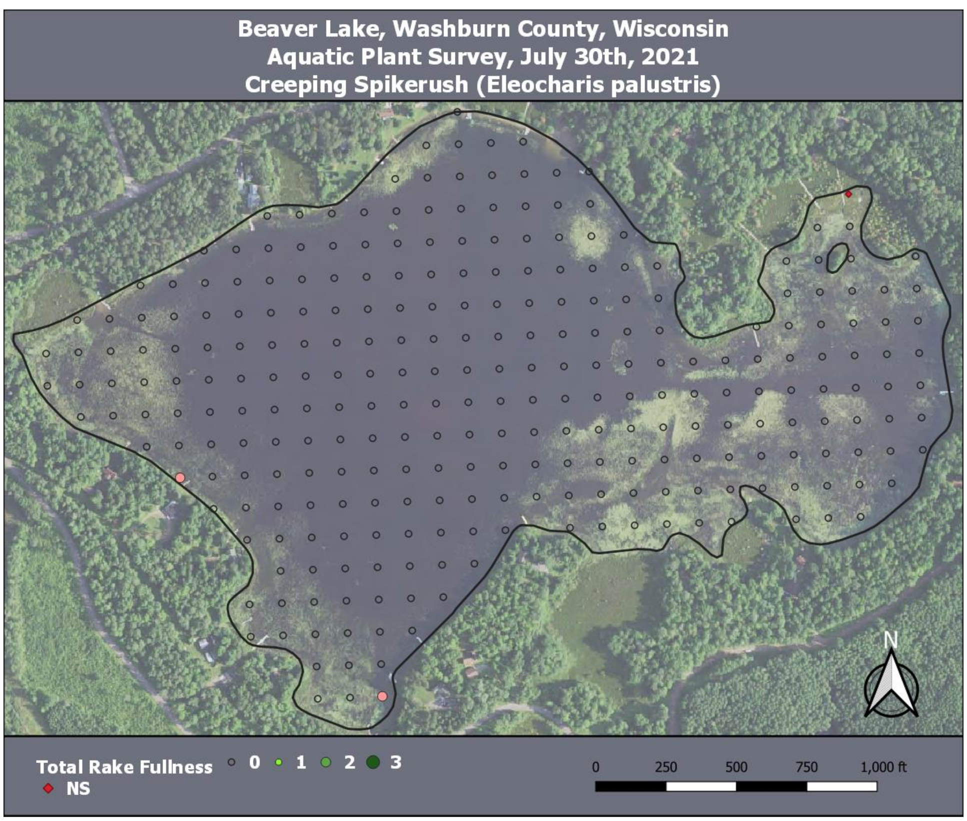

Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
Spatterdock (Nuphar variegata)
N
Total Rake Fullness
0
1
2
3
NS
0
250
500
750
1,000 ft

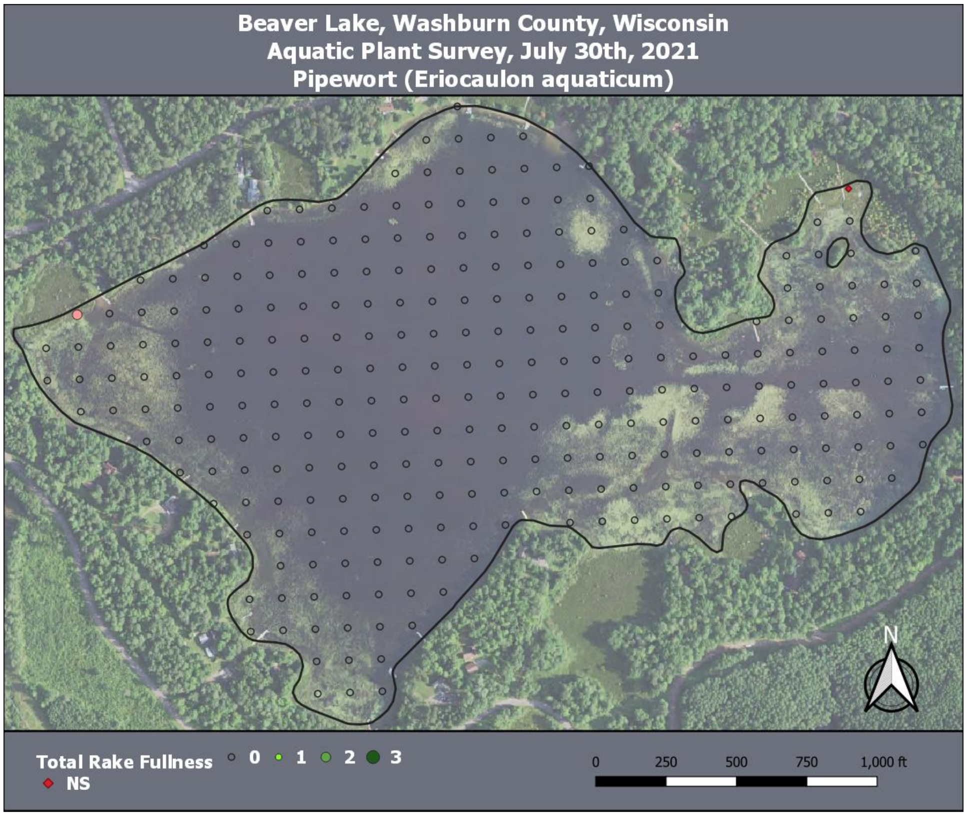

Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
Dwarf watermilfoil (Myriophyllum tenellum)
N
Total Rake Fullness
0
1
2
3
NS
0
250
500
750
1,000 ft

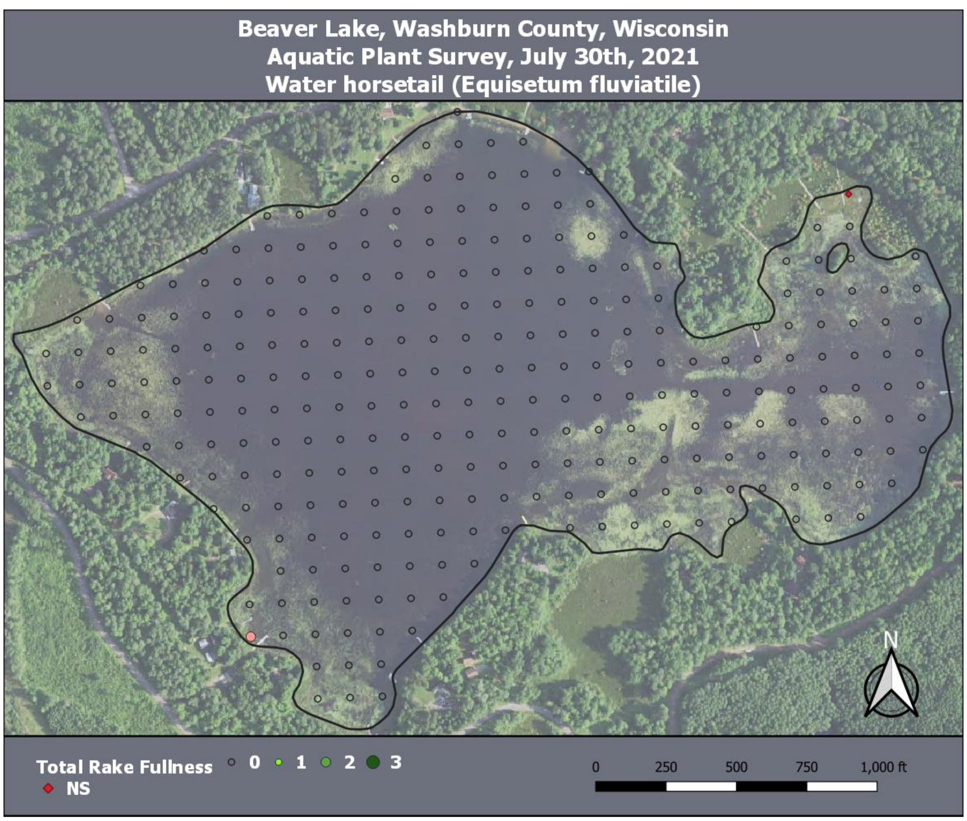

Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
Water smartweed (Polygonum amphibium)
N
Total Rake Fullness
0
1
2
3
NS
0
250
500
750
1,000 ft

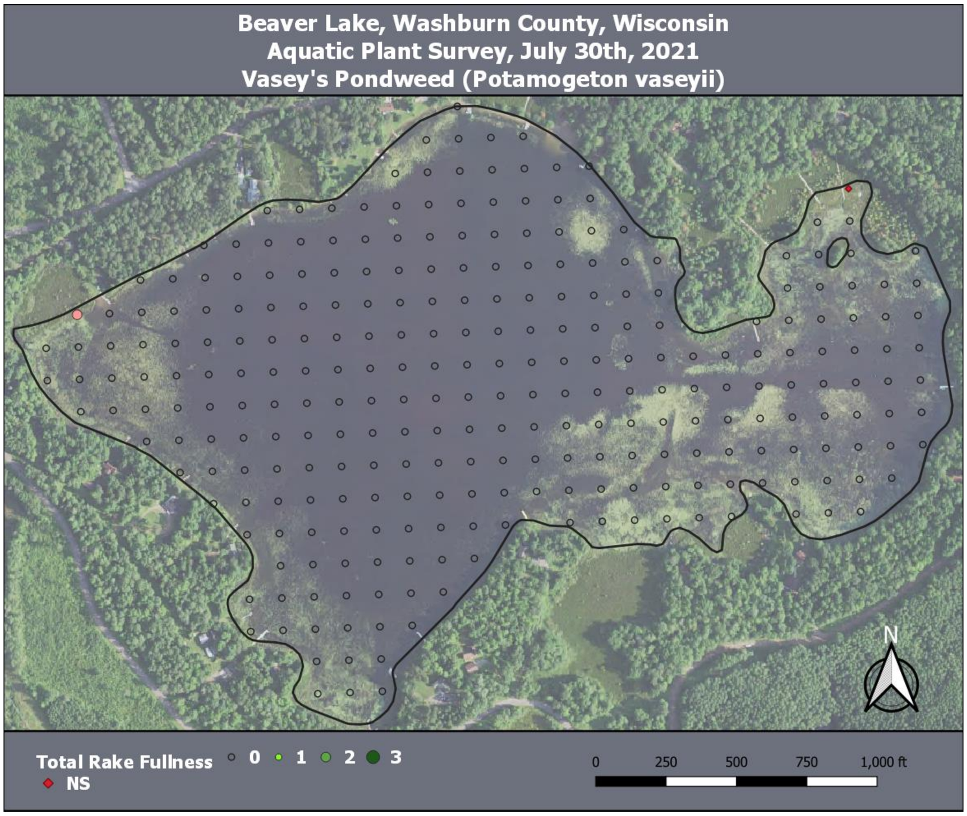

Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
Three-way Sedge (Dulichium arundinaceum)
N
Total Rake Fullness
0
1
2
3
NS
0
250
500
750
1,000 ft

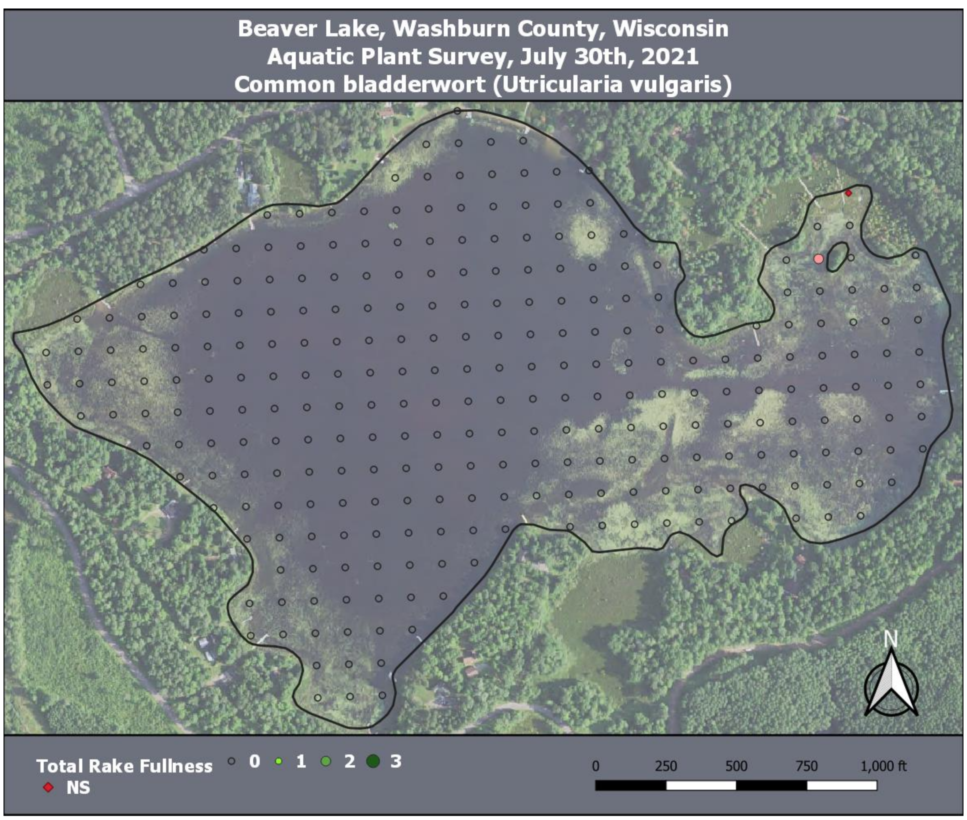

Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
Robbins' Spikerush (Eleocharis robbinsii)
N
Total Rake Fullness
0
1
2
3
NS
0
250
500
750
1,000 ft

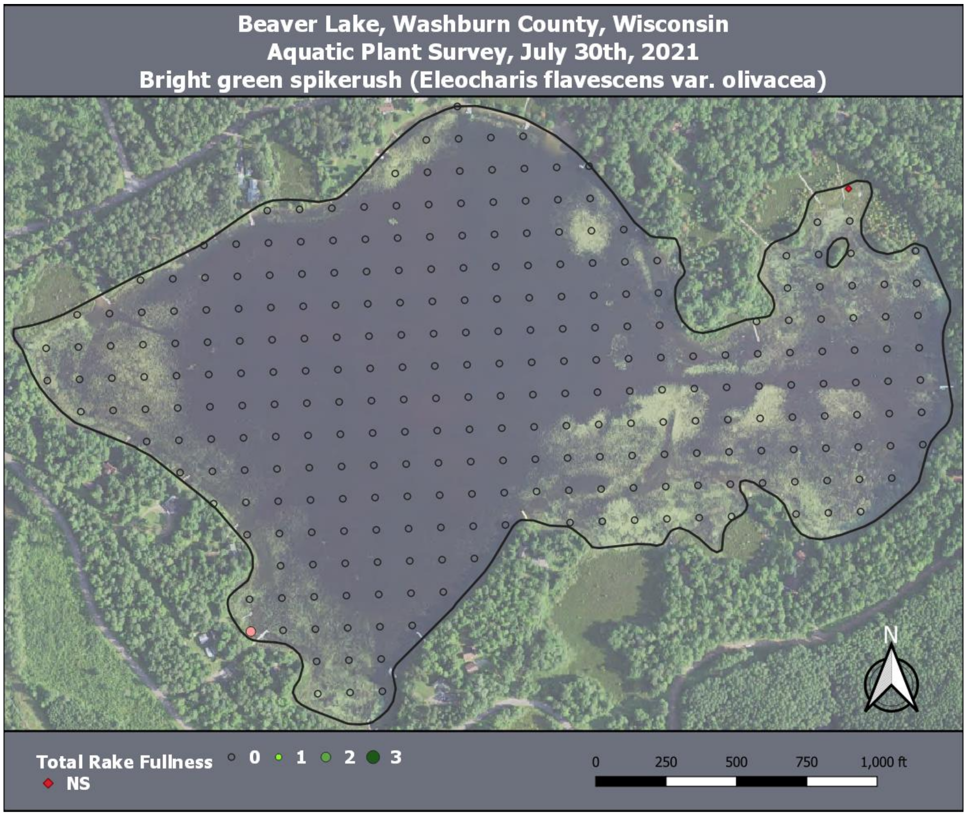

Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
Creeping Spikerush (Eleocharis palustris)
N
Total Rake Fullness
0
1
2
3
NS
0
250
500
750
1,000 ft

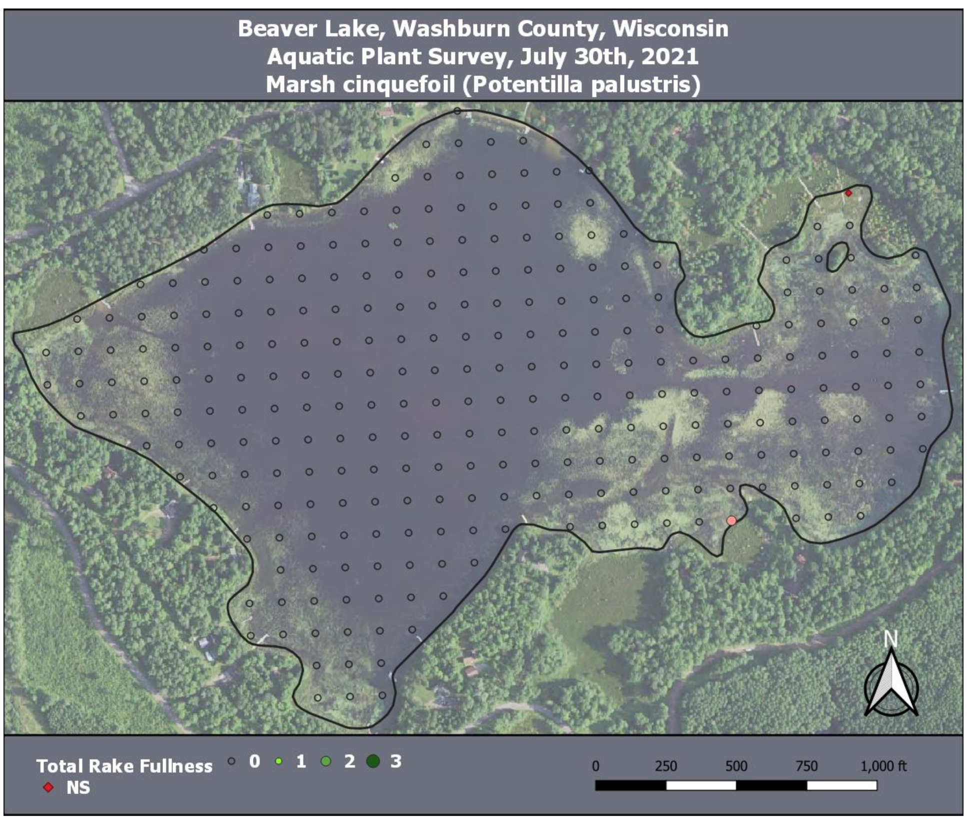

Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
Pipewort (Eriocaulon aquaticum)
N
Total Rake Fullness
0
1
2
3
NS
0
250
500
750
1,000 ft


Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
Water horsetail (Equisetum fluviatile)
N
Total Rake Fullness
0
1
2
3
NS
0
250
500
750
1,000 ft


Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
Vasey's Pondweed (Potamogeton vaseyii)
N
Total Rake Fullness 0 1 2 3
NS
0 250 500 750 1,000 ft


Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
Common bladderwort (Utricularia vulgaris)
N
Total Rake Fullness 0 1 2 3
NS
0 250 500 750 1,000 ft


Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
Bright green spikerush (Eleocharis flavescens var. olivacea)
N
Total Rake Fullness 0 1 2 3
NS
0 250 500 750 1,000 ft


Beaver Lake, Washburn County, Wisconsin
Aquatic Plant Survey, July 30th, 2021
Marsh cinquefoil (Potentilla palustris)
N
Total Rake Fullness 0 1 2 3
NS
0 250 500 750 1,000 ft