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Aquatic Plant Community of Spring Lake *(WBIC 2691200)*

Surveyed July 2011

Prepared for St. Croix Tribal Environmental Services Department – November 2011

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Introduction

Value of Aquatic Plants

Aquatic plants play an important role in freshwater lakes. They anchor sediments, buffer wave action, oxygenate water, and provide valuable habitat for aquatic animals. As a result, the amount and type of plants in a lake can greatly affect nutrient cycling, water clarity, and food-web interactions (Jeppeson et al. 1998). Furthermore, plants are very important for fish reproduction, survival, and growth, and can greatly impact the type and size of fish in a lake. However, healthy aquatic plant communities are frequently degraded by poor water clarity, excessive plant control activities, and the invasion on non-native nuisance plants. These disruptive forces alter the diversity and abundance of aquatic plants in lakes and can lead to changes in many other aspects of a lake's ecology. Consequently, it is very important that lake managers find a balance between controlling nuisance plant growth and maintaining a healthy, diverse plant community.

Purpose of Survey

Spring Lake is a locally important source of northern wild rice (*Zizania palustris*) for wildlife and human consumption. Consequently, it is important to periodically assess the abundance of wild rice and other aquatic plants to (1) track any changes, (2) protect wild rice, and (3) allow for responsible and informed management. This survey was designed to provide a baseline condition for tracking any changes in the plant community over the coming years.

Objectives of Aquatic Plant Survey

1) Develop a list of the aquatic plant taxa found in the lake
2) Estimate the percent of the lake that supports vegetation
3) Assess the abundance and distribution of wild rice in the lake
4) Characterize the distribution and abundance of other aquatic plant taxa in the lake

Description of Lake & Watershed

Spring Lake is a small (54 acres), shallow headwater lake (mean depth 1.4 ft, 3.1 ft max) in Washburn County, WI (Figs. 1 and 2; Table 1). The lake does not have a public boat access ramp, but can be reached via a carry-in access on the southeast shore, adjacent to the lake's outlet. The lake's watershed drains about 7000 acres – an area that is roughly 130 times larger than the lake. However, this watershed is largely undeveloped, with land use consisting of 51% forest, 21% water and wetland, 16% grass/pasture, 5% agriculture, and only 6% residential and commercial (L-THIA model output, Purdue Research Foundation 2010). Furthermore, the watershed is dominated by very permeable soils (type A – sand/sandy loam; L-THIA model output). Consequently, only about 0.5 inches of the typical 26" annual precipitation reaches the lake as runoff (273 acre-ft/y, L-THIA model). Outflow from the lake flows into the Namekagon River, which in turn flows into the St. Croix River.

Figure 1. Location of Spring Lake

Table 1. Spring Lake characteristics

Surface Area	54 acres
Maximum Depth	3.1 ft
Mean Depth	1.4 ft
Lake Volume	76 acre-ft
% Littoral (<15 ft)	100%
Watershed Area	6965 acres
Water Residence Time	0.28 years

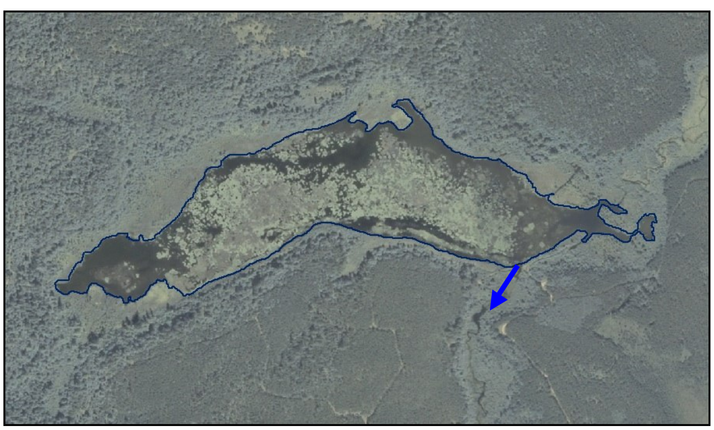


Figure 2. Map of Spring Lake showing typical extent of floating and emergent vegetation; outlet indicated by arrow.

Survey & Analysis Methods

2011 Aquatic Plant Survey

We completed a whole-lake survey of the plants in Spring Lake on July 12, 2011 using the point-intercept method described by Madsen (1999). This survey incorporated assessments at 58 sample points arranged in a grid across the lake (200-ft interpoint spacing, Fig. 5). We generated these sample points using desktop GIS software, the MDNR *Random Sample Generator* extension, and aerial imagery of the lake. We then loaded the sample point locations onto a handheld GPS unit (Garmin GPSMAP-78) to enable navigation to each point while in the field.

At each designated sample point, we sampled plants using a double-headed, 14-tine rake on an extendable pole. To ensure that each sample collected plants from a consistent area of lake sediment, the rake (13 inches wide) was dragged approximately 1 foot along the bottom before retrieving (sample area ~1 square foot). For each rake sample, all of the retrieved plants were piled on top of the rake head and assigned density ratings from 1 to 3 based upon rake coverage as described in Table 2.

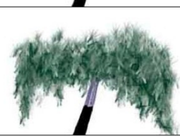
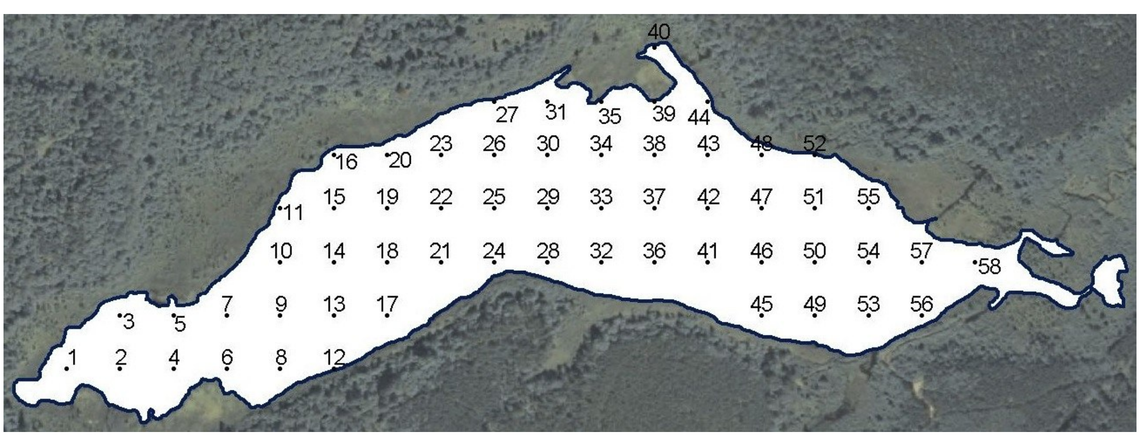
Fullness Rating	Coverage	Description
1		Only few plants. There are not enough plants to entirely cover the length of the rake head in a single layer.
2		There are enough plants to cover the length of the rake head in a single layer, but not enough to fully cover the tines.
3		The rake is completely covered and tines are not visible.

Table 2. Description of rake density ratings (provided by Wisconsin DNR)

Density ratings were assigned for all plants collectively (whole rake density) as well as for each individual plant species retrieved on the rake. Additional species that were observed growing within 10 ft of a sample point but not retrieved on the rake were given a rating of zero for that site. These "zero" species were included in the final species lists and distribution maps, but were not included in the calculation of plant community metrics and statistics.

Figure 5. Map of sample points used for the 2011 point-intercept aquatic plant survey on Spring Lake



Aquatic Plant Survey Data Analysis

% Occurrence

Description: The percent of sampled locations where a given plant taxon was found

Formula: Number of littoral sites with a given taxon ÷ N_{lit}

- N_{lit} = Total # of littoral points sampled

% Littoral Area Vegetated

Description: The percent of the littoral area that supported plants of any kind

Formula: $VA_{lit} \div TA_{lit}$

- VA_{lit} = Vegetated Littoral Area = ∑ Thiessen polygon areas for vegetated littoral points
- TA_{lit} = Total Littoral Area

% Lake Area Vegetated

Description: The percent of the entire lake area that supported plants of any kind

Formula: Vegetated Area ÷ Total Lake Area

- Vegetated Area = ∑ Thiessen polygon areas for points with vegetation
- Total Lake Area = Area calculated using delineated shoreline in ArcView GIS

% Lake with Surface Vegetation

Description: The percent of the entire lake area with plants that reach the water's surface. This is a good indicator of recreational impairment.

Formula: (Area with surface growth) ÷ Total Lake Area

- Area with surface growth = ∑ Thiessen polygon areas for points with surface vegetation
- Total Lake Area = Area calculated using delineated shoreline in ArcView GIS

Species Richness

Description: The number of different plant taxa found in the lake. Greater richness often translates into greater habitat diversity for fish.

Formula: Total number of taxa encountered in each surveyed year

Simpson's Diversity

Description: How "mixed" or diverse is the plant community? Lakes with many plant species that are evenly mixed throughout the lake have high diversity; those dominated heavily by only one or two species have low diversity. A higher number (up to 1.0) indicates greater diversity.

Formula: $1 - \sum (\text{Relative Frequency of encountered taxa})^2$

- Relative Frequency = (% occurrence of given taxon) ÷ (∑ % occurrence for encountered taxa) (see Nichols et al. 2000)

Average Number of Native Taxa/Point

Description: Another measure of the diversity of native plants in the lake.

Formula: ∑(#Native taxa per littoral point) ÷ N_{lit}

- N_{lit} = Total # of littoral points sampled

Results & Discussion

Aquatic Plant Taxa in Spring Lake

A total of 30 aquatic plant taxa (most identified to species) were found in Spring Lake during the 2011 survey (Table 3). Of these, 14 were submersed taxa, 5 were floating taxa, and 11 were emergent taxa. Shoreland plants were noted as present when adjacent to the sampled area, however we did not conduct an intensive shoreland plant survey in 2011.

Table 3. Frequency (% occurrence) of aquatic plant taxa (most identified to species) found during the 2011 Spring Lake survey. Taxa are listed from most common to least common within each category (submersed, floating, emergent). P (present) denotes taxa that were observed growing in the lake but not retrieved on any rake sample.

SCIENTIFIC NAME	COMMON NAME	% OCCURRENCE
SUBMERSED PLANTS		
Ceratophyllum demersum	Coontail	36
Elodea canadensis	Canadian waterweed	21
Potamogeton amplifolius	Large-leaf pondweed	9
Potamogeton robbinsii	Fern-leaf pondweed	7
Potamogeton foliosus	Narrow-leaf pondweed	5
Utricularia vulgaris	Common bladderwort	5
Potamogeton natans	Floating-leaf pondweed	4
Potamogeton richardsonii	Clasping-leaf pondweed	4
Potamogeton epihydrus	Ribbon-leaf pondweed	2
Potamogeton illinoensis	Illinois pondweed	2
Chara spp.	Muskgrass	P
Potamogeton oakesianus (cf.)	Oake's pondweed	P
Potamogeton zosteriformis	Flat-stem pondweed	P
Vallisneria americana	Wild celery	P
FLOATING PLANTS		
Nymphaea odorata	White waterlily	38
Spirodella polyrhiza	Large duckweed	32
Nuphar variegata	Yellow waterlily	13
Brasenia schreberi	Watershield	9
Lemna minor	Small duckweed	5
EMERGENT PLANTS		
Zizania palustris	Northern wild rice	25
Pontedaria cordata	Pickerelweed	5
Eleocharis robbinsii	Robbins spikerush	4
Schoenoplectus acutus	Hardstem bulrush	4
Schoenoplectus subterminalis	Water bulrush	4
Eleocharis palustris	Creeping spikerush	2
Typha spp.	Cattail	2
Carex spp.	Sedge	P
Cicuta bulbifera (cf.)	Bulb-bearing hemlock	P
Dulichium arundinaceum	3-way sedge	P
Sparganium spp.	Burr-reed	P

Aquatic Plant Community Statistics & Metrics

% Lake Area Vegetated
In 2011, about 80 percent of the lake supported plants. Much of this plant growth included floating and emergent taxa.

% Lake with Surface Vegetation
We found floating and emergent taxa at about 60% of the sampled sites. Although wild rice was widespread, it was found on only 25 percent of the sampled sites, with the vast majority of this rice growth being very sparse (Fig. 6). The majority of surface growth consisted of white and yellow water lilies (*N. odorata* and *N. variegata*), pickerelweed (*P. cordata*), and cattails (*Typha* spp.). These floating and emergent taxa were widespread (see distribution maps on pages 14-15).

% Littoral Area Vegetated
Spring Lake is 100% littoral, with all areas being shallower than 4 feet. However, only about 80 percent of the littoral area supported plants in 2011. The remaining 20% that did not support plants generally occurred in the north-central portion of the lake. Although sediments throughout the entire lake received ample sunlight, we encountered several large areas of bare sediment. The flocculent sediment in these areas appeared to be undisturbed, suggesting that the lack of vegetation was not the results of recent disturbance (wind etc.). Furthermore, the complete lack of vegetation in these areas suggested that localized conditions (sediment chemistry ?) may have affected plant growth.

Table 4. Plant community statistics and metrics for Spring Lake in 2011

Statistic / Metric	2011
Lake-Wide Statistics	
% Lake Area Vegetated	78
% Lake w/ Surface Growth	61
Plant Community Metrics	
Max Depth of Growth *(ft)*	3.1
Species Richness	30
Simpson's Diversity	0.91
Native Taxa per Sample	2.4
Average Plant Density (0-3)	1.3
AMCI (community index)	39
Floristic Quality Index	31

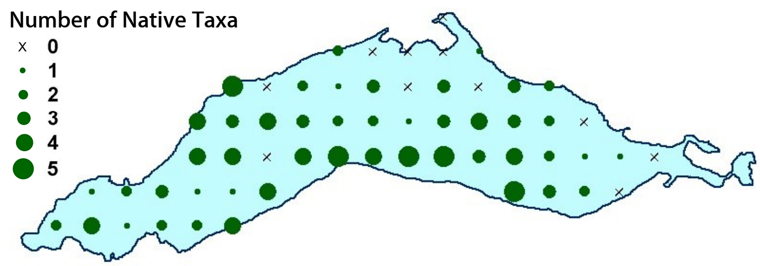
Figure 6. Floating and emergent plants typically found in the eastern half of Spring Lake in 2011. Note sparse wild rice in foreground (typical in 2011).

Figure 7. Open area with large patches of bare sediment; typically found in northern and western portion of Spring Lake in 2011

Simpson's Diversity Index
Diversity is a measure of both the number of species and the degree to which the species are equally mixed. Values close to 1.0 reflect a very diverse plant community with many species that are equally common (no strong dominance by any one species). Lower values reflect lower diversity (fewer species, clearly dominated by one or two species). In Spring Lake, this index was 0.91 in 2011; indicating a very diverse plant community.

Native Taxa per Sample
This metric provides another measure of aquatic plant diversity. In 2011, the average number of native taxa per sample in Spring Lake was 2.4 (Fig. 8, Tables 4 and 5). This is higher than typically seen in Minnesota and Wisconsin Lakes, and further indicates a very diverse and widespread plant community.

Figure 9. Number of native plant taxa at each sampled location in 2011.



Native Plant Abundance (Density Rating)
We found 14 submersed native plant taxa in Spring Lake during the 2011 survey. However, coontail (*Ceratophyllum demersum*) was consistently the most abundant native plant across all sampled depths (Fig. 10). All other plant taxa grew much less densely than coontail (average littoral densities ≤1, Fig. 10).

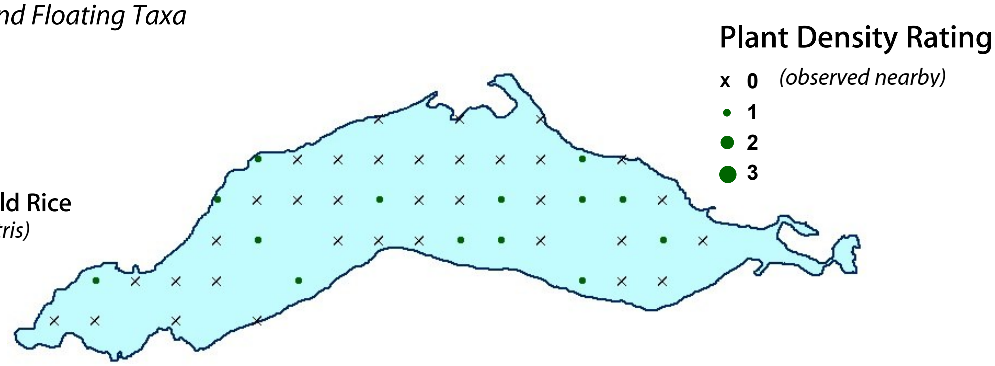
Table 5. Summary of density ratings for select plant taxa found in Spring Lake during the 2011 survey; *Average Density* = average of all sampled points, Avg Stand Density = average of all non-zero density ratings, *Maximum Density* = maximum of all sampled points.

Scientific Name	Common Name	Average Density	Avg Stand Density	Maximum Density
Submersed Taxa				
Ceratophyllum demersum	Coontail	0.4	1.2	3
Elodea canadensis	Canadian waterweed	0.3	1.3	2
Potamogeton amplifolius	Large-leaf pondweed	0.1	1.2	2
Potamogeton robbinsii	Fern-leaf pondweed	0.1	1.0	1
Potamogeton epihydrus	Ribbon-leaf pondweed	<0.1	1.0	1
Potamogeton foliosus	Narrow-leaf pondweed	<0.1	1.0	1
Potamogeton illinoensis	Illinois pondweed	<0.1	1.0	1
Potamogeton natans	Floating-leaf pondweed	<0.1	1.0	1
Potamogeton richardsonii	Clasping-leaf pondweed	<0.1	1.0	1
Utricularia vulgaris	Common bladderwort	<0.1	1.0	1
Floating and Emergent Taxa				
Brasenia schreberi	Watershield	0.1	1.2	2
Pontedaria cordata	Pickerelweed	<0.1	1.0	1
Nymphaea odorata	White waterlily	0.5	1.2	2
Nuphar variegata	Spatterdock	0.1	1.1	2
Zizania palustris	Northern wild rice	0.3	1.0	1

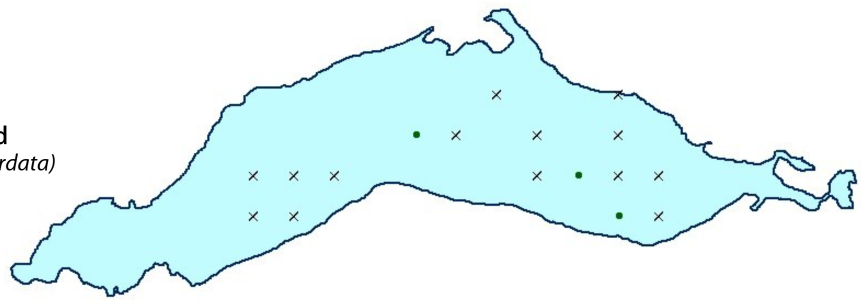
Distribution and Density Maps for Common Taxa

Emergent and Floating Taxa

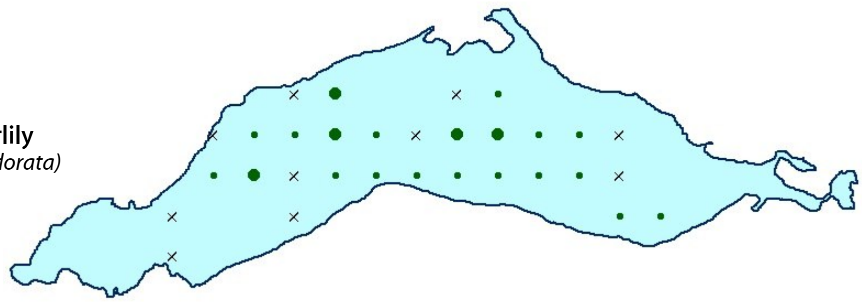
Northern Wild Rice
(Zizania palustris)



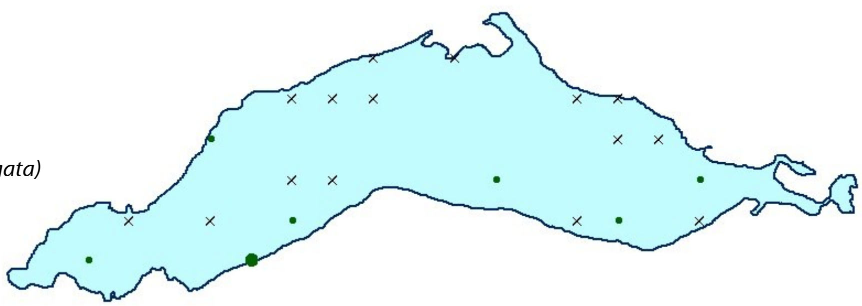
Pickerelweed
(Pontedaria cordata)



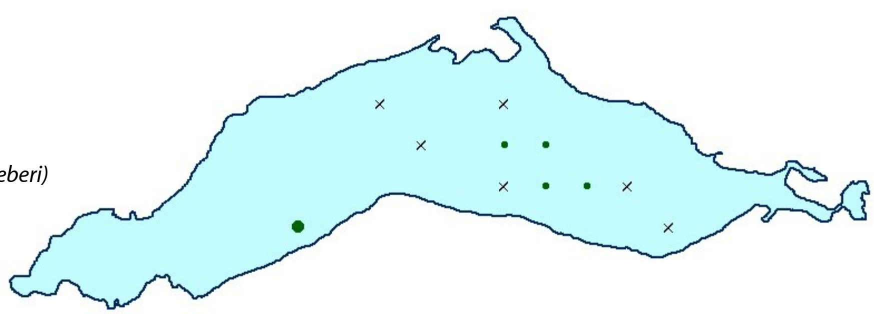
White Waterlily
(Nymphaea odorata)



Spatterdock
(Nuphar variegata)

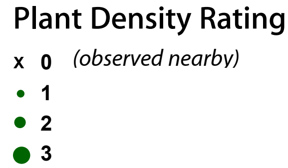


Watershield
(Brasenia schreberi)

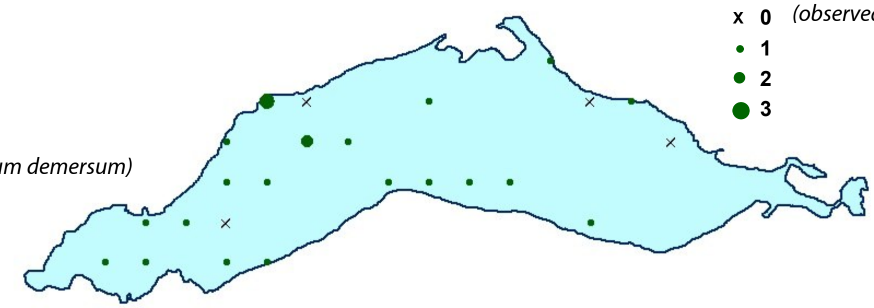


Distribution and Density Maps for Common Taxa

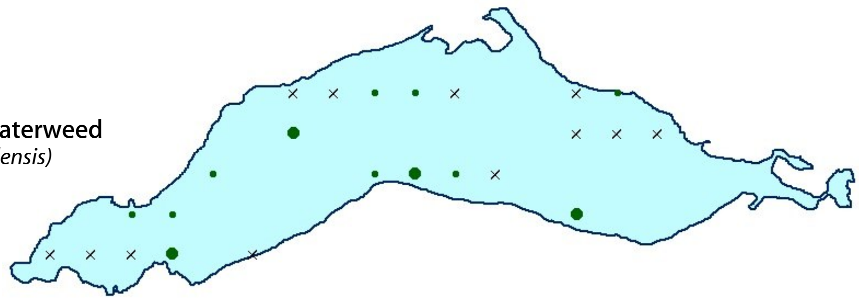
Submersed Taxa



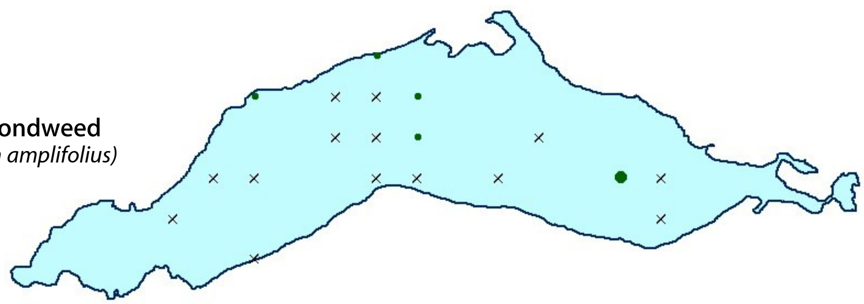
Coontail
(Ceratophyllum demersum)



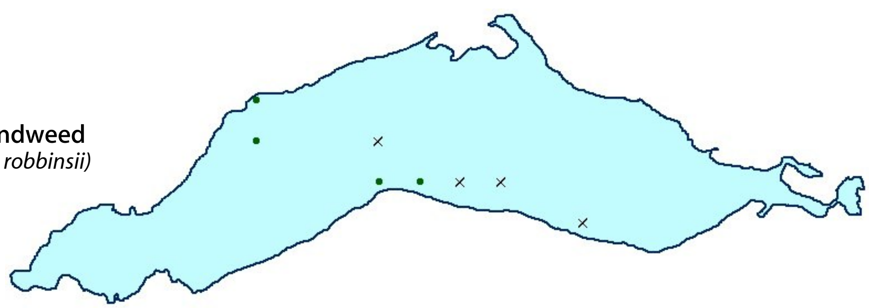
Canadian Waterweed
(Elodea canadensis)



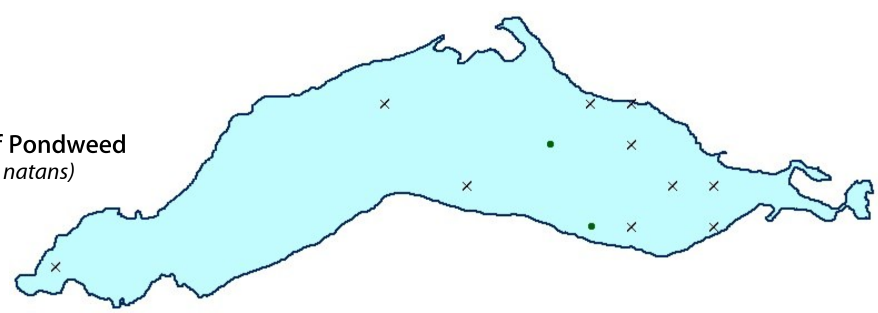
Large-leaf Pondweed
(Potamogeton amplifolius)



Fern-leaf Pondweed
(Potamogeton robbinsii)



Floating-leaf Pondweed
(Potamogeton natans)



Additional Comments on Floating and Emergent Taxa

Spring Lake supported abundant and diverse aquatic plant growth throughout most of the surveyed areas. Much of this plant growth consisted of floating and emergent taxa, which are not as easily snagged as submersed taxa when using the rake method we employed. Consequently, the rake density ratings reported for these floating and emergent taxa have almost certainly underestimated the abundance of these taxa. To ensure that management planning considers the current abundance of floating and emergent plants in Spring Lake, we have included photographs below to provide a better idea of the typical abundance of these taxa.

Figure 10. Extensive area of dense pickerelweed (*P. cordata*) in the east-central portion of Spring Lake.

Figure 11. Area of dense pickerelweed (*P. cordata*) and sparse wild rice (*Z. palustris*) in the north-central portion of Spring Lake.

Figure 12. Patch of pickerelweed (*P. cordata*), dense spatterdock (*N. variegata*) and sparse wild rice (*Z. palustris*) in the central portion of Spring Lake.

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