Aquatic Macrophyte Survey
Spooner Lake, Washburn County WI

June/August 2006

Introduction

This report presents a summary and analysis of data collected in a baseline macrophyte survey completed in July of 2006 on Spooner Lake, Washburn County Wisconsin. A June 2006 survey was completed in order to account for the early season non-native curly leaf pondweed, *Potomageton crispus*. The main survey was conducted in mid-July of 2006. All data presented here is available in spreadsheet format upon request and will be forwarded to the Wisconsin Department of Natural Resources. The primary goals of the project are to establish a baseline for long-term monitoring of aquatic plant populations and to document and map the locations of non-native invasive aquatic plant species such as *Potomageton crispus* (curly leaf pondweed) and *Myriophyllum spicatum* (Eurasian water milfoil).

Spooner Lake (WBIC: 2391200) is a 1200-acre lake in Washburn County, Wisconsin in the Town of Spooner (T40N R08W S29). It is a drainage lake with the main input from Crystal Creek and outflows into the Yellow River. The Spooner Lake Protection and Rehabilitation District sponsored this aquatic macrophyte survey, with assistance from Wisconsin Department of Natural Resources planning grant funds.

Field methods

A point intercept method was employed for the macrophyte sampling. The Wisconsin Department of Natural Resources (Wisconsin DNR) generated the sampling point grid of 1585 points. The littoral zone was initially defined as any depth less than 25 feet, leading to approximately 580 points to sample. For the early season sampling, random points within the littoral zone were sampled looking specifically for non-natives, *Potomageton crispus* in particular. The entire littoral zone was also monitored visually from shoreline to depths allowing visual observation. In the main survey, most all points within the littoral zone were sampled, and a minimum of one point deeper than a sample with no plants was collected to verify maximum plant depth. In any areas where it appeared the grid caused under-sampling, a boat survey was conducted to monitor these areas. A handheld Global Positioning System (GPS) located the sampling points in the field. The Wisconsin DNR guidelines for point location accuracy were followed.

At each sample location, a double-sided, fourteen tine rake was used to rake a 1m tow off the bow of the boat. All plants contained on the rake and those that fell off of rake when removing from lake were identified and rated as to rake fullness. The rake fullness value was used based on the criteria contained in the table below.

Rake fullness rating	**Criteria for rake fullness rating**
1	**Plant present, occupies less than ½ of tine space**
2	**Plant present, occupies more than ½ tine space**
3	**Plant present, occupies all or more than tine space**
v	**Plant not sampled but observed within 6 feet of boat**

The depth and predominant bottom type was also recorded for each sample point. All plants needing verification were bagged and cooled for later examination. Two plants from each species were also collected for creation of a voucher or herbarium collection.

Data analysis methods

Data collected was entered into a spreadsheet for analysis. The following statistics were generated from the spreadsheet:

- Frequency of occurrence for all sample points in lake
- Frequency of occurrence in littoral zone sample points
- Relative frequency
- Total sample points
- Sample points with vegetation
- Simpson's diversity index
- Maximum plant depth
- Species richness
- Floristic Quality Index

An explanation of each of these data are provided below.

<u>Frequency of occurrence for each species</u>- Frequency is expressed as a percentage by dividing the number of sites the plant is sampled by the number of total sites. There can be two values calculated for this. The first is the percentage of all sample points that this plant was sampled. The second is the percentage of littoral sample points that the plant was sampled. The first value shows how often the plant would be encountered everywhere in the lake, while the second value shows if only within the depths plants are potentially present. In either case, the greater this value, the more frequent the plant is in the lake. If one wants to compare to the whole lake, we look at the frequency of all points and if one wants to focus only where plants are more probable, then one would look at frequency at depths less than maximum at which plants were found.

Frequency of occurrence example:

Plant A sampled at 35 of 150 total points = 35/150 = 0.23 = 23%
Plant A's frequency of occurrence = 23% considering whole lake sample.

Plant A sampled at 12 of 40 littoral points = 12/40 = 0.3 = 30%
Plant A's frequency of occurrence in littoral zone = 30%

These two frequencies can tell us how common the plant was sampled in the entire lake or how common the plant was sampled at depths where plants can grow (littoral zone). Generally the second (littoral zone) will have a higher frequency since that is where plants

Relative frequency-This value shows, as a percentage, the frequency of a particular plant relative to other plants. This is not dependent on the number of points sampled. The relative frequency of all plants will add to 100%. This means that if plant A had a relative frequency of 30%, it occurred 30% of the time compared to all plants sampled or makes up 30% of all plants sampled. This value allows us to see which of the plants are the dominant species in the lake. The higher the relative frequency the more common the plant is compared to the other plants.

Relative frequency example:

Suppose we were sampling 10 points in a very small lake and got the following results:

	Frequency sampled
Plant A present at 3 sites	3 of 10 sites
Plant B present at 5 sites	5 of 10 sites
Plant C present at 2 sites	2 of 10 sites
Plant D present at 6 sites	6 of 10 sites

So one can see that Plant D is the most frequent sampled at all points with 60% (6/10) of the sites having plant D. However, the relative frequency allows us to see what the frequency is compared the other plants, without taking into account the number of sites. It is calculated by dividing the number of times a plant is sampled by the total of all plants sampled. If we add all frequencies (3+5+2+6), we get a sum of 16. We can calculate the relative frequency by dividing this sum into the individual frequency.

Plant A = 3/16 = 0.1875 or 18.75%
Plant B = 5/16 = 0.3125 or 31.25%
Plant C = 2/16 = 0.125 or 12.5%
Plant D = 6/16 = 0.375 or 37.5%

Now we can compare the plants to one another. Plant D is still the most frequent, but the relative frequency tells us that of all plants sampled at those 10 sites, 37.5% of them are Plant D. This is much lower than the frequency of occurrence (60%) because although we sampled Plant D at 6 of 10 sites, we were sampling many other plants too, thereby giving

Total sample points-This is the total number of points created for sampling on the lake. This may not be the same as the actual points sampled. When doing a survey, we don't sample at depths outside of the littoral zone (the area where plants can grow). Once the maximum depth of plants is established, many of the points deeper than this are eliminated to save time and effort.

Sample sites with vegetation- The number of sites where plants were actually sampled. This gives a good idea of the plant coverage of the lake. If 10% of all sample points had vegetation, it implies about a 10% coverage of plants in the whole lake, assuming an adequate number of sample points have been established. We also look at the number of sample sites with vegetation in the littoral zone. If 10% of the littoral zone had sample points with vegetation, then the plant coverage in the littoral zone would be estimated at 10%.

Simpson's diversity index-To measure how diverse the plant community is, Simpson's diversity index is calculated. This value can run from 0 to 1.0. The greater the value, the more diverse the plant community is in a particular lake. In theory, the value is the chance that two species sampled are different. An index of "1" means that the two will always be different (very diverse) and a "0" would indicate that they will never be different (only one species found). The more diverse the plant community, the better the lake ecosystem.

Simpson's diversity example:

If one went into a lake and found just one plant, the Simpson's diversity would be "0." This is because if we went and sampled randomly two plants, there would be a 0% chance of them being different, since there is only one plant.

If every plant sampled were different, then the Simpson's diversity would be "1." This is because if two plants were sampled randomly, there would be a 100% chance they would be different since every plant is different.

These are extreme and theoretical scenarios, but they do make the point. The greater the Simpson's index is for a lake, the greater the diversity since it represents a greater chance of

Maximum depth of plants-This depth indicates the deepest that plants were sampled. Generally more clear lakes have a greater depth of plants while lower water clarity limits light penetration and reduces the depth at which plants are found.

Species richness-The number of different individual species found in the lake. There is a number for the species richness of plants sampled, and another number that takes into account plants viewed but not actually sampled during the survey.

Floristic Quality Index-The Floristic Quality Index (FQI) is an index developed by Dr. Stanley Nichols of the University of Wisconsin-Extension. This index is a measure of the plant community in response to development (and human influence) on the lake. It takes into account the species of aquatic plants found and their tolerance for changing water quality and habitat quality. The index uses a conservatism value assigned to various plants ranging from 1 to 10. A high conservatism value indicates that a plant is intolerant while a lower value indicates tolerance. Those plants with higher values are more apt to respond adversely to water quality and habitat changes, largely due to human influence. The FQI is calculated using the number of species and the average conservatism value of all species used in the index. Therefore, a higher FQI, indicates a healthier aquatic plant community. This value can then be compared to the mean for other lakes in the assigned eco-region. There are four ecoregions used throughout Wisconsin. These are Northern Lakes and Forests, Northern Central Hardwood Forests, Driftless Area and Southeastern Wisconsin Till Plain. Grindstone Lake is in the Northern Lakes and Forest eco-region.

Summary of Northern Lakes and Forest Mean Values for Floristic Quality Index:

Mean species richness = 13

Mean average conservatism = 6.7

Mean Floristic Quality = 24.3*

*Floristic Quality has a significant correlation with area of lake (+), alkalinity(-), conductivity(-), pH(-) and Secchi depth (+). In a positive correlation, as that value rises so will FQI, while with a negative correlation, as a value rises, the FQI will decrease.

Results

Figure 1. Early season curly leaf pondweed samples

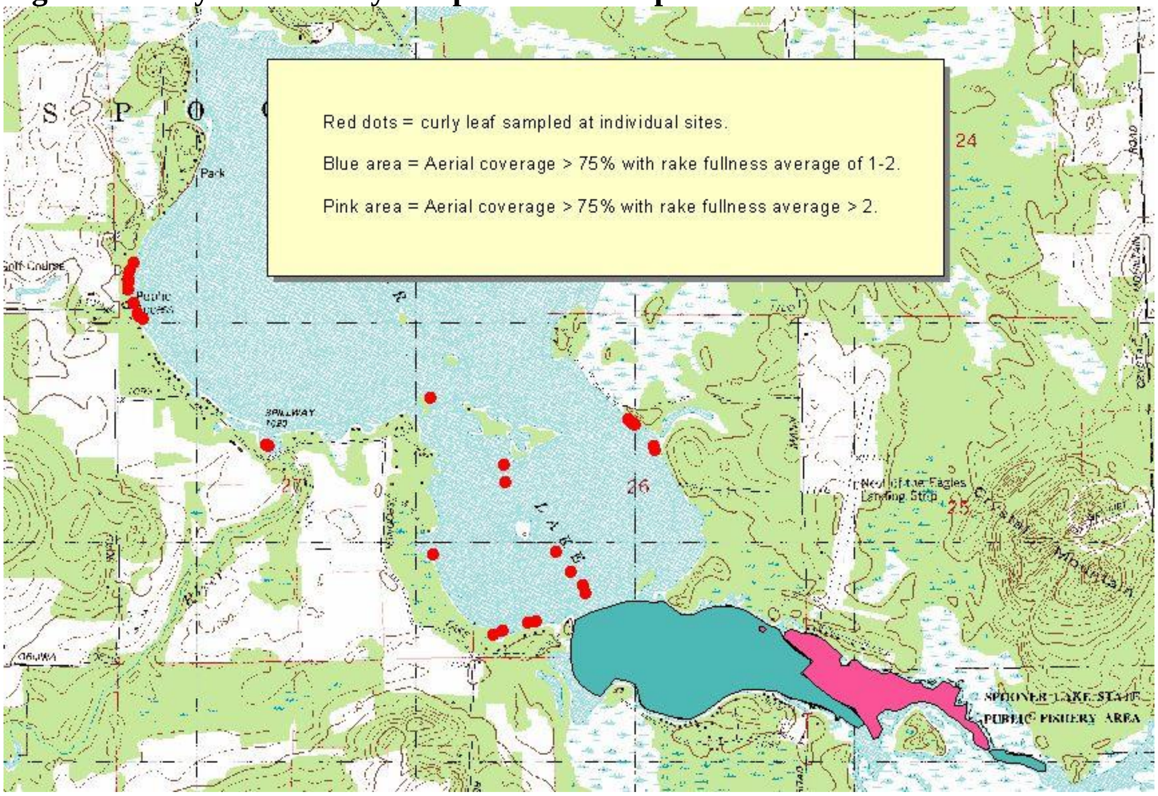
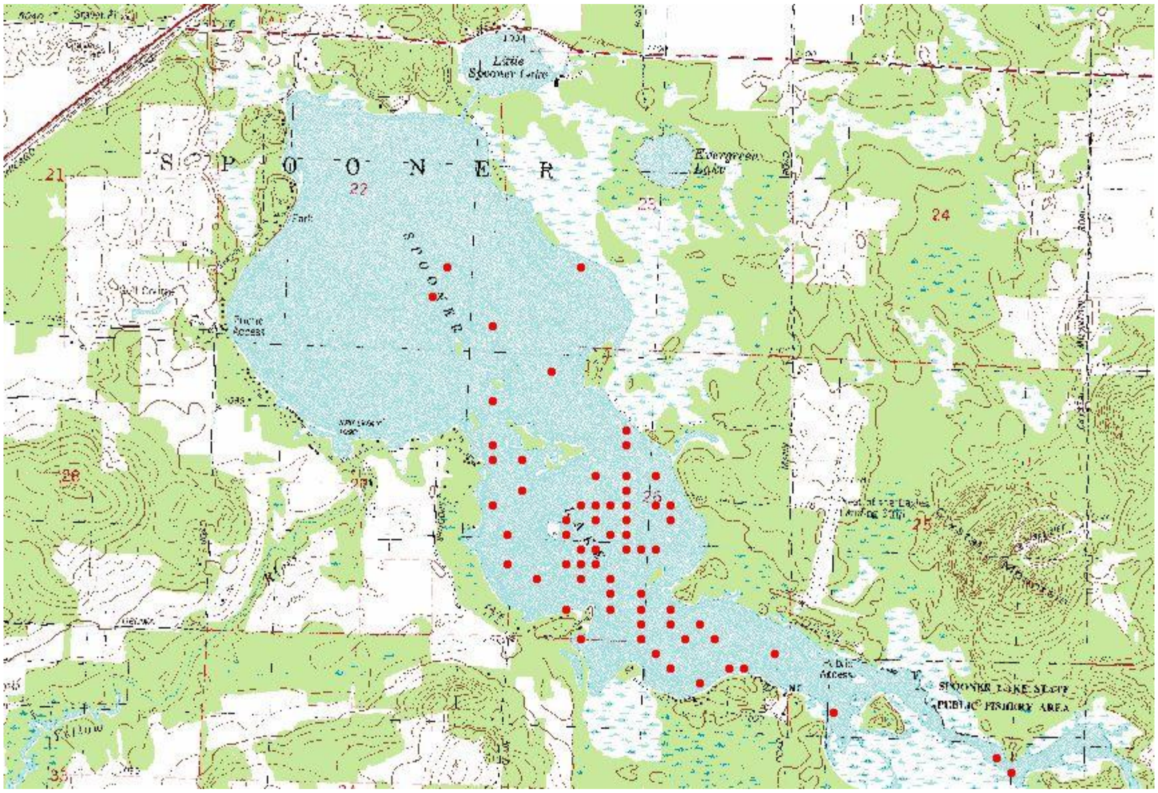


Figure 2. Late season curly leaf pondweed sample points



Species Richness

Species	Common name	Relative Freq.(%)	Freq. of occurrence
Potamogeton zosteriformis	Flat stem pondweed	23.4	75.66
Myiophyllum sibiricum	Northern milfiol	17.6	56.78
Ceratophyllum demersum	Coontail	15.2	49.26
Potamogeton friesii	Fries pondweed	13.6	38.64
Potamogeton robbinsii	Fern pondweed	9.9	31.86
Filamentous algae		4.7	15.34
Elodea canadensis	Common waterweed	3.7	11.95
Potamogeton crispus	curly leaf pondweed	3	9.59
Vallisnaria americana	Wild celery	2.2	7.08
Najas flexilis	Bushy pondweed	1.7	5.46
Stuckenia pectinatus	Sago pondweed	1.5	4.87
Potamogeton pusillus	Small pondweed	1.3	4.13
Potamogeton amplifolius	Large leaf pondweed	1.1	3.69
Heteranthera dubia	Water stargrass	0.6	2.06
Potamogeton praelongus	White-stem pondweed	0.5	1.77
Chara sp.	Muskgrass	0.3	1.03
Potamogeton richardsonii	Clasping leaf pondweed	0.3	0.88
Lemna minor	small duckweed	0.2	0.74
Nuphar odorata	white water-lily	0.1	0.15
Ranunculus aquatilis	white water crowfoot	0.1	0.15

Species of aquatic plant observed	Common name		
Megalodonta beckii	**Buttercup**		
Carex comosa	**Bottle brush sedge**		
Iris versicolor	**Blue flag iris**		
Nuphar variegata	**Spatterdock**		
Phragmites australis	**Giant reed**		
Pontederia cordata	**Pickerelweed**		
Sagittaria graminea	**Grass leaved arrowhead**		
Schoenoplectus acutus	**Hardstem bulrush**		
Schoenoplectus bulrush	**Softsem bulrush**		
Schoenoplectus fluviatilis	**River bullrush**		
Sparangium sp.	**Burreed**		
Typha latifolia	**Broad leaf cattail**		

As one can see the most frequent plant of those sampled is flat stem pondweed (*Potamogeton zosteriformis*). Although it is the most frequent, it is less than 25% showing that no one plant completely dominates the lake plant population. This lake contains many highly desirable native plants. This helps provide a healthy, diverse plant community for the lake ecosystem.

Although curly leaf pondweed was sampled, its frequency should be taken lightly since this is a late season survey. Curly leaf pondweed was surveyed in June and the map is attached with those results. Curly leaf pondweed is the only non-native plant sampled or observed visually at Spooner Lake.

<u>Other important statistics are as follows</u>:

Species richness (plants actually sampled)	**20**
Species richness (including visual observation)	**32**
Average number of species per sample site	**3.23**
Simpson's Diversity Index (1.0 is the highest possible)	**0.86**
Frequency of sites sampled with vegetation	**99.56%**

The above statistics indicate that the plant community is very diverse. The closer to 1.0 the Simpson's Index the more diverse and 0.86 is high. Also, the species richness is very high. The average rake fullness and the percentage of sampled sites with vegetation indicate a very high amount of plant coverage and biomass. This can also indicate the potential for nuisance levels of aquatic plants.

<u>Floristic Quality Index:</u>

The Floristic Quality Index is an analysis of the plant species observed in relation to the response a lake has to development and other human practices. The higher the index value the more healthy the plant community is. The plants used in the FQI represent a "C" value which is a conservatism value ranging from 1 to 10. The higher the conservatism the less tolerant the plant is to disturbances in the lake. If a lake has a very high average conservatism value, it demonstrates that the lake has many species that are intolerant of disturbances. This in turn will give a higher FQI. By comparing the lake in question to other lakes in the ecoregion, an understanding of the health of the plant community can be determined.

Eco-region of Spooner Lake is Northern Lakes and Forests-flowages	**Spooner Lake Value**	**Median for Eco-region**
Number of species used in FQI	**28**	**23.5**
Average C	**6**	**6.2**
FQI	**31.75**	**28.3**

The only segment that Spooner Lake was less than average was the average conservatism. However, with such a diverse community, the FQI value is higher than the average for lakes (flowages) studied in the ecoregion. For this reason, we may conclude that the plant community indicates one of good health, diversity and demonstrates fewer disturbances.

Discussion of Results

Spooner Lake has a very diverse and extensive plant community. The lake is 99+% covered with plants. All of the plants are native with the exception of one, *Potamogeton crispus* (curly leaf pondweed). This non-native plant is very extensive in Spooner Lake. When viewing the curly leaf pondweed map, it is evident that the southeast portion of the lake near the inlet has a very large aerial covereage and high density. During the peak growth of the curly leaf pondweed, the plants were growing to the water surface and dense enough to impede navigation. In the rest of the lake, curly leaf pondweed is sporadic in coverage and more limited to deeper water areas.

In the native plant community, there were 28 species of vascular plants and 2 species of algae either sampled or visually observed within 6 feet of the boat. No one plant completely dominated as shown in the relative frequency table. Although plants such as Potamogeton zosteriformes were very common and sampled at numerous locations, the relative frequency was less than 25% in all cases. Some species with high conservatism values were also present. These were *Potamogeton praelongus, Potamogeton robbinsii, Megalodonta beckii, Potamogeton freisii*, and *Sagittaria graminea.* The presence of these species represents good habitat and a reflection of less disturbance to the plant community.

Most of the native plants were in the submergent form. A few floating and emergent stands, such as bulrush do exist. Where there was development, lawns with non-native grasses were quiet common. In undeveloped areas the shoreline vegetation consisted of numerous varieties of native herbaceous plants along with native trees and shrubs. A fair amount of the undeveloped shoreline consists of wetland bordering the lake. These wetlands appeared to contain a high diversity of native emergent and/or wetland plants. The survey of these plants was not conducted in this project.

In the southeast bay region near the inlet, the native plants also reach nuisance levels which impede navigation. During the survey, there were areas that were very difficult to get navigate with the boat. Furthermore, there was rather extensive coverage of plants with filamentous algae.