Curly-leaf Pondweed P/I, Bed Mapping, and Warm Water Point/Intercept Macrophyte Surveys Poskin Lake (WBIC: 2098000) Barron County, Wisconsin

Hardstem bulrush

Project Initiated by:
Poskin Lake Association, Short Elliot Hendrickson Inc., and the Wisconsin Department of Natural Resources

Wild Celery in Bloom

Survey Conducted by and Report Prepared by:
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ABSTRACT

Poskin Lake (WBIC 2098000) is a 150-acre stratified, drainage lake located in west-central Barron County. It is eutrophic in nature with summer Secchi readings averaging 3.3ft and a littoral zone that extends to 10.5ft. A desire to determine the level of Curly-leaf pondweed (*Potamogeton crispus*) infestation and decide what, if any, management of CLP would be appropriate, assess the lake's water quality and clarity, and prevent exotic species like Eurasian water milfoil (*Myriophyllum spicatum*) from entering the lake prompted members of the Poskin Lake Association to authorize a CLP density and bed mapping survey on May 27 and a full lake point intercept survey on July 13, 2009. The early season survey found CLP at 11 points throughout the lake. Of these locations, nine points rated a 2 or a 3 indicating that just over 2% of the lake's surface had a sizable infestation. The full point intercept survey found macrophytes at 92 of the 403 survey points (22.8%) and identified a total of 25 native plants to species. They produced an average mean Coefficient of Conservatism of 5.7 and a slightly above average Floristic Quality Index value of 28.4. Eleven additional plants were recorded as visuals or located during the boat survey. Coontail (*Ceratophyllum demersum*), Common watermeal (*Wolffia columbiana*), Small duckweed (*Lemna minor*) and Large duckweed (*Spirodela polyrhiza*) were the most common macrophyte species being found at 82.61%, 44.57%, 42.39%, and 41.30% of survey points with vegetation respectively. Future management goals should include maintaining the lake's plant community and working to improve water clarity and quality by reducing algal and duckweed blooms. Completing an Aquatic Plant Management Plan, identifying nutrient sources and working to reduce the nutrient load coming into the lake, restoring shorelines, adding buffer strips of native vegetation, developing a CB/CW program, improving signage at the landing to educate boaters and residents about the threat of AIS, and monitoring for EWM in transects parallel to the shore at least once a month during the summer are management ideas for the Lake Association to consider moving forward.

ACKNOWLEDMENTS

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INTRODUCTION:

Poskin Lake (WBIC 2098000) is a 150-acre, stratified, drainage lake located in the Town of Clinton in central Barron County (T34N R13W S15 NW SW). The lake reaches its maximum depth of 30ft in the central basin southwest of the Vermillion River Outlet and has an average depth of 16ft (WDNR 2009). Poskin Lake is eutrophic in nature and water clarity is poor with summer Secchi readings averaging 3.3ft since 2003 (WDNR 2009). The July littoral zone reached approximately 10.5ft in 2009. Bottom substrate is variable with muck bottoms in Little Poskin, the channel, the north end of the main basin and the southwest bay, and rock/sand shorelines throughout the rest of the main basin.

Figure 1: Aerial Photo of Poskin Lake

The Poskin Lake Association (PLA), Short Elliot Hendrickson Inc. (SEHI), and the Wisconsin Department of Natural Resources (WDNR) authorized a series of full lake plant surveys as part of developing an Aquatic Plant Management Plan (APMP). On May 27, we completed a full lake Curly-leaf pondweed (*Potamogeton crispus*) density and bed mapping survey, and on July 13 we conducted warm water point/intercept survey of all aquatic macrophytes. The surveys used the WDNR's statewide guidelines for conducting systematic point intercept macrophyte sampling. The guidelines ensure that all sampling in the state will be conducted in the same manner, thus allowing data to be compared across time and space. This report represents the summary analysis of the data collected during these surveys. The immediate goals of the project were to quantify the level of the known CLP infestation, determine if Eurasian water milfoil (*Myriophyllum spicatum*) had invaded the lake, and to establish baseline data on the diversity, abundance and distribution of other native aquatic plant populations. These data provide a baseline for long-term monitoring of the lake's macrophyte community.

PLANT SURVEY METHODS:

Curly-leaf pondweed Density Survey:

Using a standard formula that takes into account the shoreline shape and distance, water clarity, depth and total lake acreage, Michelle Nault (WDNR) generated a 403 point sampling grid for Poskin Lake (Appendix I). Using this grid, we completed a CLP density survey where we recorded the level of CLP at each point in the lake's literal zone. We located each survey point using a handheld Garmin 76CSx mapping GPS unit. At each point, we recorded a depth reading with a Polar Vision hand held sonar unit. Following the establishment of the littoral zone at a maximum of 10.5ft., we sampled for CLP within the depth range of plant growth. At each of these points, we used a rake to sample an approximately 2.5ft. section of the bottom. CLP was assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 2). We also recorded visual sightings of CLP within six feet of the sample point.

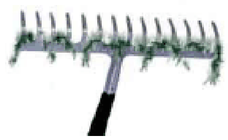
Rating	Coverage	Description
1		A few plants on rake head
2		Rake head is about ½ full Can easily see top of rake head
3		Overflowing Cannot see top of rake head

Figure 2: Rake Fullness Ratings (UWEX, 2009)

CLP Bed Mapping Survey:

Following the density survey, we used the resulting map coupled with a meandering shoreline survey to locate and map all significant beds of CLP on Poskin Lake. We defined a bed based on the following two criteria: CLP plants made up greater than 50% of all aquatic plants in the bed, and the CLP had canopied at the surface or was close enough to the surface that it would likely interfere with normal boat traffic.

Using a GPS unit, we recorded a string of waypoints that circled around the edges of the beds. We then uploaded these points into ArcMap, created bed shapefiles, and determined the total acreage and perimeter of the bed to the nearest tenth of an acre and meter respectively.

July Warm Water Full Point/Intercept Survey:

Prior to beginning the July full point intercept survey, we conducted a general boat survey of Poskin Lake to gain familiarity with the species present (Appendix II). All plants found were identified (Voss 1996, Boreman et al. 1997; Chadde 2002; Crow and Hellquist 2006), and two vouchers were pressed and mounted for herbarium specimens – one to be retained by the Poskin Lake Association, and one to be sent to the state herbarium in Stevens Point for identification confirmation. Rake sampling was completed as with the CLP density survey, but this time all plants on the rake, as well as any that were dislodged by the rake, were identified and assigned a rake fullness value. In addition to a rake rating for each species, a total rake fullness rating was also noted. Substrate (lake bottom) type was assigned at each site where the bottom was visible or it could be reliably determined using the rake.

DATA ANALYSIS:

We entered all data collected into the standard APM spreadsheet (Appendix III) (UWEX, 2009). From this, we calculated the following:

Total number of points sampled: This included the total number of points on the lake coverage that were within the littoral zone (0-maximum depth where plants are found) Initially, we continued to sample points whose depth were several feet beyond the littoral zone, but once we established this maximum depth with confidence, most points beyond this depth were not rake sampled.

Total number of sites with vegetation: These included all sites where we found vegetation after doing a rake sample. For example, if 20% of all sample sites have vegetation, it suggests that 20% of the lake has plant coverage.

Total number of sites shallower than the maximum depth of plants: This is the number of sites that are in the littoral zone. Because not all sites that are within the littoral zone actually have vegetation, we use this value to estimate how prevalent vegetation is throughout the littoral zone. For example, if 60% of the sites shallower than the maximum depth of plants have vegetation, then we estimate that 60% of the lake's littoral zone has plants.

Frequency of occurrence: The frequency of all plants (or individual species) is generally reported as a percentage of occurrences at all sample points. It can also be reported as a percentage of occurrences at sample points within the littoral zone.

Frequency of occurrence example:

Plant A is sampled at 70 out of 700 total points = 70/700 = .10 = 10%
This means that Plant A's frequency of occurrence = 10% considering the entire lake sample.

Plant A is sampled at 70 out of 350 total points in the littoral zone = 70/350 = .20 = 20%
This means that Plant A's frequency of occurrence = 20% when only considering the littoral zone.

From these frequencies, we can estimate how common each species was throughout the lake, and how common the species was at depths where plants were able to grow. Note the second value will be greater as not all the points (in this example, only ½) occur at depths shallow enough for plant growth.

Simpson's diversity index: A diversity index allows the entire plant community at one location to be compared to the entire plant community at another location. It also allows the plant community at a single location to be compared over time thus allowing a measure of community degradation or restoration at that site. With Simpson's diversity index, the index value represents the probability that two individuals (randomly selected) will be different species. The index values range from 0 -1 where 0 indicates that all the plants sampled are the same species to 1 where none of the plants sampled are the same species. The greater the index value, the higher the diversity in a given location. Although many natural variables like lake size, depth, dissolved minerals, water clarity, mean temperature, etc. can affect diversity, in general, a more diverse lake indicates a healthier ecosystem. Perhaps most importantly, plant communities with high diversity also tend to be **more resistant** to invasion by exotic species.

Maximum depth of plants: This indicates the deepest point that vegetation was sampled. In clear lakes, plants may be found at depths of over 20ft, while in stained or turbid locations, they may only be found in a few feet of water. While some species can tolerate very low light conditions, others are only found near the surface. In general, the diversity of the plant community decreases with increased depth.

Number of sites sampled using rope/pole rake: This indicates which rake type was used to take a sample. We used a 15ft pole rake, and a 25ft rope rake for sampling.

Average number of species per site: This value is reported using four different considerations. 1) **shallower than maximum depth of plants** indicates the average number of plant species at all sites in the littoral zone. 2) **vegetative sites only** indicate the average number of plants at all sites where plants were found. 3) **native species shallower than maximum depth of plants** and 4) **native species at vegetative sites only** excludes exotic species from consideration.

Species richness: This value indicates the number of different plant species found in and directly adjacent to (on the waterline) the lake. Species richness alone only counts those plants found in the rake survey. The other two values include those seen during the point intercept survey and the initial boat survey.

Mean and median depth of plants: The mean depth of plants indicates the average depth in the water column where plants were sampled. Because a few samples in deep water can skew this data, median depth is also calculated. This tells us that half of the plants sampled were in water shallower than this value, and half were in water deeper than this value.

Relative frequency: This value shows a species' frequency relative to all other species. It is expressed as a percentage, and the total of all species' relative frequency will add up to 100%. Organizing species from highest to lowest relative frequency value (Table 2) gives us an idea of which species are most important within the macrophyte community.

Relative frequency example:

Suppose that we sample 100 points and found 5 species of plants with the following results:

Plant A was located at 70 sites. Its frequency of occurrence is thus 70/100 = 70%
Plant B was located at 50 sites. Its frequency of occurrence is thus 50/100 = 50%
Plant C was located at 20 sites. Its frequency of occurrence is thus 20/100 = 20%
Plant D was located at 10 sites. Its frequency of occurrence is thus 10/100 = 10%

To calculate an individual species' relative frequency, we divide the number of sites a plant is sampled at by the total number of times all plants were sampled. In our example that would be 150 samples (70+50+20+10).

Plant A = 70/150 = .4667 or 46.67%
Plant B = 50/150 = .3333 or 33.33%
Plant C = 20/150 = .1333 or 13.33%
Plant D = 10/150 = .0667 or 6.67%

This value tells us that 46.67% of all plants sampled were Plant A.

Floristic Quality Index (FQI): This index measures the impact of human development on a lake's aquatic plants (Table 3). Species in the index are assigned a Coefficient of Conservatism (C) which ranges from 1-10. The higher the value assigned, the more likely the plant is to be negatively impacted by human activities relating to water quality or habitat modifications. Plants with low values are tolerant of human habitat modifications, and often exploit these changes to the point where they may crowd out other species. The FQI is calculated by averaging the conservatism value for each species found in the lake during the point intercept and boat surveys, and multiplying it by the square root of the total number of plant species (N) in the lake ($FQI=(\Sigma(c1+c2+c3+\ldots cn)/N)*\sqrt{N}$). Statistically speaking, the higher the index value, the healthier the lake's macrophyte community is assumed to be. Nichols (1999) identified four eco-regions in Wisconsin: Northern Lakes and Forests, Northern Central Hardwood Forests, Driftless Area and Southeastern Wisconsin Till Plain. He recommended making comparisons of lakes within ecoregions to determine the target lake's relative diversity and health. Poskin Lake is in the Northern Central Hardwood Forests Ecoregion.

RESULTS AND DISCUSSION:
Curly-leaf pondweed Density and Bed Mapping Surveys:

On May 27th, we surveyed Poskin Lake for presence and abundance of Curly-leaf pondweed. Of the 403 survey points provided by the WDNR, we sampled 213 points (the entire littoral zone and points adjacent to it). Although widely distributed throughout the lake in 1-2m of water over muck and sandy/muck substrate, we found CLP to be fairly uncommon being present in only 11 rank samples with an additional two points having visual CLP (Figure 3) (Appendix IX). Nine points had a rake fullness rating of a two or a three approximating to just over 2% of the lake having a sizable infestation.

The only significant area of CLP on the lake that met the criteria for a bed was located on the northwest end of the main basin (Figure 3). This canopied bed of CLP and Coontail (*Ceratophyllum demersum*) was 0.71 acres in size and had a perimeter of 372m. Because the bed was located adjacent to a marsh with no cabins, it seems unlikely that it will interfere with boat navigation. Because the lake lacks abundant plant growth to begin with, it is likely this bed provides important early season cover for both baitfish and gamefish. For this reason, and the likelihood that Coontail would be the only native to replace it, we feel that efforts to mechanically or chemically remove the bed may be more of a negative than a positive. For more information on Curly-leaf pondweed and other exotic species, see Appendix IX.

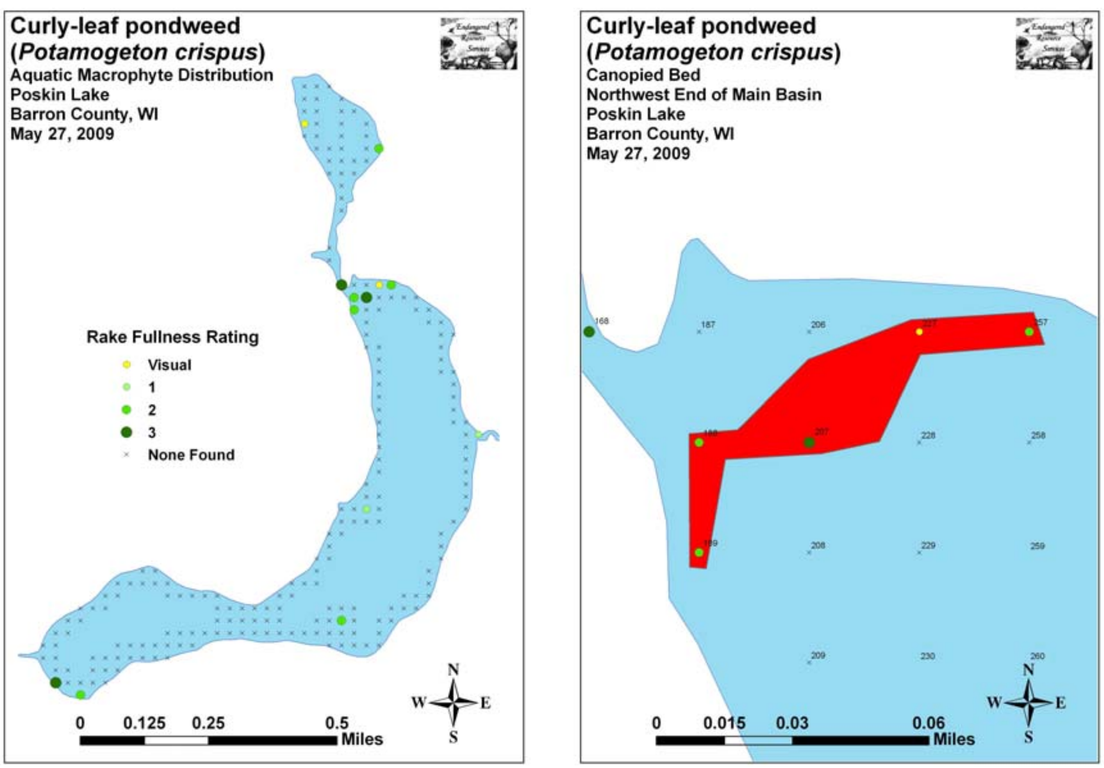


Figure 3: May CLP Density and Bed Map

July Warm Water Full Point/Intercept Survey:

Poskin Lake has several mid-lake gravel bars (including some small unmapped ones). Because of this, we opted to take depth readings at all points during the July 13 survey. (Figure 4) (Appendix IV). The main basin has sharp drop offs on both the east and west sides into 20ft+ of water. The southwest bay and the north end both have more gradual slopes into deeper water. An expansive 5ft weedy flat extends approximately 150m into the lake from the south. This structure quickly transitions into deep water, but just as quickly rises back up onto a shallow gravel flat. The channel to Little Poskin is almost non-navigable due to silt and beaver activity. Little Poskin is generally bowl shaped with a steeper drop off on the east side. The inflow of the Vermillion River (and possible spring activity?) has kept a small gravel bar mostly free of silt on the northwest end.

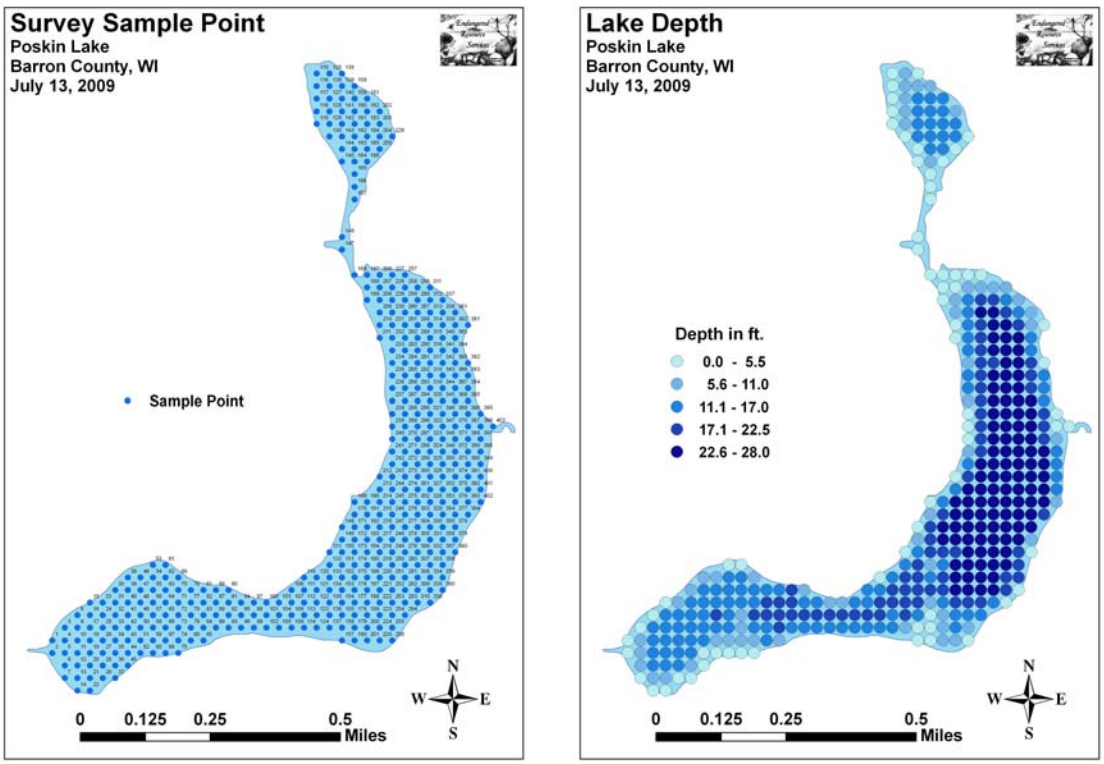
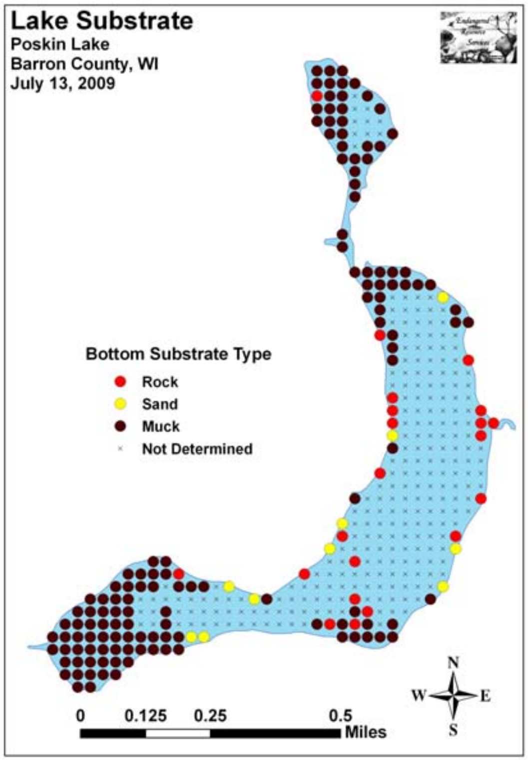


Figure 4: Poskin Lake Survey Points and Lake Depth

Of the 162 points were we could determine the substrate, 80.9% were muck, 12.9% were rock, and 6.2.7% were sand. Little Poskin, the channel, the north end of the main basin, and the south and southwest bays tended to be filled with organic muck. The rest of the perimeter of the main basin was generally rock or sand covered. We found plants growing at only 22.8% of the entire lake bottom and in 82.1% of the littoral zone (Figure 5) (Table 1) (Appendix IV).



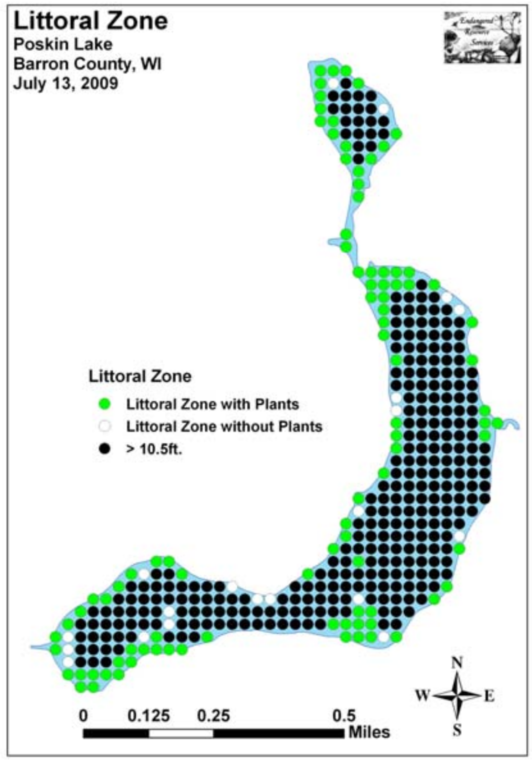


Figure 5: Poskin Lake Bottom Substrate and Littoral Zone

Table 1: Aquatic Macrophyte P/I Survey Summary Statistics
Poskin Lake, Barron County
July 13, 2009

Summary Statistics:

Total number of points sampled	403
Total number of sites with vegetation	92
Total number of sites shallower than the maximum depth of plants	112
Frequency of occurrence at sites shallower than maximum depth of plants	82.14
Simpson Diversity Index	0.89
Maximum depth of plants (ft)	10.50
Number of sites sampled using rope rake (R)	2
Number of sites sampled using pole rake (P)	160
Average number of all species per site (shallower than max depth)	3.20
Average number of all species per site (veg. sites only)	3.89
Average number of native species per site (shallower than max depth)	3.11
Average number of native species per site (veg. sites only)	3.78
Species Richness	27
Species Richness (including visuals)	33
Species Richness (including visuals and boat survey)	36
Mean depth of plants (ft)	4.06
Median depth of plants (ft)	3.00

Overall diversity was relatively high with a Simpson Diversity Index value of 0.89. Species richness was also relatively high for such a small lake with 36 total species found growing in and immediately adjacent to the water. Due to the low water clarity/light penetration, the majority of aquatic macrophytes were found growing in very shallow water with the mean depth just over 4ft and the median depth of exactly 3ft. Although we determined the littoral zone went to 10.5ft., Coontail (*Ceratophyllum demersum*), was the only species that regularly occurred below 5ft. In general, species richness, diversity and total rake biomass declined rapidly with increasing depth (Figure 6) (Appendix V).

The lake's shallow organic muck bottom areas supported the richest and densest submergent, floating, and emergent plant beds. However, the limited littoral zone restricted growth to a relatively narrow band of vegetation. In this habitat, we found Coontail to be the dominant species accompanied by Flat-stem pondweed (*Potamogeton zosteriformis*), White water lily (*Nymphaea odorata*), Common waterweed (*Elodea canadensis*) and Spatterdock (*Nuphar variegata*).

The sandy/rocky bottoms and sharp drop offs of the main basin provided only a very narrow littoral zone for plants. These areas generally supported fewer species in lower densities albeit ones unique to these habitats. We identified Wild celery (*Vallisneria americana*), Bushy pondweed (*Najas flexilis*) and Northern water milfoil (*Myriophyllum sibiricum*) as common associate species in these areas.

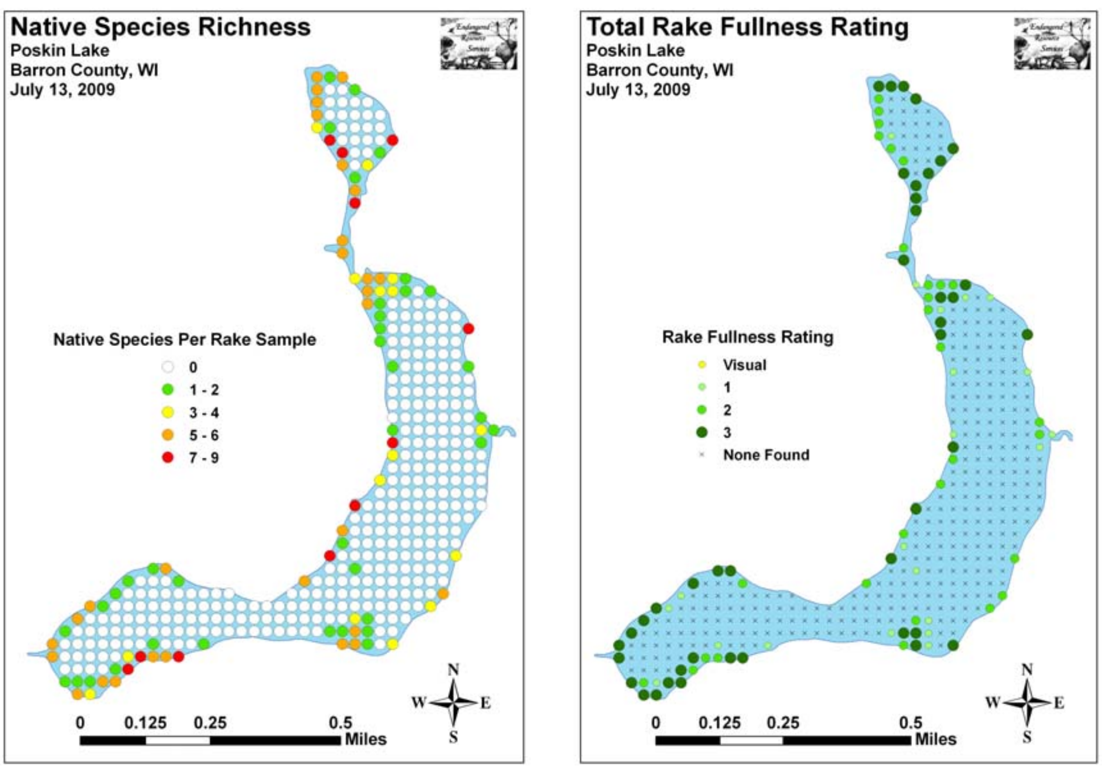


Figure 6: Native Species Richness and Total Rake Fullness Rating

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Poskin Lake, Barron County
July 13, 2009

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Ceratophyllum demersum	Coontail	76	21.23	82.61	67.86	2.00
Wolffia columbiana	Common watermeal	41	11.45	44.57	36.61	2.05
Lemna minor	Small duckweed	39	10.89	42.39	34.82	1.62
Spirodela polyrhiza	Large duckweed	38	10.61	41.30	33.93	2.13
	Filamentous algae	38	10.61	41.30	33.93	1.66
Nymphaea odorata	White water lily	22	6.15	23.91	19.64	2.00
Potamogeton zosteriformis	Flat-stem pondweed	20	5.59	21.74	17.86	1.25
Elodea canadensis	Common waterweed	15	4.19	16.30	13.39	1.33
Nuphar variegata	Spatterdock	15	4.19	16.30	13.39	2.47
Potamogeton crispus	Curly-leaf pondweed	10	2.79	10.87	8.93	1.20
Vallisneria americana	Wild celery	9	2.51	9.78	8.04	1.56
Myriophyllum sibiricum	Northern water milfoil	8	2.23	8.70	7.14	1.25
Ranunculus aquatilis	Stiff water crowfoot	4	1.12	4.35	3.57	1.00
Sparganium eurycarpum	Common bur-reed	4	1.12	4.35	3.57	2.50
Najas flexilis	Bushy pondweed	3	0.84	3.26	2.68	2.00
Potamogeton pusillus	Small pondweed	3	0.84	3.26	2.68	1.67
Heteranthera dubia	Water star-grass	2	0.56	2.17	1.79	2.00
Potamogeton strictifolius	Stiff pondweed	2	0.56	2.17	1.79	2.50
Calla palustris	Water calla	1	0.28	1.09	0.89	1.00
Callitriche palustris	Common water starwort	1	0.28	1.09	0.89	1.00
Carex comosa	Bottle brush sedge	1	0.28	1.09	0.89	3.00

Table 2 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Poskin Lake, Barron County
July 13, 2009

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Isoetes echinospora	Spiny-spored quillwort	1	0.28	1.09	0.89	1.00
Potamogeton nodosus	Long-leaf pondweed	1	0.28	1.09	0.89	2.00
Schoenoplectus tabernaemontani	Softstem bulrush	1	0.28	1.09	0.89	1.00
Typha angustifolia	Narrow-leaved cattail	1	0.28	1.09	0.89	3.00
Typha latifolia	Broad-leaved cattail	1	0.28	1.09	0.89	2.00
Zizania palustris	Northern wild rice	1	0.28	1.09	0.89	1.00
Lemna trisulca	Forked duckweed	**	**	**	**	**
Phalaris arundinacea	Reed canary grass	**	**	**	**	**
Potamogeton praelongus	White-stem pondweed	**	**	**	**	**
Potamogeton richardsonii	Clasping-leaf pondweed	**	**	**	**	**
Sagittaria latifolia	Common arrowhead	**	**	**	**	**
Sagittaria rigida	Sessile-fruited arrowhead	**	**	**	**	**
Potamogeton amplifolius	Large-leaf pondweed	***	***	***	***	***
Potamogeton obtusifolius (hybrid?)	Blunt-leaf pondweed	***	***	***	***	***
Schoenoplectus acutus	Hardstem bulrush	***	***	***	***	***

** Visual Only
*** Boat Survey Only

Coontail, Common watermeal (*Wolffia columbiana*), Small duckweed (*Lemna minor*) and Large duckweed (*Spirodela polyrhiza*) were the most common macrophyte species being found at 82.61%, 44.57%, 42.39%, and 41.30% of survey points with vegetation (Table 2) (Figure 7). Together, they combined for nearly 55% of the total relative frequency. Filamentous algae also had a relative frequency over 10. Flat-stem pondweed and White water lily were the only other macrophytes over five (Appendix VI and VII).

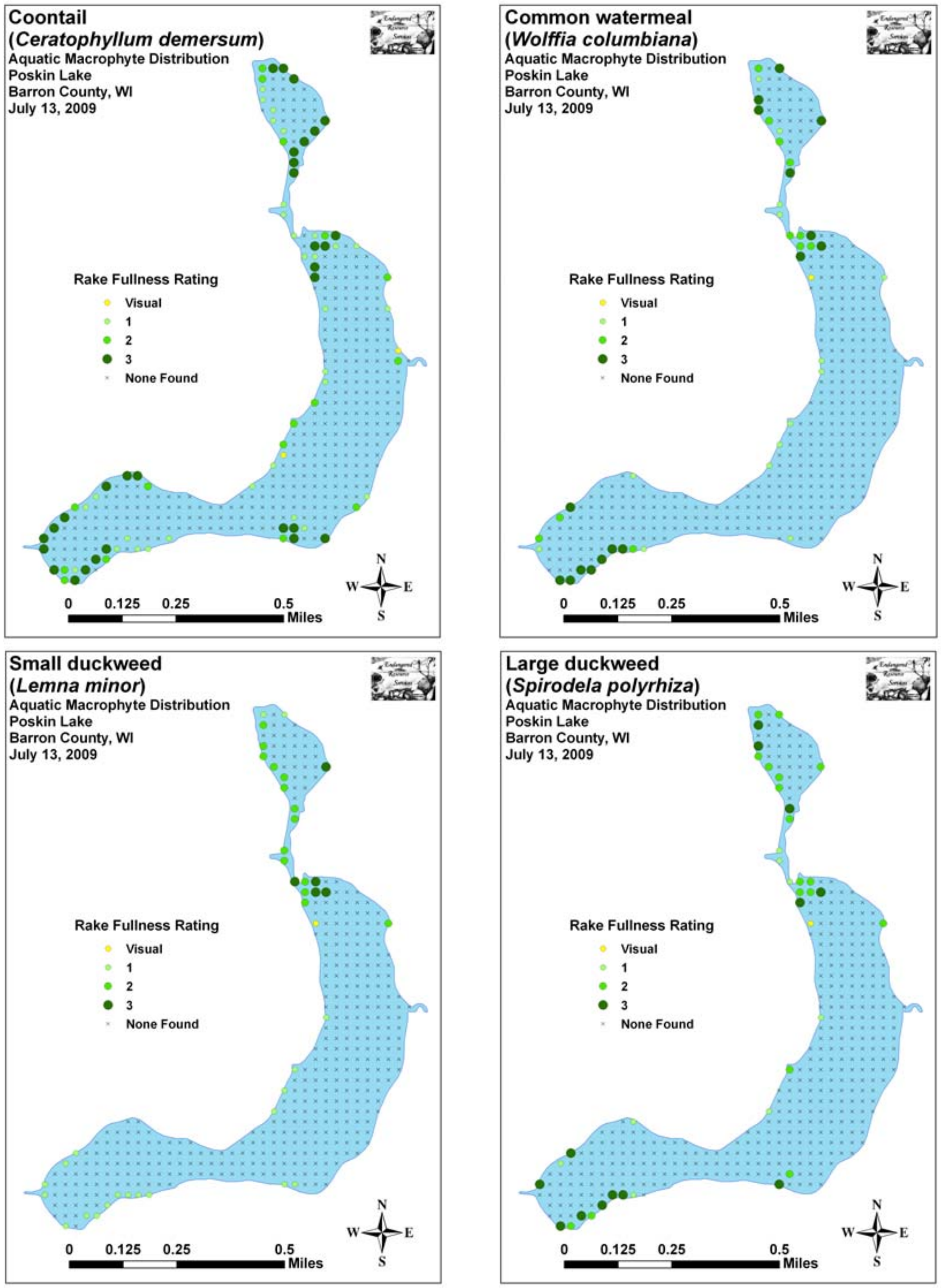


Figure 7: Poskin Lake's Most Common Species

Table 3: Floristic Quality Index of Aquatic Macrophytes
Poskin Lake, Barron County
July 13, 2009

Species	Common Name	C
Calla palustris	Wild arum	9
Callitriche palustris	Common water starwort	8
Carex comosa	Bottle brush sedge	5
Ceratophyllum demersum	Coontail	3
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Isoetes echinospora	Spiny-spored quillwort	8
Lemna minor	Small duckweed	5
Myriophyllum sibiricum	Northern water milfoil	7
Najas flexilis	Bushy pondweed	6
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Potamogeton nodosus	Long-leaf pondweed	7
Potamogeton pusillus	Small pondweed	7
Potamogeton strictifolius	Stiff pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Ranunculus aquatilis	Stiff water crowfoot	7
Schoenoplectus tabernaemontani	Softstem bulrush	4
Sparganium eurycarpum	Common bur-reed	5
Spirodela polyrhiza	Large duckweed	5
Typha angustifolia	Narrow-leaved cattail	1
Typha latifolia	Broad-leaved cattail	1
Vallisneria americana	Wild celery	6
Wolffia columbiana	Common watermeal	5
Zizania palustris	Northern wild rice	8
N		25
mean C		5.7
FQI		28.4

We identified a total of 25 native plants to species during the point intercept survey. They produced a mean Coefficient of Conservatism of 5.7 and a Floristic Quality Index of 28.4 (Table 3). Nichols (1999) reported an Average mean C for the Northern Central Hardwood Forests Region of 5.6 putting Poskin Lake almost exactly average for this part of the state. The FQI of 28.4 was slightly above the mean FQI of 20.9 for the Northern Central Hardwood Forests Region (Nichols 1999).

Currently, we believe exotic invasive species are a limited threat to Poskin Lake, but this could change rapidly in the future if Eurasian water milfoil is introduced into the lake. At the time of the July survey, we did NOT find any evidence of EWM in Poskin Lake despite its presence in other lakes further upstream in the Vermillion River Watershed. Reed canary grass is widely distributed in undeveloped shoreline areas of the lake, but this ubiquitous plant does provide some habitat for wildlife and there is no easy or cheap way to eliminate it. Curly-leaf pondweed, which was widespread but not abundant in May, had largely senesced by the time of the July survey and does not appear to play a big part in the lake's overall plant community (Figure 8). Although we did not find any Purple loosestrife (*Lythrum salicaria*), it is common in the area and should be monitored for and immediately eliminated if it becomes establish along the lakeshore in the future. Undeveloped, muck bottom areas like along the southwest bay and east of the channel would provide especially suitable habitat for this invasive wetland plant (For more information on exotic invasive species, see Appendix IX).

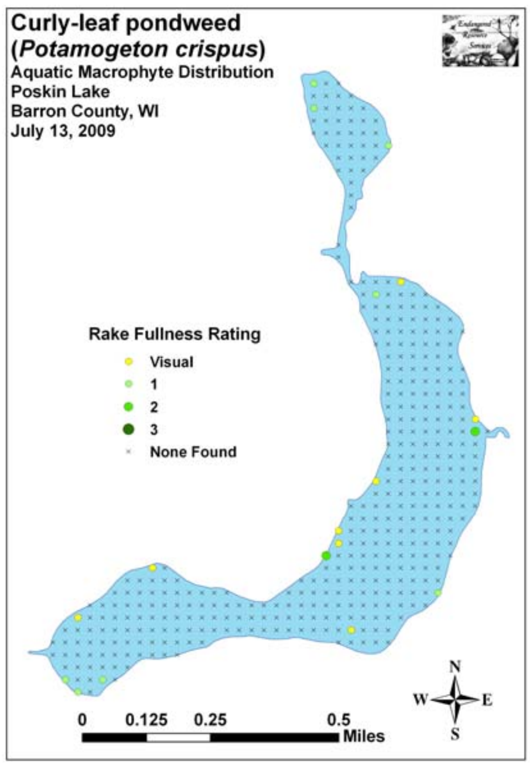


Figure 8: Curly-leaf Pondweed July Distribution

Of greater immediate concern were the large amounts of filamentous algae (relative frequency of 10.61), other floating algae, and Common watermeal, Small, Large and Forked duckweeds present in abundance at many locations throughout Poskin Lake. These species tend to proliferate in areas that have excessive nutrients. Filamentous algae were especially common in stagnant areas of the southwest bay, the southeast shoreline, along the north end of the main basin and in the channel. It was also abundant in front of a few managed lawns where fertilizer application was evident, and in areas where property owners cut the native vegetation down to the lakeshore (Figure 9).

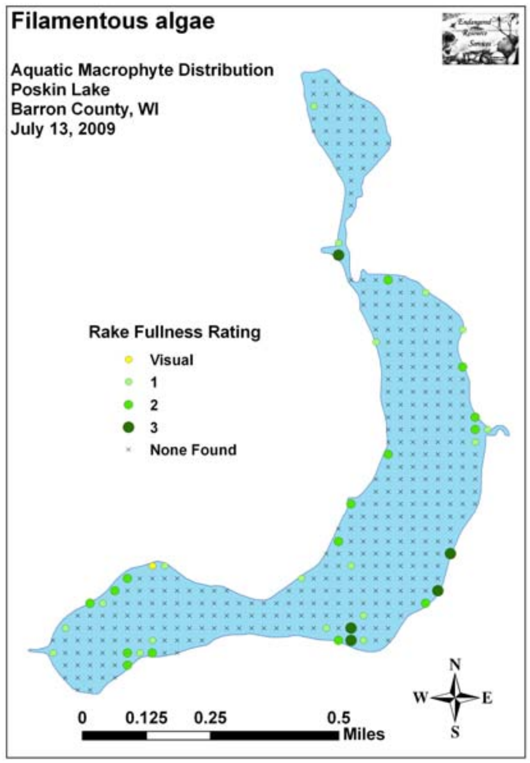


Figure 9: Filamentous Algae Distribution

CONSIDERATIONS FOR MANAGEMENT:

Poskin Lake has a limited plant community that appears to be affected by both water clarity and quality. Most sensitive species are rare and local which makes them vulnerable to lake wide extinction. Little Poskin, more than any other place on the lake, provides suitable habitat for many of these rare species. If water quality conditions improve in the future, high quality habitat plants like Wild rice (*Zizania palustris*), Large-leaf pondweed (*Potamogeton amplifolius*) and White-stem pondweed (*Potamogeton praelongus*) which are currently restricted to Little Poskin will hopefully spread into the main basin and provide improved habitat for both fish and other wildlife.

Curly-leaf pondweed:

Prior to beginning the 2009 surveys, it was brought to our attention that CLP was a concern of both the lake association and the APMP director. Based on the May 2009 CLP surveys, we believe that Curly-leaf pondweed has overtaken all suitable habitat in the lake. Because it is so widespread, eliminating it is not feasible. Despite this, CLP is not dense and may provide important early season fish habitat. If mechanical and/or chemical removal of CLP or other macrophytes are adopted as part of the APMP, the Board should be mindful that plants in general are the base of the aquatic food pyramid, provide habitat for other aquatic organisms, are important food sources for waterfowl and other wildlife, stabilize the shoreline, and work to improve water clarity by absorbing excess nutrients from the water. The reed/rush beds near the Vermillion River Outlet are especially important as they provide “nursery” habitat for baitfish and juvenile gamefish. In essence, a lake’s plants are as critical to the aquatic environment as trees are to a forest. Any plant control should be the minimum required to meet management goals while minimizing damage to native vegetation.

Water Clarity:

The high levels of filamentous and floating algae, duckweeds and watermeal in the lake are anecdotal evidence that there are excessive nutrients in the water (Boedeltje et al. 2005). Such things as internal loading from sediments, failed septic systems, and lawn and field fertilizer runoff are common causes of excess nutrients in surface water (Barko and Smart 1980, Carignan and Kalff 1982, Moeller et al. 1988). The breakdown of CLP in June is may also be a contributing factor to the algal blooms we observed in July (Wetzel 2001).

Regardless of the cause, these algal blooms decrease light penetration into the lake which leads to increased die back of plants at the edge of the littoral zone resulting in even more nutrients being released into the water. The elimination of shoreline vegetation can also increase the lake’s nutrient load by increasing runoff and adding “grass clipping” vegetation to the water. The dense areas of filamentous algae that occurred in front of some residences where there is no obvious visual reason for it may indicate septic systems are leaching nutrients into the lake. In other instances, obviously fertilized lawns may be the most likely explanation for these high levels of localized algae growth. A multiyear assessment of water quality within the watershed would be required to shed light on the specifics of nutrients within the system, as well as provide more specific suggestions on how to decrease nutrient inflow.

Educating lake residents about reducing nutrient input directly along the lake is one of the least expensive ways to decrease algal growth and improve water clarity. Not mowing down to the lakeshore, switching to a phosphorus-free fertilizer or eliminating fertilizer altogether would all be positive steps to this end. Where possible, shoreline restoration and buffer strips of native vegetation would enhance water quality by preventing erosion and runoff as well as improve the aesthetic value of the lake's highly developed shorelines.

Aquatic Invasive Species Prevention:

Finally, Aquatic Invasive Species (AIS) such as Eurasian water milfoil are an increasing problem in the lakes of northern Wisconsin in general, and several neighboring lakes in Barron County in particular. Preventing their introduction into Poskin Lake with proactive measures is strongly encouraged. Especially around the boat landing, lakeshore owners should refrain from removing native plants from the lake unless absolutely necessary as these patches of barren substrate can provide an easy place for invasive plants to take root and become established. Establishing a "Clean Boats/Clean Water" program and providing more noticeable signage at the boat landing would also offer a layer of protection against AIS by providing education, reeducation, and continual reminders of the dangers/impacts of aquatic invasive species to lake owners and visitors alike. Finally, conducting monthly or bimonthly transect surveys parallel to the shore near the lake's boat landing could result in immediate detection if AIS are introduced into the lake. The sooner an infestation is detected, the greater the chances it can be successfully controlled or even eliminated.

Management Considerations Summary:

- Preserve and maintain Poskin Lake's native plant communities.
- If controlling Curly-leaf pondweed or other macrophytes is adopted as part of the APMP, work to minimize the impact on rare and sensitive native vegetation.
- Reduce and, wherever possible, eliminate fertilizer applications and other sources of nutrients near the lakeshore.
- Encourage shoreline restoration and the establishment of native vegetation buffer strips along the lakeshore to prevent runoff.
- Encourage owners to refrain from removing native plants from the lake as these areas provide Aquatic Invasive Species an ideal place to become established.
- Establish a Clean Boats/Clean Water program/improve signage to educate lake users about Aquatic Invasive Species like Eurasian water milfoil.
- Consider transect monitoring for invasive species at the lake's boat landing at least once a month during the summer.

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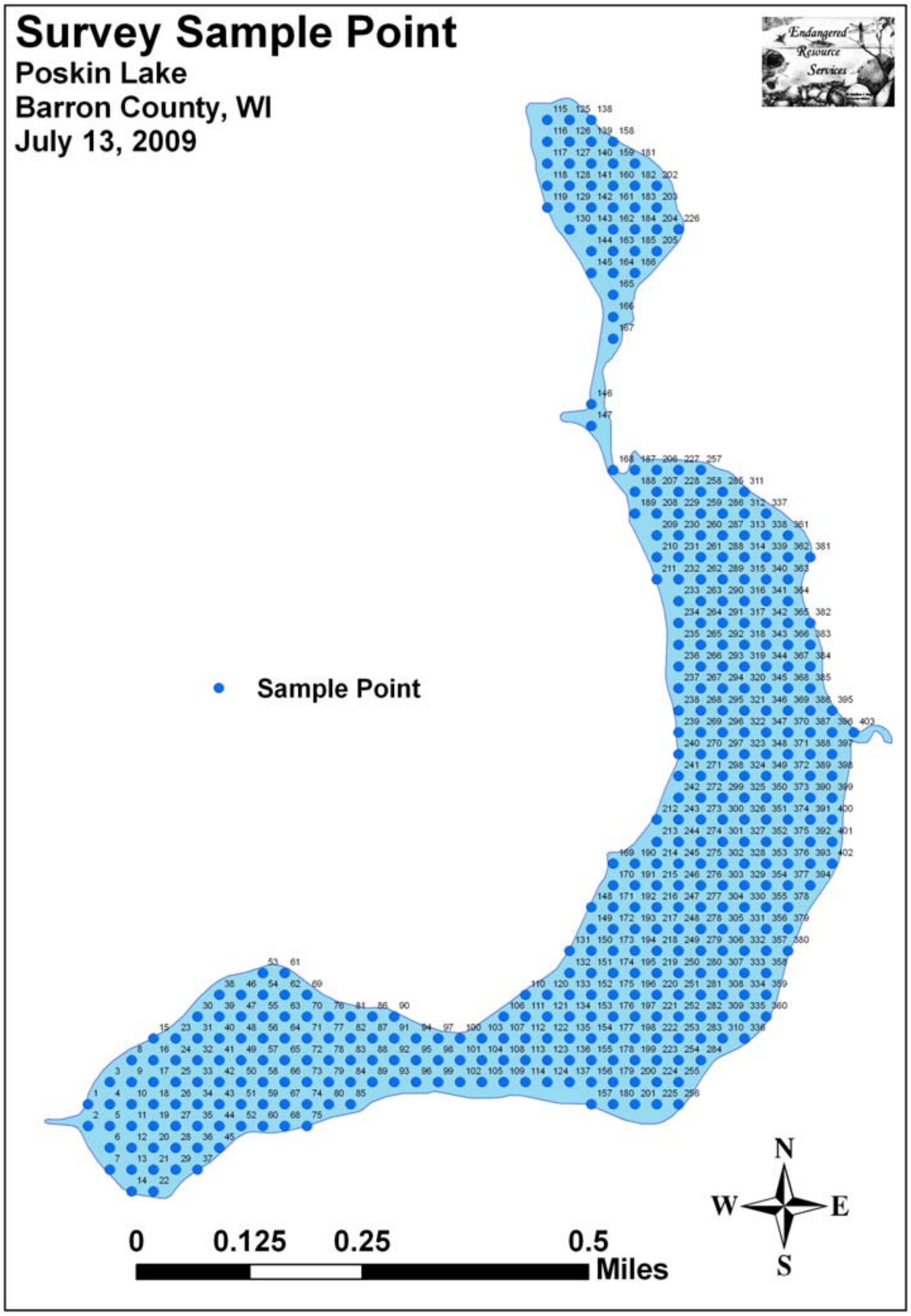
Appendix I: Poskin Lake Map with Sample Points


Survey Sample Point
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Sample Point
0
0.125
0.25
0.5
Miles
N
W
E
S

Appendix II: Boat Survey Data Sheet

Boat Survey	
Lake Name	
County	
WBIC	
Date of Survey	
(mm/dd/yy)	
workers	
Nearest Point	**Species seen, habitat information**

Appendix III: Vegetative Survey Data Sheet

Observers for this lake: names and hours worked by each:																									
Lake:									**WBIC**									**County**						**Date:**	
Site #	**Depth (ft)**	**Muck (M), Sand (S), Rock (R)**	**Rake pole (P) or rake rope (R)**	**Total Rake Fullness**	**EWM**	**CLP**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
1																									
2																									
3																									
4																									
5																									
6																									
7																									
8																									
9																									
10																									
11																									
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13																									
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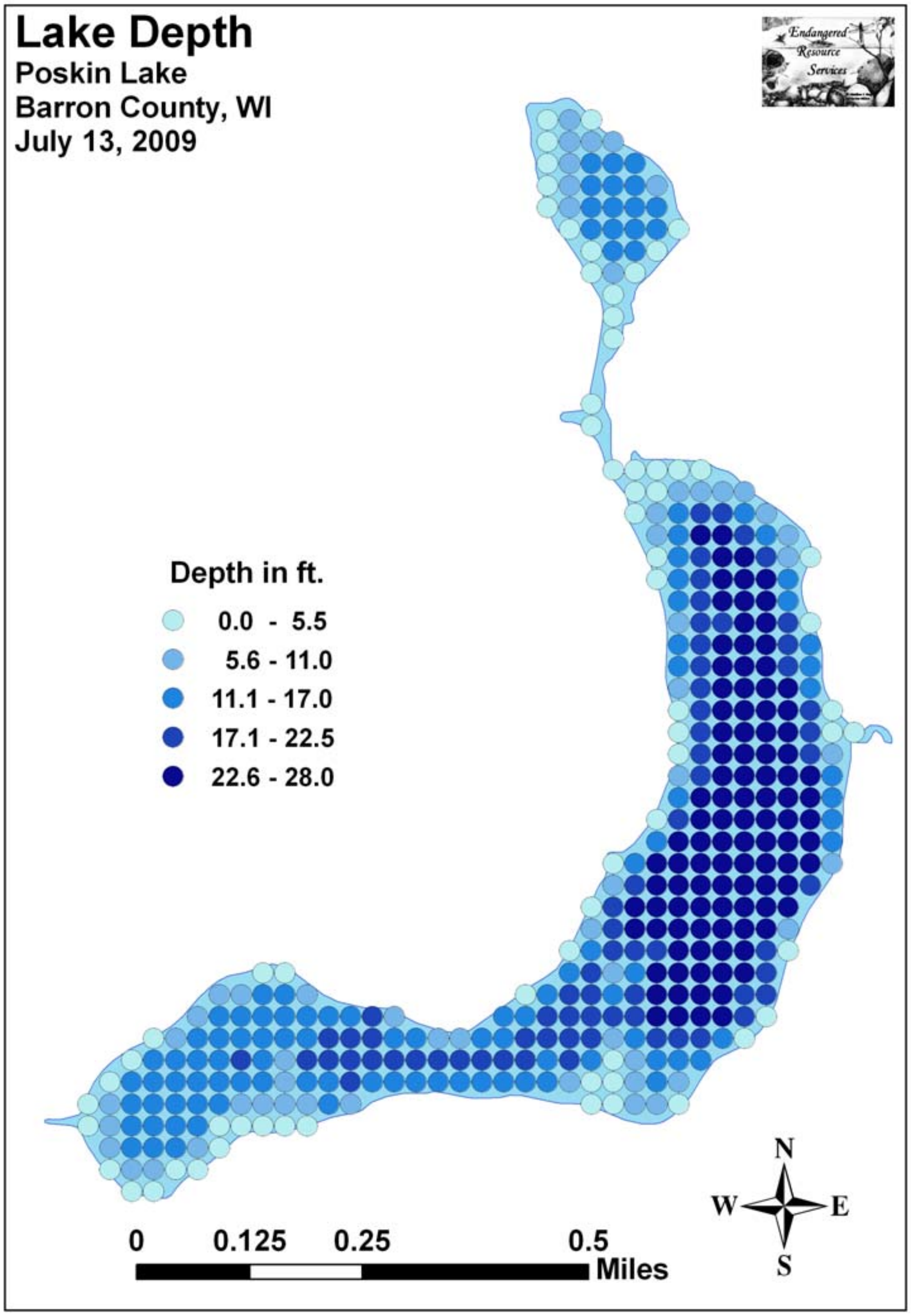
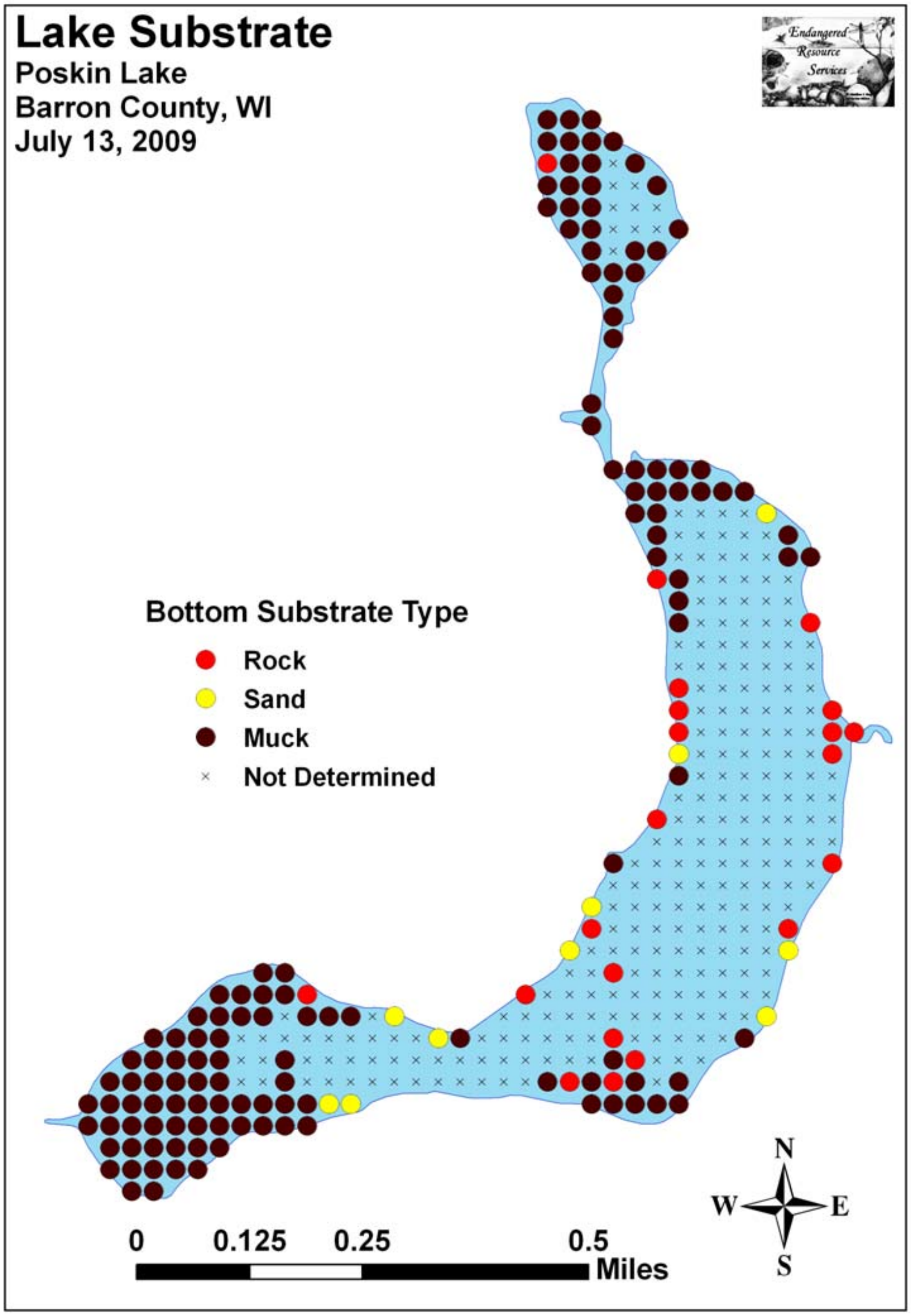
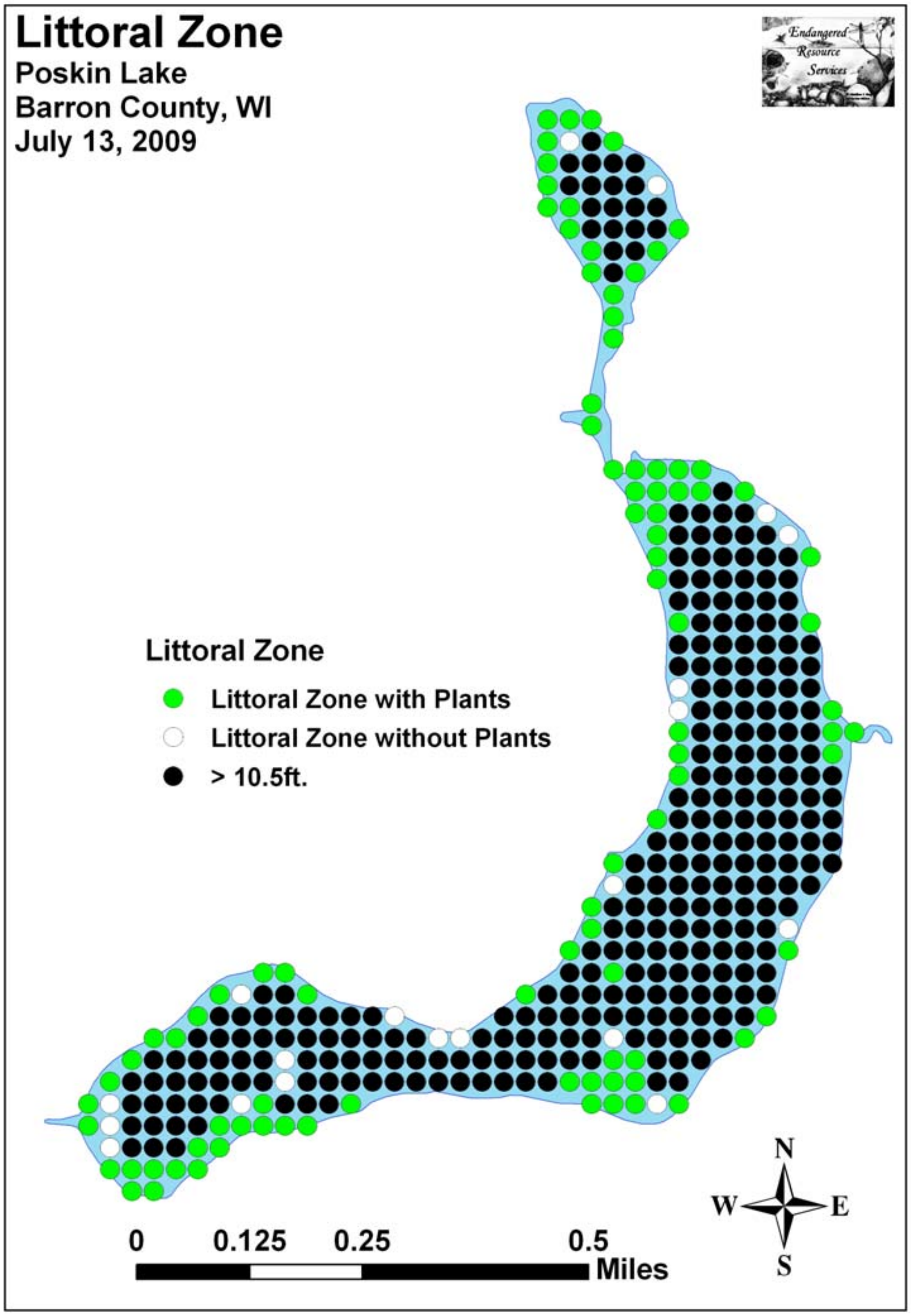
18																									
19																									
20																									

Appendix IV: Habitat Variable Maps

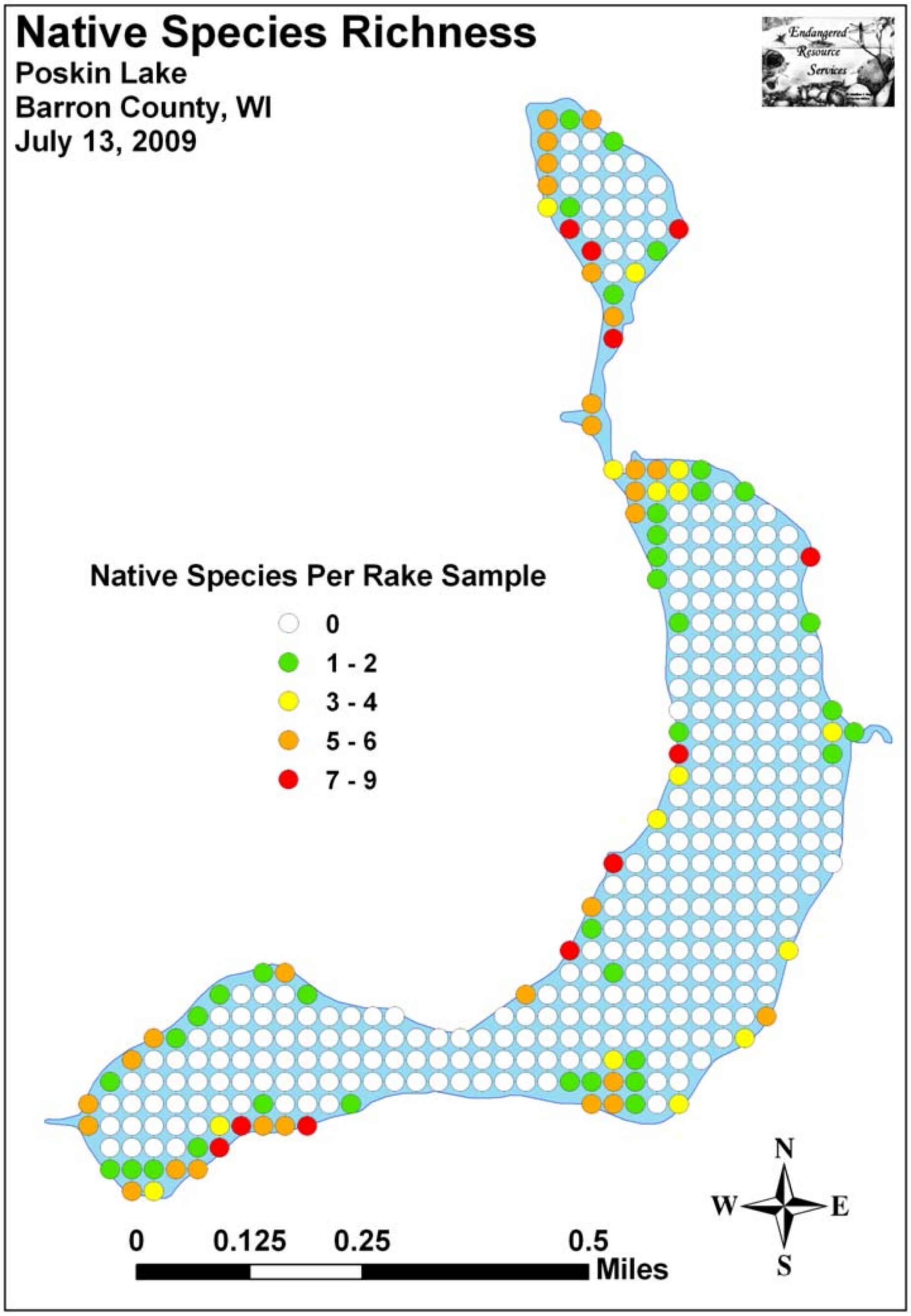

Lake Depth
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Depth in ft.
0.0 - 5.5
5.6 - 11.0
11.1 - 17.0
17.1 - 22.5
22.6 - 28.0
N
W
E
S
0
0.125
0.25
0.5
Miles


Lake Substrate
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Bottom Substrate Type
Rock
Sand
Muck
Not Determined
N
W
E
S
0
0.125
0.25
0.5
Miles

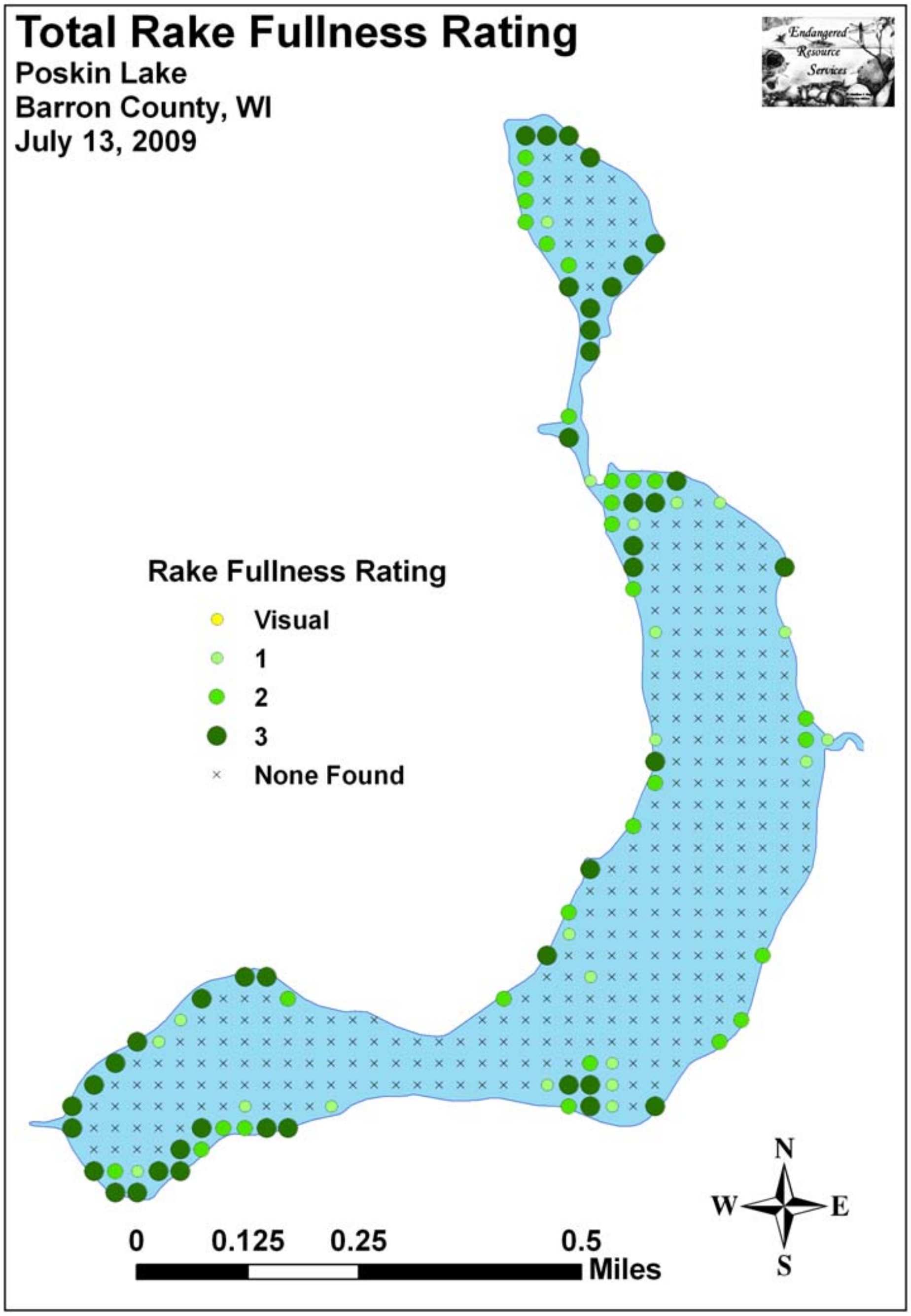


Littoral Zone
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Littoral Zone
Littoral Zone with Plants
Littoral Zone without Plants
> 10.5ft.
0
0.125
0.25
0.5
Miles
N
W
E
S

Appendix V: Native Species Richness and Total Rake Fullness Maps



Native Species Richness
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Native Species Per Rake Sample
0
1 - 2
3 - 4
5 - 6
7 - 9
0
0.125
0.25
0.5
Miles
N
W
E
S


Total Rake Fullness Rating
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
E
S

Appendix VI: Plant Species Accounts

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Calla palustris*) **Water arum**
Specimen Location: Poskin Lake; N45.42293°, W91.98235°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2009-145
Habitat/Distribution: Muck bottom at the shoreline in 0 – 0.25 meters of water. Rare - a few scattered individuals were located along shore in the southwest bay, the channel and in the north bay.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Typha angustifolia*) Narrow-leaved cattail, (*Sagittaria latifolia*) Common arrowhead, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Sparganium eurycarpum*) Common bur-reed, (*Phalaris arundinacea*) Reed canary grass

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Callitriche palustris*) **Common water starwort**
Specimen Location: Poskin Lake; N45.43921°, W91.97494°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2009-146
Habitat/Distribution: A single rake of plants was located at the point over a tiny gravel area in the north bay.
Common Associates: (*Heteranthera dubia*) Water star-grass, (*Elodea canadensis*) Common waterweed, (*Isoetes echinospora*) Spiny-spored quillwort

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Carex comosa*) **Bottle-brush sedge**
Specimen Location: Poskin Lake; N45.42293°, W91.98235°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2009-147
Habitat/Distribution: Muck bottom along the shoreline. Uncommon with a few scattered individuals located along shore in the southwest bay, the channel and in the north bay.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water arum, (*Typha angustifolia*) Narrow-leaved cattail, (*Sagittaria latifolia*) Common arrowhead, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Sparganium eurycarpum*) Common bur-reed, (*Phalaris arundinacea*) Reed canary grass

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Ceratophyllum demersum*) **Coontail**
Specimen Location: Poskin Lake; N45.42290°, W91.98434°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2009-148
Habitat/Distribution: Muck bottom in 0-3.5 meters. Abundant in most muck bottom areas of the lake to the point of being invasive at the Vermillion River Inlet and in the southwest bay.
Common Associates: (*Potamogeton crispus*) Curly-leaf pondweed**,** (*Nuphar variegata*) Spatterdock, (*Nymphaea odorata*) White water lily, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Spirodela polyrhiza*) Large duckweed, (*Wolffia columbiana*) Common watermeal, (*Lemna minor*) Small duckweed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Elodea canadensis*) **Common waterweed**
Specimen Location: Poskin Lake; N45.42368°, W91.97988°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2009-149
Habitat/Distribution: Muck bottom in 0.5-2 meters of water.
Uncommon in the main basin of Poskin – common in the north bay, the channel and at the Vermillion River Inlet.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Nymphaea odorata*) White water lily, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Heteranthera dubia*) **Water star-grass**
Specimen Location: Poskin Lake; N45.43259°, W91.97222°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2009-150
Habitat/Distribution: Firm muck and sandy muck bottoms usually in water < 1 meter deep. Rare – only found at the three rake locations.
Common Associates: (*Elodea canadensis*) Common waterweed, (*Ceratophyllum demersum*) Coontail, (*Vallisneria americana*) Wild celery, (*Najas flexilis*) Bushy pondweed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Isoetes echinospora*) **Spiny-spored quillwort**
Specimen Location: Poskin Lake; N45.43921°, W91.97494°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2009-151
Habitat/Distribution: A single rake of plants was located at the point over a tiny gravel area in the north bay. Spore analysis was used to confirm species.
Common Associates: (*Heteranthera dubia*) Water star-grass, (*Elodea canadensis*) Common waterweed, (*Callitriche palustris*) Common water starwort

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Lemna minor*) **Small duckweed**
Specimen Location: Poskin Lake; N45.42394°, W91.98488°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2009-152
Habitat/Distribution: Located floating at or just under the surface in sheltered areas. Common to abundant in the southwest and north bays and near the Vermillion River Inlet.
Common Associates: (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Spirodela polyrhiza*) Large duckweed, (*Wolffia columbiana*) Common watermeal, (*Ceratophyllum demersum*) Coontail

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Lemna trisulca*) **Forked duckweed**
Specimen Location: Poskin Lake; N45.43747°, W91.97388°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-153
Habitat/Distribution: A single specimen was located in the north bay among lilypads.
Common Associates: (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Ceratophyllum demersum*) Coontail, (*Elodea canadensis*) Common waterweed, (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Myriophyllum sibiricum*) **Northern water milfoil**
Specimen Location: Poskin Lake; N45.42368°, W91.97988°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-154
Habitat/Distribution: Muck to sand bottom in water up to 2 meters. Widespread and relatively common on the borders of the main basin.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Ceratophyllum demersum*) Coontail, (*Ranunculus aquatilis*) Stiff water crowfoot, (*Potamogeton crispus*) Curly-leaf pondweed, (*Najas flexilis*) Bushy pondweed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Najas flexilis*) **Bushy pondweed**
Specimen Location: Poskin Lake; N45.42368°, W91.97988°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-155
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-1.0 meters of water. Uncommon on the margins of the central basin.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Vallisneria americana*) Wild celery, (*Myriophyllum sibiricum*) Northern water milfoil

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Nuphar variegata*) **Spatterdock**
Specimen Location: Poskin Lake; N45.43294°, W91.97223°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-156
Habitat/Distribution: Muck bottom in 0-1m of water where it often forms dense canopies. It prefers a firmer bottom than (*Nymphaea odorata*) and is more common in sandy areas.
Common Associates: (*Nymphaea odorata*) White water lily, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Nymphaea odorata*) **White water lily**
Specimen Location: Poskin Lake; N45.43294°, W91.97223°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2009-157
Habitat/Distribution: Muck bottom in 0-1m where it forms dense canopies with other floating leaf species. Common in all calm water bays.
Common Associates: (*Nuphar variegata*) Spatterdock, (*Elodea canadensis*) Common waterweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Phalaris arundinacea*) **Reed canary grass**
Specimen Location: Poskin Lake; N45.42293°, W91.98235°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2009-158
Habitat/Distribution: Common but not abundant. Prefers thick muck soil in and out of water <0.5 meters. Primarily found on shore in undeveloped low areas. Present throughout.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water arum, (*Typha angustifolia*) Narrow-leaved cattail, (*Sagittaria latifolia*) Common arrowhead, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Sparganium eurycarpum*) Common bur-reed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Potamogeton amplifolius*) **Large-leaf pondweed**
Specimen Location: Poskin Lake; N45.43821°, W91.97192°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2009-159
Habitat/Distribution: Found growing over firm muck in 1-2 meters of water. Rare - restricted to the north bay at the edge of wild rice areas.
Common Associates: (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Elodea canadensis*) Common waterweed, (*Potamogeton praelongus*) White-stem pondweed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Potamogeton crispus*) **Curly-leaf pondweed**
Specimen Location: Poskin Lake; N45.42290°, W91.98434°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2009-160
Habitat/Distribution: Found in most mucky bottom areas in water from 1-2m deep. Relatively common and widely distributed throughout in the May survey, but rare by the time of the July survey. The only sizable monotypic bed occurred on the north end of the main basin near the Vermillion River Inlet.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Nymphaea odorata*) White water lily

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Potamogeton nodosus*) **Long-leaf pondweed**
Specimen Location: Poskin Lake; N45.43398°, W91.97277°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-161
Habitat/Distribution: Plants restricted to the channel between the north bay and the main basin. This species is more typical of rivers and apparently the water flow it prefers/requires is met at this location.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Elodea canadensis*) Common waterweed, (*Heteranthera dubia*) Water star-grass

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Potamogeton obtusifolius*) **Blunt-leaf pondweed?**
Specimen Location: Poskin Lake; N45.43432°, W91.97328°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-162
Habitat/Distribution: A single patch of plants was growing just off the channel near the point. It seems too small for this species, but it is not like any other member of the "pusillus" group I have ever seen. If not *obtusifolius*, I would guess it is a *pusillus* X *obtusifolius* hybrid. Leaves have distinct lacunar cells, are five veined, slightly reddish at the node, and have small glands. They are narrower than typical *obtusifolius*, but fall in at the bottom range Voss gives for the species. They are also much brighter green than any other *obtusifolius* I have seen. The stipules seem to be obtusifolius-like in that they are fleshy, opaque and sheath the stem. Unfortunately, no plants were in fruit.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Potamogeton nodosus*) Long-leaf pondweed, (*Elodea canadensis*) Common waterweed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Potamogeton praelongus*) **White-stem pondweed**
Specimen Location: Poskin Lake; N45.43749°, W91.97289°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-163
Habitat/Distribution: Found growing over firm muck in 1-2 meters of water. Restricted to the north bay at the edge of wild rice areas.
Common Associates: (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Elodea canadensis*) Common waterweed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Potamogeton pusillus*) **Small pondweed**
Specimen Location: Poskin Lake; N45.42368°, W91.97988°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-164
Habitat/Distribution: Uncommon over sandy muck. A few individuals were located in water <1m deep.
Common Associates: (*Vallisneria americana*) Wild celery, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Elodea canadensis*) Common waterweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Myriophyllum sibiricum*) Northern water milfoil, (*Najas flexilis*) Bushy pondweed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Potamogeton richardsonii*) **Clasping-leaf pondweed**
Specimen Location: Poskin Lake; N45.42368°, W91.97988°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-165
Habitat/Distribution: Found in sandy/muck bottom conditions in shallow water 0.5-1.0 meter deep. Relatively common and widespread throughout the main basin.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Vallisneria americana*) Wild celery, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Elodea canadensis*) Common waterweed, (*Myriophyllum sibiricum*) Northern water milfoil, (*Najas flexilis*) Bushy pondweed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Potamogeton strictifolius*) **Stiff pondweed**
Specimen Location: Poskin Lake; N45.42256°, W91.98383°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-166
Habitat/Distribution: Restricted to the southwest bay where we found several large patches growing in shallow water <1m deep over muck. Narrow, pointed leaves with 3 veins and slightly curled under margins, much branched top leaves, 9mm flower stalk, achenes with little beak and a noticeable indent along the margin distinguished this from *pusillus*. That said, it was much smaller than other *strictifolius* I've seen.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Potamogeton zosteriformis*) **Flat-stem pondweed**
Specimen Location: Poskin Lake; N45.42368°, W91.97988°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-167
Habitat/Distribution: It prefers substrate of thick organic muck. Widely distributed throughout and common in all suitable habitat.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Elodea canadensis*) Common waterweed, (*Potamogeton crispus*) Curly-leaf pondweed, (*Nymphaea odorata*) White water lily

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Ranunculus aquatilis*) **Stiff water crowfoot**
Specimen Location: Poskin Lake; N45.42659°, W91.97400°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-168
Habitat/Distribution: Widely distributed in shoreline areas around the central basin. Uncommon in water <1m over sand, rock and sandy muck.
Common Associates: (*Myriophyllum sibiricum*) Northern water milfoil, (*Potamogeton pusillus*) Small pondweed, (*Vallisneria americana*) Wild celery, (*Najas flexilis*) Bushy pondweed, (*Ceratophyllum demersum*) Coontail

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Sagittaria latifolia*) **Common arrowhead**
Specimen Location: Poskin Lake; N45.42293°, W91.98235°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-169
Habitat/Distribution: Uncommon in scattered mucky shoreline.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Sparganium eurycarpum*) Common bur-reed, (*Phalaris arundinacea*) Reed canary grass, (*Calla palustris*) Water arum

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Sagittaria rigida*) **Sessile-fruited arrowhead**
Specimen Location: Poskin Lake; N45.43294°, W91.97223°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-170
Habitat/Distribution: A nearly monotypic bed of emergents was growing at the shore at the point. A few other individuals were scattered throughout the north bay growing over firm muck.
Common Associates: (*Vallisneria americana*) Wild celery, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Schoenoplectus acutus*) **Hardstem bulrush**
Specimen Location: Poskin Lake; N45.43235°, W91.96895°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-171
Habitat/Distribution: Firm rock/sand bottoms in 0-.25m of water. A few bulrush beds occurred on the east side of the lake just north of the Vermillion River Outlet.
Common Associates: (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Vallisneria americana*) Wild celery, (*Najas flexilis*) Bushy pondweed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Schoenoplectus tabernaemontani*) **Softstem bulrush**
Specimen Location: Poskin Lake; N45.42293°, W91.98235°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-172
Habitat/Distribution: Firm muck bottoms in 0-.25m of water. Scattered individuals were interspersed with cattails and bur-reeds.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water arum, (*Typha angustifolia*) Narrow-leaved cattail, (*Sagittaria latifolia*) Common arrowhead, (*Sparganium eurycarpum*) Common bur-reed

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Sparganium eurycarpum*) **Common bur-reed**
Specimen Location: Poskin Lake; N45.42293°, W91.98235°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-173
Habitat/Distribution: Fairly common in scattered undeveloped mucky shoreline locations; especially in the southwest bay.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water arum, (*Typha angustifolia*) Narrow-leaved cattail, (*Sagittaria latifolia*) Common arrowhead, (*Schoenoplectus tabernaemontani*) Softstem bulrush

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Spirodela polyrhiza*) **Large duckweed**
Specimen Location: Poskin Lake; N45.42394°, W91.98488°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-174
Habitat/Distribution: Located floating at or just under the surface in stagnant bays. Common to abundant in the southwest and north bays and near the Vermillion River Inlet.
Common Associates: (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Wolffia columbiana*) Common watermeal, (*Lemna minor*) Small duckweed, (*Ceratophyllum demersum*) Coontail

County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Typha angustifolia*) **Narrow-leaved cattail**
Specimen Location: Poskin Lake; N45.42329°, W91.98186°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-175
Habitat/Distribution: Thick muck soil in and out of water <0.5 meters. A single patch occurred in the southwest bay at the point.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water arum, (*Sagittaria latifolia*) Common arrowhead, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Sparganium eurycarpum*) Common bur-reed

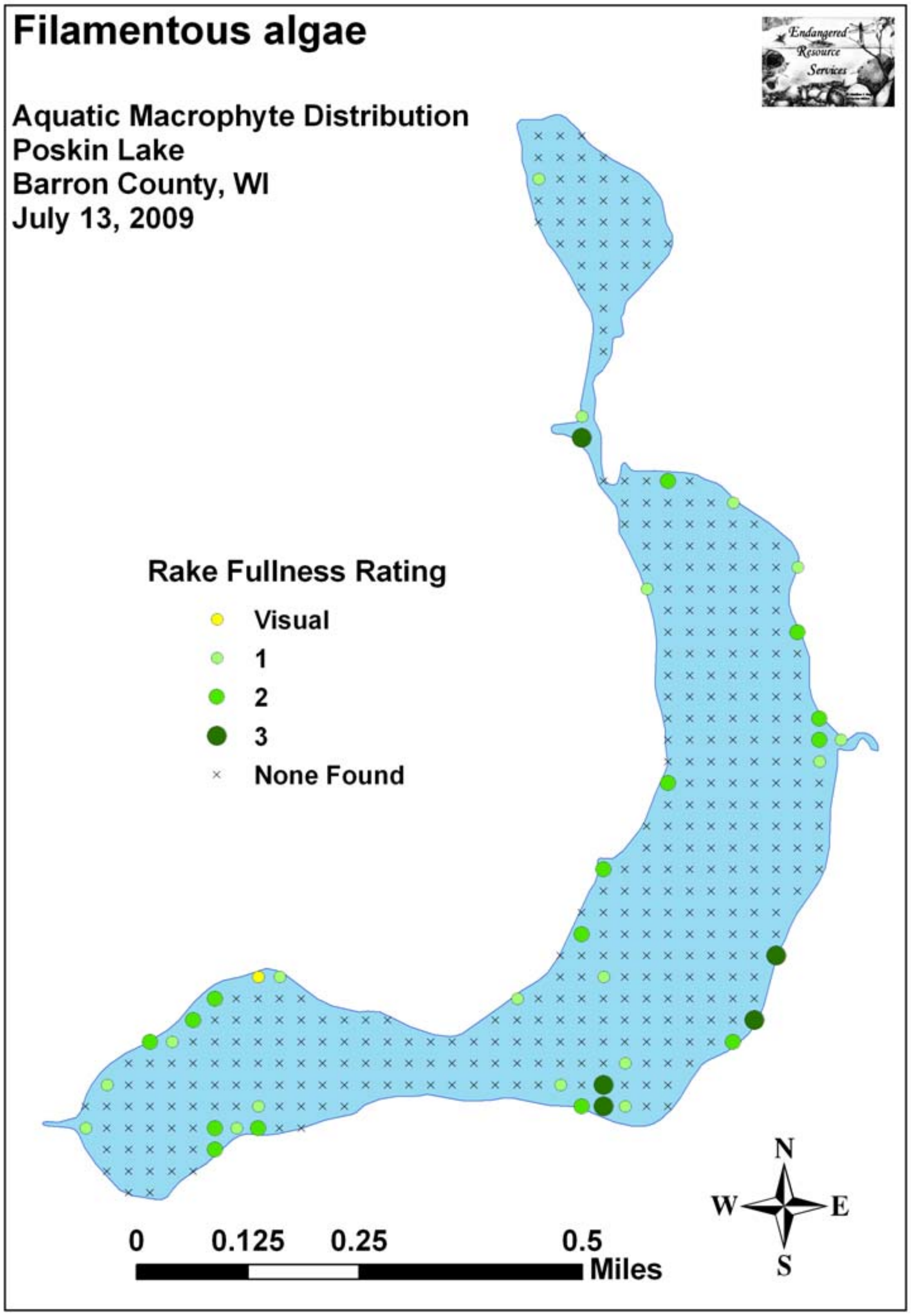
County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Typha latifolia*) **Broad-leaved cattail**
Specimen Location: Poskin Lake; N45.42293°, W91.98235°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-176
Habitat/Distribution: Thick muck soil in and out of water <0.5 meters. Found in scattered undeveloped shoreline areas throughout.
Common Associates: (*Calla palustris*) Water arum, (*Typha angustifolia*) Narrow-leaved cattail, (*Sagittaria latifolia*) Common arrowhead, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Sparganium eurycarpum*) Common bur-reed

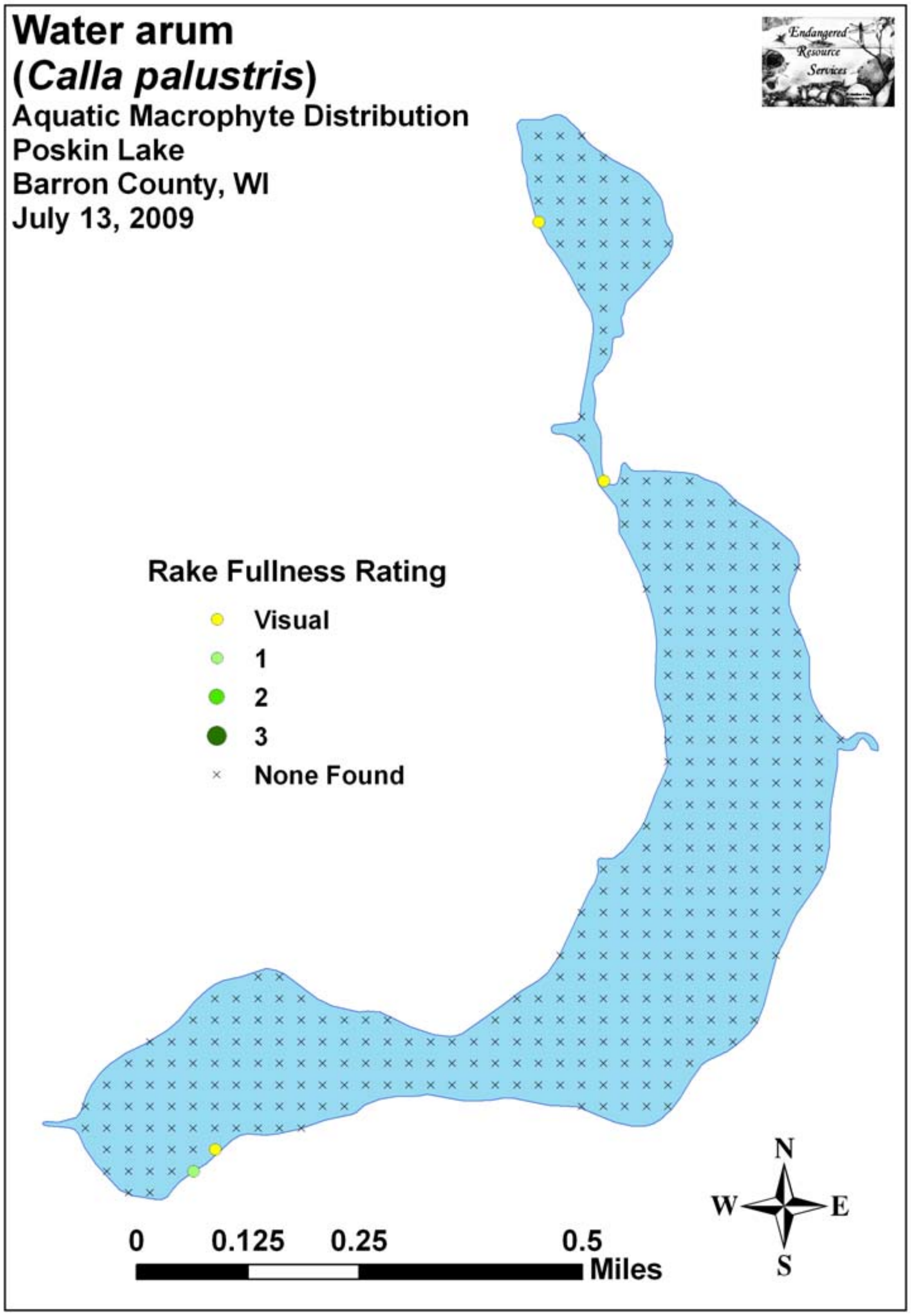
County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Vallisneria americana*) **Wild celery**
Specimen Location: Poskin Lake; N45.42979°, W91.97162°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-177
Habitat/Distribution: Found in almost any bottom conditions, but grows best in sandy to sand/muck rock bottoms in 0.5-1.0 meters of water. Common and widely distributed on the borders of the main basin.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Myriophyllum sibiricum*) Northern water milfoil

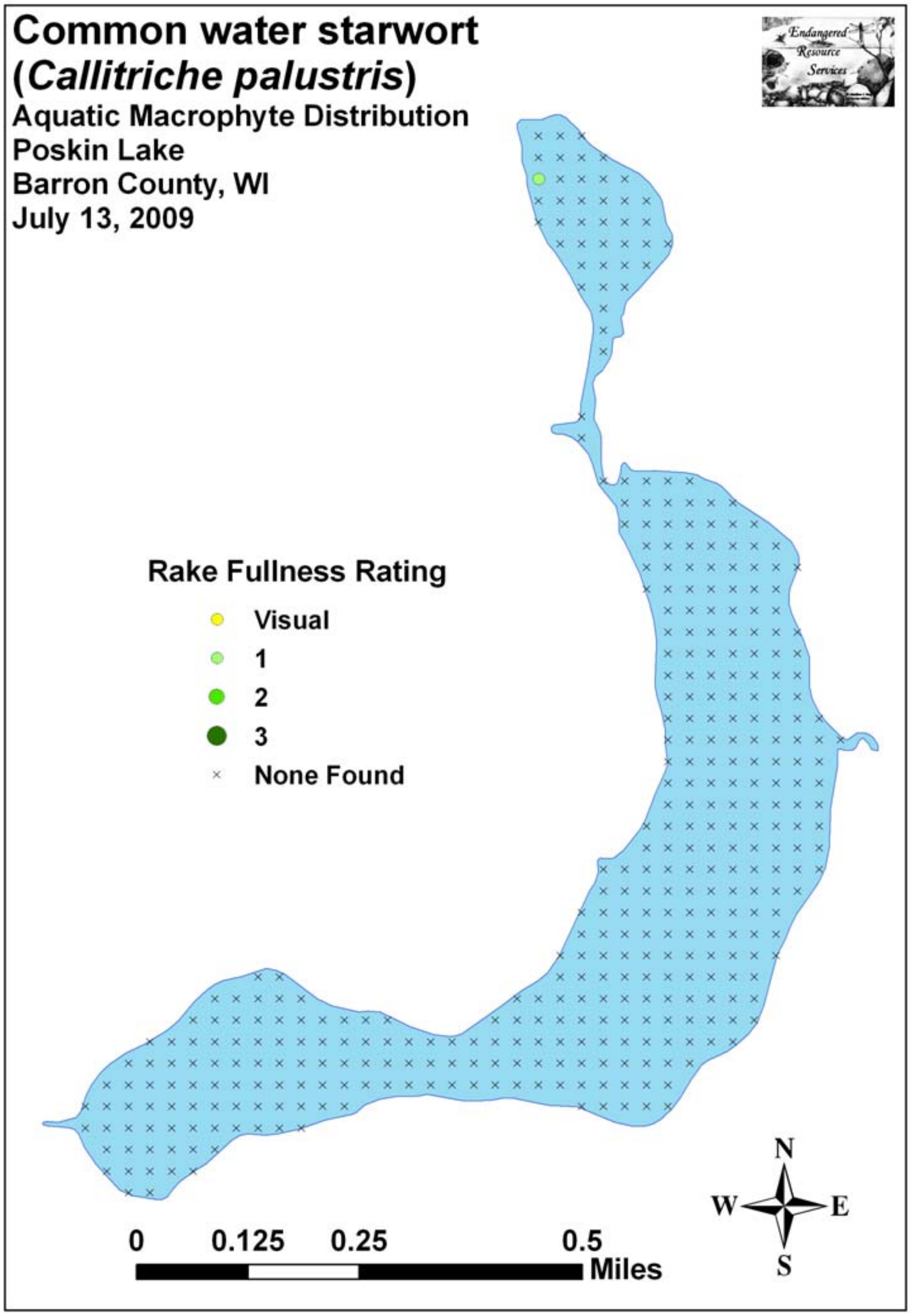
County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Wolffia columbiana*) **Common watermeal**
Specimen Location: Poskin Lake; N45.42394°, W91.98488°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-178
Habitat/Distribution: Located floating at or just under the surface in stagnant bays among lilypads. Common to abundant in the southwest and north bays and near the Vermillion River Inlet.
Common Associates: (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Spirodela polyrhiza*) Large duckweed, (*Lemna minor*) Small duckweed, (*Ceratophyllum demersum*) Coontail

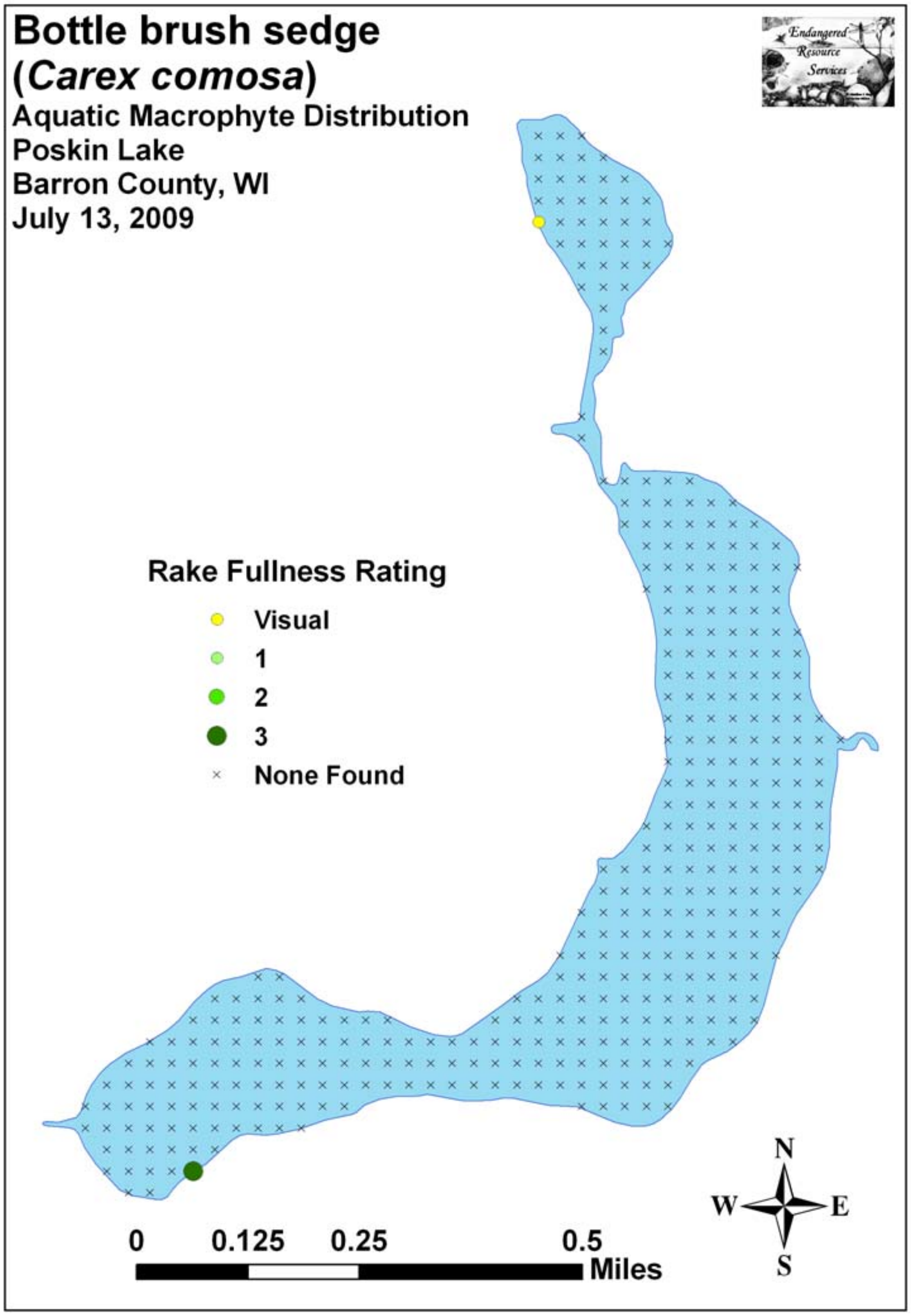
County/State: Barron County, Wisconsin **Date:** 7/13/09
Species: (*Zizania palustris*) **Northern wild rice**
Specimen Location: Poskin Lake; N45.43921°, W91.97494°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2009-179
Habitat/Distribution: Restricted to the north bay. ALL plants had been clipped by geese making it seem doubtful any will produce seeds.
Common Associates: (*Nymphaea odorata*) White water lily, (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock**,** (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Elodea canadensis*) Common waterweed

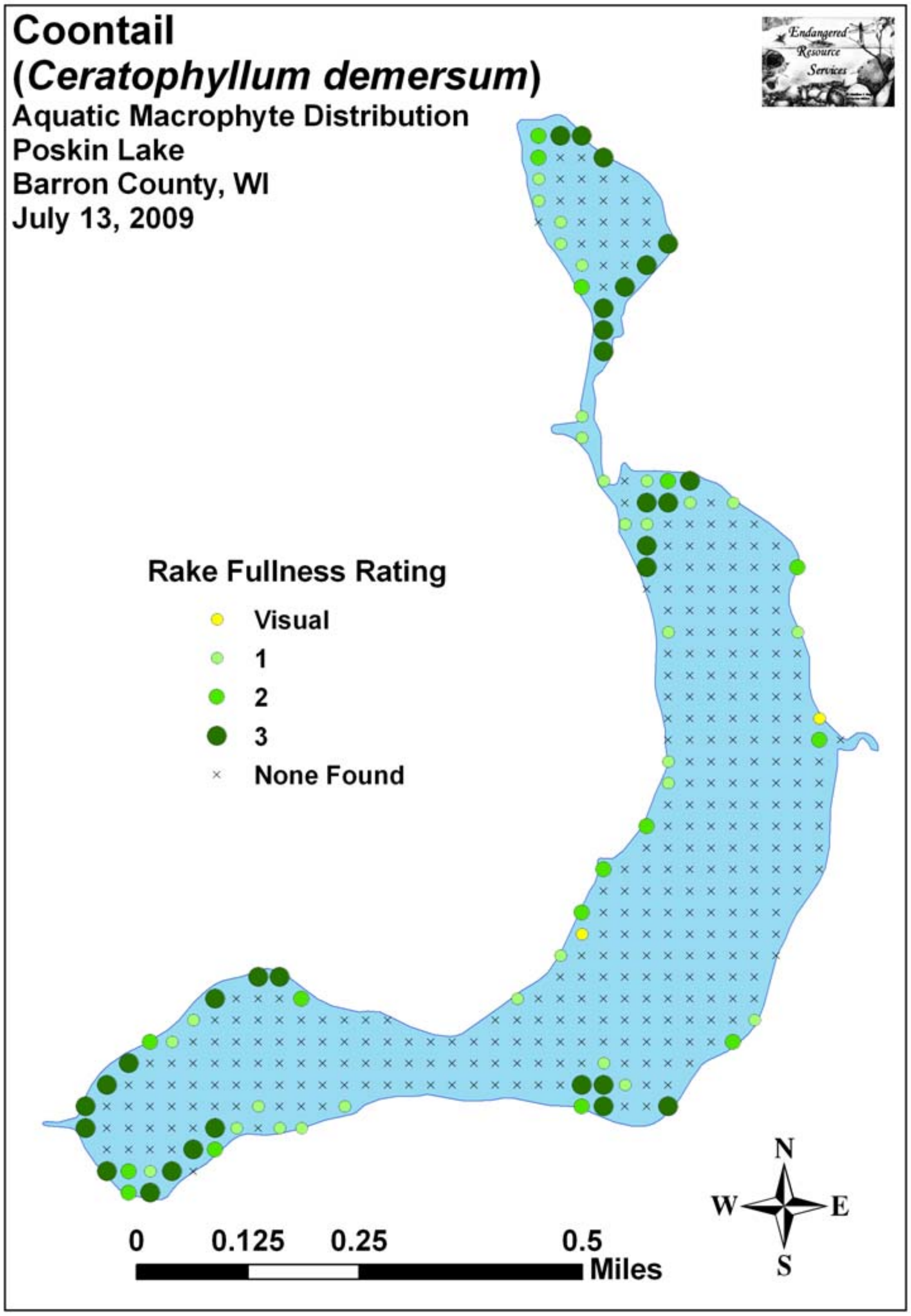
Appendix VII: Point Intercept Plant Species Distribution Maps

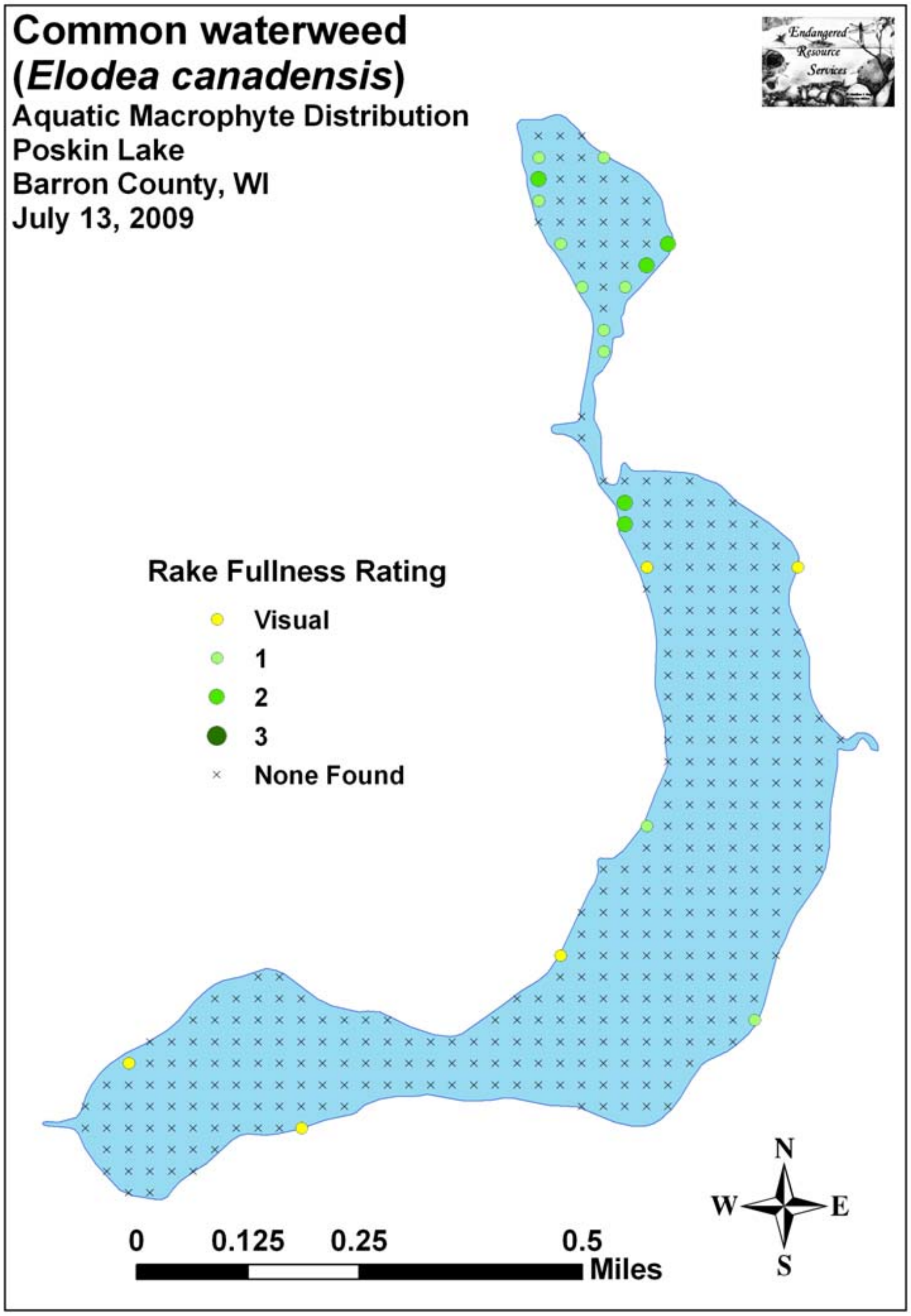

Filamentous algae
Endangered Resource Services
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Water arum
(*Calla palustris*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Common water starwort
(*Callitriche palustris*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
E
S


Bottle brush sedge
(Carex comosa)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
E
S


Coontail
(Ceratophyllum demersum)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
E
S



Common waterweed
(*Elodea canadensis*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
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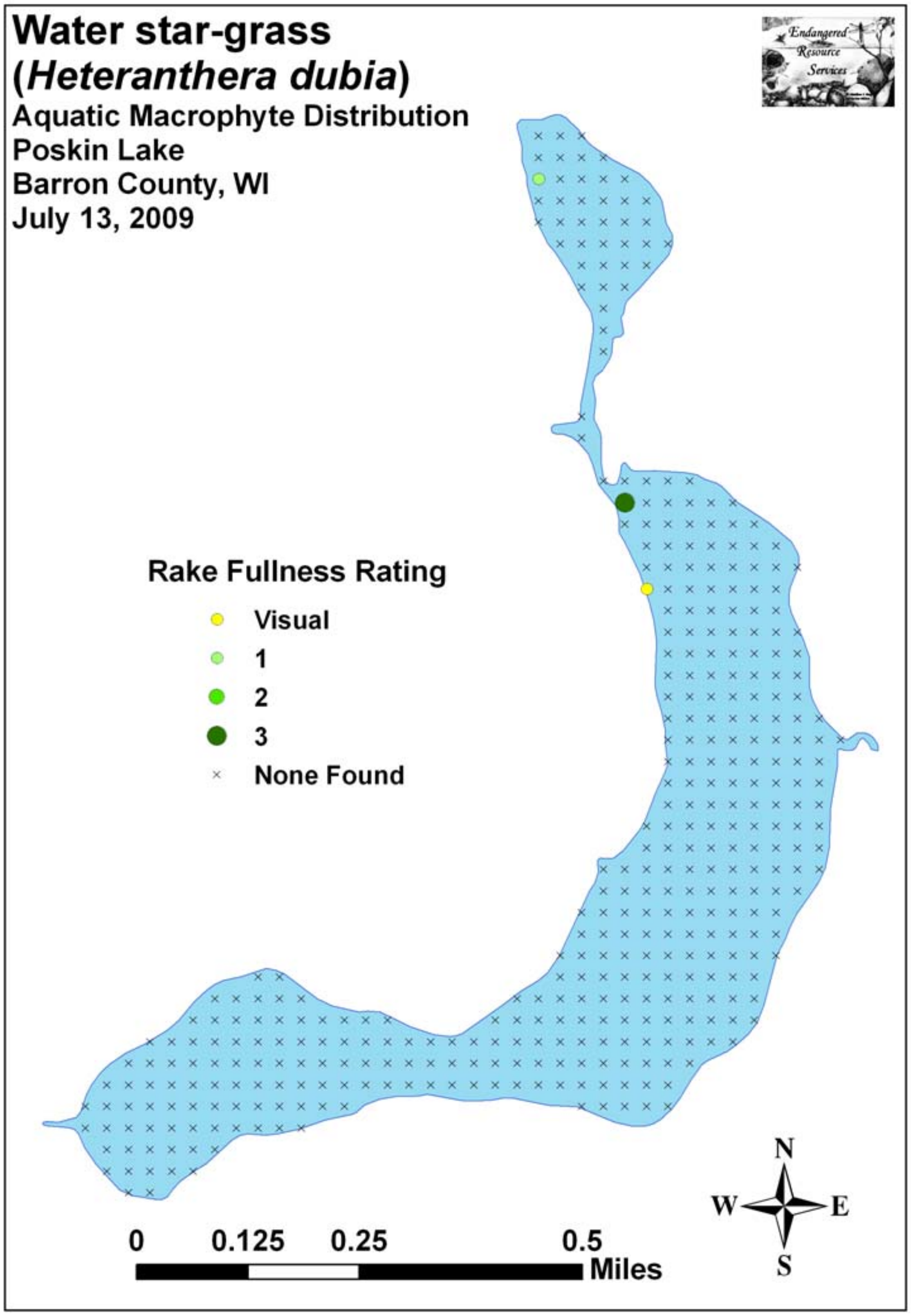
Water star-grass
(*Heteranthera dubia*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
0
0.125
0.25
0.5
Miles
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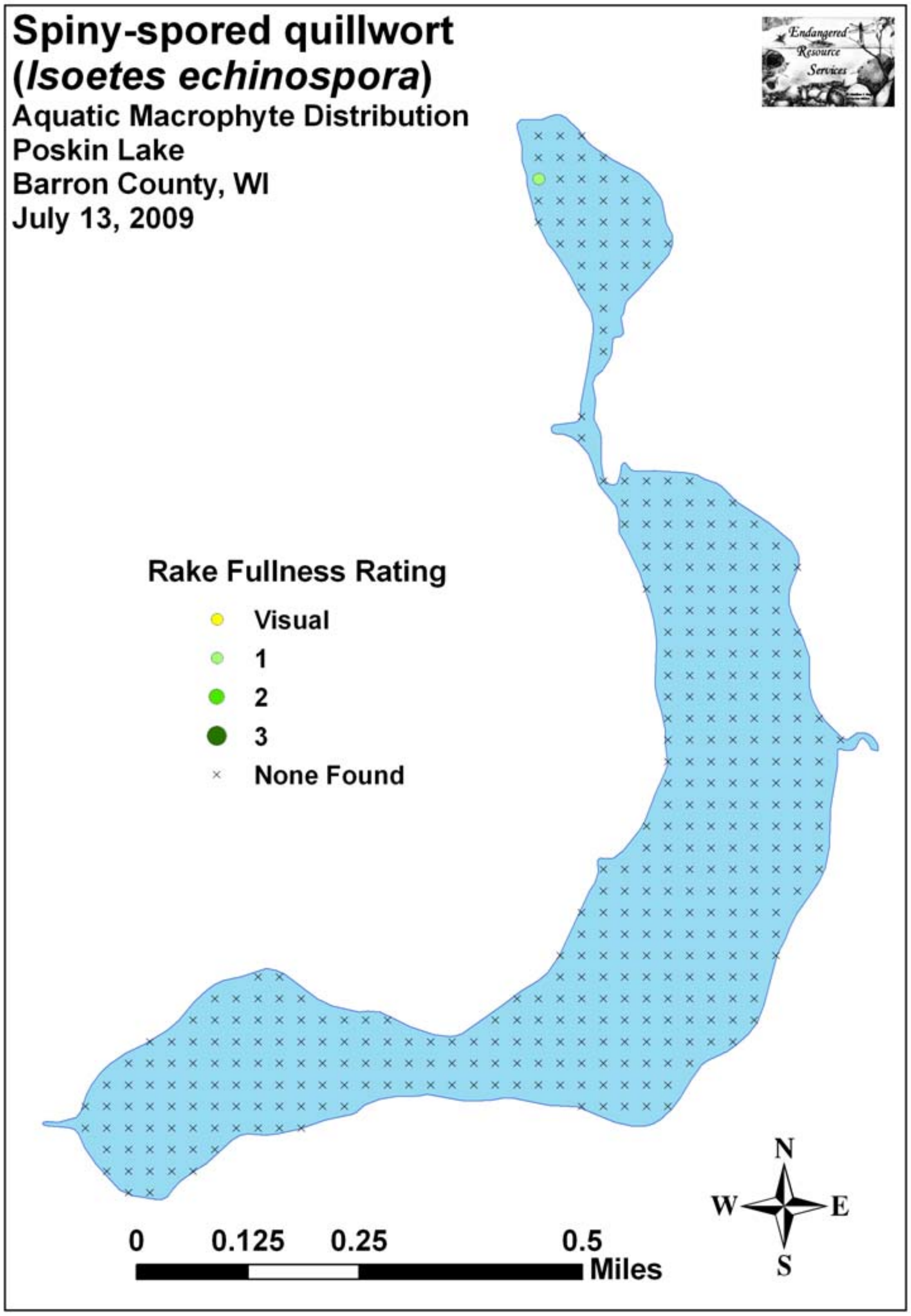
Spiny-spored quillwort
(*Isoetes echinospora*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
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W
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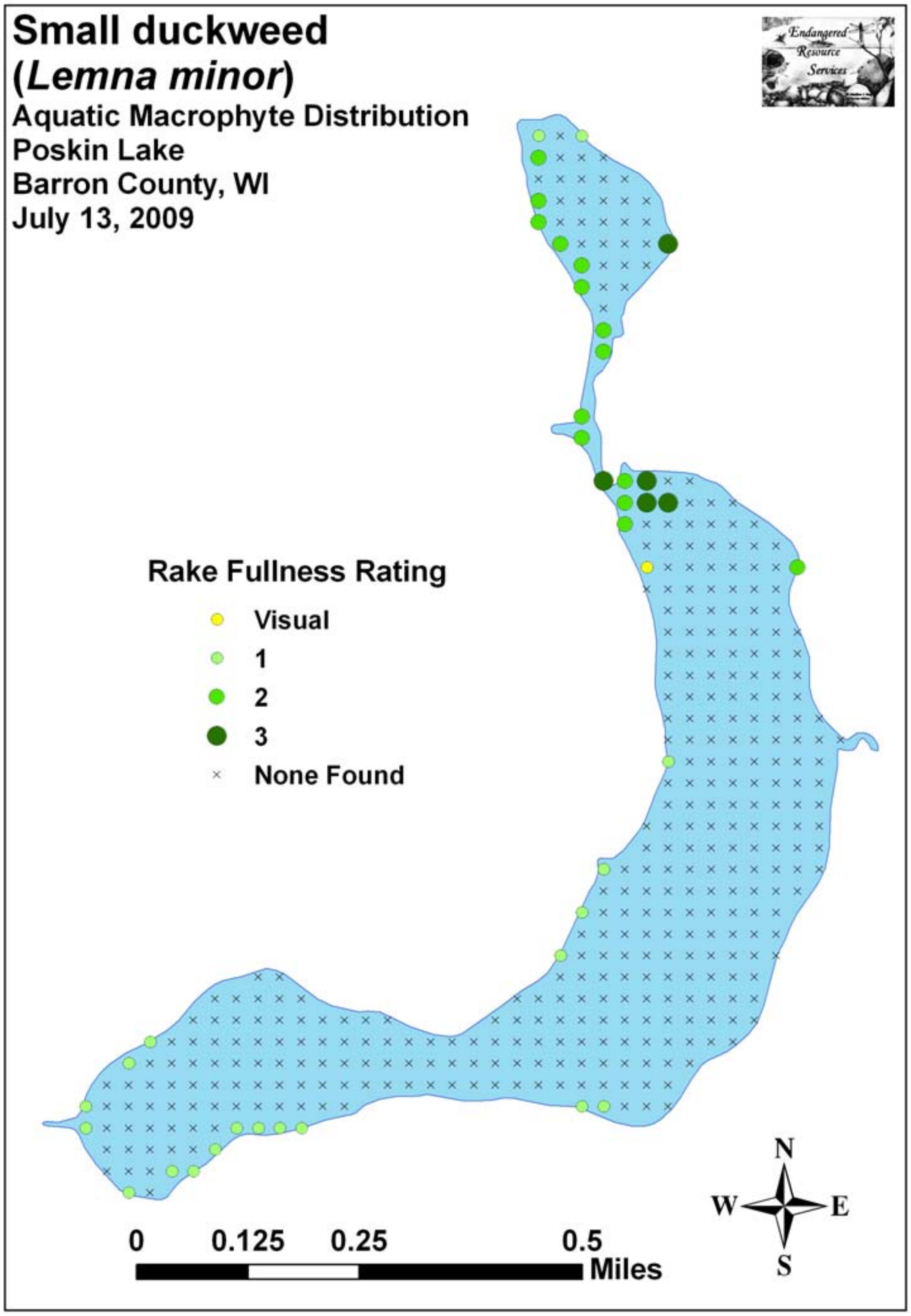
0
0.125
0.25
0.5
Miles


Small duckweed
(Lemna minor)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
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2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
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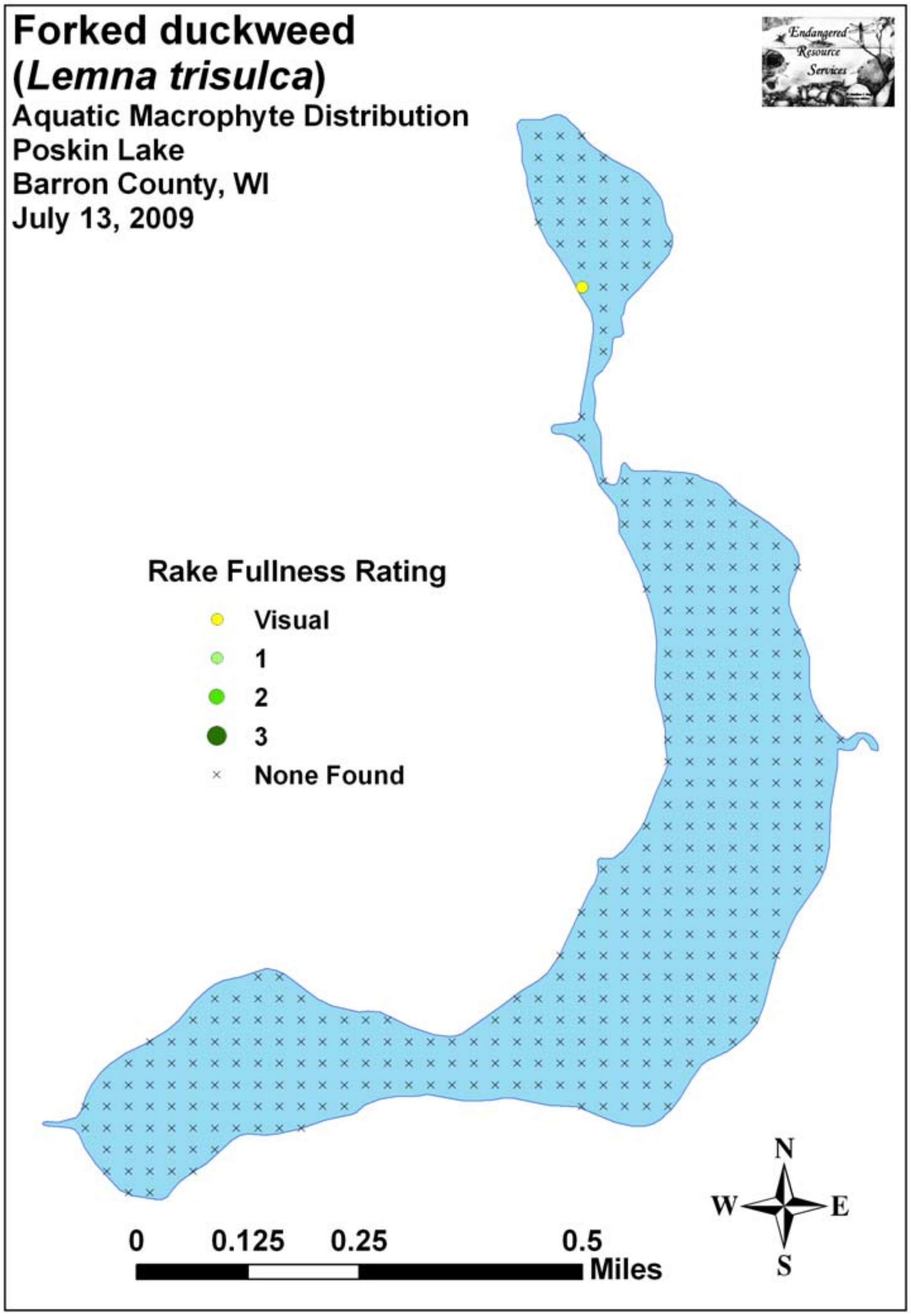
Forked duckweed
(*Lemna trisulca*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
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3
None Found
0
0.125
0.25
0.5
Miles
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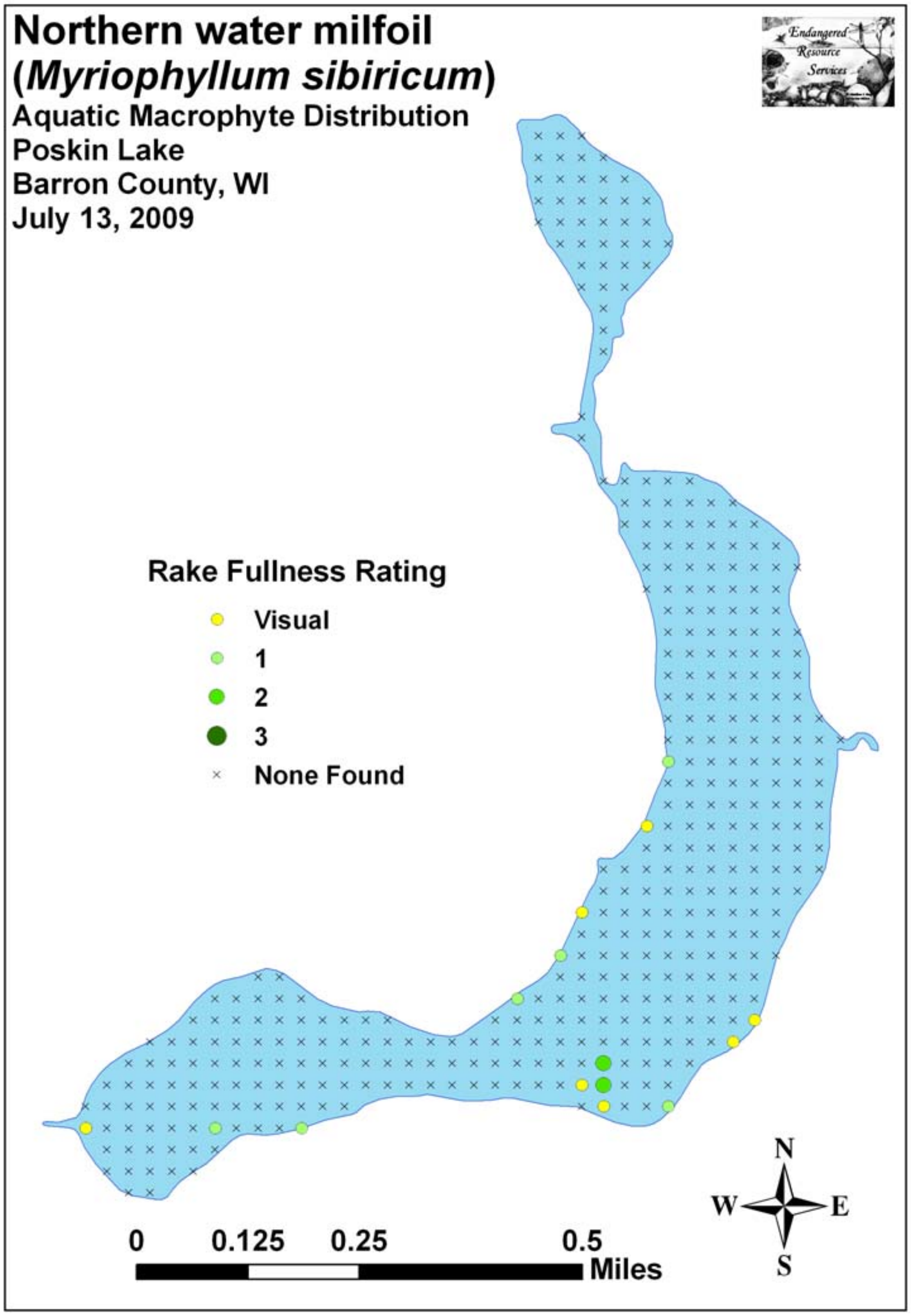
Northern water milfoil
(*Myriophyllum sibiricum*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
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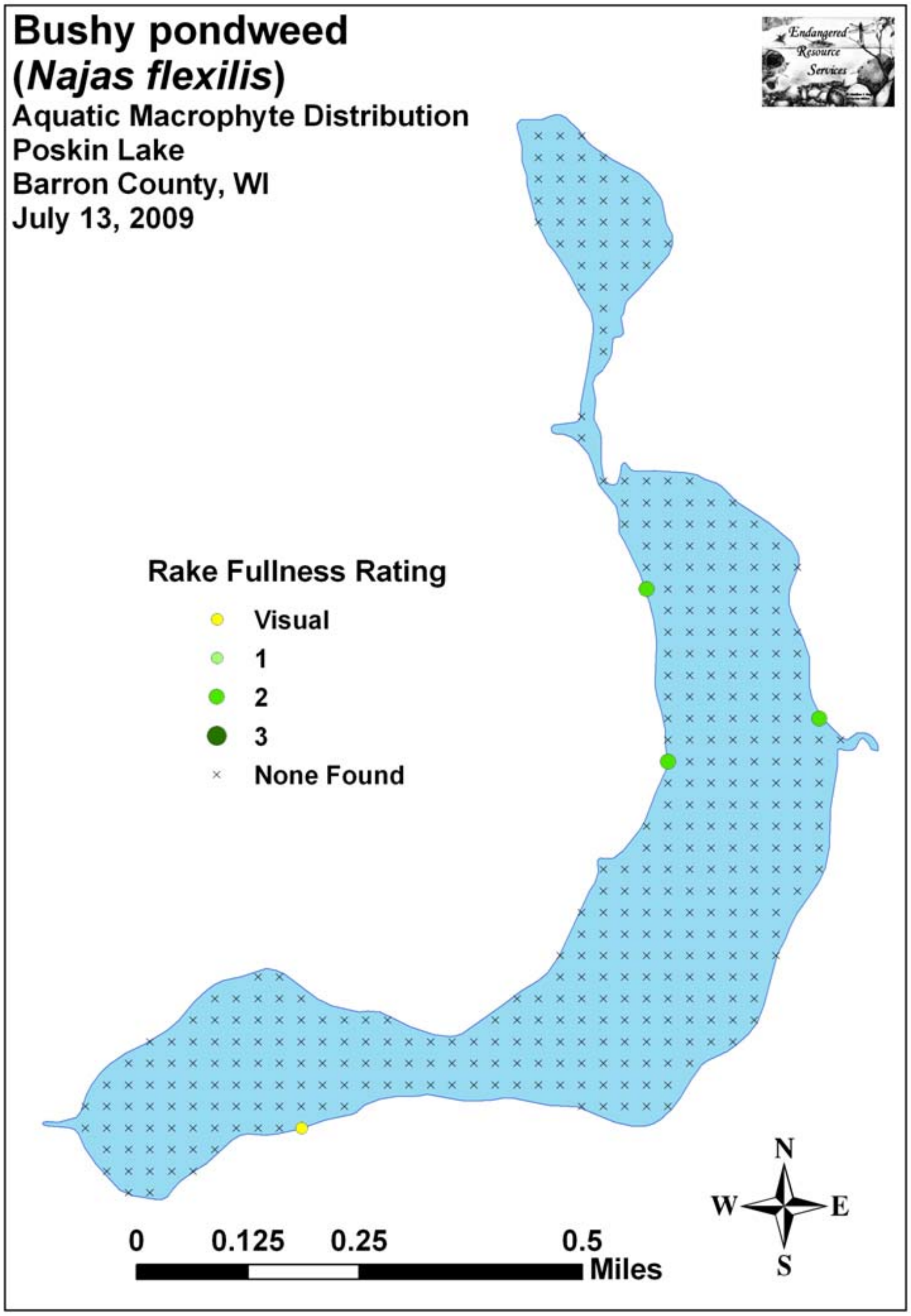
Bushy pondweed
(Najas flexilis)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
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2
3
None Found
0
0.125
0.25
0.5
Miles
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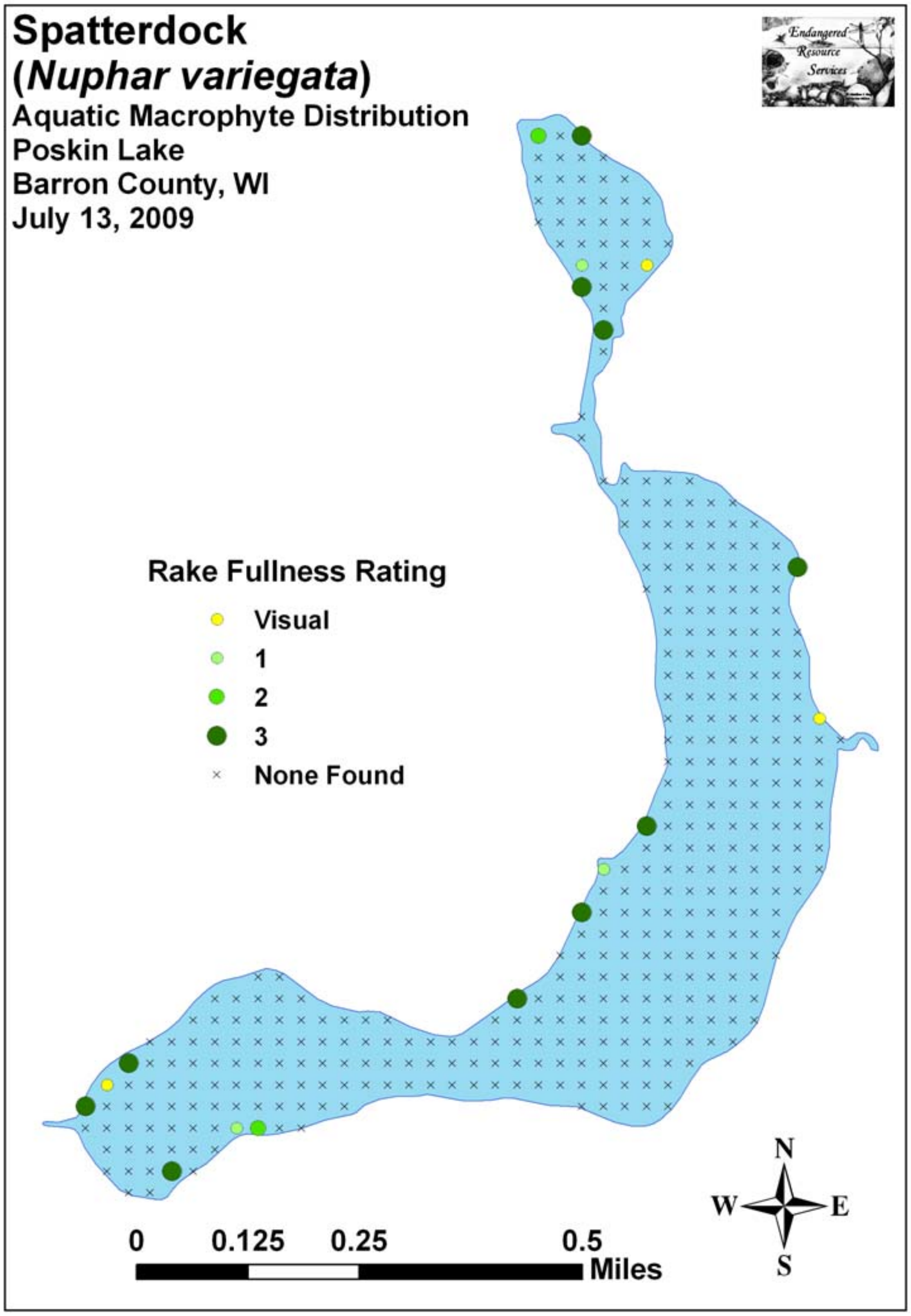
Spatterdock
(*Nuphar variegata*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
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3
None Found
0
0.125
0.25
0.5
Miles
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W
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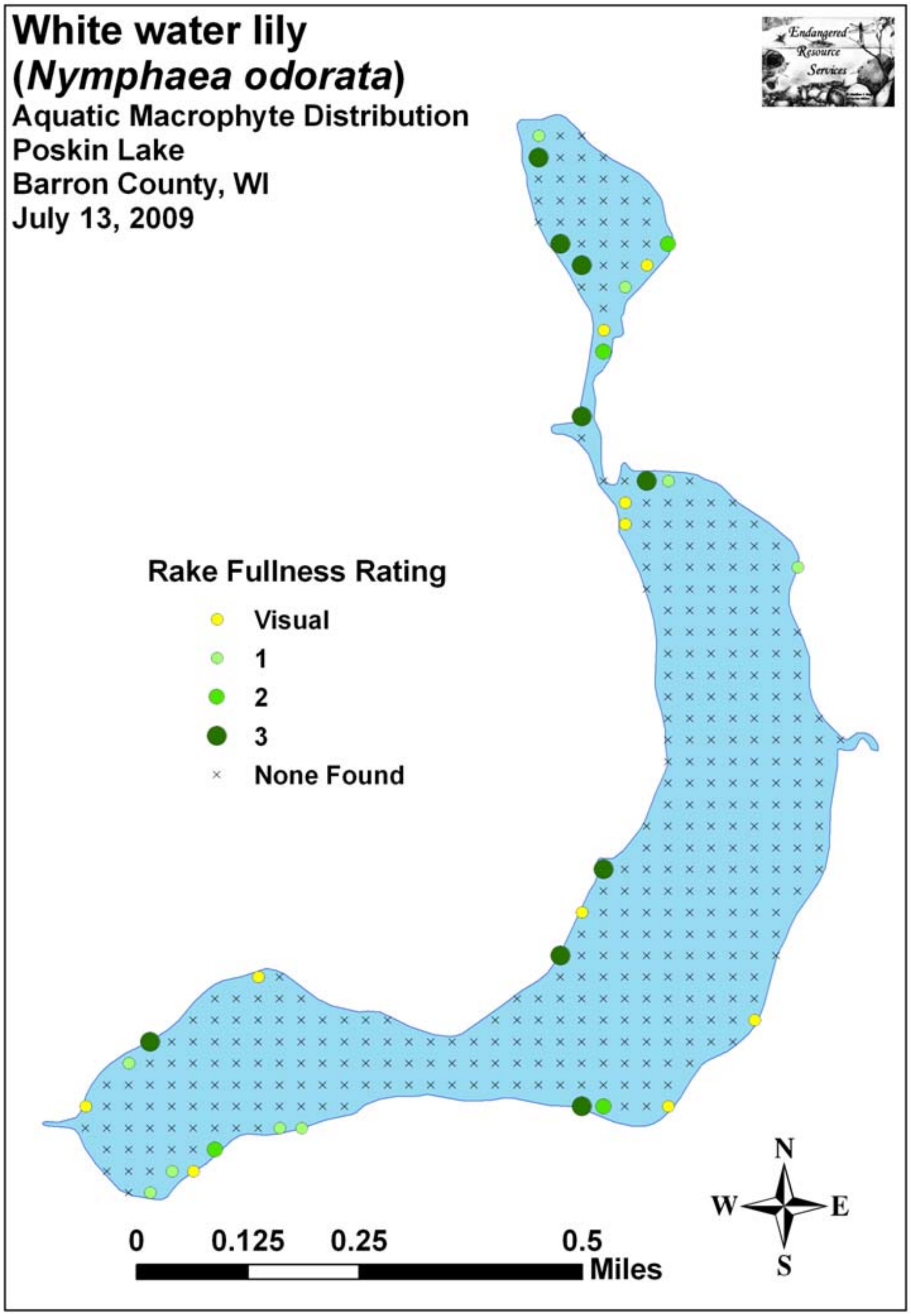
White water lily
(Nymphaea odorata)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
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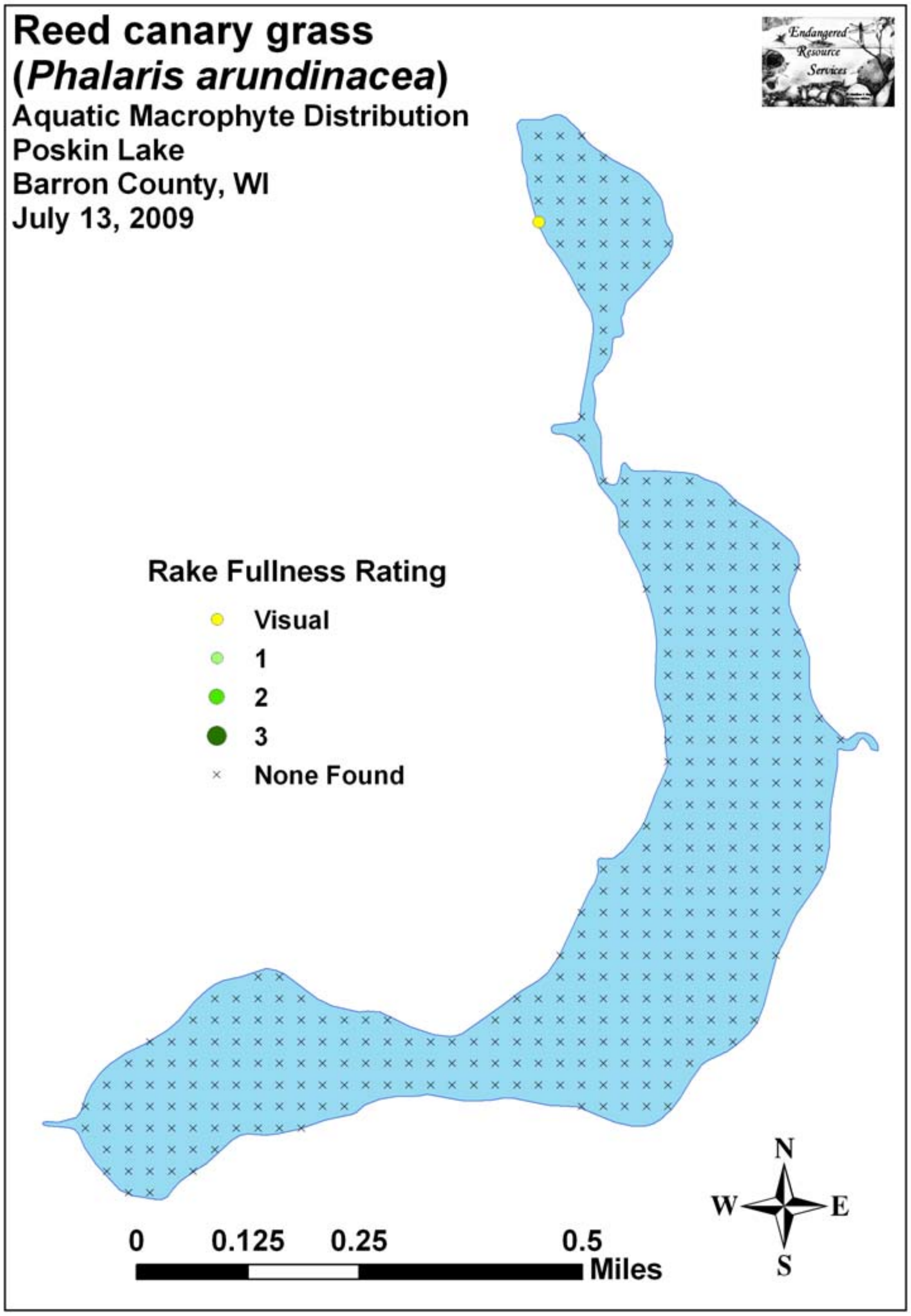
S



Reed canary grass
(Phalaris arundinacea)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
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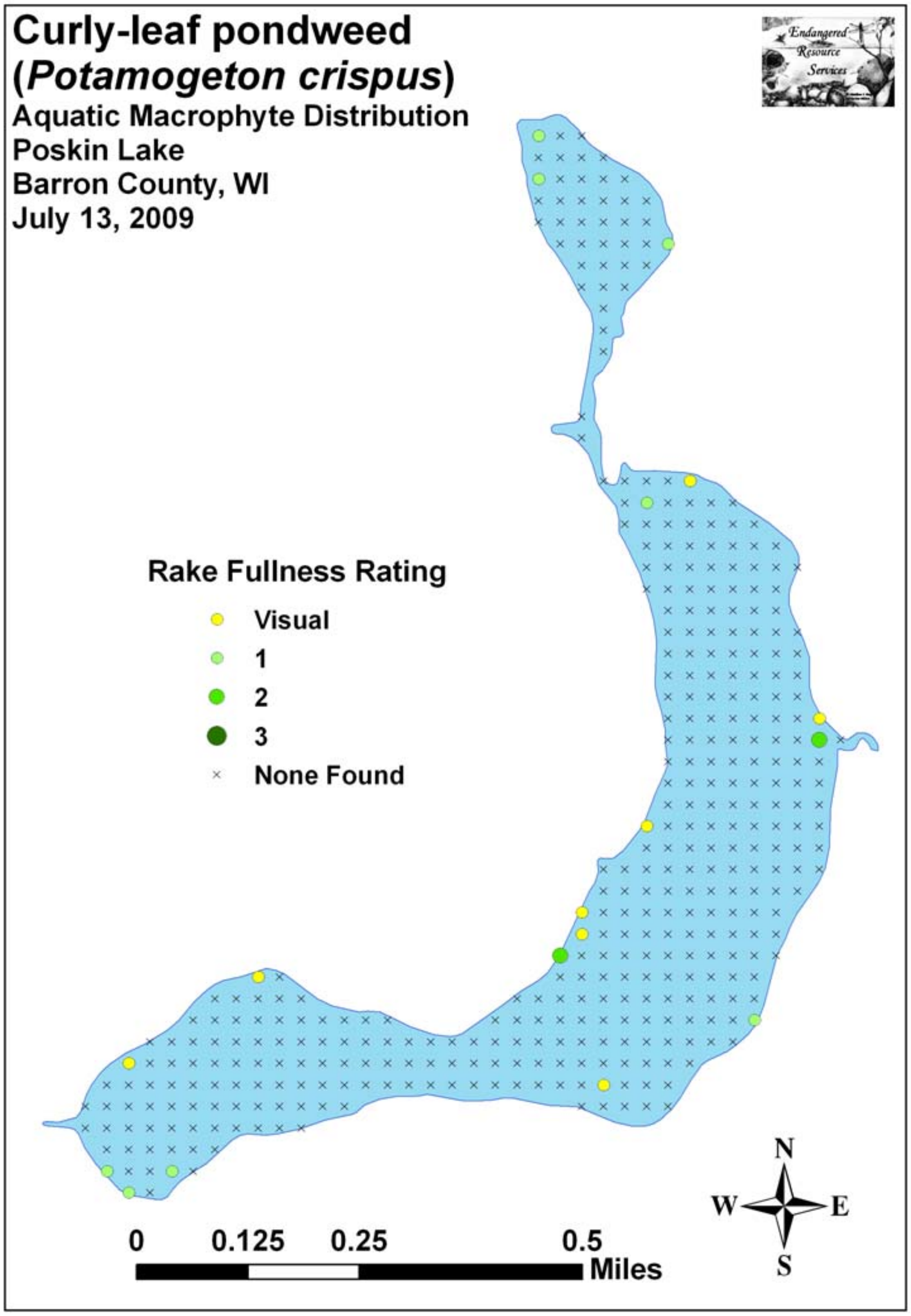
0
0.125
0.25
0.5
Miles



Curly-leaf pondweed
(*Potamogeton crispus*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
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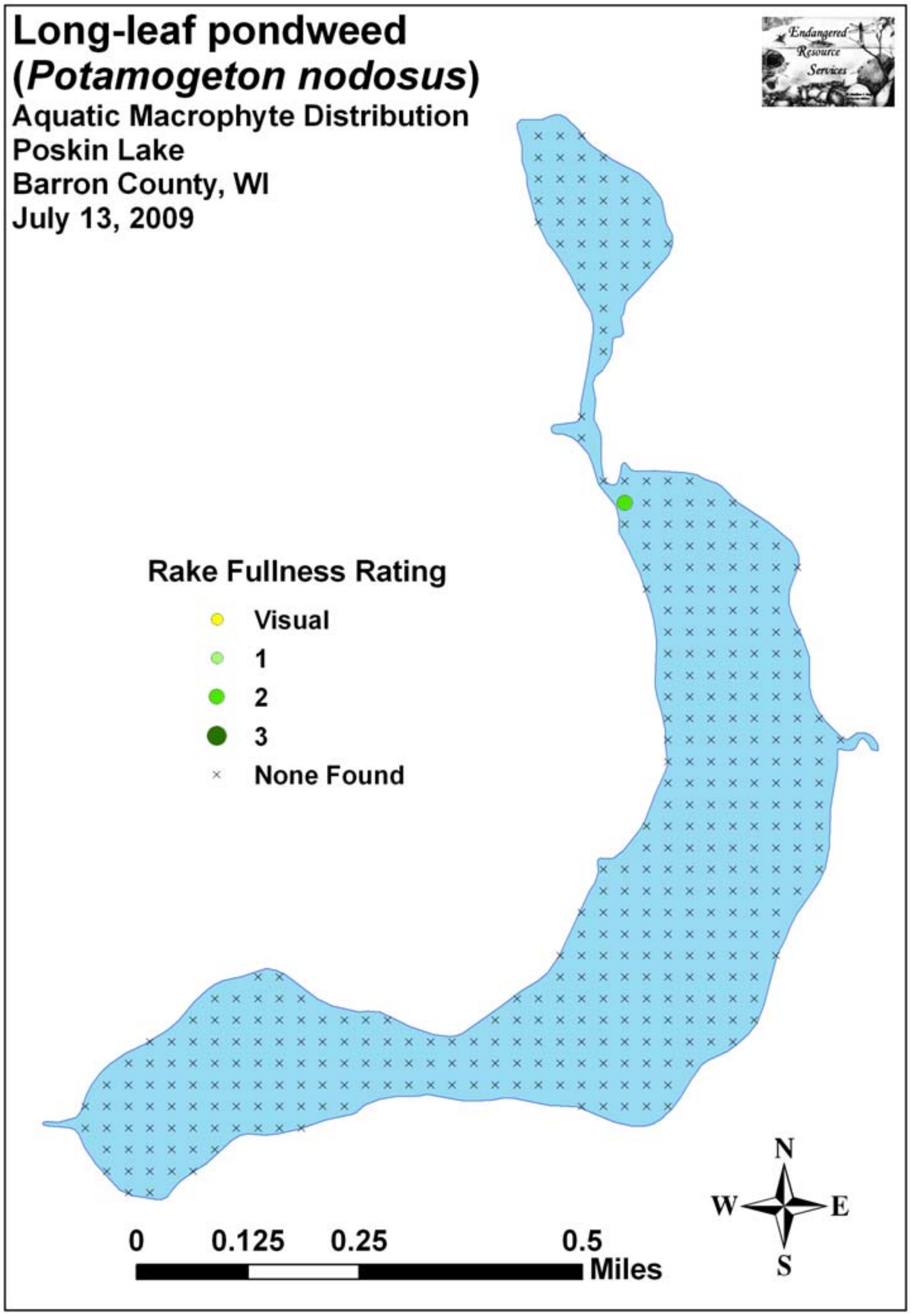
0
0.125
0.25
0.5
Miles


Long-leaf pondweed
(Potamogeton nodosus)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
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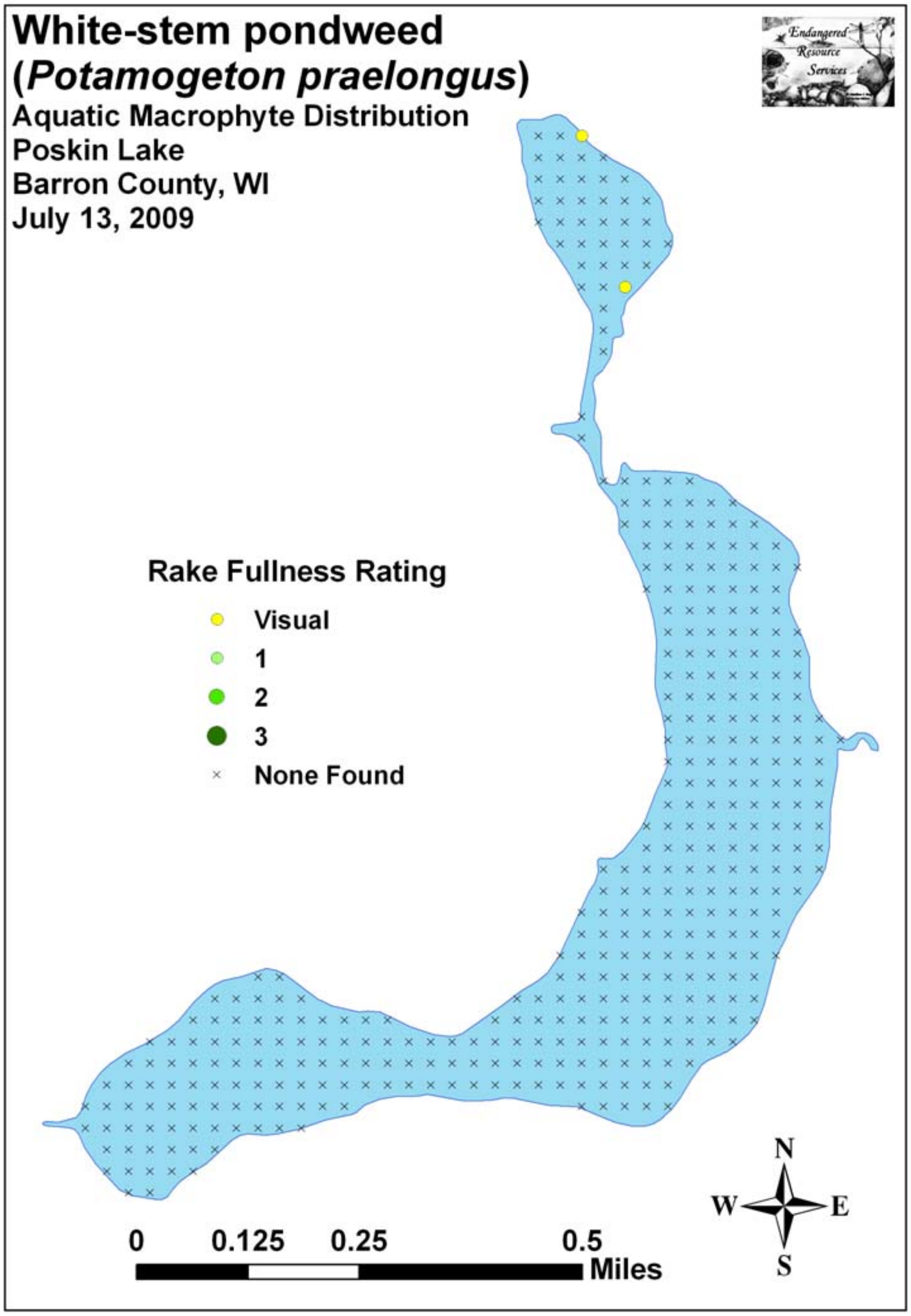
White-stem pondweed
(*Potamogeton praelongus*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
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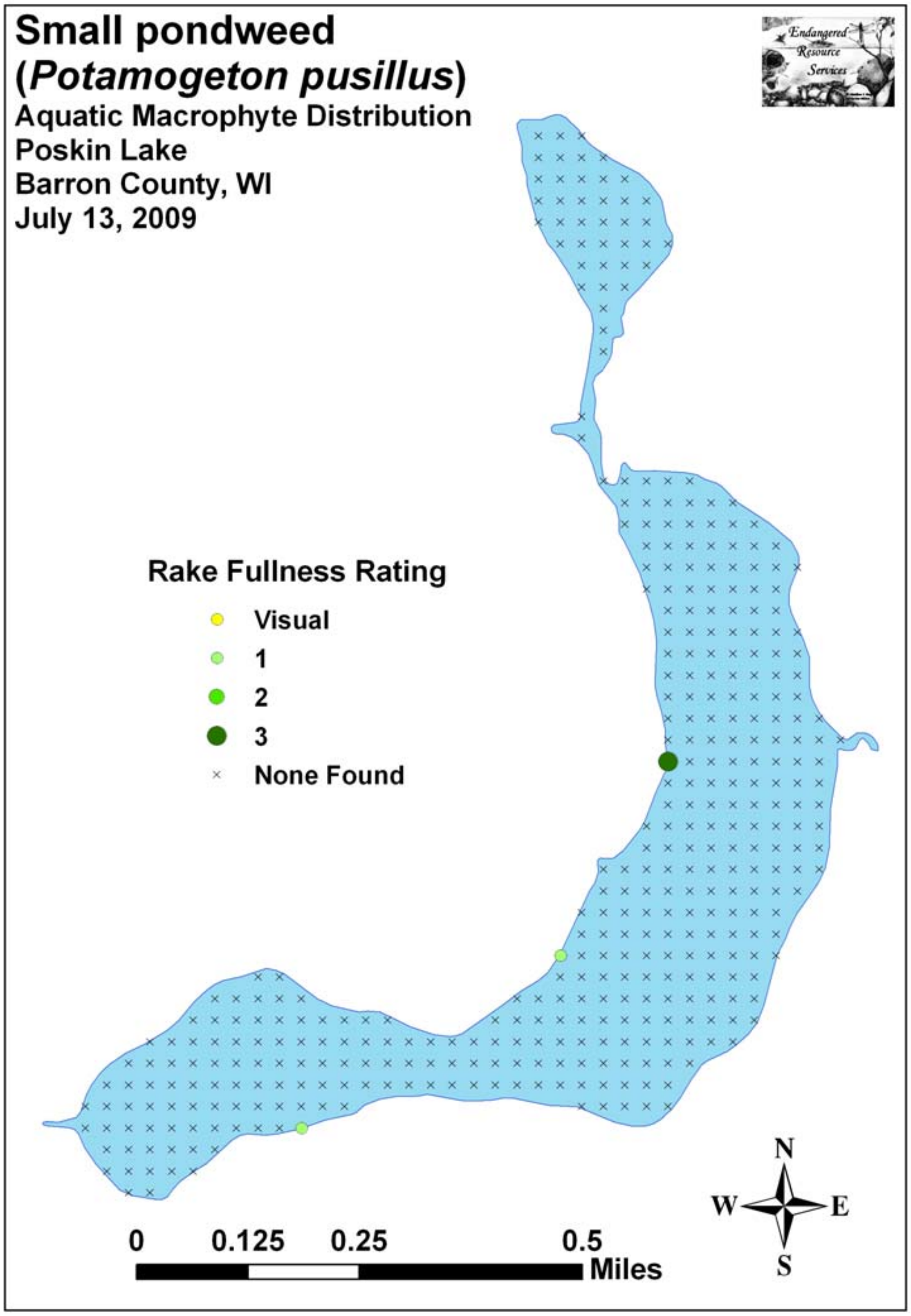
Small pondweed
(Potamogeton pusillus)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
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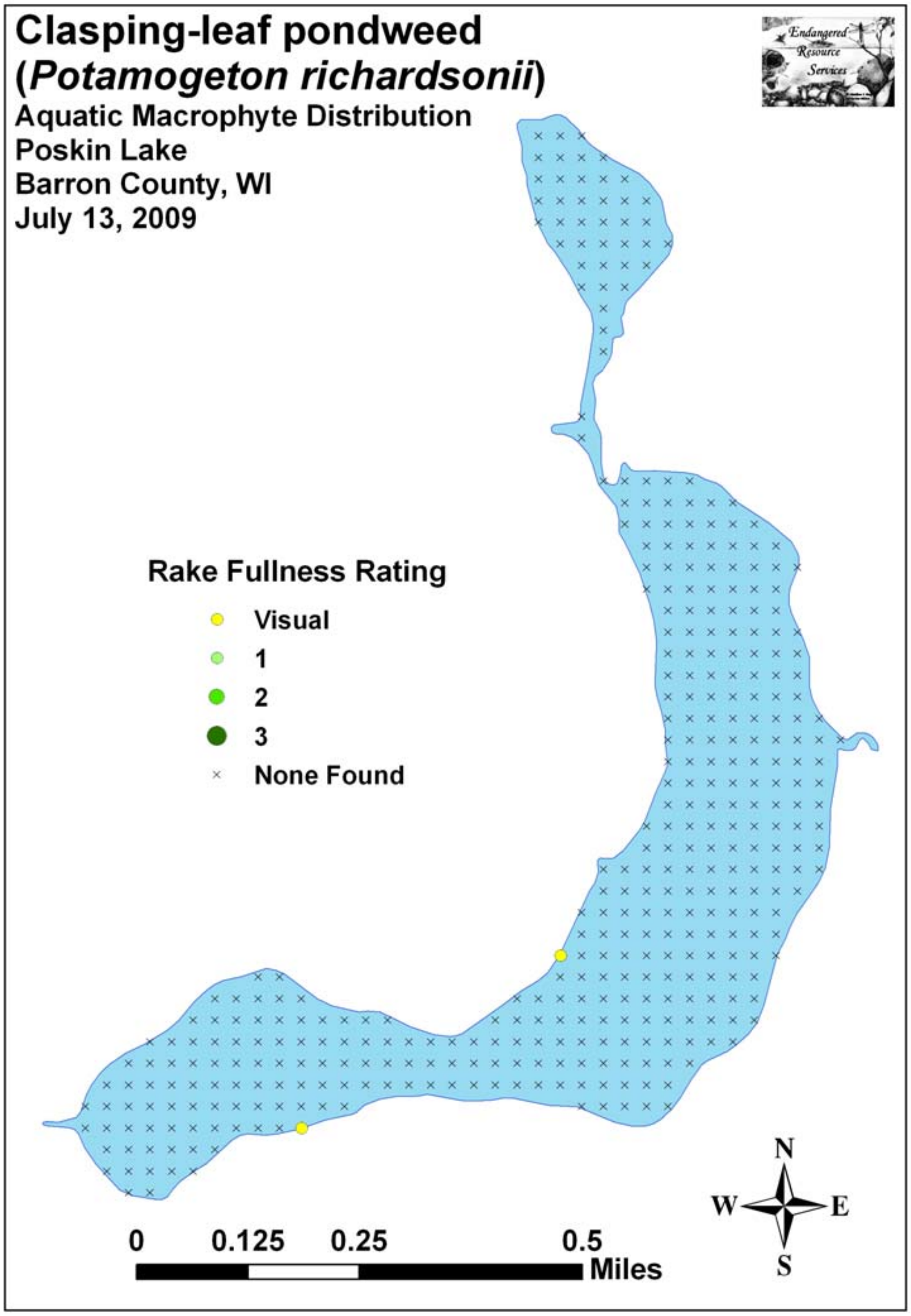
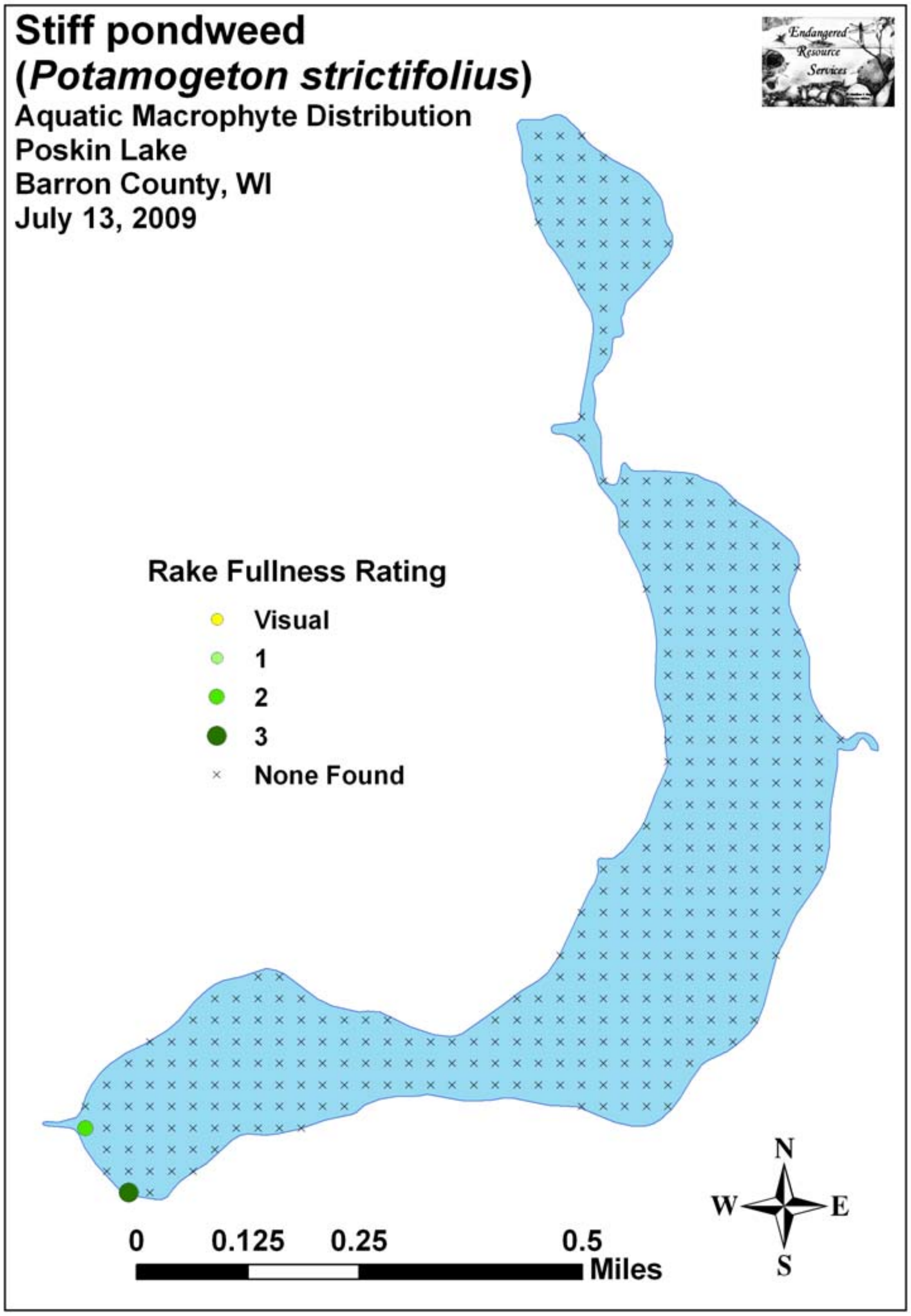
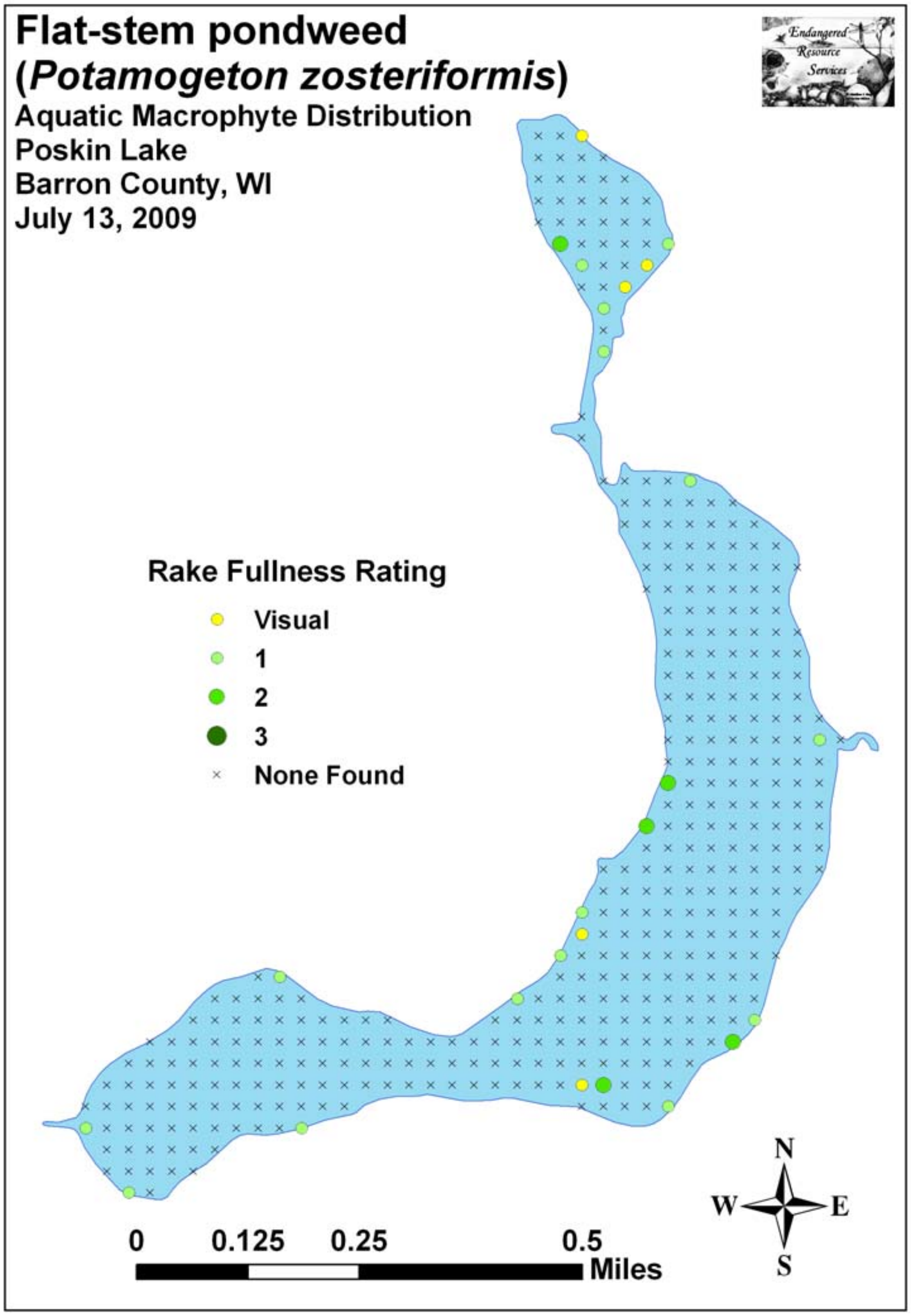
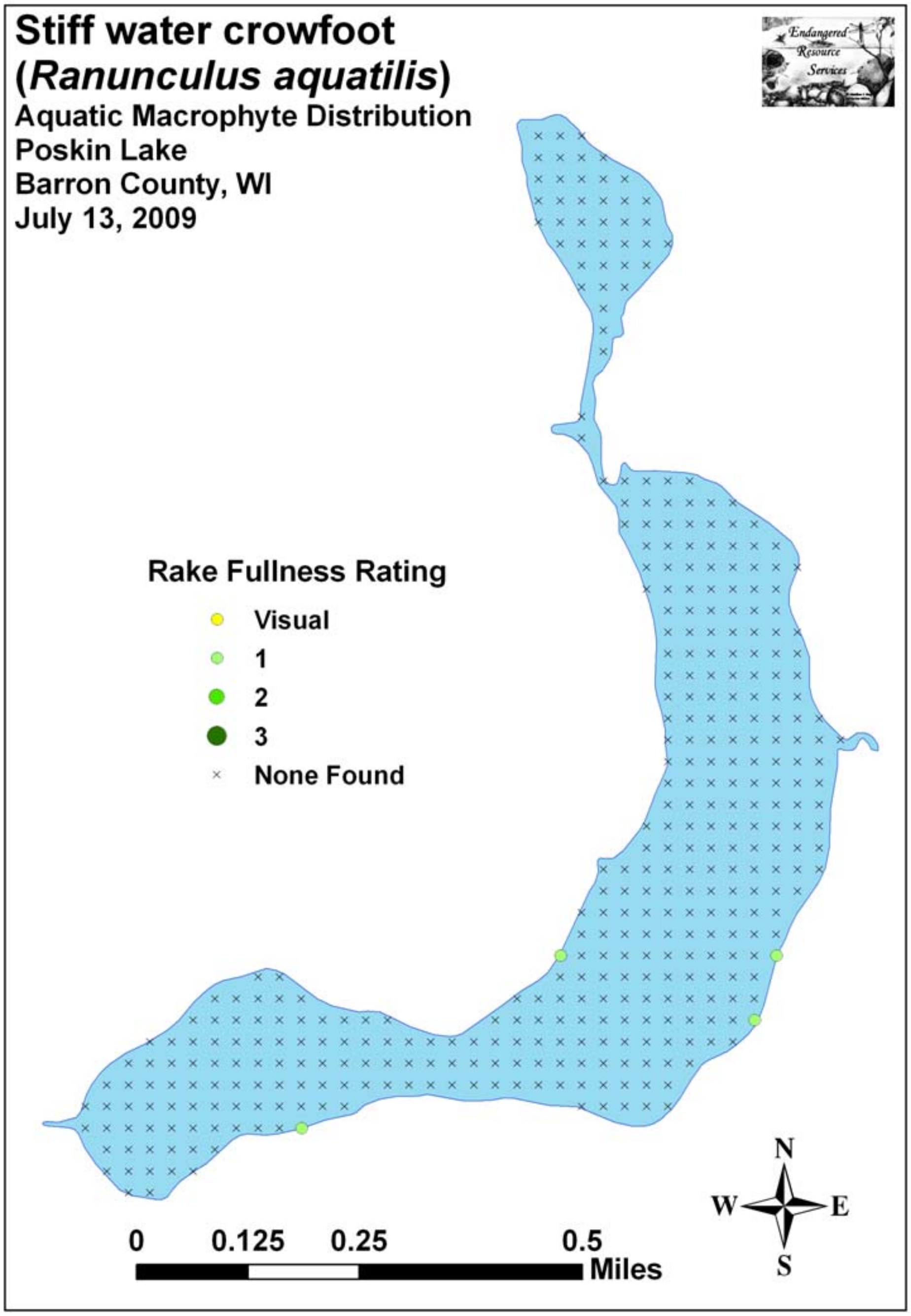
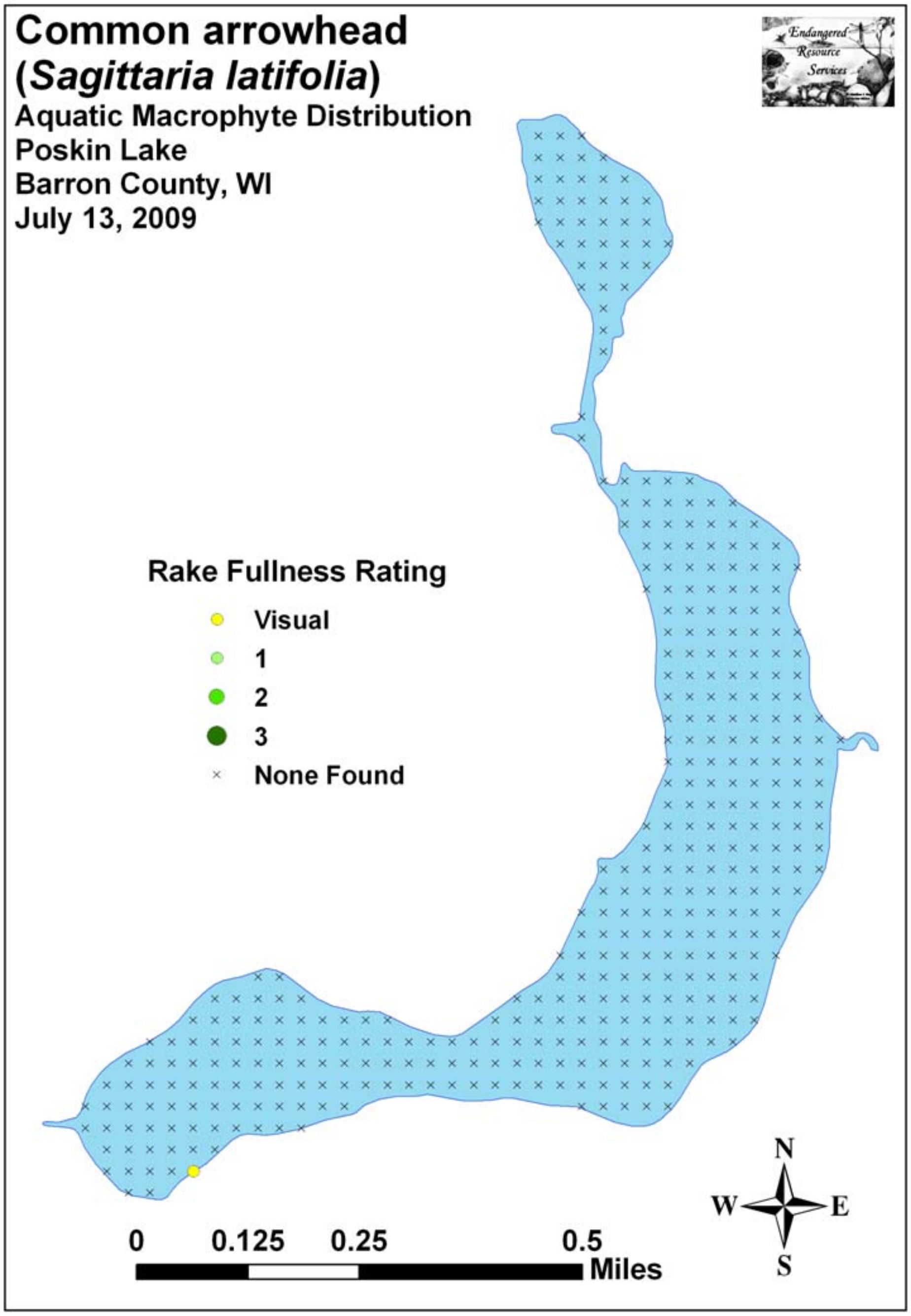

Clasping-leaf pondweed
(*Potamogeton richardsonii*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
E
S


Stiff pondweed
(*Potamogeton strictifolius*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
E
S


Flat-stem pondweed
(Potamogeton zosteriformis)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
E
S


Stiff water crowfoot
(*Ranunculus aquatilis*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
E
S


Common arrowhead
(Sagittaria latifolia)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
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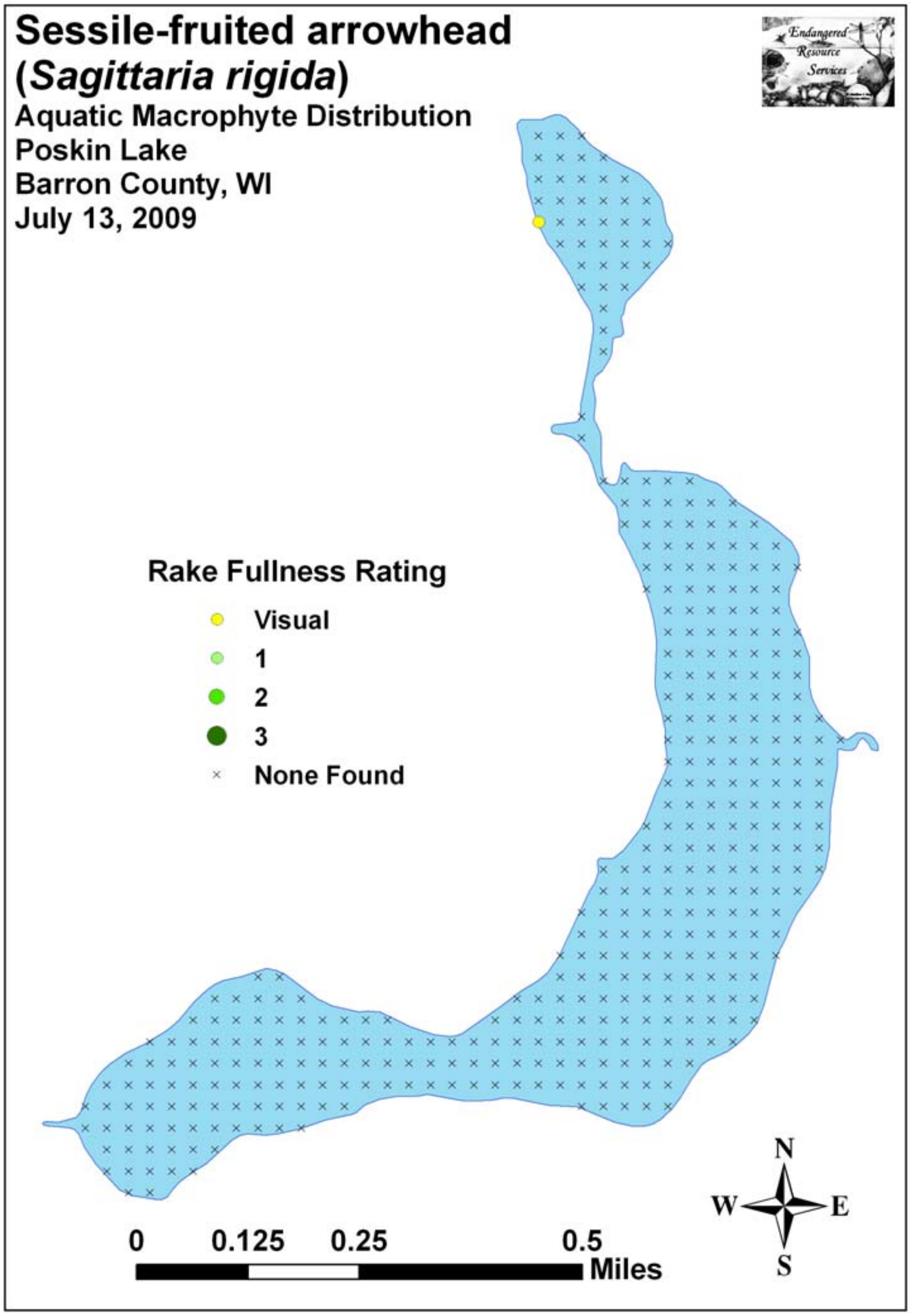
Sessile-fruited arrowhead
(Sagittaria rigida)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
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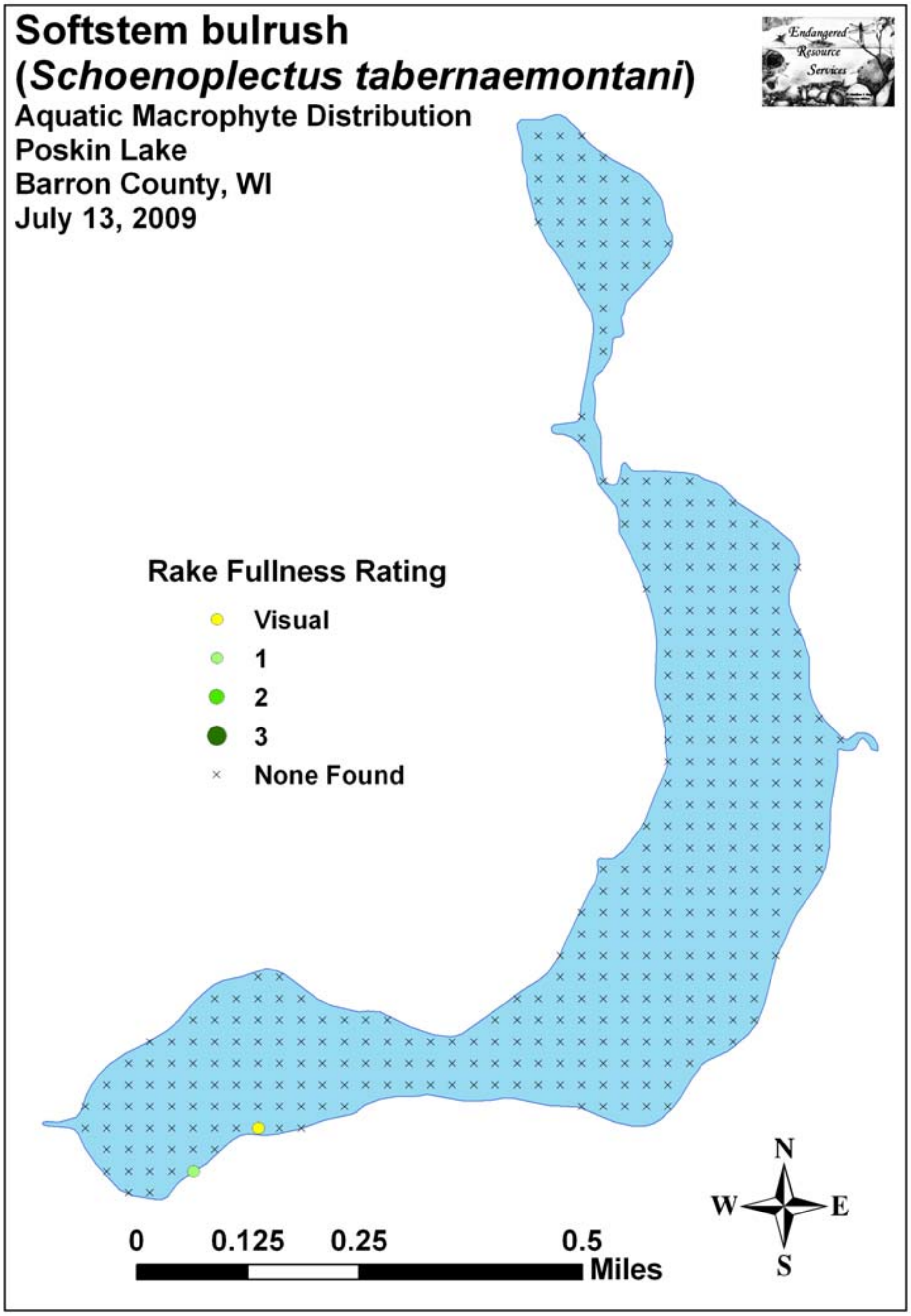
Softstem bulrush
(*Schoenoplectus tabernaemontani*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
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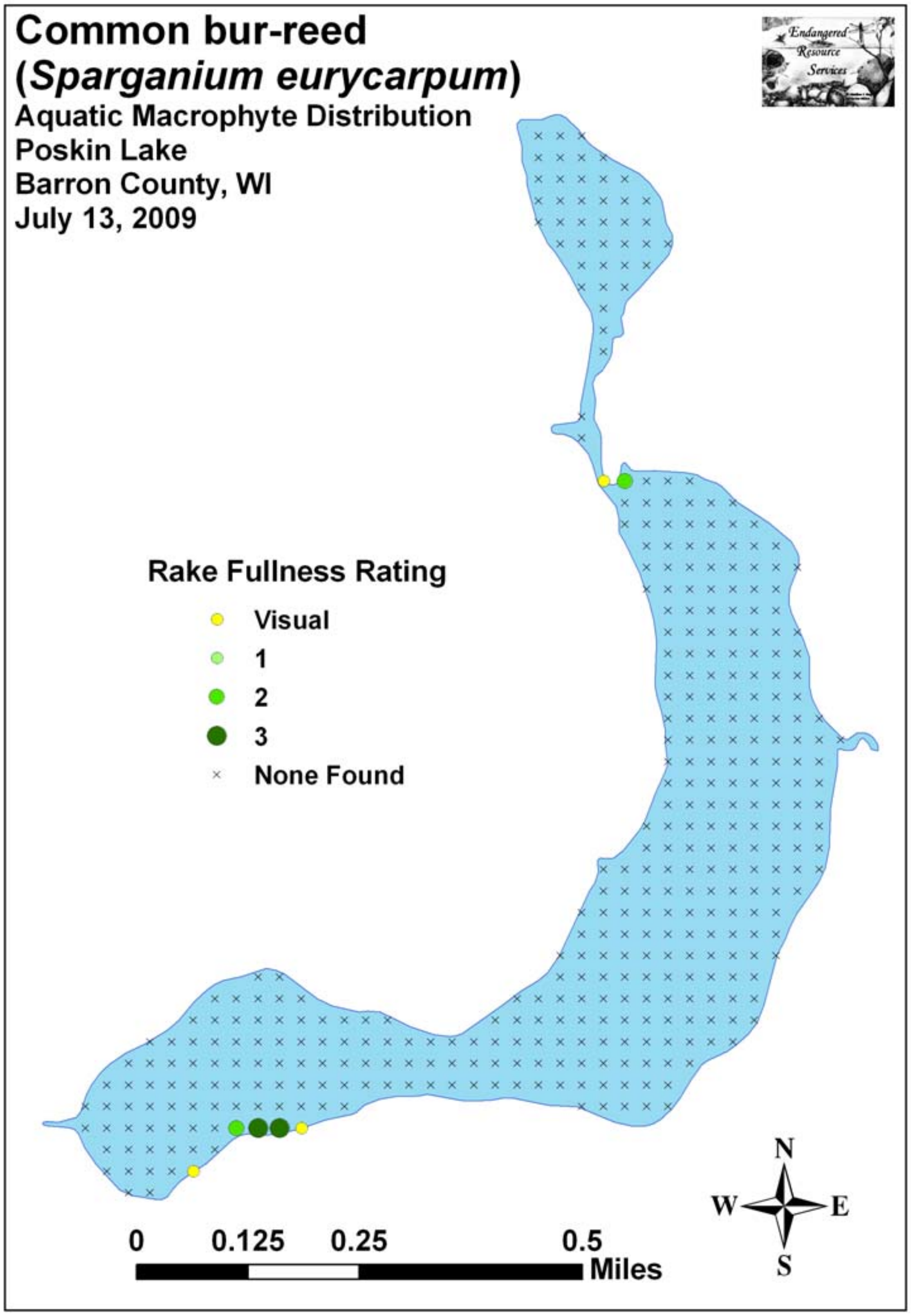
Common bur-reed
(Sparganium eurycarpum)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
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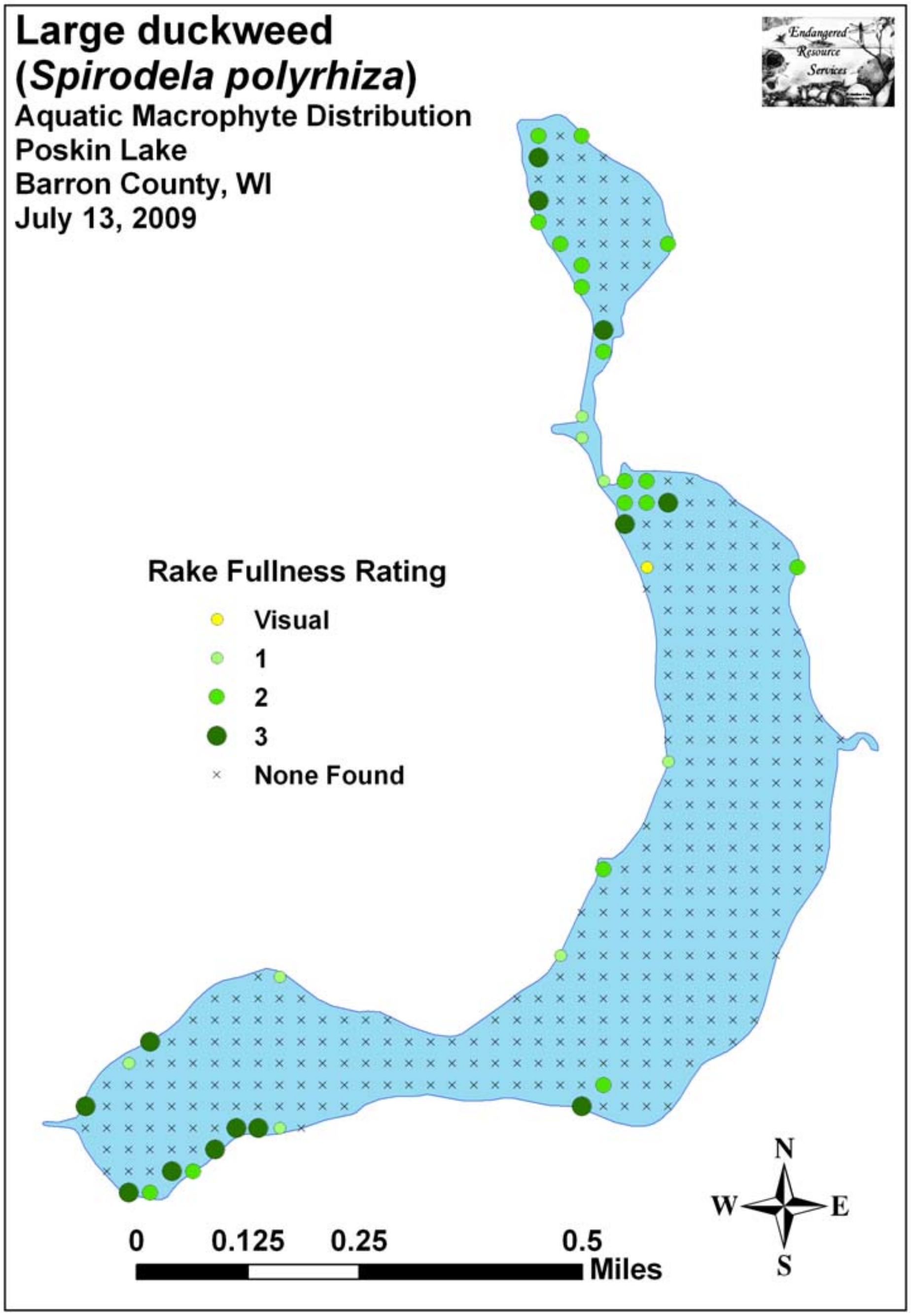
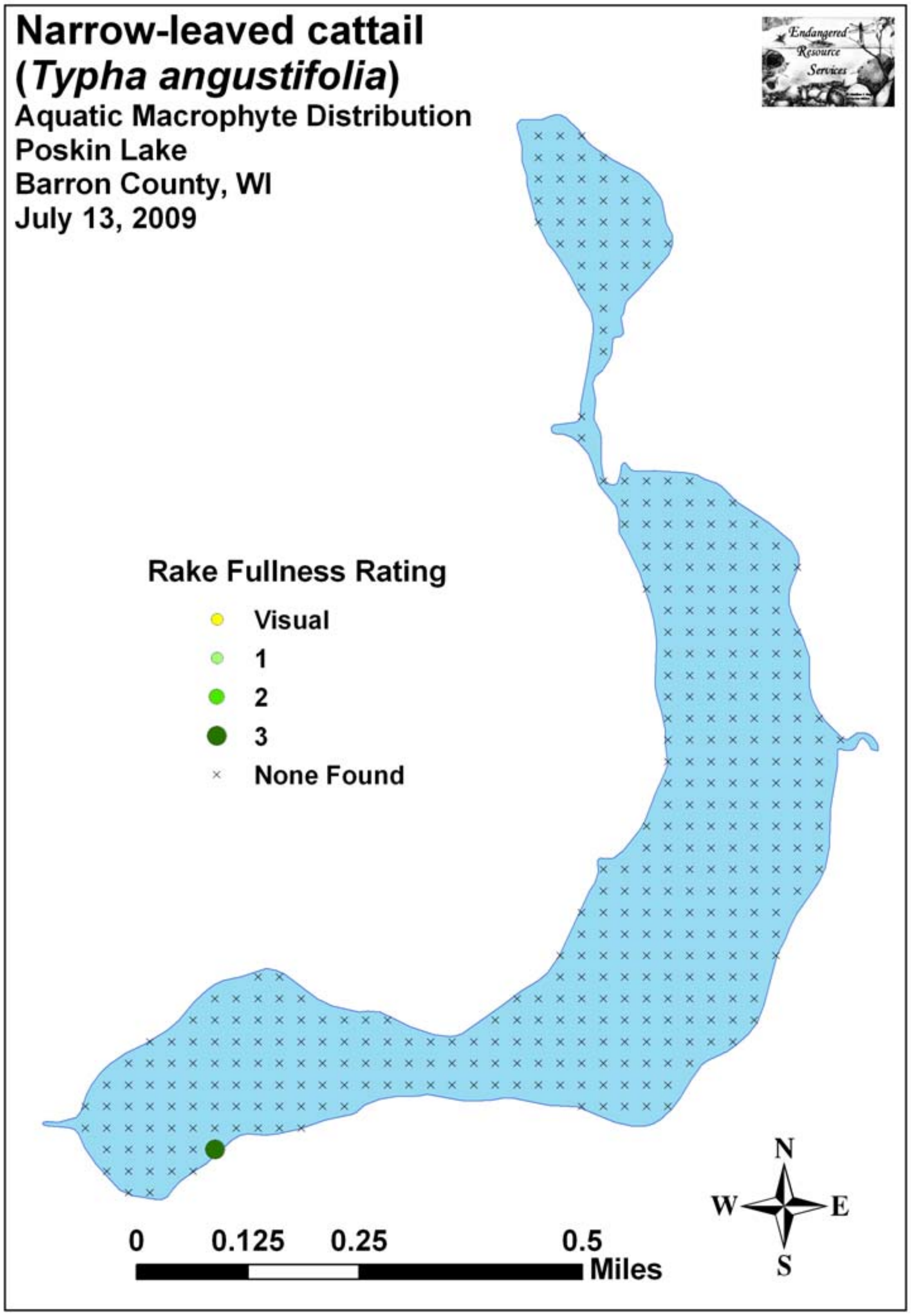
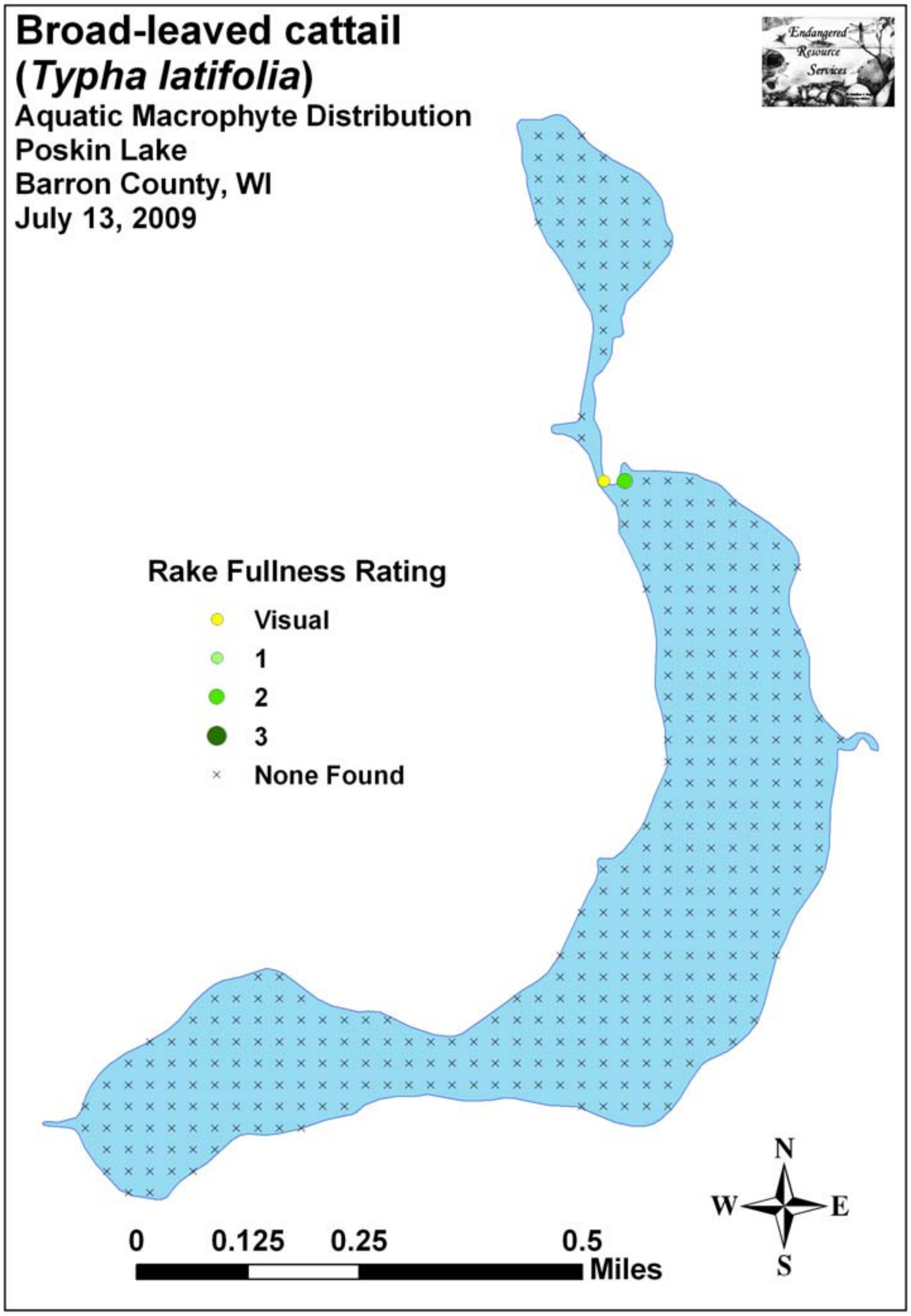
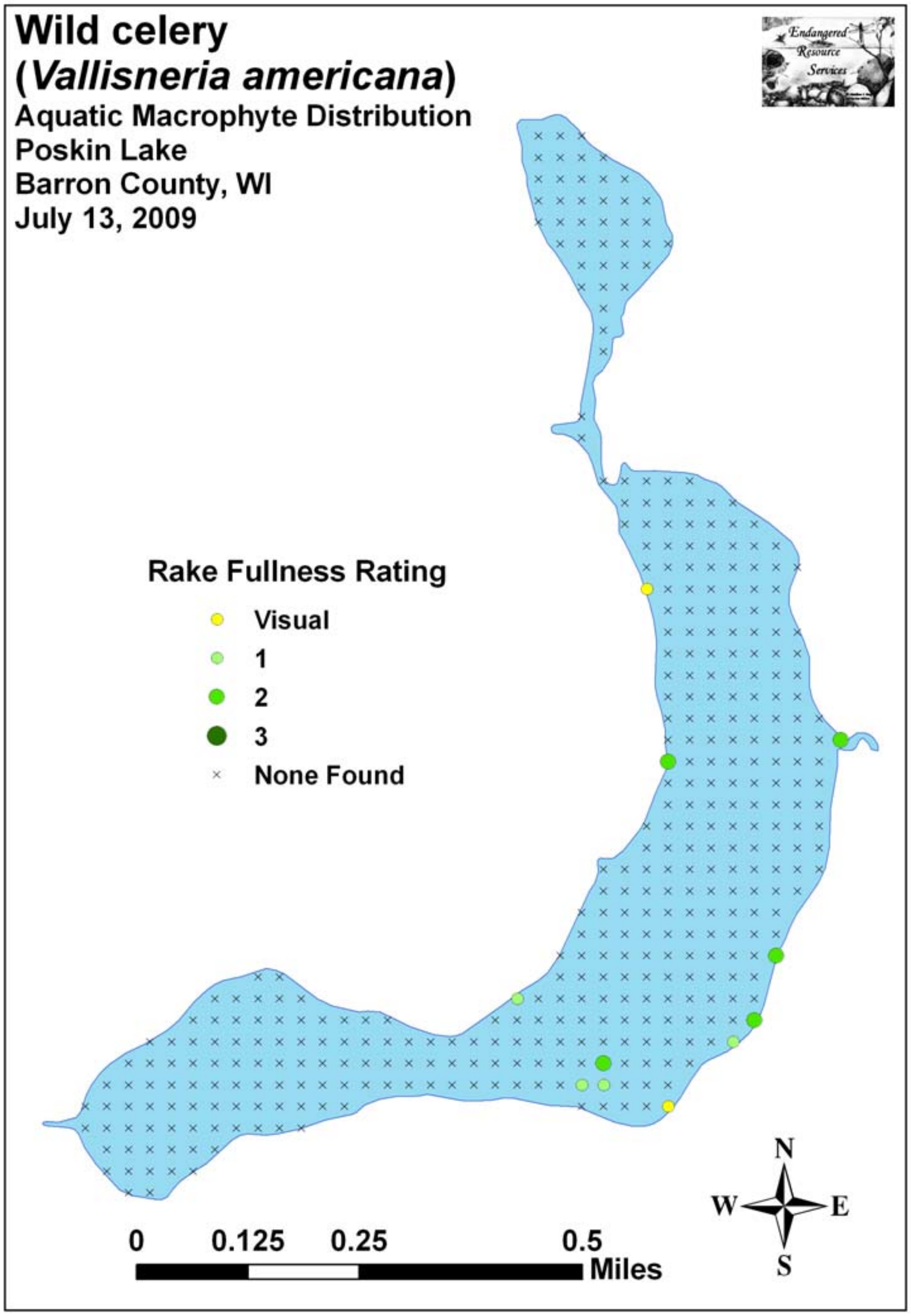
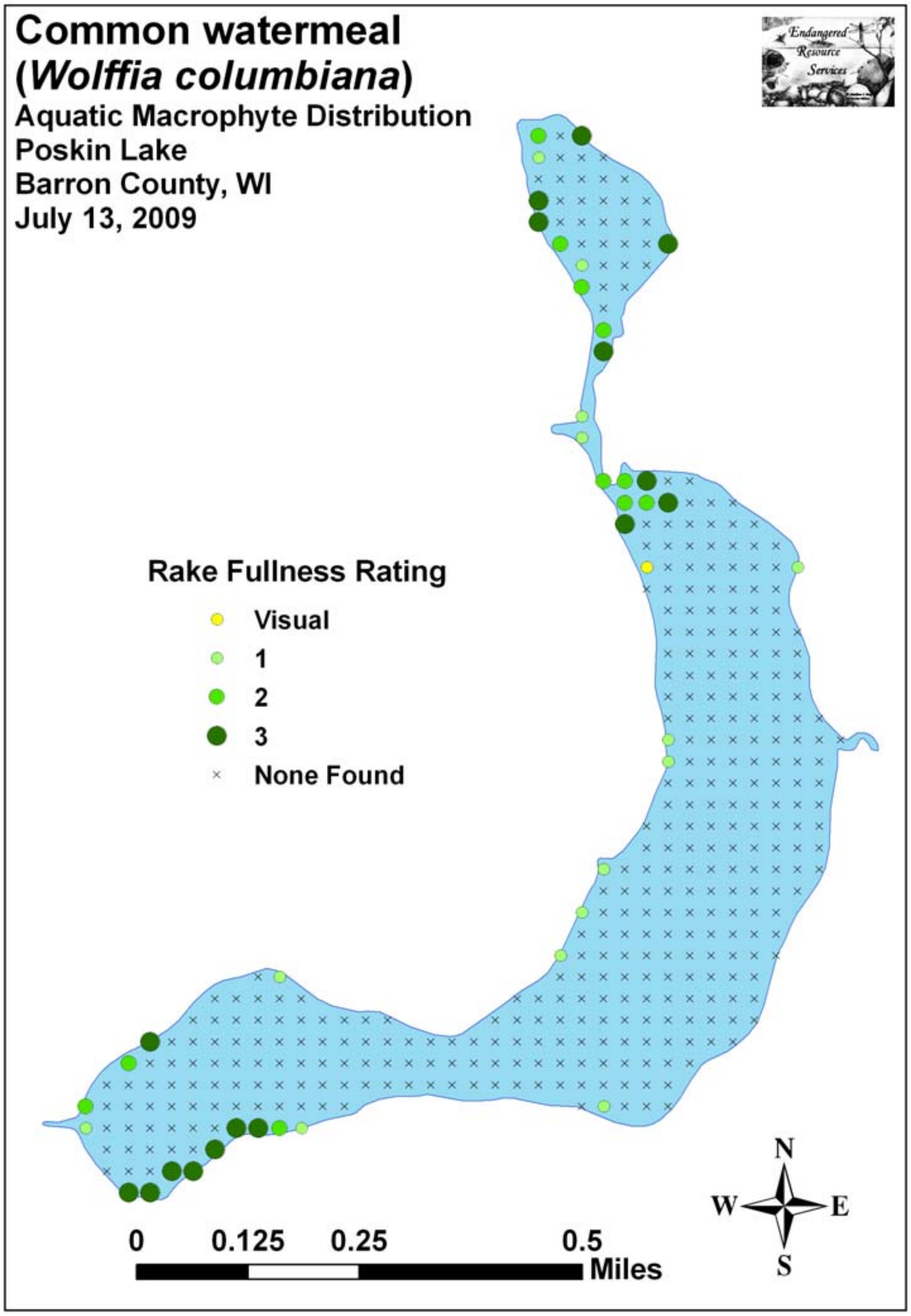

Large duckweed
(Spirodela polyrhiza)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
E
S

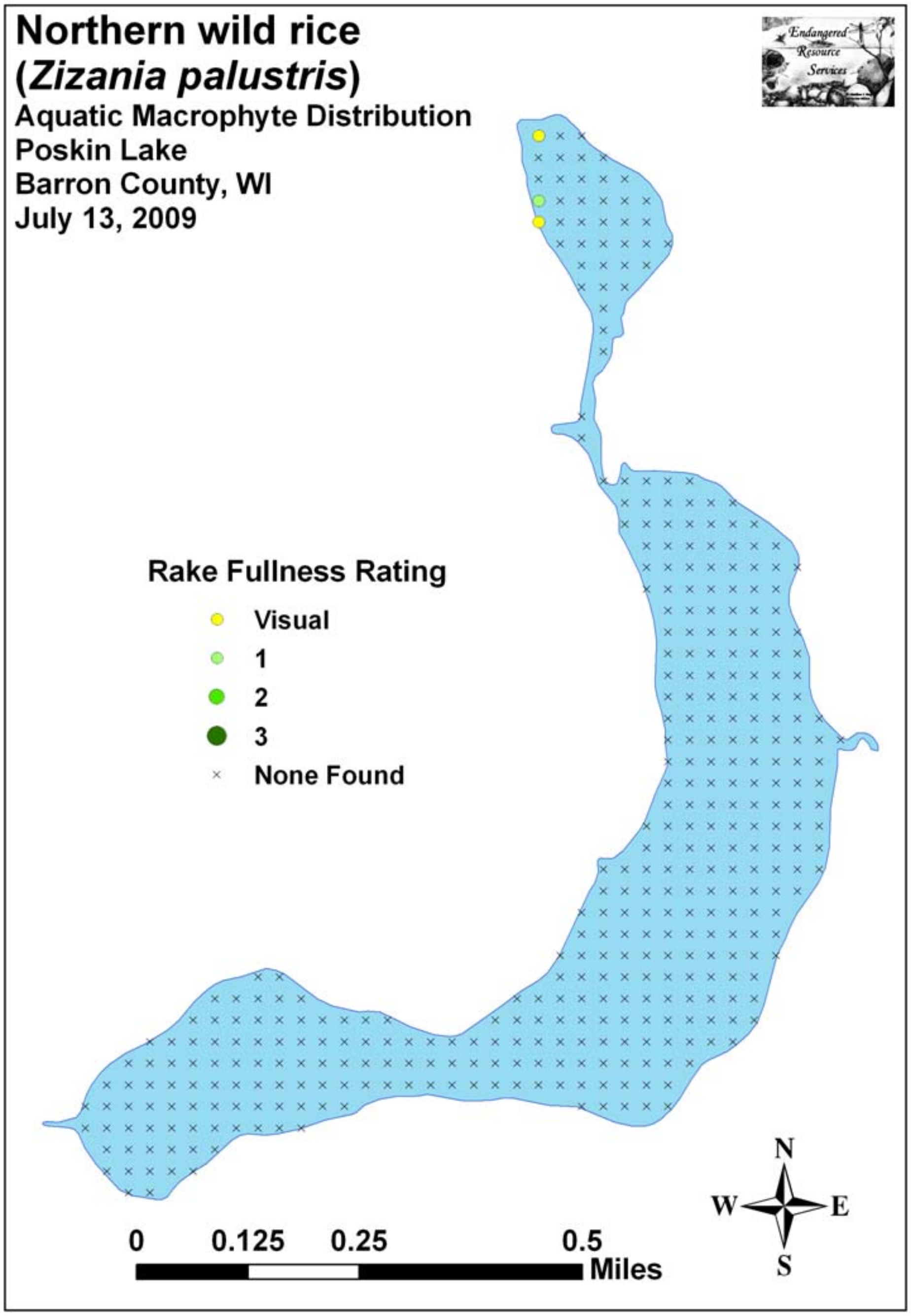

Narrow-leaved cattail
(Typha angustifolia)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Broad-leaved cattail
(*Typha latifolia*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
E
S



Wild celery
(Vallisneria americana)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Common watermeal
(Wolffia columbiana)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
E
S


Northern wild rice
(*Zizania palustris*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
July 13, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
E
S

Appendix VIII: Glossary of Biological Terms
(Adapted from UWEX 2009)

Aquatic:

organisms that live in or frequent water.

Cultural Eutrophication:

accelerated eutrophication that occurs as a result of human activities in the watershed that increase nutrient loads in runoff water that drains into lakes.

Dissolved Oxygen (DO):

the amount of free oxygen absorbed by the water and available to aquatic organisms for respiration; amount of oxygen dissolved in a certain amount of water at a particular temperature and pressure, often expressed as a concentration in parts of oxygen per million parts of water.

Diversity:

number and evenness of species in a particular community or habitat.

Drainage lakes:

Lakes fed primarily by streams and with outlets into streams or rivers. They are more subject to surface runoff problems but generally have shorter residence times than seepage lakes. Watershed protection is usually needed to manage lake water quality.

Ecosystem:

a system formed by the interaction of a community of organisms with each other and with the chemical and physical factors making up their environment.

Eutrophication:

the process by which lakes and streams are enriched by nutrients, and the resulting increase in plant and algae growth. This process includes physical, chemical, and biological changes that take place after a lake receives inputs for plant nutrients--mostly nitrates and phosphates--from natural erosion and runoff from the surrounding land basin. The extent to which this process has occurred is reflected in a lake's trophic classification: oligotrophic (nutrient poor), mesotrophic (moderately productive), and eutrophic (very productive and fertile).

Exotic:

a non-native species of plant or animal that has been introduced.

Habitat:

the place where an organism lives that provides an organism's needs for water, food, and shelter. It includes all living and non-living components with which the organism interacts.

Limnology:

the study of inland lakes and waters.

Littoral:

the near shore shallow water zone of a lake, where aquatic plants grow.

Macrophytes:

Refers to higher (multi-celled) plants growing in or near water. Macrophytes are beneficial to lakes because they produce oxygen and provide substrate for fish habitat and aquatic insects. Overabundance of such plants, especially problem species, is related to shallow water depth and high nutrient levels.

Nutrients:

elements or substances such as nitrogen and phosphorus that are necessary for plant growth. Large amounts of these substances can become a nuisance by promoting excessive aquatic plant growth.

Organic Matter:

elements or material containing carbon, a basic component of all living matter.

Photosynthesis:

the process by which green plants convert carbon dioxide (CO2) dissolved in water to sugar and oxygen using sunlight for energy. Photosynthesis is essential in producing a lake's food base, and is an important source of oxygen for many lakes.

Phytoplankton:

microscopic plants found in the water. Algae or one-celled (phytoplankton) or multicellular plants either suspended in water (Plankton) or attached to rocks and other substrates (periphyton). Their abundance, as measured by the amount of chlorophyll a (green pigment) in an open water sample, is commonly used to classify the trophic status of a lake. Numerous species occur. Algae are an essential part of the lake ecosystem and provides the food base for most lake organisms, including fish. Phytoplankton populations vary widely from day to day, as life cycles are short.

Plankton:

small plant organisms (phytoplankton and nanoplankton) and animal organisms (zooplankton) that float or swim weakly though the water.

ppm:

parts per million; units per equivalent million units; equal to milligrams per liter (mg/l)

Richness:

number of species in a particular community or habitat.

Rooted Aquatic Plants:

(macrophytes) Refers to higher (multi-celled) plants growing in or near water. Macrophytes are beneficial to lakes because they produce oxygen and provide substrate for fish habitat and aquatic insects. Overabundance of such plants, especially problem species, is related to shallow water depth and high nutrient levels.

Runoff:

water that flows over the surface of the land because the ground surface is impermeable or unable to absorb the water.

Secchi Disc:

An 8-inch diameter plate with alternating quadrants painted black and white that is used to measure water clarity (light penetration). The disc is lowered into water until it disappears from view. It is then raised until just visible. An average of the two depths, taken from the shaded side of the boat, is recorded as the Secchi disc reading. For best results, the readings should be taken on sunny, calm days.

Seepage lakes:

Lakes without a significant inlet or outlet, fed by rainfall and groundwater. Seepage lakes lose water through evaporation and groundwater moving on a down gradient. Lakes with little groundwater inflow tend to be naturally acidic and most susceptible to the effects of acid rain. Seepage lakes often have long ,residence times. and lake levels fluctuate with local groundwater levels. Water quality is affected by groundwater quality and the use of land on the shoreline.

Turbidity:

degree to which light is blocked because water is muddy or cloudy.

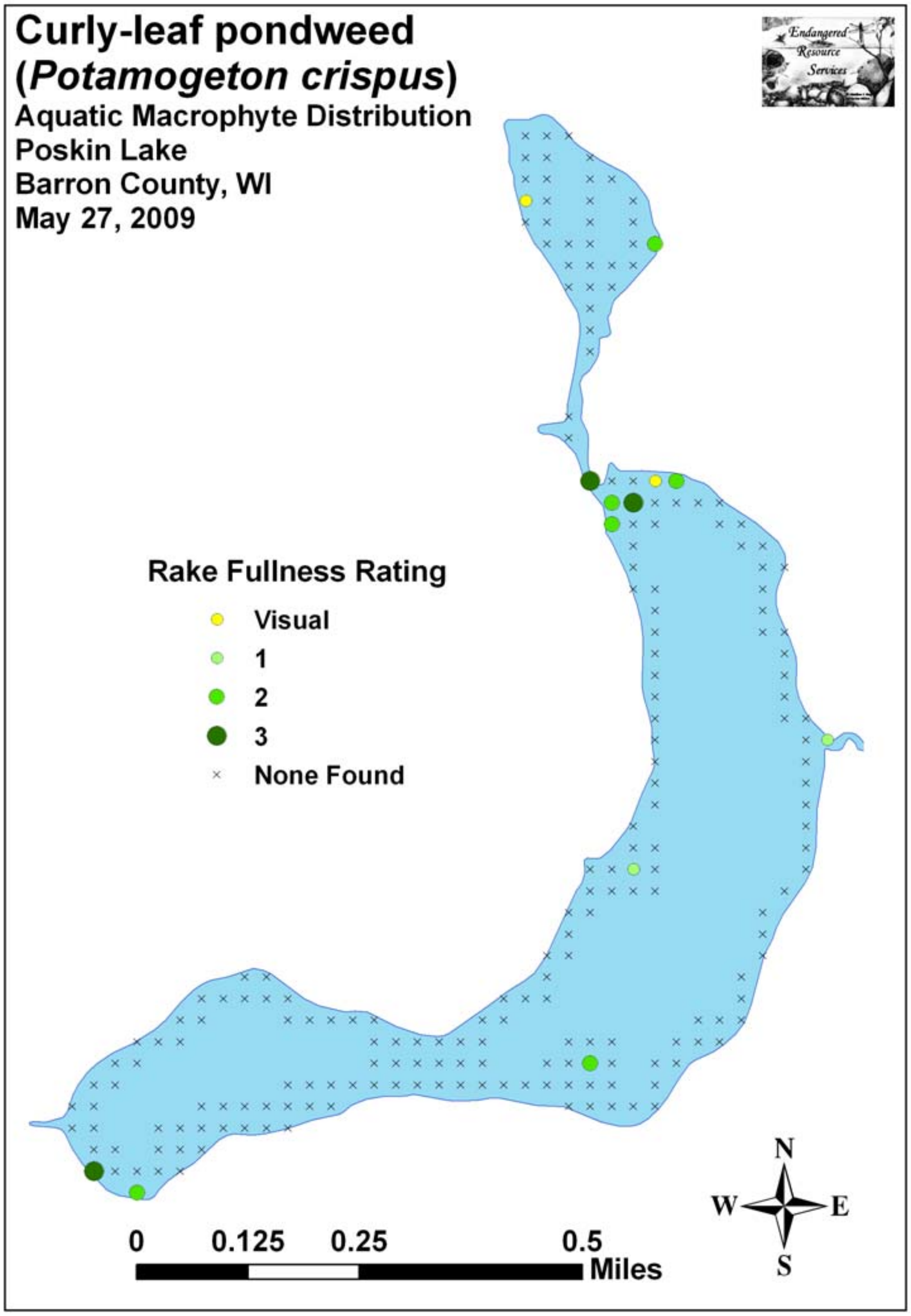
Watershed:

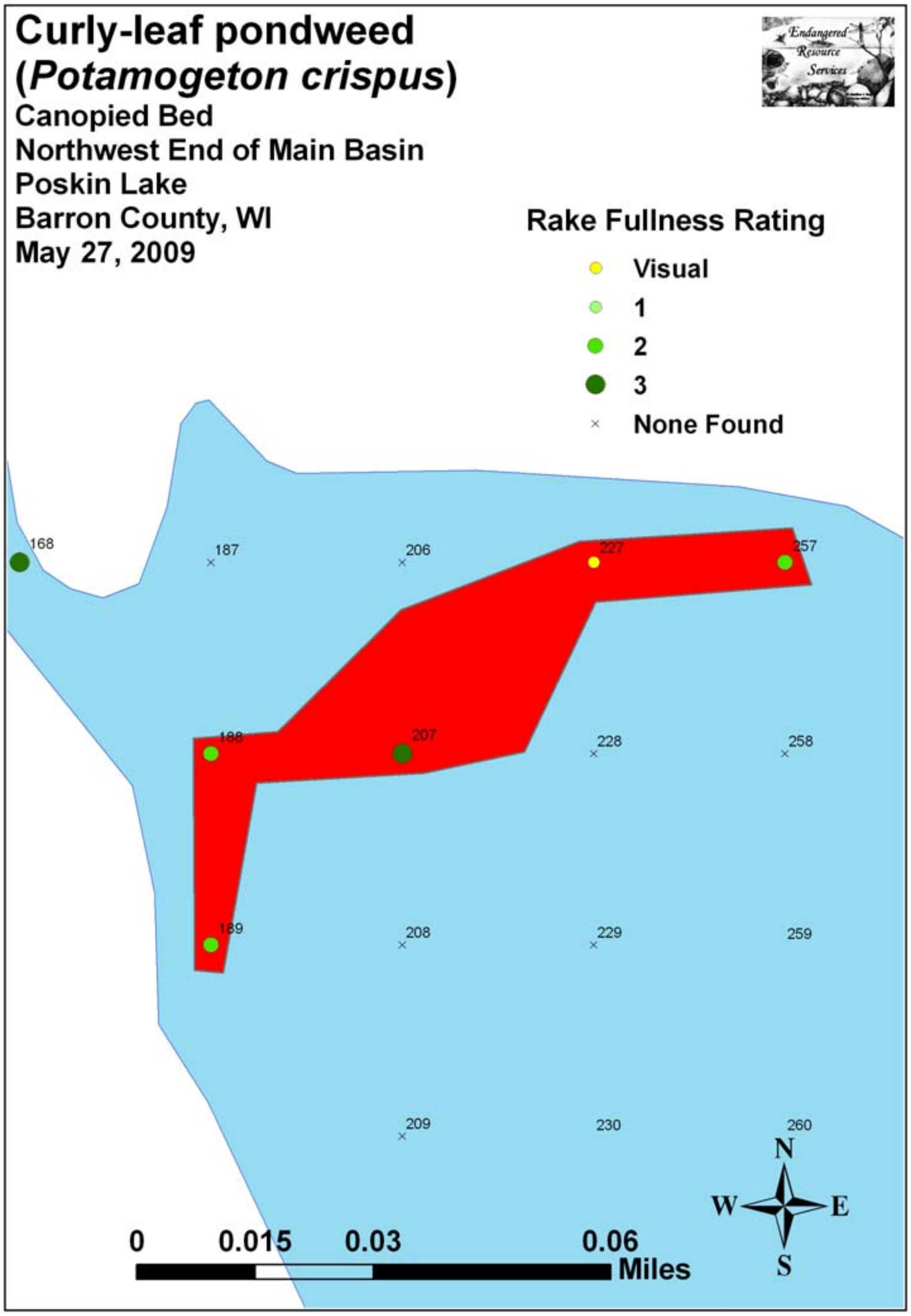
the land area draining into a specific stream, river, lake or other body of water. These areas are divided by ridges of high land.

Zooplankton:

Microscopic or barely visible animals that eat algae. These suspended plankton are an important component of the lake food chain and ecosystem. For many fish, they are the primary source of food.

Appendix IX: June CLP Survey Maps and Additional Aquatic Exotic Invasive Species Information


Curly-leaf pondweed
(*Potamogeton crispus*)
Aquatic Macrophyte Distribution
Poskin Lake
Barron County, WI
May 27, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
N
W
E
S


Curly-leaf pondweed
(Potamogeton crispus)
Canopied Bed
Northwest End of Main Basin
Poskin Lake
Barron County, WI
May 27, 2009
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
168
187
206
227
257
188
207
228
258
189
208
229
259
209
230
260
N
W
E
S
0
0.015
0.03
0.06
Miles

Curly-leaf pondweed

DESCRIPTION: Curly-leaf pondweed is an invasive aquatic perennial that is native to Eurasia, Africa, and Australia. It was accidentally introduced to United States waters in the mid-1880s by hobbyists who used it as an aquarium plant. The leaves are reddish-green, oblong, and about 3 inches long, with distinct wavy edges that are finely toothed. The stem of the plant is flat, reddish-brown and grows from 1 to 3 feet long. The plant usually drops to the lake bottom by early July

DISTRIBUTION AND HABITAT: Curly-leaf pondweed is commonly found in alkaline and high nutrient waters, preferring soft substrate and shallow water depths. It tolerates low light and low water temperatures. It has been reported in all states but Maine

LIFE HISTORY AND EFFECTS OF INVASION: Curly-leaf pondweed spreads through burr-like winter buds (turions), which are moved among waterways. These plants can also reproduce by seed, but this plays a relatively small role compared to the vegetative reproduction through turions. New plants form under the ice in winter, making curly-leaf pondweed one of the first nuisance aquatic plants to emerge in the spring.

It becomes invasive in some areas because of its tolerance for low light and low water temperatures. These tolerances allow it to get a head start on and out compete native plants in the spring. In mid-summer, when most aquatic plants are growing, curly-leaf pondweed plants are dying off. Plant die-offs may result in a critical loss of dissolved oxygen. Furthermore, the decaying plants can increase nutrients which contribute to algal blooms, as well as create unpleasant stinking messes on beaches. Curly-leaf pondweed forms surface mats that interfere with aquatic recreation. (Taken in its entirety from WDNR, 2009 http://www.dnr.state.wi.us/invasives/fact/curlyleaf_pondweed.htm)

Eurasian water milfoil

DESCRIPTION: Eurasian water milfoil is a submersed aquatic plant native to Europe, Asia, and northern Africa. It is the only non-native milfoil in Wisconsin. Like the native milfoils, the Eurasian variety has slender stems whorled by submersed feathery leaves and tiny flowers produced above the water surface. The flowers are located in the axils of the floral bracts, and are either four-petaled or without petals. The leaves are threadlike, typically uniform in diameter, and aggregated into a submersed terminal spike. The stem thickens below the inflorescence and doubles its width further down, often curving to lie parallel with the water surface. The fruits are four-jointed nut-like bodies. Without flowers or fruits, Eurasian water milfoil is nearly impossible to distinguish from Northern water milfoil. Eurasian water milfoil has 9-21 pairs of leaflets per leaf, while Northern milfoil typically has 7-11 pairs of leaflets. Coontail is often mistaken for the milfoils, but does not have individual leaflets.

DISTRIBUTION AND HABITAT: Eurasian milfoil first arrived in Wisconsin in the 1960's. During the 1980's, it began to move from several counties in southern Wisconsin to lakes and waterways in the northern half of the state. As of 1993, Eurasian milfoil was common in 39 Wisconsin counties (54%) and at least 75 of its lakes, including shallow bays in Lakes Michigan and Superior and Mississippi River pools.

Eurasian water milfoil grows best in fertile, fine-textured, inorganic sediments. In less productive lakes, it is restricted to areas of nutrient-rich sediments. It has a history of becoming dominant in eutrophic, nutrient-rich lakes, although this pattern is not universal. It is an opportunistic species that prefers highly disturbed lake beds, lakes receiving nitrogen and phosphorous-laden runoff, and heavily used lakes. Optimal growth occurs in alkaline systems with a high concentration of dissolved inorganic carbon. High water temperatures promote multiple periods of flowering and fragmentation.

LIFE HISTORY AND EFFECTS OF INVASION: Unlike many other plants, Eurasian water milfoil does not rely on seed for reproduction. Its seeds germinate poorly under natural conditions. It reproduces vegetatively by fragmentation, allowing it to disperse over long distances. The plant produces fragments after fruiting once or twice during the summer. These shoots may then be carried downstream by water currents or inadvertently picked up by boaters. Milfoil is readily dispersed by boats, motors, trailers, bilges, live wells, or bait buckets, and can stay alive for weeks if kept moist.

Once established in an aquatic community, milfoil reproduces from shoot fragments and stolons (runners that creep along the lake bed). As an opportunistic species, Eurasian water milfoil is adapted for rapid growth early in spring. Stolons, lower stems, and roots persist over winter and store the carbohydrates that help milfoil claim the water column early in spring, photosynthesize, divide, and form a dense leaf canopy that shades out native aquatic plants. Its ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of Eurasian milfoil provide only a single habitat, and threaten the integrity of aquatic communities in a number of ways; for example, dense stands disrupt predator-prey relationships by fencing out larger fish, and reducing the number of nutrient-rich native plants available for waterfowl.

Dense stands of Eurasian water milfoil also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead". Cycling of nutrients from sediments to the water column by Eurasian water milfoil may lead to deteriorating water quality and algae blooms of infested lakes. (Taken in its entirety from WDNR, 2009 http://www.dnr.state.wi.us/invasives/fact/milfoil.htm)

Reed canary grass

DESCRIPTION: Reed canary grass is a large, coarse grass that reaches 2 to 9 feet in height. It has an erect, hairless stem with gradually tapering leaf blades 3 1/2 to 10 inches long and 1/4 to 3/4 inch in width. Blades are flat and have a rough texture on both surfaces. The lead ligule is membranous and long. The compact panicles are erect or slightly spreading (depending on the plant's reproductive stage), and range from 3 to 16 inches long with branches 2 to 12 inches in length. Single flowers occur in dense clusters in May to mid-June. They are green to purple at first and change to beige over time. This grass is one of the first to sprout in spring, and forms a thick rhizome system that dominates the subsurface soil. Seeds are shiny brown in color.

Both Eurasian and native ecotypes of reed canary grass are thought to exist in the U.S. The Eurasian variety is considered more aggressive, but no reliable method exists to tell the ecotypes apart. It is believed that the vast majority of our reed canary grass is derived from the Eurasian ecotype. Agricultural cultivars of the grass are widely planted.

Reed canary grass also resembles non-native orchard grass (*Dactylis glomerata*), but can be distinguished by its wider blades, narrower, more pointed inflorescence, and the lack of hairs on glumes and lemmas (the spikelet scales). Additionally, bluejoint grass (*Calamagrostis canadensis*) may be mistaken for reed canary in areas where orchard grass is rare, especially in the spring. The highly transparent ligule on reed canary grass is helpful in distinguishing it from the others. Ensure positive identification before attempting control.

DISTRIBUTION AND HABITAT: Reed canary grass is a cool-season, sod-forming, perennial wetland grass native to temperate regions of Europe, Asia, and North America. The Eurasian ecotype has been selected for its vigor and has been planted throughout the U.S. since the 1800's for forage and erosion control. It has become naturalized in much of the northern half of the U.S., and is still being planted on steep slopes and banks of ponds and created wetlands.

Reed canary grass can grow on dry soils in upland habitats and in the partial shade of oak woodlands, but does best on fertile, moist organic soils in full sun. This species can invade most types of wetlands, including marshes, wet prairies, sedge meadows, fens, stream banks, and seasonally wet areas; it also grows in disturbed areas such as bergs and spoil piles.

LIFE HISTORY AND EFFECTS OF INVASION: Reed canary grass reproduces by seed or creeping rhizomes. It spreads aggressively. The plant produces leaves and flower stalks for 5 to 7 weeks after germination in early spring, then spreads laterally. Growth peaks in mid-June and declines in mid-August. A second growth spurt occurs in the fall. The shoots collapse in mid to late summer, forming a dense, impenetrable mat of stems and leaves. The seeds ripen in late June and shatter when ripe. Seeds may be dispersed from one wetland to another by waterways, animals, humans, or machines.

This species prefers disturbed areas, but can easily move into native wetlands. Reed canary grass can invade a disturbed wetland in less than twelve years. Invasion is associated with disturbances including ditching of wetlands, stream channelization, deforestation of swamp forests, sedimentation, and intentional planting. The difficulty of selective control makes reed canary grass invasion of particular concern. Over time, it forms large, monotypic stands that harbor few other plant species and are subsequently of little use to wildlife. Once established, reed canary grass dominates an area by building up a tremendous seed bank that can eventually erupt, germinate, and recolonize treated sites. (Taken in its entirety from WDNR, 2009 http://www.dnr.state.wi.us/invasives/fact/reed_canary.htm)

Purple loosestrife on Balsam Lake
(Photo Courtesy Brian M. Collins – Unity Biology Instructor)

DESCRIPTION: Purple loosestrife is a perennial herb 3-7 feet tall with a dense bushy growth of 1-50 stems. The stems, which range from green to purple, die back each year. Showy flowers vary from purple to magenta, possess 5-6 petals aggregated into numerous long spikes, and bloom from July to September. Leaves are opposite, nearly linear, and attached to four-sided stems without stalks. It has a large, woody taproot with fibrous rhizomes that form a dense mat.

This species may be confused with the native wing-angled loosestrife (*Lythrum alatum*) found in moist prairies or wet meadows. The latter has a winged, square stem and solitary paired flowers in the leaf axils. It is generally a smaller plant than the Eurasian loosestrife. By law, purple loosestrife is a nuisance species in Wisconsin. It is illegal to sell, distribute, or cultivate the plants or seeds, including any of its cultivars.

Distribution and Habitat: Purple loosestrife is a wetland herb that was introduced as a garden perennial from Europe during the 1800's. It is still promoted by some horticulturists for its beauty as a landscape plant, and by beekeepers for its nectar-producing capability. Currently, about 24 states have laws prohibiting its importation or distribution because of its aggressively invasive characteristics. It has since extended its range to include most temperate parts of the United States and Canada. The plant's reproductive success across North America can be attributed to its wide tolerance of physical and chemical conditions characteristic of disturbed habitats, and its ability to reproduce prolifically by both seed dispersal and vegetative propagation. The absence of natural predators, like European species of herbivorous beetles that feed on the plant's roots and leaves, also contributes to its proliferation in North America.

Purple loosestrife was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties. Low densities in most areas of the state suggest that the plant is still in the pioneering stage of establishment. Areas of heaviest infestation are sections of the Wisconsin River, the extreme southeastern part of the state, and the Wolf and Fox River drainage systems.

This plant's optimal habitat includes marshes, stream margins, alluvial flood plains, sedge meadows, and wet prairies. It is tolerant of moist soil and shallow water sites such as pastures and meadows, although established plants can tolerate drier conditions. Purple loosestrife has also been planted in lawns and gardens, which is often how it has been introduced to many of our wetlands, lakes, and rivers.

Life History and Effects of Invasion: Purple loosestrife can germinate successfully on substrates with a wide range of pH. Optimum substrates for growth are moist soils of neutral to slightly acidic pH, but it can exist in a wide range of soil types. Most seedling establishment occurs in late spring and early summer when temperatures are high.

Purple loosestrife spreads mainly by seed, but it can also spread vegetatively from root or stem segments. A single stalk can produce from 100,000 to 300,000 seeds per year. Seed survival is up to 60-70%, resulting in an extensive seed bank. Mature plants with up to 50 shoots grow over 2 meters high and produce more than two million seeds a year. Germination is restricted to open, wet soils and requires high temperatures, but seeds remain viable in the soil for many years. Even seeds submerged in water can live for approximately 20 months. Most of the seeds fall near the parent plant, but water, animals, boats, and humans can transport the seeds long distances. Vegetative spread through local perturbation is also characteristic of loosestrife; clipped, trampled, or buried stems of established plants may produce shoots and roots. Plants may be quite large and several years old before they begin flowering. It is often very difficult to locate non-flowering plants, so monitoring for new invasions should be done at the beginning of the flowering period in mid-summer.

Any sunny or partly shaded wetland is susceptible to purple loosestrife invasion. Vegetative disturbances such as water drawdown or exposed soil accelerate the process by providing ideal conditions for seed germination. Invasion usually begins with a few pioneering plants that build up a large seed bank in the soil for several years. When the right disturbance occurs, loosestrife can spread rapidly, eventually taking over the entire wetland. The plant can also make morphological adjustments to accommodate changes in the immediate environment; for example, a decrease in light level will trigger a change in leaf morphology. The plant's ability to adjust to a wide range of environmental conditions gives it a competitive advantage; coupled with its reproductive strategy, purple loosestrife tends to create monotypic stands that reduce biotic diversity.

Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displaced, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size, and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways. (Taken in its entirety from WDNR, 2009 http://www.dnr.state.wi.us/invasives/fact/loosestrife.htm)

Appendix X: Raw Data Spreadsheets