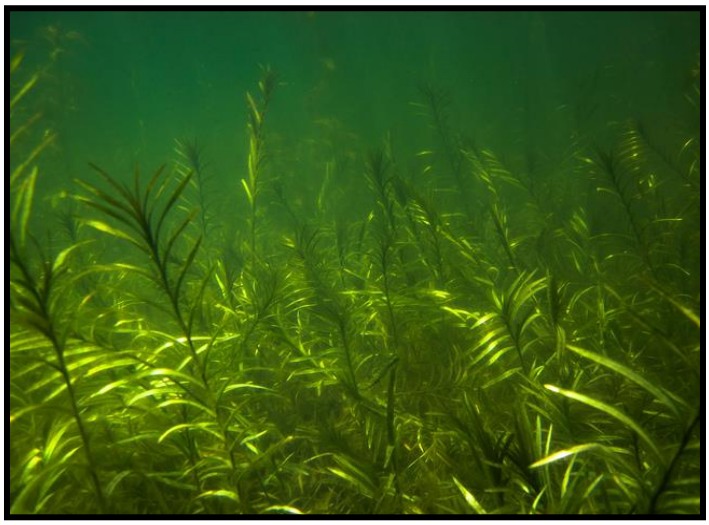
August Warm-water Point-intercept Survey and Eurasian water milfoil (*Myriophyllum spicatum*) Visible Littoral Zone Survey
North Pipe Lake (WBIC: 2485700)
Polk County, Wisconsin



Fern pondweed bed (Butterfield 2013)

North Pipe Lake Aerial Photo (2008)

Project Initiated by: Pipe and North Pipe Lake Protection and Rehabilitation District and the Wisconsin Department of Natural Resources

Torrey's three-square bulrush (Cameron 2013)

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August 10 and October 11, 2013

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ABSTRACT

North Pipe Lake (WBIC 2485700) is a 64 acre eutrophic drainage lake located in east-central Polk County, Wisconsin. The lake's average depth is approximately 18ft, and the bottom substrate is predominantly sand and rock on the east/west shorelines and nutrient rich muck in the north/south bays. Water clarity is fair with Secchi values averaging 8ft and a littoral zone that reached 12ft in 2013. As a follow up to the original full point-intercept survey and in anticipation of updating the lake's Aquatic Plant Management Plan, the Pipe and North Pipe Lake Protection and Rehabilitation District and the Wisconsin Department of Natural Resources commissioned a full point-intercept macrophyte survey on August 10, 2013, and an additional visible littoral zone survey for Eurasian water milfoil (*Myriophyllum spicatum*) (EWM) on October 11, 2013. The point-intercept survey found macrophytes at 69 points which extrapolated to plant coverage at 24.1% of the entire lake and 71.9% of the 12ft littoral zone (down from 85 points covering 29.7% of the lake and 60.3% of the 15.5ft littoral zone in 2007). We found 40 species growing in and immediately adjacent to the lake, and the 35 in the rake produced a Simpson Index Value of 0.94 (40 total species in the rake produced an identical index in 2007). Species richness at sites with plants was moderate at 3.03 species/site (down slightly from 3.06/site in 2007). Total plant growth was dense with a mean total rake fullness value at vegetative sites of 2.45 (up from an estimated 1.80 in 2007). Fern pondweed (*Potamogeton robbinsii*), White water lily (*Nymphaea odorata*), Pickerelweed (*Pontederia cordata*), and Watershield (*Brasenia schreberi*) were the most common native vascular species in 2013 being found at 44.93%, 33.33%, 20.29% and 18.84% of survey points with vegetation and accounting for 37.33% of the total relative frequency. In 2007, Fern pondweed, Sessile-fruited arrowhead (*Sagittaria rigida*), White water lily, and Needle spikerush (*Eleocharis acicularis*) were the most common native species. These four were present at 45.88%, 22.35%, 21.18% and 20.00% of survey points with vegetation, and accounted for 35.63% of the total relative frequency. From 2007 to 2013, Needle spikerush demonstrated a highly significant decline, Nitella (*Nitella* sp.) a moderately significant decline, and Waterwort (*Elatine minima*) and Pursh's bulrush (*Schoenoplectus purshianus*) significant declines. Conversely, Reed canary grass (*Phalaris arundinacea*), the only exotic species found, showed a highly significant increase as it had colonized exposed mudflats along the shoreline during previous drought summers. Common arrowhead (*Sagittaria latifolia*) showed a moderately significant increase; and Small pondweed (*Potamogeton pusillus*), Creeping spikerush (*Eleocharis palustris*), and Creeping bladderwort (*Utricularia gibba*) all had significant increases. A total of 34 native index species (up from 33 in 2007) produced a much above average mean Coefficient of Conservatism of 6.9 (identical to 2007), and a Floristic Quality Index of 40.5 (up slightly from 39.7 in 2007) that was nearly double the median for this part of the state. Two visible littoral zone searches turned up no evidence of EWM or any new invasive species (AIS). Future management consideration include maintaining the lake's sensitive, rare, and high value native plant community – especially the reeds and bulrushes that provide important fish habitat; continuing the established Clean Boats/Clean Waters watercraft education and inspections program; and conducting monthly landing and at least annual littoral zone surveys to look for the introduction of EWM or any other new exotic AIS.

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INTRODUCTION:

North Pipe Lake (WBIC 2485700) is a 64 acre drainage lake in east-central Polk County, Wisconsin in the Town of Johnstown (T35N R15W S15 NE SW). It reaches a maximum depth of 37ft in the central basin and has an average depth of approximately 18ft (WDNR 2013). The lake is eutrophic in nature with Secchi readings in 2013 averaging 8ft (WDNR 2013). This fair water clarity produced a littoral zone that extended to 12ft in August of 2013. The bottom substrate is predominately sand and rock along the east/west shorelines and a nutrient rich organic muck in the north and south bays (Figure 1) (Busch et al. 1966).

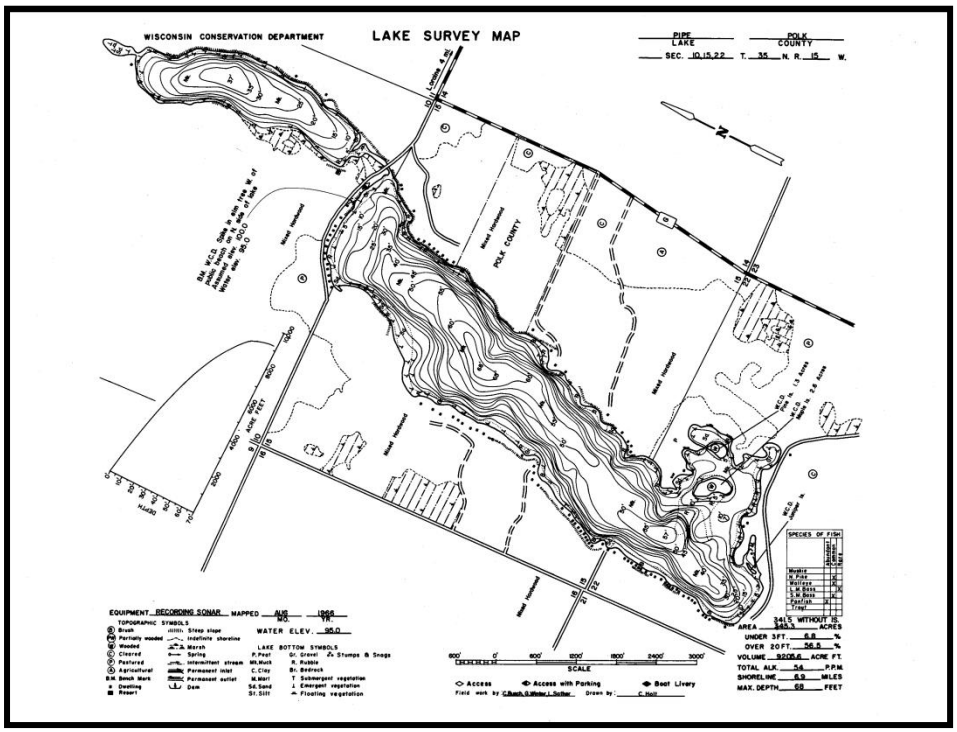


Figure 1: Pipe and North Pipe Lakes Bathymetric Map

Concern over nutrient loading in the lakes leading to a loss of water clarity, and a desire to establish baseline data should an exotic invasive species enter the lakes originally prompted members of the Pipe Lakes Protection and Rehabilitation District (PLPRD) to authorize a point-intercept survey of the lake's macrophytes as part of a broader assessment of the Pipe Lakes' Watershed in 2007. Per WDNR expectations, these plant surveys are normally updated every five years to remain current, but, due to their landing monitoring program and a lack of any active plant management, the lake was given an extension to six years (Pamela Toshner, WDNR pers. comm.). In anticipation of updating the lakes' management plan, the PLPRD authorized a warm-water point intercept survey of all macrophytes on August 10, 2013 and a fall visible littoral zone search for Eurasian water milfoil (*Myriophyllum spicatum*) (EWM) on October 11, 2013. The survey objectives were to compare the 2007 and 2013 data to determine if the lake's vegetation had changed significantly over this time, and to look for evidence that EWM or any other exotic plant species had invaded the lake. This report is the summary analysis of these two field surveys.

METHODS:

August Warm-water Full Point-intercept Survey:

Using a standard formula that takes into account the shoreline shape and distance, water clarity, depth, and total lake acres, Jennifer Hauxwell (WDNR) generated a 286 point sampling grid for North Pipe Lake (Appendix I). Prior to beginning the point-intercept survey, we conducted a rapid boat survey of the lake to regain familiarity with the species present (Appendix II). All plants found were identified, and, if it was a species not found in 2007, a pair of vouchers were pressed and mounted with one being sent to the state herbarium in Stevens Point for identification confirmation and the other going to the PLPRD. During the point-intercept survey, we located each survey point using a handheld mapping GPS unit (Garmin 76CSX) and recorded a depth reading with a metered pole rake or hand held sonar (Vexilar LPS-1). At each littoral point, we used the rake to sample an approximately 2.5ft section of the bottom. All plants on the rake, as well as any that were dislodged by the rake, were identified and assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 2). We also recorded visual sightings of plants within six feet of the sample point. In addition to a rake rating for each species, a total rake fullness rating was also noted. Substrate type (lake bottom) was assigned at each site where the bottom was visible or it could be reliably determined using the rake.

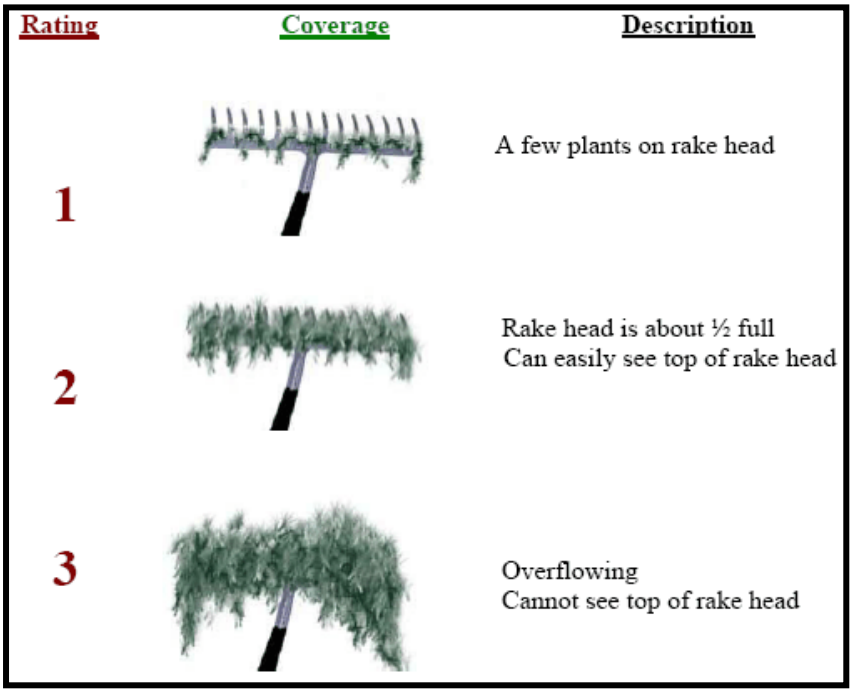


Figure 2: Rake Fullness Ratings (UWEX 2010)

Fall EWM Transect Survey:

During the fall survey, we motored around the lake at idle speed looking for any evidence of EWM's characteristic red growth top. As the lake has such a narrow visible littoral zone, we were only able to do a single transect around the majority of the lake.

DATA ANALYSIS:

We entered all data collected into the standard APM spreadsheet (Appendix II) (UWEX 2010). From this, we calculated the following:

Total number of sites visited: This included the total number of points that were accessible to be surveyed by boat.

Total number of sites with vegetation: These included all sites where vegetation was found 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, this value is used 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 within the littoral zone. It can also be reported as a percentage of occurrences at sample points with vegetation.

Frequency of occurrence example:

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

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

From these frequencies, we can estimate how common each species was at depths where plants were able to grow, and at points where plants actually were growing. Note the second value will be greater as not all the points (in this example, only ½) had plants growing at them.

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 individual plants (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.

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.

Number of sites sampled using rope/pole rake: This indicates which rake type was used to take a sample. As is standard protocol, we use a 15ft pole rake and a 30ft 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 at a sample point during the survey but not found in the rake, and those that were only seen during the initial boat survey or inter-point. **Note: Per DNR protocol, filamentous algae, freshwater sponges, aquatic moss and the aquatic liverworts *Riccia fluitans* and *Ricciocarpus natans* are excluded from these totals.**

Average rake fullness: This value is the average rake fullness of all species in the rake. It only takes into account those sites with vegetation. Although not recorded in 2007, we estimated the cumulative value based on the species rake fullness ratings (Table 1).

Relative frequency: This value shows 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 gives us an idea of which species are most important within the macrophyte community (Table 3).

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 an area's aquatic plants. The 124 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 they 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 native index species found in the lake during the point-intercept survey, 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. North Pipe Lake is in the Northern Central Hardwood Forests Ecoregion (Table 5).

**** Species that were only recorded as visuals or during the boat survey, and species found in the rake that are not included in the index are excluded from FQI analysis.**

Comparison to Past Surveys: We compared data from our August 7, 2007 survey (Tables 2 and 4) with our 2013 results to see if there were any significant changes in the lake's vegetation. Using the WDNR Pre/Post Survey Sheet, we determined 2007/2013 differences to be significant at $p<.05$, moderately significant at $p<.01$ and highly significant at $p<.005$ (UWEX 2010). It should be noted that we used the number of points with vegetation as the basis for "sample points" in the statistical calculation as changing water levels and clarity appears to have impacted plant growth (69 points with vegetation in 2013 compared to 85 points in 2007).

RESULTS:

August Warm-water Full Point-intercept Survey:

Depth soundings taken at the lake's 286 survey points revealed the lake is a classic narrow glacial "straight lake" running north to south. With the exception of the western midlake bay, the east and west shorelines drop off sharply into 15ft+ while the north and south bays slope more gradually. The lake bottoms out at approximately 37ft on the north side of the central basin (Figure 3) (Appendix III).

Sugar sand and rock occurred on the margins of the majority of the east and west shorelines, while sandy and nutrient rich organic muck dominated the north, south, and west bays. Of the 117 survey points where we could reliably determine the substrate, 44.4% were muck, 28.2% were pure sand, and the remaining 27.4% were rock (Figure 3) (Appendix III).

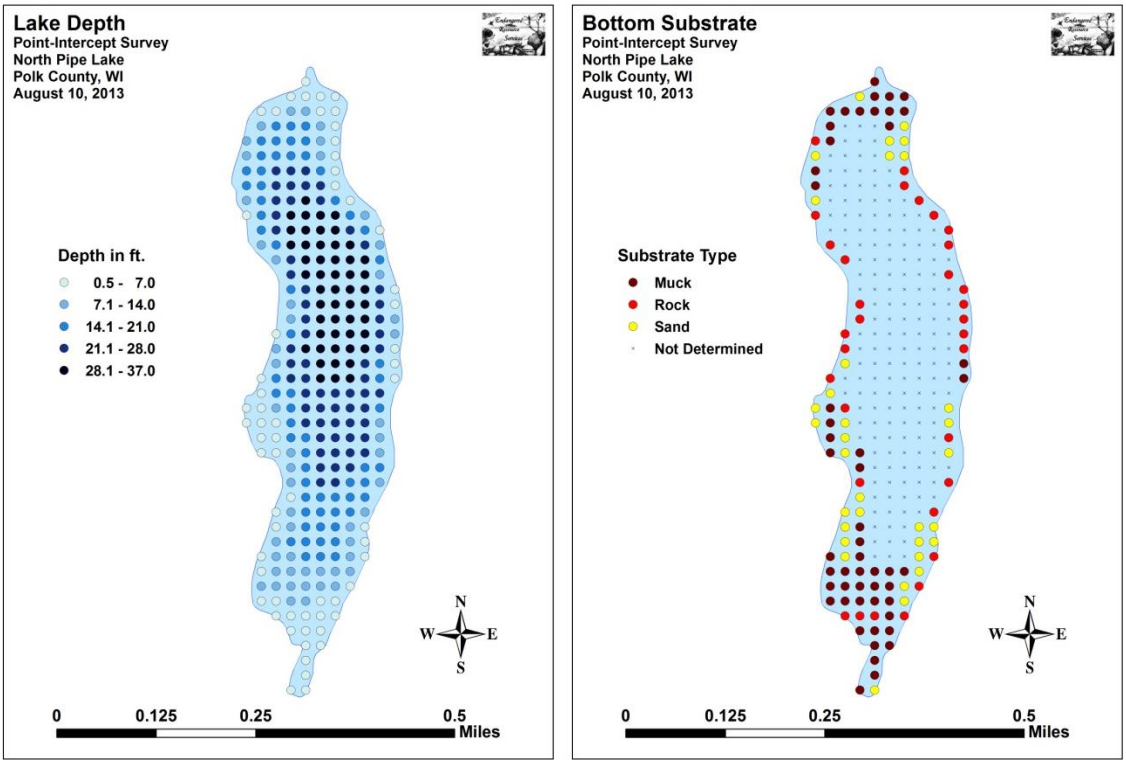


Figure 3: Lake Depth and Bottom Substrate

We found plants growing at 69 sites or on approximately 24.13% of the entire lake bottom and in 71.88% of the littoral zone (Figure 4). This represented a decrease in total coverage from 2007 when plants were located at 85 points (29.72% of the lake bottom). However, as the littoral limit dropped from 15.5ft in 2007 to 12.0ft in 2013, the relative littoral zone coverage actually increased. Despite these different littoral limits, most plants were found in shallow water during both surveys as the median depth was 3.0ft each year. A few plants found in deep water skewed the mean in both 2007 (4.8ft) and 2013 (4.0ft) (Table 1) (Appendix IV).

Table 1: Aquatic Macrophyte P/I Survey Summary Statistics
North Pipe Lake, Polk County
August 7, 2007 and August 10, 2013

Summary Statistics:	2007	2013
Total number of points sampled	286	286
Total number of sites with vegetation	85	69
Total number of sites shallower than the maximum depth of plants	141	96
Frequency of occurrence at sites shallower than maximum depth of plants	60.28	71.88
Simpson Diversity Index	0.94	0.94
Maximum depth of plants (ft)	15.5	12.0
Mean depth of plants (ft)	4.8	4.0
Median depth of plants (ft)	3.0	3.0
Average number of all species per site (shallower than max depth)	1.85	2.26
Average number of all species per site (veg. sites only)	3.07	3.14
Average number of native species per site (shallower than max depth)	1.84	2.11
Average number of native species per site (veg. sites only)	3.06	3.03
Species richness	40	35
Species richness (including visuals)	40	38
Species richness (including visuals and boat survey)	40	40
Mean rake fullness (veg. sites only – 2007 estimated)	1.80	2.45

Plant diversity was exceptionally high with a Simpson Diversity Index value of 0.94 in both years. Species richness was also moderately high for such a small lake with 40 total species found growing in and immediately adjacent to the lake in both years. The mean number of native species at sites with vegetation was also moderately high with 3.03 species found/vegetative site in 2013 – down slightly from 3.06/site in 2007 (Figure 5). Total rake fullness increased significantly from a low/moderate 1.80 in 2007 to a high 2.45 in 2013. This is likely due to the generally abrupt end of all plant growth we observed at most depths over 9ft in 2013 as compared to the gradual reduction in growth all the way to the littoral limit observed in 2007 (Figure 6) (Appendix IV).

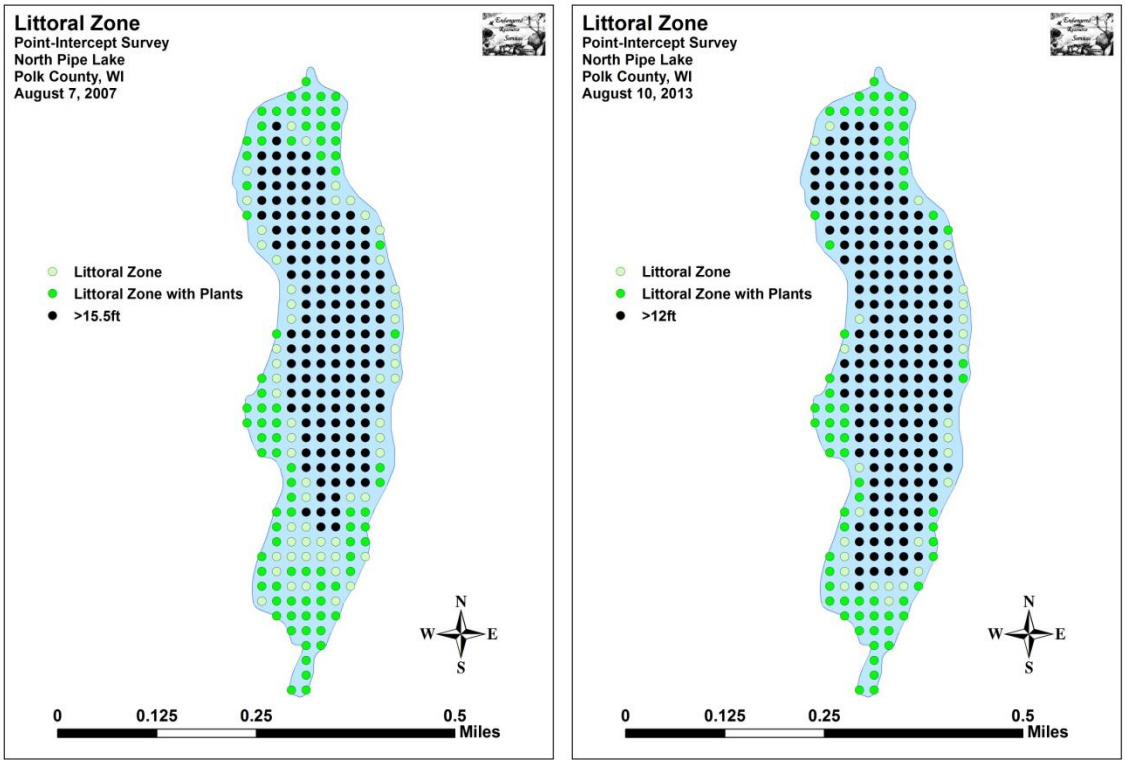


Figure 4: 2007 and 2013 Littoral Zone

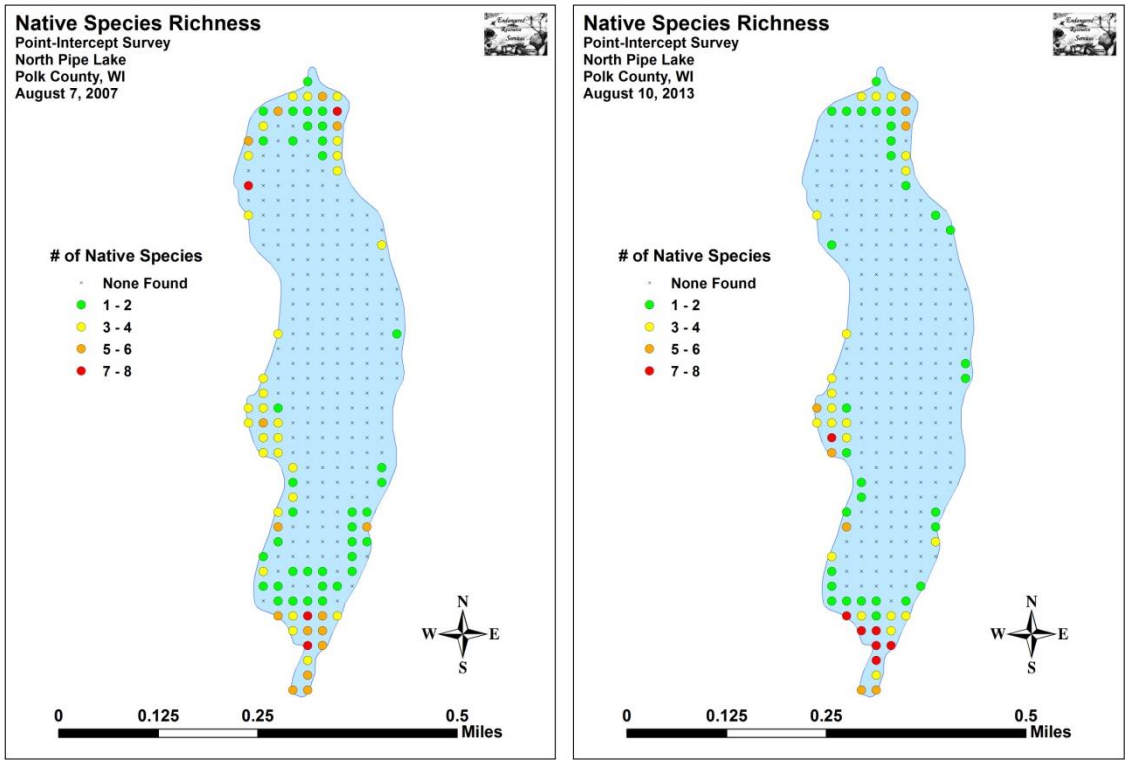


Figure 5: 2007 and 2013 Native Species Richness

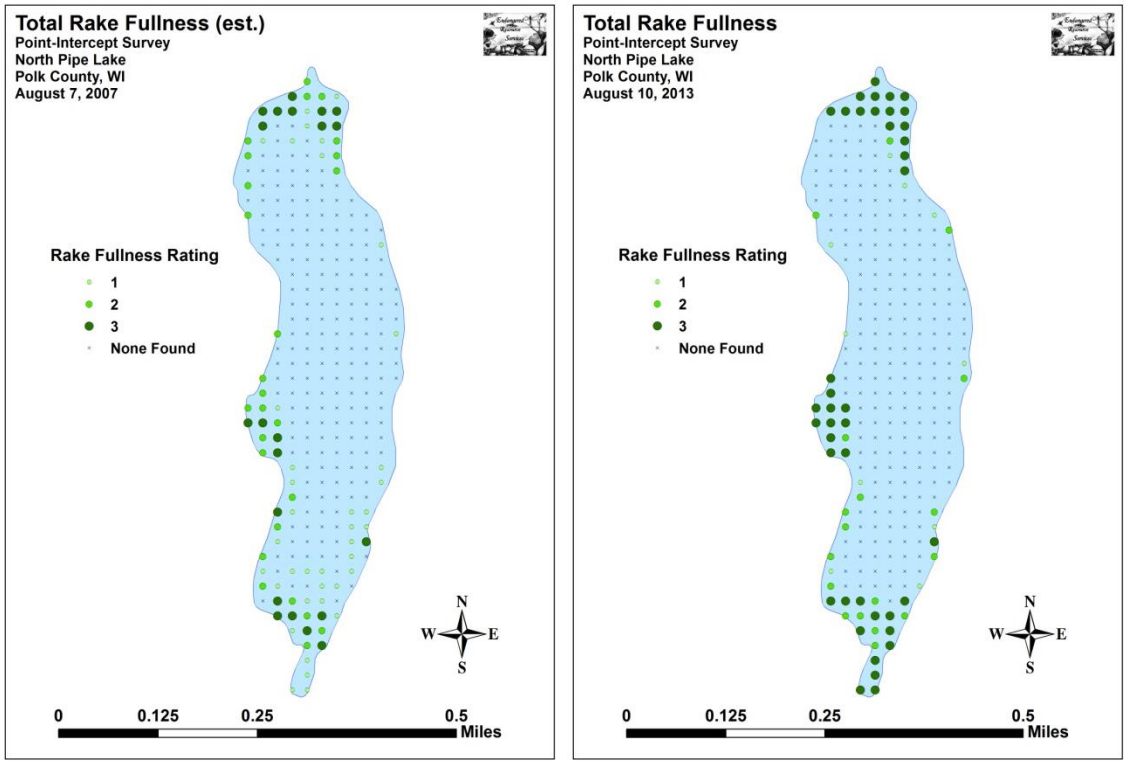


Figure 6: 2007 and 2013 Total Rake Fullness

North Pipe Lake Plant Community:

The North Pipe Lake ecosystem is home to a sensitive and rare plant community that is characteristic of soft-water lakes with fluctuating water levels. This community can be subdivided into four distinct zones (emergent, shallow submergent, floating-leaf, and deep submergent) with each zone having its own characteristic functions in the lake ecosystem. Depending on the local bottom type (sand, rock, sandy muck, or nutrient rich organic muck), these zones often had somewhat different species present.

Along sandy shorelines, the lake's emergent plant beds were dominated by Hardstem bulrush (*Schoenoplectus acutus*) and Creeping spikerush (*Eleocharis palustris*). We also found small numbers of Rice cut-grass (*Leersia oryzoides*), Common yellow lake sedge (*Carex utriculata*), and Reed canary grass (*Phalaris arundinacea*) in isolated patches.

Hardstem bulrush (Per 2002)

Creeping spikerush (Crelins 2009)

In sandy and organic muck-bottomed areas, these species were replaced by Pickerelweed (*Pontederia cordata*), River bulrush (*Bolboschoenus fluviatile*), Three-way sedge (*Dulichium arundinaceum*), Bald spikerush (*Eleocharis erythropoda*), Water horsetail (*Equisetum fluviatile*), Common arrowhead (*Sagittaria latifolia*), Sessile-fruited arrowhead (*Sagittaria rigida*), Softstem bulrush (*Schoenoplectus tabernaemontani*), Broad-leaved cattail (*Typha latifolia*), and the State Species of Special Concern ** Torrey's three-square bulrush (*Schoenoplectus torreyi*). Collectively, these emergents work to stabilize the lakeshore, provide a nursery for baitfish and juvenile gamefish, offer shelter for amphibians, and give waterfowl and predatory wading birds like herons a place to hunt.

** "Special Concern" species, like Torrey's three-square bulrush, are those species about which some problem of abundance or distribution is suspected but not yet proved. The main purpose of this category is to focus attention on certain species before they become threatened or endangered.

Pickerelweed (Texas A&M 2012)

River bulrush (Ratzlaff 2008)

Three-way sedge (Levitt 2013)

Water horsetail (Elliot 2007)

Softstem bulrush (Schwarz 2011)

Sessile-fruited arrowhead (Cameron 2013)

Just beyond the emergents, in water up to 3ft deep, shallow sugar sand areas tended to have low total biomass as the nutrient poor substrates provide habitat most suited to fine-leaved "isoetid" turf forming species. In this very narrow zone of growth, we found limited numbers of Waterwort (*Elatine minima*), Needle spikerush (*Eleocharis acicularis*), Lake quillwort (*Isoetes lacustris*), and Northern manna-grass (*Glyceria borealis*) with its thin ribbon-like floating leaves. These species work with the emergents to stabilize the bottom and prevent wave action erosion.

Waterwort (Fewless 2005)

Needle spikerush (Fewless 2005)

Lake quillwort (Kressler 2012)

Northern manna-grass (Fewless 2010)

Floating-leaf species like White-water lily (*Nymphaea odorata*), Spatterdock (*Nuphar variegata*), Watershield (*Brasenia schreberi*), Ribbon-leaf pondweed (*Potamogeton epihydrus*), Variable pondweed (*Potamogeton gramineus*), Large-leaf pondweed (*Potamogeton amplifolius*), and Floating-leaf bur-reed (*Sparganium fluctuans*) dominated the shallow organic muck-bottomed areas of the lake's north, south, and west bays. The protective canopy cover this group provides is often utilized by panfish and bass.

Spatterdock and White water lily (Falkner, 2009)

Watershield (Gmelin, 2009)

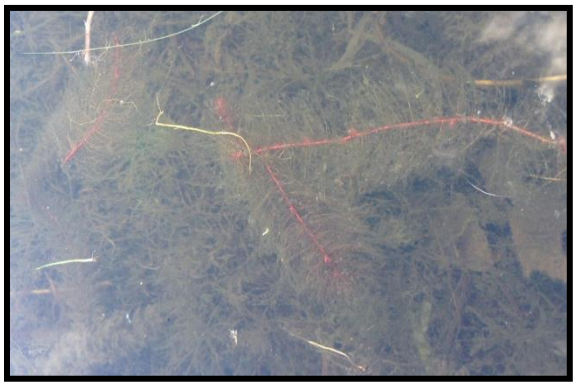
Ribbon-leaf pondweed (Petroglyph 2007)

Variable pondweed (Koshere 2002)

Large-leaf pondweed (Fewless 2012)

Floating-leaf bur-reed (Sulmann 2009)

Growing amongst these floating-leaf species, we also noted the submergent species Spiny hornwort (*Ceratophyllum echinatum*) and Farwell's water milfoil (*Myriophyllum farwellii*). We also found limited numbers of Small duckweed (*Lemna minor*), aquatic liverworts, and carnivorous bladderworts (*Utricularia* spp.) floating among the lilypads. Rather than drawing nutrients up through roots like other plants, bladderworts trap zooplankton and minute insects in their bladders, digest their prey, and use the nutrients to further their growth.



Farwell's water milfoil in Pipe Lake's southeast bay (Berg 2013)

Spiny hornwort (Skawinski 2010)

Small duckweed and Slender riccia - liverwort (Martin 2013)

Purple-fringed riccia – liverwort (Fischer 2011)

Small bladderwort (Cameron 2013)

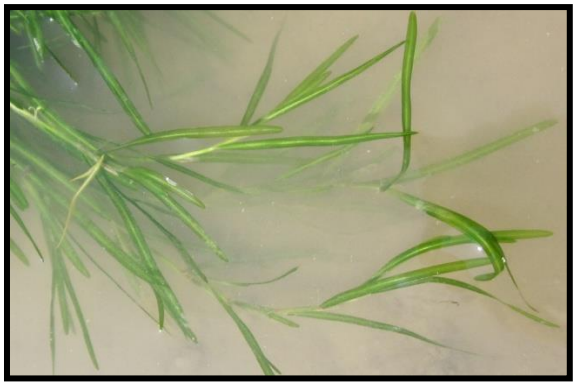
Bladders for catching plankton and insect larvae (Wontolla 2007)

Sandy muck areas in water from 3-6ft supported a rich collection of generally larger-leaved species including Slender naiad (*Najas flexilis*), Northern naiad (*Najas gracillima*), Large-leaf pondweed (*Potamogeton amplifolius*), Small pondweed (*Potamogeton pusillus*), Spiral-fruited pondweed (*Potamogeton spirillus*), and Wild celery (*Vallisneria americana*). The seeds, shoots, roots, and tubers this group supplies are heavily utilized by resident and migratory waterfowl. They also provide important habitat for baitfish and juvenile game fish as well as insects like dragonflies and mayflies during the aquatic nymph stages of their lifecycles.

Slender naiad (Cameron 2013)

Northern naiad (Ryu 2013)

Large-leaf pondweed (Martin 2002)



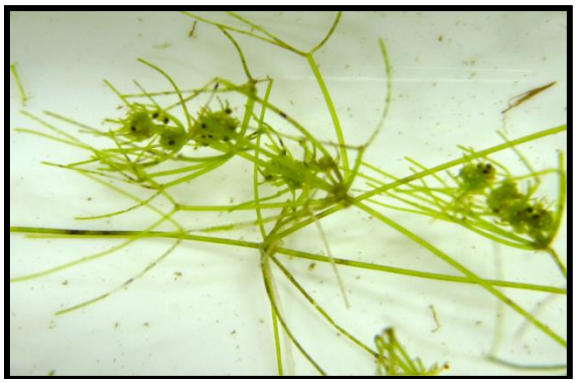
Small pondweed (Villa 2011)

Spiral-fruited pondweed (Koshere 2002)

Wild celery (Dalvi 2009)

Areas over 6ft were dominated by Fern pondweed (*Potamogeton robbinsii*) with a few scattered patches of (*Nitella* sp.) mixed in. Collectively, these species provide important deep-water habitat for mature gamefish.

Fern pondweed (Apipp 2011)



Nitella

Comparison of Native Macrophytes in 2007 and 2013:

In 2007, we found Fern pondweed, Sessile-fruited arrowhead, White water lily, and Needle spikerush, to be the most common native macrophyte species (Table 2). They were present at 45.88%, 22.35%, 21.18% and 20.00% of survey points with vegetation, and , collectively, they accounted for 35.63% of the total relative frequency (Maps for state listed and species found at five or more sites in 2007 can be found in Appendix VI).

During the 2013 survey, Fern pondweed was again the most common native species being present at 44.93% of vegetated points (Table 3). Despite this overall decline in distribution, it demonstrated a significant increase in density (1.41 in 2007 – 1.97 in 2013) (Figure 7).

Sessile-fruited arrowhead, the second most common native species in 2007, was the eighth most common native species in 2013. Present at 11.59% of points with vegetation in 2013, its decline seems to be associated with changing water levels as it was still found in the same general areas of the lake (Figure 8).

White water lily increased in both density (mean rake of 1.72 in 2007 to 1.87 in 2013) and distribution (21.18% of vegetated points in 2007 to 33.33% in 2013) to become the second most common native species in 2013. This expansion primarily occurred in the western bay midlake and along the channel to Pipe Lake – areas that were essentially exposed mudflats in 2007 and could not support this species at that time (Figure 9).

Needle spikerush, the fourth most common species in 2007 showed a highly significant decline and had all but disappeared from the lake in 2013 (Figure 10). Like Sessile-fruited arrowhead, it seems to have been a victim of changing water levels.

Pickerelweed and Watershield (20.29% and 18.84% of vegetative points) were the third and fourth most common native species in 2013. Collectively, and similar to 2007, these top four species accounted for 37.33% of the total relative frequency (Species accounts and maps for all plants found in 2013 can be found in Appendix VI and VII).

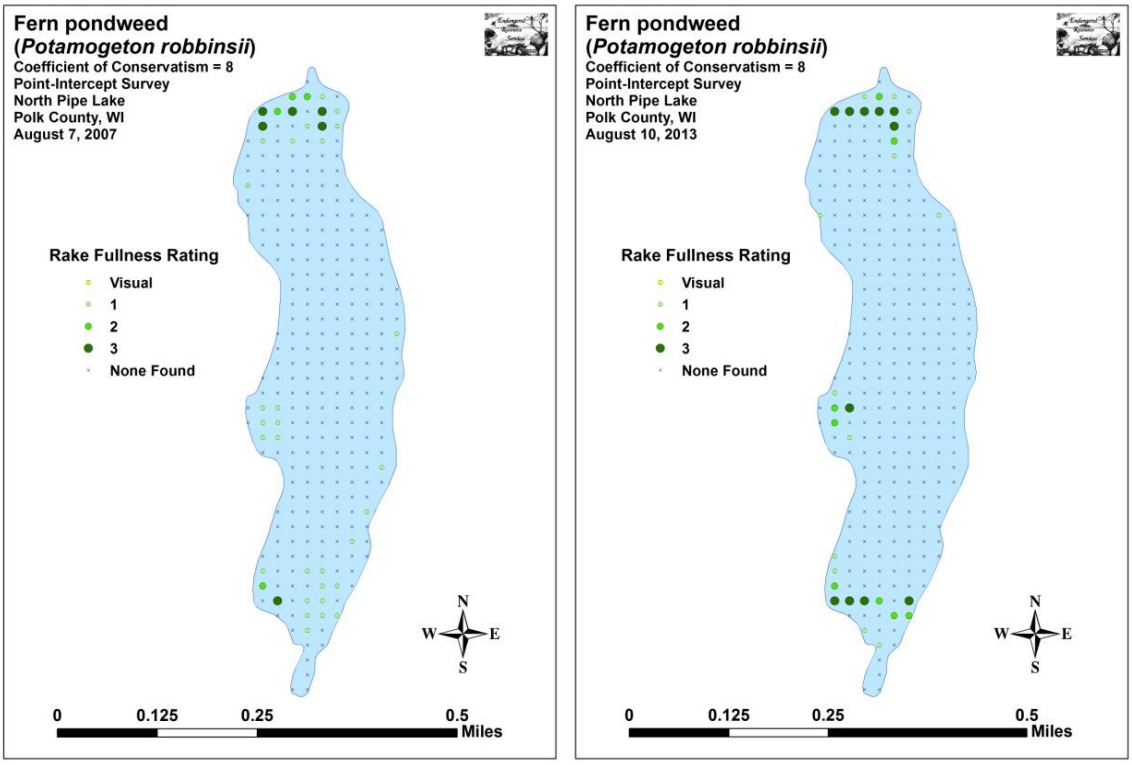


Figure 7: 2007 and 2013 Fern Pondweed Density and Distribution

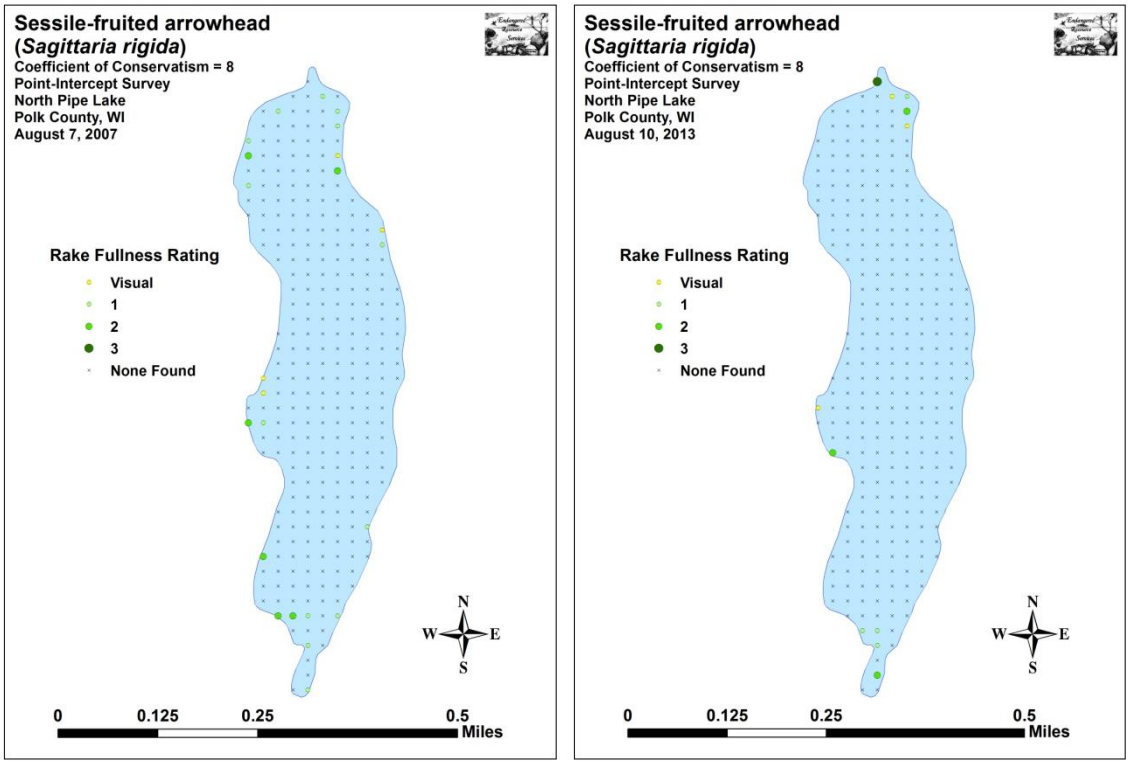


Figure 8: 2007 and 2013 Sessile-fruited Arrowhead Density and Distribution

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes
North Pipe Lake, Polk County
August 7, 2007

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Potamogeton robbinsii	Fern pondweed	39	14.94	45.88	27.46	1.41	0
Sagittaria rigida	Sessile-fruited arrowhead	19	7.28	22.35	13.38	1.32	4
Nymphaea odorata	White water lily	18	6.90	21.18	12.68	1.72	4
Eleocharis acicularis	Needle spikerush	17	6.51	20.00	11.97	1.41	1
	Filamentous algae	17	*	20.00	11.97	1.06	0
Brasenia schreberi	Watershield	15	5.75	17.65	10.56	1.93	3
Pontederia cordata	Pickerelweed	14	5.36	16.47	9.86	1.64	4
Nitella sp.	Nitella	13	4.98	15.29	9.15	1.15	0
Isoetes lacustris	Lake quillwort	12	4.60	14.12	8.45	1.33	2
Potamogeton spirillus	Spiral-fruited pondweed	12	4.60	14.12	8.45	1.25	1
Elatine minima	Waterwort	10	3.83	11.76	7.04	1.10	2
Utricularia vulgaris	Common bladderwort	9	3.45	10.59	6.34	1.11	3
	Aquatic moss	9	*	10.59	6.34	1.00	0
Najas flexilis	Slender naiad	8	3.07	9.41	5.63	1.00	0
Najas gracillima	Northern naiad	7	2.68	8.24	4.93	1.14	0
Potamogeton gramineus	Variable pondweed	7	2.68	8.24	4.93	1.43	0
Schoenoplectus purshianus	Pursh's bulrush	7	2.68	8.24	4.93	1.71	0
Nuphar variegata	Spatterdock	5	1.92	5.88	3.52	1.00	0
Potamogeton amplifolius	Large-leaf pondweed	5	1.92	5.88	3.52	1.60	1
Eleocharis ovata	Oval spikerush	4	1.53	4.71	2.82	1.25	0
Potamogeton epihydrus	Ribbon-leaf pondweed	4	1.53	4.71	2.82	2.00	1
Potamogeton pusillus	Small pondweed	4	1.53	4.71	2.82	1.00	0
Vallisneria americana	Wild celery	4	1.53	4.71	2.82	1.00	1
Juncus pelocarpus f. submersus	Brown-fruited rush	3	1.15	3.53	2.11	1.00	0

* Excluded from the Relative Frequency Calculation

Table 2 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
North Pipe Lake, Polk County
August 7, 2007

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Ceratophyllum echinatum	Spiny hornwort	2	0.77	2.35	1.41	1.00	1
Eleocharis obtusa	Blunt spikerush	2	0.77	2.35	1.41	1.00	0
Eleocharis palustris	Creeping spikerush	2	0.77	2.35	1.41	1.50	0
Leersia oryzoides	Rice cut-grass	2	0.77	2.35	1.41	1.00	0
Lemna minor	Small duckweed	2	0.77	2.35	1.41	1.00	0
Potamogeton bicupulatus	Snail-seed pondweed	2	0.77	2.35	1.41	1.00	0
Sparganium fluctuans	Floating-leaf bur-reed	2	0.77	2.35	1.41	1.00	1
Alisma triviale	Northern water-plantain	1	0.38	1.18	0.70	1.00	0
Cicuta bulbifera	Bulb-bearing water hemlock	1	0.38	1.18	0.70	1.00	0
Dulichium arundinaceum	Three-way sedge	1	0.38	1.18	0.70	1.00	1
Equisetum fluviatile	Water horsetail	1	0.38	1.18	0.70	1.00	1
Eriocaulon aquaticum	Pipewort	1	0.38	1.18	0.70	1.00	0
Lipocarpha micrantha	Small flowered hemicarpha	1	0.38	1.18	0.70	1.00	0
Phalaris arundinacea	Reed canary grass	1	0.38	1.18	0.70	2.00	0
Schoenoplectus tabernaemontani	Softstem bulrush	1	0.38	1.18	0.70	3.00	0
Sparganium emersum	Short-stemmed bur-reed	1	0.38	1.18	0.70	1.00	1
Spirodela polyrhiza	Large duckweed	1	0.38	1.18	0.70	1.00	0
Typha latifolia	Broad-leaved cattail	1	0.38	1.18	0.70	1.00	0

Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
North Pipe Lake, Polk County
August 10, 2013

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Potamogeton robbinsii	Fern pondweed	31	14.29	44.93	32.29	1.97	0
Nymphaea odorata	White water lily	23	10.60	33.33	23.96	1.87	7
	Filamentous algae	19	*	27.54	19.79	1.42	0
Phalaris arundinacea	Reed canary grass	14	6.45	20.29	14.58	1.64	8
Pontederia cordata	Pickerelweed	14	6.45	20.29	14.58	1.57	7
Brasenia schreberi	Watershield	13	5.99	18.84	13.54	2.08	5
Potamogeton pusillus	Small pondweed	11	5.07	15.94	11.46	1.36	1
Potamogeton gramineus	Variable pondweed	10	4.61	14.49	10.42	1.70	6
Potamogeton spirillus	Spiral-fruited pondweed	10	4.61	14.49	10.42	1.40	2
Eleocharis palustris	Creeping spikerush	8	3.69	11.59	8.33	2.25	3
Sagittaria latifolia	Common arrowhead	8	3.69	11.59	8.33	1.50	0
Sagittaria rigida	Sessile-fruited arrowhead	8	3.69	11.59	8.33	1.63	3
Potamogeton amplifolius	Large-leaf pondweed	6	2.76	8.70	6.25	1.00	1
Dulichium arundinaceum	Three-way sedge	5	2.30	7.25	5.21	1.40	5
Utricularia vulgaris	Common bladderwort	5	2.30	7.25	5.21	1.00	3
Equisetum fluviatile	Water horsetail	4	1.84	5.80	4.17	1.50	2
Isoetes lacustris	Lake quillwort	4	1.84	5.80	4.17	1.25	0
Potamogeton epihydrus	Ribbon-leaf pondweed	4	1.84	5.80	4.17	1.00	0
Typha latifolia	Broad-leaved cattail	4	1.84	5.80	4.17	1.75	3
Utricularia gibba	Creeping bladderwort	4	1.84	5.80	4.17	1.00	0
Vallisneria americana	Wild celery	4	1.84	5.80	4.17	1.25	0
Glyceria borealis	Northern manna grass	3	1.38	4.35	3.13	1.00	3
Najas gracillima	Northern naiad	3	1.38	4.35	3.13	1.00	0
Riccia fluitans	Slender riccia	3	*	4.35	3.13	1.00	0

* Excluded from the Relative Frequency Calculation

Table 3 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
North Pipe Lake, Polk County
August 10, 2013

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Sparganium fluctuans	Floating-leaf bur-reed	3	1.38	4.35	3.13	1.67	2
Ceratophyllum echinatum	Spiny hornwort	2	0.92	2.90	2.08	1.00	1
Elatine minima	Waterwort	2	0.92	2.90	2.08	1.00	1
Leersia oryzoides	Rice cut-grass	2	0.92	2.90	2.08	1.00	0
Najas flexilis	Slender naiad	2	0.92	2.90	2.08	1.50	0
Nuphar variegata	Spatterdock	2	0.92	2.90	2.08	2.50	0
Utricularia minor	Small bladderwort	2	0.92	2.90	2.08	1.00	1
	Aquatic moss	2	*	2.90	2.08	1.00	0
Bolboschoenus fluviatilis	River bulrush	1	0.46	1.45	1.04	2.00	1
Eleocharis erythropoda	Bald spikerush	1	0.46	1.45	1.04	1.00	0
Lemna minor	Small duckweed	1	0.46	1.45	1.04	1.00	1
Nitella sp.	Nitella	1	0.46	1.45	1.04	2.00	0
Ricciocarpus natans	Purple-fringed riccia	1	*	1.45	1.04	1.00	0
Schoenoplectus acutus	Hardstem bulrush	1	0.46	1.45	1.04	1.00	1
Sparganium emersum	Short-stemmed bur-reed	1	0.46	1.45	1.04	1.00	2
Myriophyllum farwellii	Farwell's water-milfoil	**	**	**	**	**	1
Schoenoplectus tabernaemontani	Softstem bulrush	**	**	**	**	**	1
Schoenoplectus torreyi	Torrey's three-square bulrush	**	**	**	**	**	1
Carex utriculata	Common yellow lake sedge	***	***	***	***	***	***
Eleocharis acicularis	Needle spikerush	***	***	***	***	***	***

* Excluded from the Relative Frequency Calculation ** Visual Only *** Boat Survey Only

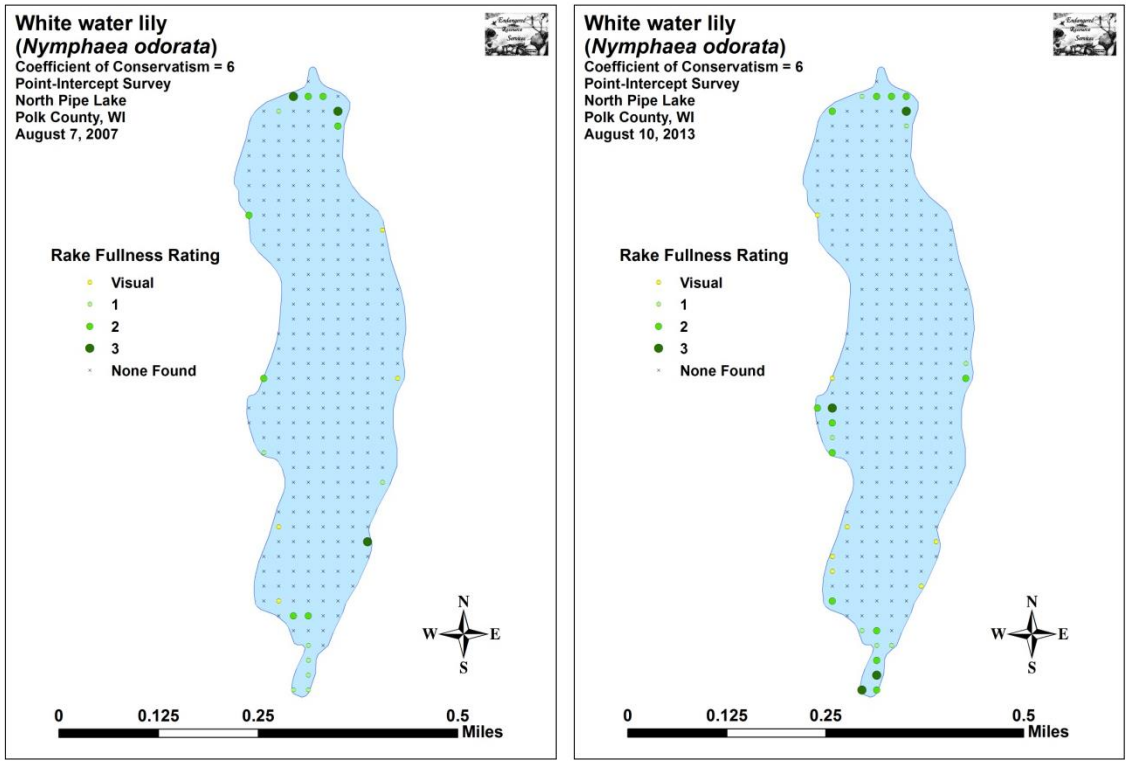


Figure 9: 2007 and 2013 White Water Lily Density and Distribution

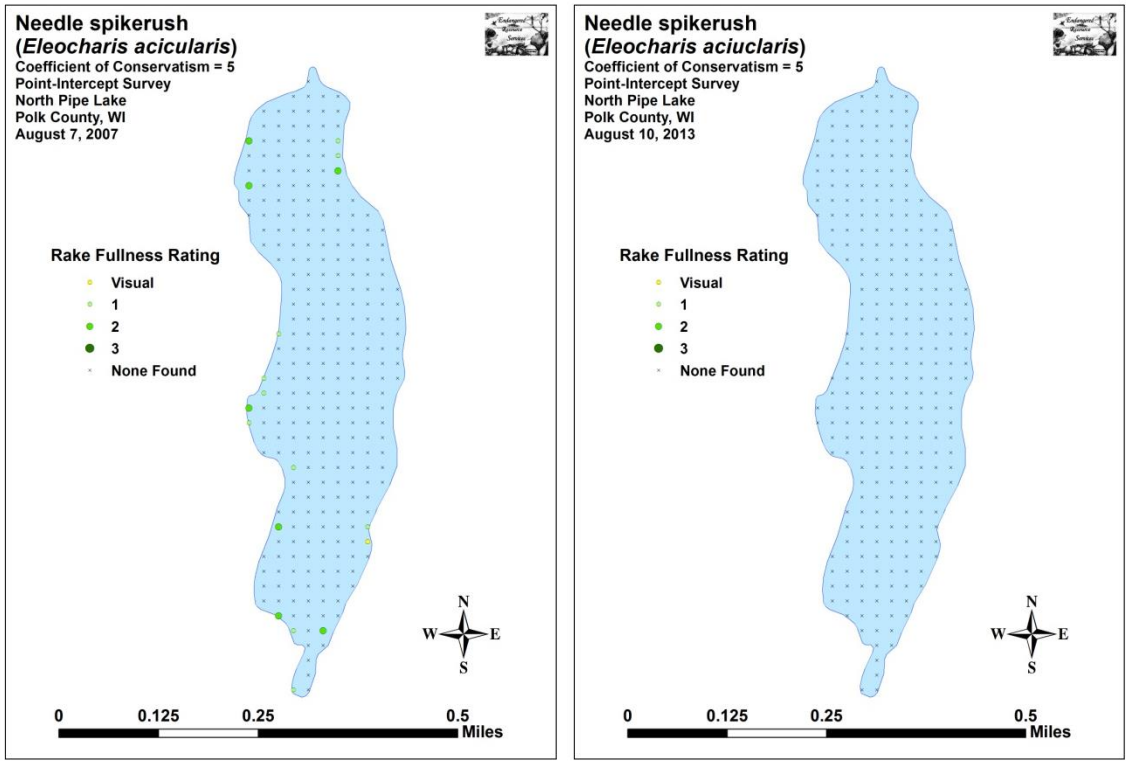
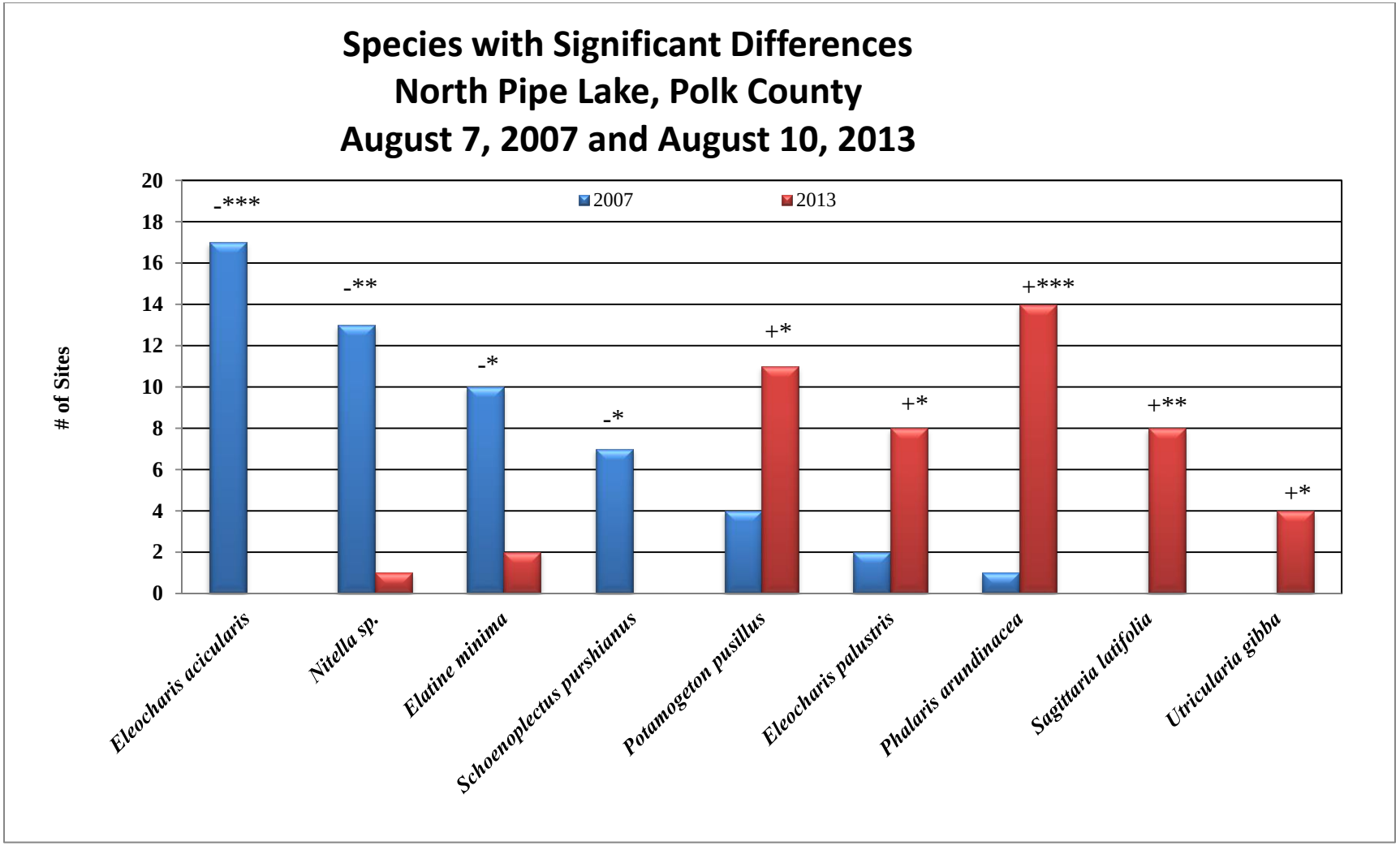


Figure 10: 2007 and 2013 Needle Spikerush Density and Distribution

In addition to the previously mentioned highly significant decline in Needle spikerush, Nitella showed a moderately significant decline (Figure 11). This species normally grows at the edge of the littoral zone, and it is again possible that rising water levels or a change in water clarity impacted this species. We also noted significant declines in Waterwort and Pursh's bulrush (*Schoenoplectus purshianus*). Both of these species were found in very shallow water over sandy muck in 2007 – areas that were now too deep to support them in 2013.

With change comes opportunity, and we noted five species significant expanded their ranges by taking advantage of new habitats created by the rising water. They included a highly significant increase in Reed canary grass which initially colonized the barren drying shoreline during the drought years, but was still hanging on after the water rose; a moderately significant increase in Common arrowhead – an emergent that can grow in or out of the water and was able to expand into organic muck bottom areas along the shoreline; and significant increases in Small pondweed, Creeping spikerush, and Creeping bladderwort (*Utricularia gibba*). All three of these species can reproduce vegetatively as well as by seeds and they seem to have gotten a jump on their neighbors in reestablishing/expanding with the changing water levels (Figure 11).



Significant differences = * p<.05, ** p<.01, *** p<.005

Figure 11: Species with Significant Differences from 2007-2013

Comparison of Filamentous Algae in 2007 an 2013:

Filamentous algae, normally associated with excessive nutrients in the water column, were located at 19 survey points with a mean rake fullness of 1.42– up from 17 points and a mean rake of 1.06 in 2007 (Figure 12). Most sites with algae were located over the most nutrient rich sediment areas in the lake. This suggests to us that nutrient recycling from these sediments, and/or the lake's limited rooted plant growth, may be partially to blame. We did not find any evidence of point-source algae in front of residences.

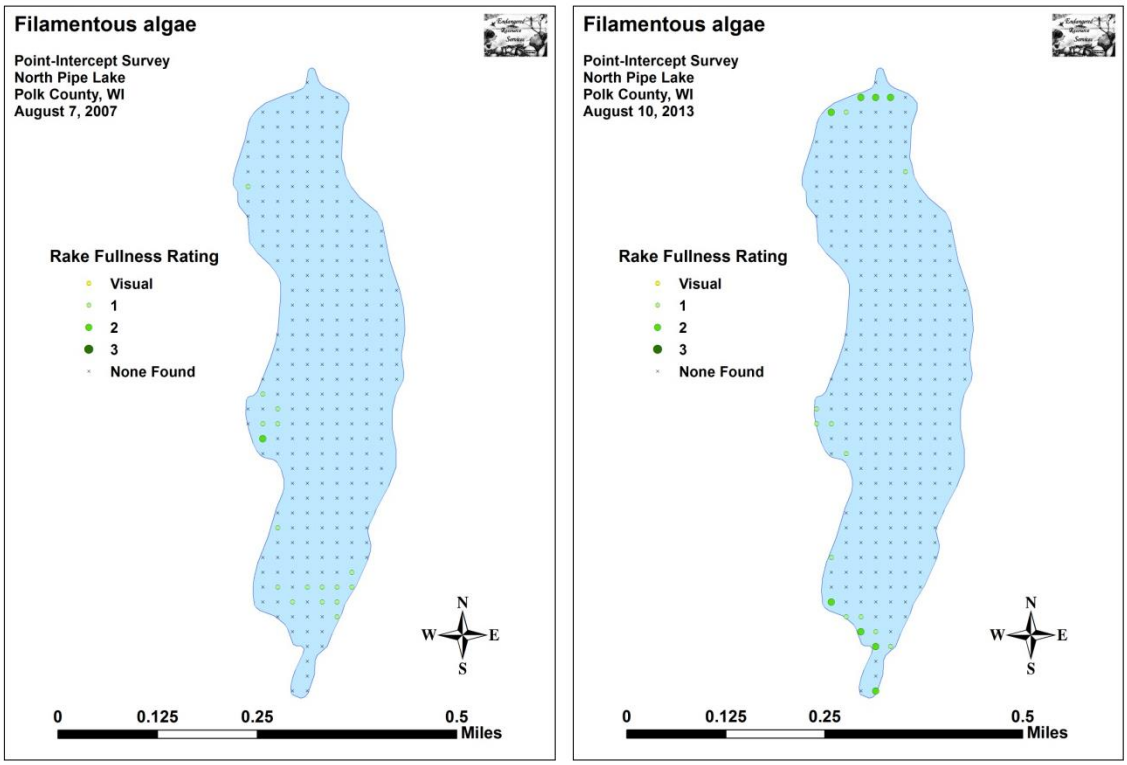


Figure 12: 2007 and 2013 Filamentous Algae Density and Distribution

Comparison of Floristic Quality Indexes in 2007 and 2013:

In 2007, we identified a total of 33 **native index species** in the rake during the point-intercept survey (Table 4). They produced a mean Coefficient of Conservatism of 6.9 and a Floristic Quality Index of 39.7.

In 2013, we identified a total of 34 **native index plants** on the rake during the point-intercept survey. They produced a mean Coefficient of Conservatism of 6.9 and a Floristic Quality Index of 40.5 (Table 5). Nichols (1999) reported an average Mean C for the Northern Central Hardwood Forests Region of 5.6 putting North Pipe Lake well above average for this part of the state. The FQI was also nearly double the median of 20.9 for the Northern Central Hardwood Forests Region (Nichols 1999). Extremely high value species of note included Spiny hornwort (C = 10), Three-way sedge (C = 9), Waterwort (C = 9), Floating-leaf bur-reed (C = 10), Creeping bladderwort (C = 10), and Small bladderwort (*Utricularia minor*) (C = 10). Torrey's three-square bulrush (C = 9), another high value species found, is not part of the index.

Table 4: Floristic Quality Index of Aquatic Macrophytes
North Pipe Lake, Polk County
August 7, 2007

Species	Common Name	C
Alisma triviale	Northern water-plantain	4
Brasenia schreberi	Watershield	6
Ceratophyllum echinatum	Spiny hornwort	10
Dulichium arundinaceum	Three-way sedge	9
Elatine minima	Waterwort	9
Eleocharis acicularis	Needle spikerush	5
Eleocharis palustris	Creeping spikerush	6
Equisetum fluviatile	Water horsetail	7
Eriocaulon aquaticum	Pipewort	9
Isoetes lacustris	Lake quillwort	8
Juncus pelocarpus f. submersus	Brown-fruited rush	8
Lemna minor	Small duckweed	4
Najas flexilis	Slender naiad	6
Najas gracillima	Northern naiad	7
Nitella sp.	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Pontederia cordata	Pickerelweed	8
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton bicupulatus	Snail-seed pondweed	9
Potamogeton epihydrus	Ribbon-leaf pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton pusillus	Small pondweed	7
Potamogeton robbinsii	Fern pondweed	8
Potamogeton spirillus	Spiral-fruited pondweed	8
Sagittaria rigida	Sessile-fruited arrowhead	8
Schoenoplectus tabernaemontani	Softstem bulrush	4
Sparganium emersum	Short-stemmed bur-reed	8
Sparganium fluctuans	Floating-leaf bur-reed	10
Spirodela polyrhiza	Large duckweed	5
Typha latifolia	Broad-leaved cattail	1
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
N		**33**
Mean C		**6.9**
FQI		**39.7**

Table 5: Floristic Quality Index of Aquatic Macrophytes
North Pipe Lake, Polk County
August 10, 2013

Species	Common Name	C
Bolboschoenus fluviatilis	River bulrush	6
Brasenia schreberi	Watershield	6
Ceratophyllum echinatum	Spiny hornwort	10
Dulichium arundinaceum	Three-way sedge	9
Elatine minima	Waterwort	9
Eleocharis erythropoda	Bald spikerush	3
Eleocharis palustris	Creeping spikerush	6
Equisetum fluviatile	Water horsetail	7
Glyceria borealis	Northern manna grass	8
Isoetes lacustris	Lake quillwort	8
Lemna minor	Small duckweed	4
Najas flexilis	Slender naiad	6
Najas gracillima	Northern naiad	7
Nitella sp.	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Pontederia cordata	Pickerelweed	8
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton epihydrus	Ribbon-leaf pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton pusillus	Small pondweed	7
Potamogeton robbinsii	Fern pondweed	8
Potamogeton spirillus	Spiral-fruited pondweed	8
Riccia fluitans	Slender riccia	7
Sagittaria latifolia	Common arrowhead	3
Sagittaria rigida	Sessile-fruited arrowhead	8
Schoenoplectus acutus	Hardstem bulrush	6
Sparganium emersum	Short-stemmed bur-reed	8
Sparganium fluctuans	Floating-leaf bur-reed	10
Typha latifolia	Broad-leaved cattail	1
Utricularia gibba	Creeping bladderwort	9
Utricularia minor	Small bladderwort	10
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
N		**34**
Mean C		**6.9**
FQI		**40.5**

Exotic Species:

Reed canary grass was the only exotic species found (Figure 13). It was often a dominant plant at and just beyond the lakeshore where it has colonized extensive patches in the wetlands adjacent to the north/west bays, next to mowed and otherwise disturbed shorelines, and around the channel to Pipe Lake (Figure 14). A ubiquitous plant in the state, there's likely little that can be done about it other than minimizing its ability to spread by maintaining native shoreline vegetation.

Figure 13: Reed Canary Grass in the Channel Between the Lakes

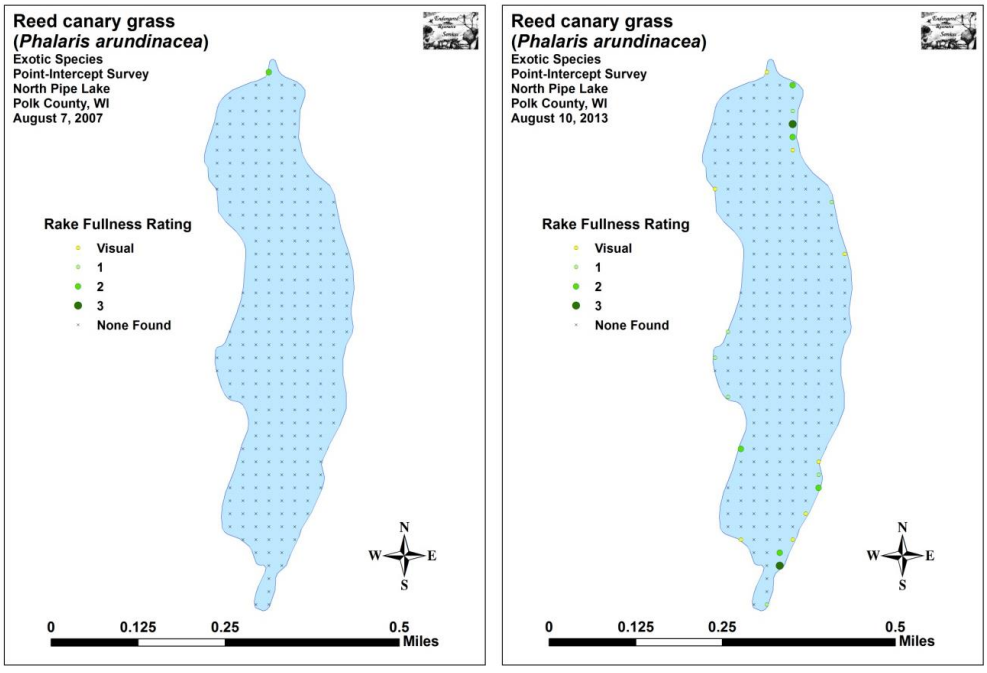


Figure 14: 2007 and 2013 Reed Canary Grass Density and Distribution

EWM Visible Littoral Zone Surveys:

Following the point-intercept survey in August and again in October, we searched the entire visible littoral zone of the lake. No sign of EWM or any other new aquatic exotic species was found during any of these surveys.

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:

Native Aquatic Macrophytes:

Aquatic plants are the basis of a lake's ecosystem and are as important to the aquatic environment as trees are to a forest. They provide habitat for fish and other aquatic organisms, serve as food sources for waterfowl and other wildlife, stabilize the shoreline, and work to improve clarity by absorbing excess nutrients from the water. Because of this, preserving them, especially the floating-leaf beds of lilypads and the emergent beds of bulrushes and spikerushes which provide critical spawning and nursery habitat for the lake's fish, should be a top priority for all lake residents.

The North Pipe Lake ecosystem, based on the many species of rare and sensitive plants present, is in excellent condition. That so many high index species call the lake home suggests a history of conservation and stewardship by lakeshore residents. During our time on the lake, we noted that the majority of residents are employing sound shoreline practices. We also consistently noticed that property owners who maintained their native shoreline vegetation tended to have healthy populations of these sensitive, desirable, and habitat-producing aquatic plants directly out from their residences, while the few areas with disturbed shorelines often did not. Hopefully, a greater understanding by all residents of the role plants play in the overall health of a lake will allow North Pipe Lake to continue being what it currently is – an ecologically diverse and healthy lake.

Eurasian Water Milfoil:

Eurasian water milfoil has now expanded into seven nearby lakes in Polk and Barron Counties, and all of them have public landings with significant in/out boat traffic. With that in mind, any suspicious looking plants found should be investigated to determine species. If any lake resident or boater discovers a plant they even suspect may be EWM, they are invited to contact Matthew Berg, ERS, LLC Research Biologist at (715) 338-7502 saintcroixdfly@gmail.com and/or Pamela Toshner/Alex Smith, Regional Lakes Management Coordinators in the Spooner DNR office at 715-635-4073 for identification confirmation. If possible, a specimen, a jpg, and the accompanying GPS coordinates of the location it was found at should be included.

Although individual awareness is important, we also encourage the PLPRD to continue their established Clean Boats/Clean Waters Program. In addition to the education CB/CW workers offer, the physical checking of incoming/outgoing watercraft provides an important safeguard for the lake. Continuation of monthly transect surveys near the lake's boat landings throughout the growing season and at least one annual meandering shoreline survey could also improve the chances of early detection if EWM or another Aquatic Invasive Species is introduced into the lake. In general, the sooner an infestation is detected, the greater the chances it can be successfully and economically controlled.

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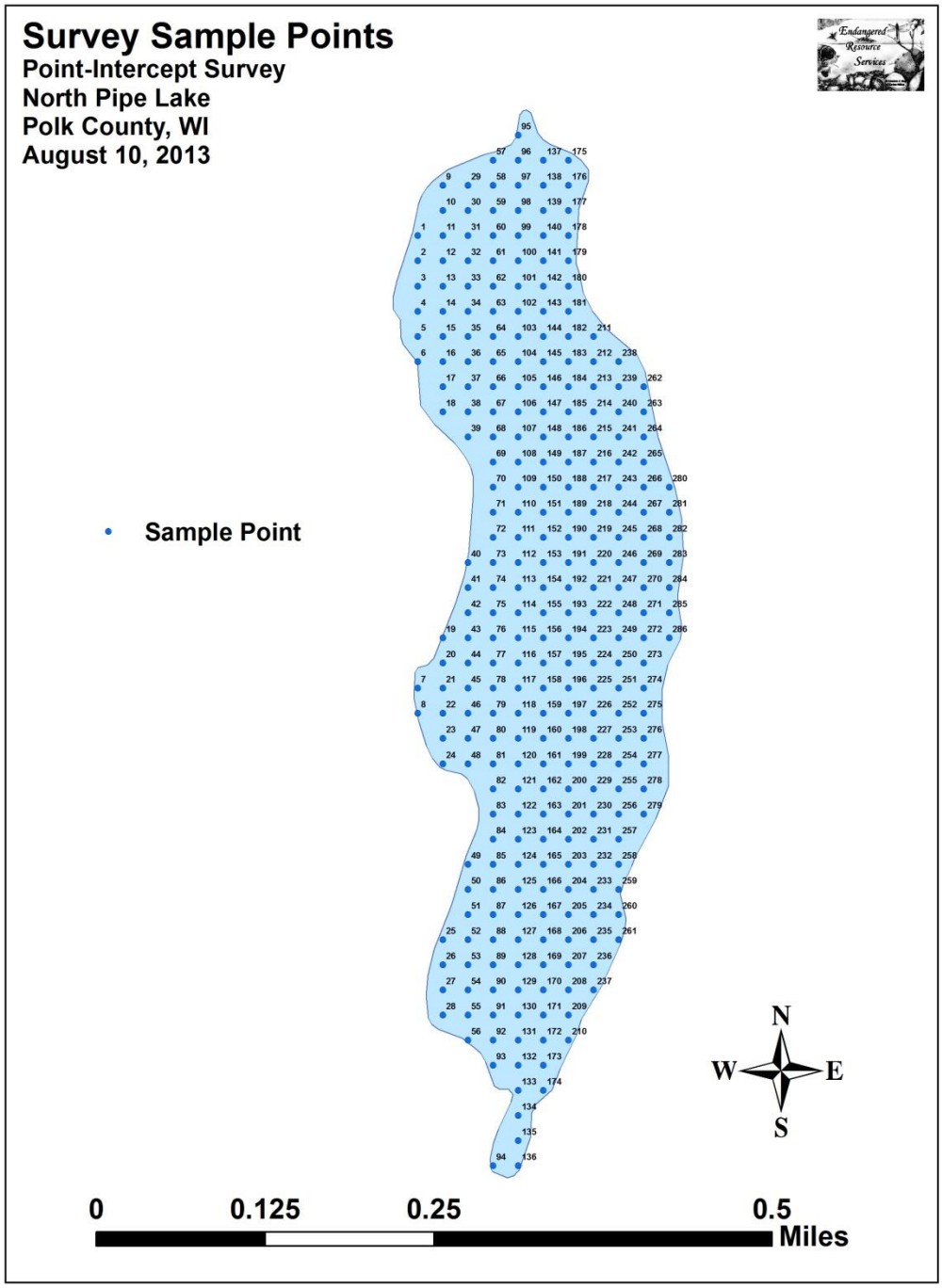
Appendix I: North Pipe Lake Survey Sample Points Map

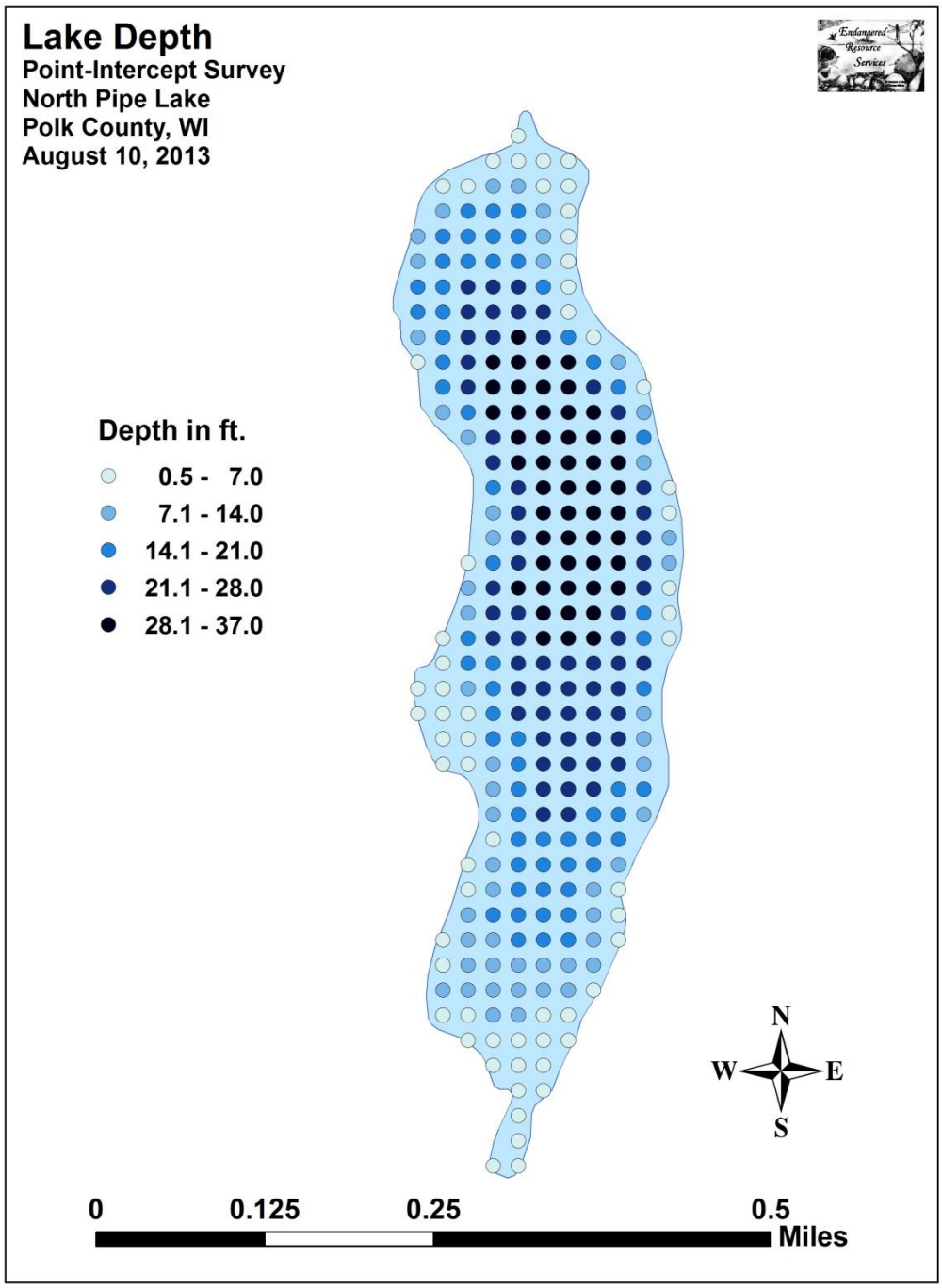

Survey Sample Points
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Sample Point
N
W
E
S
0
0.125
0.25
0.5
Miles

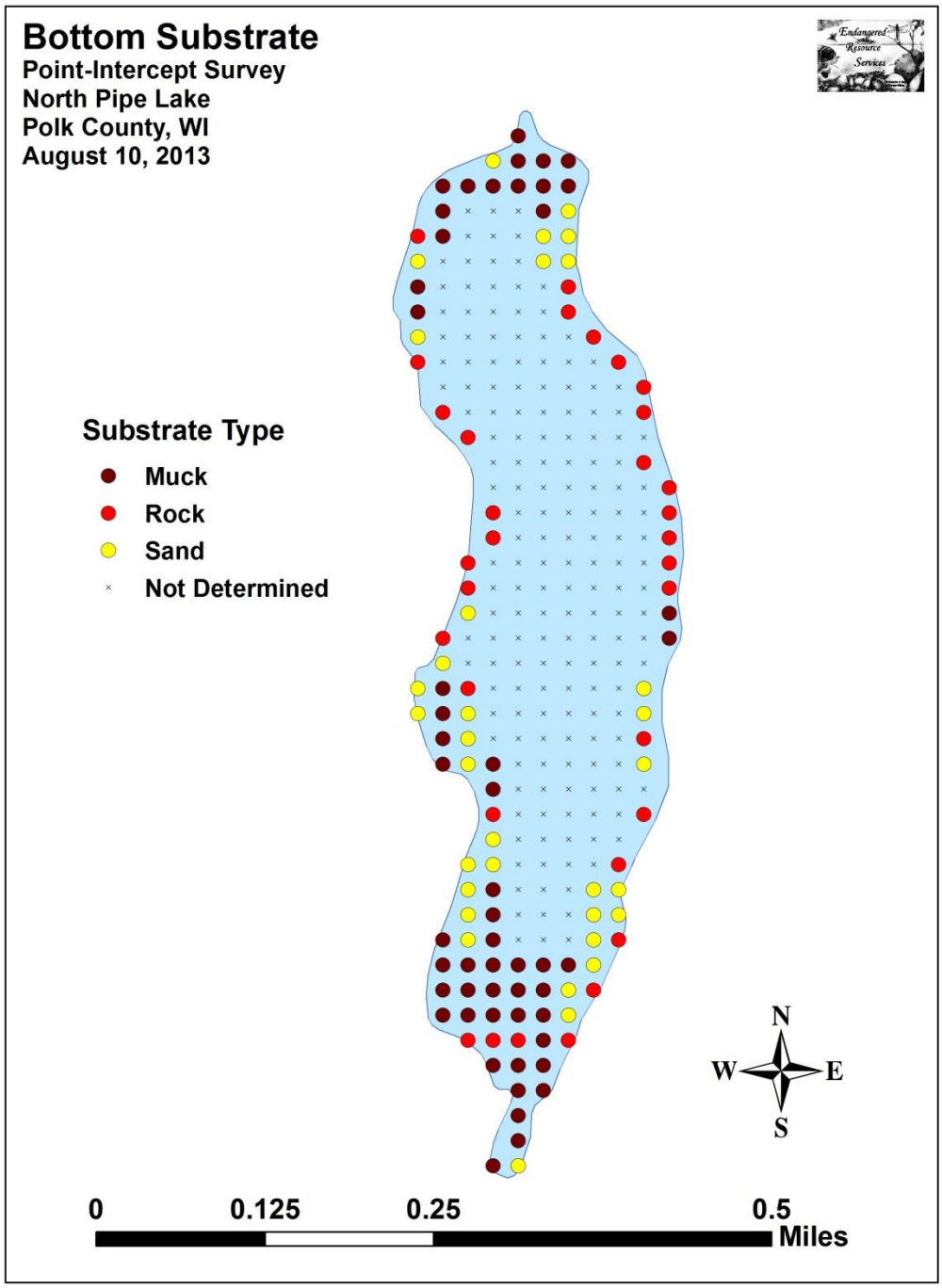
Appendix II: Boat and Vegetative Survey Data Sheets

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

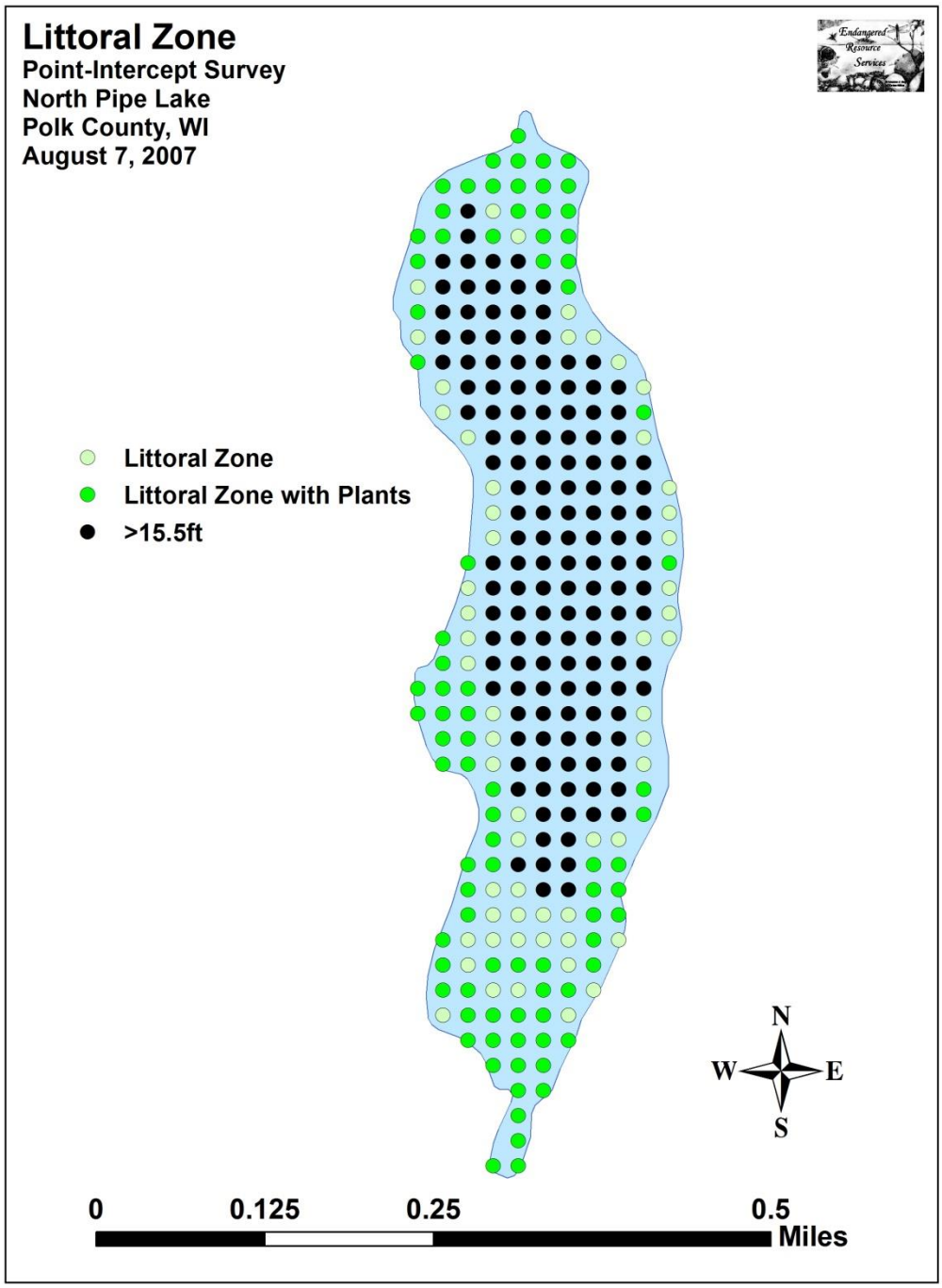
Observers for this lake: names and hours worked by each:																										
Lake:									WBIC									County						Date:	
Site #	Depth (ft)	Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	Total Rake Fullness	EWM	CLP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1																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

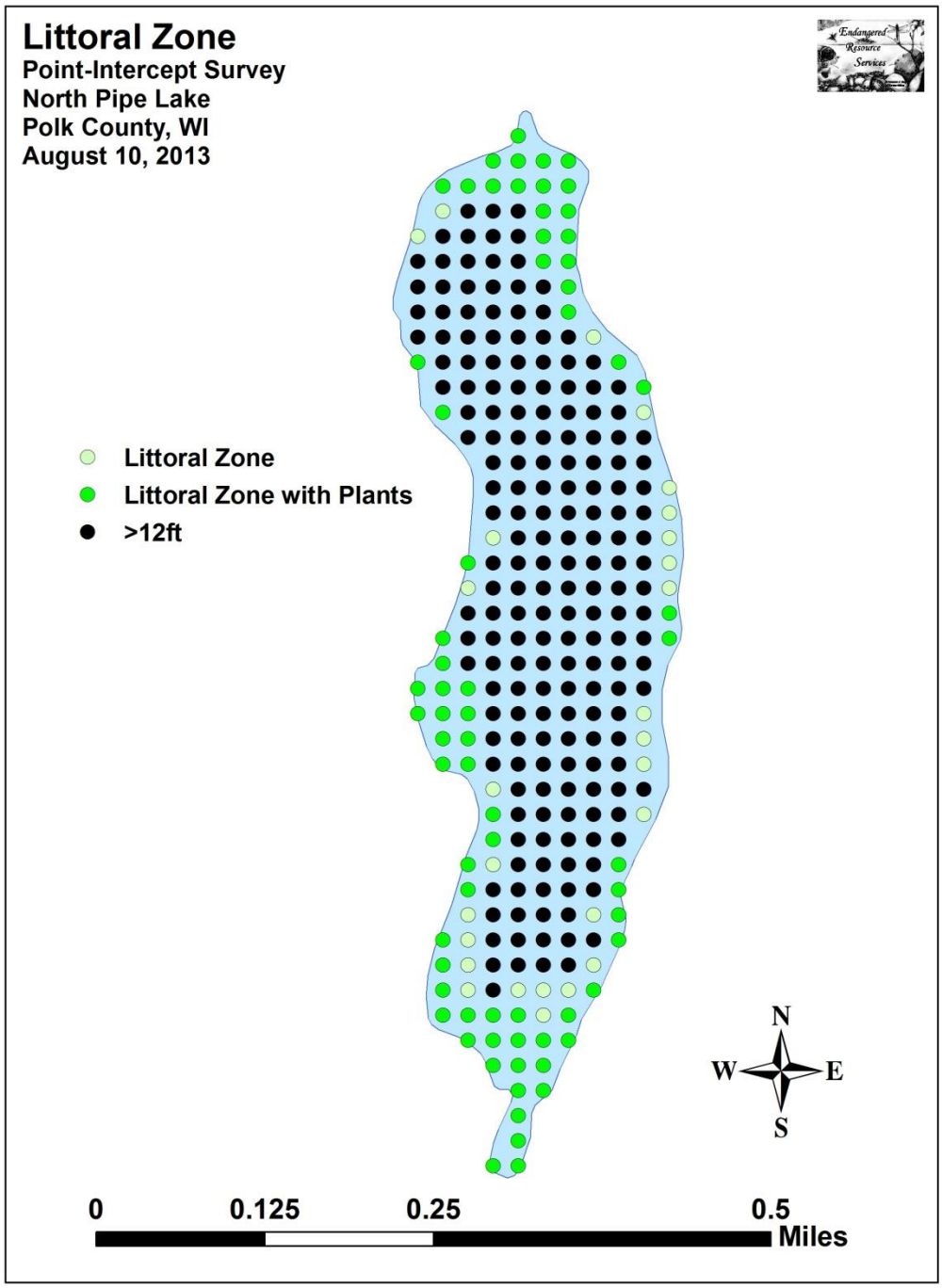
Appendix III: Habitat Variable Maps

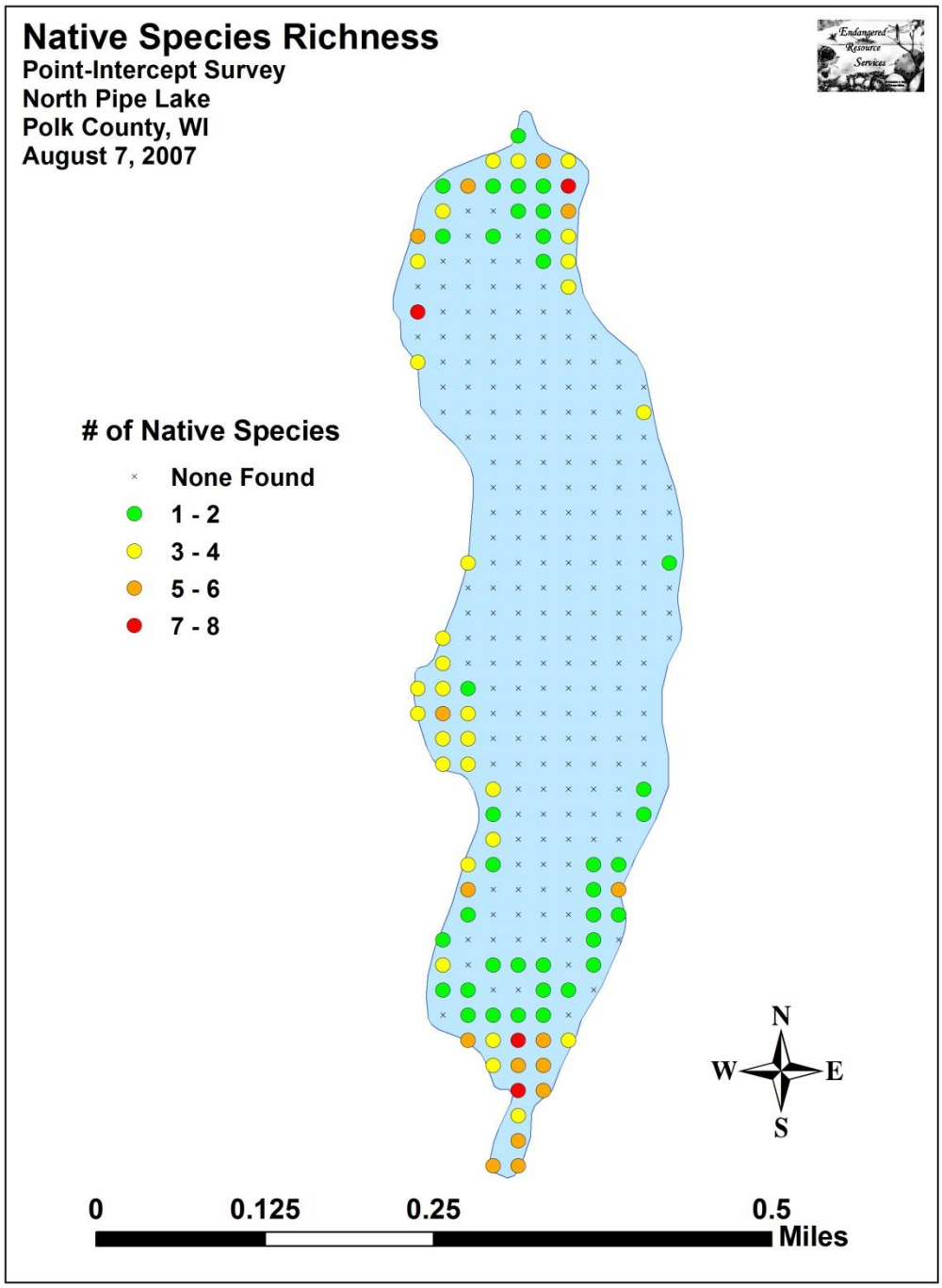

Lake Depth
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Depth in ft.
0.5 - 7.0
7.1 - 14.0
14.1 - 21.0
21.1 - 28.0
28.1 - 37.0
N
W
E
S
0
0.125
0.25
0.5
Miles

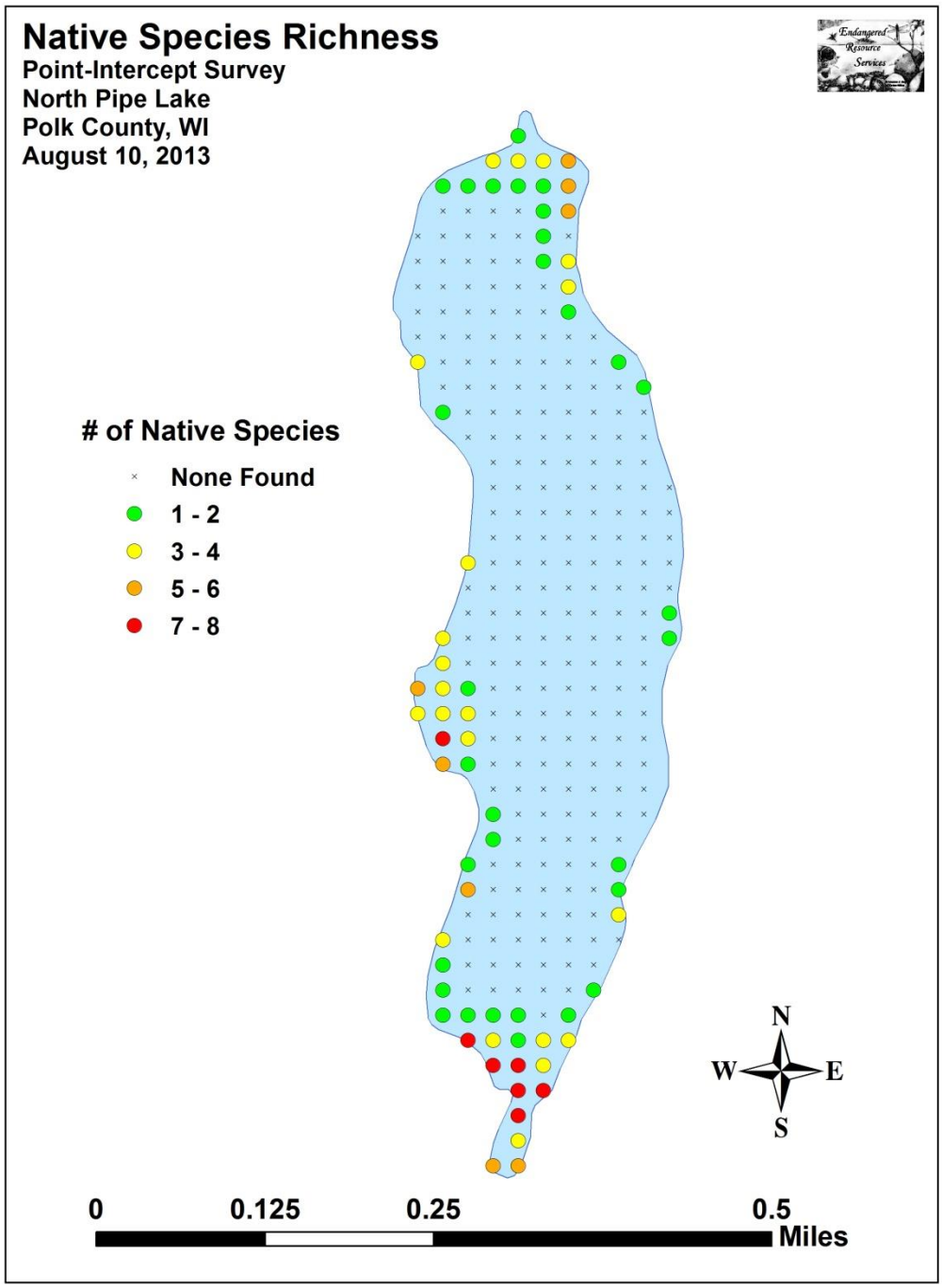

Bottom Substrate
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Substrate Type
Muck
Rock
Sand
Not Determined
N
W
E
S
0
0.125
0.25
0.5
Miles

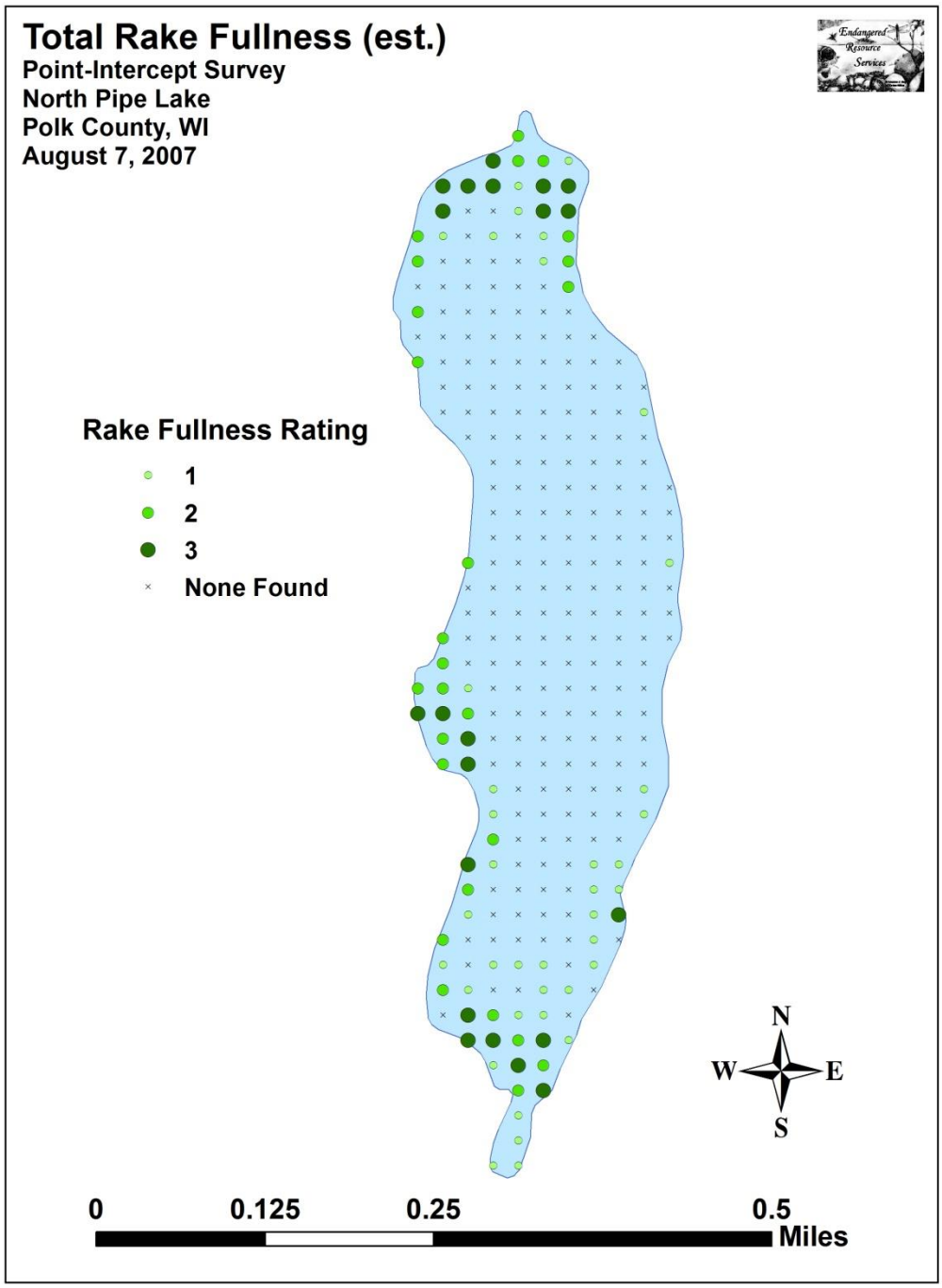
Appendix IV: 2007 and 2013 Littoral Zone, Native Species Richness and Total Rake Fullness Maps

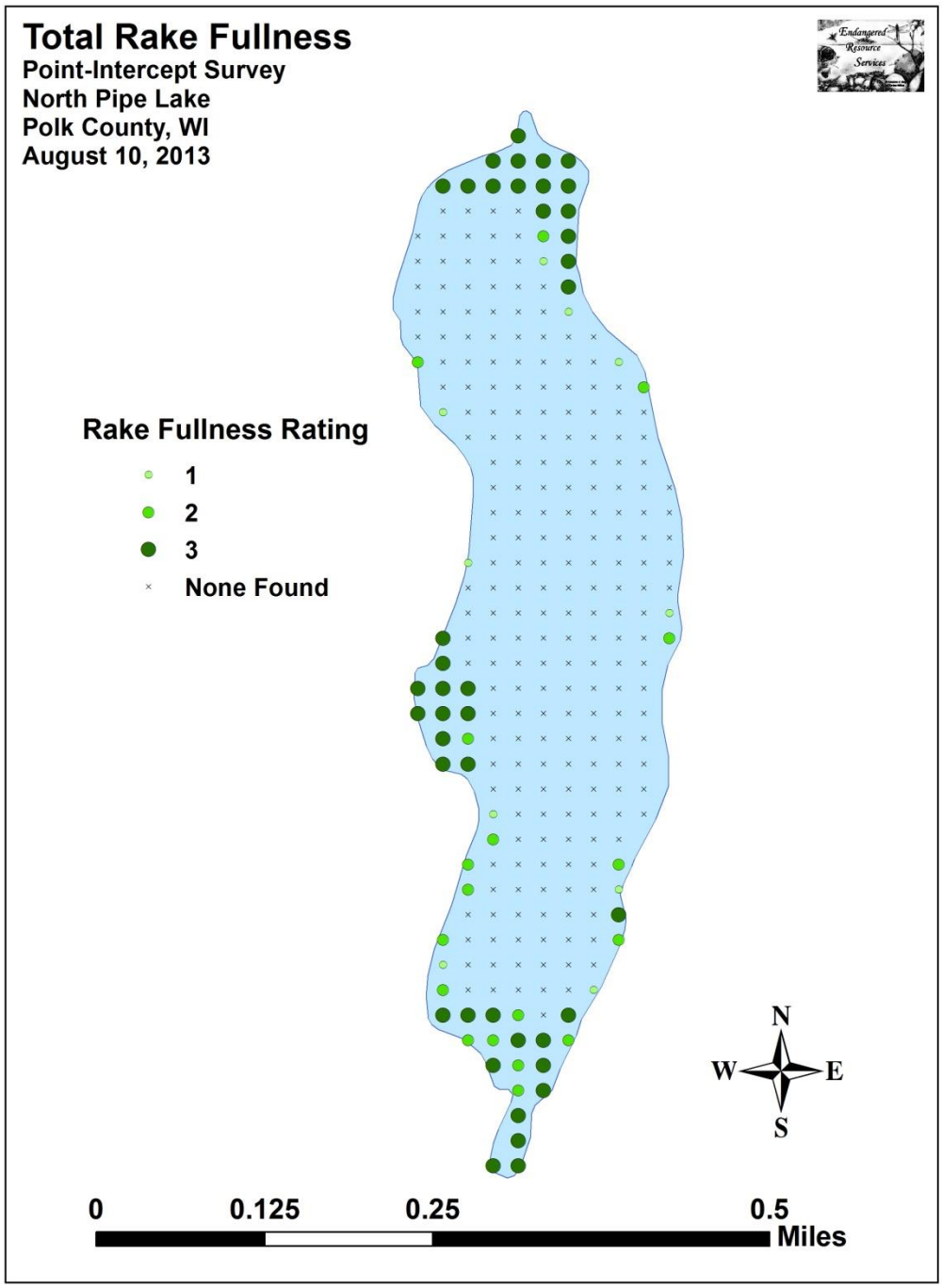

Littoral Zone
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Littoral Zone
Littoral Zone with Plants
>15.5ft
N
W
E
S
0
0.125
0.25
0.5
Miles


Littoral Zone
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Littoral Zone
Littoral Zone with Plants
>12ft
N
W
E
S
0
0.125
0.25
0.5
Miles

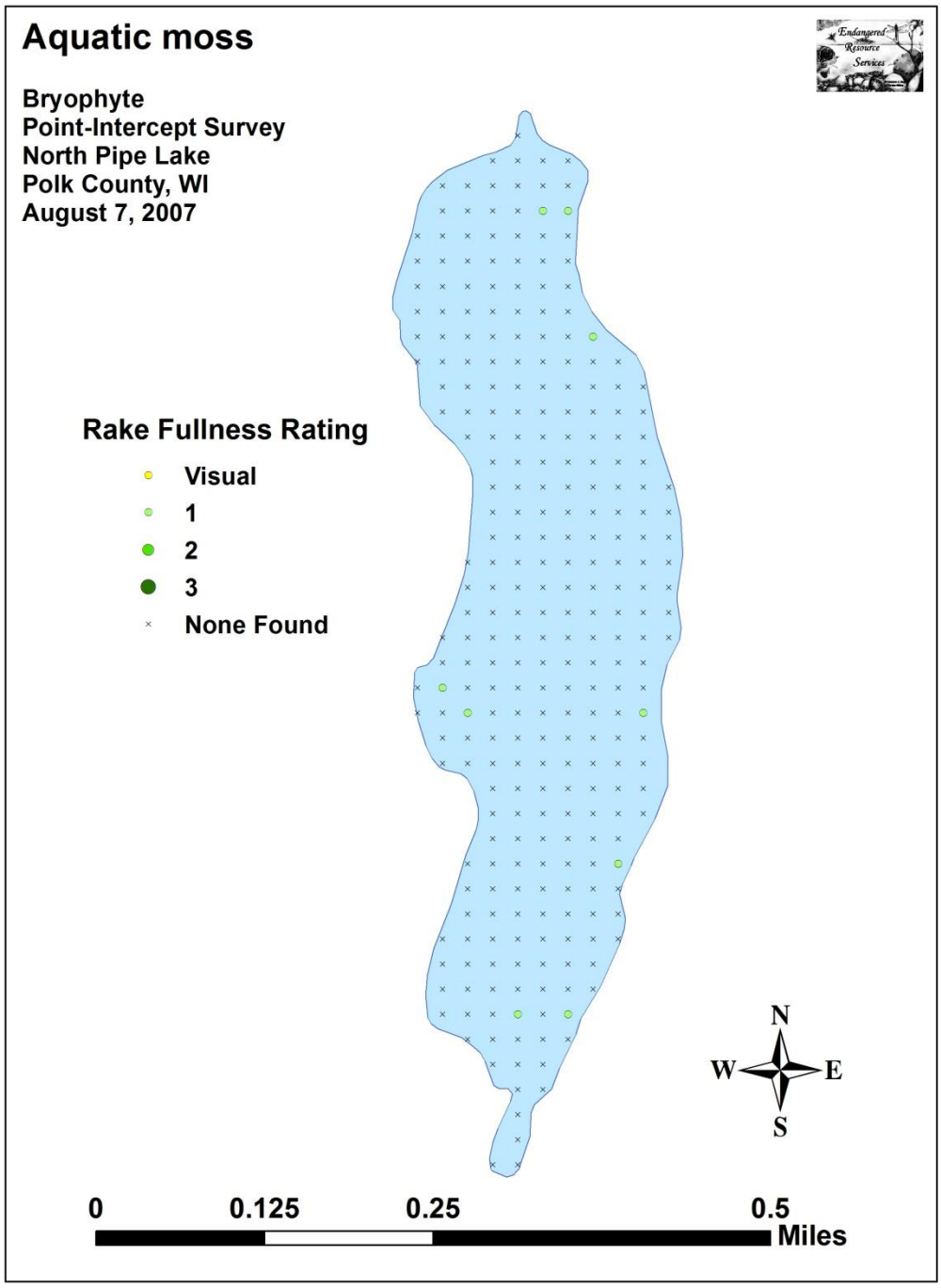

Native Species Richness
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 8
N
W
E
S
0
0.125
0.25
0.5
Miles

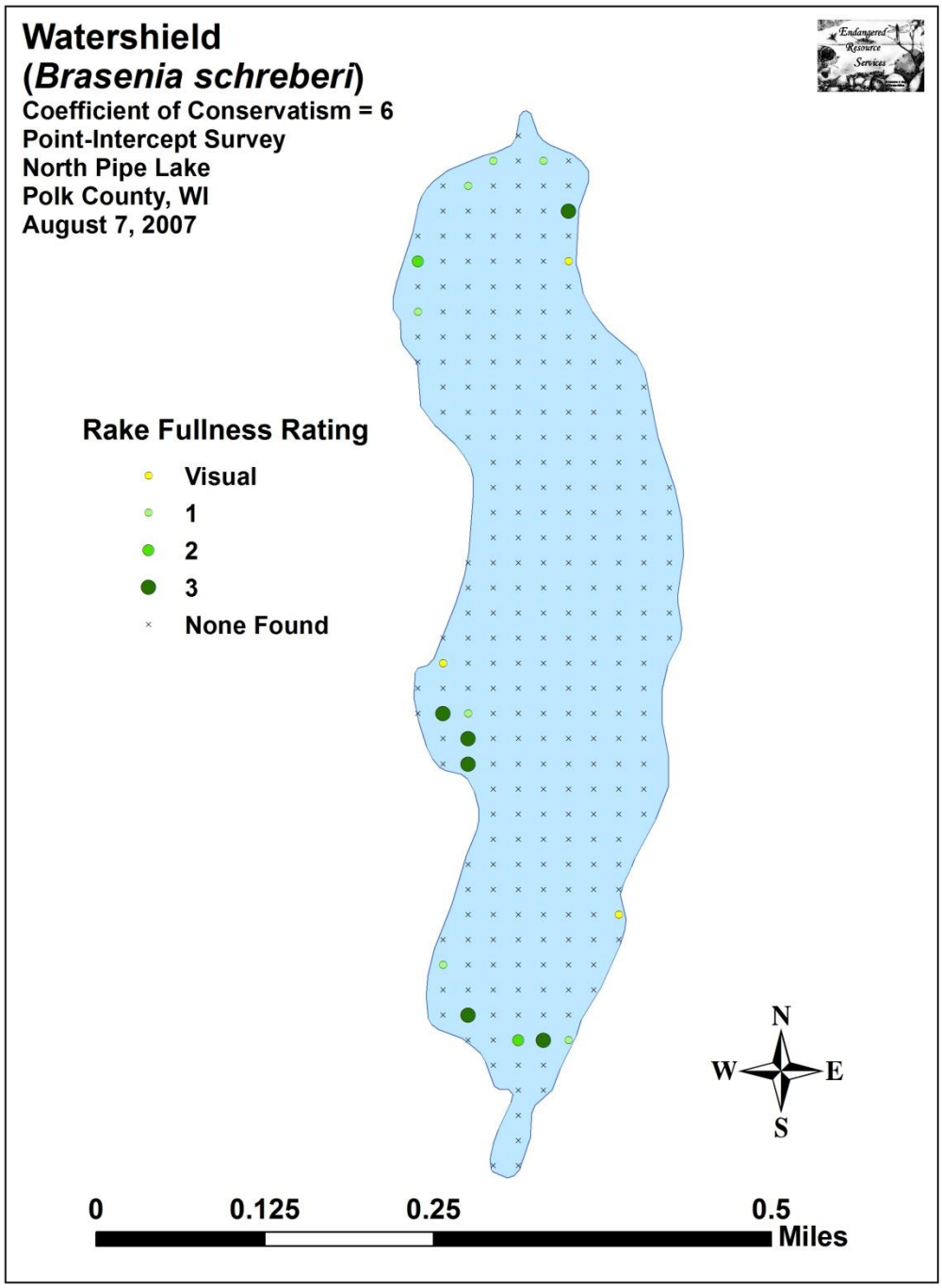

Native Species Richness
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 8
N
W
E
S
0
0.125
0.25
0.5
Miles

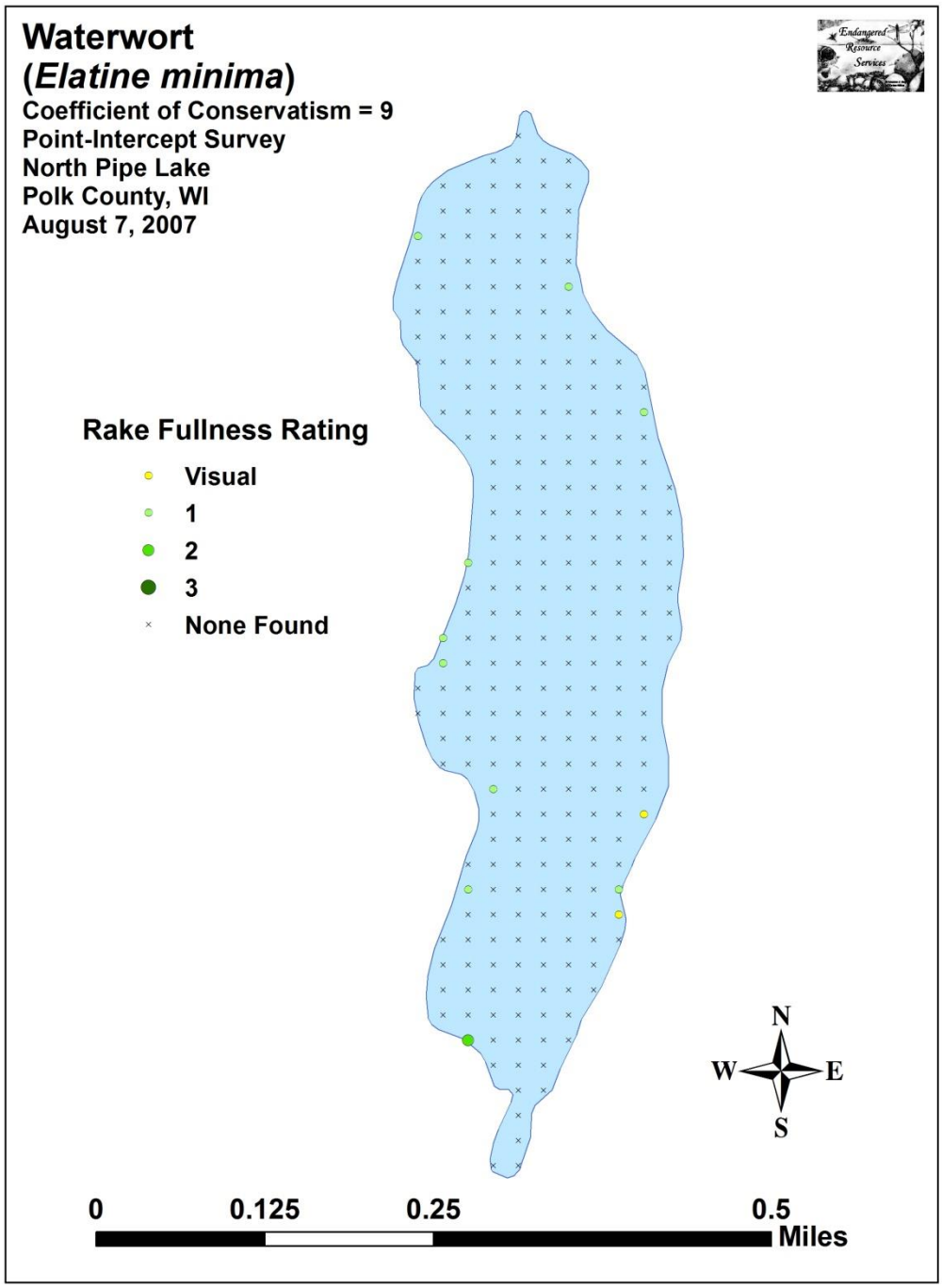

Total Rake Fullness (est.)
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

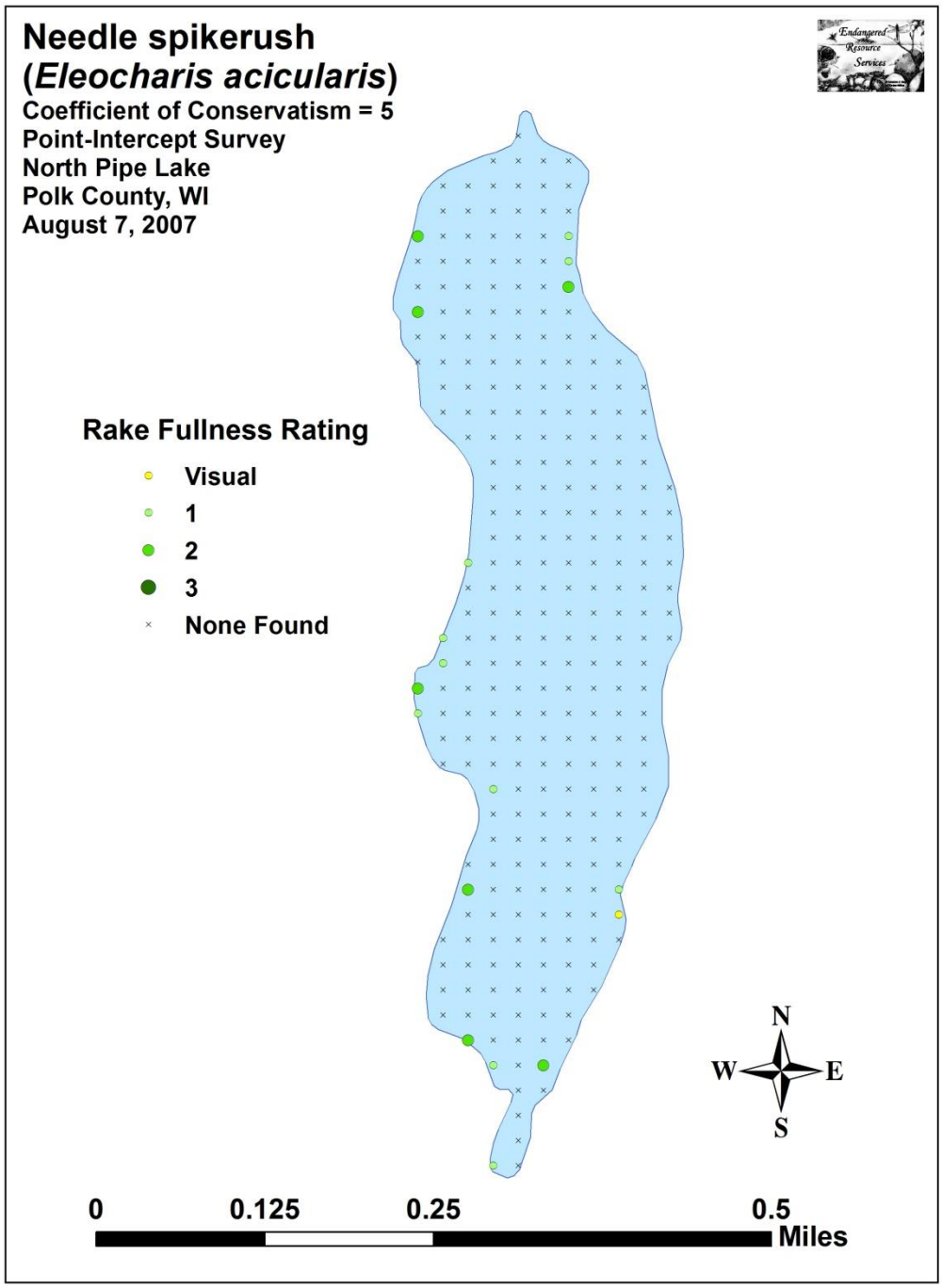

Total Rake Fullness
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

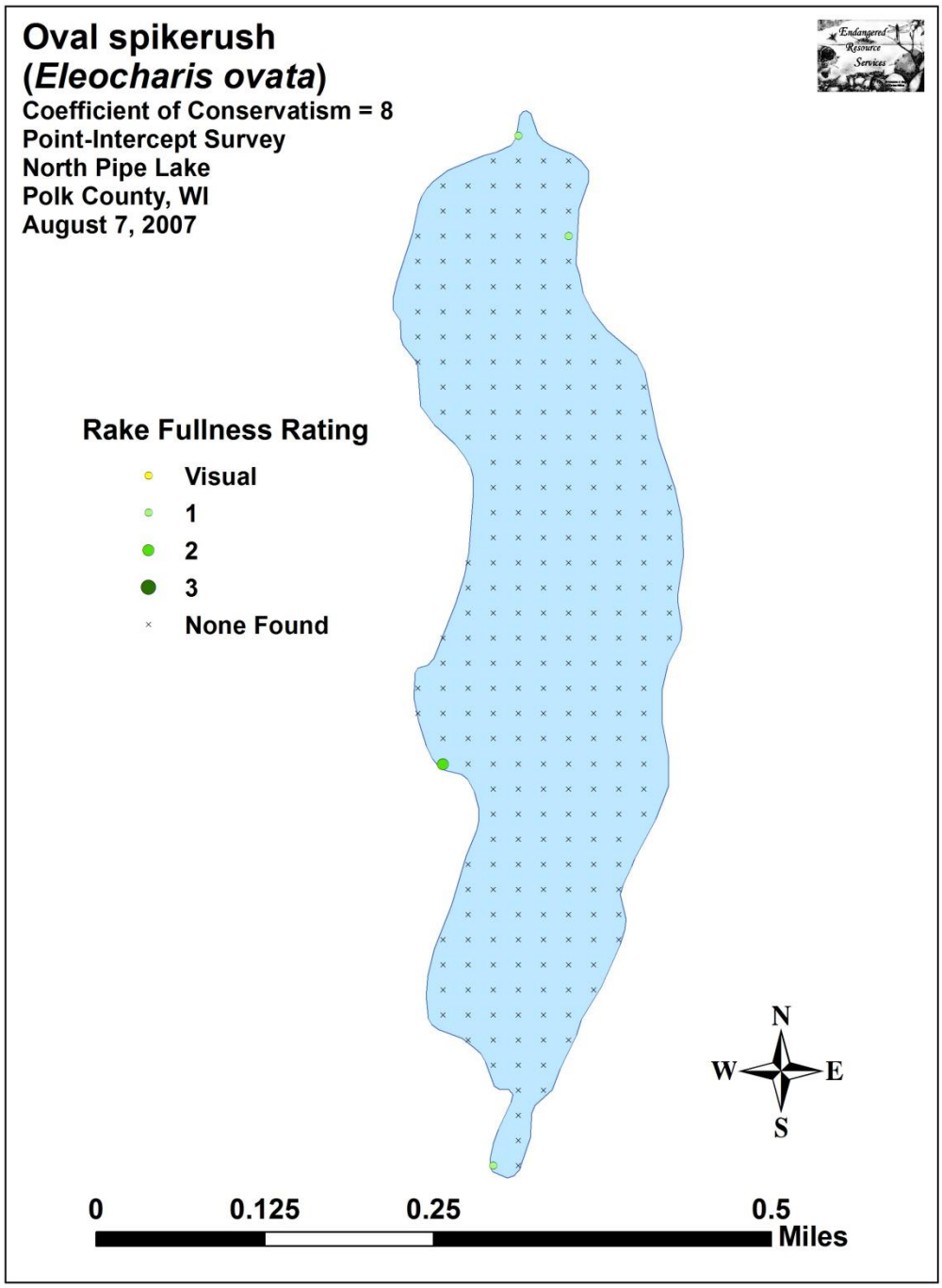
Appendix V: 2007 Most Common and State Listed Species Density and Distribution Maps

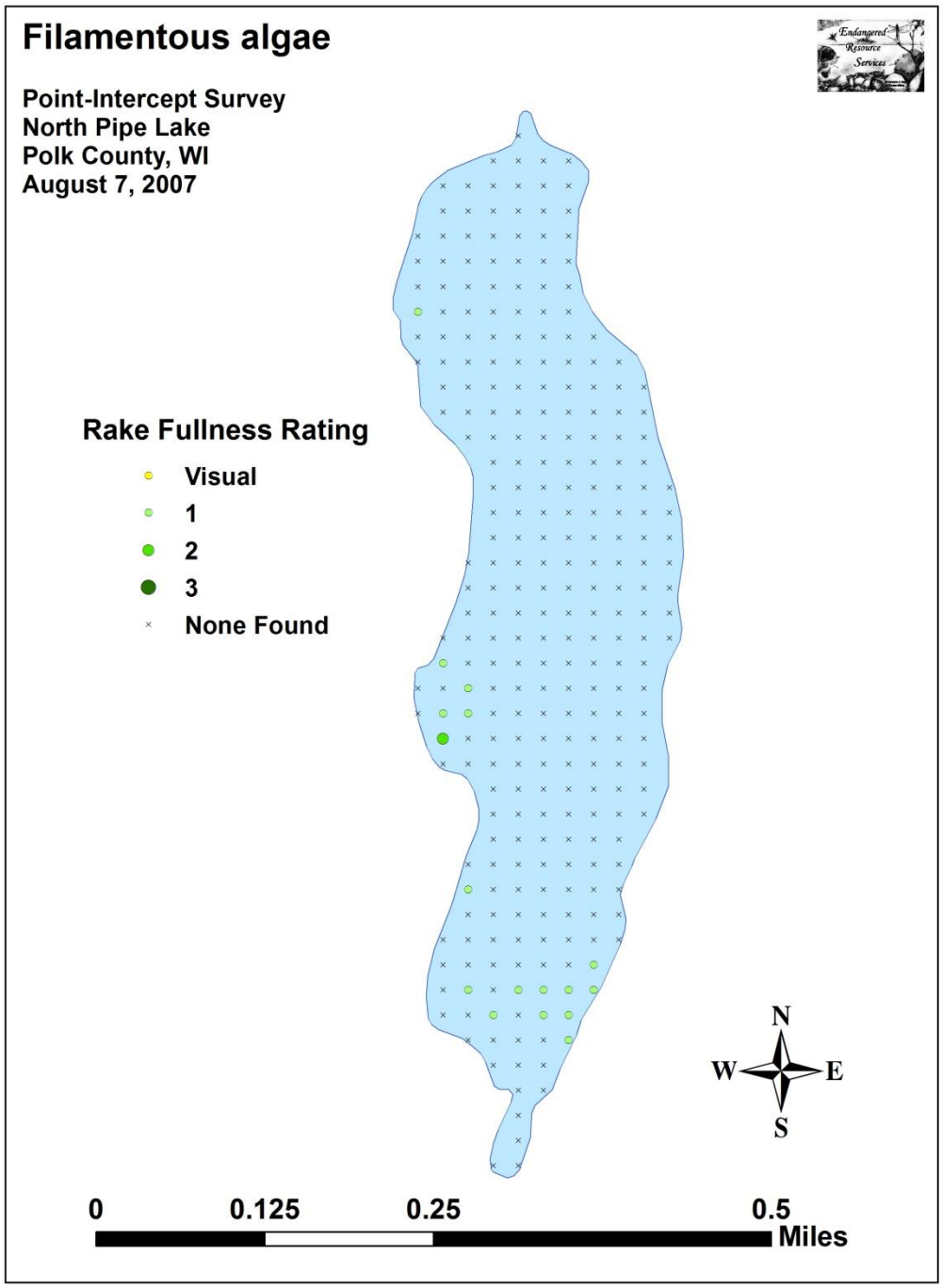

Aquatic moss
Bryophyte
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

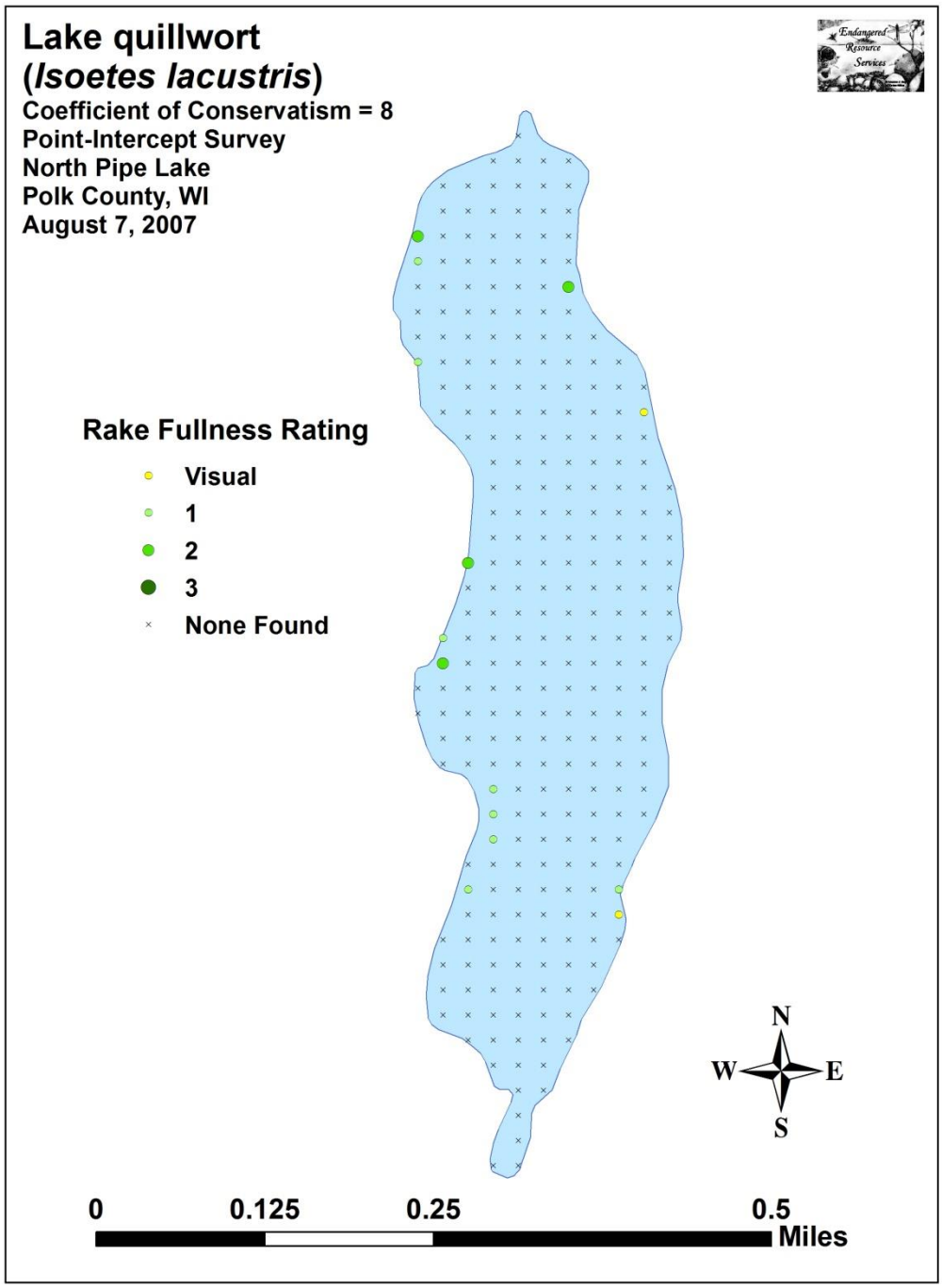

Watershield
(Brasenia schreberi)
Coefficient of Conservatism = 6
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

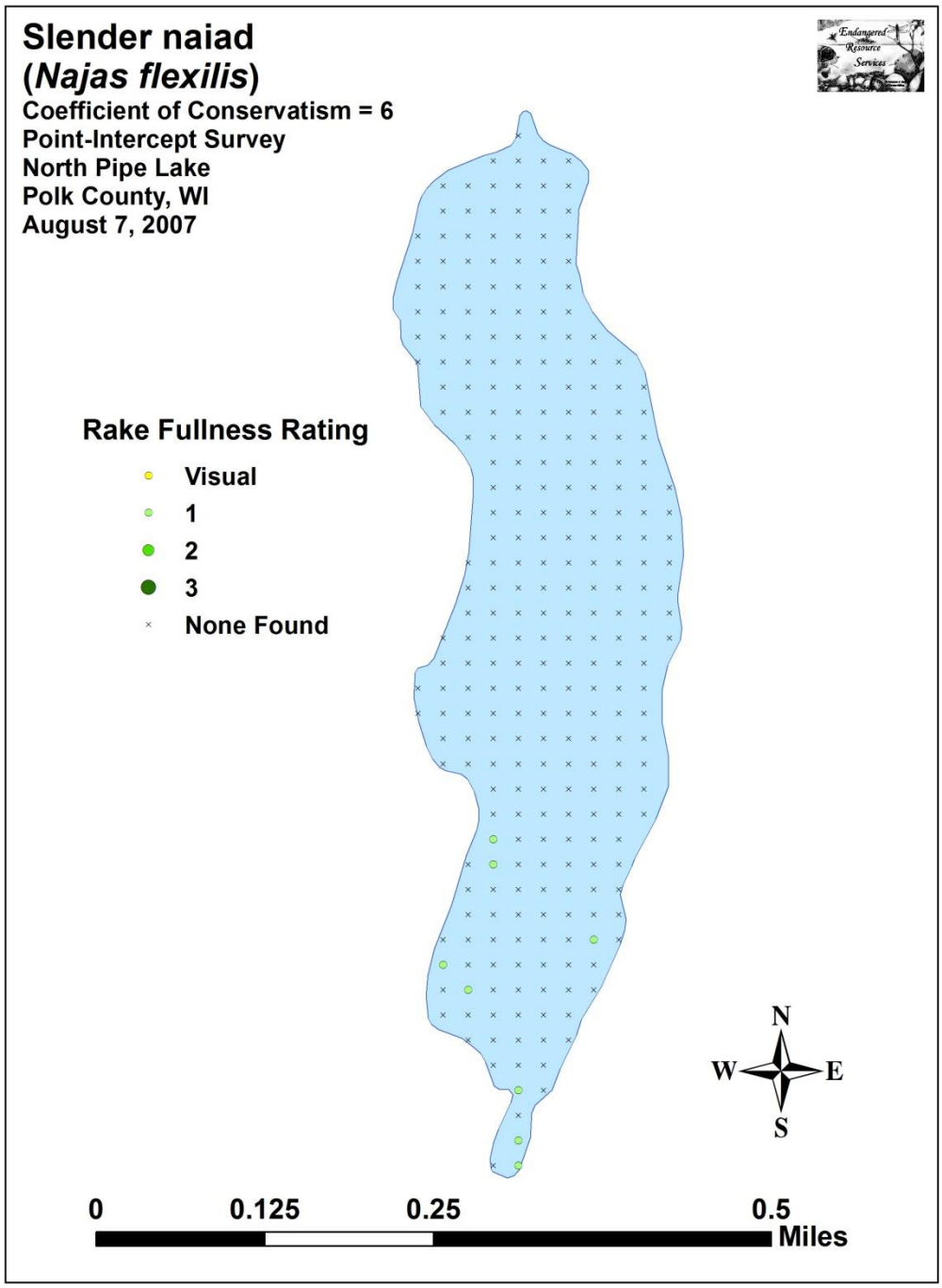

Waterwort
(Elatine minima)
Coefficient of Conservatism = 9
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

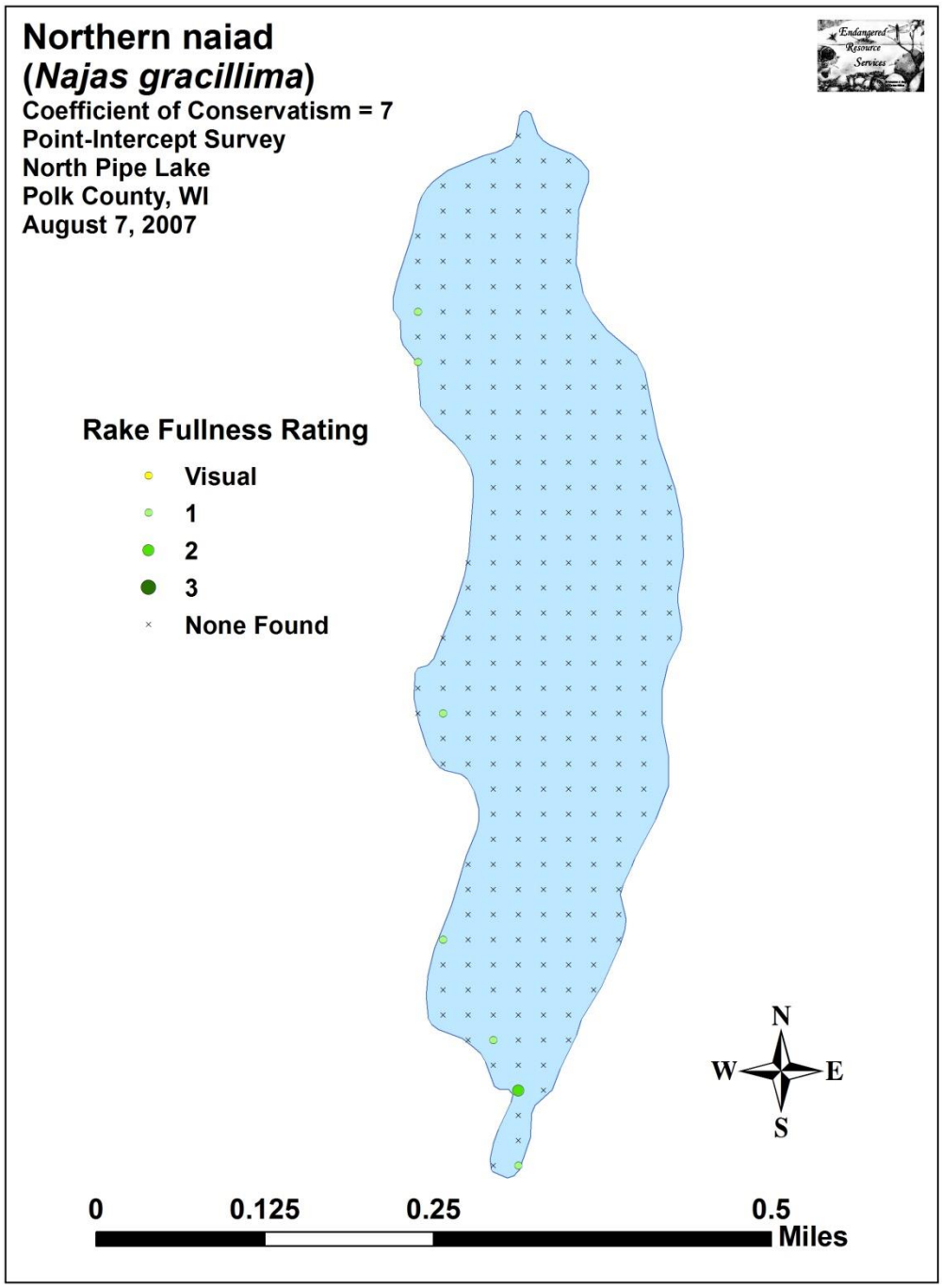

Needle spikerush
(Eleocharis acicularis)
Coefficient of Conservatism = 5
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

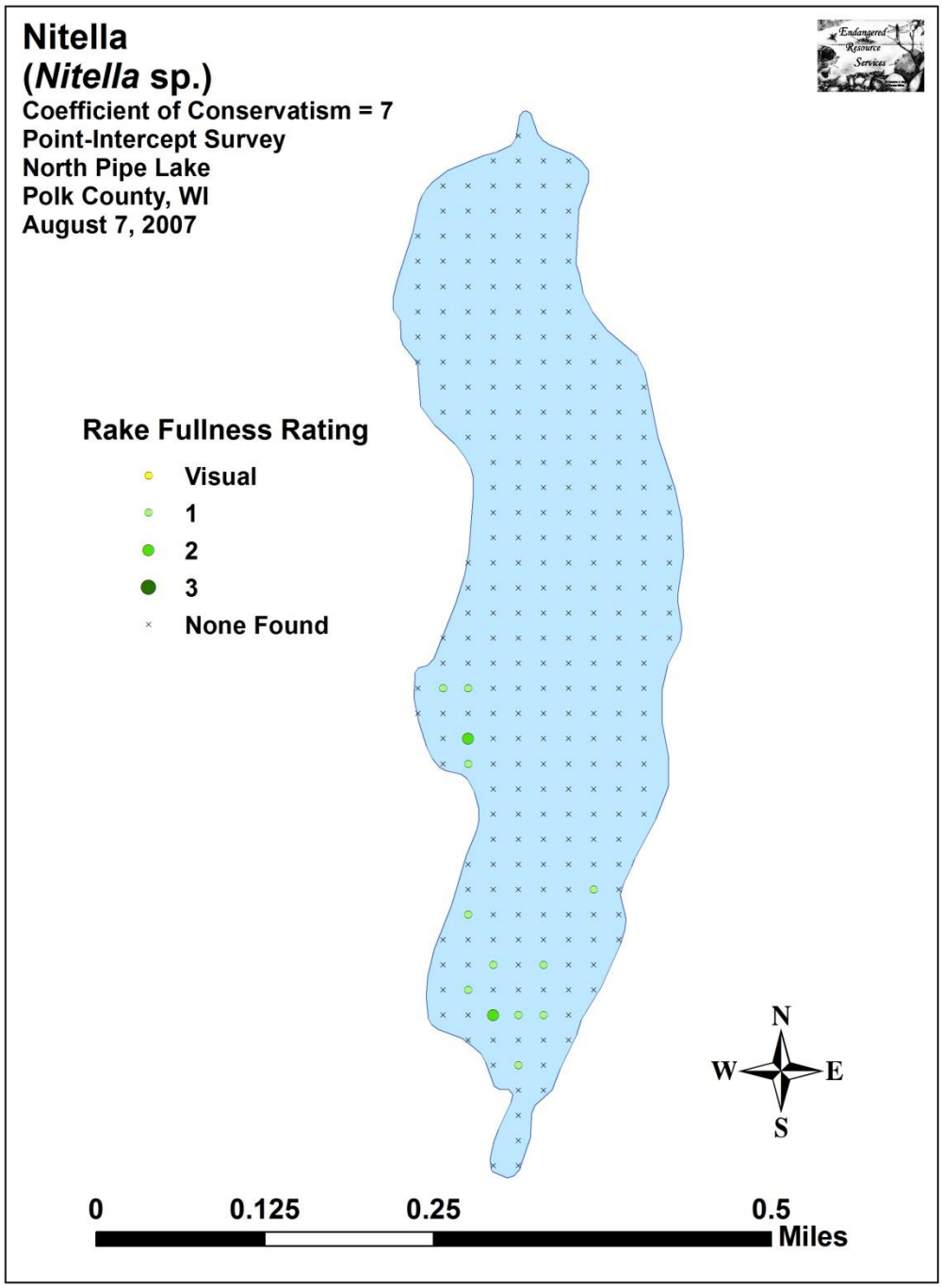

Oval spikerush
(Eleocharis ovata)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

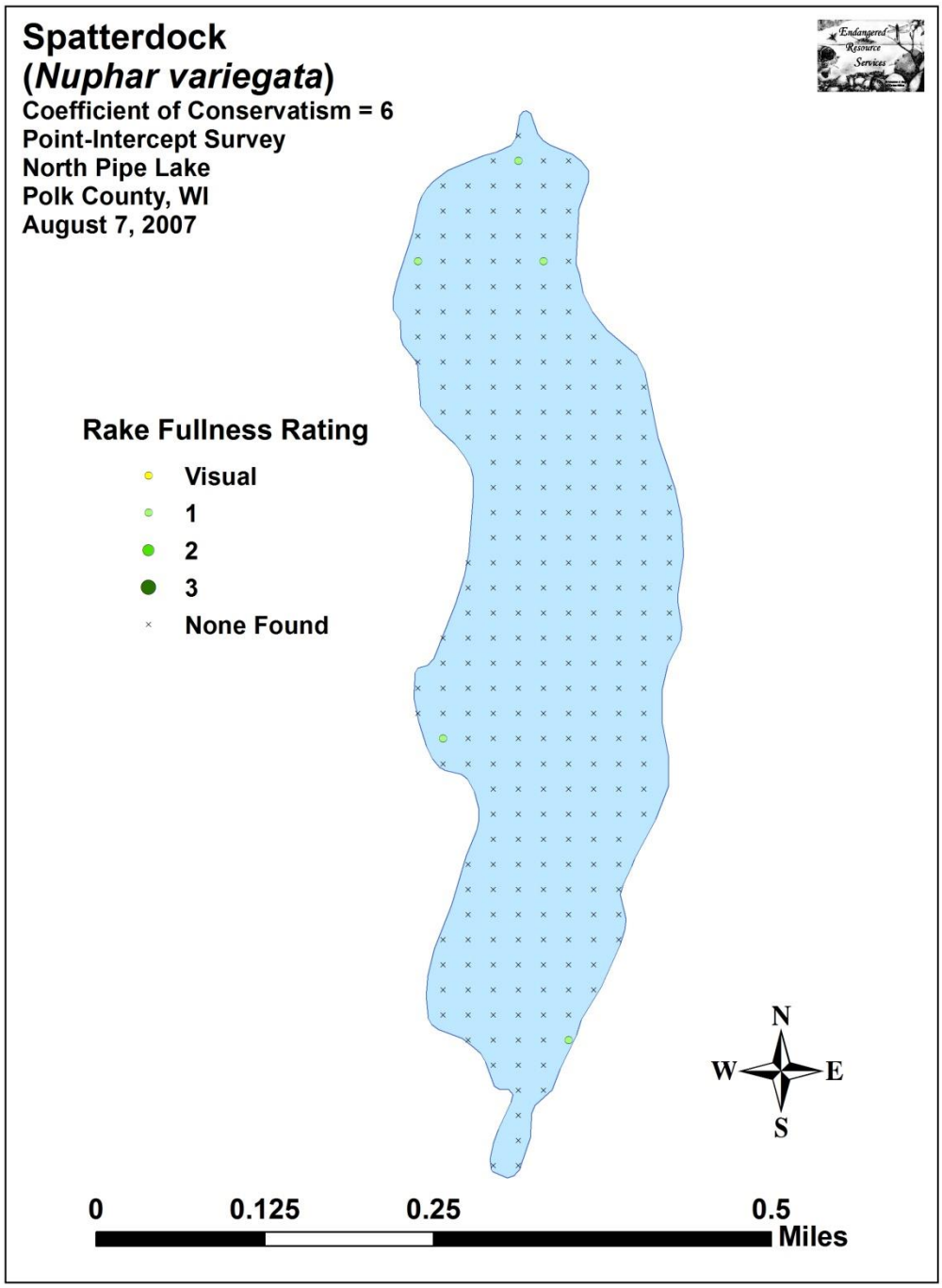

Filamentous algae
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

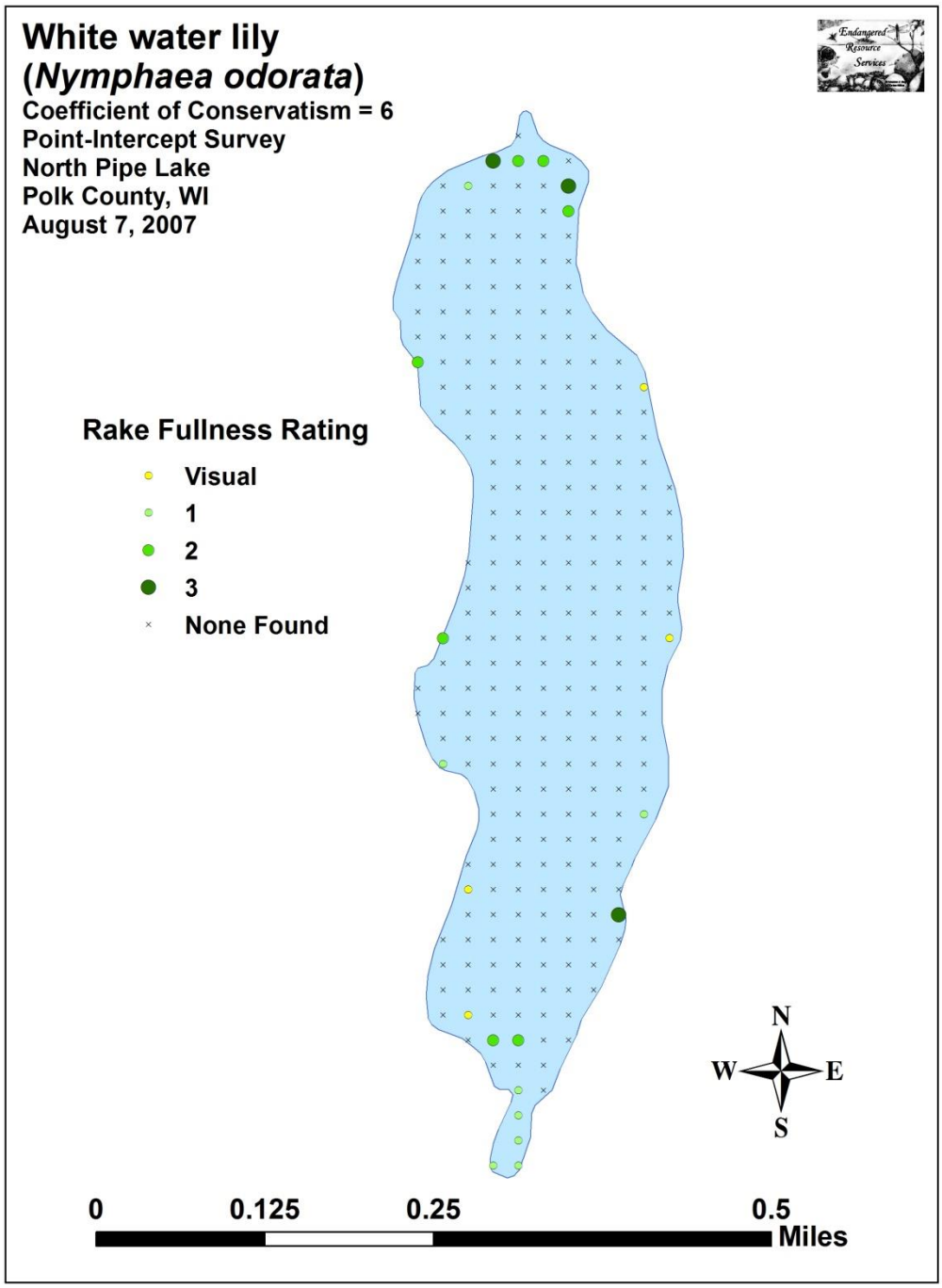

Lake quillwort
(Isoetes lacustris)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

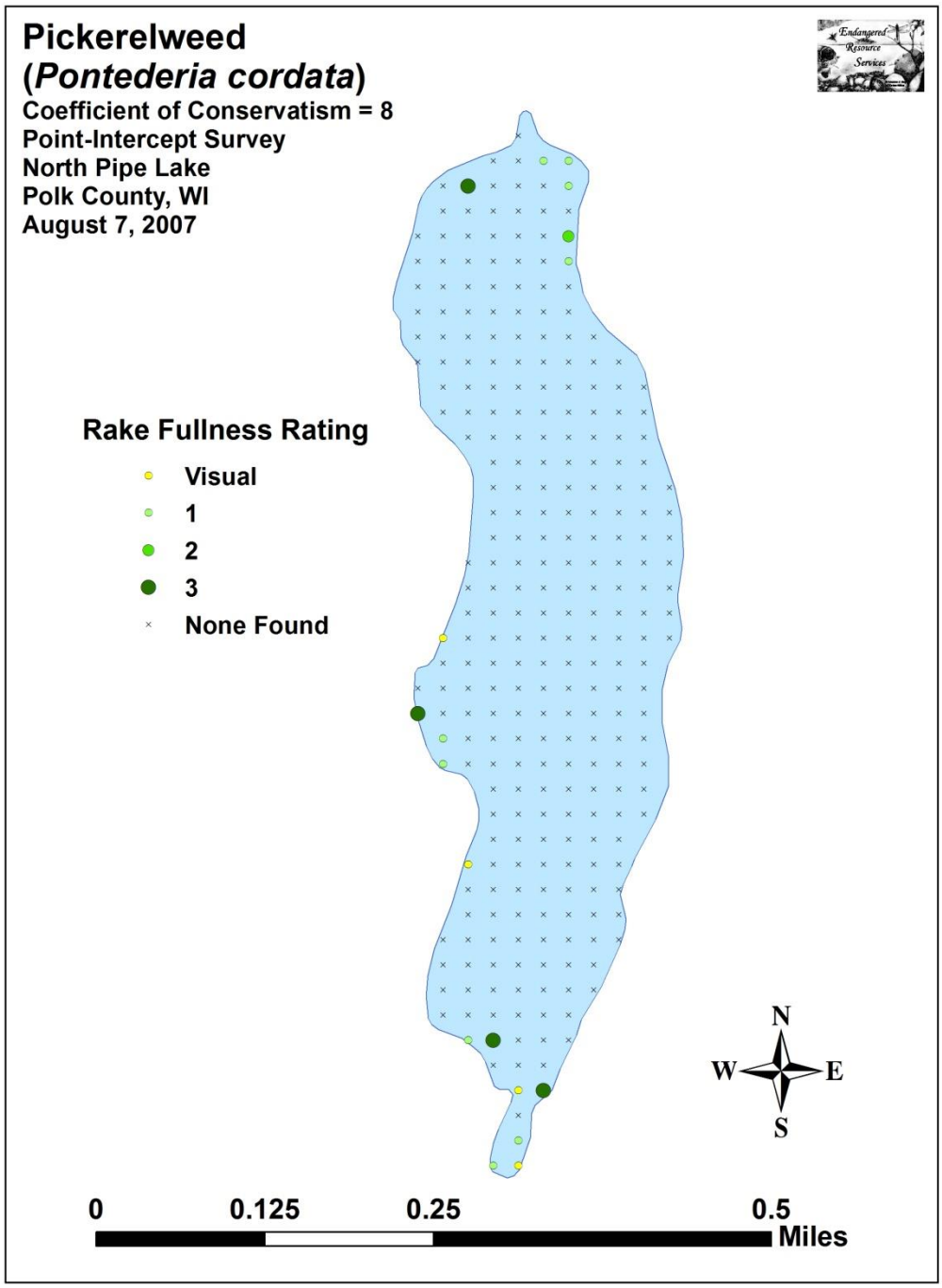

Slender naiad
(Najas flexilis)
Coefficient of Conservatism = 6
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

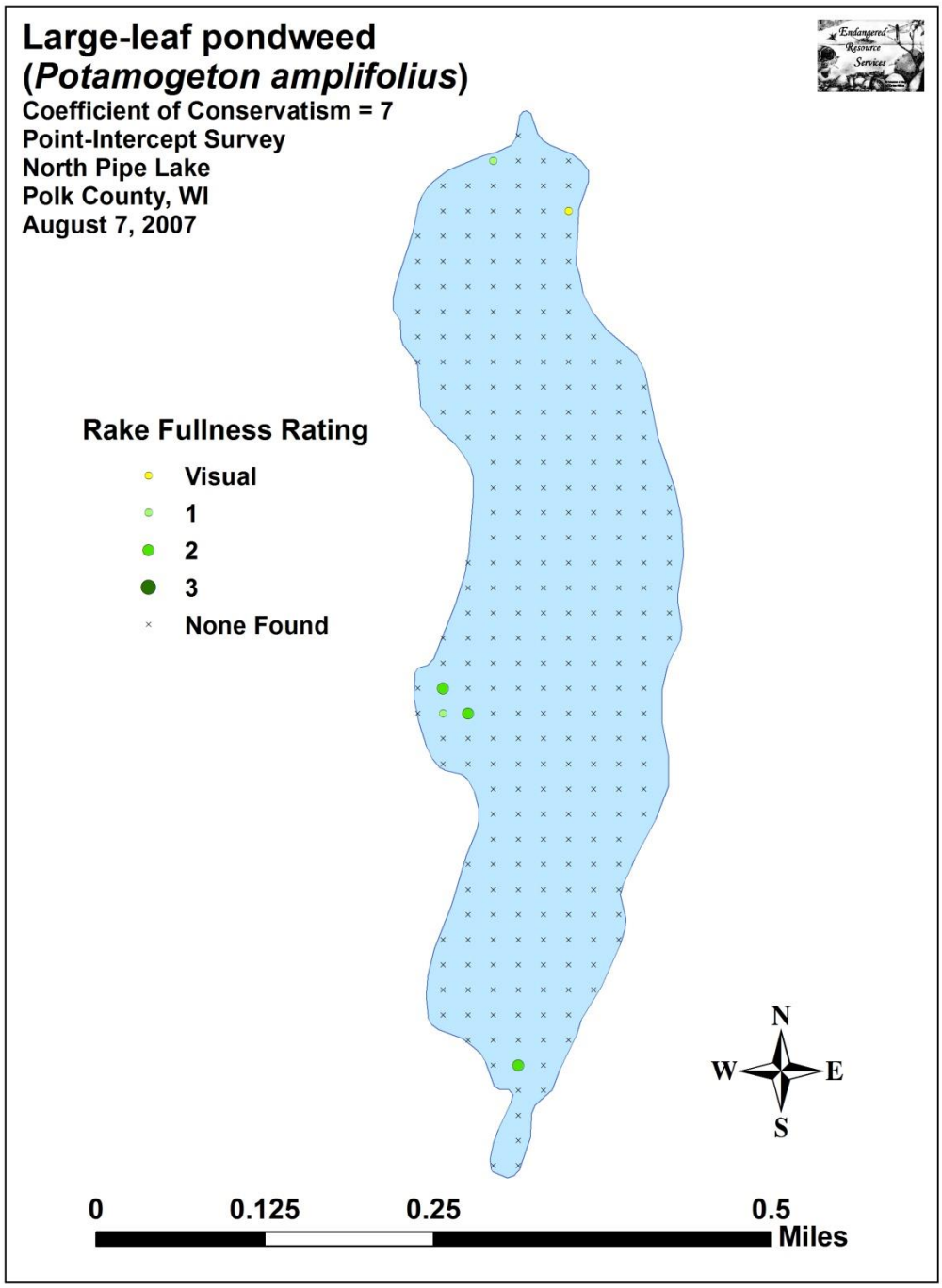

Northern naiad
(Najas gracillima)
Coefficient of Conservatism = 7
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

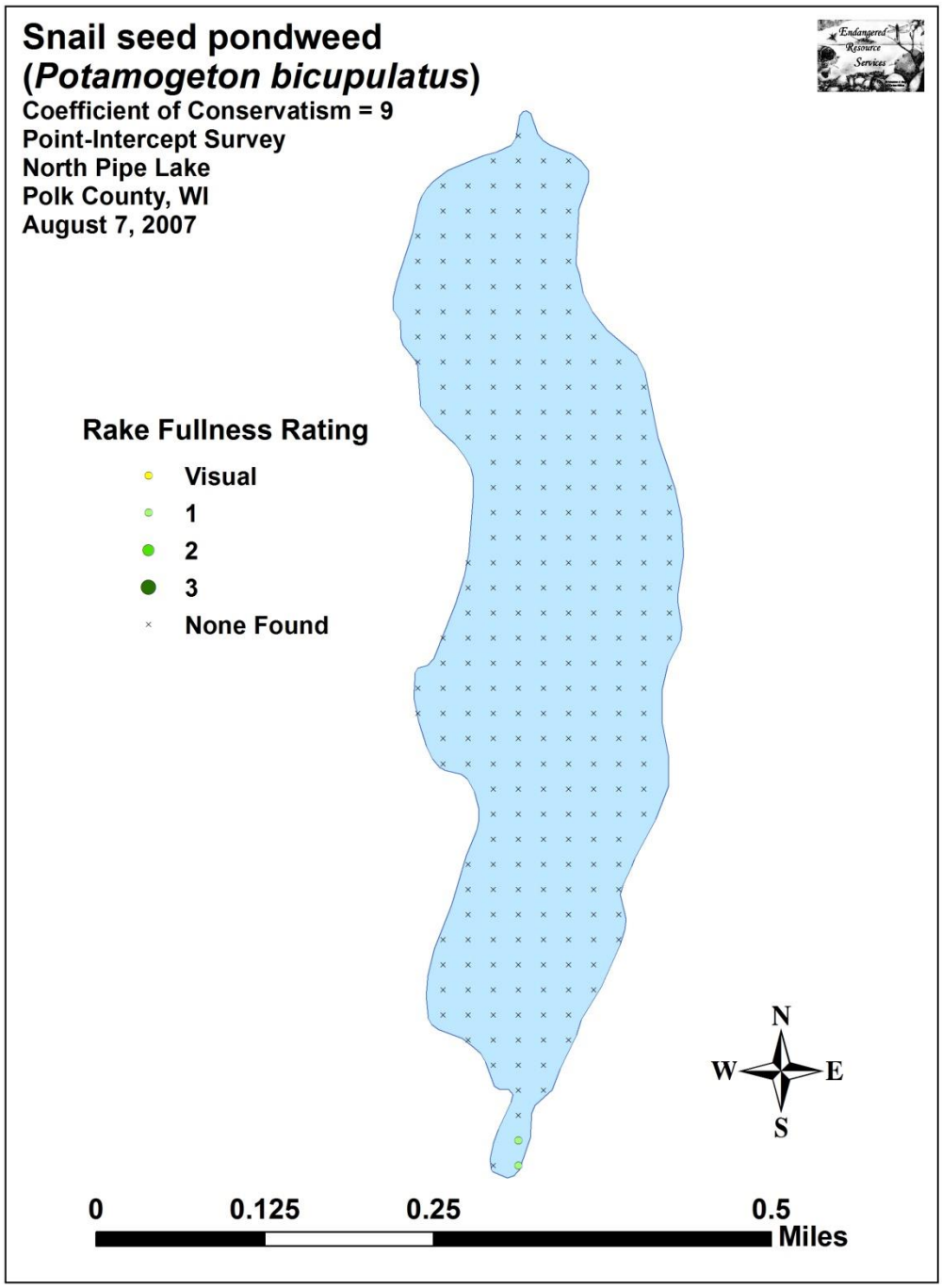

Nitella
(*Nitella* sp.)
Coefficient of Conservatism = 7
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

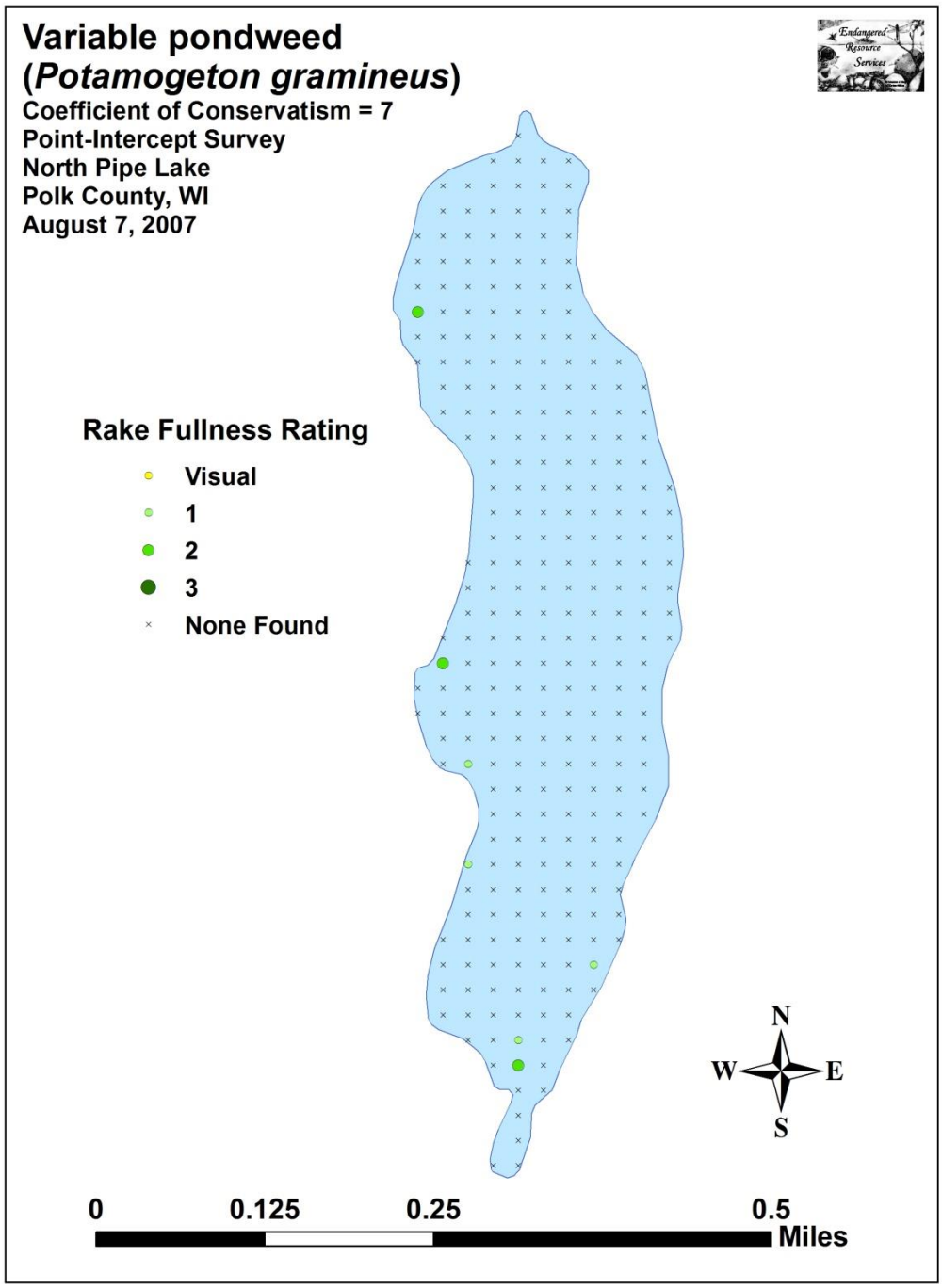

Spatterdock
(Nuphar variegata)
Coefficient of Conservatism = 6
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

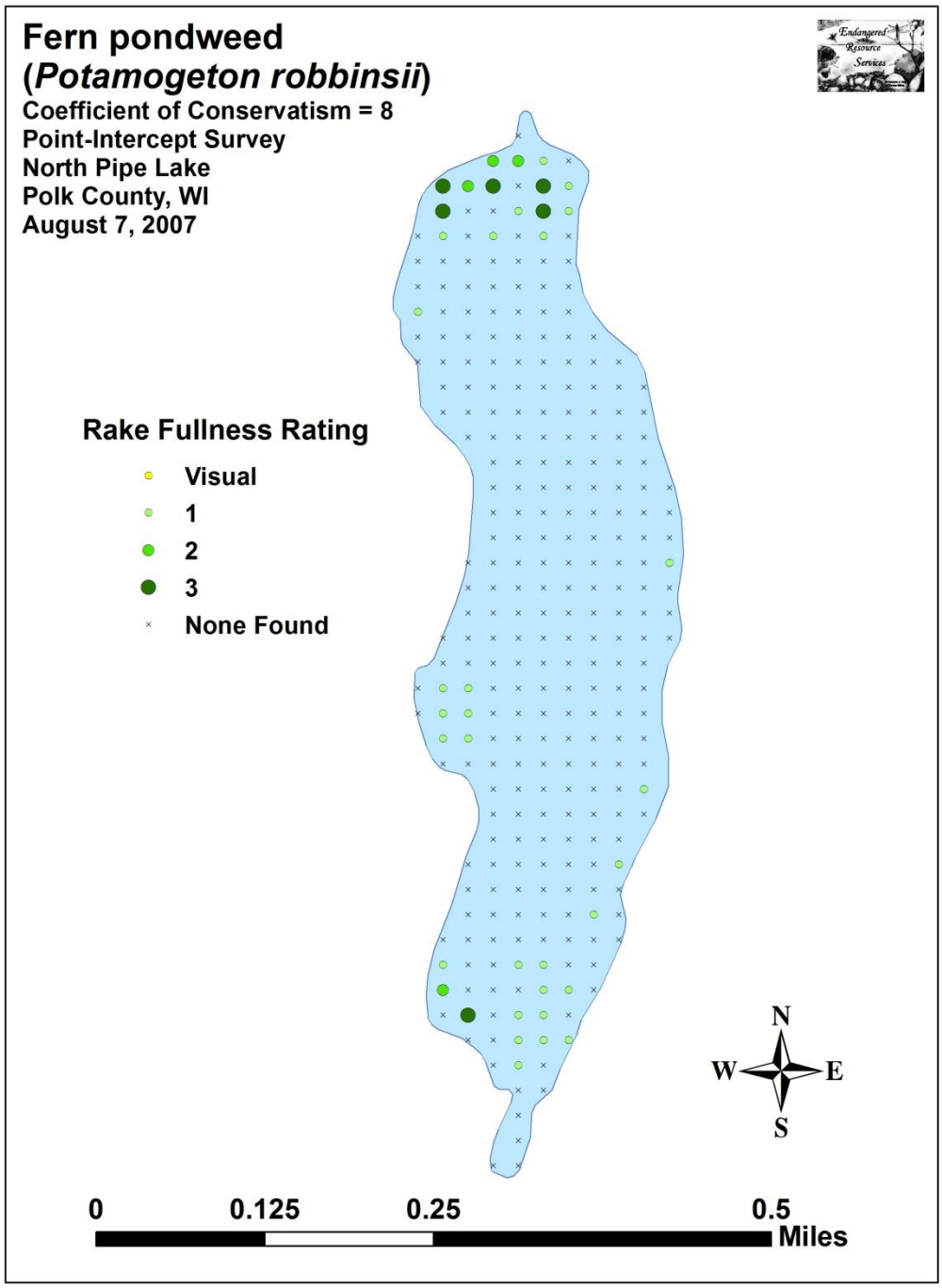

White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

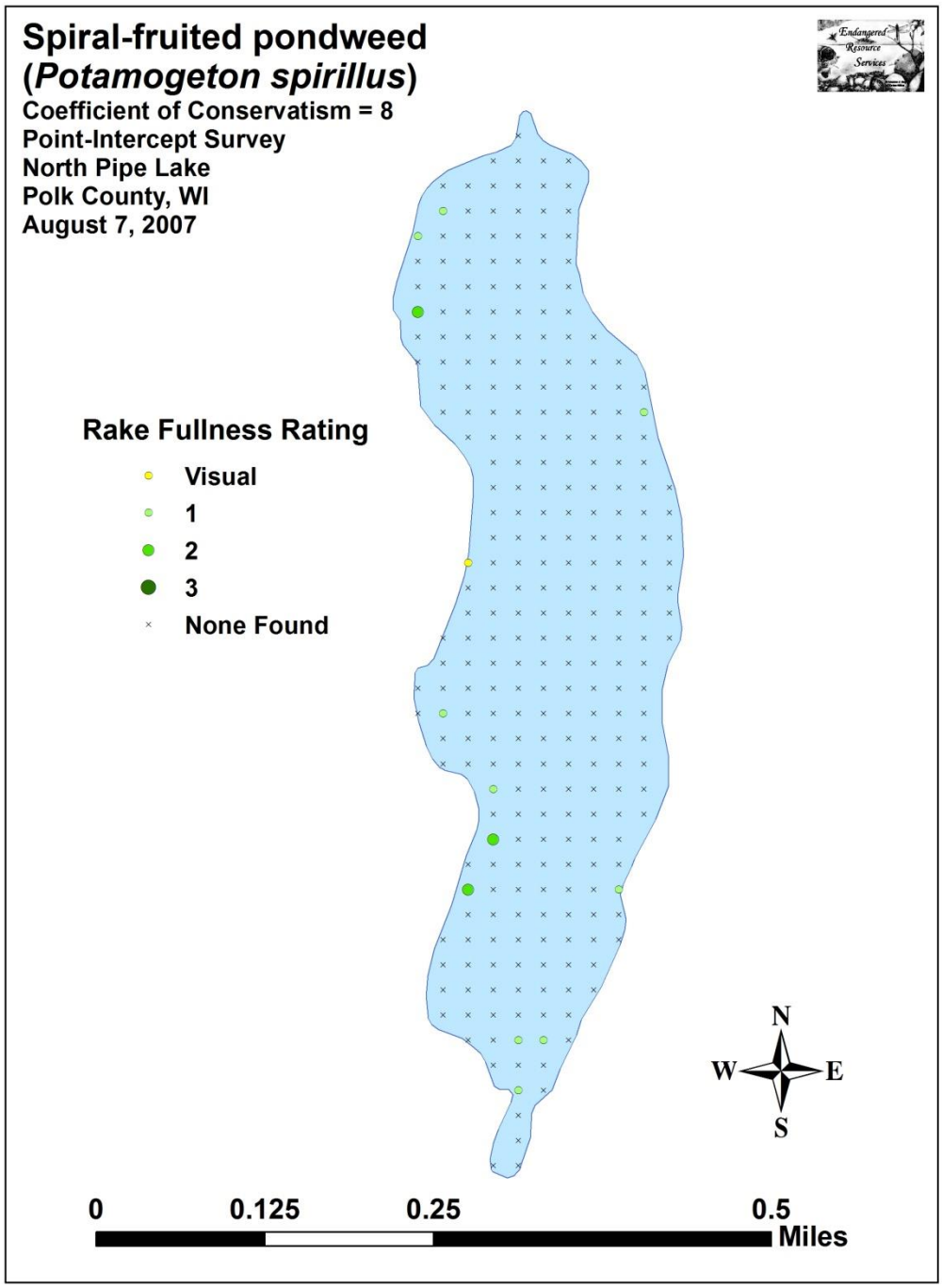

Pickerelweed
(Pontederia cordata)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

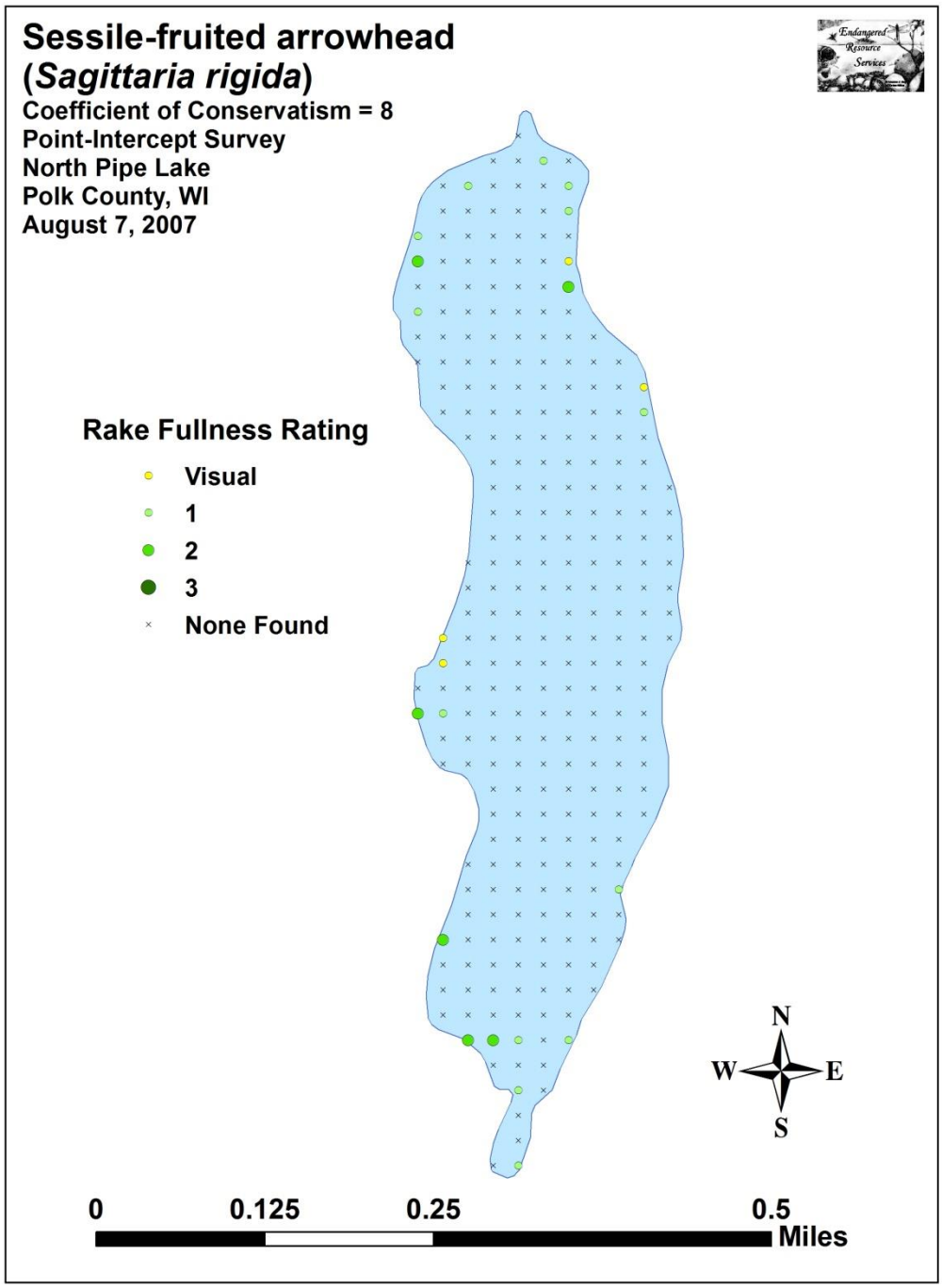

Large-leaf pondweed
(Potamogeton amplifolius)
Coefficient of Conservatism = 7
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

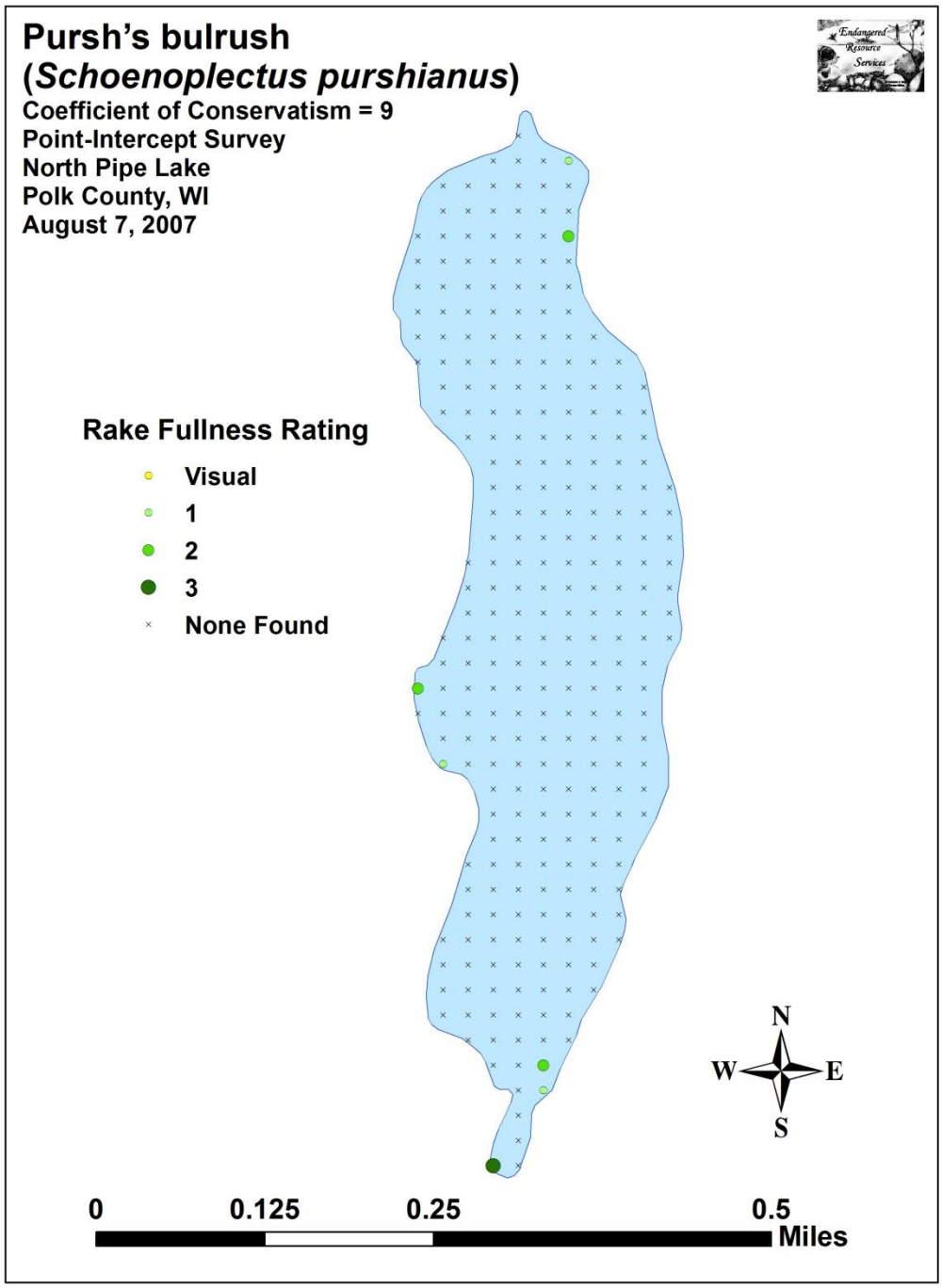

Snail seed pondweed
(Potamogeton bicupulatus)
Coefficient of Conservatism = 9
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

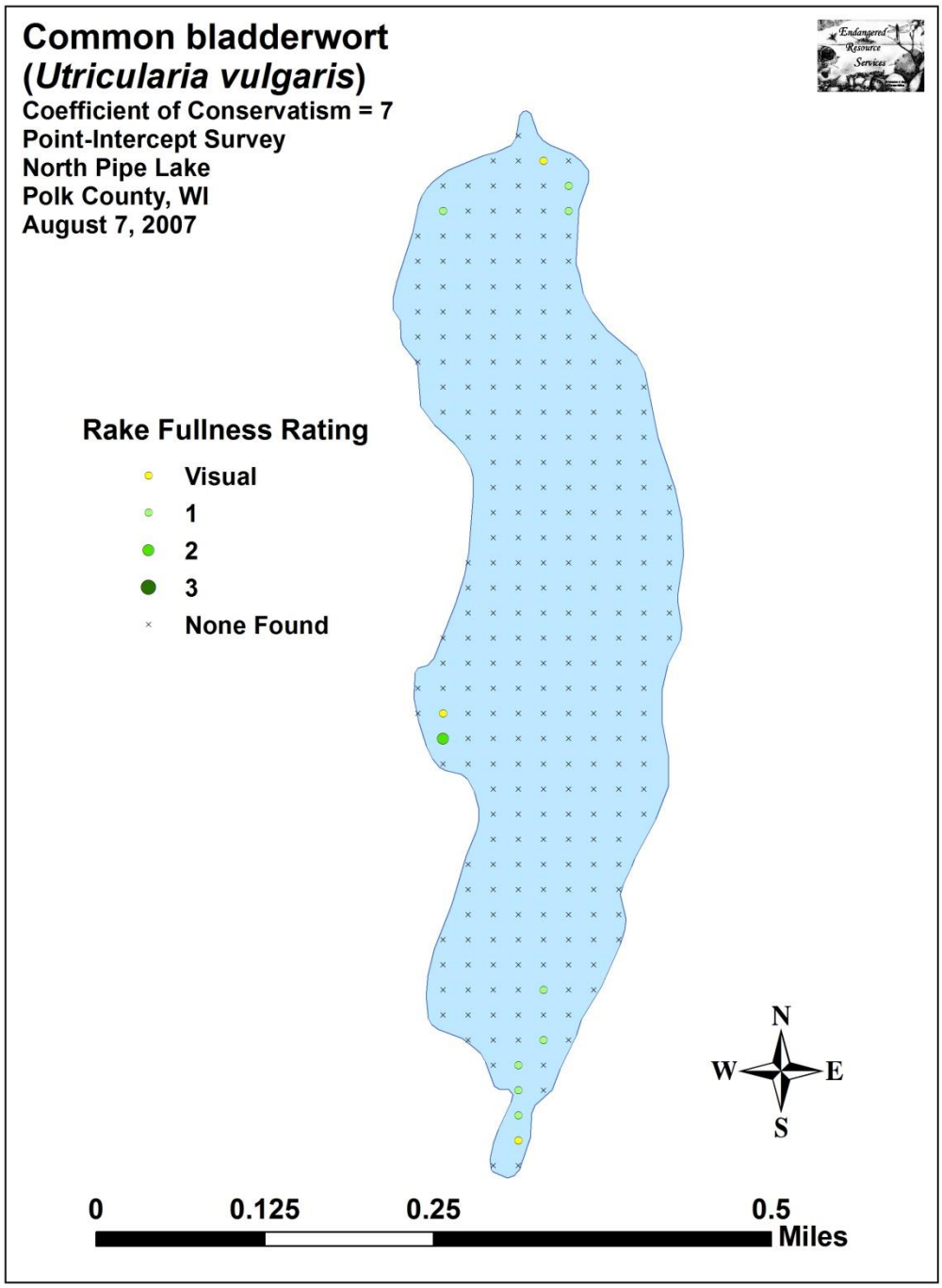

Variable pondweed
(Potamogeton gramineus)
Coefficient of Conservatism = 7
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Fern pondweed
(Potamogeton robbinsii)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Spiral-fruited pondweed
(Potamogeton spirillus)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Sessile-fruited arrowhead
(Sagittaria rigida)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Pursh's bulrush
(Schoenoplectus purshianus)
Coefficient of Conservatism = 9
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
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 bladderwort
(Utricularia vulgaris)
Coefficient of Conservatism = 7
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 7, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

Appendix VI: 2007 and 2013 Pipe Lakes Plant Species Accounts

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Alisma triviale*) **Water plantain**
Specimen Location: North Pipe Lake; N45.52649°, W92.19979°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-001
Habitat/Distribution: Muck bottom at the shoreline. Rare with only a few individuals located in recently exposed muck just north of the bridge between the lakes.
Common Associates: (*Leersia oryzoides*) Rice cut-grass, (*Sagittaria rigida*) Sessile-fruited arrowhead , (*Nymphaea odorata*) White water lily

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: Aquatic moss
Specimen Location: North Pipe Lake; N45.52731°, W92.19944°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-002
Habitat/Distribution: Rocky bottoms in 6-8 meters of water. Uncommon in North Pipe to relatively common in Pipe. It was found in deep water near rocky drop-offs.
Common Associates: (*Nitella* sp.) Nitella, (*Chara* sp.) Muskgrass

County/State: Polk County, Wisconsin **Date:** 8/10/13
Species: (*Bolboschoenus fluviatile*) **River bulrush**
Specimen Location: North Pipe Lake; N45.53407°, W92.19855°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2013-304
Habitat/Distribution: Firm sandy muck and at the shoreline. Plants were scattered along the eastern shoreline of North Pipe.
Common Associates: (*Phalaris arundinacea*) Reed canary grass, (*Schoenoplectus acutus*) Hardstem bulrush

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Brasenia schreberi*) **Watershield**
Specimen Location: North Pipe Lake; N45.53540°, W92.19976°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-003
Habitat/Distribution: Muck and mucky sand bottom in 0-2 meters. Abundant in muck bays throughout both lakes – especially in the southeast bays of Pipe
Common Associates: (*Nuphar variegata)* Spatterdock , (*Nymphaea odorata*) White water lily, (*Eleocharis robbinsii*) Robbins spikerush

County/State: Polk County, Wisconsin **Date:** 9/22/13
Species: (*Carex lasiocarpa*) **Narrow-leaved woolly sedge**
Specimen Location: Pipe Lake; N45.50826°, W92.20897°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2013-305
Habitat/Distribution: Firm sand and at the shoreline. Plants were scattered on the north point of the largest state owned island in the SE bay of Pipe.
Common Associates: (*Schoenoplectus acutus*) Hardstem bulrush, (*Carex utriculata*) Common yellow lake sedge

County/State: Polk County, Wisconsin **Date:** 9/22/13
Species: (*Carex utriculata*) **Common yellow lake sedge**
Specimen Location: Pipe Lake; N45.50826°, W92.20897°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2013-306
Habitat/Distribution: Firm sand at the shoreline. A few plants were scattered along the shoreline along the WDNR islands in the SE bay.
Common Associates: (*Phalaris arundinacea*) Reed canary grass, (*Schoenoplectus acutus*) Hardstem bulrush, (*Carex lasiocarpa*) Narrow-leaved woolly sedge

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Ceratophyllum echinatum*) **Spiny hornwort**
Specimen Location: North Pipe Lake; N45.53024°, W92.20148°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-005
Habitat/Distribution: Muck bottom in 0-1 meters. Rare at a few locations in North Pipe.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nuphar variegata)* Spatterdock, (*Nymphaea odorata*) White water lily

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Chara* sp.) **Muskgrass**
Specimen Location: Pipe Lake; N45.50831°, W92.20635°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-006
Habitat/Distribution: Sand/silt/muck bottom areas in water from 0 – 8 meter deep. Uncommon on the south end of Pipe Lake.
Common Associates: (*Nitella* sp.) Nitella, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Potamogeton spirillus*) Spiral-fruited pondweed, Aquatic moss

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Cicuta bulbifera*) **Bulb-bearing water hemlock**
Specimen Location: North Pipe Lake; N45.53648°, W92.19980°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-007
Habitat/Distribution: Muck bottom at the shoreline in 0 – 0.25 meters of water. Rare with only a few scattered individuals located along shore far north end of North Pipe.
Common Associates: (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Typha latifolia*) Broad-leaved cattail, (*Sagittaria latifolia*) Common arrowhead

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Dulichium arundinaceum*) **Three-way sedge**
Specimen Location: North Pipe Lake; N45.52649°, W92.19979°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-008
Habitat/Distribution: Located at the edge of the lake in mucky soil. Scattered locations on the south end of North Pipe and south end of Pipe.
Common Associates: (*Eleocharis ovata*) Oval spikerush, (*Eleocharis acicularis*) Needle spikerush, (*Ranunculus flammula*) Creeping spearwort, (*Leersia oryzoides*) Rice cut-grass

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Elatine minima*) **Waterwort**
Specimen Location: North Pipe Lake; N45.53132°, W92.20152°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-009
Habitat/Distribution: Rocky to sandy bottoms in 0-1.5 meters of water. Common throughout both lakes where it is scattered in plant "mats" with other small macrophytes in shallow water.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush, (*Ranunculus flammula*) Creeping spearwort, (*Isoetes lacustris*) Lake quillwort

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Eleocharis acicularis*) **Needle spikerush**
Specimen Location: North Pipe Lake; N45.53540°, W92.19976°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-011
Habitat/Distribution: Rocky to sandy bottoms in 0-2 meters of water. Abundant throughout both lakes where it forms thick mats in shallow water. Emergent form located along shore interspersed among other emergents.
Common Associates: (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush, (*Ranunculus flammula*) Creeping spearwort, (*Utricularia resupinata*) Small purple bladderwort

County/State: Polk County, Wisconsin **Date:** 8/10/13
Species: (*Eleocharis erythropoda*) **Bald spikerush**
Specimen Location: North Pipe Lake; N45.52567°, W92.20053°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2013-307
Habitat/Distribution: Firm muck at the shoreline. Plants were common on either side of the channel between the lakes in areas that had formerly been under water.
Common Associates: (*Sagittaria latifolia*) Common arrowhead, (*Sparganium androcladum*) Branched bur-reed, (*Scirpus cyperinus*) Woolgrass

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Eleocharis obtusa*) **Blunt** s**pikerush**
Specimen Location: North Pipe Lake; N45.52676°, W92.19980°
Collected/Identified by: Matthew S. Berg/Gary Fewless UWGB **Col. #:** MSB-2007-010
Habitat/Distribution: Located at the edge of the lake in mucky soil. Scattered locations on the south and west end of North Pipe
Common Associates: (*Eleocharis ovata*) Oval spikerush, (*Eleocharis acicularis*) Needle spikerush, (*Ranunculus flammula*) Creeping spearwort

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Eleocharis* ovata) **Oval spikerush**
Specimen Location: North Pipe Lake; N45.52997°, W92.20147°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-012
Habitat/Distribution: Located at the edge of the lake in mucky soil. Scattered locations on the south and west end of North Pipe
Common Associates: (*Eleocharis obtusa*) Blunt spikerush, (*Eleocharis acicularis*) Needle spikerush, (*Ranunculus flammula*) Creeping spearwort

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Eleocharis palustris*) **Creeping spikerush**
Specimen Location: North Pipe Lake; N45.53540°, W92.19976°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-013
Habitat/Distribution: Rocky/sandy bottoms in 0-1 meter of water. Widely scattered reed beds in both lakes primarily along exposed points.
Common Associates: (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Schoenoplectus acutus*) Hardstem bulrush, (*Eleocharis acicularis*) Needle spikerush

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Eleocharis robbinsii*) **Robbins spikerush**
Specimen Location: Pipe Lake; N45.50608°, W92.20679°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-014
Habitat/Distribution: Muck bottoms in 0-1 meter of water. Common in the southeast bays of Pipe.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Myriophyllum farwellii*) Farwell's water milfoil

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Elodea canadensis*) **Common waterweed**
Specimen Location: North Pipe Lake; N45.52535°, W92.2028°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-015
Habitat/Distribution: Sandy muck bottom in 0-4 meters of water. Uncommon in scattered locations throughout the north half of Pipe.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Nitella* sp.) Nitella

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Equisetum fluviatile*) **Water horsetail**
Specimen Location: North Pipe Lake; N45.53540°, W92.19976°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-016
Habitat/Distribution: Found in mucky sand over gravel in 0-1 meters of water. Rare in scattered patches on the northeast corner of North Pipe and in the southeast bays of Pipe.
Common Associates: (*Pontederia cordata*) Pickerelweed, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Isoetes lacustris*) Lake quillwort

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Eriocaulon aquaticum*) **Pipewort**
Specimen Location: North Pipe Lake; N45.52701°, W92.20097°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-017
Habitat/Distribution: Sandy to rocky bottoms in water < 1 meter deep to emergent on shore. Common in sandy soil throughout Pipe – scattered locations on North Pipe.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: Filamentous algae
Specimen Location: North Pipe Lake; N45.53024°, W92.20148°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-018
Habitat/Distribution: Muck to rocky bottoms in sheltered water from 0-4 meters deep. Uncommon in scattered locations throughout both lakes.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Nitella* sp.) Nitella

County/State: Polk County, Wisconsin **Date:** 8/11/13
Species: (*Glyceria borealis*) **Northern manna-grass**
Specimen Location: Pipe Lake; N45.50449°, W92.21302°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2013-308
Habitat/Distribution: Firm sand at the shoreline. A few plants were scattered along the south shoreline near the "unimproved landing".
Common Associates: (*Schoenoplectus acutus*) Hardstem bulrush, (*Equisetum fluviatile*) Water horsetail, (*Scirpus cyperinus*) Woolgrass

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Isoetes lacustris*) **Lake quillwort**
Specimen Location: North Pipe Lake; N45.53105°, W92.20151°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-019
Habitat/Distribution: Rocky to sandy bottoms in 0-1.5 meters of water. Relatively common throughout both lakes where it is scattered in shallow water.
Common Associates: (*Eleocharis acicularis*) Needle spikerush , (*Eriocaulon aquaticum*) Pipewort, (*Juncus pelocarpus*) Brown-fruited rush, (*Potamogeton spirillus*) Spiral-fruited pondweed

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Juncus pelocarpus*) **Brown-fruited rush**
Specimen Location: North Pipe Lake; N45.52676°, W92.19980°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-020
Habitat/Distribution: Rocky to sandy bottoms in 0-1.5 meters of water. Relatively common in North Pipe to locally abundant in Pipe where it forms thick mats in shallow water. Emergent form located along shore interspersed among other emergents.
Common Associates: (*Myriophyllum tenellum*) Dwarf water milfoil, (*Ranunculus flammula*) Creeping spearwort, (*Eleocharis acicularis*) Needle spikerush, (*Utricularia resupinata*) Small purple bladderwort

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Leersia oryzoides*) **Rice cut-grass**
Specimen Location: North Pipe Lake; N45.52649°, W92.19979°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-021
Habitat/Distribution: Located at the edge of the lake in mucky soil. Scattered locations on the south end of North Pipe.
Common Associates: (*Eleocharis ovata*) Oval spikerush, (*Eleocharis acicularis*) Needle spikerush, (*Ranunculus flammula*) Creeping spearwort, (*Dulichium arundinaceum*) Three-way sedge

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Lemna minor*) **Small duckweed**
Specimen Location: North Pipe Lake; N45.53647°, W92.20018°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-022
Habitat/Distribution: Located floating at or just under the surface in sheltered areas. Rare in the far northeast bay of North Pipe. Scattered individuals occur interspersed between the lilypads.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Nuphar variegata)* Spatterdock, (*Pontederia cordata*) Pickerelweed, (*Spirodela polyrhiza*) Large duckweed

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Lipocarpha micrantha*) **Small-flowered hemicarpha**
Specimen Location: North Pipe Lake; N45.52676°, W92.19980°
Collected/Identified by: Matthew S. Berg/Gary Fewless UWGB **Col. #:** MSB-2007-004
Habitat/Distribution: Muck bottom along the shoreline. Rare at a few locations in North Pipe.
Common Associates: (*Leersia oryzoides*) Rice cut-grass, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Eleocharis acicularis*) Needle spikerush

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Myriophyllum farwellii*) **Farwell's water milfoil**
Specimen Location: Pipe Lake; N45.50831°, W92.20635°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-023
Habitat/Distribution: Muck bottom in water up to 2 meters in depth. Southeast bay of Pipe Lake in sheltered locations.
Common Associates: (*Brasenia schreberi*) Watershield, (*Eleocharis robbinsii*) **Robbins** spikerush, (*Utricularia gibba*) Creeping bladderwort

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Myriophyllum tenellum*) **Dwarf water milfoil**
Specimen Location: Pipe Lake; N45.50644°, W92.20732°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-024
Habitat/Distribution: Preferred stable sand or rocky bottoms in 0-1 meter of water. Common throughout Pipe Lake in sandy areas.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Juncus pelocarpus*) Brown-fruited rush, (*Eriocaulon aquaticum*) Pipewort, (*Utricularia resupinata*) Small purple bladderwort

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Najas flexilis*) **Slender naiad**
Specimen Location: North Pipe Lake; N45.52567°, W92.20015°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-025
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-1.5 meters of water. Common, and widely distributed throughout both lakes.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton spirillus*) Spiral-fruited pondweed, (*Najas gracillima*) Northern naiad

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Najas gracillima*) **Northern naiad**
Specimen Location: North Pipe Lake; N45.52567°, W92.20015°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-026
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-1.5 meters of water. Uncommon but widely distributed throughout North Pipe. May also be present in Pipe. Microscopic analysis of seeds used to confirm sp. id. It occurs with other sensitive sp. and forms mixed beds with *N. flexilis*.
Common Associates: (*Potamogeton bicupulatus*) Snail-seed pondweed, (*Potamogeton epihydrus*) Ribbon-leaf pondweed, (*Potamogeton spirillus*) Spiral-fruited pondweed, (*Najas flexilis*)

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Nitella* sp.) **Nitella**
Specimen Location: North Pipe Lake; N45.53025°, W92.20109°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-027
Habitat/Distribution: Sand/silt/muck bottom areas in water from 0 – 10 meter deep. Common throughout Pipe Lake.
Common Associates: (*Chara* sp.) Muskgrass, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Potamogeton spirillus*) Spiral-fruited pondweed, Aquatic moss

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Nuphar variegata)* **Spatterdock**
Specimen Location: North Pipe Lake; N45.53024°, W92.20148°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-028
Habitat/Distribution: Muck bottom in 0-2 meters of water where it often forms dense canopies. Relatively common in most sheltered shoreline areas of North Pipe; less so in Pipe.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Nymphaea odorata*) **White water lily**
Specimen Location: North Pipe Lake; N45.53132°, W92.20152°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-029
Habitat/Distribution: Muck bottom in 0-2 meters where it forms dense canopies with other floating leaf species. Common in sheltered bays of both lakes.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nuphar variegata)* Spatterdock, (*Pontederia cordata*) Pickerelweed

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Phalaris arundinacea*) **Reed canary grass**
Specimen Location: North Pipe Lake; N45.53674°, W92.20058°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-030
Habitat/Distribution: Firm to mucky bottom in 0-0.5 meters of water. Scattered shore locations in North Pipe. It is more common away from shore.
Common Associates: Generally, this species exists in patches at the exclusion of other species.

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Pontederia cordata*) **Pickerelweed**
Specimen Location: North Pipe Lake; N45.53540°, W92.19976°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-031
Habitat/Distribution: Silt to muck bottom over firm substrate in 0-1.5 meters of water. Common in emergent beds throughout both lakes; especially in sheltered bays.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Nuphar variegata)* Spatterdock

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Potamogeton amplifolius*) **Large-leaf pondweed**
Specimen Location: North Pipe Lake; N45.52997°, W92.20147°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-032
Habitat/Distribution: Variable substrate bottoms in 1-4 meters of water. Large-leaf seemed to be most common in areas that had some, but not thick muck. Fairly common throughout on the out edge of lily pad beds where the lake drops off into deeper water.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton spirillus*) Spiral-fruited pondweed, (*Nitella* sp.) Nitella

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Potamogeton bicupulatus*) **Snail-seed pondweed**
Specimen Location: North Pipe Lake; N45.52567°, W92.20015°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-033
Habitat/Distribution: Found in sandy to mucky bottom conditions in shallow water 0.5-1.0 meter deep. Rare in both lakes being found in the channel at the south tip of North Pipe and at a few locations in the southeast bay of Pipe. This state species of Special Concern is sensitive to disturbance and pollution.
Common Associates: (*Najas gracillima*) Northern naiad, (*Potamogeton epihydrus*) Ribbon-leaf pondweed, (*Potamogeton spirillus*) Spiral-fruited pondweed, (*Najas flexilis*) Slender naiad

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Potamogeton epihydrus*) **Ribbon-leaf pondweed**
Specimen Location: North Pipe Lake; N45.52567°, W92.20015°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-034
Habitat/Distribution: Found in mucky bottom conditions in shallow water 0.5-1.5 meter deep. Rare in both lakes being found in the channel at the south tip of North Pipe and at a few locations in the southeast bay of Pipe.
Common Associates: (*Najas gracillima*) Northern naiad, (*Potamogeton bicupulatus*) Snail-seed pondweed, (*Potamogeton gramineus*) Variable pondweed, (*Najas flexilis*) Slender naiad

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Potamogeton gramineus*) **Variable pondweed**
Specimen Location: North Pipe Lake; N45.53105°, W92.2015°
Collected/Identified by: Matthew S. Berg/Sue Borman **Col. #:** MSB-2007-035
Habitat/Distribution: Found in sandy/muck bottom conditions in shallow water 0.5-1.5 m. Found in North Pipe at the edge of lilypads; Uncommon in Pipe near the channel and in the SE bays. Unusual growth forms ranging from several underwater leaves to only floating leaves. Nutlet analysis used to confirm these unusual specimens.
Common Associates: (*Pontederia cordata*) Pickerelweed, (*Potamogeton epihydrus*) Ribbon-leaf pondweed

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Potamogeton natans*) **Floating-leaf pondweed**
Specimen Location: Pipe Lake; N45.50644°, W92.20732°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-036
Habitat/Distribution: Muck and sand bottom in 1-2 meters. Rare, a single bed was located in the southeast corner of Pipe.
Common Associates: (*Brasenia schreberi*) Watershield, (*Eleocharis robbinsii*) Robbins spikerush

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Potamogeton pusillus*) **Small pondweed**
Specimen Location: North Pipe Lake; N45.52839°, W92.19910°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-037
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 1-3 meters of water. Normally the deepest growing vascular plant. Relatively common in Pipe, uncommon and local in North Pipe. It is widely distributed; especially on the edge of the drop-off.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton spirillus*) Spiral-fruited pondweed, (*Nitella* sp.) Nitella

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Potamogeton robbinsii*) **Fern pondweed**
Specimen Location: North Pipe Lake; N45.53617°, W92.2017°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-038
Habitat/Distribution: Can grow in variable substrate bottoms, but becomes dominant to the point of excluding all other species in its preferred substrate of organic muck. Grows in 0-4 meters of water, but prefers 2.5-4. Abundant on the north end of North Pipe; common elsewhere; less common in Pipe except in the northeast/southeast bays.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Potamogeton spirillus*) Spiral-fruited pondweed, (*Nitella* sp.) Nitella

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Potamogeton spirillus*) **Spiral-fruited pondweed**
Specimen Location: North Pipe Lake; N45.52971°, W92.20069°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-039
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 1-1.5 meters of water. Common, and widely distributed throughout both lakes. It is the dominant plant in most locations where its coiled seeds and curved leaves make it easy to identify.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Isoetes lacustris*) Lake quillwort, (*Vallisneria americana*) Wild celery

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Ranunculus flammula*) **Creeping spearwort**
Specimen Location: North Pipe Lake; N45.52964°, W92.20083°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-040
Habitat/Distribution: Rocky to sandy bottoms in 0-1.5 meters of water. Rare in North Pipe to locally abundant in Pipe where it forms thick mats in shallow water. Emergent form located along shore interspersed among other emergents.
Common Associates: (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush, (*Eleocharis acicularis*) Needle spikerush, (*Utricularia resupinata*) Small purple bladderwort

County/State: Polk County, Wisconsin **Date:** 8/10/13
Species: (*Riccia fluitans*) **Slender riccia**
Specimen Location: North Pipe Lake; N45.53674°, W92.20058°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2013-309
Habitat/Distribution: Muck bottom in shallow water 0-1.5m deep. Rare in North Pipe bays.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Ricciocarpus natans*) Purple fringed riccia, (*Pontederia cordata*) Pickerelweed

County/State: Polk County, Wisconsin **Date:** 8/10/13
Species: (*Ricciocarpus natans*) **Purple fringed riccia**
Specimen Location: North Pipe Lake; N45.53674°, W92.20058°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2013-310
Habitat/Distribution: Muck bottom in shallow water 0-1.5 meters deep. Rare in North Pipe's far north bay where the spring/creek enters.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Riccia fluitans*) Slender riccia, (*Pontederia cordata*) Pickerelweed

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Sagittaria rigida*) **Sessile-fruited arrowhead**
Specimen Location: North Pipe Lake; N45.53105°, W92.20151°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-041
Habitat/Distribution: Submerged forms were most common in sand and rock bottom areas while the emergent form was more common in muck bottom areas. Found in 0-2 meters of water. Common and widespread in both lakes directly along shore.
Common Associates: (*Najas flexilis*) Slender naiad, (*Potamogeton gramineus*) Variable pondweed, (*Eriocaulon aquaticum*) Pipewort

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Sagittaria latifolia*) **Common arrowhead**
Specimen Location: Pipe Lake; N45.50583°, W92.21087°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-042
Habitat/Distribution: Thick muck soil in and out of water <0.5 meters. Restricted to the far north end of North Pipe and a few locations in the southeast bays of Pipe.
Common Associates: (*Nymphaea odorata*) White water lily, (*Typha latifolia*) Broad-leaved cattail, (*Phalaris arundinacea*) Reed canary grass

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Schoenoplectus acutus*) **Hardstem bulrush**
Specimen Location: North Pipe Lake; N45.52890°, W92.20104°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-043
Habitat/Distribution: Rocky and sandy bottoms in 0-1 meter of water. Common in scattered reed beds along or on shore on both North Pipe and Pipe; especially exposed points.
Common Associates: (*Eleocharis palustris*) Creeping spikerush, (*Schoenoplectus tabernaemontani*) Softstem bulrush

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Schoenoplectus purshianus*) **Pursh's bulrush**
Specimen Location: North Pipe Lake; N45.52649°, W92.19979°
Collected/Identified by: Matthew S. Berg/Gary Fewless UWGB **Col. #:** MSB-2007-044
Habitat/Distribution: Rocky and sandy bottoms in 0 meter of water. Relatively common in scattered reed beds at the shoreline on both North Pipe and Pipe; especially exposed points.
Common Associates: (*Eleocharis palustris*) Creeping spikerush, (*Schoenoplectus acutus*) Hardstem bulrush, (*Eleocharis obtusa*) Blunt spikerush

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Schoenoplectus tabernaemontani*) **Softstem bulrush**
Specimen Location: North Pipe Lake; N45.52890°, W92.20104°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-045
Habitat/Distribution: Rocky bottoms in 0-1 meter of water. A single reed bed was located on the west shore of North Pipe Lake.
Common Associates: (*Schoenoplectus acutus*) Hardstem bulrush, (*Eleocharis palustris*) Creeping spikerush

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Schoenoplectus torreyi*) **Torrey's three-square bulrush**
Specimen Location: Pipe Lake; N45.50611°, W92.20521°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-046
Location: Numerous reed beds in the southeast bay Pipe Lake.
Habitat: Rocky bottoms in 0-1 meter of water.
Common Associates: (*Schoenoplectus acutus*) Hardstem bulrush, (*Eleocharis palustris*) Creeping spikerush

County/State: Polk County, Wisconsin **Date:** 8/11/13
Species: (*Scirpus cyperinus*) **Woolgrass**
Specimen Location: Pipe Lake; N45.52464°, W92.20121°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2013-311
Habitat/Distribution: Firm sand at the shoreline. A few plants were scattered along exposed lake bed areas and in the wetlands adjacent to the southern bays.
Common Associates: (*Phalaris arundinacea*) Reed canary grass, (*Schoenoplectus acutus*) Hardstem bulrush, (*Equisetum fluviatile*) Water horsetail, (*Glyceria borealis*) Northern manna-grass

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Sparganium androcladum*) **Branched bur-reed**
Specimen Location: Pipe Lake; N45.50611°, W92.20521°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-047
Habitat/Distribution: Muck and muck over gravel bottoms at the shoreline. One location on Pipe. All individuals were in fruit, and it is likely Shining bur-reed (*Sparganium androcladum*).
Common Associates: (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sagittaria latifolia*) Common arrowhead

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Sparganium emersum*) **Short-stemmed bur-reed**
Specimen Location: North Pipe Lake; N45.53105°, W92.20151°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-048
Habitat/Distribution: Muck and muck over gravel bottoms in 0-1 meter of water. Two locations on North Pipe. No individuals were in fruit on any of three visits making species confirmation difficult. Most of the keeled leaves were floating, but scattered individuals were tipping up out of water.
Common Associates: (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Najas flexilis*) Slender naiad, (*Sparganium fluctuans*) Floating-leaf bur-reed

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Sparganium fluctuans*) **Floating-leaf bur-reed**
Specimen Location: North Pipe Lake; N45.52971°, W92.20069°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-049
Habitat/Distribution: Muck and muck over gravel bottoms in 0-0.5 meters of water. Scattered locations directly along shore in bays of both lakes.
Common Associates: (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Najas flexilis*) Slender naiad

County/State: Polk County, Wisconsin **Date:** 9/22/13
Species: (*Spartina pectinata*) **Prairie cord grass**
Specimen Location: Pipe Lake; N45.52574°, W92.20178°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2013-312
Habitat/Distribution: Firm sand at the shoreline. A few plants were scattered along the north shore near the Pipe Lake Boat Landing.
Common Associates: (*Phalaris arundinacea*) Reed canary grass

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Spirodela polyrhiza*) **Large duckweed**
Specimen Location: North Pipe Lake; N45.52649°, W92.19979°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-050
Habitat/Distribution: Located floating at or just under the surface in sheltered areas. Rare in the far northeast and southeast bay of North Pipe. Scattered individuals occur interspersed between the lilypads.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Nuphar variegata)* Spatterdock, (*Pontederia cordata*) Pickerelweed, (*Lemna minor*) Small duckweed

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Typha latifolia*) **Broad-leaved cattail**
Specimen Location: North Pipe Lake; N45.52703°, W92.19981°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-051
Habitat/Distribution: Thick muck soil in and out of water <0.5 meters. Restricted to locations near the North Pipe Lake inlet.
Common Associates: (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Cicuta bulbifera*) Bulb-bearing water hemlock, (*Sagittaria latifolia*) Common arrowhead

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Utricularia gibba*) **Creeping bladderwort**
Specimen Location: Pipe Lake; N45.50831°, W92.20635°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-052
Habitat/Distribution: Muck bottom in shallow water 0-1.5 meters deep. Common floating among floating leaf species in mucky areas of the Southeast bays of Pipe.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Brasenia schreberi*) Watershield, (*Eleocharis robbinsii*) Robbins spikerush, (*Nymphaea odorata*) White water lily

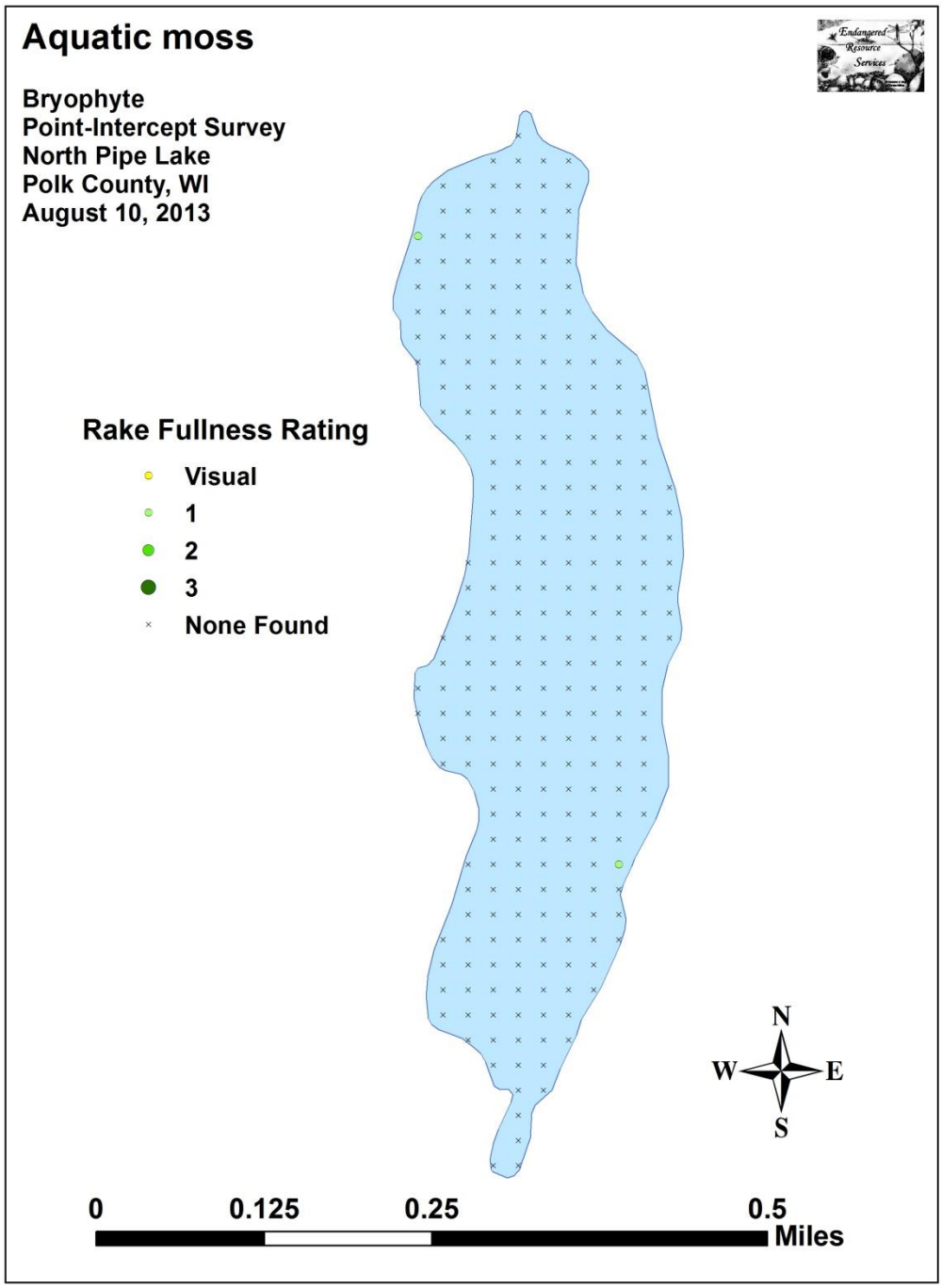
County/State: Polk County, Wisconsin **Date:** 8/11/13
Species: (*Utricularia minor*) **Small bladderwort**
Specimen Location: Pipe Lake; N45.50608°, W92.20679°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2013-313
Habitat/Distribution: Muck bottom in shallow water 0-1.5 meters deep. Rare in mucky areas of the southeast bays of Pipe and scattered throughout North Pipe.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Brasenia schreberi*) Watershield, (*Eleocharis robbinsii*) Robbins spikerush, (*Nymphaea odorata*) White water lily

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Utricularia resupinata*) **Small purple bladderwort**
Specimen Location: North Pipe Lake; N45.52964°, W92.20083°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-053
Habitat/Distribution: Sand to sandy muck in sheltered areas. Located in 0-1 meter of water, but only flowers in water <.1m. Relatively common throughout Pipe Lake in sandy, undisturbed areas. Rare in North Pipe being found at only 1 location.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Juncus pelocarpus*) Brown-fruited rush, (*Eriocaulon aquaticum*) Pipewort, (*Myriophyllum tenellum*) Dwarf water milfoil

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Utricularia vulgaris*) **Common bladderwort**
Specimen Location: North Pipe Lake; N45.53024°, W92.20148°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-054
Habitat/Distribution: Muck bottom in shallow water 0-1.5 meters deep. Common floating among floating leaf species in mucky sheltered areas of both Pipe and North Pipe.
Common Associates: (*Potamogeton epihydrus*) Ribbon-leaf pondweed, (*Utricularia gibba*) Creeping bladderwort, (*Brasenia schreberi*) Watershield, (*Eleocharis robbinsii*) Robbins spikerush

County/State: Polk County, Wisconsin **Date:** 8/3/07
Species: (*Vallisneria americana*) **Wild celery**
Specimen Location: North Pipe Lake; N45.53617°, W92.20171°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2007-055
Habitat/Distribution: Found in almost any bottom conditions, but grows best in sandy to sand/muck bottoms in 0.5-1.5 meters of water. Common and widely distributed though seldom abundant in Pipe; relatively uncommon in North Pipe.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Potamogeton spirillus*) Spiral-fruited pondweed

Appendix VII: 2013 Species Density and Distribution Maps


Aquatic moss
Bryophyte
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Rake Fullness Rating
Visual
1
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None Found
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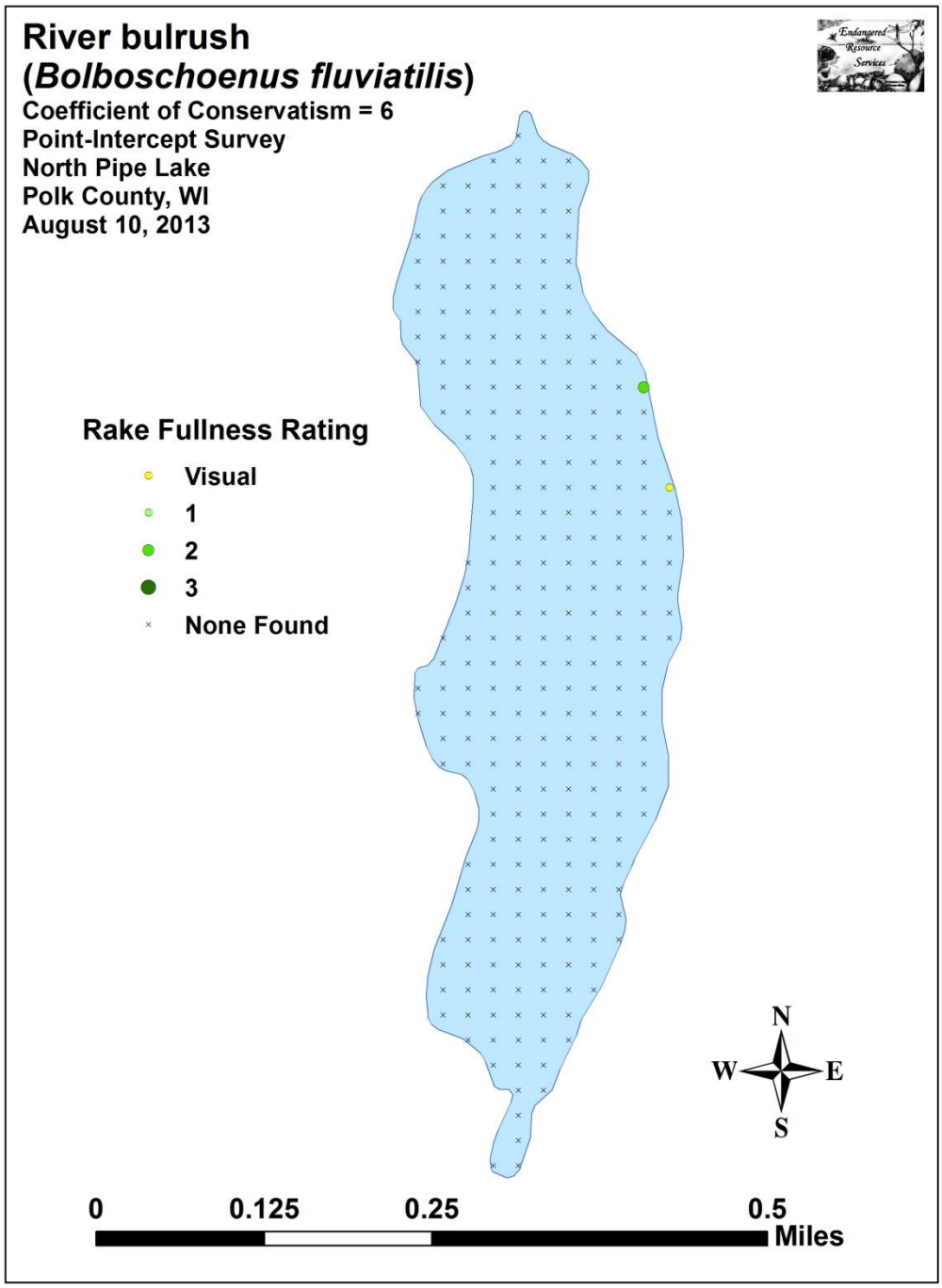
0
0.125
0.25
0.5
Miles


River bulrush
(Bolboschoenus fluviatilis)
Coefficient of Conservatism = 6
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Rake Fullness Rating
Visual
1
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None Found
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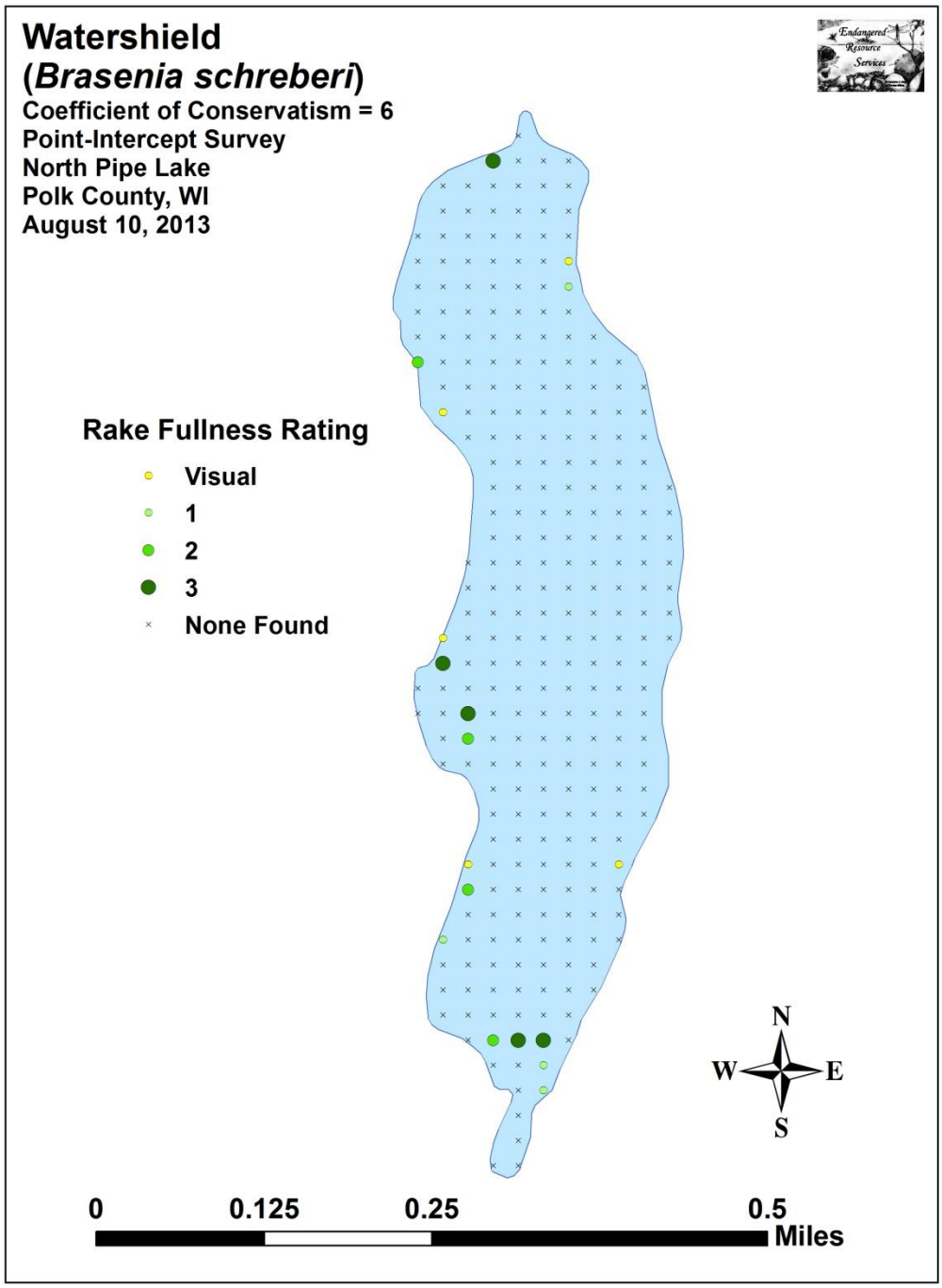
0.125
0.25
0.5
Miles


Watershield
(Brasenia schreberi)
Coefficient of Conservatism = 6
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Rake Fullness Rating
Visual
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None Found
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0.125
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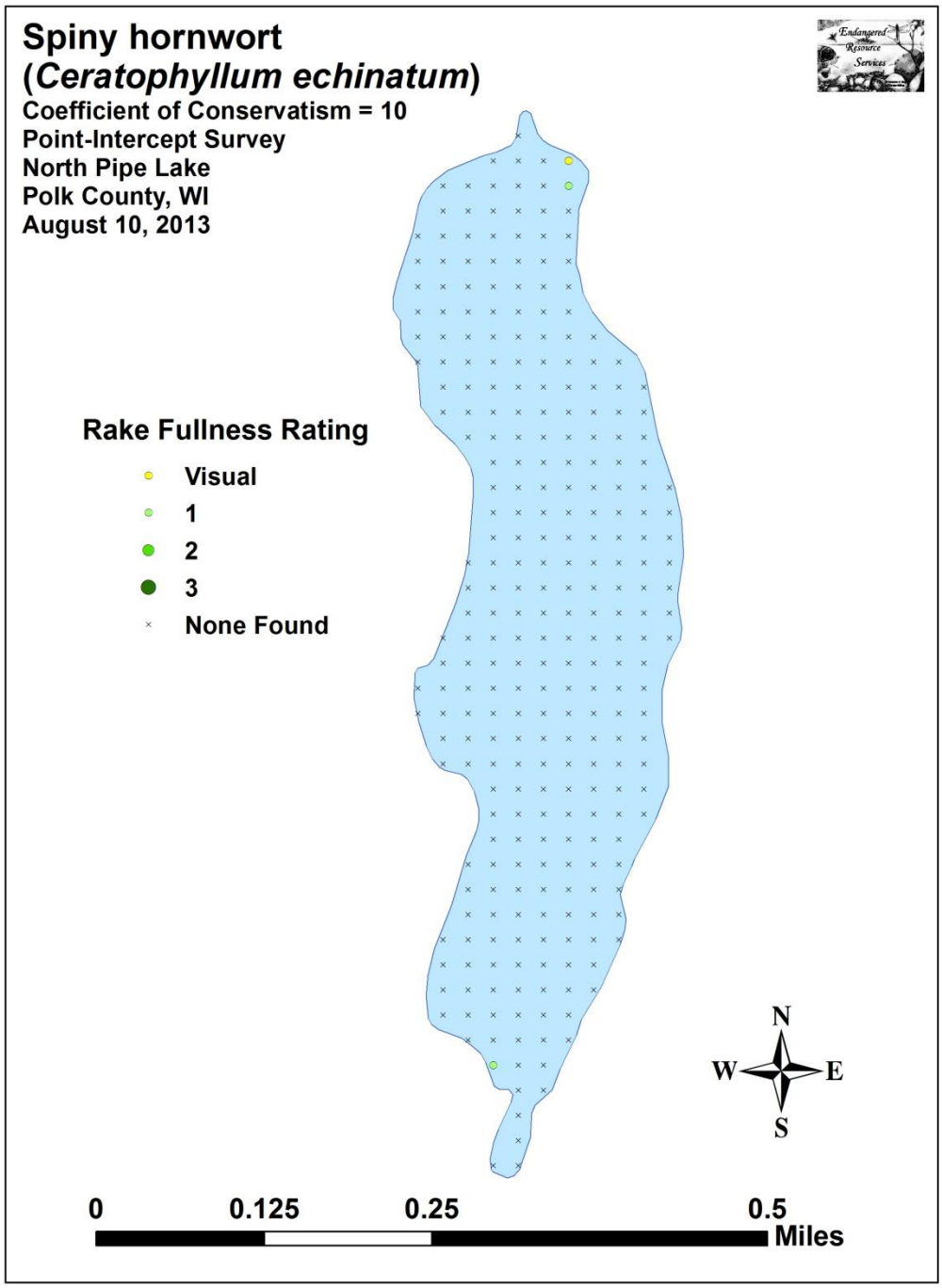
0.5
Miles


Spiny hornwort
(Ceratophyllum echinatum)
Coefficient of Conservatism = 10
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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0.125
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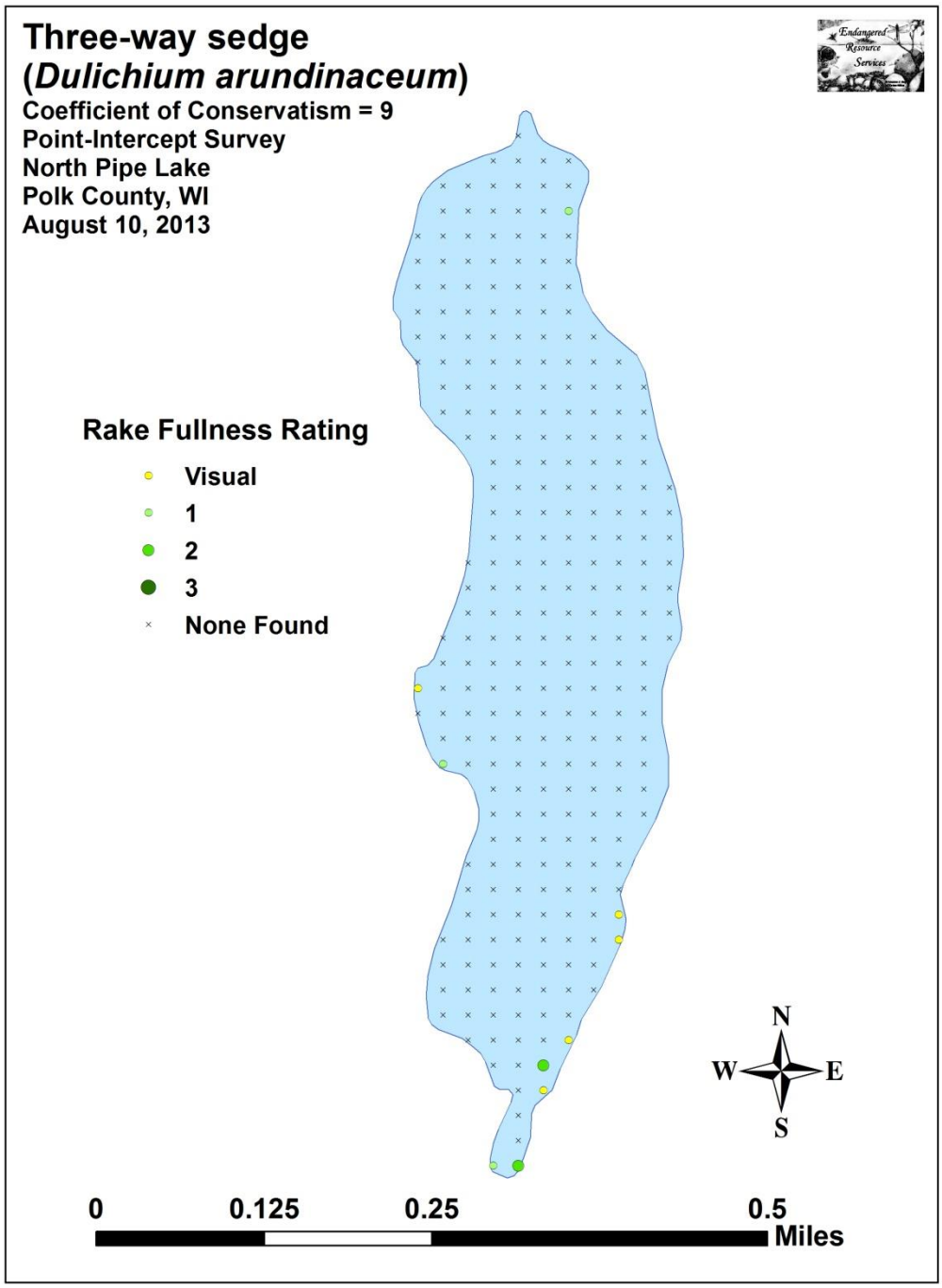
Miles


Three-way sedge
(Dulichium arundinaceum)
Coefficient of Conservatism = 9
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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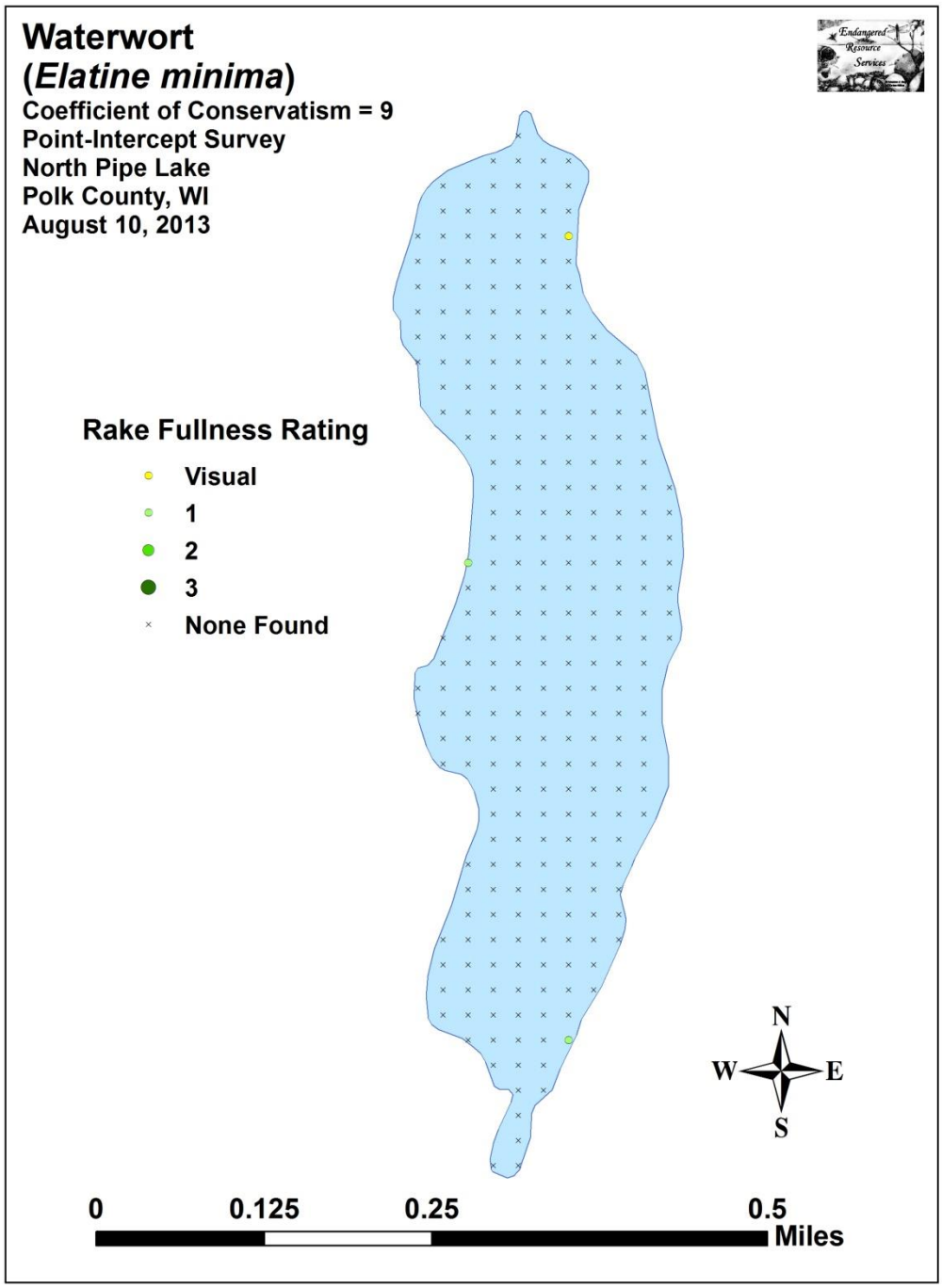
Miles


Waterwort
(Elatine minima)
Coefficient of Conservatism = 9
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Rake Fullness Rating
Visual
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None Found
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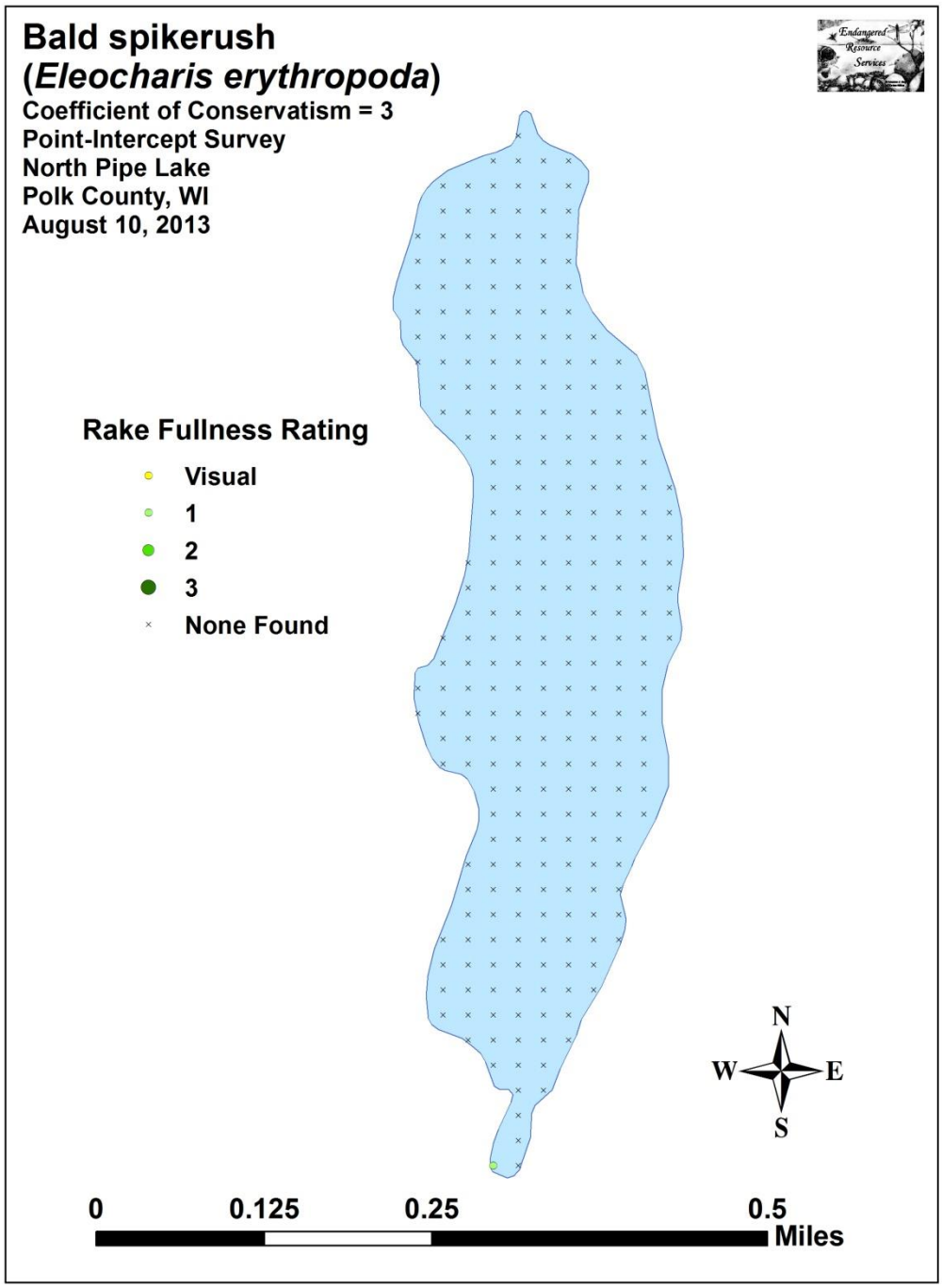
Miles


Bald spikerush
(Eleocharis erythropoda)
Coefficient of Conservatism = 3
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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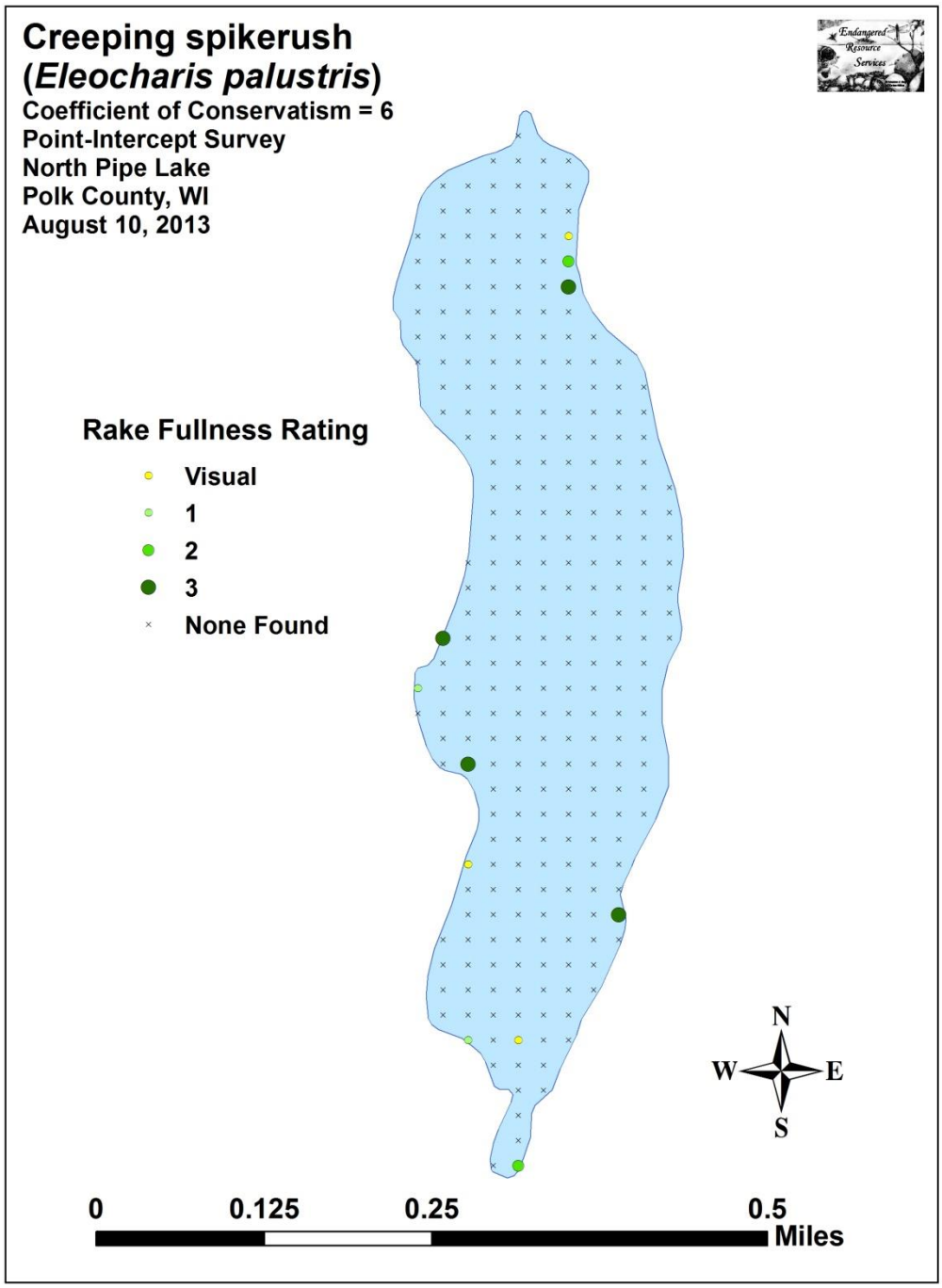
Miles


Creeping spikerush
(Eleocharis palustris)
Coefficient of Conservatism = 6
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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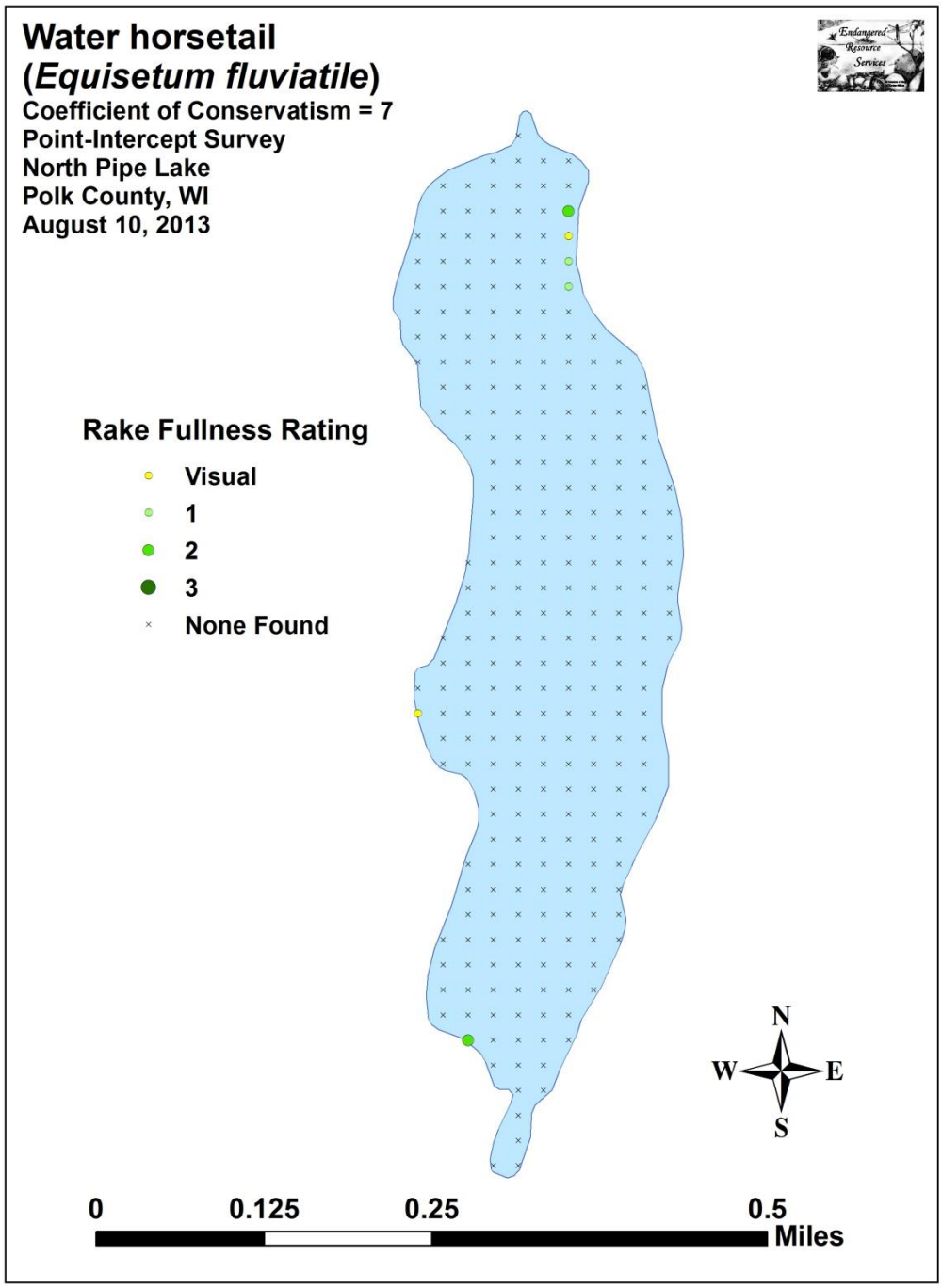
Miles


Water horsetail
(Equisetum fluviatile)
Coefficient of Conservatism = 7
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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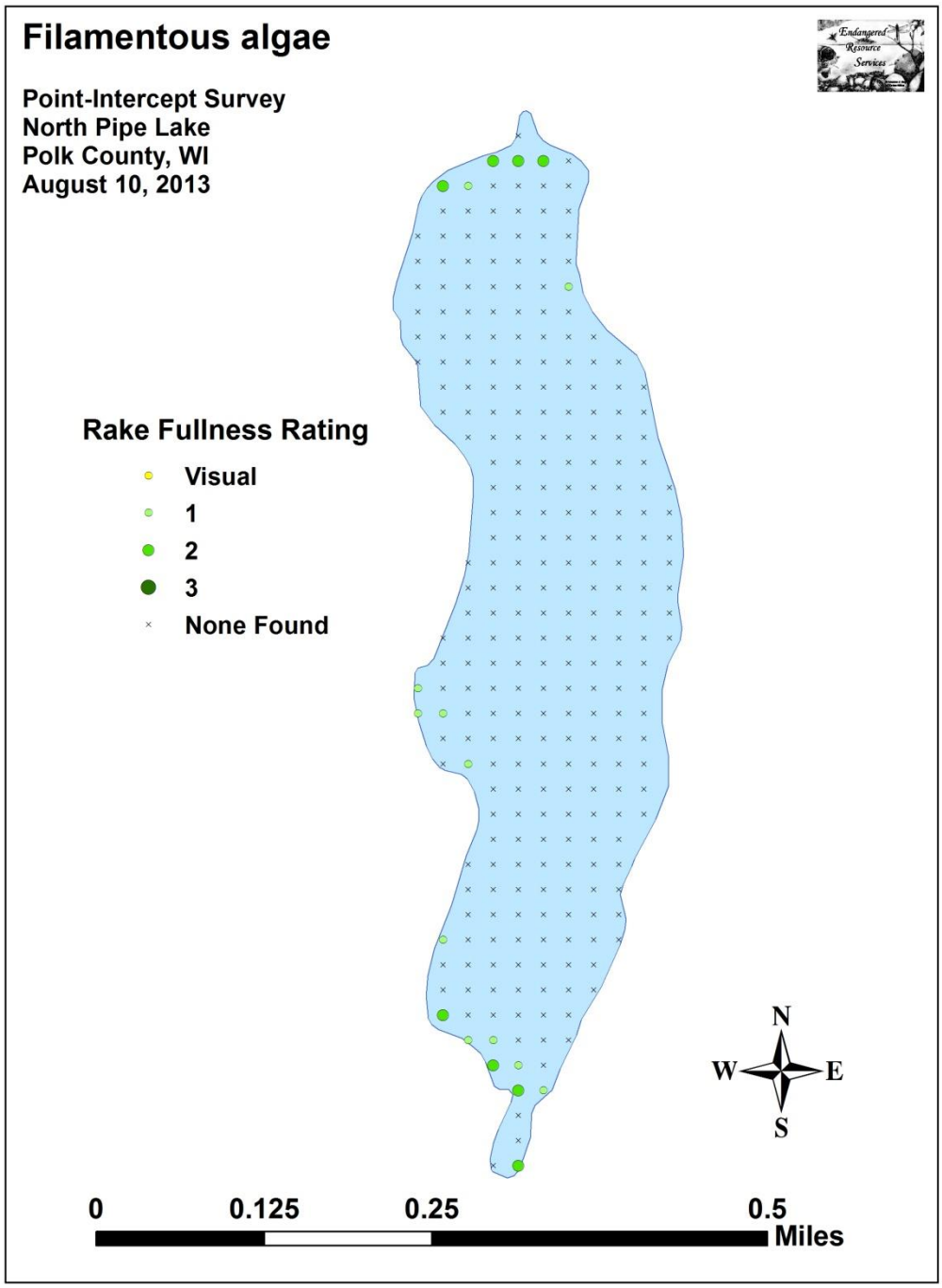
Miles


Filamentous algae
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Rake Fullness Rating
Visual
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None Found
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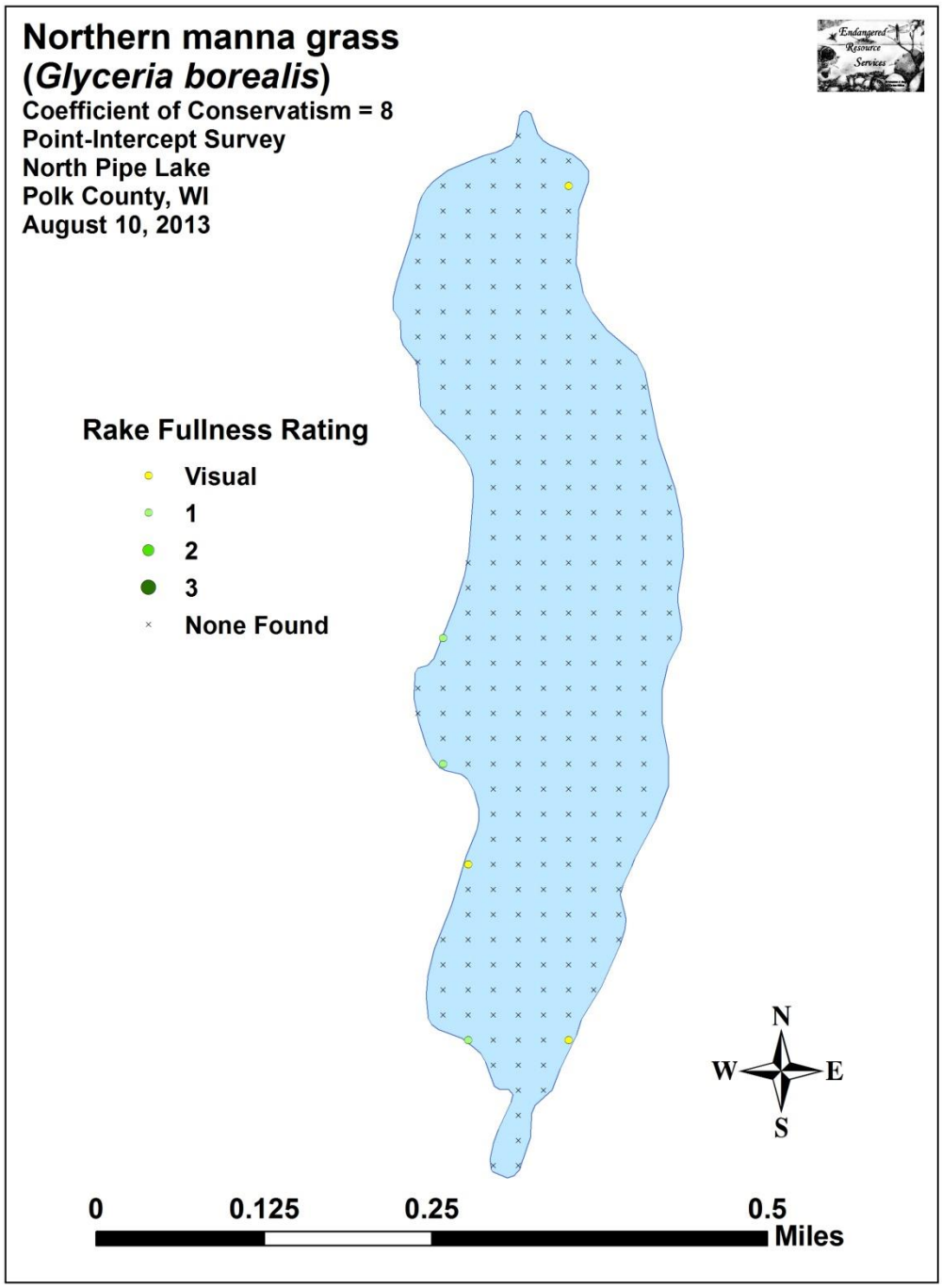
Miles


Northern manna grass
(Glyceria borealis)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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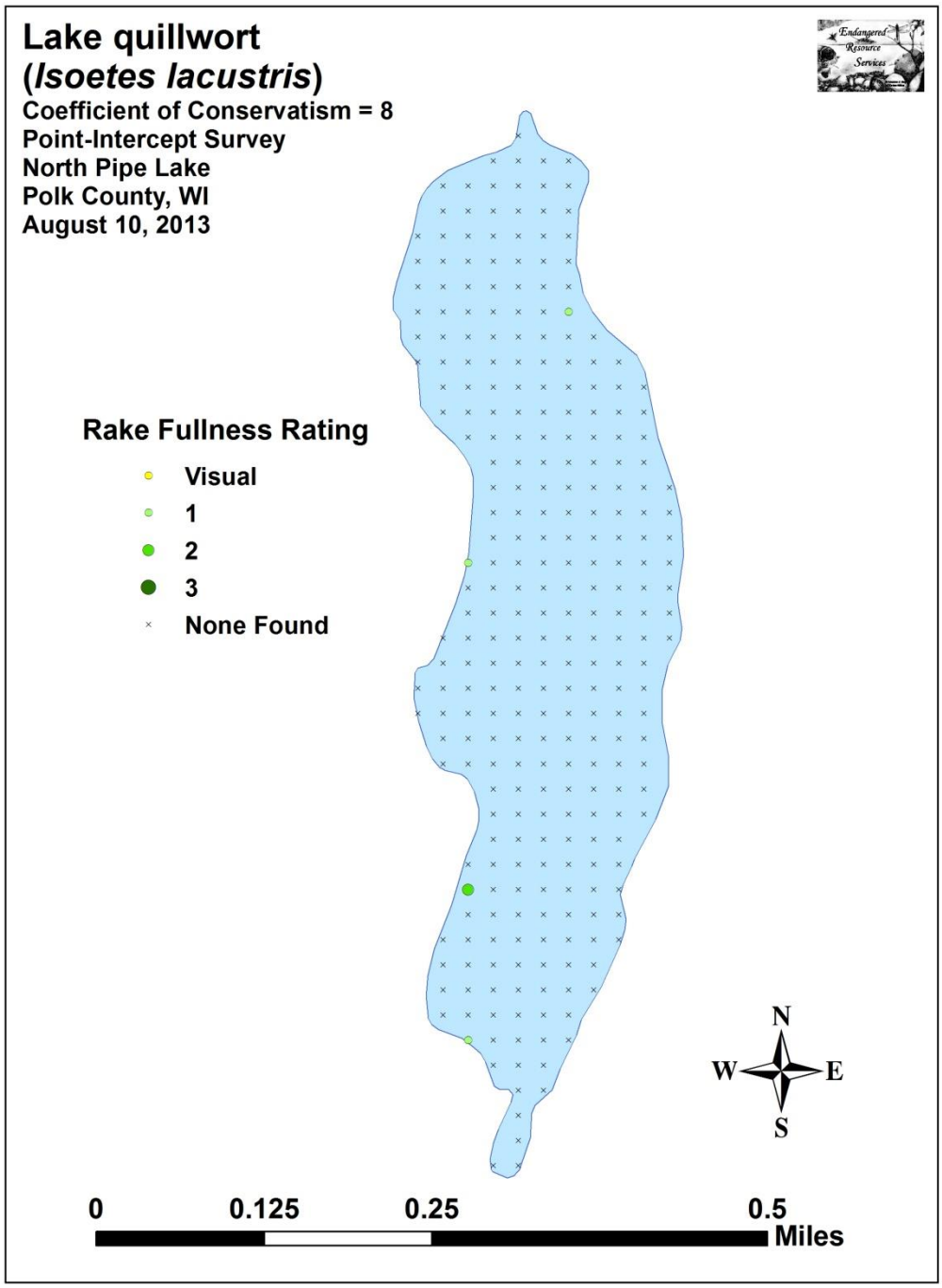
Miles


Lake quillwort
(Isoetes lacustris)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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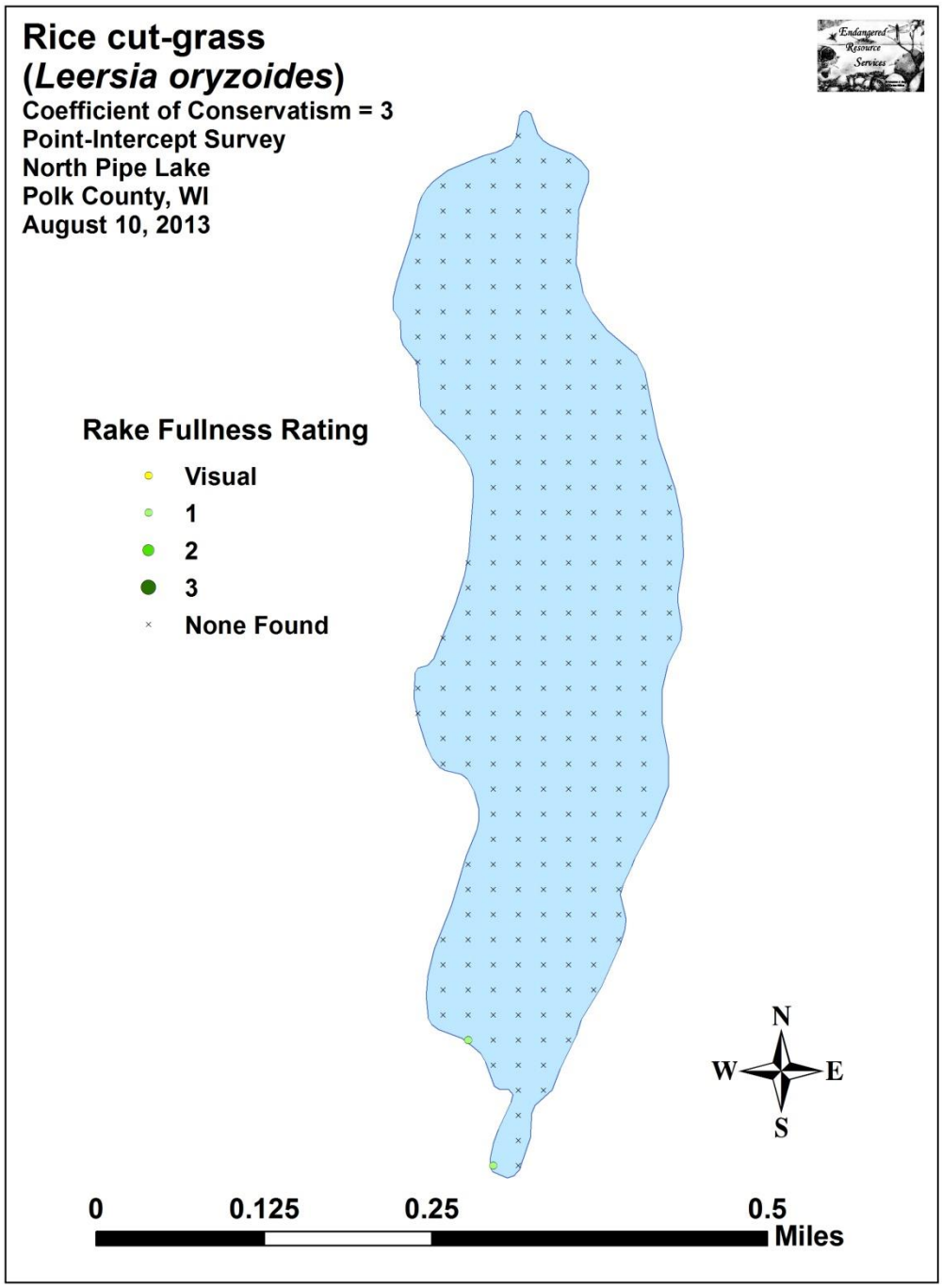
Miles


Rice cut-grass
(Leersia oryzoides)
Coefficient of Conservatism = 3
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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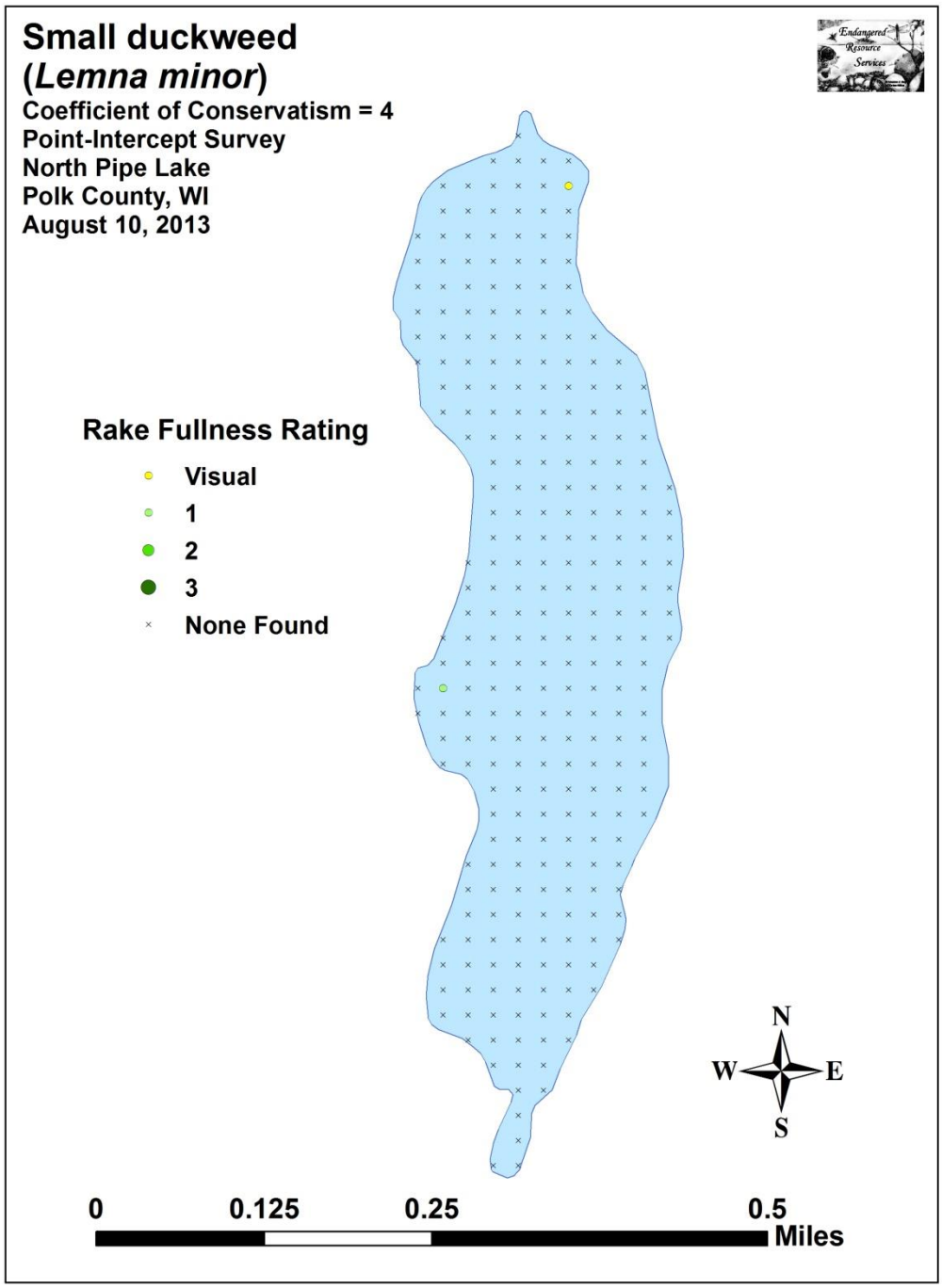
Miles


Small duckweed
(Lemna minor)
Coefficient of Conservatism = 4
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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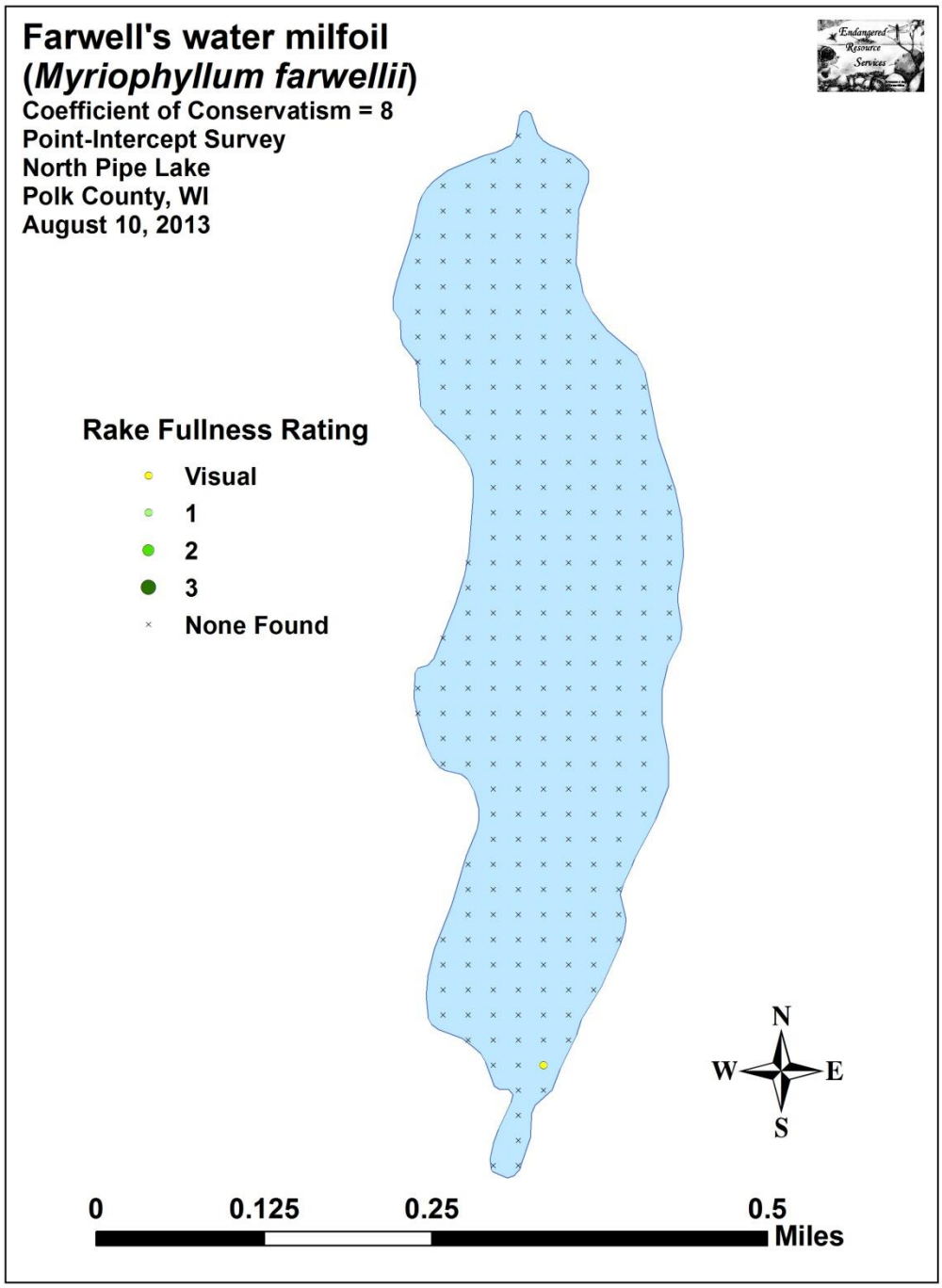
Miles


Farwell's water milfoil
(Myriophyllum farwellii)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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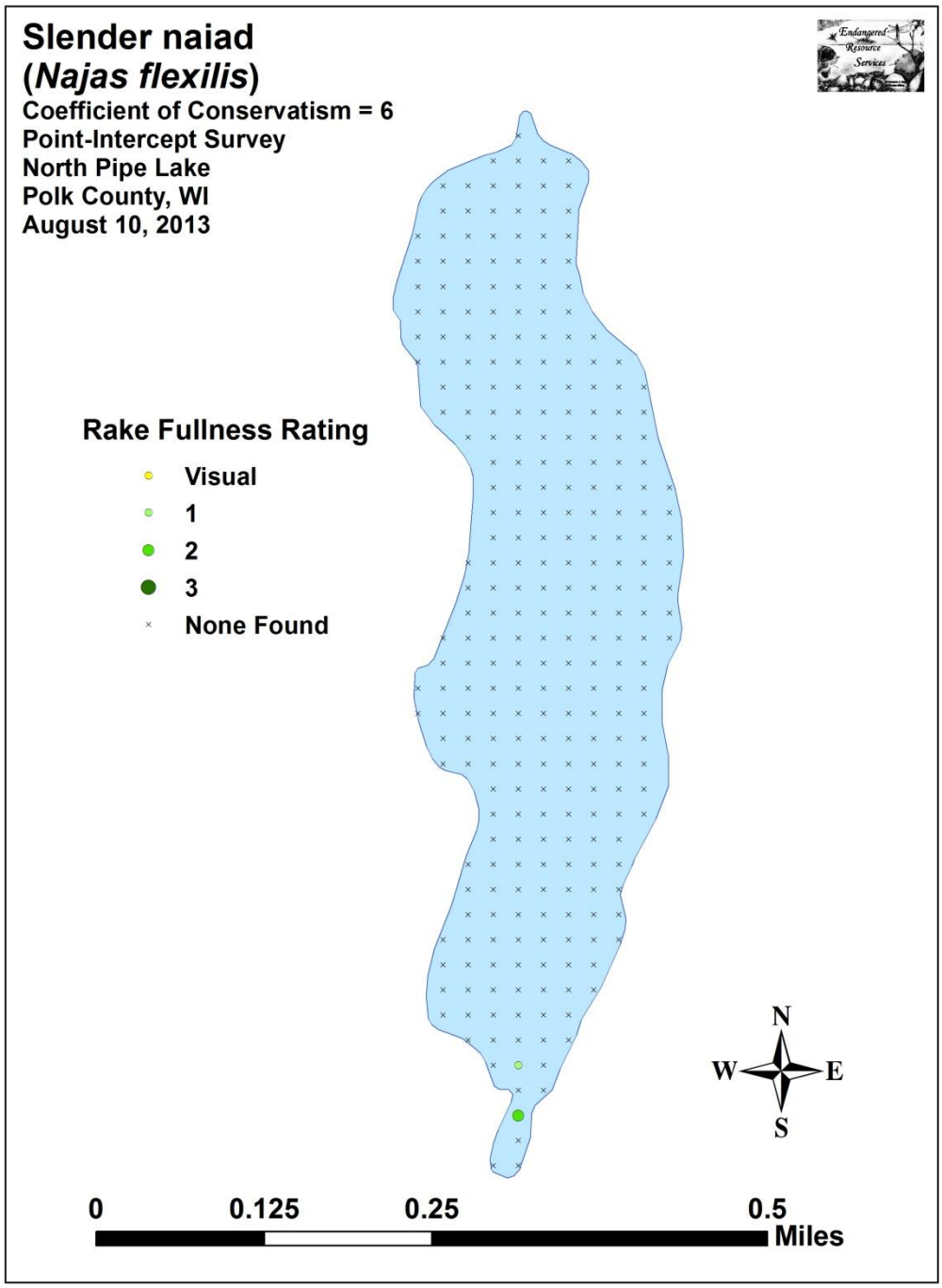
Miles


Slender naiad
(Najas flexilis)
Coefficient of Conservatism = 6
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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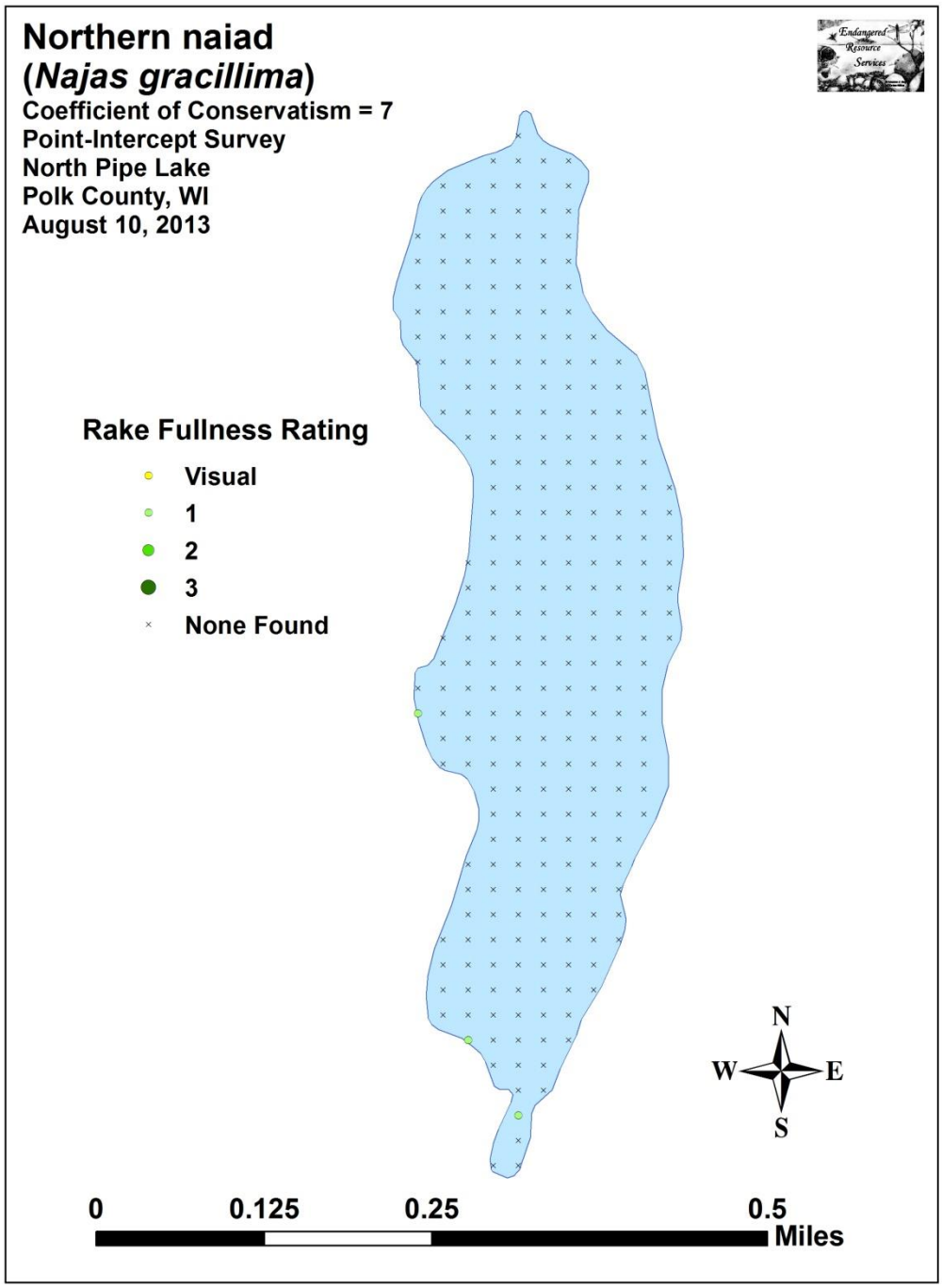
Miles


Northern naiad
(Najas gracillima)
Coefficient of Conservatism = 7
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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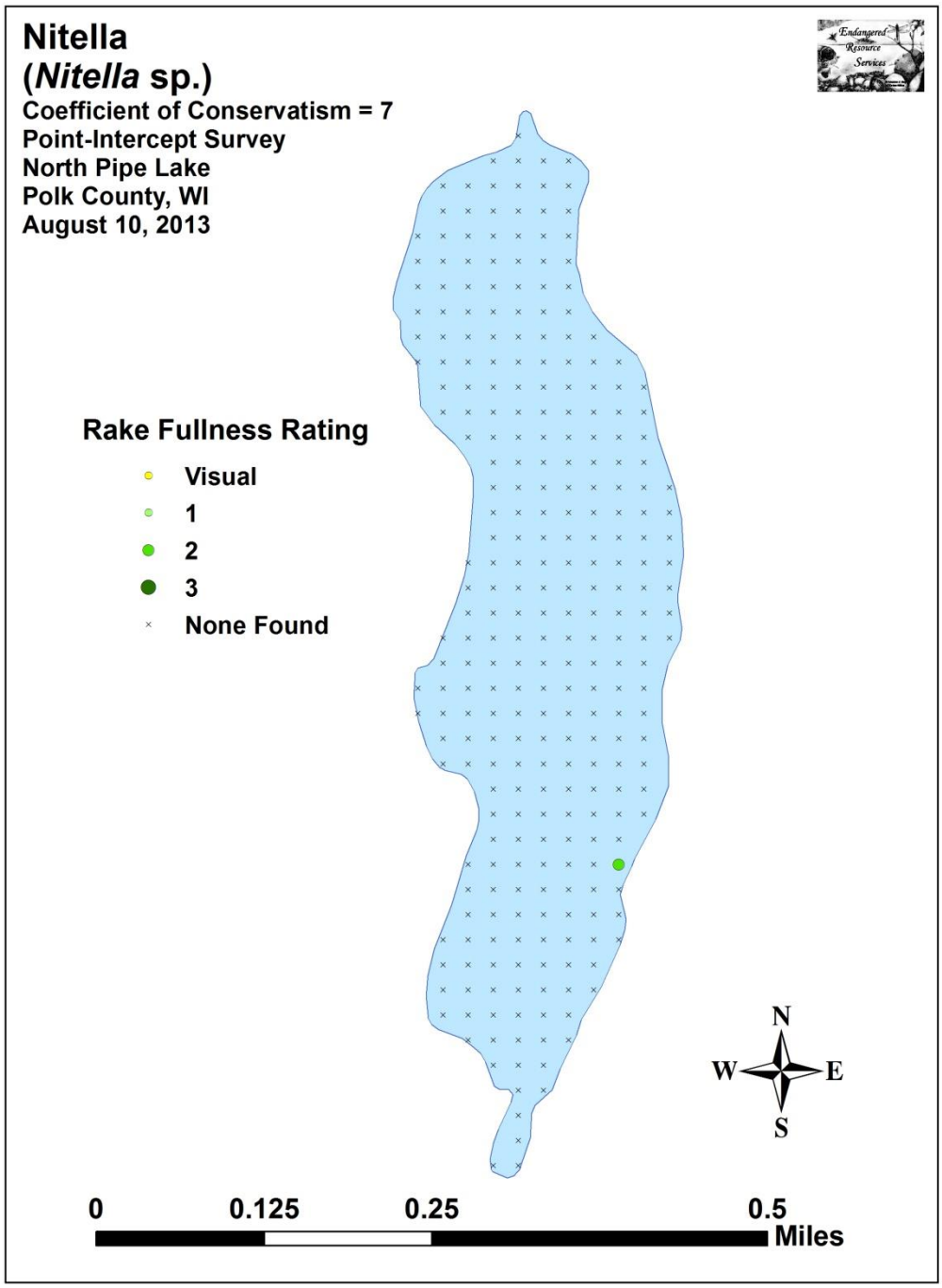
Miles


Nitella
(*Nitella* sp.)
Coefficient of Conservatism = 7
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
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0.125
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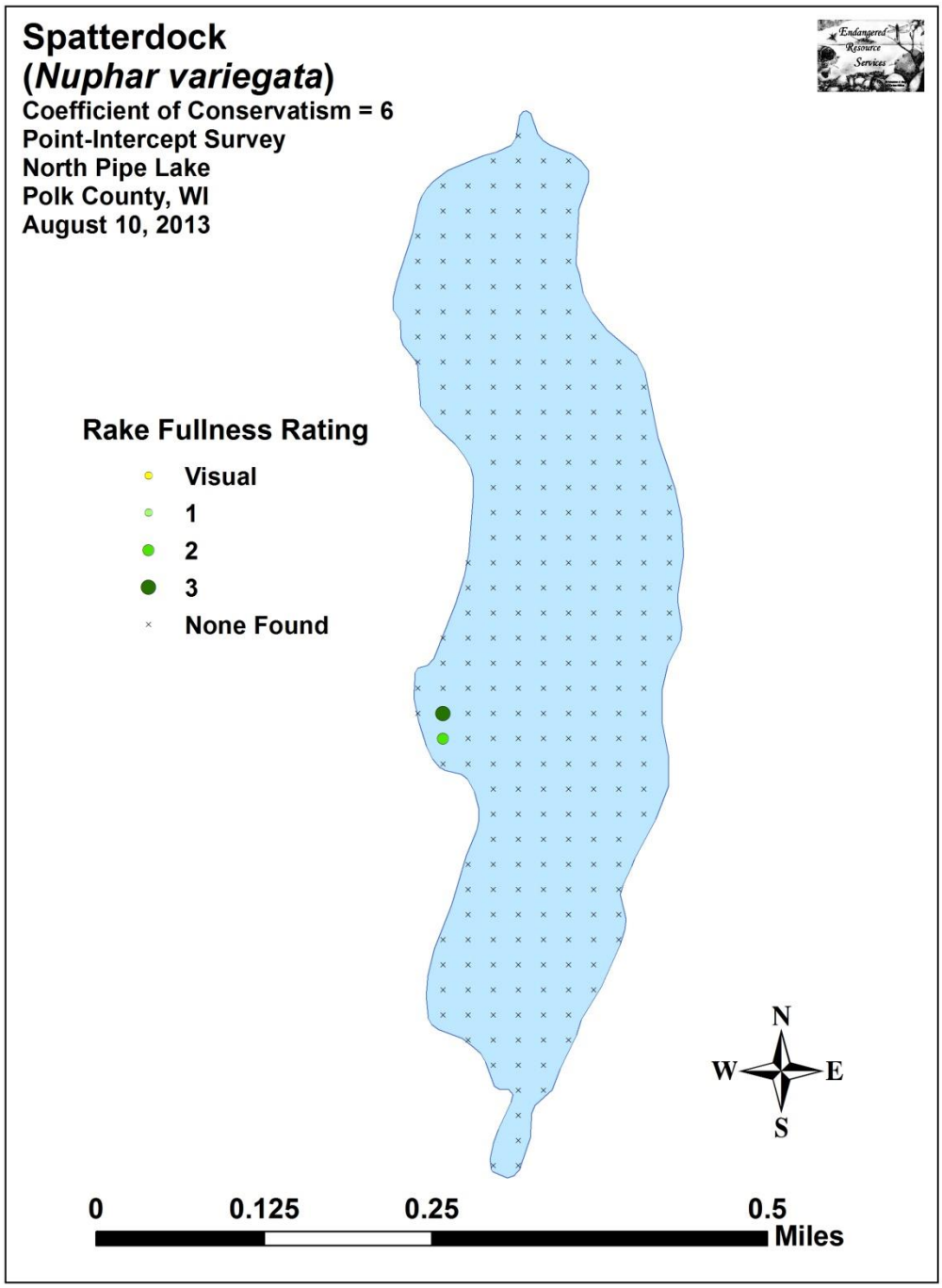
0.5
Miles


Spatterdock
(Nuphar variegata)
Coefficient of Conservatism = 6
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
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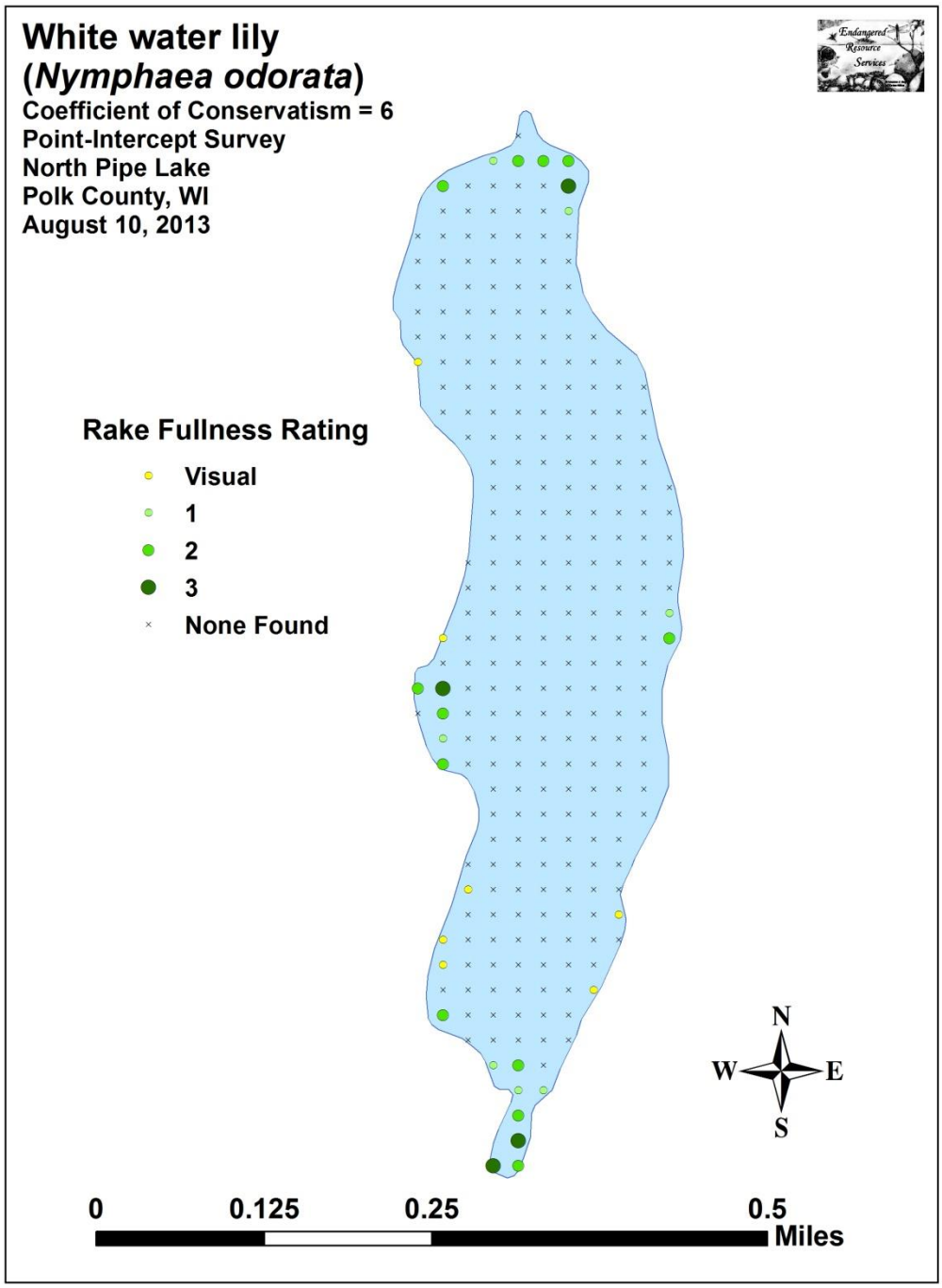
0.125
0.25
0.5
Miles


White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
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3
None Found
N
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0.125
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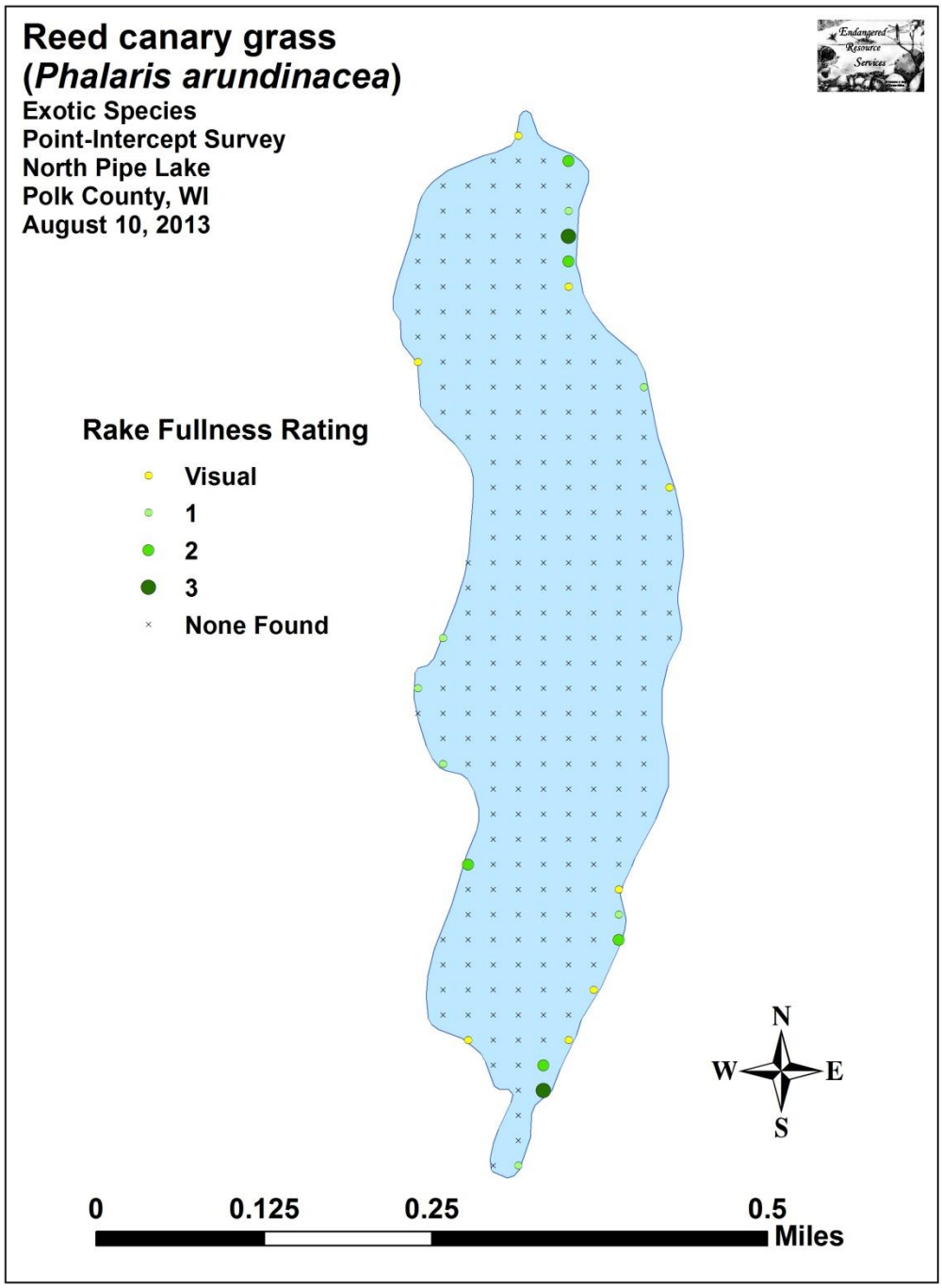
0.5
Miles


Reed canary grass
(Phalaris arundinacea)
Exotic Species
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
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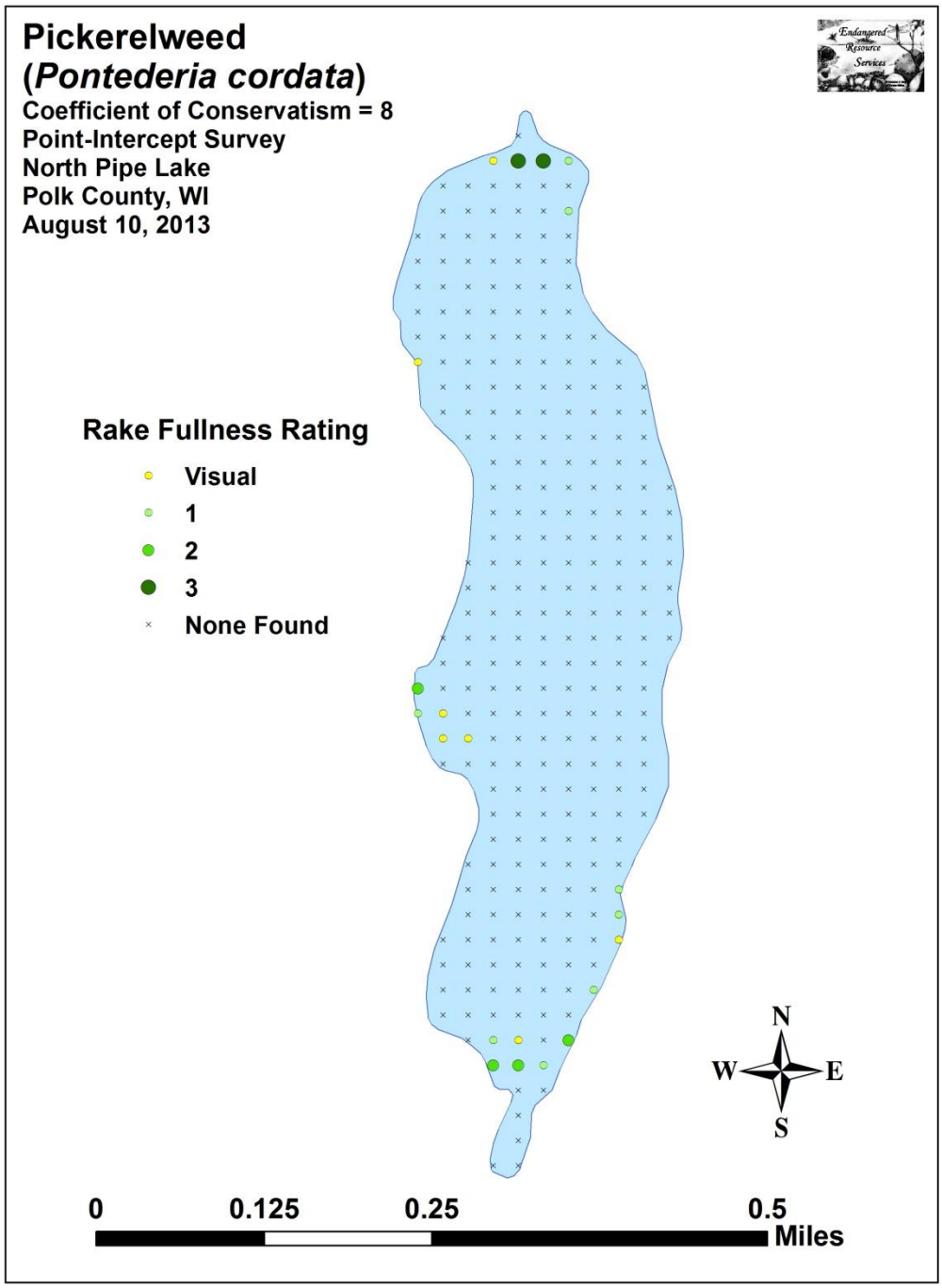
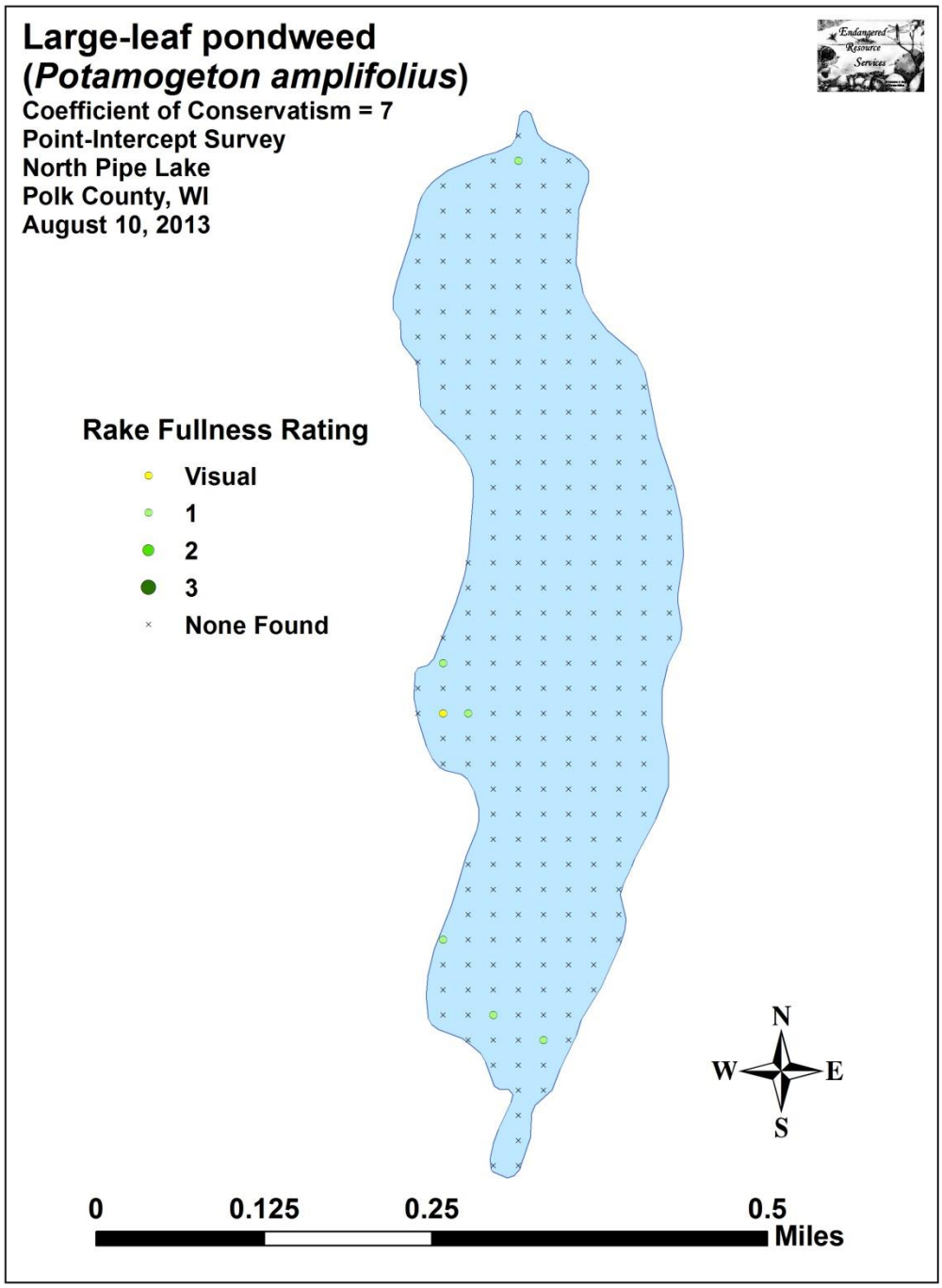
0
0.125
0.25
0.5
Miles


Pickerelweed
(Pontederia cordata)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Large-leaf pondweed
(Potamogeton amplifolius)
Coefficient of Conservatism = 7
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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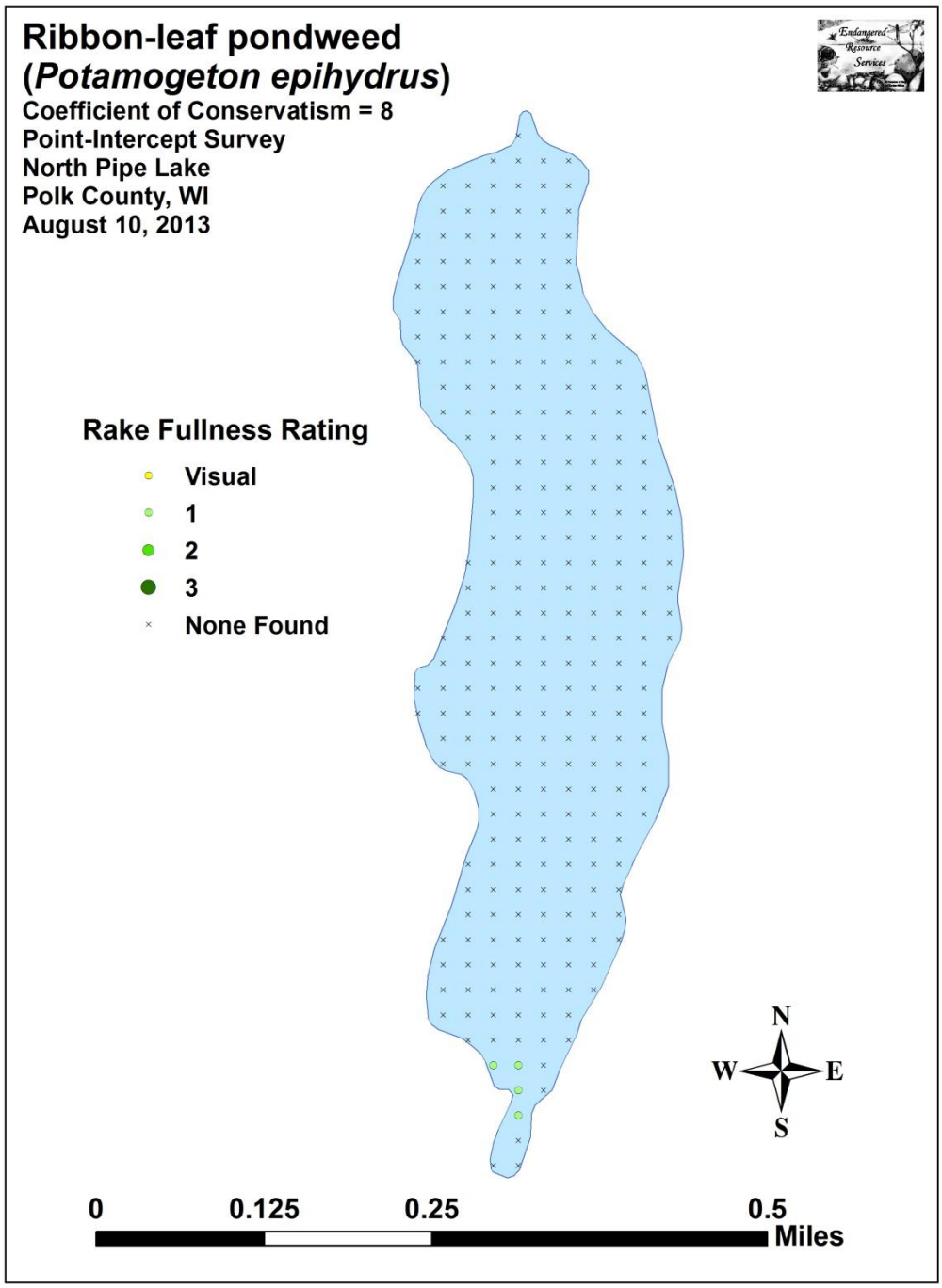
Miles


Ribbon-leaf pondweed
(Potamogeton epihydrus)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Rake Fullness Rating
Visual
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None Found
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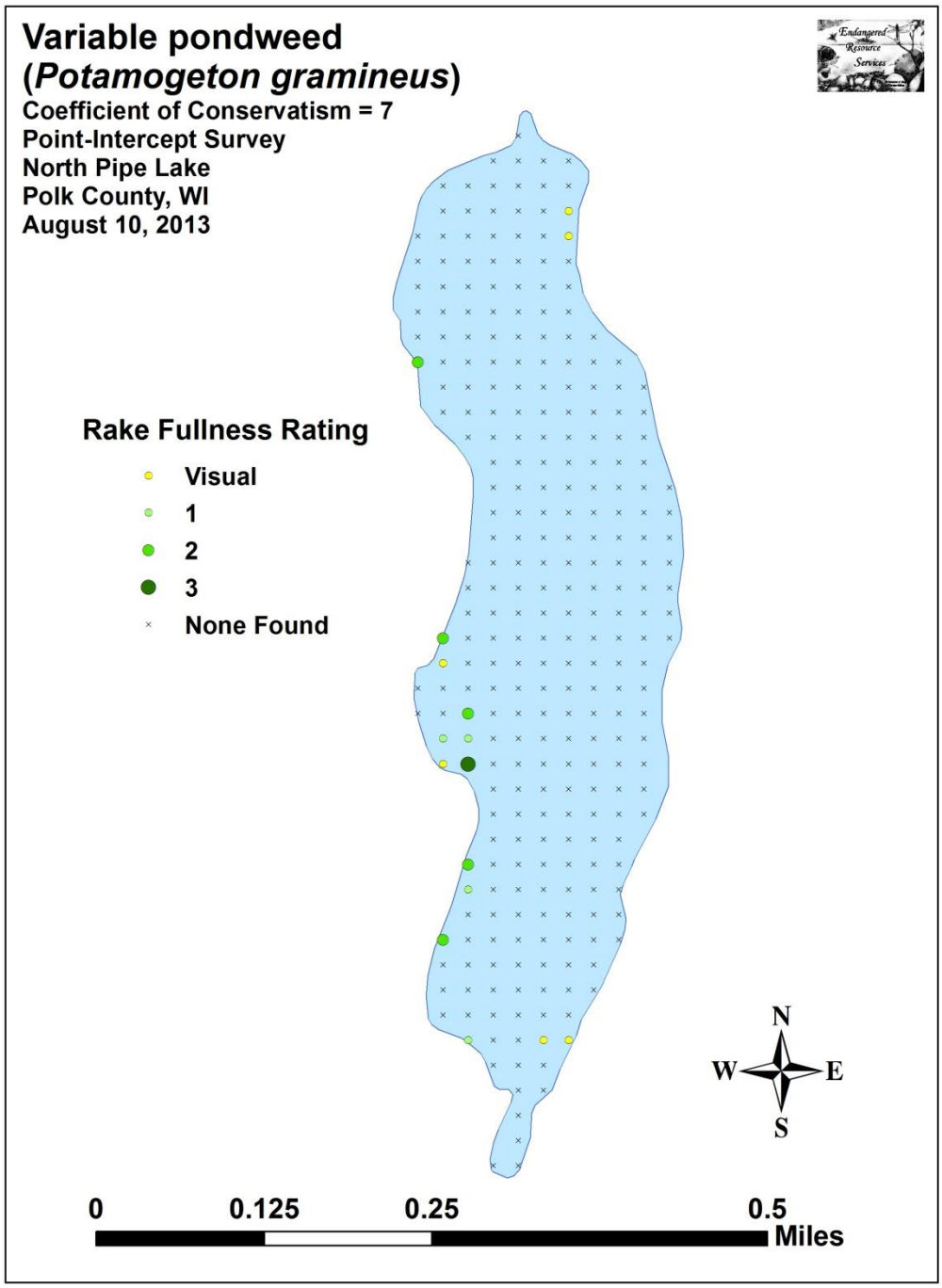
Miles


Variable pondweed
(Potamogeton gramineus)
Coefficient of Conservatism = 7
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Rake Fullness Rating
Visual
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None Found
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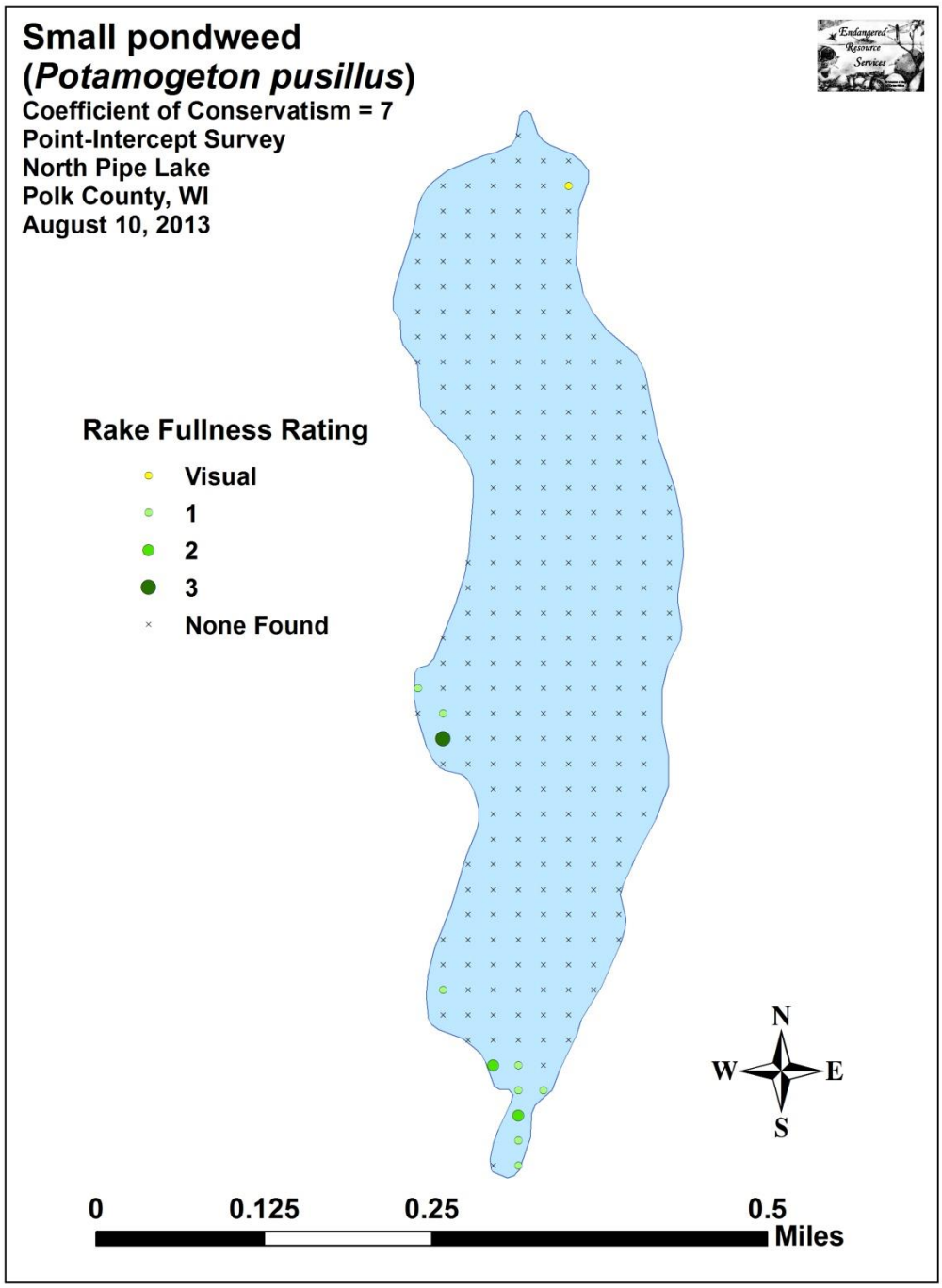
Miles


Small pondweed
(Potamogeton pusillus)
Coefficient of Conservatism = 7
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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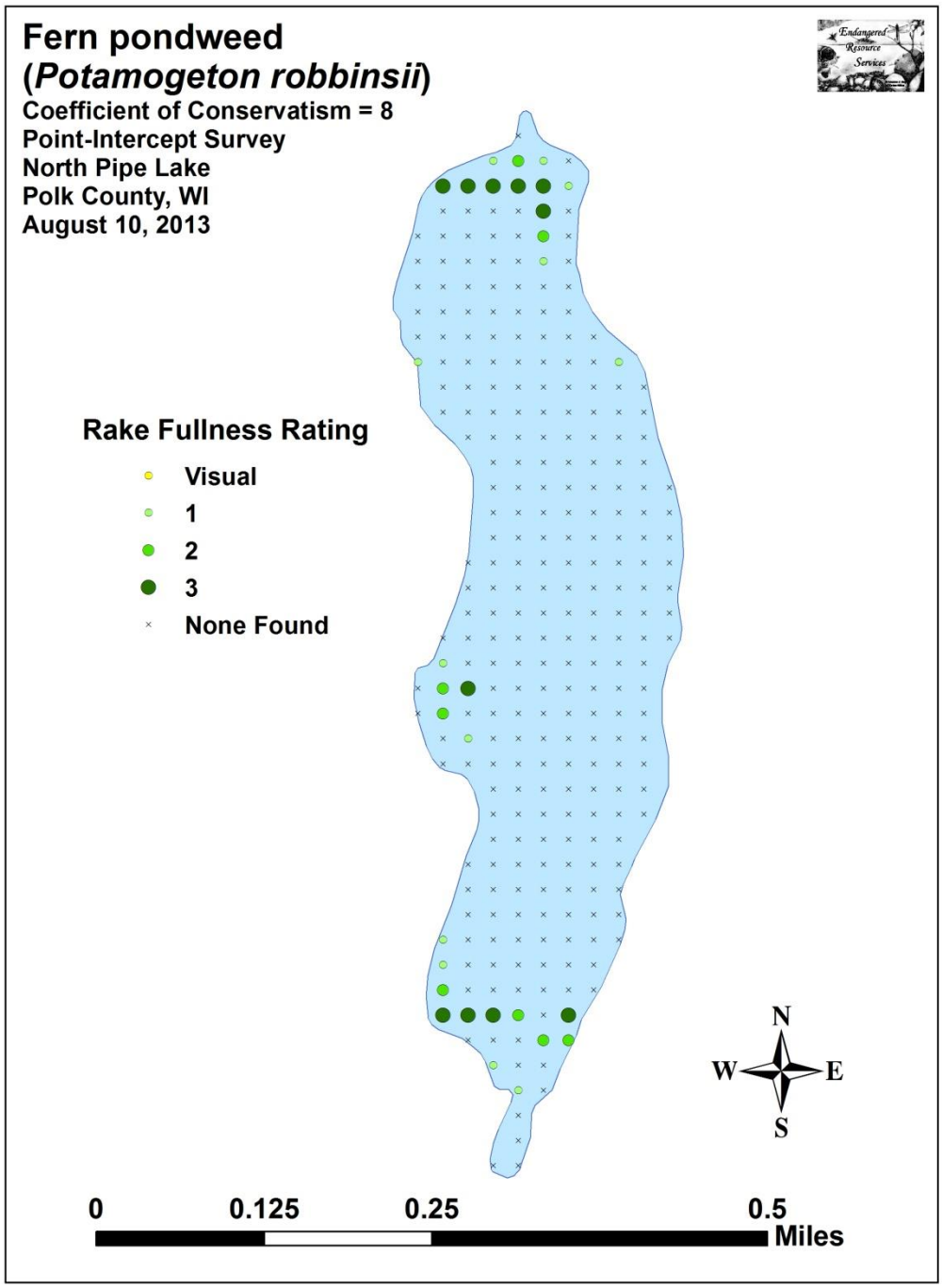
Fern pondweed
(Potamogeton robbinsii)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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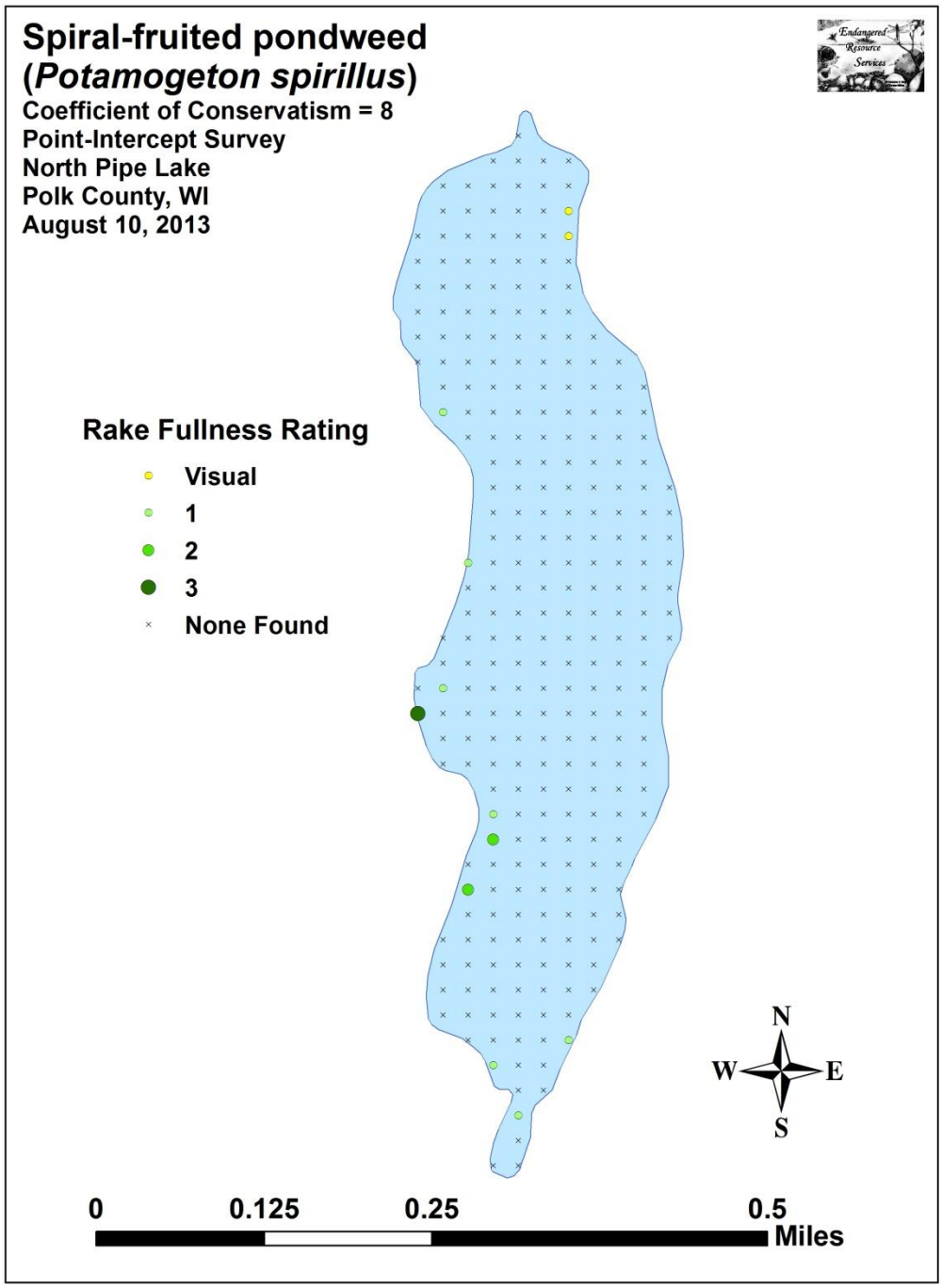
Miles


Spiral-fruited pondweed
(Potamogeton spirillus)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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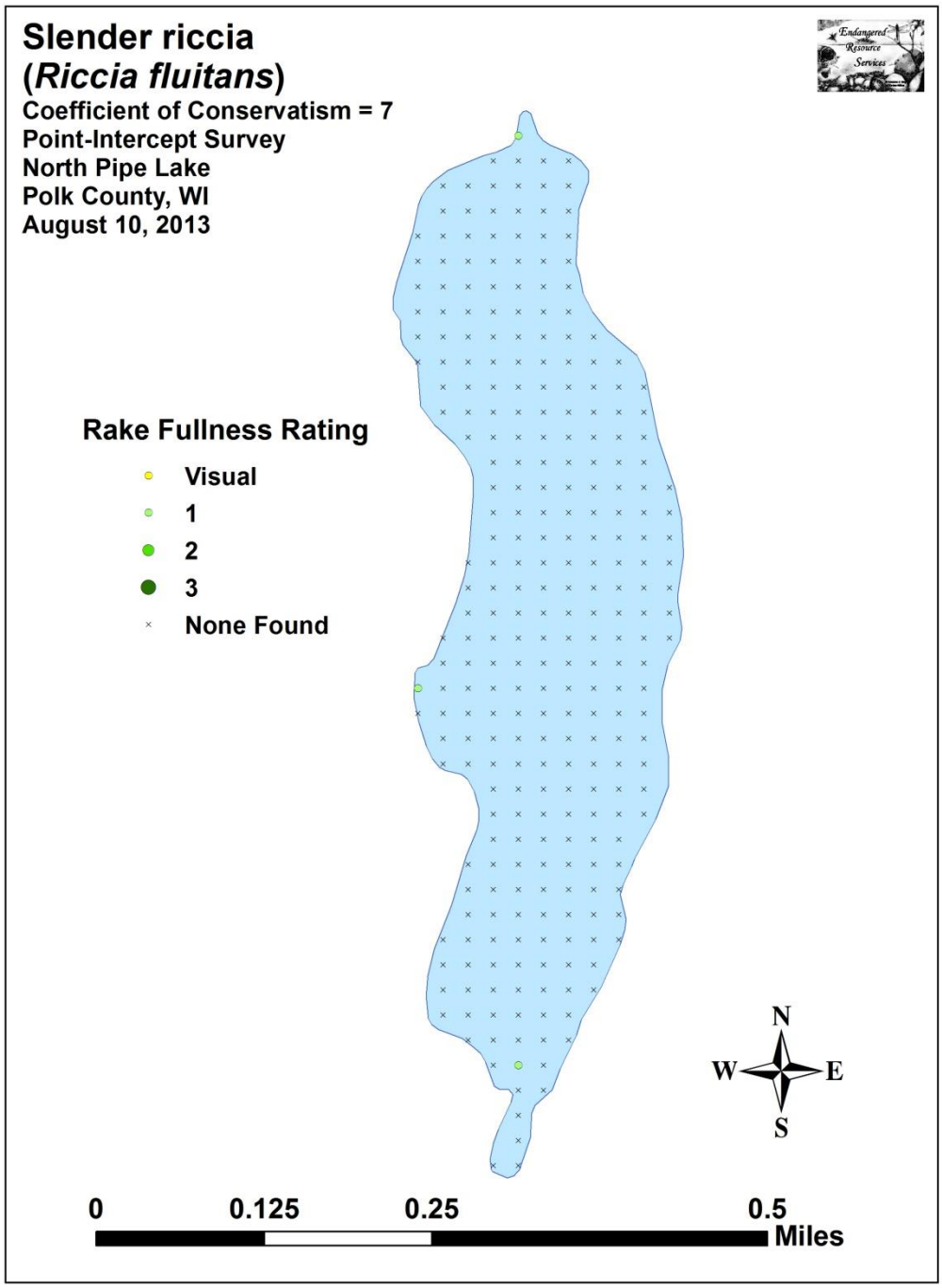
Miles


Slender riccia
(Riccia fluitans)
Coefficient of Conservatism = 7
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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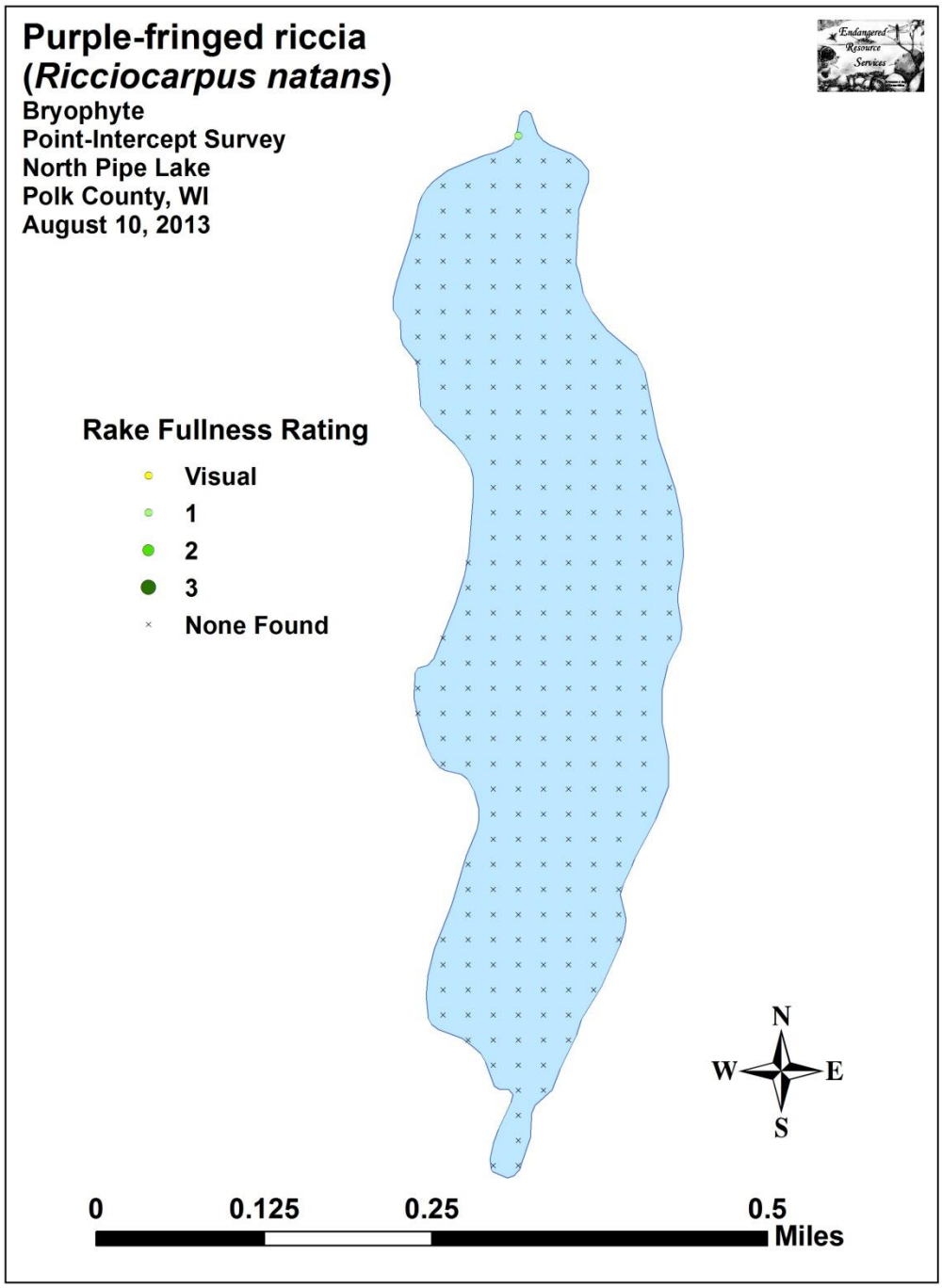
Miles


Purple-fringed riccia
(Ricciocarpus natans)
Bryophyte
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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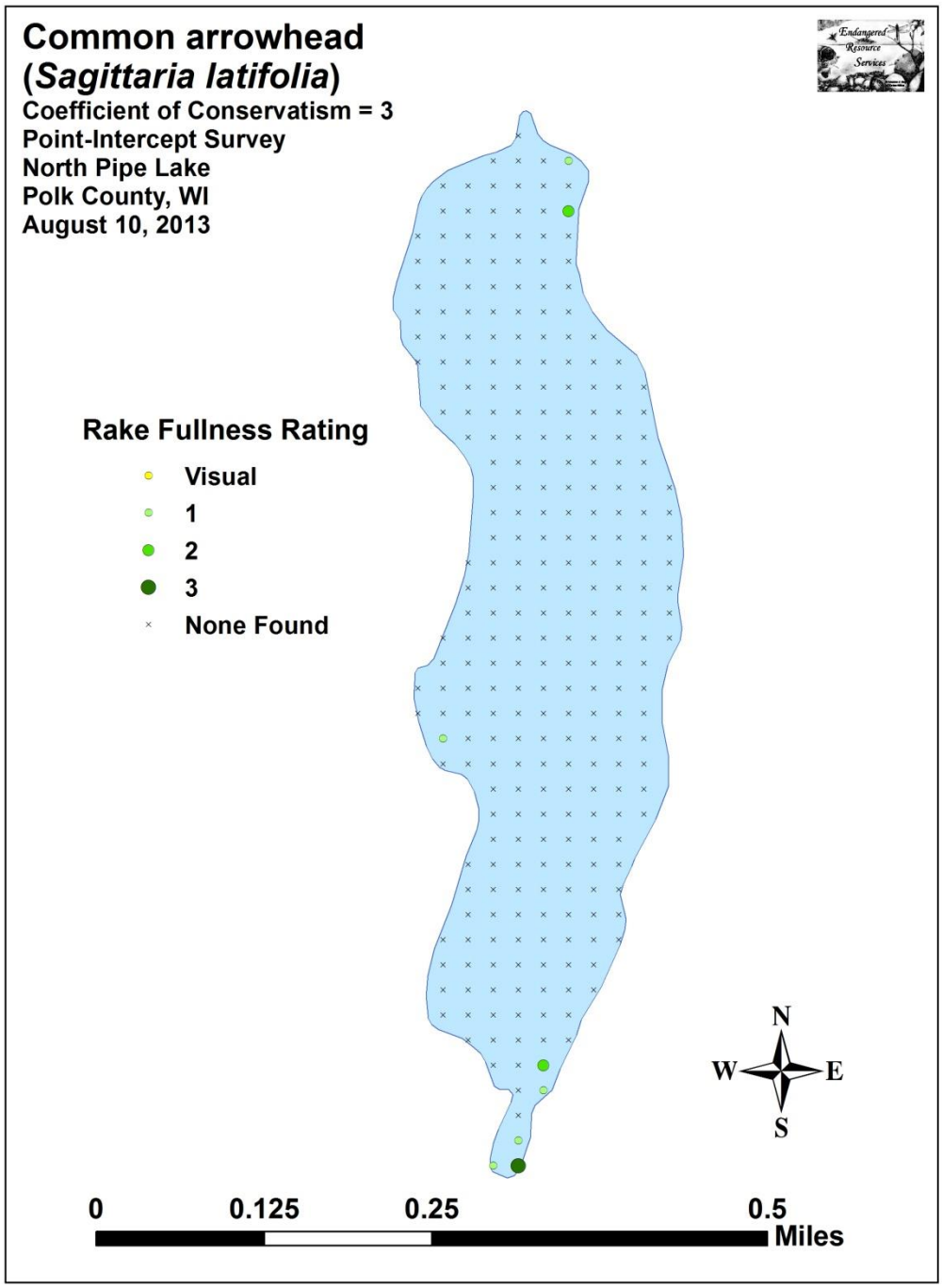
Miles


Common arrowhead
(Sagittaria latifolia)
Coefficient of Conservatism = 3
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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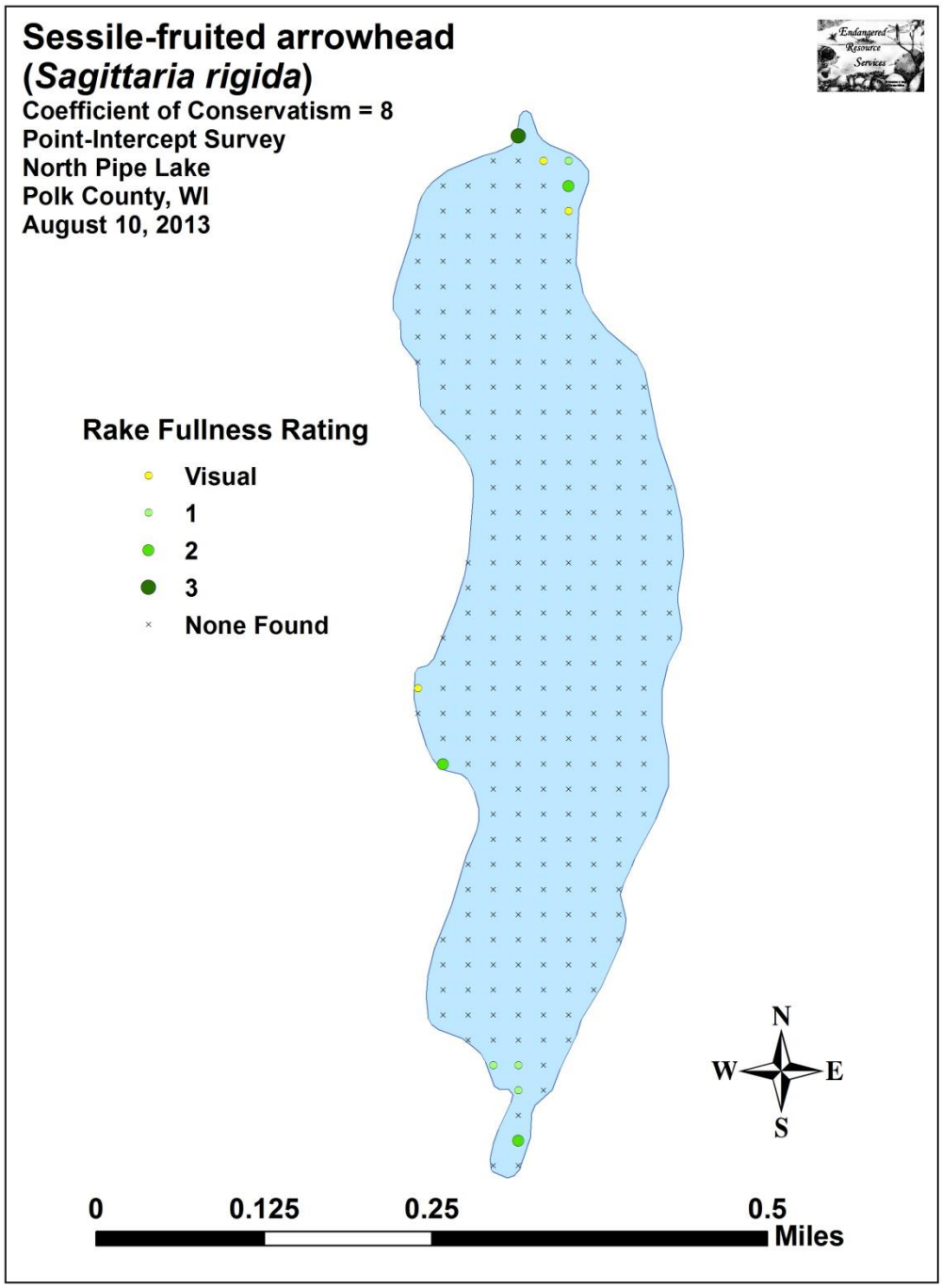
Miles


Sessile-fruited arrowhead
(Sagittaria rigida)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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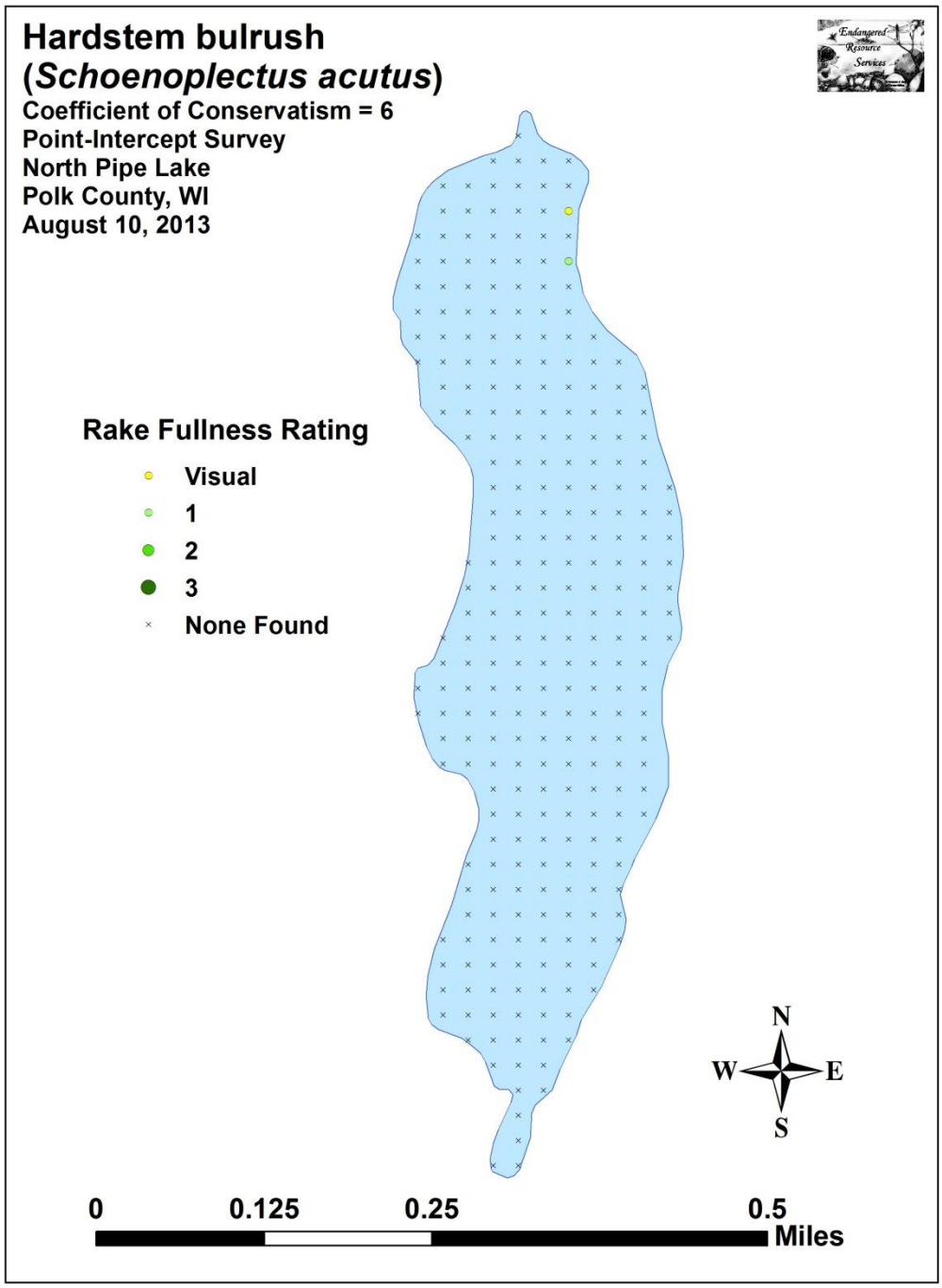
Miles


Hardstem bulrush
(Schoenoplectus acutus)
Coefficient of Conservatism = 6
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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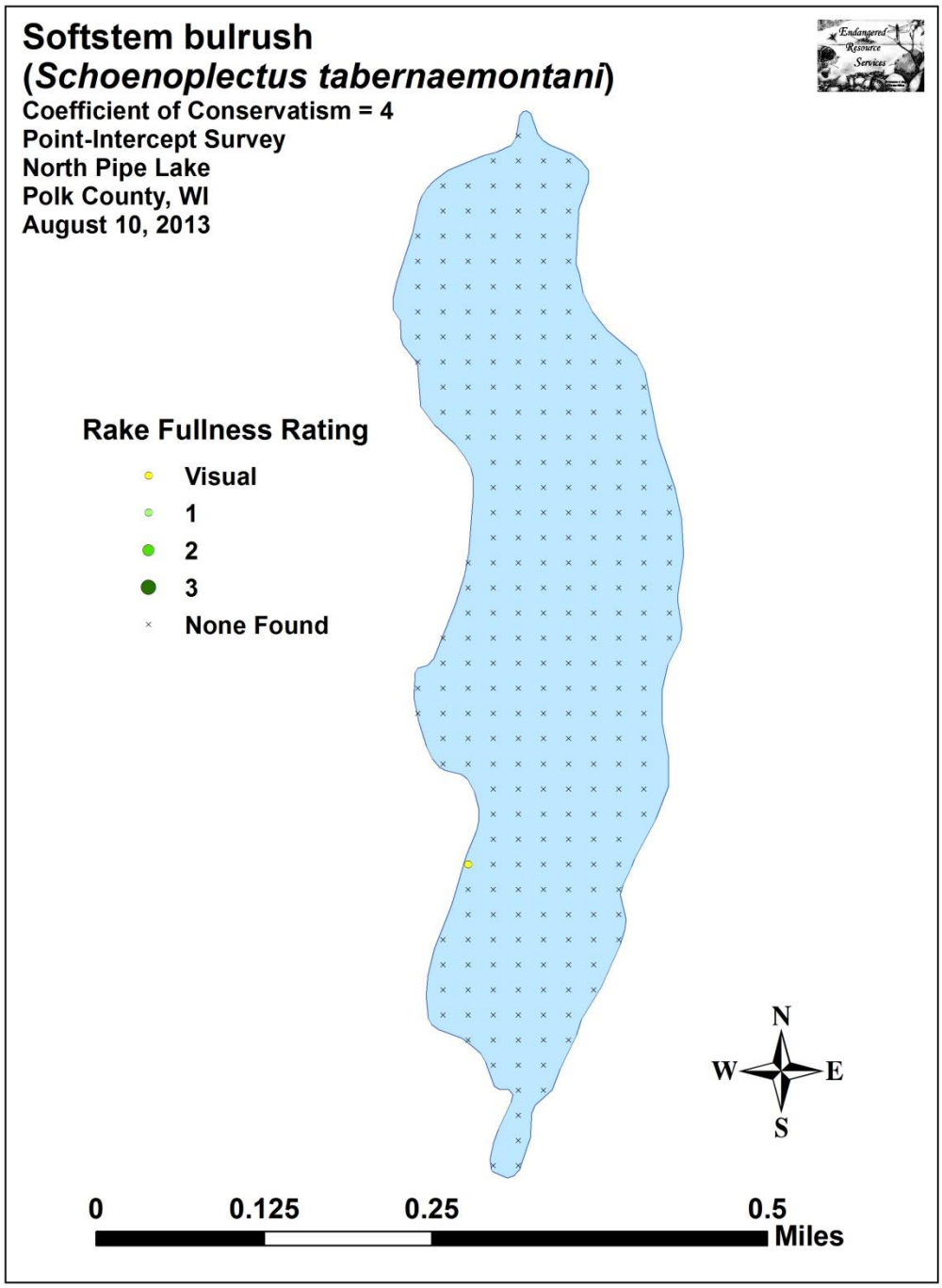
Miles


Softstem bulrush
(Schoenoplectus tabernaemontani)
Coefficient of Conservatism = 4
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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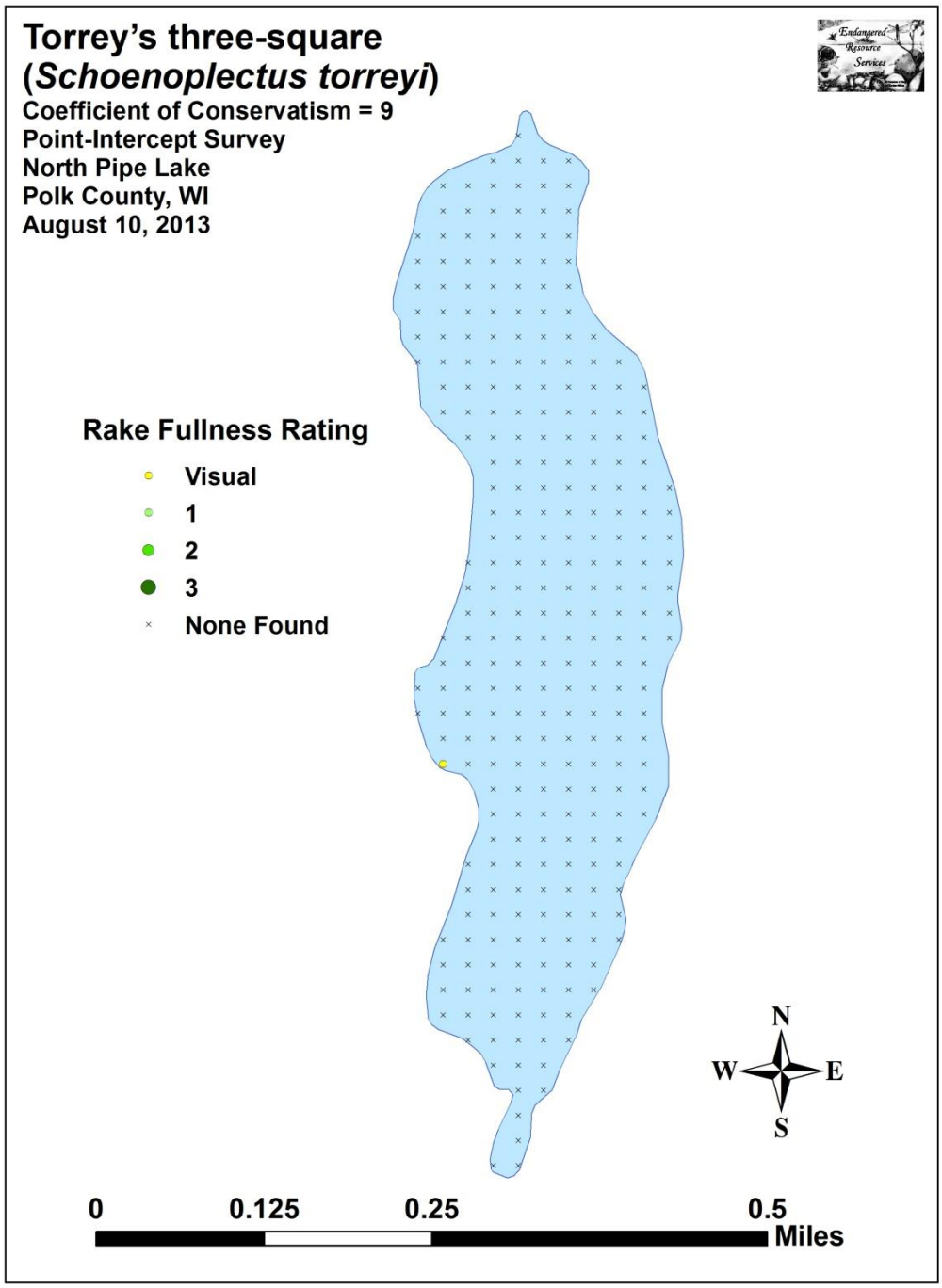
Miles


Torrey's three-square
(Schoenoplectus torreyi)
Coefficient of Conservatism = 9
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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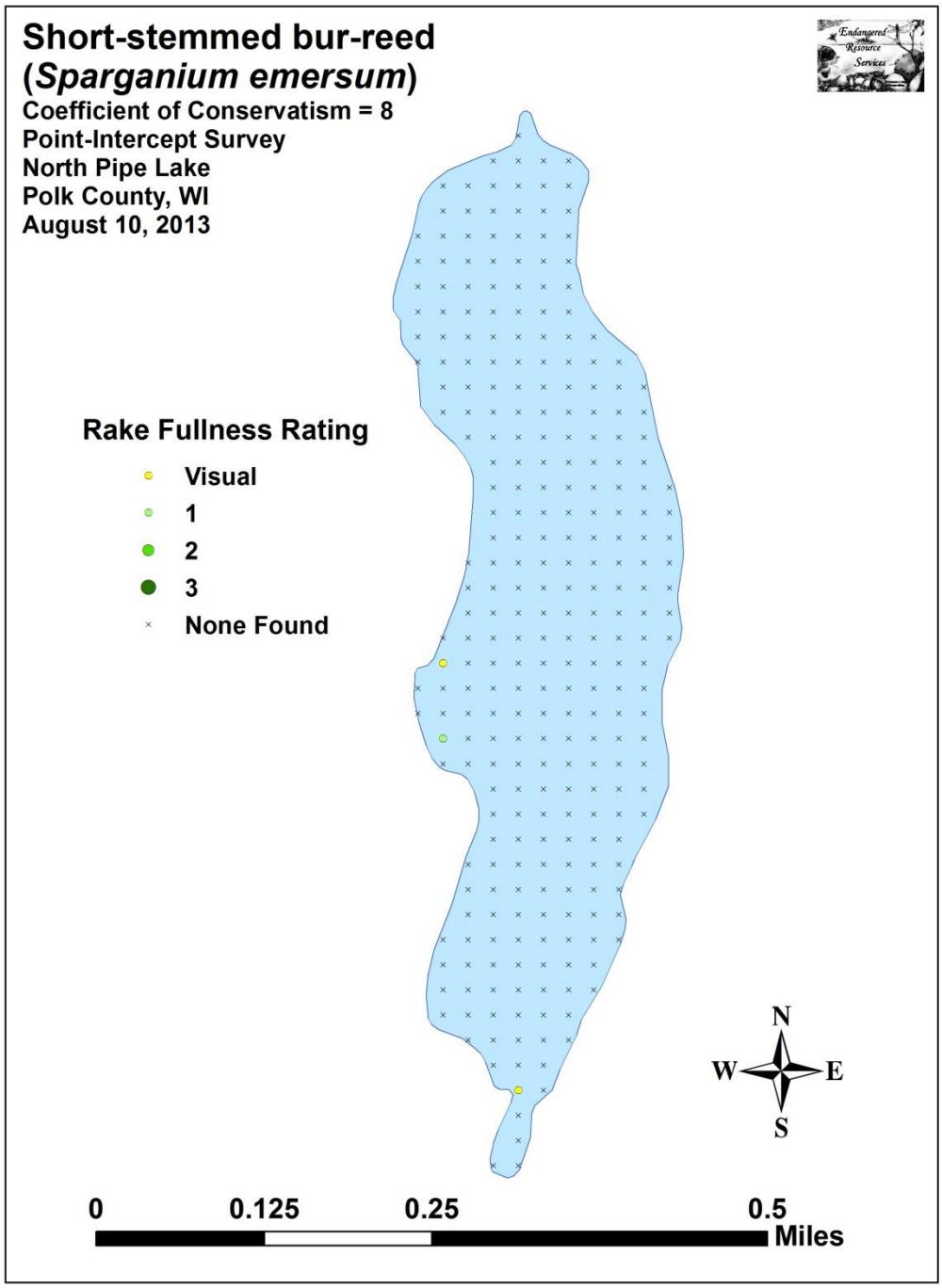
Miles


Short-stemmed bur-reed
(Sparganium emersum)
Coefficient of Conservatism = 8
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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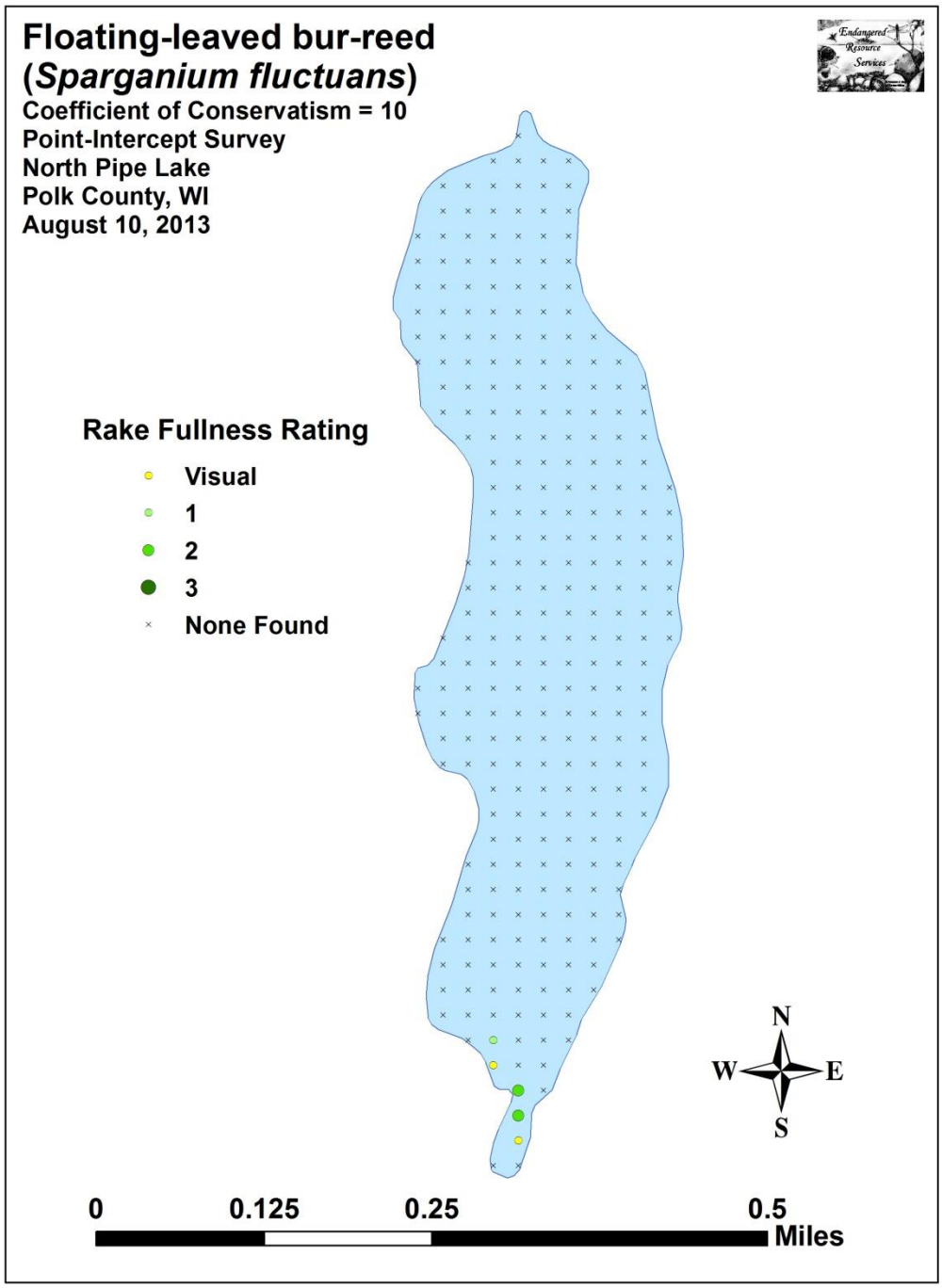
Miles


Floating-leaved bur-reed
(Sparganium fluctuans)
Coefficient of Conservatism = 10
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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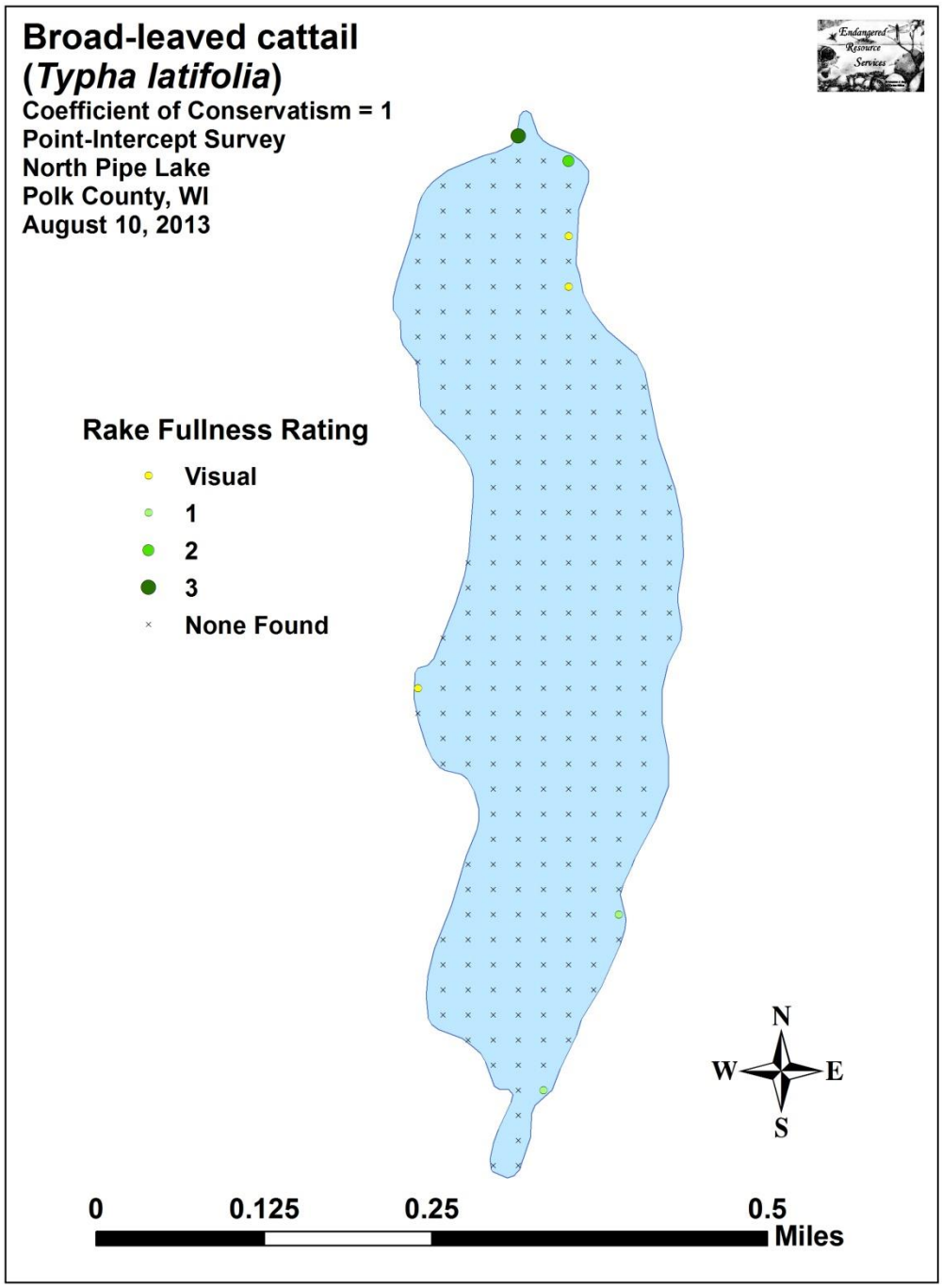
Miles


Broad-leaved cattail
(Typha latifolia)
Coefficient of Conservatism = 1
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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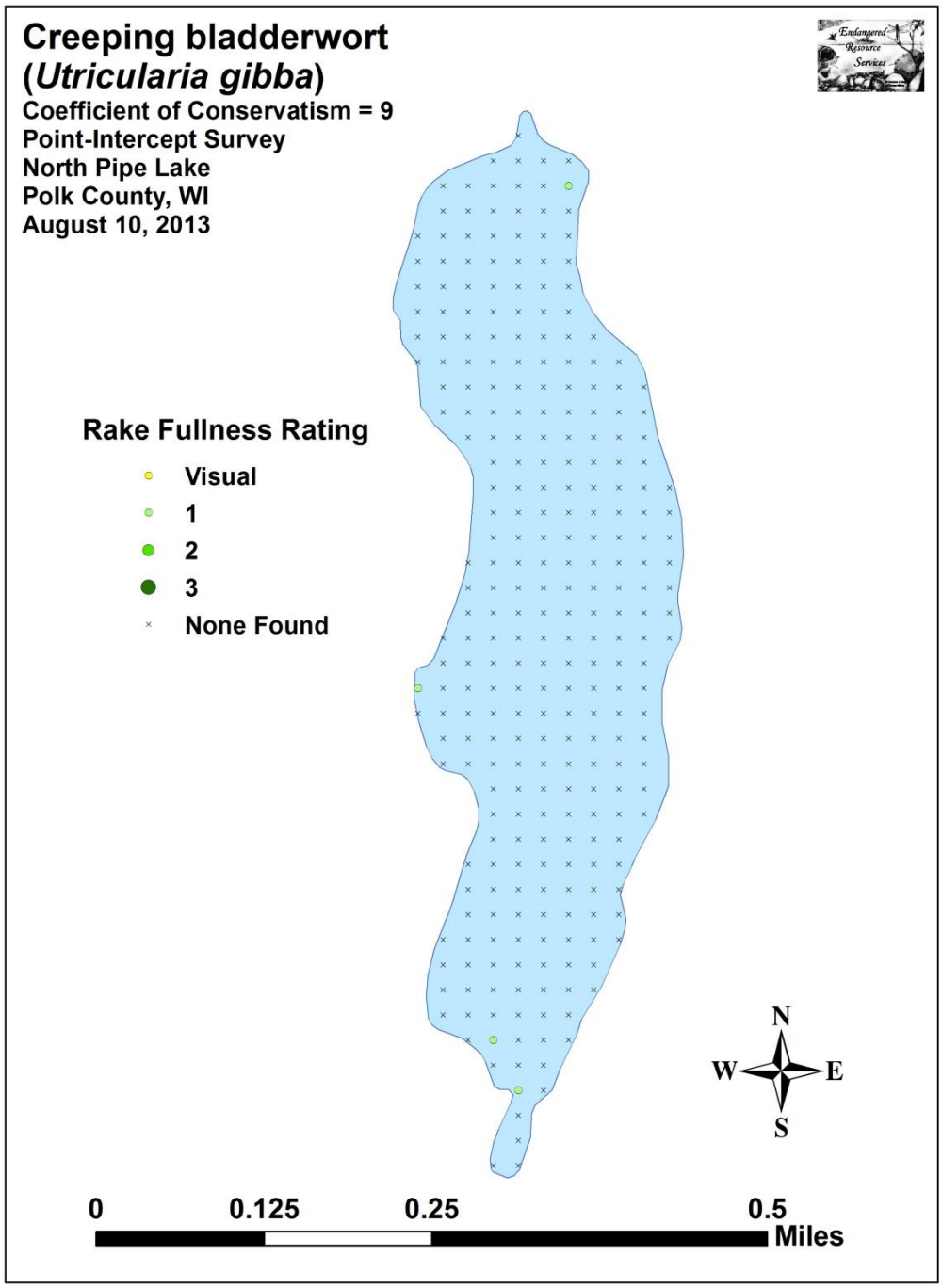
Miles


Creeping bladderwort
(Utricularia gibba)
Coefficient of Conservatism = 9
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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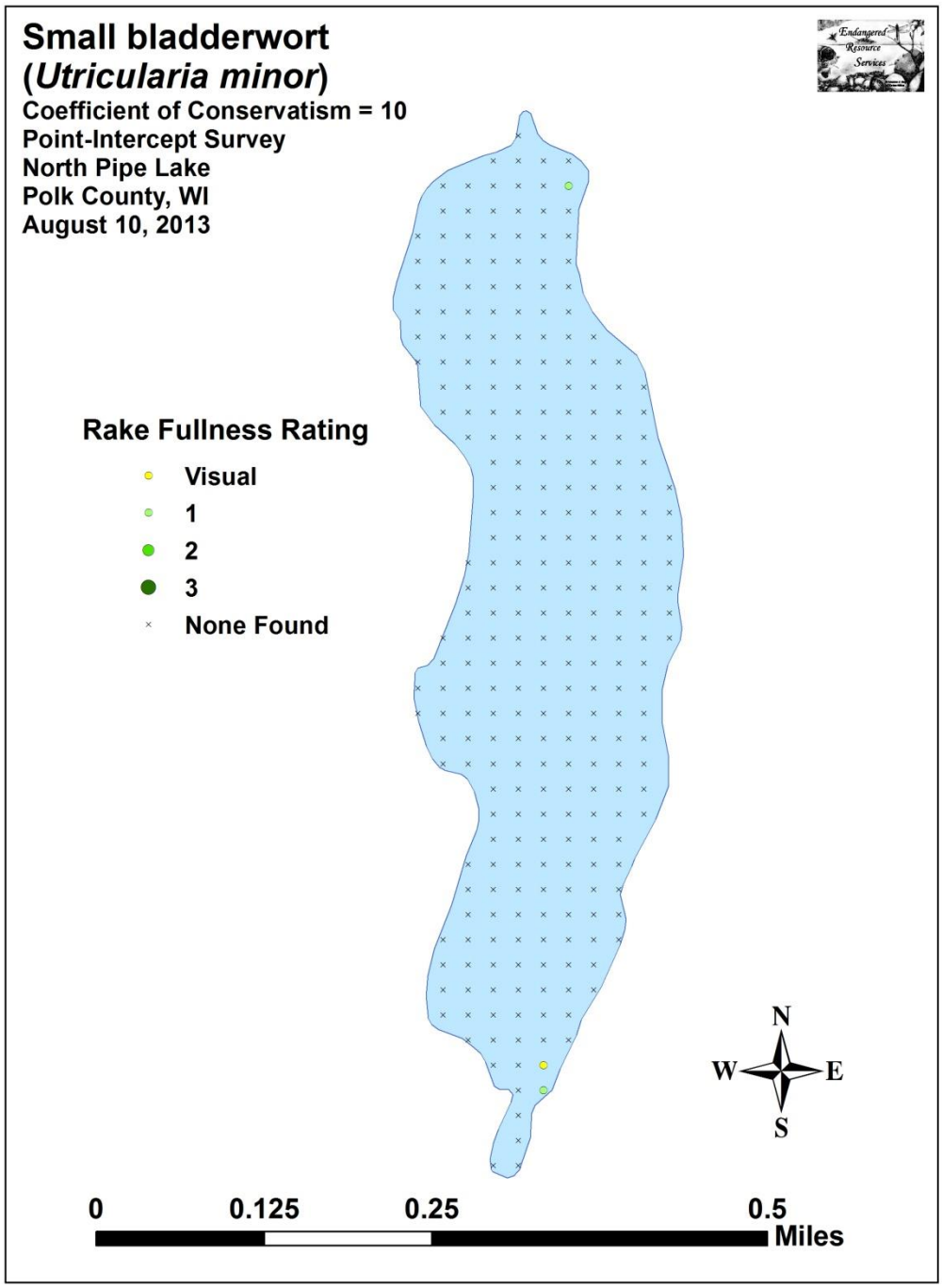
Miles


Small bladderwort
(Utricularia minor)
Coefficient of Conservatism = 10
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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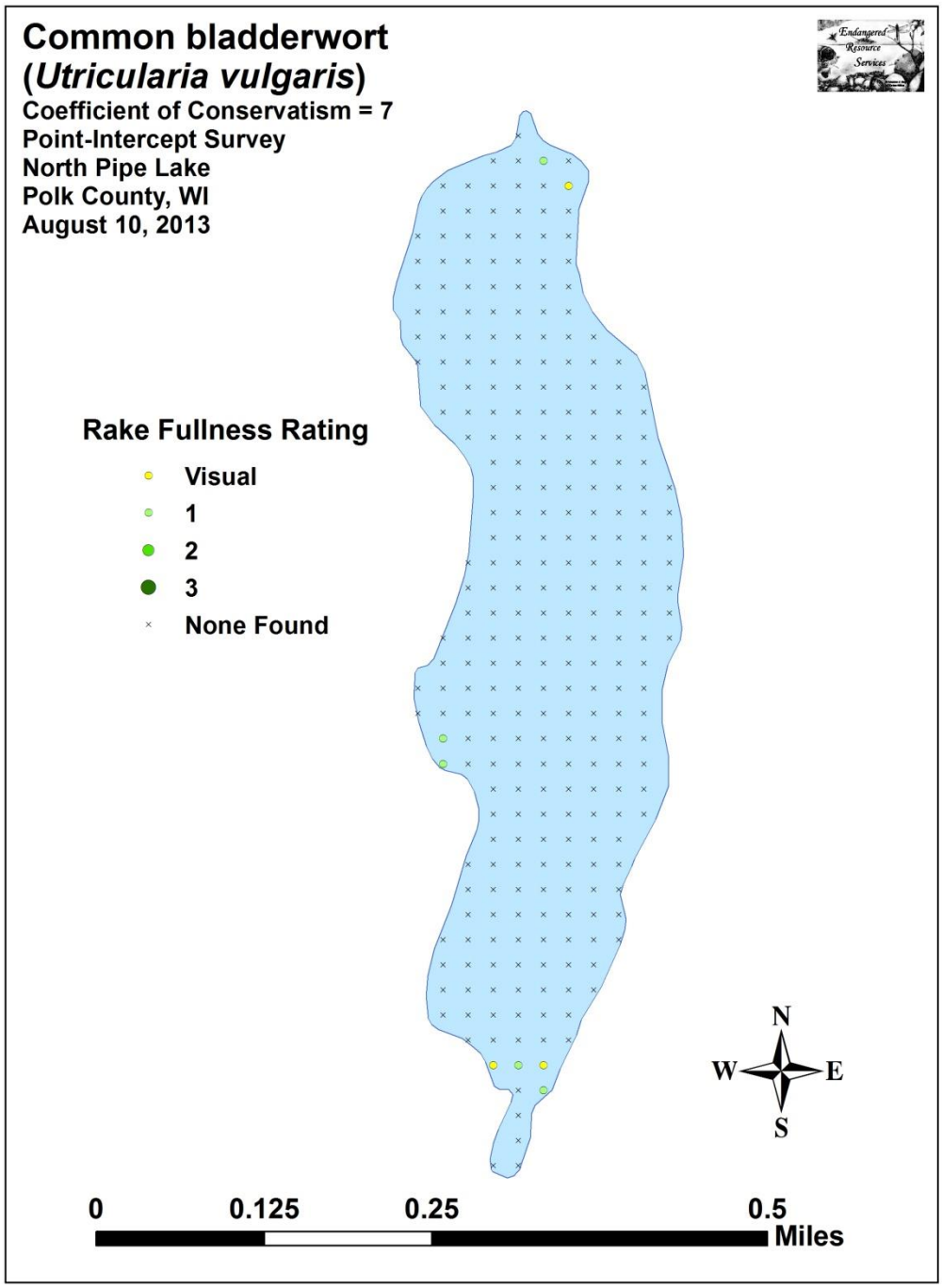
Miles


Common bladderwort
(Utricularia vulgaris)
Coefficient of Conservatism = 7
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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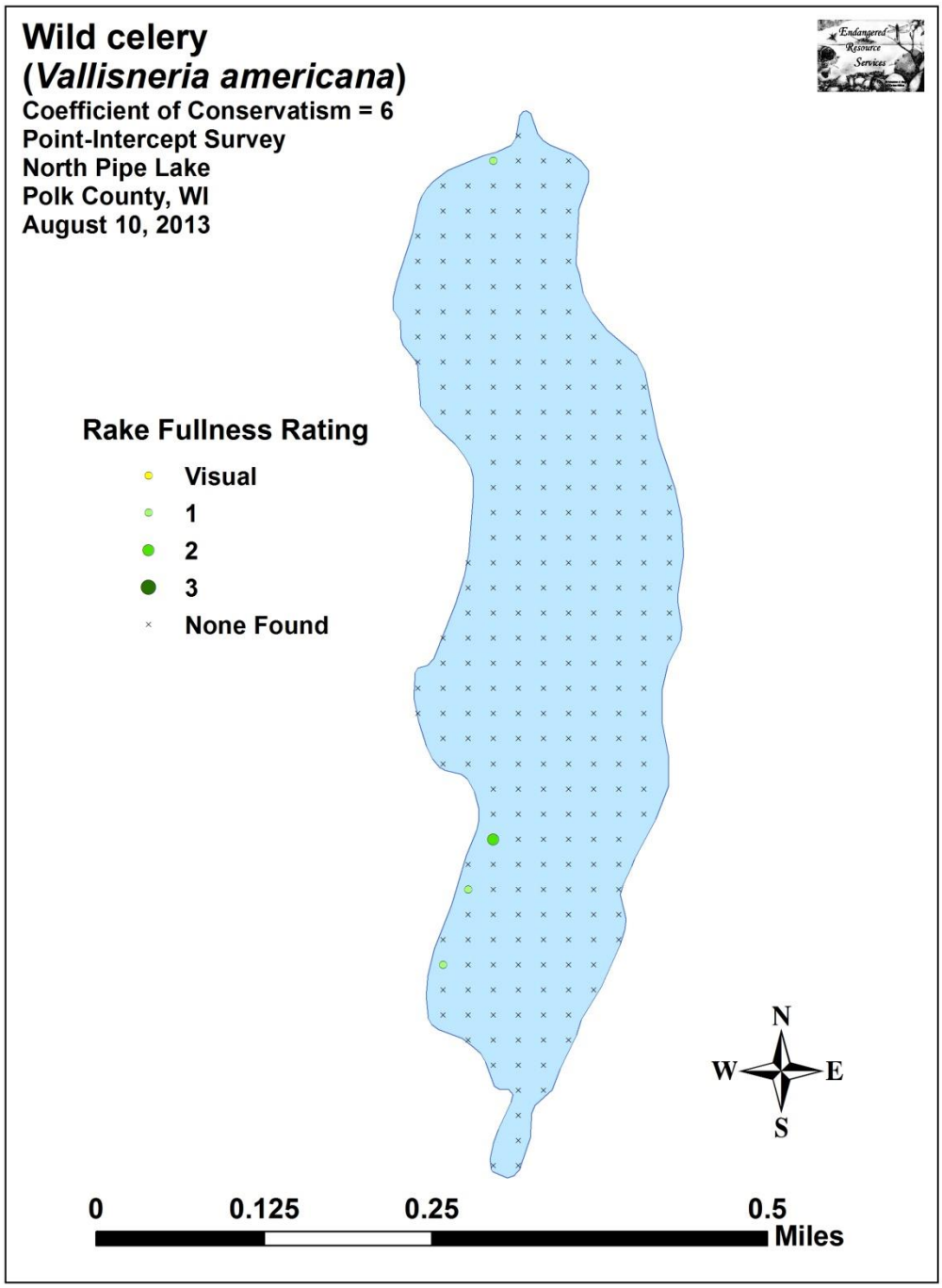
Miles


Wild celery
(Vallisneria americana)
Coefficient of Conservatism = 6
Point-Intercept Survey
North Pipe Lake
Polk County, WI
August 10, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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Miles

Appendix VIII: Aquatic Exotic Invasive Plant Species Information

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, 2013 http://www.dnr.state.wi.us/invasives/fact/milfoil.htm)

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 August

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, 2013 http://www.dnr.state.wi.us/invasives/fact/curlyleaf_pondweed.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, 2013 http://www.dnr.state.wi.us/invasives/fact/reed_canary.htm)

Purple loosestrife
(Photo Courtesy Brian M. Collins)

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 August 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, 2013 http://www.dnr.state.wi.us/invasives/fact/loosestrife.htm)

Appendix IX: Glossary of Biological Terms
(Adapted from UWEX 2010)

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 X: Raw Data Spreadsheets