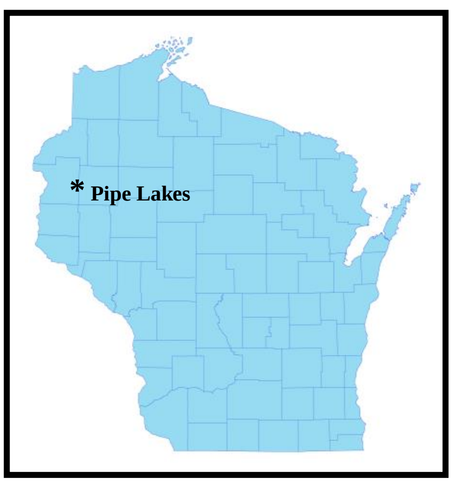
Aquatic Macrophyte Survey for North Pipe and Pipe Lakes Polk County, Wisconsin WBIC: 2485700 and 2490500

Project Sponsored by:
Wisconsin Department of Natural Resources, and the
Pipe Lakes Protection and Rehabilitation District



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ABSTRACT

North Pipe Lake (WBIC 2485700) and Pipe Lake (WBIC 2490500) combine to form a 345-acre seepage water body in east-central Polk County. The more nutrient rich North Pipe Lake is mesotrophic in nature with maximum Secchi readings near 12ft and a littoral zone that reaches 15.5ft. Pipe Lake is oligotrophic with maximum Secchi reading of 24ft and a littoral zone that extends beyond 26ft. In 2007, the Pipe Lakes Protection and Rehabilitation District, and the Wisconsin Department of Natural Resources commissioned a systematic point intercept macrophyte survey as part of a broader study of the entire watershed. The resulting survey found macrophytes at 90 of the 286 survey points on North Pipe, and 324 of 702 survey points on Pipe. We identified a total of 47 species on North Pipe, and 44 species on Pipe for an unusually high total of 55 species in and immediately adjacent to the lakes. The total from both lakes produced a mean Coefficient of Conservation of 7.1 and a much above average Floristic Index of 50.9. Robbins (fern) pondweed (*Potamogeton robbinsii*) and Sessile-fruited arrowhead (*Sagittaria rigida*) were the most common species in North Pipe being found at 43.33% and 21.11% of survey points with vegetation. Nitella (*Nitella* sp.), and Needle spikerush (*Eleocharis acicularis*) were the most common species found on Pipe Lake being found at 61.73% and 29.63% of points with vegetation. Five listed species (Special Concern) including Spiny hornwort (*Ceratophyllum echinatum*), Farwell's water milfoil (*Myriophyllum farwellii*), Torrey's three-square (*Schoenoplectus torreyi*), Water-thread pondweed (*Potamogeton bicupulatus*), and Small purple bladderwort (*Utricularia resupinata*) were also identified. Future management goals should include maintaining the lakes' healthy, diverse and rare plant community, working to reduce the nutrient load coming into the system, continued education and boat monitoring through the lakes' "Clean Boats/Clean Water" program, and consideration to monitor for Eurasian water milfoil (*Myriophyllum spicatum*) in transects parallel to the shore where people launch boats at the north and south ends of Pipe Lake at least once a month during the summer.

ACKNOWLEDMENTS

We wish to thank the Wisconsin Department of Natural Resources, and the Pipe Lakes Conservation and Rehabilitation District for funding this project; Jennifer Hauxwell for technical assistance, Michael Preissing, Dick Hollar, Larry Bresina, and Mitchel and Noah Berg for assistance in conducting this survey.

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INTRODUCTION:

North Pipe Lake (WBIC 2485700) and Pipe Lake (WBIC 2490500) combine to form a 345 acre seepage lake system (North Pipe 55 acres and Pipe 290 acres) in east-central Polk County, Wisconsin in the Town of Johnstown (T35N R15W S15 NE SW). North Pipe Lake achieves a maximum depth of 37ft in the north central basin while Pipe Lake reaches its maximum depth of 68 feet in the south central basin and has an average depth of approximately 37ft. The more nutrient rich North Pipe Lake is mesotrophic in nature with top Secchi readings from 9-12ft and a littoral zone that reaches 15.5ft. Pipe Lake is oligotrophic with Secchi reading reaching 19-24ft (WDNR 2007), and a littoral zone that extends beyond 26ft. The bottom substrate of both lakes is predominately rocks, sand, and sandy muck.

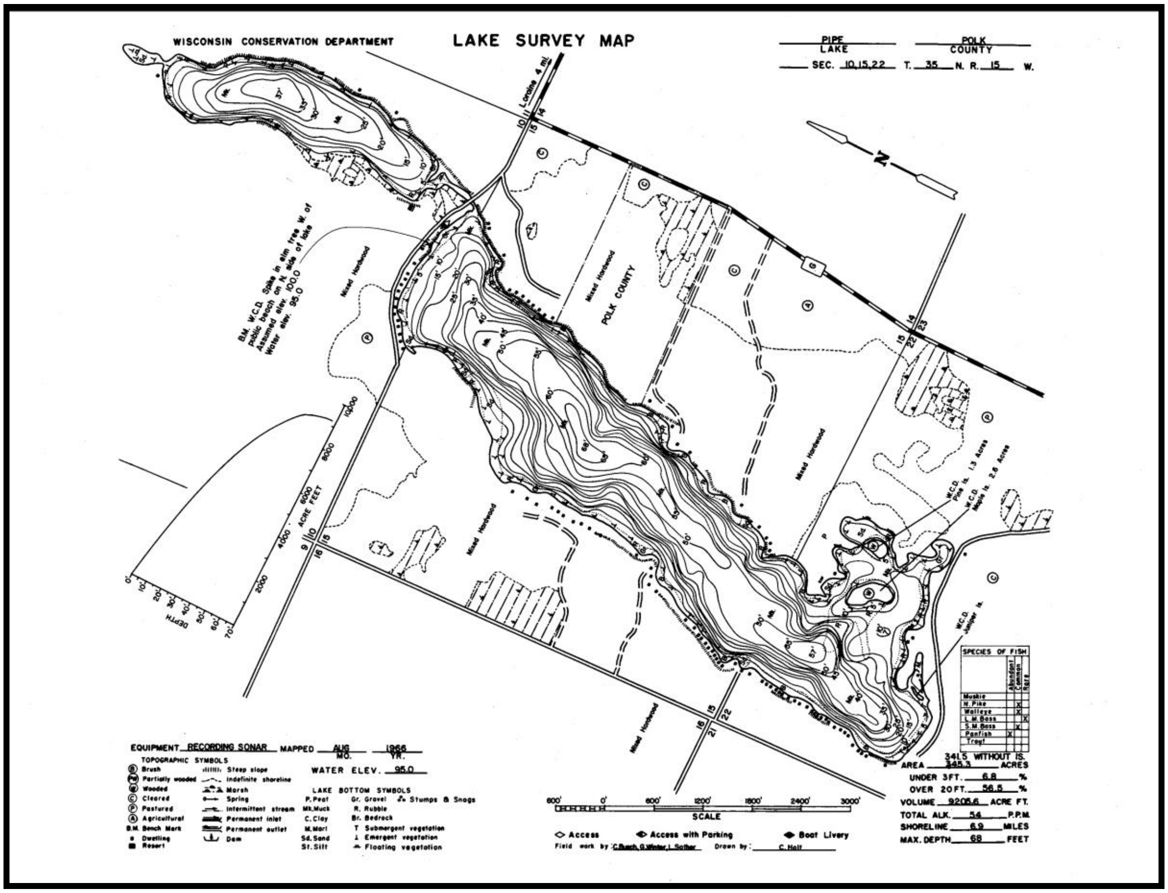


Figure 1: North Pipe and Pipe Lakes Map (Busch, C., et al. 1966).

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, prompted members of the Pipe Lakes Conservation and Rehabilitation District to authorize an extensive assessment of the Pipe Lakes Watershed. Part of this assessment required a survey of aquatic macrophytes using the Wisconsin Department of Natural Resources new statewide guidelines for conducting systematic point intercept macrophyte sampling.

The new guidelines ensure that all sampling in the state will be conducted in the same manner, thus allowing data to be compared across time and space. This report represents the summary analysis of the data collected during a survey of North Pipe and Pipe Lakes in June and August of 2007. The immediate goals of the project were to determine if Eurasian water milfoil or Curly-leaf pondweed (*Potamogeton crispus*) had invaded the lakes, and to establish baseline data on the diversity, abundance and distribution of native aquatic plant populations. These data provide a baseline for long-term monitoring of the lakes' macrophyte community.

METHODS:

Using a standard formula that takes into account the shoreline shape and distance, islands, water clarity, depth and total lake acres, Jennifer Hauxwell (WDNR) generated a sampling grid for each lake (Appendix I). In June, we conducted a Curly-leaf pondweed survey to check for the presence of this invasive species. This survey randomly selects 100 points that are likely to have Curly-leaf pondweed growing near them if it is present. If the target species is found, additional points are added to the survey so that a positive point ultimately is completely boxed in with negative survey points before moving on to the next random point. This rapid survey should result in both detection and approximate mapping of any infestation that may have occurred.

Prior to beginning the point intercept survey in August, we conducted a general boat survey of the Pipe Lakes to gain familiarity with the species present (Appendix II). All plants found were identified (Boreman et al. 1997; Chadde 2002; Crow and Hellquist 2006), and two vouchers were pressed and retained for herbarium specimens – one to be retained by the Pipe and North Pipe Lakes Protection and Rehabilitation District, and one to be sent to the state for identification confirmation. During the point intercept survey, we located each survey point using a handheld mapping GPS unit (Garmin 76Cx). At each point, we recorded a depth reading with a Polar Vision hand held sonar unit. Following the establishment of the littoral zone at 15.5 ft. on North Pipe Lake and 26ft. on Pipe Lake, we sampled for plants within the depth range of plant growth. At each of these points, we used a rake (either on a pole or a throw line depending on depth) 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. Substrate (lake bottom) type was assigned at each site where the bottom was visible or it could be reliably determined using the rake.

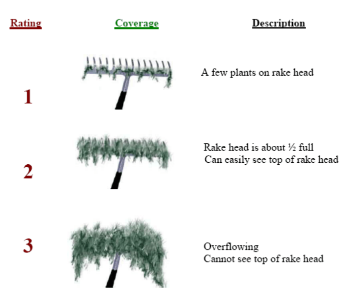


Figure 2: Rake Fullness Ratings (UWEX, 2007)

DATA ANALYSIS:

We entered all data collected into the standard APM spreadsheet (Appendix III)(UWEX, 2007). From this, we calculated the following:

Total number of points sampled: This included the total number of points on the lake coverage (Appendix I). Although depth measurements are taken at all points, only those points that were within the littoral zone (0-maximum depth where plants are found) were sampled for plants. Once we established this maximum depth, most points beyond this depth were not rake sampled.

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

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

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

Frequency of occurrence example:

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

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

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

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

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

Number of sites sampled using rope/pole rake: This indicates which rake type was used to take a sample. Protocol suggests a 15ft pole rake, and a 25ft rope rake for sampling (Wagoner personal communication).

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** indicates the average number of plants at all sites where plants were found. 3) **native species shallower than maximum depth of plants** and 4) **native species at vegetative sites only** excludes exotic species from consideration.

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

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

Relative frequency: This value shows a species' frequency relative to all other species. It is expressed as a percentage, and the total of all species' relative frequency will add up to 100%. Organizing species from highest to lowest relative frequency value (Tables 3 and 4) gives us an idea of which species are most important within the macrophyte community.

Relative frequency example:

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

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

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

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

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

Floristic Quality Index (FQI): This index measures the impact of human development on a lake's aquatic plants. Species in the index are assigned a Coefficient of Conservatism (C) which ranges from 1-10. The higher the value assigned, the more likely the plant is to be negatively impacted by human activities relating to water quality or habitat modifications. Plants with low values are tolerant of human habitat modifications, and often exploit these changes to the point where they may crowd out other species. The FQI is calculated by averaging the conservatism value for each species found in the lake. The higher the index value, the healthier the lake's macrophyte community. 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. Pipe Lake and North Pipe Lake are in the Northern Central Hardwood Forests Ecoregion.

RESULTS:

We surveyed 988 points (Figure 3) for depth (Figure 4), bottom substrate (Figure 5) and macrophytes (littoral zone only) (Figure 6) (Appendix IV).

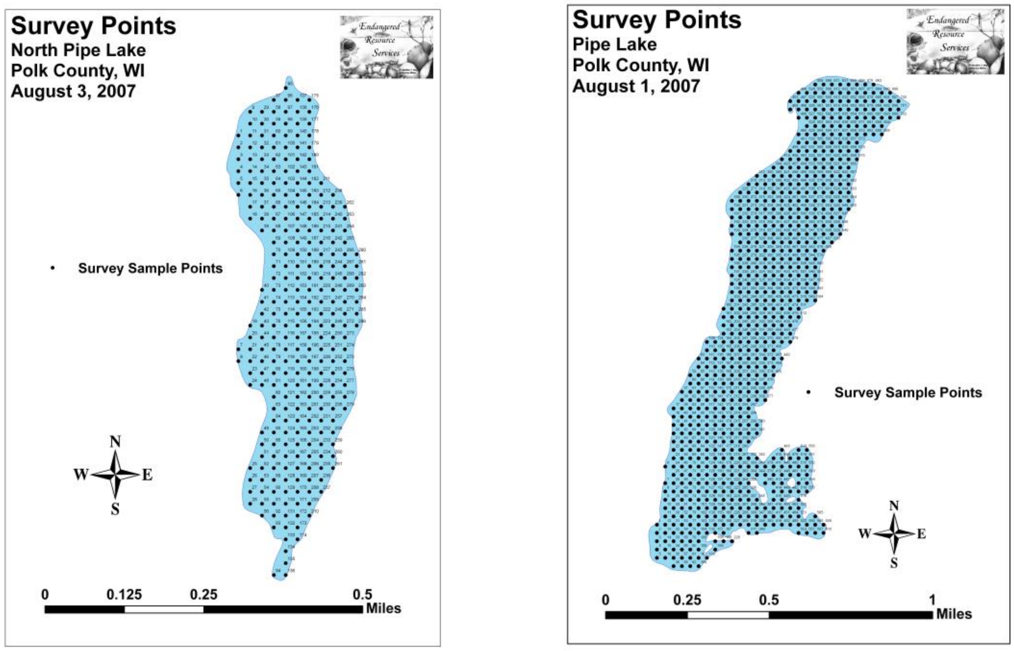


Figure 3: Survey Sample Points

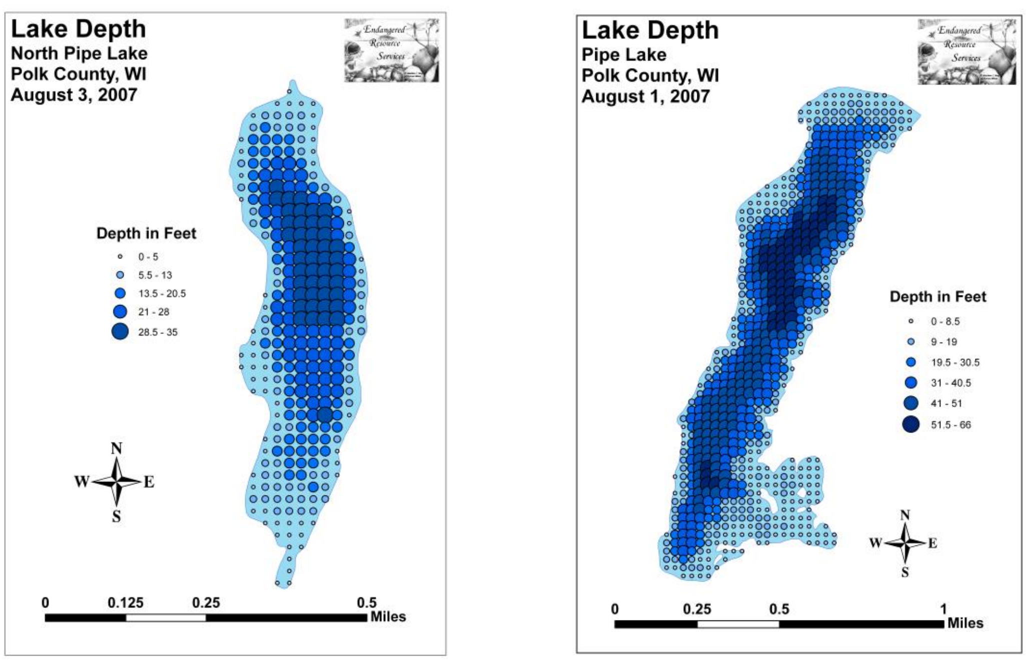


Figure 4: Lake Depth

The only rich organic muck was located in the north, south and west bays of North Pipe, the channel between the lakes, and in the expansive southeast bay of Pipe (Figure 5).

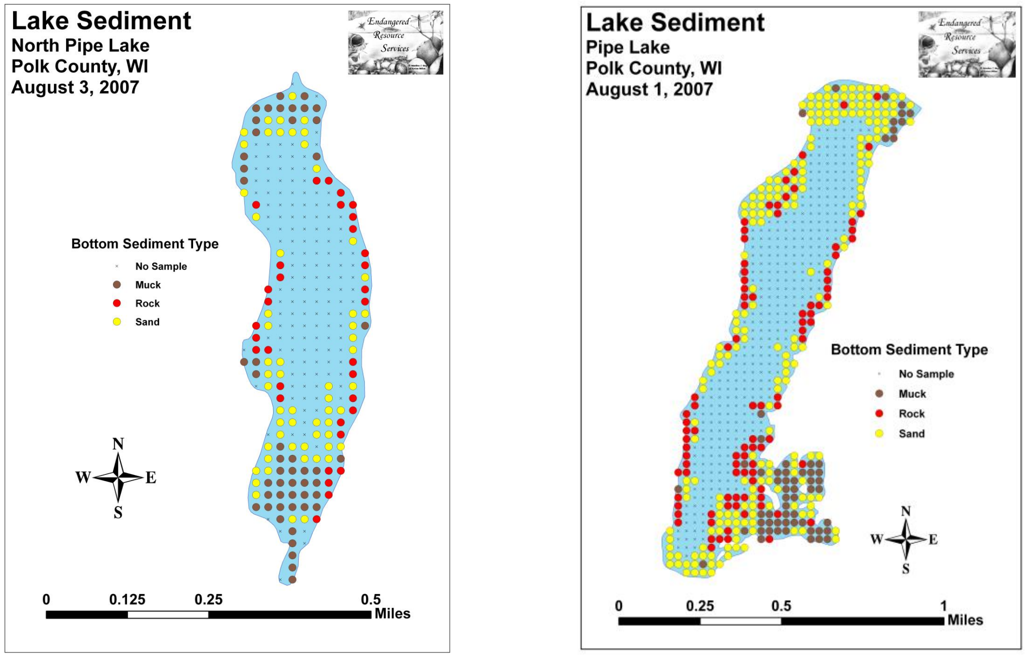


Figure 5: Lake Bottom Sediment Type

We found these mucky bays had the highest plant frequencies and densities with some sites being nearly impossible to reach due to plant growth (Figure 6).

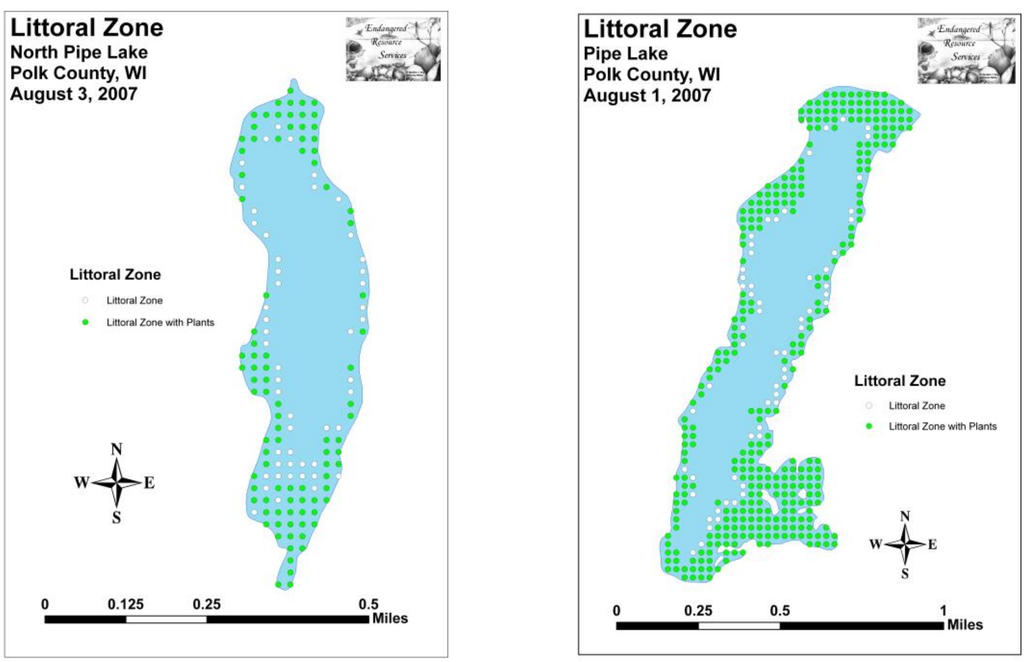


Figure 6: Littoral Zone

Table 1: Aquatic Macrophytes Survey Summary Statistics
North Pipe Lake, Polk County
August 2007

Summary Statistics:

Total number of points sampled	286
Total number of sites with vegetation	90
Total number of sites shallower than the maximum depth of plants	142
Frequency of occurrence at sites shallower than maximum depth of plants	63.38
Simpson Diversity Index	0.95
Maximum depth of plants (ft)	15.50
Number of sites sampled using rope rake (R)	87
Number of sites sampled using pole rake (P)	130
Average number of all species per site (shallower than max depth)	2.02
Average number of all species per site (veg. sites only)	3.19
Average number of native species per site (shallower than max depth)	2.02
Average number of native species per site (veg. sites only)	3.19
Species Richness	42
Species Richness (including visuals)	42
Species Richness (including visuals and boat survey)	47
Mean depth of plants (ft)	5.02
Median depth of plants (ft)	3.25

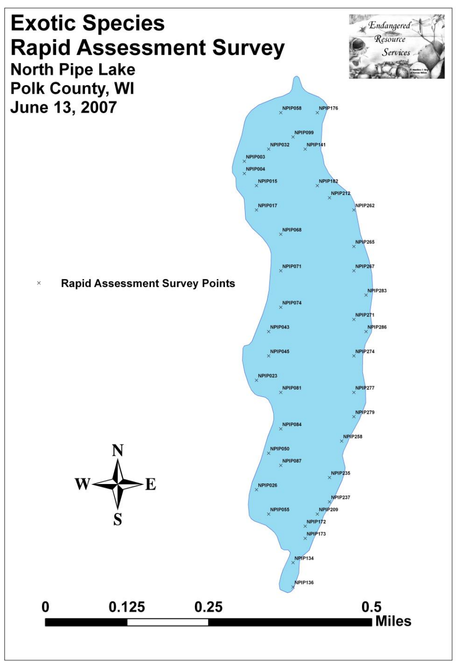
Table 2: Aquatic Macrophytes Survey Summary Statistics
Pipe Lake, Polk County
August 2007

Summary Statistics:

Total number of points sampled	702
Total number of sites with vegetation	324
Total number of sites shallower than the maximum depth of plants	384
Frequency of occurrence at sites shallower than maximum depth of plants	84.38
Simpson Diversity Index	0.91
Maximum depth of plants (ft)	26.00
Number of sites sampled using rope rake (R)	115
Number of sites sampled using pole rake (P)	268
Average number of all species per site (shallower than max depth)	2.42
Average number of all species per site (veg. sites only)	2.87
Average number of native species per site (shallower than max depth)	2.42
Average number of native species per site (veg. sites only)	2.87
Species Richness	36
Species Richness (including visuals)	37
Species Richness (including visuals and boat survey)	44
Mean depth of plants (ft)	8.00
Median depth of plants (ft)	8.96

We did not locate any Curly-leaf pondweed or Eurasian water milfoil during either the June rapid survey or the August full point-intercept survey (Figure 7). The only non-native species we did locate was Reed canary grass (*Phalaris arundinacea*) which grows in a few small patches at scattered shoreline locations around the lakes.

Although we did not locate any Purple loosestrife (*Lythrum salicaria*) on or directly adjacent to the lakes, we did notice a couple of plants on 205th Avenue south of Pipe Lake in a ditch. We eliminated these plants, but it is likely there are more in the area, and this is another exotic species that should be watched for. For more information on exotic species, see Appendix VIII.



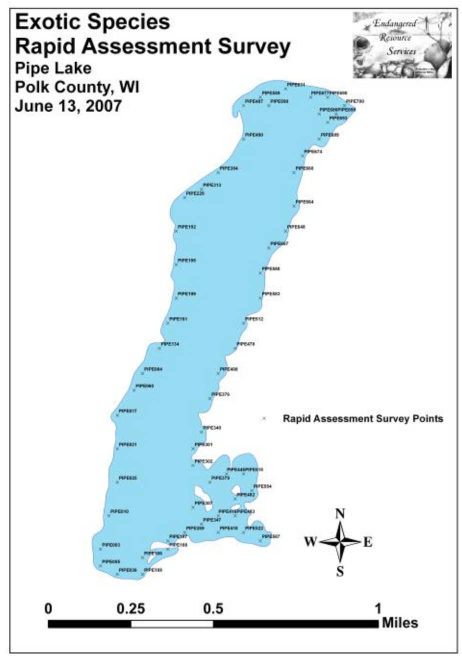
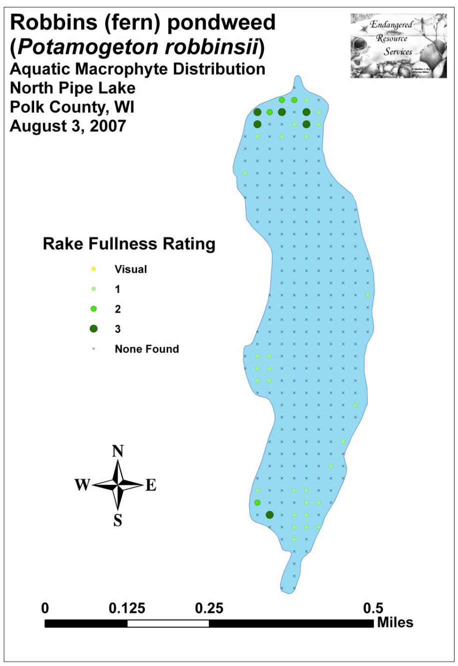


Figure 7: Exotic Species Rapid Assessment Survey Results

In North Pipe Lake, we found plants growing on approximately 31% of the entire lake bottom, and 63% of the littoral zone (Table 1). Diversity was extremely high with a Simpson Diversity Index value of 0.95. Species richness was also very high with 47 total macrophyte species found growing in and immediately adjacent to the lake (Appendix V and VI). The majority of aquatic macrophytes were found growing in shallow water with an average depth of 5ft, but a median of only 3ft. At these depths, there was high diversity and evenness with no species dominating. Although we determined the littoral zone went to 15.5 feet, in most parts of North Pipe, the "weedline" ended at 7ft. Diversity also dropped rapidly at deeper locations. Nitella over sandy/rocky bottoms, Robbins (fern) pondweed over organic muck, and Small pondweed (*Potamogeton pusillus*) over mixed substrate were the only species we found growing at depths much over 5ft. Robbins (fern) pondweed (*Potamogeton robbinsii*) and Sessile-fruited arrowhead (*Sagittaria rigida*) were the most common species in North Pipe being found at 43.33% and 21.11% of survey points with vegetation (Figure 8).



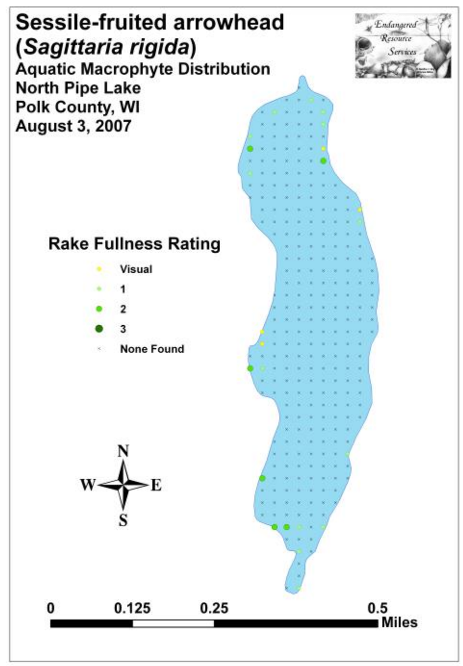
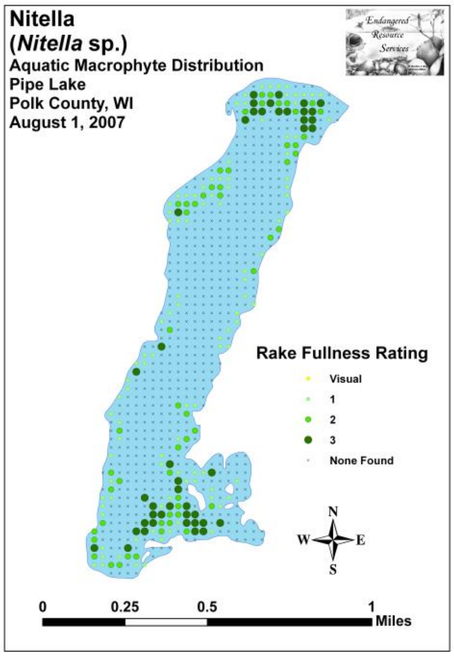


Figure 8: North Pipe Lake Dominant Species

Although it had slightly less diversity (0.91) and species richness (44 species) (Table 2), Pipe Lake had considerably more plant growth both in area covered (46% of the lake, and 84% of the littoral zone), and in volume of each rakefull. These figures are, however, somewhat misleading as single species stands of Nitella (*Nitella* sp.) was the dominant species over most of the deeper parts (>10ft) of the lake. In the shallow areas of the lake, mats of Needle spikerush (*Eleocharis acicularis*), Dwarf water milfoil (*Myriophyllum tenellum*) and Brown-fruited rush (*Juncus pelocarpus*) dominated. In 5-10ft, Spiral-fruited pondweed (*Potamogeton spirillus*), Quillwort (*Isoetes lacustris*) and Large-leaf pondweed (*Potamogeton amplifolius*) were common. Over 13ft, Nitella was the only species and it seemed to prefer depths in the low 20ft range. Nitella and Needle spikerush (*Eleocharis acicularis*) were the most common species found on Pipe Lake being found at 61.73% and 29.63% of sites with vegetation.



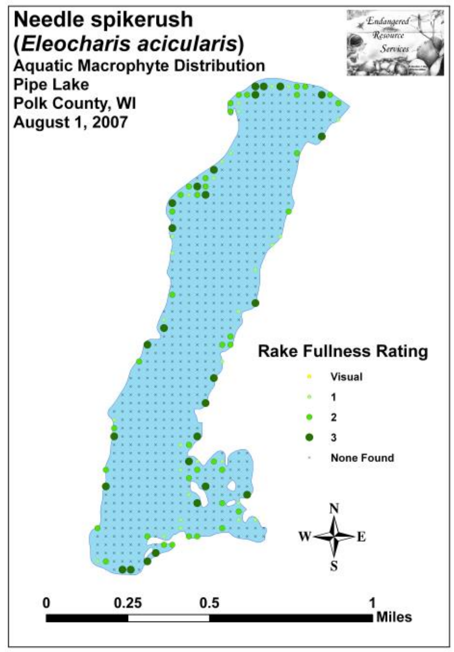


Figure 9: Pipe Lake Dominant Species

In addition to the more common species, we identified five "Special Concern"** species including Spiny hornwort (*Ceratophyllum echinatum*), Farwell's water milfoil (*Myriophyllum farwellii*), Torrey's three-square (*Schoenoplectus torreyi*), Water-thread pondweed (*Potamogeton bicupulatus*), and Small purple bladderwort (*Utricularia resupinata*). The presence of these species along with other species such as Floating-leaf bur-reed (*Sparganium fluctuans*), Dwarf water milfoil, and Northern naiad (*Najas gracillima*) that are highly sensitive to pollution is a testament to a history of good water quality that the Pipe Lakes have apparently enjoyed.

** "Special Concern" species 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.

Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
North Pipe Lake, Polk County
August 2007

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Potamogeton robbinsii	Robbins (fern) pondweed	39	13.59	43.33	27.46	1.41
Sagittaria rigida	Sessile-fruited arrowhead	19	6.62	21.11	13.38	1.32
Nymphaea odorata	White water lily	18	6.27	20.00	12.68	1.72
	Filamentous algae	17	5.92	18.89	11.97	1.06
Eleocharis acicularis	Needle spikerush	17	5.92	18.89	11.97	1.41
Brasenia schreberi	Watershield	15	5.23	16.67	10.56	1.93
Pontederia cordata	Pickerelweed	14	4.88	15.56	9.86	1.64
Nitella sp.	Nitella	13	4.53	14.44	9.15	1.15
Isoetes lacustris	Lake quillwort	12	4.18	13.33	8.45	1.33
Potamogeton spirillus	Spiral-fruited pondweed	12	4.18	13.33	8.45	1.25
Elatine minima	Waterwort	10	3.48	11.11	7.04	1.10
	Aquatic moss	9	3.14	10.00	6.34	1.00
Utricularia vulgaris	Common bladderwort	9	3.14	10.00	6.34	1.11
Najas flexilis	Bushy pondweed	8	2.79	8.89	5.63	1.00
Najas gracillima	Northern naiad	7	2.44	7.78	4.93	1.14
Potamogeton gramineus	Variable pondweed	7	2.44	7.78	4.93	1.43
Schoenoplectus purshianus	Pursh's bulrush	7	2.44	7.78	4.93	1.71
Nuphar variegata	Spatterdock	5	1.74	5.56	3.52	1.00
Potamogeton amplifolius	Large-leaf pondweed	5	1.74	5.56	3.52	1.60
Potamogeton epihydrus	Ribbon-leaf pondweed	4	1.39	4.44	2.82	2.00
Potamogeton pusillus	Small pondweed	4	1.39	4.44	2.82	1.00
Vallisneria americana	Wild celery	4	1.39	4.44	2.82	1.00
Eleocharis ovata	Oval spikerush	4	1.39	4.44	2.82	1.25
Juncus pelocarpus f. submersus	Brown-fruited rush	3	1.05	3.33	2.11	1.00

Table 3 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
North Pipe Lake, Polk County
August 2007

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Ceratophyllum echinatum	Spiny hornwort	2	0.70	2.22	1.41	1.00
Eleocharis palustris	Creeping spikerush	2	0.70	2.22	1.41	1.50
Lemna minor	Small duckweed	2	0.70	2.22	1.41	1.00
Potamogeton bicupulatus	Filament-leaf pondweed	2	0.70	2.22	1.41	1.00
Sparganium fluctuans	Floating-leaved bur-reed	2	0.70	2.22	1.41	1.00
Eleocharis obtusa	Blunt spikerush	2	0.70	2.22	1.41	1.00
Leersia oryzoides	Rice cut grass	2	0.70	2.22	1.41	1.00
Dulichium arundinaceum	Three-way sedge	1	0.35	1.11	0.70	1.00
Equisetum fluviatile,	Water horsetail	1	0.35	1.11	0.70	1.00
Eriocaulon aquaticum	Pipewort	1	0.35	1.11	0.70	1.00
Phalaris arundinacea	Reed canary grass	1	0.35	1.11	0.70	2.00
Schoenoplectus tabernaemontani	Softstem bulrush	1	0.35	1.11	0.70	3.00
Sparganium emersum	Narrow-leaf bur-reed	1	0.35	1.11	0.70	1.00
Spirodela polyrhiza	Large duckweed	1	0.35	1.11	0.70	1.00
Typha latifolia	Broad-leaved cattail	1	0.35	1.11	0.70	1.00
Alisma plantago-aquatica	Water plantain	1	0.35	1.11	0.70	1.00
Lipocarpha micrantha	Small-flowered hemicarpha	1	0.35	1.11	0.70	1.00
Cicuta bulbifera	Bulb-bearing water hemlock	1	0.35	1.11	0.70	1.00
Myriophyllum tenellum	Dwarf water milfoil	***	***	***	***	***
Ranunculus flammula	Creeping spearwort	***	***	***	***	***
Sagittaria latifolia	Common arrowhead	***	***	***	***	***
Schoenoplectus acutus	Hardstem bulrush	***	***	***	***	***
Utricularia resupinata	Small purple bladderwort	***	***	***	***	***

*** Boat Survey Only

Table 4: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Pipe Lake, Polk County, August 2007

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Nitella sp.	Nitella	200	21.53	61.73	52.08	1.72
Eleocharis acicularis	Needle spikerush	96	10.33	29.63	25.00	1.97
Potamogeton robbinsii	Robbins (fern) pondweed	73	7.86	22.53	19.01	1.73
Vallisneria americana	Wild celery	71	7.64	21.91	18.49	1.08
Potamogeton spirillus	Spiral-fruited pondweed	58	6.24	17.90	15.10	1.19
Myriophyllum tenellum	Dwarf water milfoil	44	4.74	13.58	11.46	1.75
Elatine minima	Waterwort	43	4.63	13.27	11.20	1.23
Potamogeton pusillus	Small pondweed	40	4.31	12.35	10.42	1.30
Juncus pelocarpus f. submersus	Brown-fruited rush	37	3.98	11.42	9.64	1.49
Isoetes lacustris	Lake quillwort	34	3.66	10.49	8.85	1.15
Sagittaria rigida	Sessile-fruited arrowhead	24	2.58	7.41	6.25	1.21
Najas flexilis	Bushy pondweed	23	2.48	7.10	5.99	1.00
Potamogeton amplifolius	Large-leaf pondweed	23	2.48	7.10	5.99	1.35
Eriocaulon aquaticum	Pipewort	19	2.05	5.86	4.95	1.16
Nymphaea odorata	White water lily	17	1.83	5.25	4.43	1.29
Ranunculus flammula	Creeping spearwort	17	1.83	5.25	4.43	1.59
	Filamentous algae	15	1.61	4.63	3.91	1.07
Brasenia schreberi	Watershield	13	1.40	4.01	3.39	2.54
Chara sp.	Muskgrass	11	1.18	3.40	2.86	1.27
Utricularia gibba	Creeping bladderwort	11	1.18	3.40	2.86	1.18
Utricularia resupinata	Small purple bladderwort	8	0.86	2.47	2.08	1.75
Eleocharis palustris	Creeping spikerush	6	0.65	1.85	1.56	1.67
Elodea nuttallii	Slender waterweed	6	0.65	1.85	1.56	1.00
Eleocharis robbinsii	Robbins spikerush	5	0.54	1.54	1.30	1.20
	Aquatic moss	5	0.54	1.54	1.30	1.00

Table 4 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Pipe Lake, Polk County, August 2007

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Utricularia vulgaris	Common bladderwort	5	0.54	1.54	1.30	1.20
Potamogeton epihydrus	Ribbon-leaf pondweed	4	0.43	1.23	1.04	2.00
Potamogeton gramineus	Variable pondweed	4	0.43	1.23	1.04	1.50
Pontederia cordata	Pickerelweed	3	0.32	0.93	0.78	1.67
Schoenoplectus acutus	Hardstem bulrush	3	0.32	0.93	0.78	1.00
Schoenoplectus purshianus	Pursh's bulrush	3	0.32	0.93	0.78	1.67
Sparganium fluctuans	Floating-leaved bur-reed	2	0.22	0.62	0.52	1.50
Schoenoplectus torreyi	Torrey's three-square	2	0.22	0.62	0.52	1.00
Dulichium arundinaceum	Three-way sedge	1	0.11	0.31	0.26	2.00
Myriophyllum farwellii	Farwell's water milfoil	1	0.11	0.31	0.26	1.00
Potamogeton natans	Floating-leaf pondweed	1	0.11	0.31	0.26	1.00
Sparganium androcladum	Shining bur-reed	1	0.11	0.31	0.26	1.00
Potamogeton bicupulatus	Filament-leaf pondweed	**	**	**	**	**
Eleocharis ovata	Oval spikerush	***	***	***	***	***
Equisetum fluviatile	Water horsetail	***	***	***	***	***
Najas gracillima	Northern naiad	***	***	***	***	***
Nuphar variegata	Spatterdock	***	***	***	***	***
Sagittaria latifolia	Common arrowhead	***	***	***	***	***
Typha latifolia	Broad-leaved cattail	***	***	***	***	***

** Visual Only

*** Boat Survey Only

Table 5: Floristic Quality Index of Aquatic Macrophytes
North Pipe Lake, Polk County
August 2007

Species	Common Name	C
Alisma plantago-aquatica	Water plantain	4
Brasenia schreberi	Watershield	7
Ceratophyllum echinatum	Spiny hornwort	10
Cicuta bulbifera	Bulb-bearing water hemlock	7
Dulichium arundinaceum	Three-way sedge	9
Elatine minima	Waterwort	9
Eleocharis acicularis	Needle spikerush	5
Eleocharis obtusa	Blunt spikerush	3
Eleocharis ovata	Oval spikerush	8
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
Leersia oryzoides	Rice cut-grass	3
Lemna minor	Small duckweed	5
Lipocarpha micrantha	Small-flowered hemicarpha	8
Myriophyllum tenellum	Dwarf water-milfoil	10
Najas flexilis	Bushy pondweed	6
Najas gracillima	Northern naiad	7
Nitella sp.	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Pontederia cordata	Pickerelweed	9
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton bicupulatus	Filament-leaf pondweed	9
Potamogeton epihydrus	Ribbon-leaf pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton pusillus	Small pondweed	7
Potamogeton robbinsii	Robbins (fern) pondweed	8
Potamogeton spirillus	Spiral-fruited pondweed	8
Ranunculus flammula	Creeping spearwort	9
Sagittaria latifolia	Common arrowhead	3
Sagittaria rigida	Sessile-fruited arrowhead	8
Schoenoplectus acutus	Hardstem bulrush	5
Schoenoplectus purshianus	Pursh's bulrush	9
Schoenoplectus tabernaemontani	Softstem bulrush	4
Sparganium emersum	Narrow-leaf bur-reed	8
Sparganium fluctuans	Floating-leaf-bur-reed	10

Table 5 (cont'): Floristic Quality Index of Aquatic Macrophytes
North Pipe Lake, Polk County
August 2007

Species	Common Name	C
Spirodela polyrhiza	Large duckweed	5
Typha latifolia	Broad-leaved cattail	1
Utricularia resupinata	Small purple bladderwort	9
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
N		44
mean C		6.9
FQI		46.0

Table 6: Floristic Quality Index of Aquatic Macrophytes
Pipe Lake, Polk County
August 2007

Species	Common Name	C
Brasenia schreberi	Watershield	7
Chara sp.	Muskgrass	7
Dulichium arundinaceum	Three-way sedge	9
Elatine minima	Waterwort	9
Eleocharis acicularis	Needle spikerush	5
Eleocharis ovata	Oval spikerush	8
Eleocharis palustris	Creeping spikerush	6
Eleocharis robbinsii	Robbins spikerush	10
Elodea nuttallii	Slender waterweed	7
Equisetum fluviatile	Water horsetail	7
Eriocaulon aquaticum	Pipewort	9
Isoetes lacustris	Lake quillwort	8
Juncus pelocarpus f. submersus	Brown-fruited rush	8
Myriophyllum farwellii	Farwell's water-milfoil	9
Myriophyllum tenellum	Dwarf water-milfoil	10
Najas flexilis	Bushy pondweed	6
Najas gracillima	Northern naiad	7
Nitella sp.	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Pontederia cordata	Pickerelweed	9
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton bicupulatus	Filament-leaf pondweed	8
Potamogeton epihydrus	Ribbon-leaf pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton pusillus	Small pondweed	7
Potamogeton robbinsii	Robbins (fern) pondweed	8
Potamogeton spirillus	Spiral-fruited pondweed	8
Ranunculus flammula	Creeping spearwort	9
Sagittaria latifolia	Common arrowhead	3
Sagittaria rigida	Sessile-fruited arrowhead	8
Schoenoplectus acutus	Hardstem bulrush	5
Schoenoplectus purshianus	Pursh's bulrush	9
Schoenoplectus torreyi	Torrey's three-square	9
Sparganium androcladum	Shining bur-reed	8
Sparganium fluctuans	Floating-leaf-bur-reed	10
Typha latifolia	Broad-leaved cattail	1

Table 6 (cont'): Floristic Quality Index of Aquatic Macrophytes
Pipe Lake, Polk County
August 2007

Species	Common Name	C
Utricularia gibba	Creeping bladderwort	9
Utricularia resupinata	Small purple bladderwort	9
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
N		42
mean C		7.4
FQI		48.1

We identified a total of 47 species on North Pipe, and 44 species on Pipe for an unusually high combined total of 55 species in and immediately adjacent to the lakes. The total from both lakes produced a mean Coefficient of Conservation 7.1 and a Floristic Index of 50.9. Nichols (1999) reported Average Mean C for the Northern Central Hardwood Forests Region of 5.6 putting the Pipe Lakes well above average for this part of the state. The FQI was also more than double the mean FQI of 20.9 for the Northern Central Hardwood Forests Region (Nichols 1999). These high numbers are a result of not only the sensitive plants that live here, but the diversity of many different sensitive plants.

Discussion and Considerations for Management:

The Pipe Lakes have a healthy, abundant, diverse and rare plant community that contains an unusually high number of state listed species. This is likely due to a combination of factors including its large size, varied habitats and good water quality.

Currently there are few significant concerns for the Pipe Lakes' macrophyte community. The lack of dense stands of broad-leaved plants in many parts of the lake is likely attributed to the relatively inorganic soil that makes up the majority of the lake substrate. This is natural for seepage lakes with a predominantly sandy/rocky bottom. Turbidity from suspended particles and tannins (natural chemicals from the breakdown of plants) does cloud the water and limit the amount of light that can penetrate to the lake bottom in North Pipe Lake and the southeast bays of Pipe Lake. This could be improved by accomplishing the District's stated goal of reducing nutrient runoff. In addition to improving water clarity, it would lead to native vegetation being able to growth at greater depths thus providing additional habitat. Filamentous algae, normally associated with an abundance of nutrients in the water from lawn and field fertilizer runoff, had a low relative frequency of 1.61 in Pipe Lake and a slightly higher 5.92% in North Pipe. Although these could certainly be reduced by limiting nutrient runoff, there were few places in the lake that currently exhibited excessive algal growth.

With the exception of watershield in shallow, mucky bays, the Pipe Lakes have few places that exhibit anything approaching excessive plant growth. Because dense stands of submergent vegetation are relatively rare, those that do exist, coupled with the emergent reed/rush beds along shore, are especially important as they provide some of the only cover for young fish in what is otherwise a barren lake bottom in most areas. This general lack of cover for fish should make preserving and maintaining the Pipe Lakes' plant community a top management goal. In addition to providing nursery habitat for fish, these plants are the base of the aquatic food pyramid, provide habitat for other aquatic organisms, are an important food sources for waterfowl and other wildlife, stabilize the shoreline, and work to improve water clarity by absorbing excess nutrients from the water. Whenever possible, lake shore owners should refrain from removing plants from the lake as these patches of barren substrate also provide an easy place for invasive plants to take root and become established. Reducing or eliminating fertilizer and pesticide applications will also contribute to improved water quality. Where possible, especially along the north and west shores of Pipe Lake, shoreline restoration and buffer strips of native vegetation would enhance water quality by preventing erosion as well as improve the aesthetic value of this highly developed shoreline. Analysis of the distribution maps for the most sensitive species reveals that they are reduced in abundance or absent from the most highly developed areas where residents are mowing and/or fertilizing lawns down to the shoreline or aggressively removing vegetation from the lake.

The Lake District's established "Clean Boats/Clean Water" program and noticeable signage provides the lakes with a layer of protection against aquatic invasive species by providing education, reeducation, and continual reminders of the dangers/impacts of aquatic invasive species. Expanding the "Clean Boats/Clean Water" program to 7 days a week, installing cameras to monitor boat launchings, and conducting monthly or bimonthly survey transects parallel to the shore where people launch boats at the north and south ends of Pipe Lake could offer additional layers of protection and might be things for the District to consider.

Management Recommendations Summary:

- Preserve and maintain the Pipe Lakes' diverse and rare native plant community.
- Preserve the lakes' many rush/reed beds which serve as fish nurseries.
- Encourage owners to refrain from removing native plants from the lake.
- Reduce and, wherever possible, eliminate fertilizer and pesticide applications near the lakeshore.
- Encourage shoreline restoration.
- Establish native vegetation buffer strips along the lakeshore.
- Continue or expand the lakes' Clean Boats/Clean Water campaign.
- Consider cameras or transect monitoring for invasive species at the lakes' boat landings.

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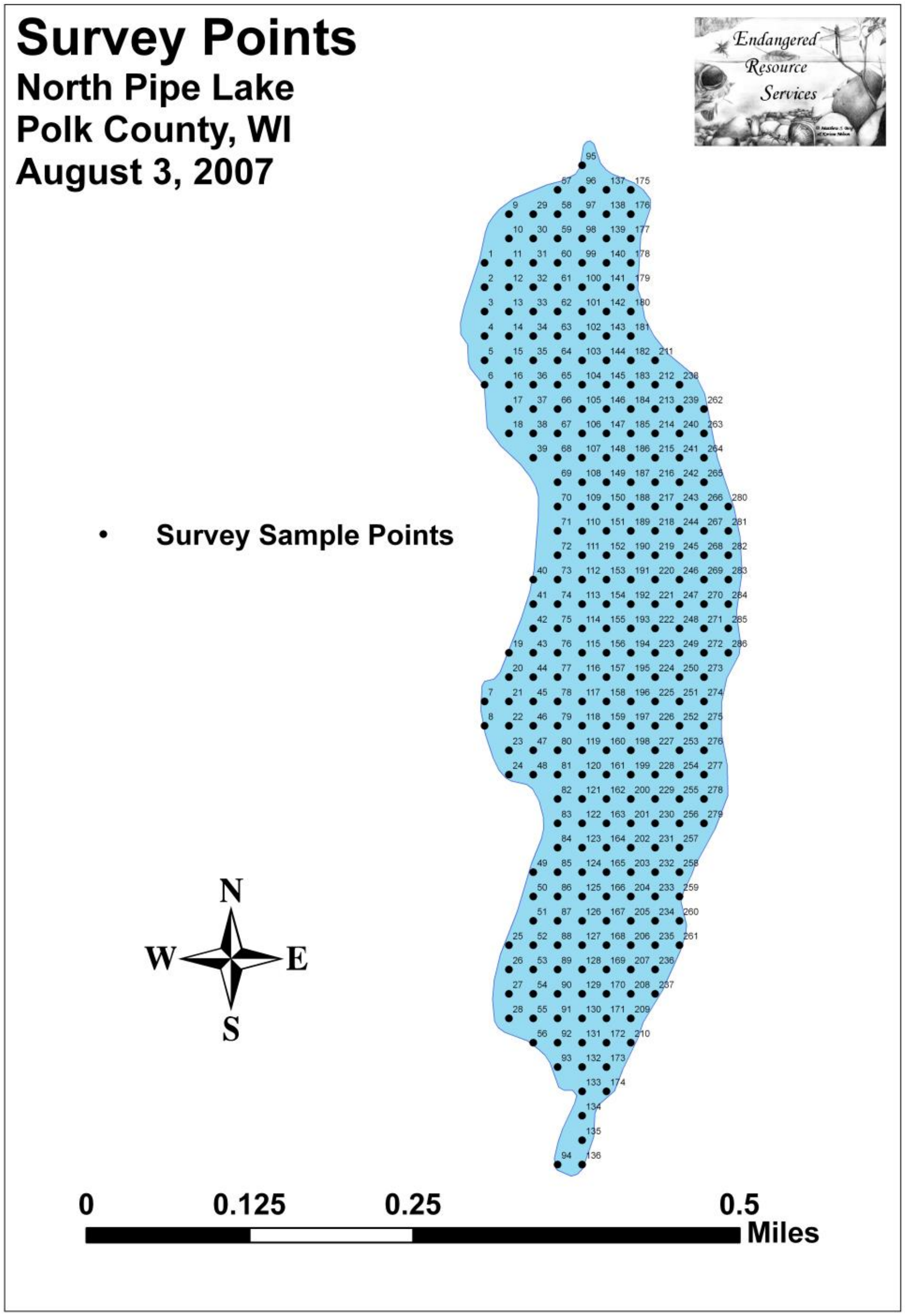
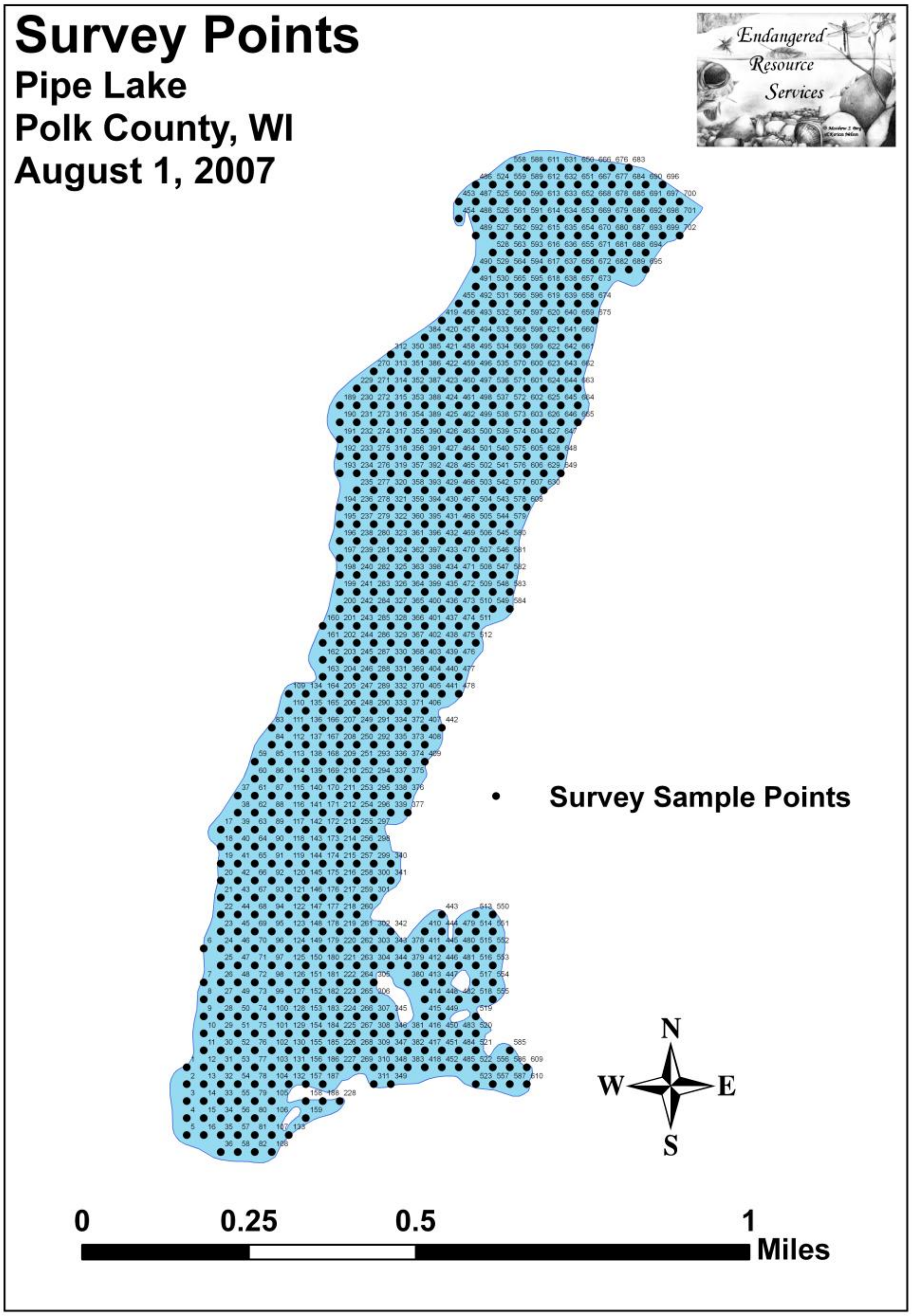
Appendix I: Pipe Lake and North Pipe Lake Maps with Sample Points


Survey Points
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Survey Sample Points
N
W
E
S
0
0.125
0.25
0.5
Miles


Survey Points
Pipe Lake
Polk County, WI
August 1, 2007
Endangered
Resource
Services
Survey Sample Points
N
W
E
S
0
0.25
0.5
1
Miles

Appendix II: Boat Survey Data Sheet

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

Appendix III: Vegetative Survey Data Sheet

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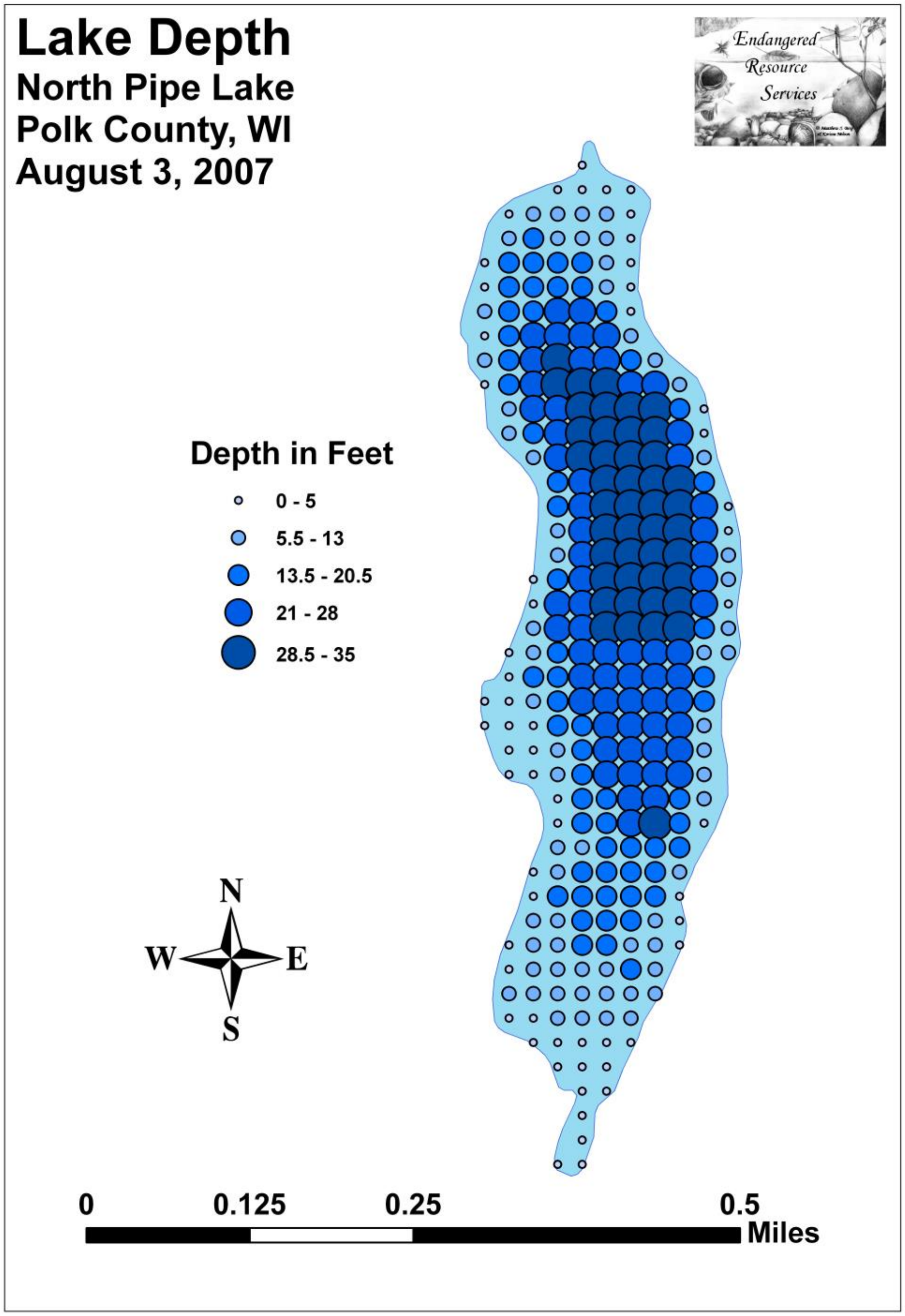
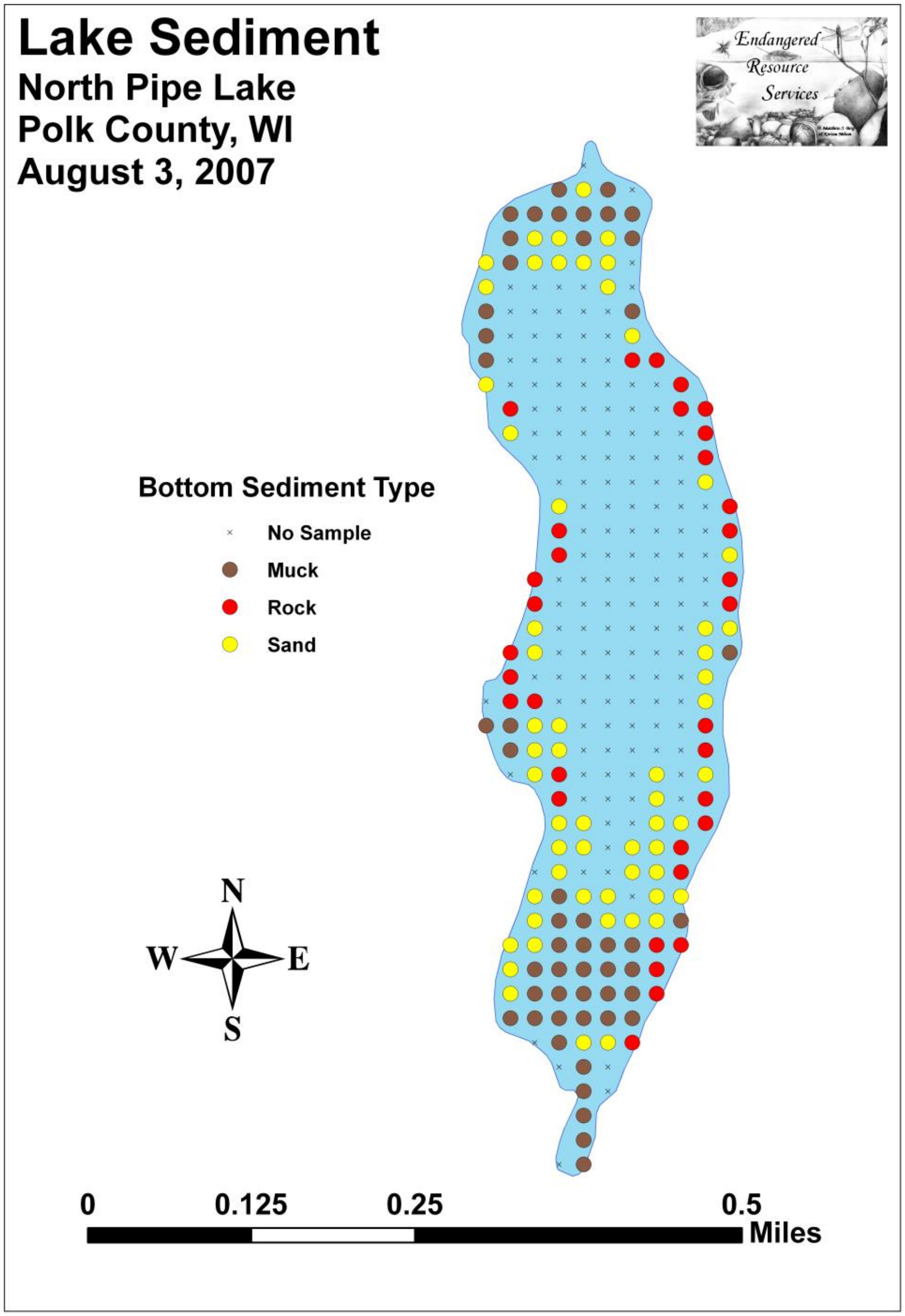
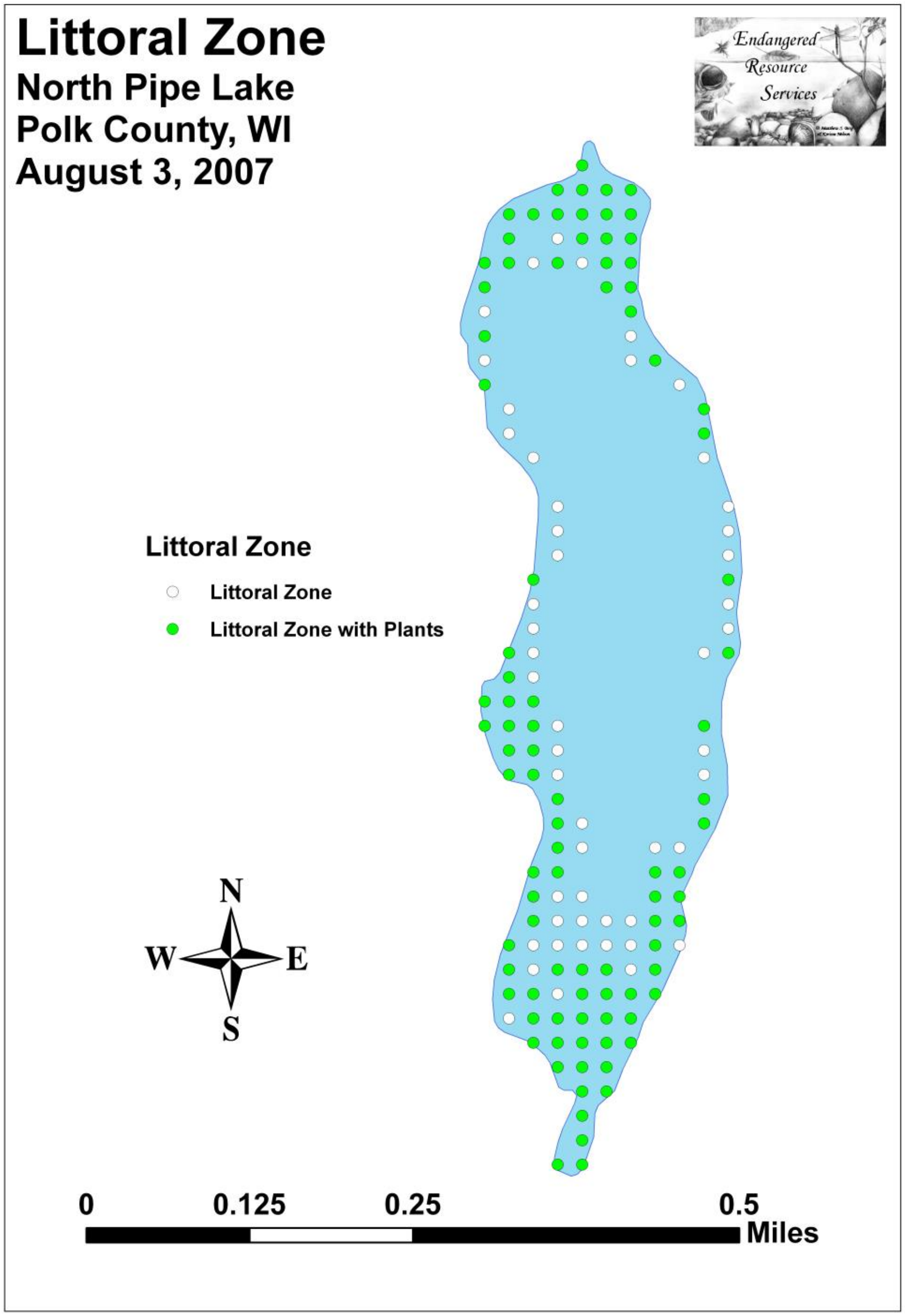
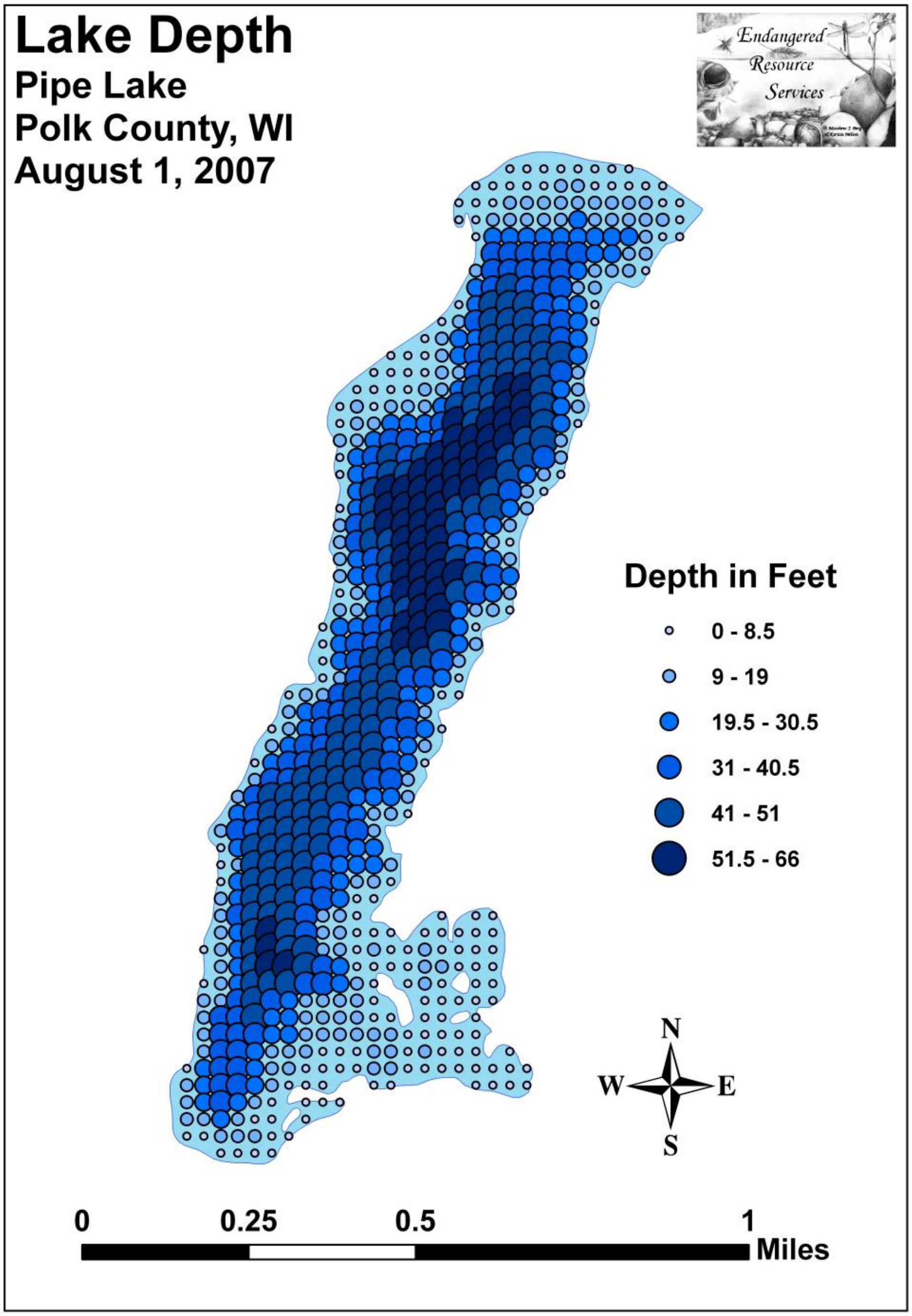
16																									
17																									
18																									
19																									
20																									

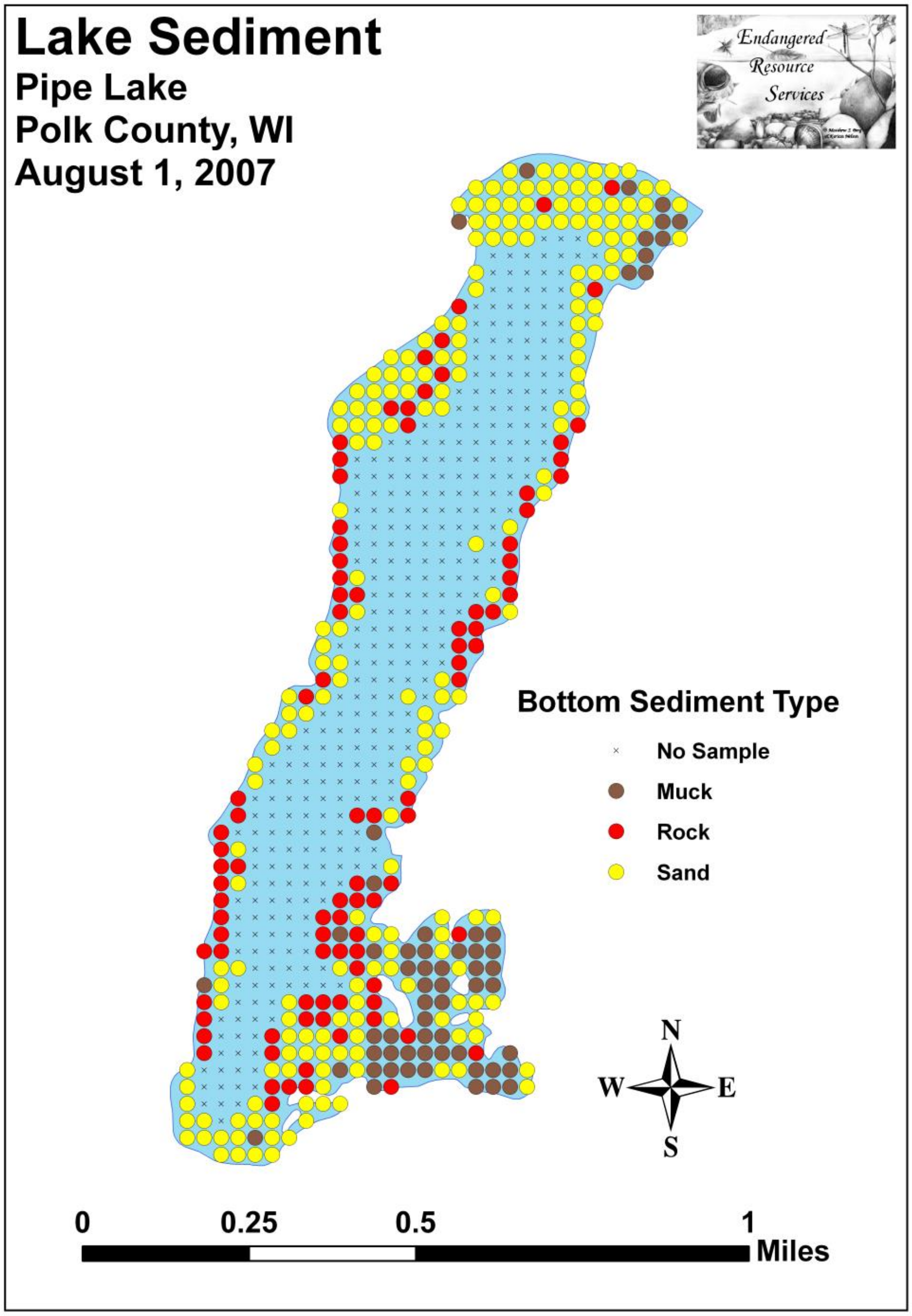
Appendix IV: Habitat Variable Maps

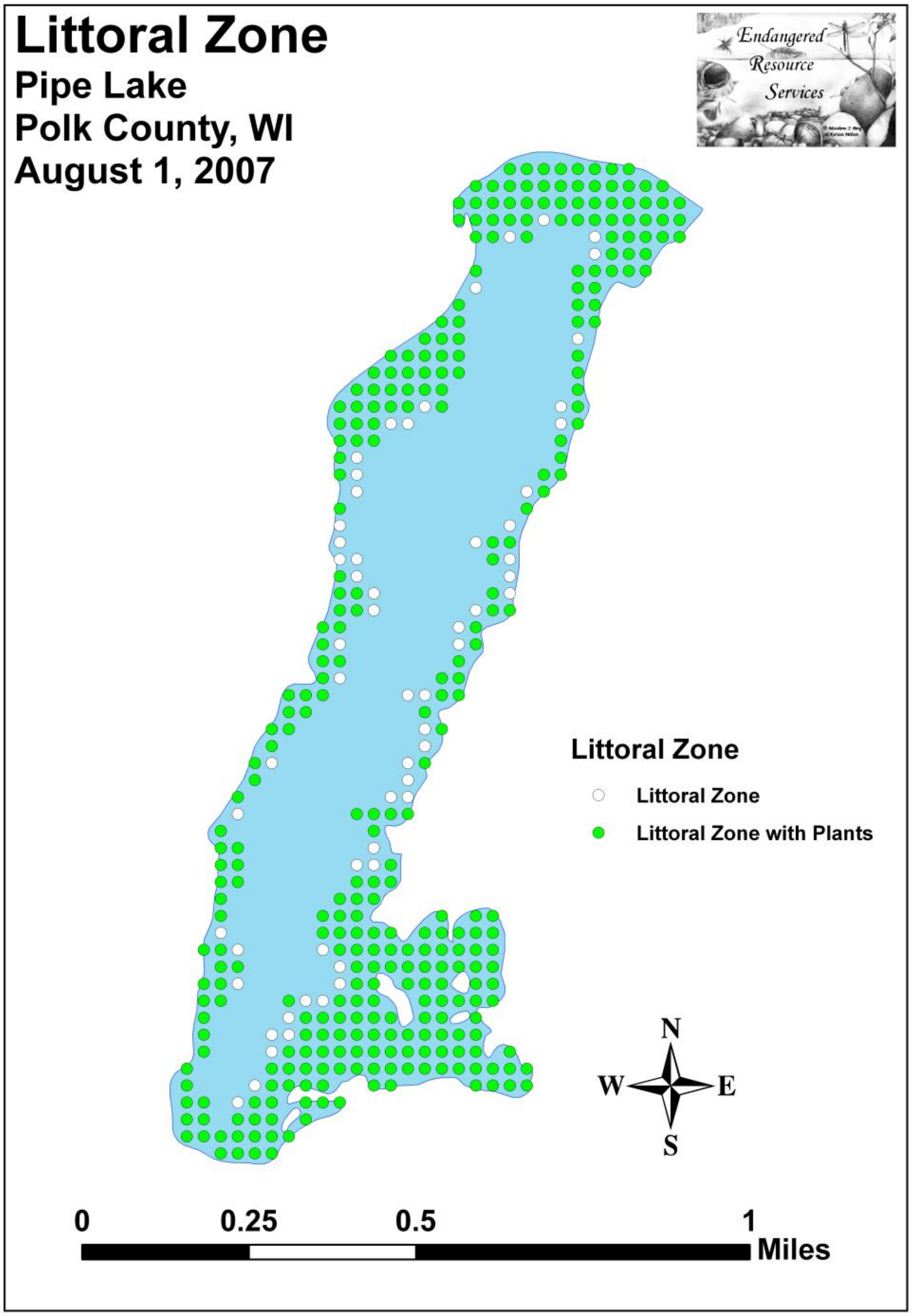

Lake Depth
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered
Resource
Services
Depth in Feet
0 - 5
5.5 - 13
13.5 - 20.5
21 - 28
28.5 - 35
N
W
E
S
0
0.125
0.25
0.5
Miles


Lake Sediment
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered
Resource
Services
Bottom Sediment Type
No Sample
Muck
Rock
Sand
N
W
E
S
0
0.125
0.25
0.5
Miles


Littoral Zone
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered
Resource
Services
Littoral Zone
Littoral Zone
Littoral Zone with Plants
N
W
E
S
0
0.125
0.25
0.5
Miles


Lake Depth
Pipe Lake
Polk County, WI
August 1, 2007
Endangered
Resource
Services
Depth in Feet
0 - 8.5
9 - 19
19.5 - 30.5
31 - 40.5
41 - 51
51.5 - 66
N
W
E
S
0
0.25
0.5
1
Miles


Lake Sediment
Pipe Lake
Polk County, WI
August 1, 2007
Endangered
Resource
Services
Bottom Sediment Type
No Sample
Muck
Rock
Sand
N
W
E
S
0
0.25
0.5
1
Miles


Littoral Zone
Pipe Lake
Polk County, WI
August 1, 2007
Endangered
Resource
Services
Littoral Zone
Littoral Zone
Littoral Zone with Plants
N
W
E
S
0
0.25
0.5
1
Miles

Appendix V: Plant Species Accounts

Species: (*Alisma plantago-aquatic*) **Water plantain**
Location: Rare with only a few individuals located in recently exposed muck just north of the bridge between the lakes.
Habitat: Muck bottom at the shoreline.
Common Associates: (*Leersia oryzoides*) Rice cut-grass
(*Sagittaria rigida*) Sessile-fruited arrowhead
(*Nymphaea odorata*) White water lily

Species: **Aquatic moss**
Location: Uncommon in North Pipe to relatively common in Pipe. It was found in deep water near rocky drop-offs.
Habitat: Rocky bottoms in 6-8 meters of water.
Common Associates: (*Nitella* sp.) Nitella
(*Chara* sp.) Muskgrass

Species: (*Brasenia schreberi*) **Watershield**
Location: Abundant in muck bays throughout both lakes – especially in the southeast bays of Pipe
Habitat: Muck and mucky sand bottom in 1-2 meters.
Common Associates: (*Nuphar variegata)* Spatterdock
(*Nymphaea odorata*) White water lily
(*Eleocharis robbinsii*) Robbin's Spikerush

Species: (*Ceratophyllum echinatum*) **Spiny hornwort**
Location: Rare at a few locations in North Pipe.
Habitat: Muck bottom in 0-1 meters.
Common Associates: (*Brasenia schreberi*) Watershield
(*Nuphar variegata)* Spatterdock
(*Nymphaea odorata*) White water lily

Species: (*Chara* sp.) **Muskgrass**
Location: Uncommon on the south end of Pipe Lake.
Habitat: Sand/silt/muck bottom areas in water from 0 – 8 meter deep.
Common Associates: (*Nitella* sp.) Nitella
(*Potamogeton amplifolius*) Large-leaf pondweed
(*Potamogeton pusillus*) Small pondweed
(*Potamogeton spirillus*) Spiral-fruited pondweed
Aquatic moss

Species: (*Cicuta bulbifera*) **Bulb-bearing water hemlock**
Location: Rare with only a few scattered individuals located along shore far north end of North Pipe.
Habitat: Muck bottom at the shoreline in 0 – 0.25 meters of water.
Common Associates: (*Sagittaria rigida*) Sessile-fruited arrowhead
(*Typha latifolia*) Broad-leaved cattail
(*Sagittaria latifolia*) Common arrowhead

Species: (*Dulichium arundinaceum*) **Three-way sedge**
Location: Scattered locations on the south end of North Pipe and south end of Pipe.
Habitat: Located at the edge of the lake in mucky soil
Common Associates: (*Eleocharis ovata*) Oval spikerush
(*Eleocharis acicularis*) Needle spikerush
(*Ranunculus flammula*) Creeping spearwort
(*Leersia oryzoides*) Rice cut-grass

Species: (*Elatine minima*) **Waterwort**
Location: Common throughout both lakes where it is scattered in plant "mats" with other small macrophytes in shallow water.
Habitat: Rocky to sandy bottoms in 0-1.5 meters of 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

Species: (*Eleocharis acicularis*) **Needle spikerush**
Location: Abundant throughout both lakes where it forms thick mats in shallow water. Emergent form located along shore interspersed among other emergents
Habitat: Rocky to sandy bottoms in 0-1.5 meters of water.
Common Associates: (*Myriophyllum tenellum*) Dwarf water milfoil
(*Juncus pelocarpus*) Brown-fruited rush
(*Ranunculus flammula*) Creeping spearwort
(*Utricularia resupinata*) Small purple bladderwort

Species: (*Eleocharis obtusa*) **Blunt spikerush**
Location: Scattered locations on the south and west end of North Pipe
Habitat: Located at the edge of the lake in mucky soil
Common Associates: (*Eleocharis ovata*) Oval spikerush
(*Eleocharis acicularis*) Needle spikerush
(*Ranunculus flammula*) Creeping spearwort

Species: (*Eleocharis* ovata) **Oval spikerush**
Location: Scattered locations on the south and west end of North Pipe
Habitat: Located at the edge of the lake in mucky soil
Common Associates: (*Eleocharis obtusa*) Blunt spikerush
(*Eleocharis acicularis*) Needle spikerush
(*Ranunculus flammula*) Creeping spearwort

Species: (*Eleocharis palustris*) **Creeping spikerush**
Location: Widely scattered reed beds in both lakes primarily along exposed points.
Habitat: Rocky/sandy bottoms in 0-1 meter of water.
Common Associates: (*Schoenoplectus tabernaemontani*) Softstem bulrush
(*Schoenoplectus acutus*) Hardstem bulrush
(*Eleocharis acicularis*) Needle spikerush

Species: (*Eleocharis robbinsii*) **Robbin's spikerush**
Location: Common in the southeast bays of Pipe.
Habitat: Muck bottoms in 0-1 meter of water.
Common Associates: (*Brasenia schreberi*) Watershield
(*Nymphaea odorata*) White water lily
(*Myriophyllum farwellii*) Farwell's milfoil

Species: (*Elodea nuttallii*) **Slender waterweed**
Location: Uncommon in scattered locations throughout the north half of Pipe.
Habitat: Sandy muck bottom in 0-4 meters of water.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed
(*Potamogeton pusillus*) Small pondweed
(*Nitella* sp.) Nitella

Species: (*Equisetum fluviatile*) **Water horsetail**
Location: Rare in scattered patches on the northeast corner of North Pipe and in the southeast bays of Pipe.
Habitat: Found in mucky sand over gravel in 0-1 meters of water.
Common Associates: (*Pontederia cordata*) Pickerelweed
(*Sagittaria rigida*) Sessile-fruited arrowhead
(*Isoetes lacustris*) Lake quillwort

Species: (*Eriocaulon aquaticum*) **Pipewort**
Location: Common in sandy soil throughout Pipe – scattered locations on North Pipe.
Habitat: Sandy to rocky bottoms in water < 1 meter deep to emergent on shore.
Common Associates: (*Eleocharis acicularis*) Needle spikerush
(*Myriophyllum tenellum*) Dwarf water milfoil
(*Juncus pelocarpus*) Brown-fruited rush

Species: Filamentous algae
Location: Uncommon in scattered locations throughout both lake.
Habitat: Muck to rocky bottoms in sheltered water from 0-4 meters deep.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed
(*Potamogeton pusillus*) Small pondweed
(*Nitella* sp.) Nitella

Species: (*Isoetes lacustris*) **Lake quillwort**
Location: Relatively common throughout both lakes where it is scattered in shallow water.
Habitat: Rocky to sandy bottoms in 0-1.5 meters of water.
Common Associates: (*Eleocharis acicularis*) Needle spikerush
(*Eriocaulon aquaticum*) Pipewort
(*Juncus pelocarpus*) Brown-fruited rush
(*Potamogeton spirillus*) Spiral-fruited pondweed

Species: (*Juncus pelocarpus*) **Brown-fruited rush**
Location: 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
Habitat: Rocky to sandy bottoms in 0-1.5 meters of water.
Common Associates: (*Myriophyllum tenellum*) Dwarf water milfoil
(*Ranunculus flammula*) Creeping spearwort
(*Eleocharis acicularis*) Needle spikerush
(*Utricularia resupinata*) Small purple bladderwort

Species: (*Leersia oryzoides*) **Rice cut-grass**
Location: Scattered locations on the south end of North Pipe.
Habitat: Located at the edge of the lake in mucky soil
Common Associates: (*Eleocharis ovata*) Spikerush
(*Eleocharis acicularis*) Needle spikerush
(*Ranunculus flammula*) Creeping spearwort
(*Dulichium arundinaceum*) Three-way sedge

Species: (*Lemna minor*) **Small duckweed**
Location: Rare in the far northeast bay of North Pipe. Scattered individuals occur interspersed between the lilypads.
Habitat: Located floating at or just under the surface in sheltered areas.
Common Associates: (*Brasenia schreberi*) Watershield
(*Nymphaea odorata*) White water lily
(*Nuphar variegata)* Spatterdock
(*Pontederia cordata*) Pickerelweed
(*Spirodela polyrhiza*) Large duckweed

Species: (*Lipocarpha micrantha*) **Small-flowered hemicarpha**
Location: Rare at a few locations in North Pipe.
Habitat: Muck bottom along the shoreline.
Common Associates: (*Leersia oryzoides*) Rice cut-grass
(*Sagittaria rigida*) Sessile-fruited arrowhead
(*Eleocharis acicularis*) Needle spikerush

Species: (*Myriophyllum farwellii*) **Farwell's water milfoil**
Location: Southeast bay of Pipe Lake in sheltered locations.
Habitat: Muck bottom in water up to 2 meters in depth.
Common Associates: (*Brasenia schreberi*) Watershield
(*Eleocharis robbinsii*) Robbin's spikerush
(*Utricularia gibba*) Creeping bladderwort

Species: (*Myriophyllum tenellum*) **Dwarf water milfoil**
Location: Common throughout Pipe Lake in sandy areas.
Habitat: Preferred stable sand or rocky bottoms in 0-1 meter of water.
Common Associates: (*Eleocharis acicularis*) Needle spikerush
(*Juncus pelocarpus*) Brown-fruited rush
(*Eriocaulon aquaticum*) Pipewort
(*Utricularia resupinata*) Small purple bladderwort

Species: (*Najas flexilis*) **Bushy pondweed**
Location: Common, and widely distributed throughout both lakes.
Habitat: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-1.5 meters of water.
Common Associates: (*Potamogeton pusillus*) Small pondweed
(*Potamogeton spirillus*) Spiral-fruited pondweed
(*Najas gracillima*) Northern naiad

Species: (*Najas gracillima*) **Northern naiad**
Location: Uncommon but widely distributed throughout North Pipe; may also be present in Pipe. Microscopic analysis of seeds needed to confirm species id, and this was not done for specimens found in Pipe. It occurs with other sensitive species and forms mixed beds with its cousin *N. flexilis*.
Habitat: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-1.5 meters of water.
Common Associates: (*Potamogeton bicupulatus*) Filament-leaf pondweed
(*Potamogeton epihydrus*) Ribbon-leaf pondweed
(*Potamogeton spirillus*) Spiral-fruited pondweed
(*Najas flexilis*) Bushy pondweed

Species: (*Nitella* sp.) **Nitella**
Location: Common throughout Pipe Lake.
Habitat: Sand/silt/muck bottom areas in water from 0 – 10 meter deep.
Common Associates: (*Chara* sp.) Muskgrass
(*Potamogeton amplifolius*) Large-leaf pondweed
(*Potamogeton pusillus*) Small pondweed
(*Potamogeton spirillus*) Spiral-fruited pondweed
Aquatic moss

Species: (*Nuphar variegata)* **Spatterdock**
Location: Relatively common in most sheltered shoreline areas of North Pipe; less so in Pipe
Habitat: Muck bottom in 0-2 meters of water where it often forms dense canopies.
Common Associates: (*Brasenia schreberi*) Watershield
(*Nymphaea odorata*) White water lily
(*Pontederia cordata*) Pickerelweed

Species: (*Nymphaea odorata*) **White water lily**
Location: Common in sheltered bays of both lakes.
Habitat: Muck bottom in 0-2 meters where it forms dense canopies with other floating leaf species.
Common Associates: (*Brasenia schreberi*) Watershield
(*Nuphar variegata)* Spatterdock
(*Pontederia cordata*) Pickerelweed

Species: (*Phalaris arundinacea*) **Reed canary grass**
Location: Scattered shore locations in North Pipe. It is more common away from shore.
Habitat: Firm to mucky bottom in 0-0.5 meters of water.
Common Associates: Generally, this species exists in patches at the exclusion of other species.

Species: (*Pontederia cordata*) **Pickerelweed**
Location: Common in emergent beds throughout both lakes; especially in sheltered bays.
Habitat: Silt to muck bottom over firm substrate in 0-1.5 meters of water.
Common Associates: (*Brasenia schreberi*) Watershield
(*Nymphaea odorata*) White water lily
(*Nuphar variegata)* Spatterdock

Species: (*Potamogeton amplifolius*) **Large-leaf pondweed**
Location: Fairly common throughout on the out edge of lily pad beds where the lake drops off into deeper water.
Habitat: 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.
Common Associates: (*Potamogeton pusillus*) Small pondweed
(*Potamogeton spirillus*) Spiral-fruited pondweed
(*Nitella* sp.) Nitella

Species: (*Potamogeton bicupulatus*) **Filament-leaf pondweed**
Location: 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.
Habitat: Found in sandy to mucky bottom conditions in shallow water 0.5-1.0 meter deep.
Common Associates: (*Najas gracillima*) Northern naiad
(*Potamogeton epihydrus*) Ribbon-leaf pondweed
(*Potamogeton spirillus*) Spiral-fruited pondweed
(*Najas flexilis*) Bushy pondweed

Species: (*Potamogeton epihydrus*) **Ribbon-leaf pondweed**
Location: 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.
Habitat: Found in mucky bottom conditions in shallow water 0.5-1.5 meter deep.
Common Associates: (*Najas gracillima*) Northern naiad
(*Potamogeton bicupulatus*) Filament-leaf pondweed
(*Potamogeton gramineus*) Variable pondweed
(*Najas flexilis*) Bushy pondweed

Species: (*Potamogeton gramineus*) **Variable pondweed**
Location: Fairly common in North Pipe at the edge of lilypads; Uncommon in Pipe near the channel and in the southeast bays. It exhibits unusual growth forms ranging from several underwater leaves to only floating leaves. Nutlet analysis used to confirm these very unusual looking gramineus specimens.
Habitat: Found in sandy/muck bottom conditions in shallow water 0.5-1.5 meter deep.
Common Associates: (*Pontederia cordata*) Pickerelweed
(*Potamogeton epihydrus*) Ribbon-leaf pondweed
(*Najas flexilis*) Bushy pondweed

Species: (*Potamogeton natans*) **Floating-leaf pondweed**
Location: Rare, a single bed was located in the southeast corner of Pipe.
Habitat: Muck and sand bottom in 1-2 meters.
Common Associates: (*Brasenia schreberi*) Watershield
(*Eleocharis robbinsii*) Robbin's Spikerush

Species: (*Potamogeton pusillus*) **Small pondweed**
Location: Relatively common in Pipe, uncommon and local in North Pipe. It is widely distributed on the edge of the drop off - in its preferred habitat it forms dense "underwater forests".
Habitat: 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.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed
(*Potamogeton spirillus*) Spiral-fruited pondweed
(*Nitella* sp.) Nitella

Species: (*Potamogeton robbinsii*) **Robbins (fern) pondweed**
Location: Abundant on the north end of North Pipe, and common elsewhere; more restricted in Pipe except in the northeast and southeast bays.
Habitat: 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.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed
(*Potamogeton pusillus*) Small pondweed
(*Potamogeton spirillus*) Spiral-fruited pondweed
(*Nitella* sp.) Nitella

Species: (*Potamogeton spirillus*) **Spiral-fruited-leaf pondweed**
Location: 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.
Habitat: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 1-1.5 meters of water.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed
(*Potamogeton pusillus*) Small pondweed
(*Isoetes lacustris*) Lake quillwort
(*Vallisneria americana*) Wild celery

Species: (*Ranunculus flammula*) **Creeping spearwort**
Location: 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
Habitat: Rocky to sandy bottoms in 0-1.5 meters of water.
Common Associates: (*Myriophyllum tenellum*) Dwarf water milfoil
(*Juncus pelocarpus*) Brown-fruited rush
(*Eleocharis acicularis*) Needle spikerush
(*Utricularia resupinata*) Small purple bladderwort

Species: (*Sagittaria rigida*) **Sessile-fruited arrowhead**
Location: Common and widespread in both lakes directly along shore.
Habitat: 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 Associates: (*Najas flexilis*) Bushy pondweed
(*Potamogeton gramineus*) Variable pondweed
(*Eriocaulon aquaticum*) Pipewort

Species: (*Sagittaria latifolia*) **Common arrowhead**
Location: Restricted to the far north end of North Pipe and a few locations in the southeast bays of Pipe.
Habitat: Thick muck soil in and out of water <0.5 meters.
Common Associates: (*Nymphaea odorata*) White water lily
(*Typha latifolia*) Broad-leaved cattail
(*Phalaris arundinacea*) Reed canary grass

Species: (*Schoenoplectus acutus*) **Hardstem bulrush**
Location: Common in scattered reed beds along or on shore on both North Pipe and Pipe; especially exposed points.
Habitat: Rocky and sandy bottoms in 0-1 meter of water.
Common Associates: (*Eleocharis palustris*) Creeping spikerush
(*Schoenoplectus tabernaemontani*) Softstem bulrush

Species: (*Schoenoplectus purshianus*) **Pursh's bulrush**
Location: Relatively common in scattered reed beds at the shoreline on both North Pipe and Pipe; especially exposed points.
Habitat: Rocky and sandy bottoms in 0 meter of water.
Common Associates: (*Eleocharis palustris*) Creeping spikerush
(*Schoenoplectus acutus*) Hardstem bulrush
(*Eleocharis obtusa*) Blunt spikerush

Species: (*Schoenoplectus tabernaemontani*) **Softstem bulrush**
Location: A single reed bed on the west shore of North Pipe Lake.
Habitat: Rocky bottoms in 0-1 meter of water.
Common Associates: (*Schoenoplectus acutus*) Hardstem bulrush
(*Eleocharis palustris*) Creeping spikerush

Species: (*Schoenoplectus torreyi*) **Torrey's three-square**
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

Species: (*Sparganium fluctuans*) **Floating-leaf bur-reed**
Location: Scattered locations directly along shore in bays of both lakes.
Habitat: Muck and muck over gravel bottoms in 0-0.5 meters of water.
Common Associates: (*Sagittaria rigida*) Sessile-fruited arrowhead
(*Najas flexilis*) Bushy pondweed

Species: (*Sparganium* sp.) **Bur-reed sp. Likely *androcladum***
Location: One location on Pipe. All individuals were in fruit, and it is likely Shining bur-reed (*Sparganium androcladum*).
Habitat: Muck and muck over gravel bottoms at the shoreline.
Common Associates: (*Sagittaria rigida*) Sessile-fruited arrowhead
(*Sagittaria latifolia*) Common arrowhead

Species: (*Sparganium* sp.) **Bur-reed sp. Likely *emersum*.**
Location: 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.
Habitat: Muck and muck over gravel bottoms in 0-1 meter of water.
Common Associates: (*Sagittaria rigida*) Sessile-fruited arrowhead
(*Najas flexilis*) Bushy pondweed
(*Sparganium fluctuans*) Floating-leaf bur-reed

Species: (*Spirodela polyrhiza*) **Large duckweed**
Location: Rare in the far northeast and southeast bay of North Pipe. Scattered individuals occur interspersed between the lilypads.
Habitat: Located floating at or just under the surface in sheltered areas.
Common Associates: (*Brasenia schreberi*) Watershield
(*Nymphaea odorata*) White water lily
(*Nuphar variegata)* Spatterdock
(*Pontederia cordata*) Pickerelweed
(*Lemna minor*) Small duckweed

Species: (*Typha latifolia*) **Broad-leaved cattail**
Location: Restricted to locations near the North Pipe Lake inlet.
Habitat: Thick muck soil in and out of water <0.5 meters.
Common Associates: (*Sagittaria rigida*) Sessile-fruited arrowhead
(*Cicuta bulbifera*) Bulb-bearing water hemlock
(*Sagittaria latifolia*) Common arrowhead

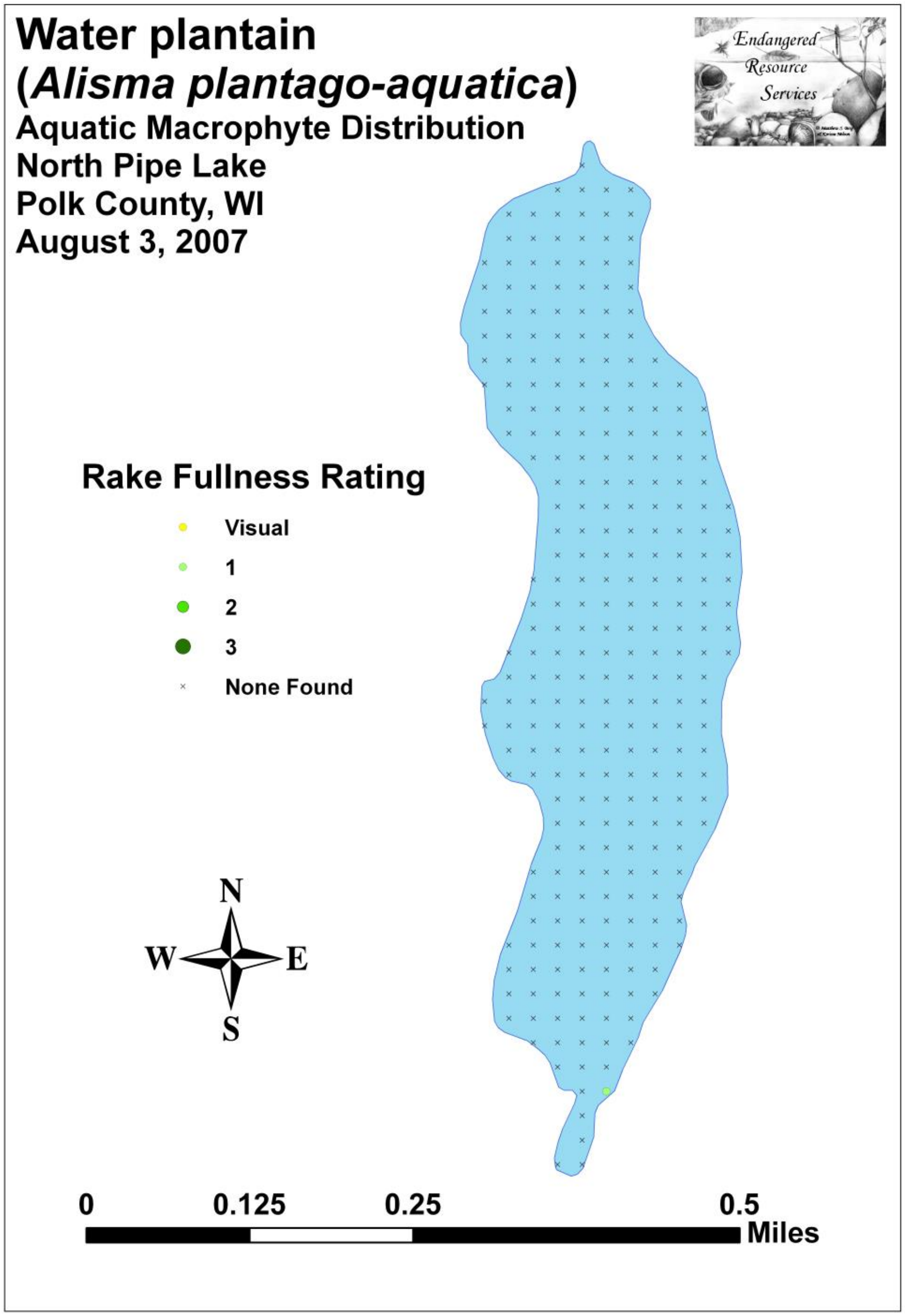
Species: (*Utricularia gibba*) **Creeping bladderwort**
Location: Common floating among floating leaf species in the southeast bay of Pipe.
Habitat: Muck bottom in shallow water 0-1.5 meters deep.
Common Associates: (*Utricularia vulgaris*) Common bladderwort
(*Brasenia schreberi*) Watershield
(*Eleocharis robbinsii*) Robbin's Spikerush
(*Nymphaea odorata*) White water lily

Species: (*Utricularia resupinata*) **Small purple bladderwort**
Location: Relatively common throughout Pipe Lake in sandy, undisturbed areas. Rare in North Pipe being found at only 1 location.
Habitat: Sand to sandy muck in sheltered areas. Located in 0-1 meter of water, but only flowers in water <.1m.
Common Associates: (*Eleocharis acicularis*) Needle spikerush
(*Juncus pelocarpus*) Brown-fruited rush
(*Eriocaulon aquaticum*) Pipewort
(*Myriophyllum tenellum*) Dwarf water milfoil

Species: (*Utricularia vulgaris*) **Common bladderwort**
Location: Common floating among floating leaf species in mucky sheltered areas of both lakes.
Habitat: Muck bottom in shallow water 0-1.5 meters deep.
Common Associates: (*Potamogeton epihydrus*) Ribbon-leaf pondweed
(*Utricularia gibba*) Creeping bladderwort
(*Brasenia schreberi*) Watershield
(*Eleocharis robbinsii*) Robbin's Spikerush

Species: (*Vallisneria americana*) **Wild celery**
Location: Common, and widely distributed though seldom abundant in Pipe; relatively uncommon in North Pipe.
Habitat: Found in almost any bottom conditions, but grows best in sandy to sand/muck bottoms in 0.5-1.5 meters of water.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed
(*Potamogeton pusillus*) Small pondweed
(*Potamogeton spirillus*) Spiral-fruited pondweed

Appendix VI: Plant Species Distribution Maps


Water plantain
(Alisma plantago-aquatica)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
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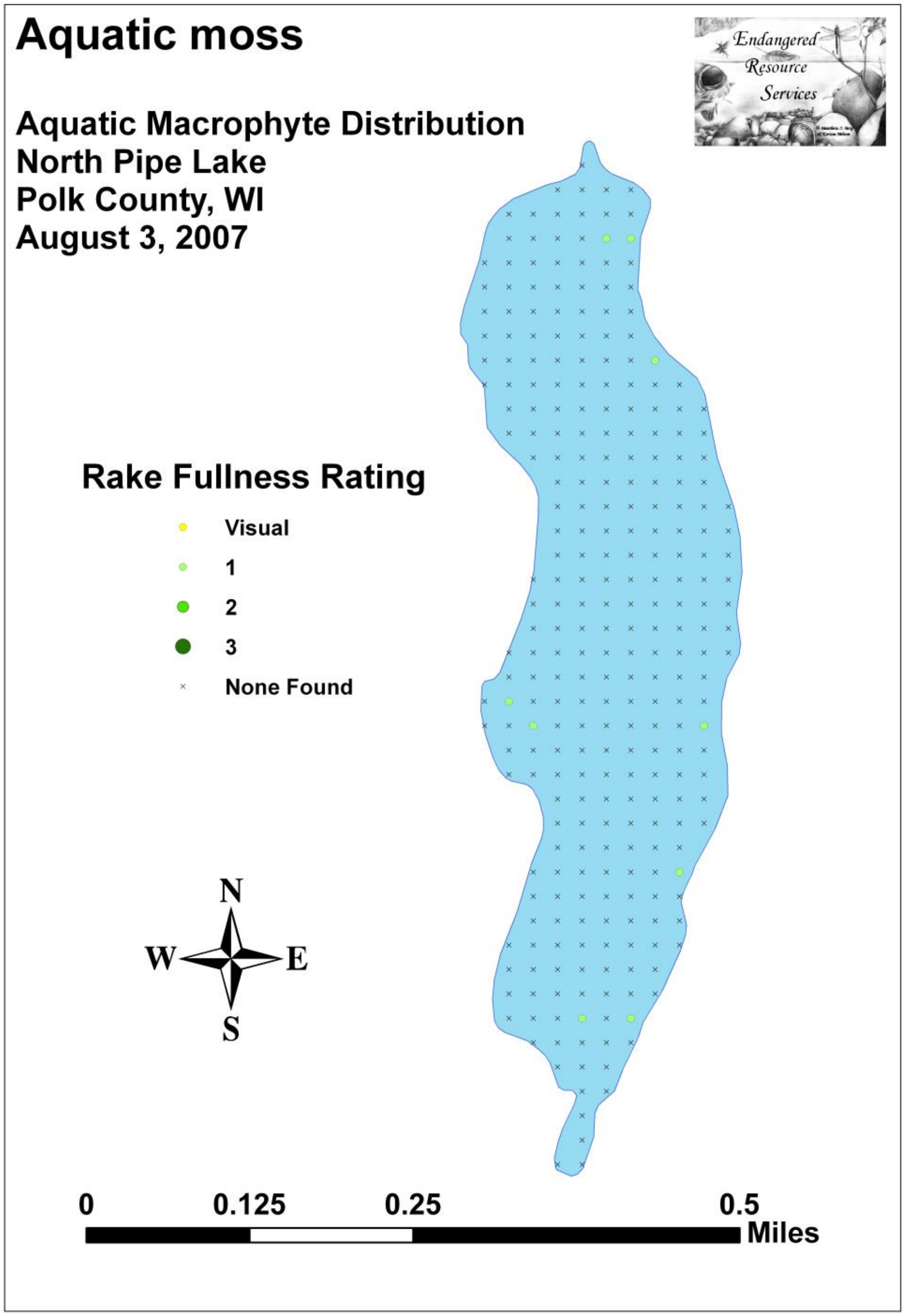
0
0.125
0.25
0.5
Miles


Aquatic moss
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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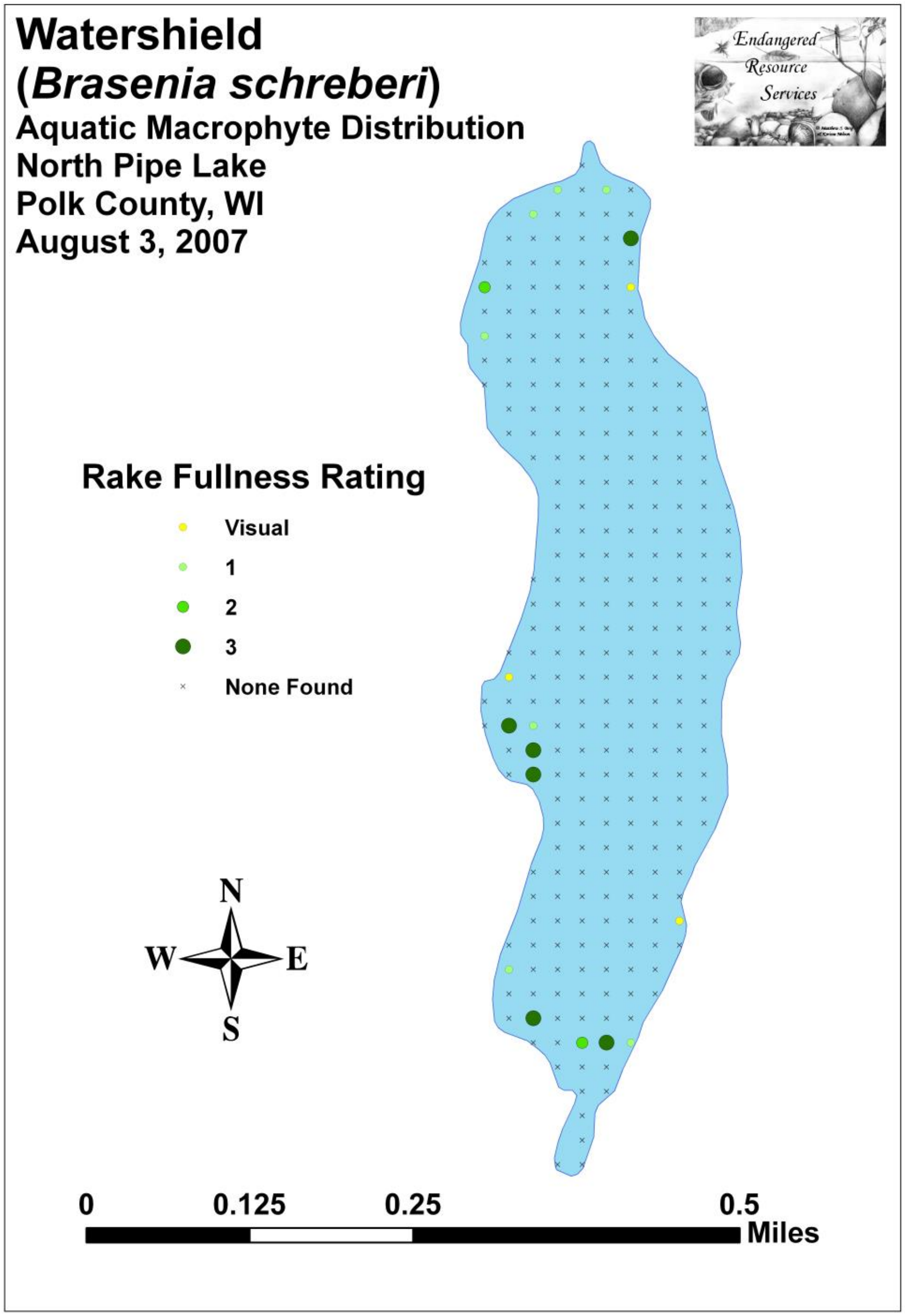
0.5
Miles


Watershield
(*Brasenia schreberi*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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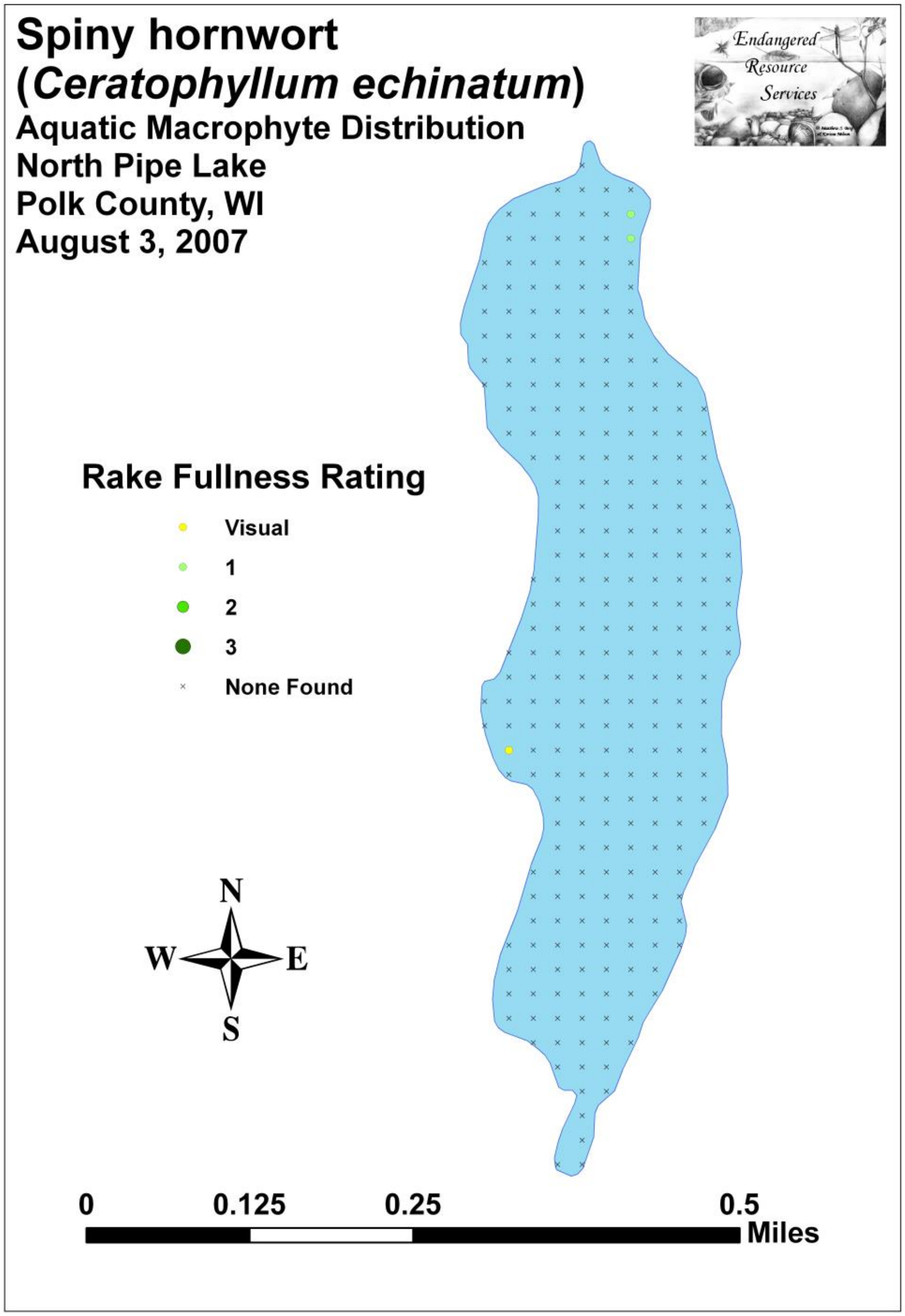
Miles


Spiny hornwort
(Ceratophyllum echinatum)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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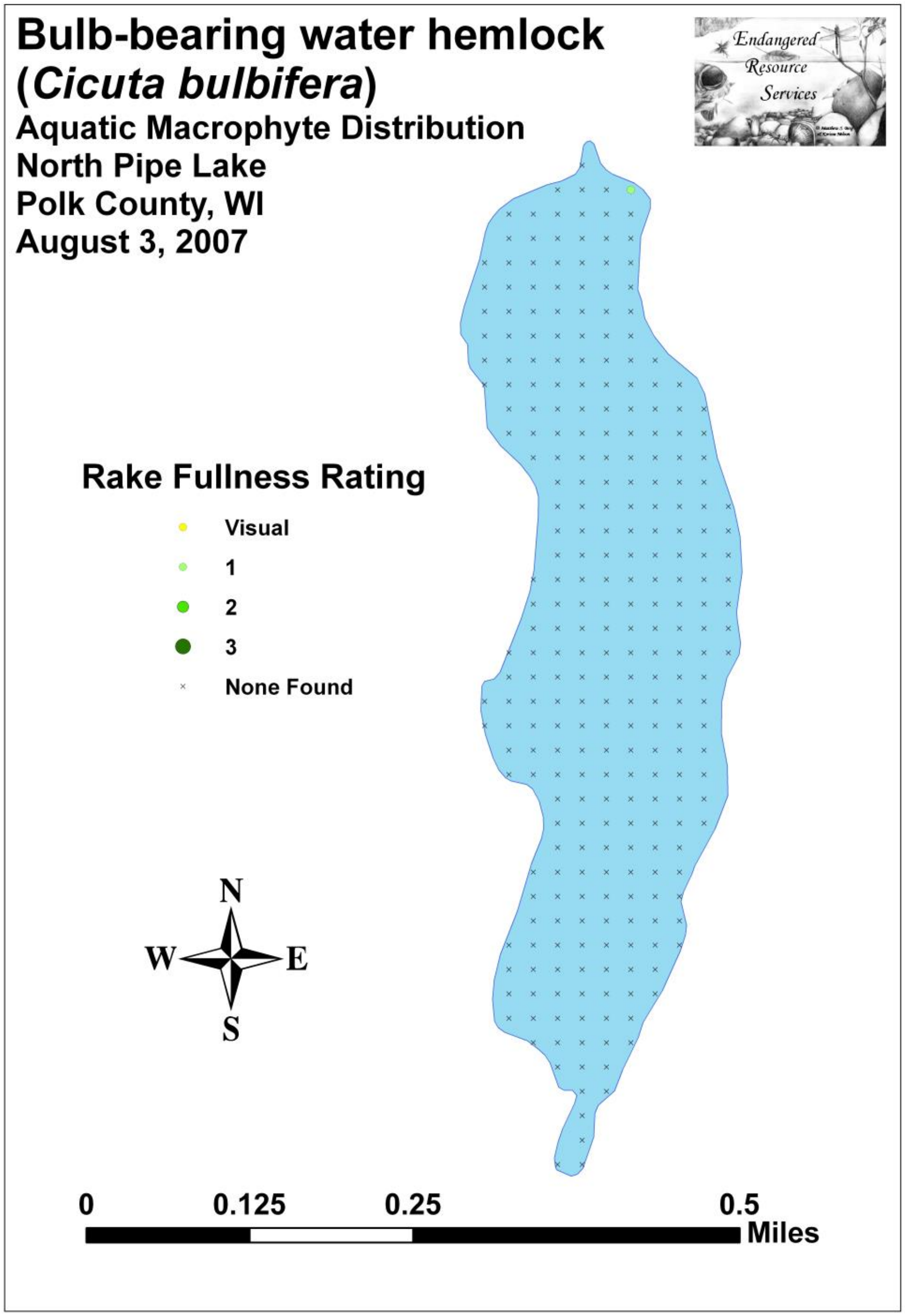
Miles


Bulb-bearing water hemlock
(*Cicuta bulbifera*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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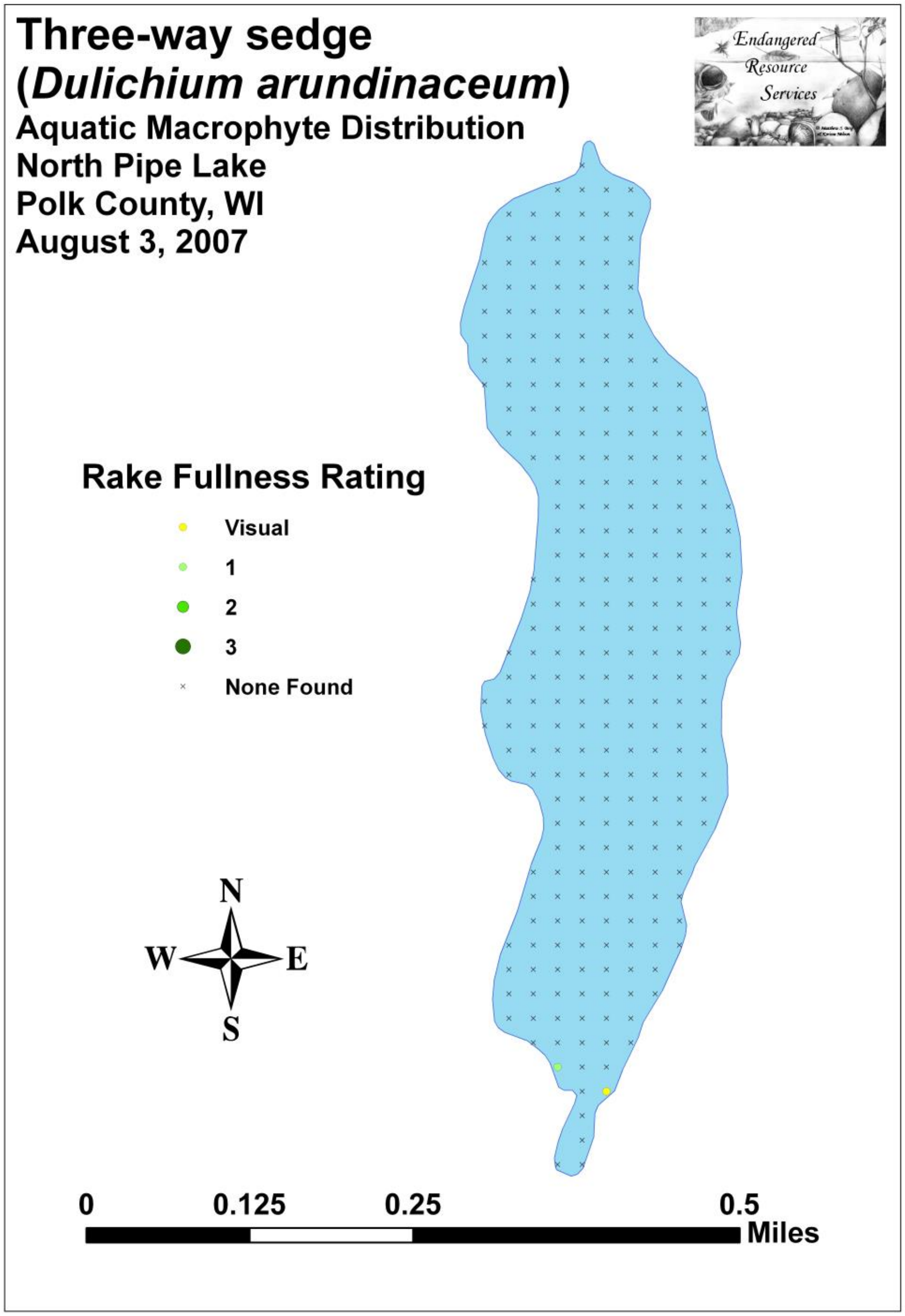
Miles


Three-way sedge
(*Dulichium arundinaceum*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered
Resource
Services
Rake Fullness Rating
Visual
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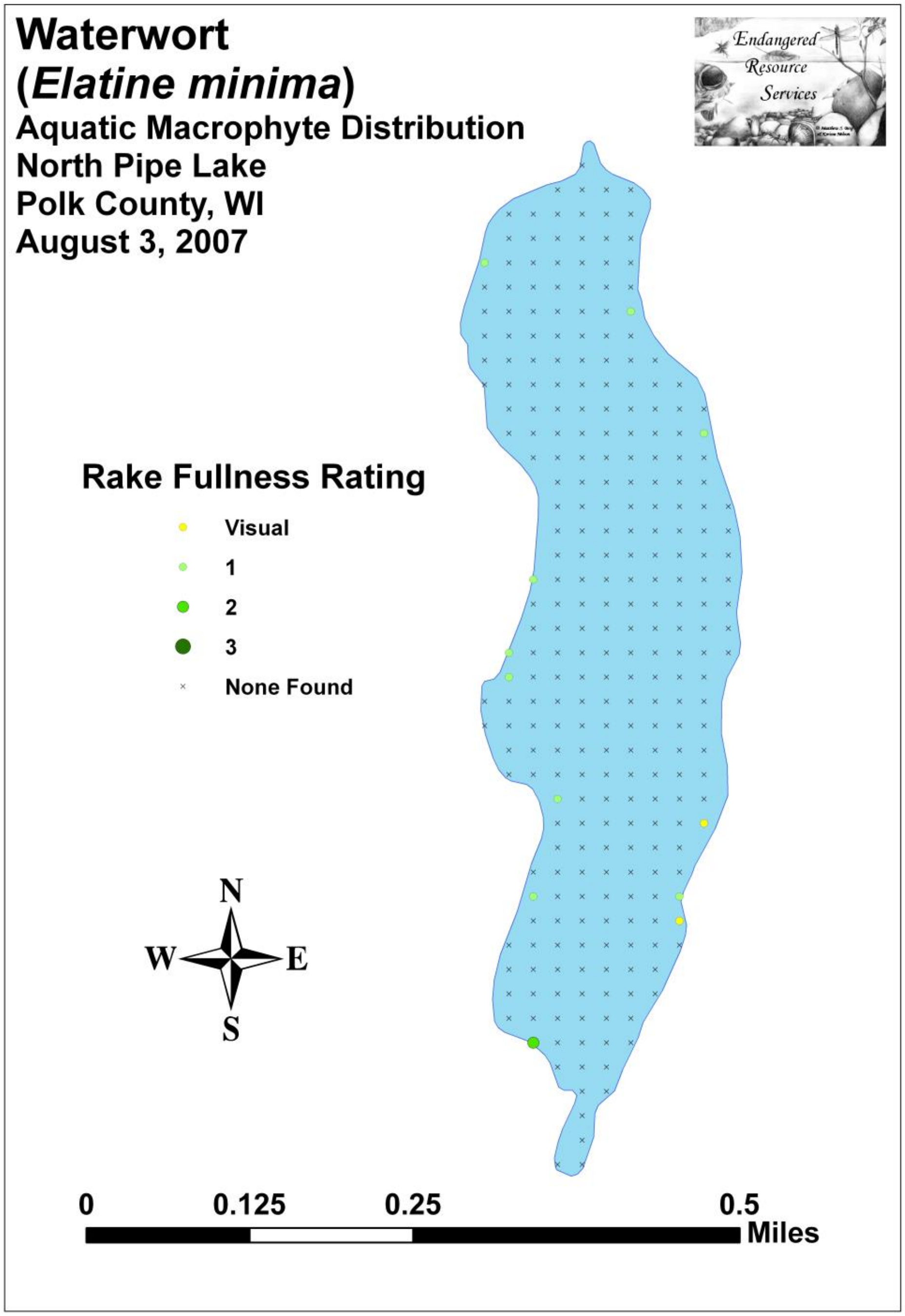
Miles


Waterwort
(Elatine minima)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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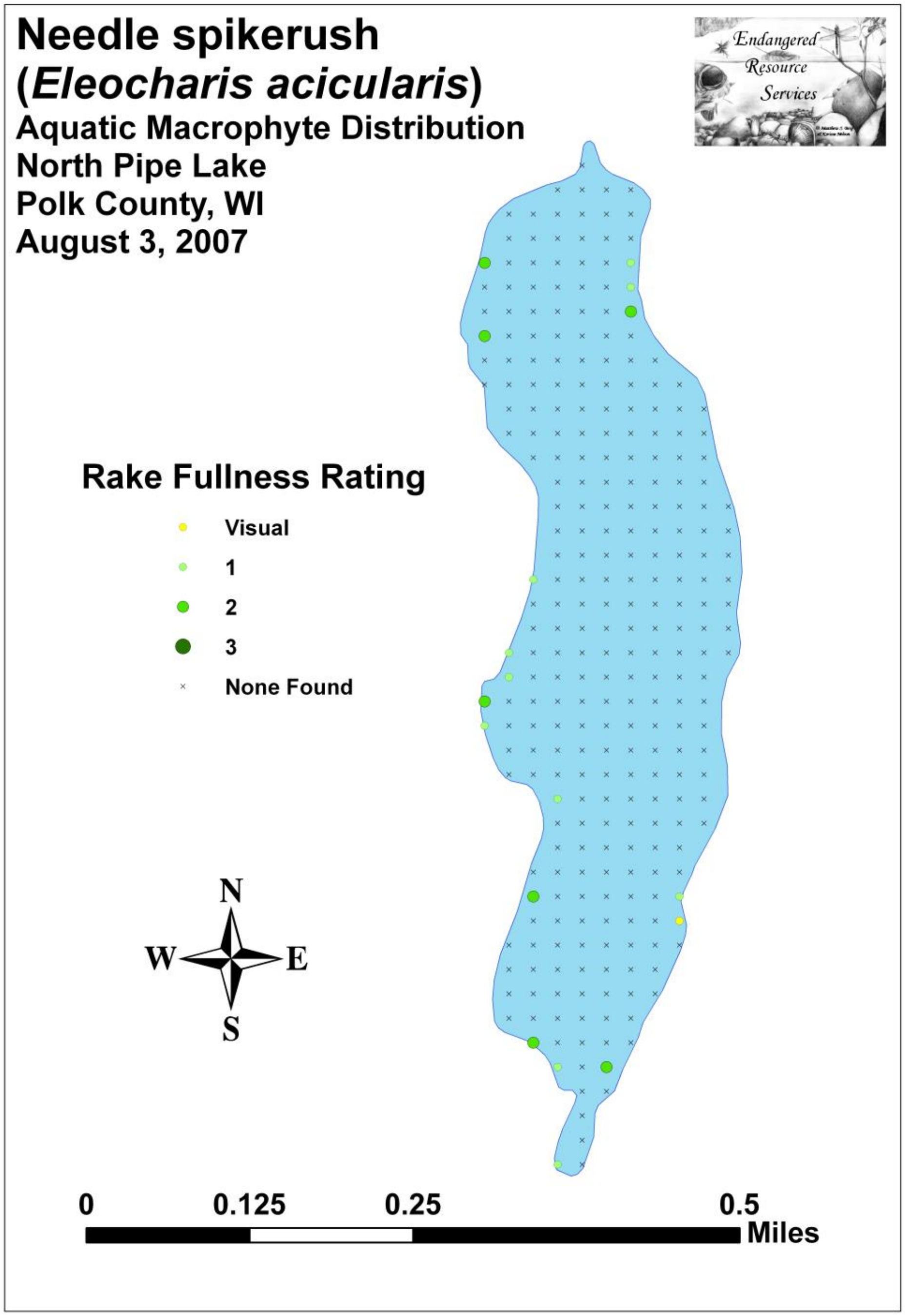
Miles


Needle spikerush
(*Eleocharis acicularis*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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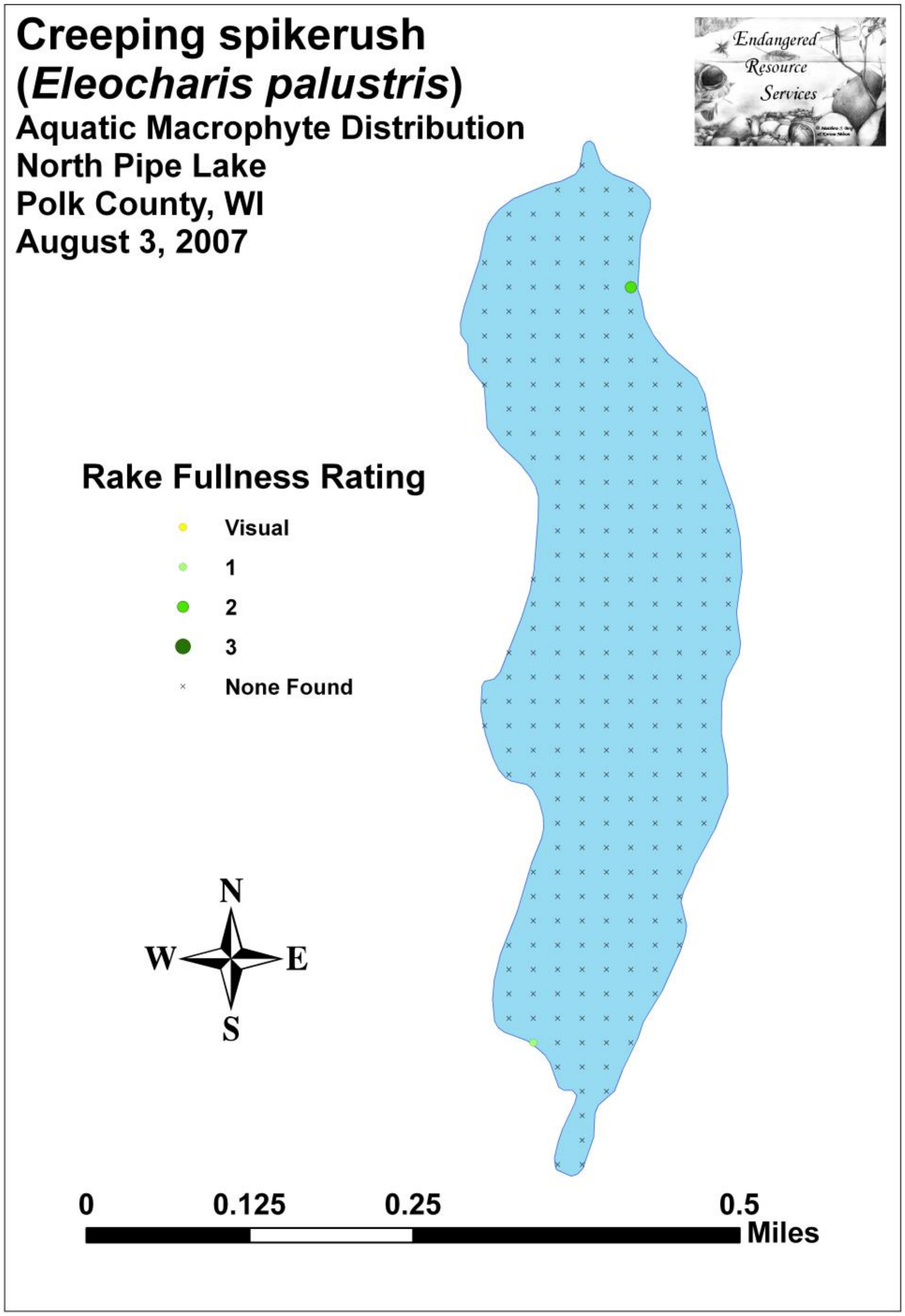
Miles


Creeping spikerush
(*Eleocharis palustris*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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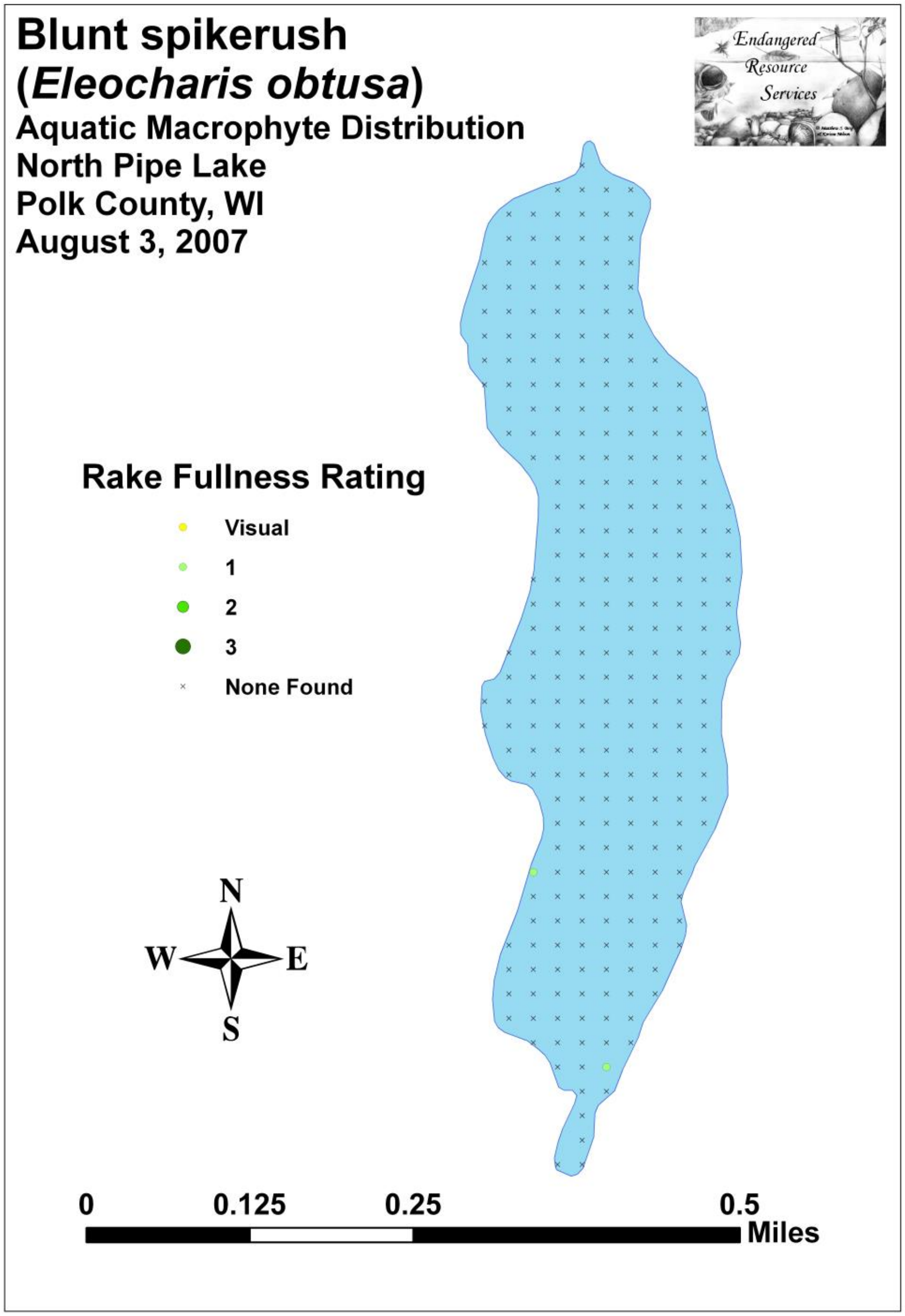
Miles


Blunt spikerush
(*Eleocharis obtusa*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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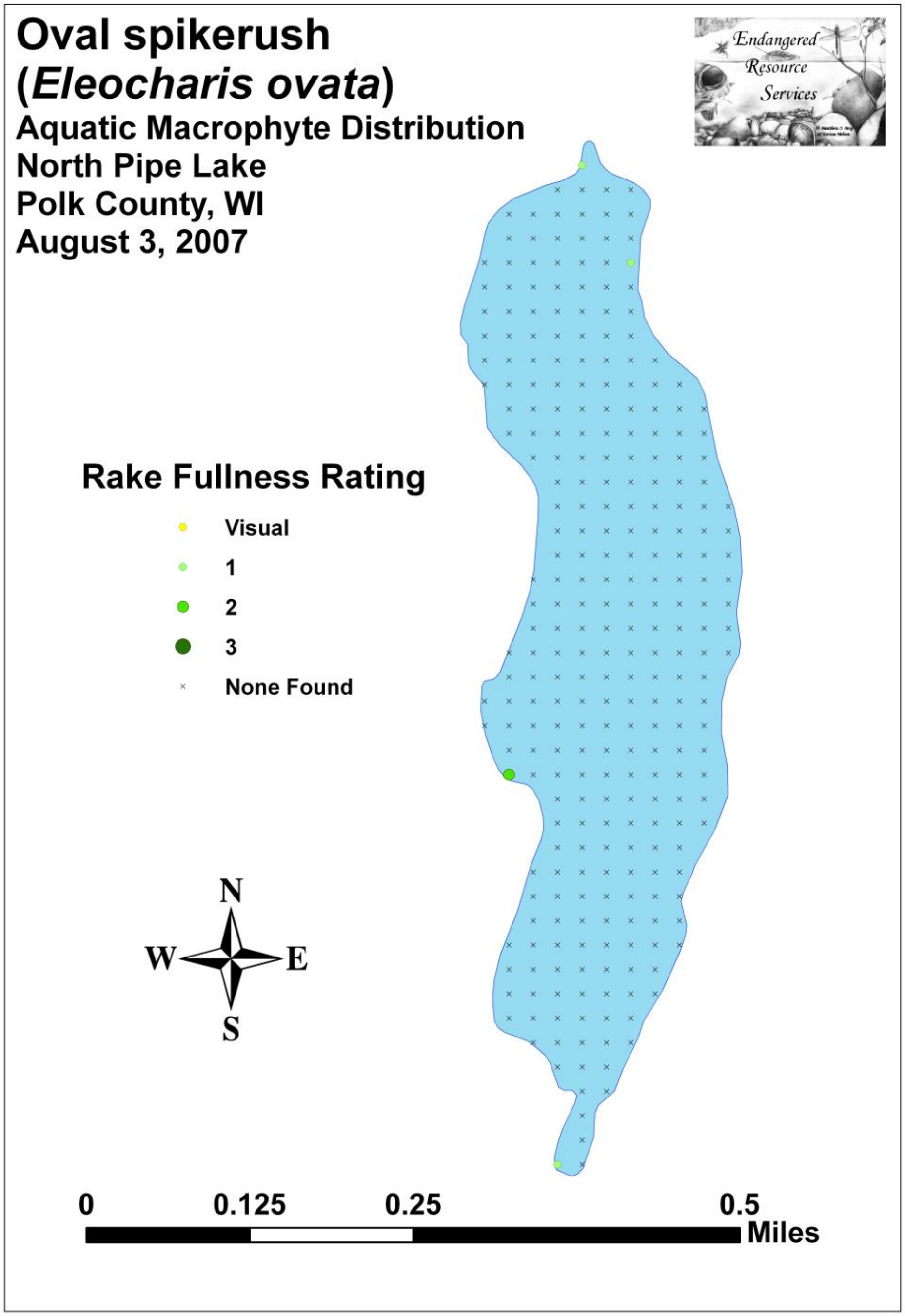
Miles


Oval spikerush
(Eleocharis ovata)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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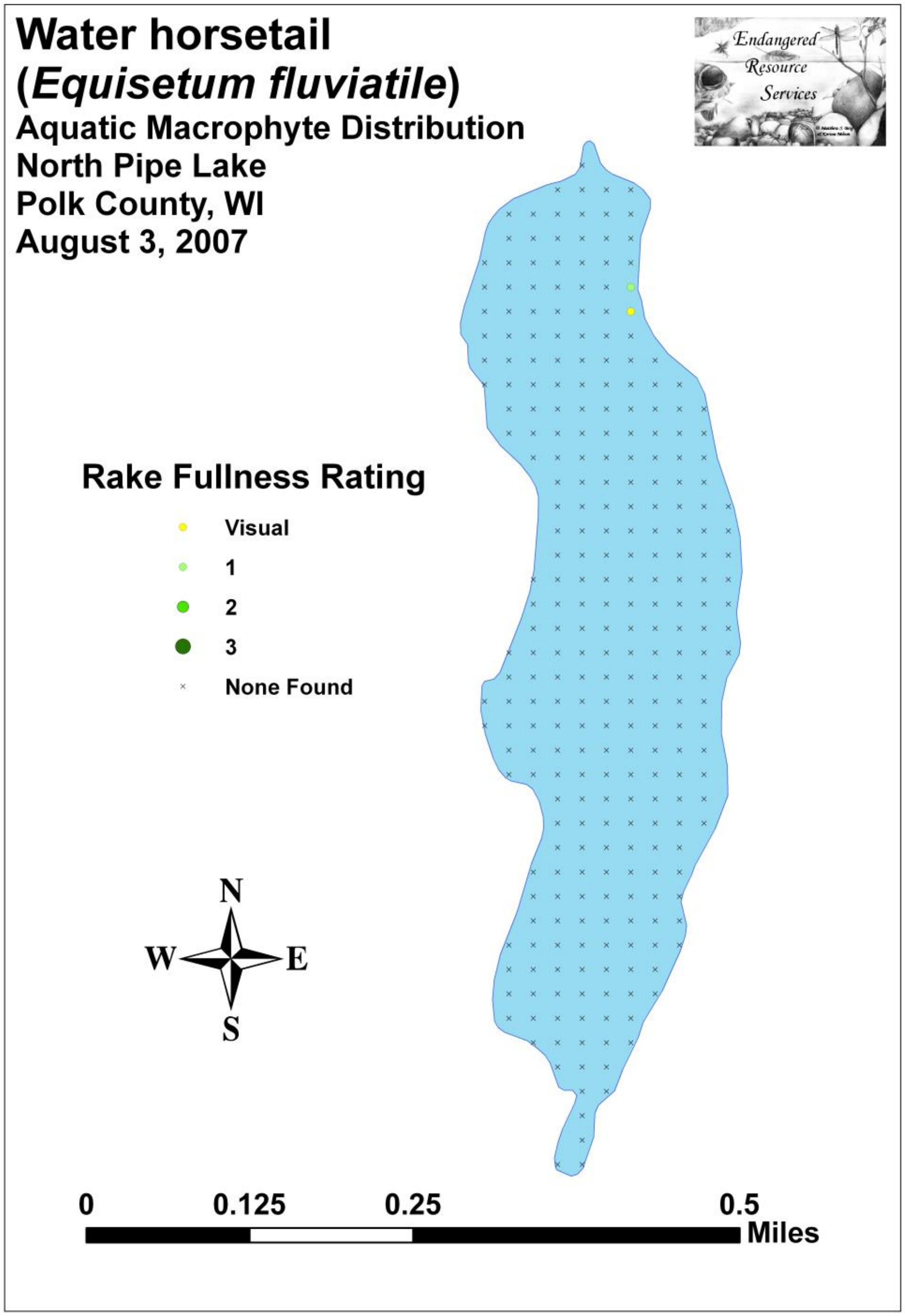
Miles


Water horsetail
(Equisetum fluviatile)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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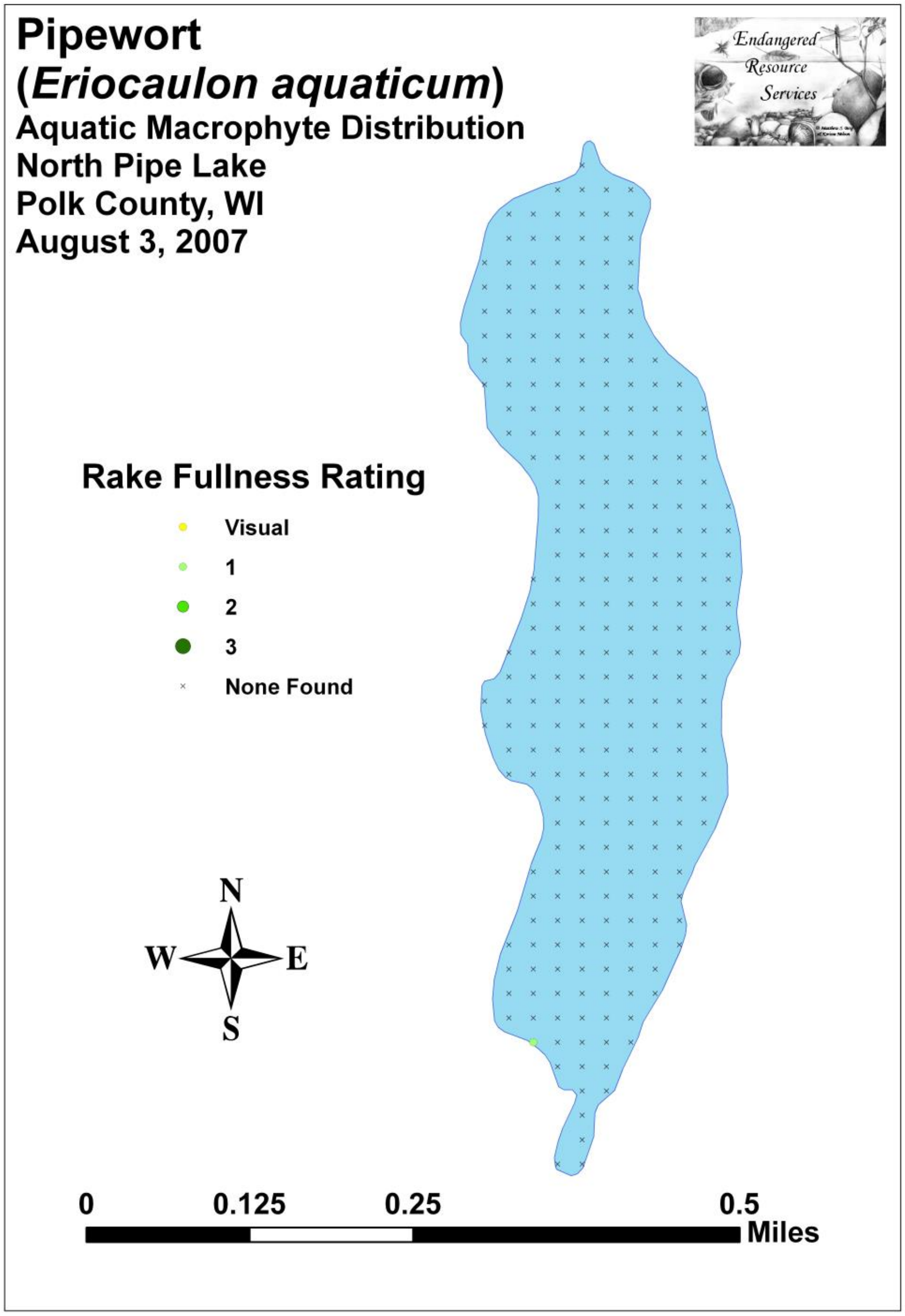
Miles



Pipewort
(*Eriocaulon aquaticum*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
N
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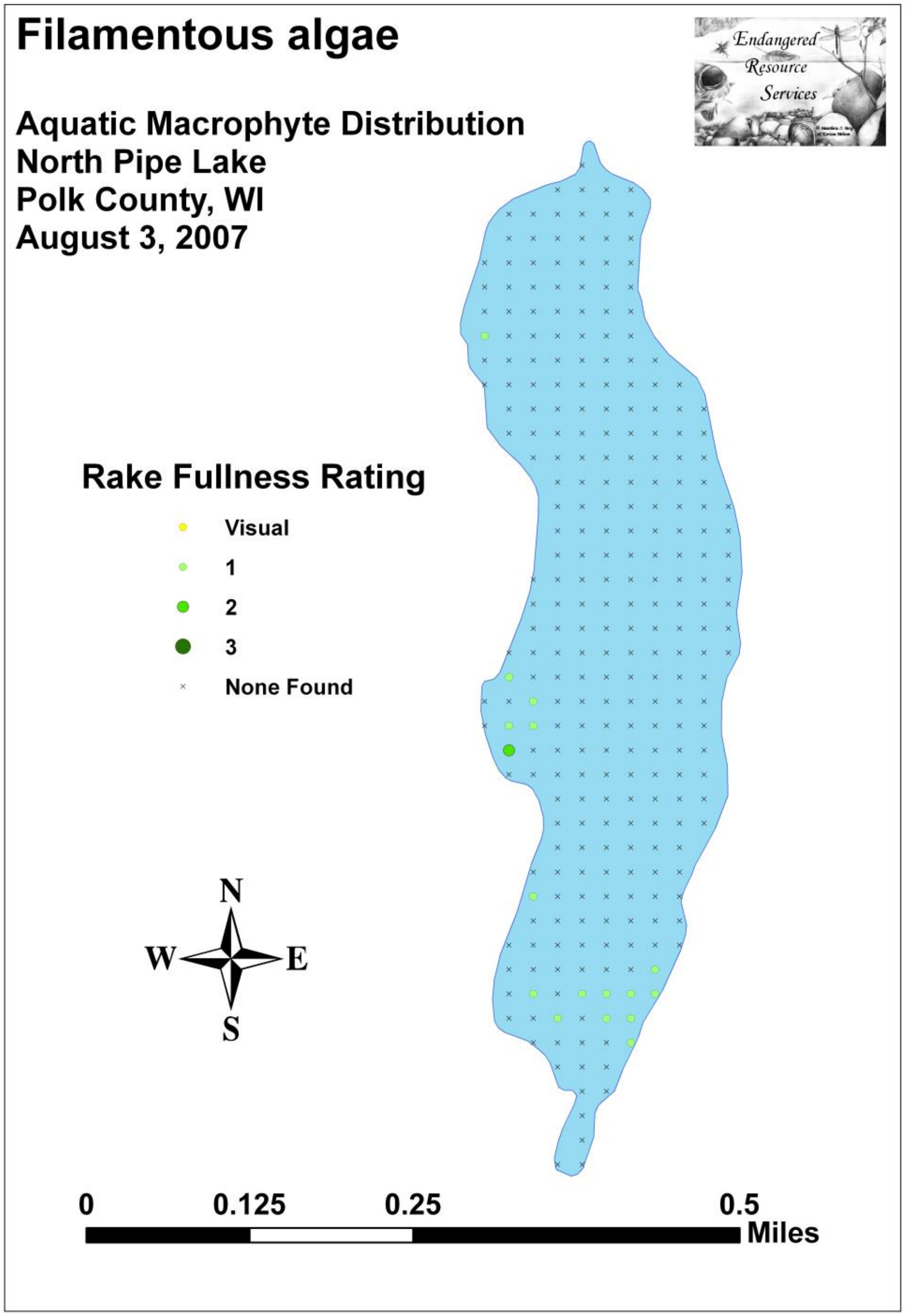
Miles


Filamentous algae
Endangered Resource Services
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Rake Fullness Rating
Visual
1
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3
None Found
N
W
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0.125
0.25
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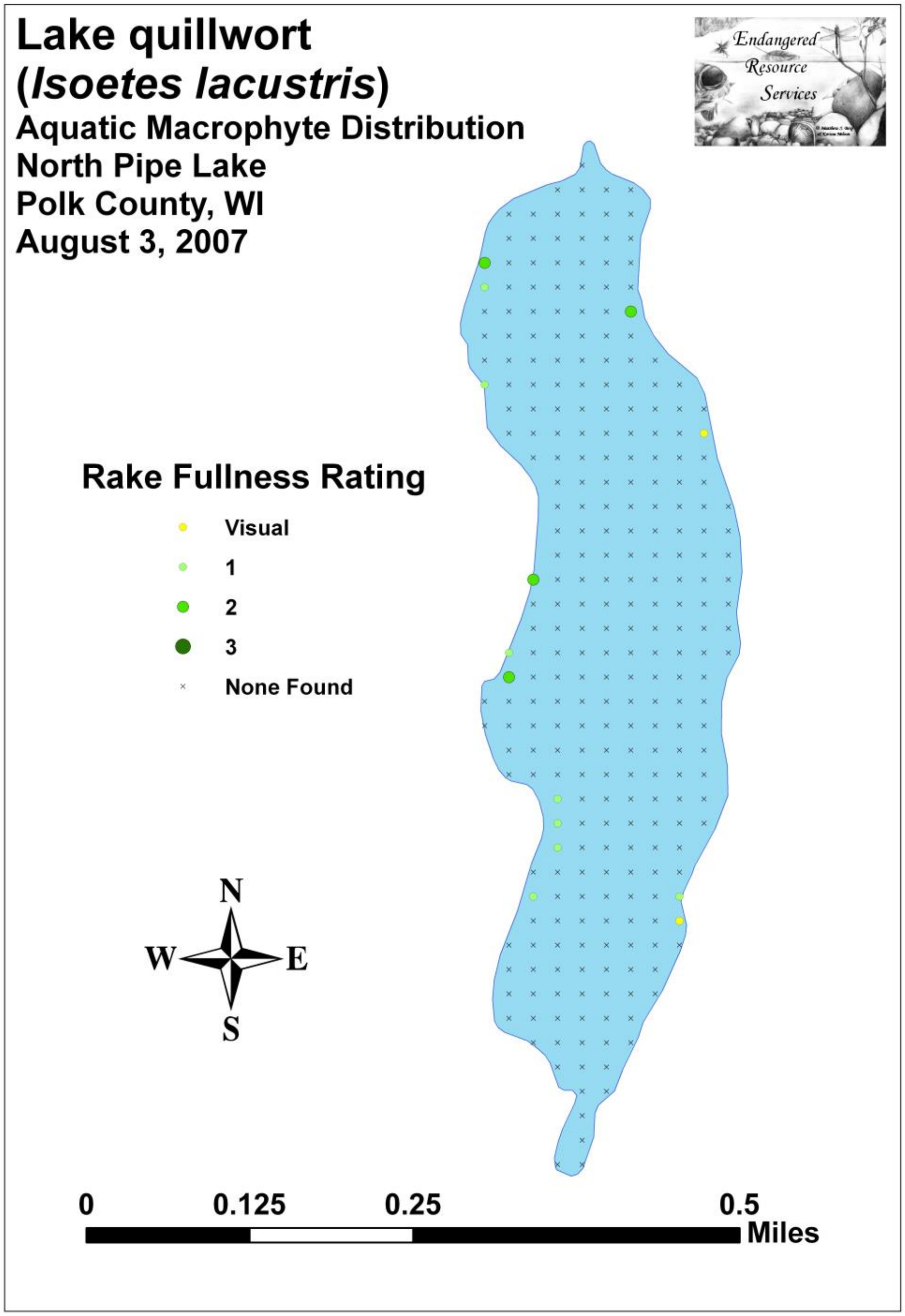
Miles


Lake quillwort
(*Isoetes lacustris*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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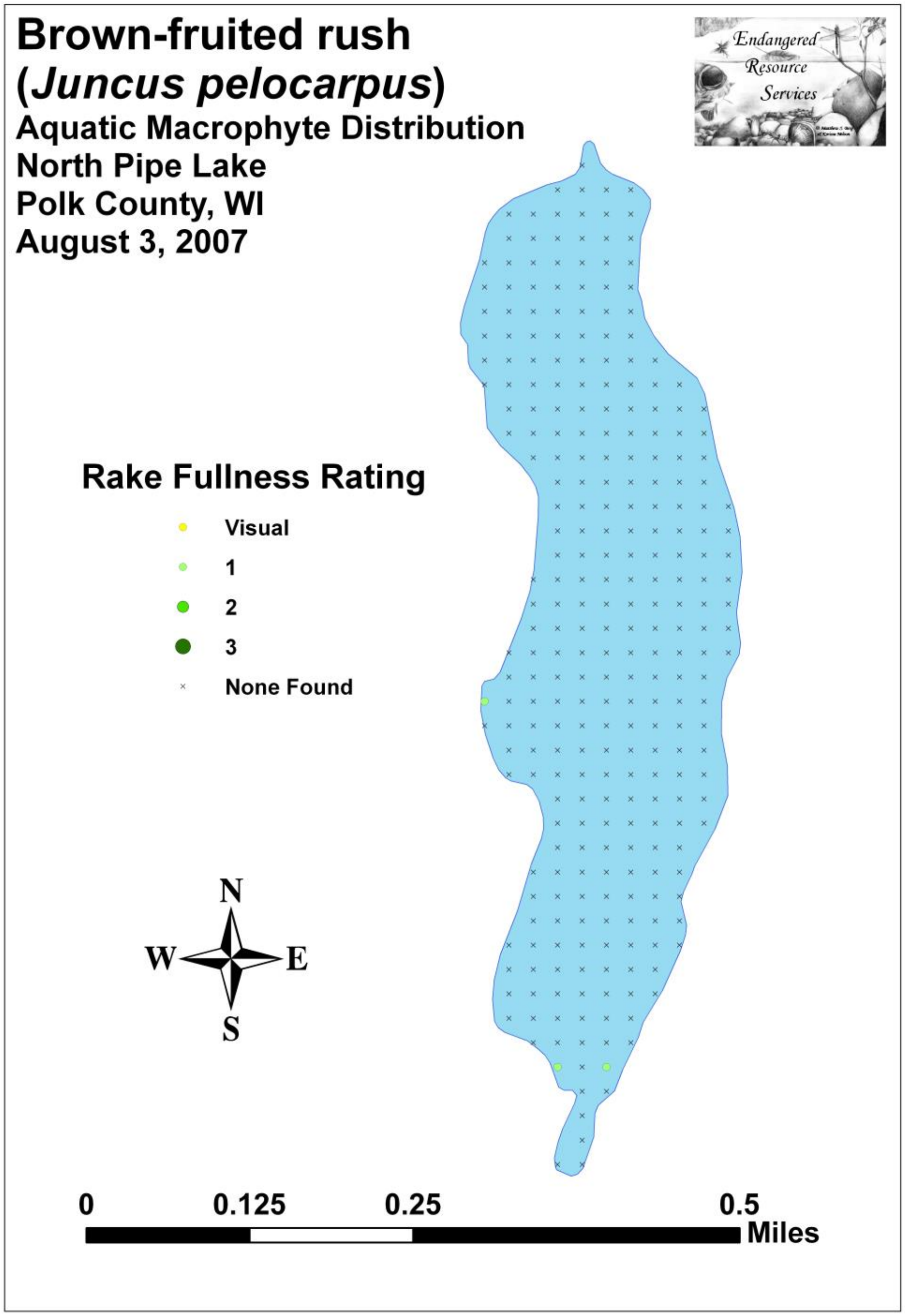
Brown-fruited rush
(*Juncus pelocarpus*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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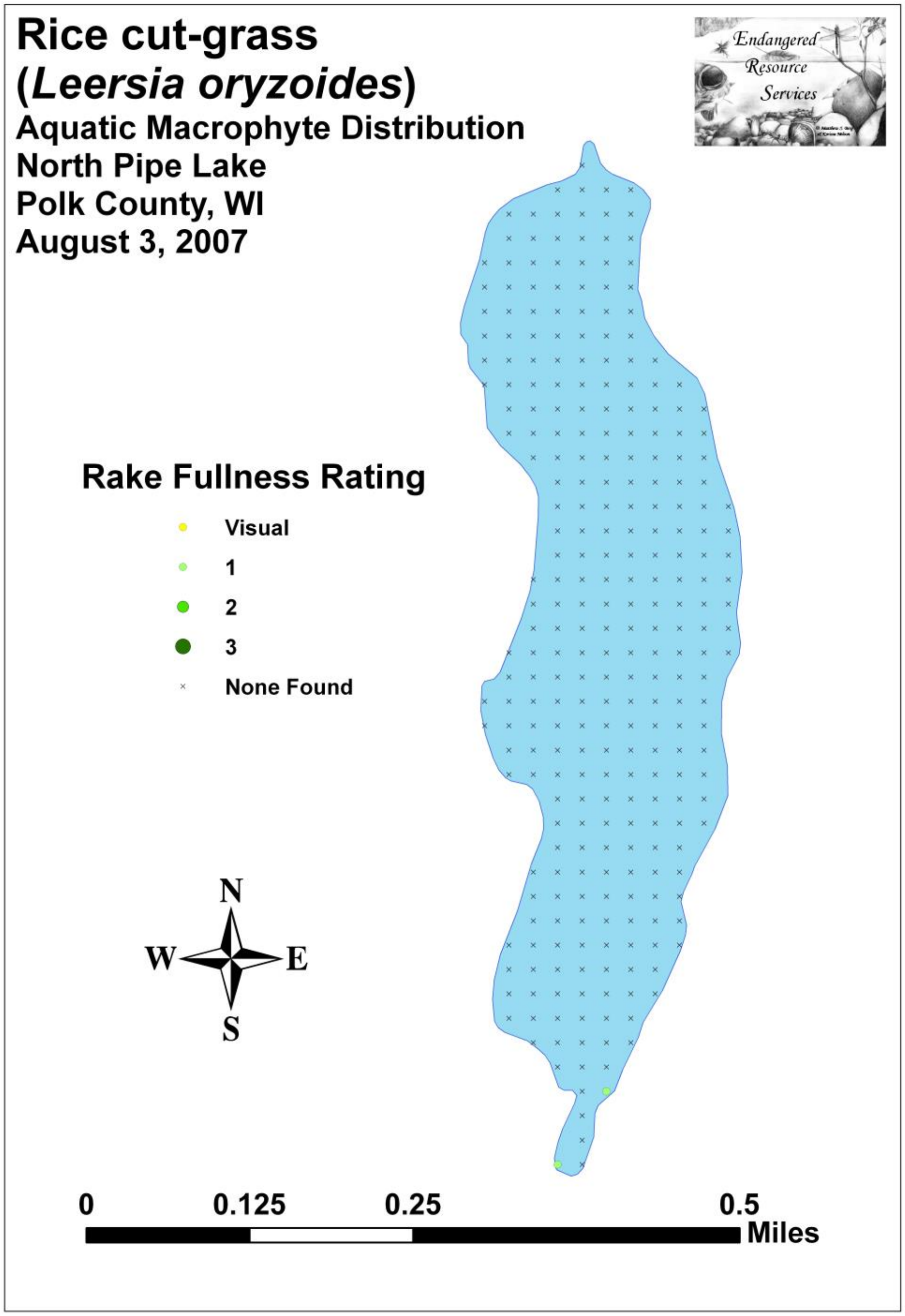
Miles


Rice cut-grass
(*Leersia oryzoides*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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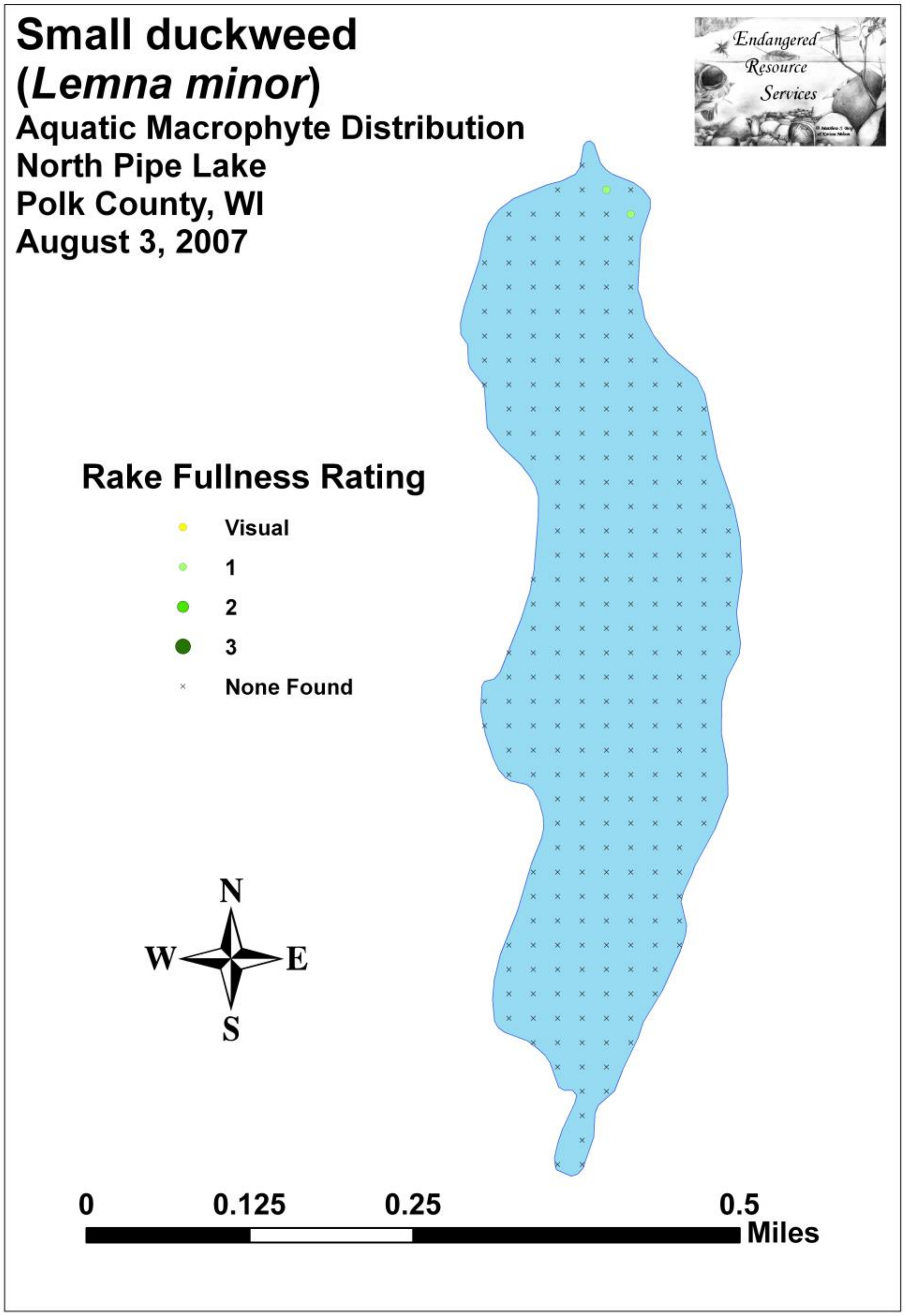
Miles


Small duckweed
(*Lemna minor*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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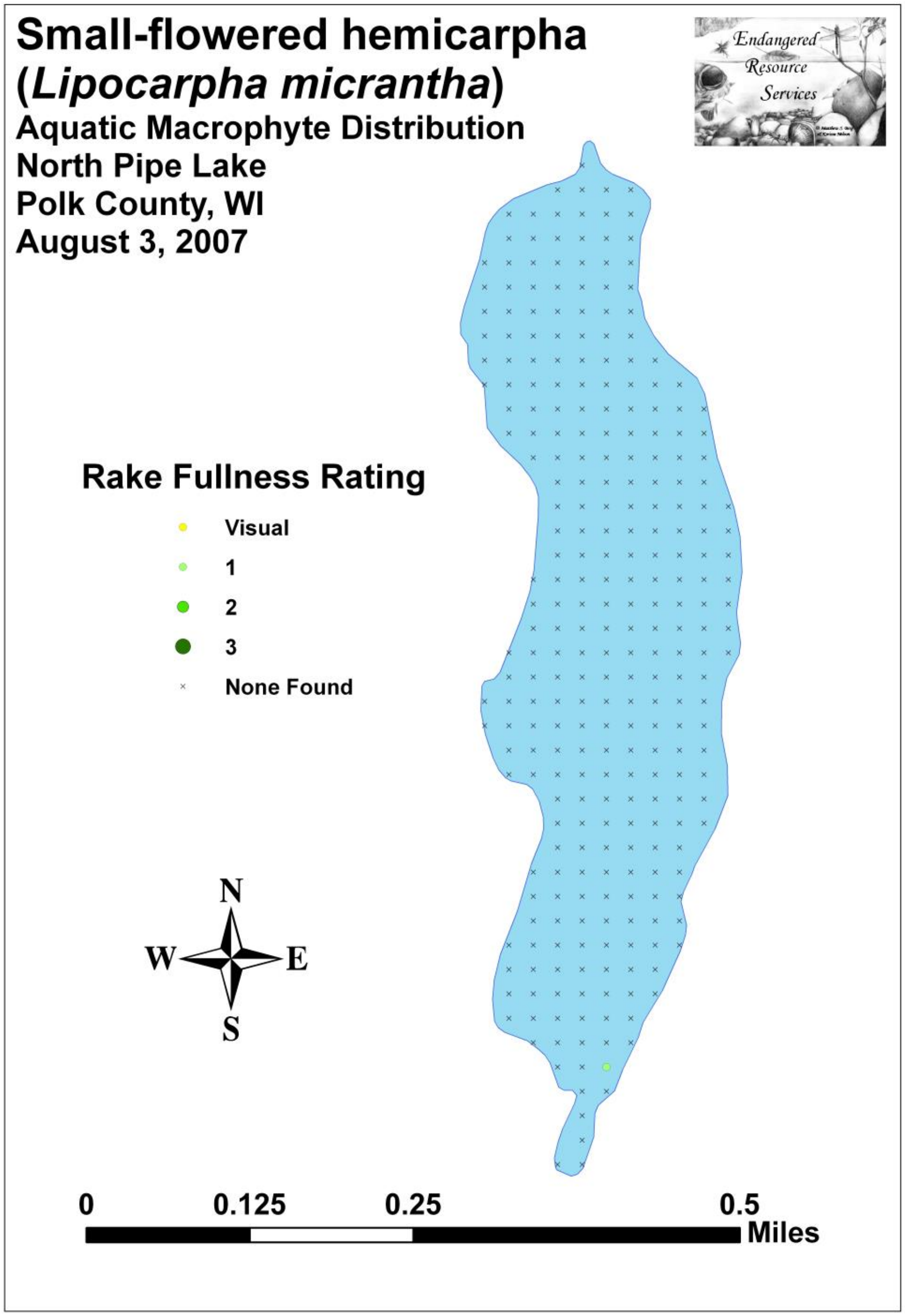
Small-flowered hemicarpha
(Lipocarpha micrantha)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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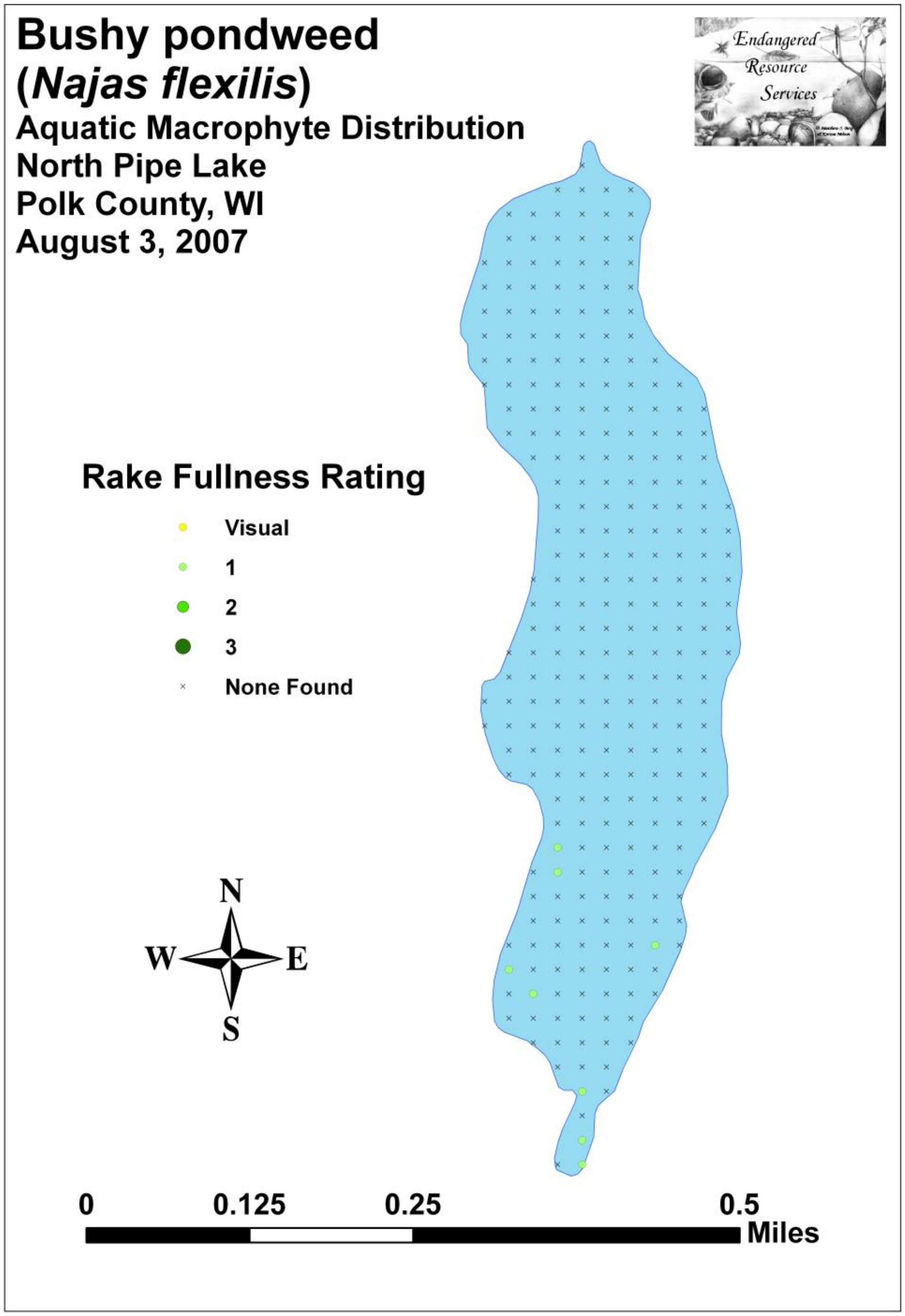
Miles


Bushy pondweed
(*Najas flexilis*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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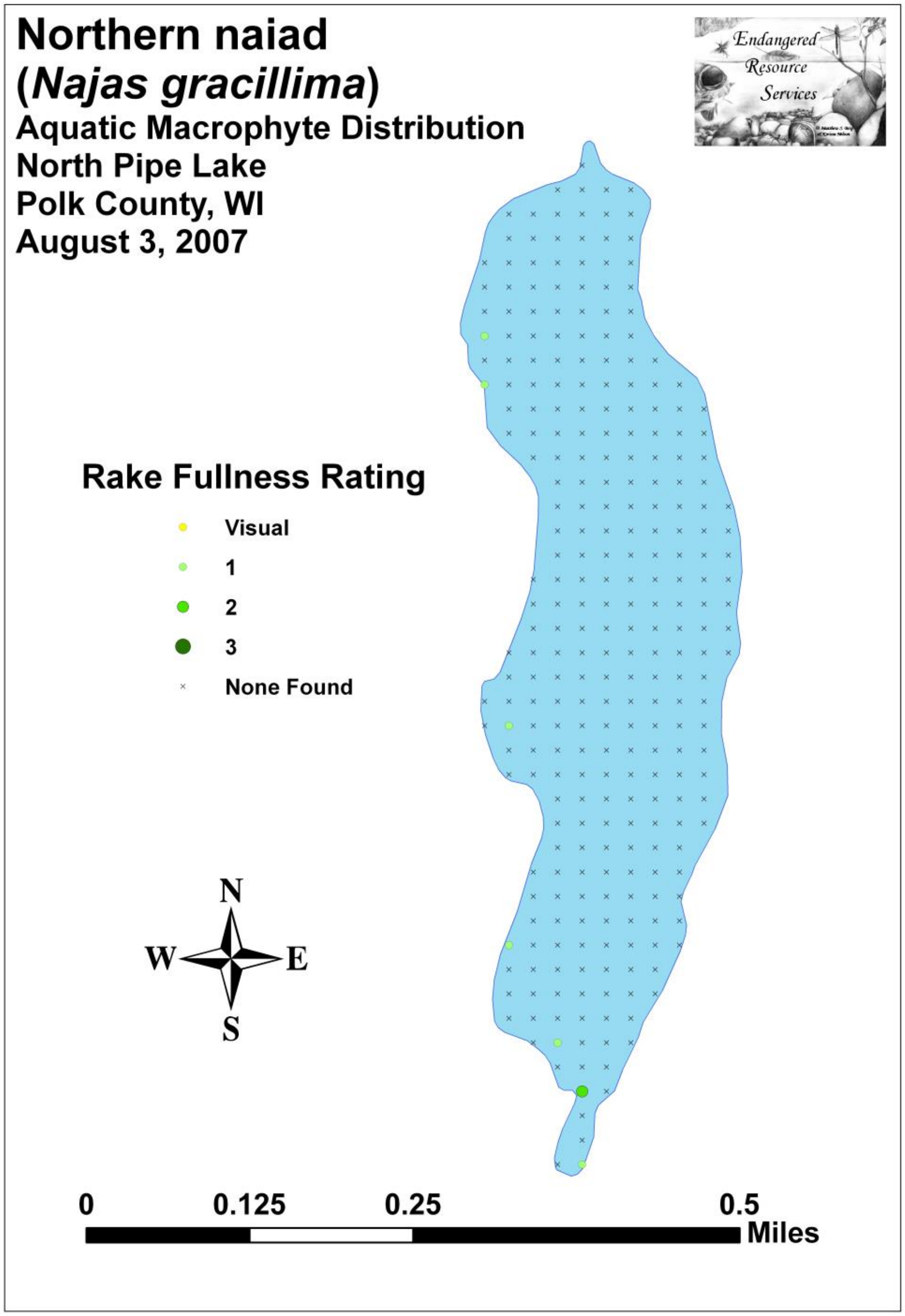
Miles


Northern naiad
(*Najas gracillima*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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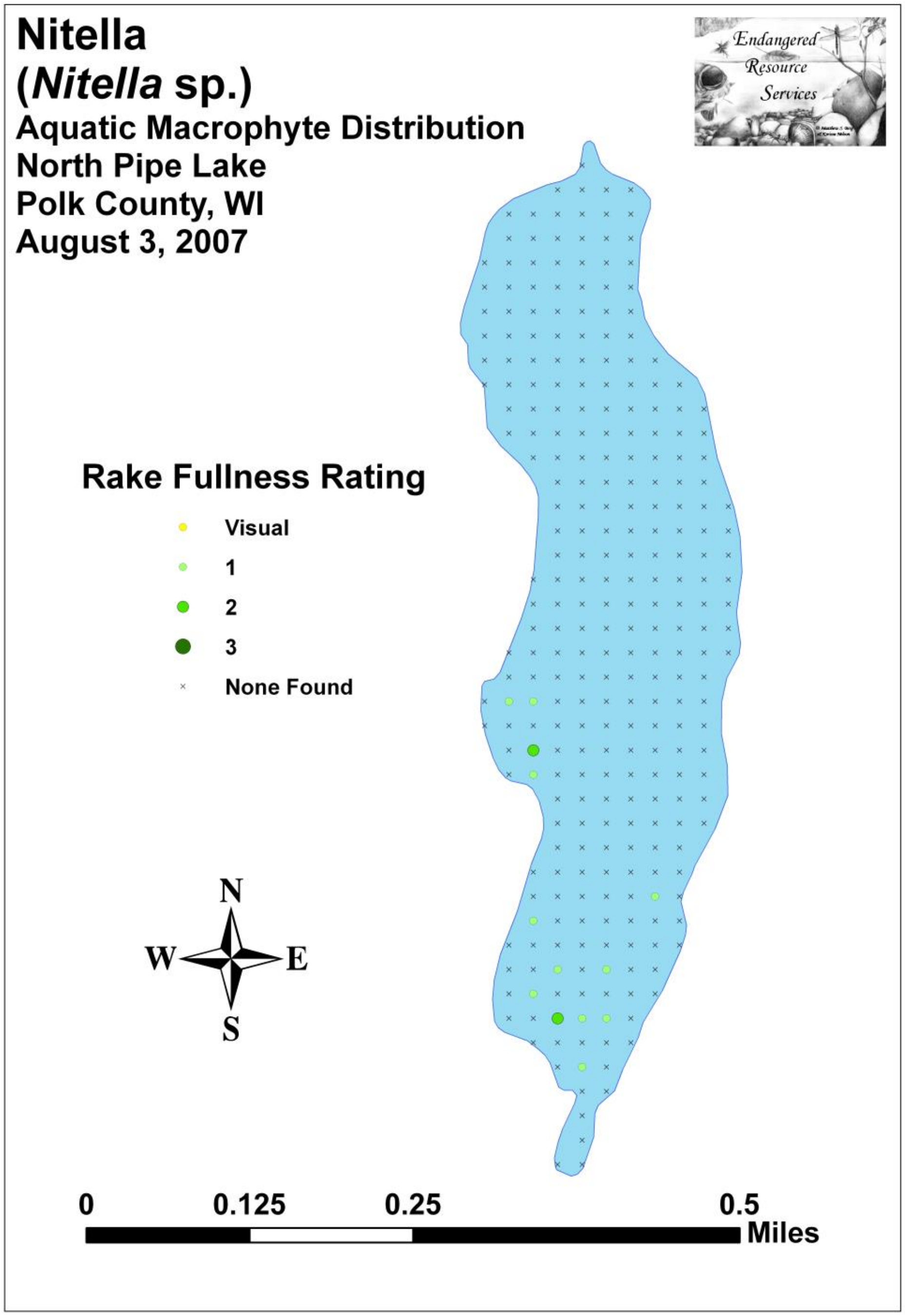
Nitella
(*Nitella* sp.)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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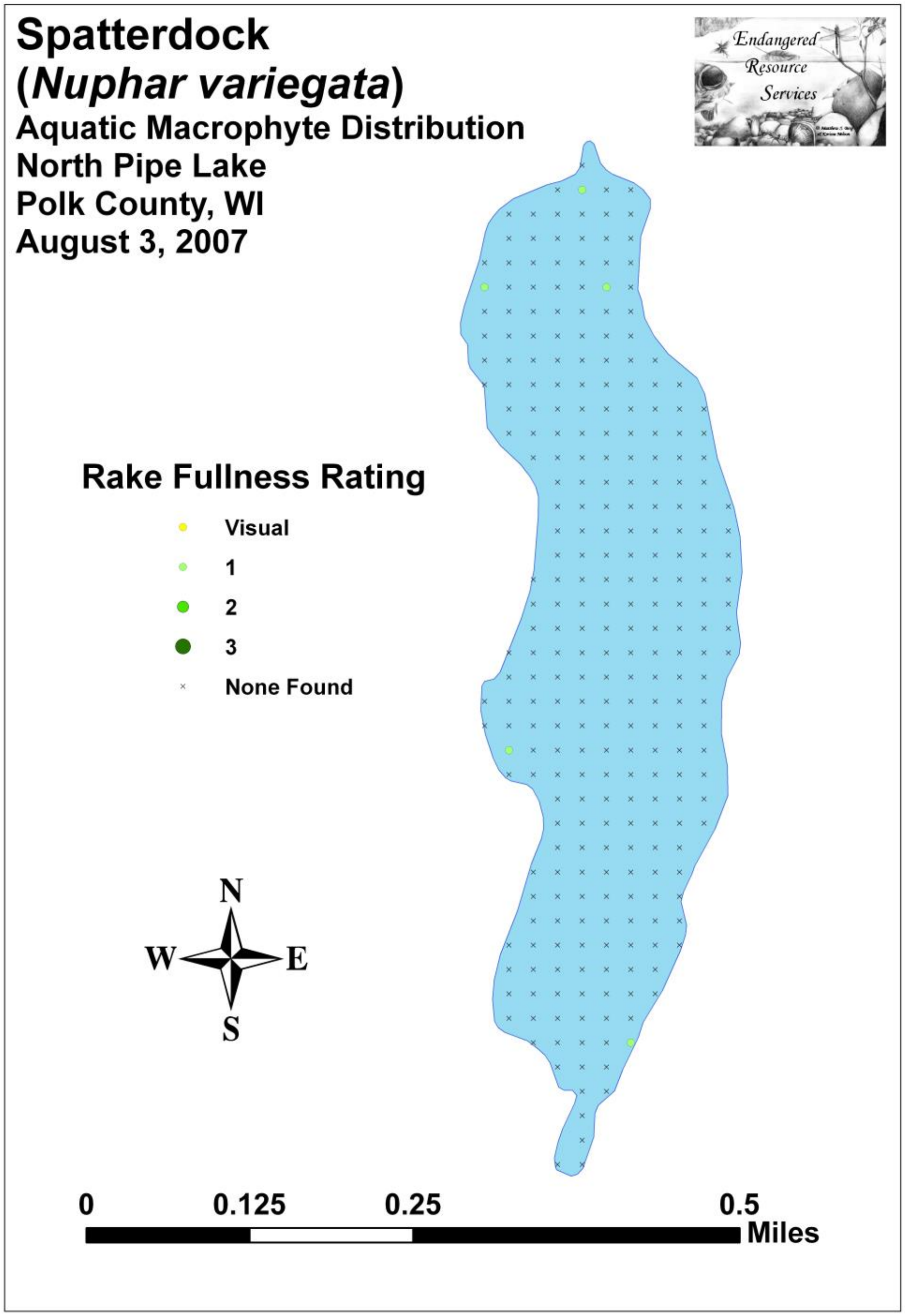
Spatterdock
(*Nuphar variegata*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
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None Found
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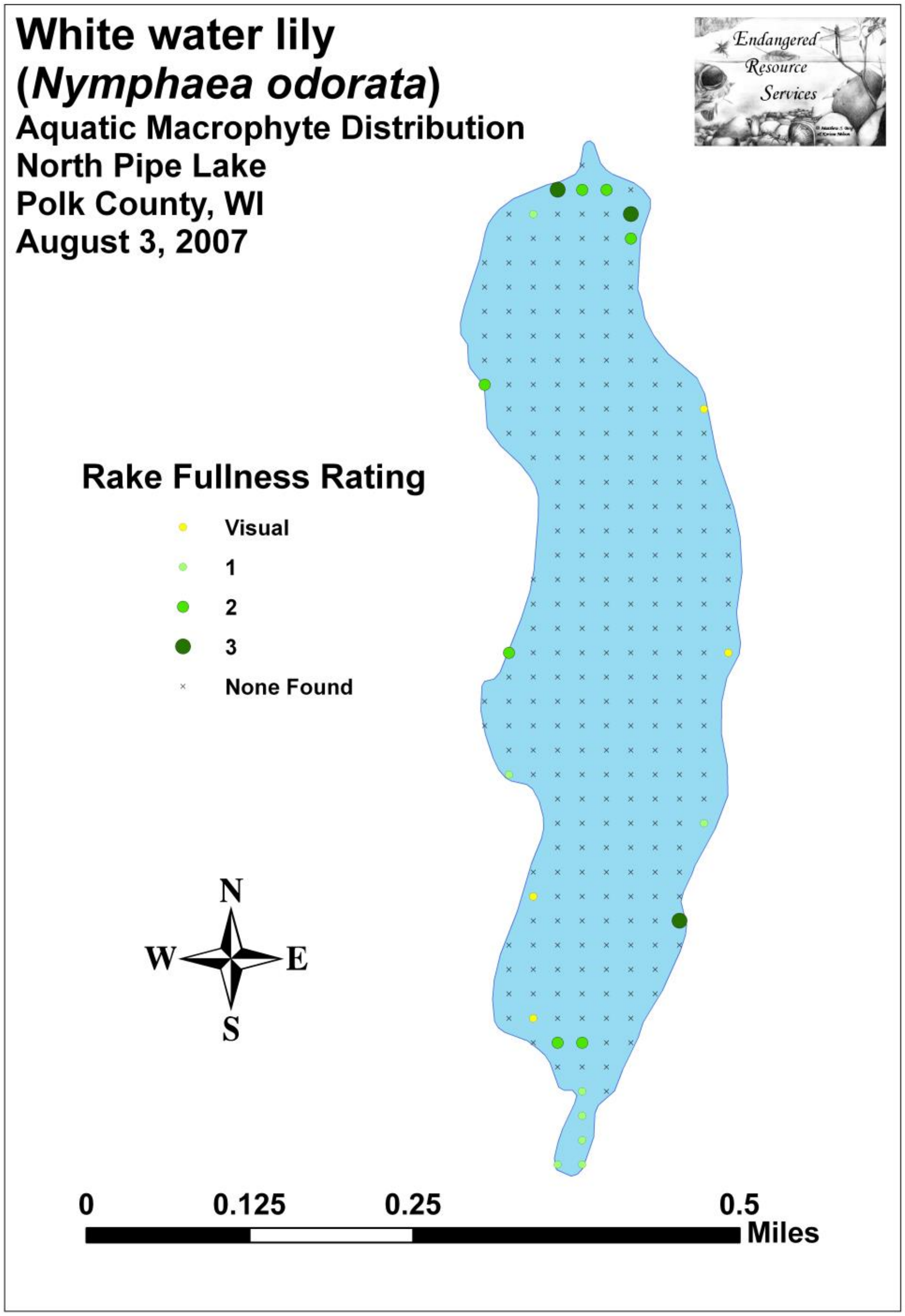
Miles


White water lily
(*Nymphaea odorata*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered
Resource
Services
Rake Fullness Rating
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None Found
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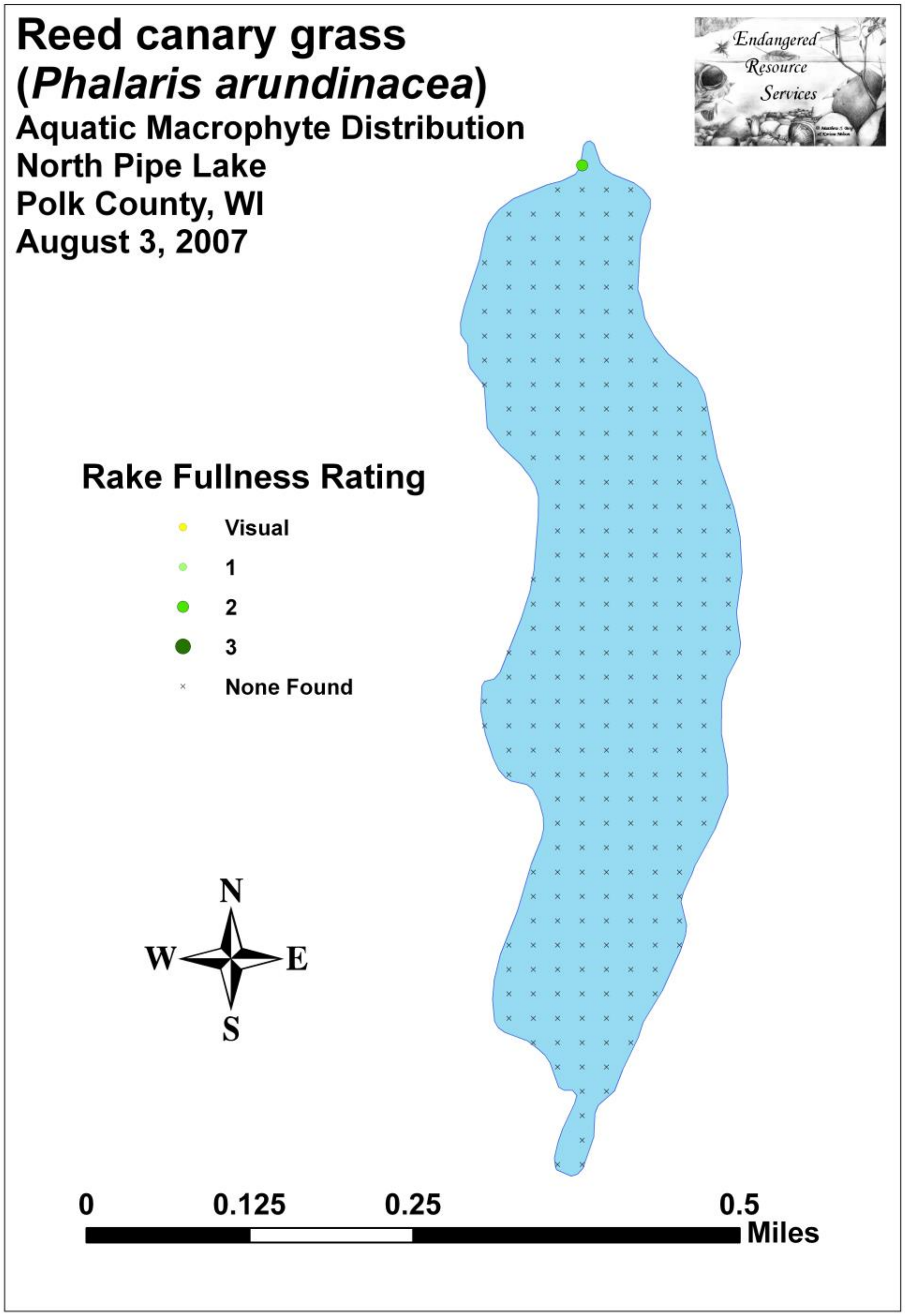
Reed canary grass
(Phalaris arundinacea)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
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None Found
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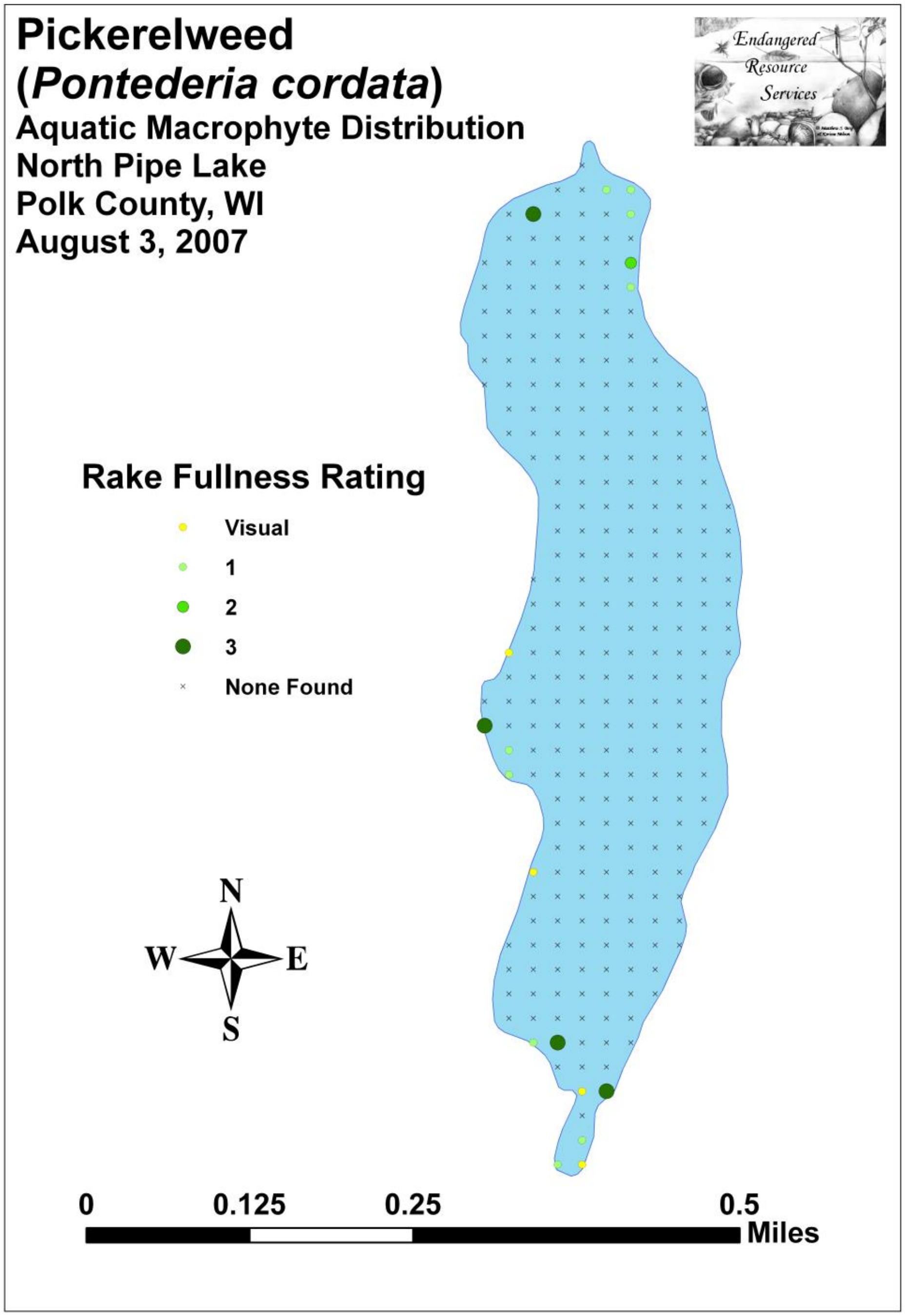
Pickerelweed
(*Pontederia cordata*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
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None Found
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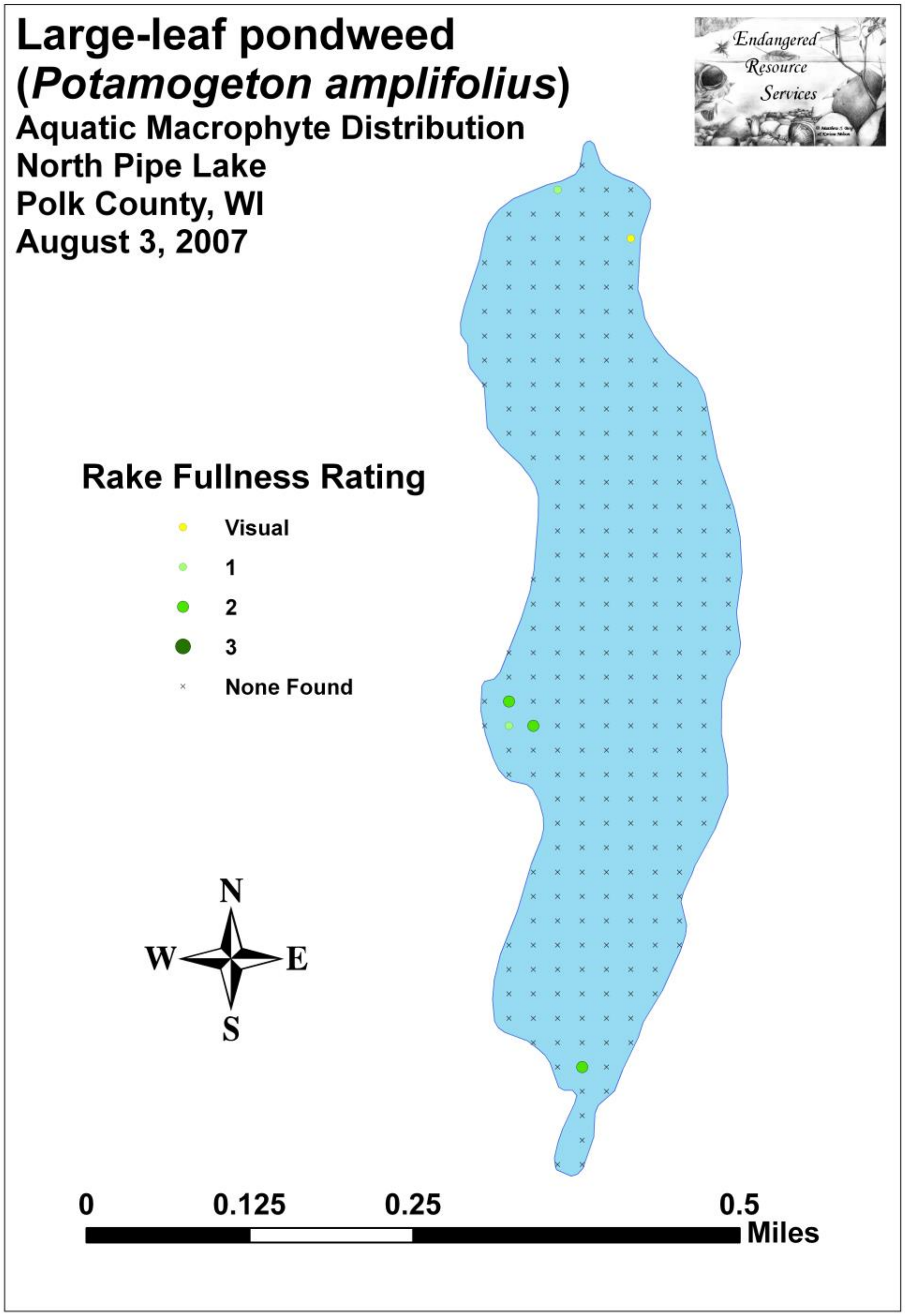
Miles


Large-leaf pondweed
(*Potamogeton amplifolius*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered
Resource
Services
Rake Fullness Rating
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None Found
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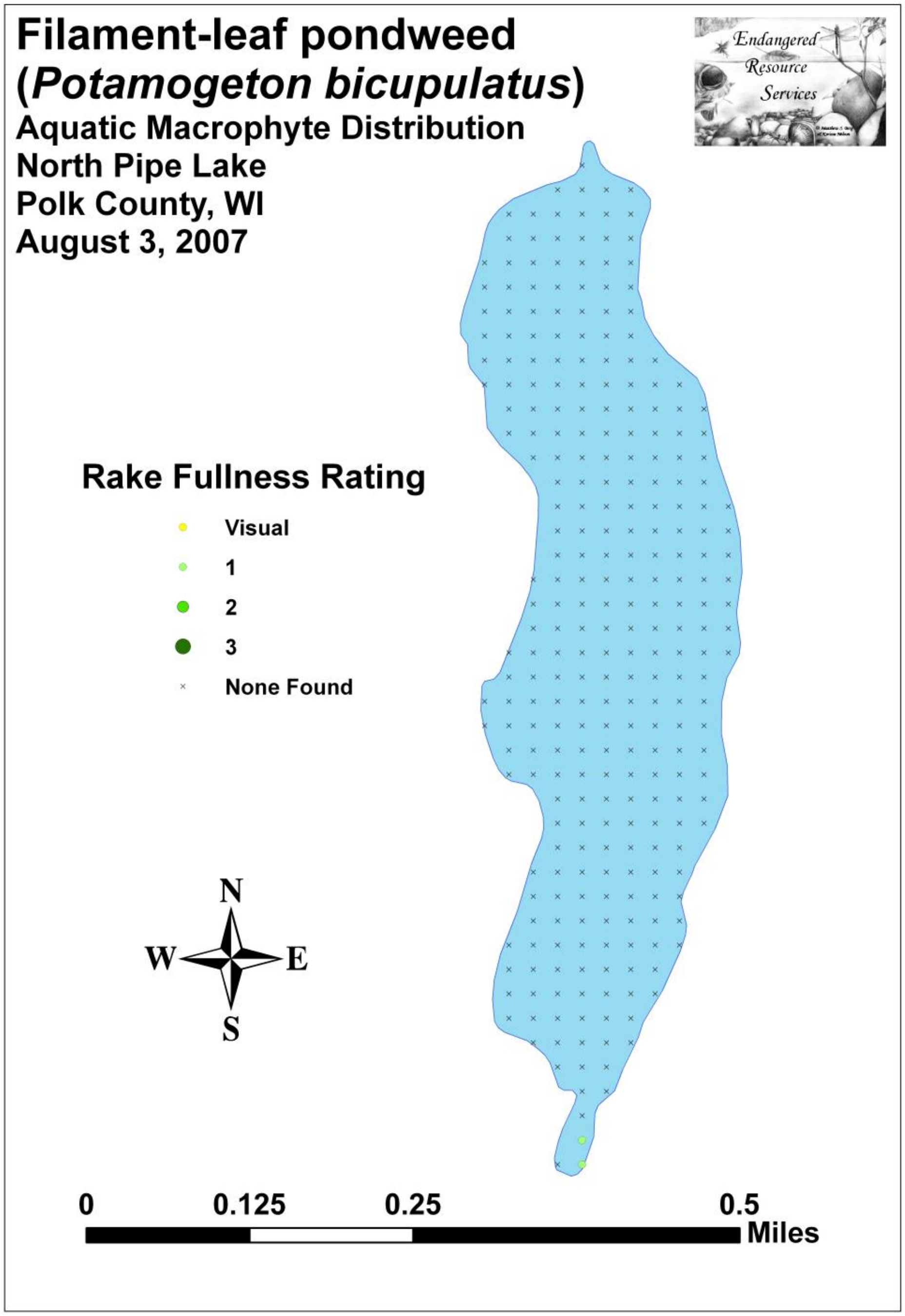
Miles


Filament-leaf pondweed
(*Potamogeton bicupulatus*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered
Resource
Services
Rake Fullness Rating
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None Found
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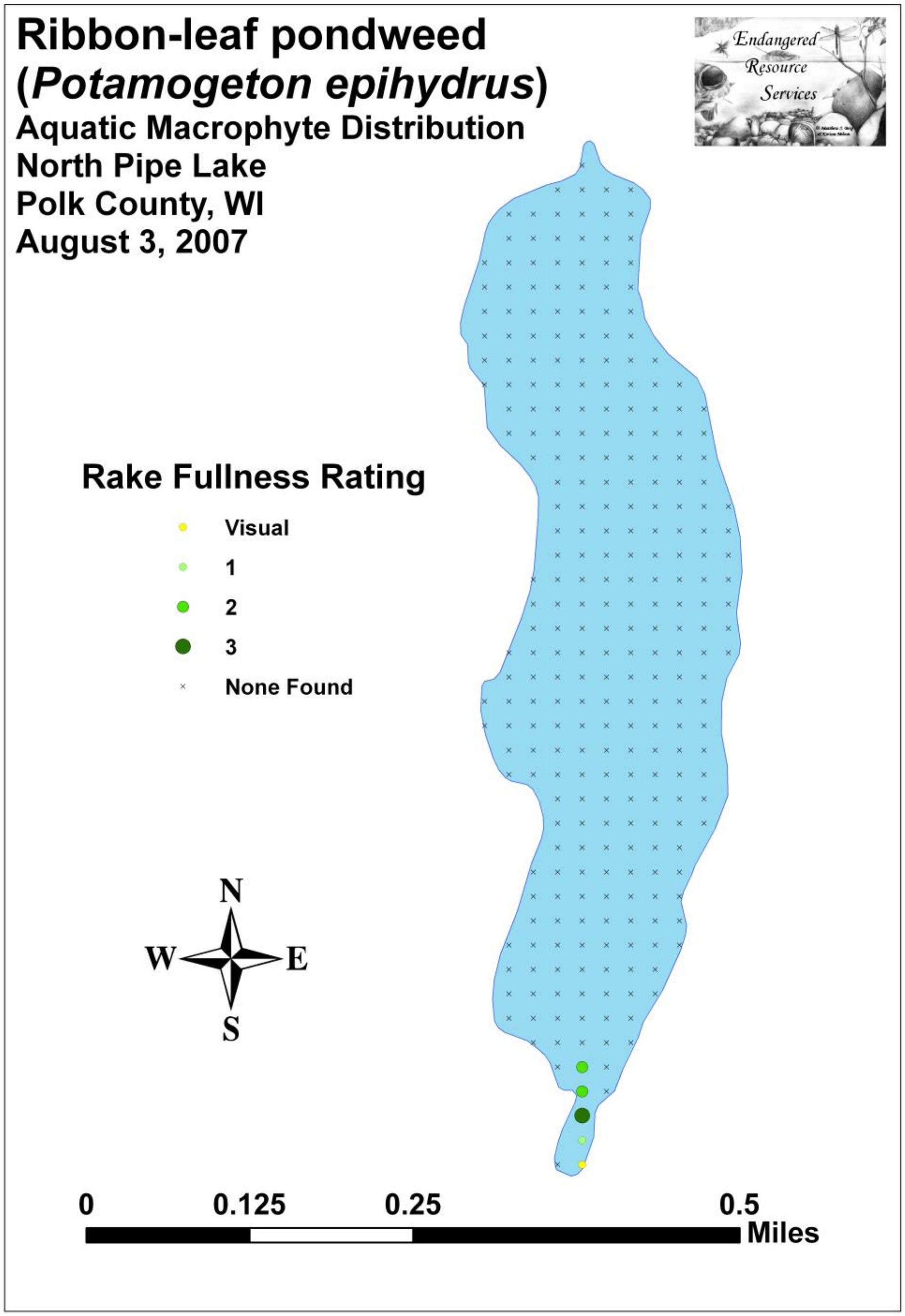
Ribbon-leaf pondweed
(Potamogeton epihydrus)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
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None Found
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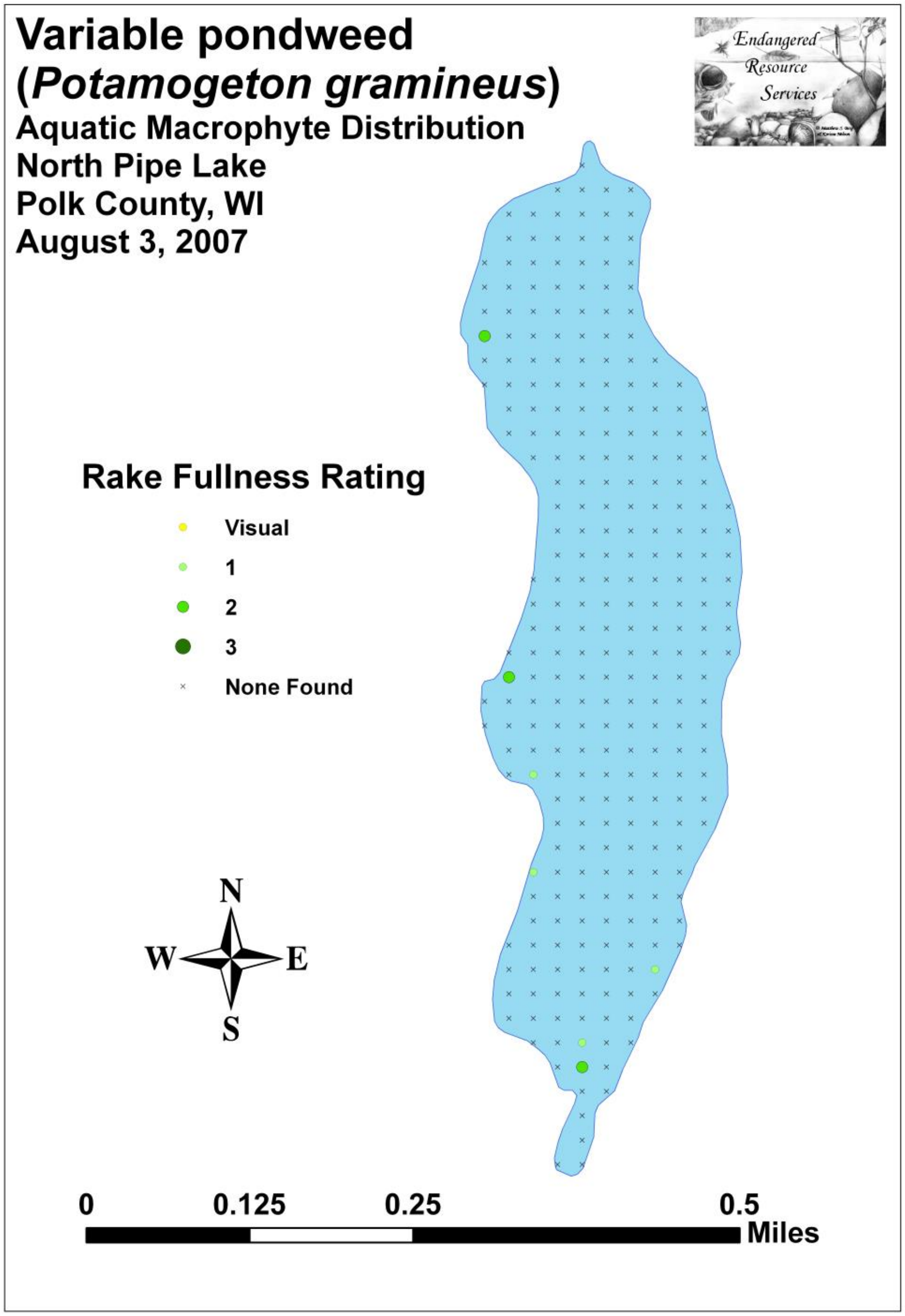
Miles


Variable pondweed
(Potamogeton gramineus)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered
Resource
Services
Rake Fullness Rating
Visual
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None Found
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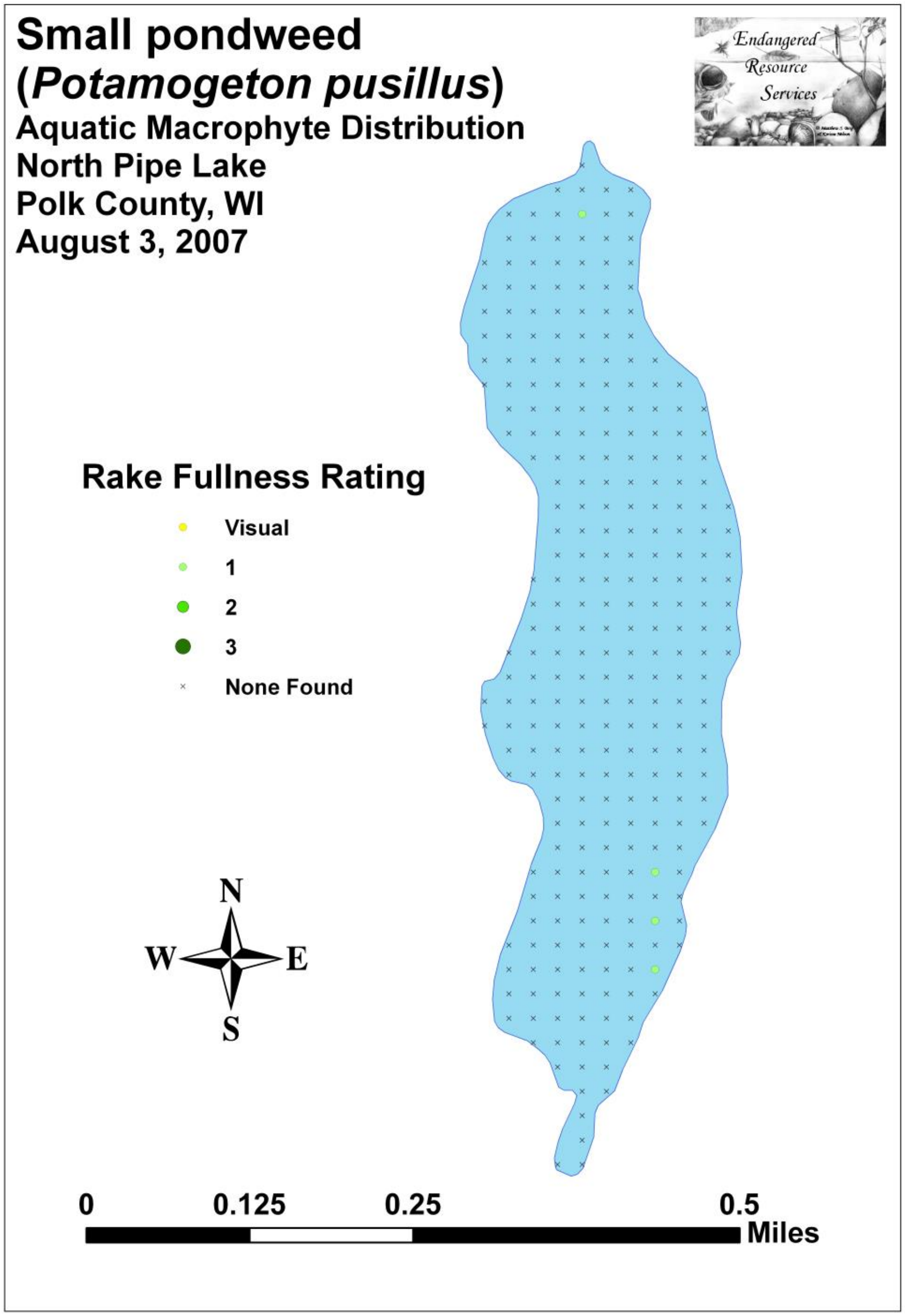
Miles



Small pondweed
(Potamogeton pusillus)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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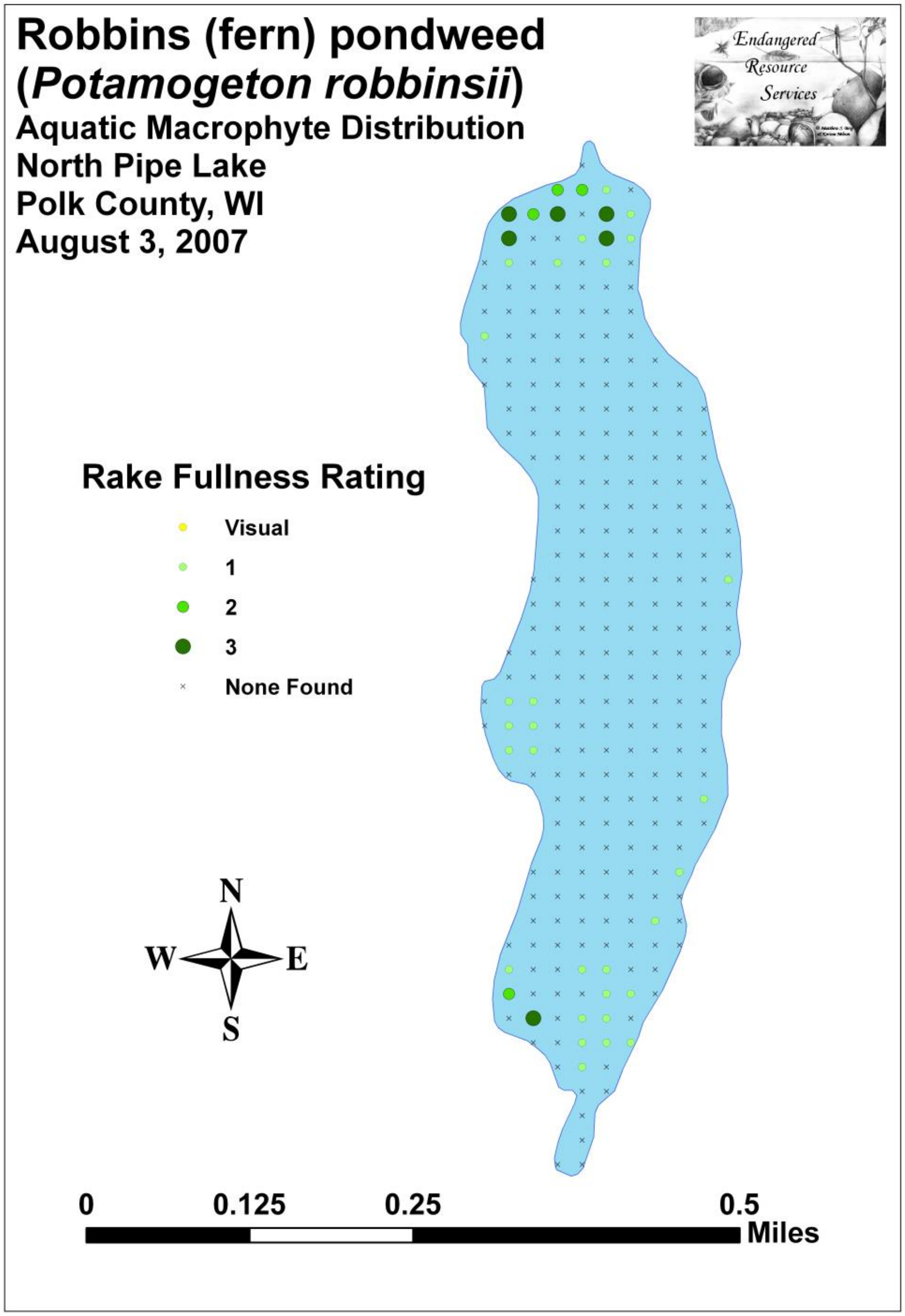

Robbins (fern) pondweed
(Potamogeton robbinsii)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
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None Found
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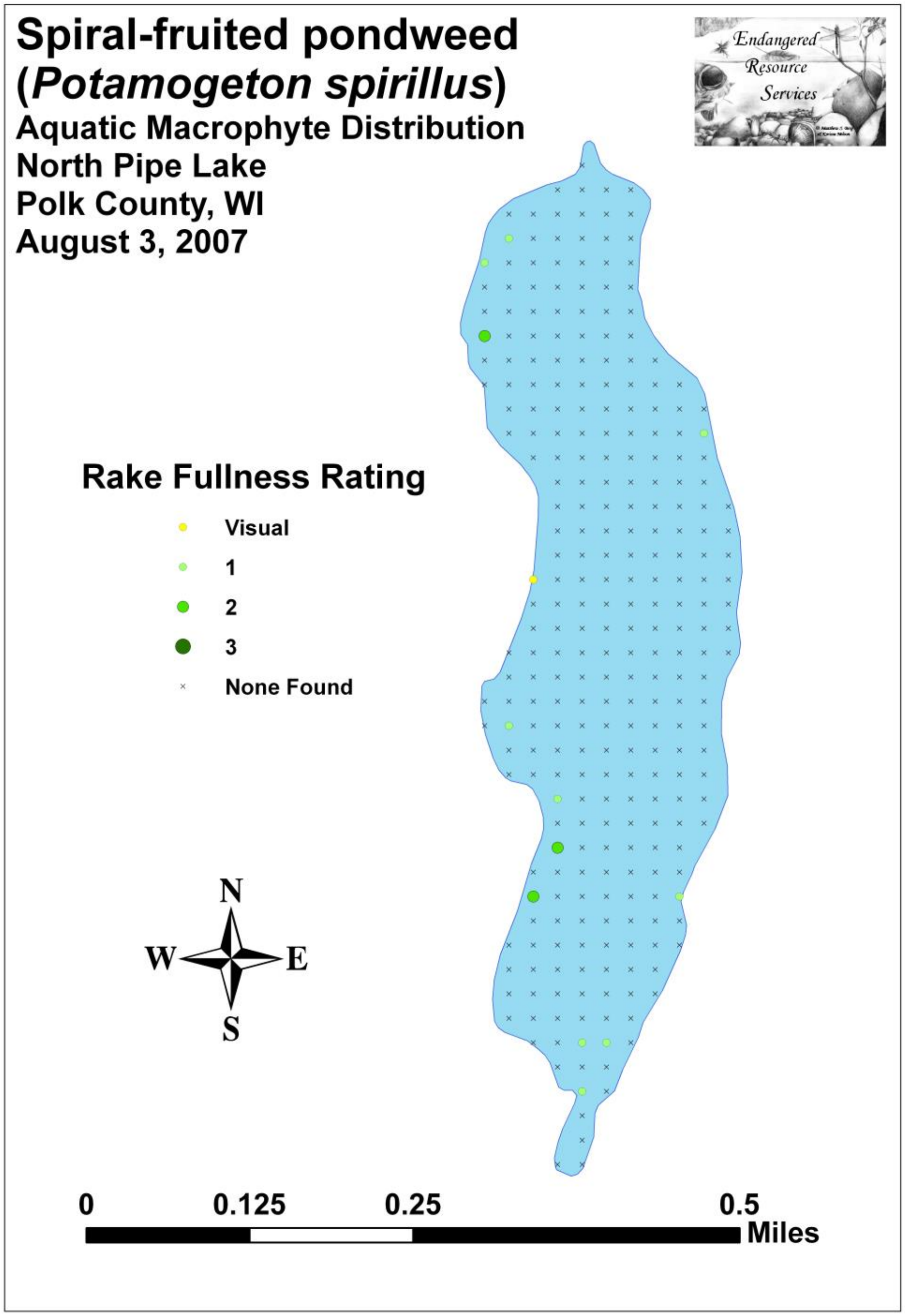
Miles


Spiral-fruited pondweed
(*Potamogeton spirillus*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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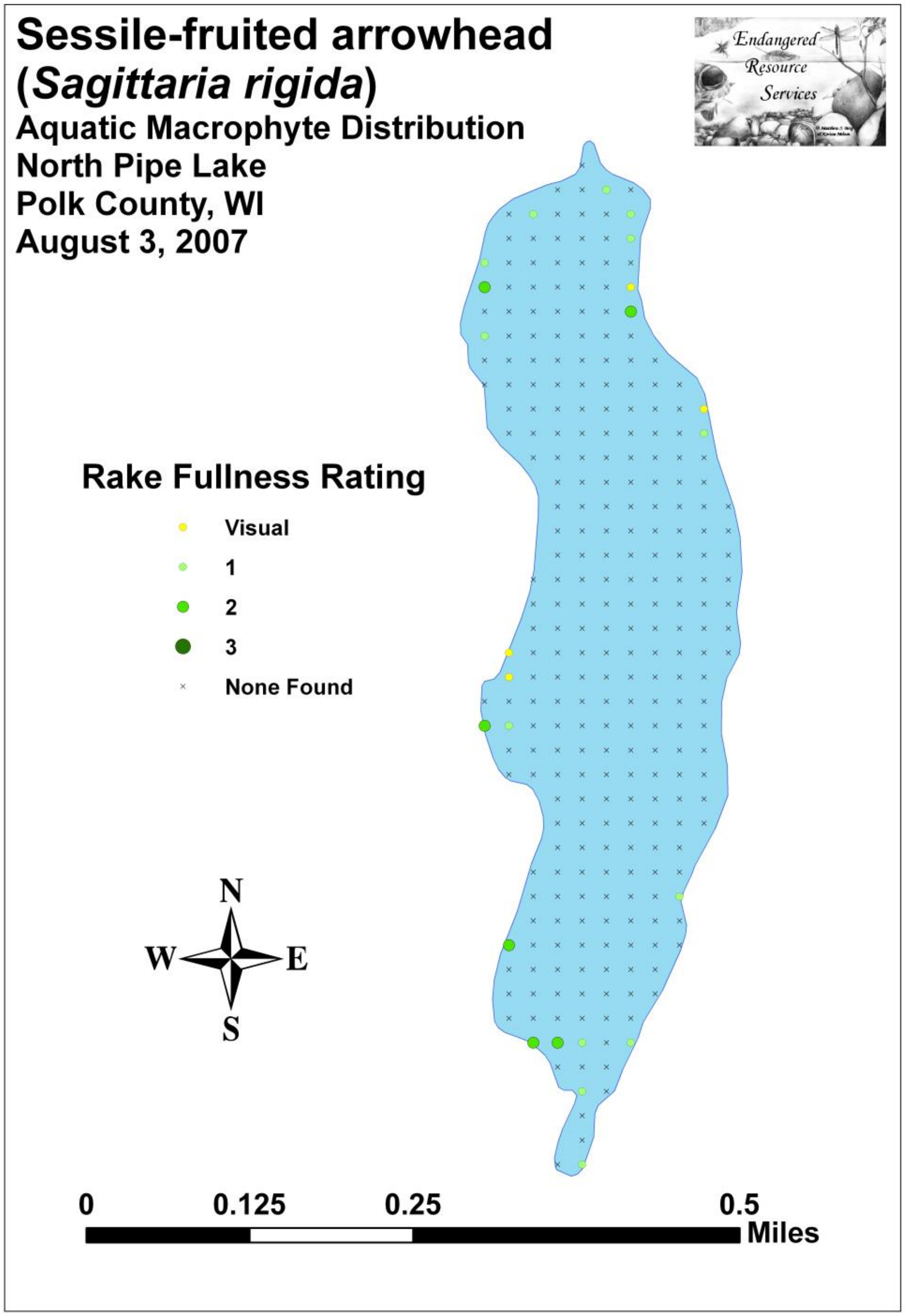
Sessile-fruited arrowhead
(Sagittaria rigida)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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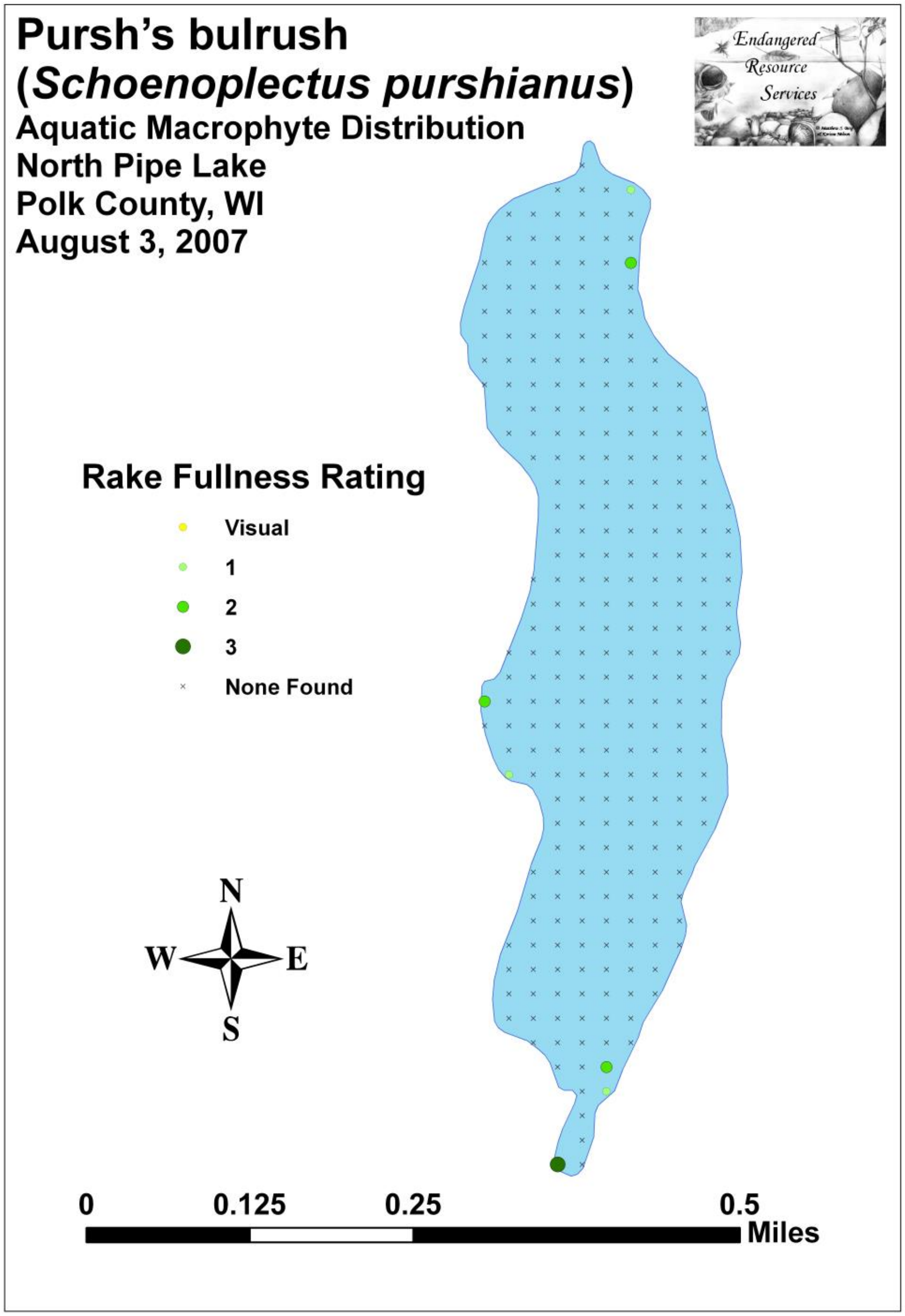
Pursh's bulrush
(Schoenoplectus purshianus)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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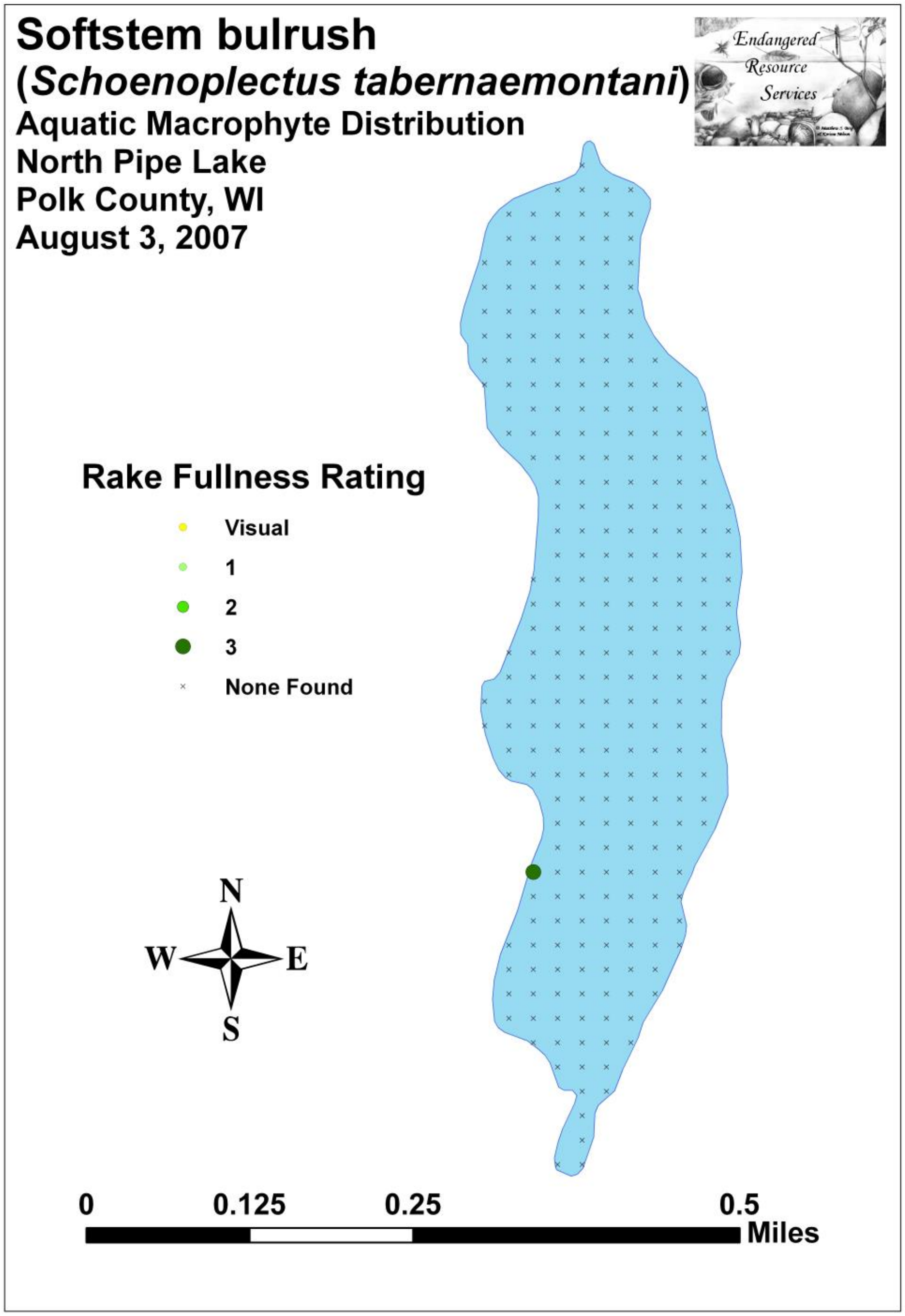
Miles


Softstem bulrush
(*Schoenoplectus tabernaemontani*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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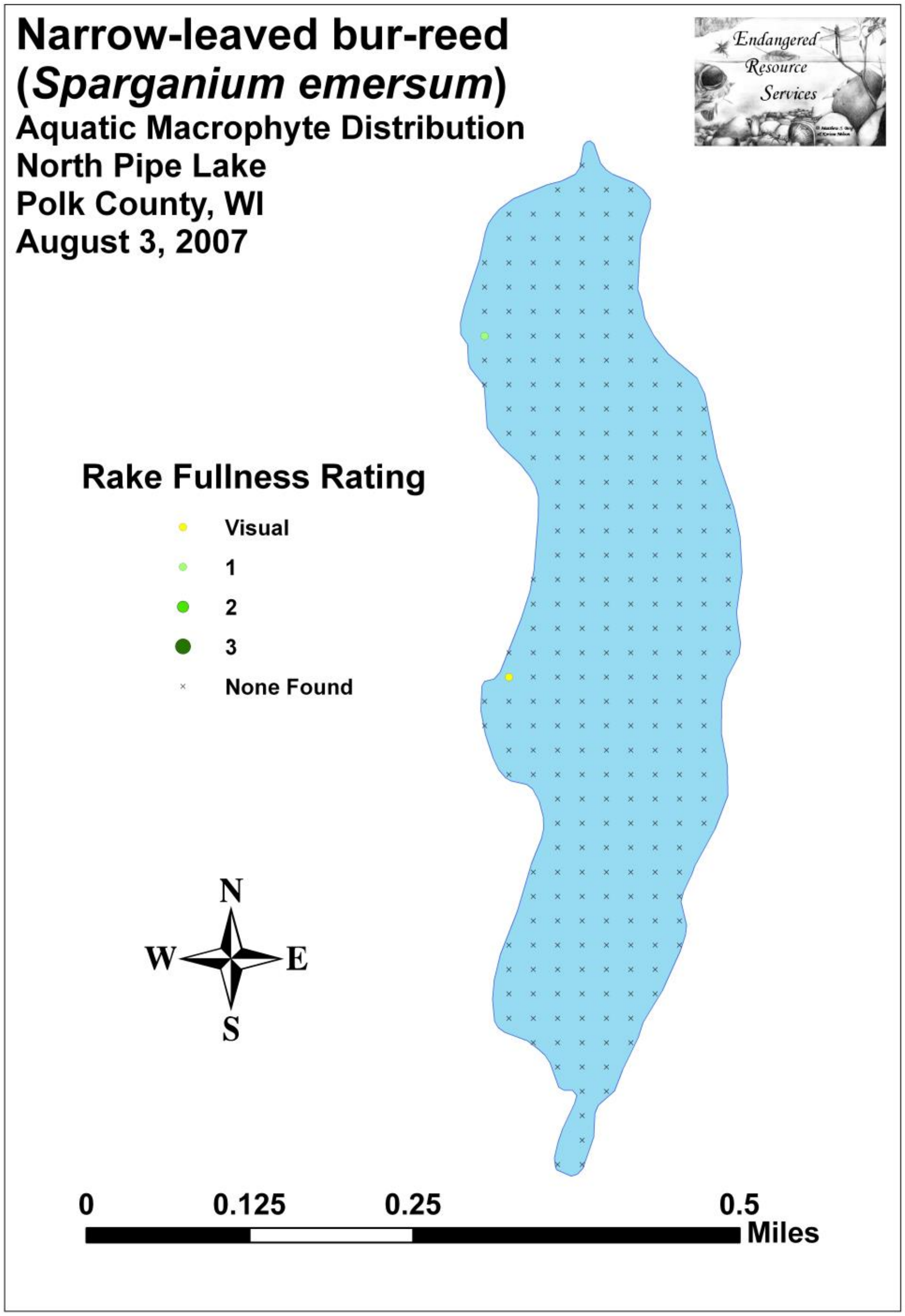
Narrow-leaved bur-reed
(Sparganium emersum)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered
Resource
Services
Rake Fullness Rating
Visual
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None Found
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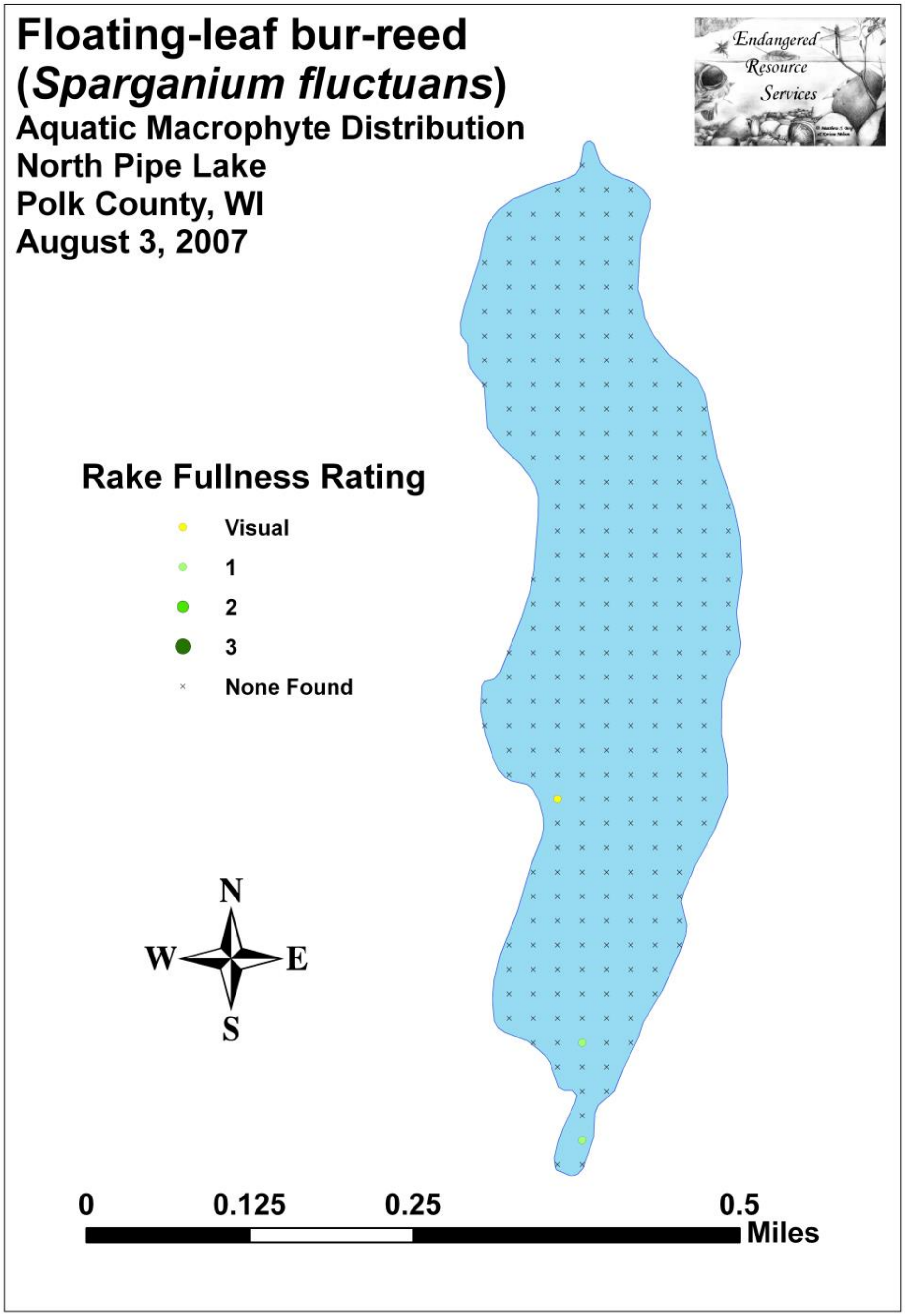

Floating-leaf bur-reed
(Sparganium fluctuans)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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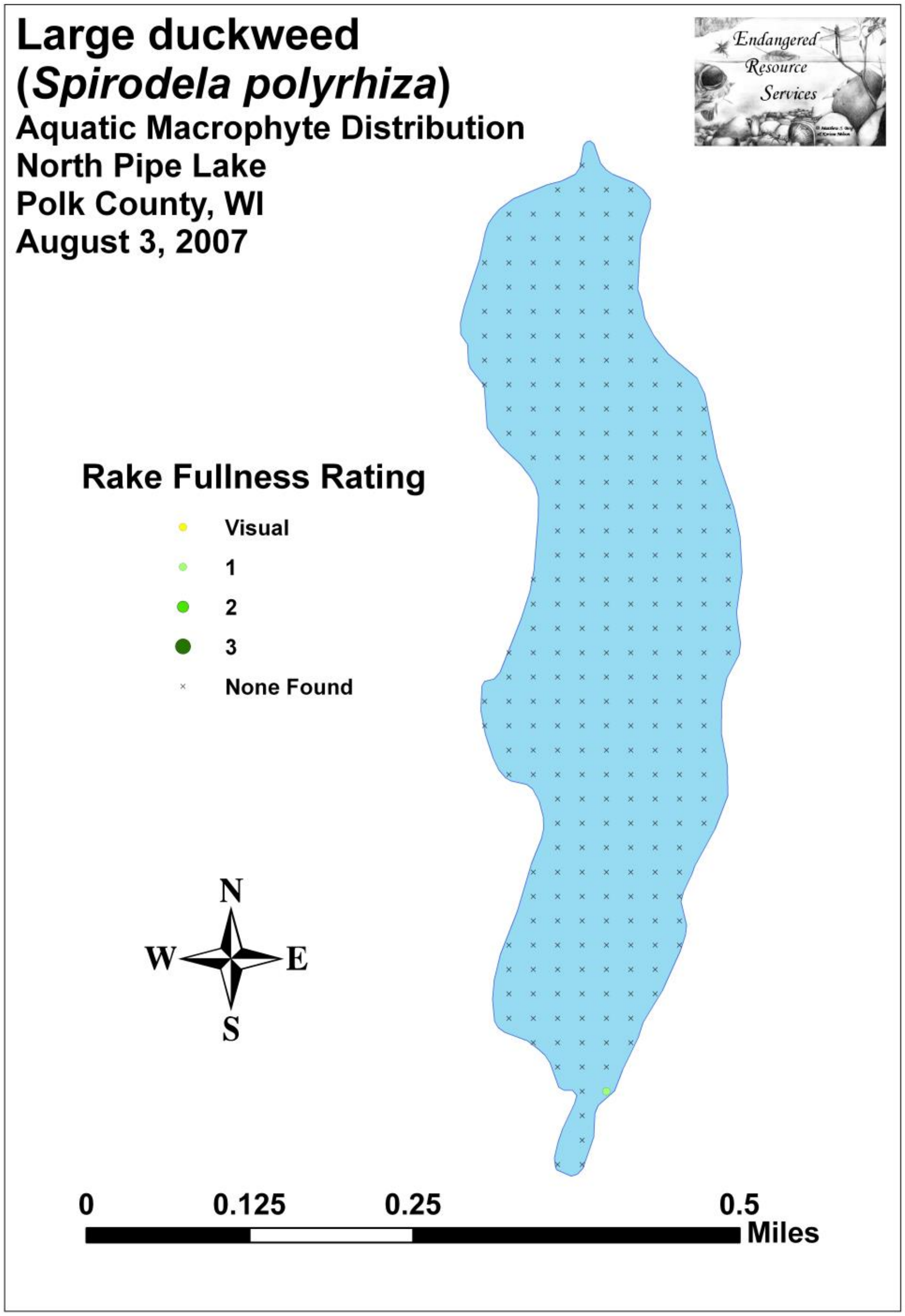
Miles


Large duckweed
(*Spirodela polyrhiza*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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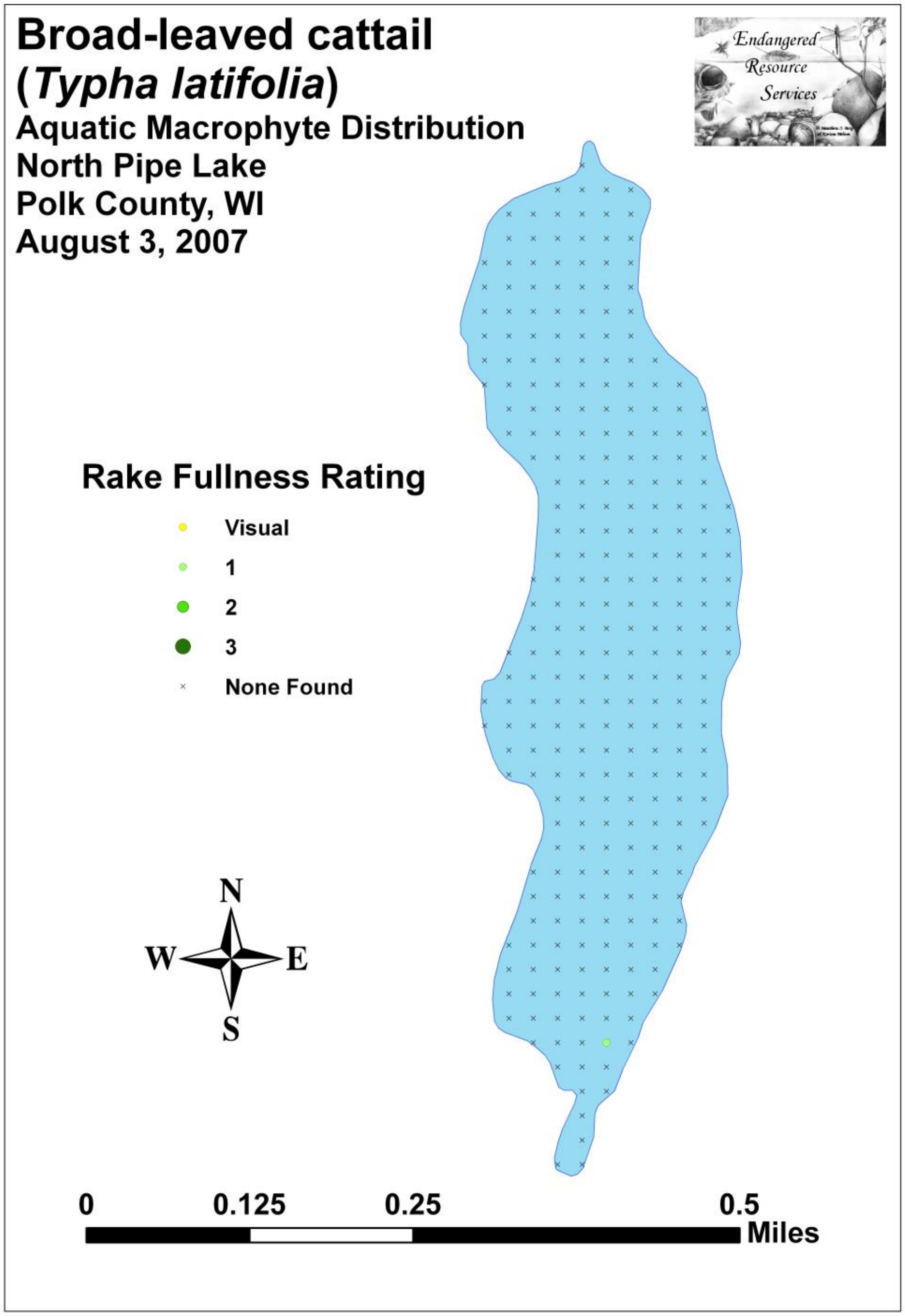
Miles


Broad-leaved cattail
(Typha latifolia)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
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None Found
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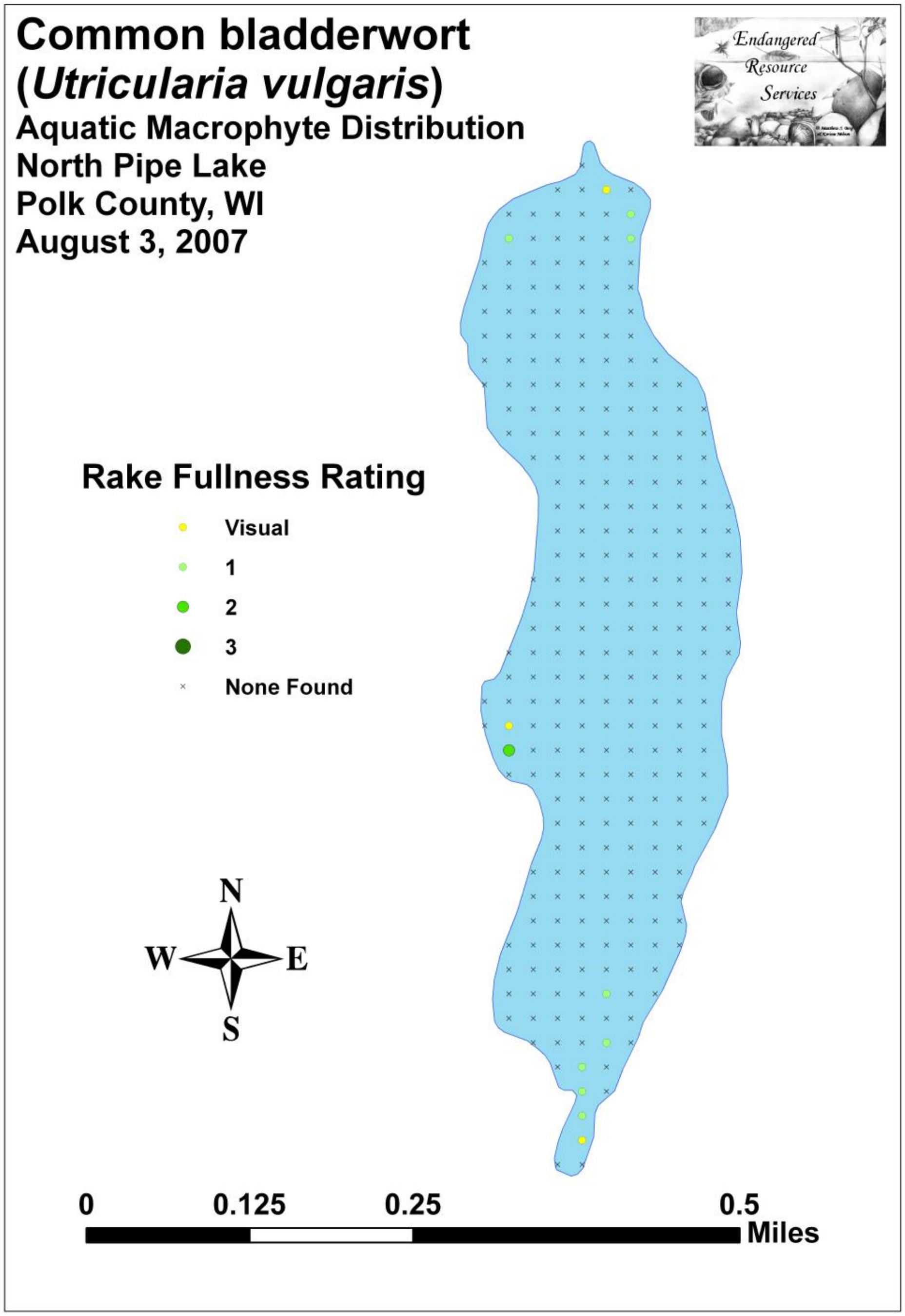
Miles


Common bladderwort
(*Utricularia vulgaris*)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
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None Found
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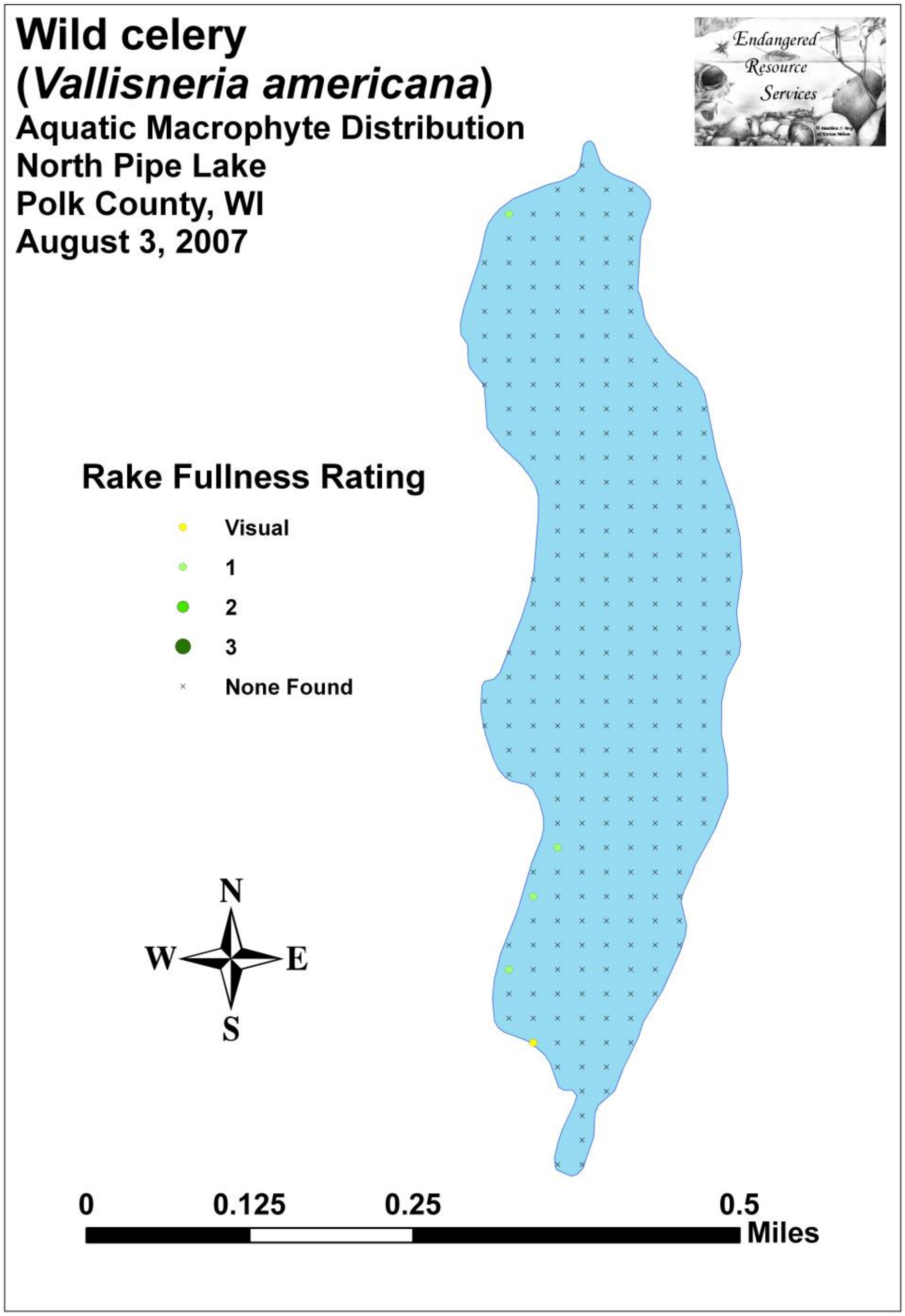
Miles


Wild celery
(Vallisneria americana)
Aquatic Macrophyte Distribution
North Pipe Lake
Polk County, WI
August 3, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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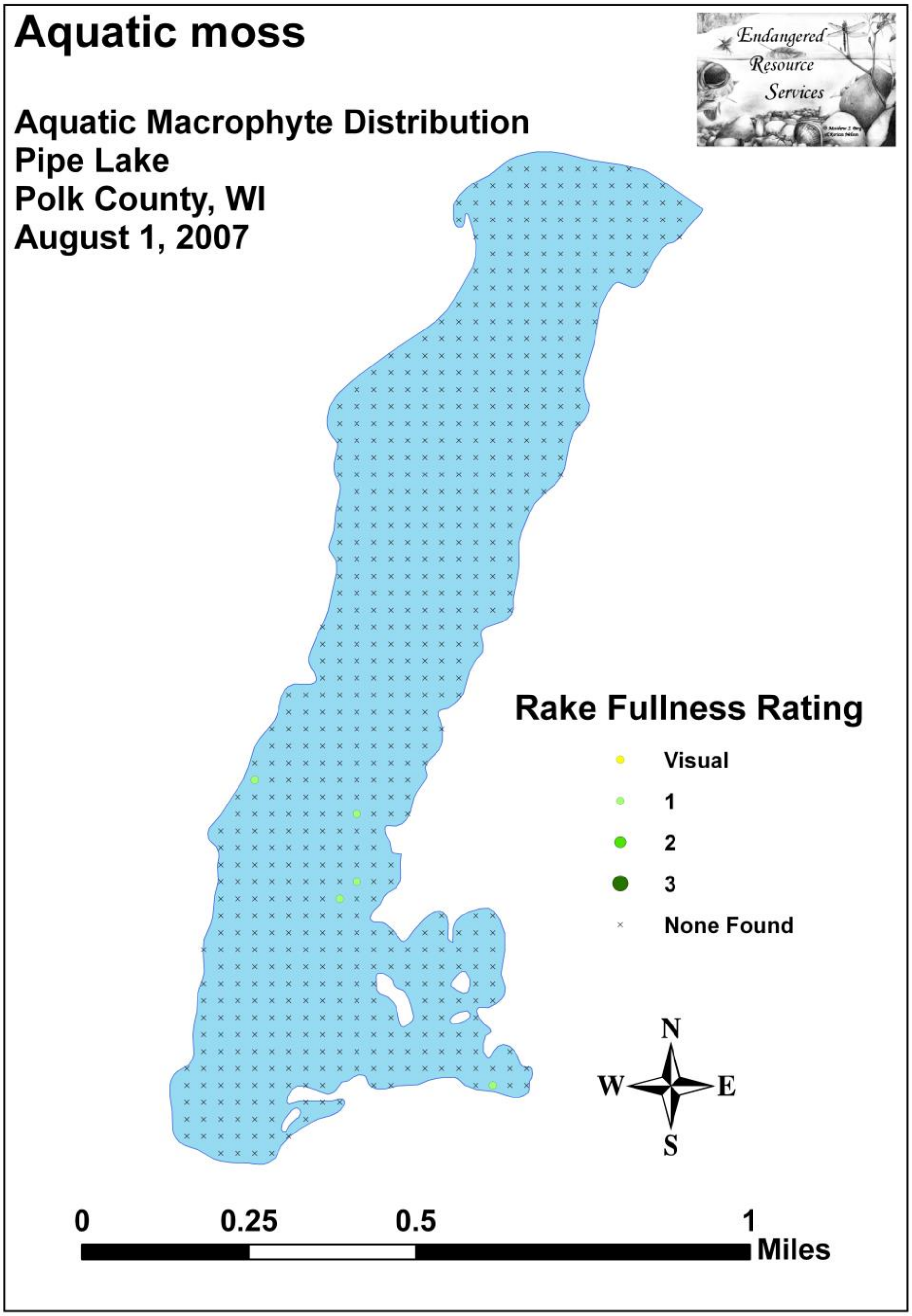
Miles



Aquatic moss
Endangered Resource Services
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Rake Fullness Rating
Visual
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None Found
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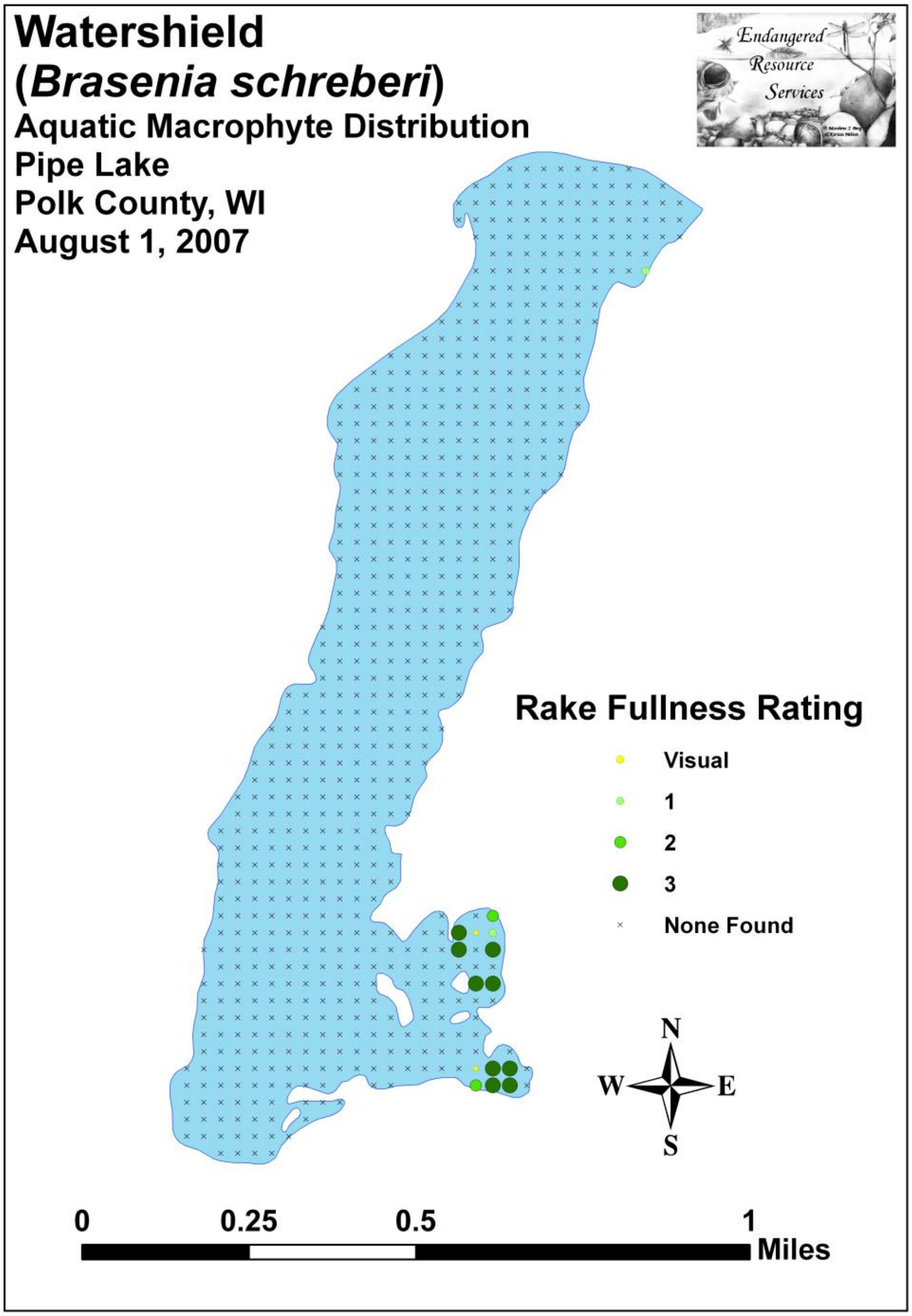
Miles


Watershield
(*Brasenia schreberi*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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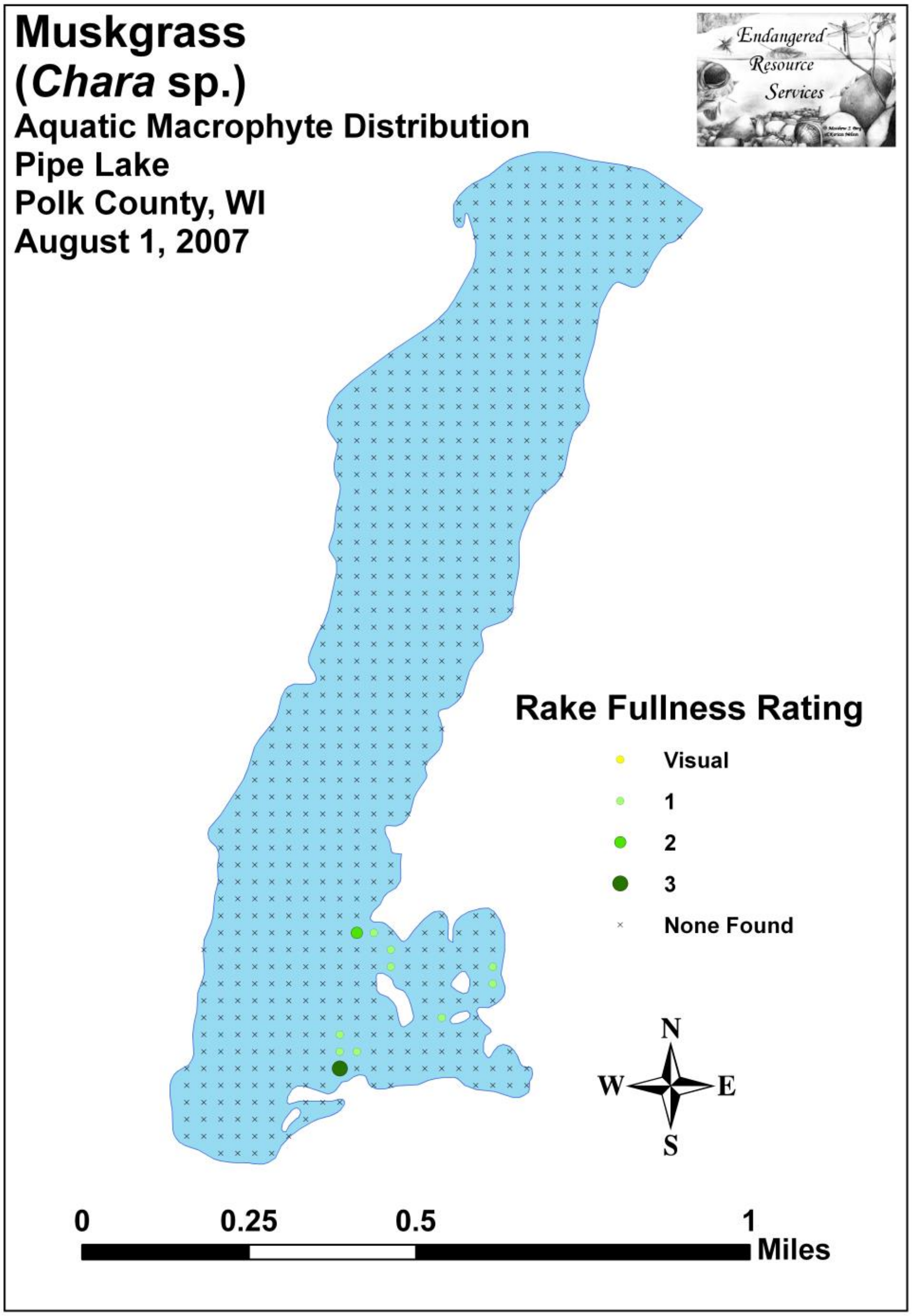
Miles


Muskgrass
(Chara sp.)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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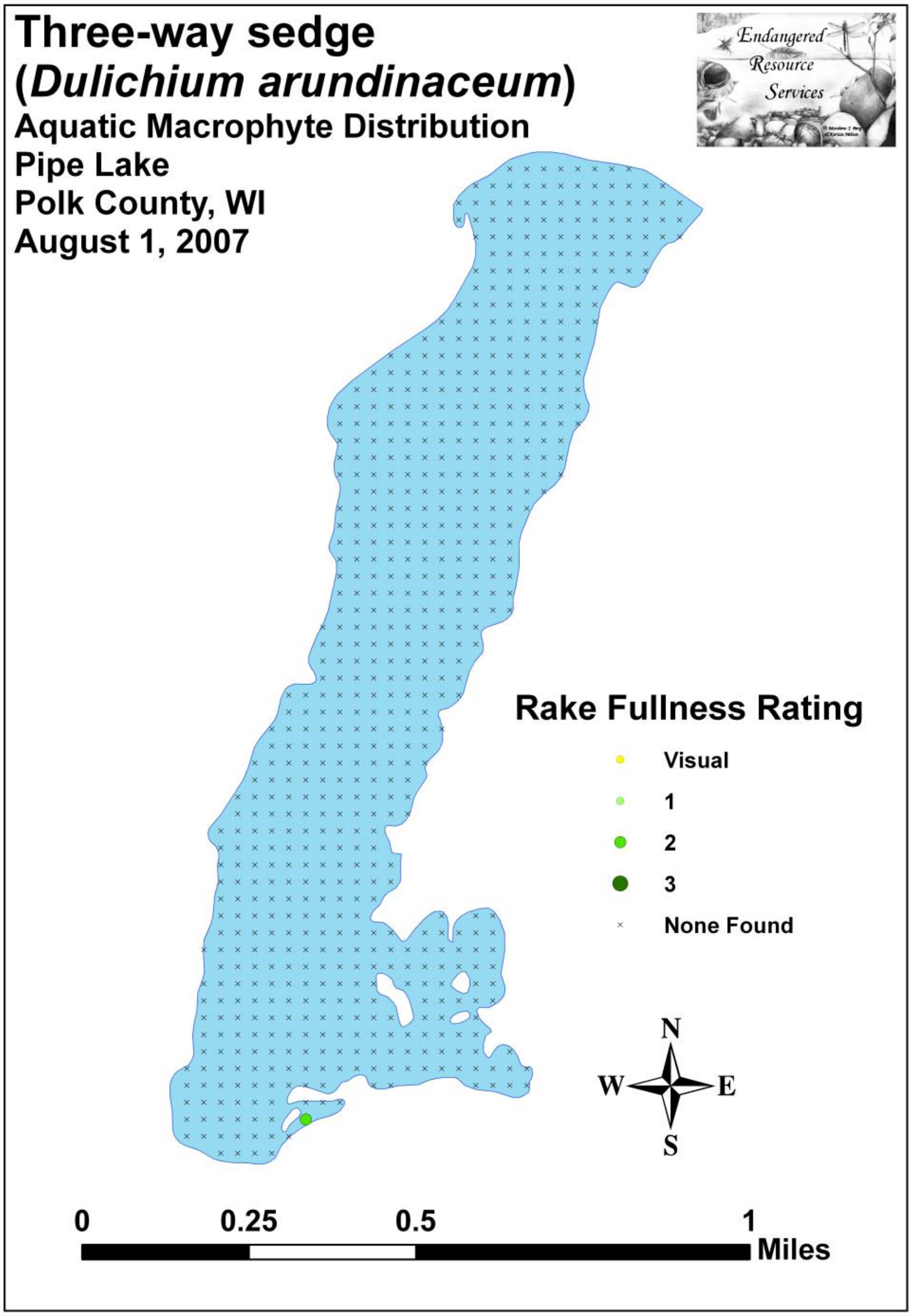

Three-way sedge
(*Dulichium arundinaceum*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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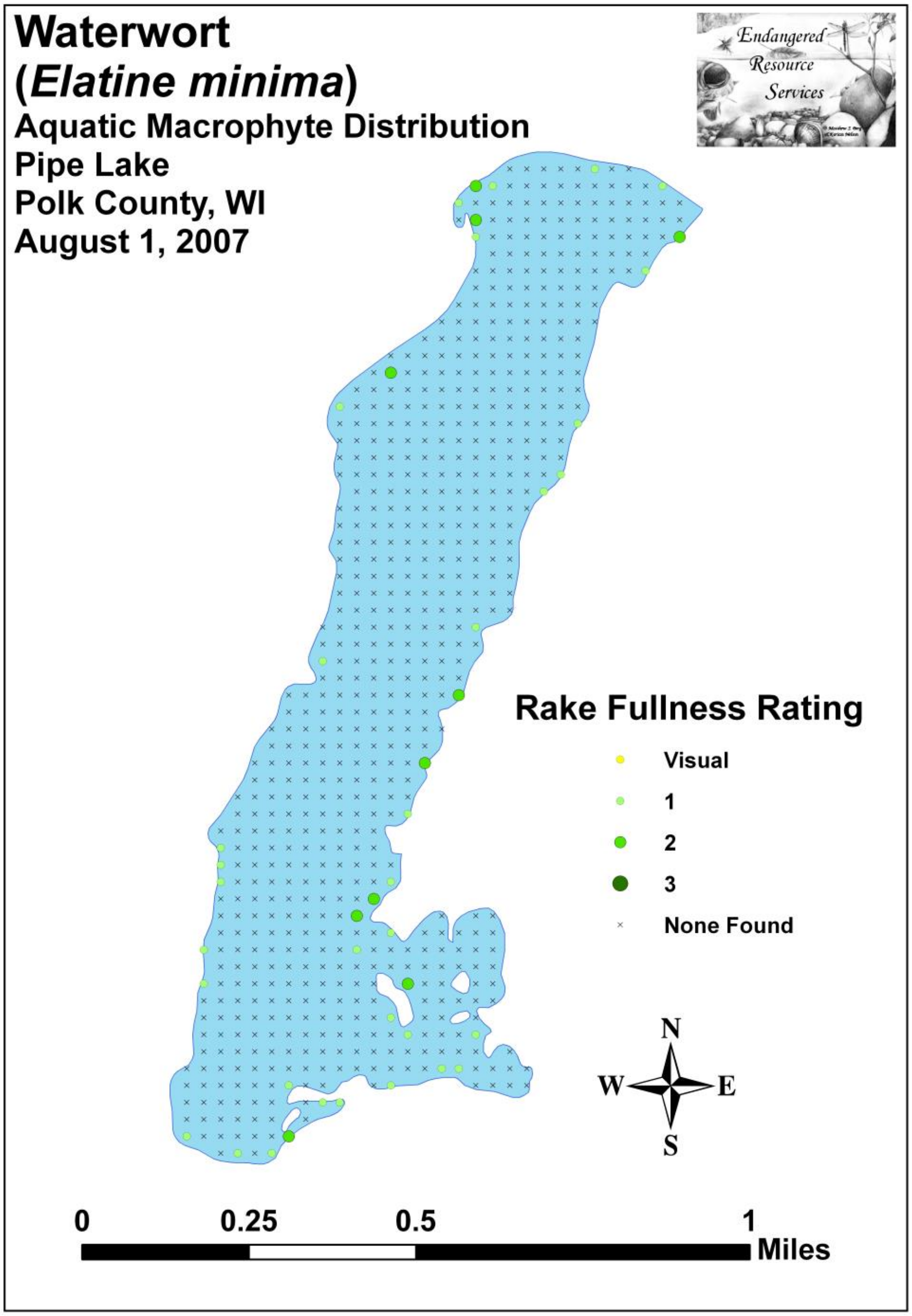
Waterwort
(Elatine minima)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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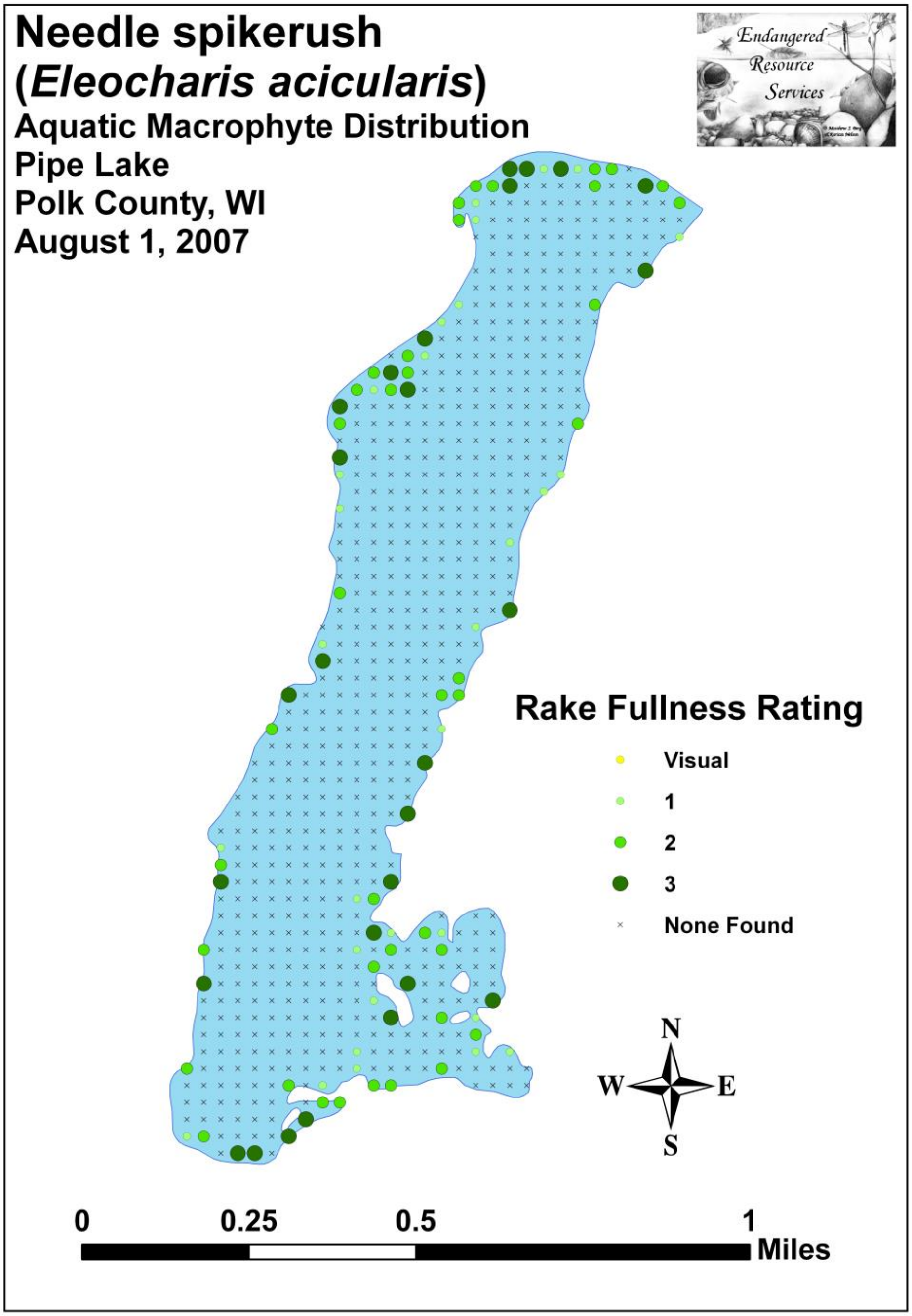
Miles


Needle spikerush
(*Eleocharis acicularis*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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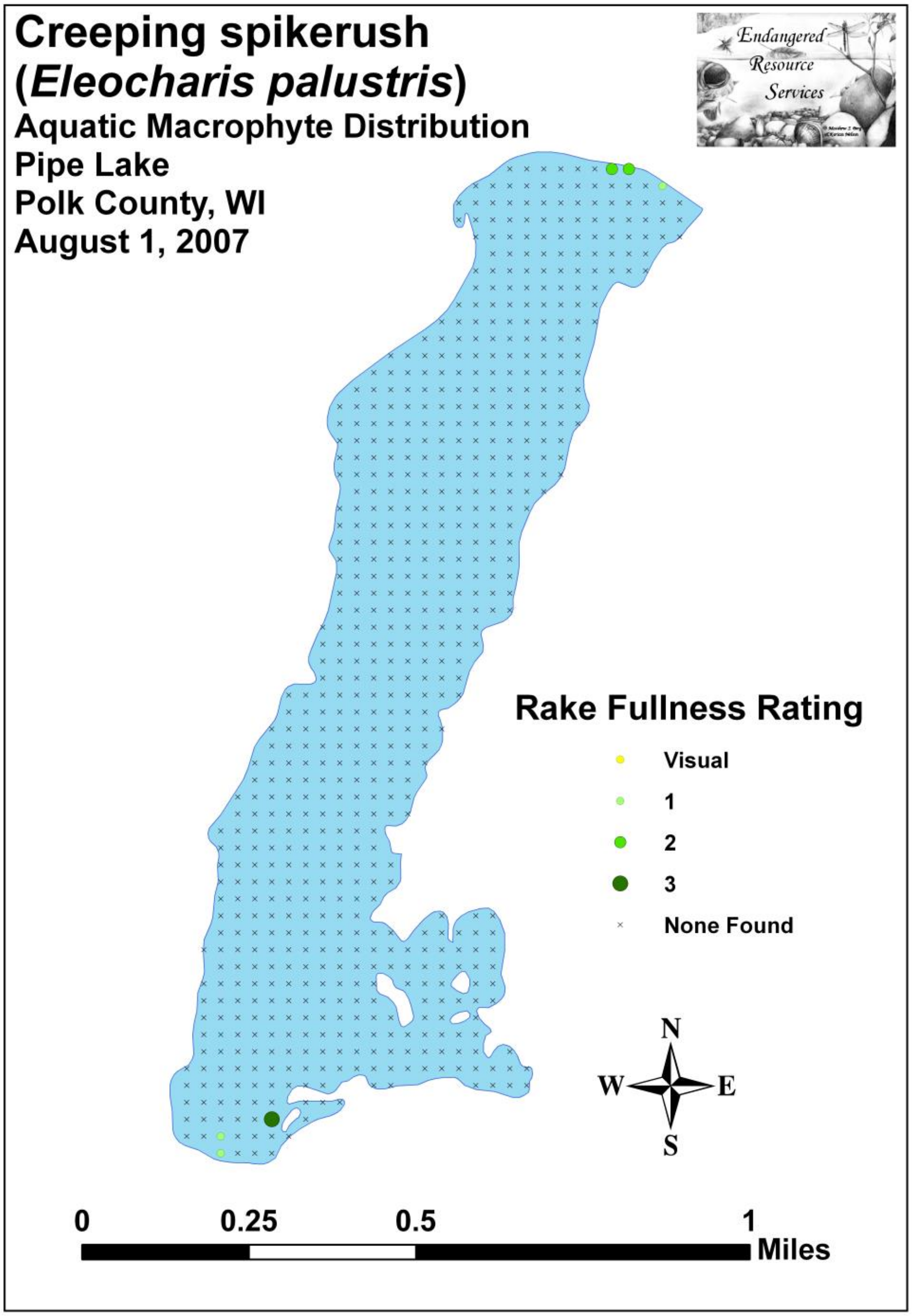
Creeping spikerush
(*Eleocharis palustris*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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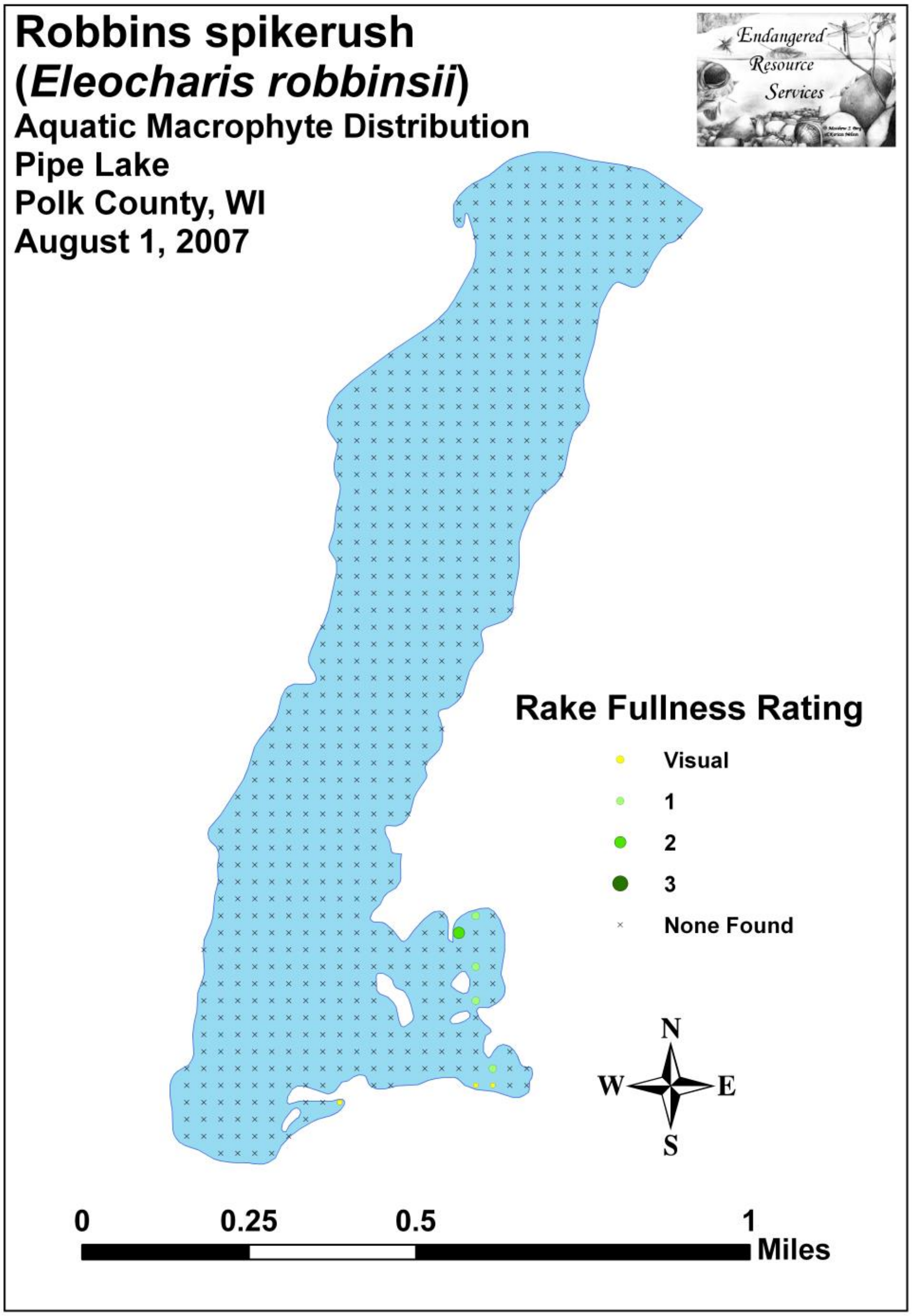
Miles


Robbins spikerush
(*Eleocharis robbinsii*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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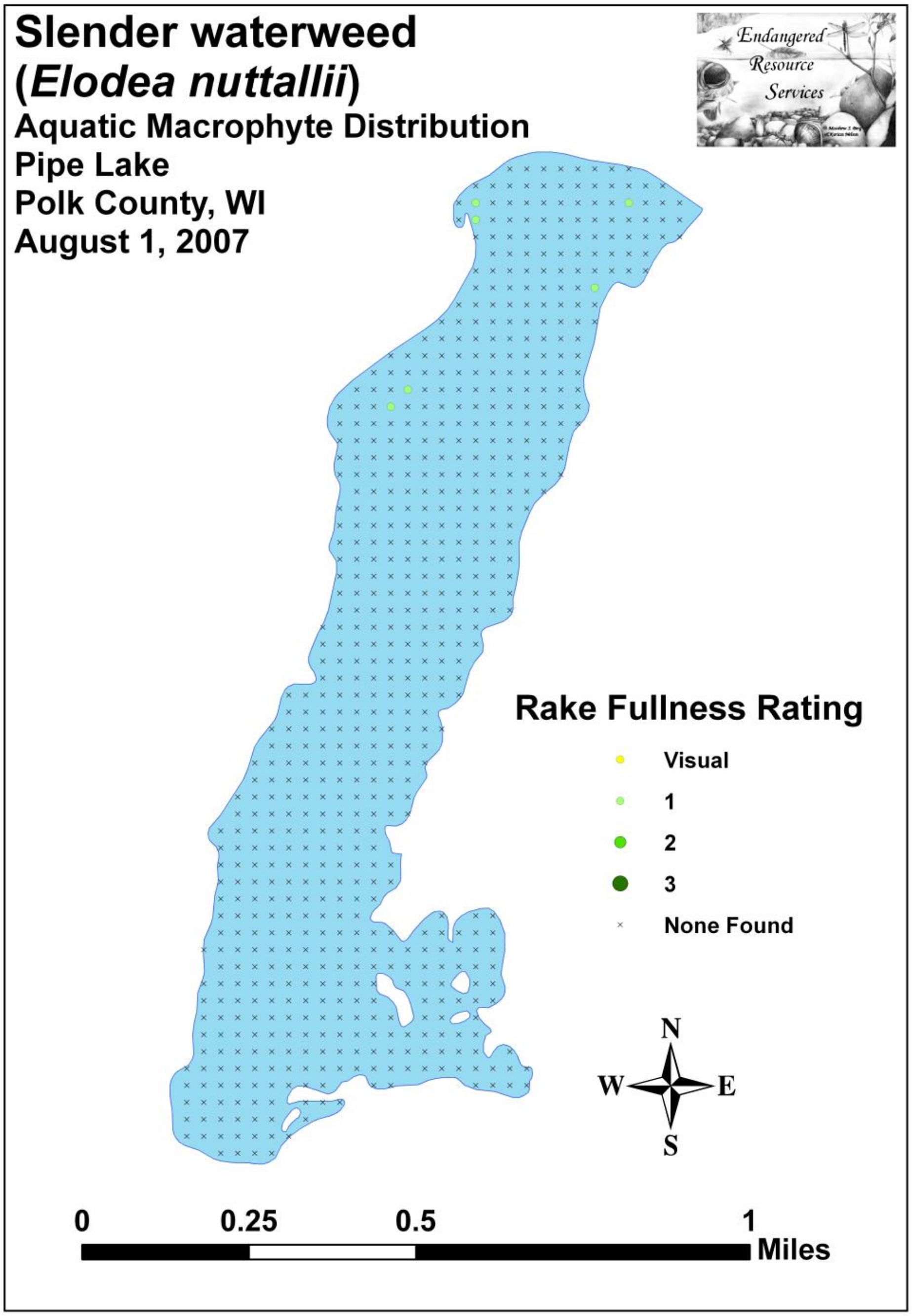
Miles


Slender waterweed
(Elodea nuttallii)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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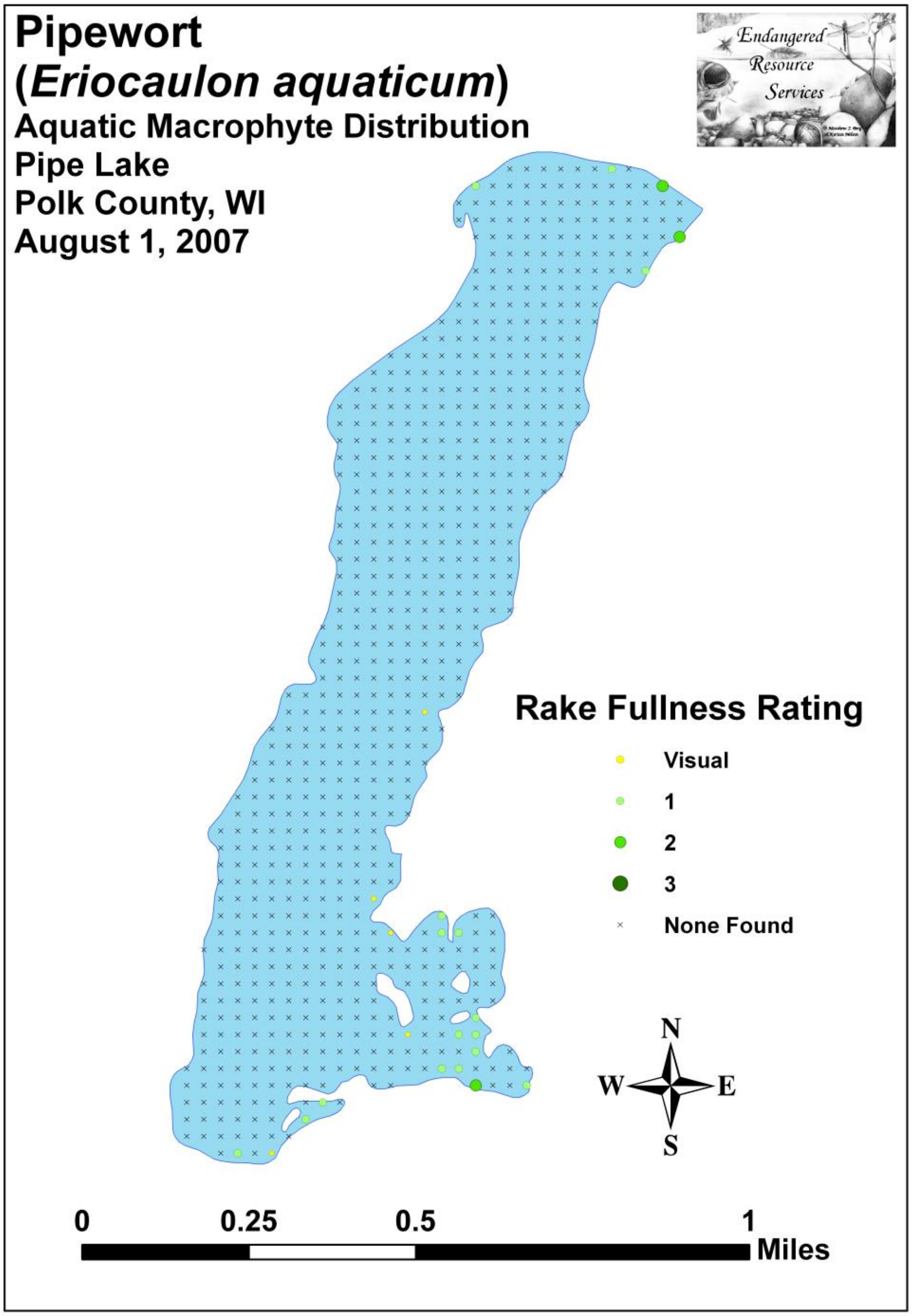
Miles



Pipewort
(*Eriocaulon aquaticum*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered
Resource
Services
Rake Fullness Rating
Visual
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None Found
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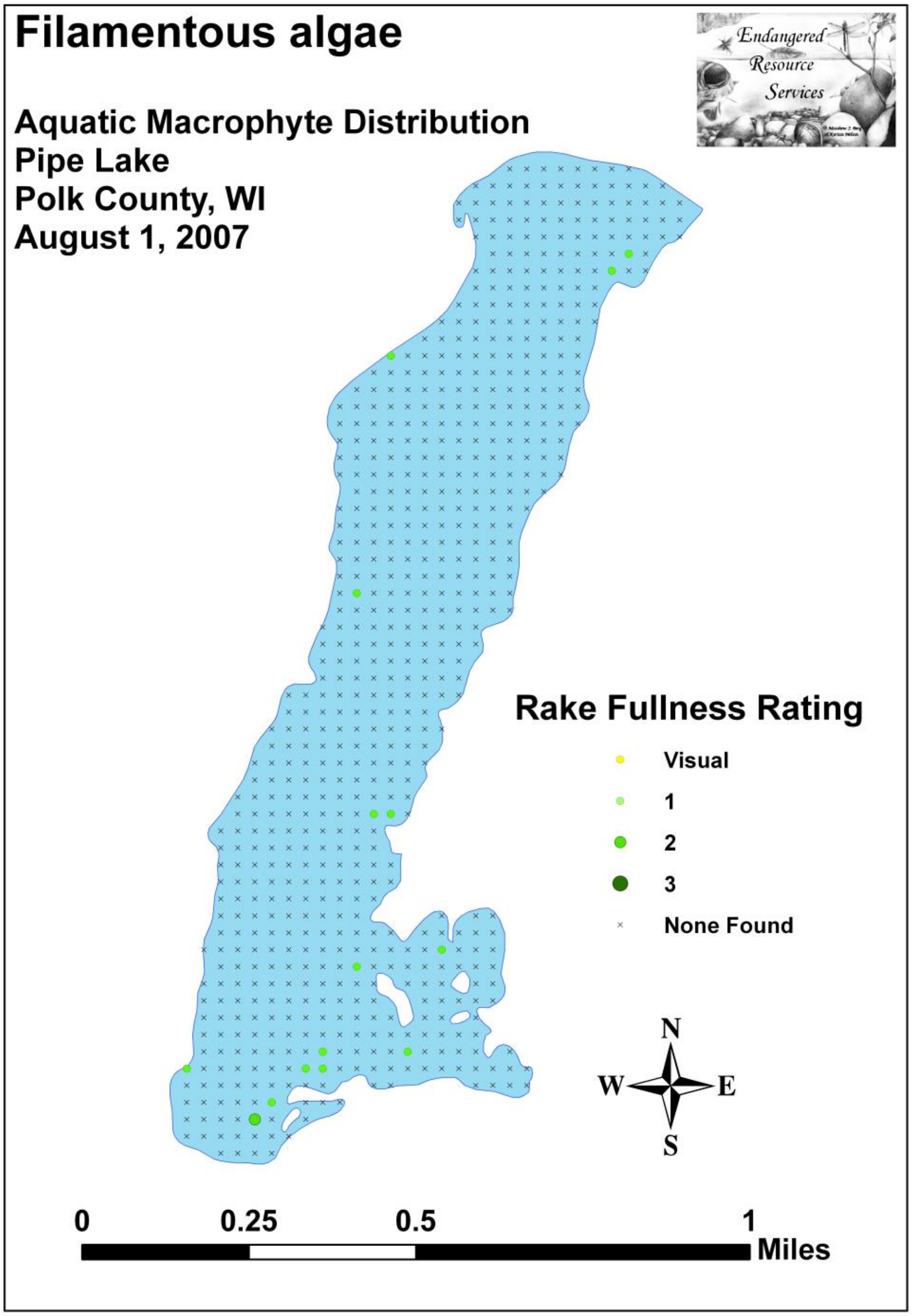
Miles



Filamentous algae
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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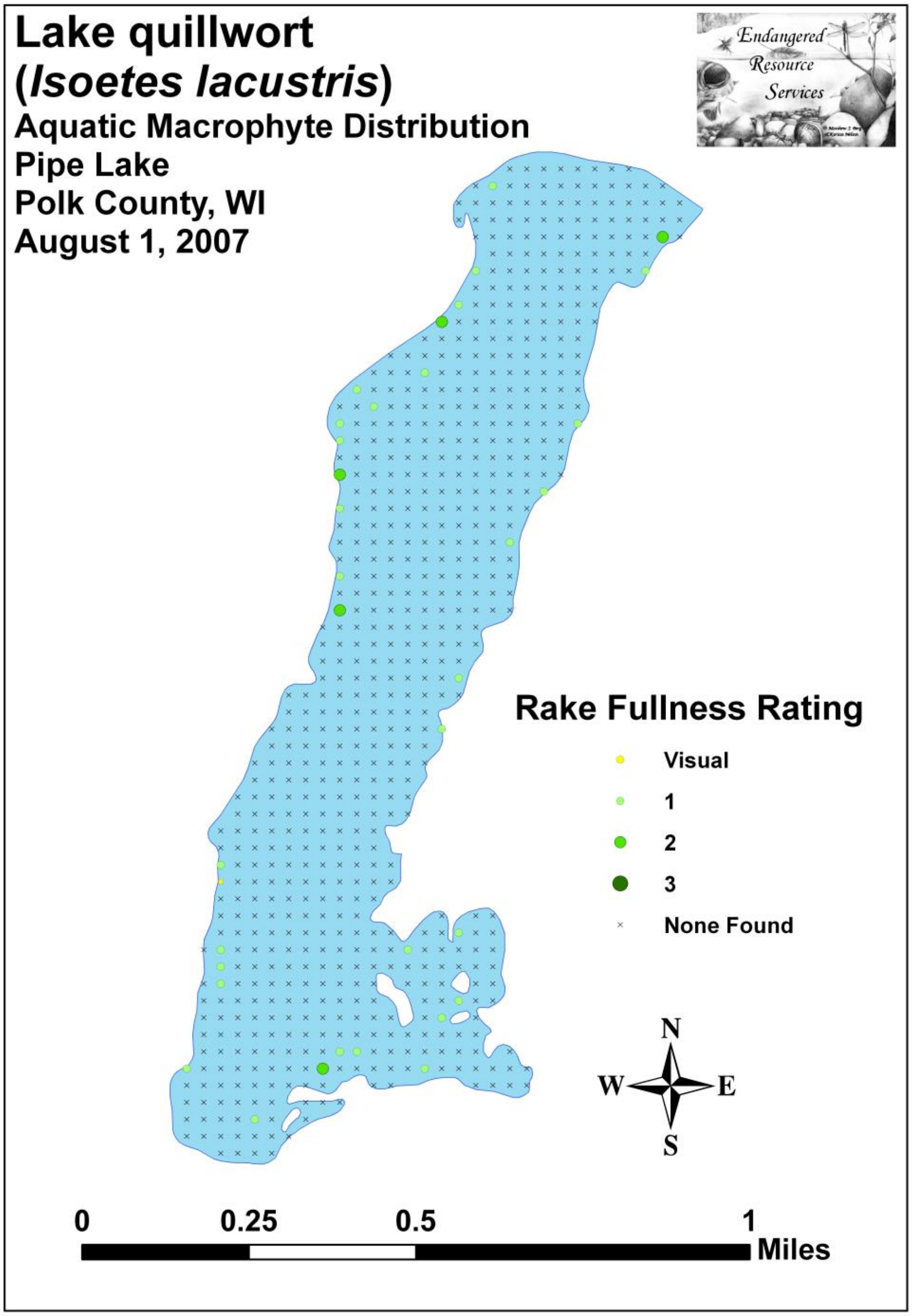
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Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
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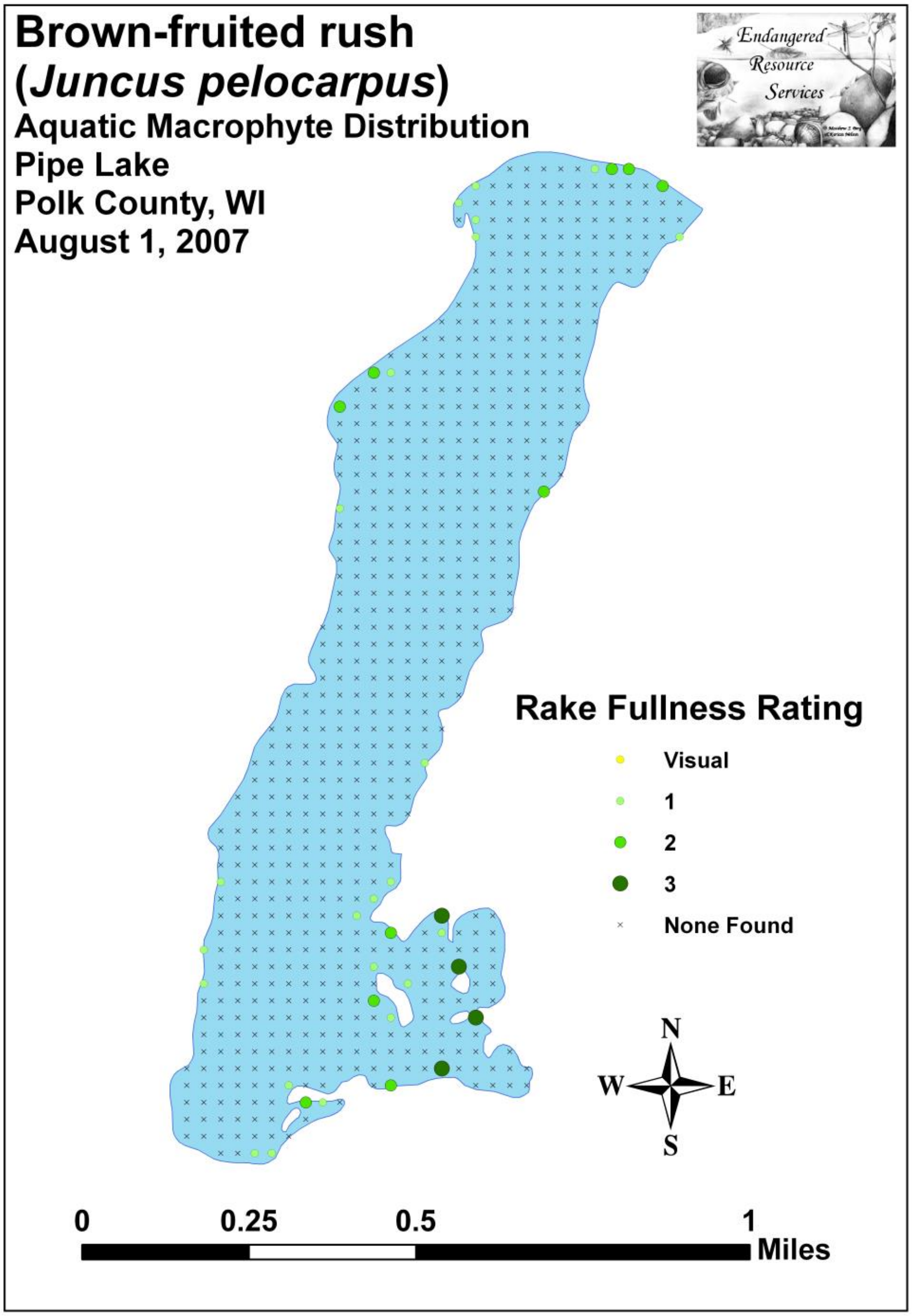
Brown-fruited rush
(*Juncus pelocarpus*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
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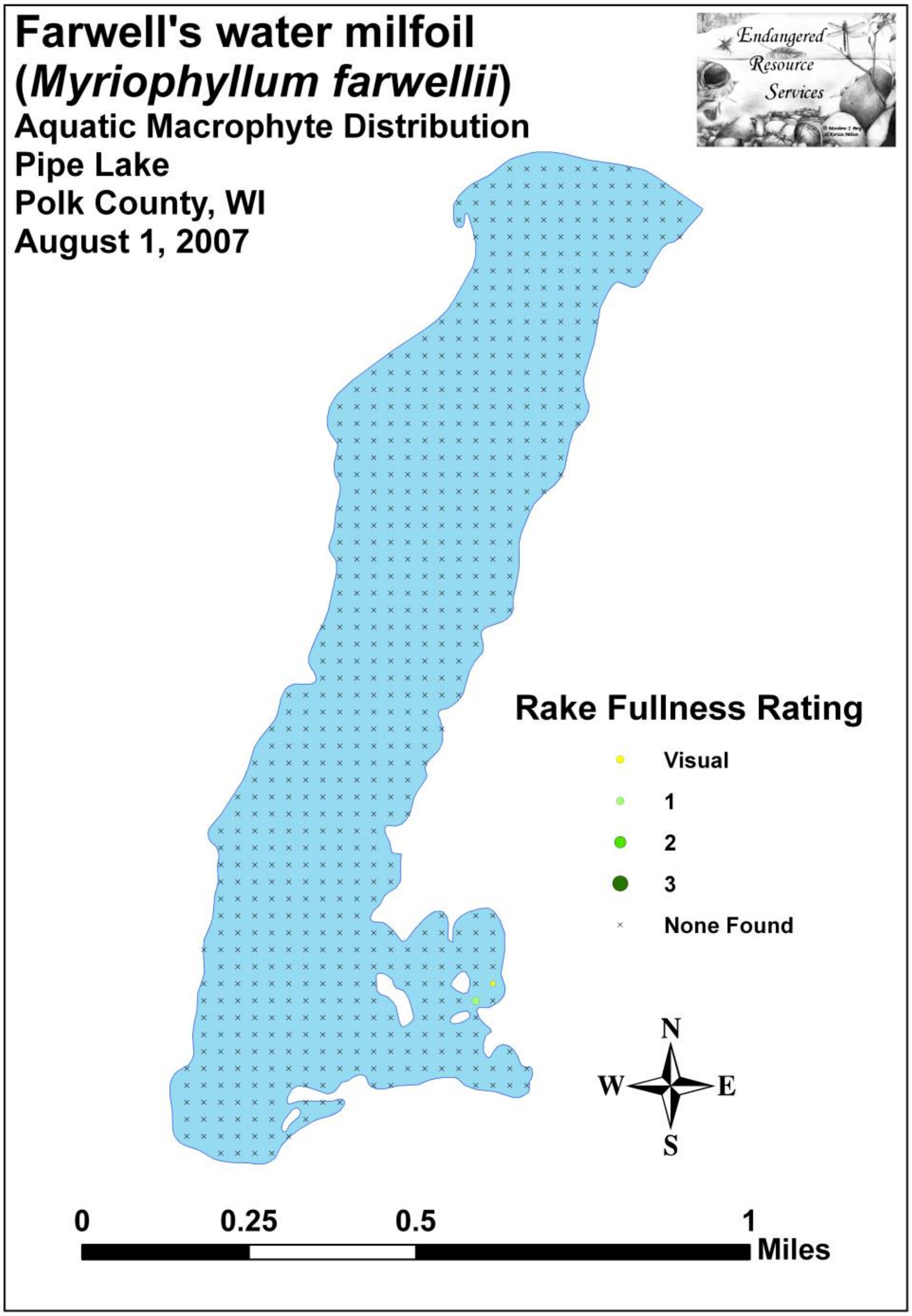
Farwell's water milfoil
(Myriophyllum farwellii)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
Rake Fullness Rating
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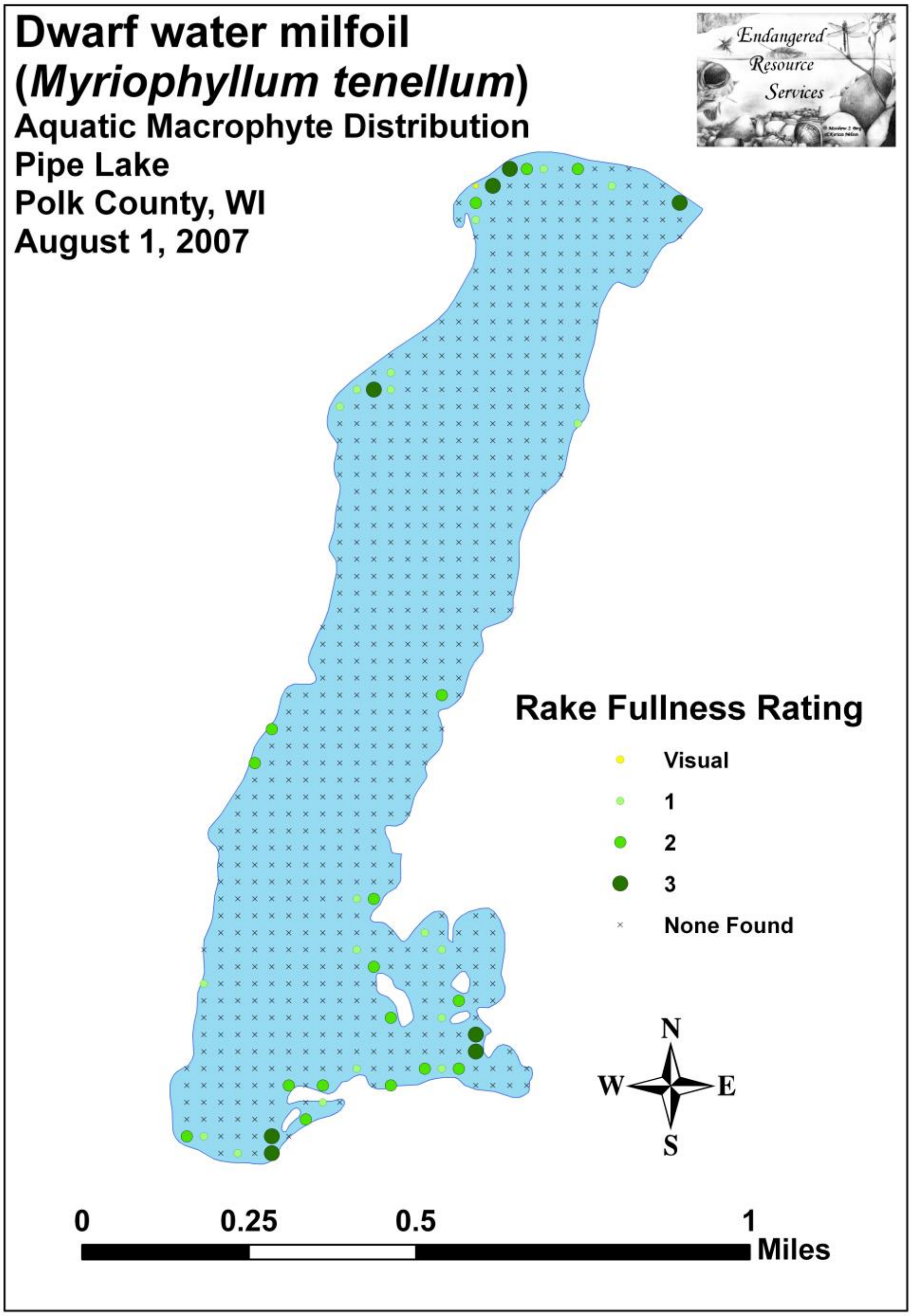
Dwarf water milfoil
(Myriophyllum tenellum)
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Polk County, WI
August 1, 2007
Endangered
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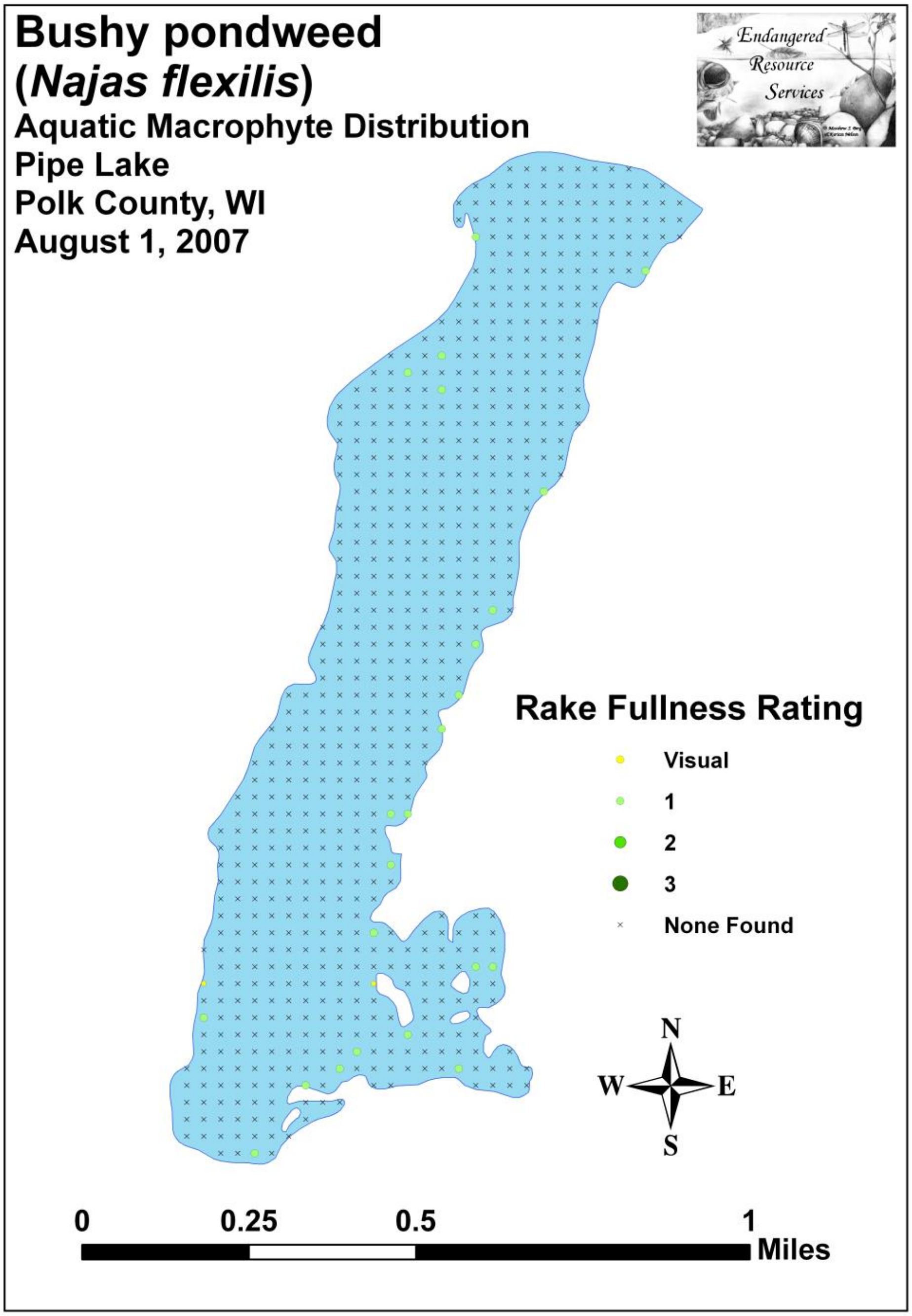
Bushy pondweed
(Najas flexilis)
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Pipe Lake
Polk County, WI
August 1, 2007
Endangered
Resource
Services
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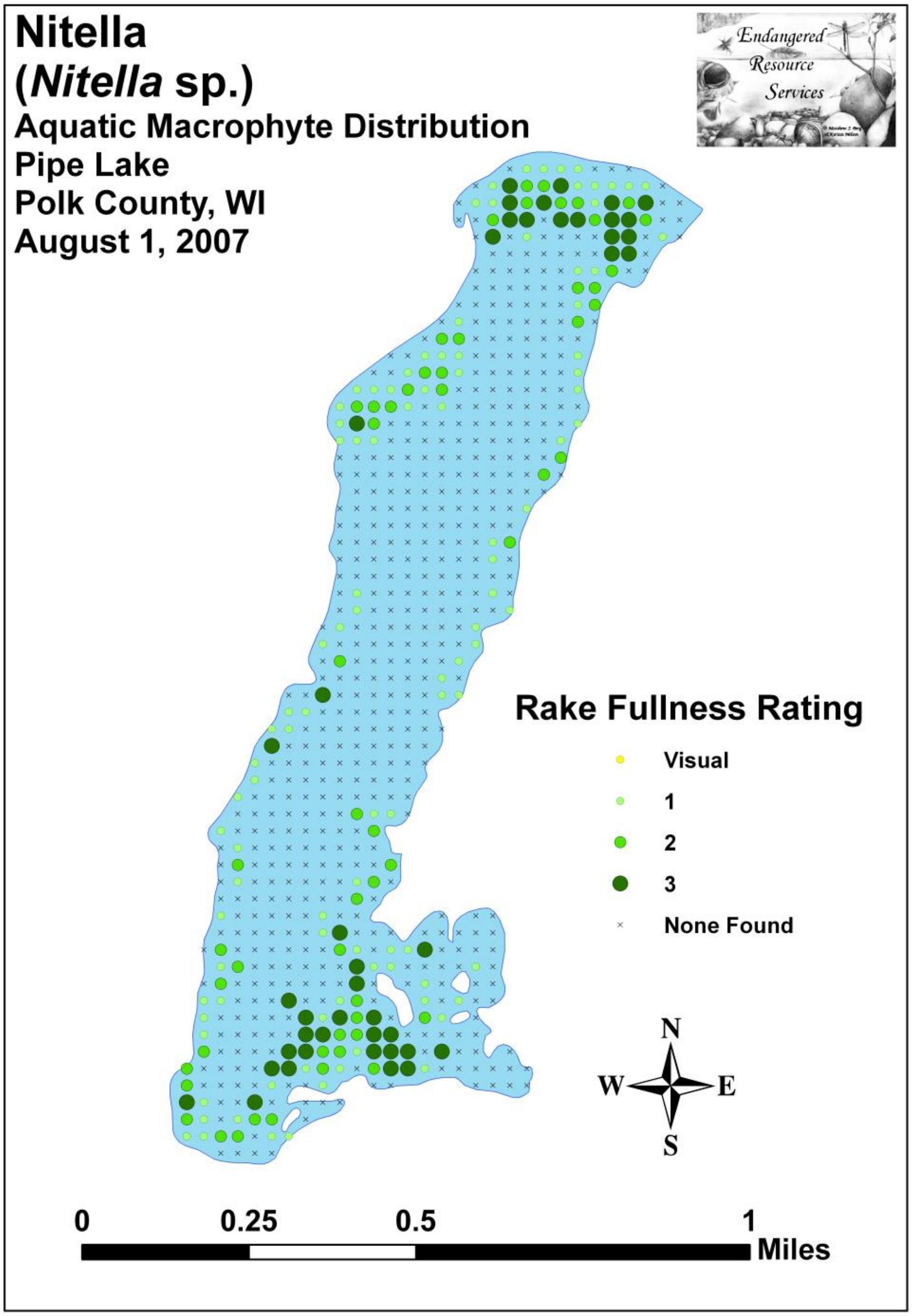

Nitella
(*Nitella* sp.)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
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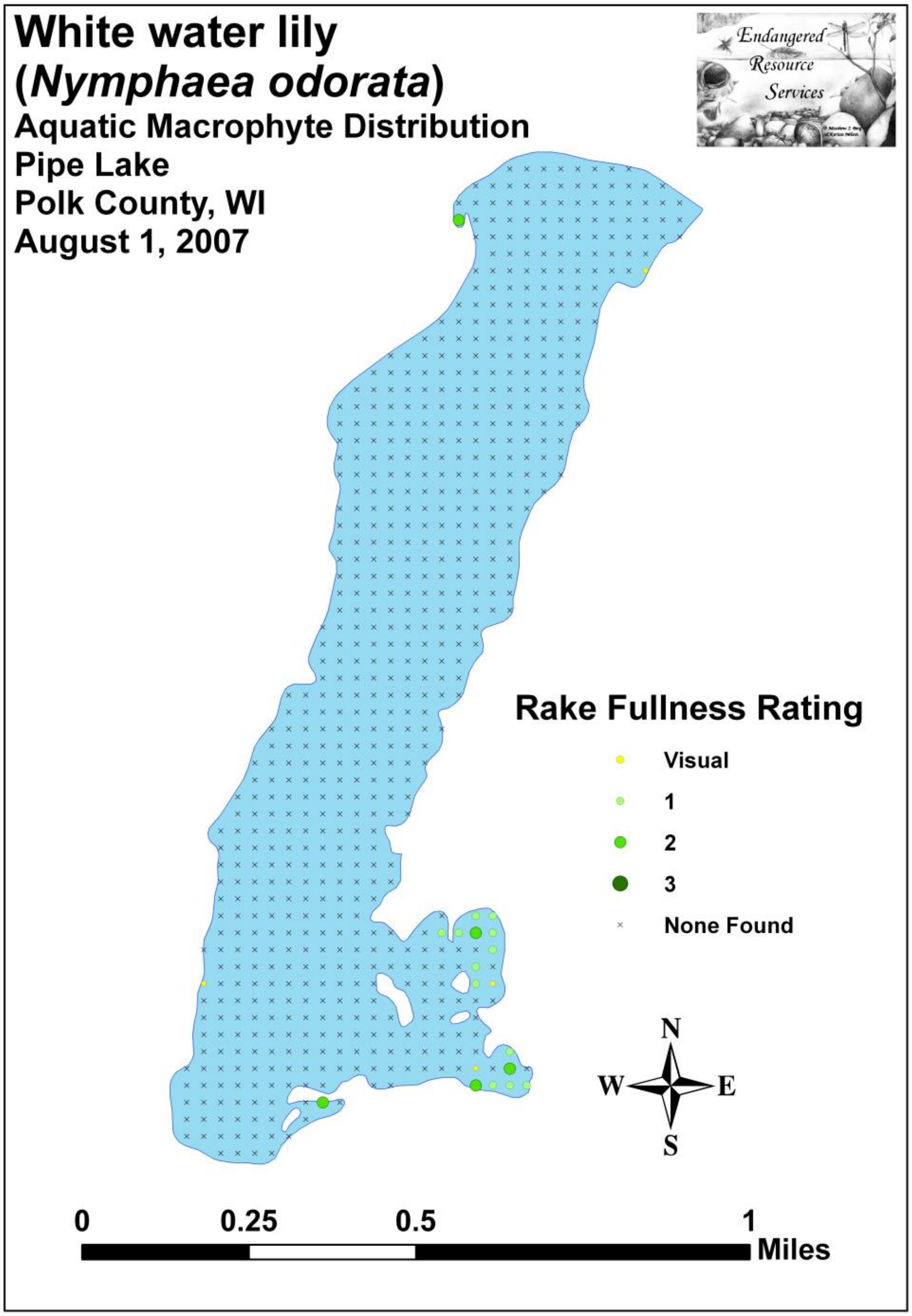
White water lily
(Nymphaea odorata)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
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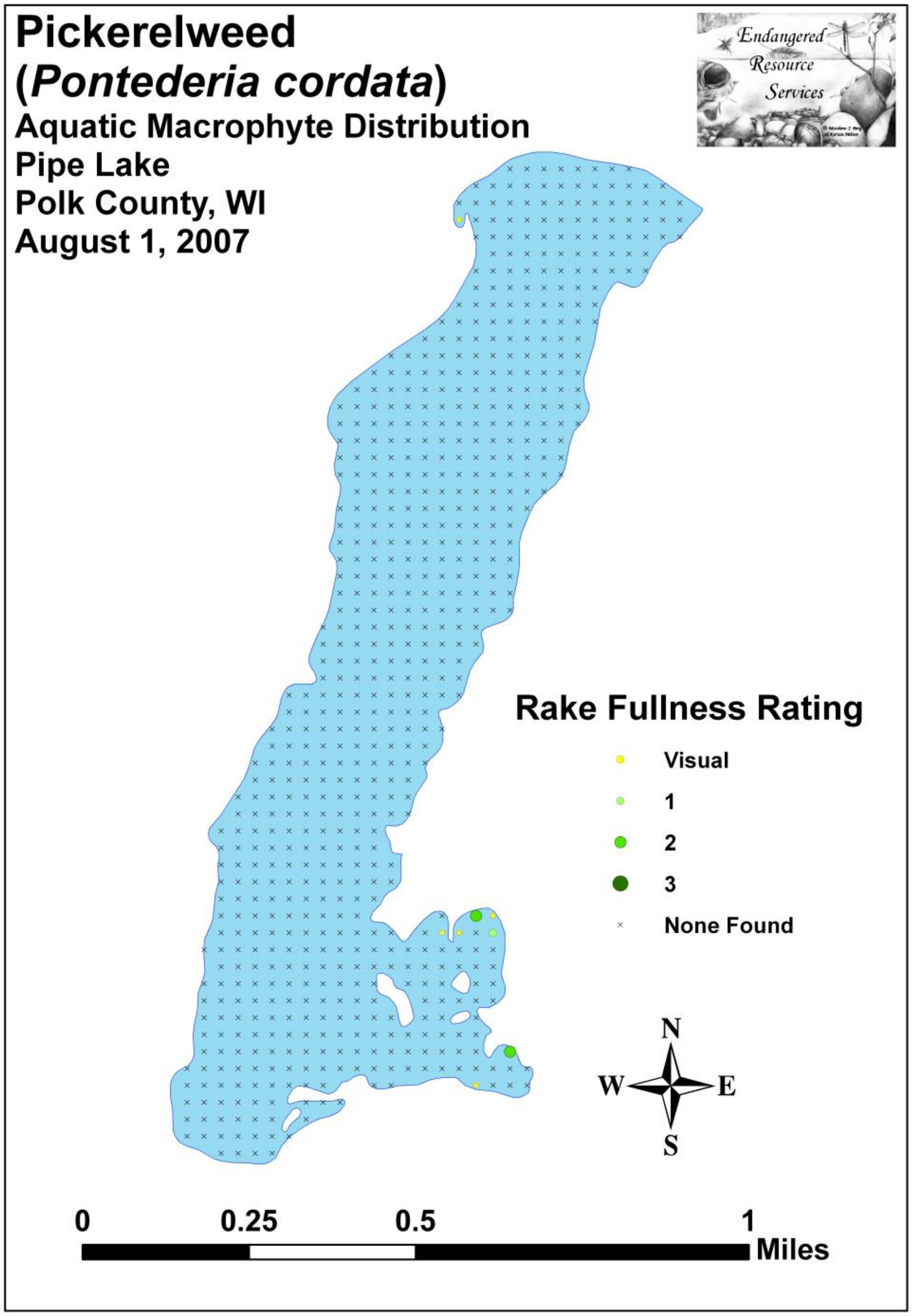

Pickerelweed
(*Pontederia cordata*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
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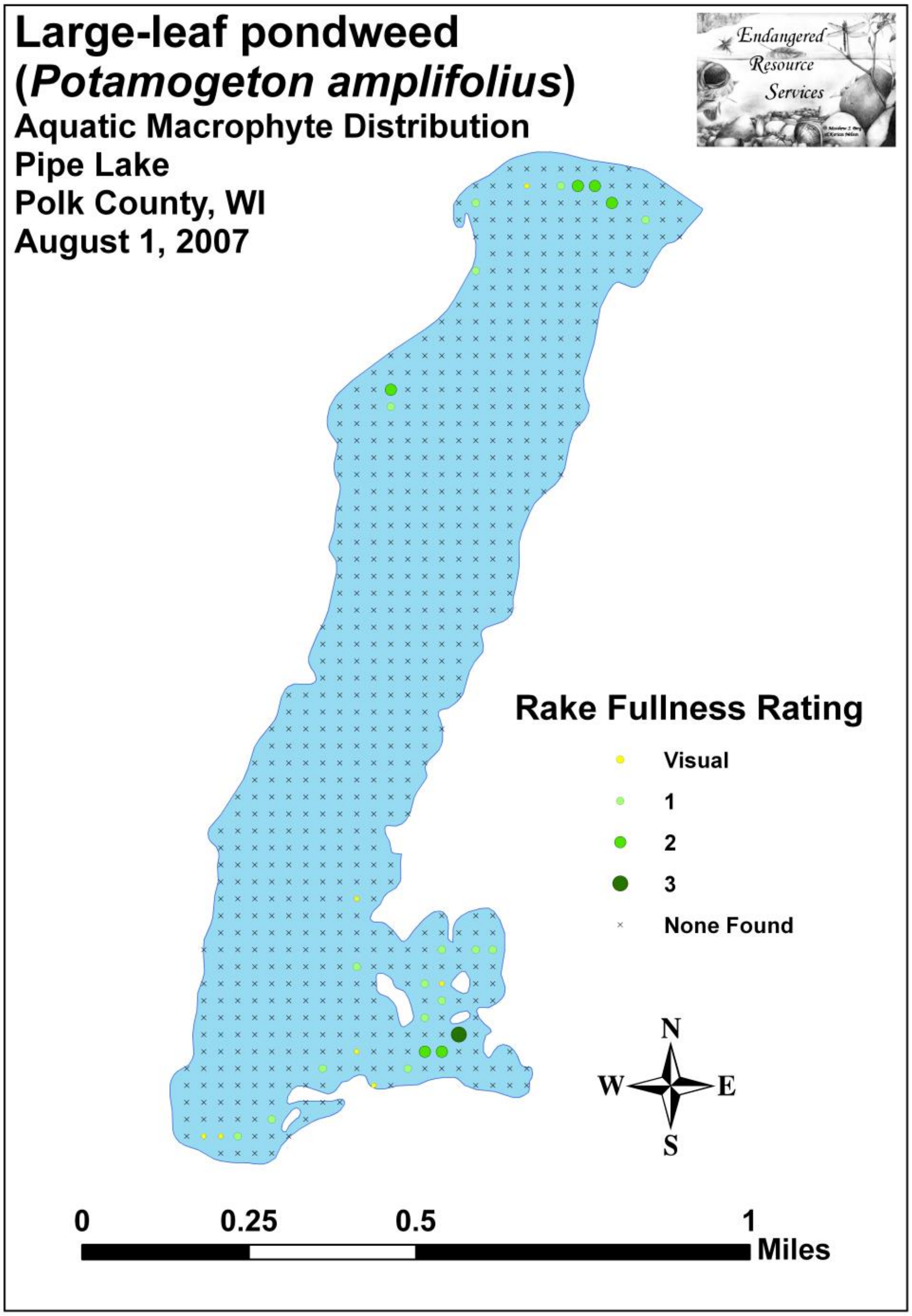
Large-leaf pondweed
(*Potamogeton amplifolius*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
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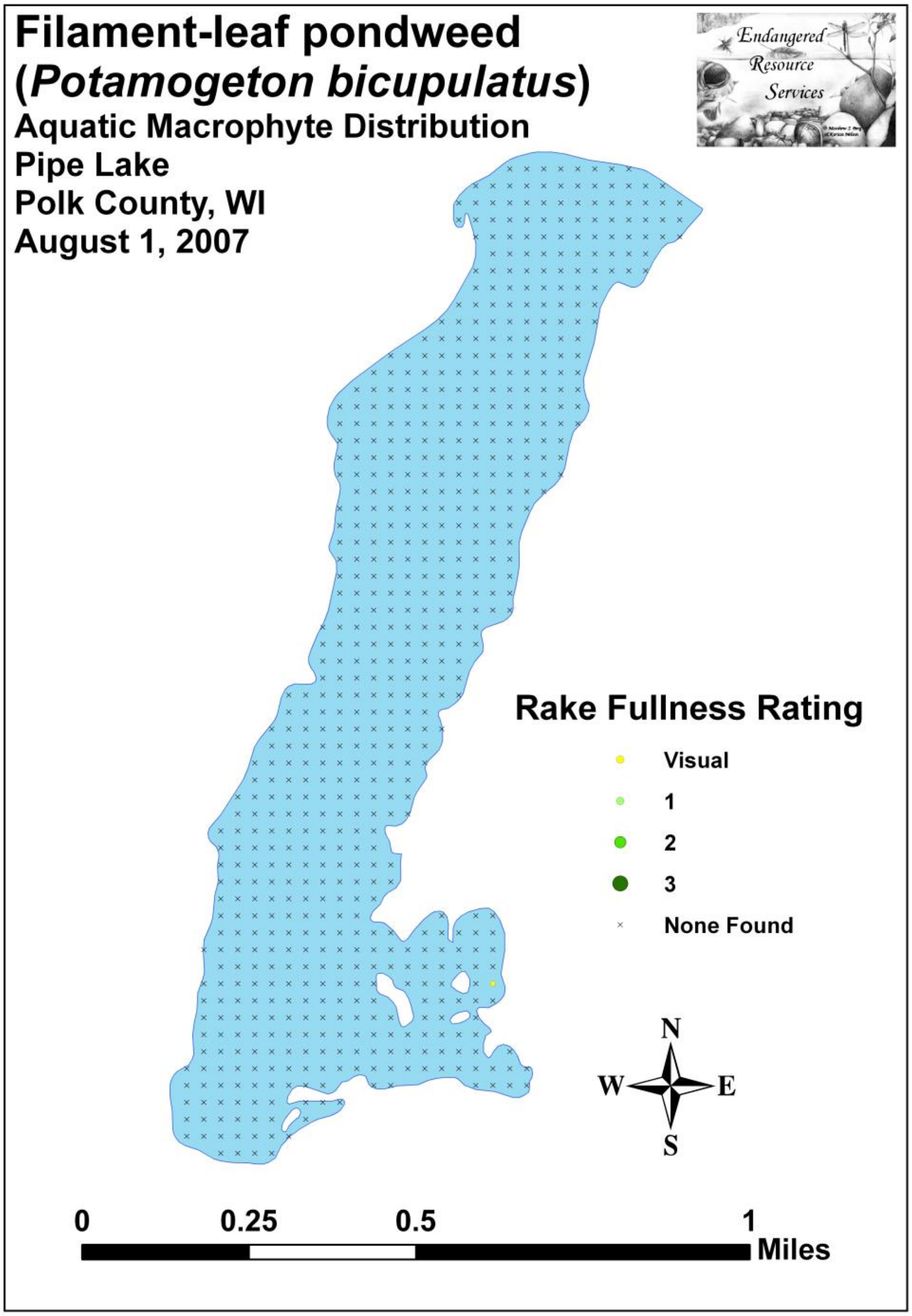

Filament-leaf pondweed
(*Potamogeton bicupulatus*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
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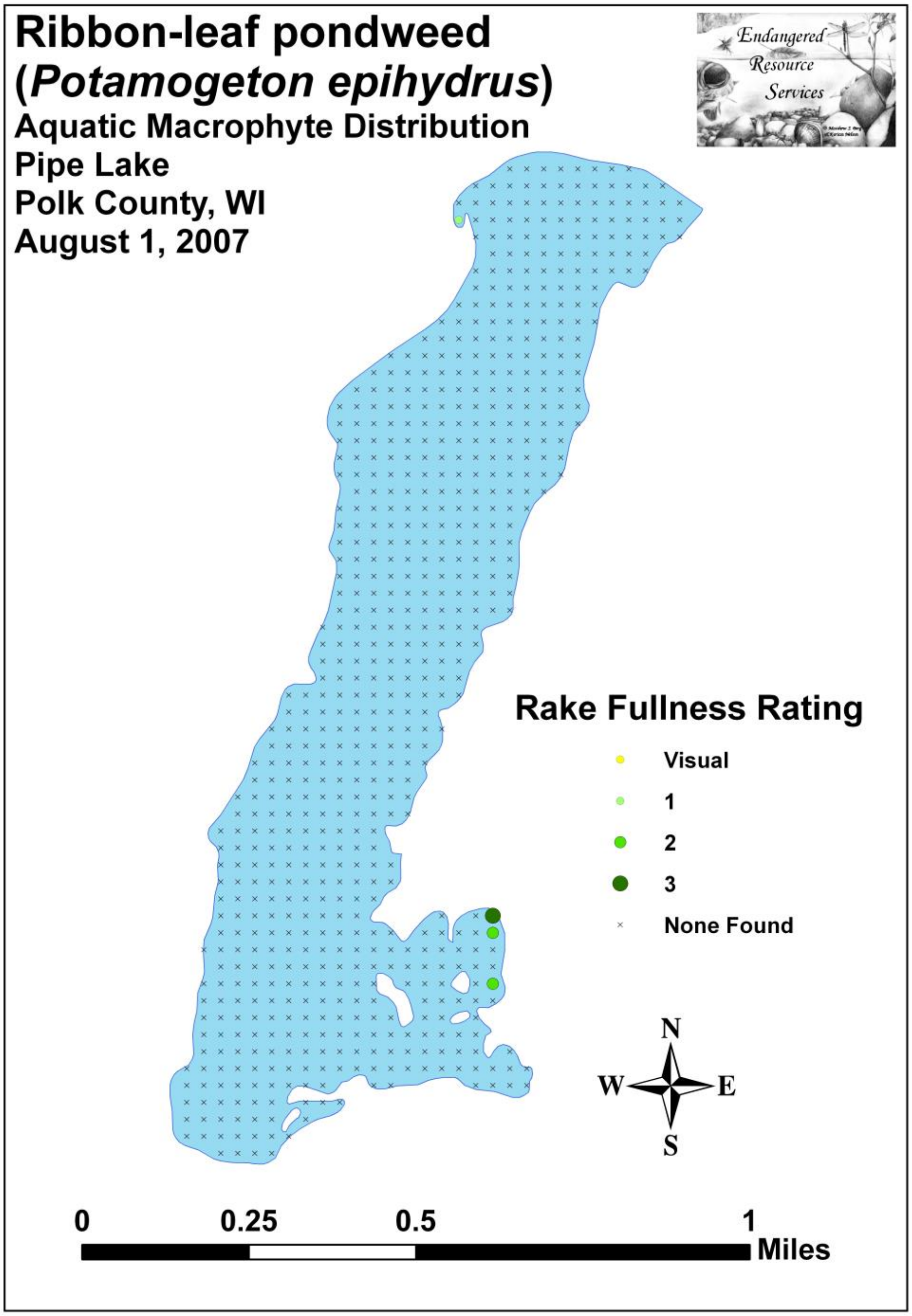
Ribbon-leaf pondweed
(*Potamogeton epihydrus*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered
Resource
Services
Rake Fullness Rating
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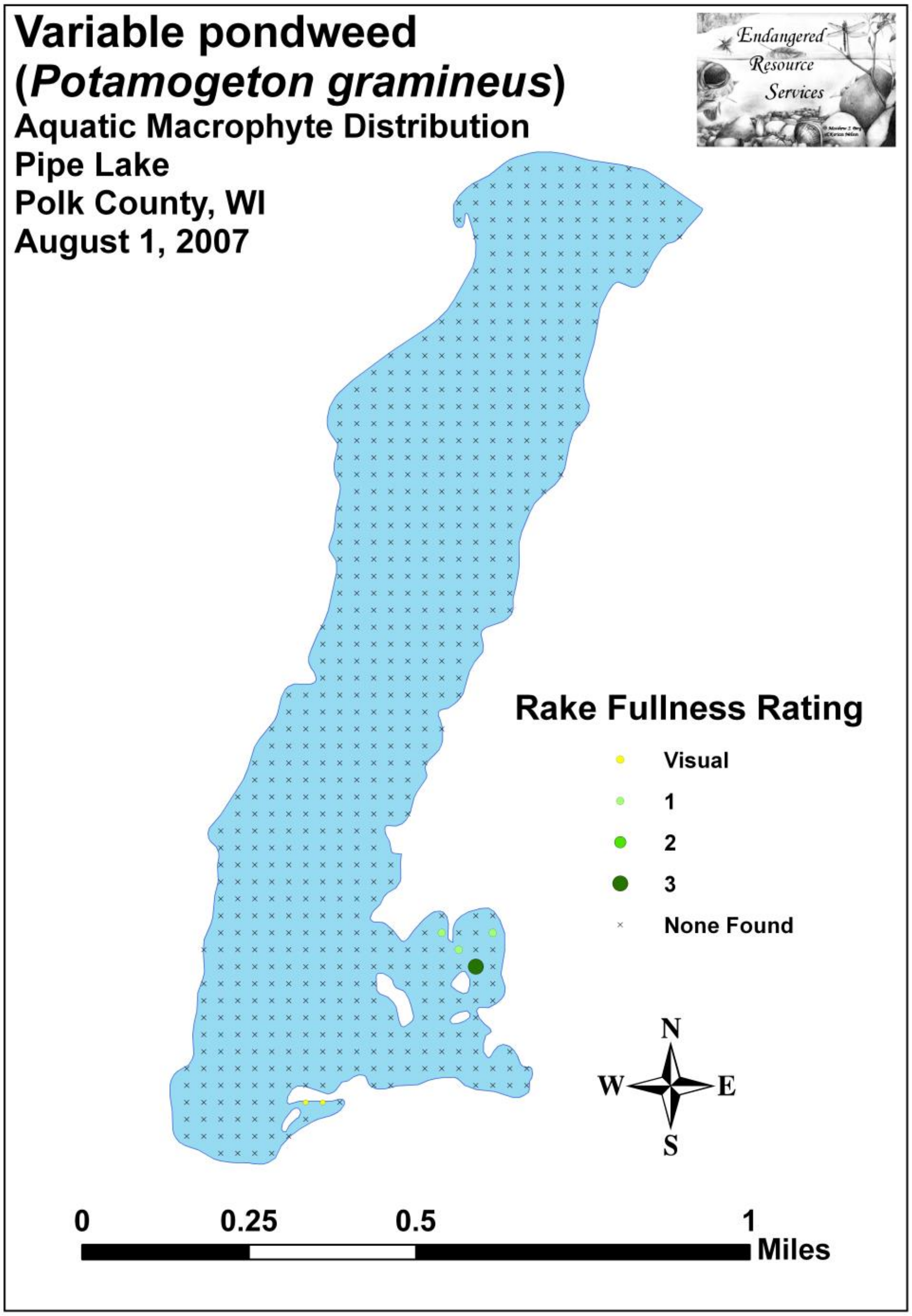
Variable pondweed
(*Potamogeton gramineus*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered
Resource
Services
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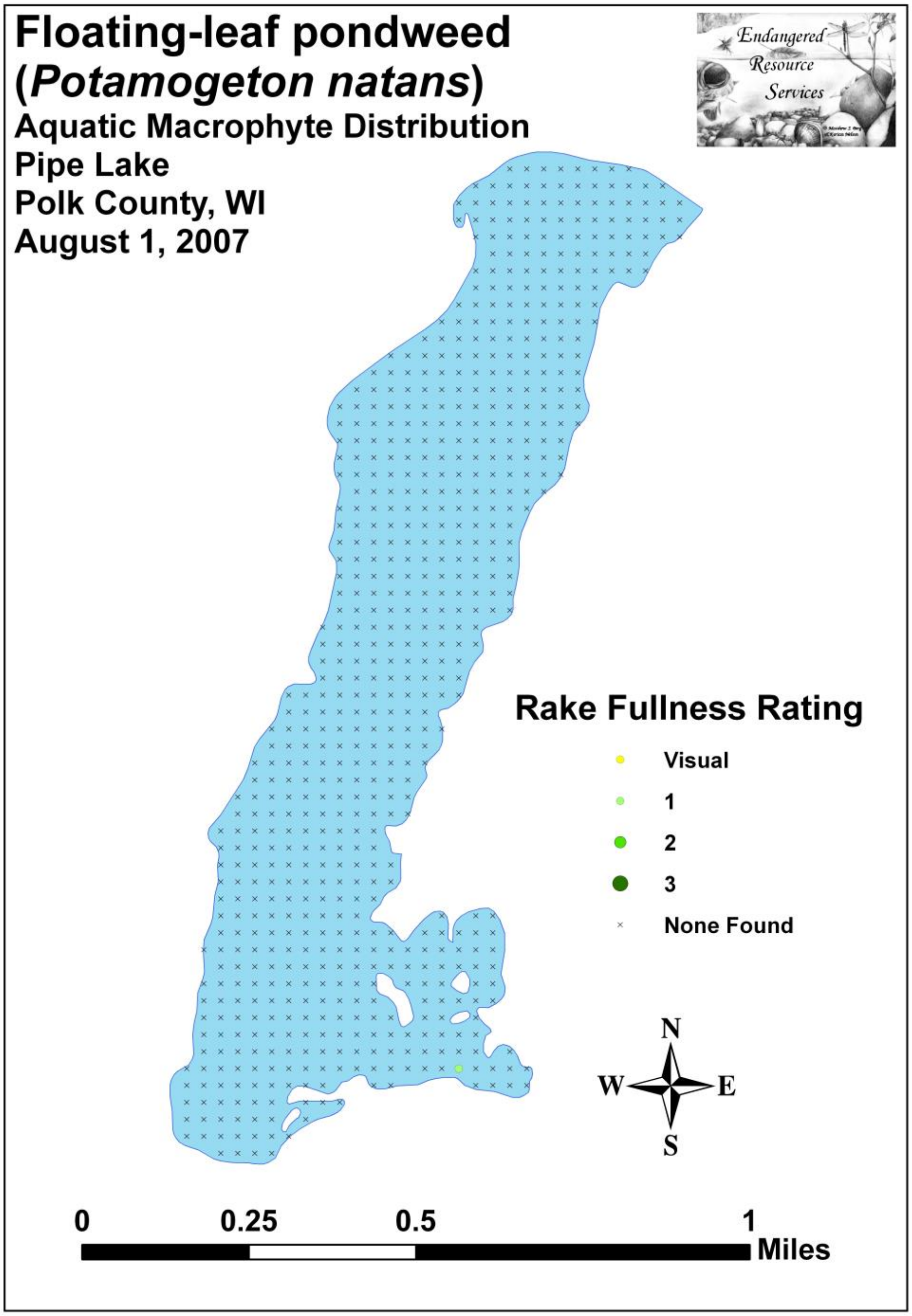
Floating-leaf pondweed
(Potamogeton natans)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
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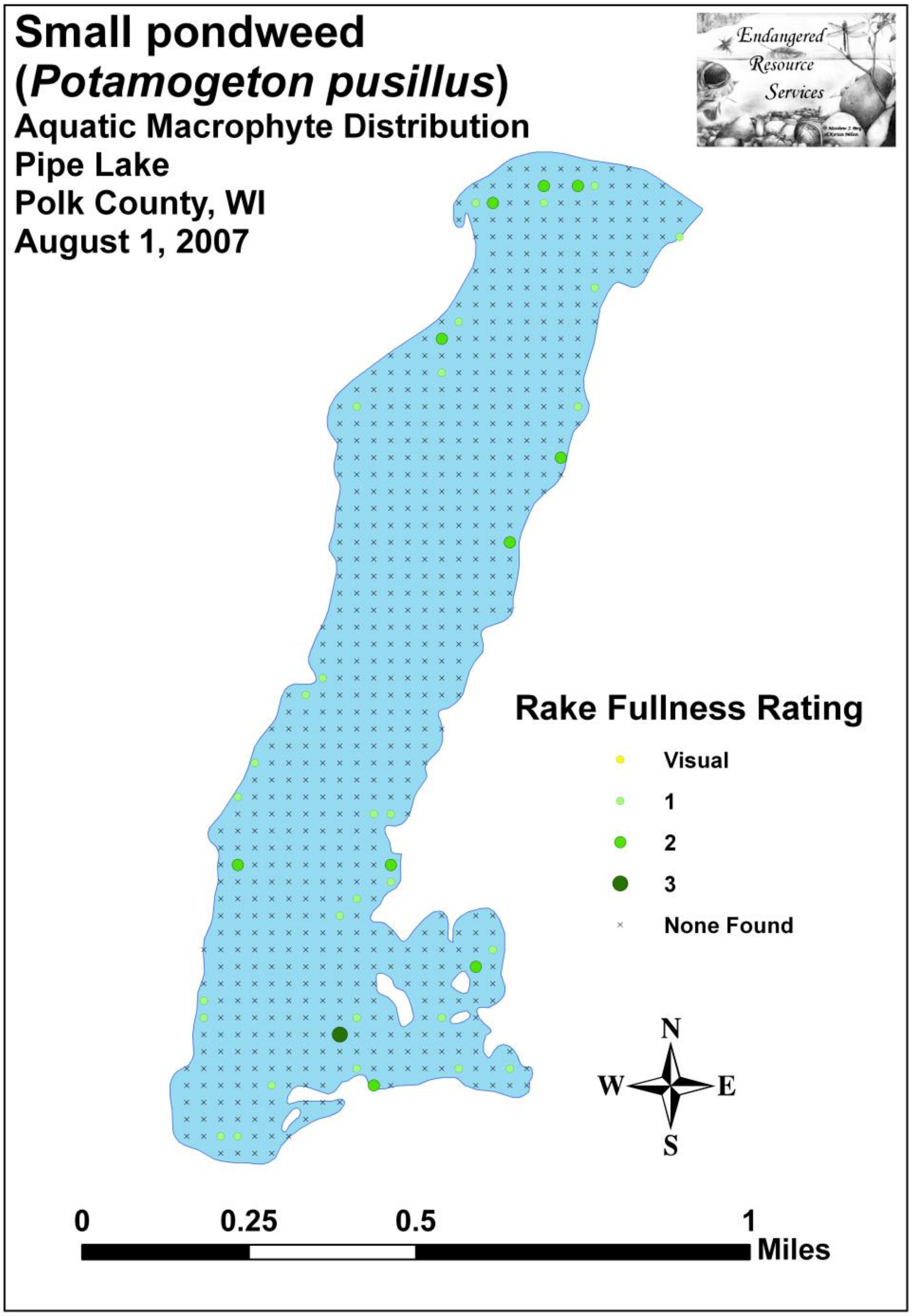
Small pondweed
(Potamogeton pusillus)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
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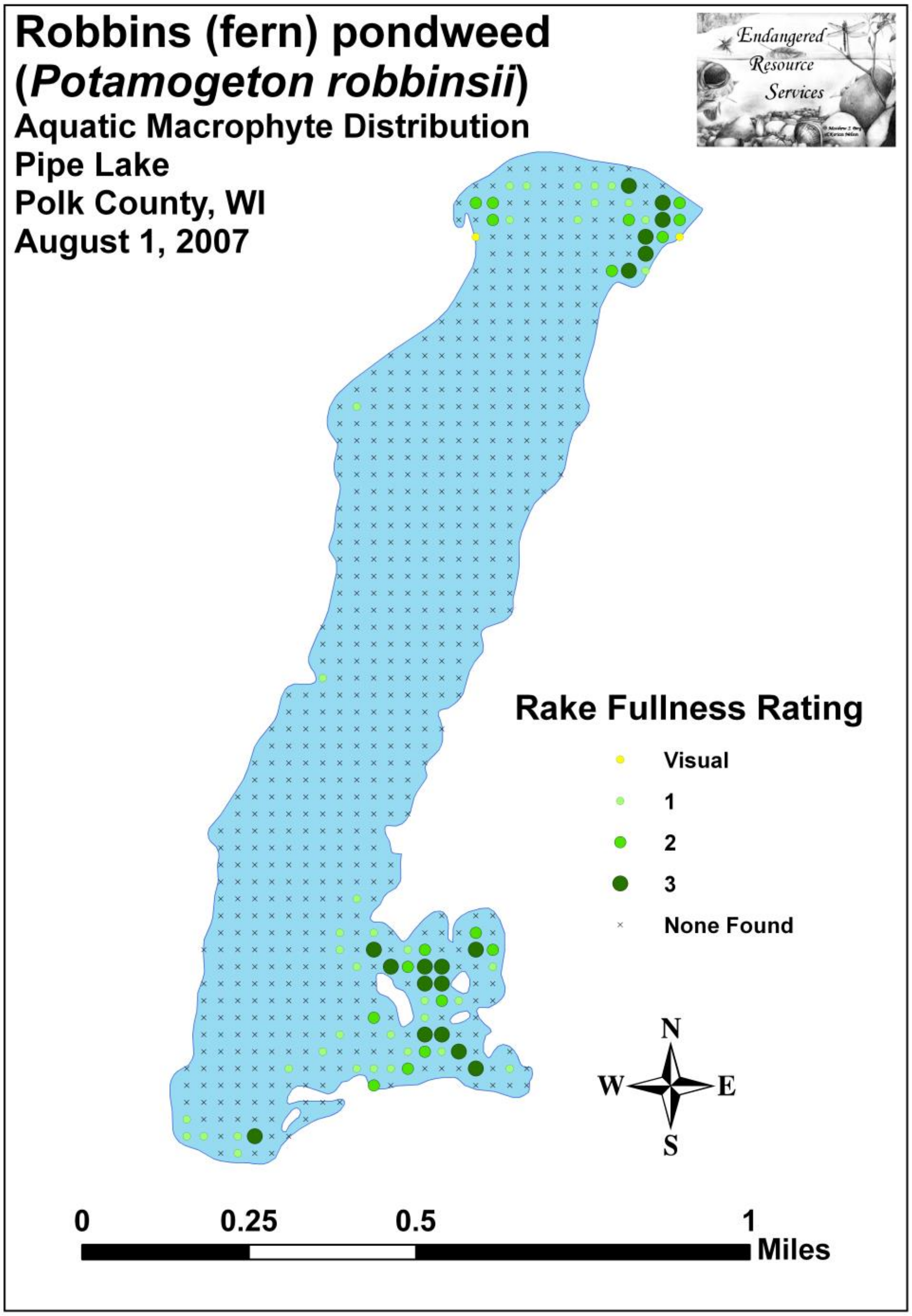
Robbins (fern) pondweed
(Potamogeton robbinsii)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
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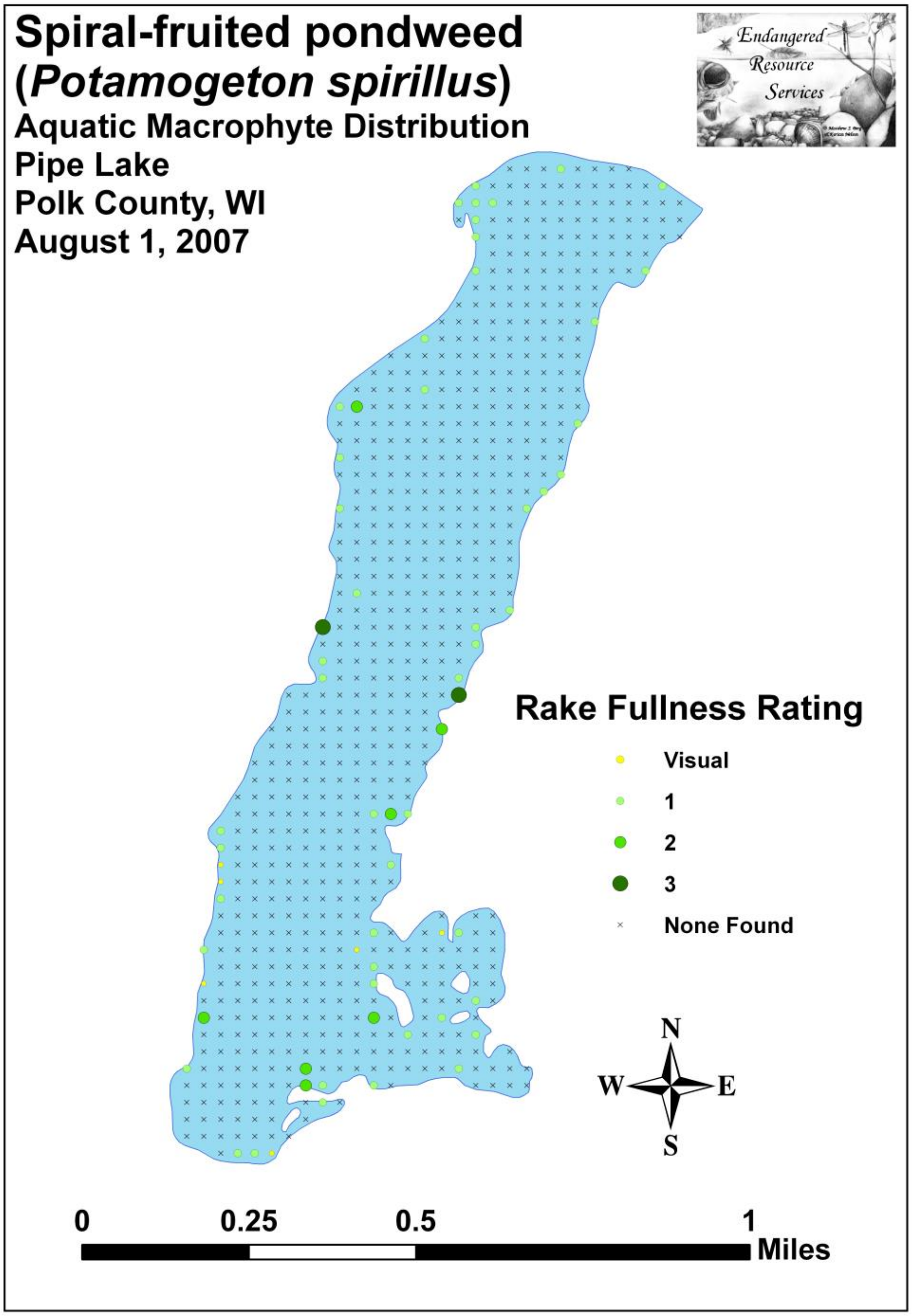
Spiral-fruited pondweed
(Potamogeton spirillus)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered
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Rake Fullness Rating
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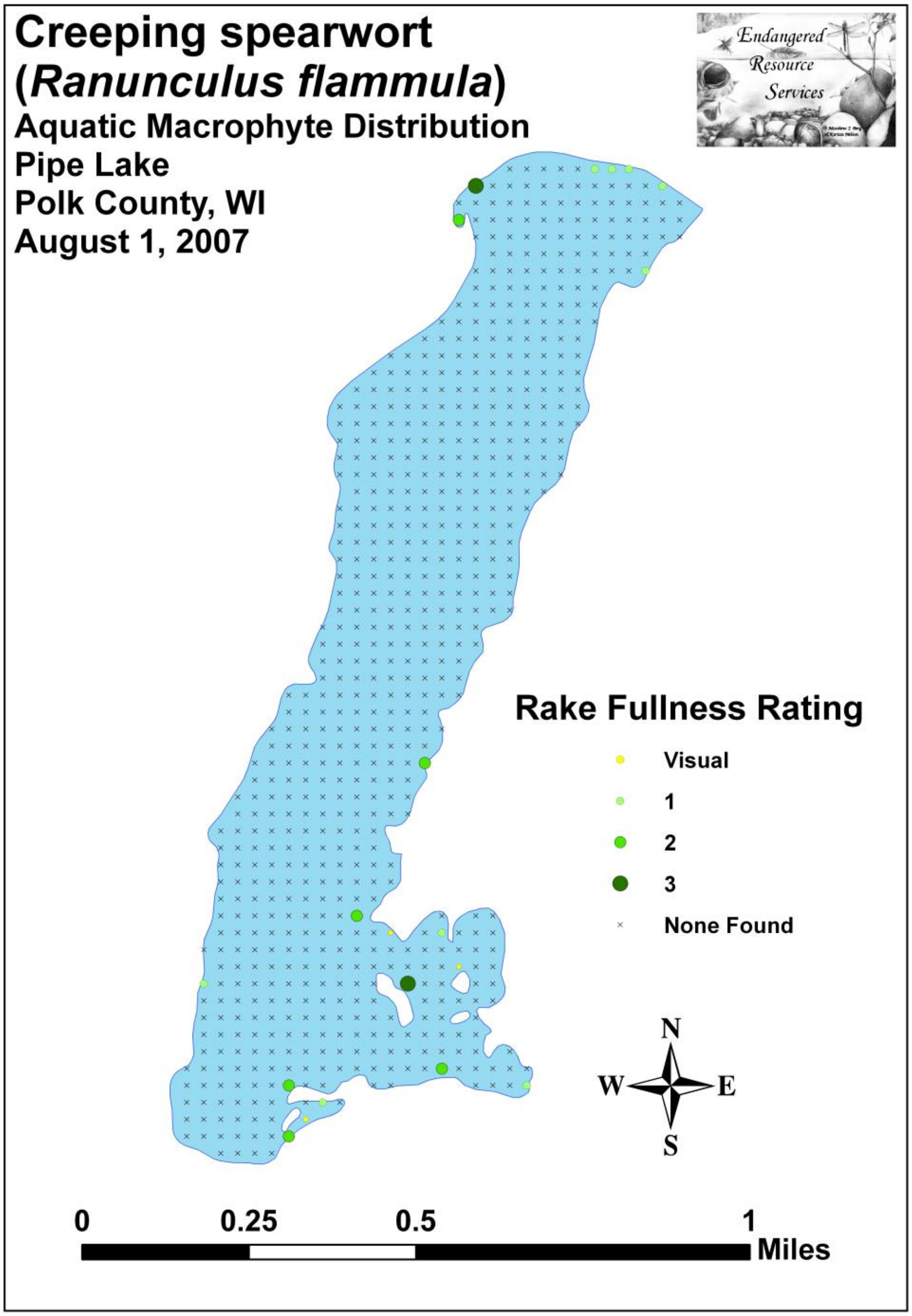
Creeping spearwort
(Ranunculus flammula)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
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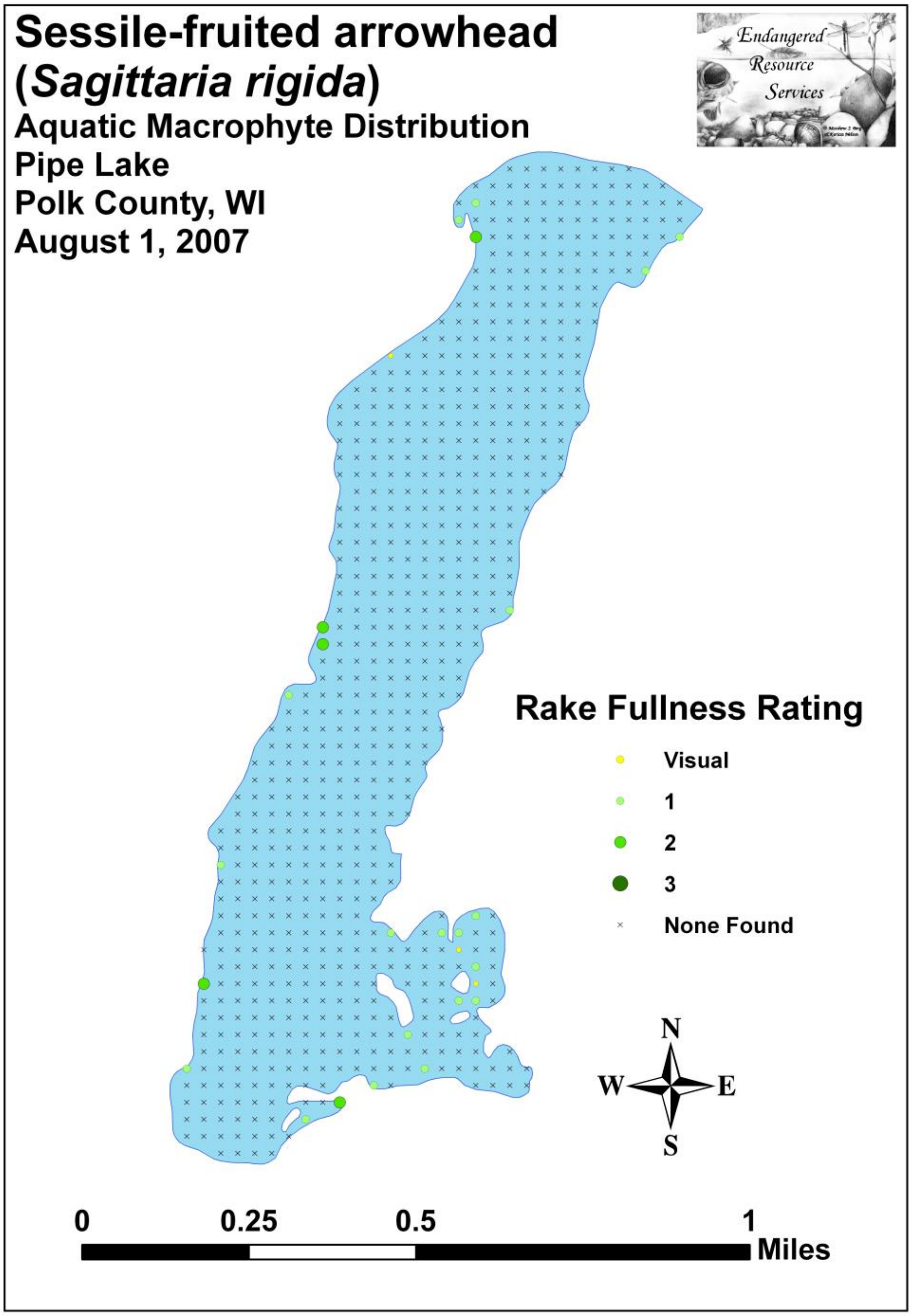
Sessile-fruited arrowhead
(*Sagittaria rigida*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered
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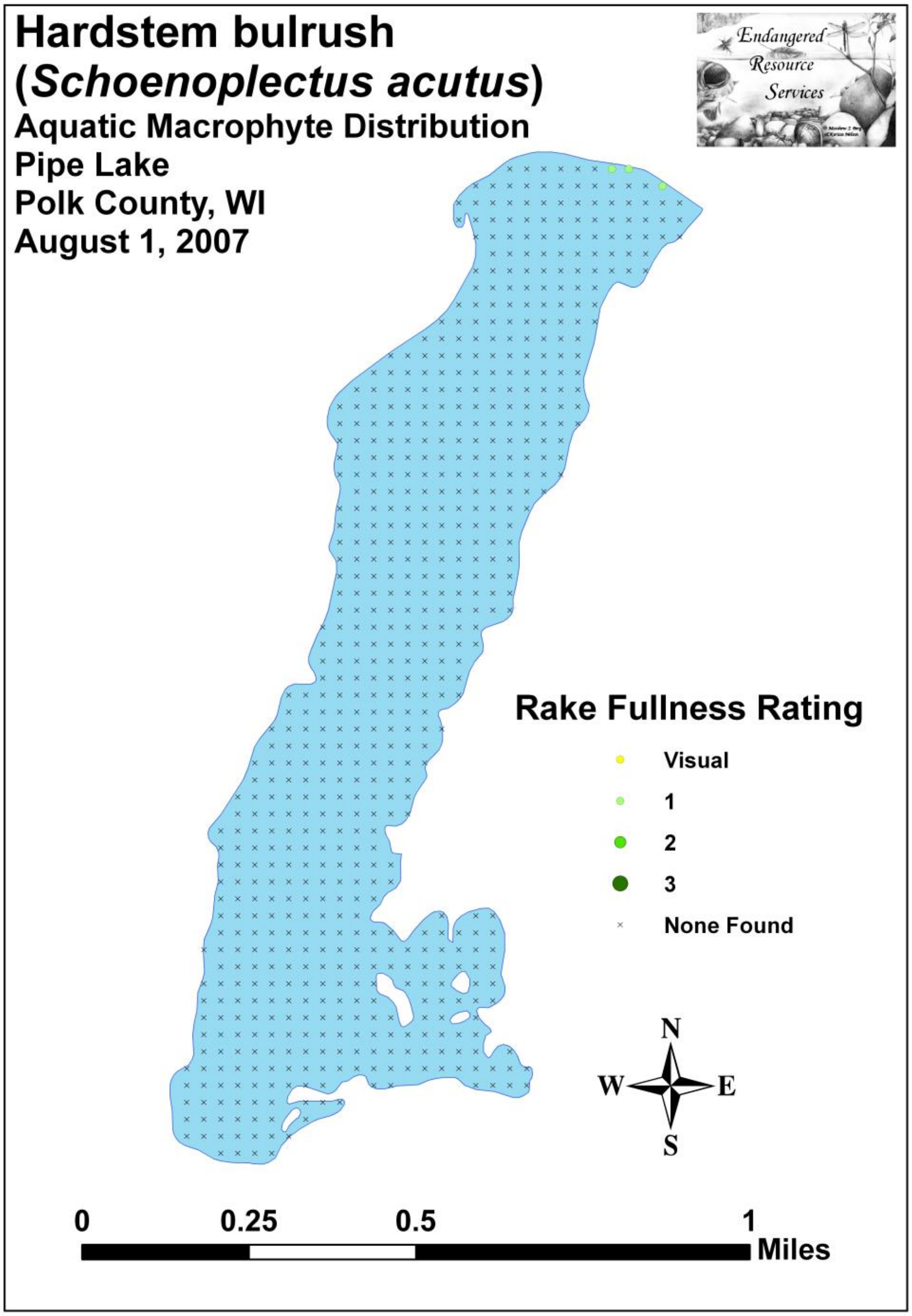

Hardstem bulrush
(*Schoenoplectus acutus*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered
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Rake Fullness Rating
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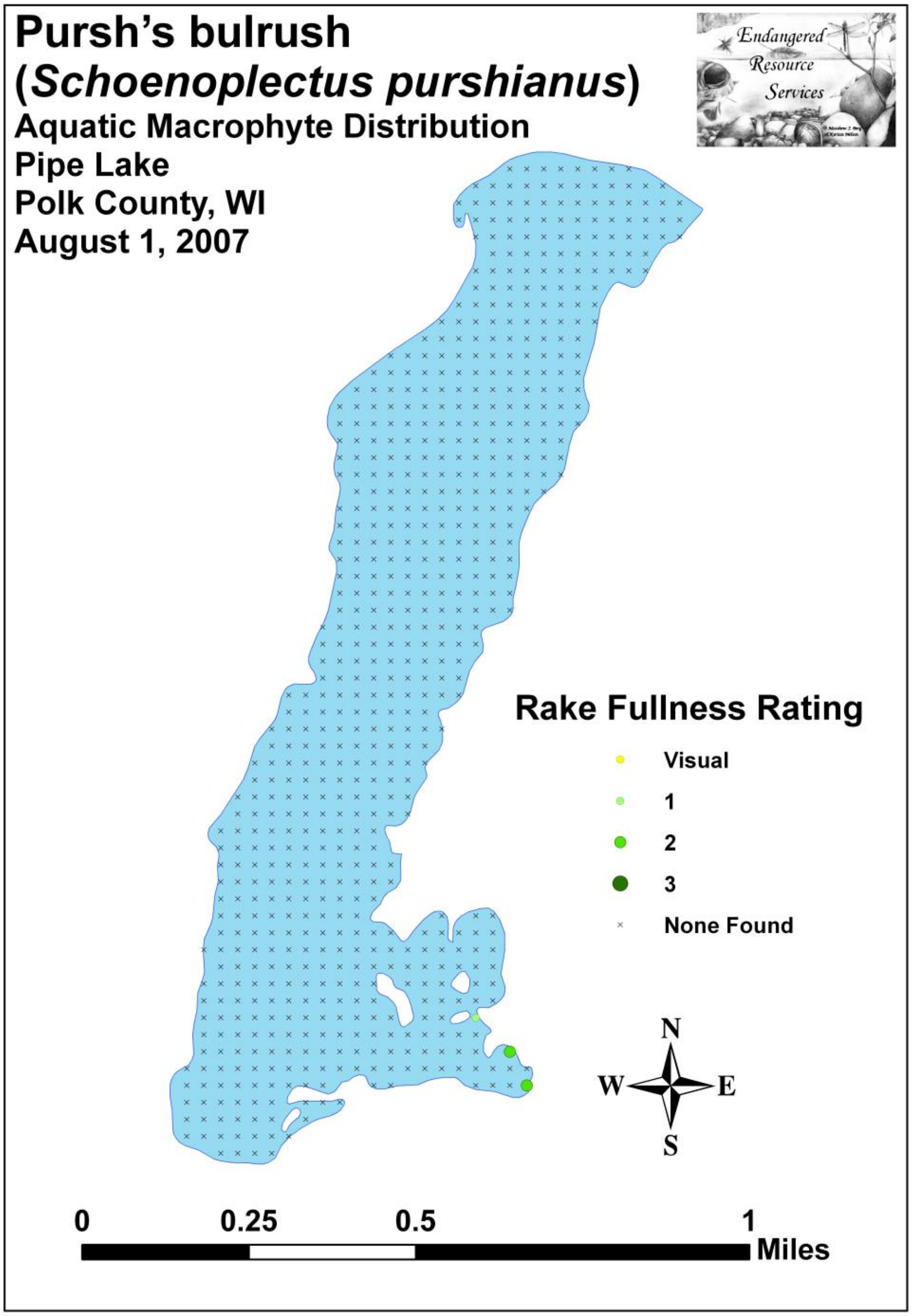
Pursh's bulrush
(*Schoenoplectus purshianus*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
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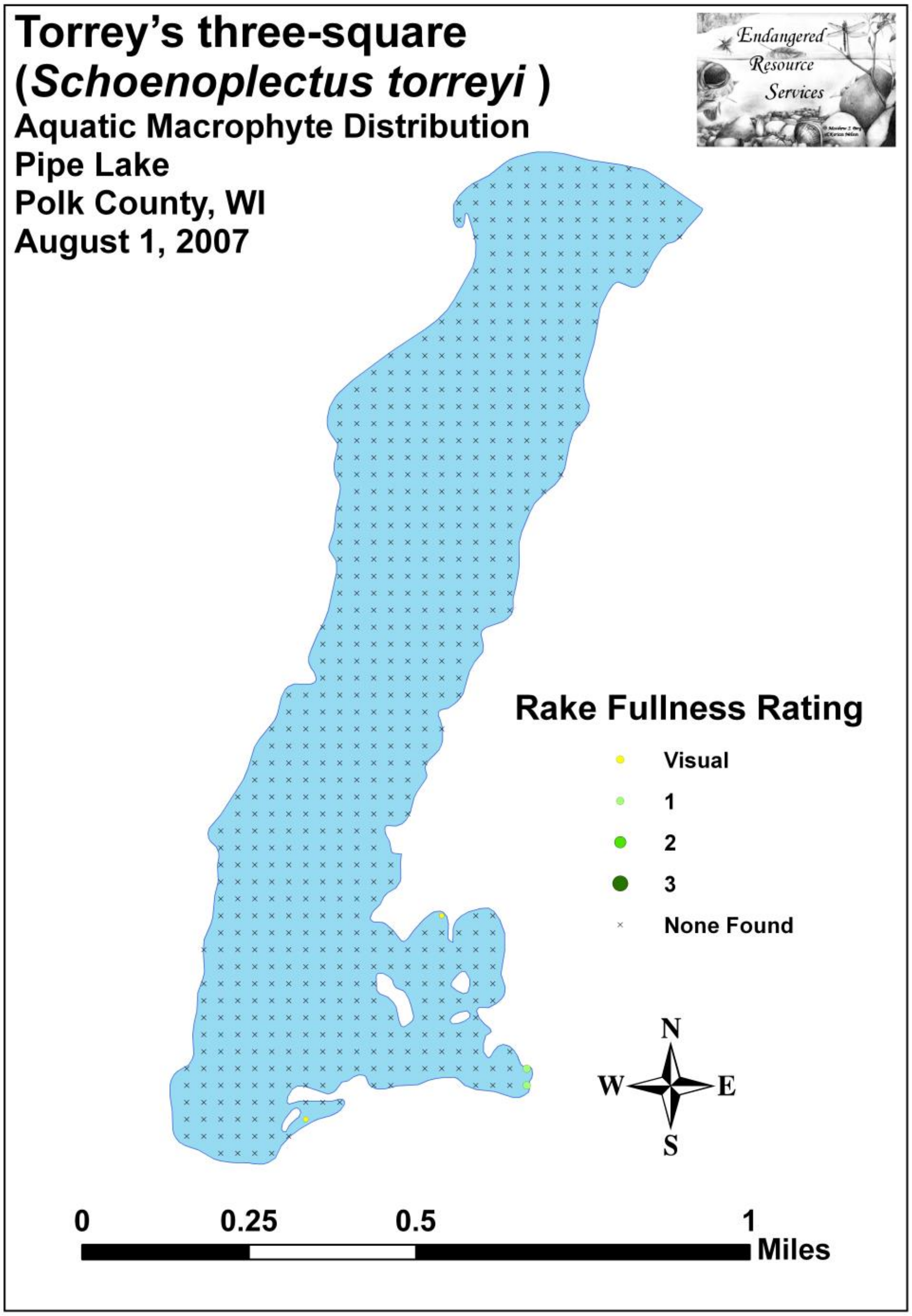
Torrey's three-square
(Schoenoplectus torreyi)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered
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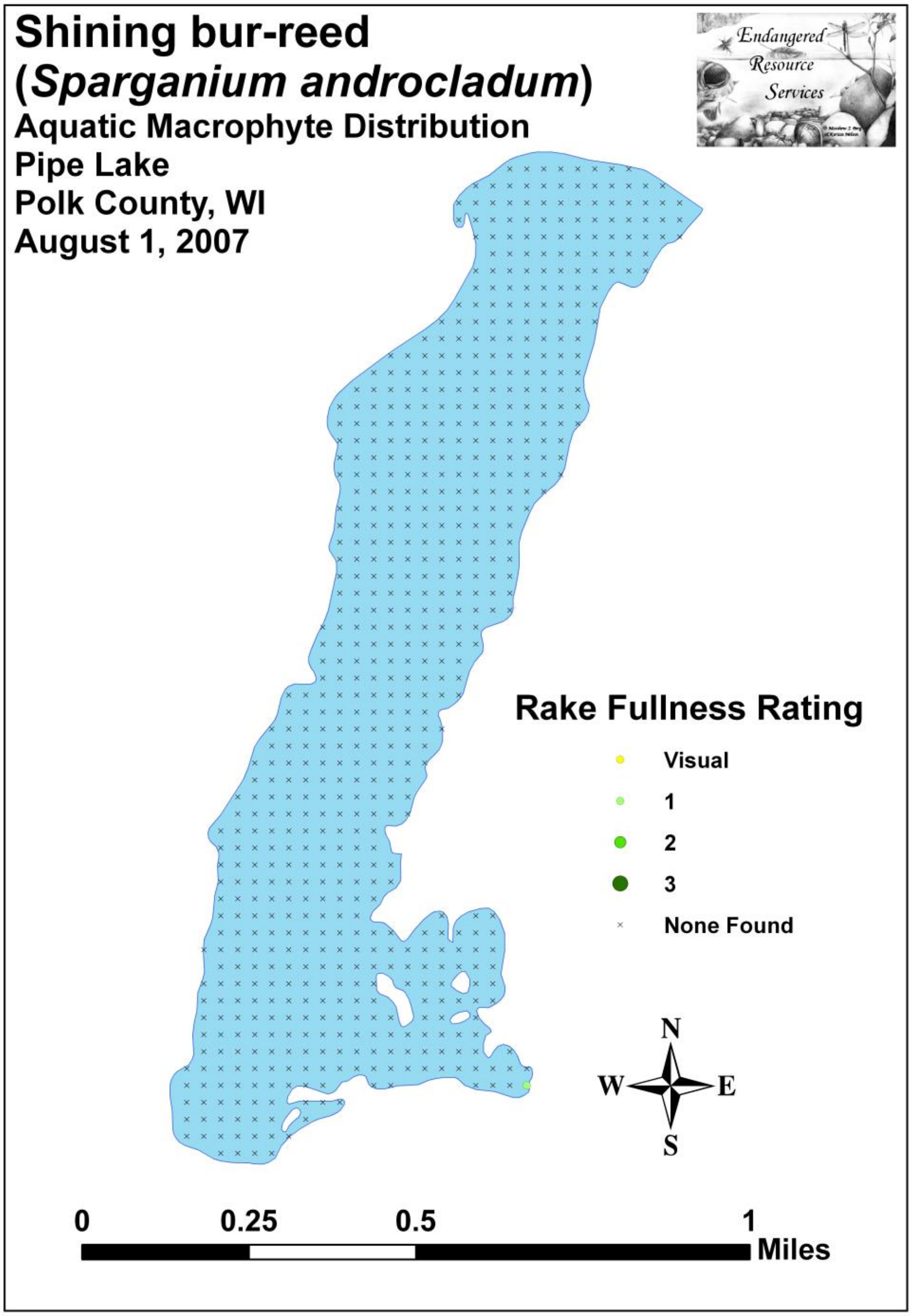
Shining bur-reed
(Sparganium androcladum)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
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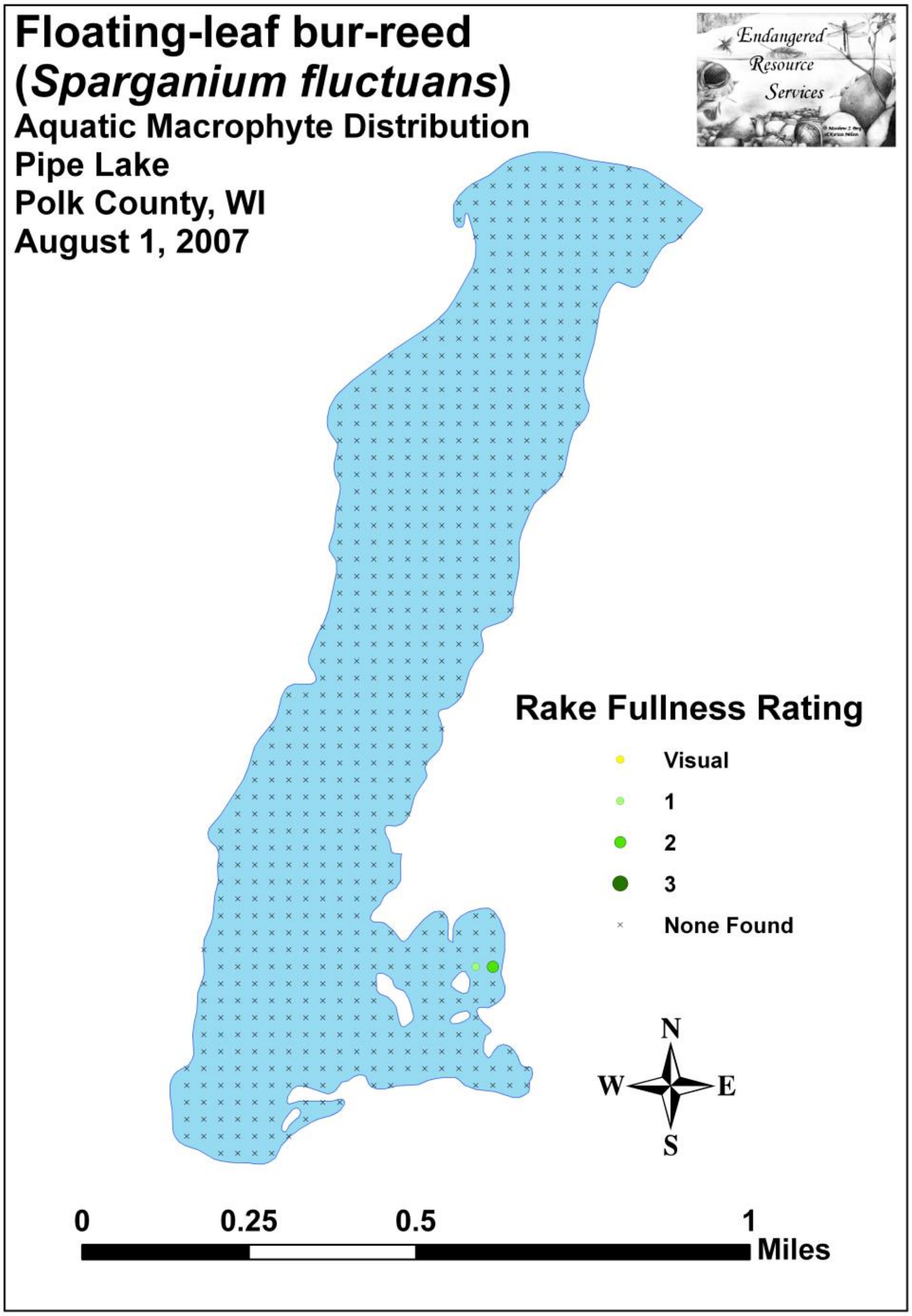
Floating-leaf bur-reed
(Sparganium fluctuans)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered
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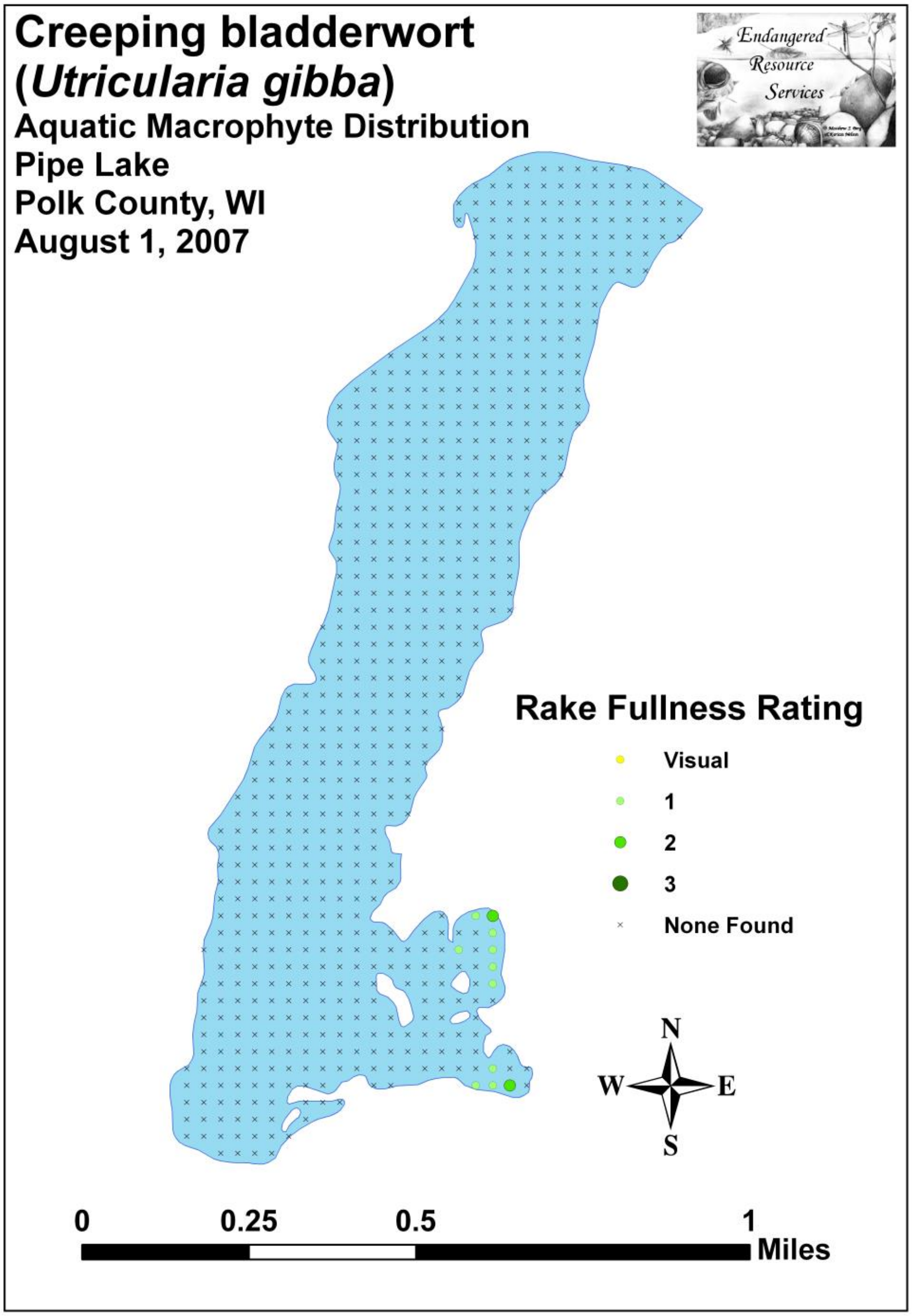
Creeping bladderwort
(Utricularia gibba)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered
Resource
Services
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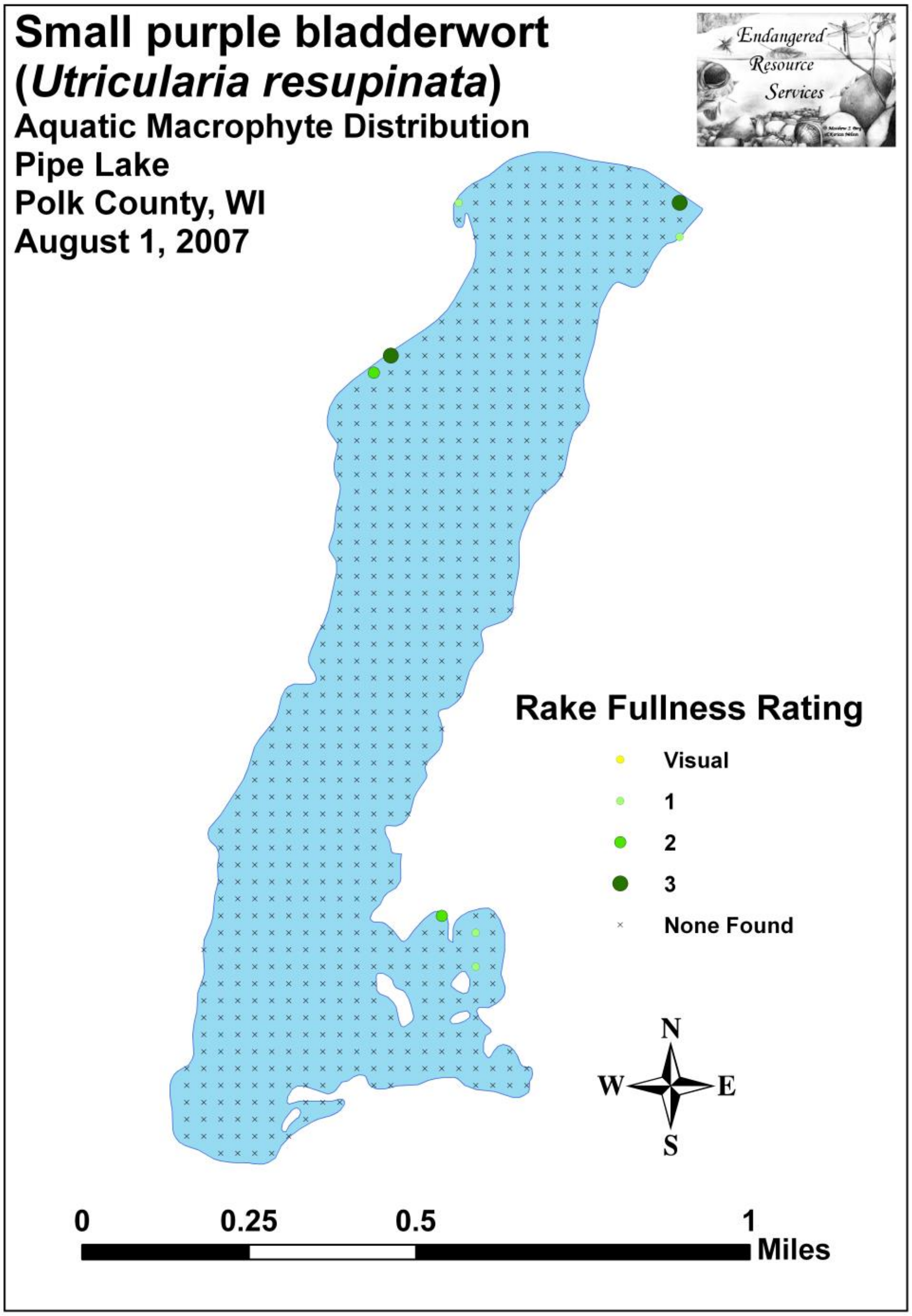
Small purple bladderwort
(*Utricularia resupinata*)
Aquatic Macrophyte Distribution
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Polk County, WI
August 1, 2007
Endangered Resource Services
Rake Fullness Rating
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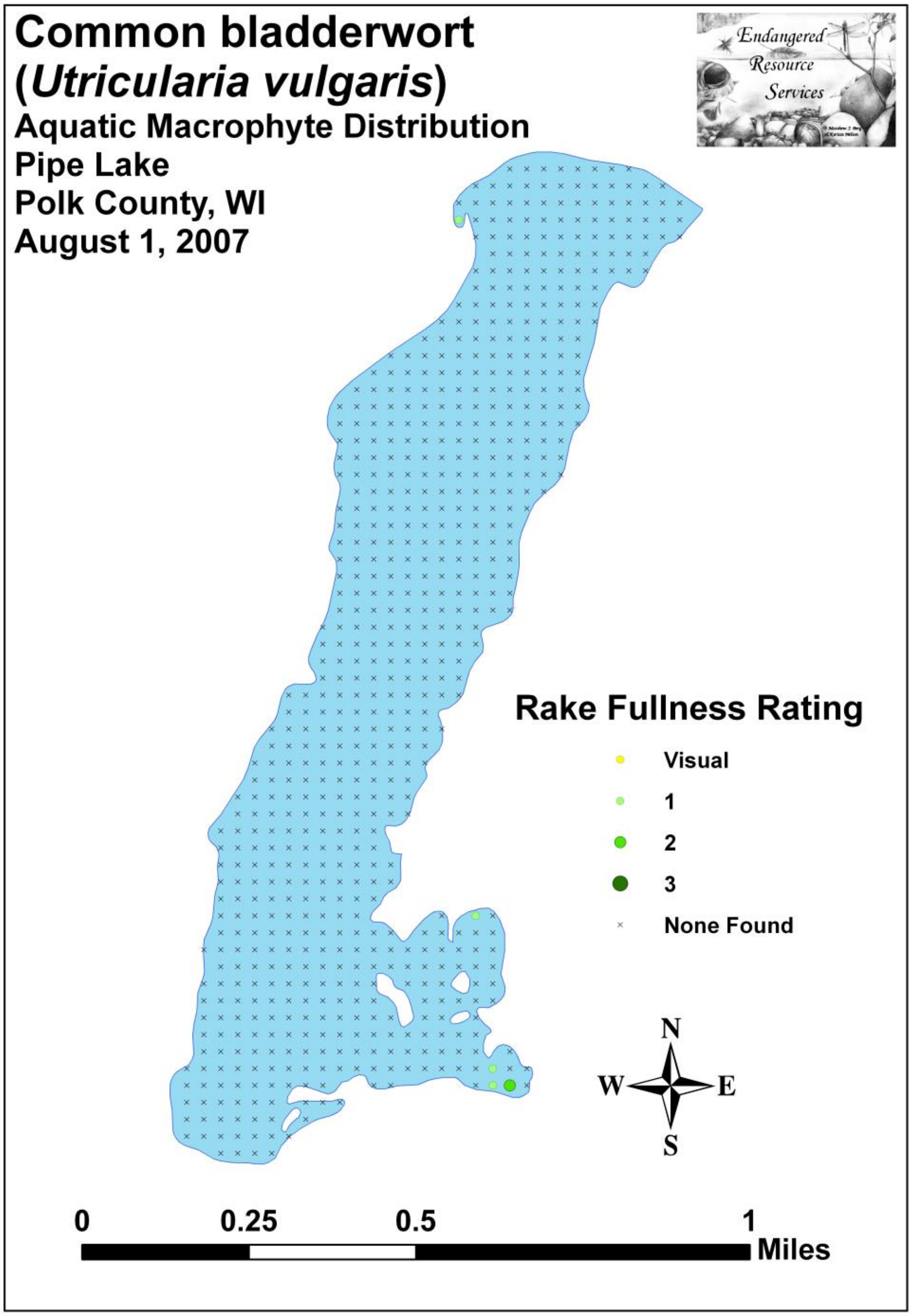
Common bladderwort
(*Utricularia vulgaris*)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
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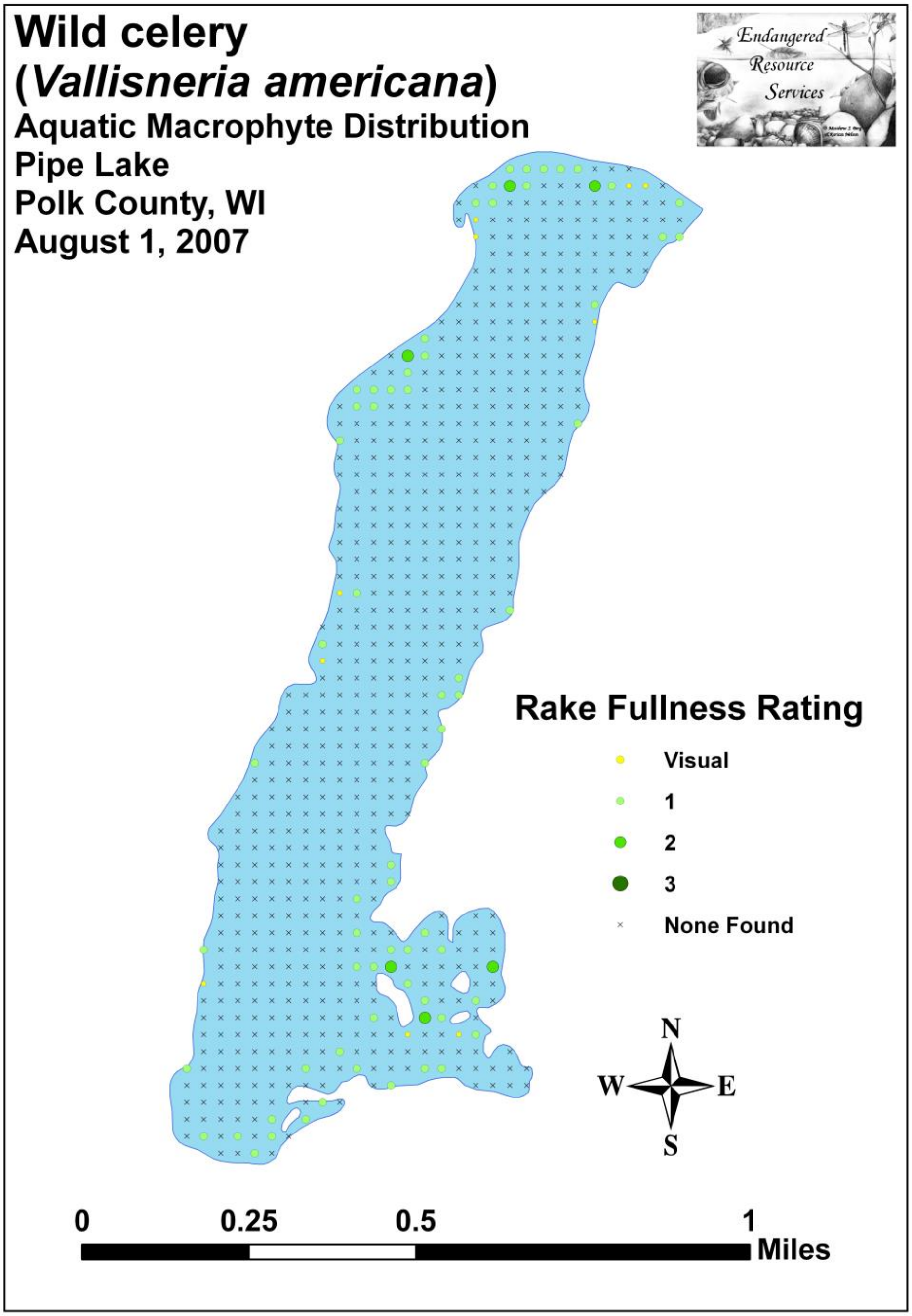
Wild celery
(Vallisneria americana)
Aquatic Macrophyte Distribution
Pipe Lake
Polk County, WI
August 1, 2007
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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Appendix VII: Glossary of Biological Terms (Adapted from UWEX 2007)

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 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)

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.

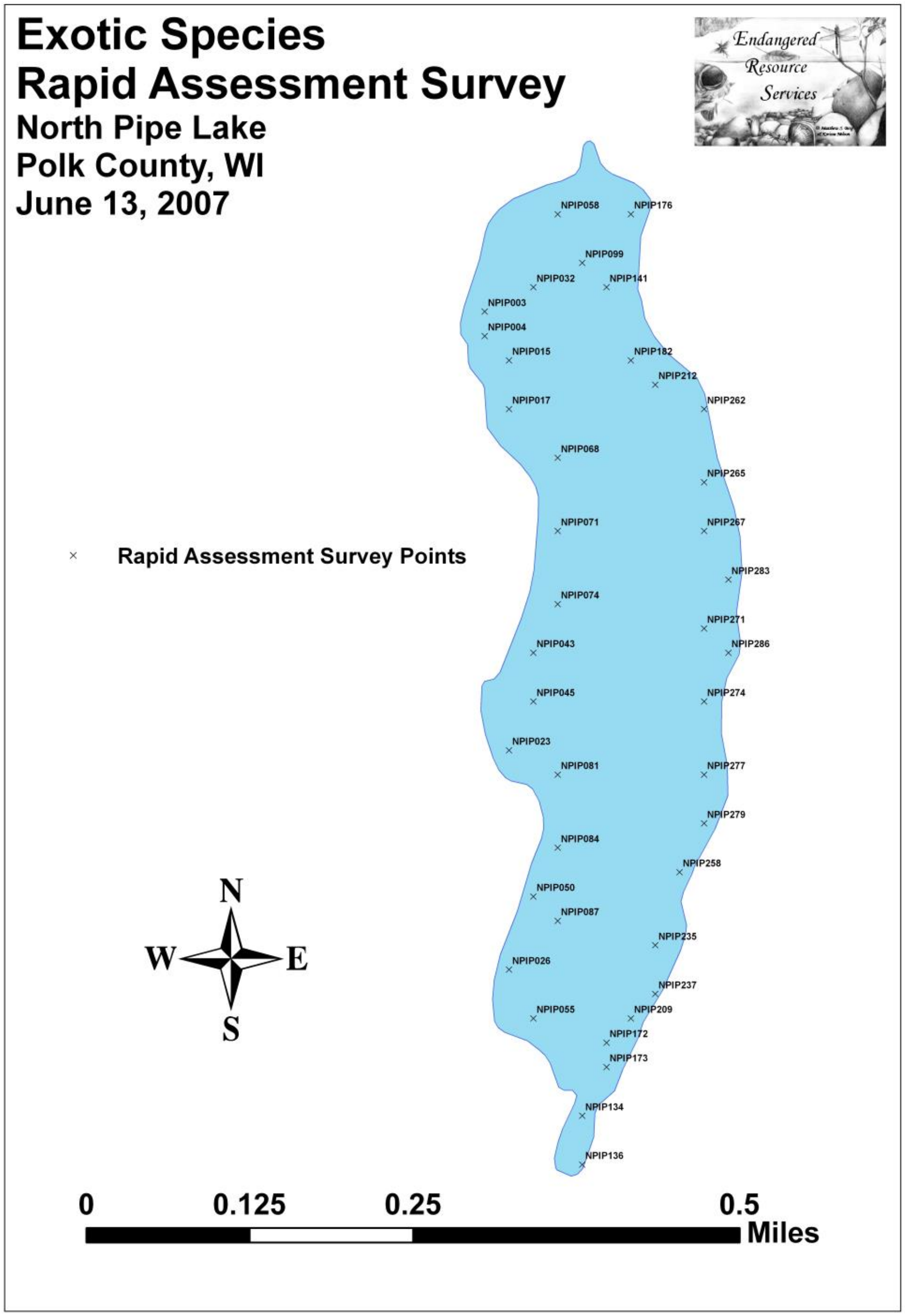
Watershed:

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 VIII: Aquatic Invasive Species Survey Maps and Information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Rapid Assessment Survey
North Pipe Lake
Polk County, WI
June 13, 2007
Endangered
Resource
Services
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NPIP176
NPIP099
NPIP032
NPIP141
NPIP003
NPIP004
NPIP015
NPIP182
NPIP212
NPIP017
NPIP262
NPIP068
NPIP265
NPIP071
NPIP267
Rapid Assessment Survey Points
NPIP283
NPIP074
NPIP271
NPIP043
NPIP286
NPIP045
NPIP274
NPIP023
NPIP081
NPIP277
NPIP279
NPIP084
NPIP258
NPIP050
NPIP087
NPIP235
NPIP026
NPIP237
NPIP055
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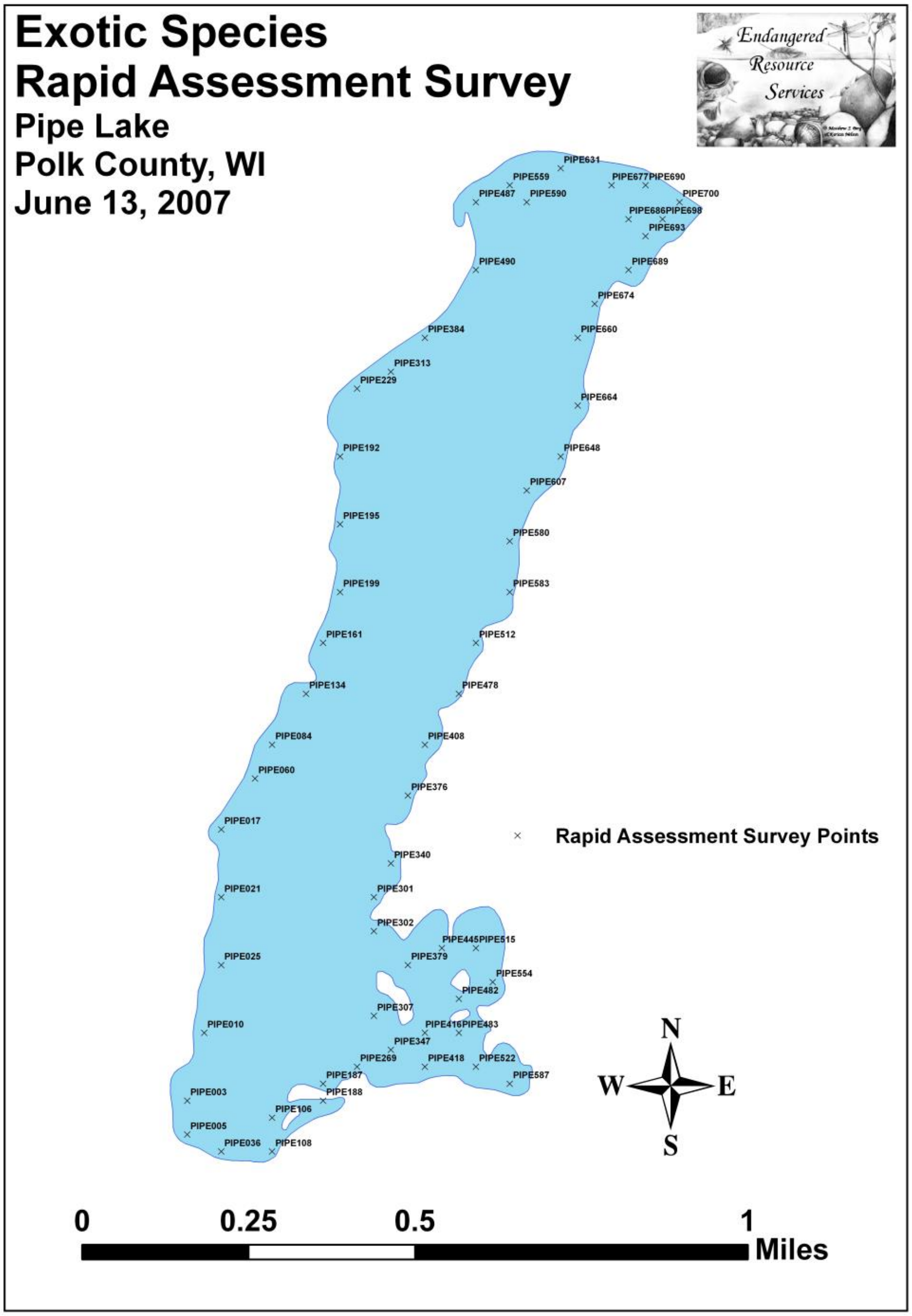

Exotic Species
Rapid Assessment Survey
Pipe Lake
Polk County, WI
June 13, 2007
Endangered Resource Services
PIPE631
PIPE559
PIPE677
PIPE690
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PIPE590
PIPE700
PIPE686
PIPE698
PIPE693
PIPE490
PIPE689
PIPE674
PIPE384
PIPE660
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PIPE229
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PIPE199
PIPE583
PIPE161
PIPE512
PIPE134
PIPE478
PIPE084
PIPE408
PIPE060
PIPE376
PIPE017
Rapid Assessment Survey Points
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PIPE301
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PIPE445
PIPE515
PIPE025
PIPE379
PIPE554
PIPE482
PIPE307
PIPE010
PIPE416
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PIPE003
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PIPE036
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Miles

Curly-leaf pondweed

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

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

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

It becomes invasive in some areas because of its tolerance for low light and low water temperatures. These tolerances allow it to get a head start on and out compete native plants in the spring. In mid-summer, when most aquatic plants are growing, curly-leaf pondweed plants are dying off. Plant die-offs may result in a critical loss of dissolved oxygen. Furthermore, the decaying plants can increase nutrients which contribute to algal blooms, as well as create unpleasant stinking messes on beaches. Curly-leaf pondweed forms surface mats that interfere with aquatic recreation. (Taken in its entirety from WDNR, 2007 http://www.dnr.state.wi.us/invasives/fact/curlyleaf_pondweed.htm)

Eurasian water milfoil

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

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

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

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

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

Dense stands of Eurasian water milfoil also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead". Cycling of nutrients from sediments to the water column by Eurasian water milfoil may lead to deteriorating water quality and algae blooms of infested lakes. (Taken in its entirety from WDNR, 2007 http://www.dnr.state.wi.us/invasives/fact/milfoil.htm)

Reed canary grass

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

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

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

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

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

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

This species prefers disturbed areas, but can easily move into native wetlands. Reed canary grass can invade a disturbed wetland in less than twelve years. Invasion is associated with disturbances including ditching of wetlands, stream channelization, deforestation of swamp forests, sedimentation, and intentional planting. The difficulty of selective control makes reed canary grass invasion of particular concern. Over time, it forms large, monotypic stands that harbor few other plant species and are subsequently of little use to wildlife. Once established, reed canary grass dominates an area by building up a tremendous seed bank that can eventually erupt, germinate, and recolonize treated sites. (Taken in its entirety from WDNR, 2007 http://www.dnr.state.wi.us/invasives/fact/reed_canary.htm)

Purple loosestrife

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

This species may be confused with the native wing-angled loosestrife (*Lythrum alatum*) found in moist prairies or wet meadows. The latter has a winged, square stem and solitary paired flowers in the leaf axils. It is generally a smaller plant than the Eurasian loosestrife.

By law, purple loosestrife is a nuisance species in Wisconsin. It is illegal to sell, distribute, or cultivate the plants or seeds, including any of its cultivars.

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

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

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

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

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

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

Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displaced, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size, and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways. (Taken in its entirety from WDNR, 2007 http://www.dnr.state.wi.us/invasives/fact/loosestrife.htm)

Appendix IX: Raw Data Spreadsheets