Aquatic Macrophyte Survey for
Devils Lake
Burnett County, Wisconsin
WBIC: 2461100

Project Sponsored by:
Wisconsin Department of Natural Resources, and the
Devils Lake Association

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ABSTRACT

Devils Lake (WBIC 2461100) is a 1,001-acre seepage water body in central Burnett County. It is oligotrophic in nature with maximum summer Secchi readings ranging from 9-13ft, and a littoral zone that extends to 22.5ft. In 2008, the Devils Lake Association and the Wisconsin Department of Natural Resources commissioned a systematic point intercept macrophyte survey in preparation for completing an Aquatic Plant Management Plan. The resulting survey found macrophytes at 360 of the 434 survey points (83%) of Devils Lake. We identified a total of 44 plants to species in and immediately adjacent to the lake that produced a mean Coefficient of Conservation of 6.6 and a very high Floristic Quality Index value of 44.0. Robbins (fern) pondweed (*Potamogeton robbinsii*), Small pondweed (*Potamogeton pusillus*), Common waterweed (*Elodea canadensis*) and Muskgrass (*Chara* sp.) were the most common species being found at 67.50%, 47.78%, 29.72% and 25.83% of survey points with vegetation respectively. In addition to these more common species, we located the state "Special Concern" species Vasey's pondweed (*Potamogeton vaseyi*). The presence of this species along with other species that are highly sensitive to pollution (such as Narrow-leaved bur-reed (*Sparganium emersum*), Dwarf water milfoil (*Myriophyllum tenellum*), Flat-leaf bladderwort (*Utricularia intermedia*), and Southern naiad (*Najas guadalupensis*)) is a testament to a history of good water quality that Devils Lake has apparently enjoyed. Future management goals should include maintaining the lake's healthy and diverse plant community, encouraging shoreline restoration, working to reduce the nutrient load coming into the system, continuing education and boat monitoring through the lake's "Clean Boats/Clean Water" program, and consideration to monitor for Eurasian water milfoil (*Myriophyllum spicatum*) in transects parallel to the shore at the east boat launch at least once a month during the summer.

ACKNOWLEDMENTS

We wish to thank the Wisconsin Department of Natural Resources, and the Devils Lake Association for funding this project; Jennifer Hauxwell for technical assistance, and Tyler Myers, Nicole Davis, and Mitchel and Noah Berg for assistance in conducting this survey.

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INTRODUCTION:

Devils Lake (WBIC 2461100) is a 1,001 acre, bowl-shaped, seepage lake in central Burnett County, Wisconsin in the Town of Oakland (T40N R16W S34 NE SW). It achieves a maximum depth of 25.5ft in the north-central basin, and has an average depth of approximately 14ft. Devils Lake is oligotrophic with good water clarity. Normal summer Secchi readings range from 9-13ft (WDNR 2008), and the littoral zone extends to 22.5ft. The bottom substrate is predominately sand, and sandy muck. The only organic muck occurs in the small finger bay in the extreme north/northeast corner of the lake.

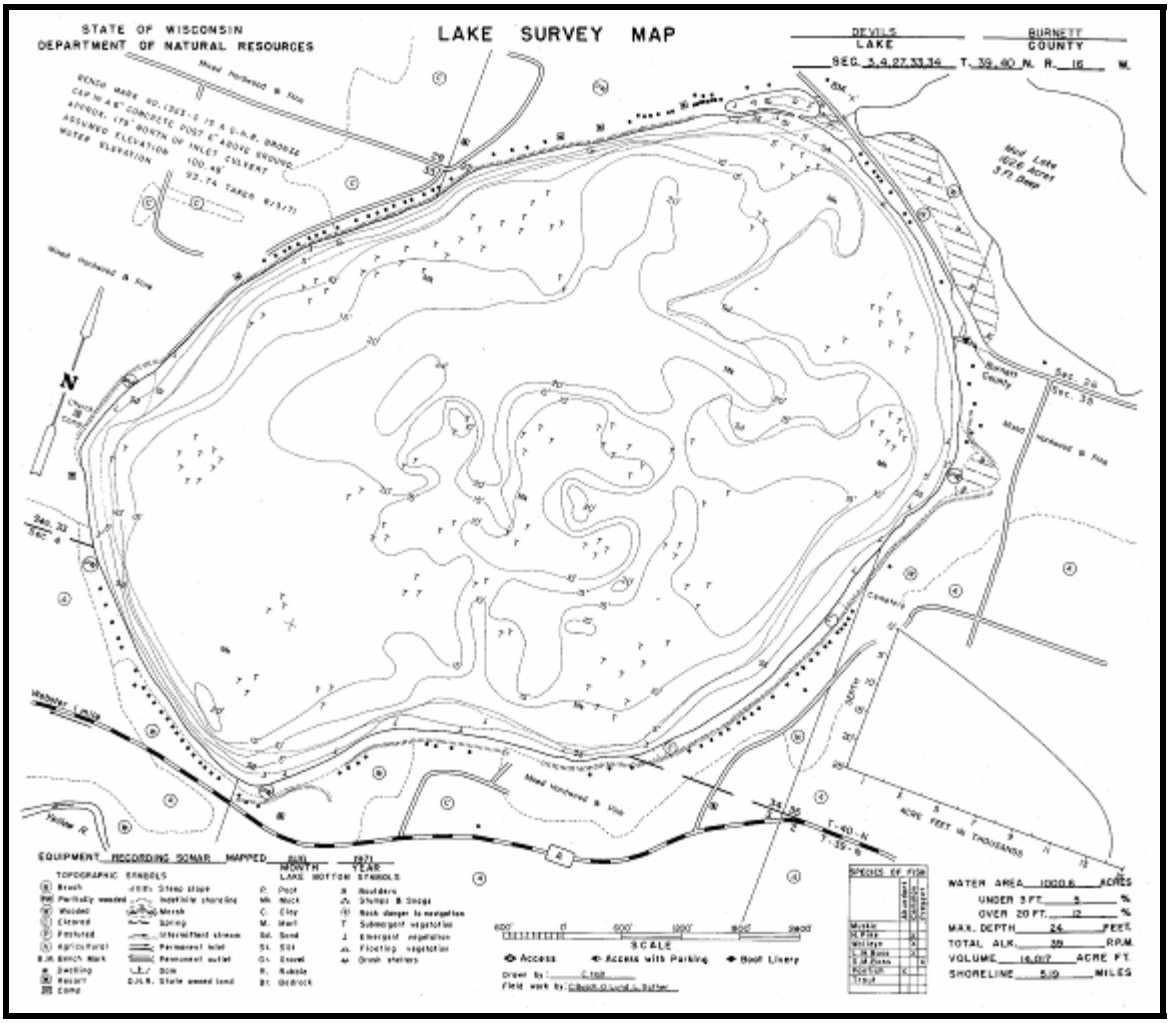


Figure 1: Devils Lake Map (Busch, C., et al. 1971).

A desire to develop an Aquatic Plant Management Plan (APMP) to be prepared should an exotic invasive species enter the lake prompted members of the Devils Lake Association to authorize a survey of aquatic macrophytes using the Wisconsin Department of Natural Resources statewide guidelines for conducting systematic point intercept macrophyte sampling. The guidelines ensure that all sampling in the state will be conducted in the same manner, thus allowing data to be compared across time and space. This report represents the summary analysis of the data collected during a survey of Devils Lake in

June and July of 2008. The immediate goals of the project were to determine if Eurasian water milfoil (*Myriophyllum spicatum*) or Curly-leaf pondweed (*Potamogeton crispus*) had invaded the lake 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 lake's macrophyte community.

PLANT SURVEY METHODS:

June Cold Water Curly-leaf pondweed Rapid Assessment Survey:

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 the 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.

July Warm Water Full Point/Intercept Survey:

Prior to beginning the point intercept survey in July, we conducted a general boat survey of Devils Lake to gain familiarity with the species present (Appendix II). All plants found were identified (Voss 1996; Boreman et al. 1997; Chadde 2002; Crow and Hellquist 2006), and two vouchers were pressed and retained for herbarium specimens – one to be retained by the Devils Lake Association, 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 22ft., 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.

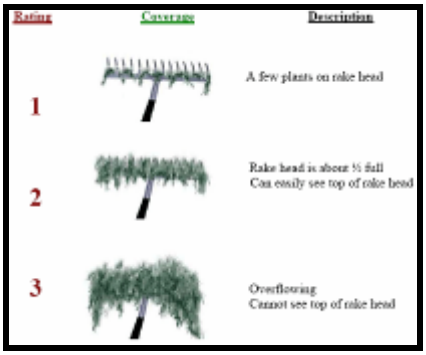


Figure 2: Rake Fullness Ratings (UWEX, 2008)

DATA ANALYSIS:

We entered all data collected into the standard APM spreadsheet (Appendix III) (UWEX, 2008). 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 and multiplying it by the square root of the total number of plant species (N) in the lake ($FQI = \Sigma(c1+c2+c3+\ldots cn)/\sqrt{N}$). Statistically speaking, the higher the index value, the healthier the lake's macrophyte community is assumed to be. Nichols (1999) identified four eco-regions in Wisconsin: Northern Lakes and Forests, Northern Central Hardwood Forests, Driftless Area and Southeastern Wisconsin Till Plain. He recommended making comparisons of lakes within ecoregions to determine the target lake's relative diversity and health. Devils Lake is in the Northern Lakes and Forests Ecoregion.

RESULTS:

June Cold Water Curly-leaf pondweed Rapid Assessment Survey:

We did **not** locate any Curly-leaf pondweed or Eurasian water milfoil or any other exotic/invasive plant species during either the June rapid assessment survey or the July full point-intercept survey (Figure 3). Although we did not locate any Purple loosestrife (*Lythrum salicaria*) on or directly adjacent to the lake, it is common in the Yellow River Drainage, and it is likely there are plants in the area. Because of this, it seems likely that Purple loosestrife will show up at Devils Lake at some point in the future. As Purple loosestrife prefers organic muck soil, the most likely point for this invasion would be the finger bay or the marsh/creek just across the road from the boat landing. For more information on exotic species, see Appendix VIII.

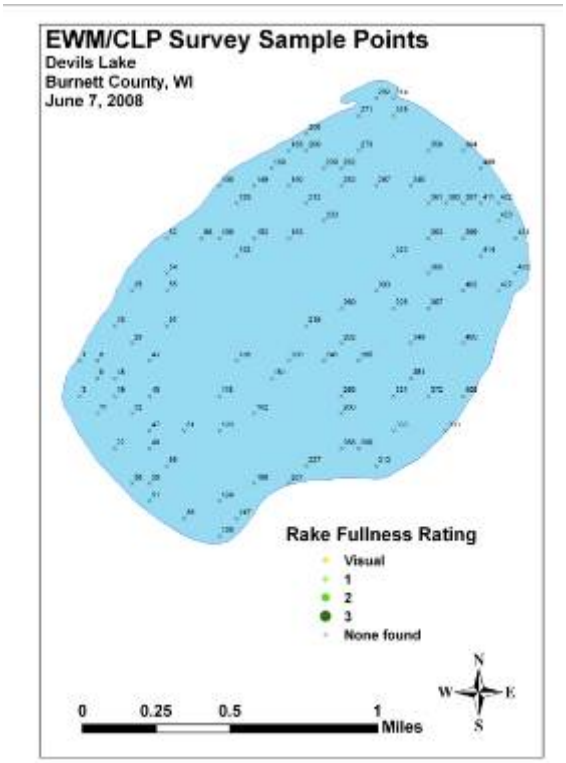


Figure 3: Cold Water Exotic Species Rapid Assessment Survey

July Warm Water Full Point/Intercept Survey:

We surveyed 434 points for depth (Figure 4), bottom substrate, and macrophytes (littoral zone) (Figure 5) (Appendix IV). The lake was an almost perfect bowl with most areas shallow enough for plants to grow. Shoreline areas were mostly sandy before transitioning into a sandy muck over the rest of the lake bottom. The south and east shores were pure sand and sloped gradually into deeper water while the north and west shores had some gravel mixed in and dropped off more rapidly. The only rich organic muck in the lake was located in the north/northeast bay. This tiny area provided habitat for 18 species that were not found anywhere else in the lake.

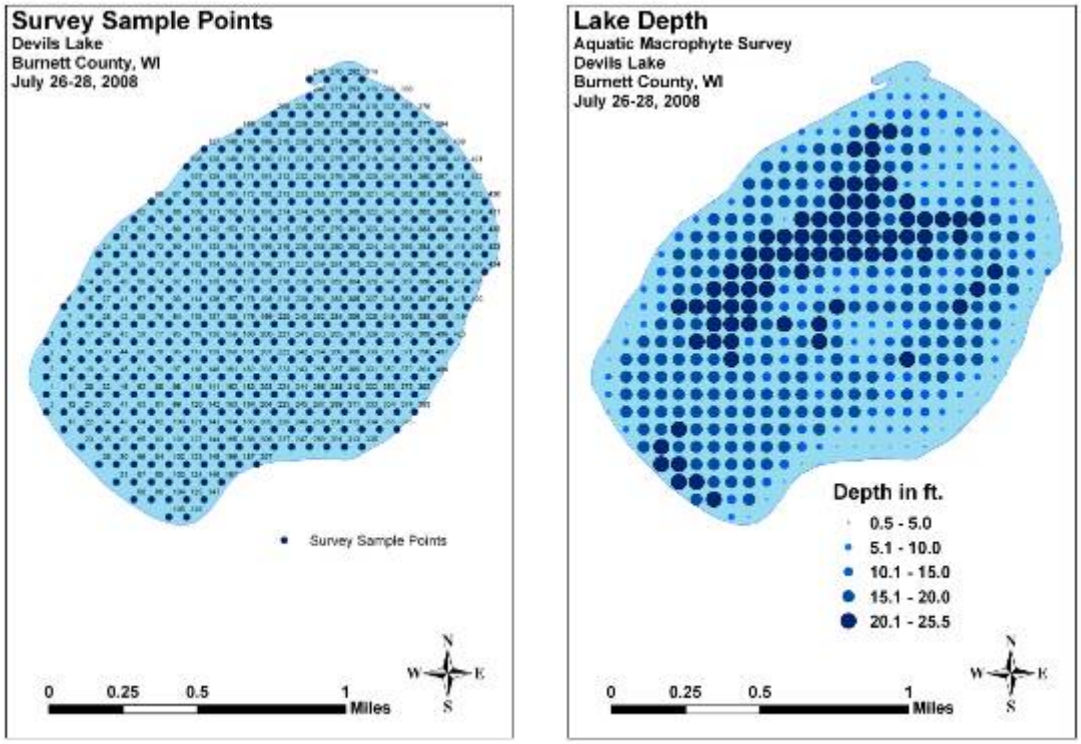


Figure 4: Survey Sample Points and Lake Depth

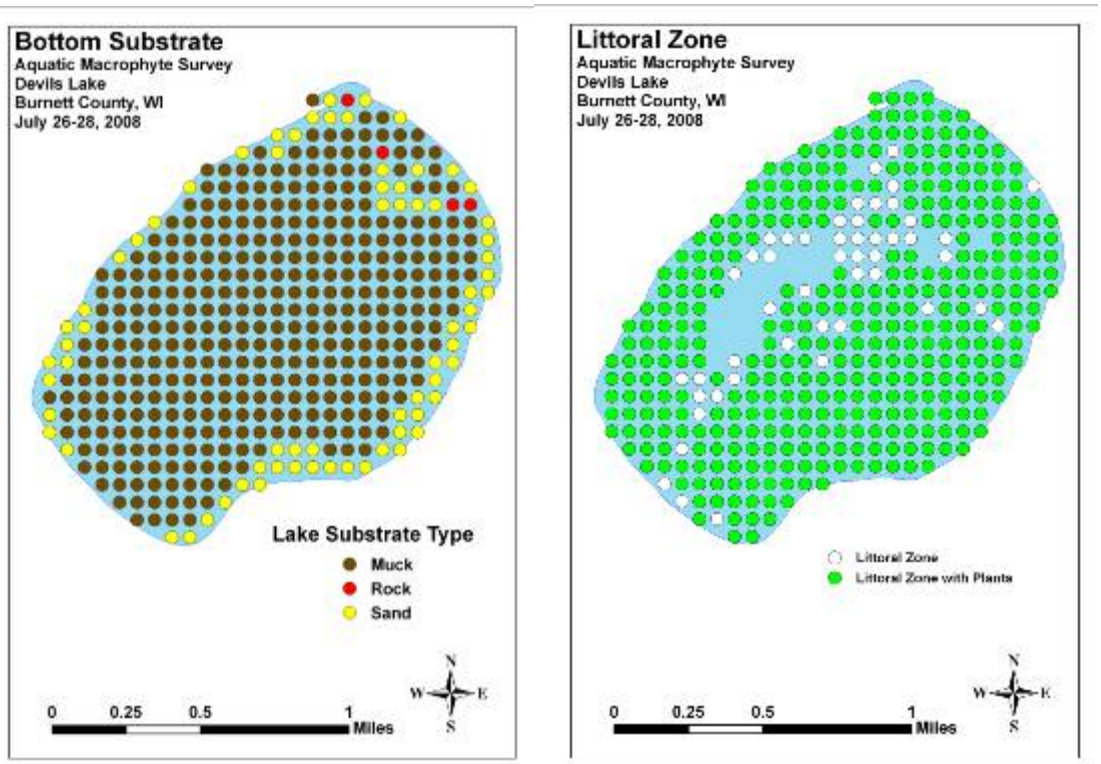


Figure 5: Lake Bottom Substrate and Littoral Zone

We found plants growing on approximately 83% of the entire lake bottom, and in 88% of the littoral zone (Table 1). Diversity was very high with a Simpson Diversity Index value of 0.90. Species richness was also very high with 46 total species found growing in and immediately adjacent to the lake (Appendix V and VI). The majority of aquatic macrophytes were found growing in deep water with a mean depth of 13.7ft, and a median depth 15.5ft. Although we determined the littoral zone went to 22.5 feet, in most parts of Devils Lake, the "weedline" ended at 20ft.

Table 1: Aquatic Macrophytes Survey Summary Statistics
Devils Lake, Burnett County
July 2008

Summary Statistics:

Total number of points sampled	434
Total number of sites with vegetation	360
Total number of sites shallower than the maximum depth of plants	408
Frequency of occurrence at sites shallower than maximum depth of plants	88.24
Simpson Diversity Index	0.90
Maximum depth of plants (ft)	22.00
Number of sites sampled using rope rake (R)	260
Number of sites sampled using pole rake (P)	174
Average number of all species per site (shallower than max depth)	2.86
Average number of all species per site (veg. sites only)	3.24
Average number of native species per site (shallower than max depth)	2.86
Average number of native species per site (veg. sites only)	3.24
Species Richness	33
Species Richness (including visuals)	34
Species Richness (including visuals and boat survey)	46
Mean depth of plants (ft)	13.7
Median depth of plants (ft)	15.5

Robbins (fern) pondweed (*Potamogeton robbinsii*), Small pondweed (*Potamogeton pusillus*), Common waterweed (*Elodea canadensis*) and Muskgrass (*Chara* sp.) were the most common species in the lake being found at 67.50%, 47.78%, 29.72% and 25.83% of survey points with vegetation respectively (Figure 6) (Table 2). Together, they combined for over 50% of the total relative frequency. In addition to these more common species, we located the state "Special Concern"** species Vasey's pondweed (*Potamogeton vaseyi*). The presence of this species along with other species that are highly sensitive to pollution (such as Narrow-leaved bur-reed (*Sparganium emersum*), Dwarf water milfoil (*Myriophyllum tenellum*), Flat-leaf bladderwort (*Utricularia intermedia*), and Southern naiad (*Najas guadalupensis*)) is a testament to a history of good water quality that Devils Lake has 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.

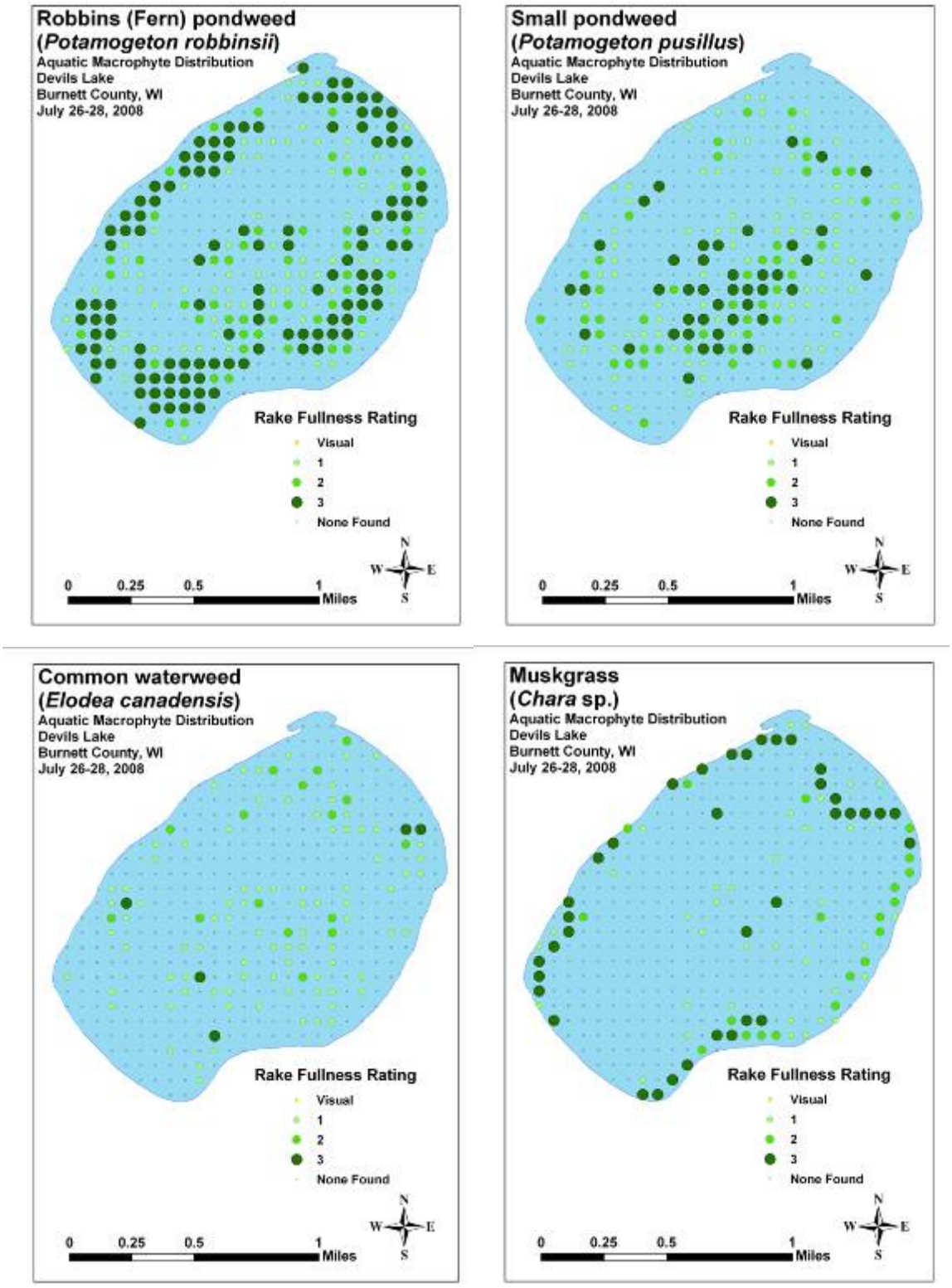


Figure 6: Devils Lake Dominant Species

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes Devils Lake, Burnett County, July 2008

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Potamogeton robbinsii	Robbins (fern) pondweed	243	20.86	67.50	59.56	2.19
Potamogeton pusillus	Small pondweed	172	14.76	47.78	42.16	1.77
Elodea canadensis	Common waterweed	107	9.18	29.72	26.23	1.24
Chara sp.	Muskgrass	93	7.98	25.83	22.79	2.01
Ceratophyllum demersum	Coontail	92	7.90	25.56	22.55	1.35
Potamogeton gramineus	Variable pondweed	78	6.70	21.67	19.12	1.50
Najas guadalupensis	Southern naiad	65	5.58	18.06	15.93	1.49
Nitella sp.	Nitella	54	4.64	15.00	13.24	1.65
Potamogeton amplifolius	Large-leaf pondweed	42	3.61	11.67	10.29	1.26
Eleocharis acicularis	Needle spikerush	32	2.75	8.89	7.84	1.75
Potamogeton praelongus	White-stem pondweed	32	2.75	8.89	7.84	1.25
Juncus pelocarpus f. submersus	Brown-fruited rush	26	2.23	7.22	6.37	1.58
Myriophyllum tenellum	Dwarf water milfoil	24	2.06	6.67	5.88	1.50
Vallisneria americana	Wild celery	22	1.89	6.11	5.39	1.50
Megalodonta beckii	Water marigold	20	1.72	5.56	4.90	1.30
Potamogeton richardsonii	Clasping-leaf pondweed	17	1.46	4.72	4.17	1.24
Najas flexilis	Bushy pondweed	15	1.29	4.17	3.68	1.40
	Filamentous algae	8	0.69	2.22	1.96	1.25
Isoetes lacustris	Lake quillwort	3	0.26	0.83	0.74	1.00
	Aquatic moss	3	0.26	0.83	0.74	1.67
Myriophyllum sibiricum	Northern water milfoil	2	0.17	0.56	0.49	1.00
Nymphaea odorata	White water lily	2	0.17	0.56	0.49	2.50
Utricularia intermedia	Flat-leaf bladderwort	2	0.17	0.56	0.49	1.50
Utricularia vulgaris	Common bladderwort	2	0.17	0.56	0.49	1.50
Brasenia schreberi	Watershield	1	0.09	0.28	0.25	1.00

Table 2 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes Devils Lake, Burnett County, July 2008

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Elatine minima	Waterwort	1	0.09	0.28	0.25	1.00
Eleocharis palustris	Creeping spikerush	1	0.09	0.28	0.25	1.00
Lemna minor	Small duckweed	1	0.09	0.28	0.25	1.00
Pontederia cordata	Pickerelweed	1	0.09	0.28	0.25	2.00
Sagittaria latifolia	Common arrowhead	1	0.09	0.28	0.25	1.00
Sagittaria rigida	Sessile-fruited arrowhead	1	0.09	0.28	0.25	1.00
Schoenoplectus acutus	Hardstem bulrush	1	0.09	0.28	0.25	1.00
Schoenoplectus pungens	Three-square	1	0.09	0.28	0.25	1.00
Sagittaria graminea	Grass-leaved arrowhead	**	**	**	**	**
Cladium mariscoides	Smooth sawgrass	***	***	***	***	***
Dulichium arundinaceum	Three-way sedge	***	***	***	***	***
Eleocharis erythropoda	Red-footed spikerush	***	***	***	***	***
Juncus effusus	Common rush	***	***	***	***	***
Nuphar variegata	Spatterdock	***	***	***	***	***
Potamogeton epihydrus	Ribbon-leaf pondweed	***	***	***	***	***
Potamogeton spirillus	Spiral-fruited pondweed	***	***	***	***	***
Potamogeton vaseyi	Vasey's pondweed	***	***	***	***	***
Potamogeton zosteriformis	Flat-stem pondweed	***	***	***	***	***
Schoenoplectus tabernaemontani	Softstem bulrush	***	***	***	***	***
Sparganium emersum	Narrow-leaved bur-reed	***	***	***	***	***
Typha latifolia	Broad-leaved cattail	***	***	***	***	***
Utricularia gibba	Creeping bladderwort	***	***	***	***	***

** Visual Only

*** Boat Survey Only

In the main basin, 17 species of plants made up almost the entire submergent community. Because the bottom substrate and depth contours were so similar throughout, plant species tended to form distinct bands that circled the lake at their preferred depth. In the shallow plant community (Mean depth <8ft.), the first three species were restricted to the sandiest near shore areas (Figure 7). These species are very short, averaging only a couple of inches in height. However, they perform important erosion control by forming dense "carpets" that trap sediment. The reed beds that grow in the shallowest water inshore from these three species provide shoreline stabilization and nurseries for young fish. They are not included in the chart here because, although they are common on the lake, the number of sample points that fall directly on the shore where they grow was not enough to adequately capture their distribution.

The last four were found in the transition from sand to sandy muck. They require more nutrient rich soil as they grow up to a few feet in height. They provide cover for small fish, and aquatic invertebrates that young fish depend on for food.

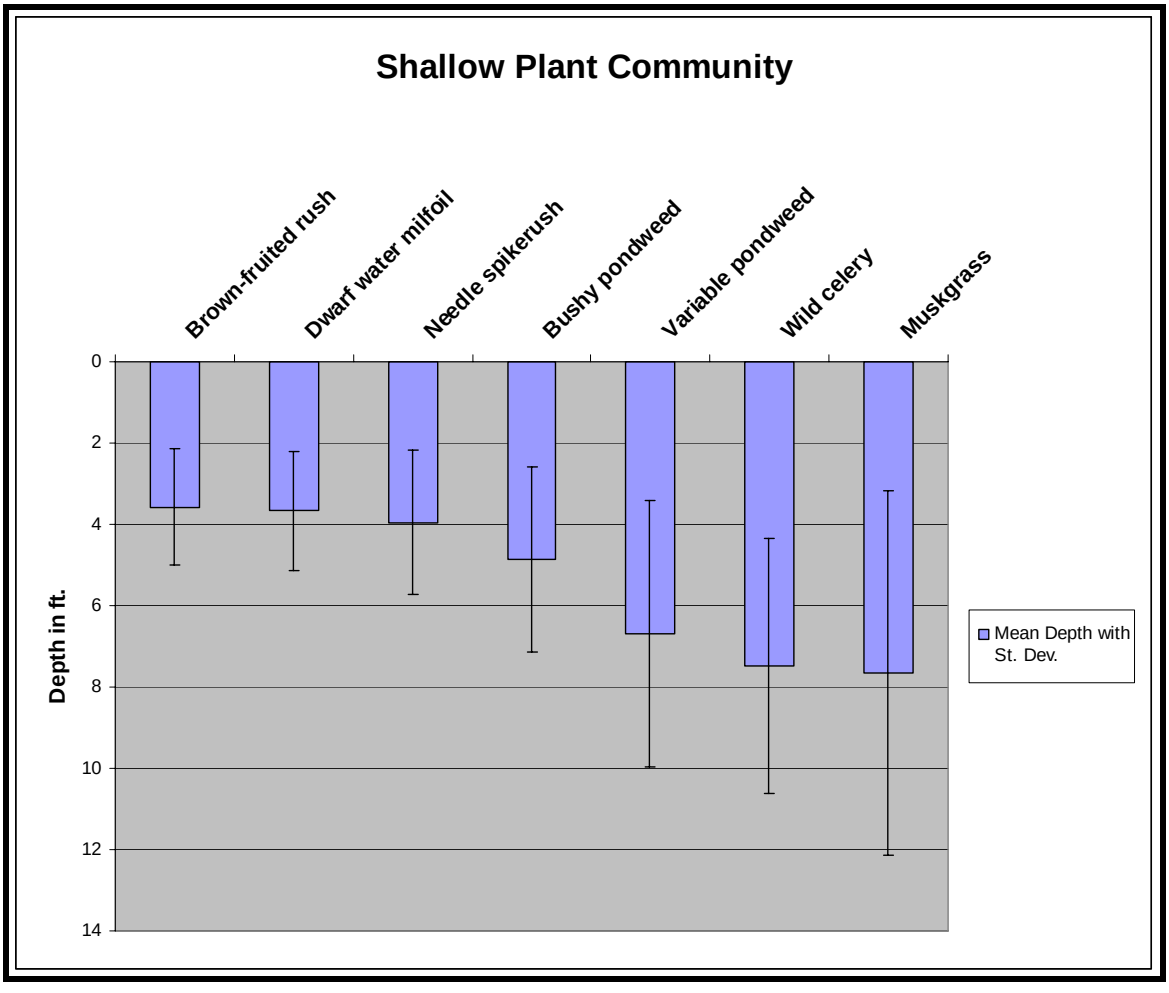


Figure 7: Devils Lake Shallow Plant Community (Mean <8ft.)

In the deep plant community (Mean depth >10ft.), the first five species were found growing together in a narrow band in approximately 8-12ft of water (Figure 8). These broad-leaved, bed forming species provide cover for mature panfish and edges that gamefish use to ambush prey. The final five species each preferred increasingly deeper water until they all disappeared in approximately 20ft of water. These species need so little light that many individuals are even able to survive under the ice. Because of this, they provide important winter cover for fish when most other plants have died back.

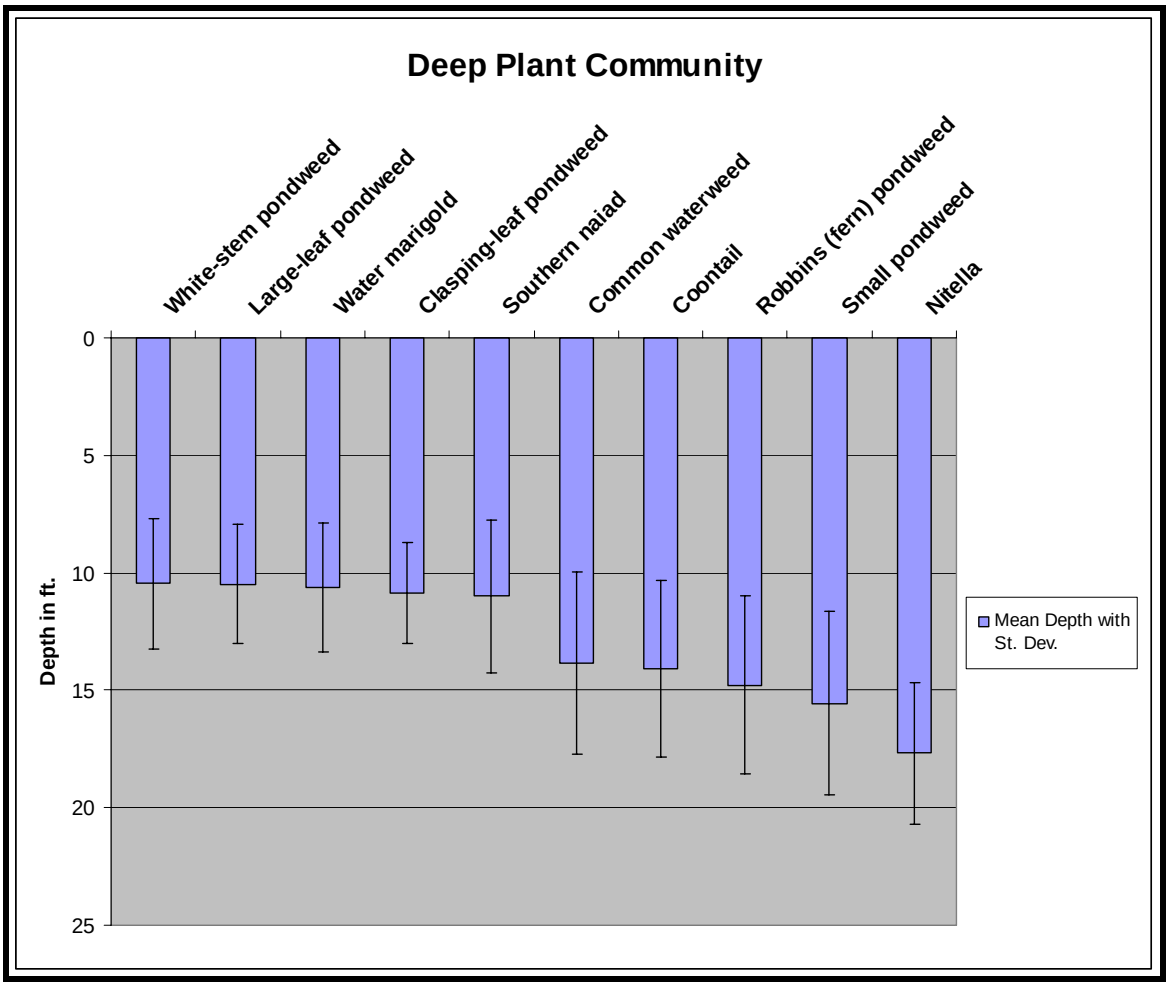


Figure 8: Devils Lake Deep Plant Community (Mean >10ft.)

We identified a total of 44 native plants to species in and immediately adjacent to Devils Lake. They produced a mean Coefficient of Conservation of 6.6 and a Floristic Index of 44.0 (Table 3). Nichols (1999) reported an Average mean C for the Northern Lakes and Forest Region of 6.7 putting Devils Lake only slightly below average for this part of the state. However, the FQI was almost double the mean FQI of 24.3 for the Northern Lakes and Forest Region (Nichols 1999). This very high FQI is likely a result of the lake's large size, variable substrate, good clarity and patches of undeveloped shoreline. All of these factors create a variety of microhabitats which offer a wide variety of plants suitable growing conditions.

Table 3: Floristic Quality Index of Aquatic Macrophytes
Devils Lake, Burnett County
July 2008

Species	Common Name	C
Brasenia schreberi	Watershield	7
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Cladium mariscoides	Smooth sawgrass	10
Dulichium arundinaceum	Three-way sedge	9
Elatine minima	Waterwort	9
Eleocharis acicularis	Needle spikerush	5
Eleocharis erythropoda	Red-footed spikerush	3
Eleocharis palustris	Creeping spikerush	6
Elodea canadensis	Common waterweed	3
Isoetes lacustris	Lake quillwort	8
Juncus effusus	Common rush	4
Juncus pelocarpus f. submersus	Brown-fruited rush	8
Lemna minor	Small duckweed	5
Megalodonta beckii	Water marigold	8
Myriophyllum sibiricum	Northern water-milfoil	7
Myriophyllum tenellum	Dwarf water-milfoil	10
Najas flexilis	Bushy pondweed	6
Najas guadalupensis	Southern 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 epihydrus	Ribbon-leaf pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Robbins (fern) pondweed	8
Potamogeton spirillus	Spiral-fruited pondweed	8
Potamogeton vaseyi	Vasey's pondweed	10
Potamogeton zosteriformis	Flat-stem pondweed	6
Sagittaria graminea	Grass-leaved arrowhead	9
Sagittaria latifolia	Common arrowhead	3
Sagittaria rigida	Sessile-fruited arrowhead	8
Schoenoplectus acutus	Hardstem bulrush	5
Schoenoplectus pungens	Three-square	5
Schoenoplectus tabernaemontani	Softstem bulrush	4

Table 3 (cont'): Floristic Quality Index of Aquatic Macrophytes
Devils Lake, Burnett County
July 2008

Species	Common Name	C
Sparganium emersum	Narrow-leaved bur-reed	8
Typha latifolia	Broad-leaved cattail	1
Utricularia intermedia	Flat-leaf bladderwort	9
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
N		44
mean C		6.6
FQI		44.0

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:

Based on our June exotic specie rapid assessment survey, July point intercept survey, and general boat survey observations, we consider Devils Lake's plant community to be healthy, abundant, and diverse. No exotic species were detected, and, although there are native plants throughout the lake, there were few places that exhibit anything approaching excessive plant growth that would interfere with boat travel or general recreation. Based on the lake's good water clarity and lack of floating or filamentous algae (Filamentous algae had a very low relative frequency of 0.69), it does not appear that there is an excess of nutrients entering the water from lawn and field fertilizer or septic runoff.

Because dense stands of submergent vegetation are relatively rare close to shore, those that do exist, coupled with the emergent reed/rush beds along shore, are especially important habitat as they provide some of the only cover for young fish. 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. Although water clarity is already good, reducing or eliminating fertilizer and pesticide applications near the lake will contribute to continued improvements in water clarity and quality. Where possible, shoreline restoration and buffer strips of native vegetation would enhance water quality by preventing erosion as well as improve the aesthetic value of highly developed shoreline areas. Analysis of 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.

In summary, there are currently few significant concerns for the lake's macrophyte community. The Lake's established "Clean Boats/Clean Water" program, landing camera, and noticeable signage provides the lake with a layer of protection against aquatic invasive species (AIS) by providing education, reeducation, and continual reminders of the dangers/impacts of aquatic invasive species. Preventing AIS introduction or detecting them immediately upon introduction when there is a chance to eliminate them will likely continue to be one of the lake association's top priorities. Expanding the "Clean Boats/Clean Water" program to 7 days a week during peek usage times in the summer, and monthly or bimonthly boat launch inspections for recently established exotic species could offer additional layers of protection and might be things for the Association to consider.

Management Recommendations Summary:

- Preserve and maintain Devils Lake's diverse native plant community.
- Preserve the lake's many rush/reed beds which serve as fish nurseries.
- Encourage owners to refrain from removing native plants from the lake as these areas provide AIS an ideal place to become established.
- Reduce and, wherever possible, eliminate fertilizer and pesticide applications near the lakeshore.
- Encourage shoreline restoration.
- Establish native vegetation buffer strips along the lakeshore.
- Continue and/or expand the lake's Clean Boats/Clean Water campaign.
- Consider transect monitoring for invasive species at the lake's boat landing.

LITERATURE CITED

Borman, S., R. Korth, and J. Temte 1997. Through the Looking Glass…A Field Guide to Aquatic Plants. Wisconsin Lakes Partnership. DNR publication FH-207-97.

Busch, C., G. Lund, and L. Sathier. [online]. 1971. Lake Map for Devils Lake - Burnett County, Wisconsin. Available from:<http://www.dnr.state.wi.us/org/water/fhp/lakes/lakemap/2461100a.htm> (2008, August).

Chadde, Steve W. 2002. A Great Lakes Wetland Flora: A complete guide to the aquatic and wetland plants of the Upper Midwest. Pocketflora Press; 2nd edition

Crow, G. E., C. B. Hellquist. 2006. Aquatic and Wetland Plants of Northeastern North America, Volume I + II: A Revised and Enlarged Edition of Norman C. Fassett's A Manual of Aquatic Plants. University of Wisconsin Press;

Nichols, Stanley A. 1999. Floristic Quality Assessment of Wisconsin Lake Plant communities with Example Applications. Journal of Lake and Reservoir Management 15 (2): 133-141.

UWEX Lakes Program. [online]. 2008. Aquatic Plant Management in Wisconsin. Available from http://www.uwsp.edu/cnr/uwexlakes/ecology/APMguide.asp (2008, September).

Voss, Edward G. 1996. Michigan Flora Vol I-III. Cranbrook Institute of Science and University of Michigan Herbarium.

WDNR. [online]. 2008. Citizen Monitoring Lake Water Quality Database. Available from https://dnrx.wisconsin.gov/x10322/ViewData.asp (2008, September).

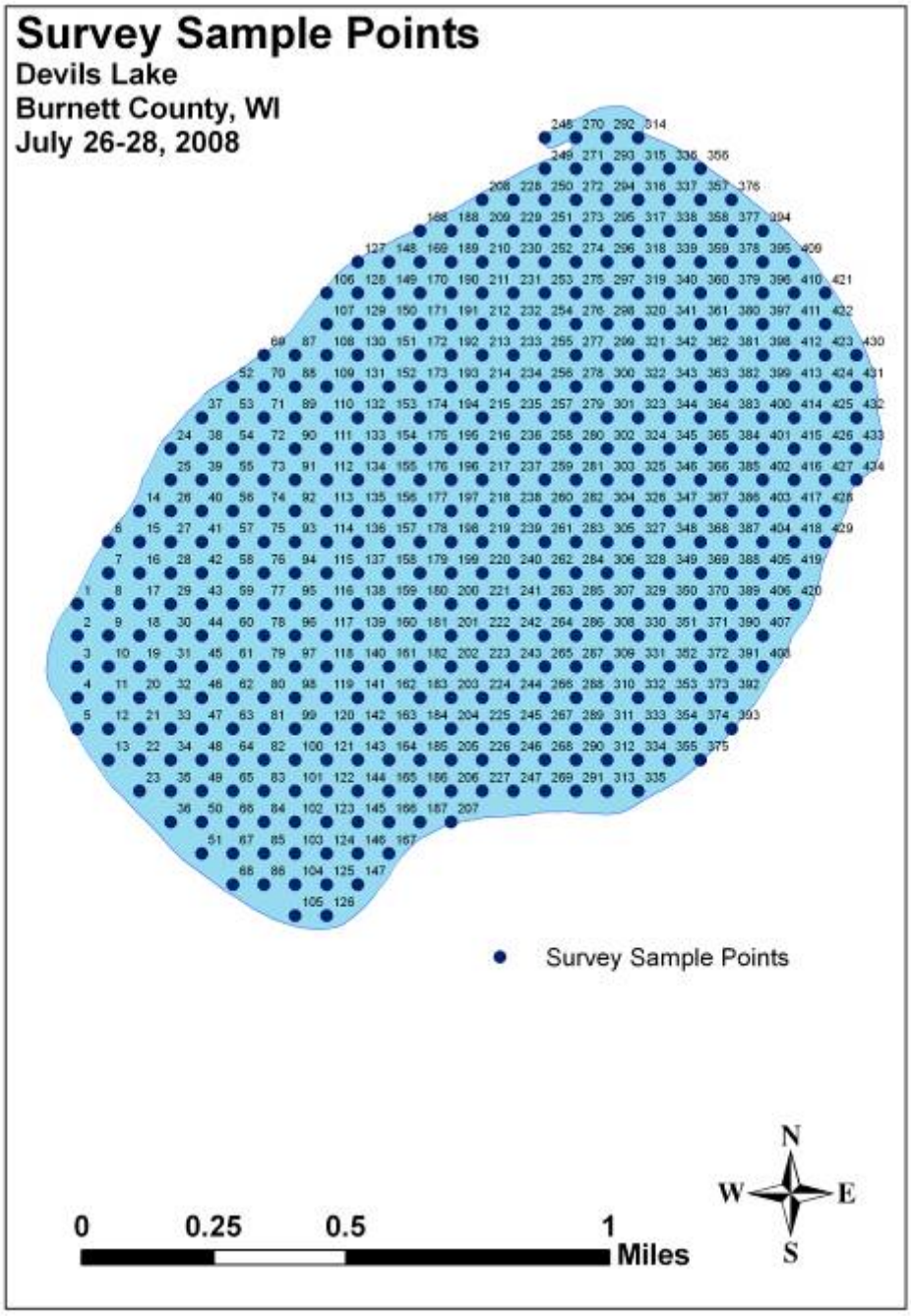
WDNR. [online]. 2008. Curly-leaf pondweed fact sheet. http://www.dnr.state.wi.us/invasives/fact/curlyleaf_pondweed.htm (2008, September).

WDNR. [online]. 2008. Eurasian water milfoil fact sheet. http://www.dnr.state.wi.us/invasives/fact/milfoil.htm (2008, September).

WDNR. [online]. 2008. Purple loosestrife fact sheet. http://www.dnr.state.wi.us/invasives/fact/loosestrife.htm (2008, September).

WDNR. [online]. 2008. Reed canary grass. http://www.dnr.state.wi.us/invasives/fact/reed_canary.htm (2008, September).

Appendix I: Devils Lake Map with Survey Sample Points


Survey Sample Points
Devils Lake
Burnett County, WI
July 26-28, 2008
Survey Sample Points
N
W
E
S
0
0.25
0.5
1
Miles

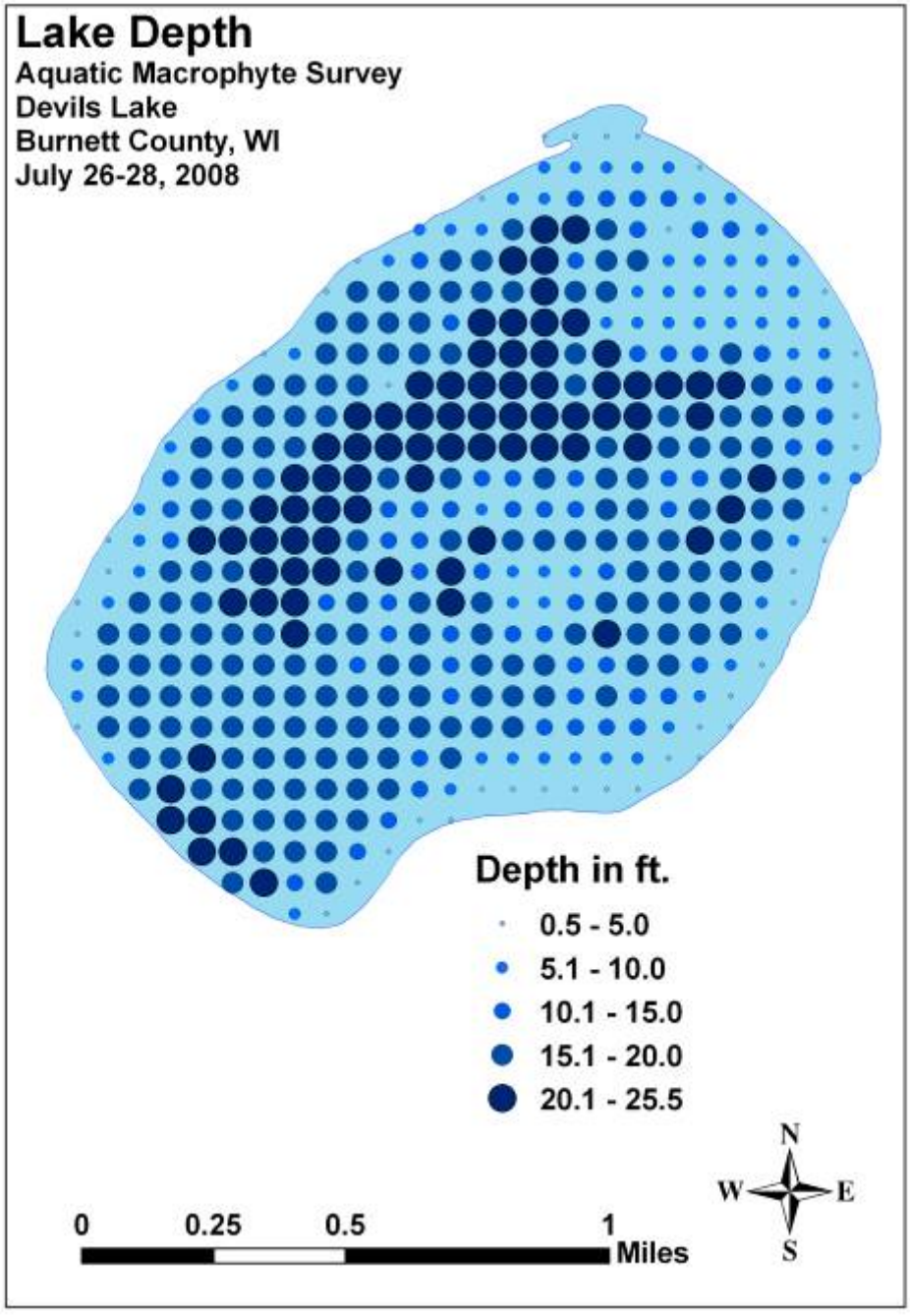
Appendix II: Boat Survey Data Sheet

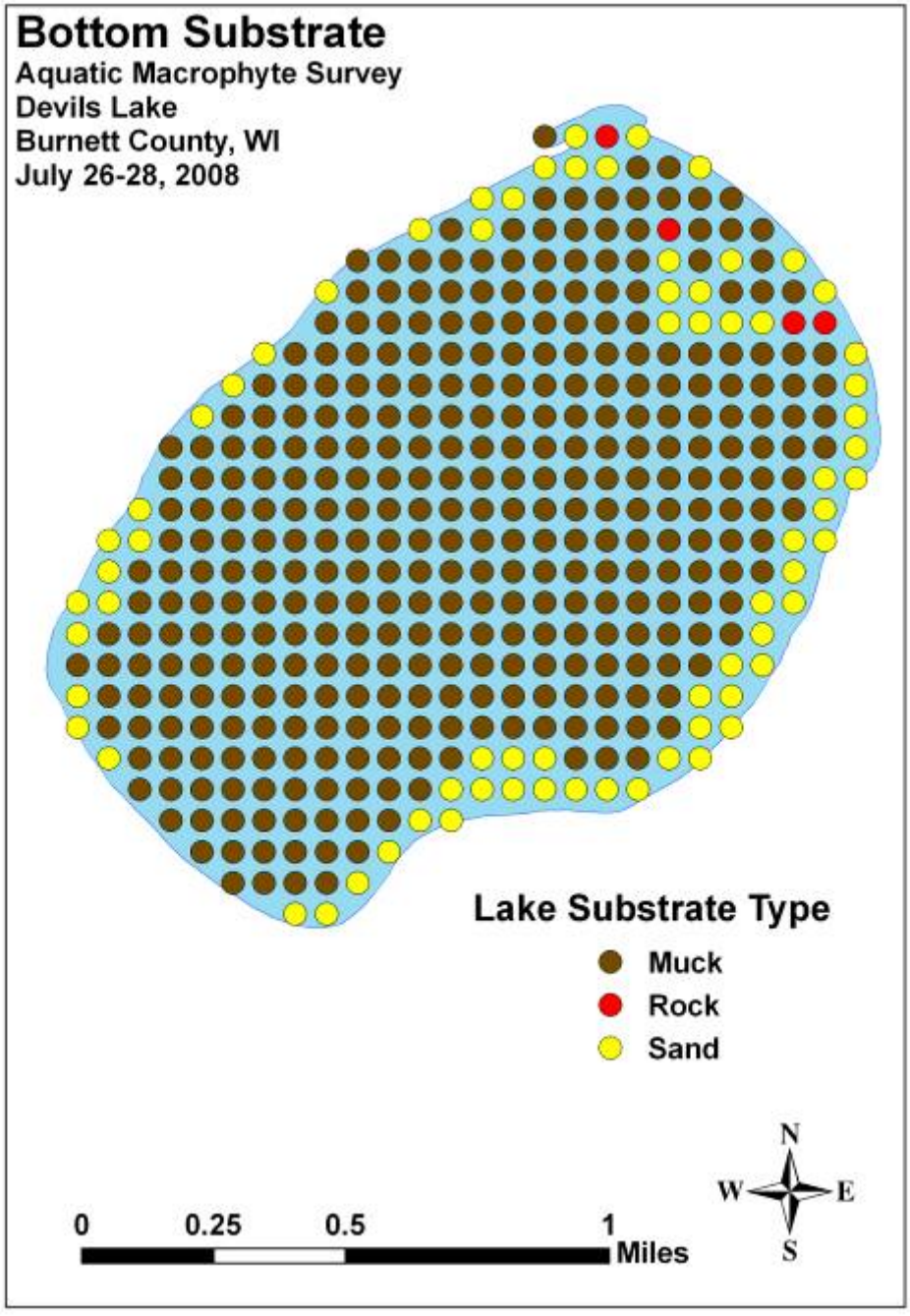
Boat Survey	
Lake Name	
County	
WBIC	
Date of Survey	
(mm/dd/yy)	
workers	
Nearest Point	**Species seen, habitat information**

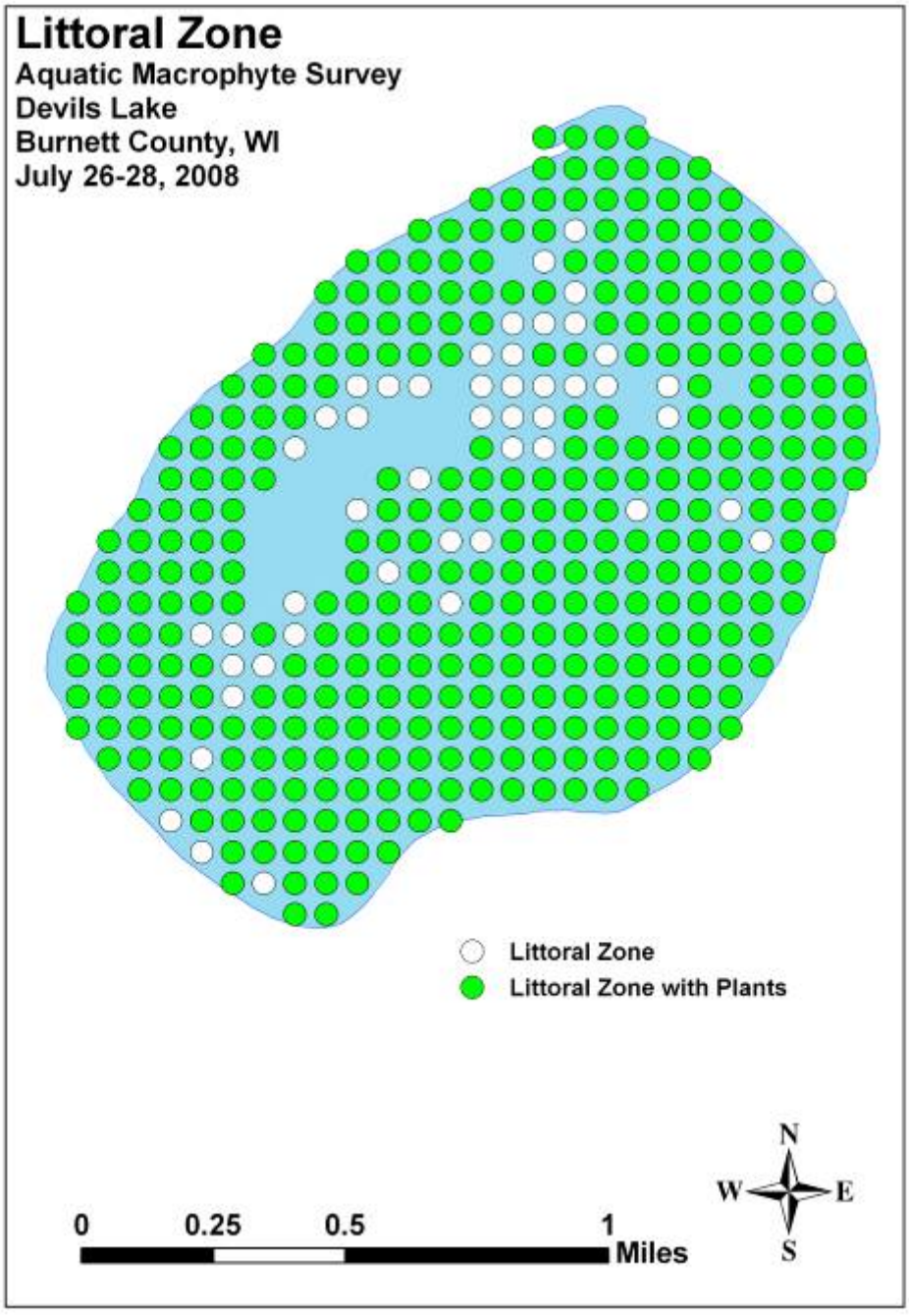
Appendix III: Vegetative Survey Data Sheet

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																									
9																									
10																									
11																									
12																									
13																									
14																									
15																									
16																									
17																									
18																									
19																									
20																									

Appendix IV: Habitat Variable Maps


Lake Depth
Aquatic Macrophyte Survey
Devils Lake
Burnett County, WI
July 26-28, 2008
Depth in ft.
0.5 - 5.0
5.1 - 10.0
10.1 - 15.0
15.1 - 20.0
20.1 - 25.5
N
W
E
S
0
0.25
0.5
1
Miles


Bottom Substrate
Aquatic Macrophyte Survey
Devils Lake
Burnett County, WI
July 26-28, 2008
Lake Substrate Type
Muck
Rock
Sand
N
W
E
S
0
0.25
0.5
1
Miles


Littoral Zone
Aquatic Macrophyte Survey
Devils Lake
Burnett County, WI
July 26-28, 2008
Littoral Zone
Littoral Zone with Plants
N
W
E
S
0
0.25
0.5
1
Miles

Appendix V: Plant Specimen Labels

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: Aquatic moss
Specimen Location: Devils Lake; N45.91504°, W92.33289°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-150
Habitat/Distribution: Mucky bottoms in 3-4 meters. Rare being found at only three locations in the lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton robbinsii*) Robbins (fern) pondweed, (*Najas guadalupensis*) Southern naiad, (*Elodea canadensis*) Common waterweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Brasenia schreberi*) **Watershield**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-151
Habitat/Distribution: Muck bottom in 0.5-1.5 meters. Rare; restricted to the small finger bay in the north/northeast corner of the lake.
Common Associates: (*Nymphaea odorata*) White water lily, (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Utricularia vulgaris*) Common bladderwort, (*Lemna minor*) Small duckweed, (*Sparganium emersum*) Narrow-leaved bur-reed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Ceratophyllum demersum*) **Coontail**
Specimen Location: Devils Lake; N45.90996°, W92.330231°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-152
Habitat/Distribution: Muck bottom in 0-5 meters. Abundant in the north/northeast bay; scattered in deep water throughout the rest of the lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton robbinsii*) Robbins (fern) pondweed, (*Nuphar variegata)* Spatterdock, (*Nymphaea odorata*) White water lily, (*Elodea canadensis*) Common waterweed, (*Nitella* sp.) Nitella

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Chara* sp.) **Muskgrass**
Specimen Location: Devils Lake; N45.90923°, W92.324076°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-153
Habitat/Distribution: Common throughout in sand and sandy muck bottom areas in water from 0 – 5 meters deep.
Common Associates: (*Potamogeton gramineus*) Variable pondweed, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush, (*Eleocharis acicularis*) Needle spikerush, (*Najas flexilis*) Bushy pondweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Cladium mariscoides*) **Smooth sawgrass**
Specimen Location: Devils Lake; N45.90315°, W92.328721°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-154
Habitat/Distribution: Sandy soil at the shoreline. Rare, a few scattered patches were located inland from beds of Three-square and Hardstem bulrush on the south/southeast shore.
Common Associates: (*Schoenoplectus acutus*) Hardstem bulrush, (*Eleocharis palustris*) Creeping spikerush, (*Juncus pelocarpus*) Brown-fruited rush, (*Schoenoplectus pungens*) Three-square

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Dulichium arundinaceum*) **Three-way sedge**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-155
Habitat/Distribution: Thick muck soil in and out of water <0.5 meters. Rare; restricted to the small finger bay in the north/northeast corner of the lake.
Common Associates: (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Typha latifolia*) Broad-leaved cattail, (*Eleocharis erythropoda*) Red-footed spikerush, (*Juncus effusus*) Common rush, (*Sagittaria latifolia*) Common arrowhead, (*Pontederia cordata*) Pickerelweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Elatine minima*) **Waterwort**
Specimen Location: Devils Lake; N45.92014°, W92.33433°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-156
Habitat/Distribution: Rocky to sandy bottoms in 0-1.0 meter of water. Rare in scattered locations along the north shore.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush, (*Isoetes lacustris*) Lake quillwort

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Eleocharis acicularis*.) **Needle spikerush**
Specimen Location: Devils Lake; N45.90923°, W92.324076°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-157
Habitat/Distribution: Sand bottoms in 0-2 meters. Almost exclusively located on the southern shore where it formed dense carpets with other "Isoetid" associates.
Common Associates: (*Chara* sp.) Muskgrass, (*Potamogeton gramineus*) Variable pondweed, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush, (*Eleocharis palustris*) Creeping spikerush, (*Najas flexilis*) Bushy pondweed, (*Schoenoplectus acutus*) Hardstem bulrush

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Eleocharis palustris*) **Creeping spikerush**
Specimen Location: Devils Lake; N45.90923°, W92.324076°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-158
Habitat/Distribution: Fairly common in 0-.75m in sandy soil. It was found scattered throughout reed beds on the south and east shores..
Common Associates: (*Schoenoplectus acutus*) Hardstem bulrush, (*Schoenoplectus pungens*) Three-square, (*Najas flexilis*) Bushy pondweed, (*Chara* sp.) Muskgrass, (*Potamogeton gramineus*) Variable pondweed, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush, (*Eleocharis acicularis*) Needle spikerush

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Eleocharis erythropoda*) **Red-footed spikerush**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-159
Habitat/Distribution: Thick muck soil in and out of water <0.5 meters. Rare; restricted to the small finger bay in the north/northeast corner of the lake.
Common Associates: (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Typha latifolia*) Broad-leaved cattail, (*Pontederia cordata*) Pickerelweed, (*Juncus effusus*) Common rush, (*Dulichium arundinaceum*) Three-way sedge, (*Sagittaria latifolia*) Common arrowhead

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Elodea canadensis*) **Common waterweed**
Specimen Location: Devils Lake; N45.90996°, W92.330231°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-160
Habitat/Distribution: Muck bottom in 2-6 meters of water, but most common in 4-5 meter range. Common throughout.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Ceratophyllum demersum*) Coontail, (*Najas guadalupensis*) Southern naiad, (*Nitella* sp.) Nitella, (*Potamogeton robbinsii*) Robbins (fern) pondweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Isoetes lacustris*) **Lake quillwort**
Specimen Location: Devils Lake; N45.904867°, W92.32879°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-161
Habitat/Distribution: Rare; a few individuals were found at only three sites in 2 meters of water over sand.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Potamogeton gramineus*) Variable pondweed, (*Chara* sp.) Muskgrass, (*Vallisneria americana*) Wild celery

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Juncus effusus*) **Common rush**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-162
Habitat/Distribution: Thick muck soil in and out of water <0.5 meters. Rare; restricted to the small finger bay in the north/northeast corner of the lake.
Common Associates: (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Typha latifolia*) Broad-leaved cattail, (*Eleocharis erythropoda*) Red-footed spikerush, (*Dulichium arundinaceum*) Three-way sedge, (*Sagittaria latifolia*) Common arrowhead, (*Pontederia cordata*) Pickerelweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Juncus pelocarpus*) **Brown-fruited rush**
Specimen Location: Devils Lake; N45.90923°, W92.324076°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-163
Habitat/Distribution: Sand bottoms in 0-2 meters. Almost exclusively located on the southern shore where it was formed dense carpets with other "Isoetid" associates.
Common Associates: (*Chara* sp.) Muskgrass, (*Potamogeton gramineus*) Variable pondweed, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Eleocharis acicularis*) Needle spikerush, (*Najas flexilis*) Bushy pondweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Lemna minor*) **Small duckweed**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-164
Habitat/Distribution: Muck bottom in 0.5-1.5 meters. Rare; restricted to the small finger bay in the north/northeast corner of the lake. Scattered individuals found floating between the lilypads.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Utricularia vulgaris*) Common bladderwort, (*Sparganium emersum*) Narrow-leaved bur-reed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Megalodonta beckii*) **Water marigold**
Specimen Location: Devils Lake; N45.90996°, W92.330231°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-165
Habitat/Distribution: Muck bottom in 3-5 meters of water.
Relatively common and widely distributed throughout the lake.
Common Associates: (*Potamogeton robbinsii*) Robbins (fern) pondweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Najas guadalupensis*) Southern naiad, (*Elodea canadensis*) Common waterweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Myriophyllum sibiricum*) **Northern water milfoil**
Specimen Location: Devils Lake; N45.92076°, W92.33287°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-166
Habitat/Distribution: Rare. A few individuals were found in 3 meters of water in the main lake; a few additional clusters were present in 1meters of water over muck in the north/northeast bay.
Common Associates: (*Potamogeton gramineus*) Variable pondweed, (*Potamogeton pusillus*) Small pondweed, (*Ceratophyllum demersum*) Coontail, (*Najas guadalupensis*) Southern naiad, (*Elodea canadensis*) Common waterweed, (*Potamogeton robbinsii*) Robbins (fern) pondweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Myriophyllum tenellum*) **Dwarf water milfoil**
Specimen Location: Devils Lake; N45.90923°, W92.324076°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-167
Habitat/Distribution: Sand bottoms in 0-2 meters. Almost exclusively located on the southern shore where it was formed dense carpets with other "Isoetid" associates.
Common Associates: (*Chara* sp.) Muskgrass, (*Potamogeton gramineus*) Variable pondweed, (*Juncus pelocarpus*) Brown-fruited rush, (*Eleocharis acicularis*) Needle spikerush, (*Najas flexilis*) Bushy pondweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Najas flexilis*) **Bushy pondweed**
Specimen Location: Devils Lake; N45.91438°, W92.32306°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-168
Habitat/Distribution: Found primarily in sand bottoms in 1.5-2.0 meters of water. Uncommon, but widely distributed throughout the lake at this depth.
Common Associates: (*Chara* sp.) Muskgrass, (*Potamogeton gramineus*) Variable pondweed, (*Juncus pelocarpus*) Brown-fruited rush, (*Eleocharis acicularis*) Needle spikerush, (*Myriophyllum tenellum*) Dwarf water milfoil

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Najas guadalupensis*) **Southern naiad**
Specimen Location: Devils Lake; N45.90996°, W92.33023°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-169
Habitat/Distribution: Common throughout in a relatively narrow band from 2.5-4.5 meters over sandy muck.
Common Associates: Common Associates: (*Potamogeton praelongus*) White-stem pondweed, (*Potamogeton pusillus*) Small pondweed, (*Ceratophyllum demersum*) Coontail, (*Elodea canadensis*) Common waterweed, (*Potamogeton robbinsii*) Robbins (fern) pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Nitella* sp.) **Nitella**
Specimen Location: Devils Lake; N45.90991°, W92.33267°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-170
Habitat/Distribution: Muck bottom areas in water 3-6.5 meters. Relatively common and widely distributed throughout. Along with *P. robbinsii*, it was often the deepest macrophytes found.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton robbinsii*) Robbins (fern) pondweed, (*Elodea canadensis*) Common waterweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Nuphar variegata)* **Spatterdock**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-171
Habitat/Distribution: Muck bottom in 0.5-1.5 meters. Rare; restricted to the small finger bay in the north/northeast corner of the lake.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Ceratophyllum demersum*) Coontail, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Utricularia vulgaris*) Common bladderwort, (*Lemna minor*) Small duckweed, (*Sparganium emersum*) Narrow-leaved bur-reed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Nymphaea odorata*) **White water lily**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-172
Habitat/Distribution: Muck bottom in 0.5-1.5 meters. Rare; restricted to the small finger bay in the north/northeast corner of the lake.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nuphar variegata*) Spatterdock, (*Ceratophyllum demersum*) Coontail, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Utricularia vulgaris*) Common bladderwort, (*Lemna minor*) Small duckweed, (*Sparganium emersum*) Narrow-leaved bur-reed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Pontederia cordata*) **Pickerelweed**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-173
Habitat/Distribution: Silt to muck bottom over firm substrate in 0-1.0 meter of water. Rare; restricted to the small finger bay in the north/northeast corner of the lake.
Common Associates: (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Typha latifolia*) Broad-leaved cattail, (*Eleocharis erythropoda*) Red-footed spikerush, (*Juncus effusus*) Common rush, (*Dulichium arundinaceum*) Three-way sedge, (*Sagittaria latifolia*) Common arrowhead

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Potamogeton amplifolius*) **Large-leaf pondweed**
Specimen Location: Devils Lake; N45.90996°, W92.330231°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-174
Habitat/Distribution: Common throughout in a relatively narrow band from 2.5-4.5 meters over sandy muck.
Common Associates: Common Associates: (*Potamogeton praelongus*) White-stem pondweed, (*Potamogeton pusillus*) Small pondweed, (*Ceratophyllum demersum*) Coontail, (*Najas guadalupensis*) Southern naiad, (*Elodea canadensis*) Common waterweed, (*Potamogeton robbinsii*) Robbins (fern) pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Potamogeton epihydrus*) **Ribbon-leaf pondweed**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-175
Habitat/Distribution: A few small patches were found in the finger bay in the north/northeast corner of the lake. Plants were growing among lilies in .5-1.5 meters of water.
Common Associates: : (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Utricularia vulgaris*) Common bladderwort, (*Lemna minor*) Small duckweed, (*Sparganium emersum*) Narrow-leaved bur-reed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Potamogeton gramineus*) **Variable pondweed**
Specimen Location: Devils Lake; N45.90923°, W92.324076°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-176
Habitat/Distribution: Bushy short form was common in sandy bottom conditions in shallow water 0.5-2 meters deep. Larger form was fairly common throughout in 3-4 meters over sandy muck.
Common Associates: (*Chara* sp.) Muskgrass, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush, (*Eleocharis acicularis*) Needle spikerush, (*Najas flexilis*) Bushy pondweed, (*Najas guadalupensis*) Southern naiad

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Potamogeton praelongus*) **White-stem pondweed**
Specimen Location: Devils Lake; N45.91424°, W92.33041°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-177
Habitat/Distribution: Common throughout in a relatively narrow band from 2.5-4.5 meters over sandy muck.
Common Associates: Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Ceratophyllum demersum*) Coontail, (*Najas guadalupensis*) Southern naiad, (*Elodea canadensis*) Common waterweed, (*Potamogeton robbinsii*) Robbins (fern) pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Potamogeton pusillus*) **Small pondweed**
Specimen Location: Devils Lake; N45.90996°, W92.330231°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-178
Habitat/Distribution: Found in almost any bottom conditions at deeps from 1-7 meters, but grows best in sand bottoms in 4-5 meters of water. Common to abundant throughout.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed, (*Ceratophyllum demersum*) Coontail, (*Najas guadalupensis*) Southern naiad, (*Elodea canadensis*) Common waterweed, (*Nitella* sp.) Nitella, (*Potamogeton robbinsii*) Robbins (fern) pondweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Potamogeton richardsonii*) **Clasping-leaf pondweed**
Specimen Location: Devils Lake; N45.90996°, W92.330231°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-179
Habitat/Distribution: Found in sandy/muck bottom conditions in water 3-5 meters deep. Uncommon, but fairly widespread.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton gramineus*) Variable pondweed, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Ceratophyllum demersum*) Coontail, (*Najas guadalupensis*) Southern naiad

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Potamogeton robbinsii*) **Robbins (fern) pondweed**
Specimen Location: Devils Lake; N45.90996°, W92.330231°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-180
Habitat/Distribution: Can grow in variable substrate bottoms, but becomes dominant to the point of excluding all other species in its preferred substrate of organic muck. Grows in 0-4.5 meters of water, but prefers 2.5-4. Widespread and abundant.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Ceratophyllum demersum*) Coontail, (*Najas guadalupensis*) Southern naiad, (*Elodea canadensis*) Common waterweed, (*Nitella* sp.) Nitella

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Potamogeton spirillus*) **Spiral-fruited-leaf pondweed**
Specimen Location: Devils Lake; N45.92014°, W92.33433°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-181
Habitat/Distribution: A handful of clusters with just a few plants in each were found scattered on the south side of the north/northeast bay/just north of the peninsula in <1m of water in sand near shore. Its coiled seeds and curled leaves make it easy to identify.
Common Associates: (*Potamogeton vaseyi*) Vasey's pondweed, (*Elatine minima*) Waterwort, (*Potamogeton epihydrus*) Ribbon-leaf pondweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Potamogeton vaseyi*) **Vasey's pondweed**
Specimen Location: Devils Lake; N45.92014°, W92.33433°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-182
Habitat/Distribution: A single small patch was located just inside the peninsula that forms the finger bay in the north/northeast corner of the lake. Plants were growing in sand in <1m of water.
Common Associates: (*Potamogeton spirillus*) Spiral-fruited-leaf pondweed, (*Elatine minima*) Waterwort, (*Potamogeton epihydrus*) Ribbon-leaf pondweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Potamogeton zosteriformis*) **Flat-stem pondweed**
Specimen Location: Devils Lake; N45.92076°, W92.33287°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-183
Habitat/Distribution: It prefers substrate of thick organic muck which was only found in the north/northeast finger bay. A very few plants were found growing in water 1-2 meters deep.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Elodea canadensis*) Common waterweed, (*Myriophyllum sibiricum*) Northern water milfoil

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Sagittaria graminea*) **Grass-leaved arrowhead**
Specimen Location: Devils Lake; N45.91097°, W92.32285°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-184
Habitat/Distribution: Sand bottoms in 0-1.5 meters. Rare; a few scattered individuals were located on the southern shore. Both the emergent and submergent forms were rare.
Common Associates: (*Schoenoplectus pungens*) Three-square, (*Najas flexilis*) Bushy pondweed, (*Chara* sp.) Muskgrass, (*Potamogeton gramineus*) Variable pondweed, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush, (*Eleocharis acicularis*) Needle spikerush, (*Eleocharis palustris*) Creeping spikerush

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Sagittaria latifolia*) **Common arrowhead**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-185
Habitat/Distribution: Thick muck soil in and out of water <0.5 meters. Rare; restricted to the small finger bay in the north/northeast corner of the lake.
Common Associates: (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Typha latifolia*) Broad-leaved cattail, (*Eleocharis erythropoda*) Red-footed spikerush, (*Juncus effusus*) Common rush, (*Dulichium arundinaceum*) Three-way sedge, (*Pontederia cordata*) Pickerelweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Sagittaria rigida*) **Sessile-fruited arrowhead**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-186
Habitat/Distribution: Submerged forms were most common in sand and rock bottom areas outside the north/northeast bay while the emergent form was only found in muck soil in the bay. Found in 0-2 meters of water.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Utricularia vulgaris*) Common bladderwort

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Schoenoplectus acutus*) **Hardstem bulrush**
Specimen Location: Devils Lake; N45.90923°, W92.324076°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-187
Habitat/Distribution: Sand bottoms in 0-1.5 meters. Almost exclusively located on the southern shore where it was the deepest reed growing at the edge of beds.
Common Associates: (*Schoenoplectus pungens*) Three-square, (*Najas flexilis*) Bushy pondweed, (*Chara* sp.) Muskgrass, (*Potamogeton gramineus*) Variable pondweed, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush, (*Eleocharis acicularis*) Needle spikerush, (*Eleocharis palustris*) Creeping spikerush

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Schoenoplectus pungens*) **Three-square**
Specimen Location: Devils Lake; N45.90315°, W92.328721°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-188
Habitat/Distribution: Sand bottoms in 0-.75 meters. Almost exclusively located on the southern shore where it was the dominant shallow water reed.
Common Associates: (*Schoenoplectus acutus*) Hardstem bulrush, (*Najas flexilis*) Bushy pondweed, (*Chara* sp.) Muskgrass, (*Potamogeton gramineus*) Variable pondweed, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush, (*Eleocharis acicularis*) Needle spikerush, (*Eleocharis palustris*) Creeping spikerush

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Schoenoplectus tabernaemontani*) **Softstem bulrush**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-189
Habitat/Distribution: Thick muck soil in and out of water <0.5 meters. Rare; restricted to the small finger bay in the north/northeast corner of the lake.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Eleocharis erythropoda*) Red-footed spikerush, (*Juncus effusus*) Common rush, (*Dulichium arundinaceum*) Three-way sedge, (*Sagittaria latifolia*) Common arrowhead, (*Pontederia cordata*) Pickerelweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Sparganium emersum*) **Narrow-leaved bur-reed**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-190
Habitat/Distribution: Muck bottom in 0.5-1.0 meters. Rare; restricted to the small finger bay in the north/northeast corner of the lake.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Utricularia vulgaris*) Common bladderwort, (*Lemna minor*) Small duckweed

County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Typha latifolia*) **Broad-leaved cattail**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-191
Habitat/Distribution: Thick muck soil in and out of water <0.5 meters. Rare; restricted to the small finger bay in the north/northeast corner of the lake.
Common Associates: (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Eleocharis erythropoda*) Red-footed spikerush, (*Juncus effusus*) Common rush, (*Dulichium arundinaceum*) Three-way sedge, (*Sagittaria latifolia*) Common arrowhead, (*Pontederia cordata*) Pickerelweed

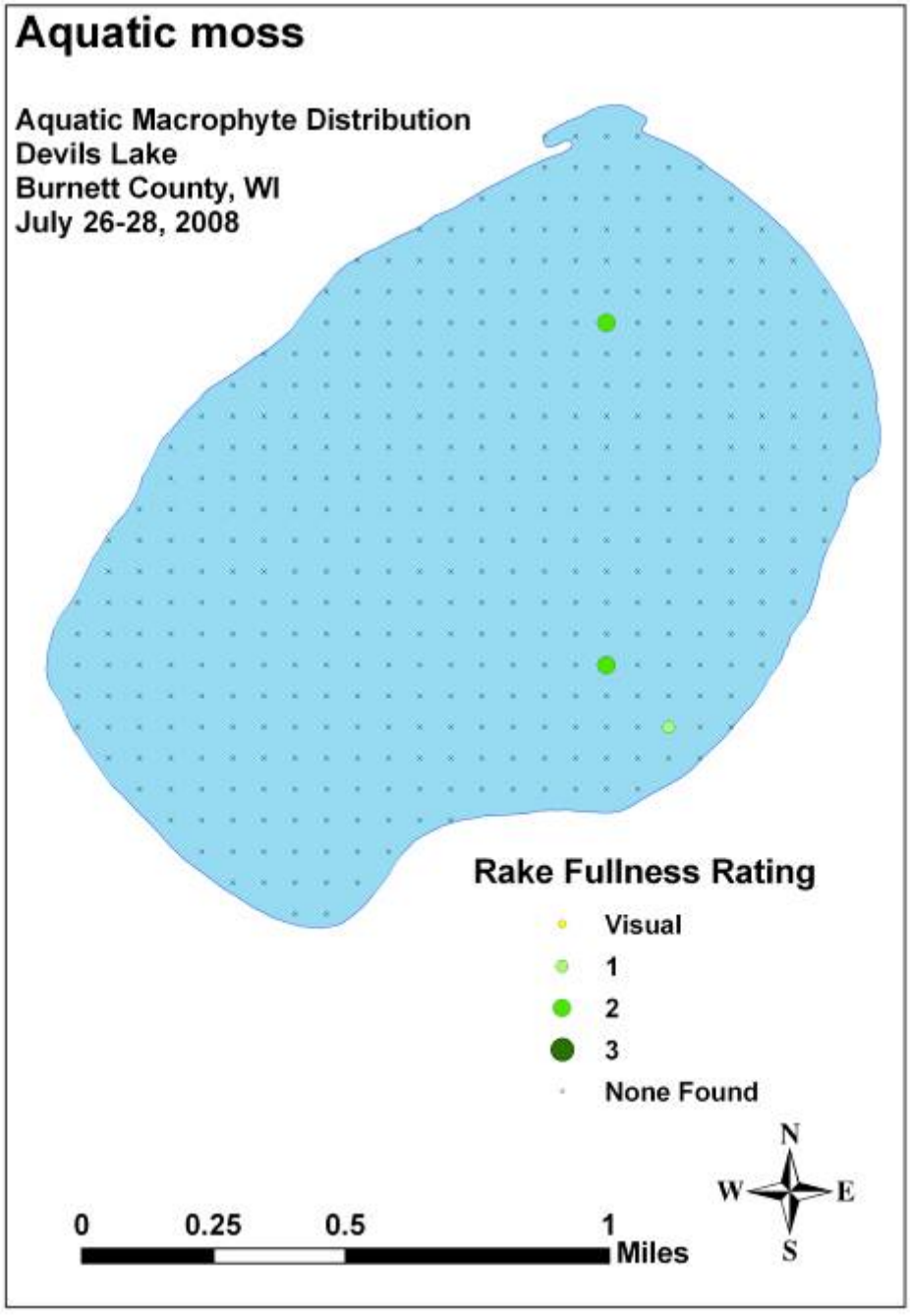
County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Utricularia intermedia*) **Flat-leaf bladderwort**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-192
Habitat/Distribution: Floating among lily pads over muck bottom in 0.5-1.5 meters. Rare; restricted to the small finger bay in the north/northeast corner of the lake.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Utricularia vulgaris*) Common bladderwort, (*Lemna minor*) Small duckweed, (*Sparganium emersum*) Narrow-leaved bur-reed

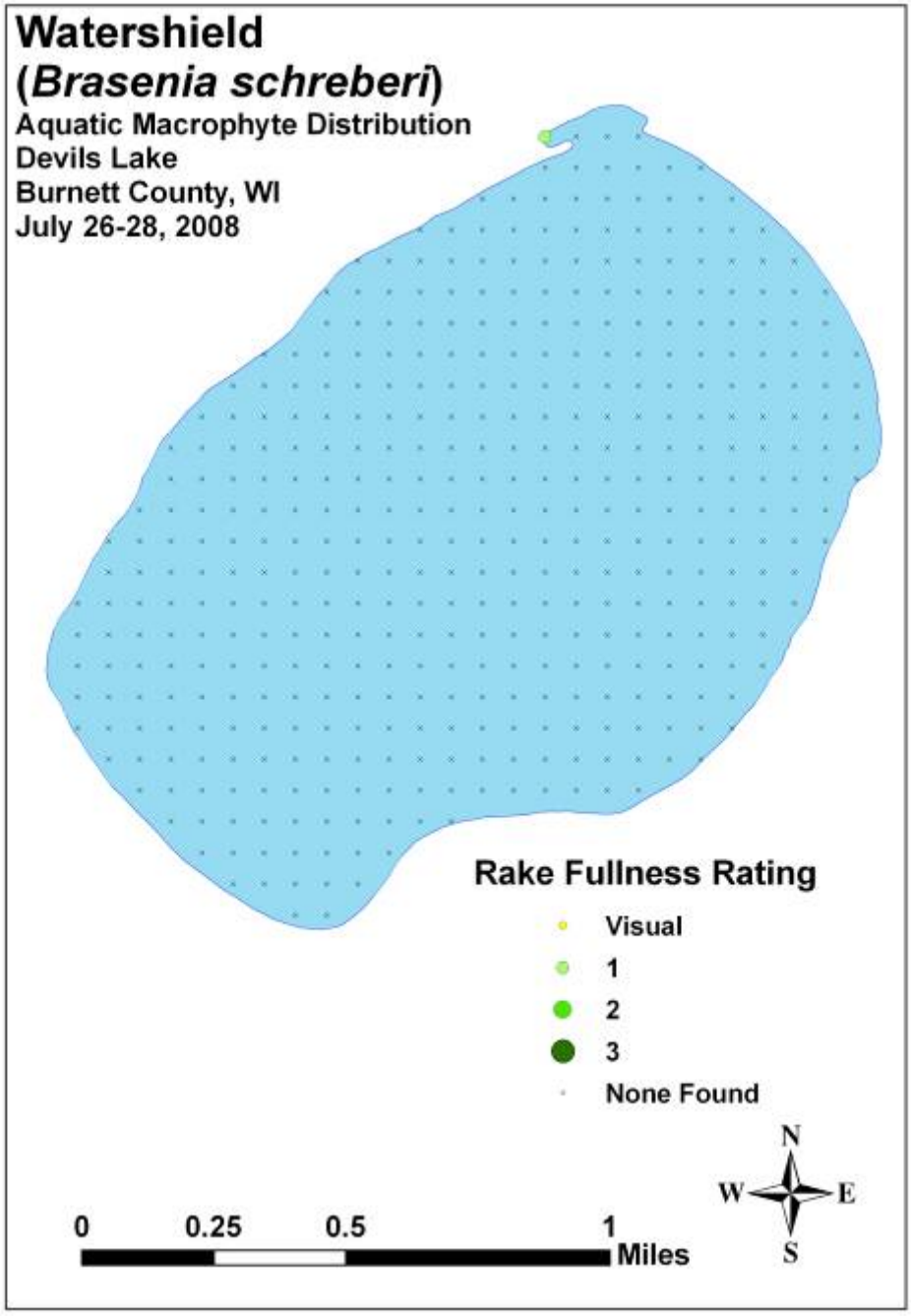
County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Utricularia vulgaris*) **Common bladderwort**
Specimen Location: Devils Lake; N45.92012°, W92.33555°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-193
Habitat/Distribution: Floating among lily pads over muck bottom in 0.5-1.5 meters. Rare; restricted to the small finger bay in the north/northeast corner of the lake.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Lemna minor*) Small duckweed, (*Sparganium emersum*) Narrow-leaved bur-reed

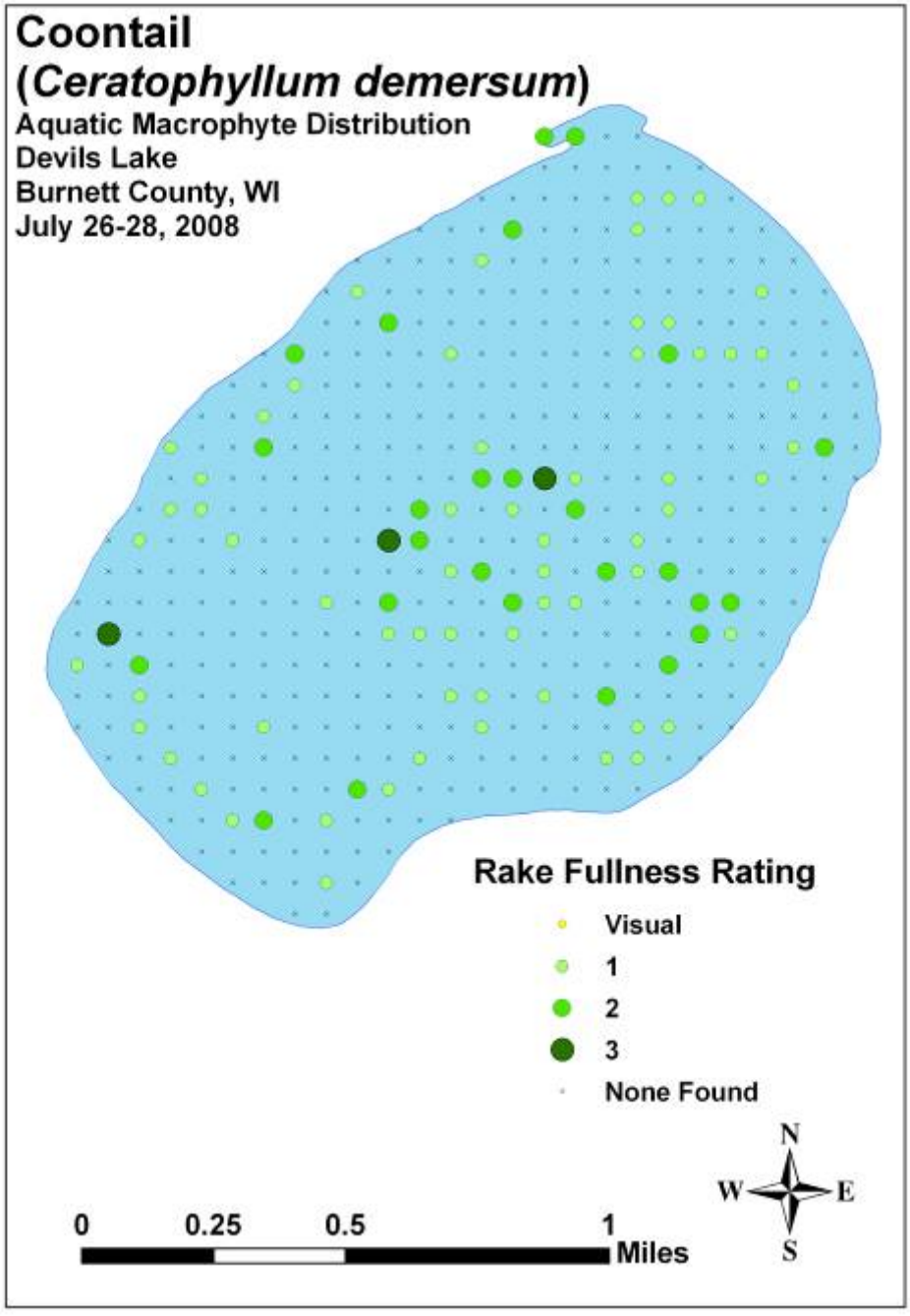
County/State: Burnett County, Wisconsin **Date:** 7/26/08
Species: (*Vallisneria americana*) **Wild celery**
Specimen Location: Devils Lake; N45.90748°, W92.32645°
Collected/Identified by: Matthew S. Berg **Col. #:** MSB-2008-194
Habitat/Distribution: Found in sandy to sand/muck bottoms in 2-4 meters of water. Uncommon, but distributed throughout.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton gramineus*) Variable pondweed, (*Chara* sp.) Muskgrass, (*Najas guadalupensis*) Southern naiad

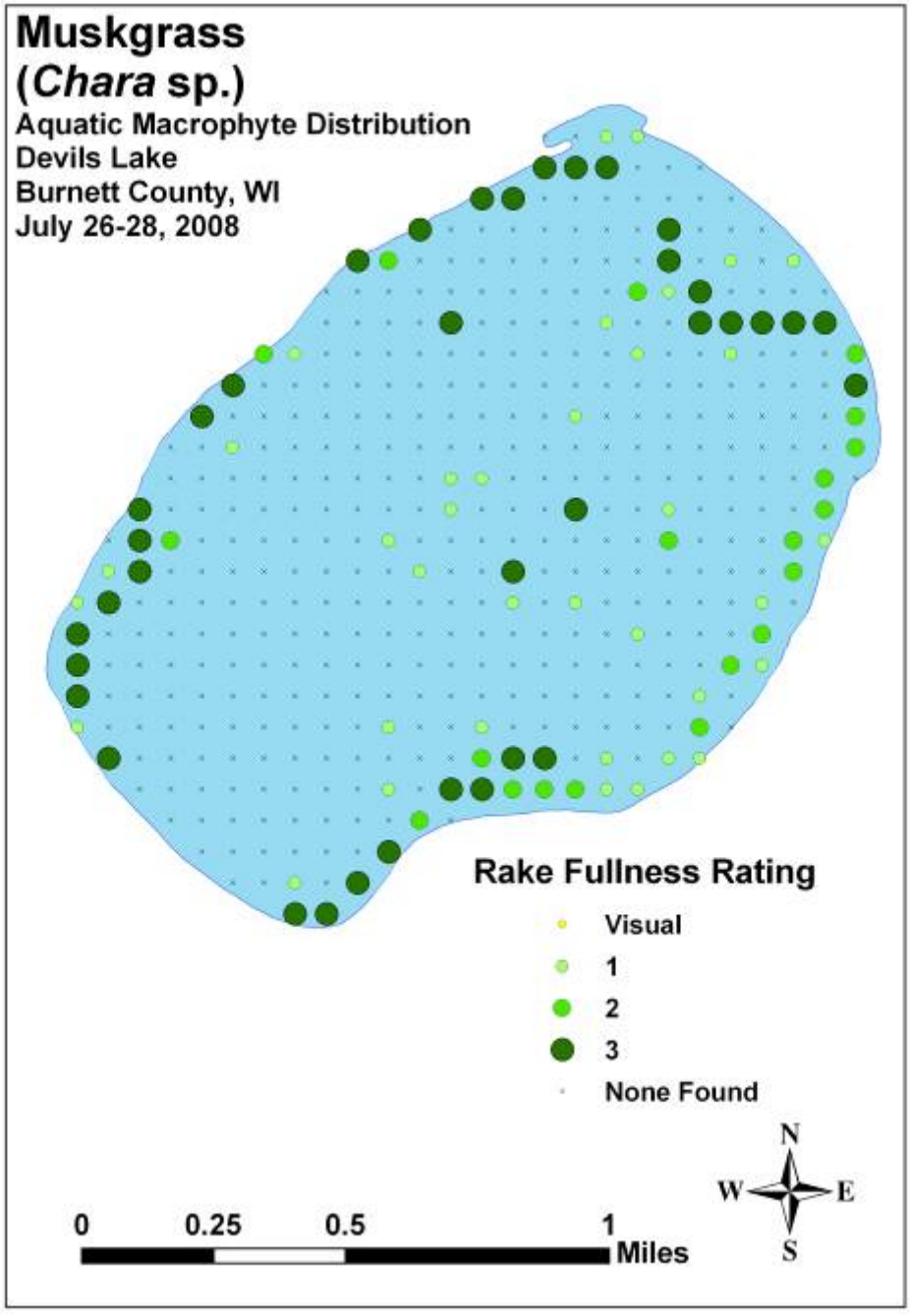
County/State: Washburn County, Wisconsin **Date:** 7/27/08
Species: Filamentous algae
Collected/Identified by: Matthew S. Berg
Habitat/Distribution: Rare; found at only a handful of locations; mostly in deep water 17ft+.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Chara* sp.) Muskgrass

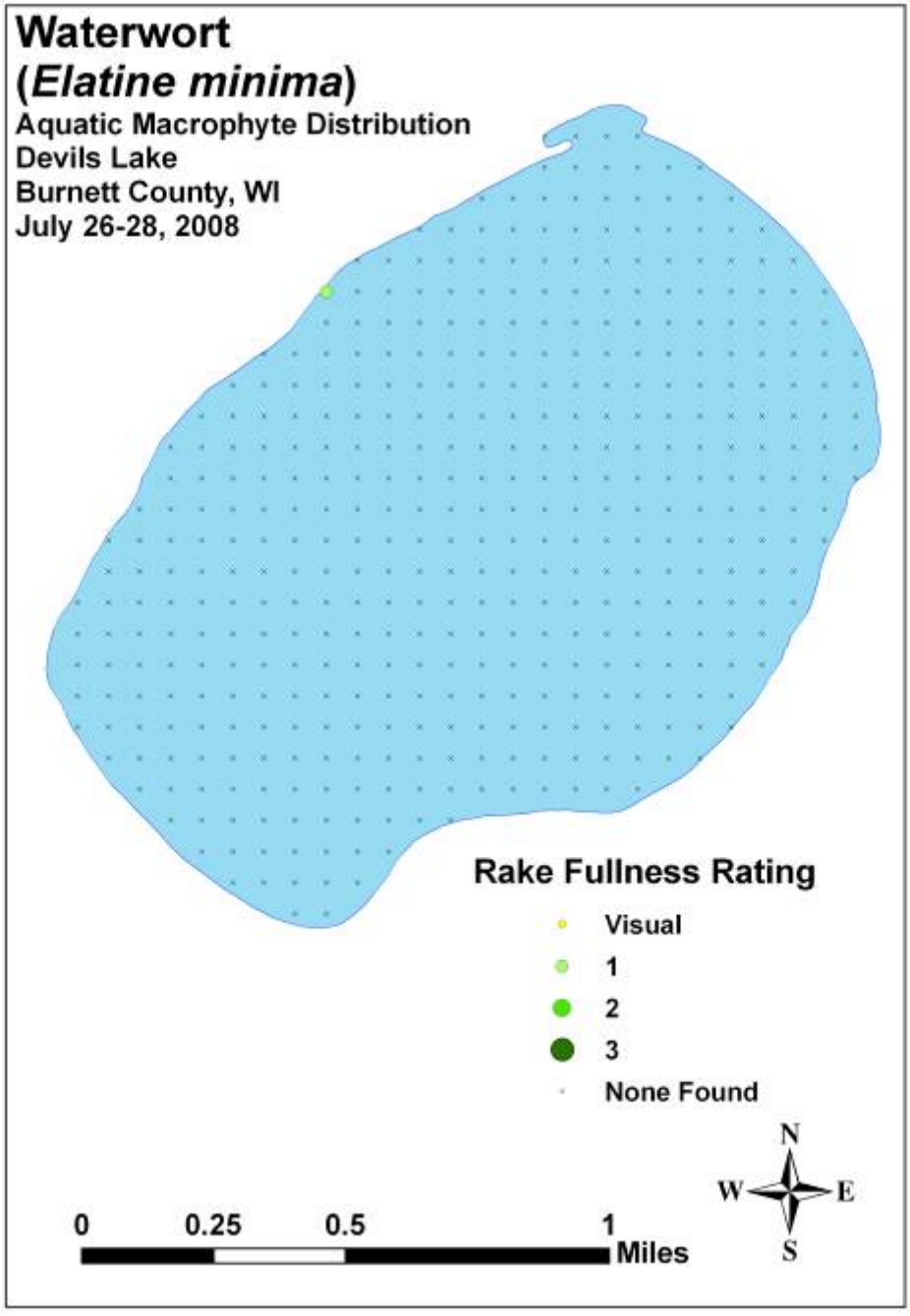
Appendix VI: Plant Species Distribution Maps

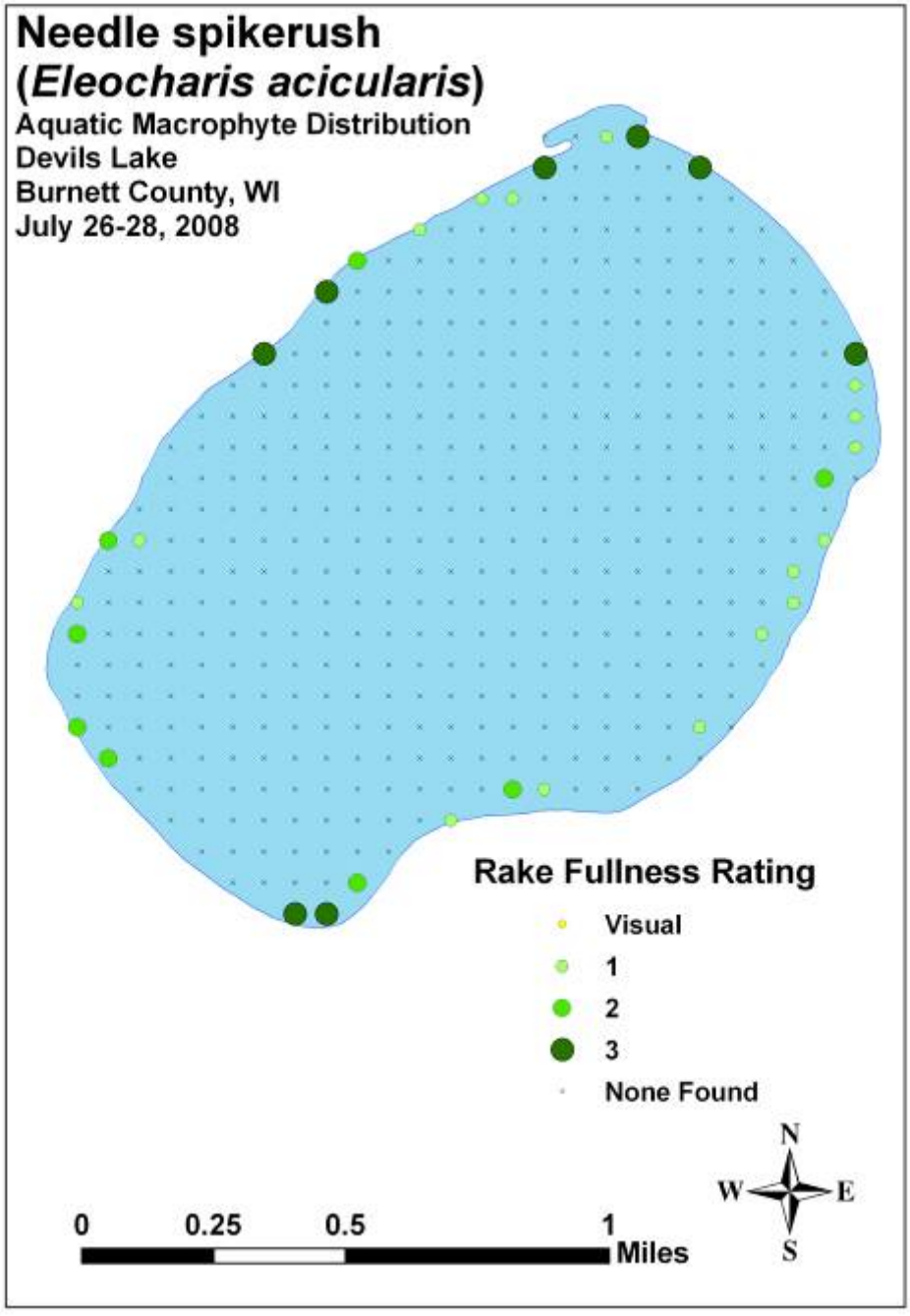

Aquatic moss
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

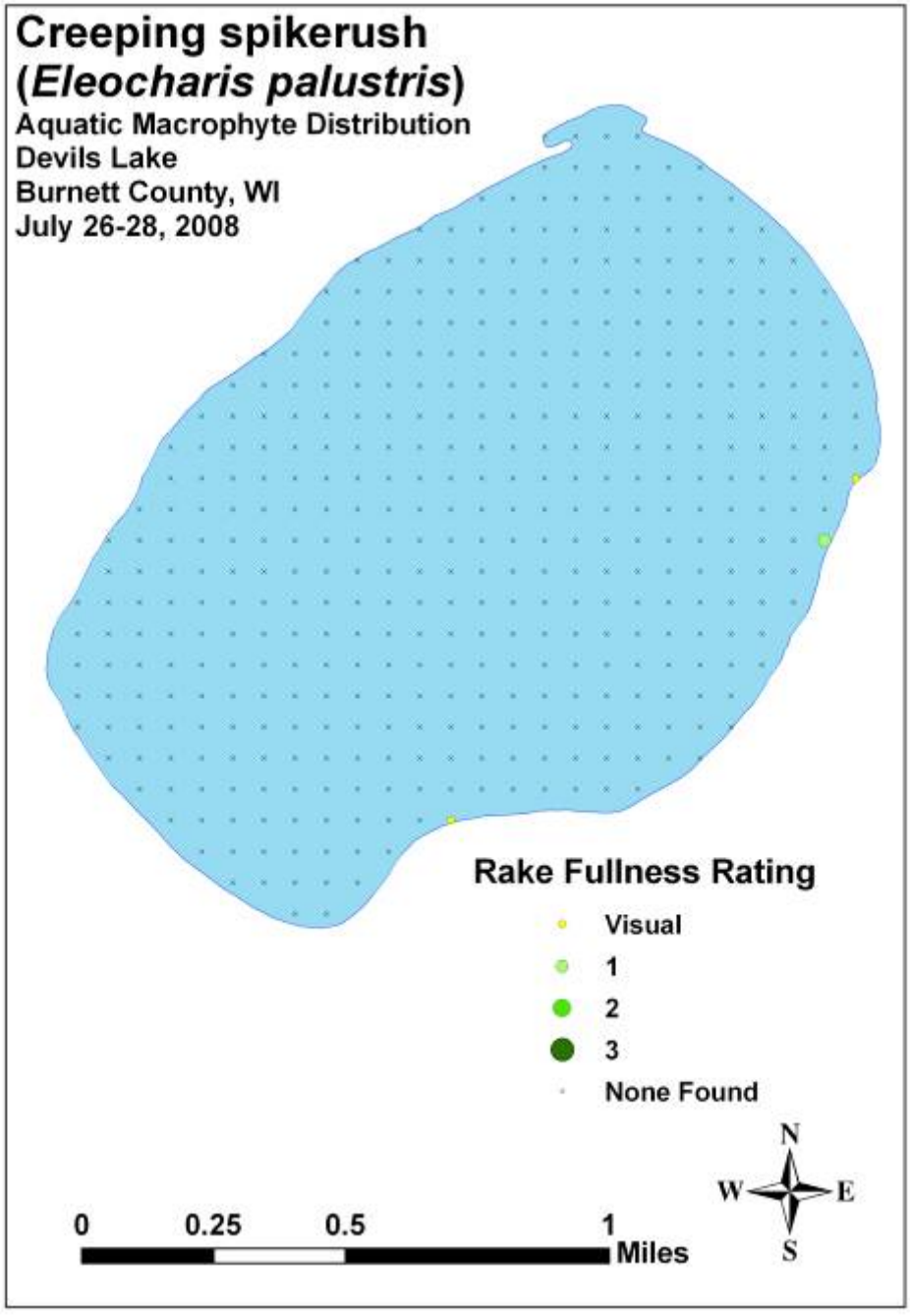

Watershield
(Brasenia schreberi)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

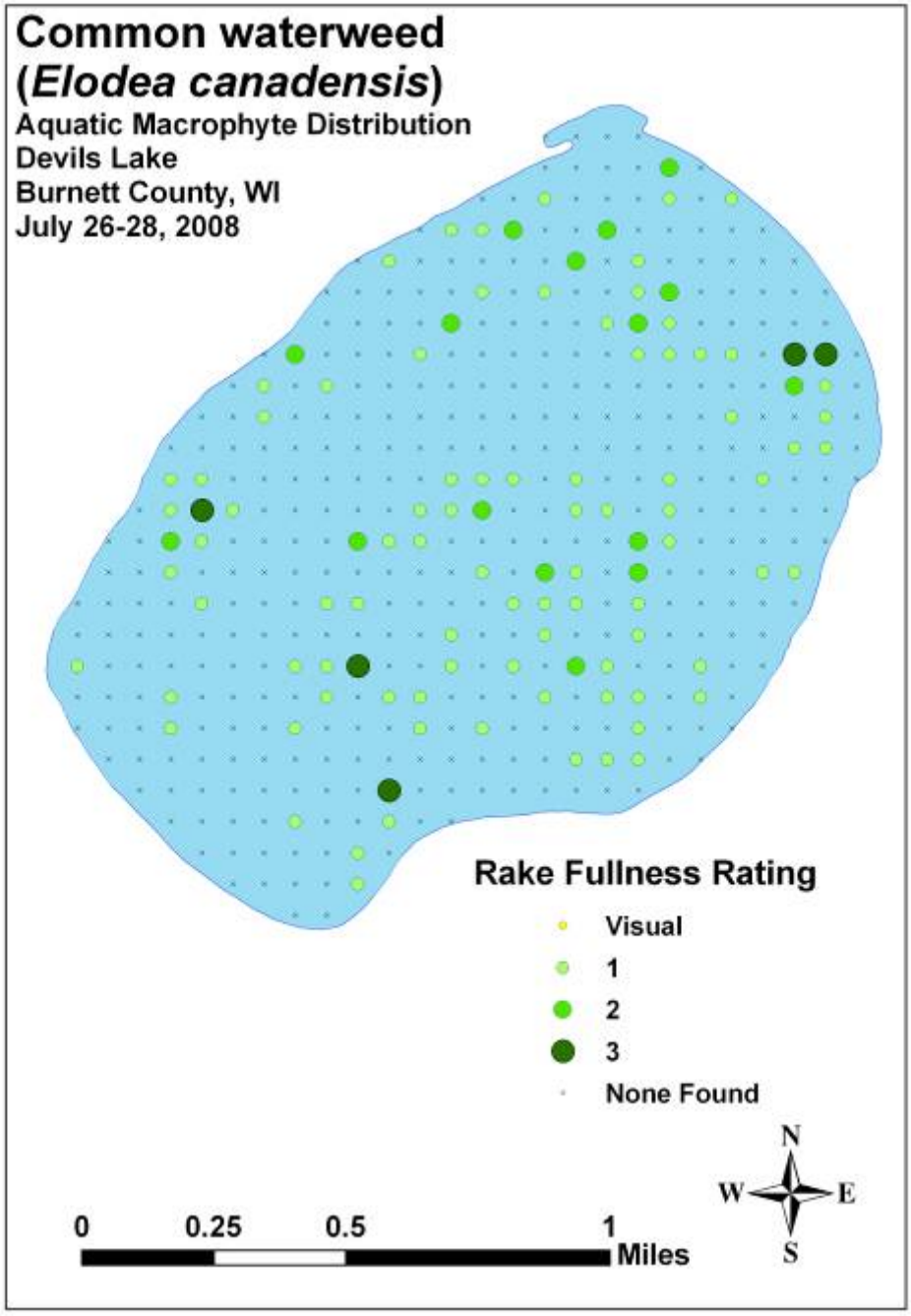

Coontail
(Ceratophyllum demersum)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

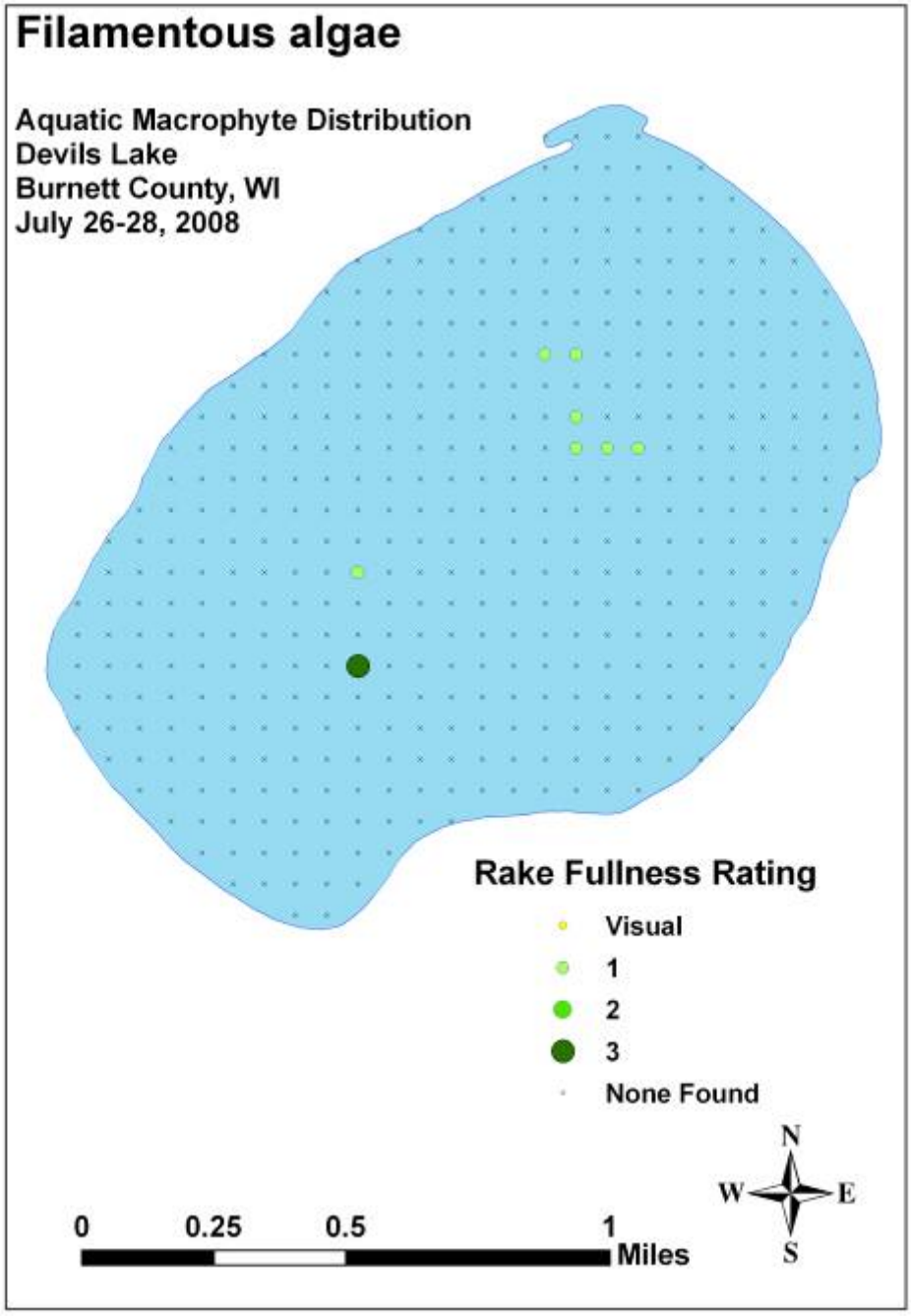

Muskgrass
(Chara sp.)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

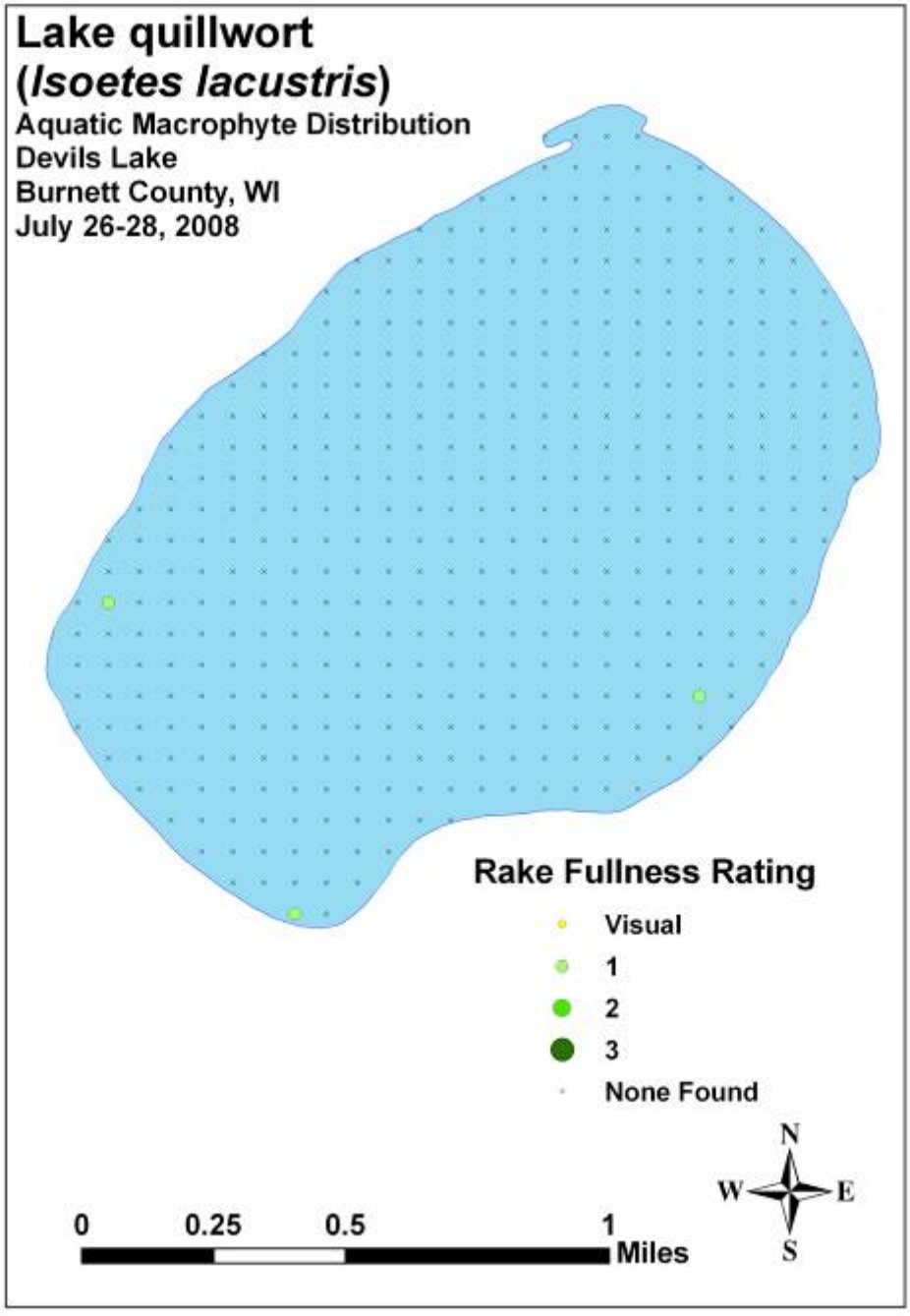

Waterwort
(Elatine minima)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

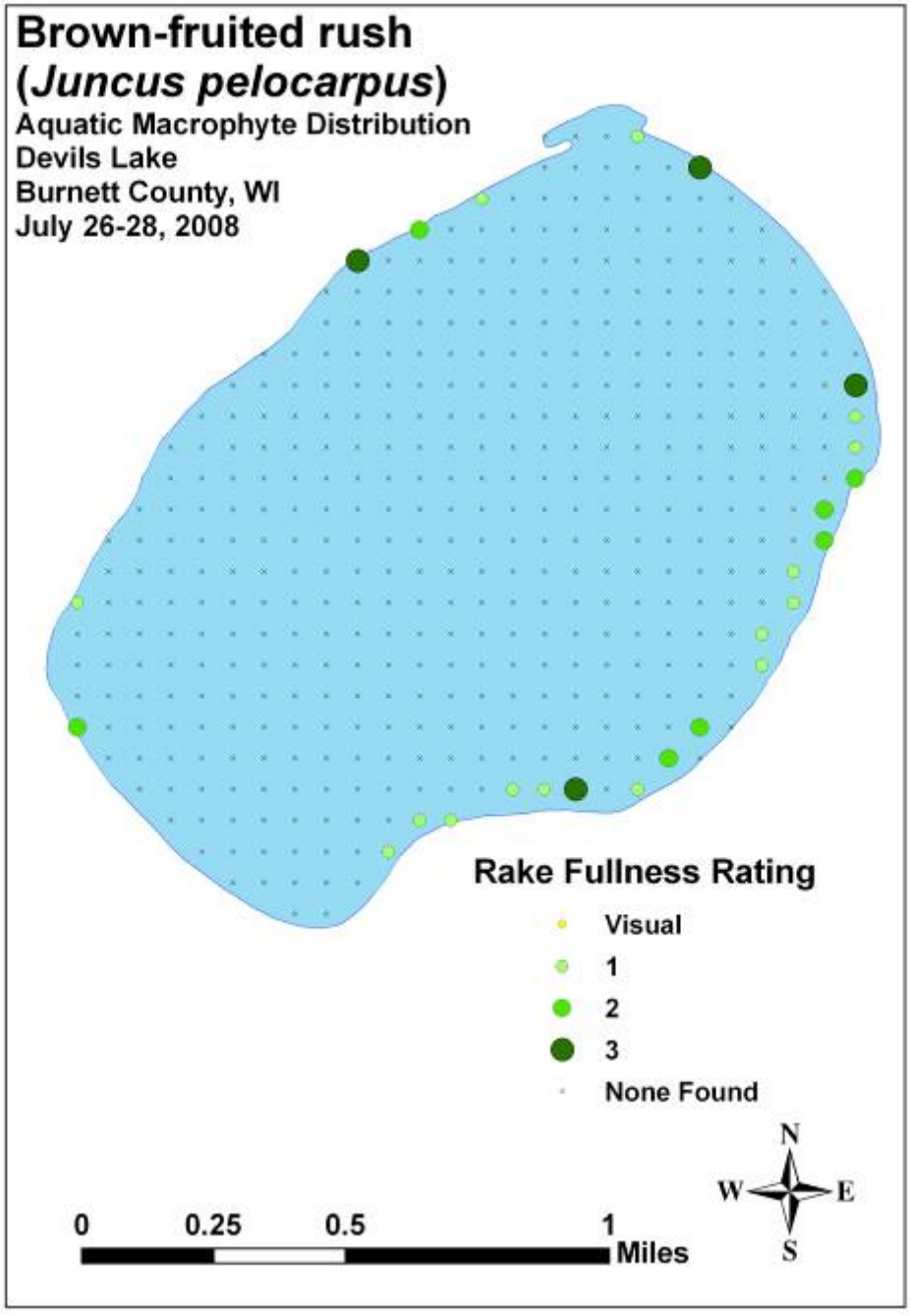

Needle spikerush
(Eleocharis acicularis)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

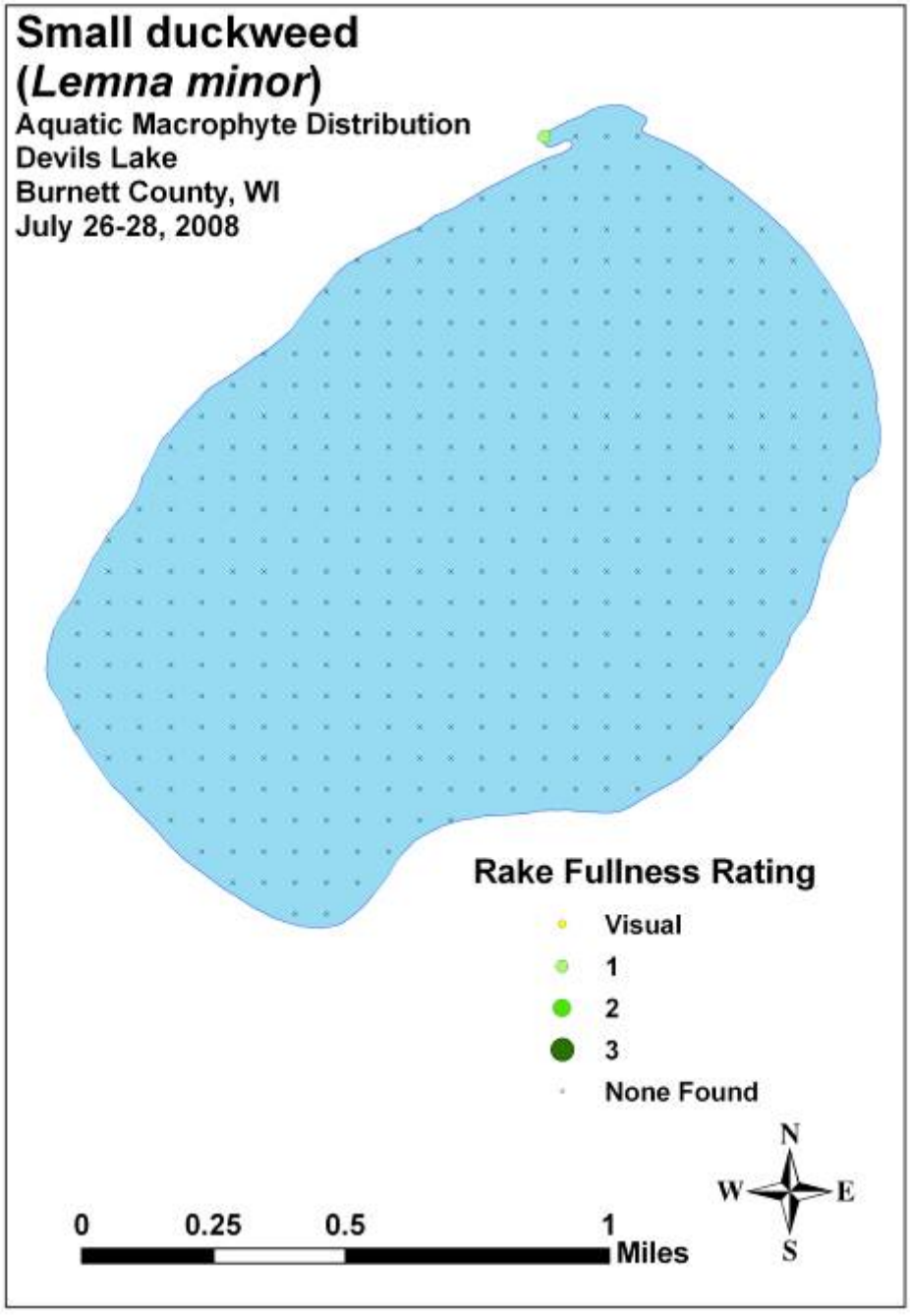

Creeping spikerush
(Eleocharis palustris)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

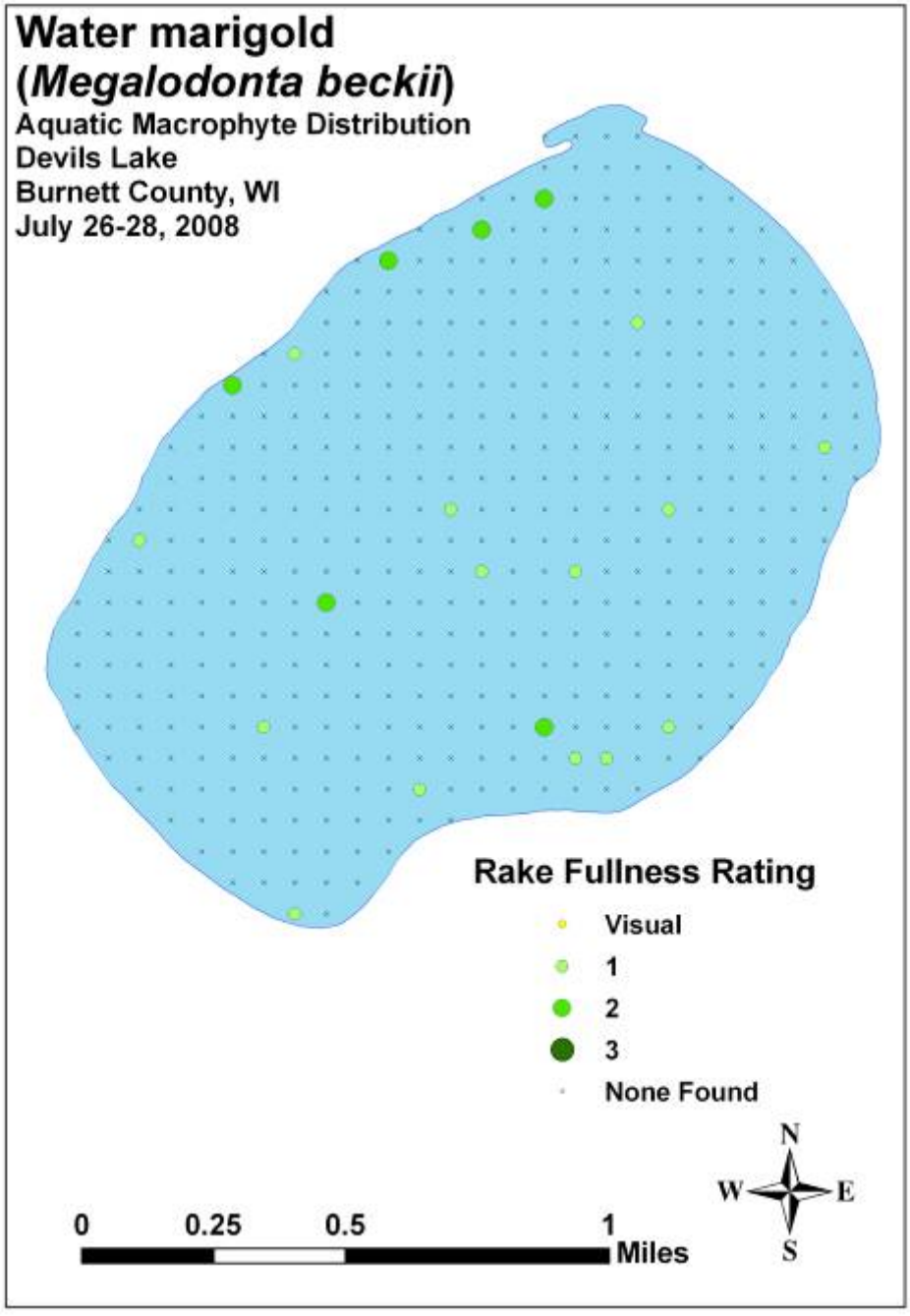

Common waterweed
(Elodea canadensis)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

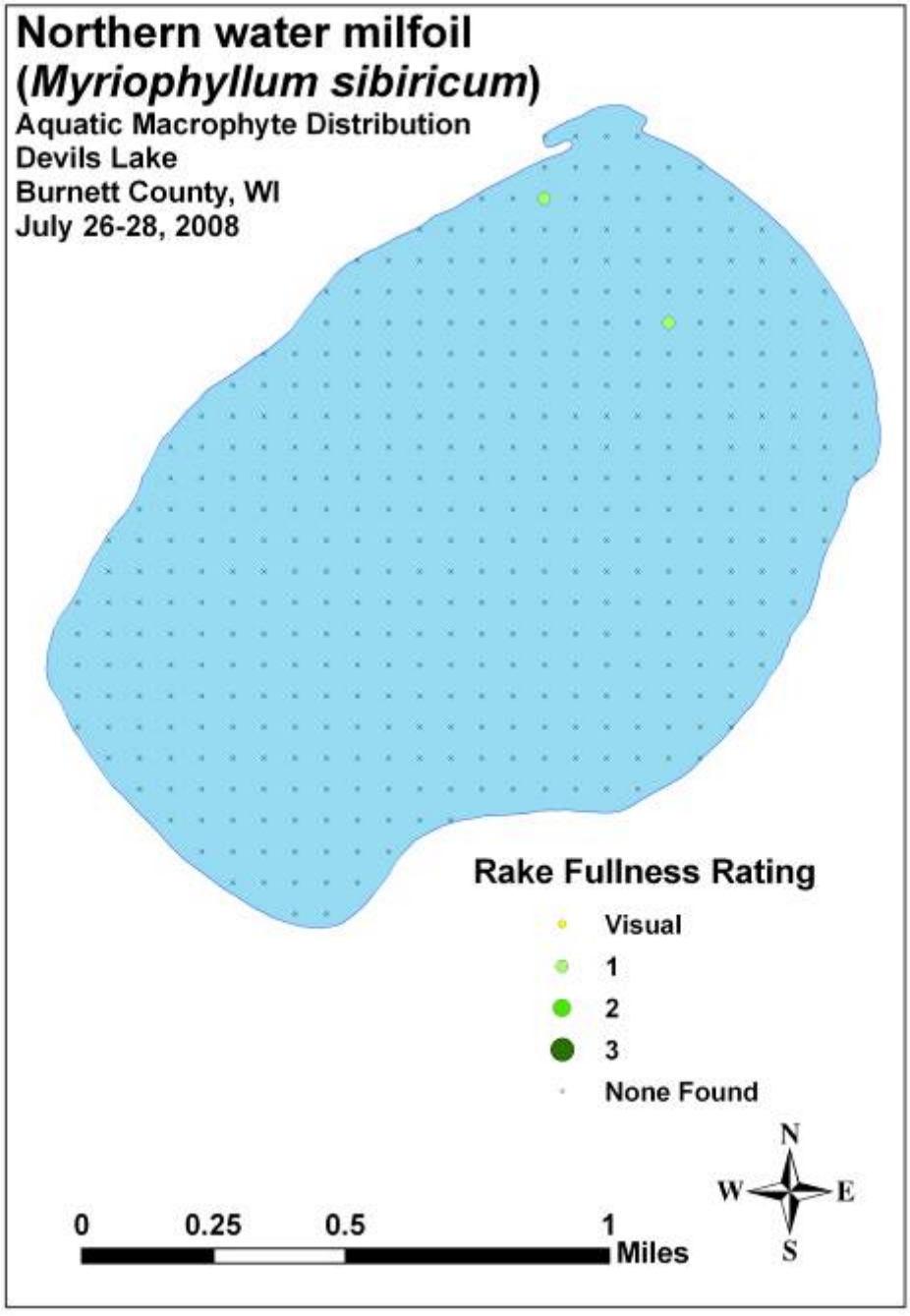

Filamentous algae
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

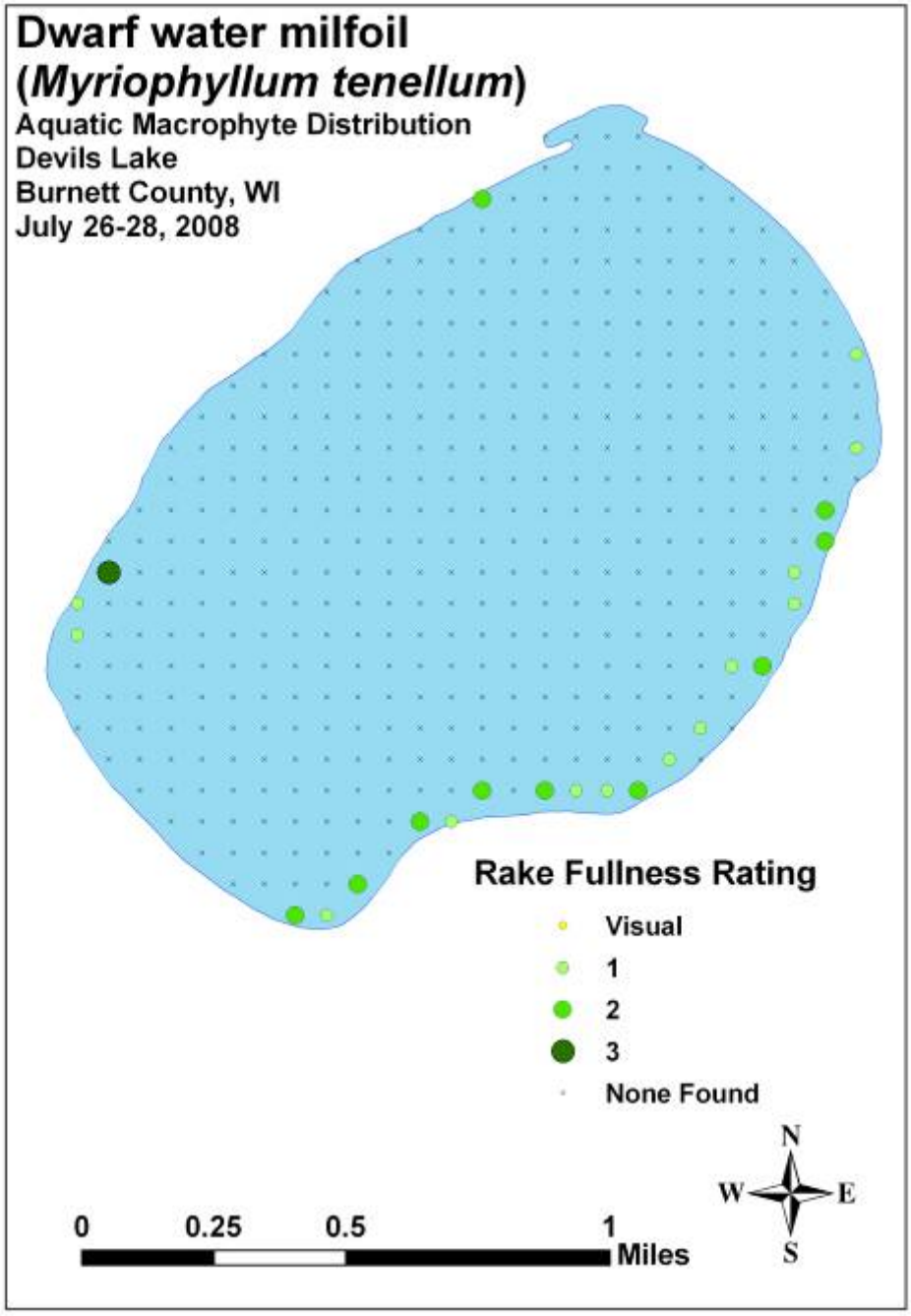

Lake quillwort
(Isoetes lacustris)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

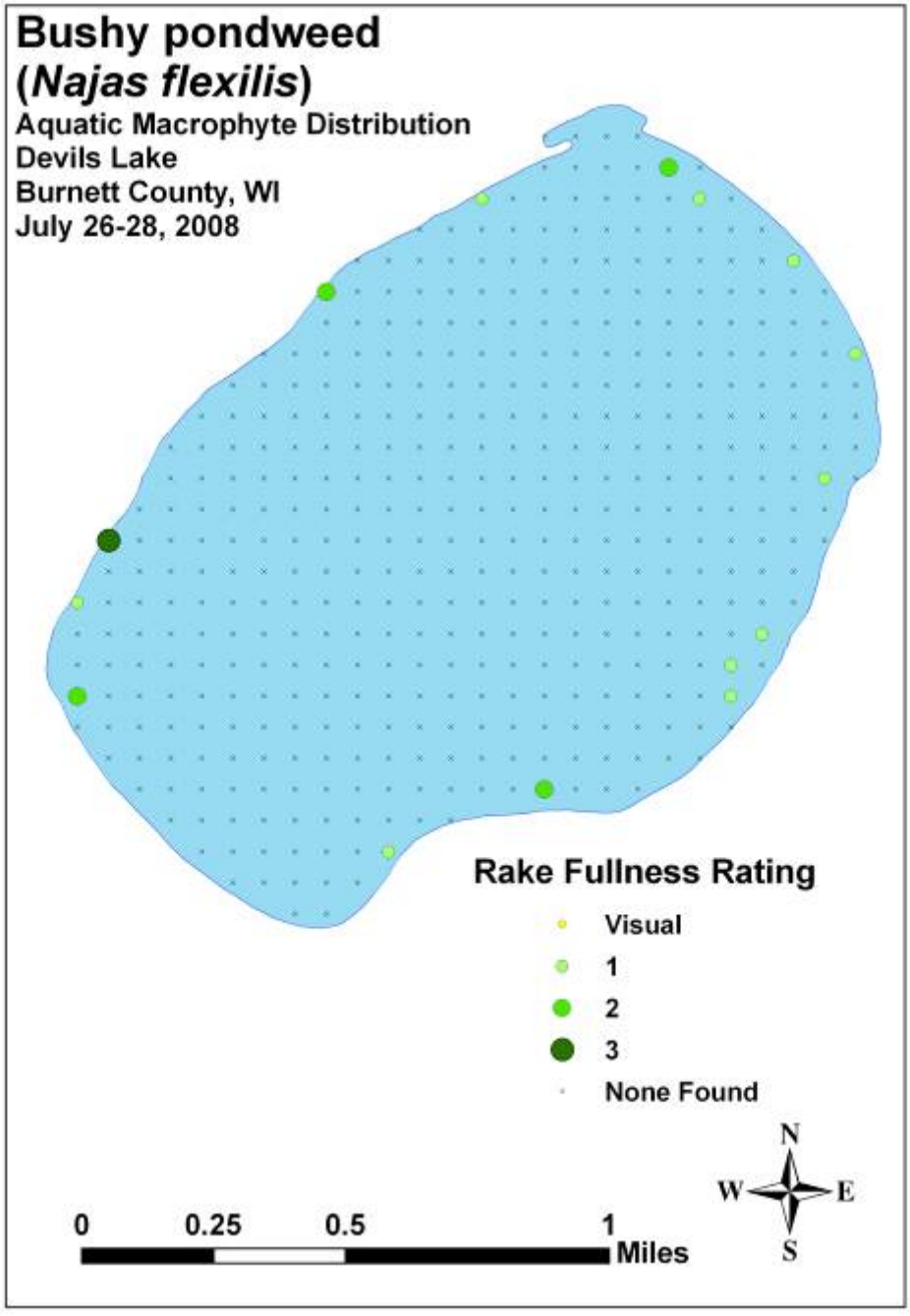

Brown-fruited rush
(Juncus pelocarpus)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

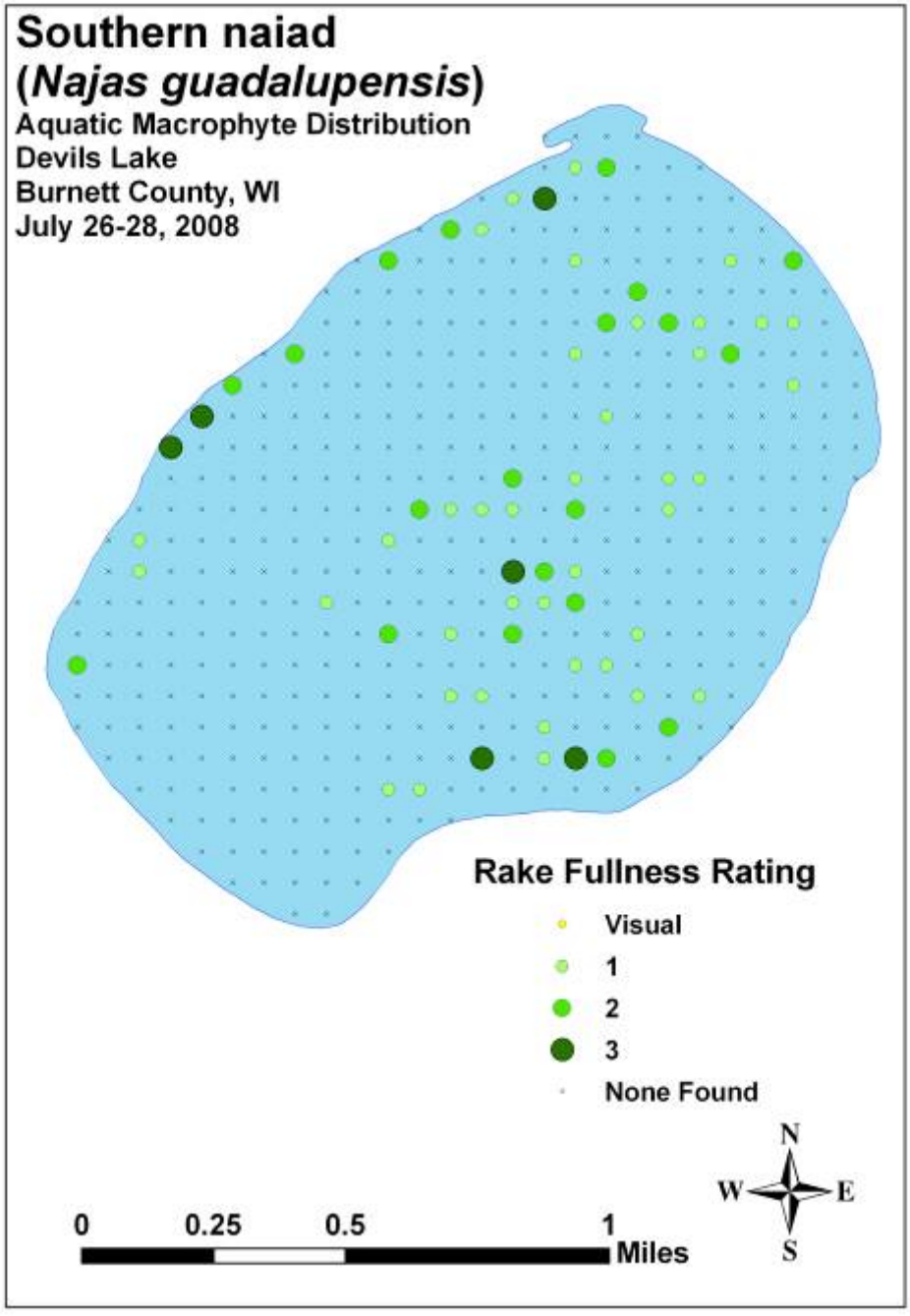

Small duckweed
(Lemna minor)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

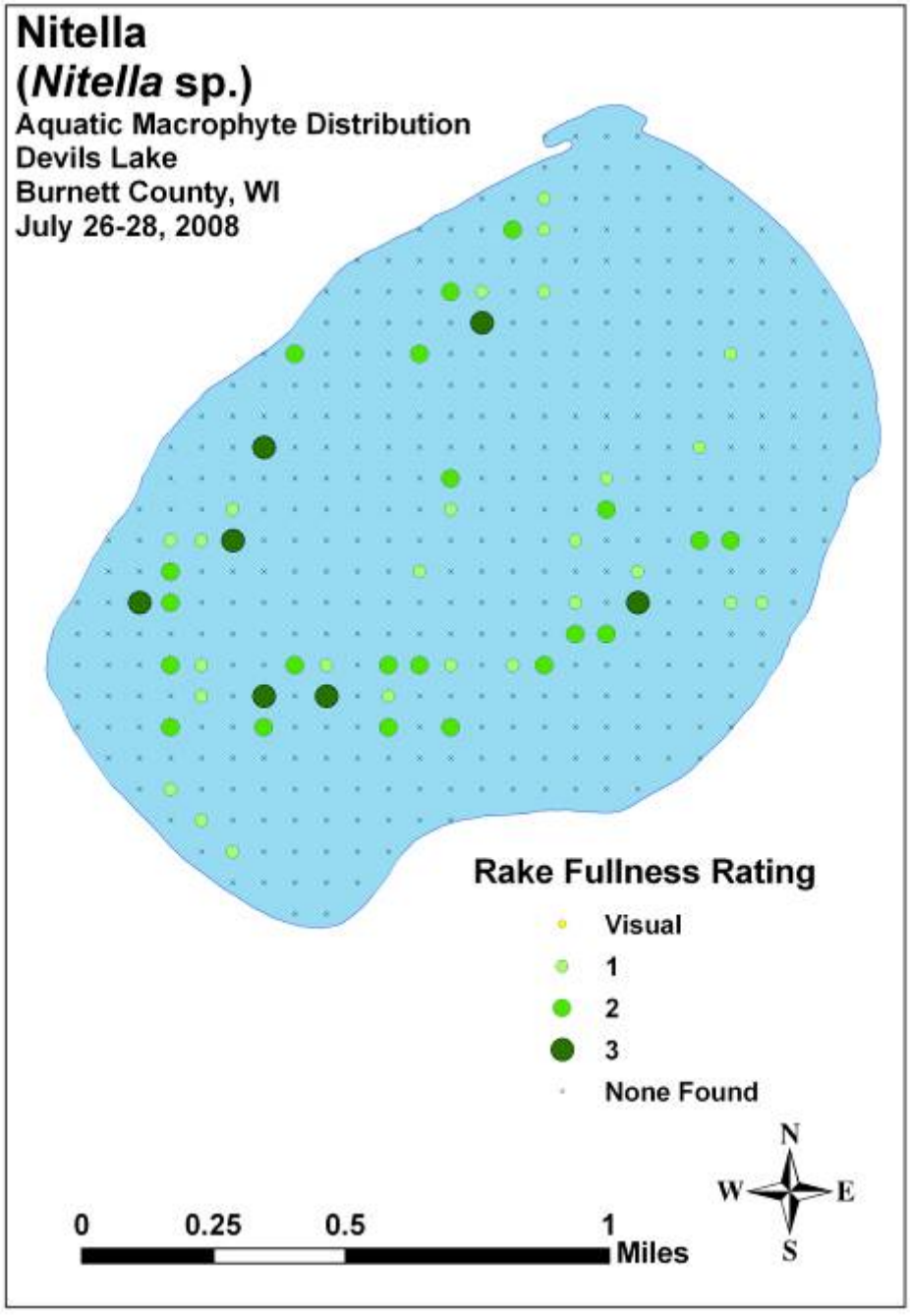

Water marigold
(Megalodonta beckii)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Northern water milfoil
(Myriophyllum sibiricum)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Dwarf water milfoil
(Myriophyllum tenellum)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Bushy pondweed
(Najas flexilis)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Southern naiad
(Najas guadalupensis)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Nitella
(*Nitella* sp.)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
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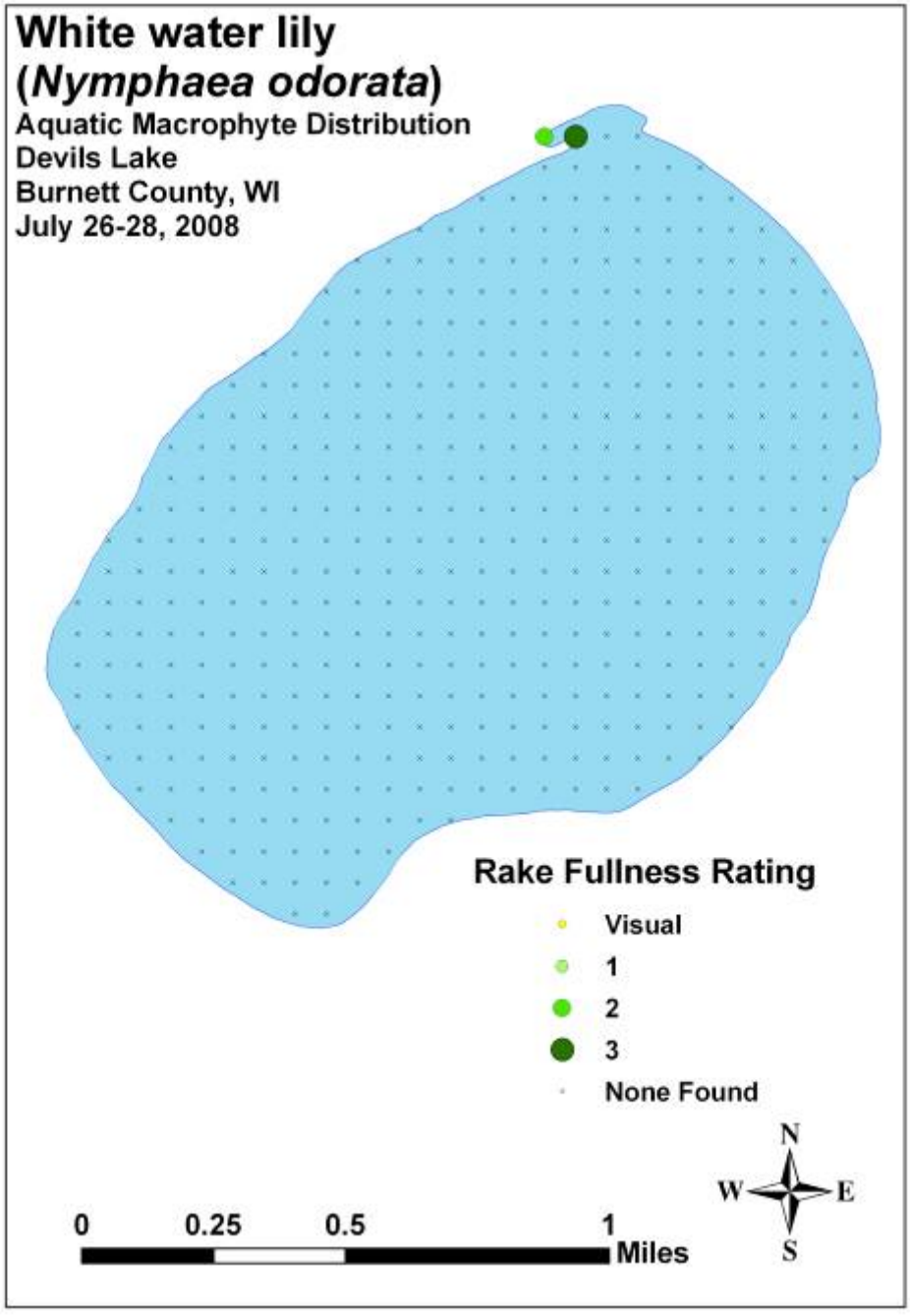
1
Miles


White water lily
(Nymphaea odorata)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
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None Found
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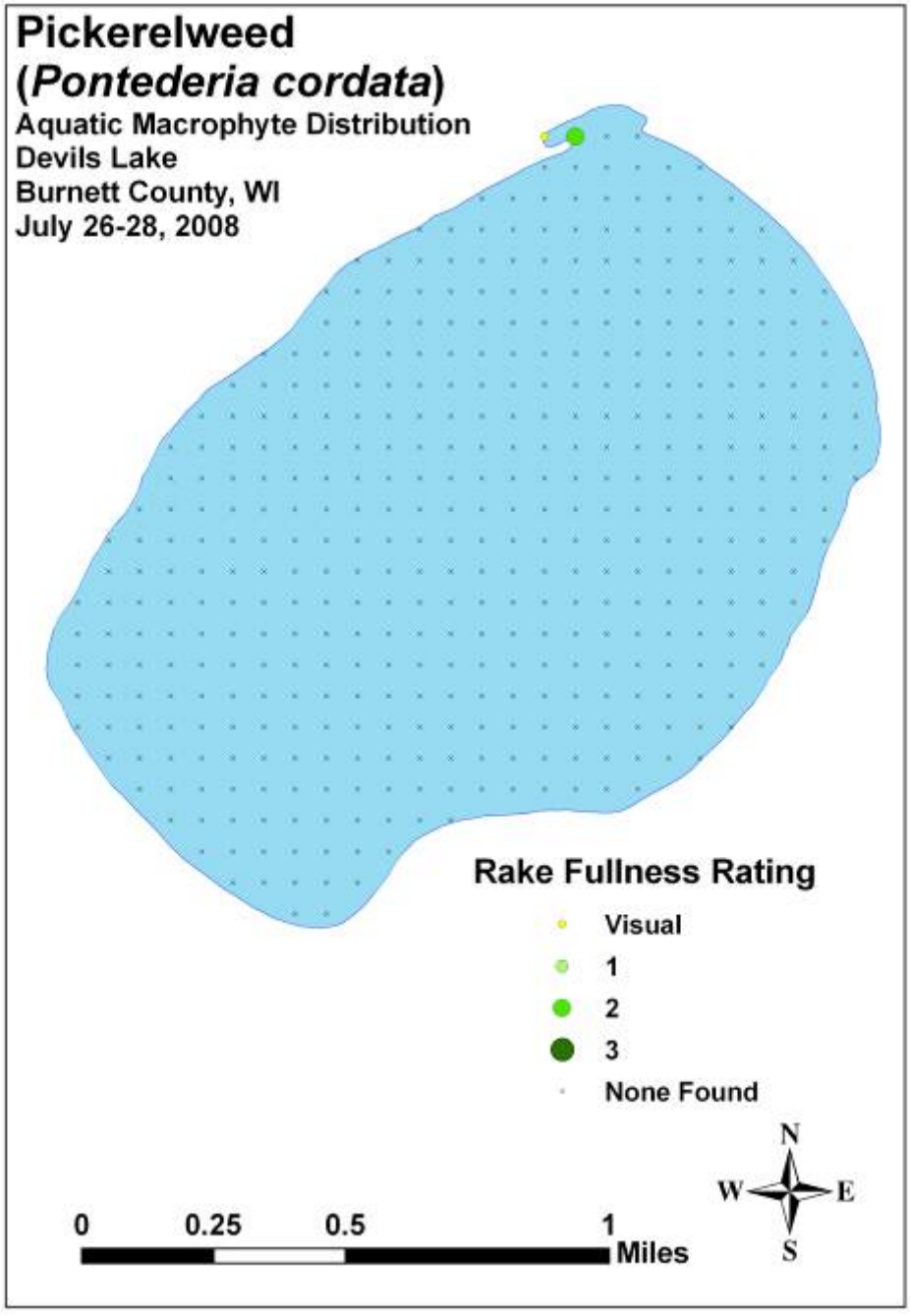
Miles


Pickerelweed
(Pontederia cordata)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
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None Found
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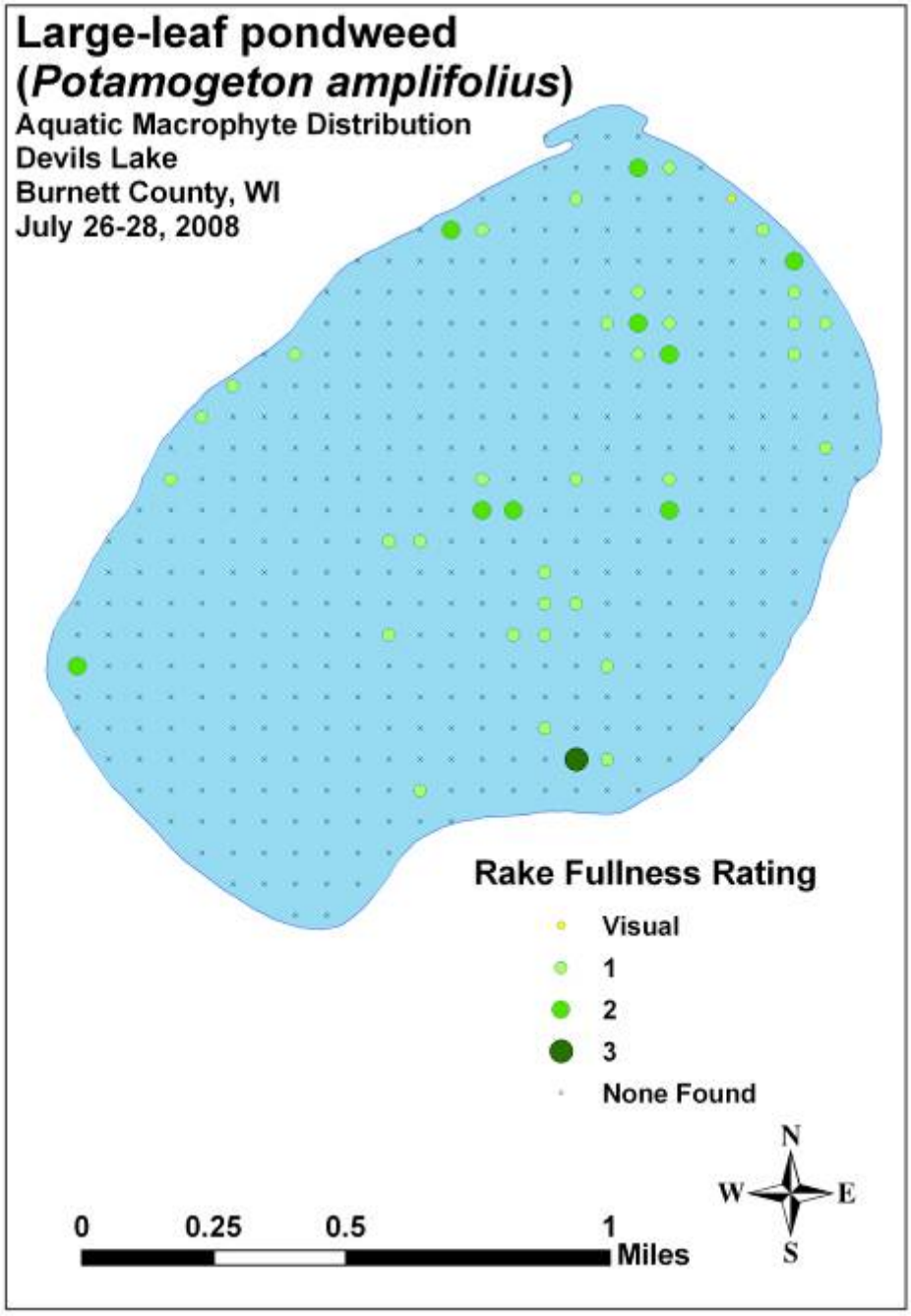
Miles


Large-leaf pondweed
(Potamogeton amplifolius)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
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None Found
N
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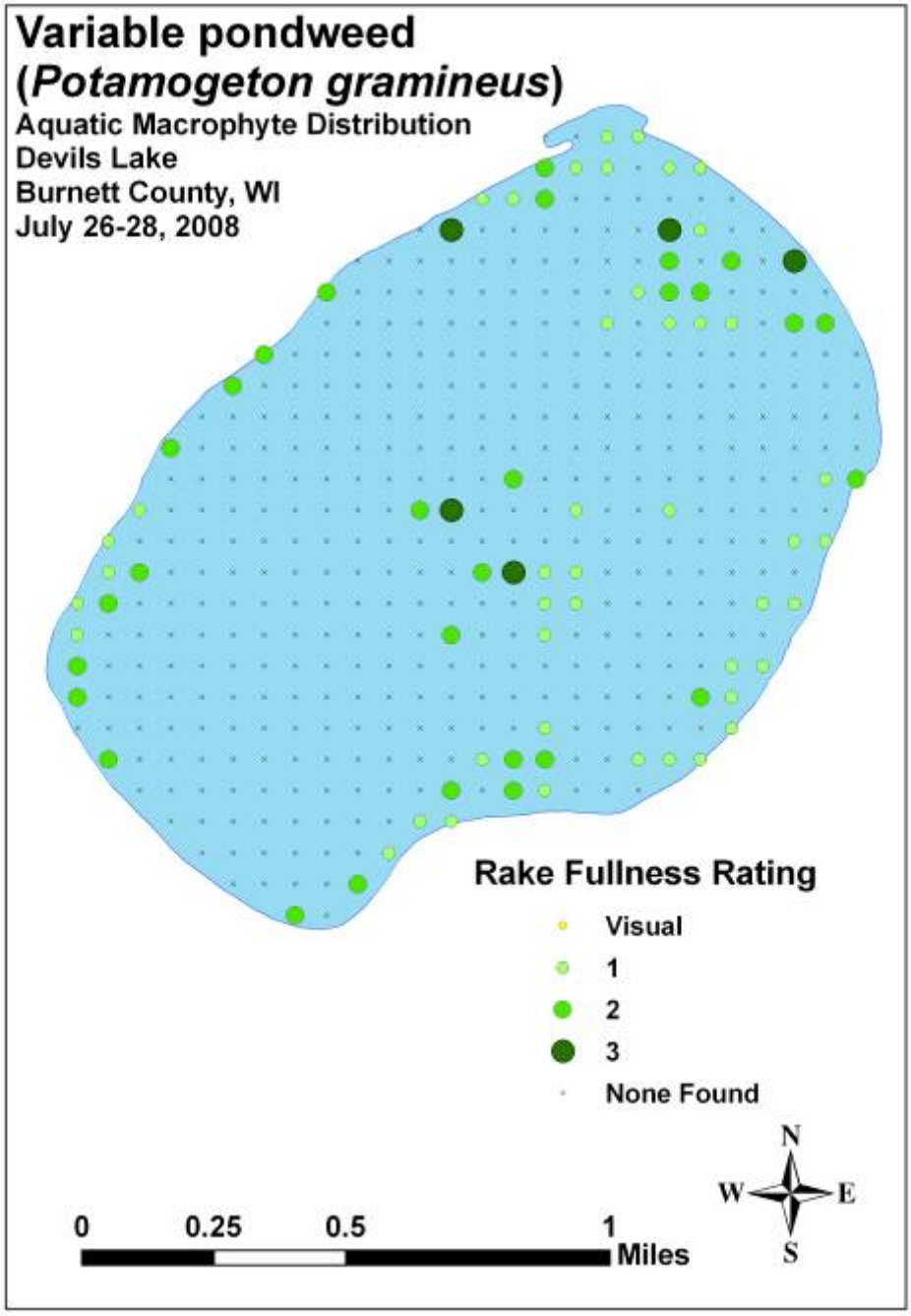
0.5
1
Miles


Variable pondweed
(Potamogeton gramineus)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
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2
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None Found
N
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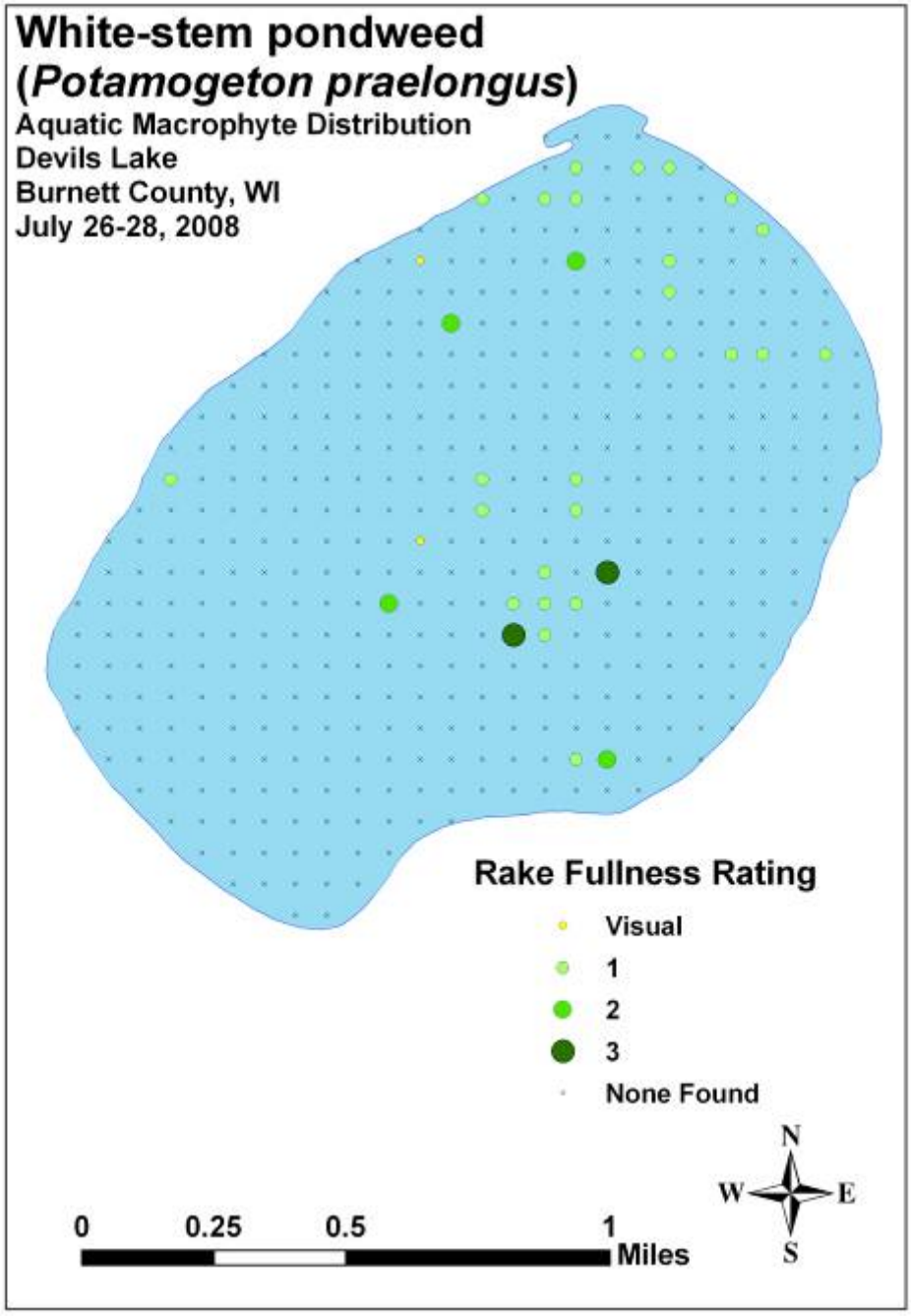
1
Miles


White-stem pondweed
(Potamogeton praelongus)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
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None Found
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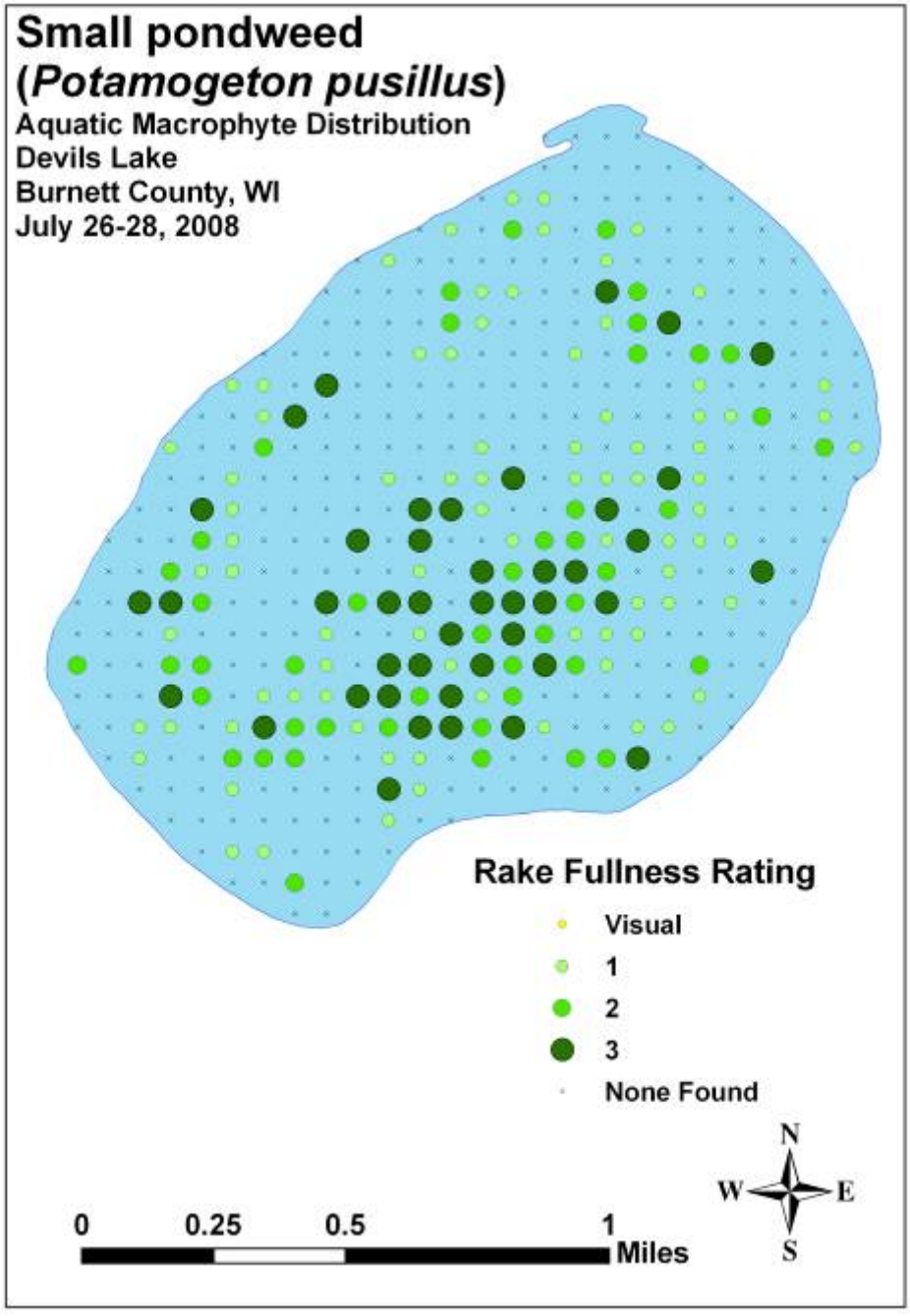
Miles


Small pondweed
(Potamogeton pusillus)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
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None Found
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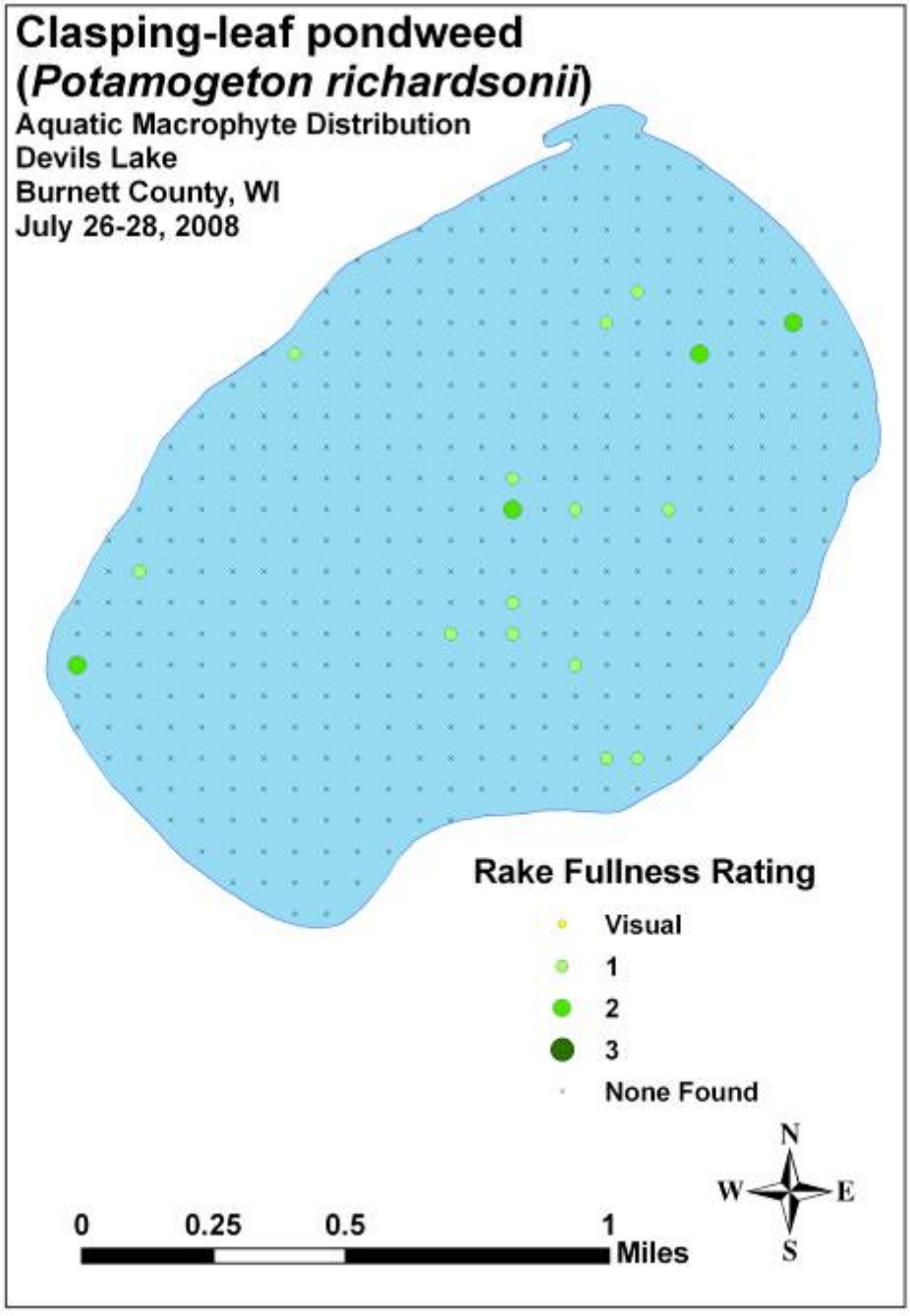
Miles


Clasping-leaf pondweed
(Potamogeton richardsonii)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
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None Found
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0.5
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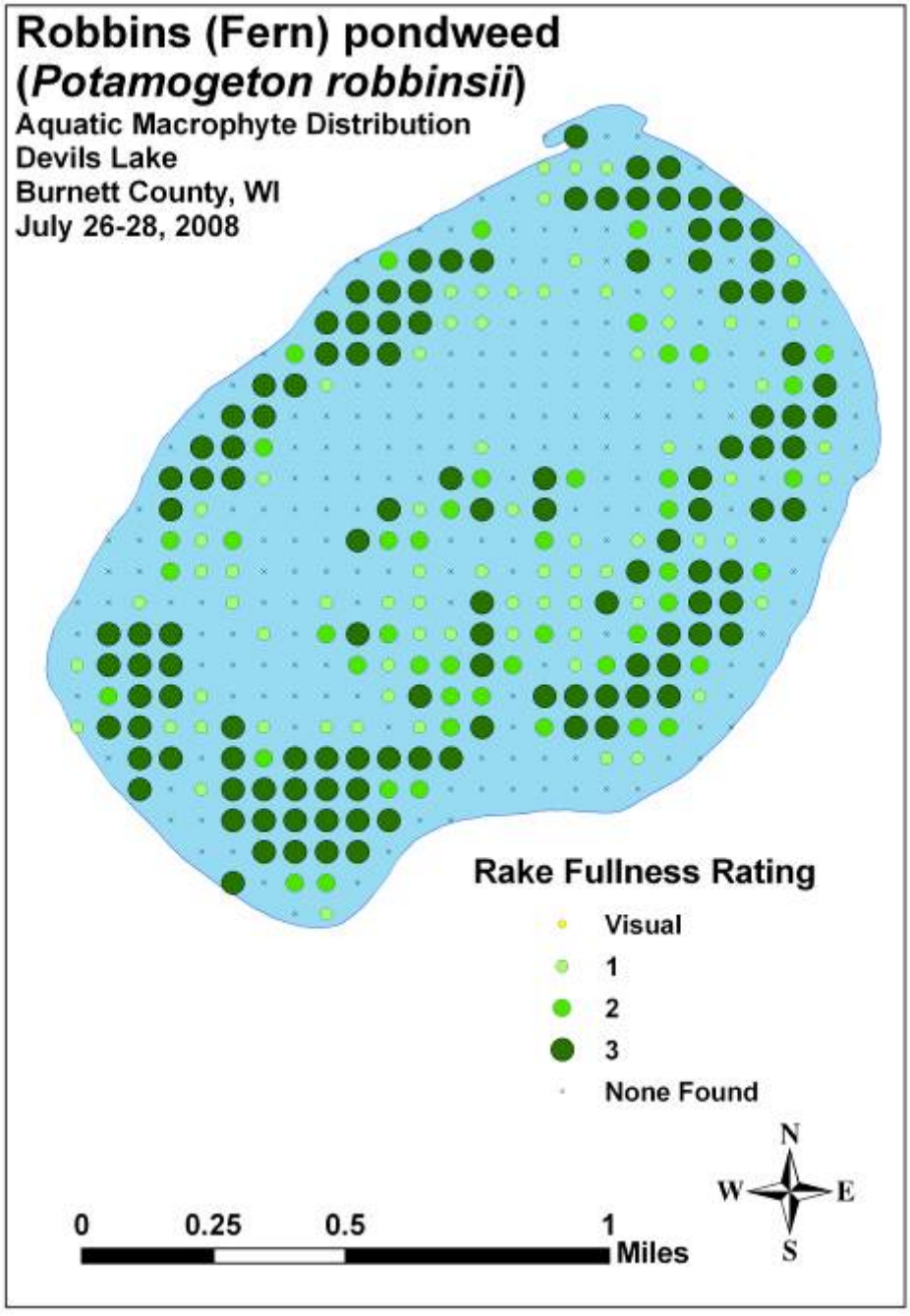
Miles


Robbins (Fern) pondweed
(Potamogeton robbinsii)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
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None Found
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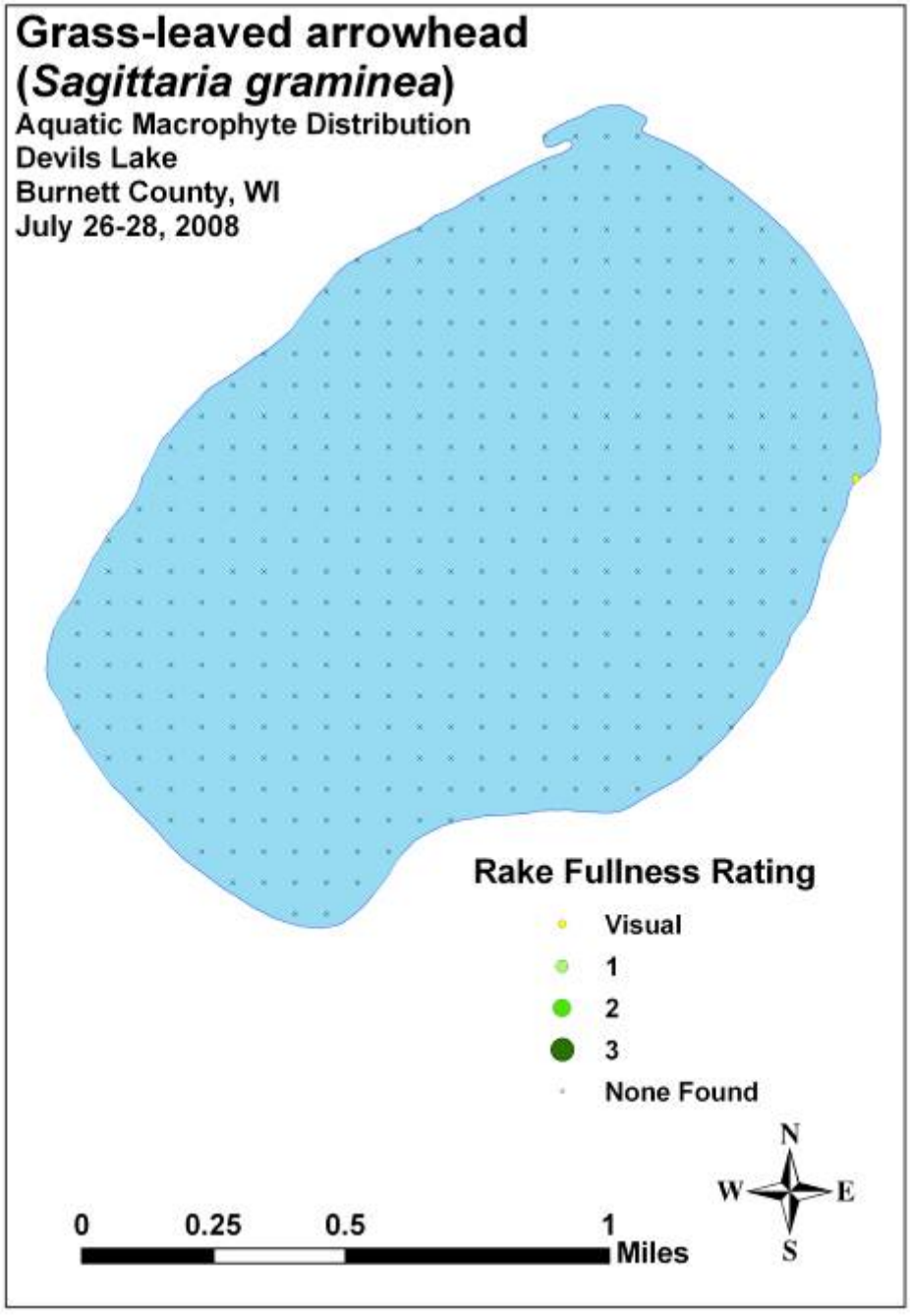
0.5
1
Miles


Grass-leaved arrowhead
(Sagittaria graminea)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
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None Found
N
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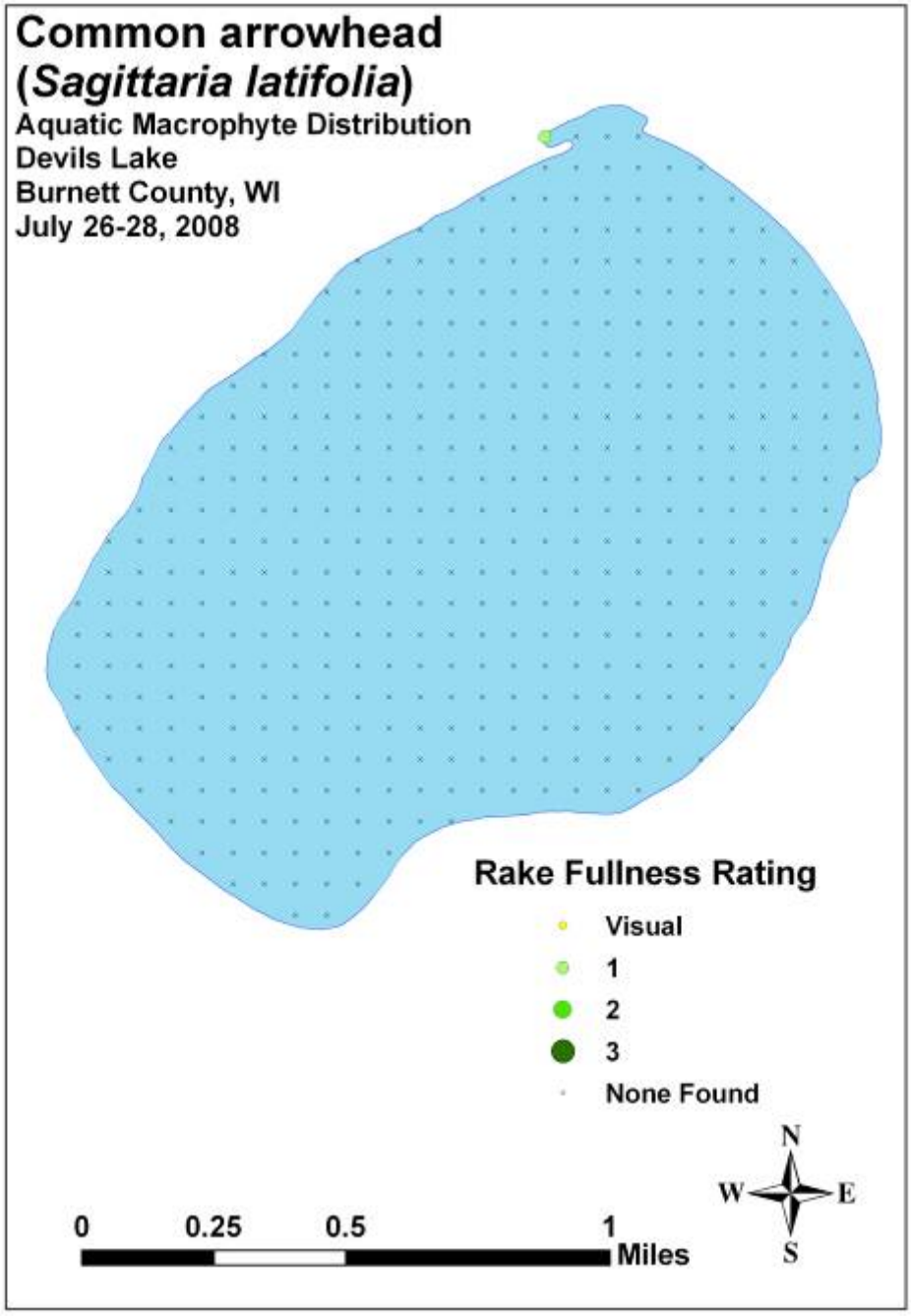
0.5
1
Miles


Common arrowhead
(Sagittaria latifolia)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
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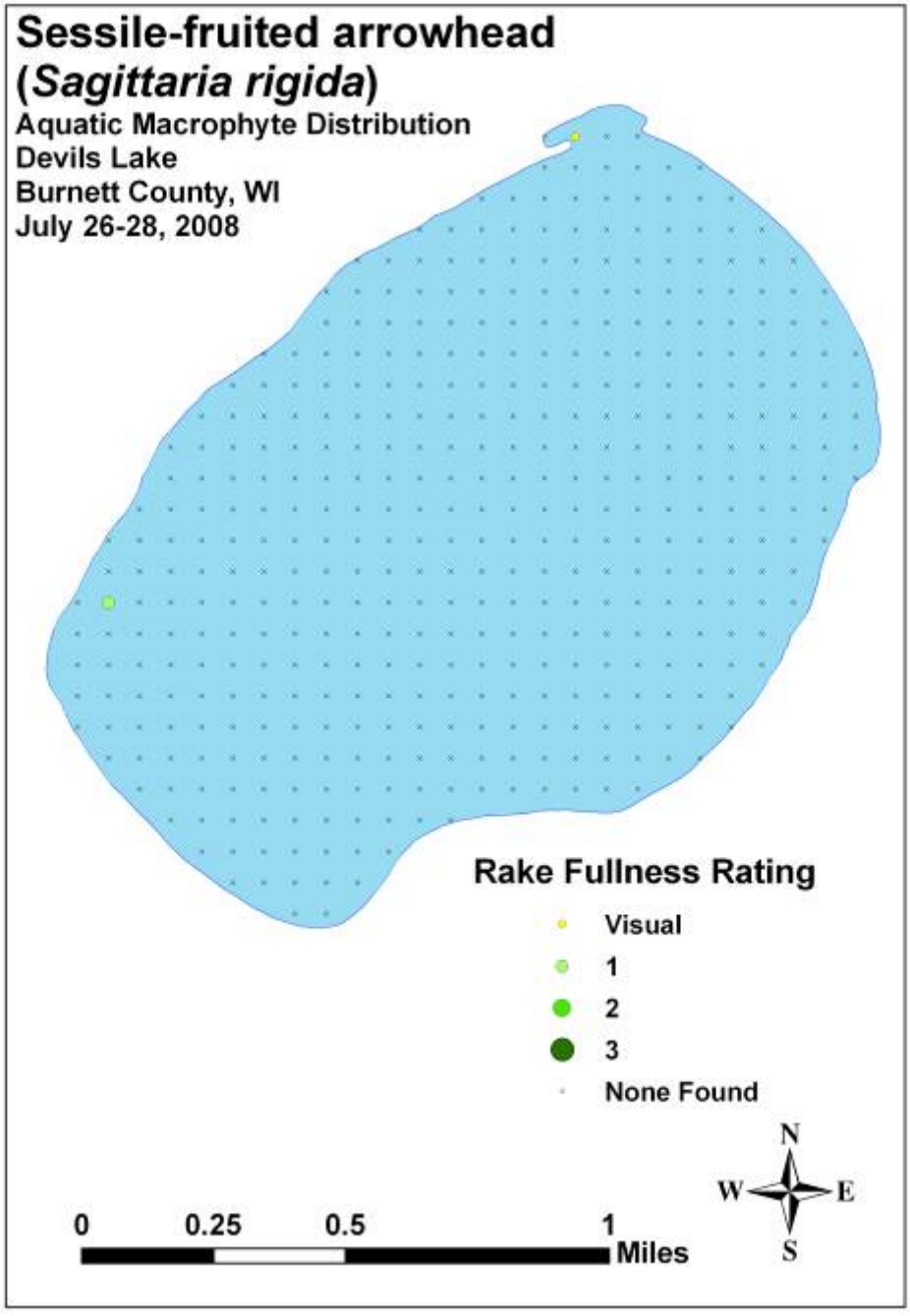
S
0
0.25
0.5
1
Miles


Sessile-fruited arrowhead
(Sagittaria rigida)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
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None Found
N
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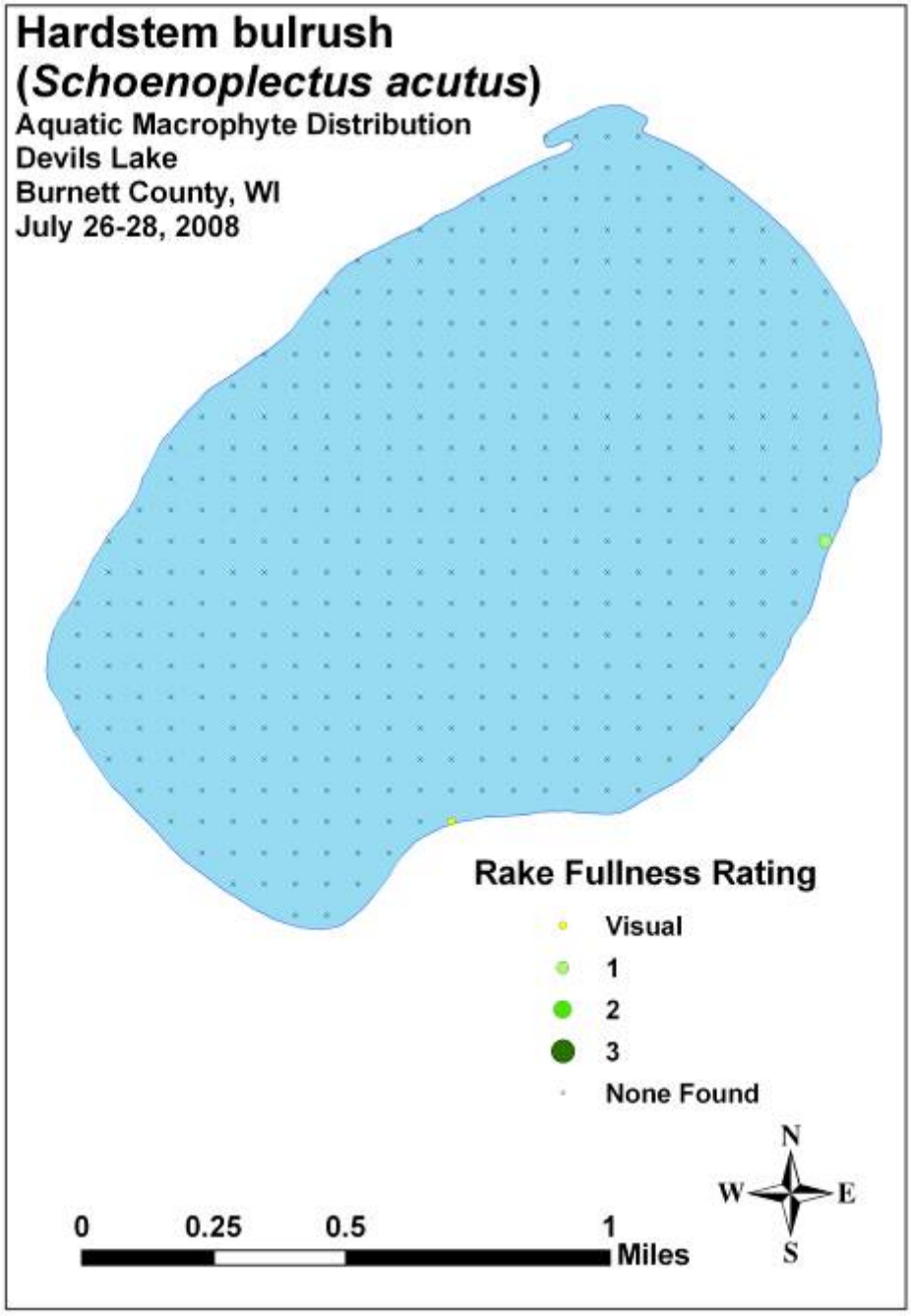
0.5
1
Miles


Hardstem bulrush
(Schoenoplectus acutus)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
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None Found
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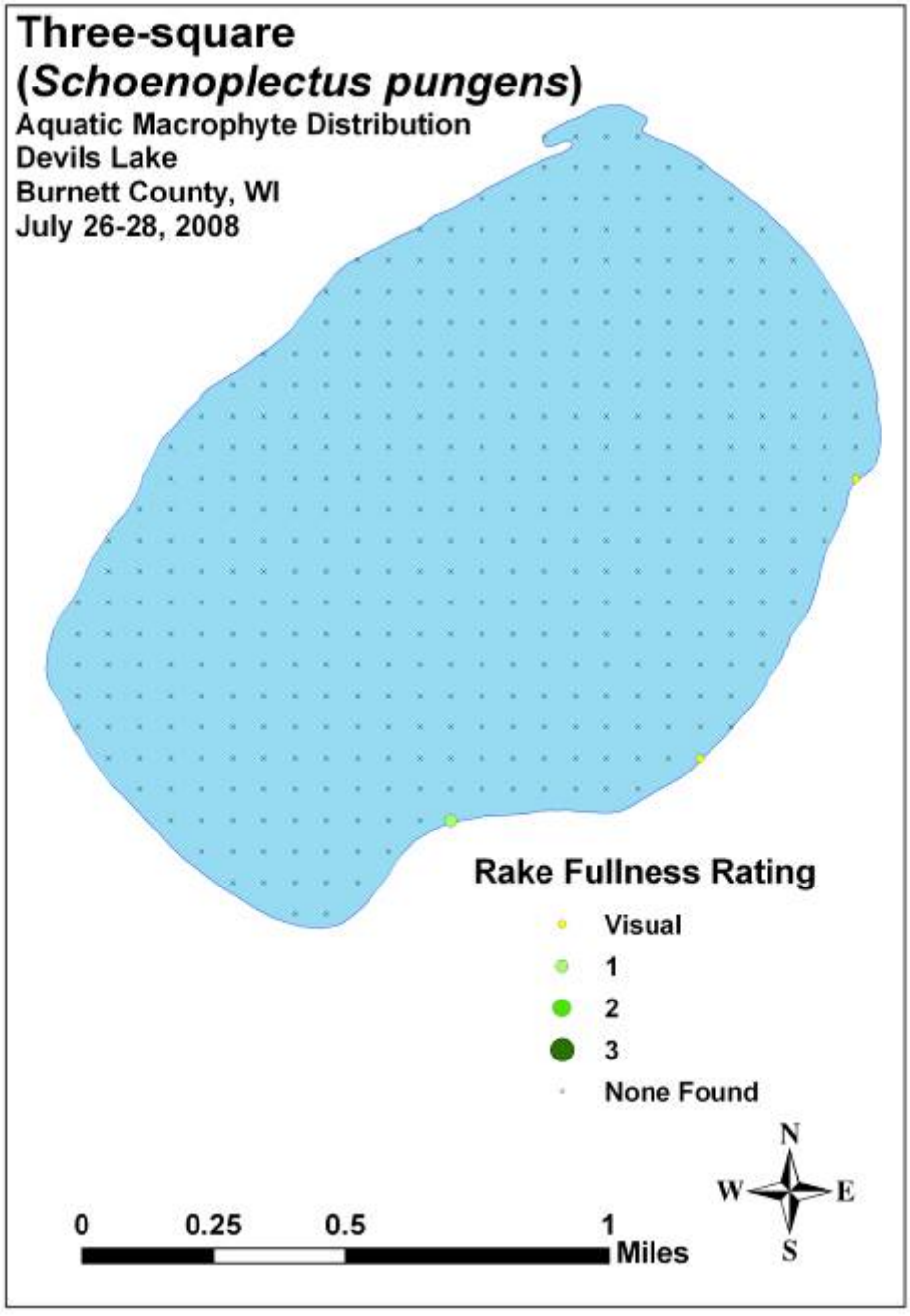
Miles


Three-square
(Schoenoplectus pungens)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
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None Found
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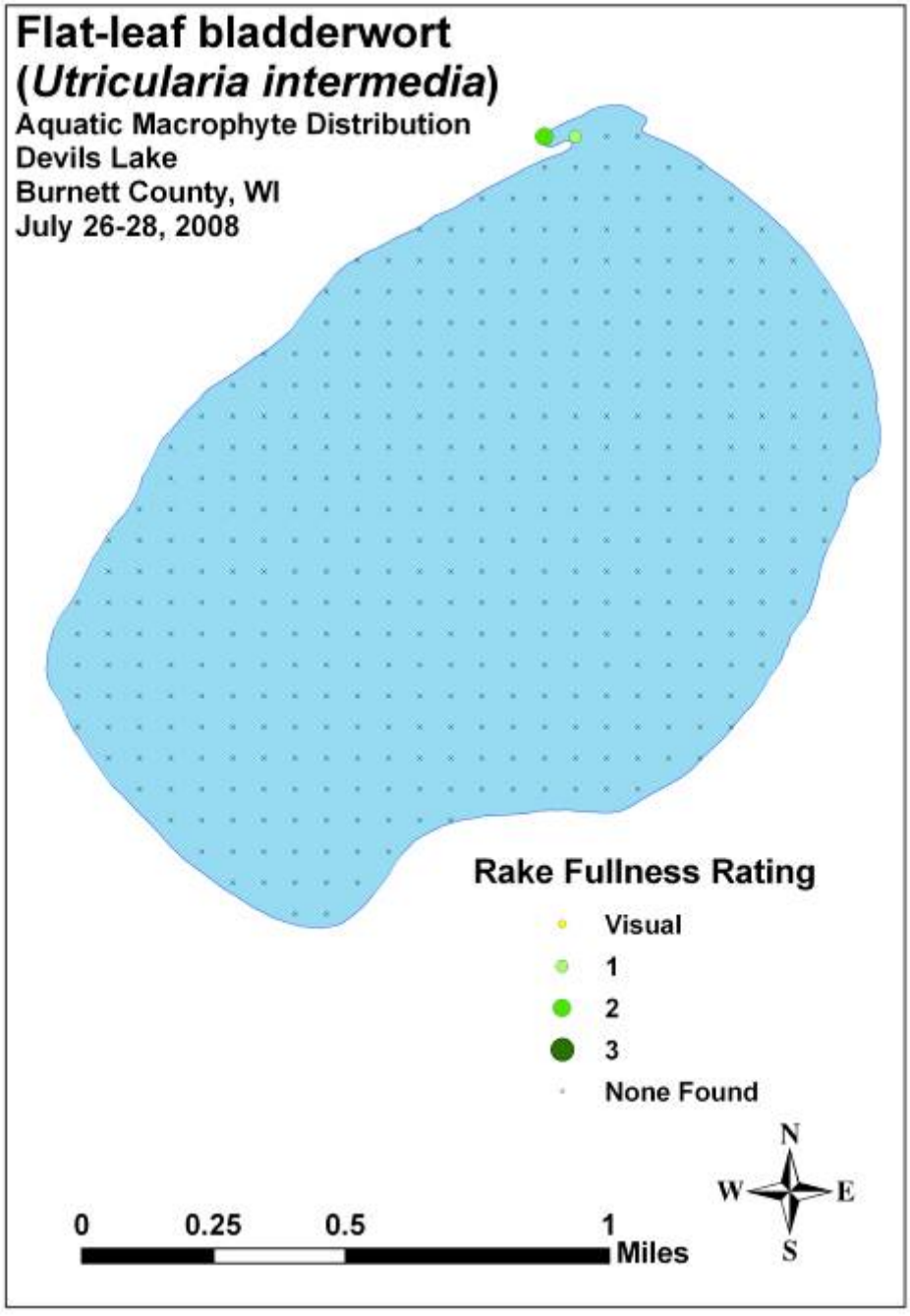
Miles


Flat-leaf bladderwort
(Utricularia intermedia)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
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3
None Found
N
W
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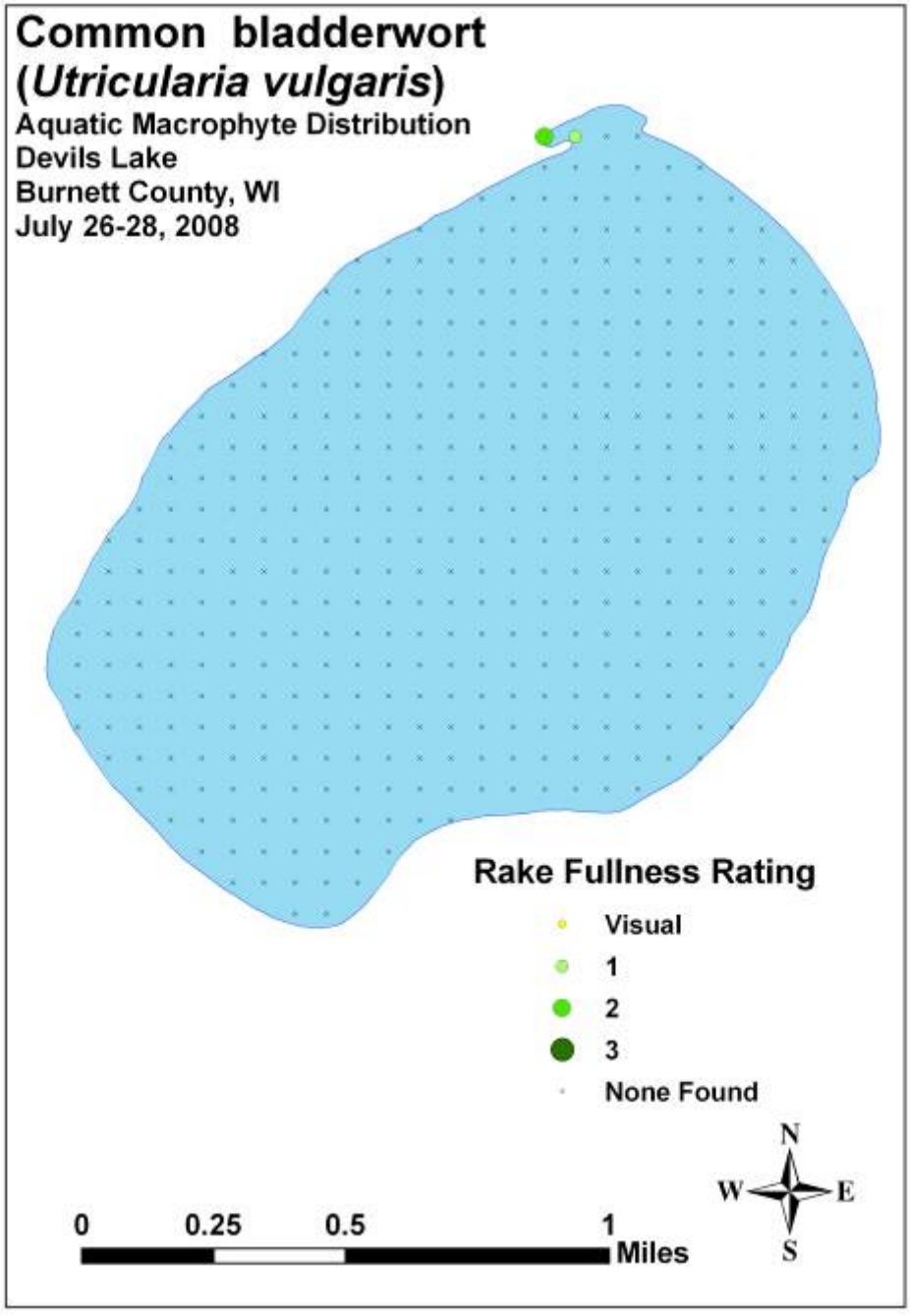
0.5
1
Miles


Common bladderwort
(Utricularia vulgaris)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
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0.5
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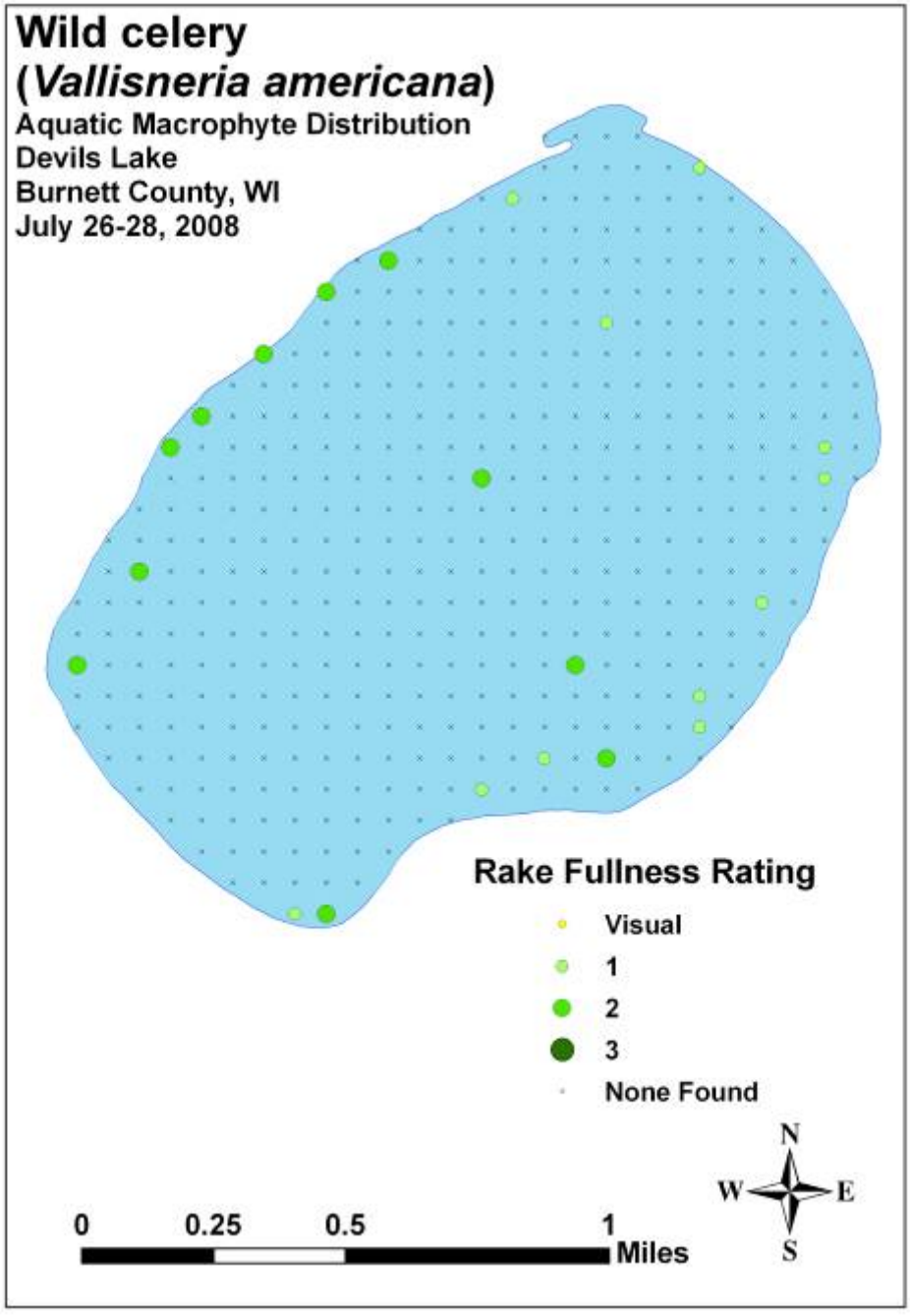
Miles


Wild celery
(Vallisneria americana)
Aquatic Macrophyte Distribution
Devils Lake
Burnett County, WI
July 26-28, 2008
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
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0
0.25
0.5
1
Miles

Appendix VII: Glossary of Biological Terms
(Adapted from UWEX 2008)

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.

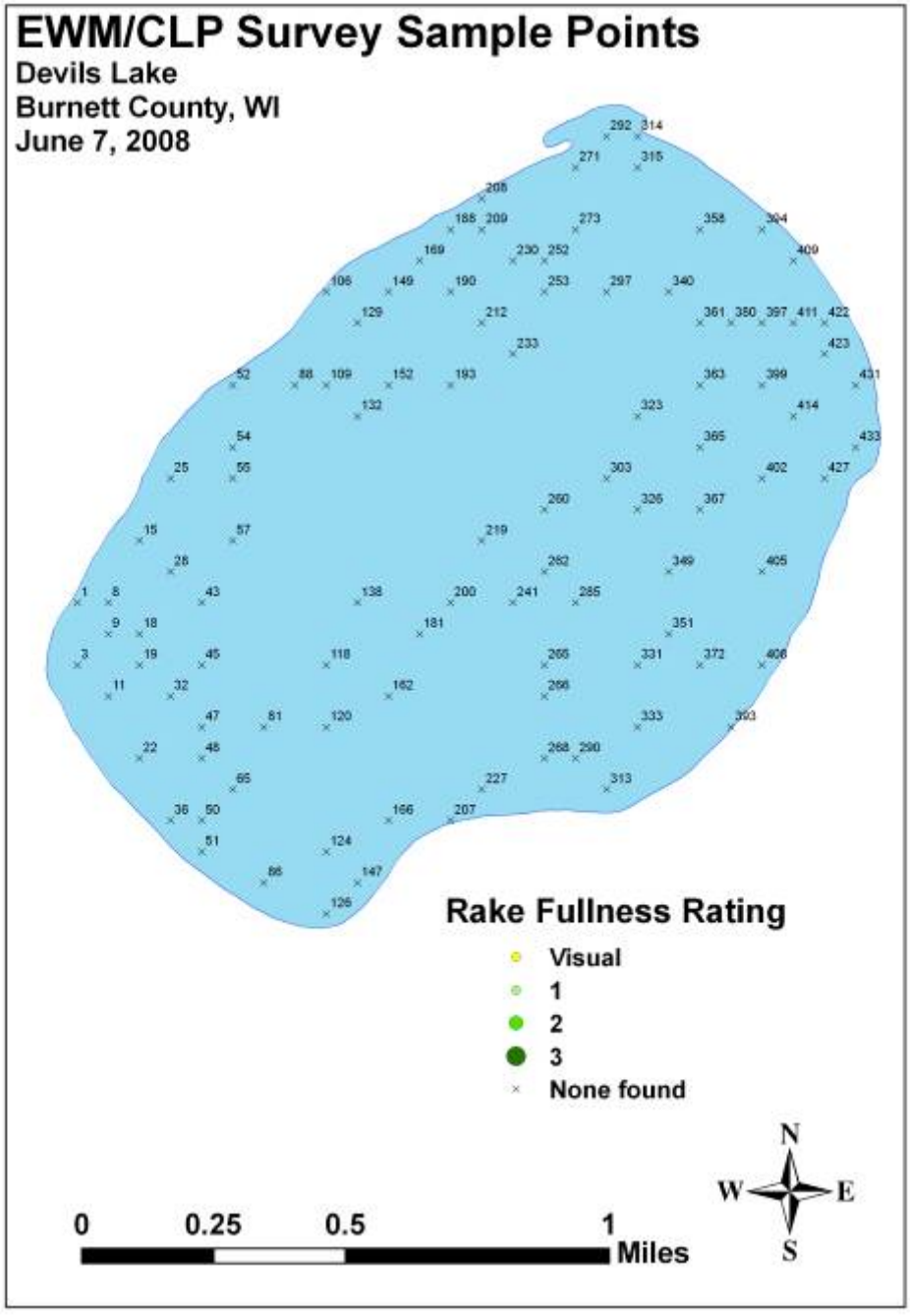
Watershed:

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 Map and Information


EWM/CLP Survey Sample Points
Devils Lake
Burnett County, WI
June 7, 2008
Rake Fullness Rating
Visual
1
2
3
None found
N
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0
0.25
0.5
1
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, 2008 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, 2008 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, 2008 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, 2008 http://www.dnr.state.wi.us/invasives/fact/loosestrife.htm)

Appendix IX: Raw Data Spreadsheets