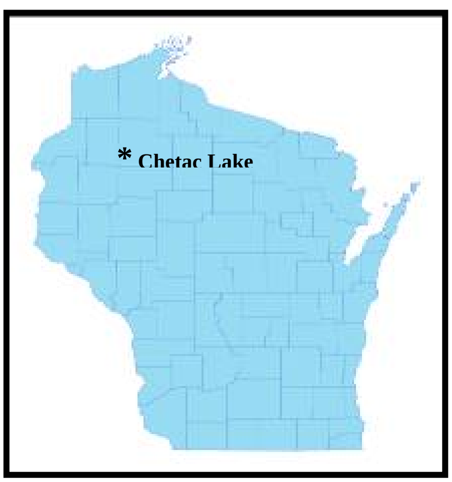
Aquatic Macrophyte Survey for Chetac Lake Sawyer County, Wisconsin WBIC: 2113300


Project Initiated by:
Wisconsin Department of Natural Resources,
Big Chetac Chain Lake Association and
Short Elliott Hendrickson Inc.



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Page

ABSTRACT

Chetac Lake (WBIC 2113300) is a 1,920-acre stratified drainage lake in southwestern Sawyer County. It is eutrophic (nutrient rich) in nature with an estimated maximum summer Secchi range of 5-7ft, and a littoral zone that extends to 12.5ft. A desire to determine the level of Curly-leaf pondweed (*Potamogeton crispus*) infestation and decide what, if any, management of CLP would be appropriate, prompted members of the Big Chetac Chain Lake Association to authorize two surveys of aquatic macrophytes in 2008. In June, we found CLP at 340 survey points which approximates to more than 35% of the lake's total surface. Of these, we rated 285 a two or a three meaning nearly 30% of the lake's surface had a significant infestation. The July point intercept survey found macrophytes at 269 of 970 survey points or approximately 28% of the lake. Many sites that had dense monotypic CLP growth in June did not have any native species growing at them in July after the CLP had senesced. Curly-leaf pondweed, Small pondweed (*Potamogeton pusillus*), Coontail (*Ceratophyllum demersum*), and Flat-stem pondweed (*Potamogeton zosteriformis*) were the most common macrophytes being found at 48.70%, 48.33%, 42.38% and 18.96% of survey points with vegetation respectively. Overall diversity was very high with a Simpson Index value of 0.91. All together, we identified a total of 44 native plants in and immediately adjacent to the lake. They produced an above average mean Coefficient of Conservatism of 6.5 and a Floristic Quality Index of 43.1 that was more than double the average for this part of the state. Future management priorities should include preserving the lake's native plant communities and completing an Aquatic Plant Management Plan that outlines what, if anything, will be done to control Curly-leaf pondweed. We also recommend working to reduce algal blooms by acting on the septic system study results, reducing or eliminating fertilizer applications near the lake, and restoring shorelines by adding buffer strips of native vegetation to prevent runoff. Finally, developing a proactive strategy to minimize the chances of a Eurasian water milfoil (*Myriophyllum spicatum*) introduction into the lake by improving signage at the lake's landings, developing a Citizen Lake Water Monitoring Program, implementing a Clean Boats/Clean Water campaign, and monitoring for EWM in transects parallel to the shore at the boat landings at least once a month during the summer are other management ideas for the Lake Association to consider.

ACKNOWLEDMENTS

We wish to thank the Big Chetac Chain Lake Association for funding this project; Jennifer Hauxwell - WDNR for technical assistance, Sandy Raby for helping coordinate the project and Michael Preissing, Jessica Ilgen and Mitchel and Noah Berg for assistance in conducting this survey.

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION:

Chetac Lake (WBIC 2113300) is a 1,920-acre stratified drainage lake in southwestern Sawyer County, Wisconsin in the Town of Edgewater (T37N R09W S19 NE NE). It achieves a maximum depth of 28ft in the narrows between the islands in the south basin, and has an average depth of approximately 14ft. Chetac Lake is eutrophic (nutrient rich) with poor to fair water clarity. Historical summer Secchi readings were unavailable, but we estimated a range from 5-7ft with a summer littoral zone extending to 12.5ft. The bottom substrate is predominately muck in the lake's side bays and throughout the north and south ends, and a mixture of sand and rock along exposed shorelines, the mid-lake narrows and around the southern islands.

Figure 1: Chetac Lake Aerial Photo

A desire to determine the level of Curly-leaf pondweed (*Potamogeton crispus*) (CLP) infestation, and decide what, if any, management of CLP would be appropriate, prompted members of the Big Chetac Chain Lake Association to authorize a survey of aquatic macrophytes using the Wisconsin Department of Natural Resources (WDNR) 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 two surveys of Chetac Lake in June and July of 2008. The immediate goals of the project were to map the abundance and distribution of CLP, determine if Eurasian water milfoil (*Myriophyllum spicatum*) had invaded the lake, and to establish initial 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 Survey:

Using a standard formula that takes into account the shoreline shape and distance, islands, water clarity, depth and total lake acreage, Jennifer Hauxwell (WDNR) generated a sampling grid for Chetac Lake (Appendix I). In June, we conducted a Curly-leaf pondweed survey to determine the distribution and density of this invasive species. This survey randomly selects approximately 20% of all points (in this case 200) that are likely to have Curly-leaf pondweed growing near them if it is present. If CLP is found at a point, 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 detection, rake density and approximate mapping of the infestation.

July Warm Water Full Point/Intercept Survey:

On July 20th, prior to beginning the point intercept survey, we conducted a general boat survey of Chetac 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 Big Chetac Chain 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 12.5ft., we sampled for plants within the depth range of plant growth. At each of these points, we used a rake on a pole 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.

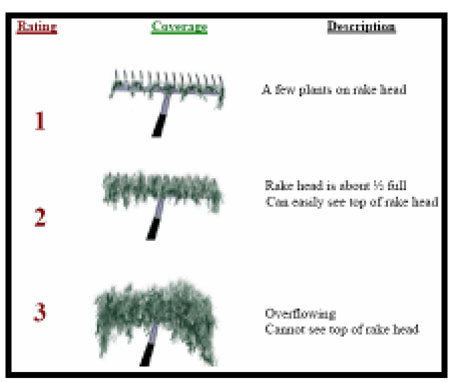

Figure 2: Rake Fullness Ratings (UWEX, 2008)

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.

<u>Simpson's diversity index:</u> 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.

<u>Maximum depth of plants:</u> 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.

<u>Number of sites sampled using rope/pole rake:</u> 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).

<u>Average number of species per site:</u> 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.

<u>Species richness:</u> 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.

<u>Mean and median depth of plants</u>: 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.

<u>Relative frequency:</u> 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 during the point intercept and boat surveys and multiplying it by the square root of the total number of plant species (N) in the lake $(FQI=(\Sigma(c1+c2+c3+\ldots cn)/N)*\sqrt{N}$ Statistically speaking, the higher the index value, the healthier the lake's macrophyte community is assumed to be. Nichols (1999) identified four eco-regions in Wisconsin: Northern Lakes and Forests, North 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. Chetac Lake is in the North Central Hardwood Forests Ecoregion.

RESULTS:

June Cold Water Curly-leaf pondweed Survey:

Although we originally established 200 points for the June rapid survey, the high rate of positive results for Curly-leaf pondweed ultimately resulted in our sampling 645 of 970 points or approximately 2/3rds of the lake (Figure 3) (Appendix IV). We found CLP at 340 of 970 survey points or slightly more than 35% of the lake's total surface. Of these, we rated 259 points or 27% of the lake's surface area as a three – In other words, the rake head was covered with CLP. An additional 26 points were rated a two for a combined area of significant infestation nearing 30%. In its preferred muck bottom habitat in 3-10ft of water, CLP reached its highest densities. It grew especially vigorously in the sheltered areas of the lake's many bays. In these areas, it almost always formed a solid canopy, excluded most if not all other macrophytes, and made boating difficult. However, it was also obvious that it provides cover for the abundant panfish population of the lake. We observed school after school in and adjacent to these dense beds. Closer into shore, Coontail, water lilies, and wild rice seemed to have a competitive advantage over CLP, and, other than a few scattered individuals, it was rarely found in areas <3ft. With few exceptions, our rakefull rating was a 2 in water 8-11ft deep, and a 1 in water 12-14ft deep. On the lake's drop offs, it was the deepest growing plant found. Based on the specimens we collected from these depths, it was apparent that this was less than ideal habitat as most plant appeared to be "barely hanging on", and thus we were not surprised to find that between June and the end of July, the littoral zone shrunk from 14 to 12.5ft.

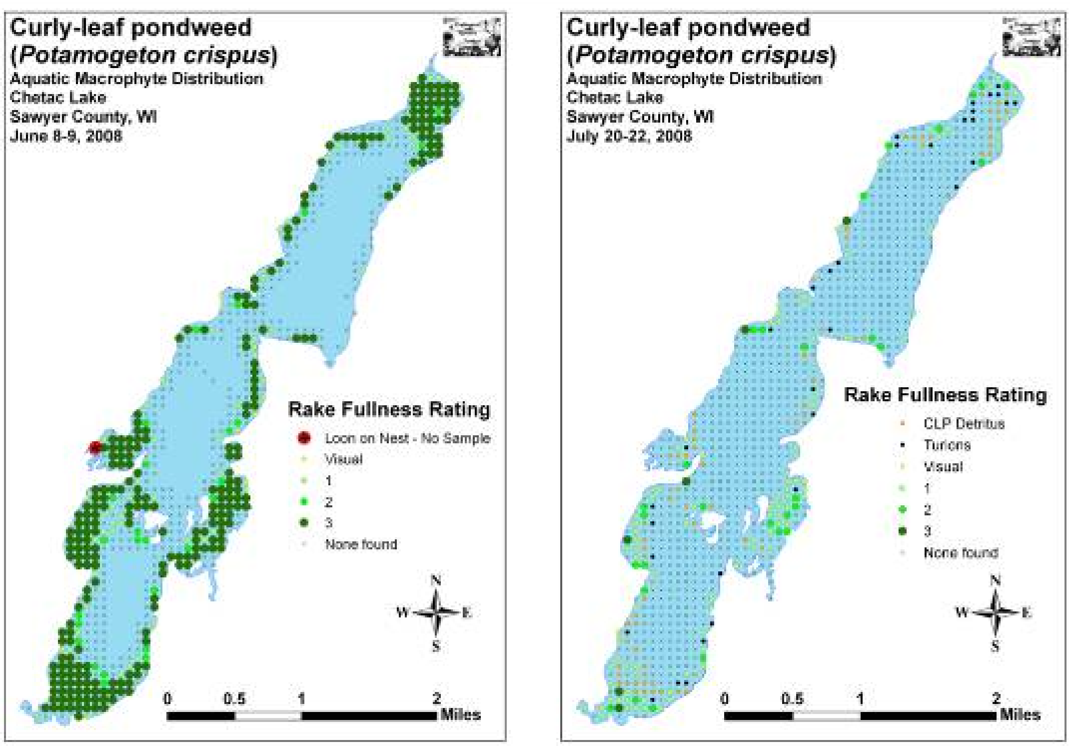

Figure 3: CLP June and July Distribution

By July, most of the plants had senesced, but we still found a significant infestation (2 or 3 rakefull) at 35 sites, and at least some live CLP at 96 additional sites for a total of almost 14% of the lake surface. This translated into over 33% of the littoral zone still having CLP late into July. Although most sites with CLP also had rotting leaves, stems, and turions (over wintering bud that will produce a new plant next spring) from plants that had senesced, we only recorded their presence if there was no other evidence of CLP. Considering this, we located an additional 71 sites with CLP detritus only and 33 sites that had detritus and/or turions. All factors combined, a total of 235 sites – more than 24% of the lake surface - exhibited evidence of CLP infestation into July (Figure 3). For more information on exotic species, see Appendix IX.

July Warm Water Full Point/Intercept Survey:

We surveyed 970 points for depth (Figure 4). The lake forms a series of three elongated bowls connected by deep channels. The north basin is gently sloping from north to south with rapid east/west drop-offs into a 20+ft. flat. The central and southern basins are bordered by many bays and slope more gradually to flats in the 12-20ft range. The notable exception is the deep channel that runs between the southern islands.

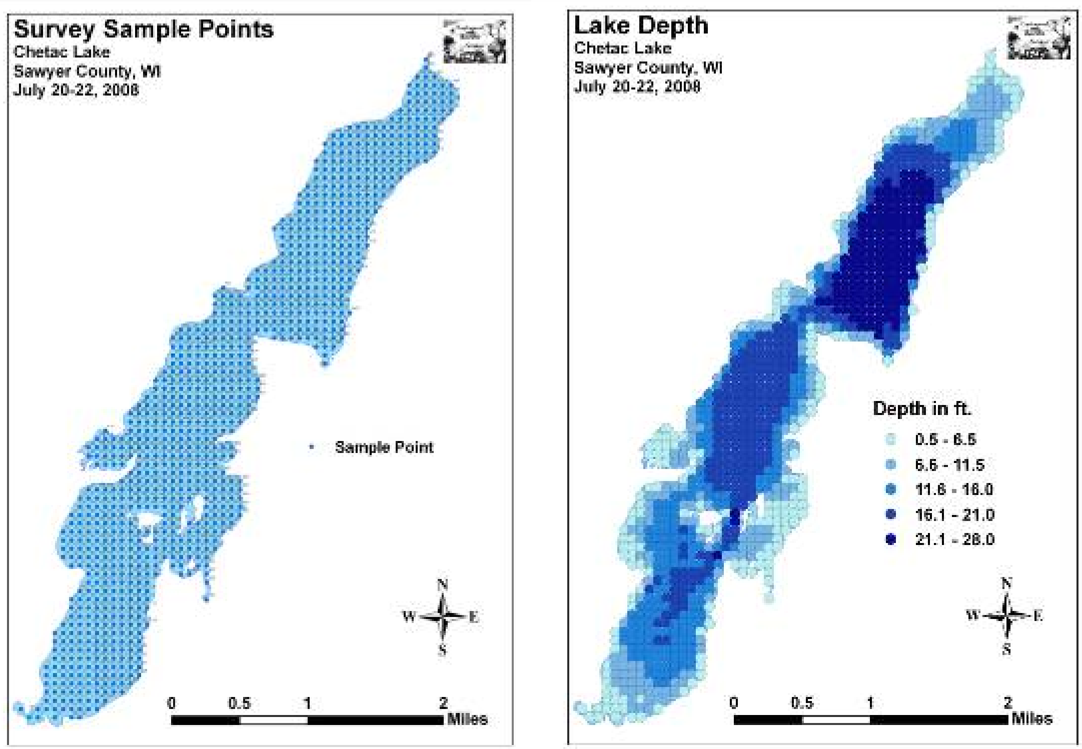

Figure 4: Survey Sample Points and Lake Depth

Of the 392 survey points that fell in the littoral zone, 80% were organic muck, 15% were rock, and 5% were sand (Figure 5) (Appendix V). The lakes topography resulted in expansive plant beds in the north bay around the Benson Creek inlet, the eastern bay near the Knuteson and Malviney Creek inlets, the bays west and northwest of the islands, and the south bay near the outlet to Birch Lake. The shallow water and thick organic muck in these areas promoted both plant density and species richness. The sandy/rocky bottom and relatively narrow littoral zone along the east and west sides of the north basin, the central narrows, and around the islands supported relatively fewer species in lower densities albeit ones unique to this habitat.

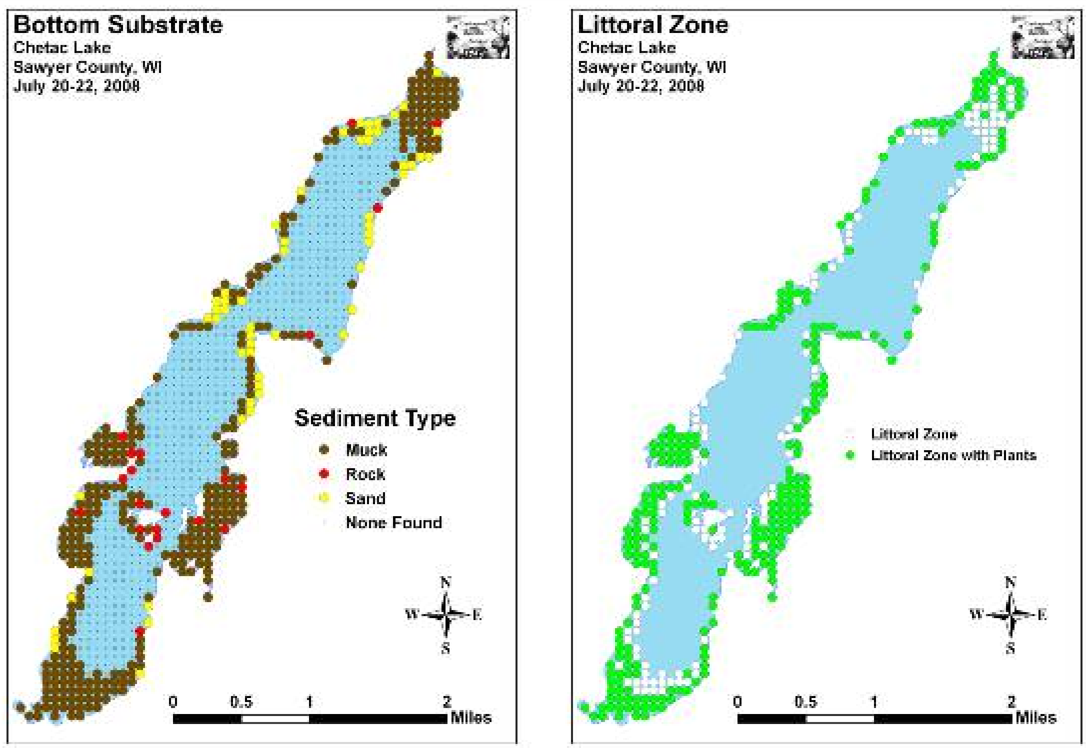

Figure 5: Lake Bottom Substrate and Littoral Zone

We found plants growing on approximately 27.7% of the entire lake bottom, and in 68.6% of the littoral zone (Table 1). Many survey sites that had dense monotypic CLP growth in June did not have any native species growing at them in July after the CLP had senesced. Overall diversity was very high with a Simpson Diversity Index value of 0.91. Species richness was also very high with 48 total species found growing in and immediately adjacent to the lake (Appendix VI and VII). The majority of aquatic macrophytes were found growing in relatively shallow water with a mean depth of 5.9ft, and a median depth 6.0ft.

Table 1: Aquatic Macrophytes Survey Summary Statistics
Chetac Lake, Sawyer County
July 20-22, 2008

Summary Statistics:

Total number of points sampled	970
Total number of sites with vegetation	269
Total number of sites shallower than the maximum depth of plants	392
Frequency of occurrence at sites shallower than maximum depth of plants	68.6
Simpson Diversity Index	0.91
Maximum depth of plants (ft)	12.5
Number of sites sampled using rope rake (R)	0
Number of sites sampled using pole rake (P)	396
Average number of all species per site (shallower than max depth)	2.04
Average number of all species per site (veg. sites only)	2.97
Average number of native species per site (shallower than max depth)	1.55
Average number of native species per site (veg. sites only)	2.67
Species Richness	37
Species Richness (including visuals)	42
Species Richness (including visuals and boat survey)	48
Mean depth of plants (ft)	5.9
Median depth of plants (ft)	6.0

Curly-leaf pondweed, Small pondweed (*Potamogeton pusillus*), Coontail (*Ceratophyllum demersum*), and Flat-stem pondweed (*Potamogeton zosteriformis*) were the most common macrophyte species (Table 2). We found them at 48.70%, 48.33%, 42.38% and 18.96% of survey points with vegetation respectively. All four were widely distributed throughout the lake over organic muck (Figure 6). Although many species were also widely distributed, only CLP, Small pondweed and Coontail had a rel. freq. over 14%, and no other species was over 10%. Together, these three species combined for over 47% of the total relative frequency.

In general, we found bottom substrate to be the best predictor of the plant community at any given location in Chetac Lake. Although both Curly-leaf pondweed and Small pondweed were more abundant over organic muck, they were true habitat generalists being found throughout the lake regardless of bottom type. Coontail, Flat-stem pondweed, Robbins (Fern) pondweed (*Potamogeton robbinsii*), White water lily (*Nymphaea odorata*), Spatterdock (*Nuphar variegata*), Forked duckweed (*Lemna trisulca*), Small duckweed (*Lemna minor*), Large duckweed (*Spirodela polyrhiza*) and Northern water milfoil (*Myriophyllum sibiricum*) dominated over organic muck areas. In sandy areas, we found Fries' pondweed (*Potamogeton friesii*), Bushy pondweed (*Najas flexilis*) Wild celery (*Vallisneria americana*), Sago pondweed (*Stuckenia pectinata*), and Clasping-leaf pondweed (*Potamogeton richardsonii*) to be the dominant species. Each of these communities provided unique habitats and food sources for mammals, birds, fish, aquatic insects and other invertebrates.

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Chetac Lake, Sawyer County
July 20-22, 2008

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Potamogeton crispus	Curly-leaf pondweed	131	16.42	48.70	33.42	1.31
Potamogeton pusillus	Small pondweed	130	16.29	48.33	33.16	1.41
Ceratophyllum demersum	Coontail	114	14.29	42.38	29.08	1.98
	Filamentous algae	59	7.39	21.93	15.05	1.76
Potamogeton zosteriformis	Flat-stem pondweed	51	6.39	18.96	13.01	1.31
Lemna trisulca	Forked duckweed	49	6.14	18.22	12.50	1.29
Potamogeton friesii	Fries' pondweed	36	4.51	13.38	9.18	1.92
Lemna minor	Small duckweed	25	3.13	9.29	6.38	1.12
Spirodela polyrhiza	Large duckweed	25	3.13	9.29	6.38	1.16
Najas flexilis	Bushy pondweed	24	3.01	8.92	6.12	1.75
Potamogeton robbinsii	Robbins (fern) pondweed	22	2.76	8.18	5.61	1.59
Vallisneria americana	Wild celery	16	2.01	5.95	4.08	1.50
Nymphaea odorata	White water lily	15	1.88	5.58	3.83	1.87
Nitella sp.	Nitella	13	1.63	4.83	3.32	1.77
Stuckenia pectinata	Sago pondweed	12	1.50	4.46	3.06	2.17
Nuphar variegata	Spatterdock	10	1.25	3.72	2.55	2.10
Myriophyllum sibiricum	Northern water-milfoil	9	1.13	3.35	2.30	1.44
Potamogeton richardsonii	Clasping-leaf pondweed	9	1.13	3.35	2.30	1.56
Elodea canadensis	Common waterweed	6	0.75	2.23	1.53	1.50
Chara sp.	Muskgrass	5	0.63	1.86	1.28	1.60
Potamogeton natans	Floating-leaf pondweed	5	0.63	1.86	1.28	1.80
Ranunculus aquatilis	Stiff water crowfoot	5	0.63	1.86	1.28	1.20
Heteranthera dubia	Water star-grass	3	0.38	1.12	0.77	1.00
Potamogeton praelongus	White-stemmed pondweed	3	0.38	1.12	0.77	1.33
Sagittaria rigida	Sessile-fruited arrowhead	3	0.38	1.12	0.77	2.00

Table 2 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Chetac Lake, Sawyer County
July 20-22, 2008

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Utricularia vulgaris	Common bladderwort	3	0.38	1.12	0.77	1.00
Callitriche hermaphroditica	Autumnal water starwort	2	0.25	0.74	0.51	2.00
Callitriche palustris	Common water starwort	2	0.25	0.74	0.51	1.00
Typha latifolia	Broad-leaved cattail	2	0.25	0.74	0.51	3.00
Zizania palustris	Northern wild rice	2	0.25	0.74	0.51	3.00
Calla palustris	Water arum	1	0.13	0.37	0.26	2.00
Carex comosa	Bottle brush sedge	1	0.13	0.37	0.26	1.00
Eleocharis erythropoda	Red-footed spikerush	1	0.13	0.37	0.26	2.00
	Aquatic moss	1	0.13	0.37	0.26	3.00
Potamogeton illinoensis	Illinois pondweed	1	0.13	0.37	0.26	2.00
Schoenoplectus acutus	Hardstem bulrush	1	0.13	0.37	0.26	2.00
Schoenoplectus tabernaemontani	Softstem bulrush	1	0.13	0.37	0.26	2.00
Megalodonta beckii	Water marigold	**	**	**	**	**
Myriophyllum verticillatum	Whorled water-milfoil	**	**	**	**	**
Potamogeton epihydrus	Ribbon-leaf pondweed	**	**	**	**	**
Potamogeton vaseyi	Vasey's pondweed	**	**	**	**	**
Utricularia intermedia	Flat-leaf bladderwort	**	**	**	**	**
Dulichium arundinaceum	Three-way sedge	***	***	***	***	***
Eleocharis palustris	Creeping spikerush	***	***	***	***	***
Phalaris arundinacea	Reed canary grass	***	***	***	***	***
Pontederia cordata	Pickerelweed	***	***	***	***	***
Potentilla palustris	Marsh cinquefoil	***	***	***	***	***
Sparganium emersum	Narrow-leaf bur-reed	***	***	***	***	***

** Visual Only

*** Boat Survey Only

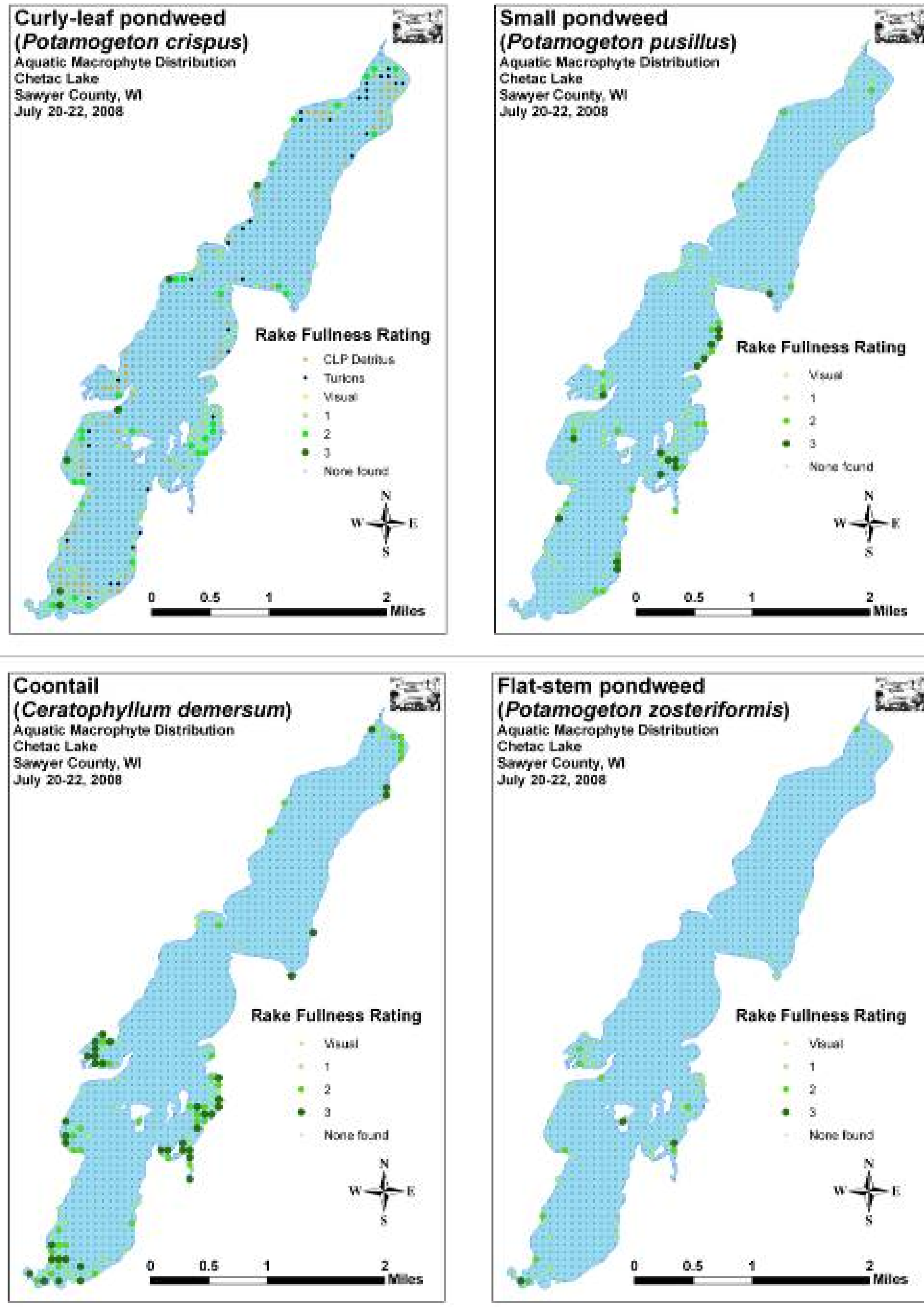

Figure 6: Chetac Lake's Most Common Macrophytes

Table 3: Floristic Quality Index of Aquatic Macrophytes
Chetac Lake, Sawyer Counties
July 20-22, 2008

Species	Common Name	C
Calla palustris	Water arum	9
Callitriche hermaphroditica	Autumnal water starwort	9
Callitriche palustris	Common water starwort	8
Carex comosa	Bottle brush sedge	5
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Dulichium arundinaceum	Three-way sedge	9
Eleocharis erythropoda	Red-footed spikerush	3
Eleocharis palustris	Creeping spikerush	6
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Lemna minor	Small duckweed	5
Lemna trisulca	Forked duckweed	6
Megalodonta beckii	Water marigold	8
Myriophyllum sibiricum	Northern water-milfoil	7
Myriophyllum verticillatum	Whorled water-milfoil	8
Najas flexilis	Bushy pondweed	6
Nitella sp.	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Pontederia cordata	Pickerelweed	9
Potamogeton epihydrus	Ribbon-leaf pondweed	8
Potamogeton friesii	Fries' pondweed	8
Potamogeton illinoensis	Illinois pondweed	6
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Robbins (fern) pondweed	8
Potamogeton vaseyi	Vasey's pondweed	10
Potamogeton zosteriformis	Flat-stem pondweed	6
Potentilla palustris	Marsh cinquefoil	8
Ranunculus aquatilis	Stiff water crowfoot	7
Sagittaria rigida	Sessile-fruited arrowhead	8
Schoenoplectus acutus	Hardstem bulrush	5
Schoenoplectus tabernaemontani	Softstem bulrush	4
Sparganium emersum	Narrow-leaf bur-reed	8
Spirodela polyrhiza	Large duckweed	5
Stuckenia pectinata	Sago pondweed	3
Typha latifolia	Broad-leaved cattail	1

Table 3 cont': Floristic Quality Index of Aquatic Macrophytes
Chetac Lake, Sawyer Counties
July 27 – August 1, 2008

Species	Common Name	C
Utricularia intermedia	Flat-leaf bladderwort	9
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
Zizania palustris	Northern wild rice	8
N		44
mean C		6.5
FQI		43.1

We identified a total of 44 native plants to species in and immediately adjacent to Chetac Lake (Curly-leaf pondweed, Reed canary grass, Aquatic moss and Filamentous algae were excluded from this analysis as they are not native or could not be identified to species). They produced a mean Coefficient of Conservatism of 6.5 and a Floristic Index of 43.1 (Table 3). Nichols (1999) reported an Average Mean C of 5.6 for the North Central Hardwood Forests Region putting Chetac Lake well above average for this part of the state. The FQI was also more than double the mean FQI of 20.9 for the North Central Hardwood Forests Region (Nichols 1999). This exceptionally high FQI is likely a result of Chetac Lake's large size, variable substrate, mixed clarity and diverse water flow conditions. All of these factors create numerous microhabitats which offer a wide variety of plants suitable growing conditions.

Besides Curly-leaf pondweed, Reed canary grass (*Phalaris arundinacea*) was the only other exotic species we found. It was common in the marsh areas around the north and south bays, and in undeveloped areas on the east and west shorelines. We did **not** locate any Eurasian water milfoil, Purple Loosestrife or any other previously undocumented exotic species during either the June or July surveys. For more information on exotic species, see Appendix IX.

With one exception, analysis of species richness at survey sites that did and did not have Curly-leaf pondweed failed to show a significant negative relationship. Only CLP Detritus locations had significantly lower species richness than areas with no CLP (Figure 7). The observed nearly significant negative trend with turions and the significant trend with detritus only locations may have more to do with the depths at these locations than with CLP. Many of the turion and detritus sites were at the edge of the July littoral zone where few native plants filled in the areas left vacant by the now senesced CLP. This was not the case in shallower water where native plants were found growing in many areas where CLP seemed to have excluded everything in June. In general, the high standard deviation rates seen in each analysis likely indicates that other factors such as depth, substrate and light penetration are likely more important than CLP presence/absence in determining species richness at any given site.

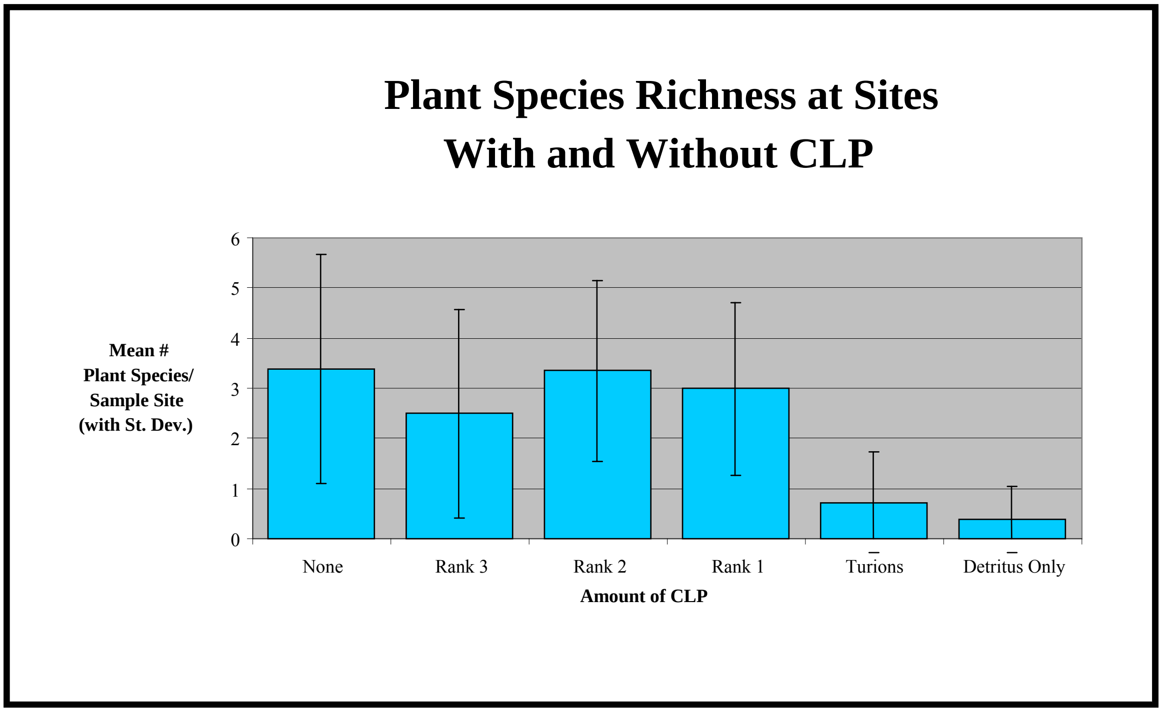

Figure 7: Species Richness With and Without CLP

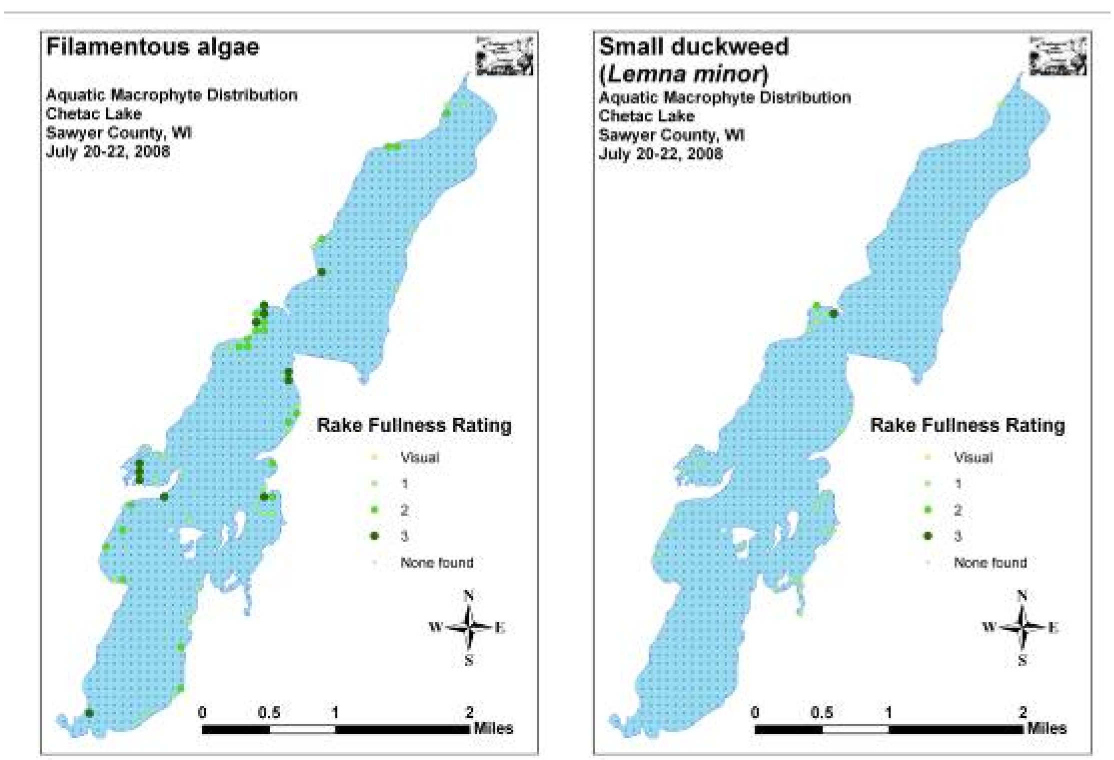

Figure 8: Filamentous algae and Small duckweed

Figure 9: Filamentous algae among Wild rice Plants in Shallow Areas

We noted significant amounts of filamentous algae (relative frequency of 7.39), other floating algae, and Small duckweed throughout Chetac Lake (Figures 7 and 8). We found them to be especially common in stagnant areas of bays over organic muck, in front of "managed" lawns where fertilizer application was evident, and in areas where property owners cut the native vegetation down to the lakeshore (Figure 9). Some properties had large amounts of algae in front of them for no apparent reason, but septic system analysis in the summer of 2008 revealed 47 failed systems on the lake (Raby personal communication). Graphing these failed systems onto a map of the lakeshore will likely show strong correlation with these previously unexplained high algae concentrations.

Figure 10: Elimination of Native Shoreline Vegetation

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:

Chetac Lake has an abundant and diverse plant community. This is likely due to a combination of factors including its large size, reasonably good water clarity throughout, very good water clarity near the many stream inlets (note the aerial photo), and varied habitats including some that are relatively free of CLP (again near the many stream inlets). Based on our survey and observations, we feel that CLP management, improving water clarity, and taking proactive measures to prevent the introduction of Eurasian water milfoil into Chetac Lake should be high on a list of priorities to consider as the lake associations develops management strategies moving forward. A team approach that uses all available data from this report, fisheries data, and lake usership surveys coupled with open and frank communication between the WDNR, interested citizens and SEH, Inc. will be critical in formulating the best APMP possible for the lake.

Curly-leaf pondweed control possibilities:

Based on the 2008 surveys, we believe that Curly-leaf pondweed has overtaken most suitable habitat in the lake. Contrary to what we had feared following the June survey where it appeared that CLP was totally excluding native vegetation over large areas of the lake, many plants such as Coontail, Small pondweed, Flat-stem pondweed, water lilies, and Wild rice seemed to be successfully filling in areas once CLP died back. This was especially true in shallow areas <4ft. Although higher rates of CLP did show a reduction in native plant species richness, the trend was not significant except in areas that only had CLP detritus in July. This is encouraging as it means native plants have been able to survive alongside CLP. They may be at reduced levels, but at least the important and varied habitat they provide for a variety of young and mature fish and the food those fish depend on are being maintained at some level.

Because Curly-leaf pondweed is so common and so widespread in the lake, elimination is not feasible. With this in mind, the lake association has three likely options. Do nothing and see if changes in nutrient levels result in decreased CLP growth; mechanically remove CLP beds with weed cutters in the spring when growth is the densest and native plants will be least effected; and chemical application to beds in a manner prescribed by the DNR to maximize control of CLP while minimizing impact on native vegetation.

All of these control methods have pros and cons. Doing nothing means the lake will continue to have large areas where navigation is difficult in the spring. The June die off of CLP will also continue to contribute to the lake's summer algae blooms as the nutrients from decomposing plants are released into the water faster than they can be absorbed and utilized by macrophytes. On the positive side, it also means that the lake's bluegill fishery will have large plant beds for cover during their spawning period.

Weed cutters will result in a sizable annual expense as the lake's large size will likely require purchase and upkeep or rental of one or more machines, hiring an operator(s), renting trucks to haul plants away, and disposal charges associated with the removal of these many truckloads of plants. A large unknown to removing these plants is whether native plant species will take the place of CLP, and what, if any, impact this removal may have on fish reproduction/populations.

In our opinion, chemical treatment is the least desirable option. It would likely be incredibly expensive, and the amount of herbicide needed to treat the largest beds would possibly exceed allowable chemical limits for the water body. Spot application may make sense in certain areas, but no individual should apply herbicides without first receiving WDNR approval. The Aquatic Plant Management Plan will likely address a proper procedure for any and all chemical use in the lake.

If or when any control methods are to be implemented, bed perimeter/acreage mapping (in accordance with WDNR protocol) will need to be completed before and after the control regiment to determine the effectiveness of the control. Because each bed of CLP is unique in size, density and proximity to high boat traffic areas, a bed by bed management approach may be the best strategy. This will allow the association to learn as they go without throwing energy and resources into a solution strategy that has unknown outcomes. Until the effects of a chosen control strategy can be assessed, if a bed is not interfering with recreation or water access, the best policy may be to ignore it and focus energy and resources on other locations that are a problem.

If mechanical and/or chemical removal are adopted as part of the APMP, the Lake Association should be mindful that plants in general 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. The reed/rush beds in the bays around and east of the islands are especially important as they provide “nursery” habitat for baitfish and juvenile gamefish. In essence, a lake’s plants are as critical to the aquatic environment as trees are to a forest. Any plant control should be the minimum required to meet management goals for CLP while minimizing damage to native vegetation.

Water Clarity Improvement:

The high levels of filamentous and floating algae in the lake are strong anecdotal evidence that there are excessive nutrients in the water from such things as dead plant breakdown, failed septic systems, and lawn and field fertilizer runoff.

The breakdown of CLP in June is likely contributing to the algal blooms we observed in July. These algal blooms decrease light penetration into the lake which leads to increased die back of plants at the edge of the littoral zone resulting in even more nutrients being released into the water. The elimination of shoreline vegetation can also increase the lake’s nutrient load by increasing runoff and adding “grass clipping” vegetation to the water. The dense areas of filamentous algae that occurred in front of some residences where there is no obvious visual reason for it may indicate septic systems are leaching nutrients into the lake. In other instances, obviously fertilized lawns seemed to be the most likely explanation for these high levels of localized algae growth.

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

Acting on the septic system study will require initial expense, but it promises to pay significant dividends towards improving water clarity and quality. Because the lake does not currently have a Secchi disc or water quality monitoring program, we strongly encourage the initiation of these simple and inexpensive programs. Gathering this data starting next summer will allow the Lake Association to determine how other management decisions are impacting water clarity and quality over time. To find out more about lake monitoring, see the WDNR Citizen Lake Monitoring website at http://www.uwsp.edu/cnr/uwexlakes/clmn/get-involved.asp.

Aquatic Invasive Species Prevention:

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

Management Considerations Summary:

- Preserve and maintain Chetac Lake's native plant communities.
- Complete an Aquatic Plant Management Plan that outlines what, if anything, will be done to control Curly-leaf pondweed in the lake.
- Reduce algal blooms by acting on the results of the Septic System study.
- Reduce and, wherever possible, eliminate fertilizer applications near the lakeshore.
- Encourage shoreline restoration and the establishment of native vegetation buffer strips along the lakeshore to prevent runoff.
- Consider establishing a Citizen Lake Monitoring Program to track changes in water clarity and quality.
- Consider establishing a Clean Boats/Clean Water campaign to prevent the introduction of Aquatic Invasive Species like Eurasian water milfoil.
- Encourage owners to refrain from removing native plants from the lake as these areas provide Aquatic Invasive Species an ideal place to become established.
- Consider transect monitoring for invasive species at the lake's boat landing at least once a month during the summer.

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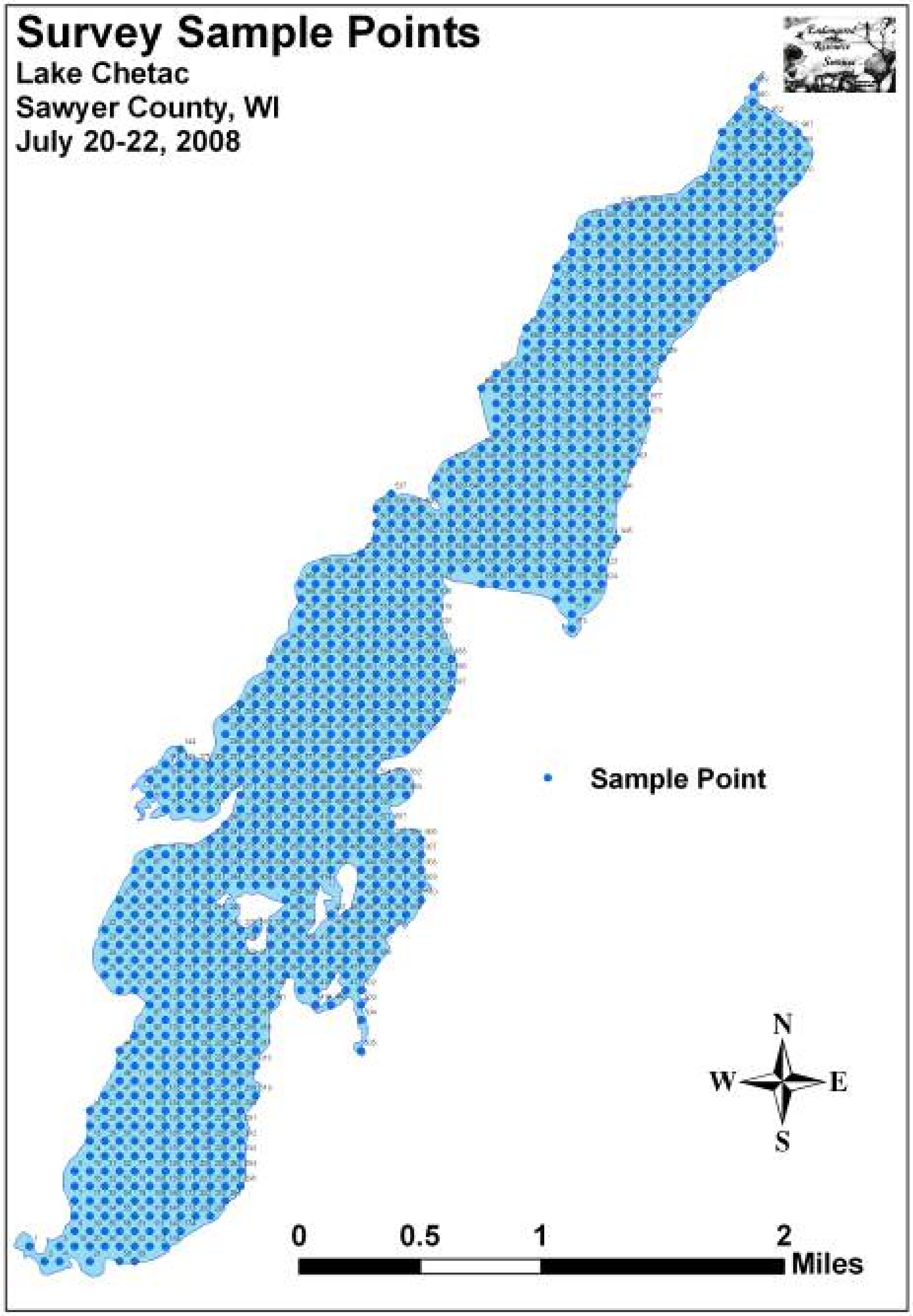
WDNR. [online]. 2008. Reed canary grass. http://www.dnr.state.wi.us/invasives/fact/reed_canary.htm (2008, September).

Appendix I: Chetac Lake Map with Survey Sample Points



Survey Sample Points
Lake Chetac
Sawyer County, WI
July 20-22, 2008
Sample Point
N
W
E
S
0
0.5
1
2
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																									
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8																									
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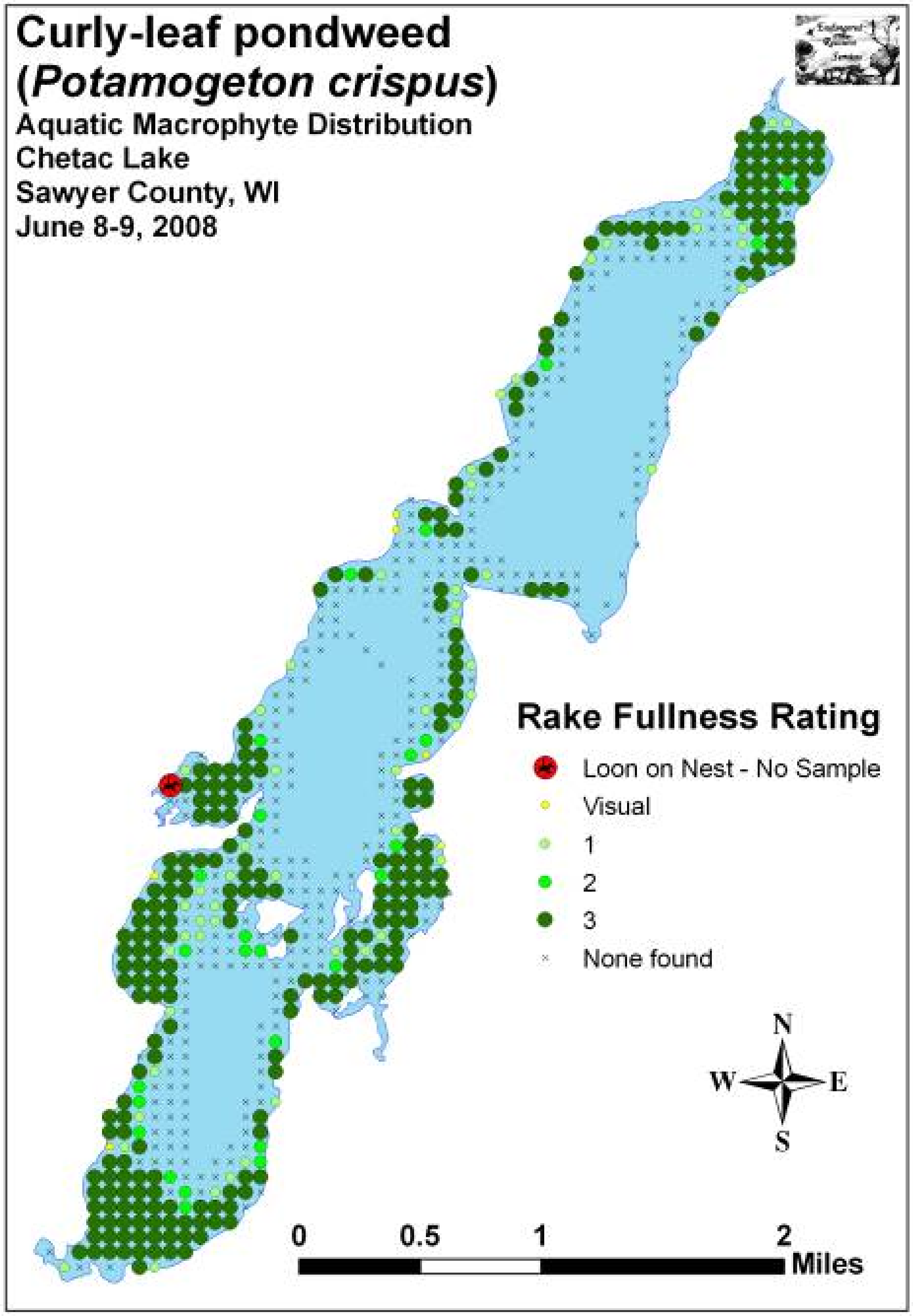
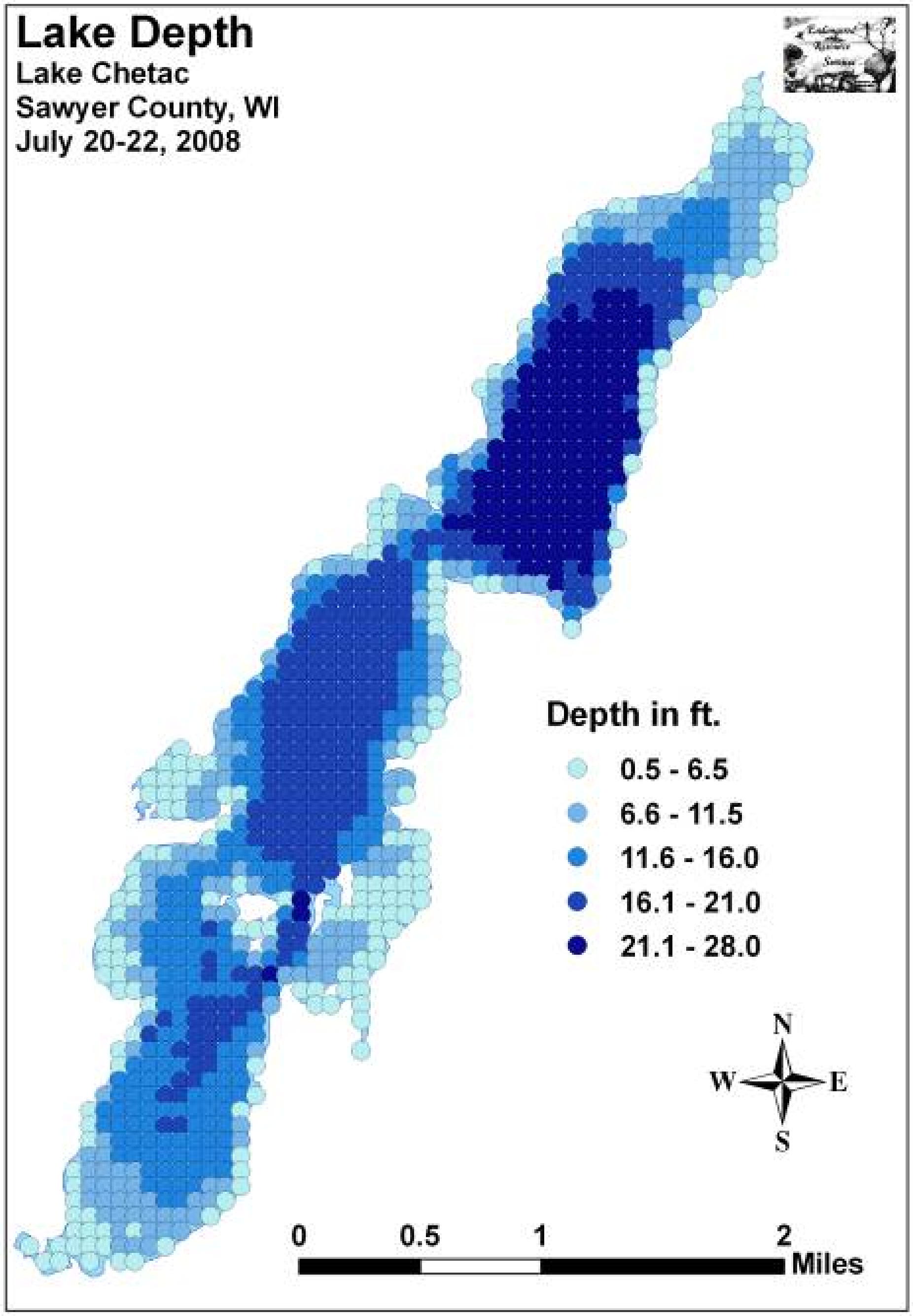
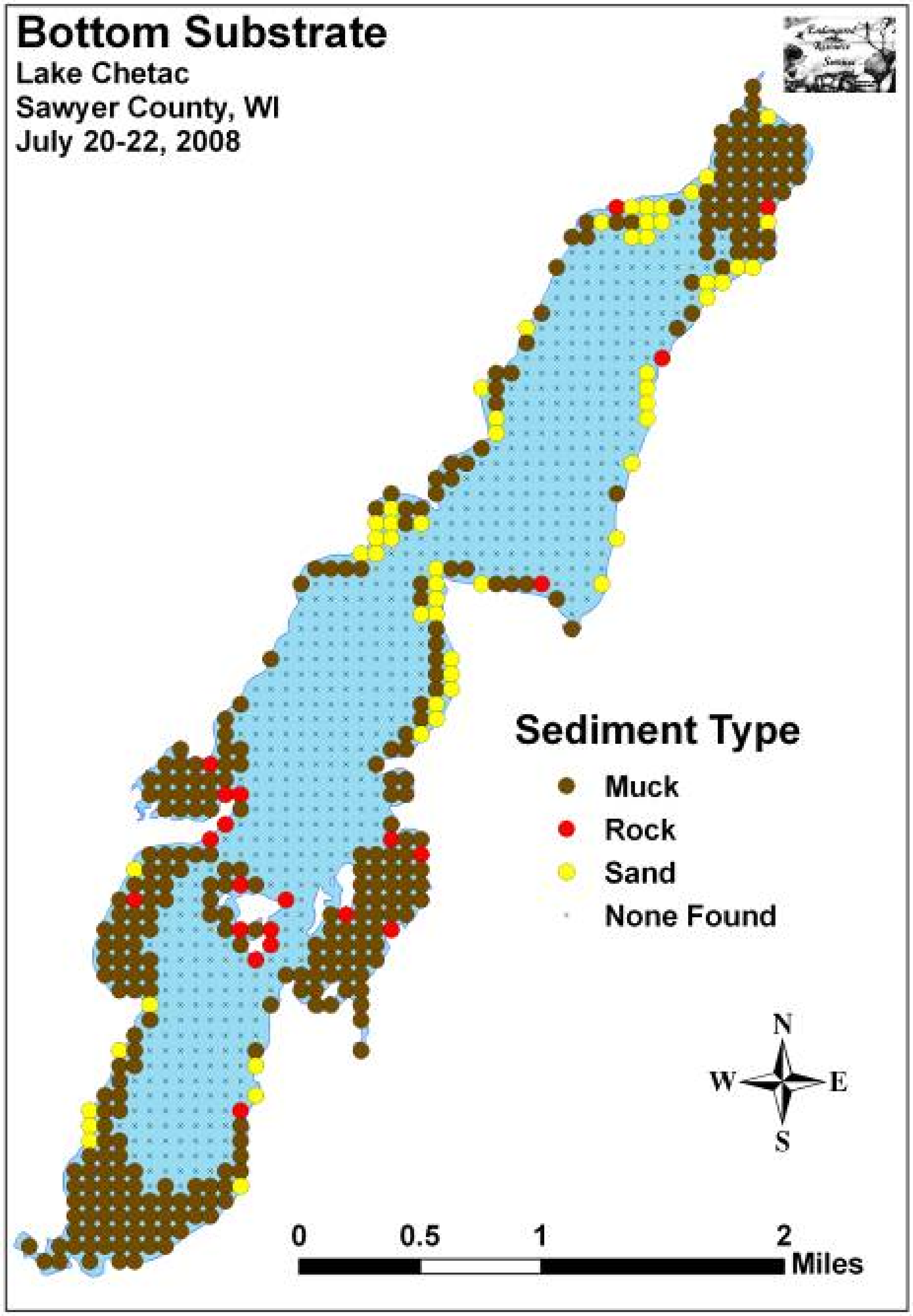
20																									

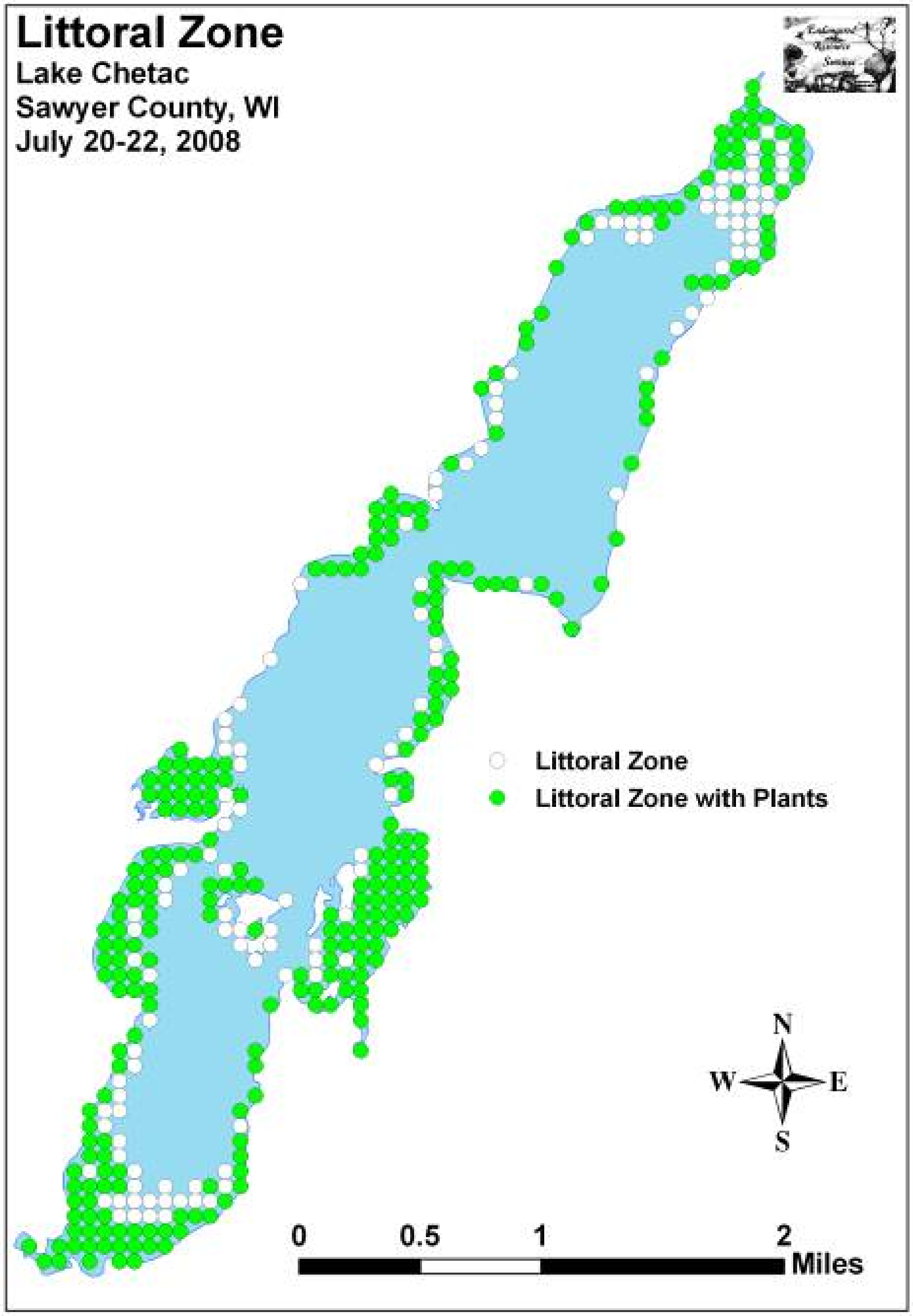
Appendix IV: Cold Water Curly-leaf pondweed Survey Map


Curly-leaf pondweed
(*Potamogeton crispus*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
June 8-9, 2008
Rake Fullness Rating
Loon on Nest - No Sample
Visual
1
2
3
None found
N
W
E
S
0
0.5
1
2
Miles

Appendix V: Habitat Variable Maps


Lake Depth
Lake Chetac
Sawyer County, WI
July 20-22, 2008
Depth in ft.
0.5 - 6.5
6.6 - 11.5
11.6 - 16.0
16.1 - 21.0
21.1 - 28.0
N
W
E
S
0
0.5
1
2
Miles


Bottom Substrate
Lake Chetac
Sawyer County, WI
July 20-22, 2008
Sediment Type
Muck
Rock
Sand
None Found
N
W
E
S
0
0.5
1
2
Miles


Littoral Zone
Lake Chetac
Sawyer County, WI
July 20-22, 2008
Littoral Zone
Littoral Zone with Plants
N
W
E
S
0
0.5
1
2
Miles

Appendix VI: Plant Species Accounts

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: **Aquatic moss**
Specimen Location: Chetac Lake; N45.68089°, W91.51016°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-101
Habitat/Distribution: Mucky bottoms in 0-1.5 meters. Rare with a few scattered patches near shore in the bays east of the islands, and at a single survey point in the southeast end of the lake.
Common Associates: (*Potamogeton friesii*) Fries' pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Lemna trisulca*) Forked duckweed, (*Ceratophyllum demersum*) Coontail

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Calla palustris*) **Water arum**
Specimen Location: Chetac Lake; N45.69811°, W91.50163°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-102
Habitat/Distribution: Muck bottom at the shoreline in 0 – 0.25 meters of water. Rare with only a few scattered individuals located along shore near the Benson Creek inlet and in the sheltered bays of the islands.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Spirodela polyrhiza*) Large duckweed, (*Carex comosa*) Bottle-brush sedge, (*Potentilla palustris*) Marsh cinquefoil

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Callitriche hermaphroditica*) **Autumnal water starwort**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-103
Habitat/Distribution: Muck bottom in shallow water <1m. Rare being found only at the Benson Creek inlet on the north end of the lake. In places, it completely covered the bottom.
Common Associates: (*Callitriche palustris*) Common water starwort, (*Ranunculus aquatilis*) Stiff water crowfoot, (*Chara* sp.) Muskgrass, (*Stuckenia pectinata*) Sago pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Callitriche palustris*) **Common water starwort**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-104
Habitat/Distribution: Muck bottom in shallow water <1m. Rare being found only at the Benson Creek inlet on the north end of the lake. Found growing among the much more numerous Autumnal starwort.
Common Associates: (*Callitriche hermaphroditica*) Autumnal water starwort, (*Ranunculus aquatilis*) Stiff water crowfoot, (*Chara* sp.) Muskgrass, (*Stuckenia pectinata*) Sago pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Carex comosa*) **Bottle-brush sedge**
Specimen Location: Chetac Lake; N45.69811°, W91.50163°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-105
Habitat/Distribution: Muck bottom at the shoreline in 0 – 0.25 meters of water. Rare with only a few scattered individuals located in the sheltered bays of the islands.
Common Associates: (*Calla palustris*) Water arum, (*Typha latifolia*) Broad-leaved cattail, (*Spirodela polyrhiza*) Large duckweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Ceratophyllum demersum*) **Coontail**
Specimen Location: Chetac Lake; N45.74628°, W91.46564°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-106
Habitat/Distribution: Muck bottom in 0-4 meters. Abundant throughout; especially common in the muck bays in the lower third of the lake. Along with Small and Curly-leaf pondweed, it was the deepest growing macrophyte.
Common Associates: (*Potamogeton crispus*) Curly-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Potamogeton robbinsii*) Robbins (fern) pondweed, (*Lemna trisulca*) Forked duckweed, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Chara* sp.) **Muskgrass**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-107
Habitat/Distribution: Uncommon in sand/silt bottom areas in water from 0 – 1 meter deep. Species at Benson Creek inlet was different from elsewhere in the lake.
Common Associates: (*Callitriche palustris*) Common water starwort, (*Ranunculus aquatilis*) Stiff water crowfoot, (*Callitriche hermaphroditica*) Autumnal water starwort, (*Stuckenia pectinata*) Sago pondweed, (*Najas flexilis*) Bushy pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Dulichium arundinaceum*) **Three-way sedge**
Specimen Location: Chetac Lake; N45.69338°, W91.50003°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-108
Habitat/Distribution: Located at the edge of the water in mucky soil. Uncommon in scattered locations in the muck bays east of the islands.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water arum, (*Eleocharis erythropoda*) Red-footed spikerush, (*Schoenoplectus tabernaemontani*) Softstem bulrush

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Eleocharis erythropoda*) **Red-footed spikerush**
Specimen Location: Chetac Lake; N45.69363°, W91.50023°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-109
Habitat/Distribution: Located at the edge of the water in mucky soil. Uncommon in scattered locations in the muck bays east of the islands.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water arum, (*Dulichium arundinaceum*) Three-way sedge, (*Schoenoplectus tabernaemontani*) Softstem bulrush

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Eleocharis palustris*) **Creeping spikerush**
Specimen Location: Chetac Lake; N45.69726°, W91.49776°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-110
Habitat/Distribution: Mucky to firm bottoms in 0-0.5 meters of water. Found in the bay east of the islands where it formed dense reed beds with Hardstem bulrush.
Common Associates: (*Schoenoplectus acutus*) Hardstem bulrush, (*Potamogeton crispus*) Curly-leaf pondweed, (*Lemna trisulca*) Forked duckweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Elodea canadensis*) **Common waterweed**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-111
Habitat/Distribution: Muck bottom in 0-1.5 meters of water.
Uncommon in stagnant areas of bays in the south end of the lake and near the Benson Creek inlet.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Potamogeton pusillus*) Small pondweed, (*Spirodela polyrhiza*) Large duckweed, (*Lemna minor*) Small duckweed, (*Myriophyllum sibiricum*) Northern water milfoil, (*Nuphar variegata*) Spatterdock

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Heteranthera dubia*) **Water star-grass**
Specimen Location: Chetac Lake; N45.71810°, W91.48675°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-112
Habitat/Distribution: Firm muck bottoms usually in water 0.5-2.5 meters deep. Rare with only scattered individuals throughout and never abundant.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Lemna trisulca*) Forked duckweed, Filamentous algae

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Lemna minor*) **Small duckweed**
Specimen Location: Chetac Lake; N45.72249°, W91.49586°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-113
Habitat/Distribution: Located floating at or just under the surface in sheltered areas. Scattered individuals found interspersed between the lilypads. Wind and current scattered them throughout the lake.
Common Associates: (*Nymphaea odorata*) White water lily, (*Nuphar variegata)* Spatterdock, (*Spirodela polyrhiza*) Large duckweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton pusillus*) Small pondweed, Filamentous algae

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Lemna trisulca*) **Forked duckweed**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-114
Habitat/Distribution: Located entangled in other plants and along the bottom. Common throughout in almost any bottom type in water up to 2.5 meters deep.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Ceratophyllum demersum*) Coontail

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Megalodonta beckii*) **Water marigold**
Specimen Location: Chetac Lake; N45.70783°, W91.51474°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-115
Habitat/Distribution: A single cluster of plants was found in the west bay in 0.5 meters of water over muck.
Common Associates: (*Nymphaea odorata*) White water lily**,** (*Potamogeton robbinsii*) Robbins (fern) pondweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton pusillus*) Small pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Myriophyllum sibiricum*) **Northern water milfoil**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-116
Habitat/Distribution: Muck to sand bottom in water up to 2 meters. Widespread and relatively common throughout the lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Ceratophyllum demersum*) Coontail, (*Ranunculus aquatilis*) Stiff water crowfoot, (*Potamogeton crispus*) Curly-leaf pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Myriophyllum verticillatum*) **Whorled water milfoil**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-117
Habitat/Distribution: Muck bottom in < 1.5 meters of water. Only plants found were in the unnamed creek inlet east of the islands.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Pontederia cordata*) Pickerelweed, (*Potamogeton vaseyi*) Vasey's pondweed, (*Myriophyllum sibiricum*) Northern water milfoil, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sparganium emersum*) Narrow-leaf bur-reed, (*Potamogeton natans*) Floating-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Najas flexilis*) **Bushy pondweed**
Specimen Location: Chetac Lake; N45.72905°, W91.47547°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-118
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/sand bottoms in 0.5-1.5 meters of water. Relatively common, and widely distributed throughout the lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton friesii*) Fries's pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Vallisneria americana*) Wild celery, (*Stuckenia pectinata*) Sago pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Nitella* sp.) **Nitella**
Specimen Location: Chetac Lake; N45.72249°, W91.49586°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-119
Habitat/Distribution: Primarily muck and sand bottom area in water 2-4 meters deep. Relatively common and widely scattered throughout.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton crispus*) Curly-leaf pondweed, Filamentous algae

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Nuphar variegata)* **Spatterdock**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-120
Habitat/Distribution: Muck bottom in 0-1.5 meters of water where it often forms dense canopies. Relatively common in muck bays and sheltered shoreline areas. It prefers a firmer bottom than (*Nymphaea odorata*).
Common Associates: (*Nymphaea odorata*) White water lily, (*Potamogeton natans*) Floating-leaf pondweed, (*Pontederia cordata*) Pickerelweed, (*Ceratophyllum demersum*) Coontail, Filamentous algae

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Nymphaea odorata*) **White water lily**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-121
Habitat/Distribution: Muck bottom in 0-2 meters where it forms dense canopies with other floating leaf species. Common in calm water bays throughout the lake.
Common Associates: (*Nuphar variegata)* Spatterdock, (*Elodea canadensis*) Common waterweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Spirodela polyrhiza*) Large duckweed, (*Lemna minor*) Small duckweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Phalaris arundinacea*) **Reed canary grass**
Specimen Location: Chetac Lake; N45.69460°, W91.521844°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-122
Habitat/Distribution: Prefers thick muck soil in and out of water <0.5 meters. Primarily found on shore in undeveloped low areas.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water arum, (*Schoenoplectus tabernaemontani*) Softstem bulrush

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Pontederia cordata*) **Pickerelweed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-123
Habitat/Distribution: Muck bottom in < 1.0 meter of water. Scattered beds in calm southern bays.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Potamogeton vaseyi*) Vasey's pondweed, (*Myriophyllum sibiricum*) Northern water milfoil, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sparganium emersum*) Narrow-leaf bur-reed, (*Potamogeton natans*) Floating-leaf pondweed, (*Myriophyllum verticillatum*) Whorled water milfoil

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Potamogeton crispus*) **Curly-leaf pondweed**
Specimen Location: Chetac Lake; N45.74443°, W91.46945°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-124
Habitat/Distribution: Found in most mucky bottom areas in water from 1-4.5m deep. Abundant to the point of restricting boat traffic early in the season.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Lemna trisulca*) Forked duckweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Potamogeton epihydrus*) **Ribbon-leaf pondweed**
Specimen Location: Chetac Lake; N45.69911°, W91.49395°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-125
Habitat/Distribution: Found in mucky bottom conditions in shallow water 0.5-1.5 meter deep. A single bed of plants was located at the Knuteson Creek inlet.
Common Associates: (*Potamogeton illinoensis*) Illinois pondweed, (*Elodea canadensis*) Common waterweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Ceratophyllum demersum*) Coontail, (*Ranunculus aquatilis*) Stiff water crowfoot, (*Zizania palustris*) Northern wild rice

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Potamogeton friesii*) **Fries's pondweed**
Specimen Location: Chetac Lake; N45.74443°, W91.46945°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-126
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-2.5 meters of water. Relatively common, and widely distributed in sandy and rocky areas throughout the lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Vallisneria americana*) Wild celery, (*Stuckenia pectinata*) Sago pondweed, (*Najas flexilis*) Bushy pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Potamogeton illinoensis*) **Illinois pondweed**
Specimen Location: Chetac Lake; N45.69911°, W91.49395°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-127
Habitat/Distribution: Found in mucky bottom conditions in shallow water 0.5-1.5 meter deep. A single bed of plants was located at the Knuteson Creek inlet.
Common Associates: (*Elodea canadensis*) Common waterweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Ceratophyllum demersum*) Coontail, (*Ranunculus aquatilis*) Stiff water crowfoot, (*Zizania palustris*) Northern wild rice, (*Potamogeton epihydrus*) Ribbon-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Potamogeton natans*) **Floating-leaf pondweed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-128
Habitat/Distribution: Muck bottom in < 1.0 meters of water. Only plants found were in the bay/unnamed creek inlet east of the islands.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Pontederia cordata*) Pickerelweed, (*Potamogeton vaseyi*) Vasey's pondweed, (*Myriophyllum sibiricum*) Northern water milfoil, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sparganium emersum*) Narrow-leaf bur-reed, (*Myriophyllum verticillatum*) Whorled water milfoil

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Potamogeton praelongus*) **White-stem pondweed**
Specimen Location: Chetac Lake; N45.67813°, W91.51522°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-129
Habitat/Distribution: Variable substrate in 1-2 meters of water. It seems to be most common in areas that had some, but not thick muck over gravel of sand. Rare, found at a handful of scattered locations on the south end of the lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Ceratophyllum demersum*) Coontail, (*Myriophyllum sibiricum*) Northern water milfoil, (*Potamogeton crispus*) Curly-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Potamogeton pusillus*) **Small pondweed**
Specimen Location: Chetac Lake; N45.74353°, W91.46943°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-130
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0-4 meters of water. Normally it and Coontail, and Curly-leaf pondweed are the deepest growing vascular plant. It is abundant throughout the lake.
Common Associates: (*Potamogeton crispus*) Curly-leaf pondweed, (*Vallisneria americana*) Wild celery, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Potamogeton friesii*) Fries's pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Potamogeton richardsonii*) **Clasping-leaf pondweed** **Specimen Location:** Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-131
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-1.5 meters of water. Relatively common, and widely distributed in sandy and rocky areas throughout the lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton friesii*) Fries's pondweed, (*Vallisneria americana*) Wild celery, (*Stuckenia pectinata*) Sago pondweed, (*Najas flexilis*) Bushy pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Potamogeton robbinsii*) **Robbins (fern) pondweed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-132
Habitat/Distribution: Organic muck in 0.5-3 meters of water. Widespread and relatively common in the southern half of the lake, but absent in the northern half.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton crispus*) Curly-leaf pondweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Lemna trisulca*) Forked duckweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Potamogeton vaseyi*) **Vasey's pondweed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-133
Habitat/Distribution: Muck bottom in < 1.0 meters of water. Only plants found were in the unnamed creek inlet east of the islands.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Pontederia cordata*) Pickerelweed, (*Myriophyllum sibiricum*) Northern water milfoil, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sparganium emersum*) Narrow-leaf bur-reed, (*Potamogeton natans*) Floating-leaf pondweed, (*Myriophyllum verticillatum*) Whorled water milfoil

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Potamogeton zosteriformis*) **Flat-stem pondweed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-134
Habitat/Distribution: It prefers substrate of thick organic muck. Widely distributed and common in all four lakes where it grows in 0-3 meters of water.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Potamogeton pusillus*) Small pondweed, (*Potamogeton crispus*) Curly-leaf pondweed**,** (*Lemna trisulca*) Forked duckweed, (*Potamogeton friesii*) Fries's pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Potentilla palustris*) **Marsh cinquefoil**
Specimen Location: Chetac Lake; N45.748244°, W91.46701°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-135
Habitat/Distribution: Muck bottom at the shoreline in 0 – 0.25 meters of water. Rare with only a few scattered individuals located along the Benson Creek inlet.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water arum

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Ranunculus aquatilis*) **Stiff water crowfoot**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-136
Habitat/Distribution: Uncommon at a few widely scattered locations. Found primarily over muck and sandy muck in shallow water <1m deep.
Common Associates: (*Callitriche hermaphroditica*) Autumnal water starwort, (*Callitriche palustris*) Common water starwort, (*Chara* sp.) Muskgrass

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Sagittaria rigida*) **Sessile-fruited arrowhead**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-137
Habitat/Distribution: Firm muck bottom in < 0.5 meters of water. Scattered locations; especially in areas that had some water flow.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Pontederia cordata*) Pickerelweed, (*Potamogeton vaseyi*) Vasey's pondweed, (*Myriophyllum sibiricum*) Northern water milfoil, (*Sparganium emersum*) Narrow-leaf bur-reed, (*Potamogeton natans*) Floating-leaf pondweed, (*Myriophyllum verticillatum*) Whorled water milfoil

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Schoenoplectus acutus*) **Hardstem bulrush**
Specimen Location: Chetac Lake; N45.69725898°, W91.4977581°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-138
Habitat/Distribution: Mucky to firm bottoms in 0-0.5 meters of water. Found in the bay east of the islands where it formed dense reed beds with Creeping spikerush.
Common Associates: (*Eleocharis palustris*) Creeping spikerush, (*Potamogeton crispus*) Curly-leaf pondweed**,** (*Lemna trisulca*) Forked duckweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Schoenoplectus tabernaemontani*) **Softstem bulrush**
Specimen Location: Chetac Lake; N45.69363°, W91.50023°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-139
Habitat/Distribution: Firm muck bottoms in 0-0.5 meter of water. Uncommon; scattered clusters occurred in at the shoreline in bays throughout the south end of the lake.
Common Associates: (*Potamogeton natans*) Floating-leaf pondweed, (*Spirodela polyrhiza*) Large duckweed, (*Eleocharis erythropoda*) Red-footed spikerush, (*Lemna minor*) Small duckweed, (*Typha latifolia*) Broad-leaved cattail, (*Nymphaea odorata*) White water lily

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Sparganium emersum*) **Narrow-leaf bur-reed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-140
Habitat/Distribution: Muck bottom in < 1.0 meters of water. Only plants found were in the unnamed creek inlet east of the islands.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Pontederia cordata*) Pickerelweed, (*Potamogeton vaseyi*) Vasey's pondweed, (*Myriophyllum sibiricum*) Northern water milfoil, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Potamogeton natans*) Floating-leaf pondweed, (*Myriophyllum verticillatum*) Whorled water milfoil

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Spirodela polyrhiza*) **Large duckweed**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-141
Habitat/Distribution: Located floating at or just under the surface in stagnant bays. Common, but less so than Small duckweed. Scattered individuals occur interspersed between the lilypads and wild rice beds.
Common Associates: (*Nymphaea odorata*) White water lily, (*Nuphar variegata)* Spatterdock, (*Lemna minor*) Small duckweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton pusillus*) Small pondweed, (*Zizania palustris*) Northern wild rice

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Stuckenia pectinata*) **Sago pondweed**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-142
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-1.5 meters of water. Fairly common, especially in the narrows, and along sandy shoreline areas.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton friesii*) Fries's pondweed, (*Vallisneria americana*) Wild celery, (*Najas flexilis*) Bushy pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Typha latifolia*) **Broad-leaved cattail**
Specimen Location: Chetac Lake; N45.69811°, W91.50163°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-143
Habitat/Distribution: Muck bottom at the shoreline in 0 – 0.25 meters of water. Relatively common throughout; especially in undeveloped low areas and in sheltered bays.
Common Associates: (*Calla palustris*) Water arum, (*Spirodela polyrhiza*) Large duckweed, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Zizania palustris*) Northern wild rice

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Utricularia intermedia*) **Flat-leaf bladderwort**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-144
Habitat/Distribution: Muck bottom in < 1.0 meters of water. Only plants found were in the unnamed creek inlet east of the islands.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Pontederia cordata*) Pickerelweed, (*Potamogeton vaseyi*) Vasey's pondweed, (*Myriophyllum sibiricum*) Northern water milfoil, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sparganium emersum*) Narrow-leaf bur-reed, (*Potamogeton natans*) Floating-leaf pondweed, (*Myriophyllum verticillatum*) Whorled water milfoil

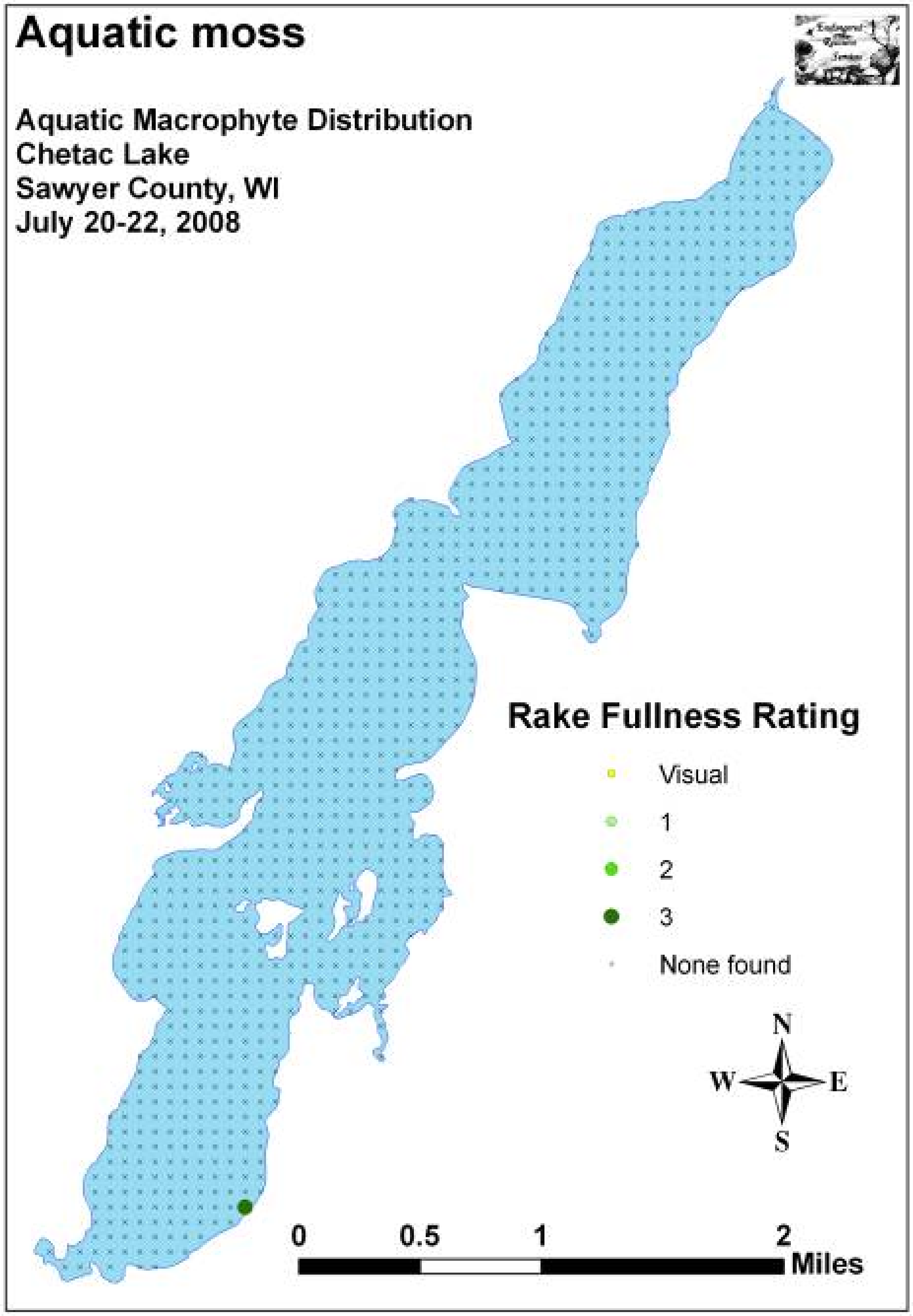
County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Utricularia vulgaris*) **Common bladderwort**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-145
Habitat/Distribution: Floating over muck bottoms in < 1.5 meters of water. Only plants found were in the unnamed creek inlet east of the islands and in the bog areas near pt. 114.
Common Associates: (*Utricularia intermedia*) Flat-leaf bladderwort, (*Potamogeton vaseyi*) Vasey's pondweed, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sparganium emersum*) Narrow-leaf bur-reed, (*Potamogeton natans*) Floating-leaf pondweed, (*Myriophyllum verticillatum*) Whorled water milfoil

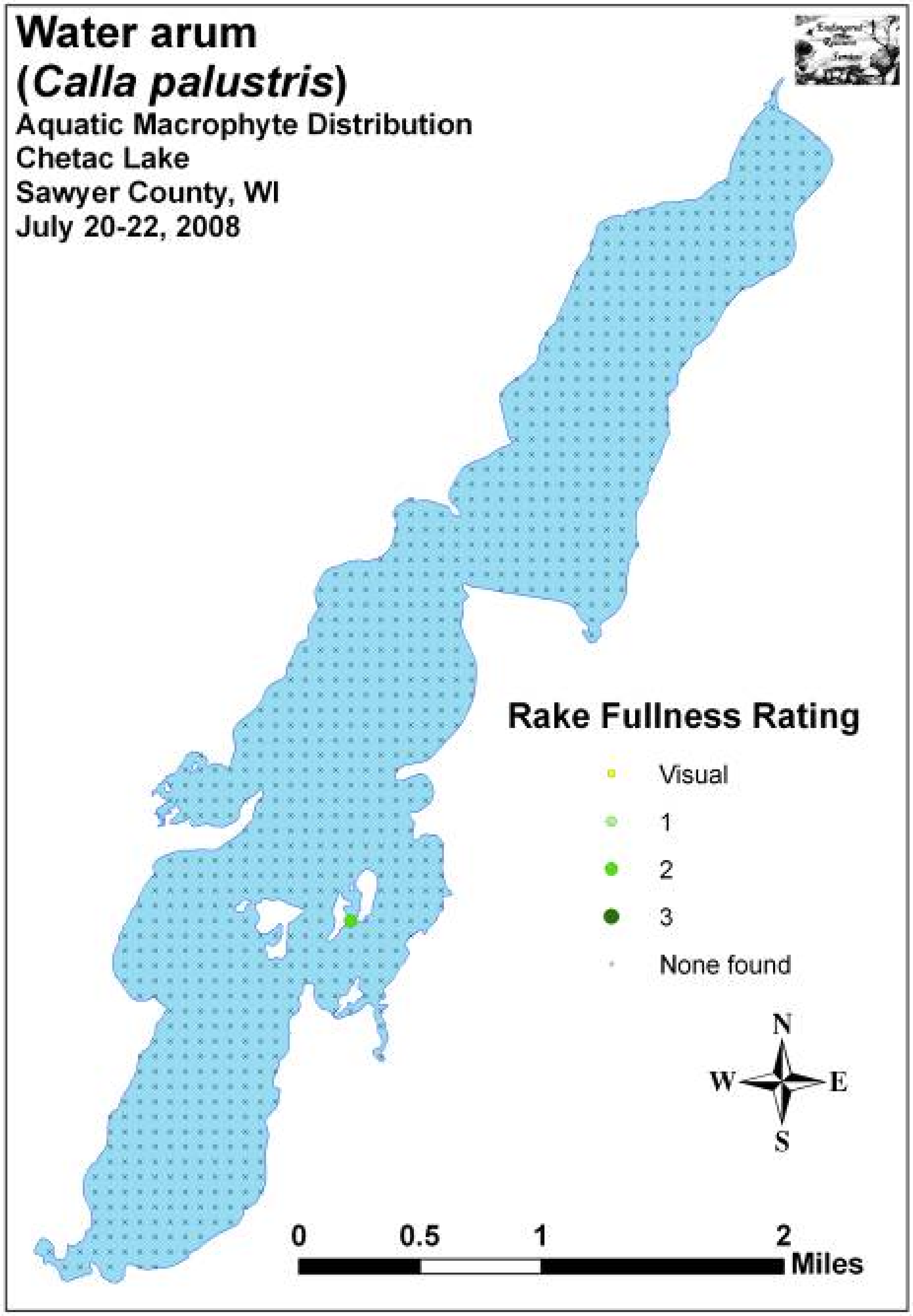
County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Vallisneria americana*) **Wild celery**
Specimen Location: Chetac Lake; N45.72905°, W91.47547°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-146
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/sand bottoms in 0.5-1.5 meters of water. Relatively common, and widely distributed in sandy and rocky areas throughout the lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton friesii*) Fries's pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Stuckenia pectinata*) Sago pondweed, (*Najas flexilis*) Bushy pondweed

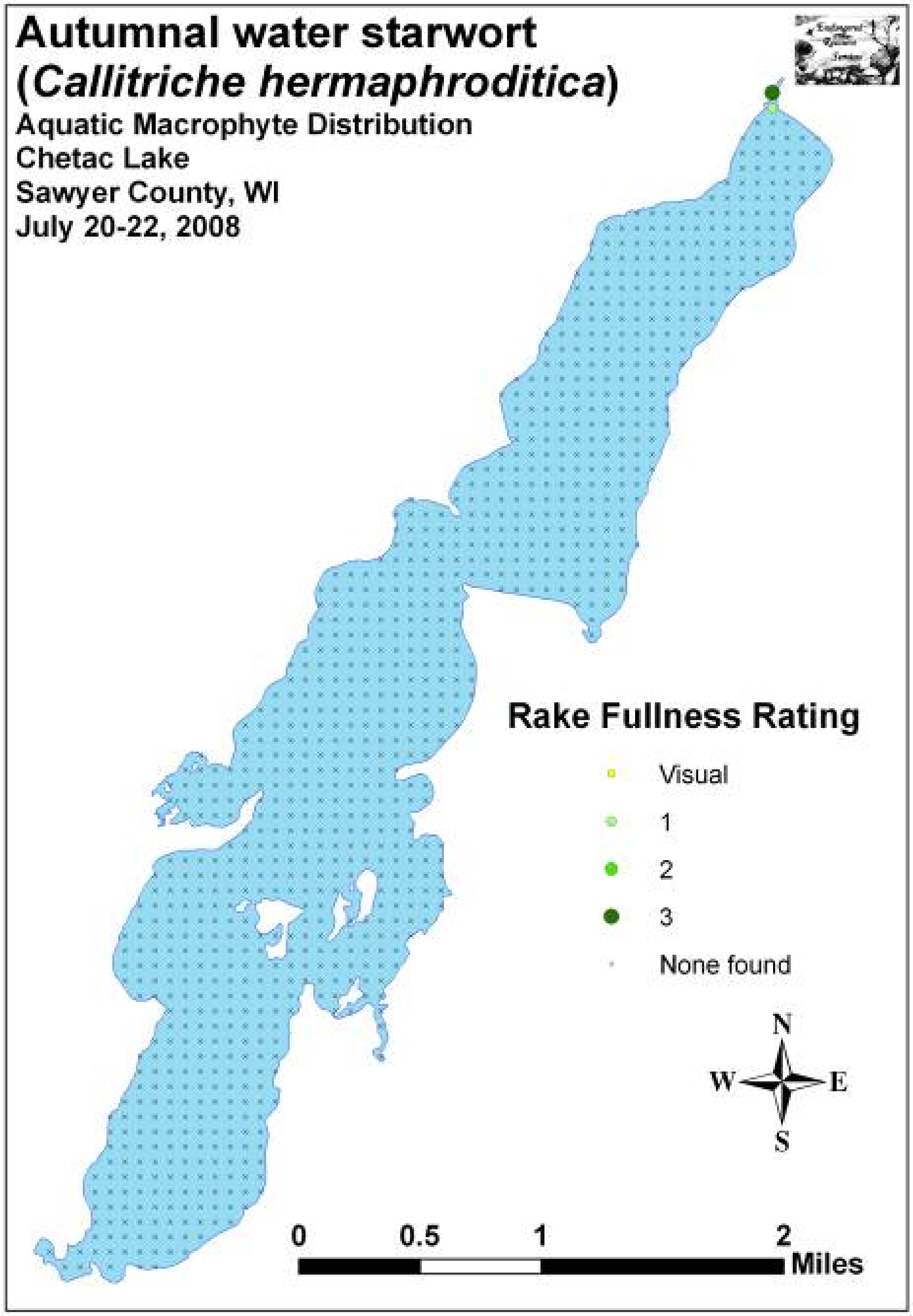
County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Zizania palustris*) **Northern wild rice**
Specimen Location: Chetac Lake; N45.69911°, W91.49395°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-147
Habitat/Distribution: Thick muck bottom in shallow water 0-1.0 meter deep. Common to abundant in the bay east of the islands.
Common Associates: (*Potamogeton natans*) Floating-leaf pondweed, (*Spirodela polyrhiza*) Large duckweed, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Lemna minor*) Small duckweed, (*Typha latifolia*) Broad-leaved cattail

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: **Filamentous algae**
Habitat/Distribution: Common to abundant throughout over all bottom types. It was especially evident in front of properties with "well maintained" grass lawns where fertilizer was apparently being spread near the lakeshore.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton crispus*) Curly-leaf pondweed**,** (*Ceratophyllum demersum*) Coontail

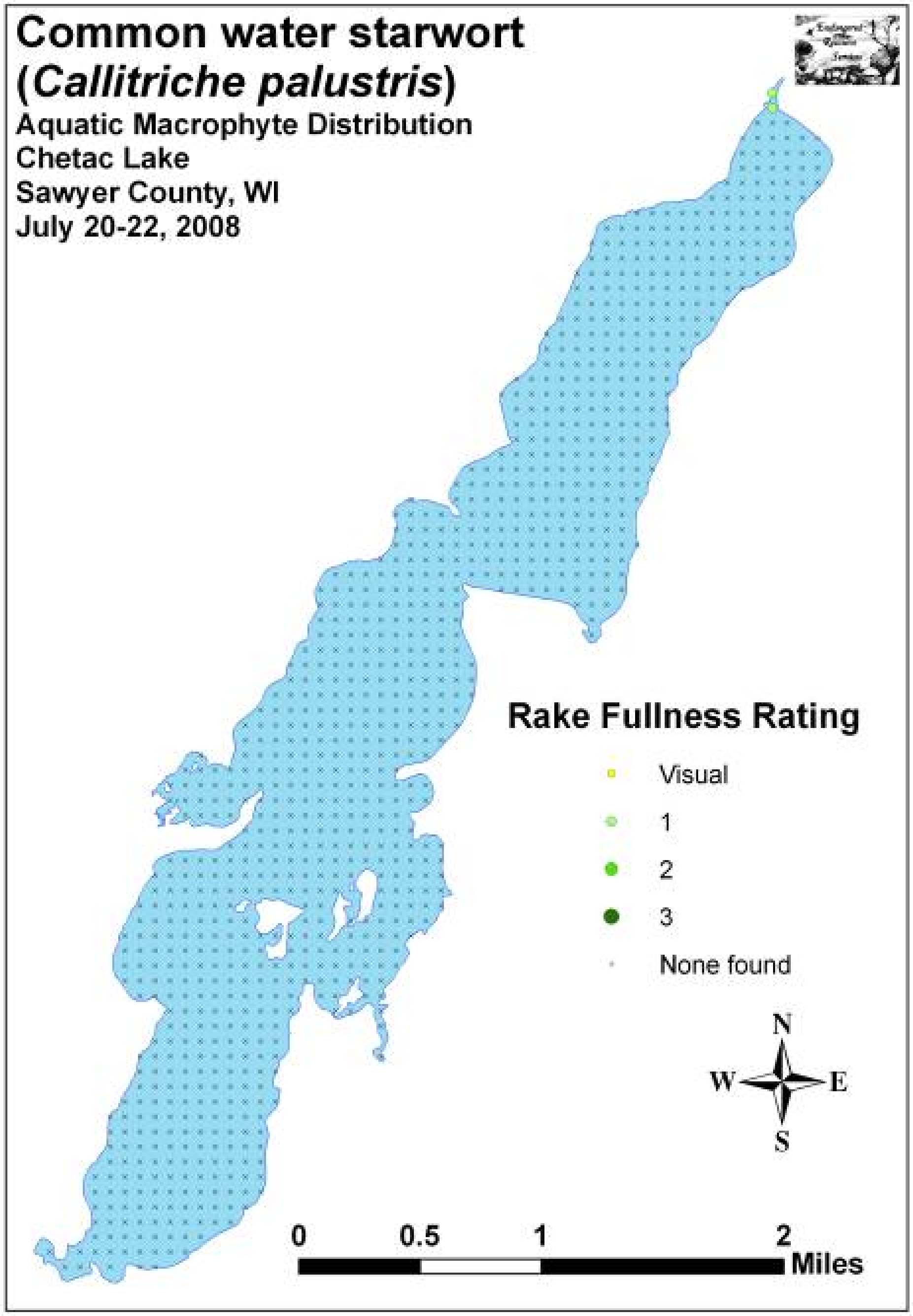
Appendix VII: Point Intercept Plant Species Distribution Maps


Aquatic moss
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
1
2
3
None found
N
W
E
S
0
0.5
1
2
Miles

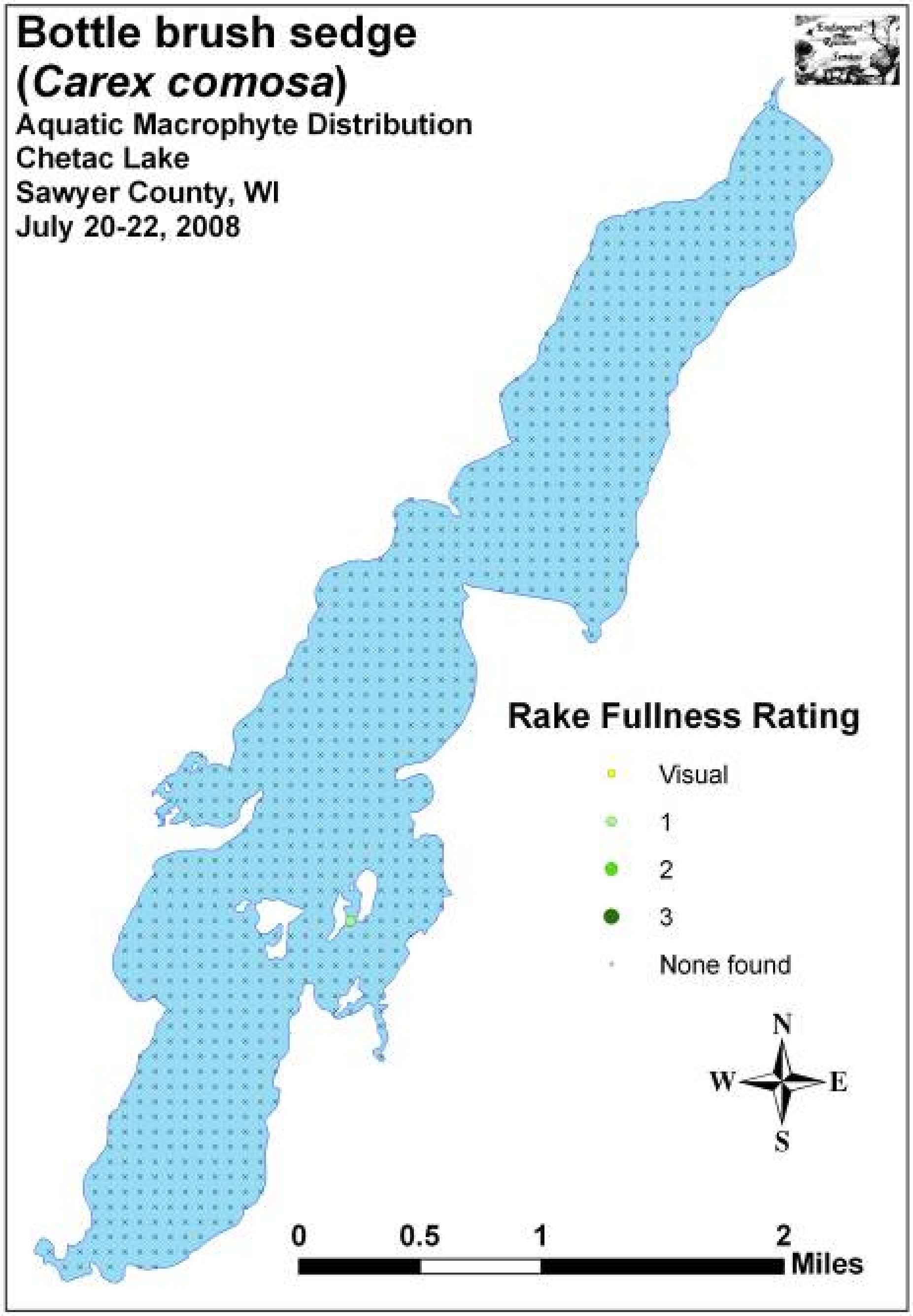

Water arum
(Calla palustris)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
1
2
3
None found
N
W
E
S
0
0.5
1
2
Miles

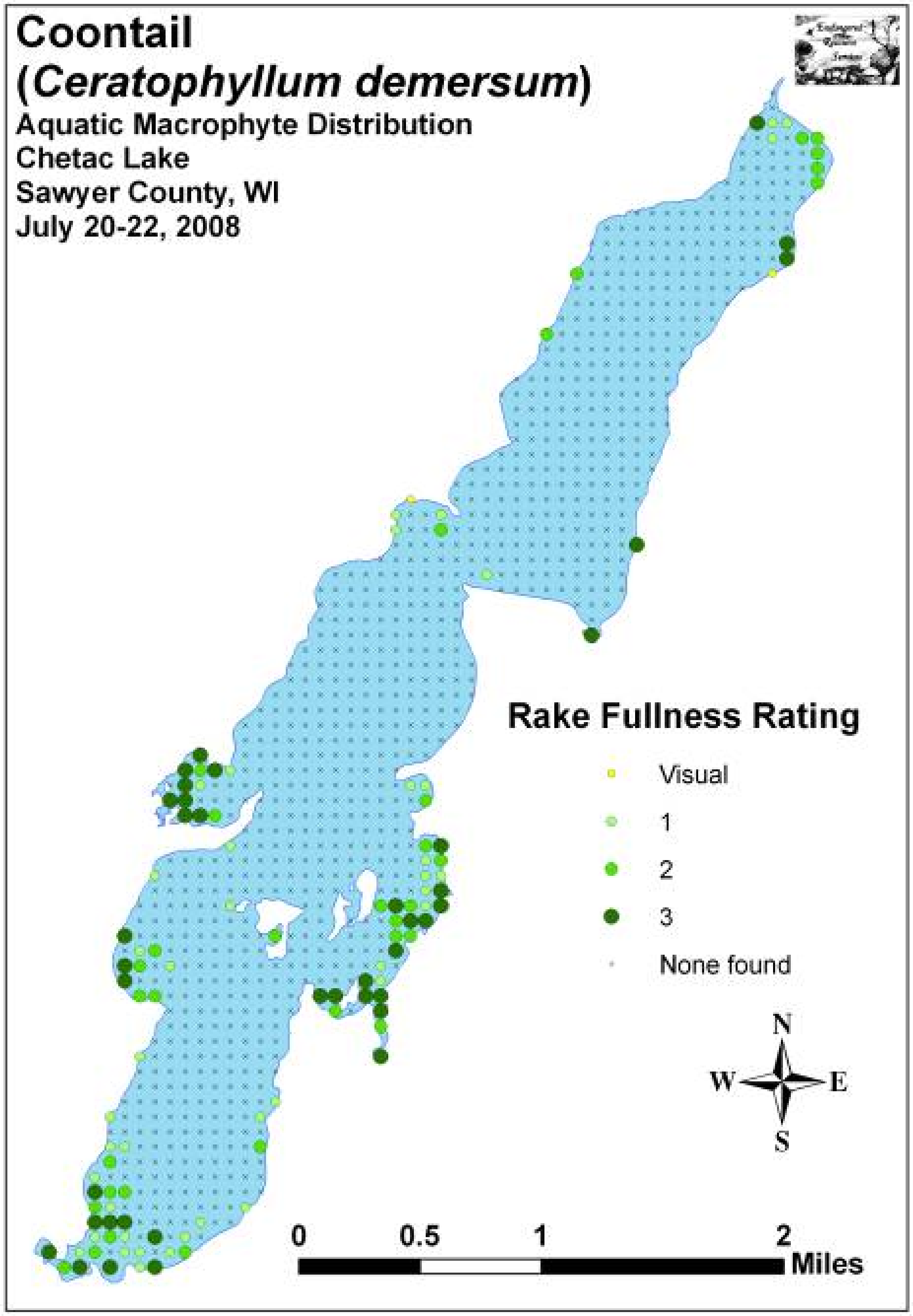


Autumnal water starwort
(*Callitriche hermaphroditica*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
1
2
3
None found
N
W
E
S
0
0.5
1
2
Miles

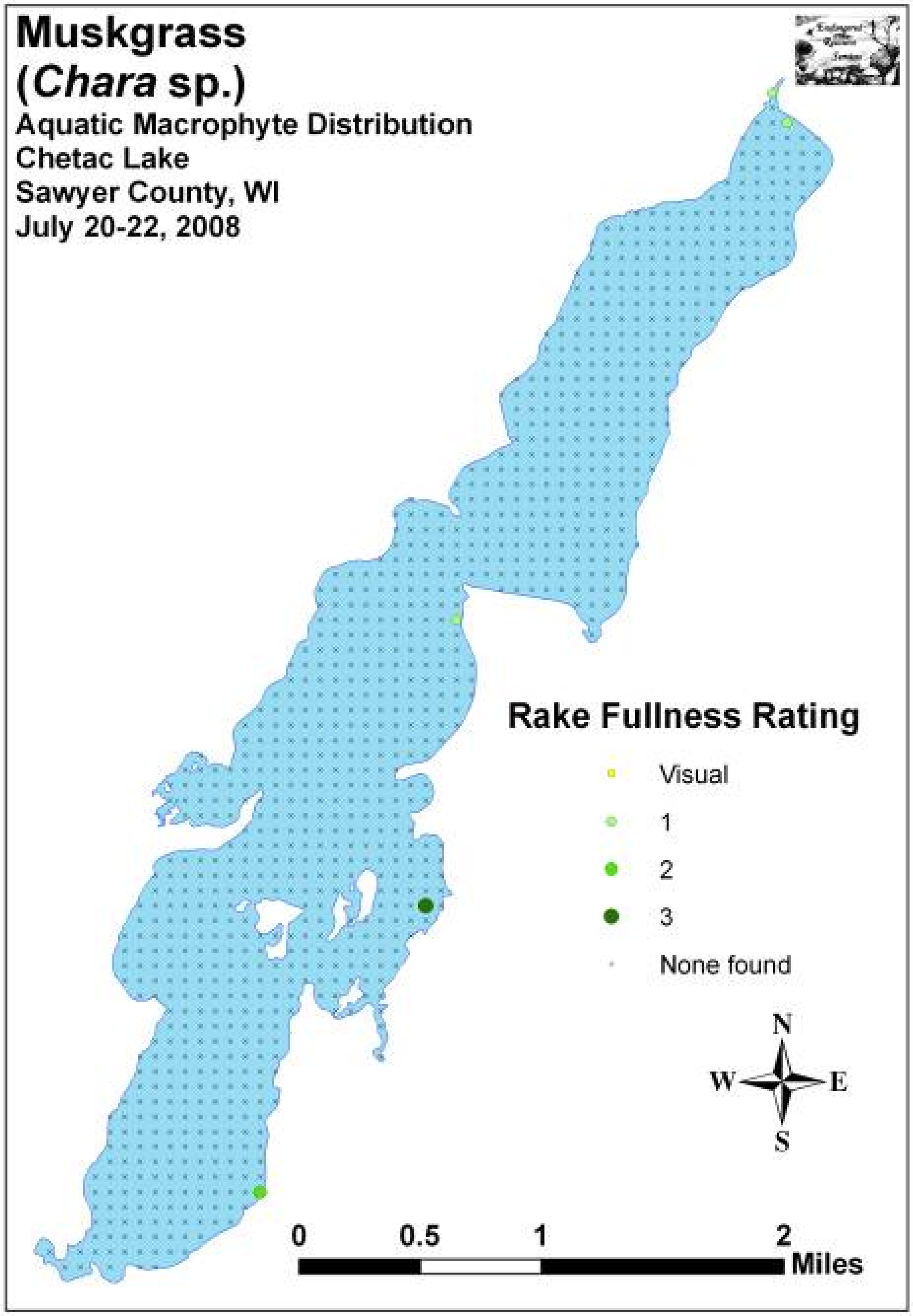


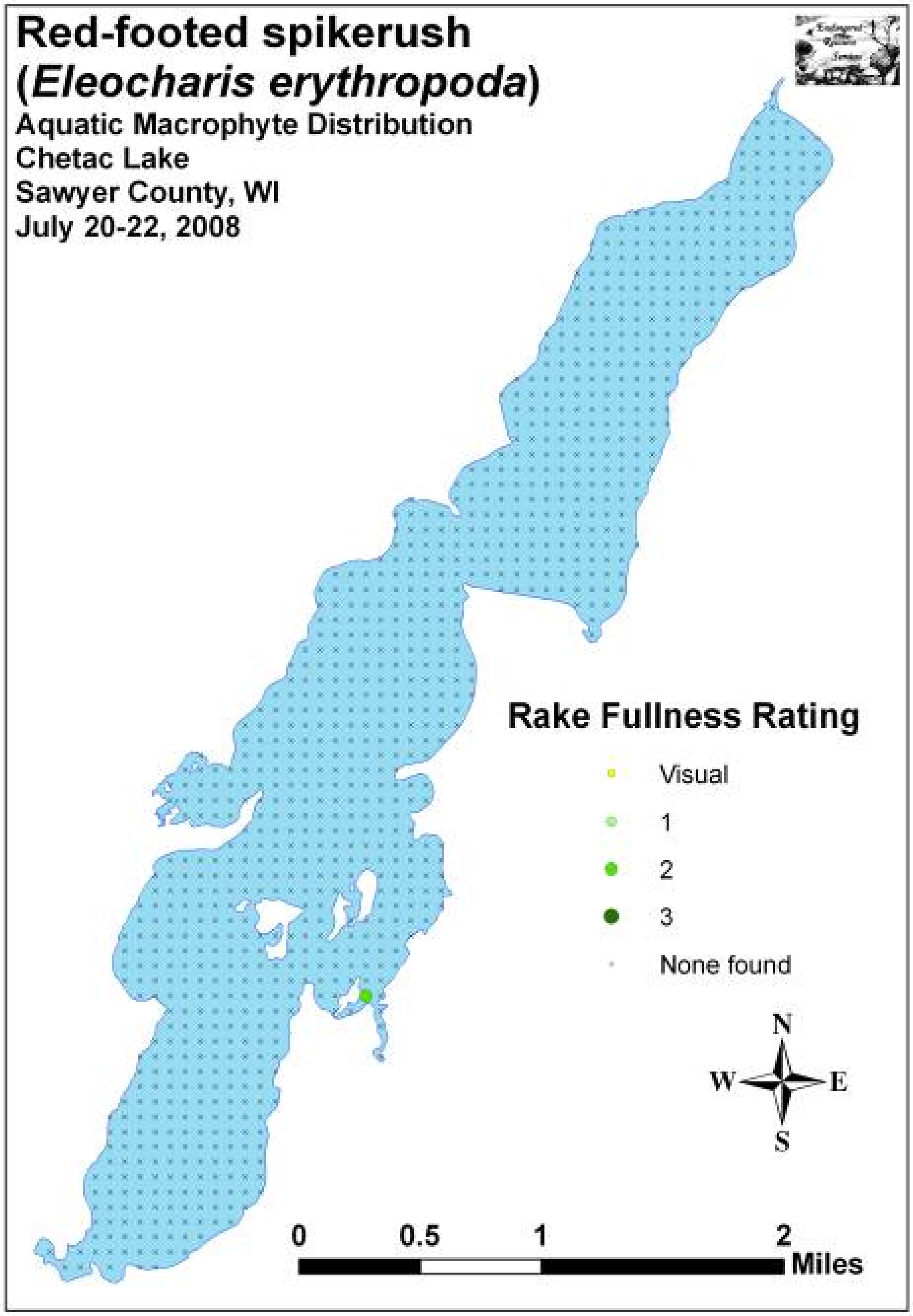
Common water starwort
(Callitriche palustris)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
1
2
3
None found
N
W
E
S
0
0.5
1
2
Miles


Bottle brush sedge
(*Carex comosa*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
1
2
3
None found
N
W
E
S
0
0.5
1
2
Miles



Coontail
(Ceratophyllum demersum)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
1
2
3
None found
N
W
E
S
0
0.5
1
2
Miles


Muskgrass
(*Chara* sp.)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
1
2
3
None found
N
W
E
S
0
0.5
1
2
Miles



Red-footed spikerush
(Eleocharis erythropoda)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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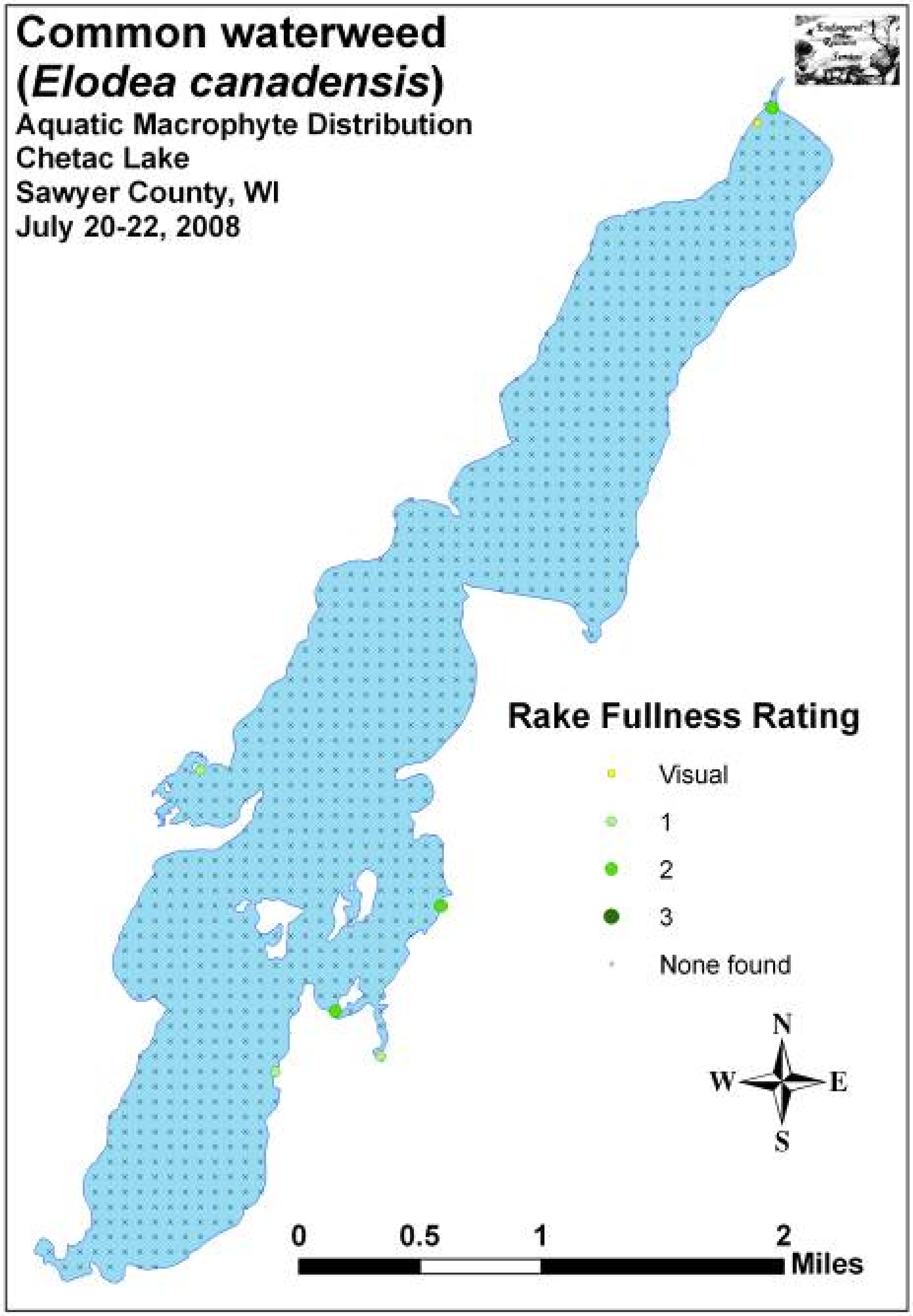
Common waterweed
(Elodea canadensis)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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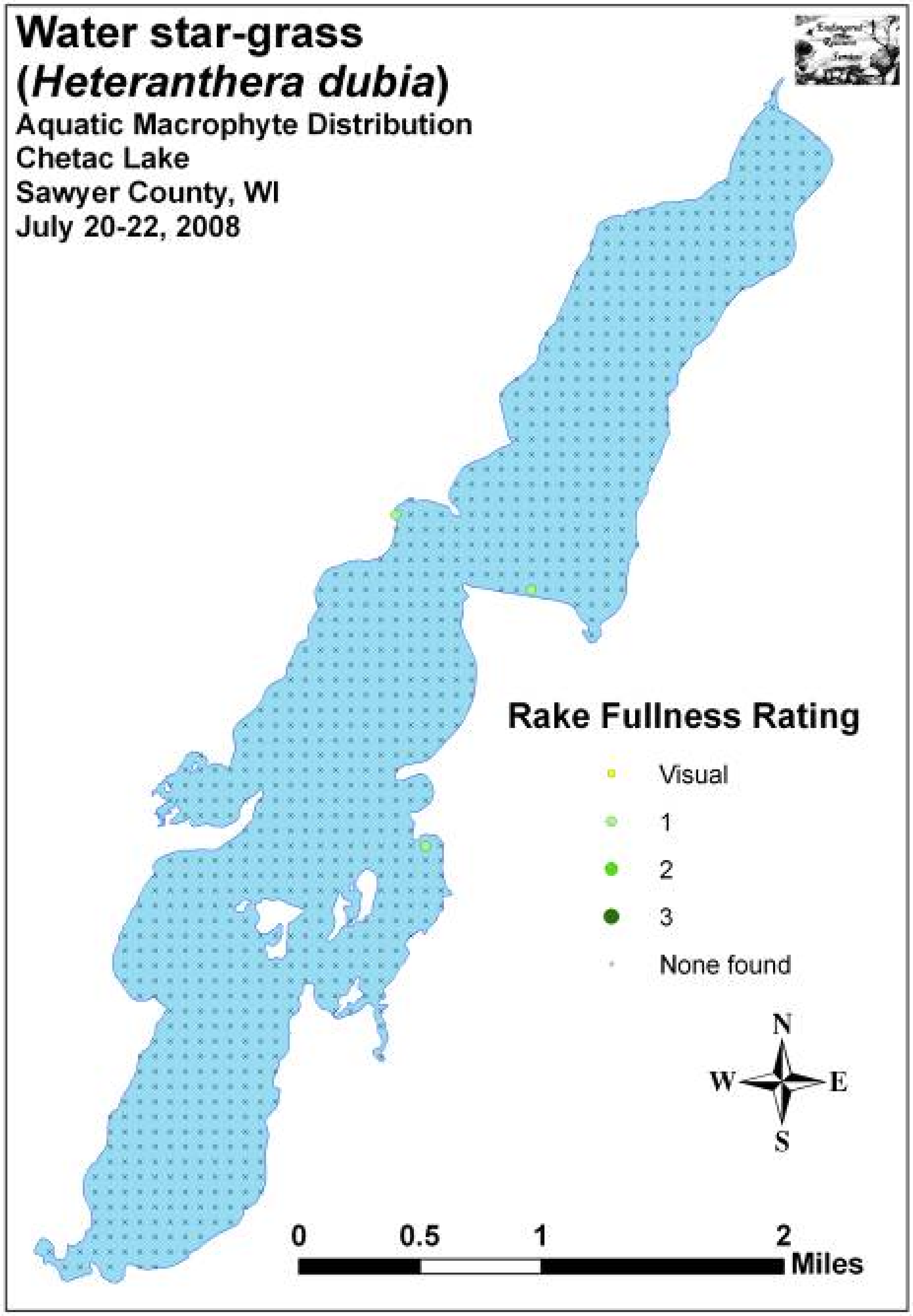
Water star-grass
(Heteranthera dubia)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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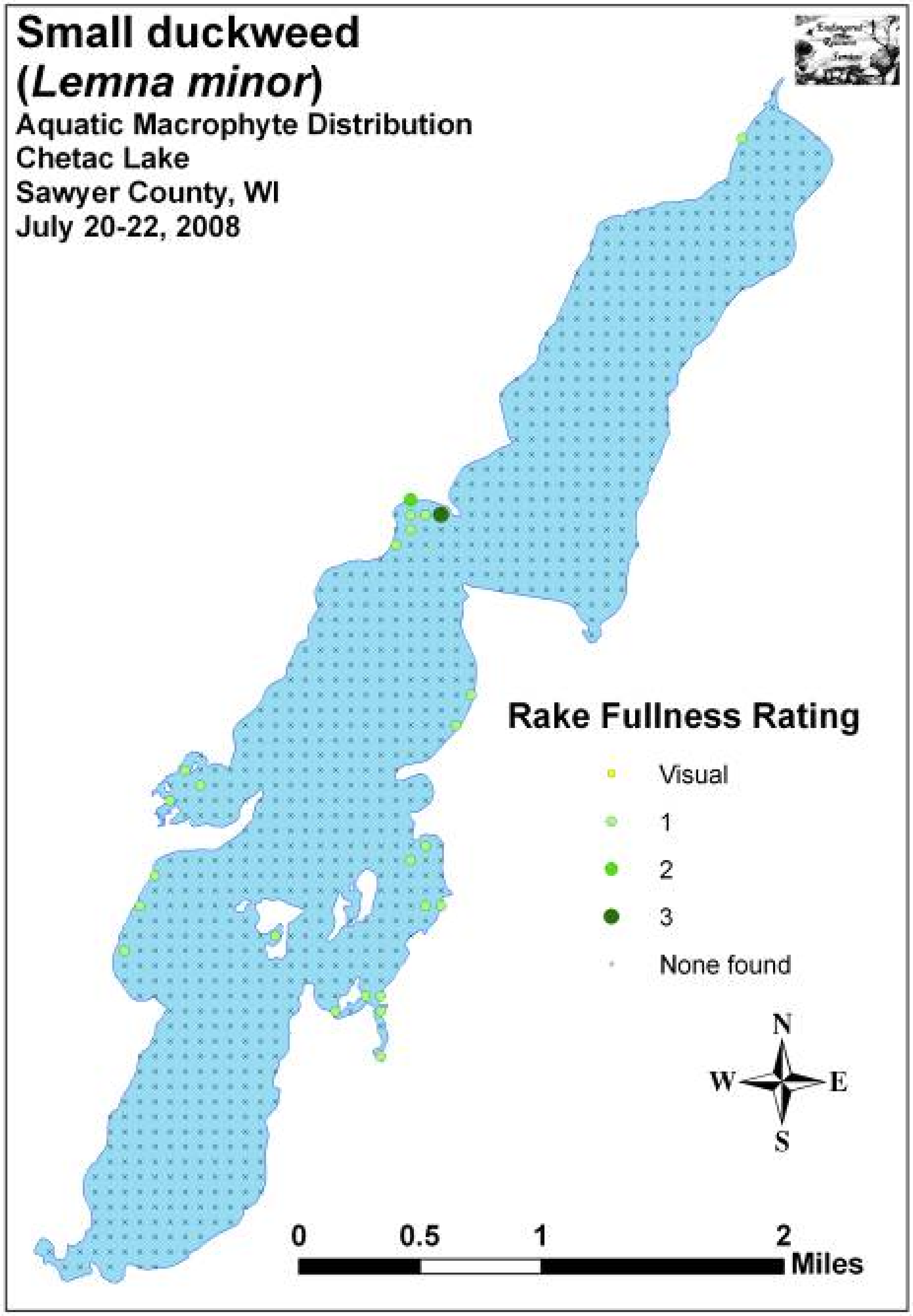
Small duckweed
(*Lemna minor*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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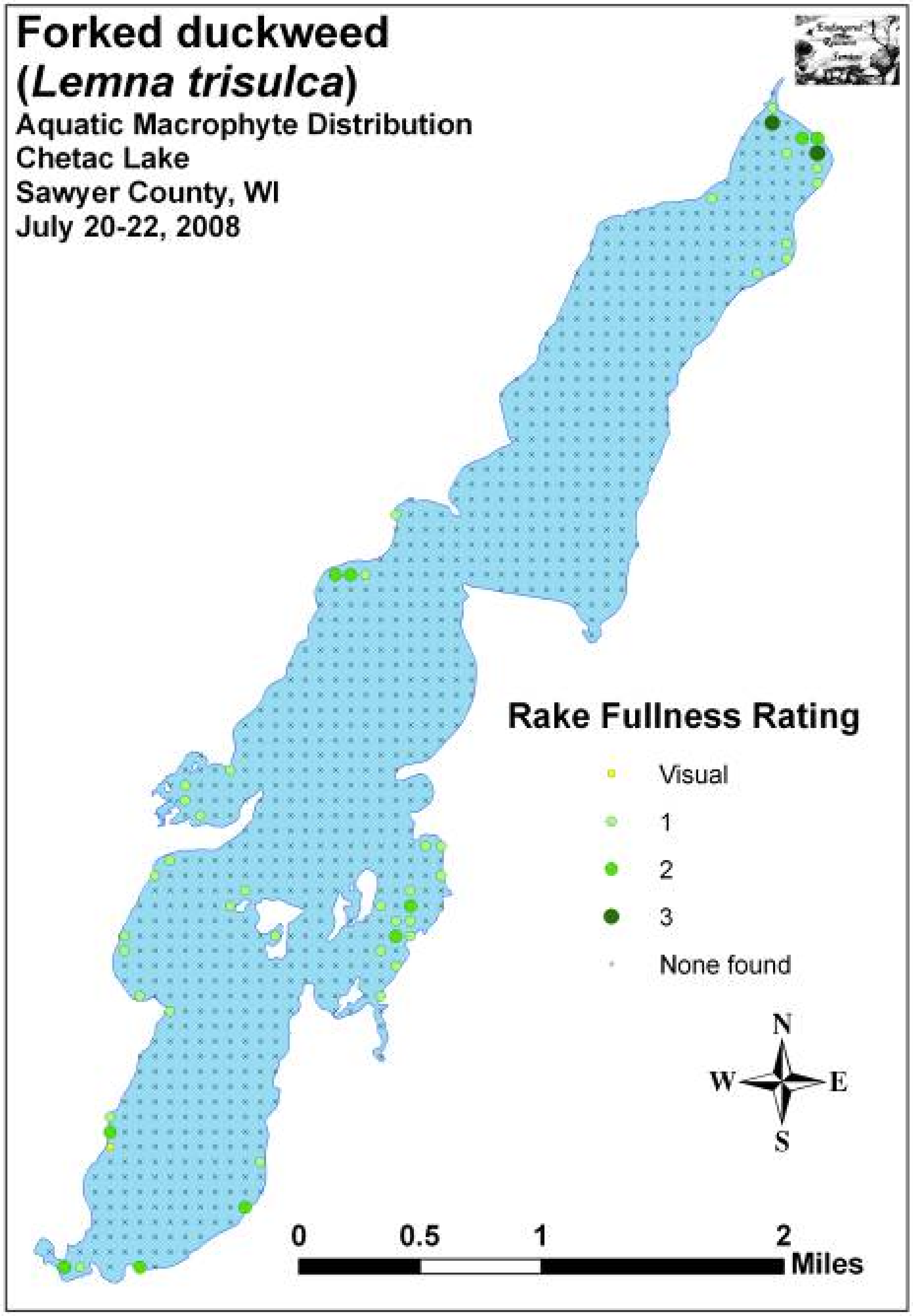
Forked duckweed
(Lemna trisulca)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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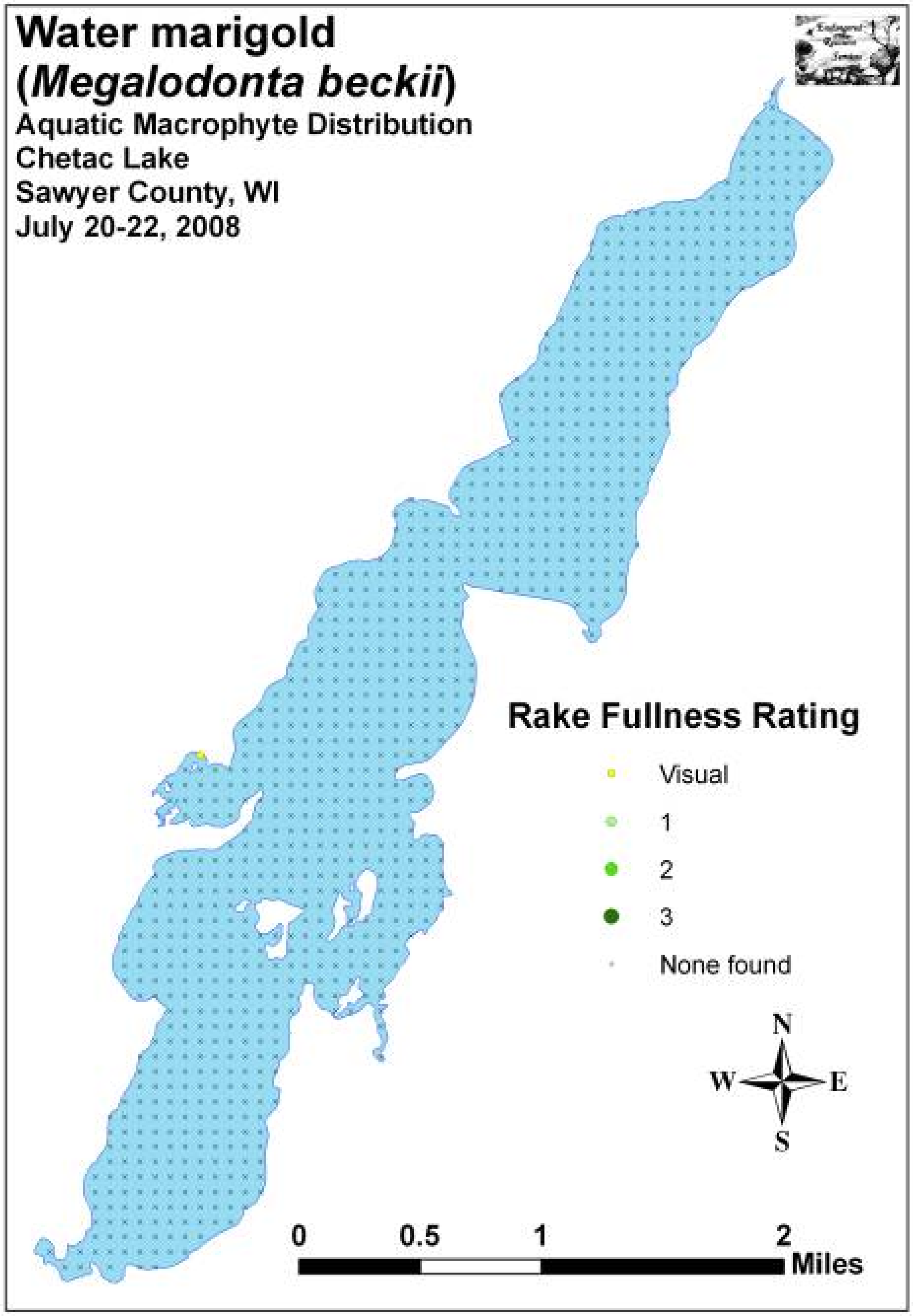

Water marigold
(*Megalodonta beckii*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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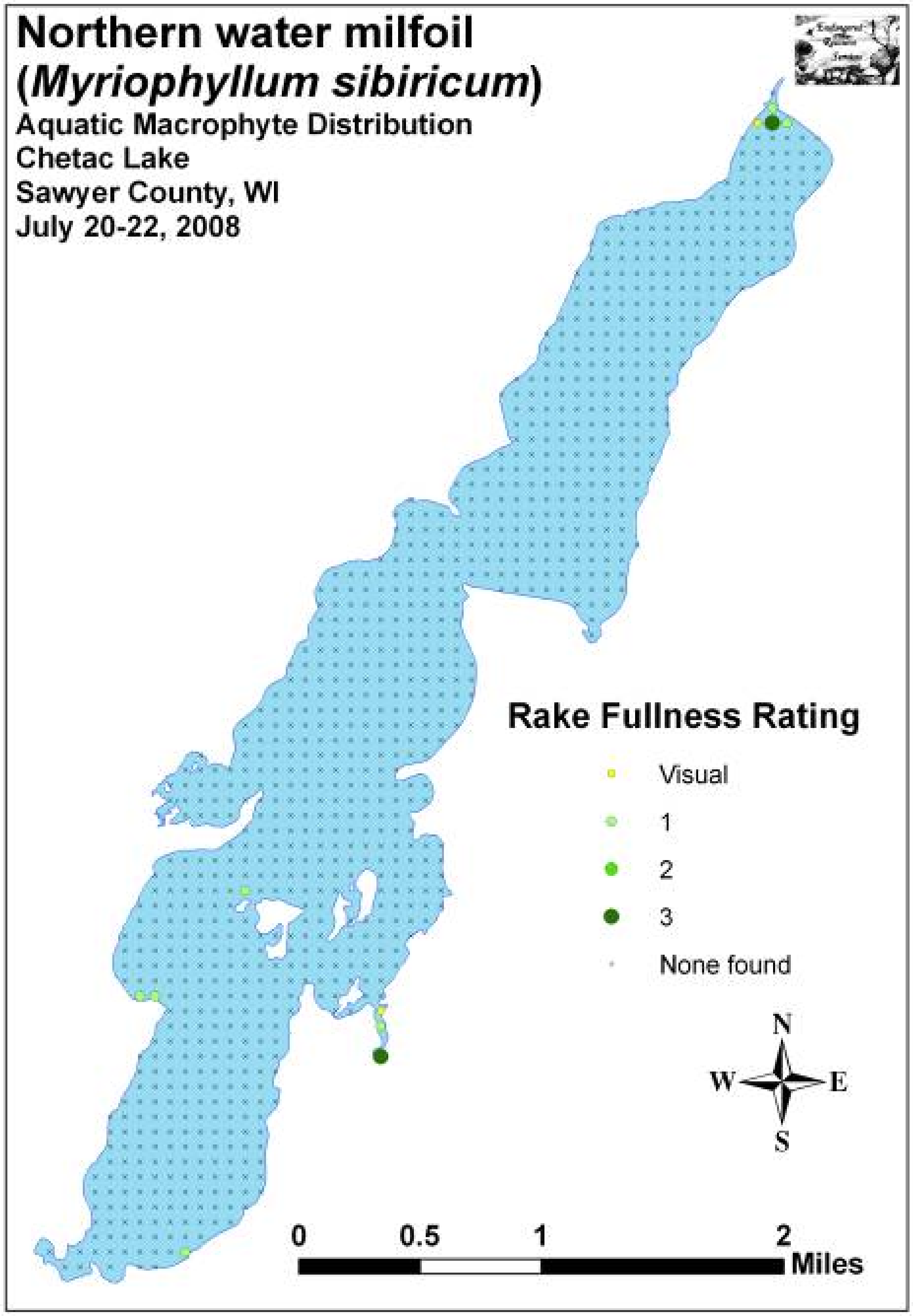
Northern water milfoil
(*Myriophyllum sibiricum*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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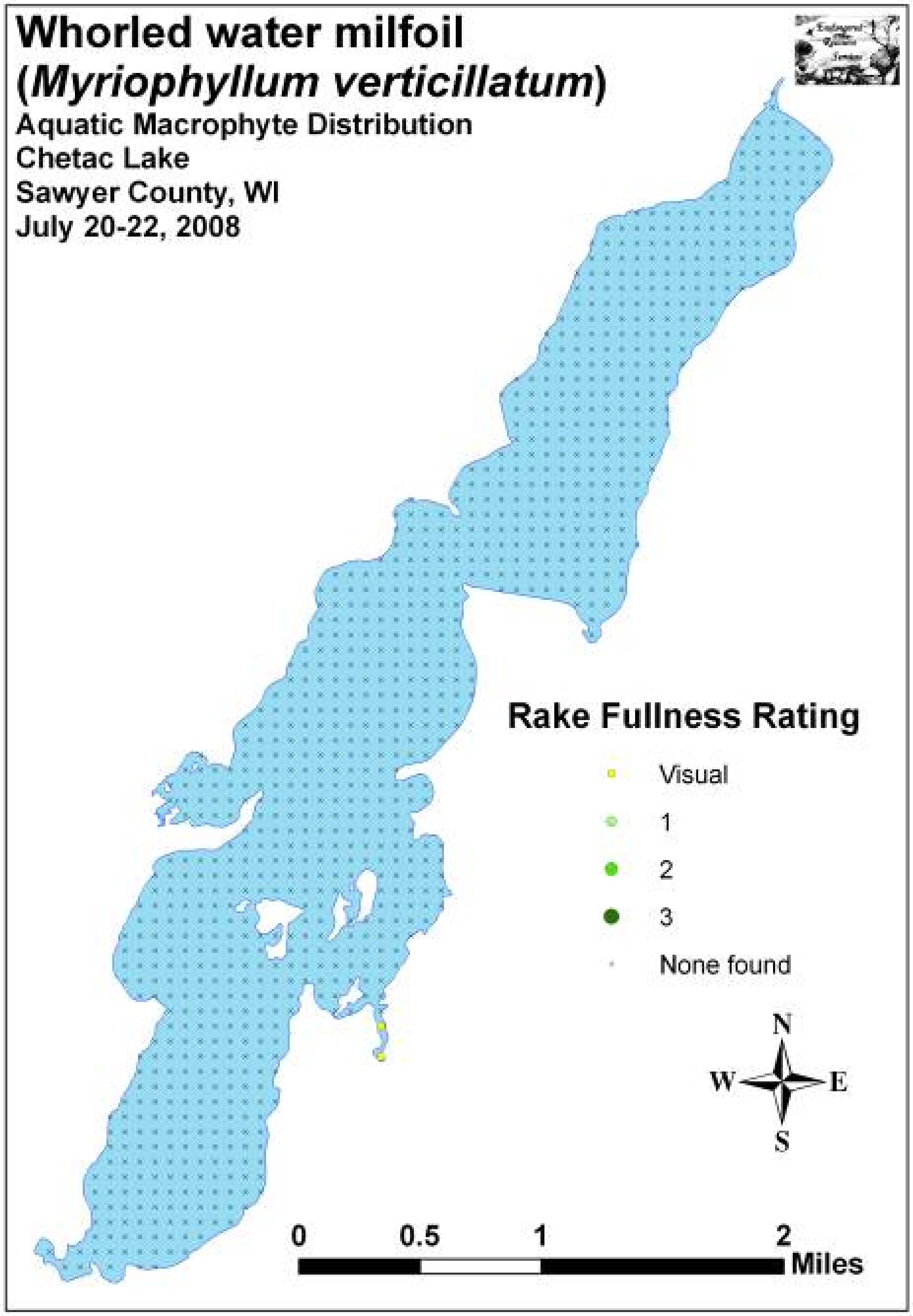

Whorled water milfoil
(*Myriophyllum verticillatum*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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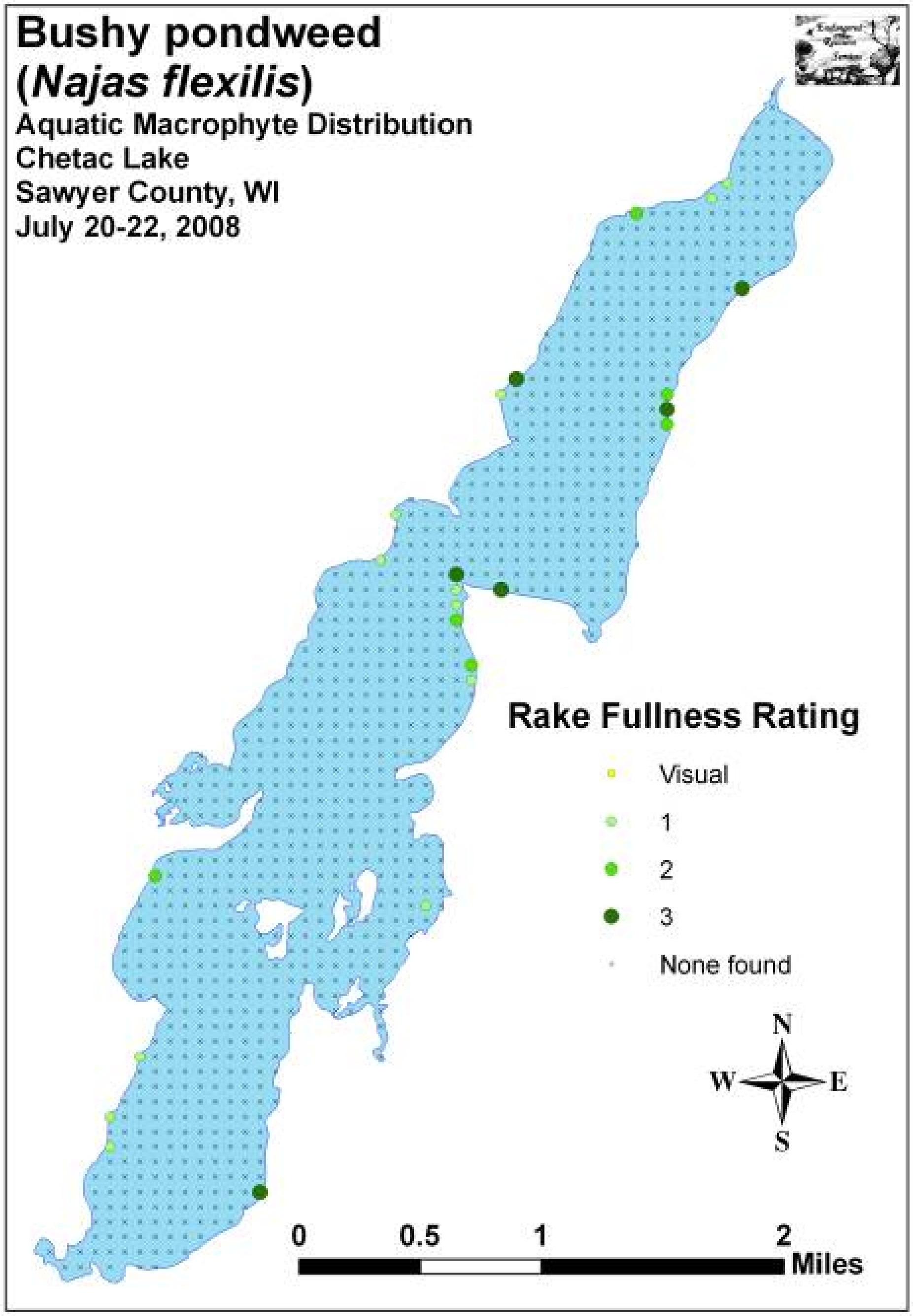

Bushy pondweed
(*Najas flexilis*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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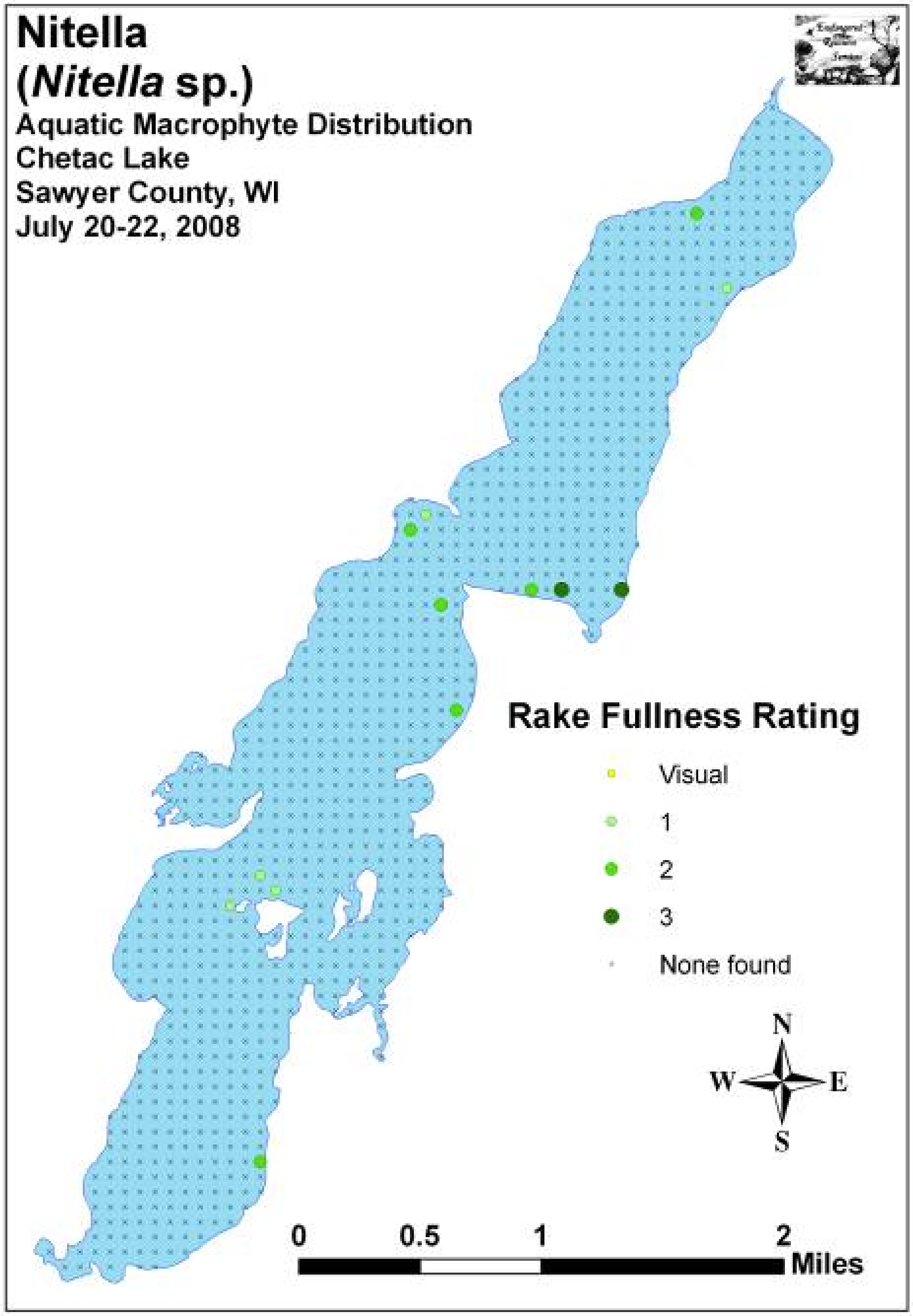

Nitella
(*Nitella* sp.)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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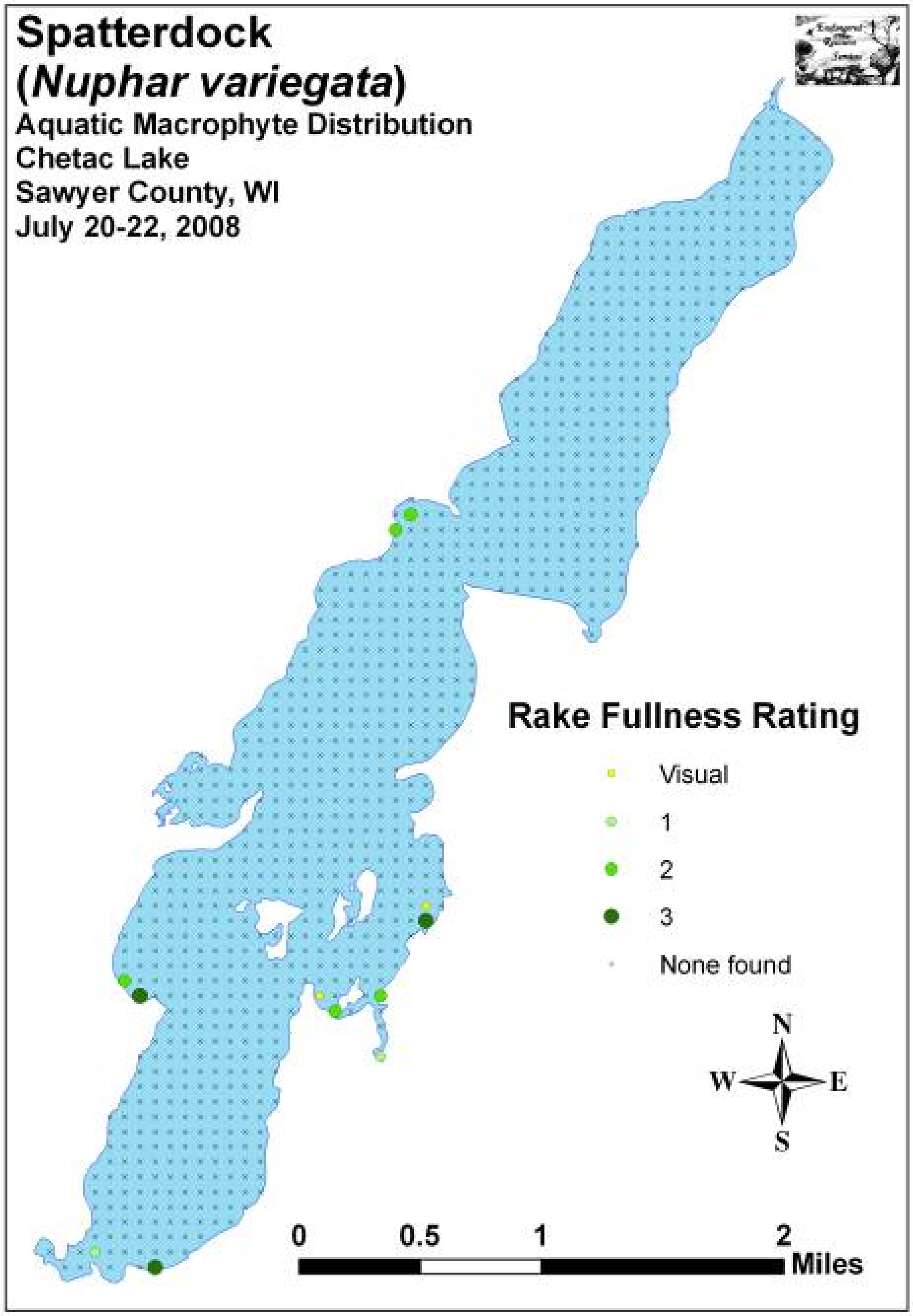
Spatterdock
(Nuphar variegata)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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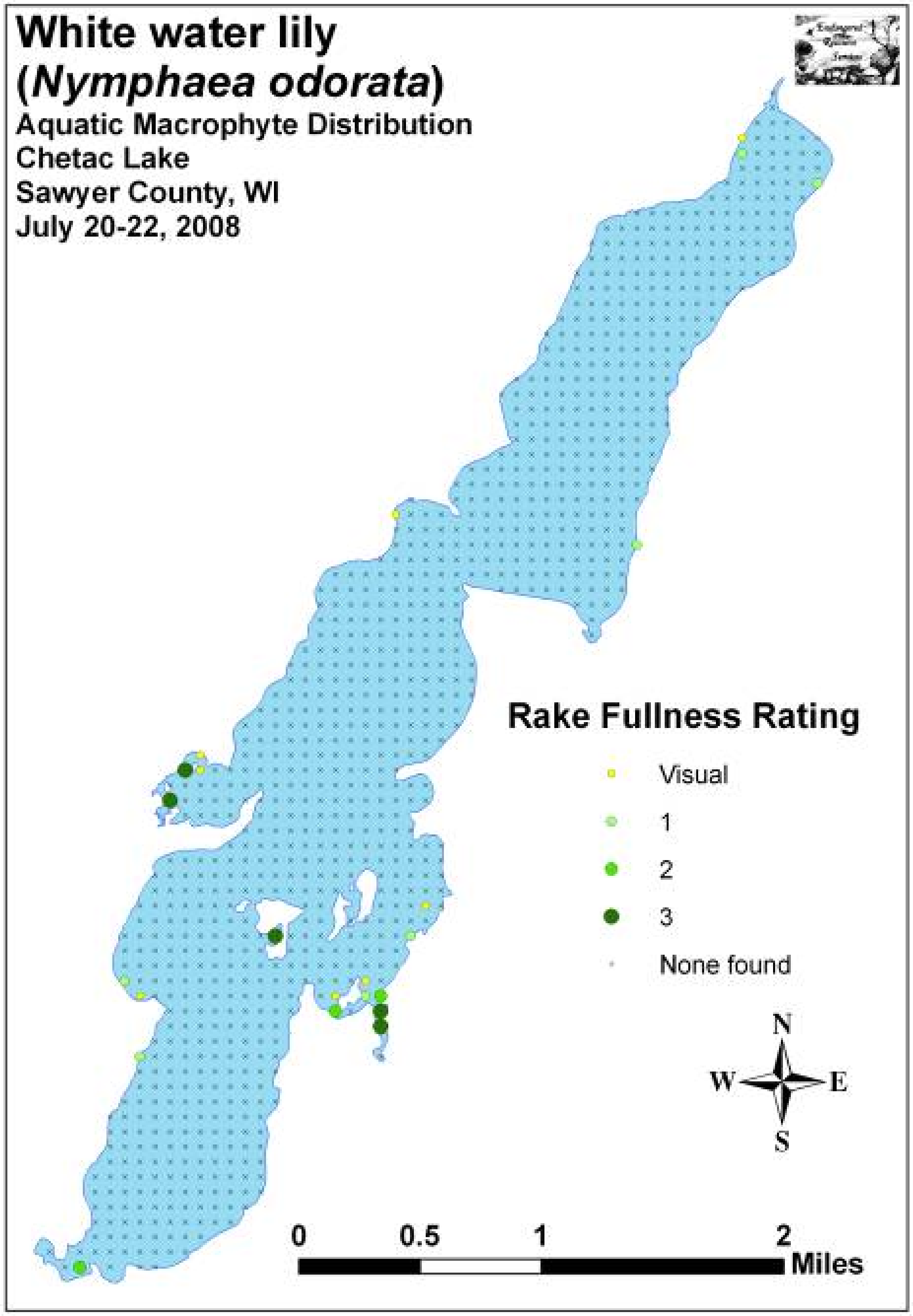
White water lily
(*Nymphaea odorata*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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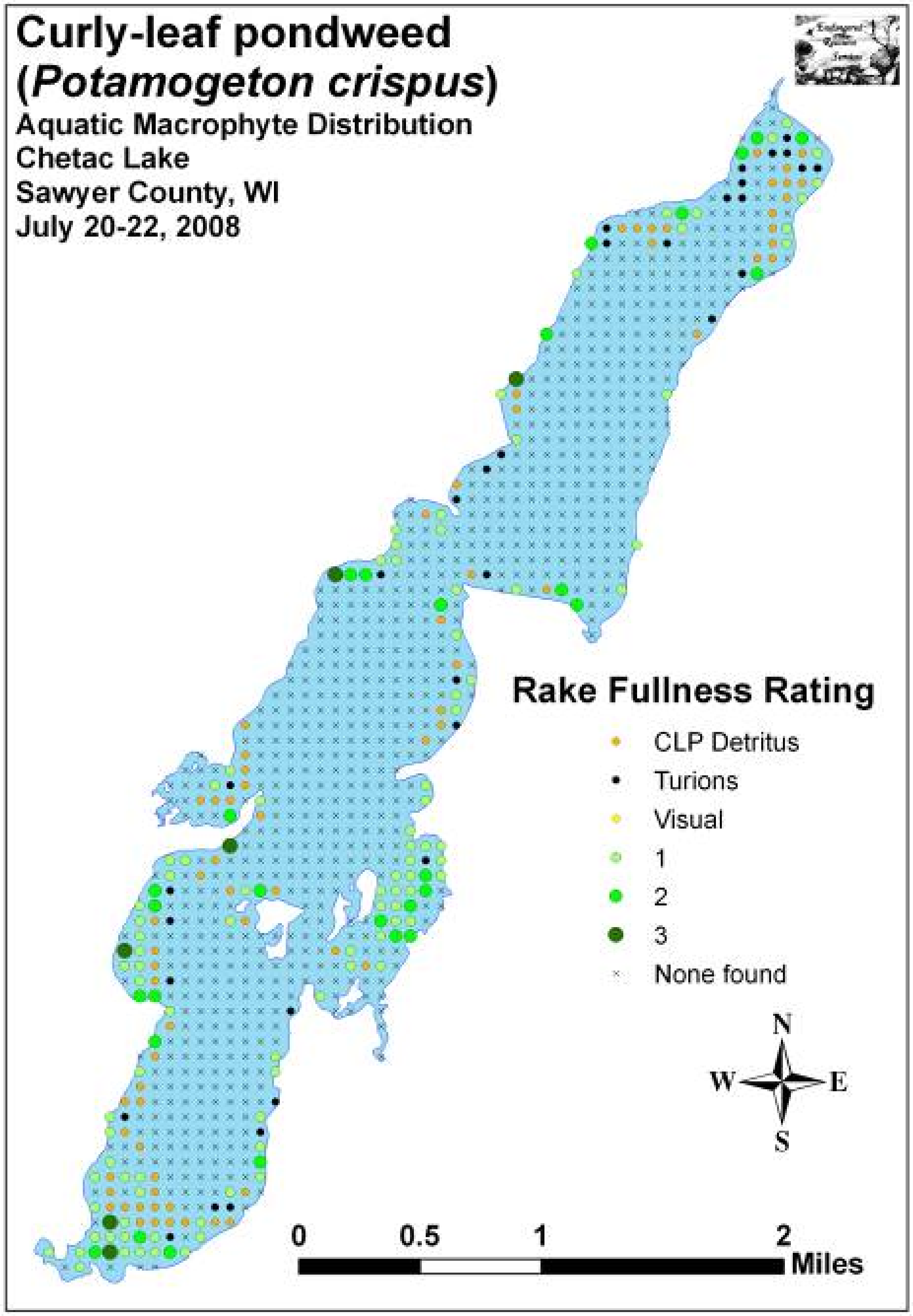
Curly-leaf pondweed
(Potamogeton crispus)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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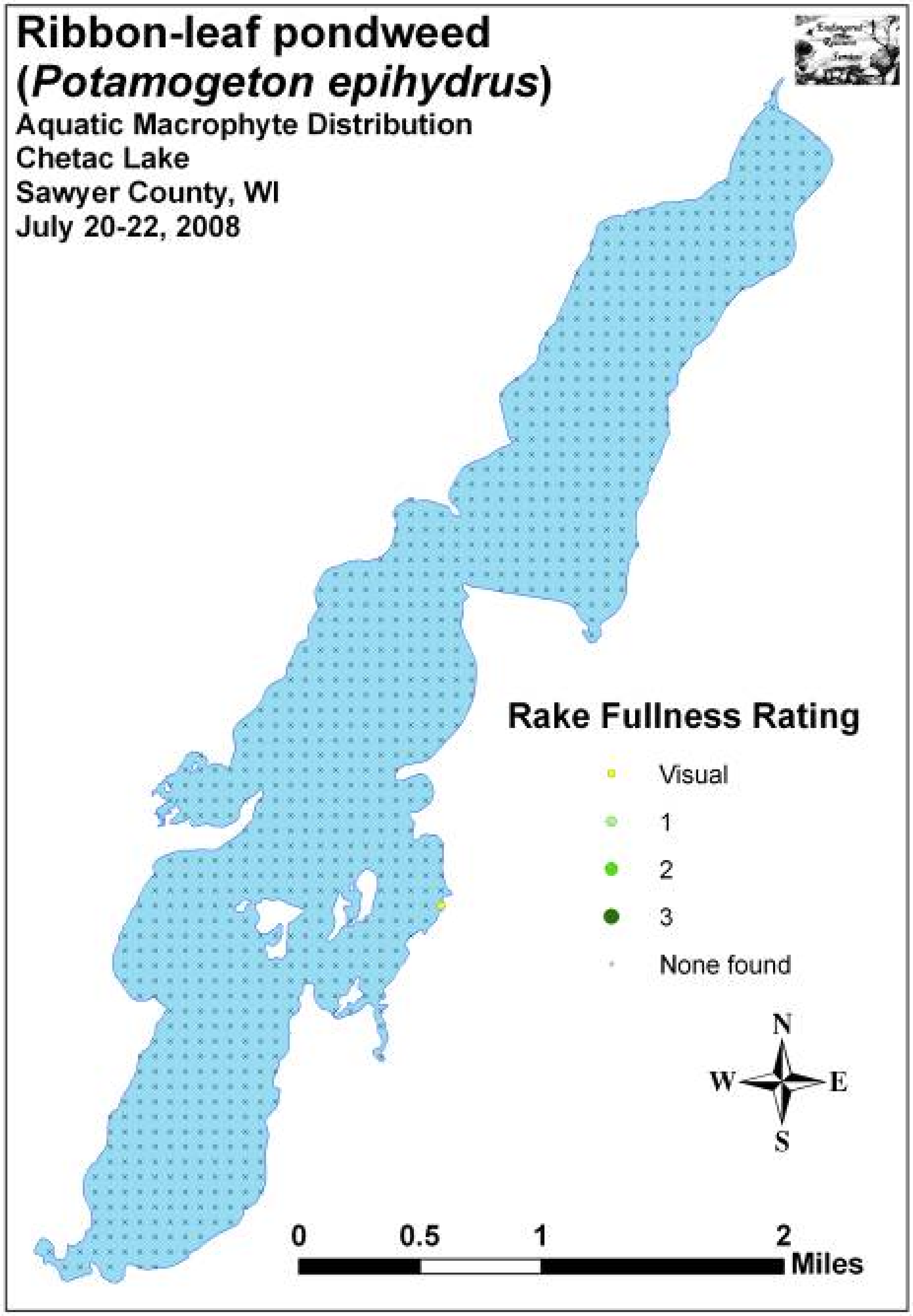

Ribbon-leaf pondweed
(Potamogeton epihydrus)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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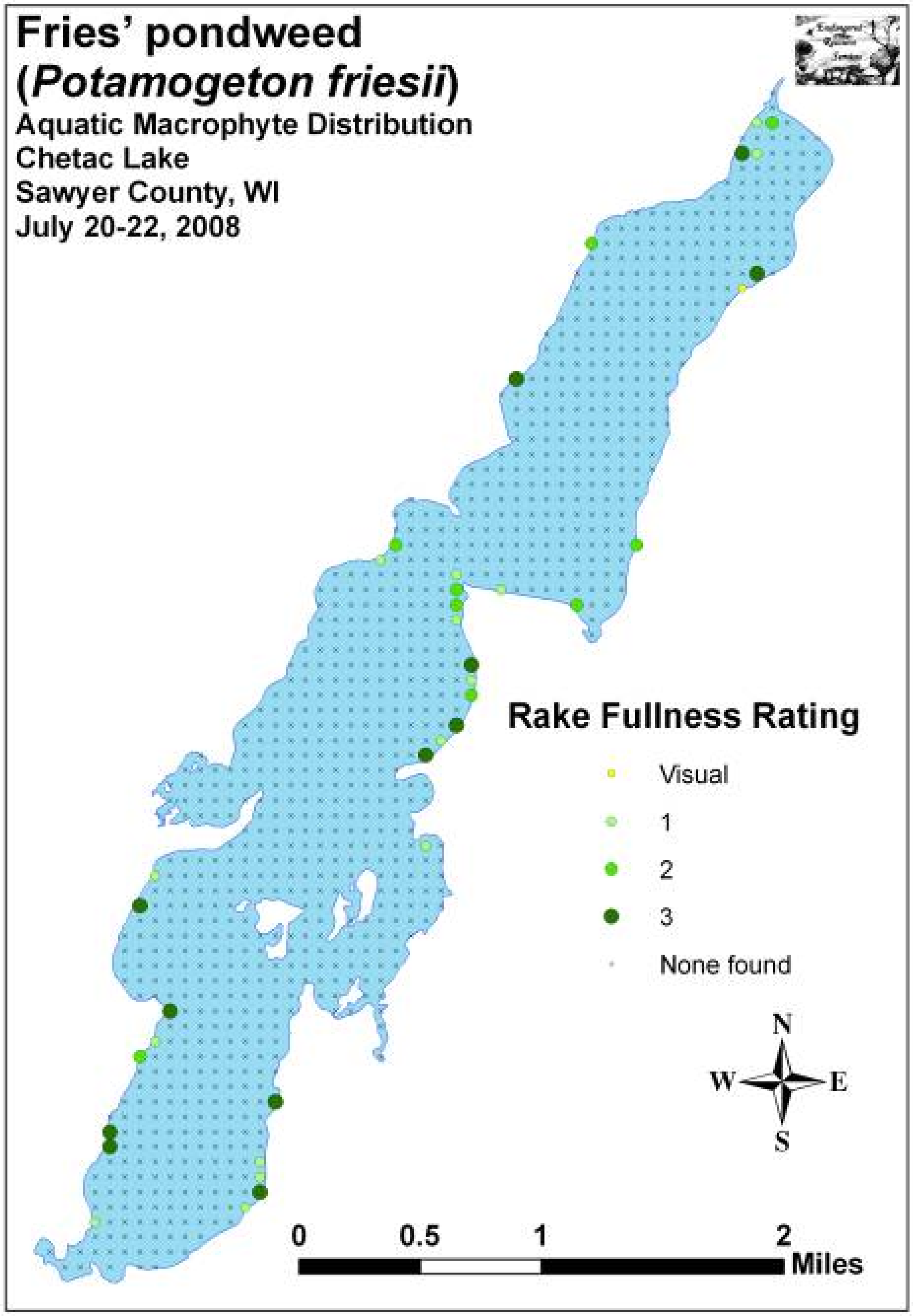
Fries' pondweed
(Potamogeton friesii)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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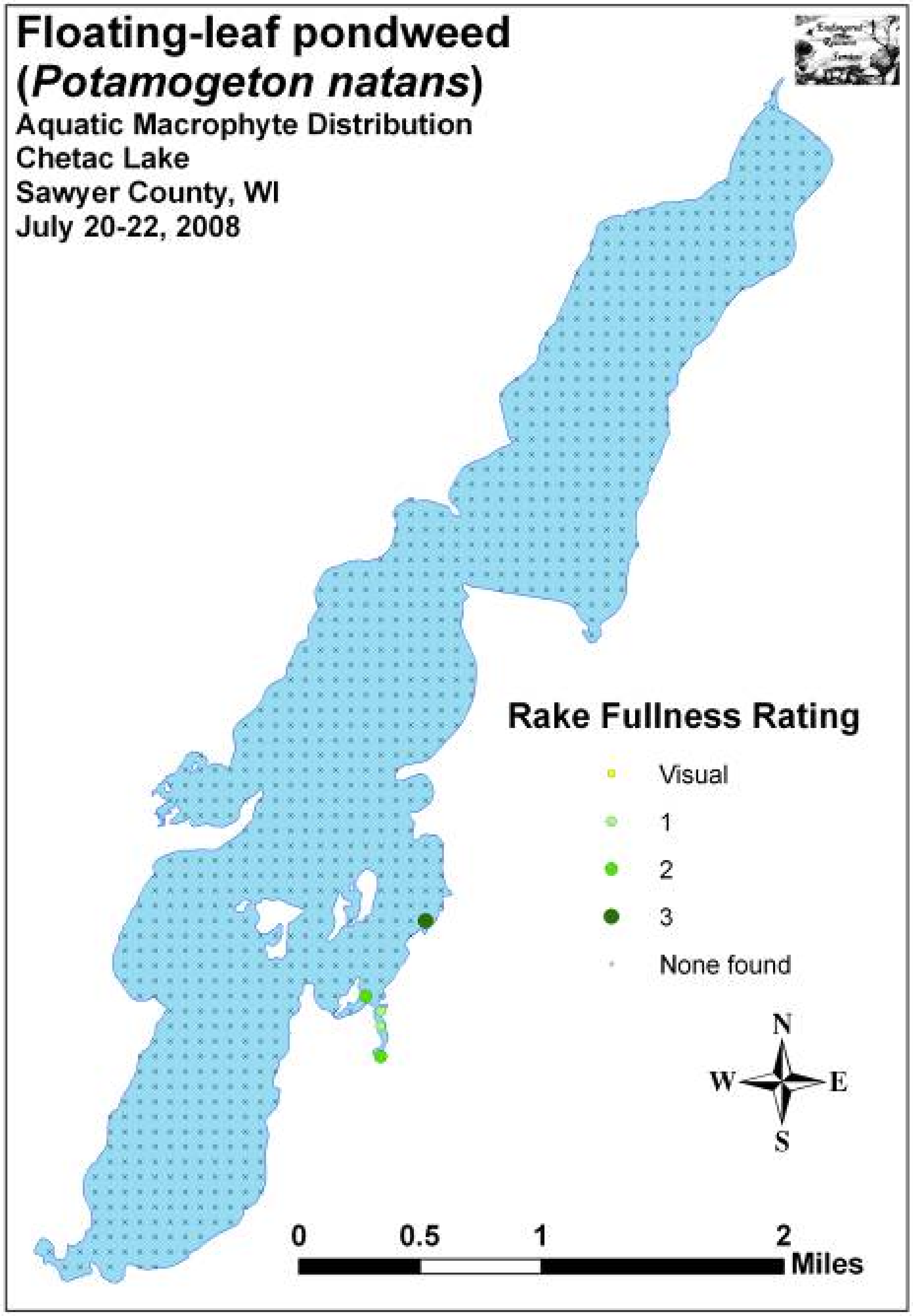
Floating-leaf pondweed
(Potamogeton natans)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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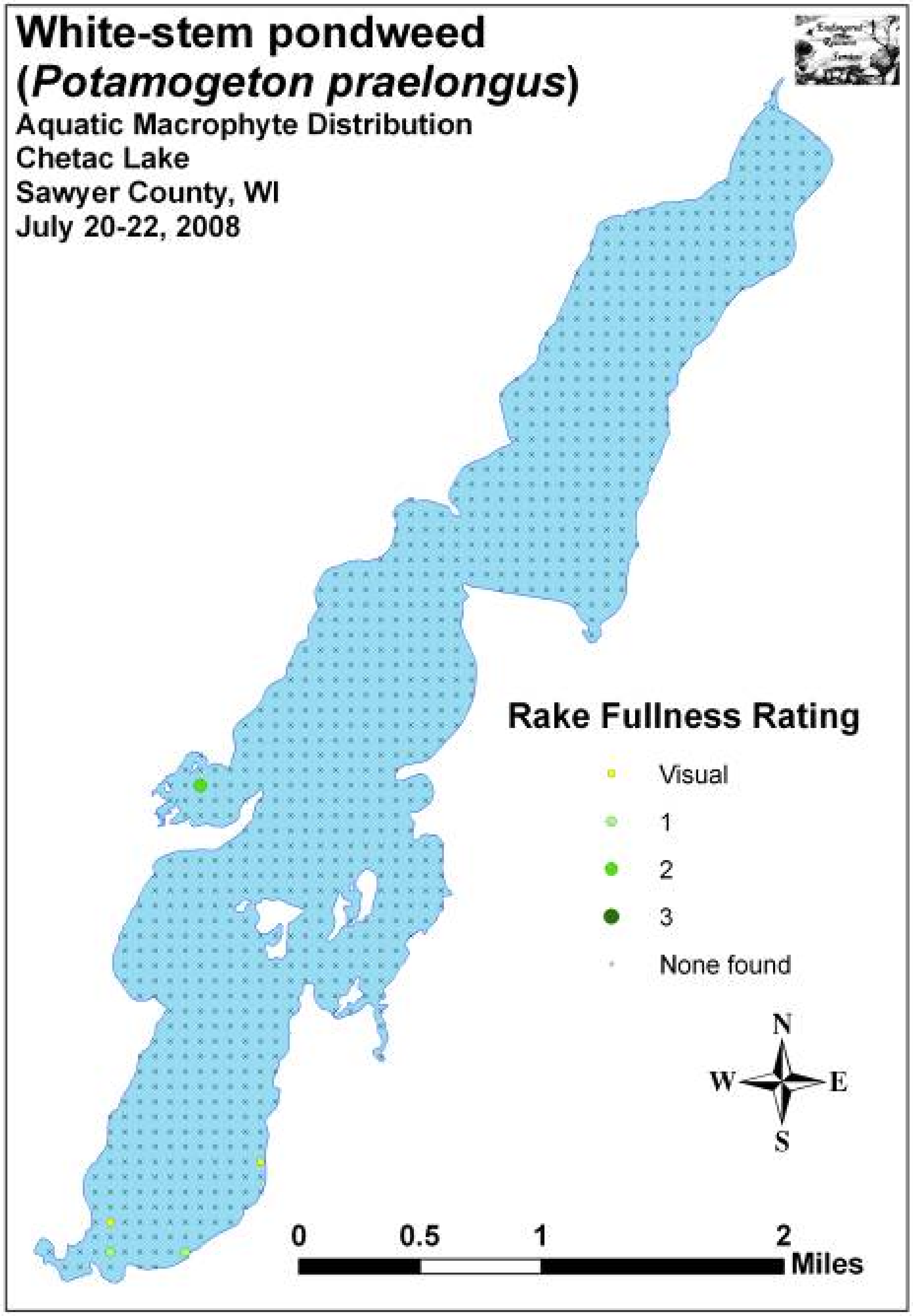
White-stem pondweed
(*Potamogeton praelongus*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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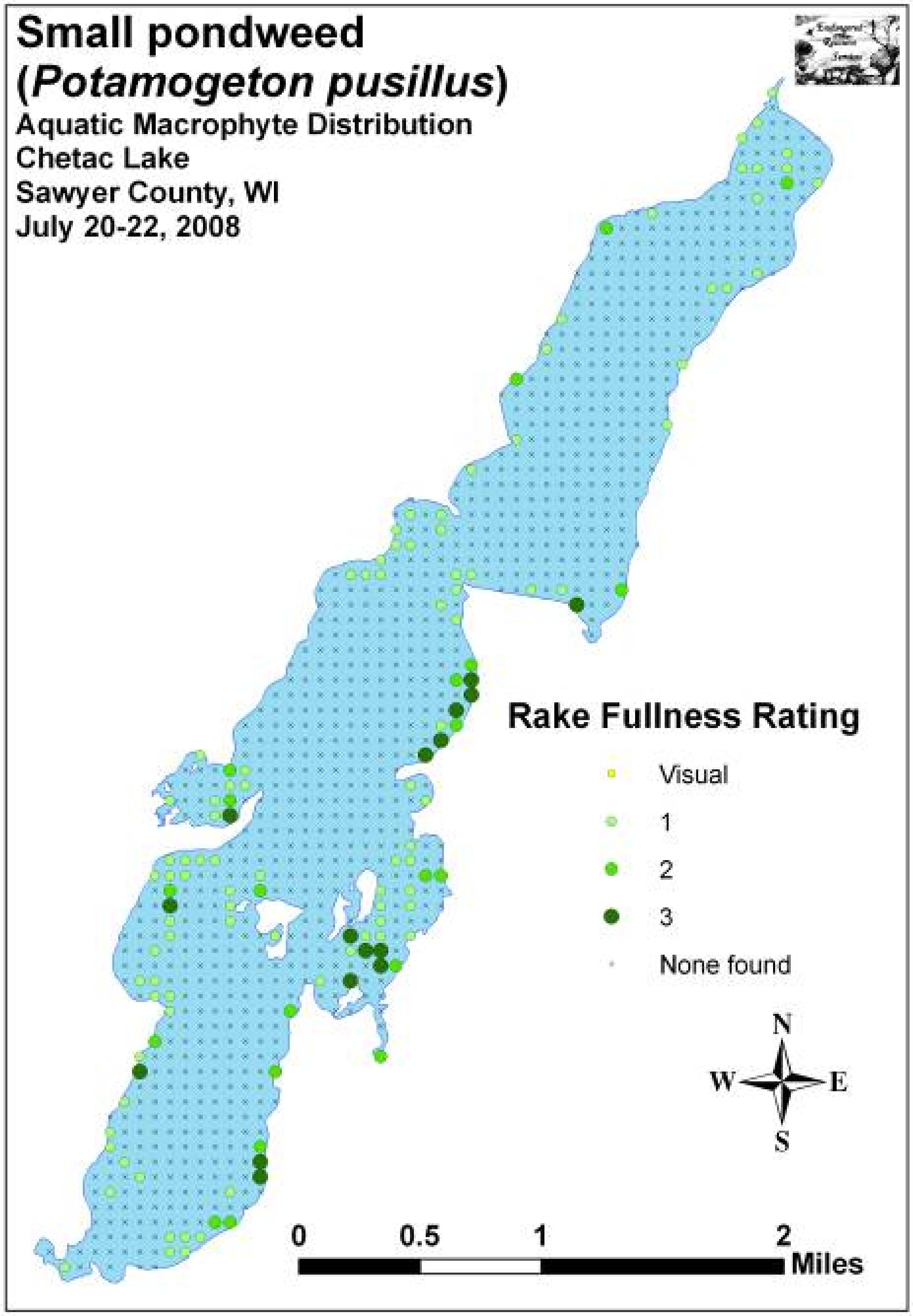

Small pondweed
(*Potamogeton pusillus*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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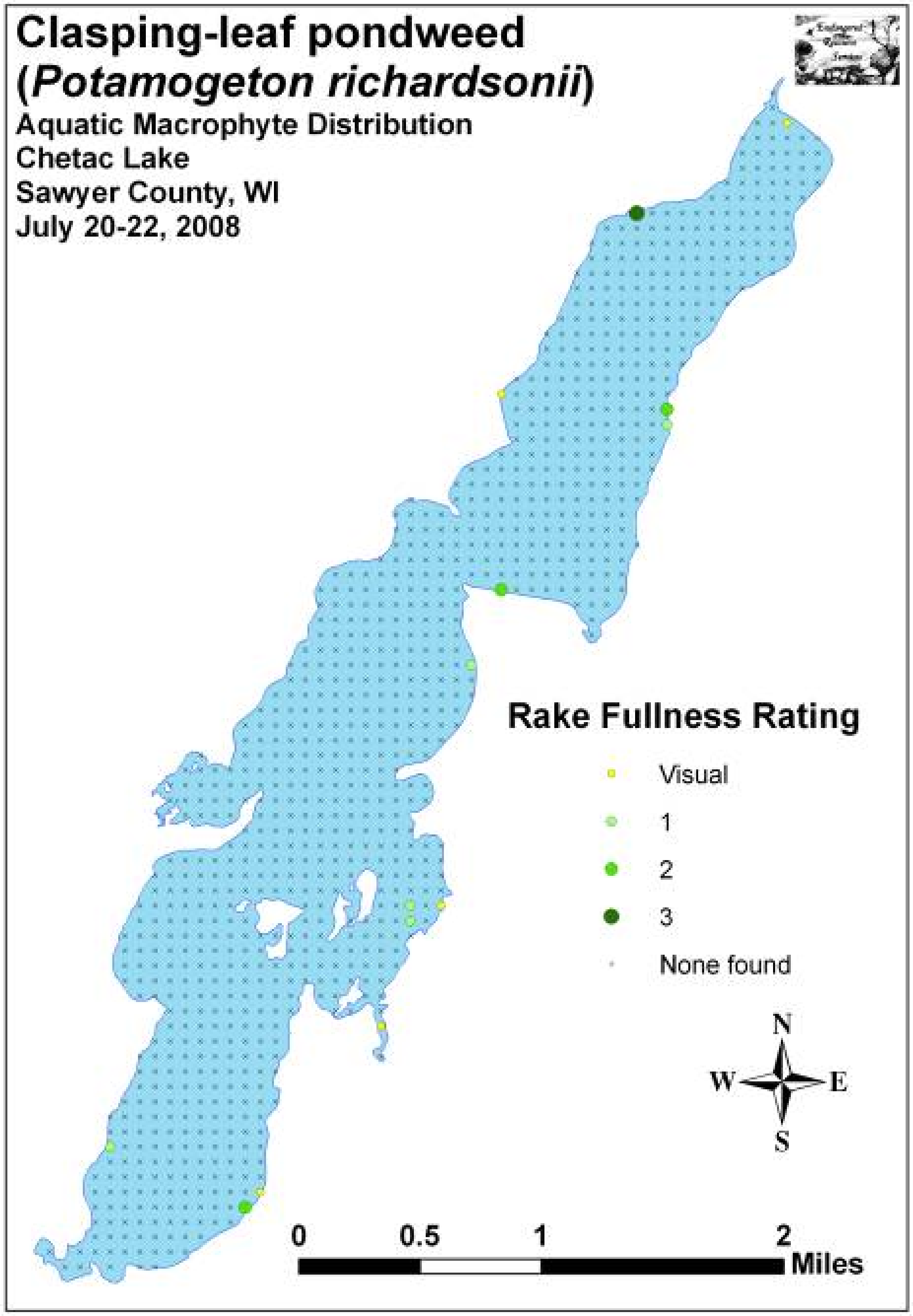
Clasping-leaf pondweed
(*Potamogeton richardsonii*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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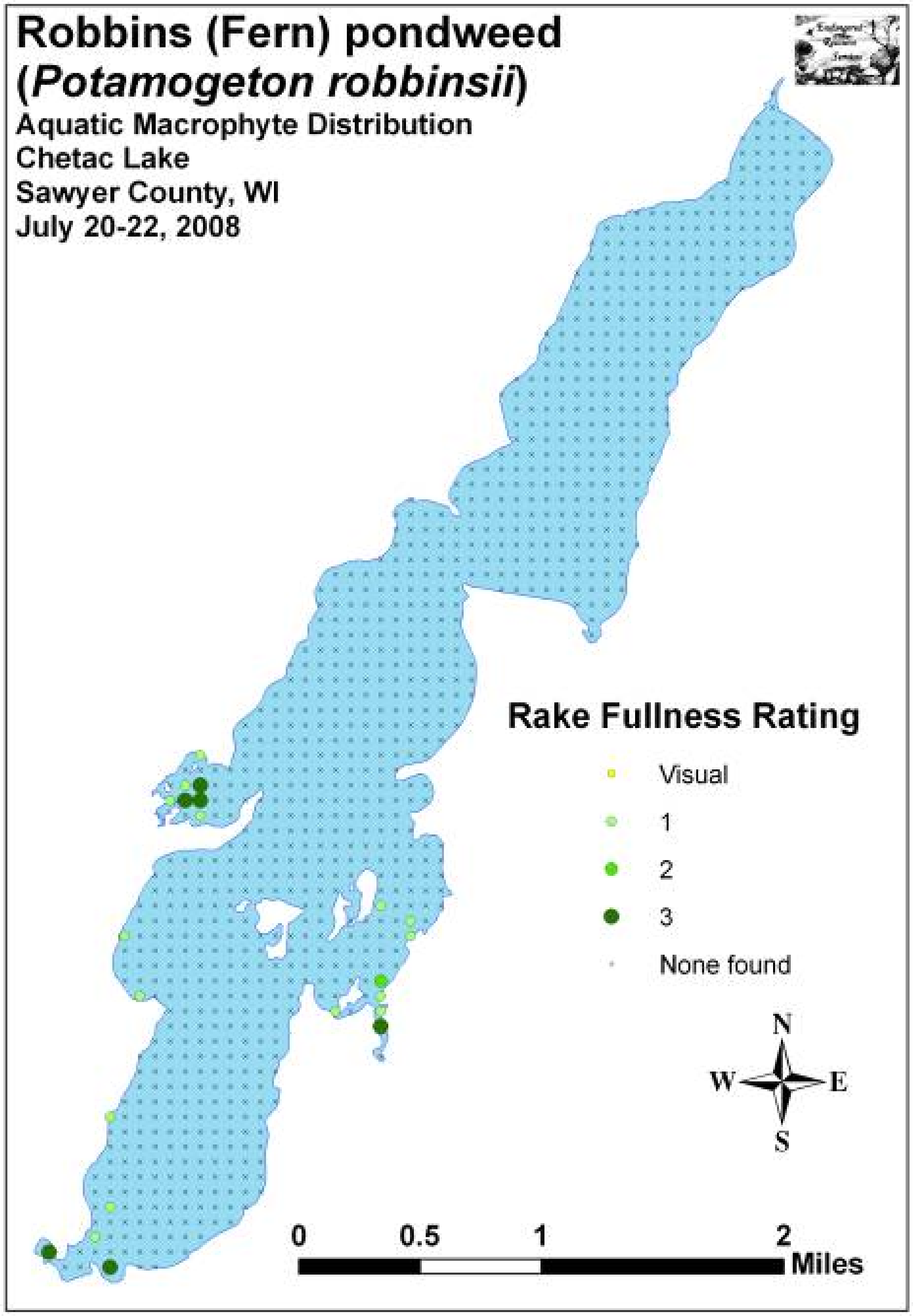
Robbins (Fern) pondweed
(Potamogeton robbinsii)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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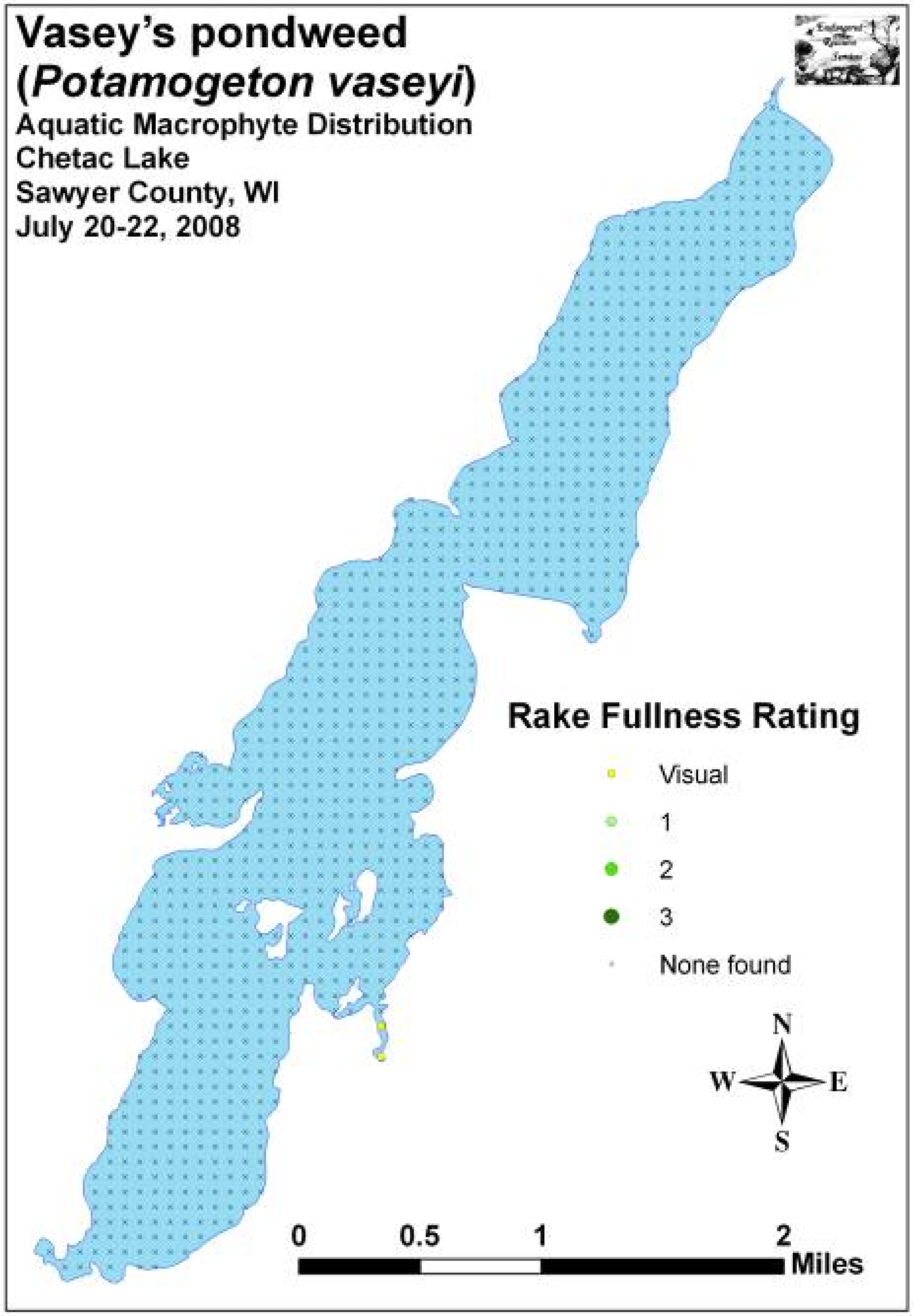
Vasey's pondweed
(Potamogeton vaseyi)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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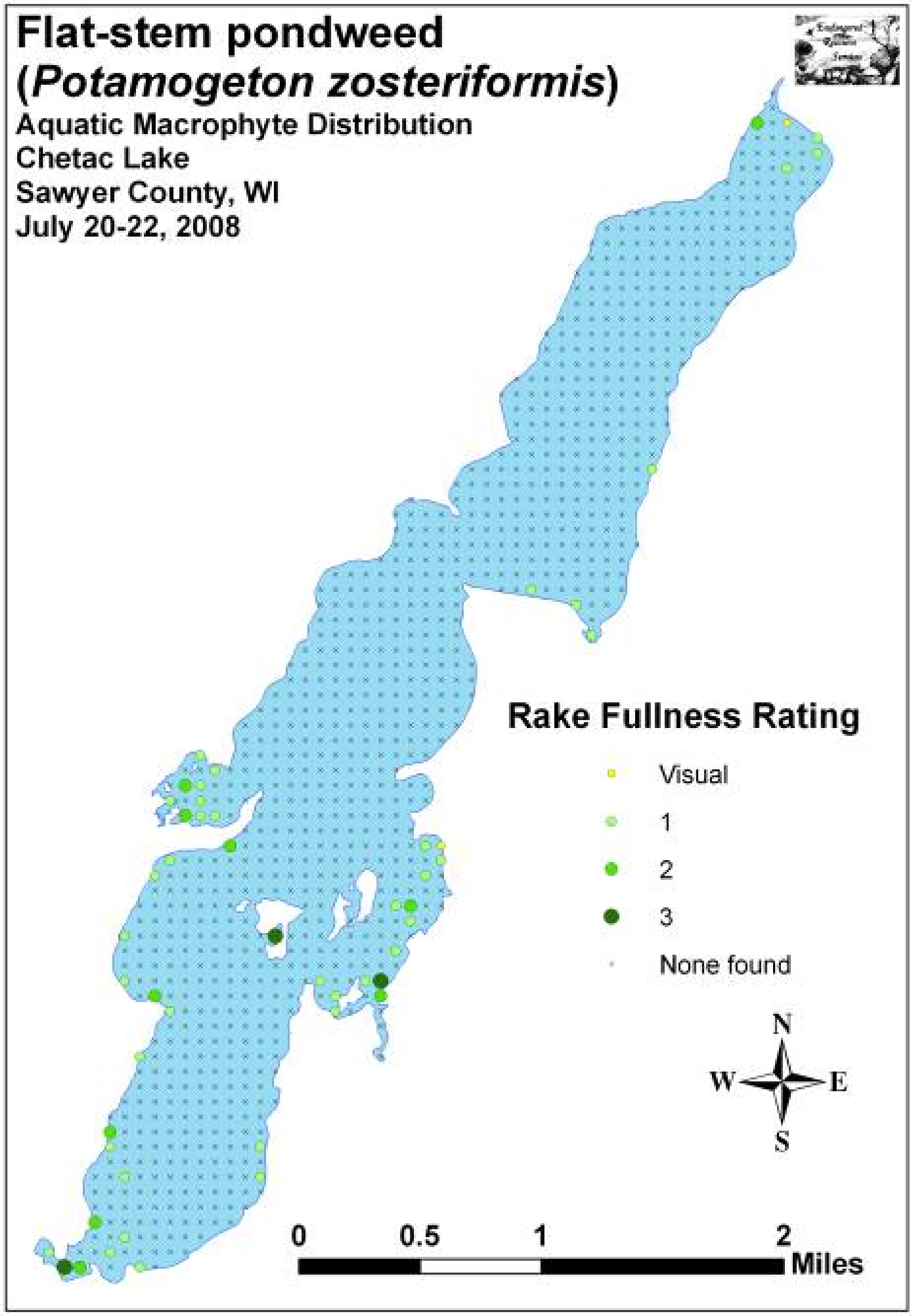
Flat-stem pondweed
(Potamogeton zosteriformis)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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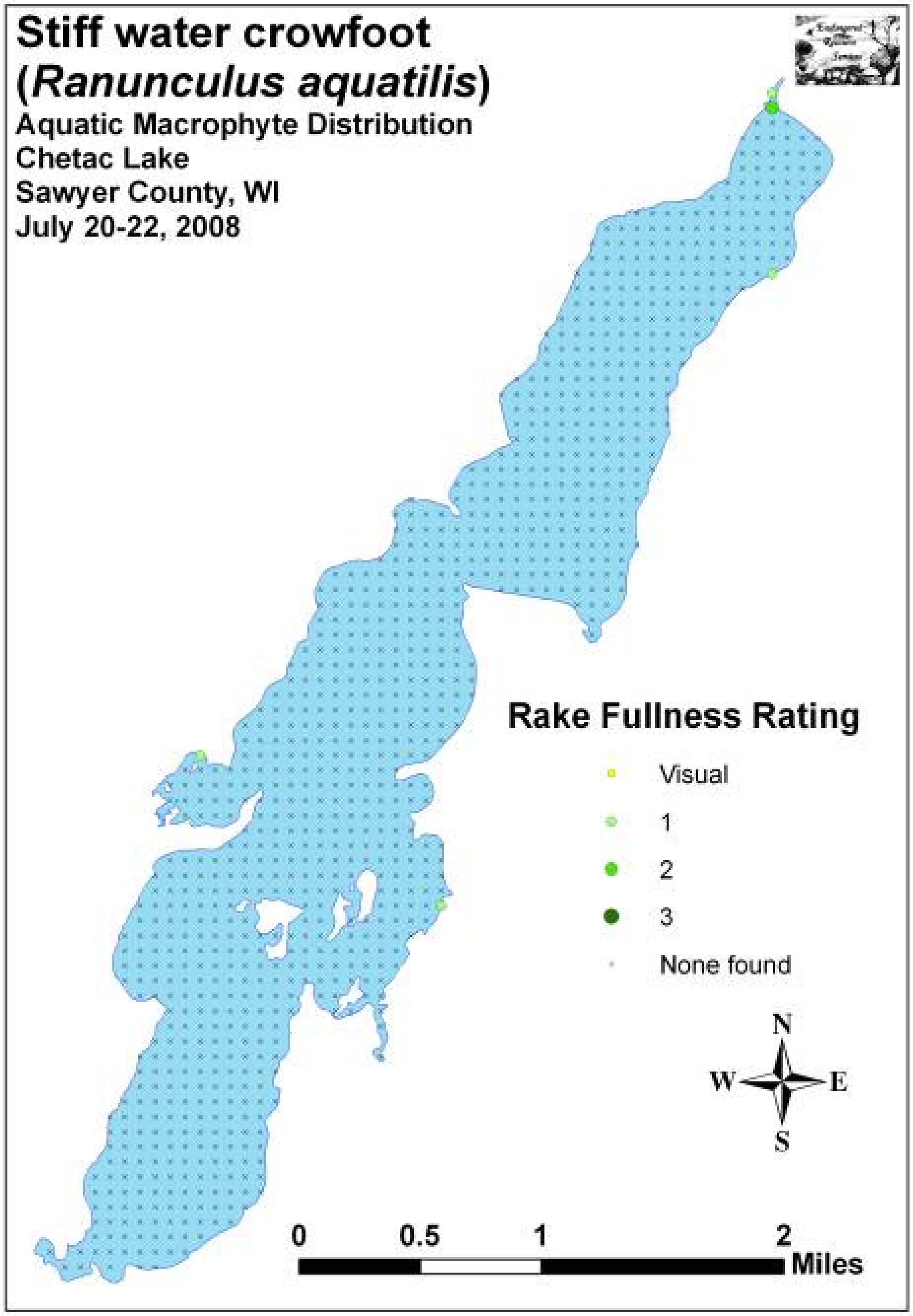
Stiff water crowfoot
(Ranunculus aquatilis)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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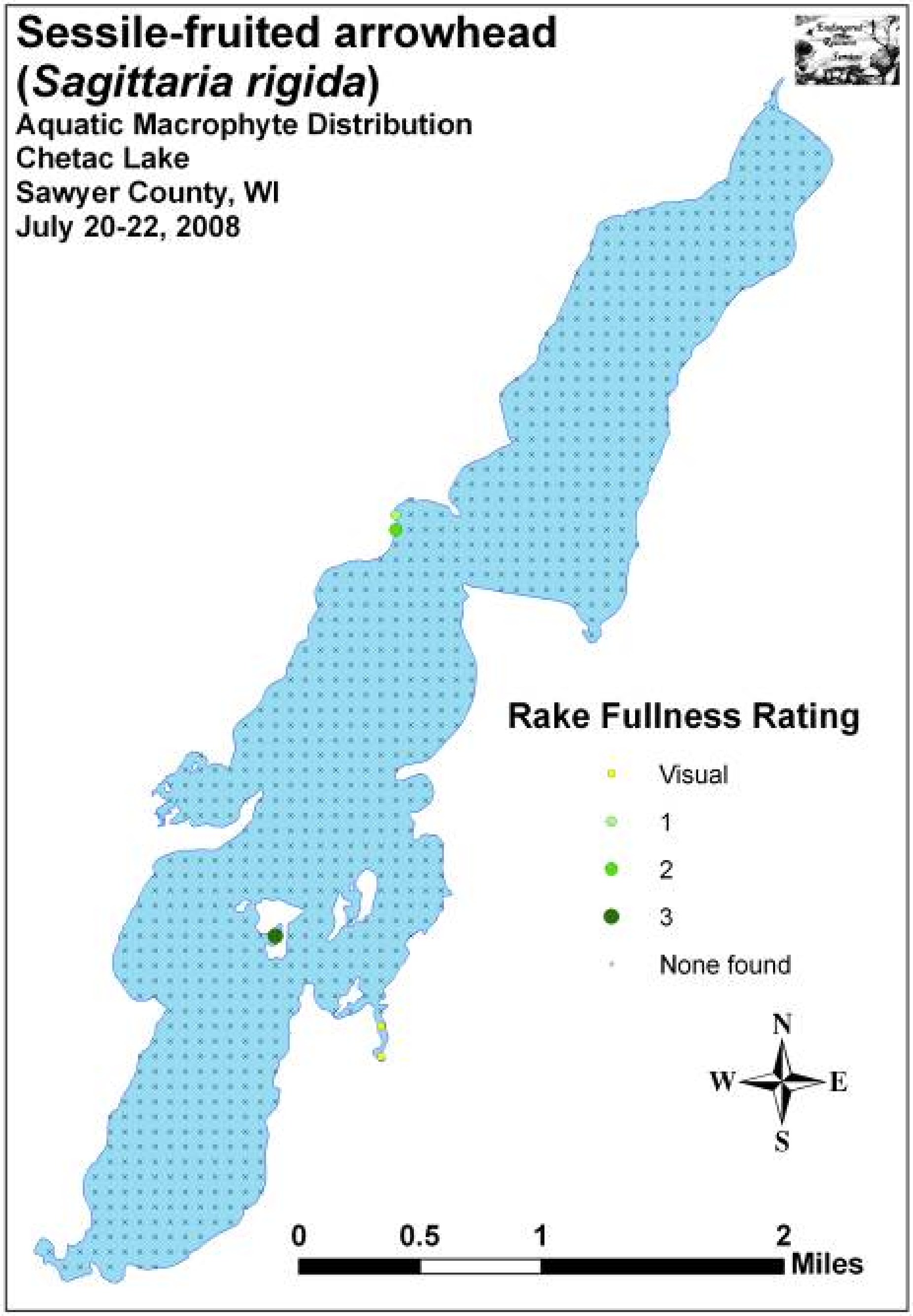
Sessile-fruited arrowhead
(Sagittaria rigida)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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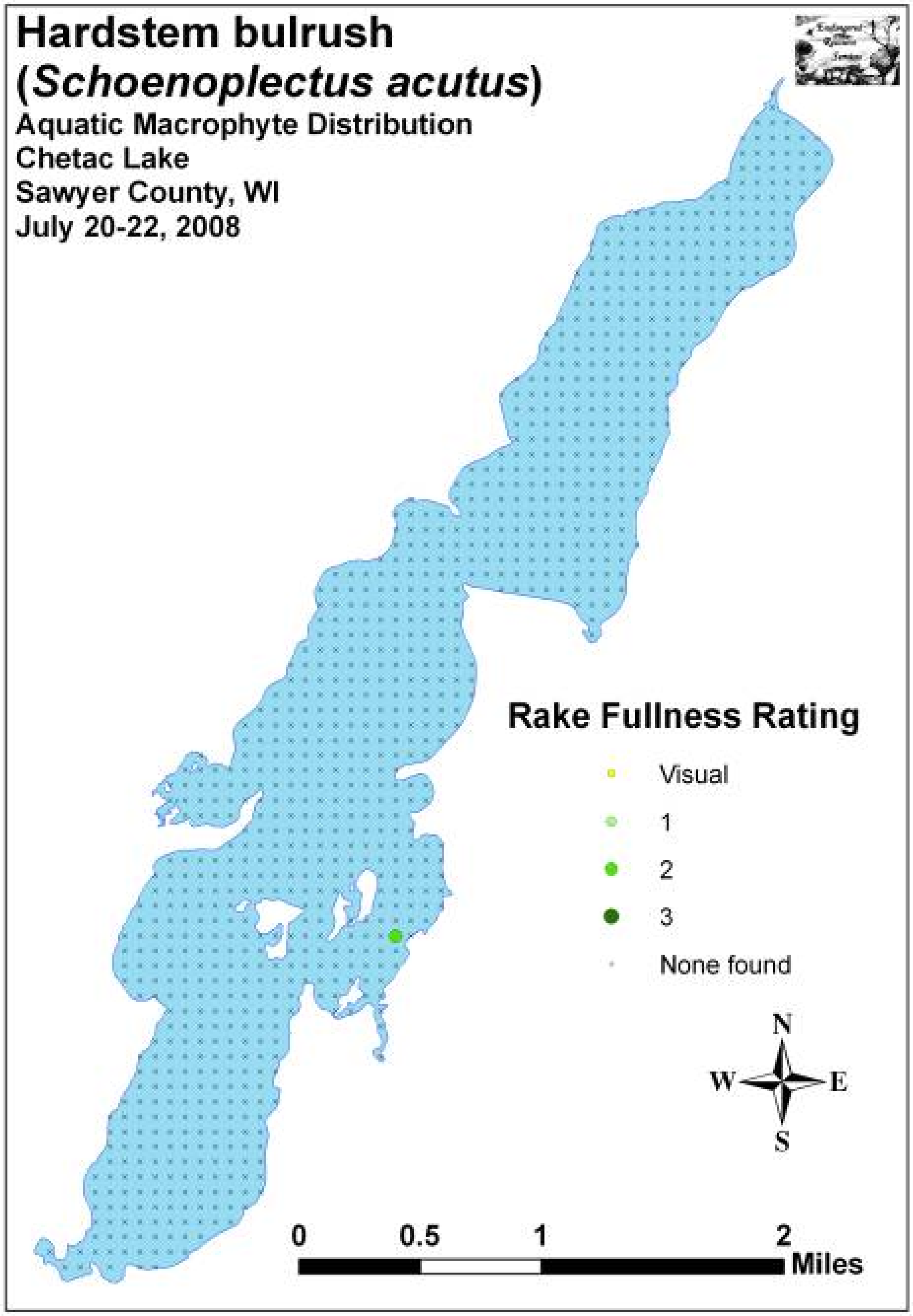
Hardstem bulrush
(Schoenoplectus acutus)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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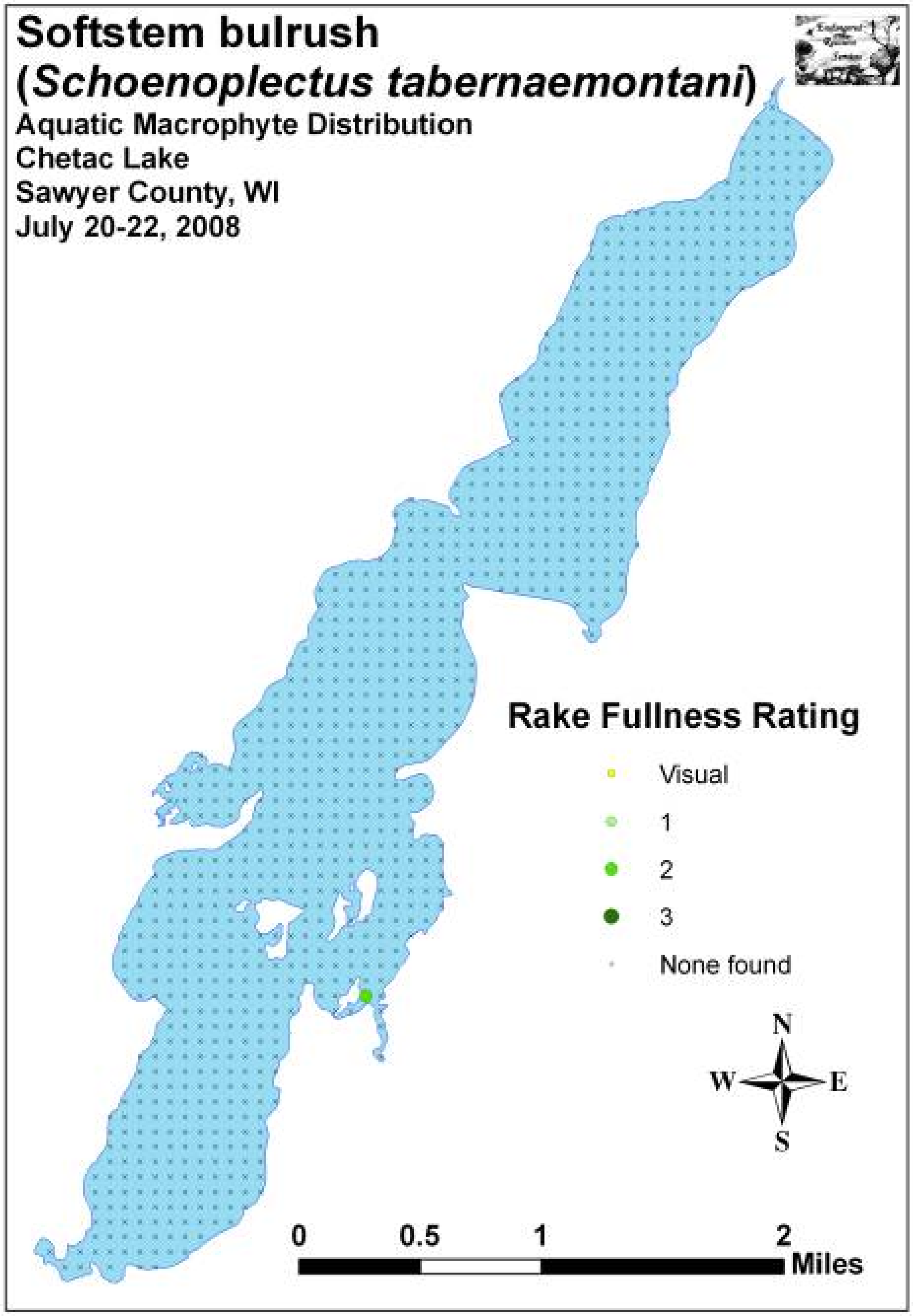
Softstem bulrush
(*Schoenoplectus tabernaemontani*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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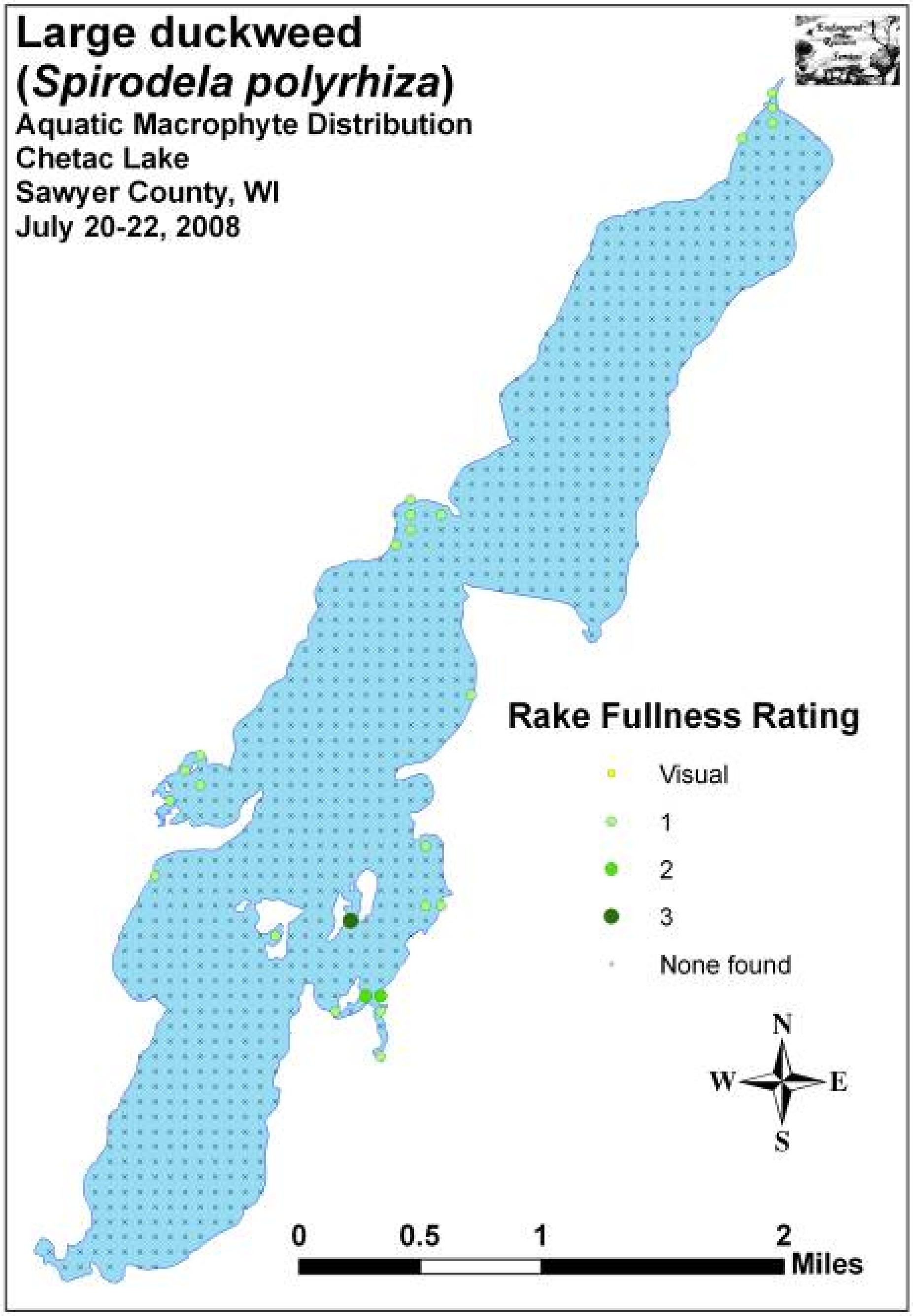
Large duckweed
(*Spirodela polyrhiza*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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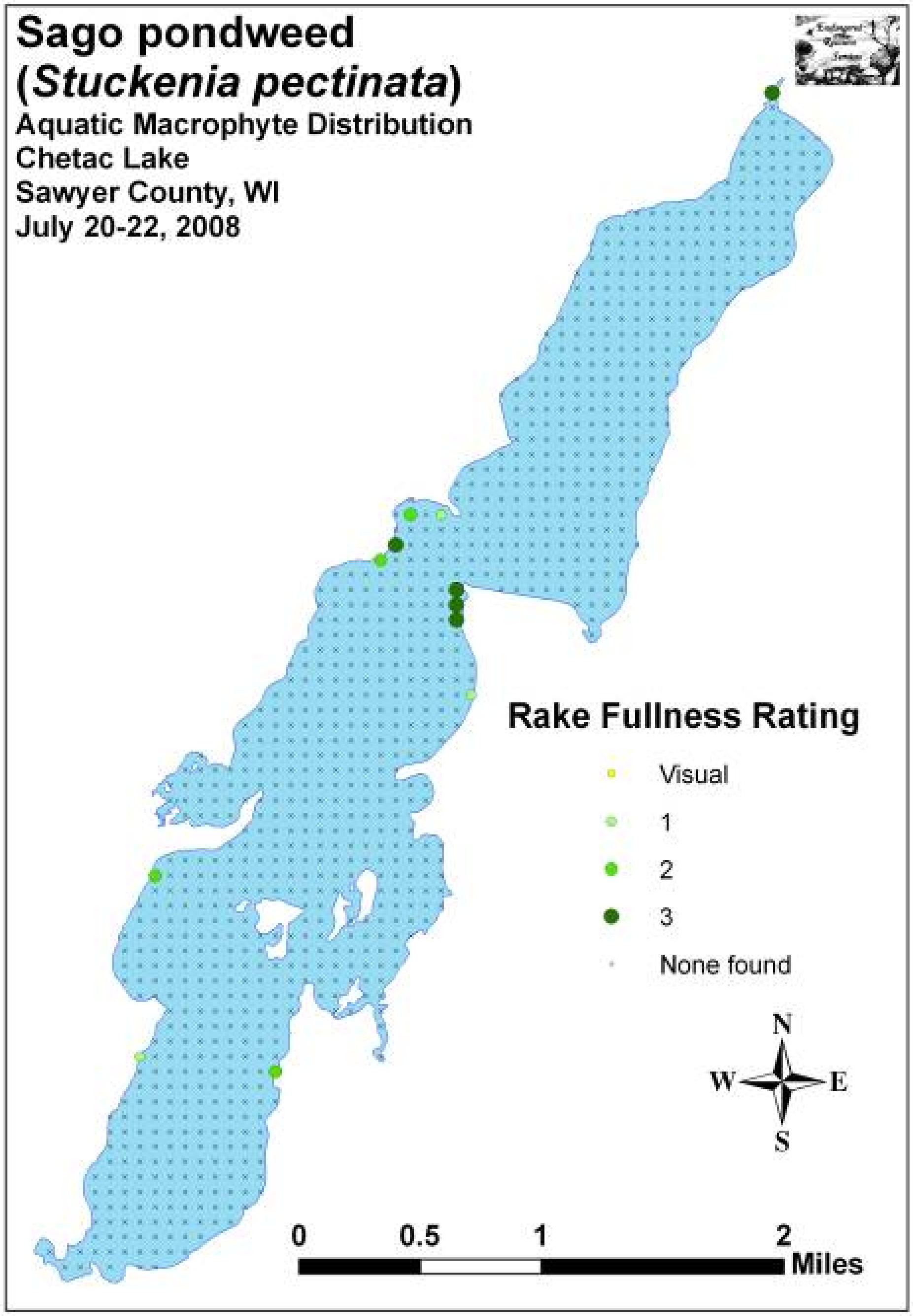

Sago pondweed
(*Stuckenia pectinata*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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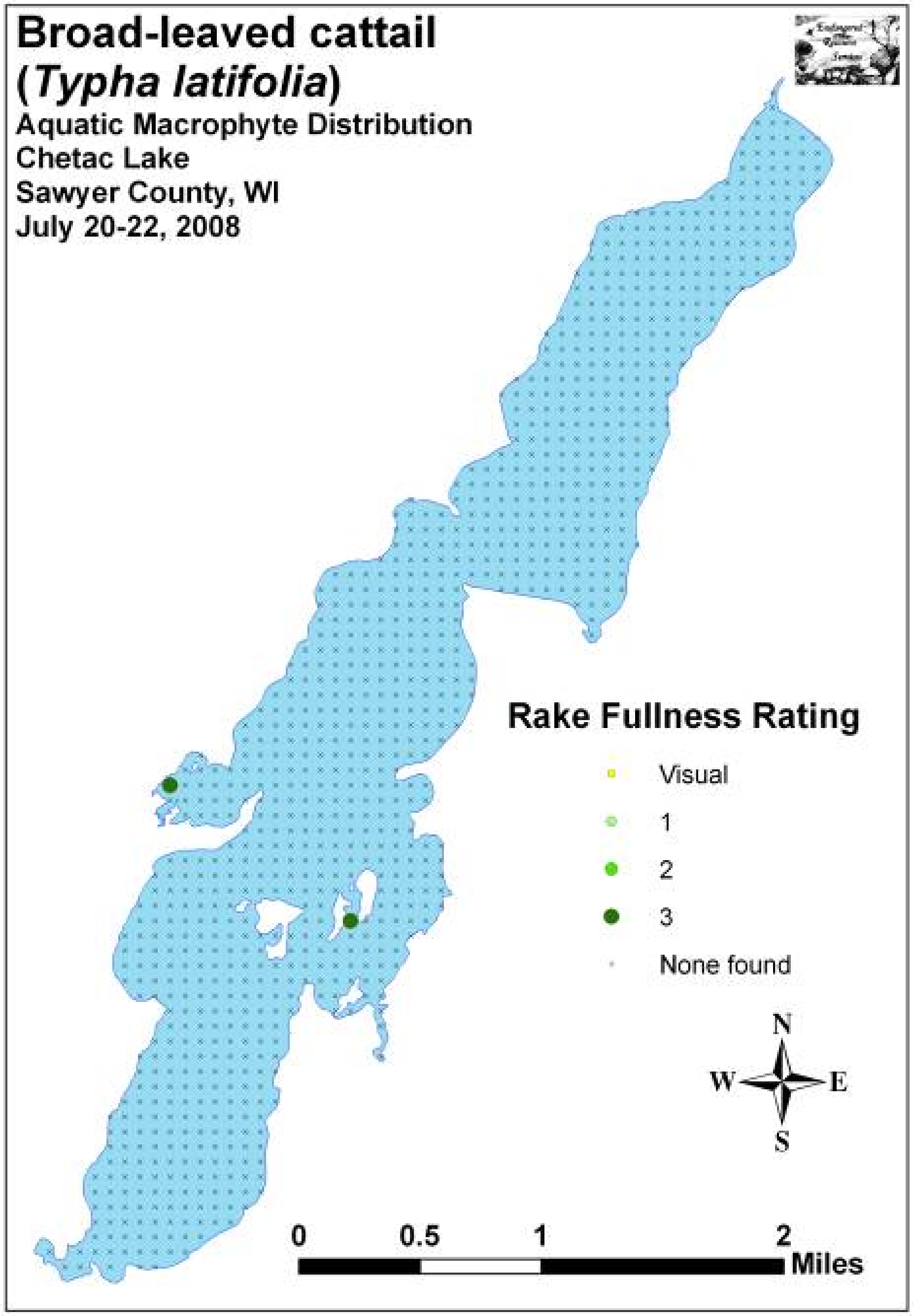

Broad-leaved cattail
(*Typha latifolia*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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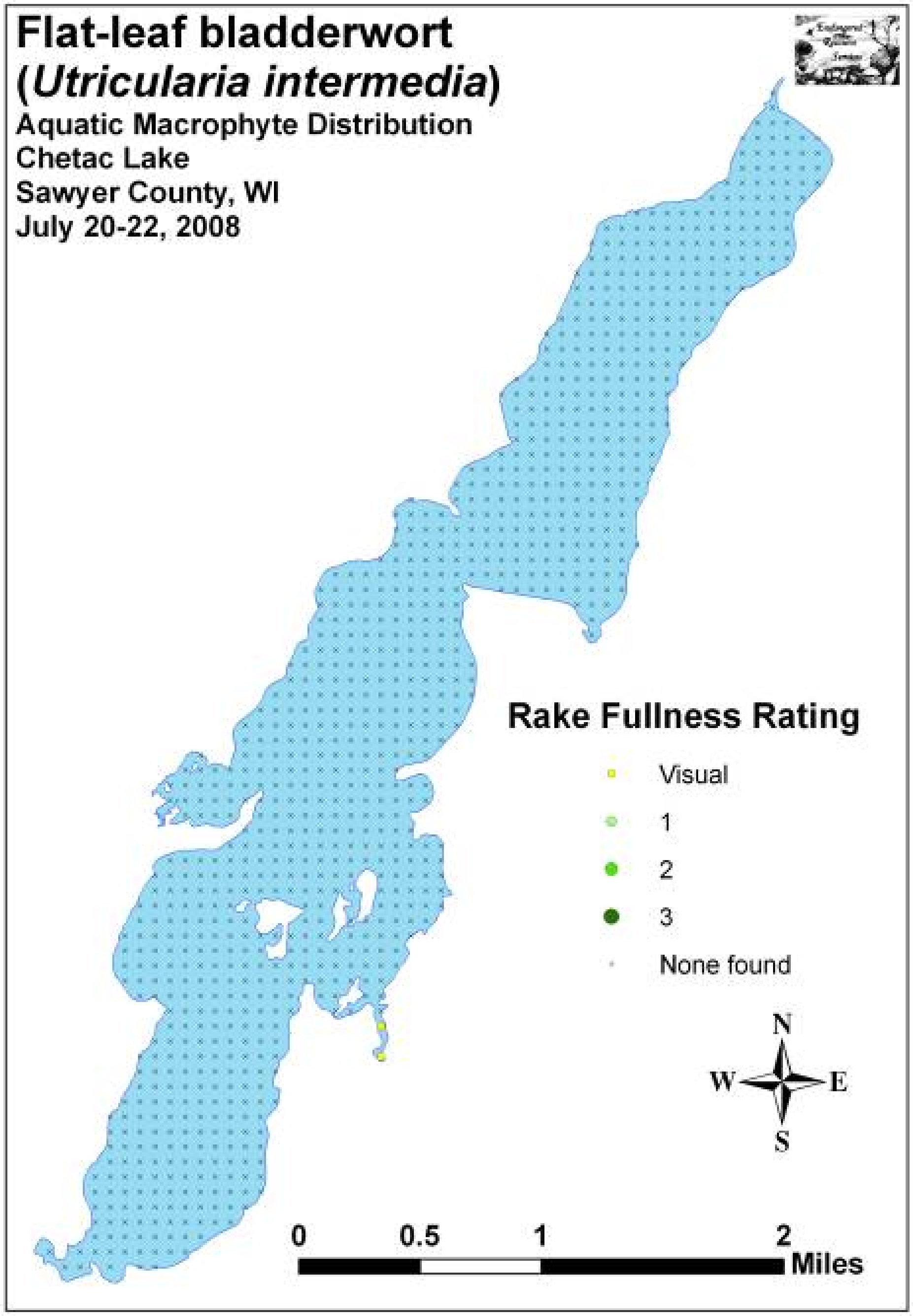
Flat-leaf bladderwort
(Utricularia intermedia)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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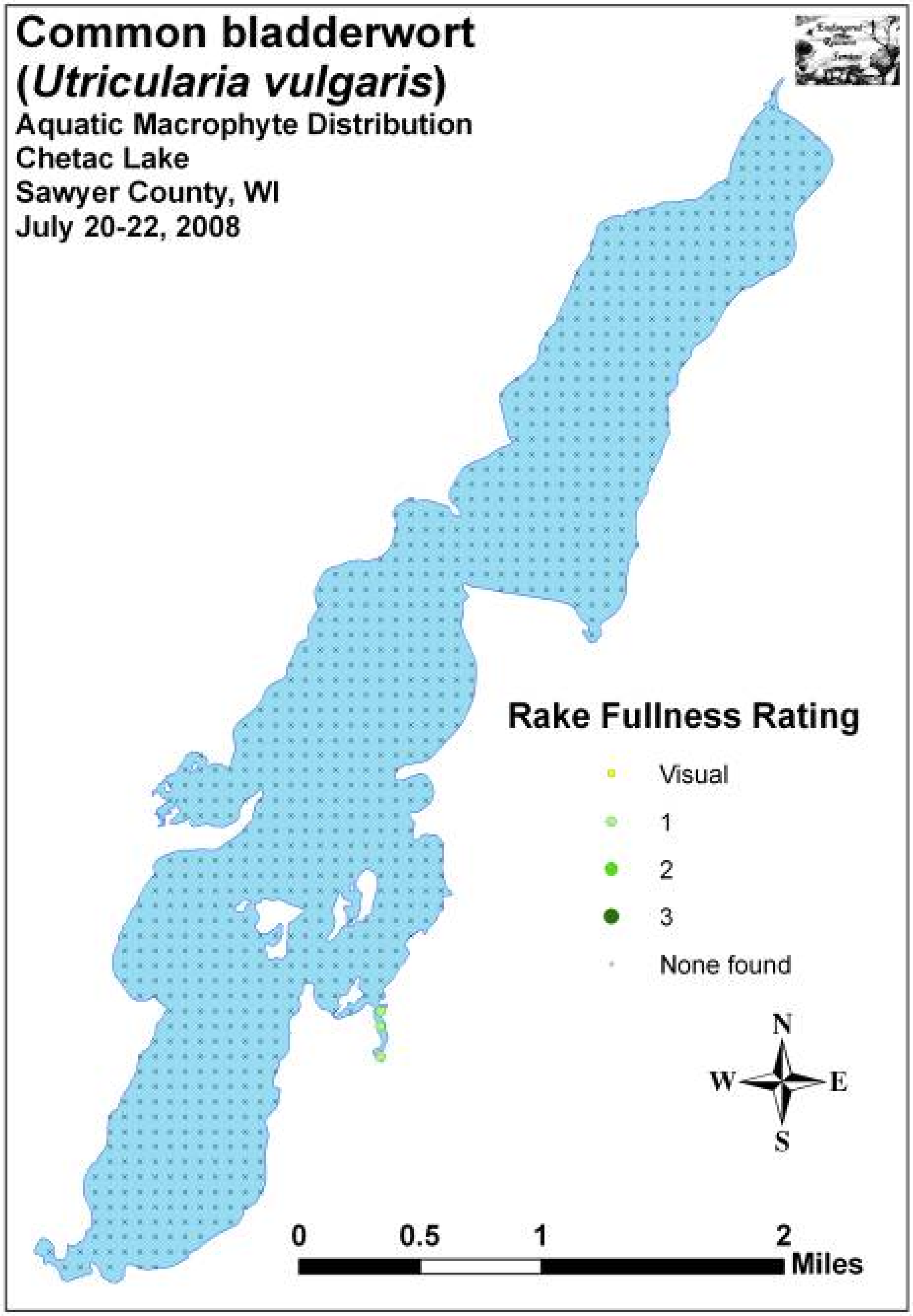
Common bladderwort
(*Utricularia vulgaris*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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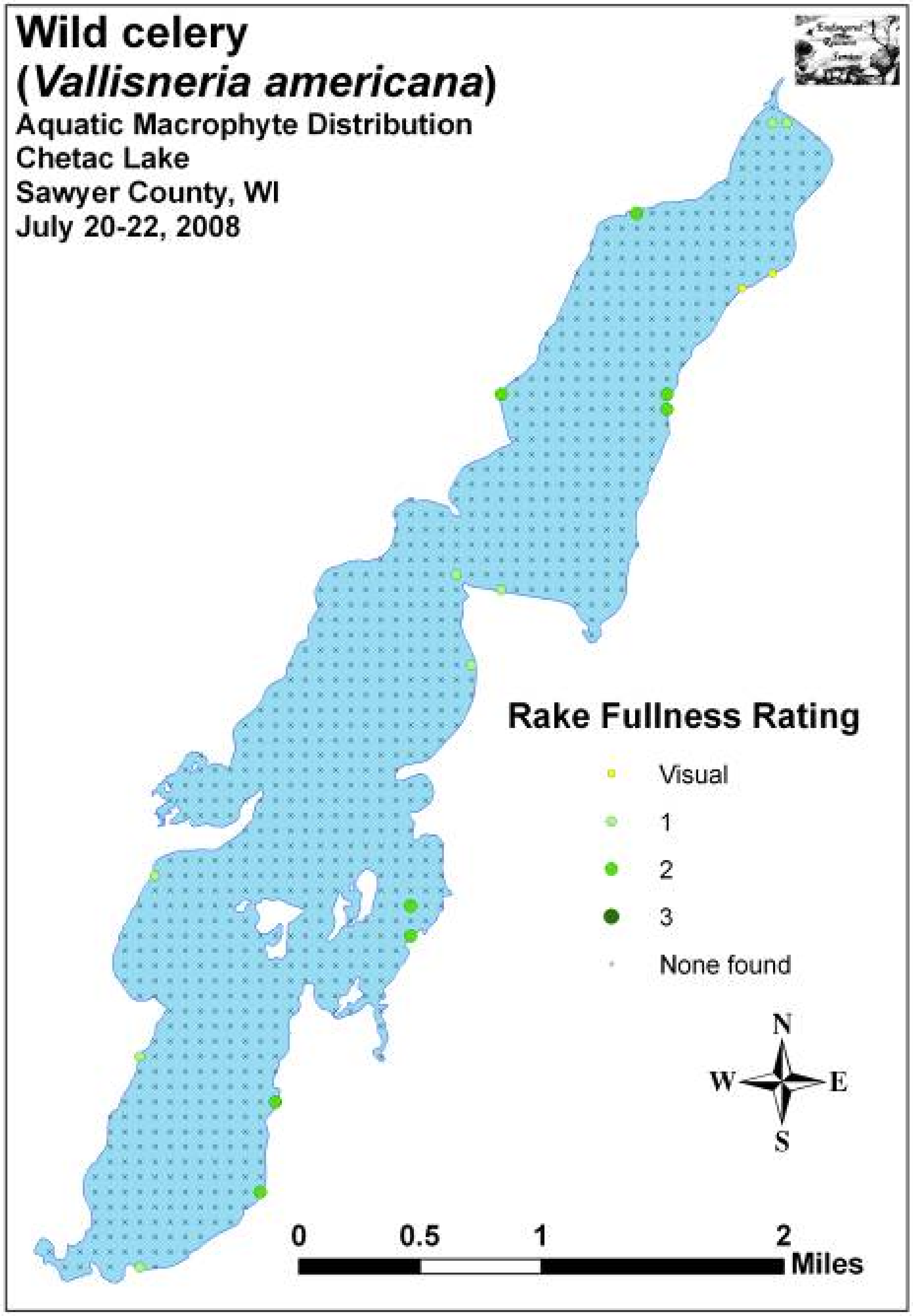
Wild celery
(*Vallisneria americana*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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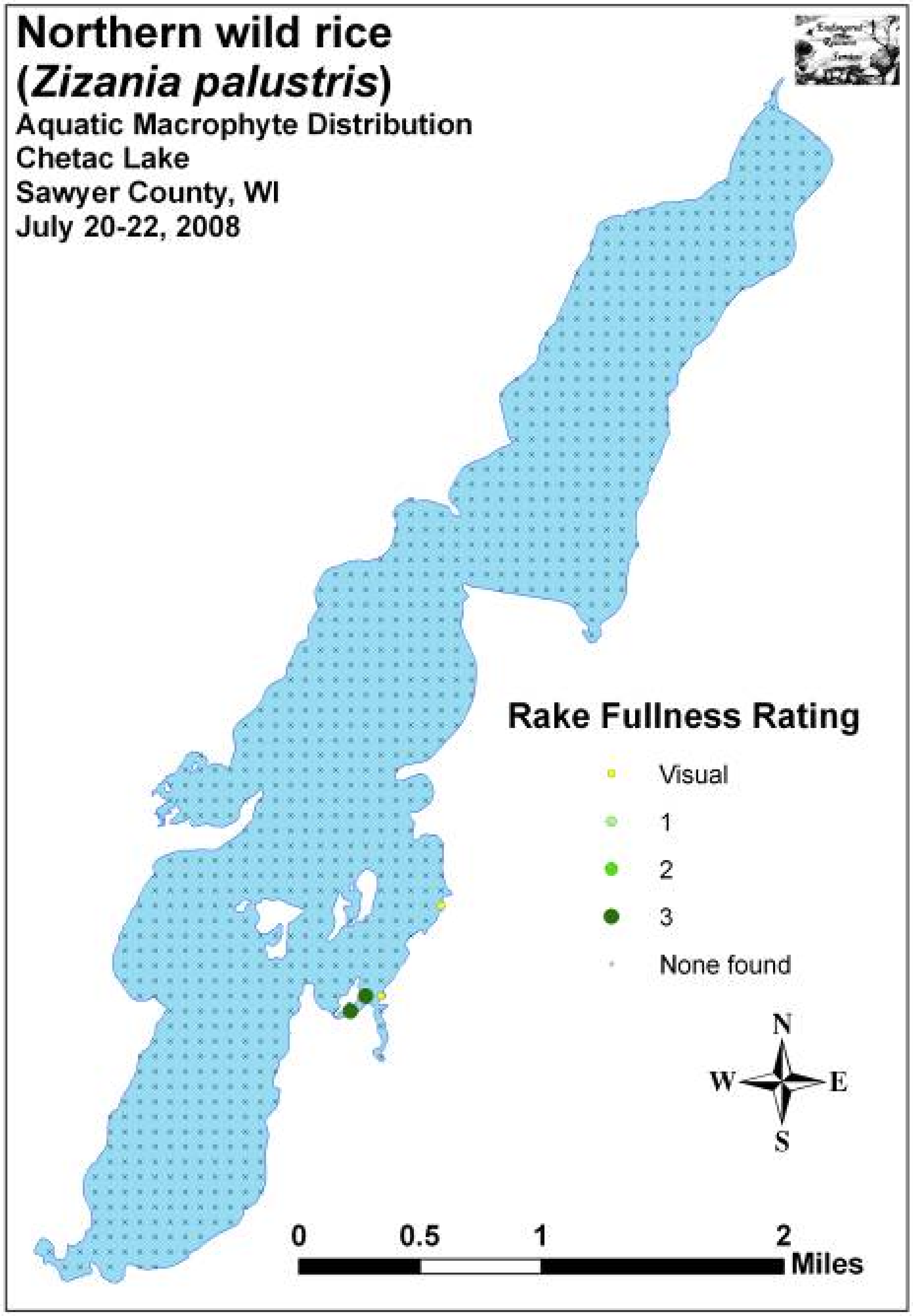
Northern wild rice
(*Zizania palustris*)
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
Visual
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None found
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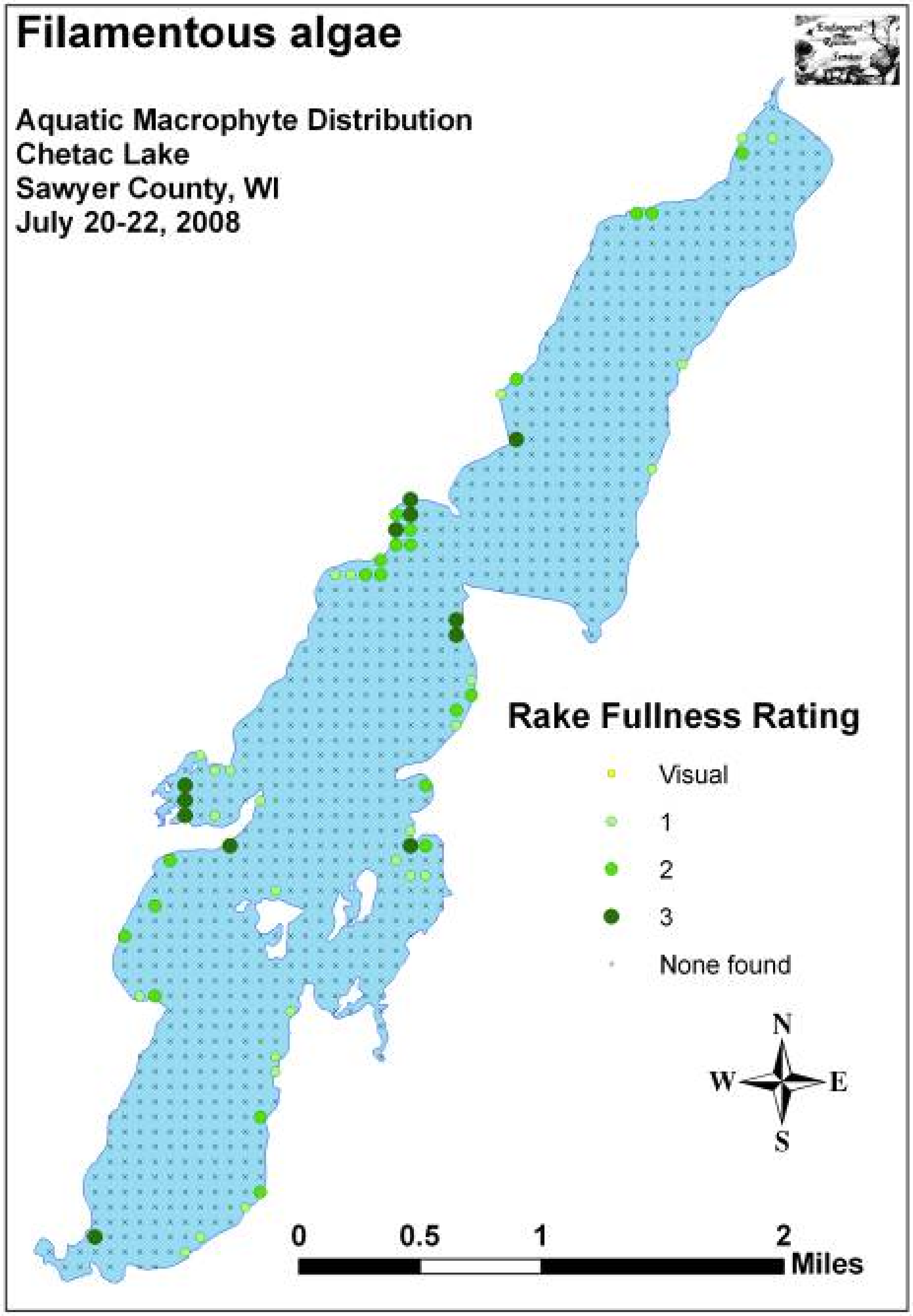
Filamentous algae
Aquatic Macrophyte Distribution
Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
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None found
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VIII: Glossary of Biological Terms (Adapted from UWEX 2008)

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 and evenness of species in a particular community or habitat.

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

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

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

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

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

Limnology:
the study of inland lakes and waters.

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

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

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

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

Photosynthesis:
: the process by which green plants convert carbon dioxide (CO_2) dissolved in water to sugar and oxygen using sunlight for energy. Photosynthesis is essential in producing a lake's food base, and is an important source of oxygen for many lakes.

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

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

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

Richness:
number of species in a particular community or habitat.

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

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

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

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

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

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

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

Appendix IX: Aquatic Exotic Invasive Species Information

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 X: Raw Data Spreadsheets