# Curly-leaf Pondweed and Full Warm Water Point/Intercept Macrophyte Surveys
# Granite Lake (WBIC: 2100800)
# Barron County, Wisconsin

Pickerelweed (Alexander, 2009)

Project Initiated by:
Granite Lake Association, and the
Wisconsin Department of Natural Resources


Blunt-leaf pondweed (Koshere, 2002)

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May 27 and July 28-29, 2009

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# ABSTRACT

Granite Lake (WBIC 2100800) is a 154-acre stratified, drainage lake located in northwestern Barron County. It is eutrophic in nature with 2009 summer Secchi readings averaging 5.5ft and a littoral zone that extends to 15.5ft. A desire to develop an Aquatic Plant Management Plan, determine if exotic species like Eurasian water milfoil (*Myriophyllum spicatum*) had invaded the lake, and to establish baseline data on the richness, diversity, abundance and distribution of other native aquatic plant populations prompted members of the Granite Lake Association to authorize a CLP density survey on May 27 and a full lake point intercept survey on July 28-29, 2009. The early season survey found CLP at a single point in the southeast end of the lake. The full point intercept survey found macrophytes at 80 of the 505 survey points (15.8%) and identified a total of 22 native plants to species. They produced a slightly above average mean Coefficient of Conservatism of 6.2 and an above average Floristic Quality Index value of 29.0. Three exotic species (Purple loosestrife (*Lythrum salicaria*), Reed canary grass (*Phalaris arundinacea*), and CLP), and 11 additional native species recorded as visuals or located during the boat survey increased the total to 36 species found in or immediately adjacent to the lake. Bushy pondweed (*Najas flexilis*), Filamentous algae, Coontail (*Ceratophyllum demersum*) and Spatterdock (*Nuphar variegata*) were the most common macrophyte species being found at 38.75%, 37.50%, 28.75%, and 15.00% of survey points with vegetation respectively. Future management goals should include maintaining the lake's limited, but unique plant community, monitoring CLP, eliminating Purple loosestrife and continuing to work on improving water clarity and quality. Completing an Aquatic Plant Management Plan, identifying nutrient sources and working to reduce the nutrient load coming into the lake, restoring shorelines, adding buffer strips of native vegetation, maintaining signage at the landing to educate boaters and residents about the threat of AIS, and monitoring for EWM in transects parallel to the shore at least once a month during the summer are management ideas for the Lake Association to consider moving forward.

# ACKNOWLEDMENTS

We wish to thank the Wisconsin Department of Natural Resources' Michelle Nault and Alison Mikulyuk for technical assistance, and Tyler Myers, and Mitchel and Noah Berg for assistance in conducting these surveys.

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## INTRODUCTION:

Granite Lake (WBIC 2100800) is a 154-acre, stratified, drainage lake located in the Town of Lakeland in northwest Barron County (T36N R13W S29 SE SW). The lake reaches its maximum depth of 34ft in the north-central basin due west of the east bay and has an average depth of 18ft (WDNR 2009). Granite Lake is eutrophic in nature and water clarity is poor with summer Secchi readings averaging 5.5ft in 2009 (WDNR 2009). The lake is, however, experiencing consistent improvement in clarity since the early 90's when the average was 3.3ft. The littoral zone reached approximately 15.5ft in both May and July, 2009. Bottom substrate was predominantly rock and sand along the central basin with organic muck bottoms in the north and south bays as well as the creek inlet/outlet.

**Figure 1: Aerial Photo of Granite Lake**

The Granite Lake Association (GLA) and the Wisconsin Department of Natural Resources (WDNR) authorized a series of full lake plant surveys as a prerequisite to developing an Aquatic Plant Management Plan (APMP). On May 27, we completed a full lake Curly-leaf pondweed (*Potamogeton crispus*) density survey, and on July 28-29 we conducted a warm water point/intercept survey of all aquatic macrophytes. The surveys used the WDNR's statewide guidelines for conducting systematic point intercept macrophyte sampling. The guidelines ensure that all surveys in the state will be conducted in the same manner, thus allowing data to be compared across time and space. This report represents the summary analysis of the data collected during these surveys. The immediate goals of the project were to determine if Curly-leaf pondweed or Eurasian water milfoil (*Myriophyllum spicatum*) had invaded the lake, and to establish baseline data on the richness, diversity, abundance and distribution of other native aquatic plant populations. These data provide a baseline for long-term monitoring of the lake's macrophyte community.

## PLANT SURVEY METHODS:

### Curly-leaf pondweed Density Survey:

Using a standard formula that takes into account the shoreline shape and distance, water clarity, depth and total lake acreage, Michelle Nault (WDNR) generated a 505 point sampling grid for Granite Lake (Appendix I). Using this grid, we completed a CLP density survey where we surveyed for CLP at each point in the lake's literal zone. We located each survey point using a handheld Garmin 76CSx mapping GPS unit. At each point, we recorded a depth reading with a Polar Vision hand held sonar unit. Following the establishment of the littoral zone at a maximum of 15.5ft., we sampled for CLP within the depth range of plant growth. At each of these points, we used a rake to sample an approximately 2.5ft. section of the bottom. CLP was assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 2). We also recorded visual sightings of CLP within six feet of the sample point.

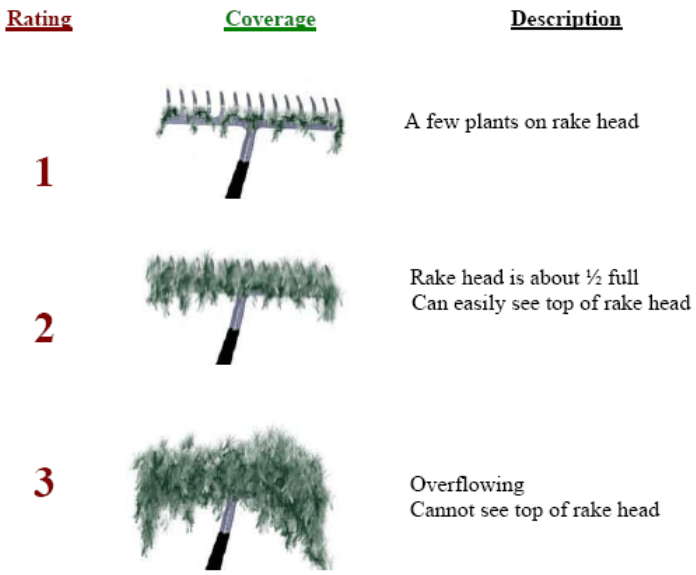


**Figure 2: Rake Fullness Ratings (UWEX, 2009)**

### July Warm Water Full Point/Intercept Survey:

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

## DATA ANALYSIS:

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

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

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

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

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

Frequency of occurrence example:

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

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

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

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

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

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

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

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

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

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

Relative frequency example:

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

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

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

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

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

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

## RESULTS AND DISCUSSION:

## Curly-leaf pondweed Density Survey:

On May 27th, we surveyed Granite Lake for presence and abundance of Curly-leaf pondweed. Of the 505 survey points provided by the WDNR, we sampled 217 points (the entire littoral zone and points adjacent to it). As Granite Lake was not previously known to have CLP, we were surprised when we rake sampled four CLP plants at point 460 on the southeast end of the lake (Figure 3). Several further rakings at the spot and a careful visual inspection produced no further plants. We also did not locate CLP anywhere else in the lake during the spring survey. We did, however, locate and eliminate four additional plants during the July warm water P/I survey – two on the opposite side of the same bay where they were found in May, and two in the east bay (Figure 3). We also located a handful of plants in the lake outlet.

Because the plants were widely distributed, it is quite likely that CLP has been present in Granite Lake for some time and has simply gone undetected due to its extremely low density. Our experience has shown that CLP normally grows best over thick organic muck in sheltered bays of high nutrient lakes. With the exception of the far north and south bays near the river inlet and outlet, the lake probably offers little suitable habitat for CLP, and it does not appear likely that it will be a management issue in the near future. For more information on Curly-leaf pondweed and other exotic species, see Appendix IX.

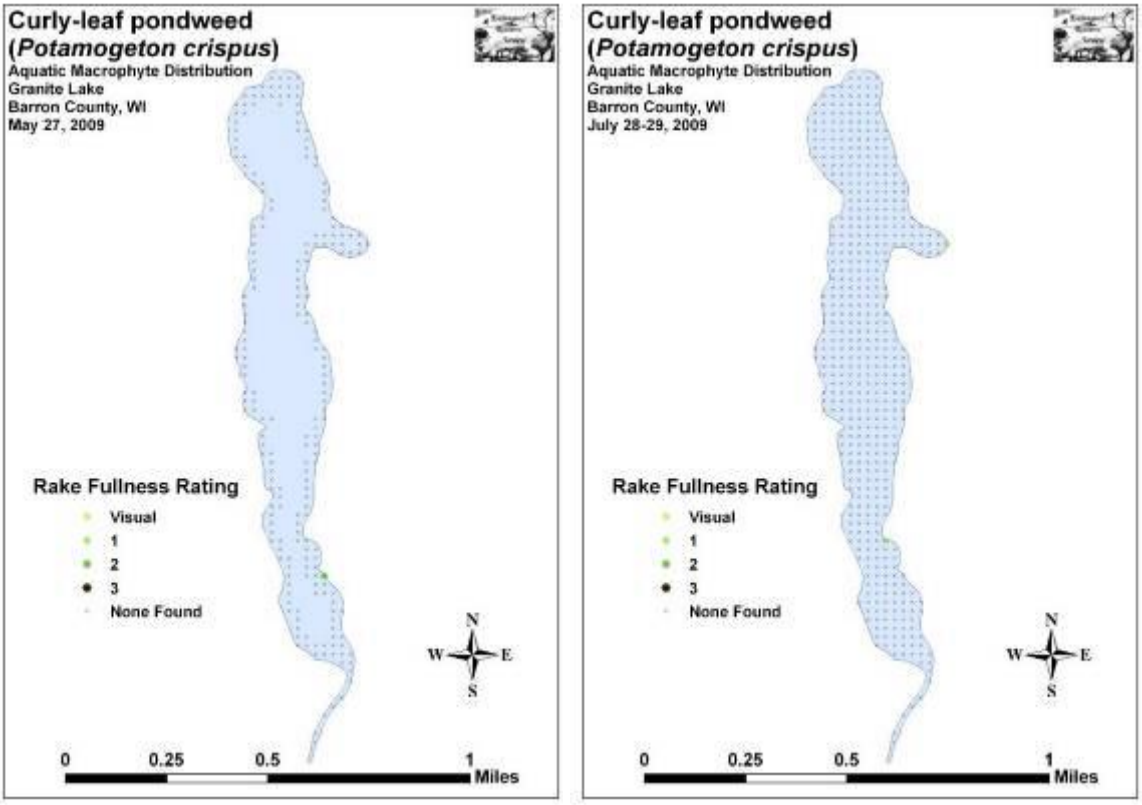


**Figure 3: May and July CLP Distribution**

## July Warm Water Full Point/Intercept Survey:

Granite Lake is a classic narrow glacial "straight lake" running north/south. (Figure 4) (Appendix IV). The main basin has sharp drop offs on both the east and west sides into 15ft+ of water. The north and south end both have more gradual slopes into deeper water. The lake's single side bay on the east side drops off rapidly to the deepest point in the lake.

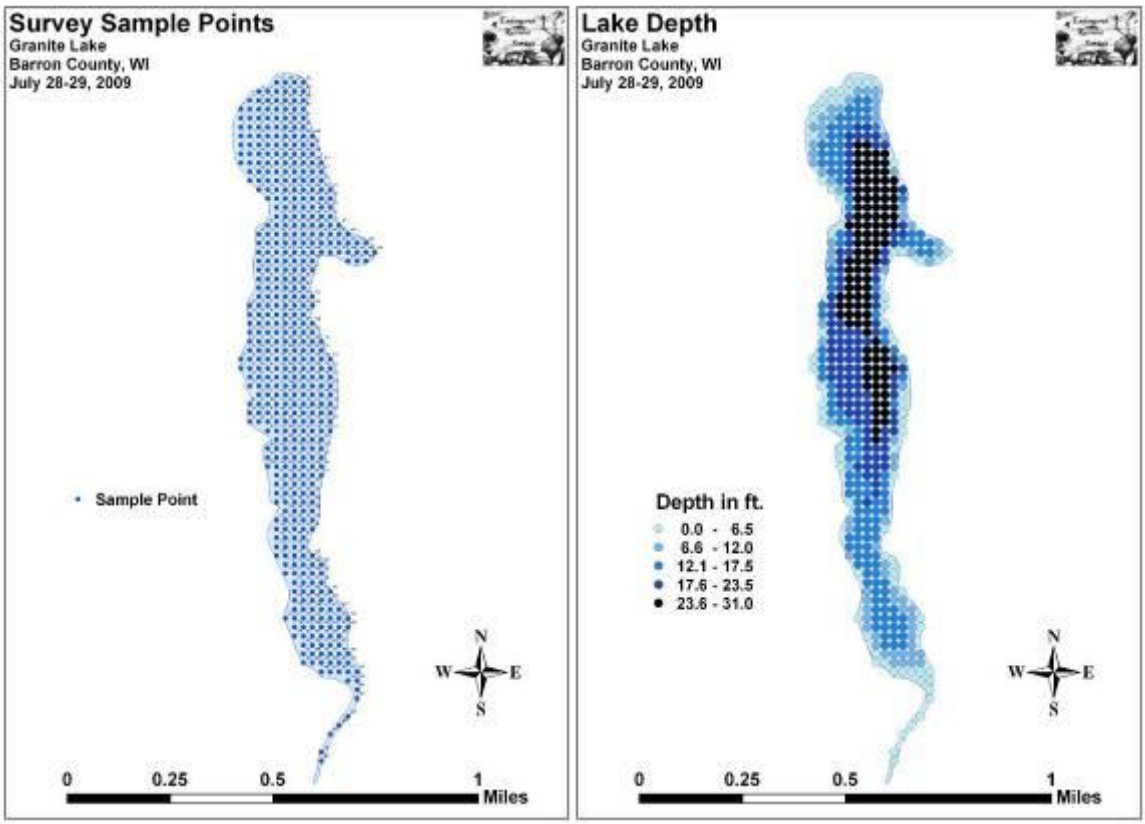


**Figure 4: Granite Lake Survey Points and Lake Depth**

Of the 261 points were we could determine the substrate, 46.7% were muck, 25.3% were rock, and 28.0% were sand. The creek inlet and outlet, the north and south ends of the main basin, and the east bay tended to be filled with organic muck and sandy muck. The rest of the perimeter of the main basin was generally rock or sand covered. We found plants growing on only 15.8% of the entire lake bottom and in 32.3% of the littoral zone (Figure 5) (Table 1) (Appendix IV).

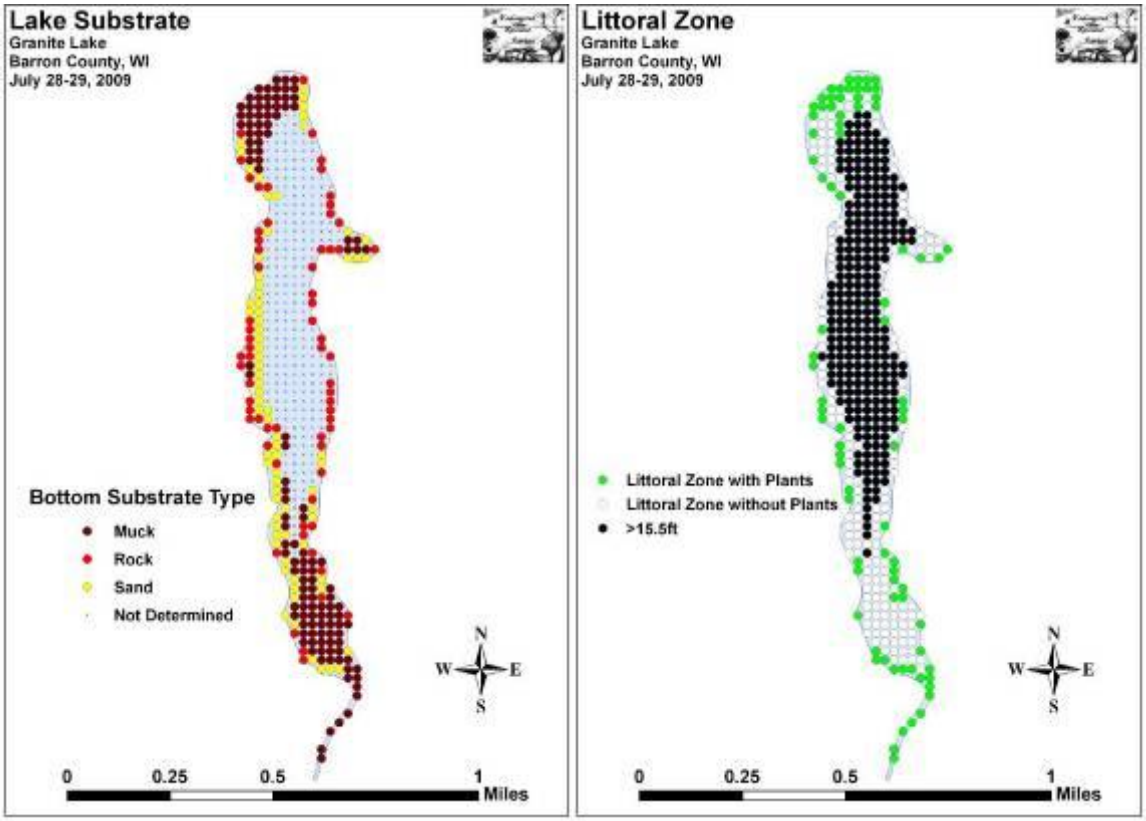


**Figure 5: Granite Lake Bottom Substrate and Littoral Zone**

## Table 1: Aquatic Macrophyte P/I Survey Summary Statistics
## Granite Lake, Barron County
## July 28-29, 2009

Summary Statistics:

| | |
|---|---|
| Total number of points sampled | 505 |
| Total number of sites with vegetation | 80 |
| Total number of sites shallower than the maximum depth of plants | 248 |
| Frequency of occurrence at sites shallower than maximum depth of plants | 32.26 |
| Simpson Diversity Index | 0.88 |
| Maximum depth of plants (ft) | 15.50 |
| Number of sites sampled using rope rake (R) | 25 |
| Number of sites sampled using pole rake (P) | 236 |
| Average number of all species per site (shallower than max depth) | 0.63 |
| Average number of all species per site (veg. sites only) | 1.96 |
| Average number of native species per site (shallower than max depth) | 0.63 |
| Average number of native species per site (veg. sites only) | 1.94 |
| Species Richness | 25 |
| Species Richness (including visuals) | 26 |
| Species Richness (including visuals and boat survey) | 36 |
| Mean depth of plants (ft) | 4.92 |
| Median depth of plants (ft) | 4.00 |

Overall diversity was relatively high with a Simpson Diversity Index value of 0.88. Species richness was also relatively high for such a small lake with 36 total species found growing in and immediately adjacent to the water. Due to the water clarity/light penetration, the majority of aquatic macrophytes were found growing in very shallow water with the mean depth just of 4.92ft and the median depth of exactly 4ft. Although we determined the littoral zone went to 15.5ft., Bushy pondweed (*Najas flexilis*), Coontail (*Ceratophyllum demersum*), and Filamentous algae were the only species that regularly occurred below 5ft. In general, species richness, diversity and total rake biomass declined rapidly with increasing depth (Figure 6) (Appendix V).

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

The sandy/rocky bottoms and sharp drop offs of the main basin provided only a very narrow littoral zone for plants. These areas generally supported much lower densities and fewer species albeit ones unique to these habitats. We identified Bushy pondweed (*Najas flexilis*), Spiral-fruited pondweed (*Potamogeton spirillus*), and Hardstem bulrush (*Schoenoplectus acutus*) as common associate species in these areas.

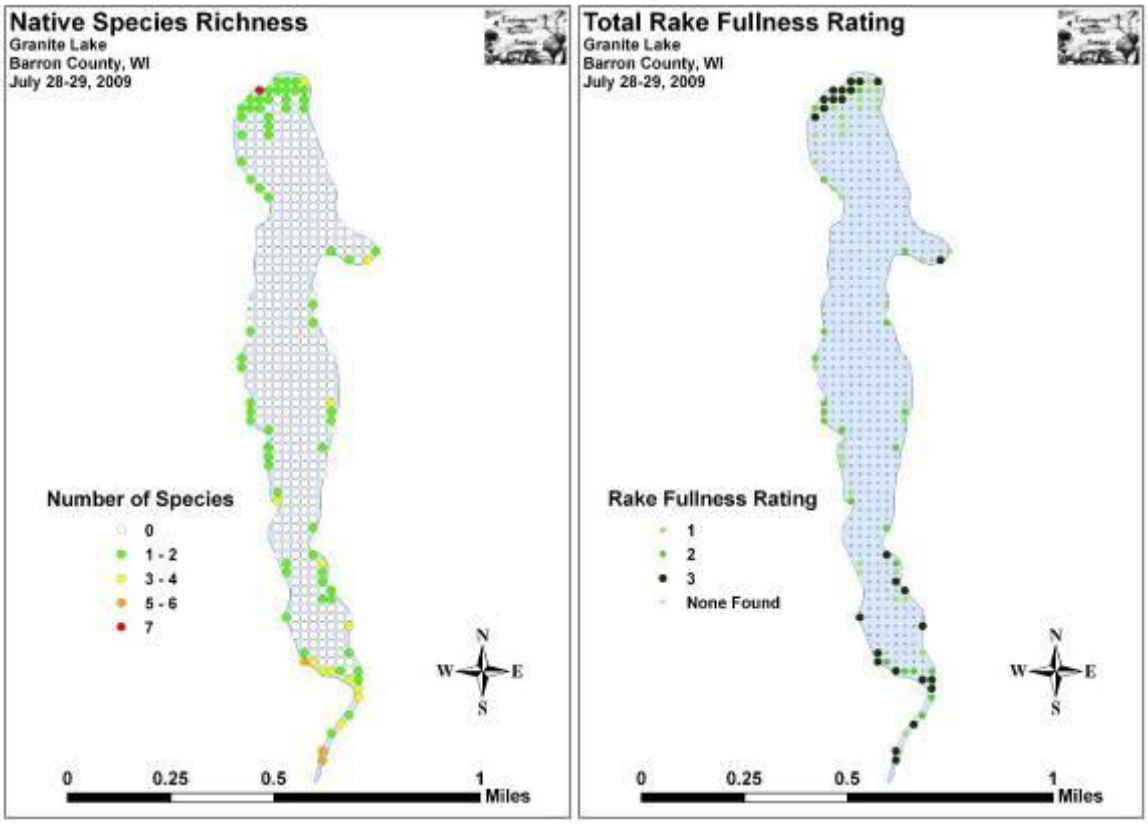


**Figure 6: Native Species Richness and Total Rake Fullness Rating**

**Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes**
**Granite Lake, Barron County**
**July 28-29, 2009**

| Species | Common Name | Total Sites | Relative Freq. | Freq. in Veg. | Freq. in Lit. | Mean Rake |
|---|---|---|---|---|---|---|
| *Najas flexilis* | Bushy pondweed | 31 | 19.75 | 38.75 | 12.50 | 1.55 |
| | Filamentous algae | 30 | 19.11 | 37.50 | 12.10 | 1.93 |
| *Ceratophyllum demersum* | Coontail | 23 | 14.65 | 28.75 | 9.27 | 1.83 |
| *Nuphar variegata* | Spatterdock | 12 | 7.64 | 15.00 | 4.84 | 2.50 |
| *Elodea canadensis* | Common waterweed | 11 | 7.01 | 13.75 | 4.44 | 1.91 |
| *Potamogeton amplifolius* | Large-leaf pondweed | 7 | 4.46 | 8.75 | 2.82 | 1.57 |
| *Potamogeton pusillus* | Small pondweed | 6 | 3.82 | 7.50 | 2.42 | 1.17 |
| *Nitella* sp. | Nitella | 4 | 2.55 | 5.00 | 1.61 | 1.25 |
| *Nymphaea odorata* | White water lily | 4 | 2.55 | 5.00 | 1.61 | 1.25 |
| *Potamogeton natans* | Floating-leaf pondweed | 4 | 2.55 | 5.00 | 1.61 | 1.50 |
| *Lemna minor* | Small duckweed | 3 | 1.91 | 3.75 | 1.21 | 1.00 |
| *Pontederia cordata* | Pickerelweed | 3 | 1.91 | 3.75 | 1.21 | 1.33 |
| *Potamogeton epihydrus* | Ribbon-leaf pondweed | 3 | 1.91 | 3.75 | 1.21 | 2.33 |
| *Potamogeton zosteriformis* | Flat-stem pondweed | 3 | 1.91 | 3.75 | 1.21 | 2.00 |
| *Potamogeton crispus* | Curly-leaf pondweed | 2 | 1.27 | 2.50 | 0.81 | 1.00 |
| *Schoenoplectus acutus* | Hardstem bulrush | 2 | 1.27 | 2.50 | 0.81 | 2.50 |
| *Equisetum fluviatile* | Water horsetail | 1 | 0.64 | 1.25 | 0.40 | 2.00 |
| *Heteranthera dubia* | Water star-grass | 1 | 0.64 | 1.25 | 0.40 | 1.00 |
| *Phalaris arundinacea* | Reed canary grass | 1 | 0.64 | 1.25 | 0.40 | 2.00 |
| *Potamogeton foliosus* | Leafy pondweed | 1 | 0.64 | 1.25 | 0.40 | 1.00 |
| *Potamogeton obtusifolius* | Blunt-leaf pondweed | 1 | 0.64 | 1.25 | 0.40 | 1.00 |

## Table 2 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
## Granite Lake, Barron County
## July 28-29, 2009

| Species | Common Name | Total Sites | Relative Freq. | Freq. in Veg. | Freq. in Lit. | Mean Rake |
|---|---|---|---|---|---|---|
| *Potamogeton spirillus* | Spiral-fruited pondweed | 1 | 0.64 | 1.25 | 0.40 | 2.00 |
| *Sagittaria rigida* | Sessile-fruited arrowhead | 1 | 0.64 | 1.25 | 0.40 | 1.00 |
| *Schoenoplectus tabernaemontani* | Softstem bulrush | 1 | 0.64 | 1.25 | 0.40 | 2.00 |
| *Spirodela polyrhiza* | Large duckweed | 1 | 0.64 | 1.25 | 0.40 | 1.00 |
| *Carex lacustris* | Lake sedge | ** | ** | ** | ** | ** |
| *Bolboschoenus fluviatilis* | River bulrush | *** | *** | *** | *** | *** |
| *Dulichium arundinaceum* | Threeway sedge | *** | *** | *** | *** | *** |
| *Eleocharis palustris* | Creeping spikerush | *** | *** | *** | *** | *** |
| *Glyceria borealis* | Northern manna grass | *** | *** | *** | *** | *** |
| *Juncus dudleyi* | Dudley's rush | *** | *** | *** | *** | *** |
| *Lythrum salicaria* | Purple loosestrife | *** | *** | *** | *** | *** |
| *Sagittaria latifolia* | Common arrowhead | *** | *** | *** | *** | *** |
| *Scirpus atrovirens* | Black bulrush | *** | *** | *** | *** | *** |
| *Sparganium eurycarpum* | Common bur-reed | *** | *** | *** | *** | *** |
| *Typha latifolia* | Broad-leaved cattail | *** | *** | *** | *** | *** |
| | | | | | | |

** Visual Only

*** Boat Survey Only

Bushy pondweed, Filamentous algae, Coontail and Spatterdock were the most common macrophyte species being found at 38.75%, 37.50%, 28.75%, and 15.00% of survey points with vegetation (Table 2) (Figure 7). Together, they combined for just over 61% of the total relative frequency. Common waterweed (7.01) was the only other macrophyte with a relative frequency over five (Appendix VI and VII).

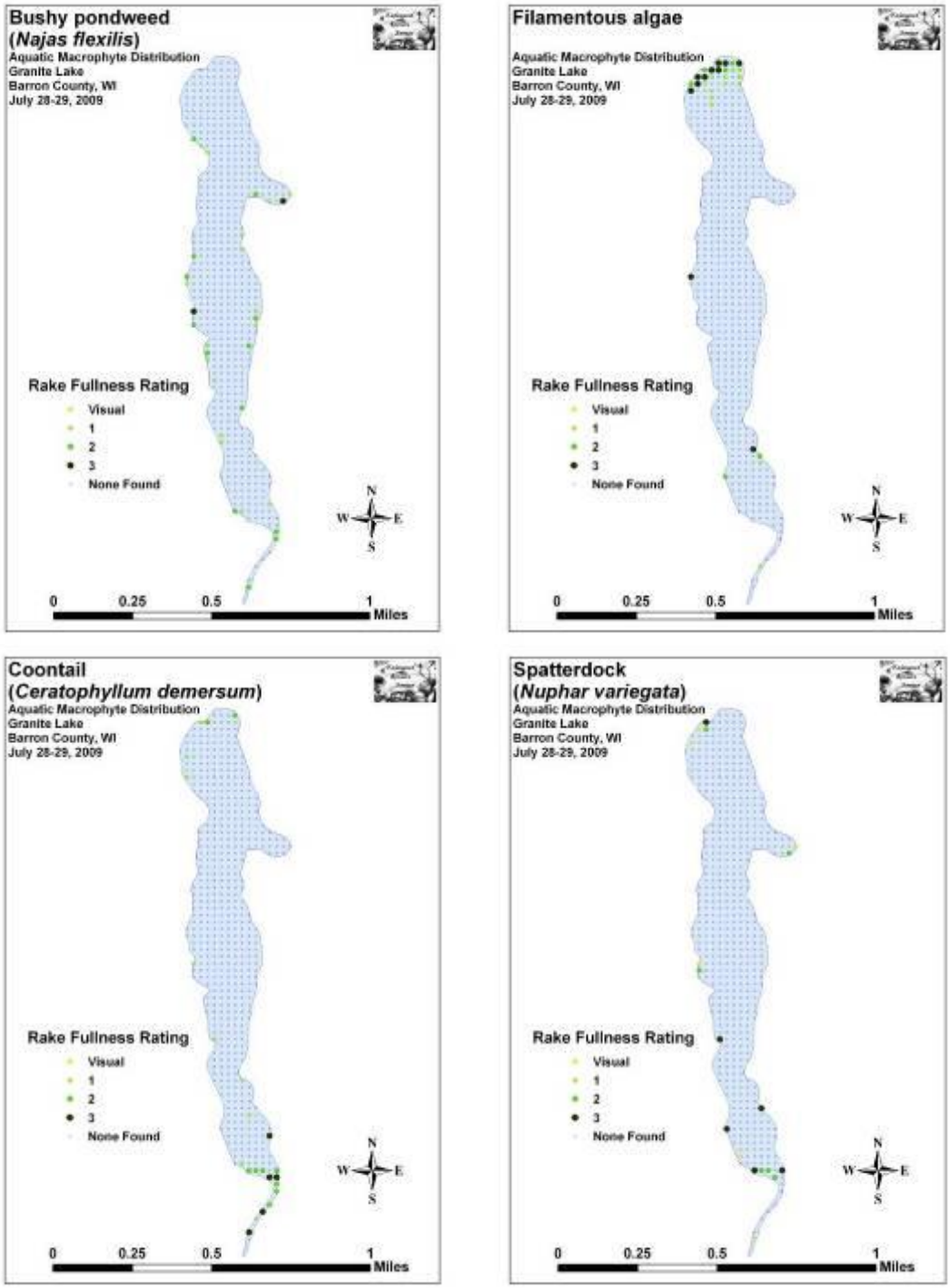


**Figure 7: Granite Lake's Most Common Species**

## Table 3: Floristic Quality Index of Aquatic Macrophytes
## Granite Lake, Barron County
## July 28-29, 2009

| Species | Common Name | C |
|---|---|---|
| *Ceratophyllum demersum* | Coontail | 3 |
| *Elodea canadensis* | Common waterweed | 3 |
| *Equisetum fluviatile* | Water horsetail | 7 |
| *Heteranthera dubia* | Water star-grass | 6 |
| *Lemna minor* | Small duckweed | 5 |
| *Najas flexilis* | Bushy pondweed | 6 |
| *Nitella* sp. | Nitella | 7 |
| *Nuphar variegata* | Spatterdock | 6 |
| *Nymphaea odorata* | White water lily | 6 |
| *Pontederia cordata* | Pickerelweed | 9 |
| *Potamogeton amplifolius* | Large-leaf pondweed | 7 |
| *Potamogeton epihydrus* | Ribbon-leaf pondweed | 8 |
| *Potamogeton foliosus* | Leafy pondweed | 6 |
| *Potamogeton natans* | Floating-leaf pondweed | 5 |
| *Potamogeton obtusifolius* | Blunt-leaf pondweed | 9 |
| *Potamogeton pusillus* | Small pondweed | 7 |
| *Potamogeton spirillus* | Spiral-fruited pondweed | 8 |
| *Potamogeton zosteriformis* | Flat-stem pondweed | 6 |
| *Sagittaria rigida* | Sessile-fruited arrowhead | 8 |
| *Schoenoplectus acutus* | Hardstem bulrush | 5 |
| *Schoenoplectus tabernaemontani* | Softstem bulrush | 4 |
| *Spirodela polyrhiza* | Large duckweed | 5 |
| | | |
| N | | 22 |
| mean C | | 6.2 |
| FQI | | 29.0 |

We identified a total of 22 native plants to species during the point intercept survey. Several of these, including Blunt-leaf pondweed (*Potamogeton obtusifolius*) and Pickerelweed (*Pontederia cordata*), are very sensitive to human disturbance and indicate the lake possesses areas of high quality habitat. All plants combined, they produced a mean Coefficient of Conservatism of 6.2 and a Floristic Quality Index of 29.0 (Table 3). Nichols (1999) reported an average mean C for the Northern Central Hardwood Forests Region of 5.6 putting Granite Lake slightly above average for this part of the state. The FQI of 29.0 was also slightly above the mean FQI of 20.9 for the Northern Central Hardwood Forests Region (Nichols 1999).

Currently, we believe exotic invasive species are a limited threat to the Granite Lake ecosystem, but this could change rapidly in the future if Eurasian water milfoil is introduced into the lake or if Purple loosestrife continues to spread. At the time of the July survey, we did NOT find any evidence of EWM in Granite Lake despite its presence in several other area lakes. Reed canary grass is widely distributed in undeveloped shoreline areas of the lake, but this ubiquitous plant does provide some habitat for wildlife and there is no easy or cheap way to eliminate it. As previously mentioned, Curly-leaf pondweed does not appear to play a big part in the lake's overall plant community. Purple loosestrife (*Lythrum salicaria*) probably represents the most immediate threat to the lake. It was widely scattered throughout; especially in the southwest end of the lake. Undeveloped, muck bottom areas like along the inlet/outlet channels would provide especially suitable habitat for this invasive wetland plant to expand into (For more information on exotic invasive species, see Appendix IX).

Of greater immediate concern were the large amounts of filamentous algae (relative frequency of 19.11), present in abundance at several locations throughout Granite Lake. It tends to proliferate in areas that have excessive nutrients, and was especially common along the north end of the main basin and the southeast shoreline. It was also abundant in front of a few managed lawns where fertilizer application was evident, and in areas where property owners cut the native vegetation down to the lakeshore (Figure 9).

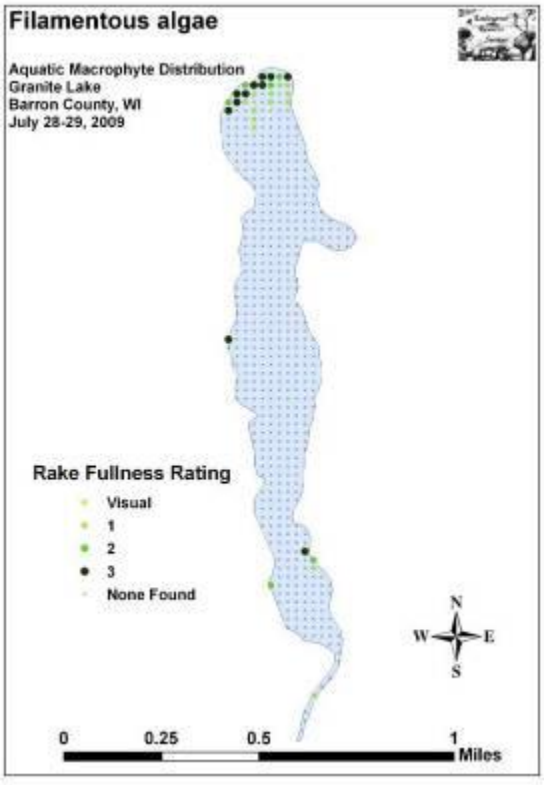


**Figure 8: Filamentous Algae Distribution**

## CONSIDERATIONS FOR MANAGEMENT:

### Native Aquatic Macrophytes:

Granite Lake has a very limited plant community that appears to be affected by water clarity, quality, and, perhaps most importantly, lack of suitable growing substrate as the lake's dominant sand/rock areas provide generally poor growing conditions for most species. Because the lake's macrophytes are so limited, preserving them is critical to maintaining a healthy lake. In essence, a lake's plants are as critical to the aquatic environment as trees are to a forest. They are the base of the aquatic food pyramid, provide habitat for other aquatic organisms, are important food sources for waterfowl and other wildlife, stabilize the shoreline, and work to improve water clarity by absorbing excess nutrients from the water. The scattered reed/rush beds are especially important as they provide some of the only "nursery" habitat for baitfish and juvenile gamefish.

The lake also has several sensitive species that are rare and local making them vulnerable to lake-wide extinction. For example, Blunt-leaf pondweed, which was previously unknown from west-central Wisconsin, was found at only two locations in the lake and the entire population probably consists of no more than 100-200 individual plants.

### Curly-leaf pondweed:

Because this is a new or at least previously unknown infestation, I called Frank Koshere, Aquatic Plant Specialist with the WDNR. We agreed that treatment for a few plants when no others were located doesn't make sense. Nevertheless, the presence of any CLP is worth noting, and continued monitoring in the location is probably warranted.

### Purple loosestrife:

The presence of purple loosestrife along the margins of the lake is troubling as an infestation can quickly go from a few to 1,000's of plants. The plant is easily identifiable when it blooms in late July/early August, and lakeshore owners should locate and remove it from their property at this time before it goes to seed. Because plants are few in number with no more than a handful in any one area and probably fewer than 50 total plants around the lake, residents could and should easily eliminate the plant in summer 2010. Regular annual check-ups should follow. Because the plant can resprout from root fragments, a shovel is recommended to ensure total root removal.

### Water Clarity:

The filamentous and floating algae in the lake are anecdotal evidence that there are excessive nutrients in the water (Boedeltje et al. 2005). Such things as internal loading from sediments, failed septic systems, and lawn and field fertilizer runoff are common causes of excess nutrients in surface water (Barko and Smart 1980, Carignan and Kalff 1982, Moeller et al. 1988).

Regardless of the cause, these algal blooms decrease light penetration into the lake which leads to increased die back of plants at the edge of the littoral zone resulting in even more nutrients being released into the water. The elimination of shoreline vegetation can also increase the lake's nutrient load by increasing runoff and adding "grass clipping" vegetation to the water. The dense areas of filamentous algae that occurred in front of

some residences where there is no obvious visual reason for it may indicate septic systems are leaching nutrients into the lake. In other instances, obviously fertilized lawns may be the most likely explanation for these high levels of localized algae growth. A multiyear assessment of water quality within the watershed would be required to shed light on the specifics of nutrients within the system, as well as provide more specific suggestions on how to decrease nutrient inflow.

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

Improved Secchi readings in Granite Lake over the past 15+ years indicate this trend is definitely heading in the right direction (WDNR 2009). Hopefully, a greater understanding of how individual property owners can have lake-wide impacts will result in more people taking appropriate conservation measures to ensure water quality for all.

## Aquatic Invasive Species Prevention:

Aquatic Invasive Species (AIS) such as Eurasian water milfoil are an increasing problem in the lakes of northern Wisconsin in general, and several neighboring lakes in Barron County in particular. Preventing their introduction into Granite 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. Maintaining the noticeable signage at the boat landing offers 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. Conducting monthly or bimonthly transect surveys parallel to the shore near the lake's boat landing could result in immediate detection if AIS are introduced into the lake. The sooner an infestation is detected, the greater the chances it can be successfully controlled or even eliminated. Finally, completing an Aquatic Plant Management Plan prior to an infestation would help streamline an appropriate response if/when an infestation of EWM or some other AIS occurs.

## Management Considerations Summary:

- Preserve and maintain Granite Lake's native plant communities.
- Be aware that Curly-leaf pondweed is present in the lake.
- Reduce and, wherever possible, eliminate fertilizer applications and other sources of nutrients input near the lakeshore.
- Encourage shoreline restoration and the establishment of native vegetation buffer strips along the lakeshore to prevent runoff.
- Encourage owners to refrain from removing native plants from the lake as these areas provide Aquatic Invasive Species an ideal place to become established.
- Maintain signage at the boat landing to educate lake users about Aquatic Invasive Species like Eurasian water milfoil.
- Consider transect monitoring for invasive species at the lake's boat landing at least once a month during the summer.
- Complete an Aquatic Plant Management Plan that would outline a course of action if EWM or some other invasive plant is introduced into the lake.

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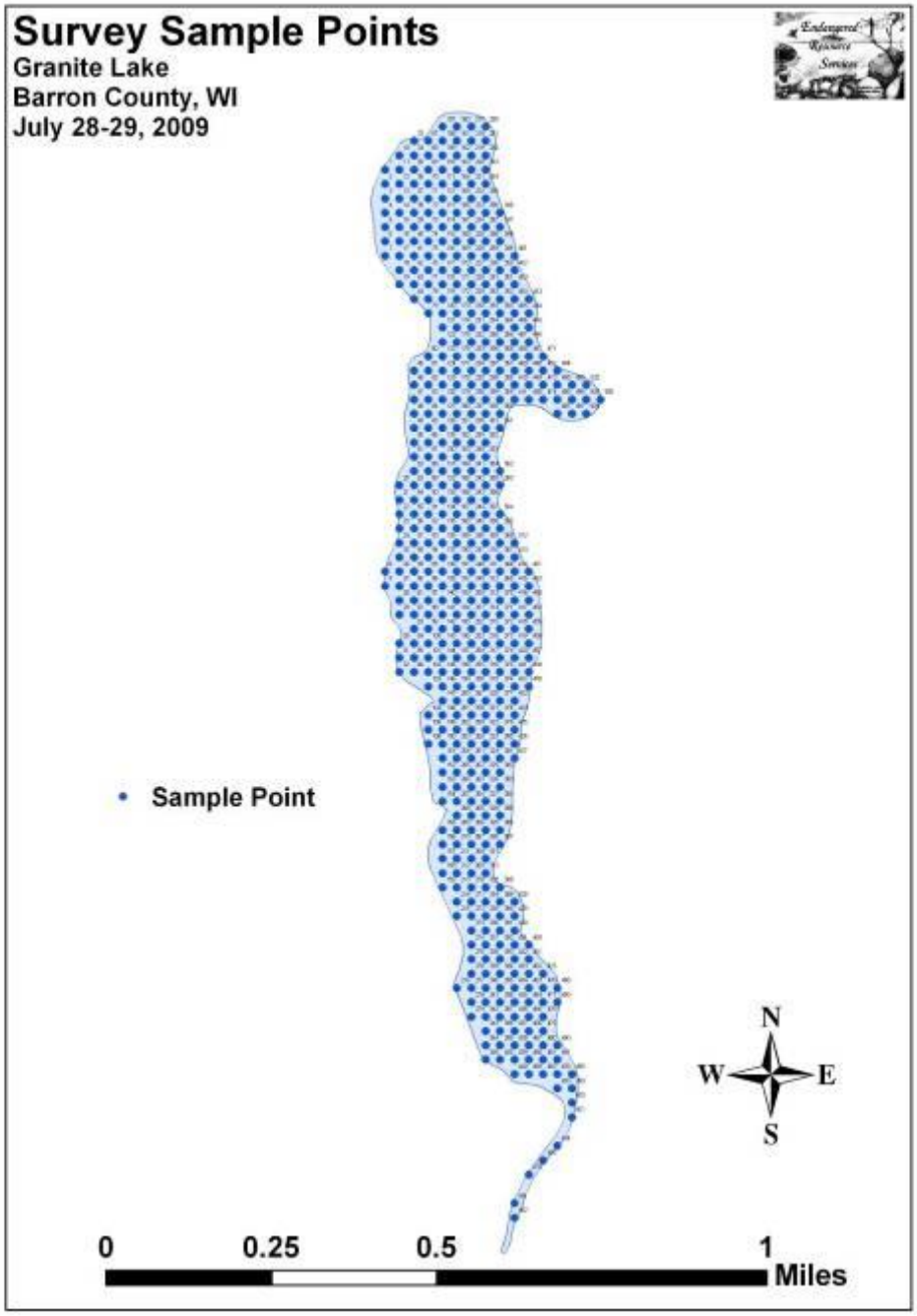
## Appendix I:  Granite Lake Map with Sample Points


Survey Sample Points
Granite Lake
Barron County, WI
July 28-29, 2009
Sample Point
N
W
E
S
0
0.25
0.5
1
Miles

## Appendix II:  Boat Survey Data Sheet

| **Boat Survey** | |
|---|---|
| **Lake Name** | |
| **County** | |
| **WBIC** | |
| **Date of Survey** | |
| **(mm/dd/yy)** | |
| **workers** | |
| | |
| **Nearest Point** | **Species seen, habitat information** |
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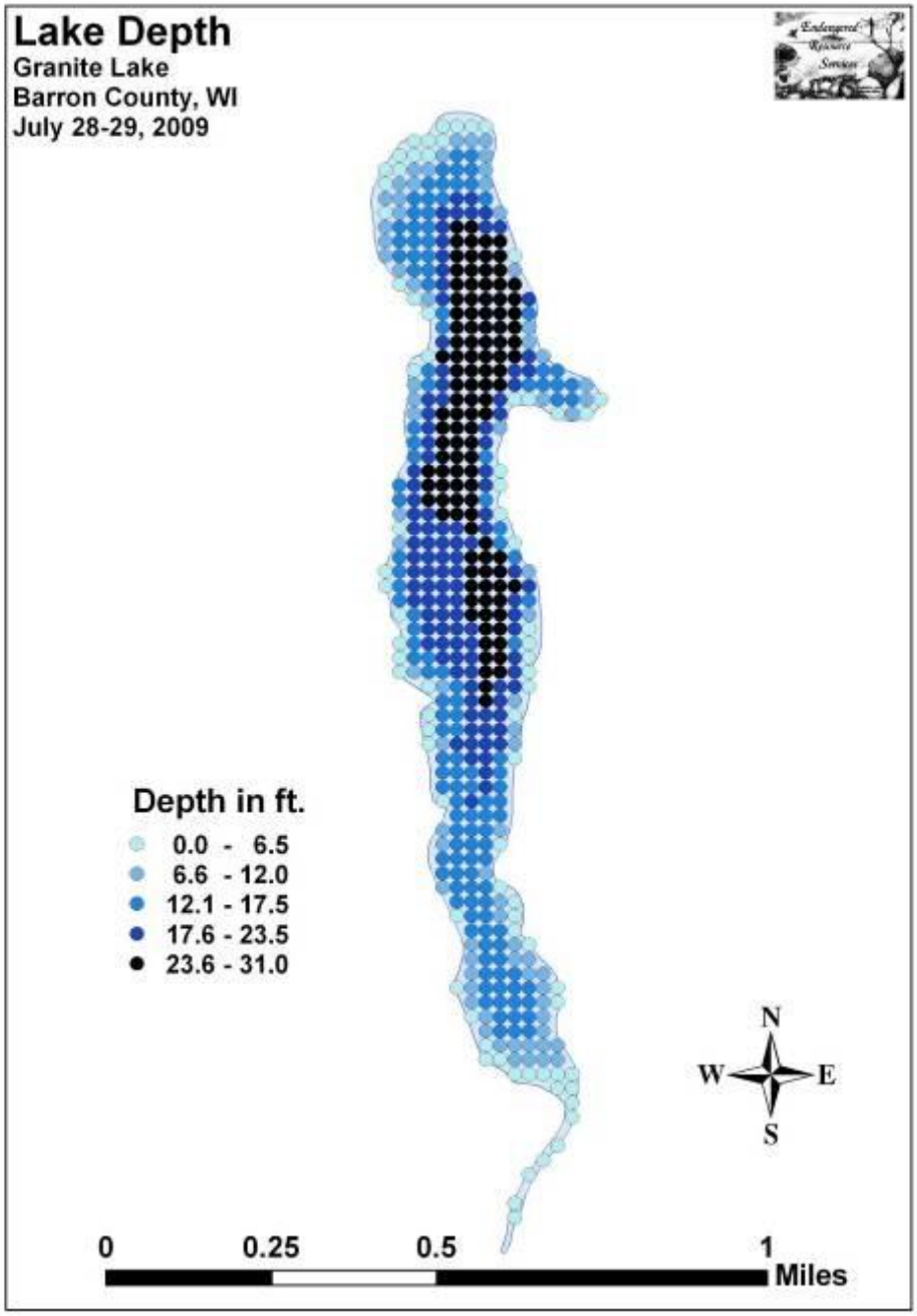
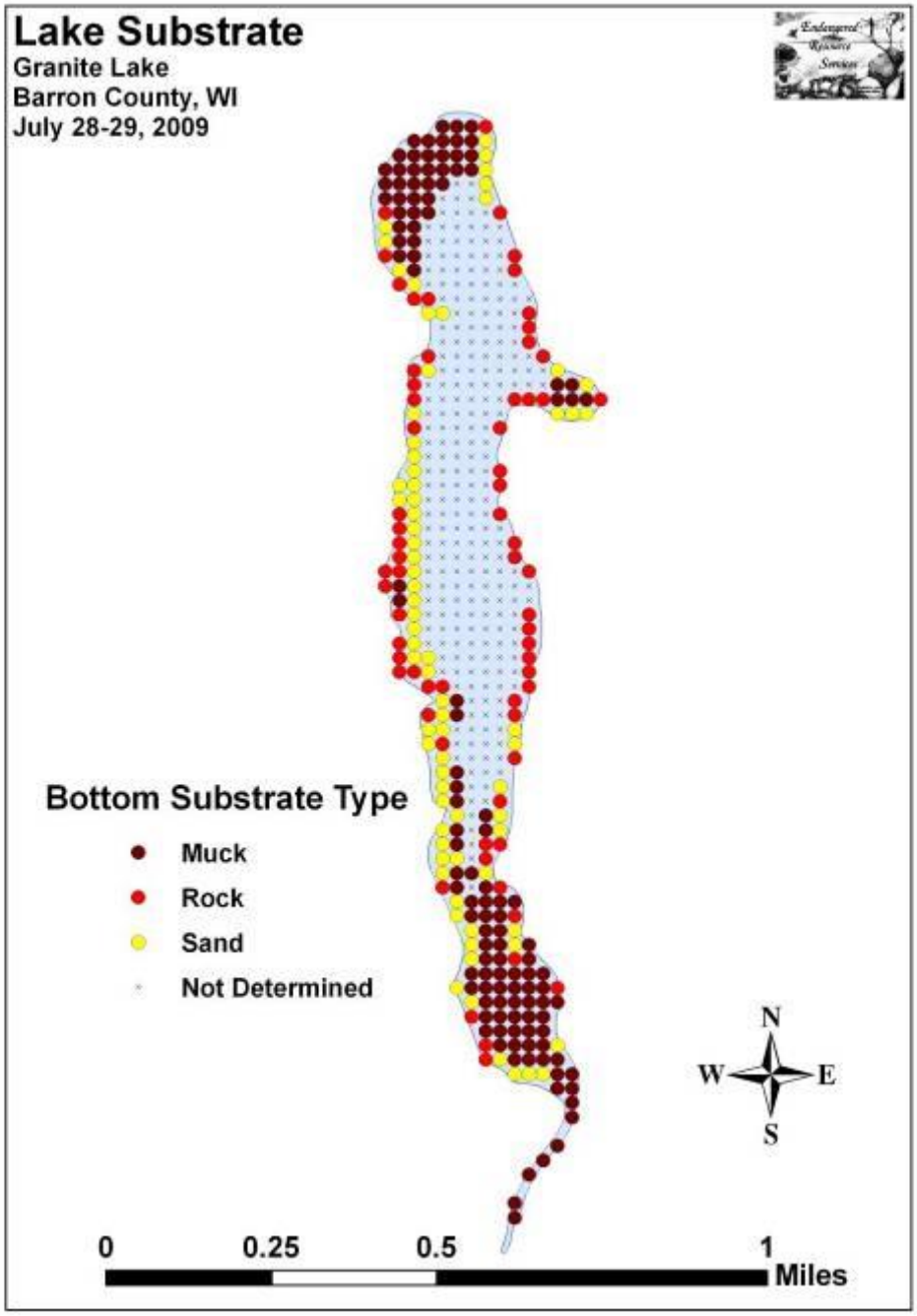
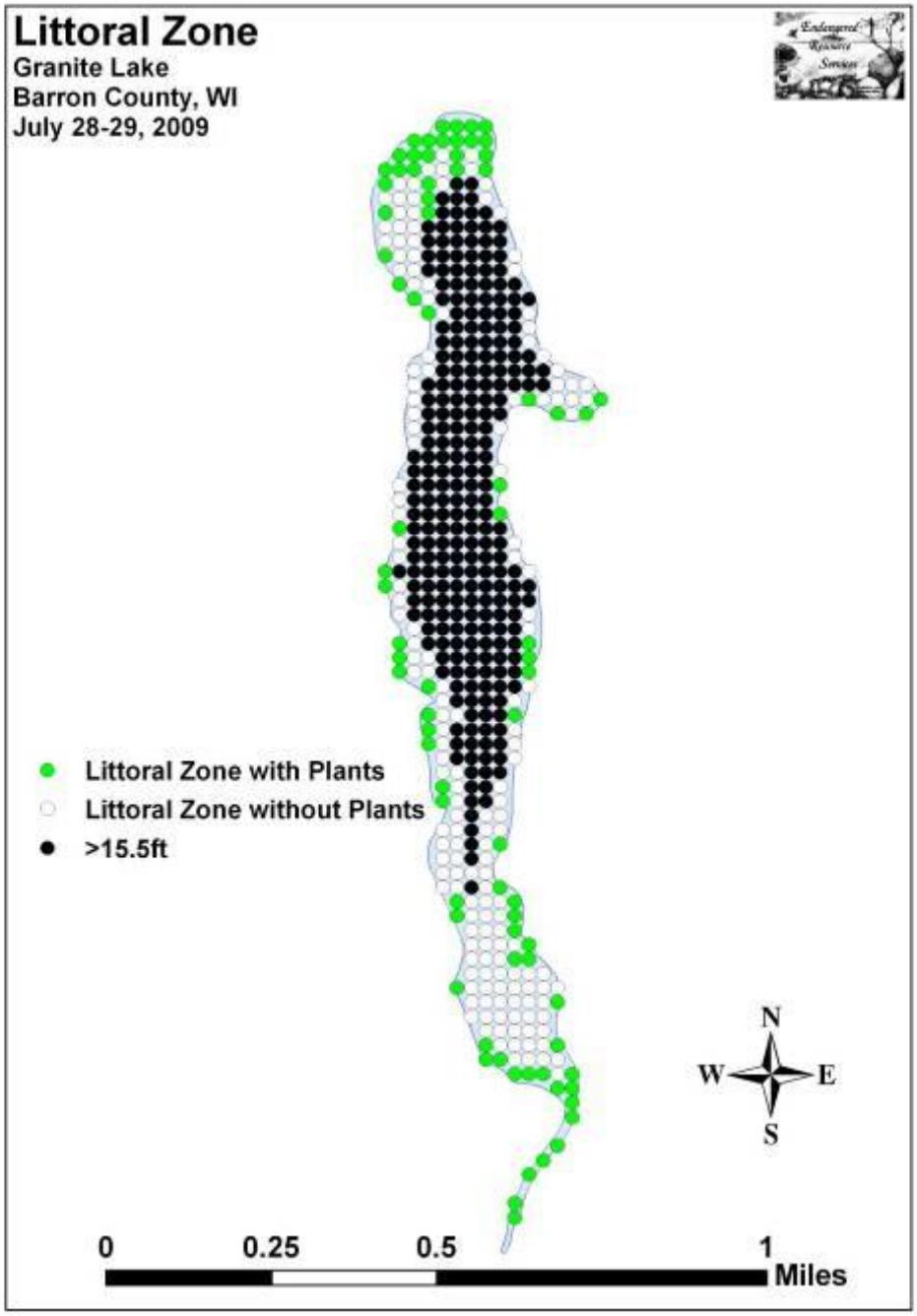
## Appendix III:  Vegetative Survey Data Sheet

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

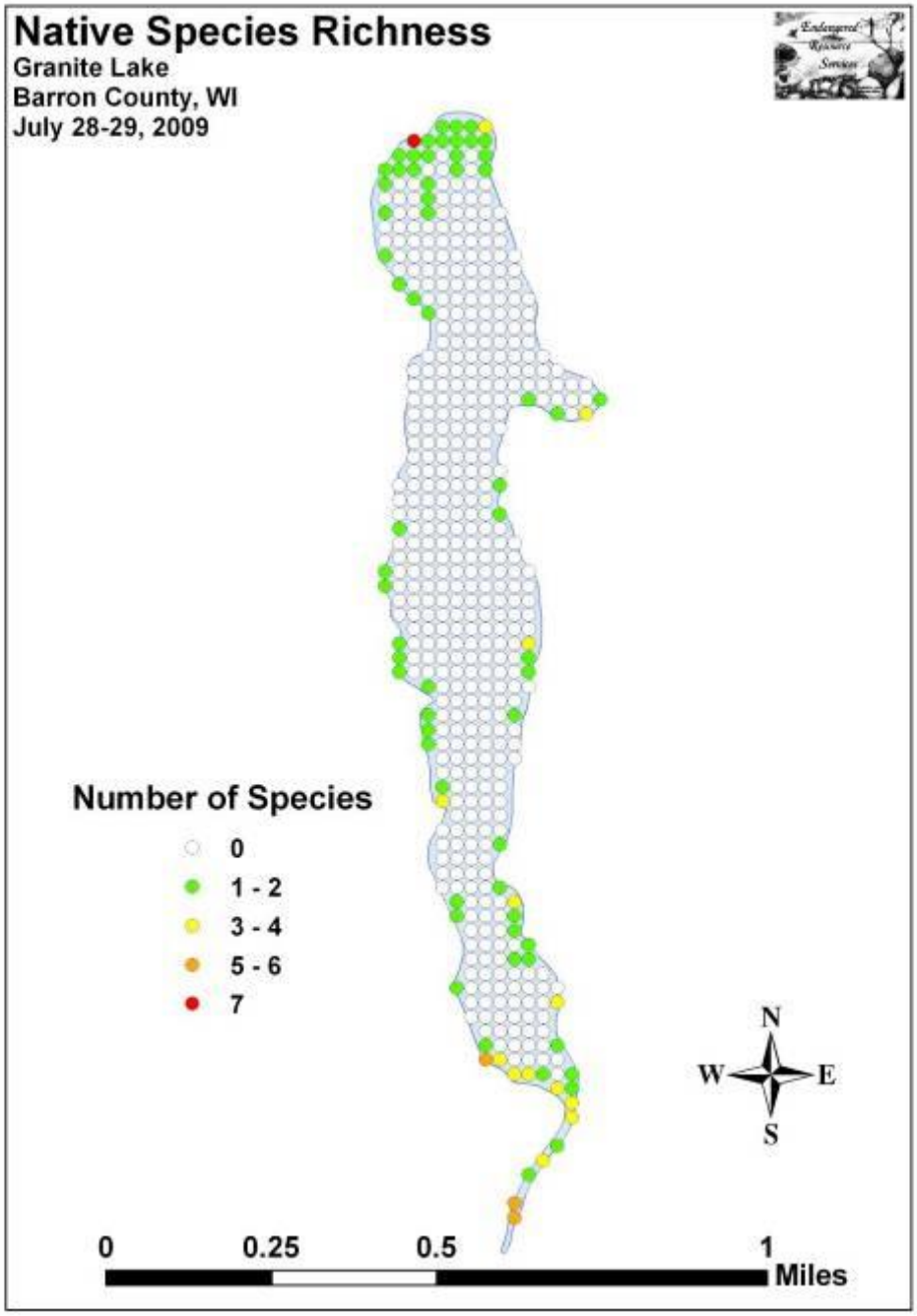
# Appendix IV:  Habitat Variable Maps

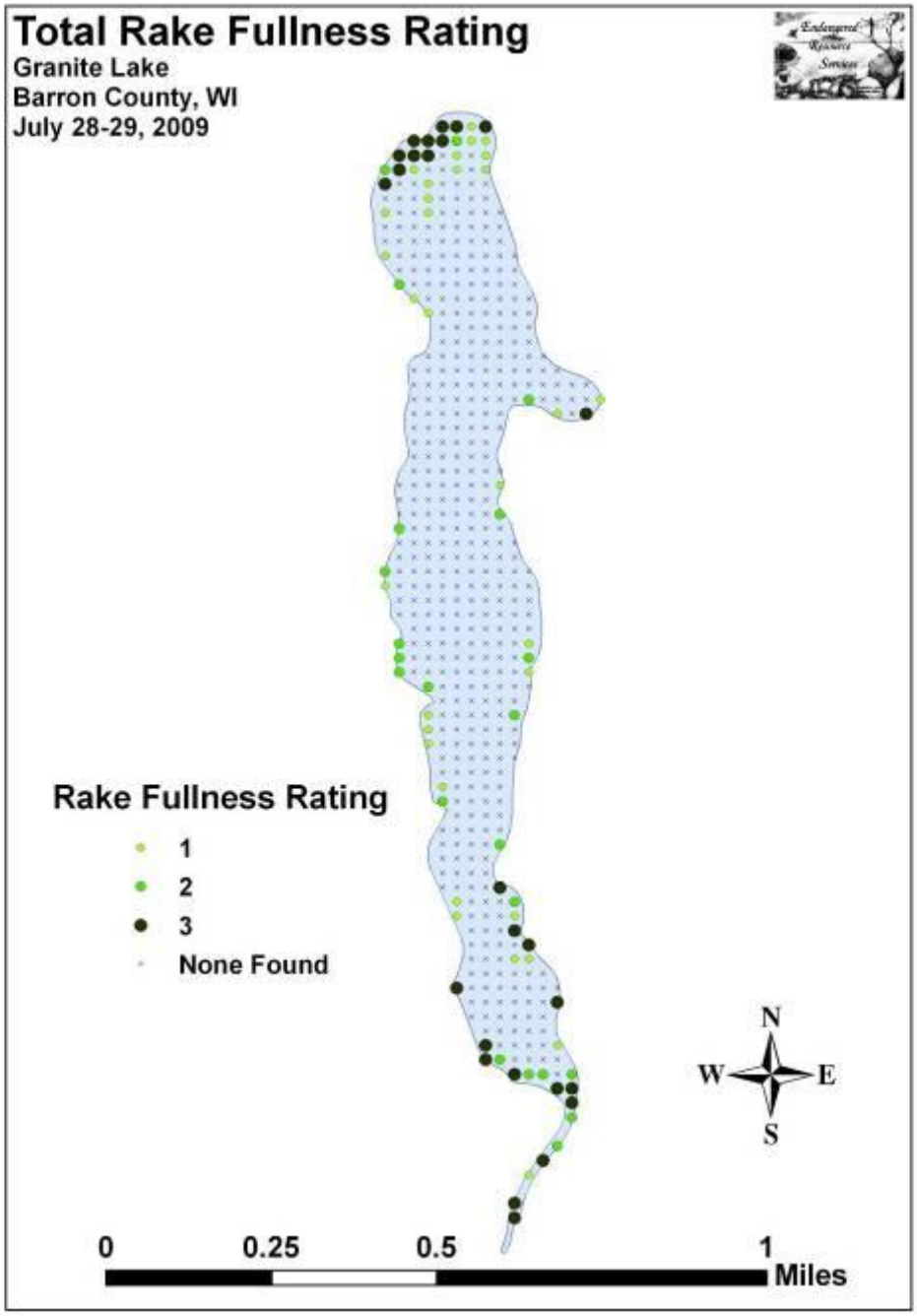

Lake Depth
Granite Lake
Barron County, WI
July 28-29, 2009
Depth in ft.
0.0 - 6.5
6.6 - 12.0
12.1 - 17.5
17.6 - 23.5
23.6 - 31.0
N
W
E
S
0
0.25
0.5
1
Miles


Lake Substrate
Granite Lake
Barron County, WI
July 28-29, 2009
Bottom Substrate Type
Muck
Rock
Sand
Not Determined
N
W
E
S
0
0.25
0.5
1
Miles


Littoral Zone
Granite Lake
Barron County, WI
July 28-29, 2009
Littoral Zone with Plants
Littoral Zone without Plants
>15.5ft
N
W
E
S
0
0.25
0.5
1
Miles

## Appendix V: Native Species Richness and Total Rake Fullness Maps


Native Species Richness
Granite Lake
Barron County, WI
July 28-29, 2009
Number of Species
0
1 - 2
3 - 4
5 - 6
7
N
W
E
S
0
0.25
0.5
1
Miles


Total Rake Fullness Rating
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

# Appendix VI:  Plant Species Accounts

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Bolboschoenus fluviatilis*) **River bulrush**
**Specimen Location:** Granite Lake; N45.57704°, W92.00505°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-228
**Habitat/Distribution:** Uncommon in scattered muck locations along primarily the western shoreline and at the creek inlet and outlet.
**Common Associates:** (*Phalaris arundinacea*) Reed canary grass, (*Sparganium eurycarpum*) Common bur-reed

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Carex lacustris*) **Lake sedge**
**Specimen Location:** Granite Lake; N45.57612°, W92.00809°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-229
**Habitat/Distribution:** Single large bed of plants found growing in .25 meters of water from the point to the shoreline.
**Common Associates:** (*Nuphar variegata*) Spatterdock, (*Najas flexilis*) Bushy pondweed, (*Eleocharis palustris*) Creeping spikerush, (*Sparganium eurycarpum*) Common bur-reed

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Ceratophyllum demersum*) **Coontail**
**Specimen Location:** Granite Lake; N45.58933°, W92.00901°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-230
**Habitat/Distribution:** Most common over muck bottoms in 0-3 meters. Widespread, but only abundant in the south bay and in the creek outlet.
**Common Associates:** (*Nuphar variegata*) Spatterdock, (*Nymphaea odorata*) White water lily, (*Elodea canadensis*) Common waterweed

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Dulichium arundinaceum*) **Threeway sedge**
**Specimen Location:** Granite Lake; N45.56705°, W92.00418°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-231
**Habitat/Distribution:** Muck bottom along the shoreline. Scattered locations in the lake outlet.
**Common Associates:** (*Phalaris arundinacea*) Reed canary grass, (*Sparganium eurycarpum*) Common bur-reed, (*Sagittaria latifolia*) Common arrowhead

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Eleocharis palustris*) **Creeping spikerush**
**Specimen Location:** Granite Lake; N45.57174°, W92.00690°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-232
**Habitat/Distribution:** Firm muck/sand bottom along the shoreline. A few plants were present at widely scattered locations, but the only sizable bed was at the point.
**Common Associates:** (*Sparganium eurycarpum*) Common bur-reed, (*Schoenoplectus acutus*) Hardstem bulrush, (*Bolboschoenus fluviatilis*) River bulrush, (*Carex lacustris*) Lake sedge

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Elodea canadensis*) **Common waterweed**
**Specimen Location:** Granite Lake; N45.58903°, W92.00855°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-233
**Habitat/Distribution:** Variable bottom in 1-2 meters of water.
Relative common and widespread throughout. A depauperate ecotype likely due to the scarcity of its normal preferred habitat of organic muck. Most terminal leaves were crowded, between 1.6 and 2.3mm wide and had length/width ratios that were mostly < 4:1.
**Common Associates:** (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Najas flexilis*) Bushy pondweed

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Equisetum fluviatile*) **Water horsetail**
**Specimen Location:** Granite Lake; N45.56922°, W92.00605°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-234
**Habitat/Distribution:** Found in mucky sand over gravel in 0-1 meters of water. A few large patches were scattered in the south bay.
**Common Associates:** (*Pontederia cordata*) Pickerelweed, (*Schoenoplectus acutus*) Hardstem bulrush, (*Nuphar variegata*) Spatterdock, (*Najas flexilis*) Bushy pondweed, (*Potamogeton natans*) Floating-leaf pondweed

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Glyceria borealis*) **Northern manna grass**
**Specimen Location:** Granite Lake; N45.57084°, W92.00387°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-235
**Habitat/Distribution:** A small stand was located in from the point in water <.25m deep over firm sand/rock substrate.
**Common Associates:** (*Najas flexilis*) Bushy pondweed

**County/State:** Barron County, Wisconsin **Date:** 7/29/09
**Species:** (*Heteranthera dubia*) **Water star-grass**
**Specimen Location:** Granite Lake; N45.58343°, W92.00432°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-236
**Habitat/Distribution:** Firm mucky/sand bottoms in water < 1 meter deep. Only a handful of individuals were found in the east bay and directly across from the bay on the western shore.
**Common Associates:** (*Najas flexilis*) Bushy pondweed

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Juncus dudleyi*) **Dudley's rush**
**Specimen Location:** Granite Lake; N45.57824°, W92.00930°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-237
**Habitat/Distribution:** A few individuals were located at the boat landing in firm muck just away from the water's edge. Told from *J. tenuis* by the auricles at the leaf sheaths being truncated and barely visible rather than 1-3mm long in *tenuis*.
**Common Associates:** (*Phalaris arundinacea*) Reed canary grass**,** (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Scirpus atrovirens*) Black bulrush

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Lemna minor*) **Small duckweed**
**Specimen Location:** Granite Lake; N45.58933°, W92.00901°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-238
**Habitat/Distribution:** Located floating at or just under the surface in sheltered areas. Scattered individuals found interspersed between the lilypads in the north and south bays and in the creek inlet/outlet.
**Common Associates:** (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Spirodela polyrhiza*) Large duckweed

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Lythrum salicaria*) **Purple loosestrife**
**Specimen Location:** Granite Lake; N45.57084°, W92.00387°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-239
**Habitat/Distribution:** Uncommon but widely distributed in muck soil at the lakeshore. Most plants were scattered along the southeast shoreline.
**Common Associates:** (*Typha latifolia*) Broad-leaved cattail, (*Phalaris arundinacea*) Reed canary grass

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Najas flexilis*) **Bushy pondweed**
**Specimen Location:** Granite Lake; N45.57768°, W92.00905°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-240
**Habitat/Distribution:** Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-1.5 meters of water. The most common species in the lake, it was widely distributed throughout, but seldom abundant.
**Common Associates:** (*Potamogeton pusillus*) Small pondweed, (*Potamogeton spirillus*) Spiral-fruited pondweed, (*Schoenoplectus acutus*) Hardstem bulrush

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Nitella* sp.) **Nitella**
**Specimen Location:** Granite Lake; N45.56923°, W92.00561°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-241
**Habitat/Distribution:** Muck bottom area in water generally less than 2 meters deep. Rare and widely scattered.
**Common Associates:** (*Ceratophyllum demersum*) Coontail, (*Elodea canadensis*) Common waterweed, (*Najas flexilis*) Bushy pondweed

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Nuphar variegata*) **Spatterdock**
**Specimen Location:** Granite Lake; N45.58933°, W92.00901°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-242
**Habitat/Distribution:** Muck bottom in 0-2 meters of water where it often forms dense canopies. Common in the north, south and mid lay bays. 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, (*Elodea canadensis*) Common waterweed

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Nymphaea odorata*) **White water lily**
**Specimen Location:** Granite Lake; N45.58933°, W92.00901°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-243
**Habitat/Distribution:** Muck bottom in 0-2 meters where it forms dense canopies. Common in the lake's north and south bays – scattered elsewhere.
**Common Associates:** (*Nuphar variegata*) Spatterdock, (*Ceratophyllum demersum*) Coontail

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Phalaris arundinacea*) **Reed canary grass**
**Specimen Location:** Granite Lake; N45.57824°, W92.00930°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-244
**Habitat/Distribution:** Common but not abundant. Prefers thick muck soil in and out of water <0.25 meters. Primarily found on shore in undeveloped low areas.
**Common Associates:** (*Lythrum salicaria*) Purple loosestrife**,** (*Typha latifolia*) Broad-leaved cattail, (*Sagittaria latifolia*) Common arrowhead, (*Dulichium arundinaceum*) Threeway sedge

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Pontederia cordata*) **Pickerelweed**
**Specimen Location:** Granite Lake; N45.57824°, W92.00930°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-245
**Habitat/Distribution:** Silt to muck bottom over firm substrate in 0-1 meter of water. Common in emergent beds scattered throughout the lake; especially in sheltered bays.
**Common Associates:** (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Equisetum fluviatile*) Water horsetail, (*Sagittaria rigida*) Sessile-fruited arrowhead

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Potamogeton amplifolius*) **Large-leaf pondweed**
**Specimen Location:** Granite Lake; N45.56609°, W92.00505°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-246
**Habitat/Distribution:** Relatively common and widely distributed throughout where it formed patchy beds over muck and sandy muck areas. One of the few broad-leaved plants in the lake, *amplifolius* provides some of Granite's best fish habitat.
**Common Associates:** (*Najas flexilis*) Bushy pondweed, (*Ceratophyllum demersum*) Coontail

**County/State:** Barron County, Wisconsin **Date:** 5/27/09
**Species:** (*Potamogeton crispus*) **Curly-leaf pondweed**
**Specimen Location:** Granite Lake; N45.57177°, W92.00480°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-247
**Habitat/Distribution:** Found in mucky bottom areas in water from 1-2.5m deep. Rare with a total of 8 plants seen in the lake during the CLP and warm water P/I survey. A few additional plants were located in the lake outlet.
**Common Associates:** (*Elodea canadensis*) Common waterweed, (*Ceratophyllum demersum*) Coontail

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Potamogeton epihydrus*) **Ribbon-leaf pondweed**
**Specimen Location:** Granite Lake; N45.56609°, W92.00505°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-248
**Habitat/Distribution:** Found in sand - muck bottom conditions in shallow water 0.5-1.0 meter deep. Scattered locations in the south bay and in the lake outlet. It was more common in May. Perhaps grazed by Carp?
**Common Associates:** (*Potamogeton pusillus*) Small pondweed, (*Elodea canadensis*) Common waterweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed

**County/State:** Barron County, Wisconsin **Date:** 7/29/09
**Species:** (*Potamogeton foliosus*) **Leafy pondweed**
**Specimen Location:** Granite Lake; N45.58345°, W92.00342°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-249
**Habitat/Distribution:** Variable substrate in 0-2 meters of water. Rare being found at only one point and seen in two other locations. May be more common than survey indicated. Keeled fruits and a lack of nodal glands were needed to separate plants from the very similar *P. pusillus*. Few individuals were in fruit so we erred on the side of caution and called them small if there was uncertainty.
**Common Associates:** (*Elodea canadensis*) Common waterweed, (*Nuphar variegata*) Spatterdock

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Potamogeton natans*) **Floating-leaf pondweed**
**Specimen Location:** Granite Lake; N45.56892°, W92.00515°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-250
**Habitat/Distribution:** Muck and sand bottom in 1meter of water. Restricted to the south bay. Especially common near the outlet.
**Common Associates:** (*Ceratophyllum demersum*) Coontail, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Elodea canadensis*) Common waterweed, (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Pontederia cordata*) Pickerelweed

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Potamogeton obtusifolius*) **Blunt-leaf pondweed**
**Specimen Location:** Granite Lake; N45.58933°, W92.00901°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-251
**Habitat/Distribution:** Uncommon in thick muck bottom areas near the creek inlet on the north side in shallow water 0.5-1 meter deep. A few stunted individuals were also found in the far end of the east bay.
**Common Associates:** (*Ceratophyllum demersum*) Coontail, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Nuphar variegata*) Spatterdock, (*Nymphaea odorata*) White water lily

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Potamogeton pusillus*) **Small pondweed**
**Specimen Location:** Granite Lake; N45.57768°, W92.00905°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-252
**Habitat/Distribution:** Found in almost any bottom conditions, but grew best in muck bottoms in 1-2 meters of water. It was widely distributed but uncommon except for a few places in the south bay. Plants were especially depauperate and looked very similar to *foliosus*. We separated by the faint nodal glands and winter buds that were common and small, but *pusillus* like. No plants were in fruit.
**Common Associates:** (*Ceratophyllum demersum*) Coontail, (*Elodea canadensis*) Common waterweed

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Potamogeton spirillus*) **Spiral-fruited pondweed**
**Specimen Location:** Granite Lake; N45.56922°, W92.00605°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-253
**Habitat/Distribution:** Found in rock/ sand bottoms in 0-1 meter of water. Uncommon, but widely distributed throughout the lake. Its coiled seeds and curled leaves make it easy to separate from other thin leaved pondweeds.
**Common Associates:** (*Najas flexilis*) Bushy pondweed

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Potamogeton zosteriformis*) **Flat-stem pondweed**
**Specimen Location:** Granite Lake; N45.56609°, W92.00505°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-254
**Habitat/Distribution:** Rare; found only in the lake outlet growing over thick organic muck in <1.5m of water.
**Common Associates:** (*Ceratophyllum demersum*) Coontail, (*Potamogeton epihydrus*) Ribbon-leaf pondweed, (*Pontederia cordata*) Pickerelweed

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Sagittaria latifolia*) **Common arrowhead**
**Specimen Location:** Granite Lake; N45.56705°, W92.00418°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-255
**Habitat/Distribution:** Emergent plants were present along the shoreline of the lake outlet.
**Common Associates:** (*Lythrum salicaria*) Purple loosestrife**,** (*Typha latifolia*) Broad-leaved cattail, (*Dulichium arundinaceum*) Threeway sedge

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Sagittaria rigida*) **Sessile-fruited arrowhead**
**Specimen Location:** Granite Lake; N45.57824°, W92.00930°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-256
**Habitat/Distribution:** Emergent plants were present in scattered mucky shoreline locations to a depth of .5 meters.
**Common Associates:** (*Schoenoplectus acutus*) Hardstem bulrush, (*Bolboschoenus fluviatilis*) River bulrush, (*Pontederia cordata*) Pickerelweed, (*Najas flexilis*) Bushy pondweed, (*Equisetum fluviatile*) Water horsetail

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Schoenoplectus acutus*) **Hardstem bulrush**
**Specimen Location:** Granite Lake; N45.57824°, W92.00930°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-257
**Habitat/Distribution:** A number of reed beds were located at rocky points throughout.
**Common Associates:** (*Najas flexilis*) Bushy pondweed, (*Nuphar variegata*) Spatterdock, (*Sagittaria rigida*) Sessile-fruited arrowhead

**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Schoenoplectus tabernaemontani*) **Softstem bulrush**
**Specimen Location:** Granite Lake; N45.57768°, W92.00905°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-258
**Habitat/Distribution:** Firm muck bottoms in 0-.5 meter of water. Scattered individuals were interspersed with other emergents in the outlet and a monotypic bed was located at the point.
**Common Associates:** (*Dulichium arundinaceum*) Threeway sedge, (*Sagittaria latifolia*) Common arrowhead, (*Phalaris arundinacea*) Reed canary grass

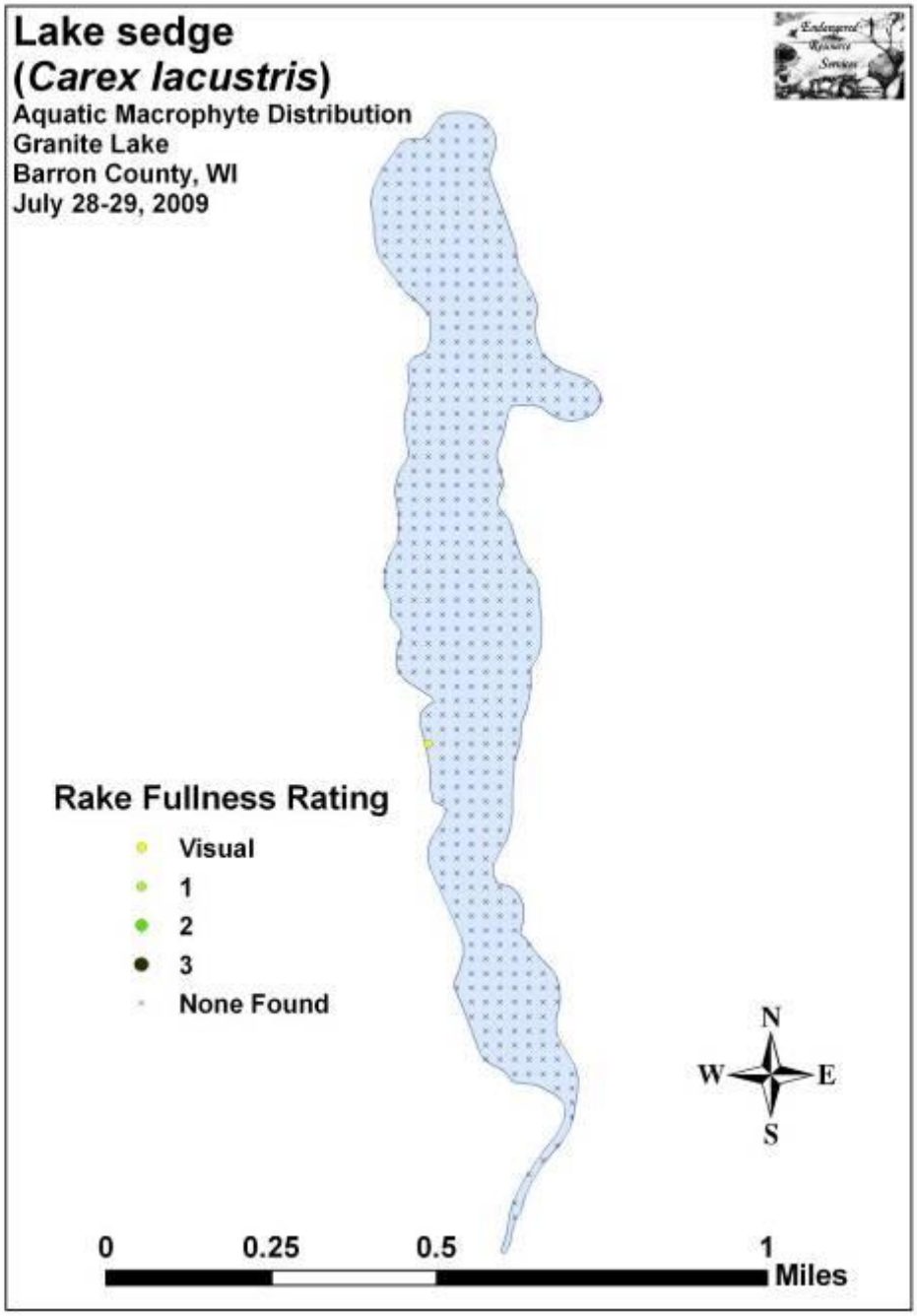
**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Scirpus atrovirens*) **Black bulrush**
**Specimen Location:** Granite Lake; N45.57824°, W92.00930°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-259
**Habitat/Distribution:** A single fruiting specimen was collected at the boat landing.
**Common Associates:** (*Phalaris arundinacea*) Reed canary grass**,** (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Juncus dudleyi*) Dudley's rush

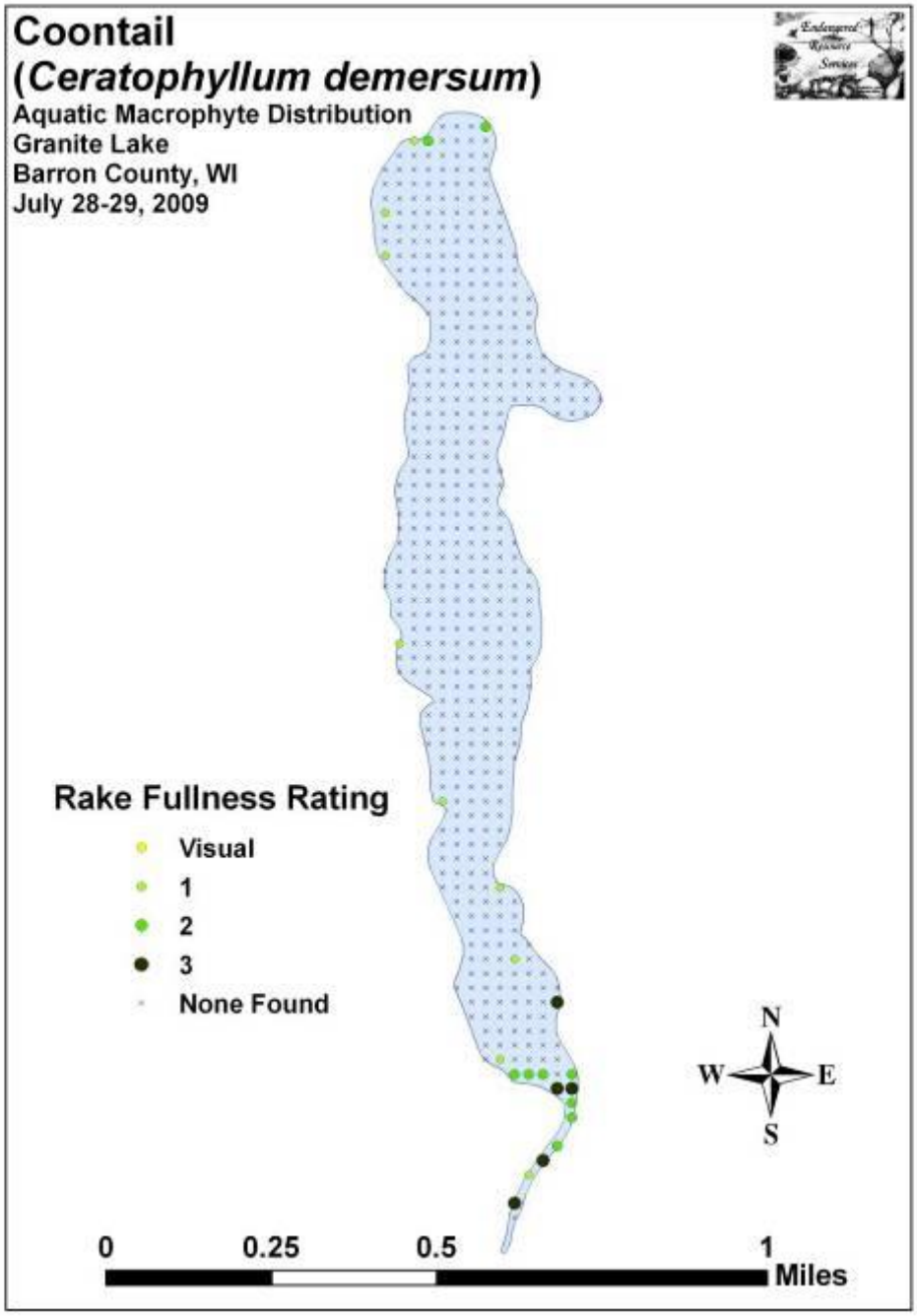
**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Sparganium eurycarpum*) **Common bur-reed**
**Specimen Location:** Granite Lake; N45.57174°, W92.00690°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-260
**Habitat/Distribution:** Muck bottom along the shoreline. A few scattered beds were located on the southwest and south shorelines.
**Common Associates:** (*Eleocharis palustris*) Creeping spikerush, (*Bolboschoenus fluviatilis*) River bulrush

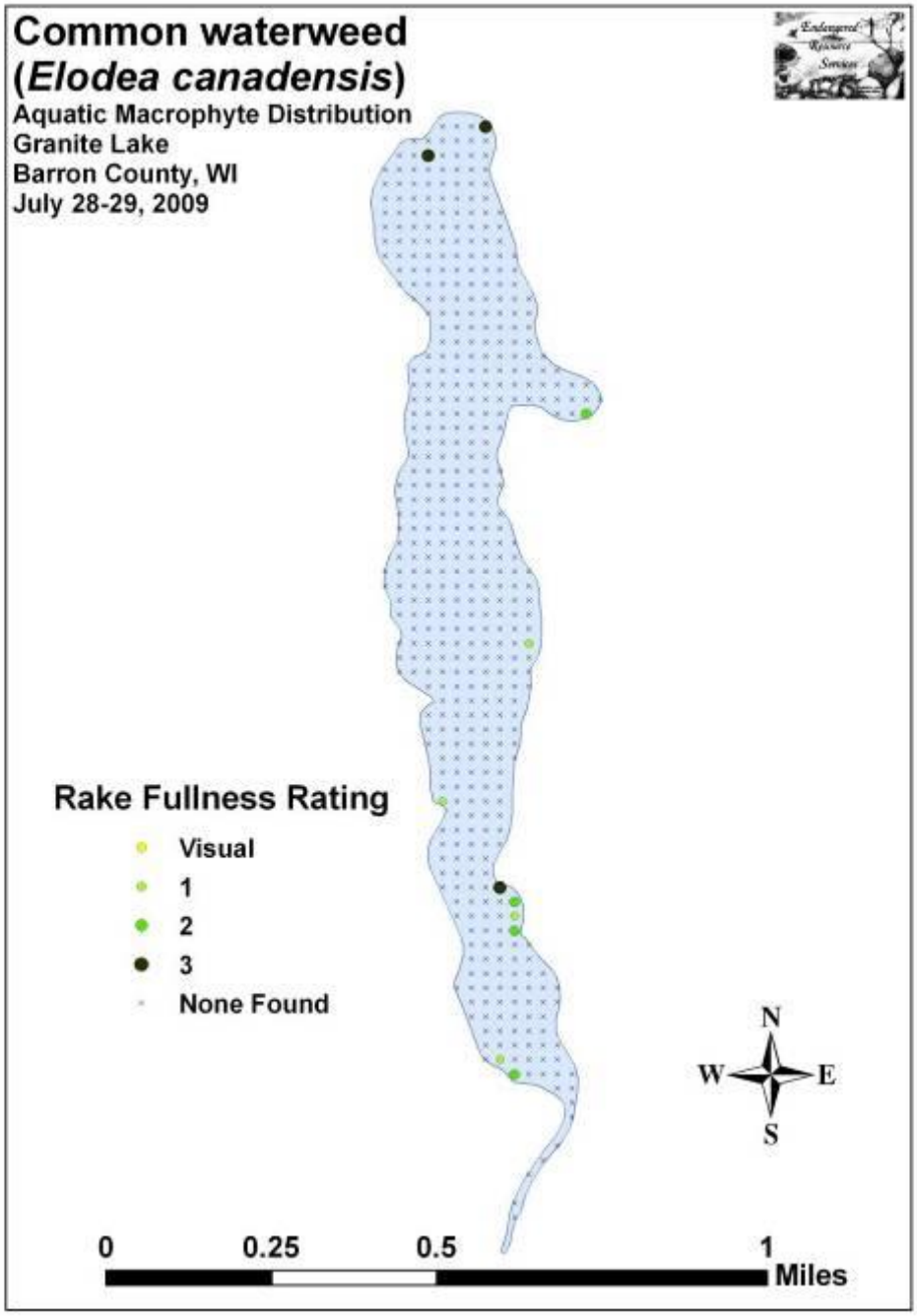
**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Spirodela polyrhiza*) **Large duckweed**
**Specimen Location:** Granite Lake; N45.58933°, W92.00901°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-261
**Habitat/Distribution:** Located floating at or just under the surface. Rare; only a few scattered individuals occurred interspersed between the lilypads near the creek inlet on the north side of the lake.
**Common Associates:** (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Lemna minor*) Small duckweed, (*Potamogeton obtusifolius*) Blunt-leaf pondweed

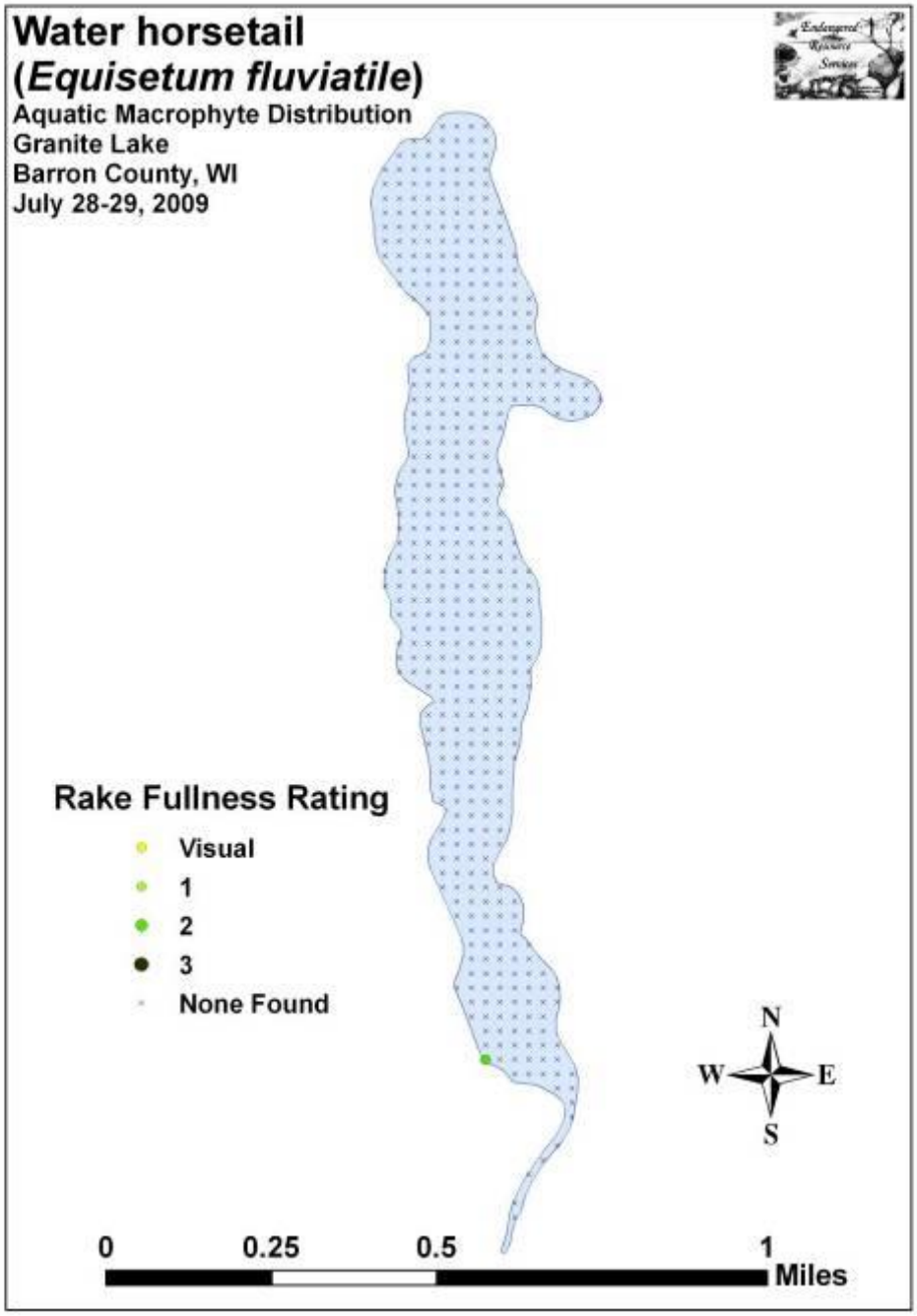
**County/State:** Barron County, Wisconsin **Date:** 7/28/09
**Species:** (*Typha latifolia*) **Broad-leaved cattail**
**Specimen Location:** Granite Lake; N45.56609°, W92.00505°
**Collected/Identified by: Matthew S. Berg Col. #:** MSB-2009-262
**Habitat/Distribution:** Thick muck soil in and out of water <0.25 meters. Found in undeveloped shoreline areas primarily near the lake outlet.
**Common Associates:** (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Sagittaria latifolia*) Common arrowhead, (*Lythrum salicaria*) Purple loosestrife, (*Phalaris arundinacea*) Reed canary grass

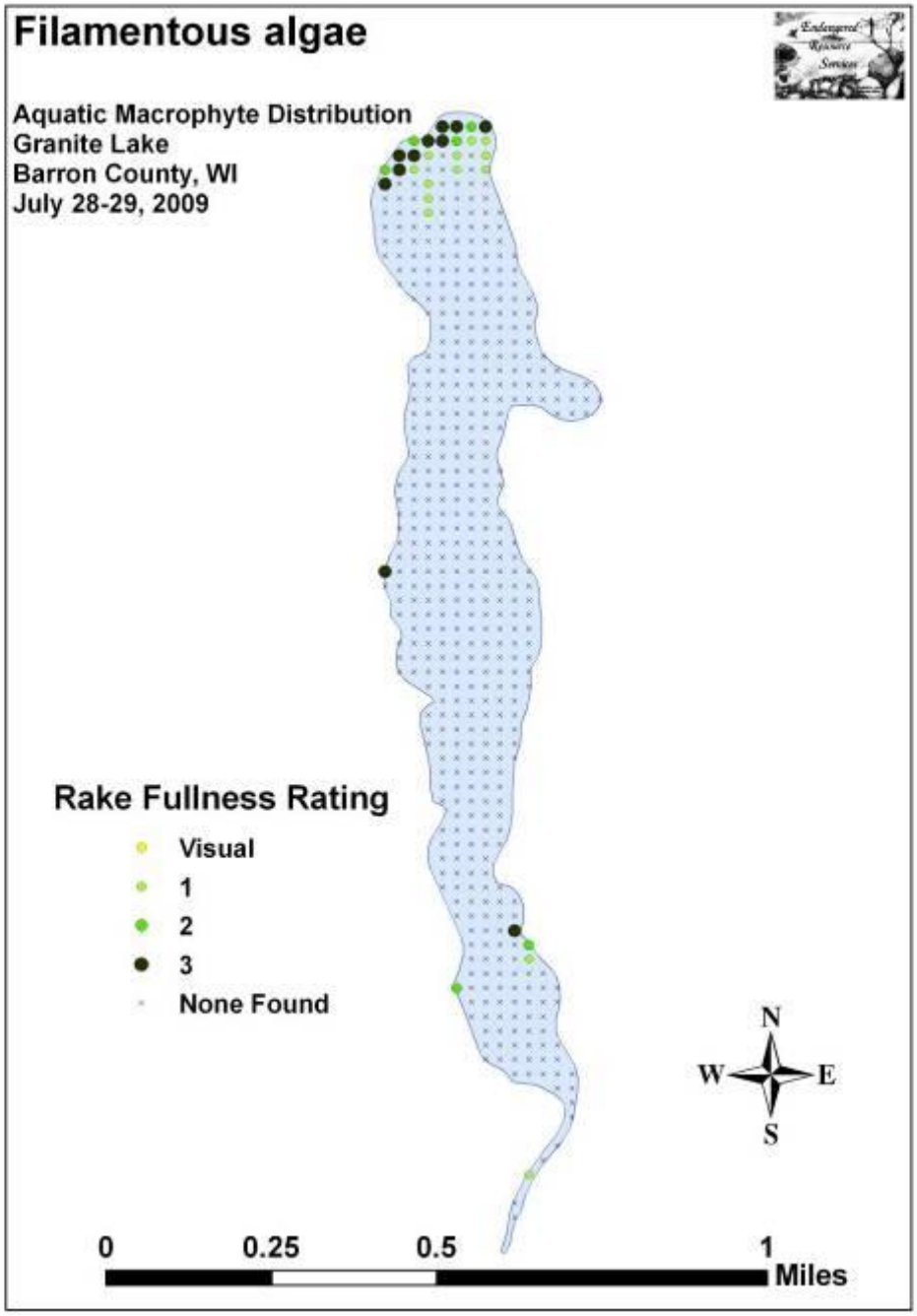
## Appendix VII:  Point Intercept Plant Species Distribution Maps

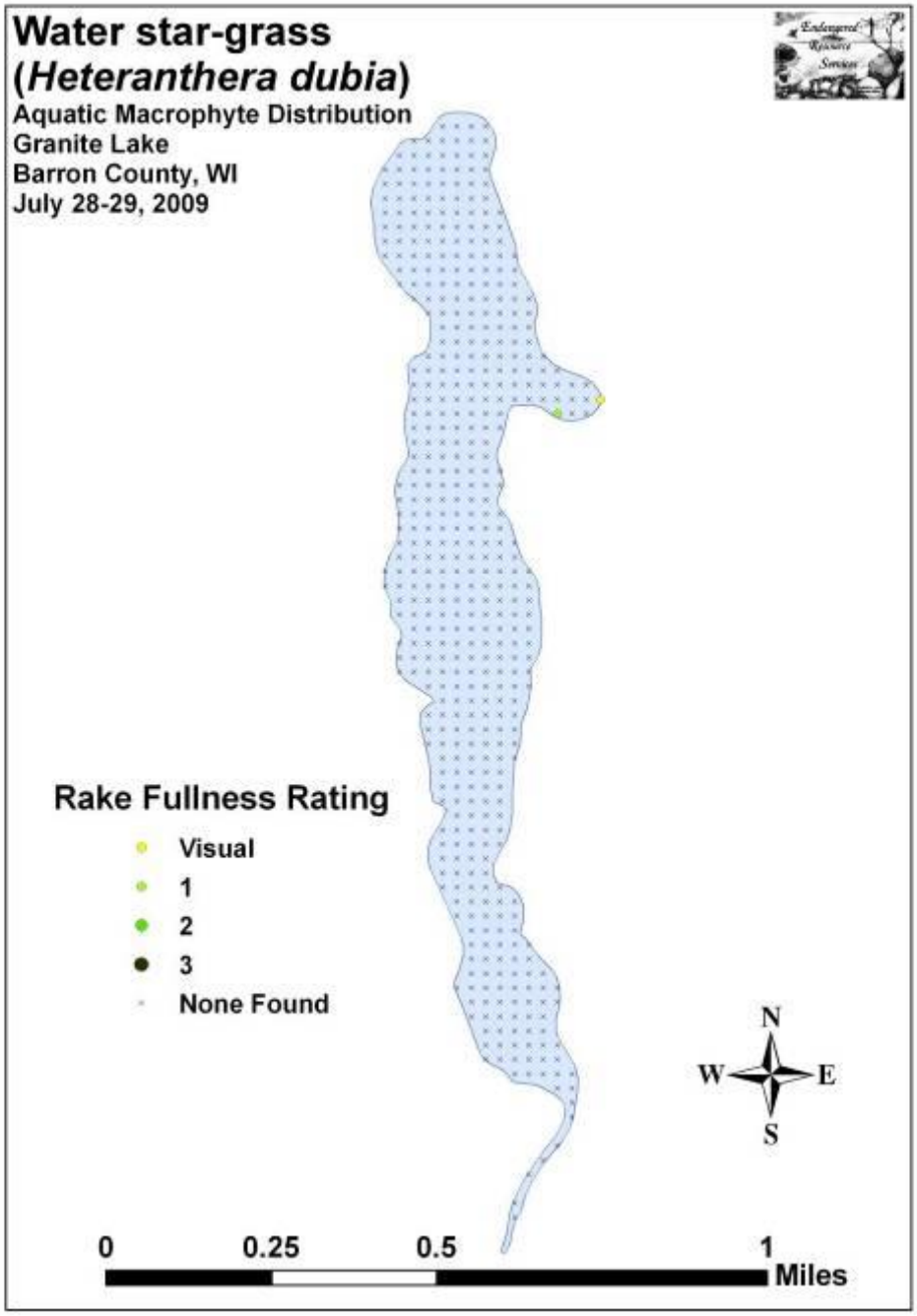

Lake sedge
(Carex lacustris)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

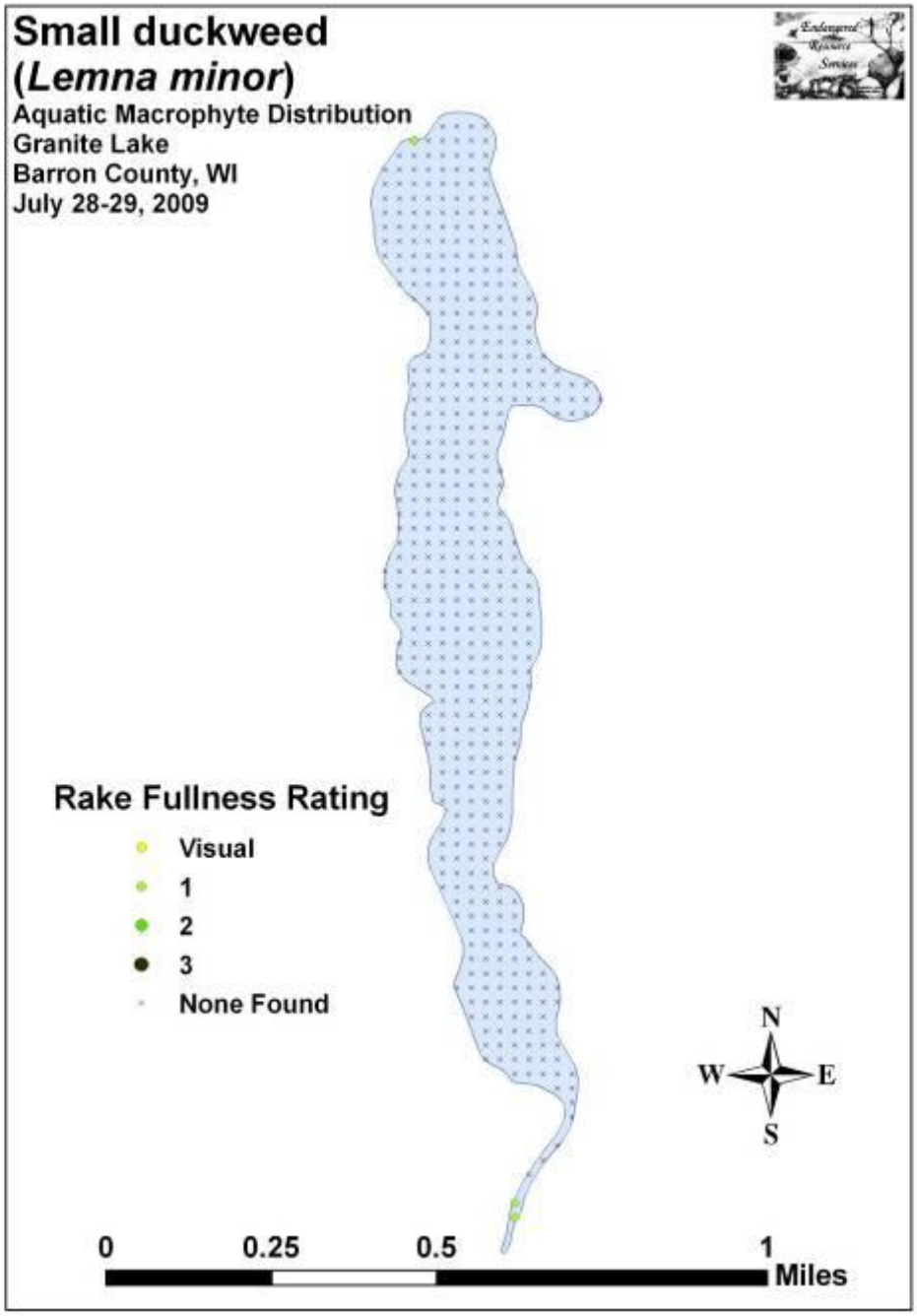

Coontail
(Ceratophyllum demersum)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

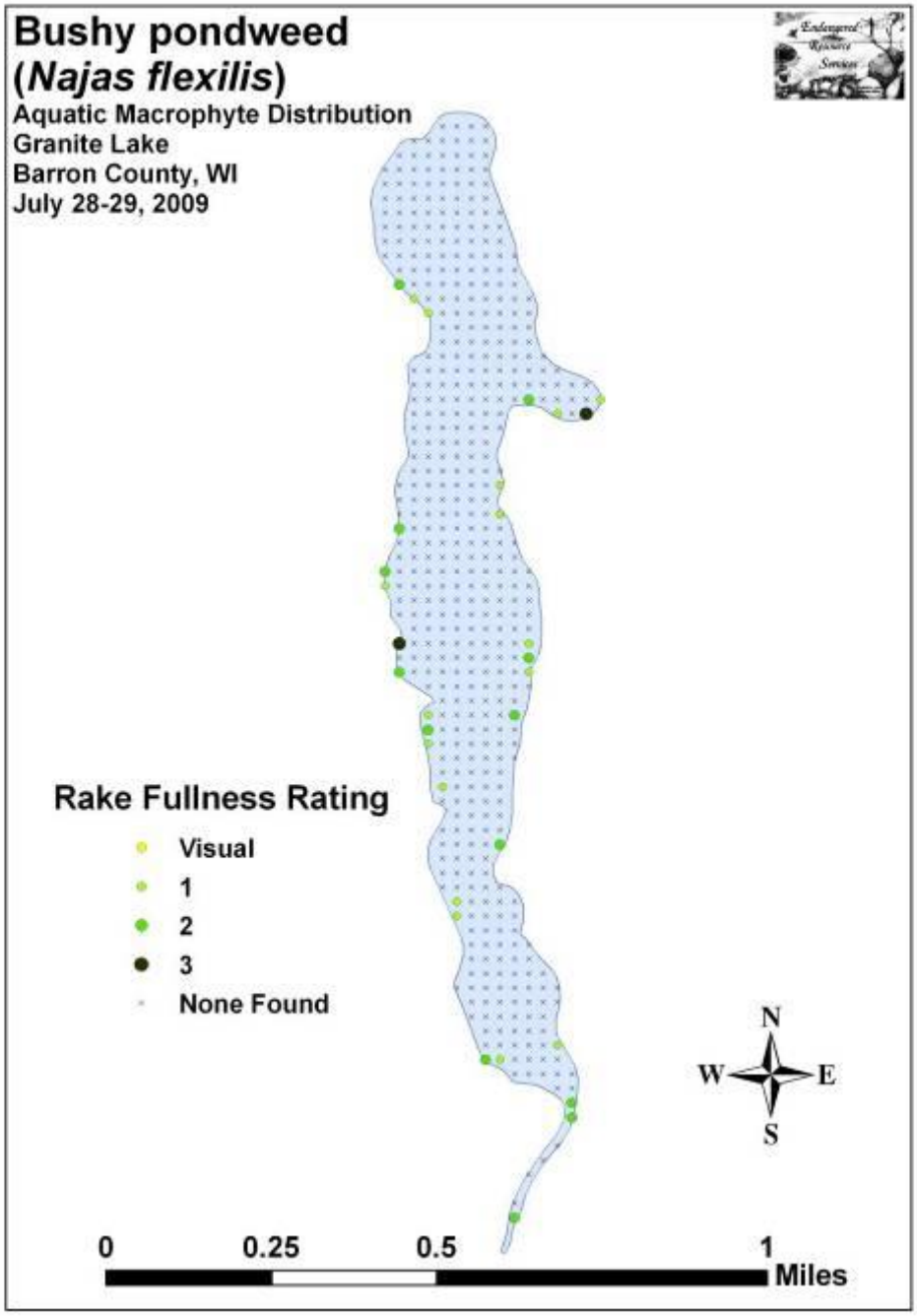

Common waterweed
(Elodea canadensis)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

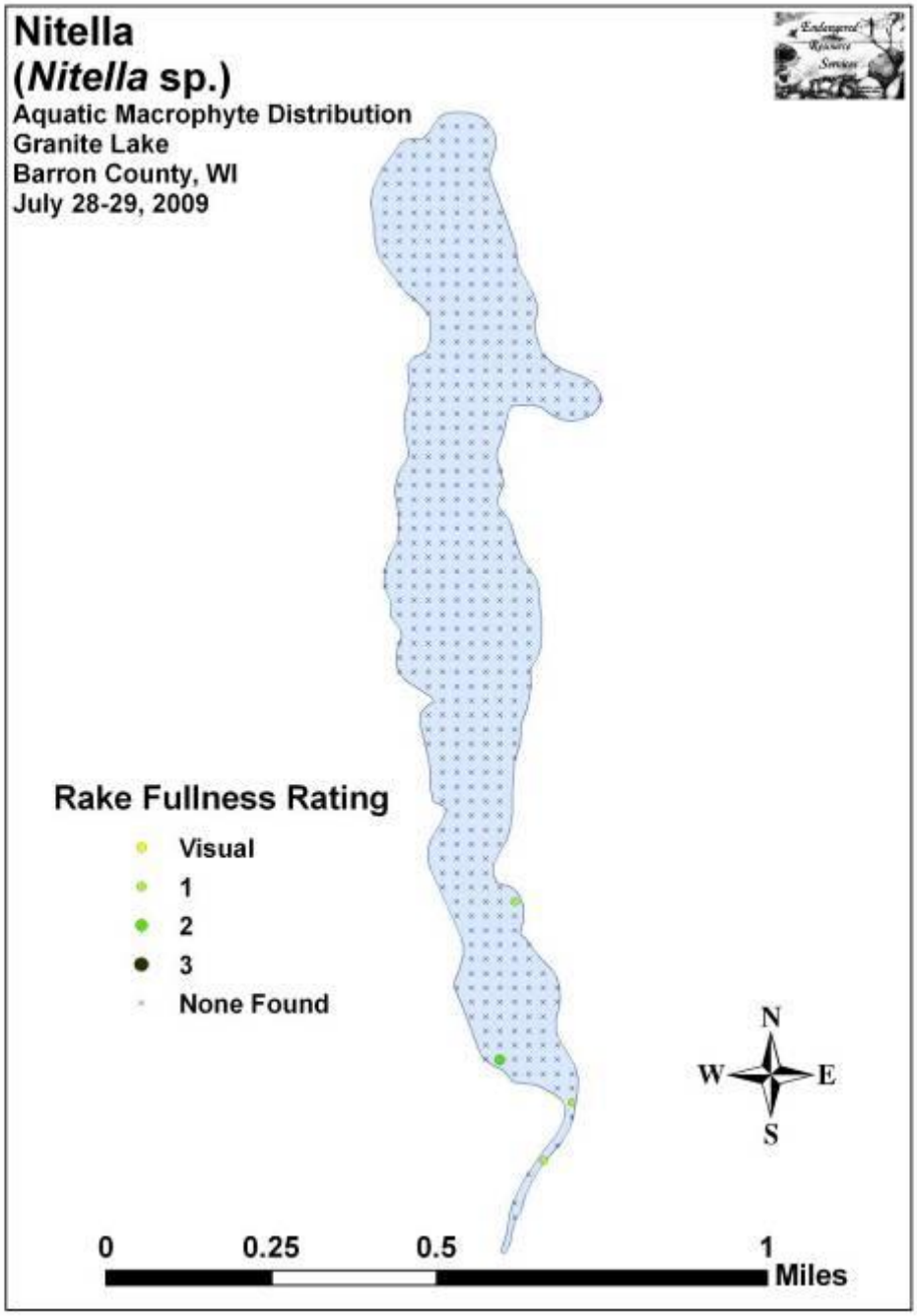

Water horsetail
(Equisetum fluviatile)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

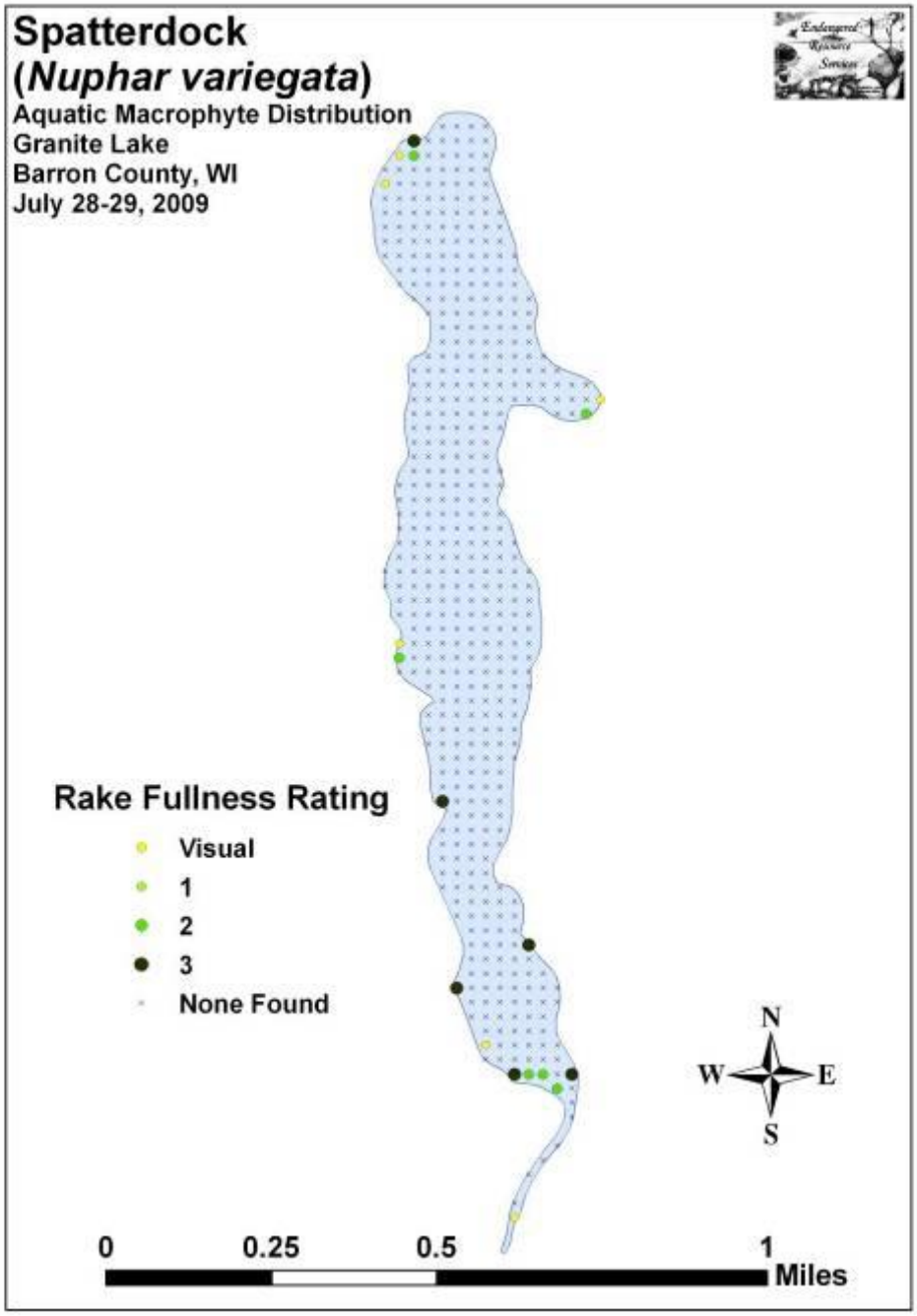

Filamentous algae
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

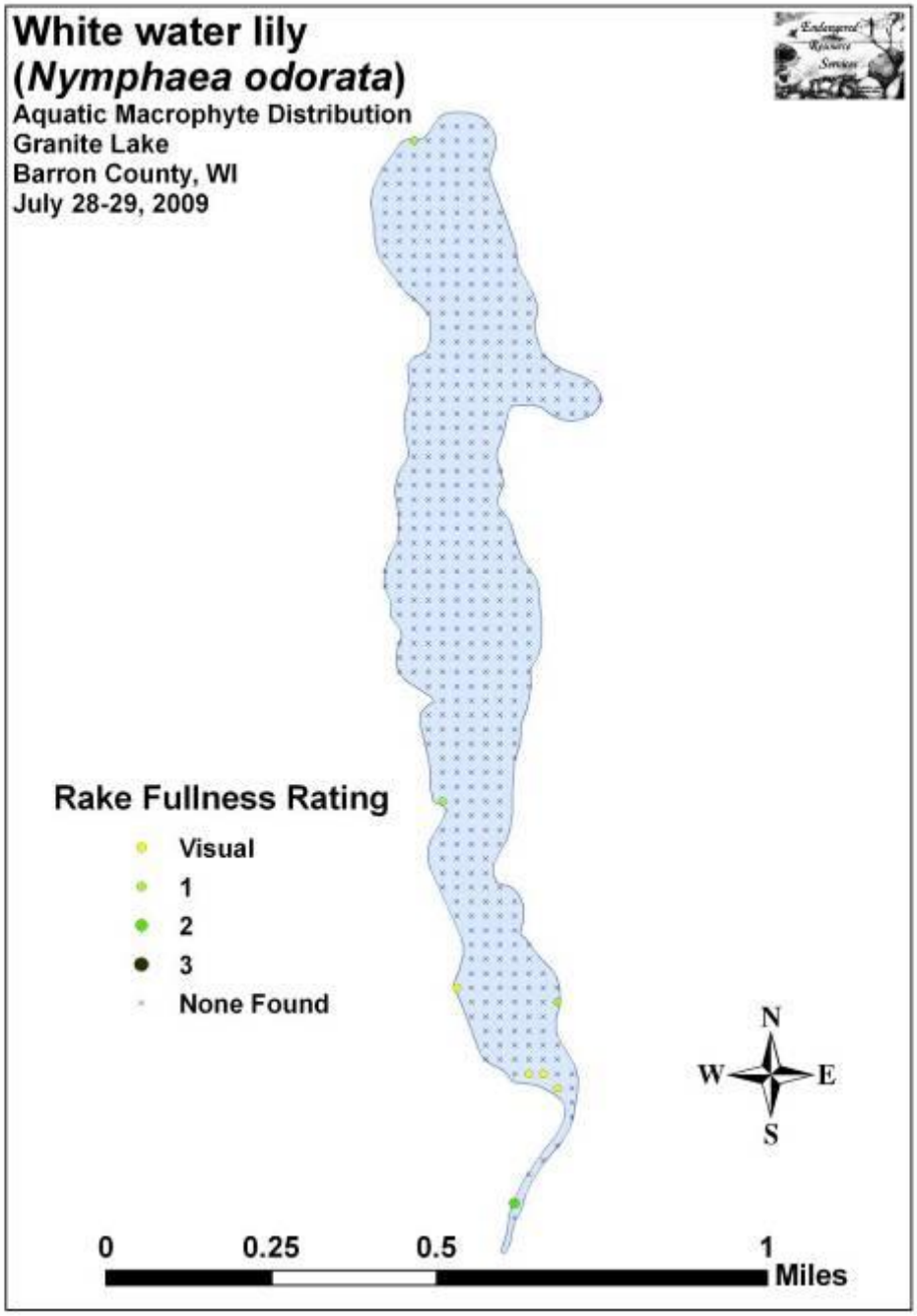

Water star-grass
(Heteranthera dubia)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

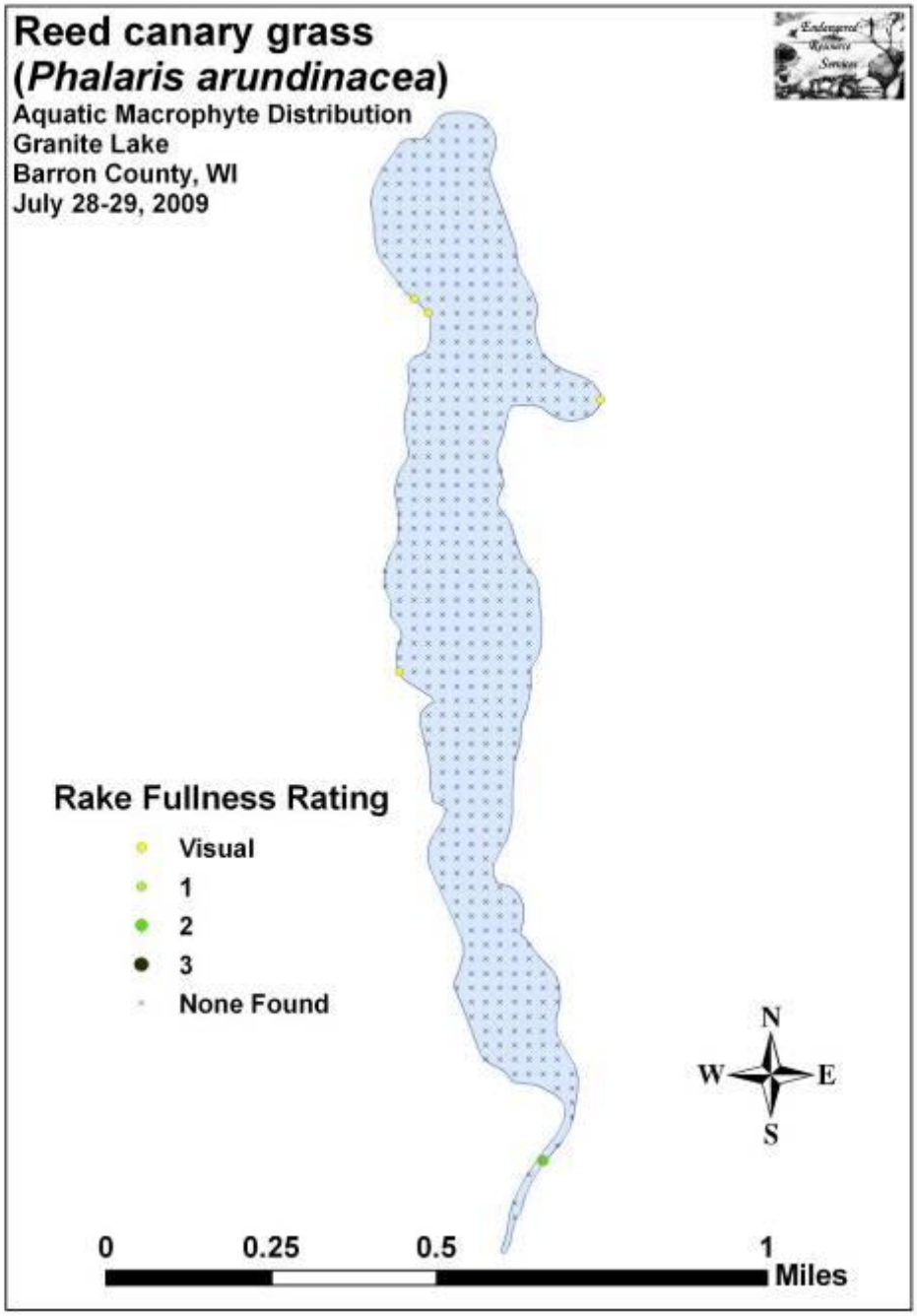

Small duckweed
(Lemna minor)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

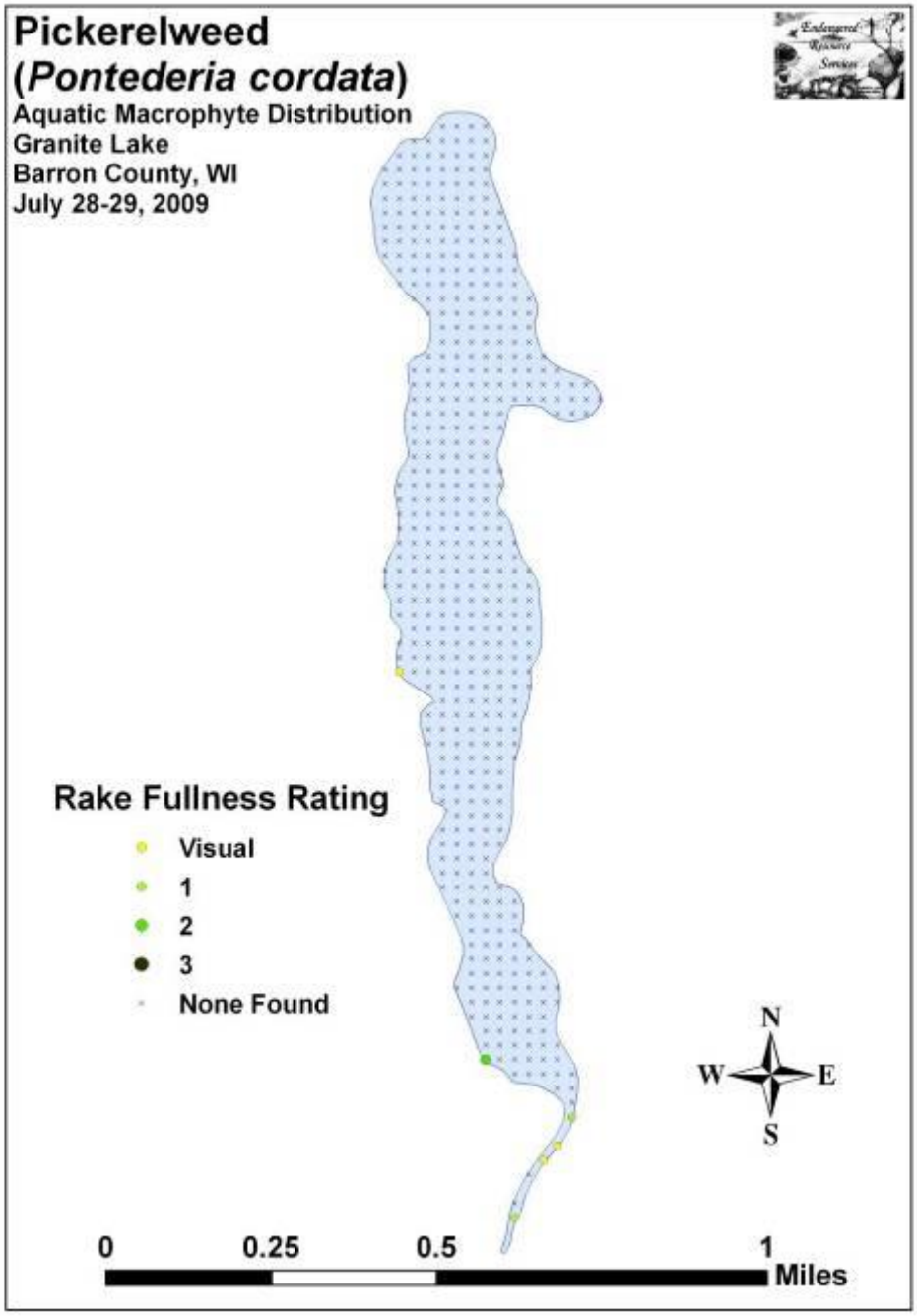

Bushy pondweed
(Najas flexilis)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

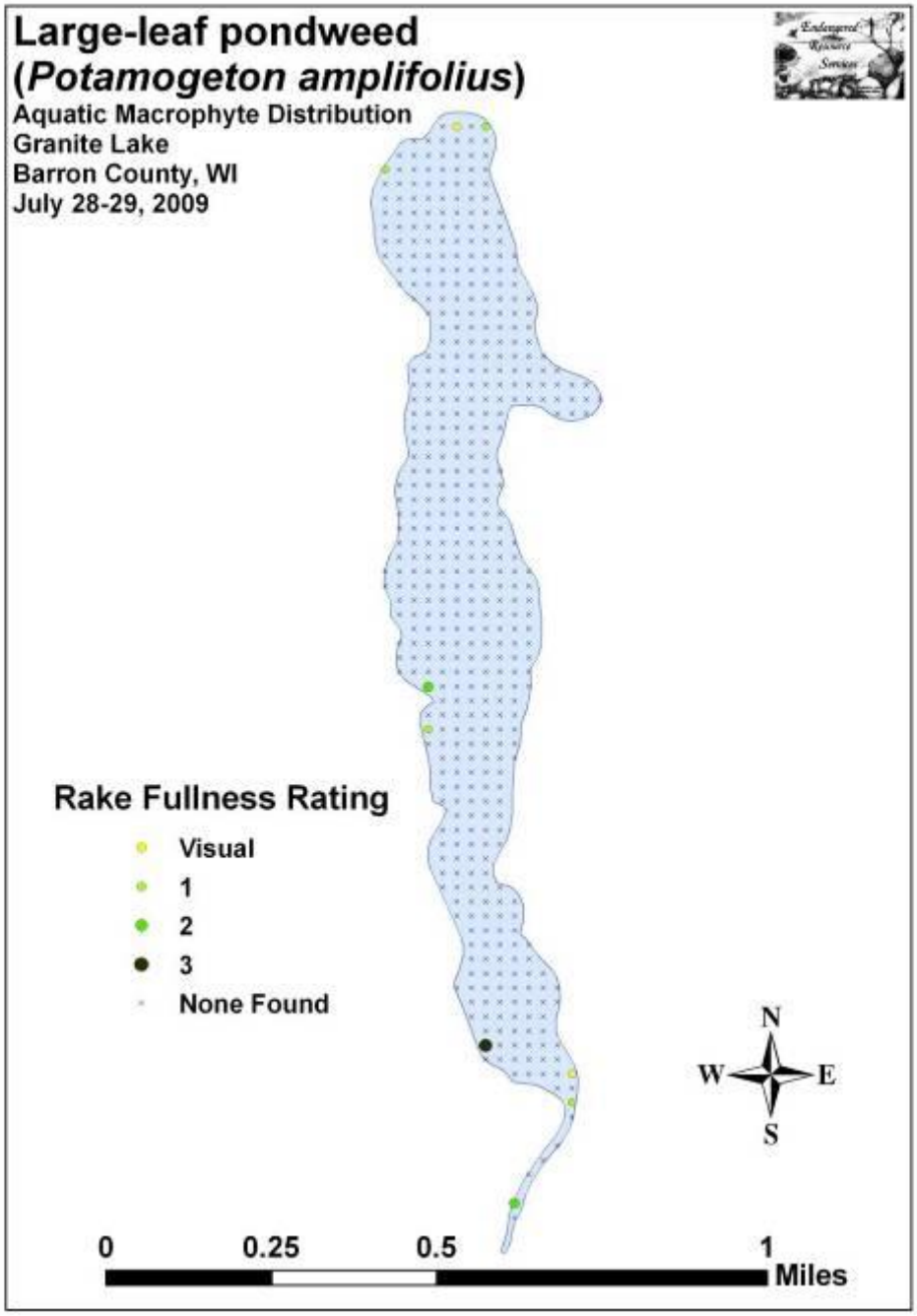

Nitella
(Nitella sp.)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

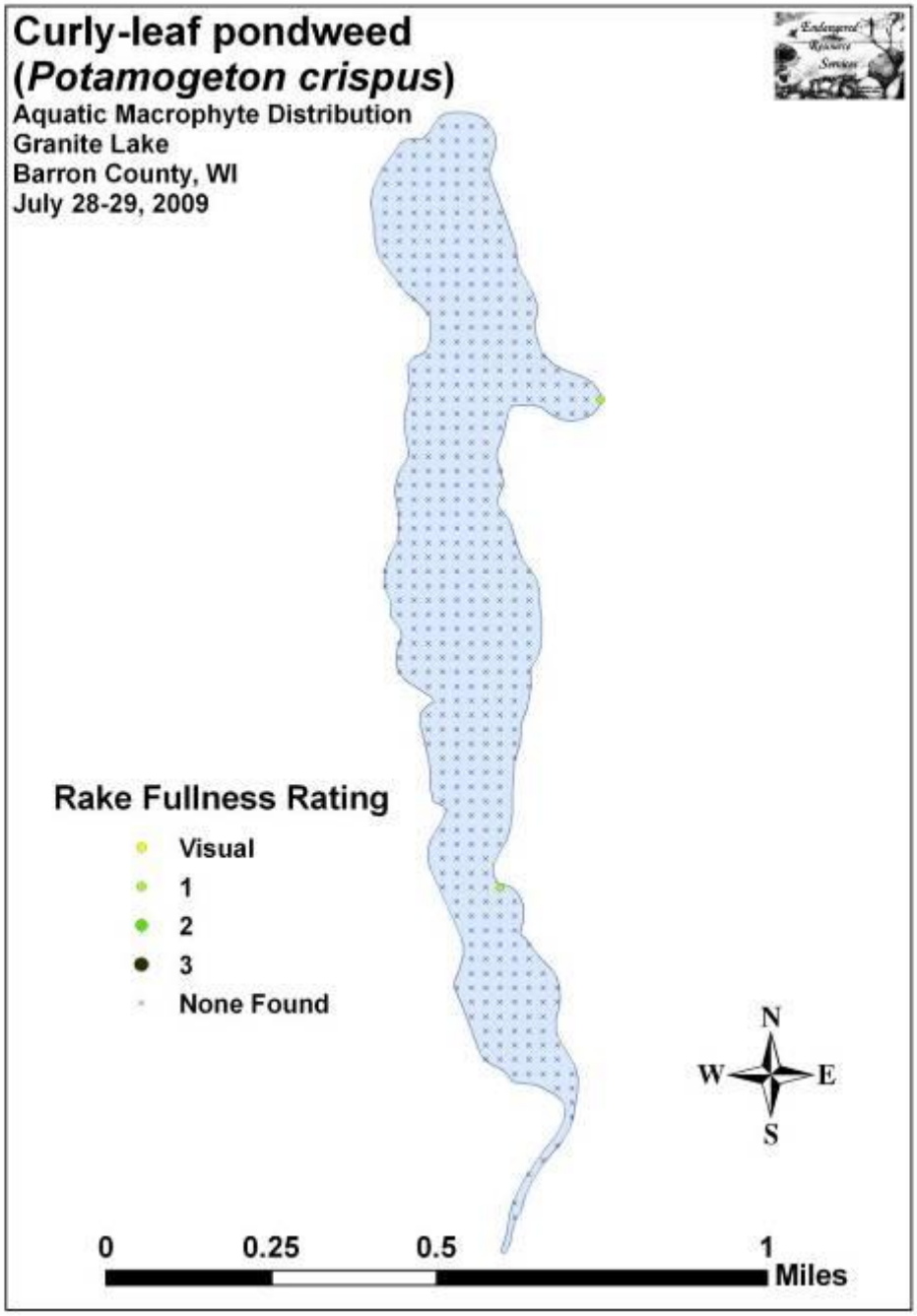

Spatterdock
(Nuphar variegata)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

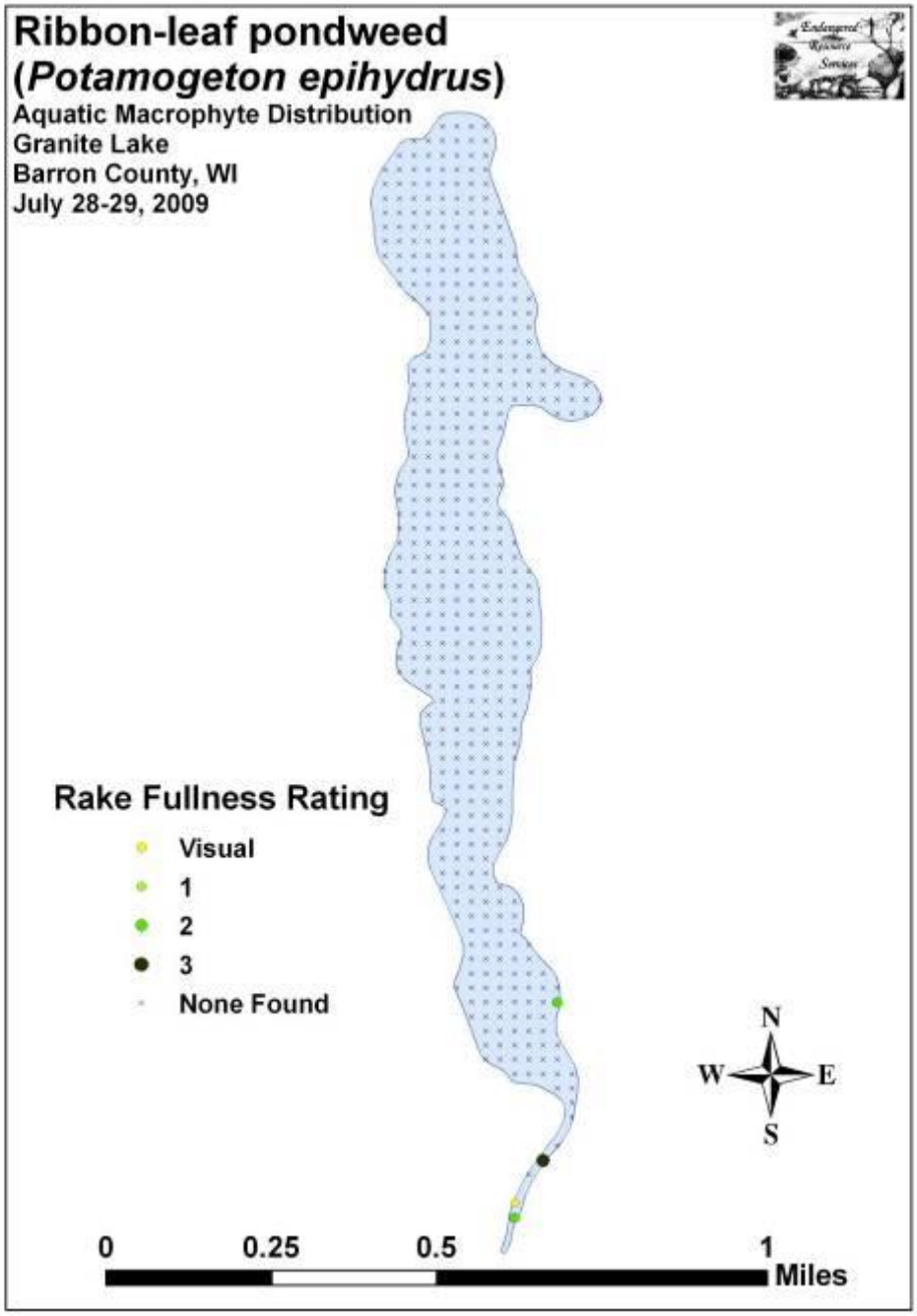

White water lily
(Nymphaea odorata)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

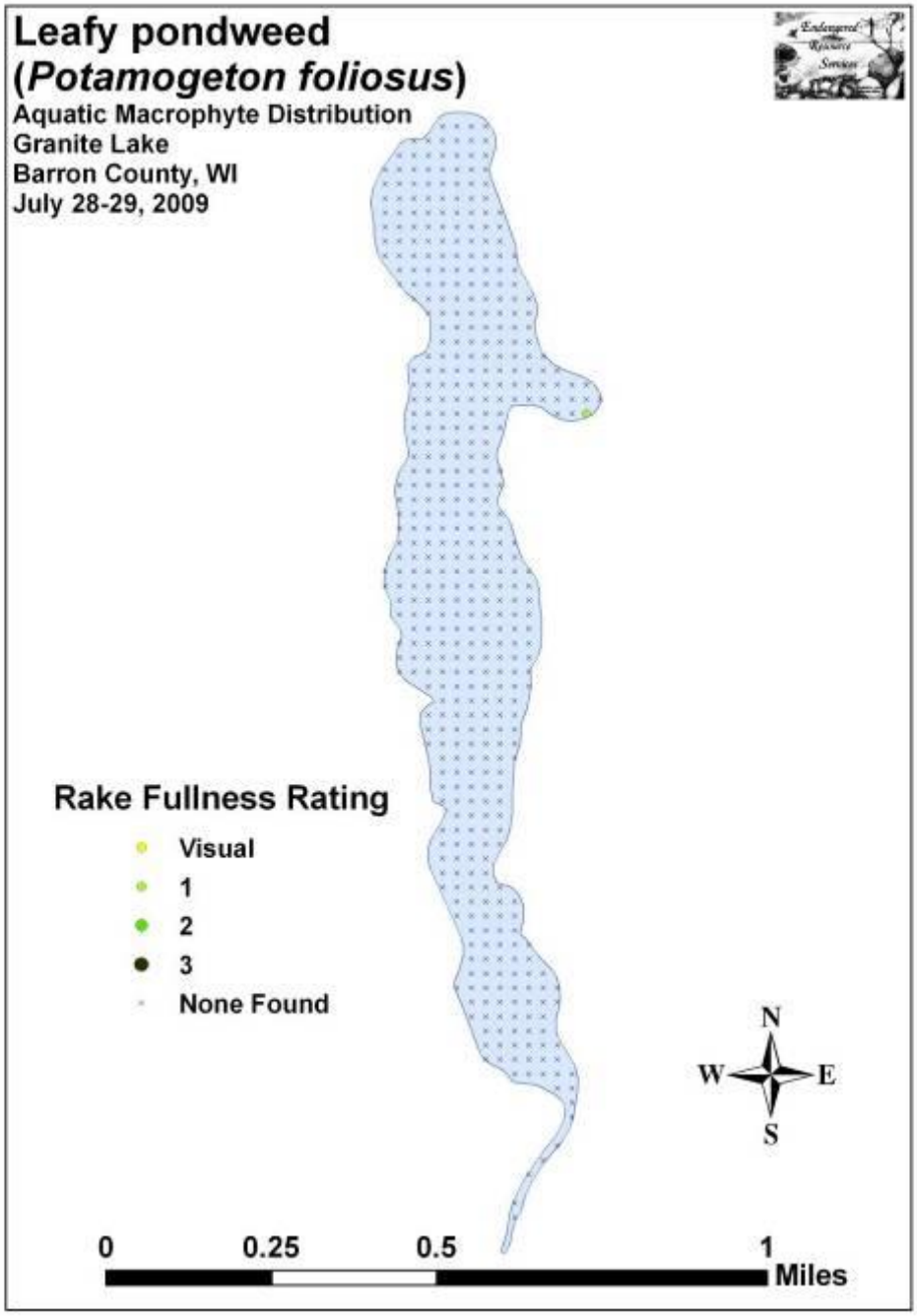

Reed canary grass
(Phalaris arundinacea)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

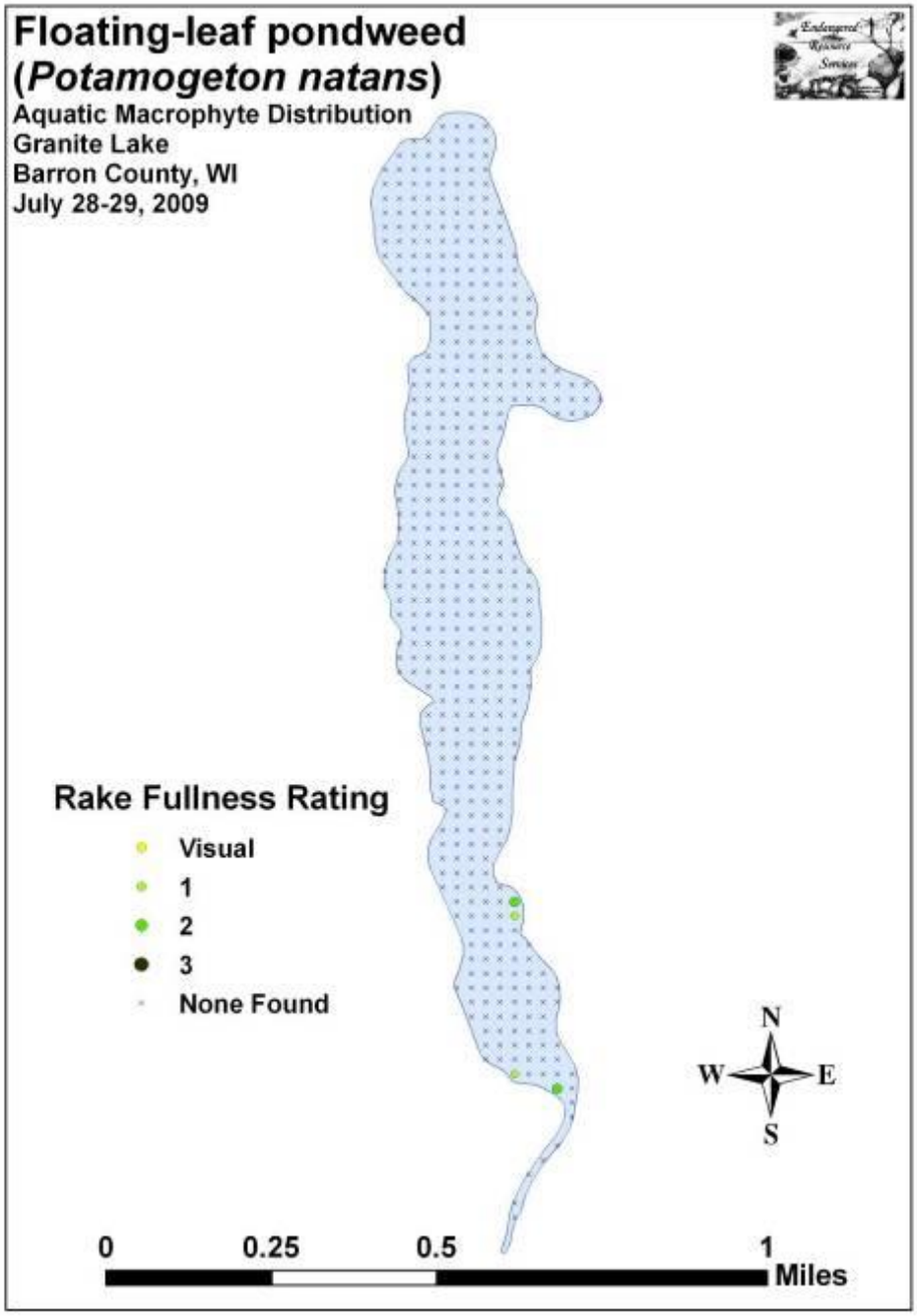

Pickerelweed
(Pontederia cordata)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

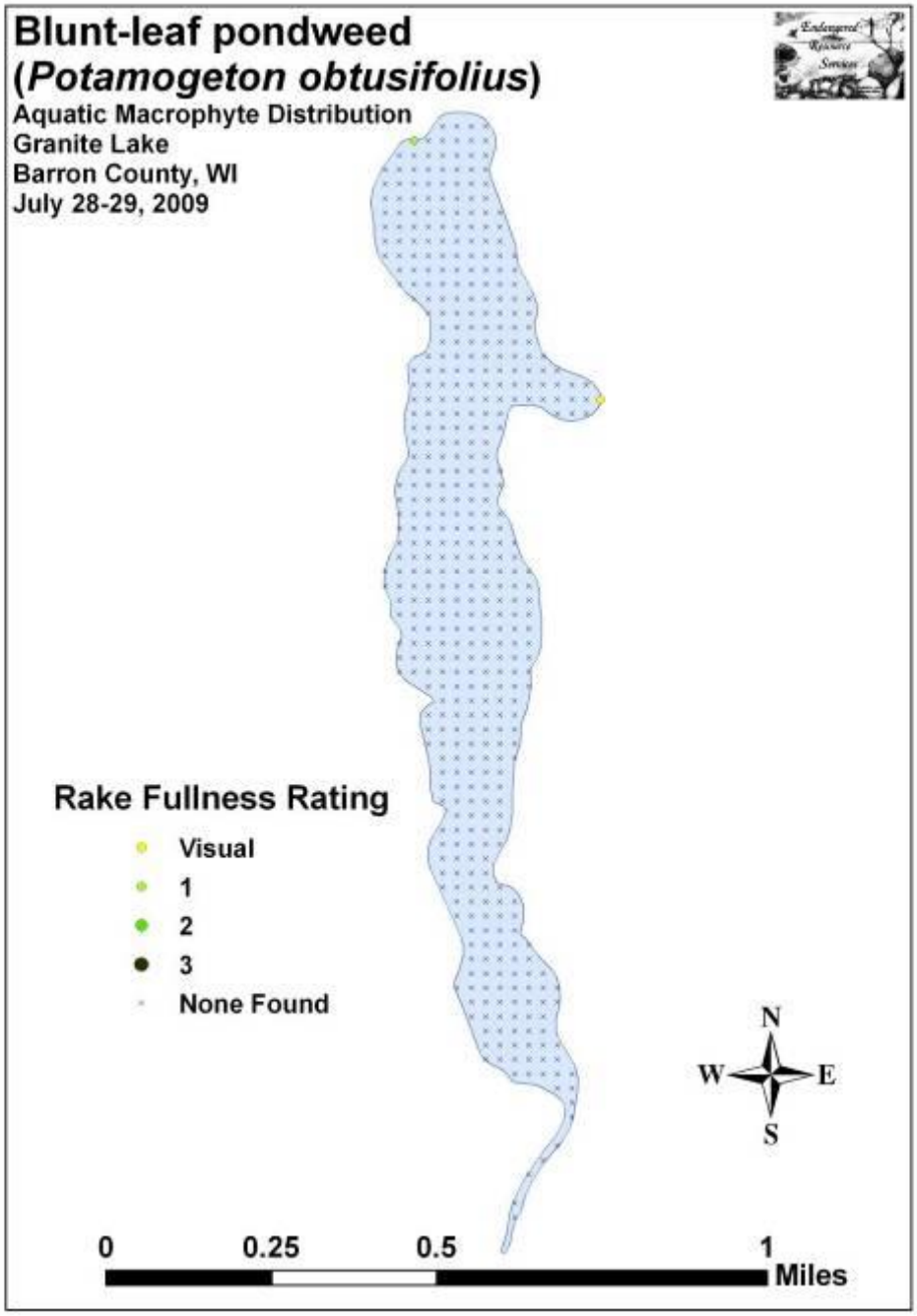

Large-leaf pondweed
(Potamogeton amplifolius)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

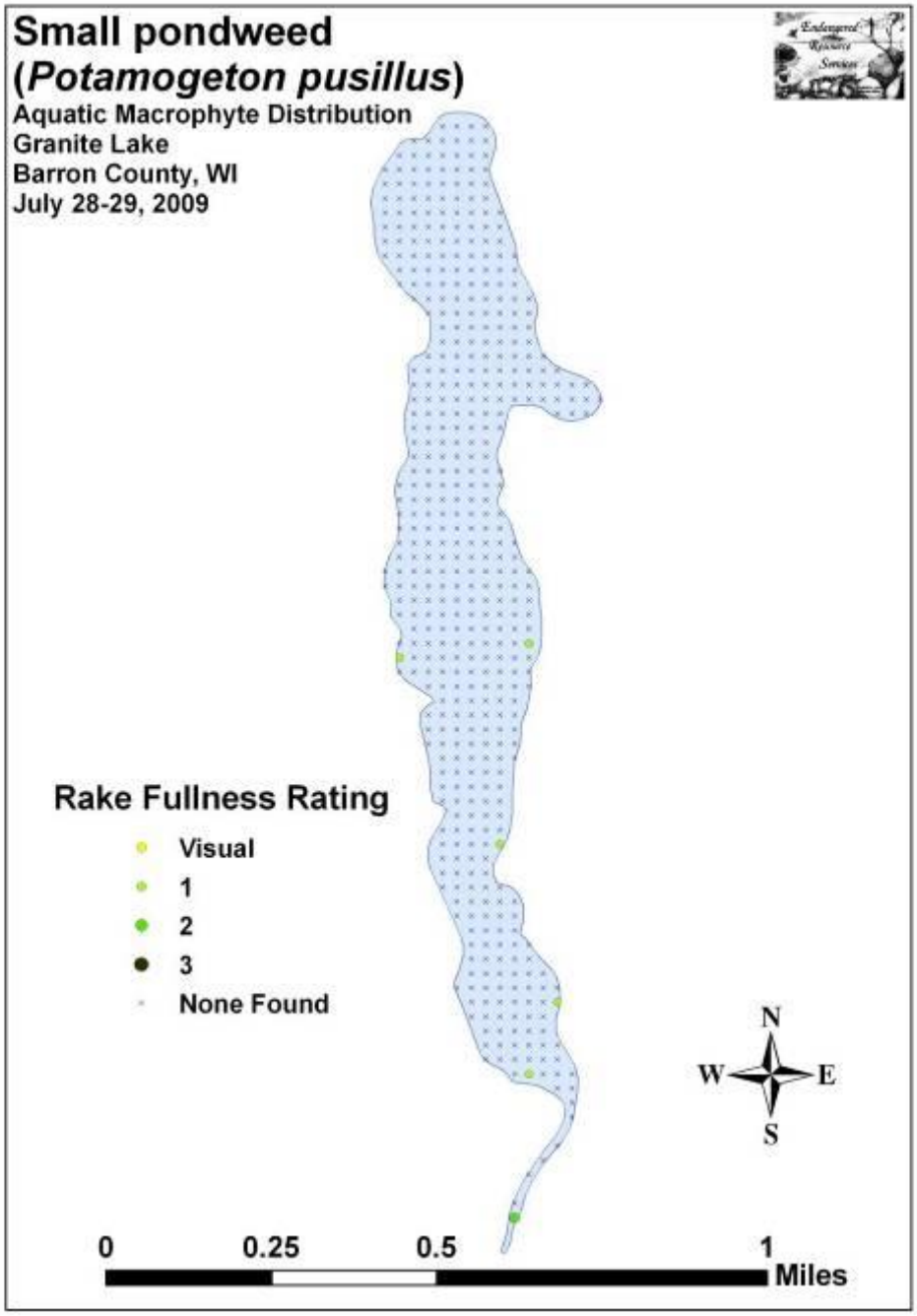

Curly-leaf pondweed
(Potamogeton crispus)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

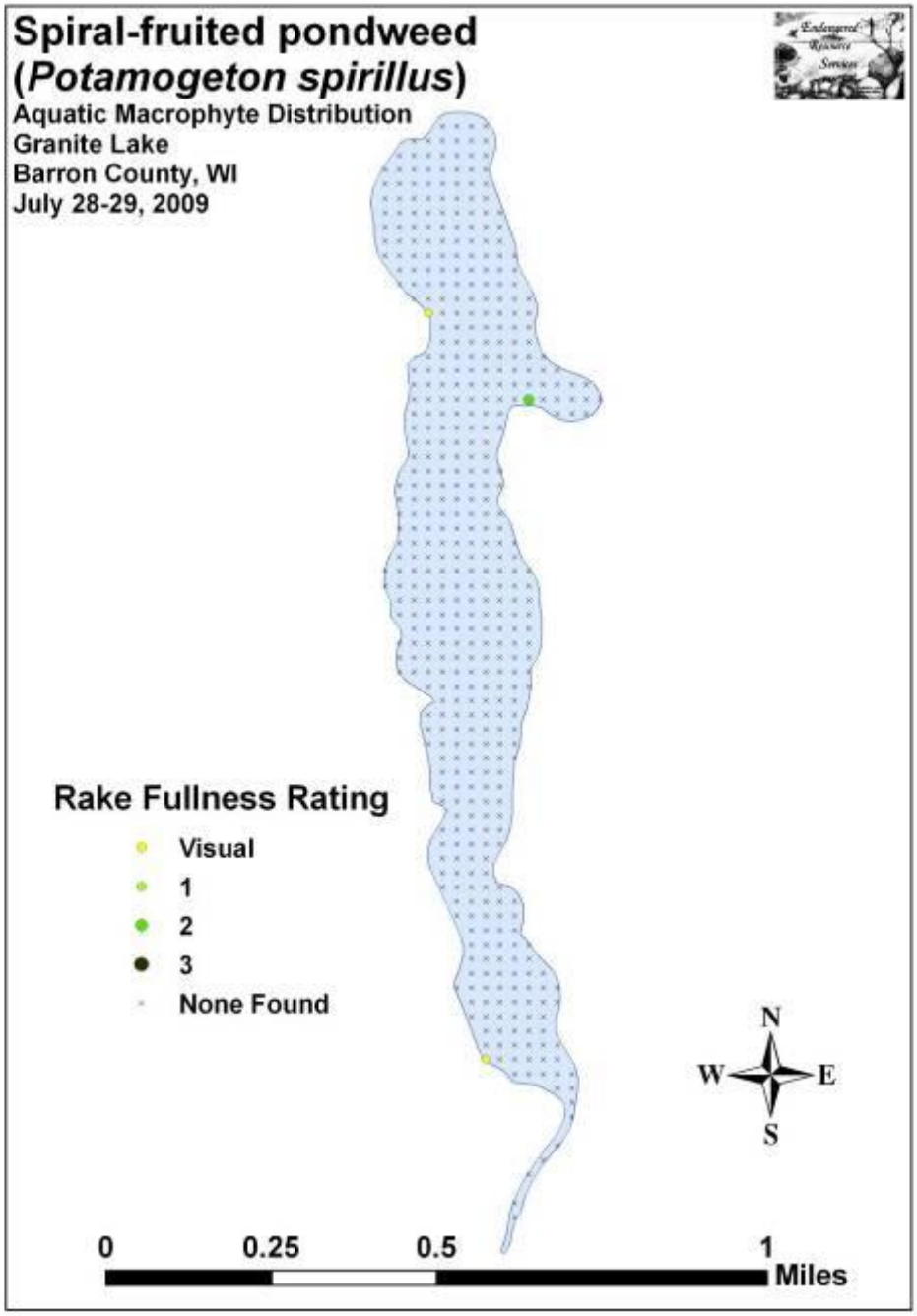

Ribbon-leaf pondweed
(Potamogeton epihydrus)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

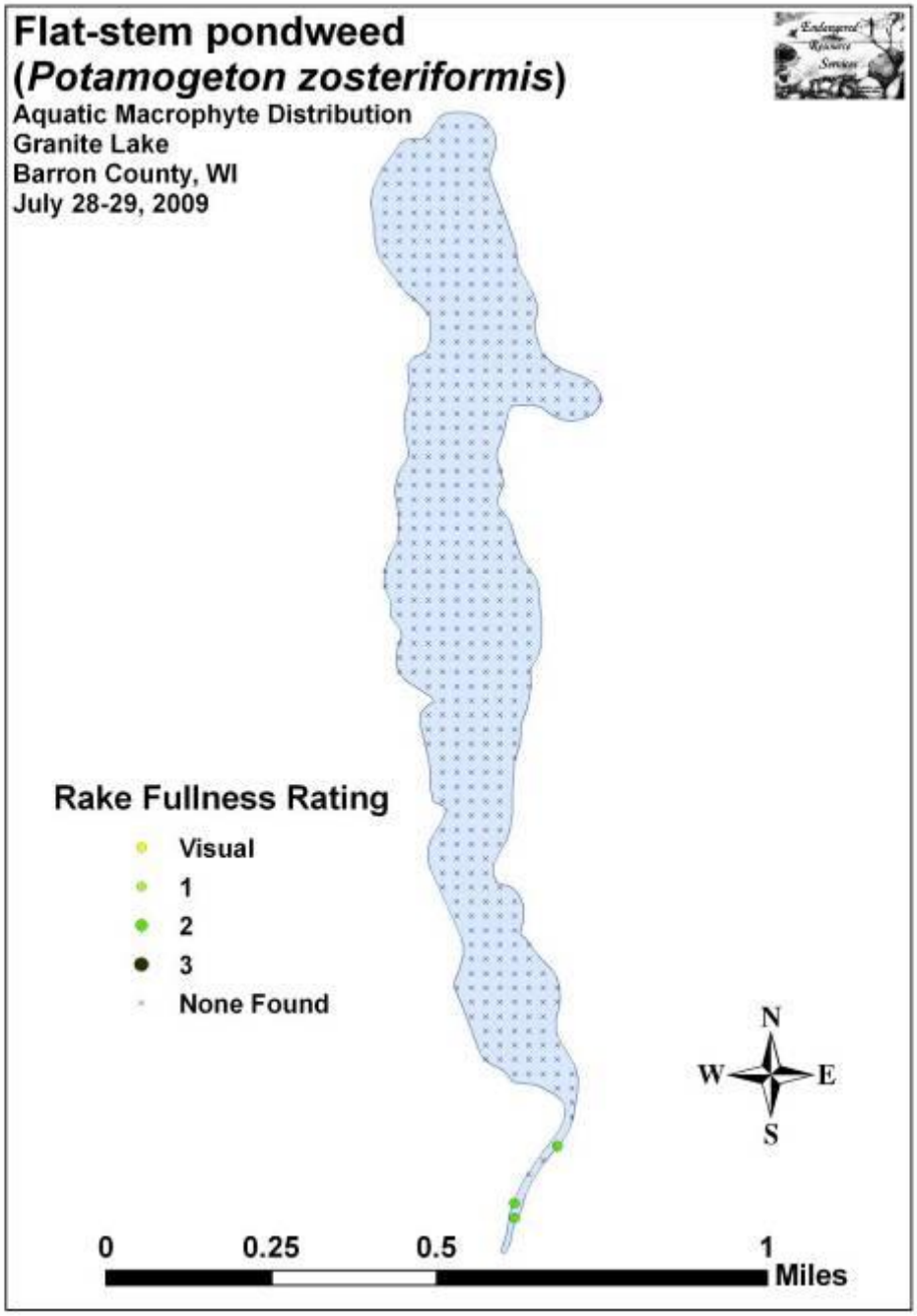

Leafy pondweed
(Potamogeton foliosus)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

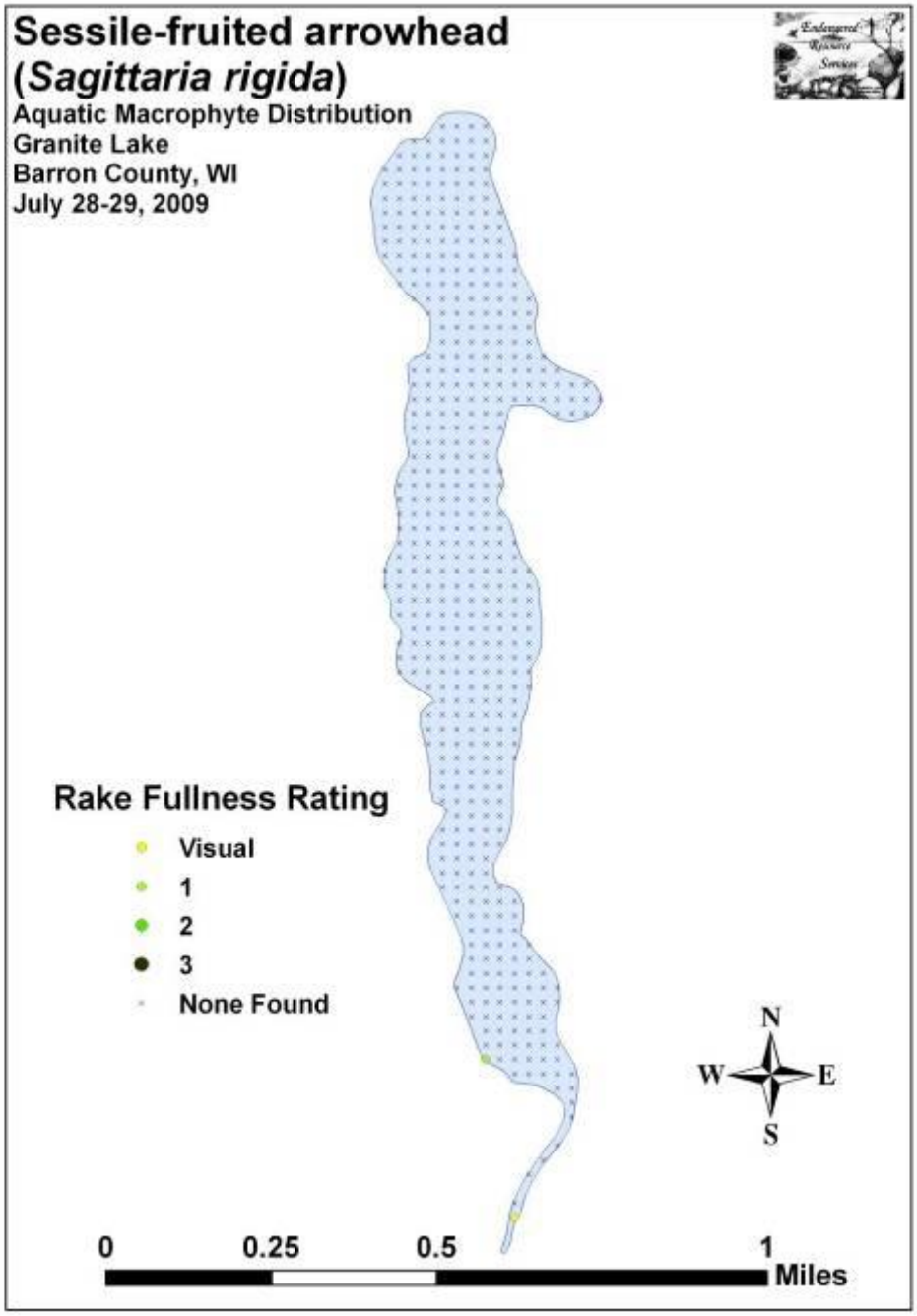

Floating-leaf pondweed
(Potamogeton natans)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

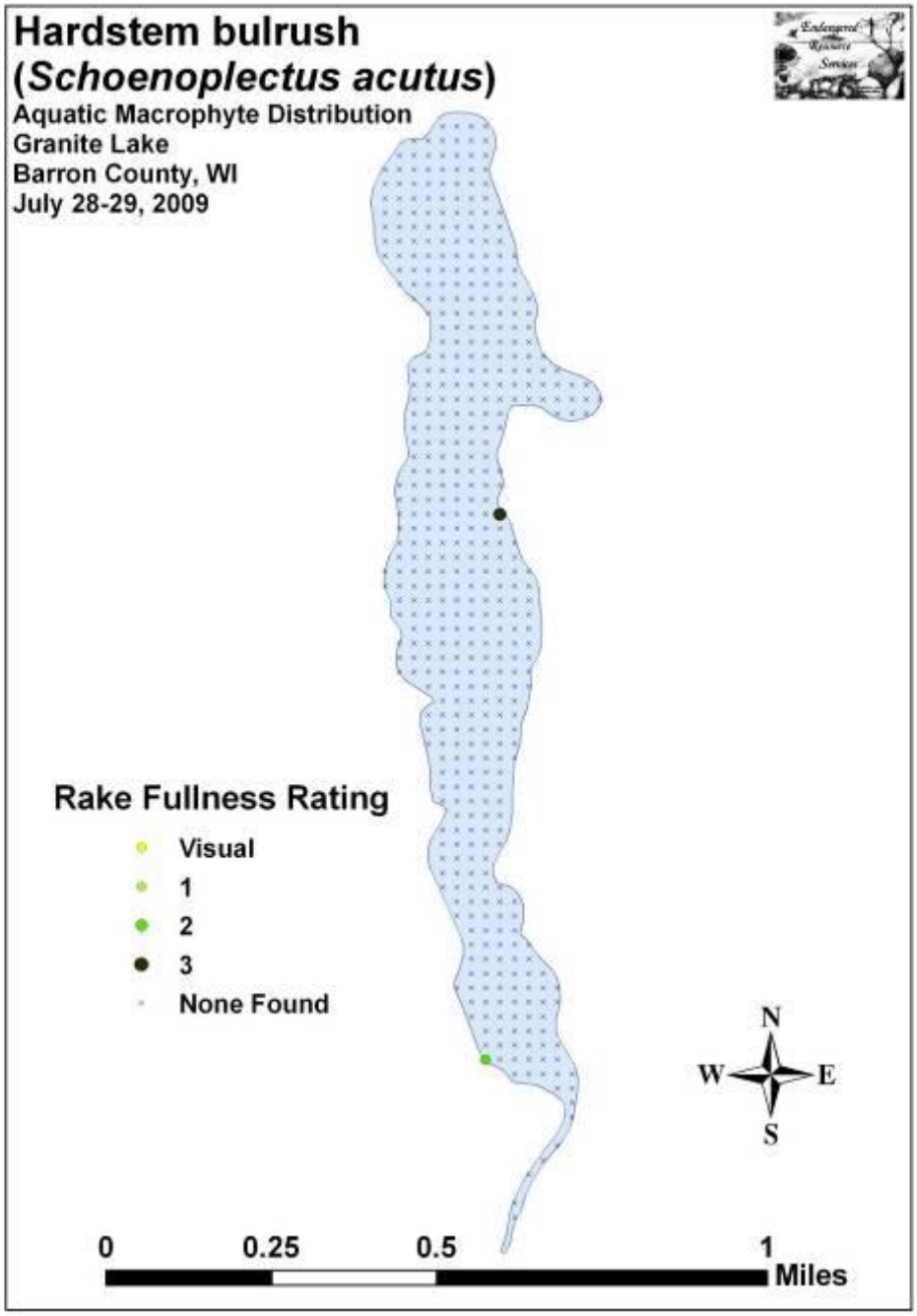

Blunt-leaf pondweed
(Potamogeton obtusifolius)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

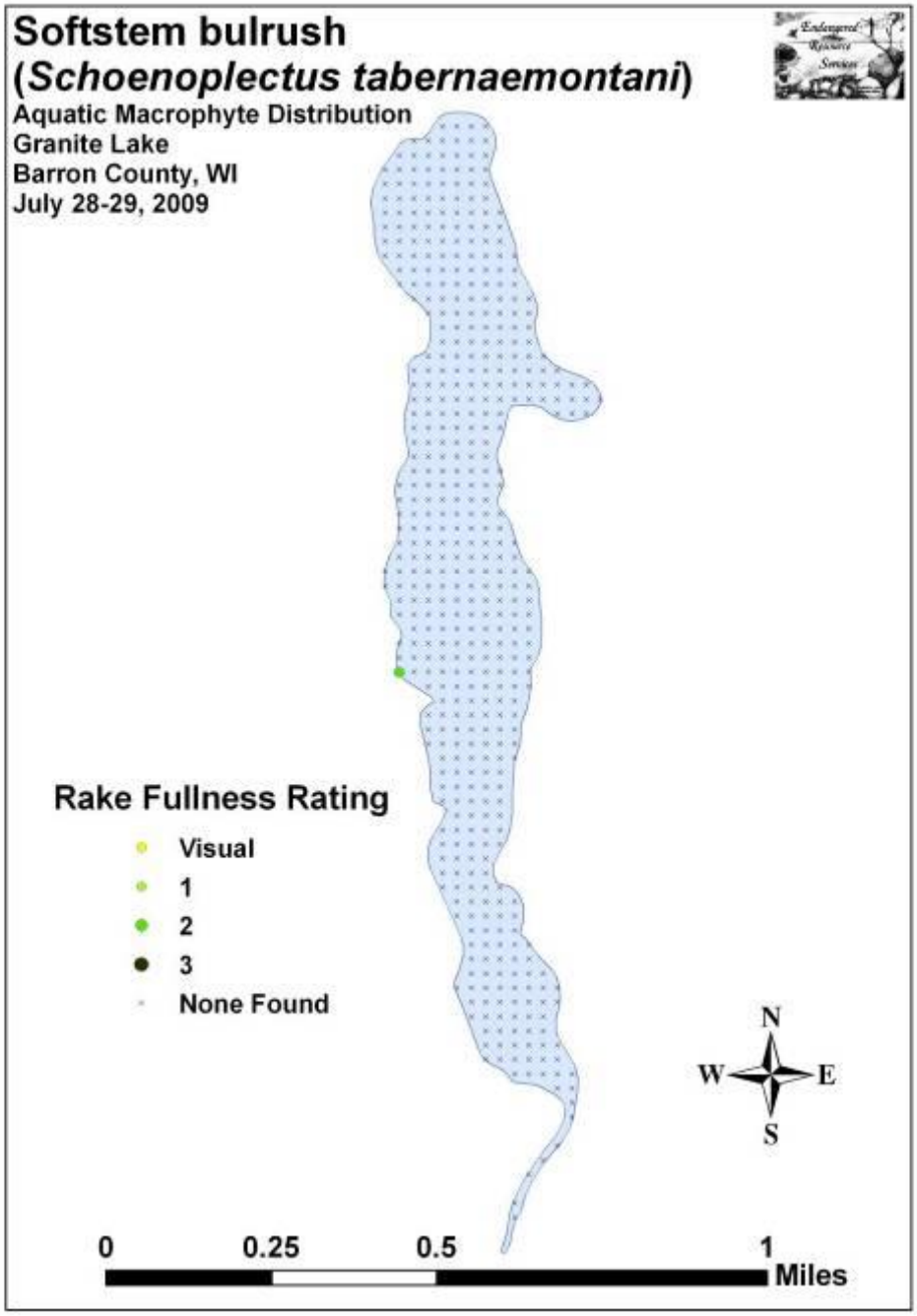

Small pondweed
(Potamogeton pusillus)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Spiral-fruited pondweed
(Potamogeton spirillus)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Flat-stem pondweed
(Potamogeton zosteriformis)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Sessile-fruited arrowhead
(Sagittaria rigida)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Hardstem bulrush
(Schoenoplectus acutus)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Softstem bulrush
(Schoenoplectus tabernaemontani)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
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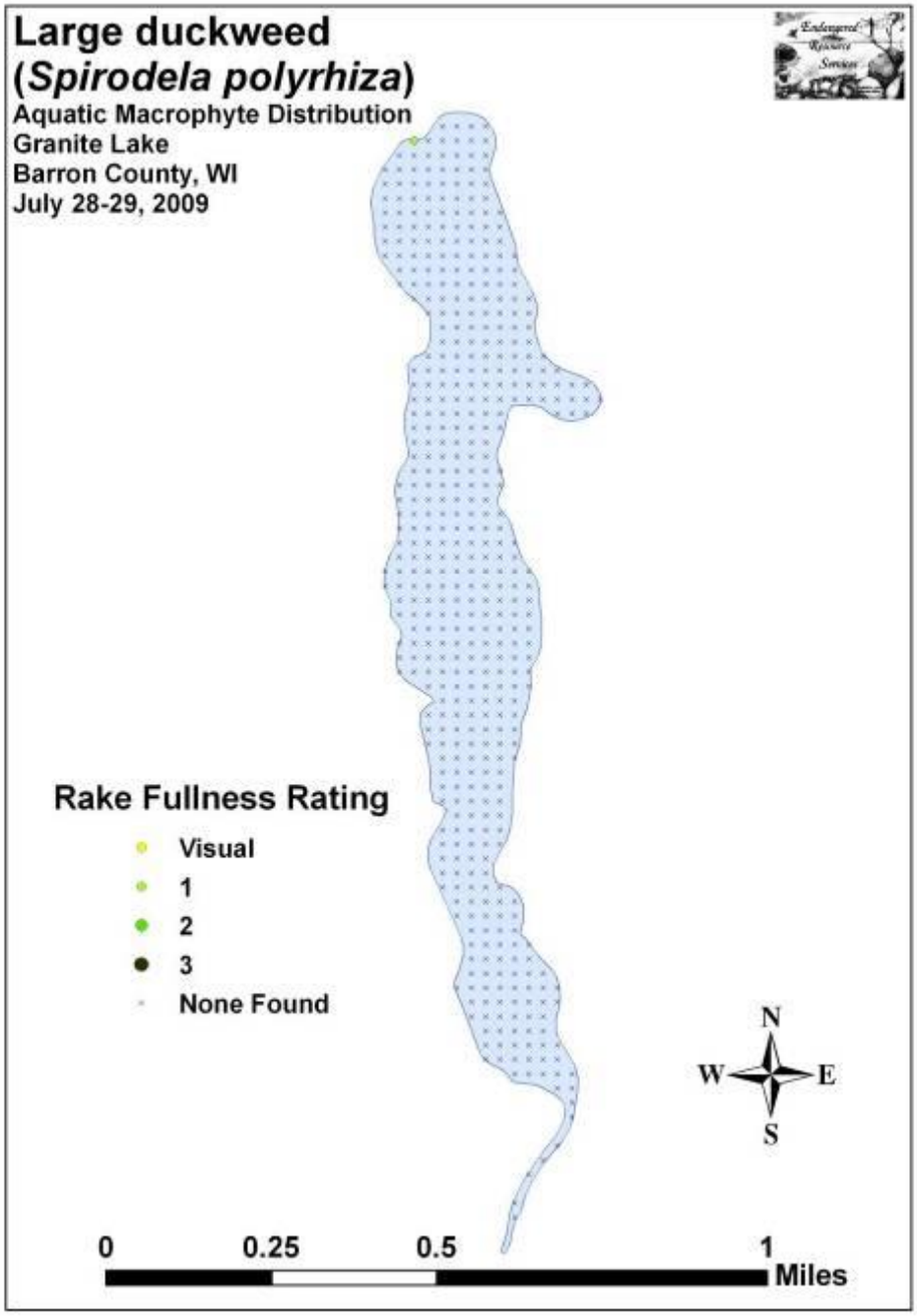
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Large duckweed
(Spirodela polyrhiza)
Aquatic Macrophyte Distribution
Granite Lake
Barron County, WI
July 28-29, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

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

Aquatic:

organisms that live in or frequent water.

Cultural Eutrophication:

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

Dissolved Oxygen (DO):

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

Diversity:

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

Drainage lakes:

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

Ecosystem:

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

Eutrophication:

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

Exotic:

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

Habitat:

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

Limnology:

the study of inland lakes and waters.

Littoral:

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

Macrophytes:

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

Nutrients:

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

Organic Matter:

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

Photosynthesis:

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

Phytoplankton:

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

Plankton:

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

ppm:

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

Richness:

number of species in a particular community or habitat.

Rooted Aquatic Plants:

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

Runoff:

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

Secchi Disc:

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

Seepage lakes:

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

Turbidity:

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

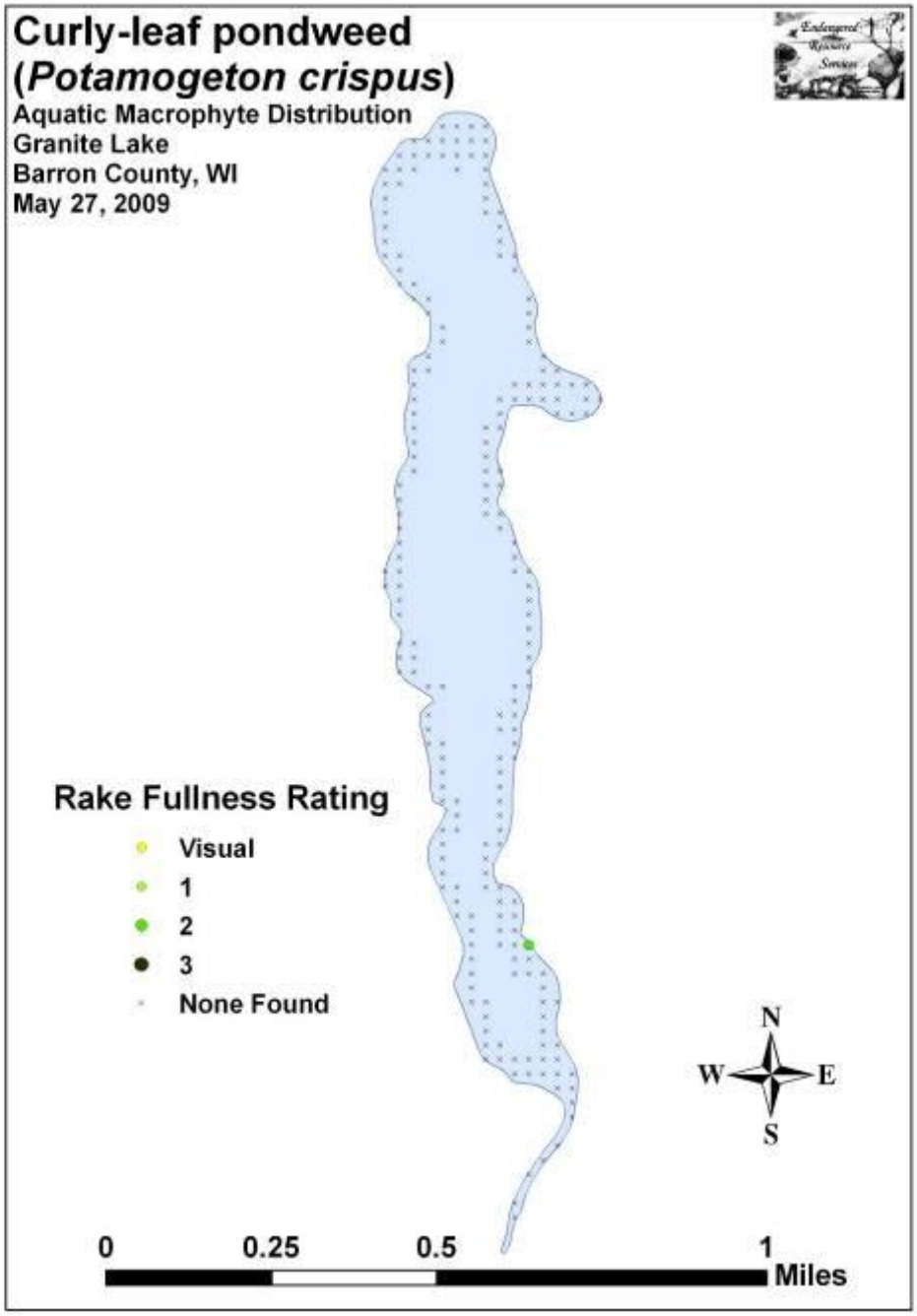
Watershed:

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

Zooplankton:

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

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


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

**Curly-leaf pondweed**

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

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

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

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

**Eurasian water milfoil**

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

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

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

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

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

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


**Reed canary grass**

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

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

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

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

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

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

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

**Purple loosestrife**
(Photo Courtesy Brian M. Collins)

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

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

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

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

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

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

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

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

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

## Appendix X: Raw Data Spreadsheets