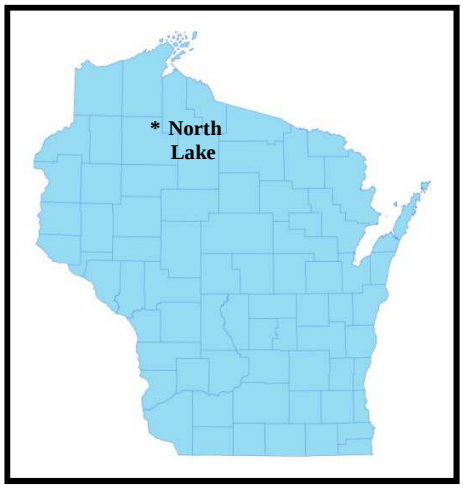
Curly-leaf Pondweed and Full Warm Water Point/Intercept Macrophyte Surveys
North Lake – Spider Chain (WBIC: 2436000)
Sawyer County, Wisconsin

North Lake aerial photo (2010)

Wild rice on North Lake's southeastern shoreline (Berg 2012)

Project Initiated by:

Spider Chain of Lakes Association, Short Elliot Hendrickson Inc., and the Wisconsin Department of Natural Resources (Grant AEPP-354-12)



Common bladderwort in bloom (Hunt 2010)

Survey Conducted by and Report Prepared by:

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April 21-22, May 28, and August 7, 11, 2012

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ABSTRACT

North Lake (WBIC 2436000) is a 132-acre stratified drainage lake located in north-central Sawyer County, WI. It is mesotrophic bordering on eutrophic in nature with Secchi readings from 1989-2012 averaging 7.9ft, and a littoral zone that extended to 13.5ft in 2012. A desire to determine if exotic species like Curly-leaf pondweed (*Potamogeton crispus*) 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 prompted members of the Spider Chain of Lakes Association, Short, Elliot and Hendrickson, Inc., and the WDNR to authorize a CLP density survey on April 21-22, a CLP bed mapping survey on May 28, and a full lake point intercept survey on August 7, 11, 2012. None of these surveys found evidence of CLP, EWM, or any other exotic species. The August survey found macrophytes at 170 of the 403 survey points (42.2%)/213 littoral points (79.8%), produced an extremely high Simpson's Diversity Index of 0.93, and had a moderate average rake fullness rating of 2.18. We identified a total of 39 plants growing in and immediately adjacent to the lake. Flat-stem pondweed (*Potamogeton zosteriformis*), Coontail (*Ceratophyllum demersum*), Slender naiad (*Najas flexilis*), and White water lily (*Nymphaea odorata*) were the most common species being found at 51.18%, 47.06%, 37.06%, and 31.18% of survey points with vegetation, and collectively they represented 41.37% of the total relative frequency. The 34 native index species found in the rake produced an above average mean Coefficient of Conservatism of 6.8 and a Floristic Quality Index of 39.8 that was much above the median value for this part of the state. Northern wild rice (*Zizania palustris*) was represented by a single plant at two points. The sum population on the entire lake likely wasn't more than a few 100 plants. Future management considerations include maintaining the lake's native plant communities; working to improve water clarity by reducing nutrient inputs along the lakeshore by such things as avoiding motor startups in shallow water, maintaining buffer strips of native vegetation, eliminating fertilizer applications, bagging grass clippings, removing pet waste, and disposing of fire pit ash away from the lake; and conducting at least annual lake-wide meandering littoral zone surveys to monitor for Aquatic Invasive Species like Purple loosestrife (*Lythrum salicaria*); supporting ongoing AIS prevention and control throughout the Spider Chain of Lakes; and developing an Aquatic Plant Management Plan that clarifies a response if a new AIS is introduced into the lake.

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INTRODUCTION:

North Lake (WBIC 2436000) is a 132-acre, stratified, drainage lake located in the Town of Spider Lake in north-central Sawyer County (T42N R7W S14/15). The lake reaches a maximum depth of 30ft on the east side of the central basin and has an average depth of approximately 14ft. The lake is bordered by several Tamarack bogs, and the tannins they produce stain the water brown. This resulted in Secchi values at the time of the survey of 7ft, and a littoral zone that reached approximately 13.5ft. This fair water clarity was consistent with Secchi readings from 1989-2012 that averaged 7.9ft, and classified the lake as mesotrophic bordering on eutrophic (WDNR 2012). Bottom substrate is predominantly nutrient rich organic muck with the exception of scattered sand and gravel along the shoreline, extending from midlake points, and on the 4-6ft gravel bar that runs due south of the east side peninsula (Figure 1) (Roth et al. 1969).

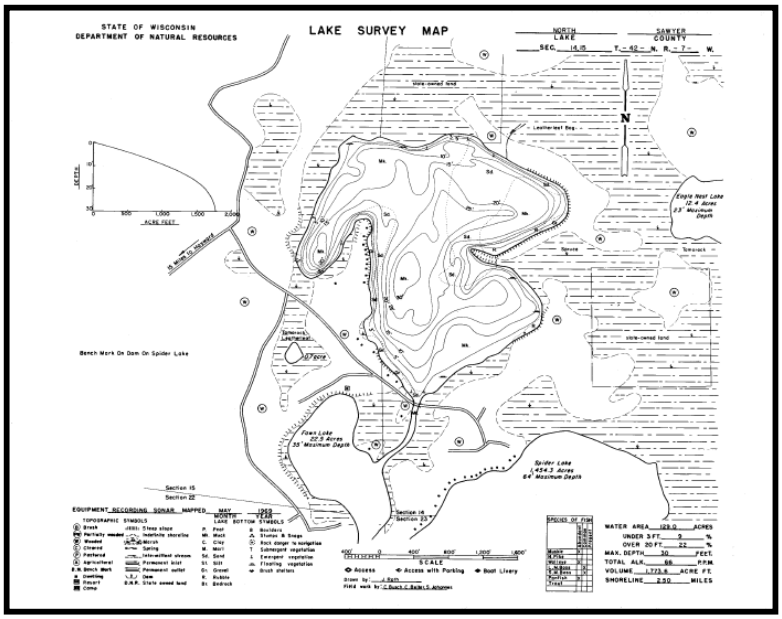


Figure 1: North Lake Bathymetric Map

In 2012, the Spider Chain of Lakes Association (SCLA), Short Elliot Hendrickson, Inc. (SEH), and the Wisconsin Department of Natural Resources (WDNR) authorized a series of full lake plant surveys on North Lake prior to developing an Aquatic Plant Management Plan for the lake. On April 21-22nd, we completed a cold water Curly-leaf pondweed (*Potamogeton crispus*) (CLP) point intercept survey. This was followed by a CLP bed mapping survey on May 28th, and a warm water point intercept survey of all aquatic macrophytes on August 7, 11th. All of these surveys used the WDNR's statewide guidelines for conducting systematic point intercept macrophyte sampling. These methods ensure that all surveys in the state will be conducted in the same manner, thus allowing data to be compared across time and space. The immediate goals of the surveys were to determine if CLP or Eurasian water milfoil (*Myriophyllum spicatum*) had invaded the lake, and to establish 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 as well as a way to measure any impacts on the lake's plants if an AIS is introduced or if active management occurs in the future.

METHODS:

Cold Water Curly-leaf Pondweed Point Intercept Survey:

Using a standard formula that takes into account the shoreline shape and distance, islands, water clarity, depth and total acreage, Michelle Nault (WDNR) generated a 403 point sampling grid for North Lake (Appendix I). Using this grid, we completed a density survey where we sampled for CLP at each point on the grid. We located each survey point using a handheld mapping GPS unit (Garmin 76CSx) and 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.

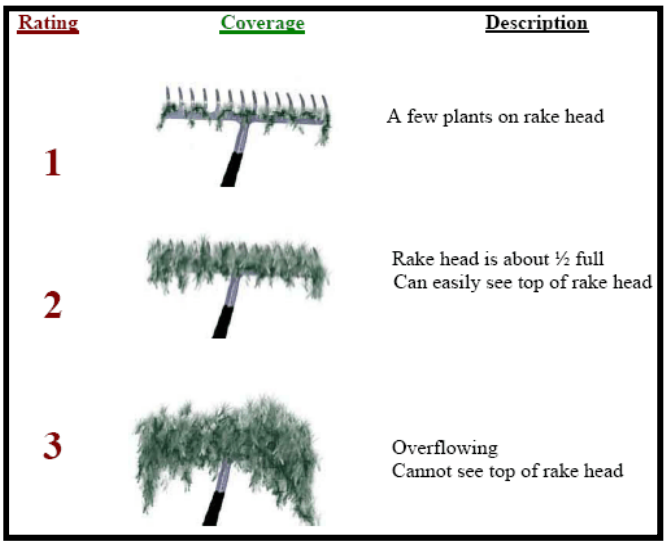


Figure 2: Rake Fullness Ratings (UWEX 2010)

CLP Bed Mapping Survey:

Following the CLP point intercept survey, we used a meandering littoral zone search to locate and delineate all significant beds of CLP on the lake. We defined a bed based on the following two criteria: CLP plants made up greater than 50% of all aquatic plants in the area, and the CLP had canopied at the surface or was close enough to the surface that it would likely interfere with normal boat traffic.

Upon finding a bed, we circled around the perimeter and used a GPS unit to record waypoints at regular intervals. We then uploaded these points into ArcMap 9.3.1, created bed shapefiles using the WDNR Forestry Tools Extension, and determined the total acreage of the beds to the nearest hundredth of an acre.

August Full Point Intercept Macrophyte Survey:

Prior to beginning the August point intercept survey, we conducted a general boat survey of the 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; Skawinski 2011), and two vouchers were pressed and mounted for herbarium specimens – one to be retained by the SCLA, and one to be sent to the state herbarium in

Stevens Point for identification confirmation. We again located each survey point with a GPS, recorded a depth reading with a Polar Vision hand held sonar unit, and took a rake sample. All plants on the rake, as well as any that were dislodged by the rake, were identified and assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 2). We also recorded visual sightings of plants within six feet of the sample point not found in the rake. 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 II) (UWEX, 2010). From this, we calculated the following:

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

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 within the littoral zone. It can also be reported as a percentage of occurrences at sample points with vegetation.

Frequency of occurrence example:

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

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

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

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

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

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

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

Average rake fullness: This value is the average rake fullness of all species in the rake. It only takes into account those sites with vegetation (Table 1).

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 gives us an idea of which species are most important within the macrophyte community (Table 2).

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. The 124 species in the index are assigned a Coefficient of Conservatism (C) which ranges from 1-10. The higher the value assigned, the more likely the plant is to be negatively impacted by human activities relating to water quality or habitat modifications. Plants with low values are tolerant of human habitat modifications, and they often exploit these changes to the point where they may crowd out other species. The FQI is calculated by averaging the conservatism value for each native index species found in the lake during the point intercept survey**, and multiplying it by the square root of the total number of plant species (N) in the lake ($FQI=(\Sigma(c1+c2+c3+\ldots cn)/N)*\sqrt{N}$). Statistically speaking, the higher the index value, the healthier the lake's macrophyte community is assumed to be. Nichols (1999) identified four eco-regions in Wisconsin: Northern Lakes and Forests, Northern Central Hardwood Forests, Driftless Area and Southeastern Wisconsin Till Plain. He recommended making comparisons of lakes within ecoregions to determine the target lake's relative diversity and health. North Lake is in the Northern Lakes and Forests Ecoregion (Table 3).

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

RESULTS:

Cold Water Curly-leaf pondweed Surveys:

On April 21-22nd, we surveyed North Lake for the presence and abundance of Curly-leaf pondweed. We rake sampled all points in the lake, but did not find any evidence of CLP at or between points or during the meandering boat survey we conducted of the lake's visible littoral zone (Figure 3) (Appendix III). We also did not find any CLP when we returned on May 28th to look for plants that should have topped out by this point in the growing season.

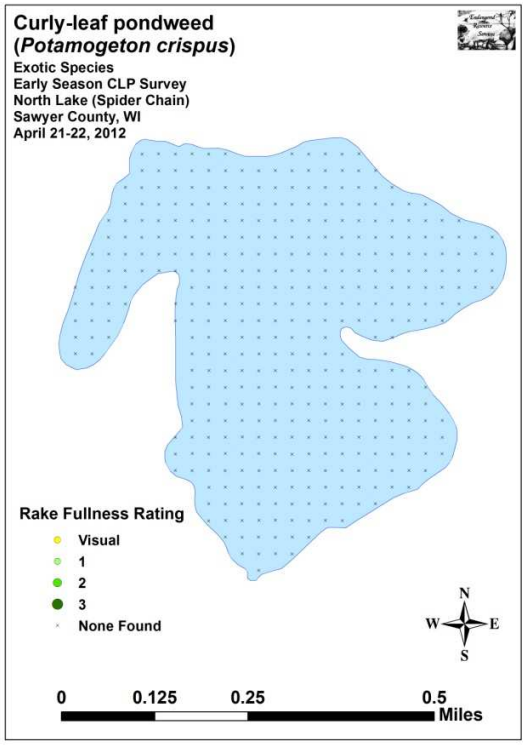


Figure 3: April 21-22, 2012 CLP Survey

August Full Point Intercept Macrophyte Survey:

Depth soundings taken at North Lake's 403 points demonstrated a highly varied underwater topography with numerous small bowls that bottomed out at 20-30ft, a small sand/gravel hump that topped out at 6ft in the northeast bay, and a shallow 4-6ft deep 200yrd+ long gravel bar that extended due south from the tip of the eastern peninsula. The western shoreline south of the western peninsula, and the borders of the western finger bay both dropped off sharply into 20+ft of water while the southeast and northwest bays slopped much more gradually into deep water (Figure 4) (Appendix IV).

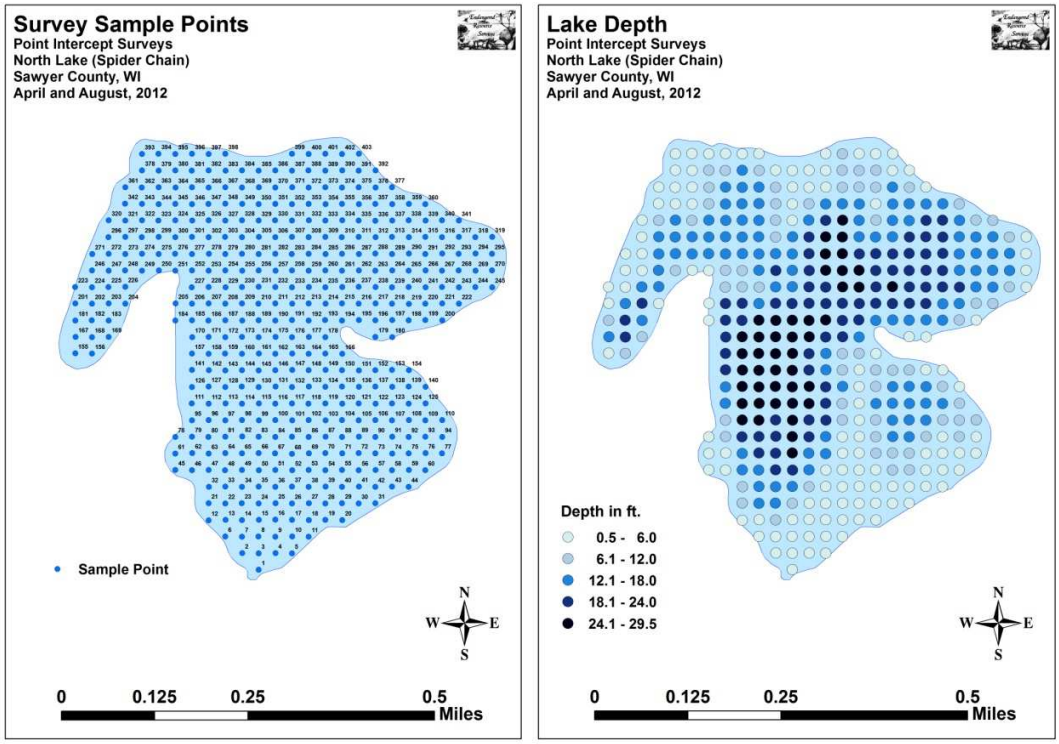


Figure 4: North Lake Survey Points and Lake Depth

Nutrient rich organic muck dominated the lake bottom covering 96.2% of the 260 survey points where we could reliably determine substrate. Most sandy areas (1.5% of survey points) were located along the western shoreline, while most rock-bottomed areas (2.3% of survey points) were found on the shallow north/south gravel bar (Figure 5).

Plant distribution was somewhat patchy in nature. Collectively, we found plants growing at 170 sites or approximately 42.2% of the entire lake bottom, and in 79.8% of the 13.5ft littoral zone (Figure 5) (Table 1) (Appendix IV).

The lake's overall diversity was extremely high with a Simpson Diversity Index value of 0.93. Species richness was also fairly high for such a small lake with 34 species found in the rake during the survey. This total jumped to 39 when including visuals and plants found during the boat survey.

We found a moderately high 4.02 species at sites with vegetation, and this dropped only slightly to 3.21 species per site when considering the entire littoral zone. The total rake fullness was moderate averaging 2.18 at sites with vegetation. Although the littoral zone extended to 13.5ft, few sites beyond 10ft had plants, and species richness in general declined rapidly at sites over 6ft (Figure 6). These few deep water sites skewed the mean depth of plant growth to 5.6ft, while the median depth was only 4.5ft (Appendix V).

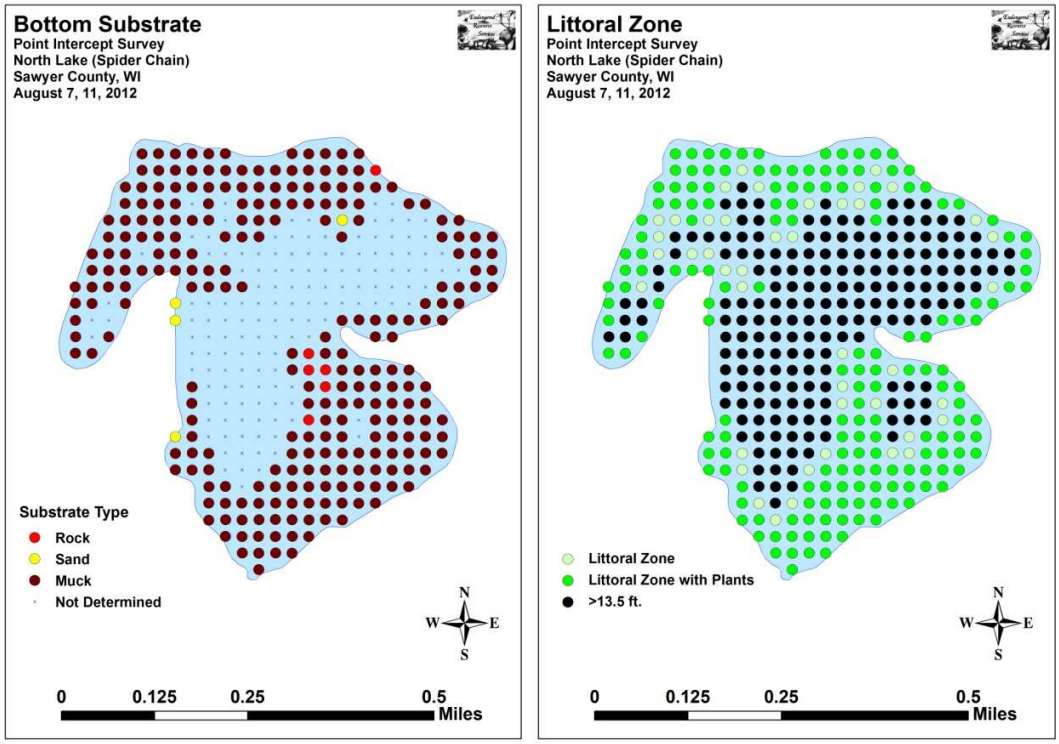


Figure 5: Bottom Substrate and Littoral Zone

Table 1: Aquatic Macrophyte P/I Survey Summary Statistics
North Lake, Sawyer County
August 7, 11, 2012

Summary Statistics:

Total number of points sampled	403
Total number of sites with vegetation	170
Total number of sites shallower than the maximum depth of plants	213
Frequency of occurrence at sites shallower than maximum depth of plants	79.81
Simpson Diversity Index	0.93
Maximum depth of plants (ft)	13.5
Mean depth of plants (ft)	5.6
Median depth of plants (ft)	4.5
Number of sites sampled using rope rake (R)	26
Number of sites sampled using pole rake (P)	234
Average number of all species per site (shallower than max depth)	3.21
Average number of all species per site (veg. sites only)	4.02
Average number of native species per site (shallower than max depth)	3.21
Average number of native species per site (veg. sites only)	4.02
Species Richness	34
Species Richness (including visuals)	34
Species Richness (including visuals and boat survey)	39
Average rake fullness (veg. sites only)	2.18

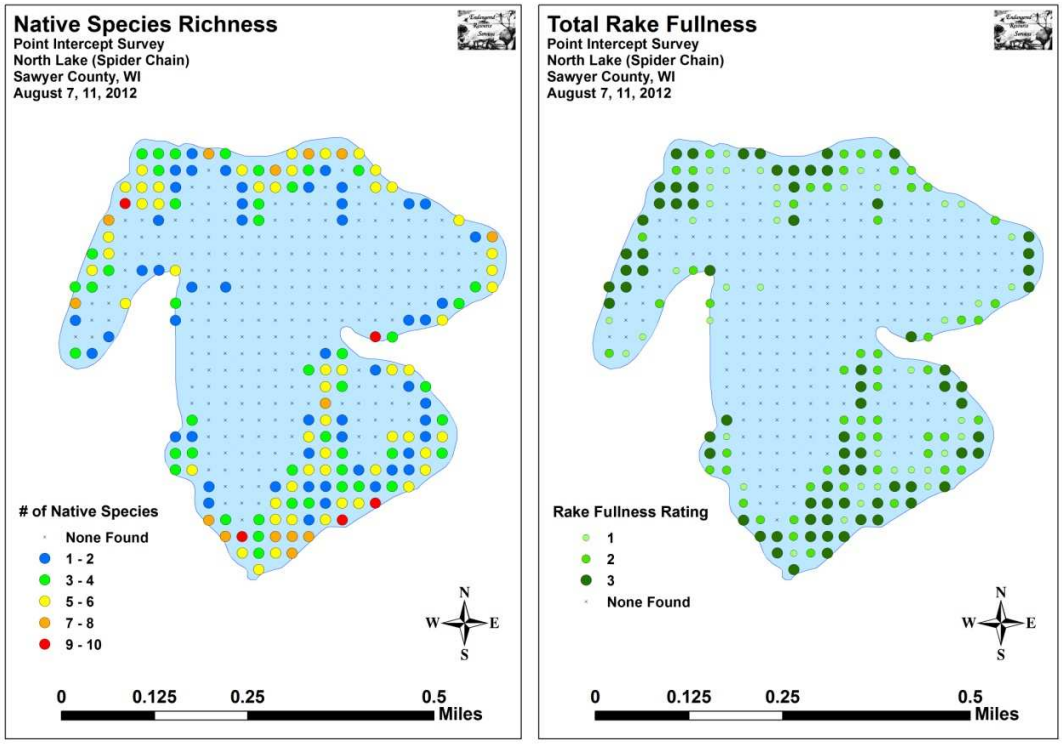


Figure 6: Native Species Richness and Total Rake Fullness

North Lake Plant Community:

The North Lake ecosystem is home to a rich and diverse plant community which can be subdivided into four distinct zones (emergent, floating-leaf, shallow submergent, and deep submergent) with each zone having its own characteristic functions in the lake ecosystem. Depending on the local bottom type (rock, sand, or muck), these zones often had somewhat different species present.

In shallow areas, beds of emergent plants stabilize the lakeshore, break up wave action, provide a nursery for baitfish and juvenile gamefish, offer shelter for amphibians, and give waterfowl and predatory wading birds like herons a place to hunt. These areas also provide important habitat for invertebrates like dragonflies and mayflies.

Especially near the channel outlet and off the midlake points, we documented beds of Pickerelweed (*Pontederia cordata*) and Hardstem bulrush (*Schoenoplectus acutus*) with lesser numbers of Water horsetail (*Equisetum fluviatile*) and Creeping spikerush (*Eleocharis palustris*) established over sand, gravel and firm muck in water generally <2.5ft deep. Along the shoreline and growing on floating muck bogs, we found limited numbers of Short-stemmed bur-reed (*Sparganium emersum*), Northern wild rice (*Zizania palustris*), Softstem bulrush (*Schoenoplectus tabernaemontani*), Water bulrush (*Schoenoplectus subterminalis*), Wild calla (*Calla palustris*), Bottle brush sedge (*Carex comosa*), and Broad-leaved cattail (*Typha latifolia*). In open canopied areas adjacent to the tamarack bogs in the northwest bays and along the southwestern shoreline, Narrow-leaved woolly sedge (*Carex lasiocarpa*) dominated the lakeshore in large often monotypic stands.

Pickerelweed and Hardstem bulrush (Berg 2011)

Water horsetail (Elliot 2007)

Creeping spikerush (Crelins 2009)

Short-stemmed bur-reed (Sullman 2010)

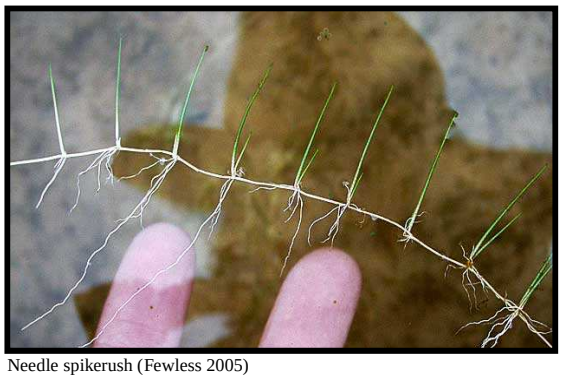
Softstem bulrush (Schwarz 2011)

Bottle brush sedge (Reznicek 2011)

Narrow-leaved woolly sedge (O'Brien 2011)

Wild calla (Pierce 2001)

Shallow sand and sandy muck areas in water from 2-5ft deep generally supported fine to moderate-leaved species such as Needle spikerush (*Eleocharis acicularis*), Slender naiad (*Najas flexilis*), Water star-grass (*Heteranthera dubia*), Wild celery (*Vallisneria americana*), Variable pondweed (*Potamogeton gramineus*), and Muskgrass (*Chara* sp.). The roots, shoots, and seeds of these plants are heavily utilized by waterfowl for food. They also provide important habitat for the lake's fish throughout their lifecycles, as well as a myriad of invertebrates like scuds, dragonfly and mayfly nymphs, and snails.



Needle spikerush (Fewless 2005)

Slender naiad (Apipp 2009)

Wild celery (Dalvi 2009)

Variable pondweed (Koshere 2002)

In shallow areas that had more nutrient rich muck, we found floating-leaf species like White-water lily (*Nymphaea odorata*), Spatterdock (*Nuphar variegata*), Watershield (*Brasenia schreberi*), Large-leaf pondweed (*Potamogeton amplifolius*), Ribbon-leaf pondweed (*Potamogeton epihydrus*), and Floating-leaf pondweed (*Potamogeton natans*). The protective canopy cover these species provide is often utilized by panfish and bass, and mature gamefish are often found prowling around the edges of these beds.

Spatterdock and White water lily (Falkner 2009)

Watershield (Gmelin 2009)

Large-leaf pondweed (Fewless 2010)

Ribbon-leaf pondweed (Petroglyph 2007)

Growing among the floating-leaf canopy, we frequently also encountered Water bulrush (*Schoenoplectus subterminalis*), Whorled water milfoil (*Myriophyllum verticillatum*), and a host of carnivorous bladderworts species including Creeping bladderwort (*Utricularia gibba*), Flat-leaf bladderwort (*Utricularia intermedia*), Small bladderwort (*Utricularia minor*), and Common bladderwort (*Utricularia vulgaris*). Rather than drawing nutrients up through roots like other plants, bladderworts trap zooplankton and minute insects in their bladders, digest their prey, and use the nutrients to further their growth.

Whorled water milfoil (Sulman 2008)

Flat-leaf bladderwort (Koshere 2002)

Common bladderwort flowers among lilypads (Hunt 2010)

Bladders for catching plankton and insect larvae (Wontolla 2007)

Deeper areas from 5-10ft over thicker muck were generally dominated by broader-leaved species such as Large-leaf pondweed (*Potamogeton amplifolius*), Fern pondweed (*Potamogeton robbinsii*), Common waterweed (*Elodea canadensis*), Illinois pondweed (*Potamogeton illinoensis*), Clasping-leaf pondweed (*Potamogeton richardsonii*), Coontail (*Ceratophyllum demersum*), White-stem pondweed (*Potamogeton praelongus*), and Flat-stem pondweed (*Potamogeton zosteriformis*). All of these species offer prime habitat for mature gamefish like the lake's trophy muskies.

Large-leaf pondweed (Martin 2002)

White-stem pondweed (Fewless 2005)

Coontail (Hassler, 2011)

Common waterweed (Fischer, 2011)

Small pondweed (Villa 2011)

Flat-stem pondweed (Fewless 2004)

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes
North Lake, Sawyer County
August 7, 11, 2012

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sightings
Potamogeton zosteriformis	Flat-stem pondweed	87	12.72	51.18	40.85	1.57	4
Ceratophyllum demersum	Coontail	80	11.70	47.06	37.56	1.18	1
Najas flexilis	Slender naiad	63	9.21	37.06	29.58	1.11	2
Nymphaea odorata	White water lily	53	7.75	31.18	24.88	1.81	3
Nuphar variegata	Spatterdock	44	6.43	25.88	20.66	1.95	5
Potamogeton amplifolius	Large-leaf pondweed	43	6.29	25.29	20.19	1.28	12
Utricularia gibba	Creeping bladderwort	41	5.99	24.12	19.25	1.22	0
Myriophyllum sibiricum	Northern water-milfoil	33	4.82	19.41	15.49	1.12	14
	Filamentous algae	32	*	18.82	15.02	1.59	0
Chara sp.	Muskgrass	27	3.95	15.88	12.68	1.70	0
Potamogeton robbinsii	Fern pondweed	27	3.95	15.88	12.68	1.41	4
Potamogeton pusillus	Small pondweed	22	3.22	12.94	10.33	1.14	5
Utricularia vulgaris	Common bladderwort	20	2.92	11.76	9.39	1.10	1
Potamogeton praelongus	White-stem pondweed	19	2.78	11.18	8.92	1.21	14
Potamogeton natans	Floating-leaf pondweed	16	2.34	9.41	7.51	1.50	5
Vallisneria americana	Wild celery	15	2.19	8.82	7.04	1.27	0
Heteranthera dubia	Water star-grass	14	2.05	8.24	6.57	1.21	0
Brasenia schreberi	Watershield	13	1.90	7.65	6.10	2.08	1
Elodea canadensis	Common waterweed	13	1.90	7.65	6.10	1.00	0
Nitella sp.	Nitella	11	1.61	6.47	5.16	1.64	0
Potamogeton richardsonii	Clasping-leaf pondweed	7	1.02	4.12	3.29	1.43	0
Utricularia minor	Small bladderwort	6	0.88	3.53	2.82	1.00	0

* Excluded from Rel. Freq. Calc.

Table 2 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
North Lake, Sawyer County
August 7, 11, 2012

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sightings
Potamogeton friesii	Fries' pondweed	5	0.73	2.94	2.35	1.00	1
Bidens beckii	Water marigold	4	0.58	2.35	1.88	1.25	1
Pontederia cordata	Pickerelweed	4	0.58	2.35	1.88	2.00	3
Schoenoplectus acutus	Hardstem bulrush	3	0.44	1.76	1.41	1.67	1
Utricularia intermedia	Flat-leaf bladderwort	3	0.44	1.76	1.41	1.00	0
Eleocharis palustris	Creeping spikerush	2	0.29	1.18	0.94	1.50	1
Sparganium emersum	Short-stemmed bur-reed	2	0.29	1.18	0.94	1.00	3
Zizania palustris	Northern wild rice	2	0.29	1.18	0.94	1.00	0
Eleocharis acicularis	Needle spikerush	1	0.15	0.59	0.47	2.00	0
Myriophyllum verticillatum	Whorled water-milfoil	1	0.15	0.59	0.47	1.00	1
Potamogeton epihydrus	Ribbon-leaf pondweed	1	0.15	0.59	0.47	1.00	1
Potamogeton gramineus	Variable pondweed	1	0.15	0.59	0.47	2.00	0
Schoenoplectus subterminalis	Water bulrush	1	0.15	0.59	0.47	1.00	0
Carex comosa	Bottle brush sedge	***	***	***	***	***	***
Carex lasiocarpa	Narrow-leaved woolly sedge	***	***	***	***	***	***
Equisetum fluviatile	Water horsetail	***	***	***	***	***	***
Schoenoplectus tabernaemontani	Softstem bulrush	***	***	***	***	***	***
Typha latifolia	Broad-leaved cattail	***	***	***	***	***	***

*** Boat Survey Only

Flat-stem pondweed, Coontail, Slender naiad, and White water lily were the most common macrophyte species being found at 51.18%, 47.06%, 37.06%, and 31.18% of survey points with vegetation (Table 2) (Figure 7). Together, they combined for a very low 41.37% of the total relative frequency (Typically, the top four species account for >50%). This suggests the plant community is very even with no species dominating at the expense of others. Spatterdock (6.43), Large-leaf pondweed (6.29), Creeping bladderwort (5.99), and Northern water milfoil (4.82) were the only other species with a relative frequency over 4.0 (Species accounts and maps for all species are located in Appendixes VI and VII).

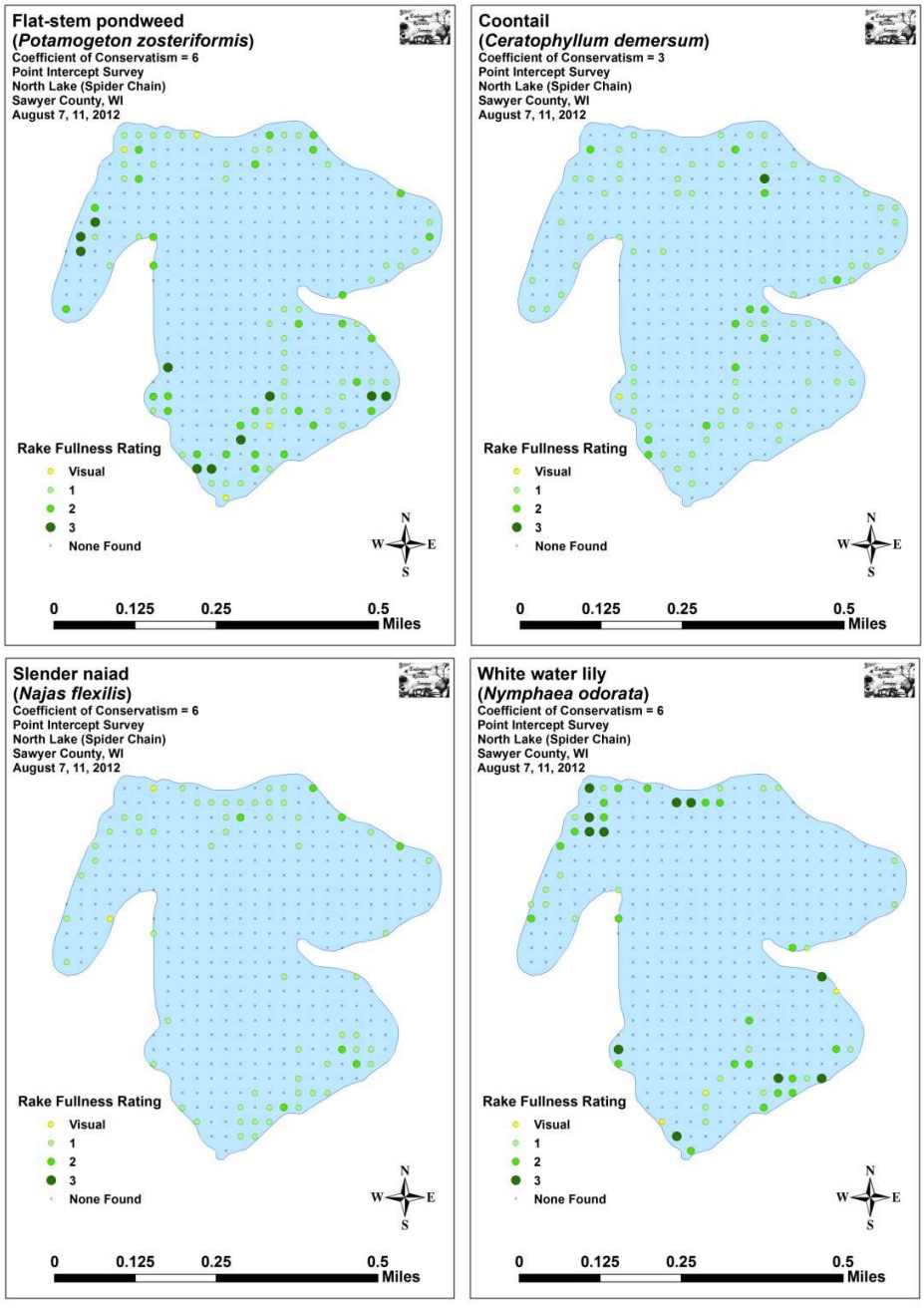


Figure 7: North Lake's Most Common Macrophyte Species

Table 3: Floristic Quality Index of Aquatic Macrophytes
North Lake, Sawyer County
August 7, 11, 2012

Species	Common Name	C
Bidens beckii	Water marigold	8
Brasenia schreberi	Watershield	6
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Eleocharis acicularis	Needle spikerush	5
Eleocharis palustris	Creeping spikerush	6
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Myriophyllum sibiricum	Northern water-milfoil	6
Myriophyllum verticillatum	Whorled water-milfoil	8
Najas flexilis	Slender naiad	6
Nitella sp.	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Pontederia cordata	Pickerelweed	8
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton epihydrus	Ribbon-leaf pondweed	8
Potamogeton friesii	Fries' pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Schoenoplectus acutus	Hardstem bulrush	6
Schoenoplectus subterminalis	Water bulrush	9
Sparganium emersum	Short-stemmed bur-reed	8
Utricularia gibba	Creeping bladderwort	9
Utricularia intermedia	Flat-leaf bladderwort	9
Utricularia minor	Small bladderwort	10
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
Zizania palustris	Northern wild rice	8
N		**34**
Mean C		**6.8**
FQI		**39.6**

We identified a total of 34 **native index plants** on the rake during the point intercept survey. They produced a mean Coefficient of Conservatism of 6.8 and a Floristic Quality Index of 39.6 (Table 3). Nichols (1999) reported an average mean C for the Northern Lakes and Forest Region of 6.7 putting North Lake slightly above average for this part of the state. The FQI was, however, well above the median FQI of 24.3 for the Northern Lakes and Forest Region (Nichols 1999). Contributing to these high values were four exceptionally sensitive/high value species of note. They included Water bulrush (C=9), Creeping bladderwort (C=9), Flat-leaf bladderwort (C=9), and Small bladderwort (C=10).

Exotic Species:

As in the May survey, we did NOT find any evidence of Eurasian water milfoil, Curly-leaf pondweed, Purple loosestrife (*Lythrum salicaria*), or any other exotic species. By all accounts, North Lake appears to be in ecologically pristine condition (For more information on aquatic exotic invasive plant species, see Appendix VIII).

Filamentous and Blue-green Algae:

We located filamentous algae at 32 sites throughout North Lake. It was present at approximately 19% of sites with vegetation and had an average rake fullness value of 1.59. We also found blobs of Blue-green algae that were identified as belonging to the genus *Planktothrix* (Gina LaLiberte/Craig Roesler, WDNR Phycologists – personal communication) (Figure 8). These algae normally proliferate when there are excessive nutrients in the water column.

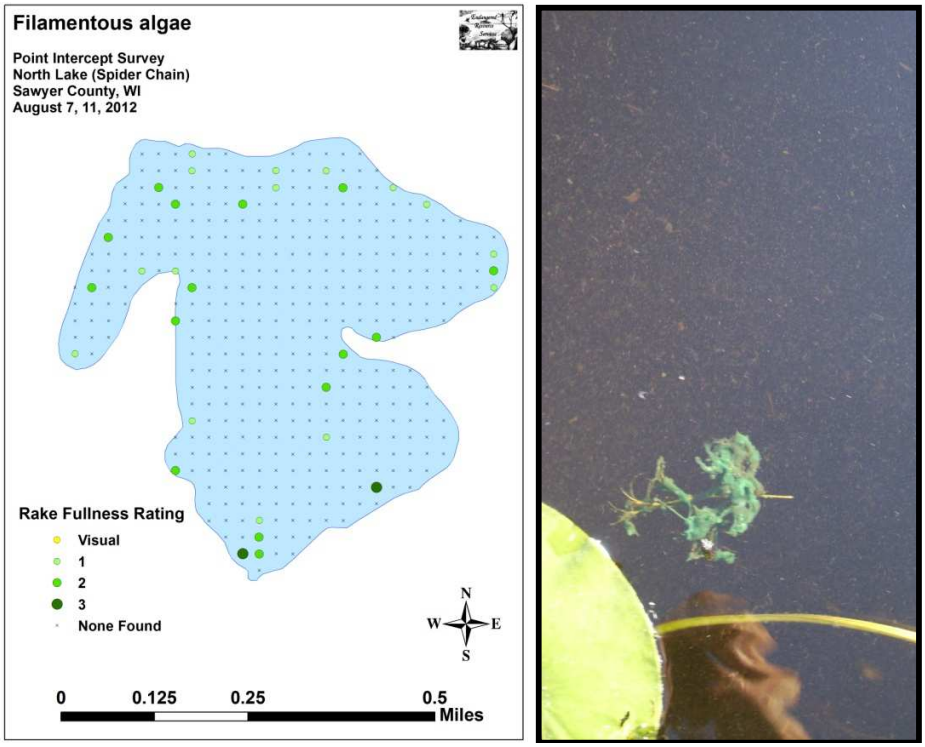


Figure 8: Filamentous Algae Density and Distribution/ Blue-green Algae (*Planktothrix isothrix*) Blobs in the North Bays

Northern Wild Rice:

Wild rice, a plant of significant wildlife and cultural value, was found in the rake at two points and represented by a single plant at each location (Figure 9). Collectively, the lake didn't appear to support more than a few 100 plants as they were widely scattered among the floating muck bogs in the southeast and northwest bays. Plants were never continuous, and there was no place on the lake that was fit for human harvest (Figure 10).

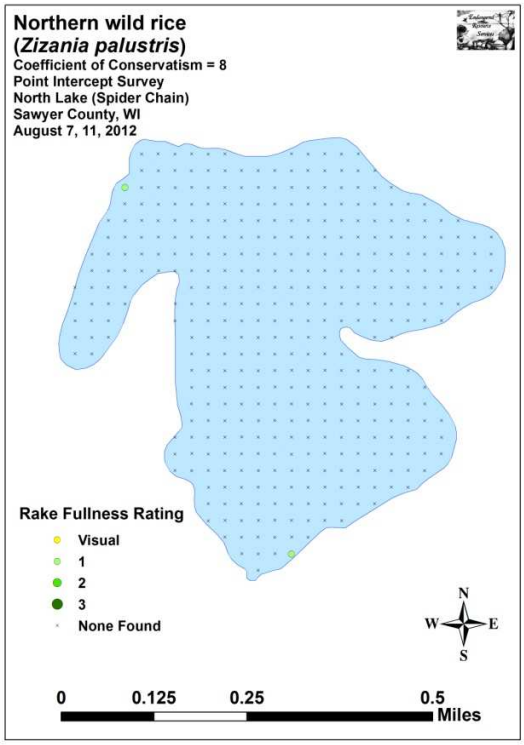


Figure 9: Northern Wild Rice Density and Distribution

Figure 10: Low Density Wild Rice in the Southeast Bay

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:

The Role of Native Macrophytes:

Like trees in a forest, a lake's rooted plants are the basis of the aquatic ecosystem. They capture the sun's energy and turn it into usable food, "clean" the water of excess nutrients, and provide habitat for other organisms like the lake's fish populations. Because of this, preserving them is critical to maintaining a lake's overall health. North Lake currently has a diverse and abundant native plant community that is typical of pristine bog lakes in northern Wisconsin. The presence of so many high value species suggests a history of good water quality and lakeshore owner stewardship.

Water Clarity and Algae

Filamentous and Blue-green algae were more prevalent in North Lake than anywhere else in the Spider Chain. There was, however, no correlation between our data and residences on the lake. This suggests that the nutrients that are feeding this algal growth are more likely from a natural source like nutrient recycling from sediments. Although a comprehensive nutrient study would be required to confirm this, the presence of large amounts of decomposing plants that were at the end of their natural yearly life cycle, and residents of the lake reporting they see this type of "blob" Blue-green algae every year is anecdotal evidence that these blooms are a natural event.

During our time on the lake, we noted that the vast majority of property owners were practicing sound shoreline conservation; however, there is always room for improvement. Because excess nutrients in the water column promote algal growth and can lead to declines in both water clarity and quality, residents should evaluate how their shoreline practices may be impacting the lake. Simple things like establishing a buffer strip of native vegetation along the lake shore to prevent erosion, bagging grass clippings, switching to a phosphorus-free fertilizer or eliminating fertilizer near the lake altogether, collecting pet waste, and disposing of the ash from fire pits away from the lakeshore can all significantly reduce nutrients entering the lake (Figure 11).

Figure 11: Natural Shoreline vs. Mowing Down to the Shoreline

Ultimately, regardless of the cause of these algal blooms, the lake's residents should be mindful to provide their pets with fresh water and shower both their pets and themselves if they go swimming in this or any other lake in Wisconsin. As Gina LaLiberte, WDNR stated, residents and their pets are unlikely to see any negative issues with the algae if they take these common sense precautions to prevent ingesting or prolonged skin contact with the algae.

Figure 12: Purple loosestrife and Galerucella Beetles

Purple Loosestrife:

Although we didn't find any Purple Loosestrife on the borders of North Lake, it is scattered around East Bay in Big Spider and on the western shoreline of Clear Lake. Because of this, it could conceivably show up here in the future. With this in mind, residents should be on the lookout for the plant's bright fuchsia candle-shaped flower spikes which appear in August and last through September. If found, the location should be reported to the SCLA so *Galerucella* beetles can be released on the plants. The plants, if few in number, could also be removed by hand, bagged to prevent seed dispersal, and disposed of away from the lake. As the plants have an extensive root system, care should be taken to remove the entire plant as even small root fragments can survive and produce new plants the following year (Figure 12).

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 nearby lakes in Sawyer County in particular. Although North Lake has no public access, any exotic species that find their way into one member of the Spider Chain are likely to ultimately spread to all members.

Besides supporting the landing monitoring on Clear Lake and other efforts to control exotic species in the Spider Chain, North Lake residents should consider conducting at least one annual meandering survey of the lake's entire visible littoral zone as these surveys can result in early detection if a new AIS is introduced into the lake. The sooner a new infestation is detected, the greater the chances it can be successfully and economically controlled. Finally, developing 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 the native plants and the critical habitat they provide for the whole lake ecosystem.
- Work to maintain or even improve water clarity and reduce algal growth by limiting nutrient inputs.
- Specifically, avoid mowing down to the lakeshore and reduce or, if possible, eliminate grass clippings runoff, fertilizer applications, and other sources of nutrients like pet waste and fire pit ashes near the lakeshore.
- Encourage shoreline restoration and the establishment of native vegetation buffer strips along the lakeshore to further prevent runoff and erosion.
- Monitor for Purple loosestrife in August and September, and report any plants to the SCLA so *Galerucella* beetles can be released on them/they can be removed by hand.
- Consider carrying out at least one annual meandering shoreline surveys of the lake's littoral zone to look for new AIS.
- Complete an Aquatic Plant Management Plan that clarifies a potential response to a new AIS, such as Eurasian water milfoil, if one becomes established in the lake.

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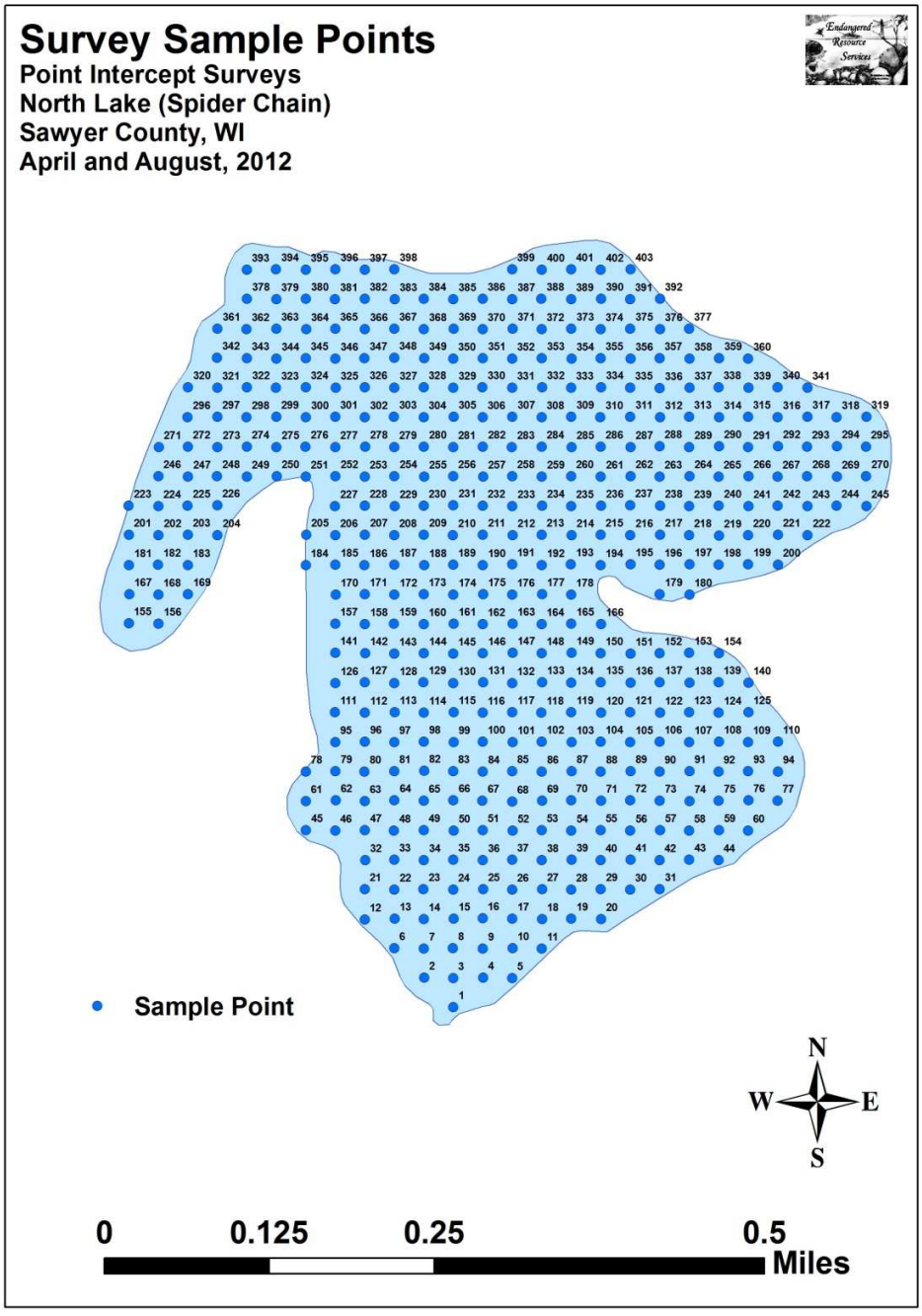
Appendix I: North Lake Survey Sample Points


Survey Sample Points
Point Intercept Surveys
North Lake (Spider Chain)
Sawyer County, WI
April and August, 2012
Endangered Resource Services
Sample Point
N
W
E
S
0
0.125
0.25
0.5
Miles

Appendix II: Boat and Vegetative Survey Data Sheets

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

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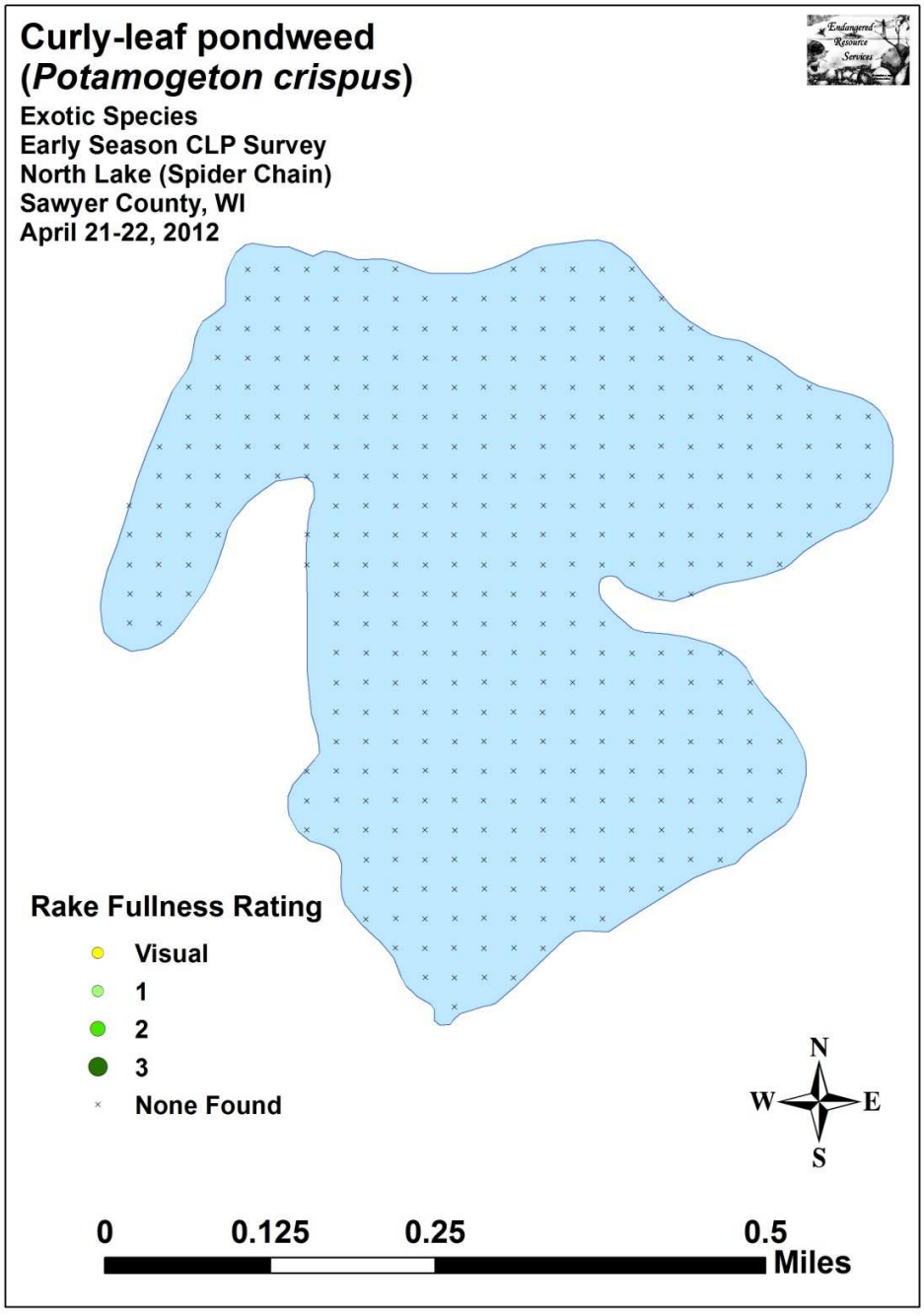
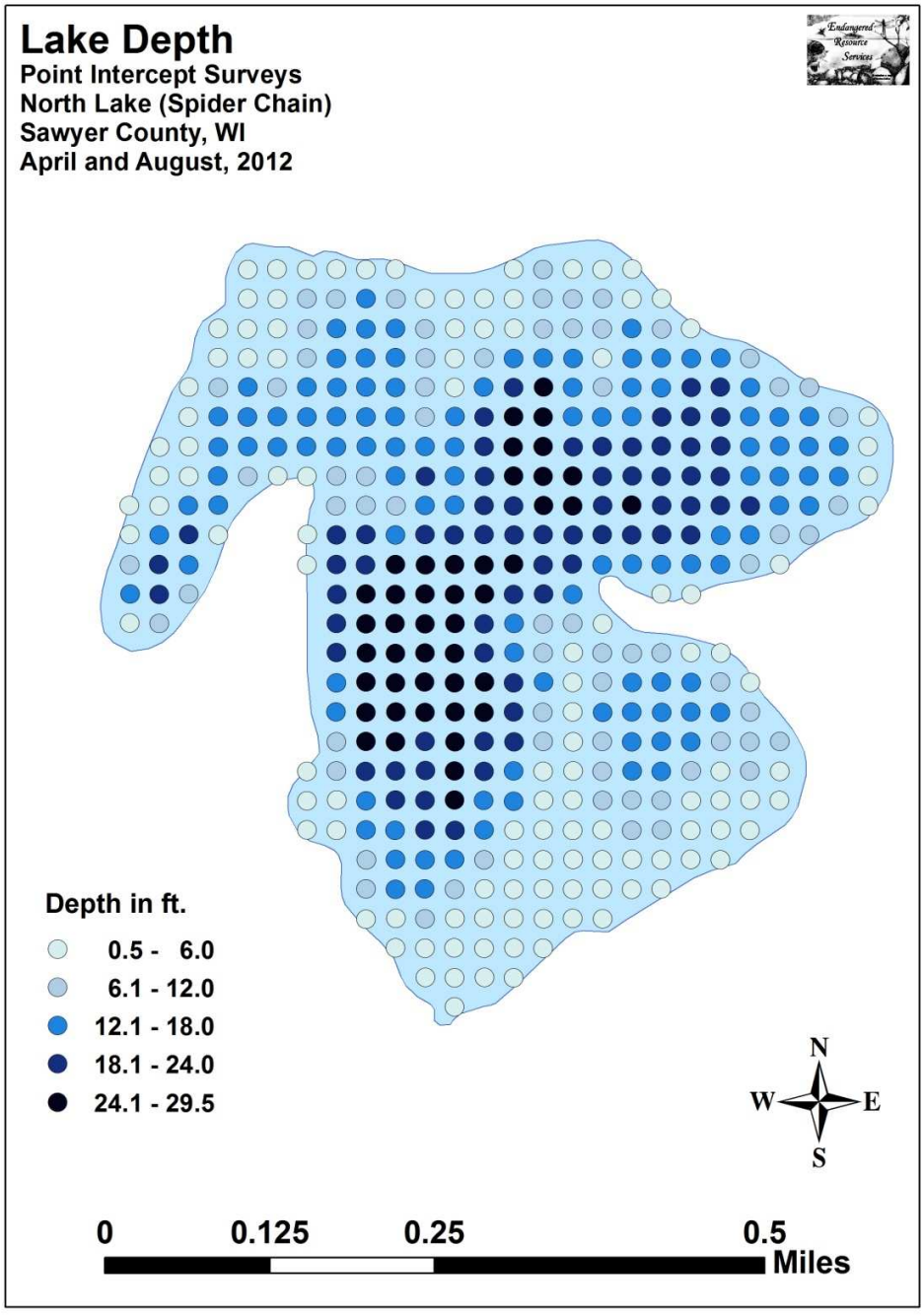
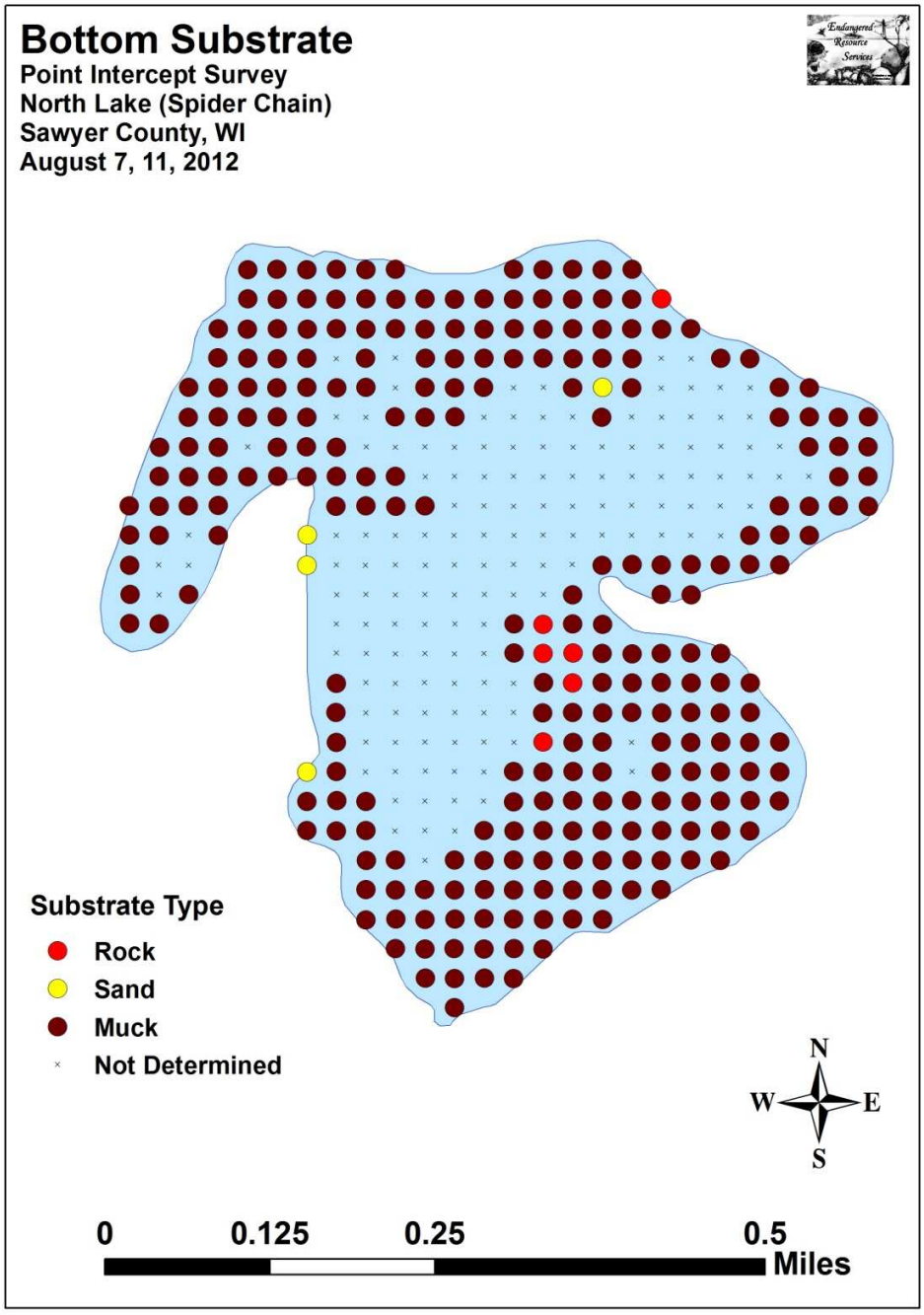
15																									
16																									
17																									
18																									
19																									
20																									

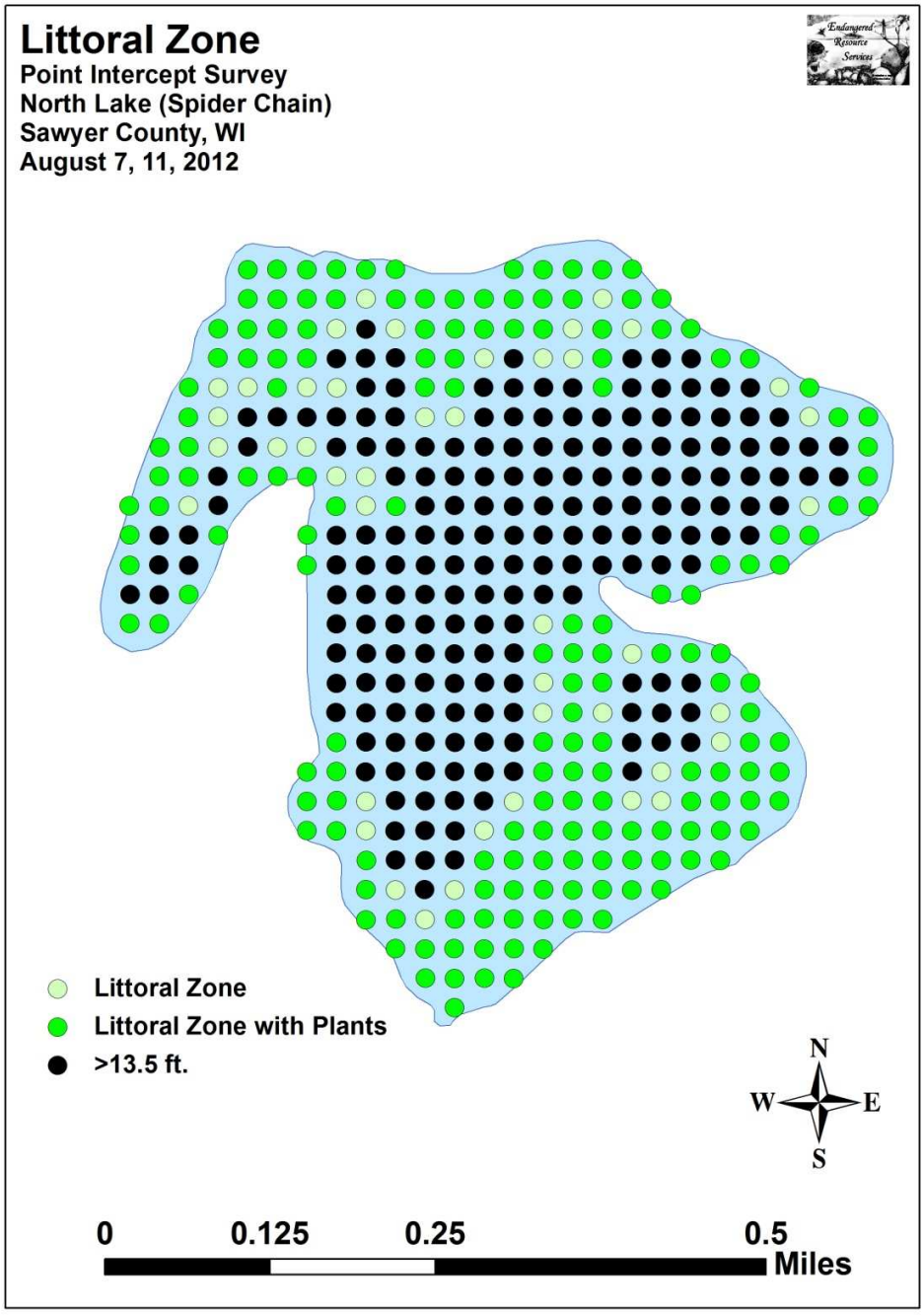
Appendix III: CLP Survey Map


Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
Early Season CLP Survey
North Lake (Spider Chain)
Sawyer County, WI
April 21-22, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

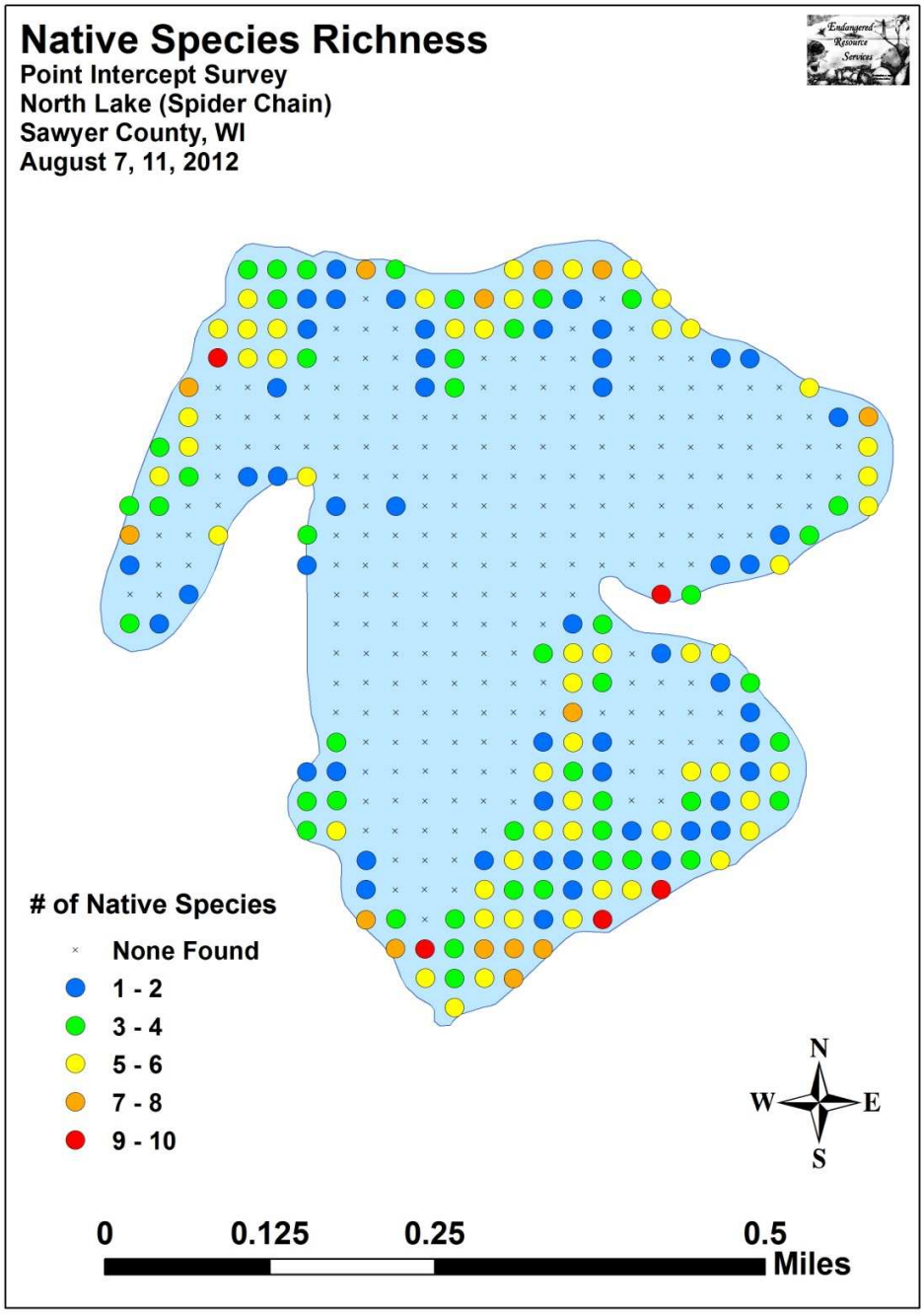
Appendix IV: Habitat Variable Maps

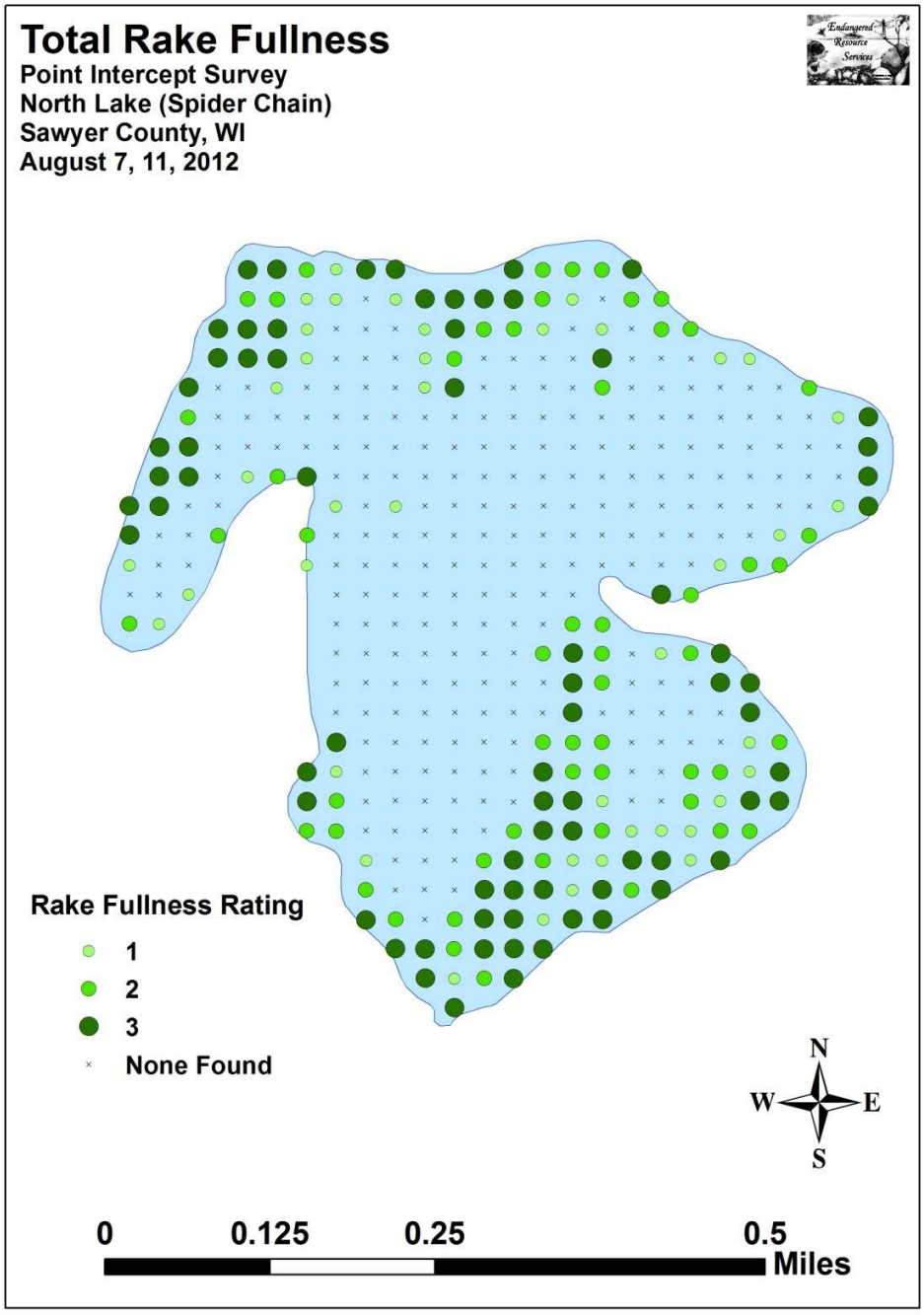

Lake Depth
Point Intercept Surveys
North Lake (Spider Chain)
Sawyer County, WI
April and August, 2012
Endangered Resource Services
Depth in ft.
0.5 - 6.0
6.1 - 12.0
12.1 - 18.0
18.1 - 24.0
24.1 - 29.5
N
W
E
S
0
0.125
0.25
0.5
Miles


Bottom Substrate
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Substrate Type
Rock
Sand
Muck
Not Determined
N
W
E
S
0
0.125
0.25
0.5
Miles


Littoral Zone
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Littoral Zone
Littoral Zone with Plants
>13.5 ft.
N
W
E
S
0
0.125
0.25
0.5
Miles

Appendix V: Native Species Richness and Total Rake Fullness Maps


Native Species Richness
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 8
9 - 10
N
W
E
S
0
0.125
0.25
0.5
Miles


Total Rake Fullness
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

Appendix VI: Spider Chain Plant Species Accounts

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Bidens beckii*) **Water marigold**
Specimen Location: Clear Lake; N46.09775°, W91.23184°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-277
Habitat/Distribution: Muck bottom in 0.5-2.5 meters of water.
Widely scattered throughout all four lakes; especially common in Spider's north and north east bays.
Common Associates: (*Potamogeton robbinsii*) Fern pondweed, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton praelongus*) White-stem pondweed, (*Potamogeton pusillus*) Small pondweed, (*Elodea canadensis*) Common waterweed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Brasenia schreberi*) **Watershield**
Specimen Location: Clear Lake; N46.09805°, W91.24279°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-278
Habitat/Distribution: Muck and mucky sand bottom in 0.5-1.5 meters. Common to abundant in nutrient rich organic muck bottom bays.
Common Associates: (*Nuphar variegata*) Spatterdock, (*Nymphaea odorata*) White water lily, (*Potamogeton natans*) Floating-leaf pondweed, (*Pontederia cordata*) Pickerelweed, (*Utricularia vulgaris*) Common bladderwort, (*Utricularia gibba*) Creeping bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Calamagrostis canadensis*) **Blue joint**
Specimen Location: Clear Lake; N46.09305°, W91.23599°
Also found in: Spider Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-279
Habitat/Distribution: Muck and mucky sand bottom at the shoreline. Relatively common and widely distributed in open canopy shoreline areas.
Common Associates: (*Phalaris arundinacea*) Reed canary grass, (*Sagittaria latifolia*) Common arrowhead, (*Juncus effusus*) Common rush, (*Carex comosa*) Bottlebrush sedge

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Calla palustris*) **Wild calla**
Specimen Location: Clear Lake; N46.09947°, W91.22945°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-280
Habitat/Distribution: Muck soil at the shoreline. Plants were growing on/near the bogs in the north bays of Clear Lake.
Common Associates: (*Carex lasiocarpa*) Narrow-leaved woolly sedge, (*Comarum palustre*) Marsh cinquefoil, (*Brasenia schreberi*) Watershield

State: Sawyer County, Wisconsin **Date:** 8/8/12
Species: (*Carex atherodes*) **Hairy-leaved lake sedge**
Specimen Location: Spider Lake; N46.07646°, W91.23740°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-283
Habitat/Distribution: Sandy muck at the shoreline. A large bed occurred near the Spider Creek Outlet/South boat landing on the west shoreline. A single individual was found in fruit at this late date, and it was sent to the herbarium.
Common Associates: (*Pontederia cordata*) Pickerelweed, (*Schoenoplectus acutus*) Hardstem bulrush

State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Carex comosa*) **Bottle brush sedge**
Specimen Location: Clear Lake; N46.09805°, W91.24279°
Also found in: North and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-281
Habitat/Distribution: Muck and mucky sand bottom at the shoreline. Relatively common and widely distributed in open canopy shoreline areas.
Common Associates: (*Phalaris arundinacea*) Reed canary grass, (*Sagittaria latifolia*) Common arrowhead, (*Juncus effusus*) Common rush, (*Calamagrostis canadensis*) Blue joint

State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Carex lasiocarpa*) **Narrow-leaved woolly sedge**
Specimen Location: Clear Lake; N46.09947°, W91.22945°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-282
Habitat/Distribution: Muck soil at the shoreline. Plants were common to abundant in bog margins of all four lakes.
Common Associates: (*Nymphaea odorata*) White water lily, (*Comarum palustre*) Marsh cinquefoil, (*Brasenia schreberi*) Watershield, (*Calla palustris*) Water calla, (*Schoenoplectus subterminalis*) Water bulrush, (*Eleocharis robbinsii*) Robbins' spikerush

State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Carex utriculata*) **Common yellow lake sedge**
Specimen Location: Clear Lake; N46.09696°, W91.22635°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-284
Habitat/Distribution: Muck bottom along the shoreline. Fairly common on the west and southwest shorelines near the public boat landing.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Lythrum salicaria*) Purple loosestrife, (*Carex lasiocarpa*) Narrow-leaved woolly sedge, (*Sagittaria latifolia*) Common arrowhead

County/State: Sawyer County, Wisconsin **Date:** 8/8/12
Species: (*Ceratophyllum demersum*) **Coontail**
Specimen Location: Spider Lake; N46.10130°, W91.21189°
Also found in: North and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-285
Habitat/Distribution: Muck bottom in 0-5+ meters. Common and widely distributed in all three lakes although seldom abundant or monotypic.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Nymphaea odorata*) White water lily, (*Elodea canadensis*) Common waterweed, (*Myriophyllum sibiricum*) Northern water milfoil

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Chara* sp.) **Muskgrass**
Specimen Location: Clear Lake; N46.09609°, W91.22876°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg/Paul M. Skawinski Col. #: MSB-2012-286
Habitat/Distribution: *C. vulgaris* was most common in sand/rock bottom areas (especially on exposed points), while *C. braunii* (North Lake only) and *C. globularis* were more common over muck. The later in water from 0 – 5+ meters deep.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Potamogeton gramineus*) Variable pondweed, (*Najas flexilis*) Slender naiad, (*Elodea canadensis*) Common waterweed, (*Ceratophyllum demersum*) Coontail, (*Nitella* sp.) Nitella

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Dulichium arundinaceum*) **Three-way sedge**
Specimen Location: Clear Lake; N46.09805°, W91.24279°
Also found in: Fawn Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-287
Habitat/Distribution: Located at the edge of the water in mucky soil. Scattered locations on the edges of boggy areas.
Common Associates: (*Nymphaea odorata*) White water lily, (*Eleocharis palustris*) Creeping spikerush, (*Brasenia schreberi*) Watershield, (*Pontederia cordata*) Pickerelweed, (*Schoenoplectus subterminalis*) Water bulrush, (*Equisetum fluviatile*) Water horsetail

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Elatine minima*) **Waterwort**
Specimen Location: Clear Lake; N46.09090°, W91.23959°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-288
Habitat/Distribution: Rare; only plants were found in Clear Lake, and almost all of them were on the south and west side of Butternut island. Plants were growing over sand/gravel in water <1m deep.
Common Associates: (*Chara* sp.) Muskgrass, (*Potamogeton gramineus*) Variable pondweed, (*Utricularia resupinata*) Small purple bladderwort, (*Najas flexilis*) Slender naiad, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush, (*Eleocharis acicularis*) Needle spikerush

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Eleocharis acicularis*) **Needle spikerush**
Specimen Location: Clear Lake; N46.09644°, W91.23546°
Also found in: Spider and North Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-289
Habitat/Distribution: Common in sand/rock bottom areas usually in water from 0 – 2 meters deep. Widespread in Clear and Spider, but rare in North where it primarily grew as an emergent on floating muck mats.
Common Associates: (*Chara* sp.) Muskgrass, (*Potamogeton gramineus*) Variable pondweed, (*Ranunculus flammula*) Creeping spearwort, (*Najas flexilis*) Slender naiad, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Juncus pelocarpus*) Brown-fruited rush, (*Utricularia resupinata*) Small purple bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/12
Species: (*Eleocharis robbinsii*) **Robbins' spikerush**
Specimen Location: Spider Lake; N46.07401°, W91.24743°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-290
Habitat/Distribution: Thick muck bottom in 0-0.5 meters of water. Plants were abundant in the spring inlet found in the southwest corner of the southwest bay of Little Spider.
Common Associates: (*Nuphar variegata*) Spatterdock, (*Nymphaea odorata*) White water lily, (*Potamogeton natans*) Floating-leaf pondweed, (*Pontederia cordata*) Pickerelweed, (*Brasenia schreberi*) Watershield, (*Utricularia vulgaris*) Common bladderwort, (*Utricularia gibba*) Creeping bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Eleocharis palustris*) **Creeping spikerush**
Specimen Location: Clear Lake; N46.09262°, W91.23720°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-291
Habitat/Distribution: Firm, rocky bottoms in 0-1 meter of water. Scattered individuals were found growing in Hardstem bulrush beds or in larger monotypic stands.
Common Associates: (*Schoenoplectus acutus*) Hardstem bulrush, (*Eleocharis palustris*) Creeping spikerush, (*Equisetum fluviatile*) Water horsetail, (*Chara* sp.) Muskgrass, (*Potamogeton gramineus*) Variable pondweed

County/State**:** Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Elodea canadensis*) **Common waterweed**
Specimen Location: Clear Lake; N46.09775°, W91.23184°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-292
Habitat/Distribution: Muck bottom in 0-6 meters of water.
Common and widespread, but only abundant in the north and northeast bays of Big Spider.
Common Associates: (*Potamogeton crispus*) Curly-leaf pondweed**,** (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Vallisneria americana*) Wild celery

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Equisetum fluviatile*) **Water horsetail**
Specimen Location: Clear Lake; N46.08962°, W91.24078°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-293
Habitat/Distribution: Sandy and firm muck bottoms in 0-.5m of water. Widely scattered locations throughout all four lakes. Most plants were found on exposed points or next to bogs.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Schoenoplectus acutus*) Hardstem bulrush, (*Najas flexilis*) Slender naiad, (*Potamogeton gramineus*) Variable pondweed, (*Eleocharis palustris*) Creeping spikerush

County/State**:** Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Eriocaulon aquaticum*) **Pipewort**
Specimen Location: Clear Lake; N46.09609°, W91.22876°
Also found in: Spider Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-294
Habitat/Distribution: Firm sand and sandy muck bottoms in water <1.5m deep. Common and widespread in Clear, but largely restricted to the southern bays in Little Spider.
Common Associates: (*Najas flexilis*) Slender naiad, (*Potamogeton gramineus*) Variable pondweed, (*Eleocharis acicularis*) Needle spikerush, (*Utricularia resupinata*) Small purple bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/9/12
Species: (*Heteranthera dubia*) **Water star-grass**
Specimen Location: Spider Lake; N46.11361°, W91.20963°
Also found in: North and Fawn Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-295
Habitat/Distribution: Firm nutrient rich organic muck and sand bottoms in water up to 4m. Widespread and common throughout Big Spider; scattered in Fawn and North; absent from the marl/muck of Little Spider and Clear.
Common Associates: (*Najas flexilis*) Slender naiad, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Elodea canadensis*) Common waterweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Potamogeton robbinsii*) Fern pondweed

County/State: Sawyer County, Wisconsin **Date:** 8/11/12
Species: (*Isoetes echinospora*) **Spiny-spored quillwort**
Specimen Location: Spider Lake; N46.11120°, W91.21631°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-296
Habitat/Distribution: Firm sand bottoms in water <1m deep. Only plants found were at the point.
Common Associates: (*Najas flexilis*) Slender naiad, (*Potamogeton gramineus*) Variable pondweed, (*Eleocharis acicularis*) Needle spikerush

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Isoetes lacustris*) **Lake quillwort**
Specimen Location: Clear Lake; N46.10024°, W91.23676°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-297
Habitat/Distribution: Sandy muck bottom in water <1.5m deep. A single plant was found at the point.
Common Associates: (*Najas flexilis*) Slender naiad, (*Potamogeton gramineus*) Variable pondweed, (*Utricularia resupinata*) Small purple bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Juncus effusus*) **Common rush**
Specimen Location: Clear Lake; N46.09805°, W91.24279°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-298
Habitat/Distribution: Rocky to sandy bottoms at the shoreline. Plants were scattered along the western shoreline north of the boat landing.
Common Associates: (*Lythrum salicaria*) Purple loosestrife, (*Typha latifolia*) Broad-leaved cattail, (*Phalaris arundinacea*) Reed canary grass, (*Sagittaria latifolia*) Common arrowhead

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Juncus pelocarpus*) **Brown-fruited rush**
Specimen Location: Clear Lake; N46.10109°, W91.23617°
Also found in: Spider Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-299
Habitat/Distribution: Rocky to sandy bottoms in < 1 meter of water. Common throughout Clear; widely scattered throughout Spider.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Elatine minima*) Waterwort, (*Ranunculus flammula*) Creeping spearwort, (*Najas flexilis*) Slender naiad, (*Potamogeton gramineus*) Variable pondweed, (*Chara* sp.) Muskgrass, (*Littorella uniflora*) Littorella, (*Utricularia resupinata*) Small purple bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/10/12
Species: (*Leersia oryzoides*) **Rice cut-grass**
Specimen Location: Spider Lake; N46.09777°, W91.21433°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-300
Habitat/Distribution: Located at the shoreline over sand and firm sandy muck.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Pontederia cordata*) Pickerelweed

County/State: Sawyer County, Wisconsin **Date:** 8/11/12
Species: (*Lemna minor*) **Small duckweed**
Specimen Location: Spider Lake; N46.10935°, W91.22552°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-301
Habitat/Distribution: Located floating at or just under the surface in sheltered areas. Only plants found were at the point.
Common Associates: (*Pontederia cordata*) Pickerelweed, (*Utricularia gibba*) Creeping bladderwort, (*Brasenia schreberi*) Watershield

County/State: Sawyer County, Wisconsin **Date:** 8/10/12
Species: (*Littorella uniflora*) **Littorella**
Specimen Location: Spider Lake; N46.10709°, W91.21790°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-302
Habitat/Distribution: Only plants found were around the point where a small bed (few 1,000's of plants max) was established on the south shore of the island in water <1m deep.
Common Associates: (*Ranunculus flammula*) Creeping spearwort, (*Juncus pelocarpus*) Brown-fruited rush

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Lythrum salicaria*) **Purple loosestrife**
Specimen Location: Clear Lake; N46.09805°, W91.24279°
Also found in: Spider Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-303
Habitat/Distribution: Most plants were located near the Clear Lake boat landing. Another handful of plants were found in Spider on the north shoreline of the northeast bay.
Common Associates: (*Juncus effusus*) Common rush, (*Typha latifolia*) Broad-leaved cattail, (*Carex lasiocarpa*) Narrow-leaved woolly sedge, (*Phalaris arundinacea*) Reed canary grass

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Myriophyllum sibiricum*) **Northern water milfoil**
Specimen Location: Clear Lake; N46.11699°, W91.21664°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-304
Habitat/Distribution: Nutrient rich organic muck bottoms in water up to 4 meters deep. Widespread and common throughout Big Spider and Clear; scattered in Fawn; absent or rare in the marl/nutrient poor muck of Little Spider and Clear.
Common Associates: (*Najas flexilis*) Slender naiad, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Elodea canadensis*) Common waterweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Potamogeton pusillus*) Small pondweed, (*Vallisneria americana*) Wild celery, (*Heteranthera dubia*) Water star-grass

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Myriophyllum tenellum*) **Dwarf water milfoil**
Specimen Location: Clear Lake; N46.09609°, W91.22876°
Also found in: Spider Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-305
Habitat/Distribution: Rocky to sandy bottoms in 0-2 meters of water. Common and widely distributed in Clear, but rare in Big Spider on exposed island points and shorelines.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Juncus pelocarpus*) Brown-fruited rush, (*Elatine minima*) Waterwort, (*Ranunculus flammula*) Creeping spearwort, (*Utricularia resupinata*) Small purple bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/11/12
Species: (*Myriophyllum verticillatum*) **Whorled water-milfoil**
Specimen Location: North Lake; N46.11636°, W91.21477°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-306
Habitat/Distribution: Mucky bottoms in 0-1 meter of water. Rare; Restricted to the southeast end of the east bay where it was abundant among the many small muck bogs that were floating to the surface.
Common Associates: (*Zizania palustris*) Northern wild rice, (*Sparganium emersum*) Short-stemmed bur-reed, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Utricularia vulgaris*) Common bladderwort, (*Brasenia schreberi*) Watershield

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Najas flexilis*) **Slender naiad**
Specimen Location: Clear Lake; N46.10027°, W91.23312°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-307
Habitat/Distribution: Found in almost any bottom conditions in 0.5-4.0 meters of water. Widely distributed and common throughout.
Common Associates: (*Chara* sp.) Muskgrass, (*Potamogeton gramineus*) Variable pondweed, (*Vallisneria americana*) Wild celery, (*Eleocharis acicularis*) Needle spikerush, (*Juncus pelocarpus*) Brown-fruited rush, (*Najas guadalupensis*) Southern naiad

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Najas guadalupensis var. olivacea*) **Southern naiad**
Specimen Location: Clear Lake; N46.09607°, W91.23120°
Also found in: Spider Lake
Collected/Identified by: Matthew S. Berg/Dr. Donald Les, UCONN
Col. #: MSB-2012-308
Habitat/Distribution: Abundant over marl and muck bottoms in 0.5-5.5 meters of water at the point. Told from *N. flexilis* by the dark green color, brittle nature of stems, and blunt leaf tips that don't taper. Plants dominated many areas in the bays and shallow flats of Little Spider and Clear Lake.
Common Associates: (*Potamogeton gramineus*) Variable pondweed, (*Sagittaria cristata*) Crested arrowhead, (*Najas flexilis*) Slender naiad, (*Potamogeton illinoensis*) Illinois pondweed, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton robbinsii*) Fern pondweed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Nitella* sp.) **Nitella**
Specimen Location: Spider Lake; N46.10149°, W91.19423°
Also found in: North Lake
Collected/Identified by: Matthew S. Berg/Paul M. Skawinski Col. #: MSB-2012-309
Habitat/Distribution: Muck bottom area in water generally from 3-5 meters. *N. flexilis* dominated the bottom in the northeast finger bay of Big Spider while *N. acuminata?* was common scattered throughout North Lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Elodea canadensis*) Common waterweed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Nuphar variegata*) **Spatterdock**
Specimen Location: Clear Lake; N46.09947°, W91.22945°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-310
Habitat/Distribution: Muck/Marl/Sand bottoms in 0.5-2 meters of water where it often forms dense canopies. Less common than White water lily in muck bays and along sheltered shorelines.
Common Associates: (*Nymphaea odorata*) White water lily, (*Potamogeton natans*) Floating-leaf pondweed, (*Pontederia cordata*) Pickerelweed, (*Brasenia schreberi*) Watershield

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Nymphaea odorata*) **White water lily**
Specimen Location: Clear Lake; N46.09805°, W91.24279°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-311
Habitat/Distribution: Muck bottom in 0-2 meters where it often formed dense canopies with other floating-leaf species. Common to abundant in calm water bays throughout all four lakes.
Common Associates: (*Nuphar variegata*) Spatterdock,
(*Brasenia schreberi*) Watershield, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Utricularia vulgaris*) Common bladderwort, (*Pontederia cordata*) Pickerelweed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Nymphaea odorata*) **White water lily – pink morph**
Specimen Location: Spider Lake; N46.08664°, W91.23642°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-312
Habitat/Distribution: Muck bottom in 0.5-1.5 meters where a few hundred bright pink flowers/dark maroon lilypads was found scattered with normal White water lilies. Restricted to shoreline southwest of the North Star Boy Camp in Little Spider.
Common Associates: (*Nuphar variegata*) Spatterdock,
(*Elodea canadensis*) Common waterweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Utricularia vulgaris*) Common bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/9/12
Species: (*Polygonum amphibium*) **Water smartweed**
Specimen Location: Spider Lake; N46.09771°, W91.21937°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-313
Habitat/Distribution: Rare; A few clusters of plants were located over rock and sand near the shore in 1meter of water in Big Spider.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Potamogeton gramineus*) Variable pondweed, (*Najas flexilis*) Slender naiad, (*Ranunculus flammula*) Creeping spearwort

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Pontederia cordata*) **Pickerelweed**
Specimen Location: Clear Lake; N46.09805°, W91.24279°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-314
Habitat/Distribution: Silt to muck bottom over firm substrate in 0-1.5 meters of water. Common in emergent beds throughout all four lakes; especially in sheltered bays.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Eleocharis palustris*) Creeping spikerush

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Potamogeton amplifolius*) **Large-leaf pondweed**
Specimen Location: Clear Lake; N46.09608°, W91.22937°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-315
Habitat/Distribution: Found in most muck bottom areas in water from 1-5m deep. Common and widely distributed throughout all four lakes; especially common over marl/muck areas in Little Spider and Clear.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Potamogeton praelongus*) White-stem pondweed, (*Ceratophyllum demersum*) Coontail, (*Najas guadalupensis*) Southern naiad

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Potamogeton crispus*) **Curly-leaf pondweed**
Specimen Location: Spider Lake; N46.09712°, W91.22020°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-316
Habitat/Distribution: Widely distributed throughout Big Spider/represented by a handful of plants in Little Spider. Seldom invasive, CLP occupied a fairly narrow ecological niche in 8-12ft of water over thick organic rich muck.
Common Associates: (*Elodea canadensis*) Common waterweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Heteranthera dubia*) Water stargrass

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Potamogeton epihydrus*) **Ribbon-leaf pondweed**
Specimen Location: Clear Lake; N46.09091°, W91.23838°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-317
Habitat/Distribution: Found in mucky bottom conditions in water from 0.5-3 meters deep. Uncommon to rare, but widely distributed.
Common Associates: (*Nuphar variegata*) Spatterdock, (*Najas flexilis*) Slender naiad, (*Myriophyllum sibiricum*) Northern water milfoil, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Potamogeton foliosus*) **Leafy pondweed**
Specimen Location: Spider Lake; N46.10192°, W91.20853°
Also found in: Fawn Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-318
Habitat/Distribution: Rare in 1-3.5m over muck; a few individuals were found in Big Spider and Fawn.
Common Associates: (*Najas flexilis*) Slender naiad, (*Potamogeton pusillus*) Small pondweed, (*Nymphaea odorata*) White water lily, (*Brasenia schreberi*) Watershield

County/State: Sawyer County, Wisconsin **Date:** 8/9/12
Species: (*Potamogeton friesii*) **Fries' pondweed**
Specimen Location: Spider Lake; N46.10115°, W91.22618°
Also found in: North and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-319
Habitat/Distribution: Uncommon over muck in water 1-3 meters deep. All location represented by a few plants. This early maturing species may have been more common earlier in the growing season.
Common Associates: (*Najas flexilis*) Slender naiad, (*Vallisneria americana*) Wild celery, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Elodea canadensis*) Common waterweed, (*Potamogeton robbinsii*) Fern Pondweed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Potamogeton gramineus*) **Variable pondweed**
Specimen Location: Clear Lake; N46.09644°, W91.23546°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-320
Habitat/Distribution: Compact morph most common in sandy/muck/marl bottom conditions in shallow water 0.5-1 meter deep, with the larger morph found to 4 meters. Deeper water specimens merged morphologically with *P. illinoensis*, and it seems likely there may be some gene flow between the two species on the lake. Abundant in Clear and Spider; rare in North and Fawn.
Common Associates: (*Najas flexilis*) Slender naiad, (*Potamogeton praelongus*) White-stem pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Chara* sp.) Muskgrass, (*Elodea canadensis*) Common waterweed, (*Najas guadalupensis*) Southern naiad, (*Sagittaria cristata*) Crested arrowhead

County/State: Sawyer County, Wisconsin **Date:** 8/9/12
Species: (*Potamogeton illinoensis*) **Illinois pondweed**
Specimen Location: Clear Lake; N46.09301°, W91.22179°
Also found in: Spider and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-321
Habitat/Distribution: Muck, sand and rock bottom in 0.5-4m of water. Most common in more nutrient rich organic muck area in Big Spider and Fern. Also found on rock bars in the upper 1/3rd of Little Spider. Submerged leaves had 15-17 veins on most leaves, and plants had large keeled stipules. Morphology was continuous with deep water *P. gramineus*, and it seems there is likely some gene flow between the species.
Common Associates: (*Najas flexilis*) Slender naiad, (*Vallisneria americana*) Wild celery, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Elodea canadensis*) Common waterweed, (*Potamogeton robbinsii*) Fern Pondweed, (*Potamogeton strictifolius*) Stiff Pondweed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Potamogeton natans*) **Floating-leaf pondweed**
Specimen Location: Clear Lake; N46.09805°, W91.24279°
Also found in: Spider and North Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-322
Habitat/Distribution: Muck and sand bottoms in <1.5meters of water. Scattered beds occurred in all three lakes; especially common near floating muck bogs in North Lake.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Utricularia vulgaris*) Common bladderwort, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Pontederia cordata*) Pickerelweed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Potamogeton praelongus*) **White-stem pondweed**
Specimen Location: Clear Lake; N46.09608°, W91.22937°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-323
Habitat/Distribution: Muck and marl bottom in <4.5meters of water. Common and widespread in all four lakes.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Najas flexilis*) Slender naiad, (*Najas guadalupensis*) Southern naiad, (*Potamogeton praelongus*) White-stem pondweed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Potamogeton pusillus*) **Small pondweed**
Specimen Location: Clear Lake; N46.09805°, W91.24279°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-324
Habitat/Distribution: Nutrient rich organic muck bottoms in 1-6 meters of water. A single cluster was seen in Clear Lake and it was rare in Little Spider, but plants were common and widely distributed in Big Spider, Fawn and North Lakes.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Elodea canadensis*) Common waterweed, (*Najas flexilis*) Slender naiad, (*Myriophyllum sibiricum*) Northern water milfoil

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Potamogeton richardsonii*) **Clasping-leaf pondweed**
Specimen Location: Clear Lake; N46.09775°, W91.23184°
Also found in: Spider and North Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-325
Habitat/Distribution: Found in sand and muck bottom conditions in water 1-3.5 meters deep. Common and widespread in North and Big Spider; Uncommon and local in Fawn, Little Spider and Clear Lakes.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed, (*Najas flexilis*) Slender naiad, (*Myriophyllum sibiricum*) Northern water milfoil, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Elodea canadensis*) Common waterweed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Potamogeton robbinsii*) **Fern pondweed**
Specimen Location: Clear Lake; N46.09898°, W91.23552°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-326
Habitat/Distribution: Often dominant in its preferred habitat of organic muck in 2-4 meters of water – found from 1-6m. Plants were abundant in the "deep hole" in Clear and throughout Little Spider, and common in the boggy north/northeast bays of Big Spider and throughout Fawn and North Lakes.
Common Associates: (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton praelongus*) White-stem pondweed, (*Potamogeton crispus*) Curly-leaf pondweed, (*Ceratophyllum demersum*) Coontail, (*Elodea canadensis*) Common waterweed, (*Myriophyllum sibiricum*) Northern water milfoil

County/State: Sawyer County, Wisconsin **Date:** 8/9/12
Species: *(Potamogeton strictifolius)* **Stiff pondweed**
Specimen Location: Spider Lake; N46.10556°, W91.19600°
Also found in: Fawn Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-327
Habitat/Distribution: Uncommon over thin muck and rock in 1-3.5m of water. Most plants were most common in the northeast bay of Big Spider, but were also regularly encountered in the shallow flats and rock bars in the north and northeast bays of Little Spider. A single cluster was found in Fawn Lake.
Common Associates: (*Potamogeton illinoensis*) Illinois pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Najas flexilis*) Slender naiad, (*Elodea canadensis*) Common waterweed, (*Potamogeton gramineus*) Variable pondweed, (*Vallisneria americana*) Wild celery, (*Myriophyllum sibiricum*) Northern water milfoil

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Potamogeton zosteriformis*) **Flat-stem pondweed**
Specimen Location: Clear Lake; N46.09817°, W91.23185°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-328
Habitat/Distribution: Thick nutrient rich organic muck bottom areas in water from 1-5.5m deep. Widely distributed and common in North, Fawn, and Big Spider; uncommon to rare in Little Spider and Clear Lakes.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Elodea canadensis*) Common waterweed, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton praelongus*) White-stem pondweed, (*Najas flexilis*) Slender naiad, (*Myriophyllum sibiricum*) Northern water milfoil

County/State: Sawyer County, Wisconsin **Date:** 8/9/12
Species: *(Ranunculus aquatilis)* **White water crowfoot**
Specimen Location: Spider Lake; N46.10243°, W91.21611°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-329
Habitat/Distribution: Rare; plants were scattered along rock/gravel bars and exposed points in water <1.5. Located at only four points in Big Spider.
Common Associates: (*Schoenoplectus acutus*) Hardstem bulrush, (*Najas flexilis*) Slender naiad, (*Potamogeton gramineus*) Variable pondweed, (*Chara* sp.) Muskgrass

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: *(Ranunculus flammula)* **Creeping spearwort**
Specimen Location: Clear Lake; N46.10024°, W91.23676°
Also found in: Spider Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-330
Habitat/Distribution: Sand and sandy muck along undeveloped shorelines in water <1m deep. Scattered locations in both lakes; especially common along islands.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Elatine minima*) Waterwort, (*Utricularia resupinata*) Small purple bladderwort, (*Najas flexilis*) Slender naiad, (*Potamogeton gramineus*) Variable pondweed, (*Chara* sp.) Muskgrass, (*Littorella uniflora*) Littorella, (*Juncus pelocarpus*) Brown-fruited rush

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Sagittaria cristata*) **Crested arrowhead**
Specimen Location: Clear Lake; N46.09607°, W91.23120°
Also found in: Spider Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-331
Habitat/Distribution: Marl and muck in water <2m deep. Plants were common in Clear Lake and the marl bottomed southern bays of Little Spider. In many areas of these broad sterile flats, *S. cristata* was the only plant present.
Common Associates: (*Potamogeton gramineus*) Variable pondweed, (*Najas guadalupensis*) Southern naiad, (*Najas flexilis*) Slender naiad, (*Potamogeton illinoensis*) Illinois pondweed, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton robbinsii*) Fern pondweed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Sagittaria latifolia*) **Common arrowhead**
Specimen Location: Clear Lake; N46.09805°, W91.24279°
Also found in: Fawn Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-332
Habitat/Distribution: Relatively common in undeveloped shoreline areas with firm muck bottom in 0-0.25m of water.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Phalaris arundinacea*) Reed canary grass, (*Dulichium arundinaceum*) Three-way sedge, (*Lythrum salicaria*) Purple loosestrife, (*Carex comosa*) Bottle brush sedge

County/State: Sawyer County, Wisconsin **Date:** 8/9/12
Species: (*Schoenoplectus acutus*) **Hardstem bulrush**
Specimen Location: Spider Lake; N46.10554°, W91.19852°
Also found in: North Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-333
Habitat/Distribution: Rocky and sandy bottoms in 0-1.5 meters of water. Common in scattered reed beds on rock bars/shallow sunken islands and along shore; especially on exposed points of Big Spider.
Common Associates: (*Eleocharis palustris*) Creeping spikerush, (*Eleocharis acicularis*) Needle spikerush, (*Chara* sp.) Muskgrass, (*Pontederia cordata*) Pickerelweed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: *(Schoenoplectus subterminalis)* **Water bulrush**
Specimen Location: Clear Lake; N46.10153°, W91.23436°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-334
Habitat/Distribution: Muck bottoms in <1.5m of water. Uncommon in boggy bays and near/on floating muck mats on Spider, North and Clear; however, plants were abundant in the outlet channel to Spider from Fawn.
Common Associates: (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Brasenia schreberi*) Watershield, (*Utricularia gibba*) Creeping bladderwort, (*Pontederia cordata*) Pickerelweed, (*Potamogeton gramineus*) Variable pondweed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Schoenoplectus tabernaemontani*) **Softstem bulrush**
Specimen Location: Clear Lake; N46.09350°, W91.23418°
Also found in: North Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-335
Habitat/Distribution: Firm muck bottoms in 0.5-1.0 meter of water. Scattered individuals were located on the northeast end of the eastern side of Butternut island.
Common Associates: (*Calamagrostis canadensis*) Blue joint**,** (*Eleocharis palustris*) Creeping spikerush, (*Dulichium arundinaceum*) Three-way sedge

County/State: Sawyer County, Wisconsin **Date:** 8/11/12
Species: (*Scirpus cyperinus*) **Woolgrass**
Specimen Location: Fawn Lake; N46.11358°, W91.22146°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-336
Habitat/Distribution: Firm muck bottoms in 0-0.25 meter of water. Scattered individuals were located on the western shore of Fawn.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Sparganium emersum*) Short-stemmed bur-reed**,** (*Sagittaria latifolia*) Common arrowhead, (*Dulichium arundinaceum*) Three-way sedge, (*Carex lasiocarpa*) Narrow-leaved woolly sedge

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: *(Sparganium angustifolium)* **Narrow-leaved bur-reed**
Specimen Location: Clear Lake; N46.09805°, W91.24279°
Also found in: Spider Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-337
Habitat/Distribution: Sand and sandy muck in water <1.5m. More common than the survey indicated in Clear Lake where small beds were encountered in many shoreline areas; especially on the western shoreline. In Big Spider, it was rare being only seen at three locations.
Common Associates: (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Najas flexilis*) Slender naiad, (*Utricularia gibba*) Creeping bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/10/12
Species: (*Sparganium emersum*) **Short-stemmed bur-reed**
Specimen Location: Spider Lake; N46.11191°, W91.20455°
Also found in: North and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-338
Habitat/Distribution: Firm muck in water <1m deep. Plants were common in the creek inlet on the far northeast end of the north bay on Big Spider, the channels entering/exiting Fawn, and mixed with rice in the eastern bay of North Lake.
Common Associates: (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Zizania palustris*) Northern wild rice, (*Utricularia vulgaris*) Common bladderwort, (*Myriophyllum verticillatum*) Whorled water milfoil

County/State: Sawyer County, Wisconsin **Date:** 8/10/12
Species: (*Sparganium fluctuans*) **Floating-leaf bur-reed**
Specimen Location: Spider Lake; N46.10266°, W91.19425°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-339
Habitat/Distribution: Firm muck bottoms in water from 1-1.5m. Beds were scattered throughout Big Spider's northeast and northwest bays.
Common Associates: (*Nuphar variegata*) Spatterdock, (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Utricularia gibba*) Creeping bladderwort, (*Chara* sp.) Muskgrass, (*Heteranthera dubia*) Water star-grass

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Typha latifolia*) **Broad-leaved cattail**
Specimen Location: Clear Lake; N46.09805°, W91.24279°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-340
Habitat/Distribution: Thick muck soil in and out of water <0.25 meter deep. Uncommon in scattered undeveloped shoreline areas throughout.
Common Associates: (*Lythrum salicaria*) Purple loosestrife, (*Phalaris arundinacea*) Reed canary grass, (*Leersia oryzoides*) Rice cut-grass, (*Schoenoplectus tabernaemontani*) Softstem bulrush

County/State: Sawyer County, Wisconsin **Date:** 8/8/12
Species: (*Utricularia gibba*) **Creeping bladderwort**
Specimen Location: Spider Lake; N46.11636°, W91.21477°
Also found in: North and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-341
Habitat/Distribution: Muck bottom in 0-3m of water. Plants were especially common in North Lake where they were often found interspersed/wrapped around the stems of other plants.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Utricularia minor*) Small bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/12
Species: (*Utricularia intermedia*) **Flat-leaf bladderwort**
Specimen Location: Spider Lake; N46.11636°, W91.21477°
Also found in: North and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-342
Habitat/Distribution: Muck bottom in shallow water 0-1.5 meters deep. Relatively common in boggy bays throughout all three lakes.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Utricularia gibba*) Creeping bladderwort, (*Zizania palustris*) Northern wild rice, (*Sparganium emersum*) Short-stemmed bur-reed

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: *(Utricularia resupinata)* **Small purple bladderwort**
Specimen Location: Clear Lake; N46.10024°, W91.23676°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-343
Habitat/Distribution: Sand and sandy muck bottom in shallow water 0-1.5 meters deep. Relatively common throughout Clear where it often carpeted the bottom with other "isoetids". Surprisingly absent from other similar looking habitat in Little Spider.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Myriophyllum tenellum*) Dwarf water milfoil, (*Elatine minima*) Waterwort, (*Ranunculus flammula*) Creeping spearwort, (*Najas flexilis*) Slender naiad, (*Potamogeton gramineus*) Variable pondweed, (*Chara* sp.) Muskgrass, (*Juncus pelocarpus*) Brown-fruited rush

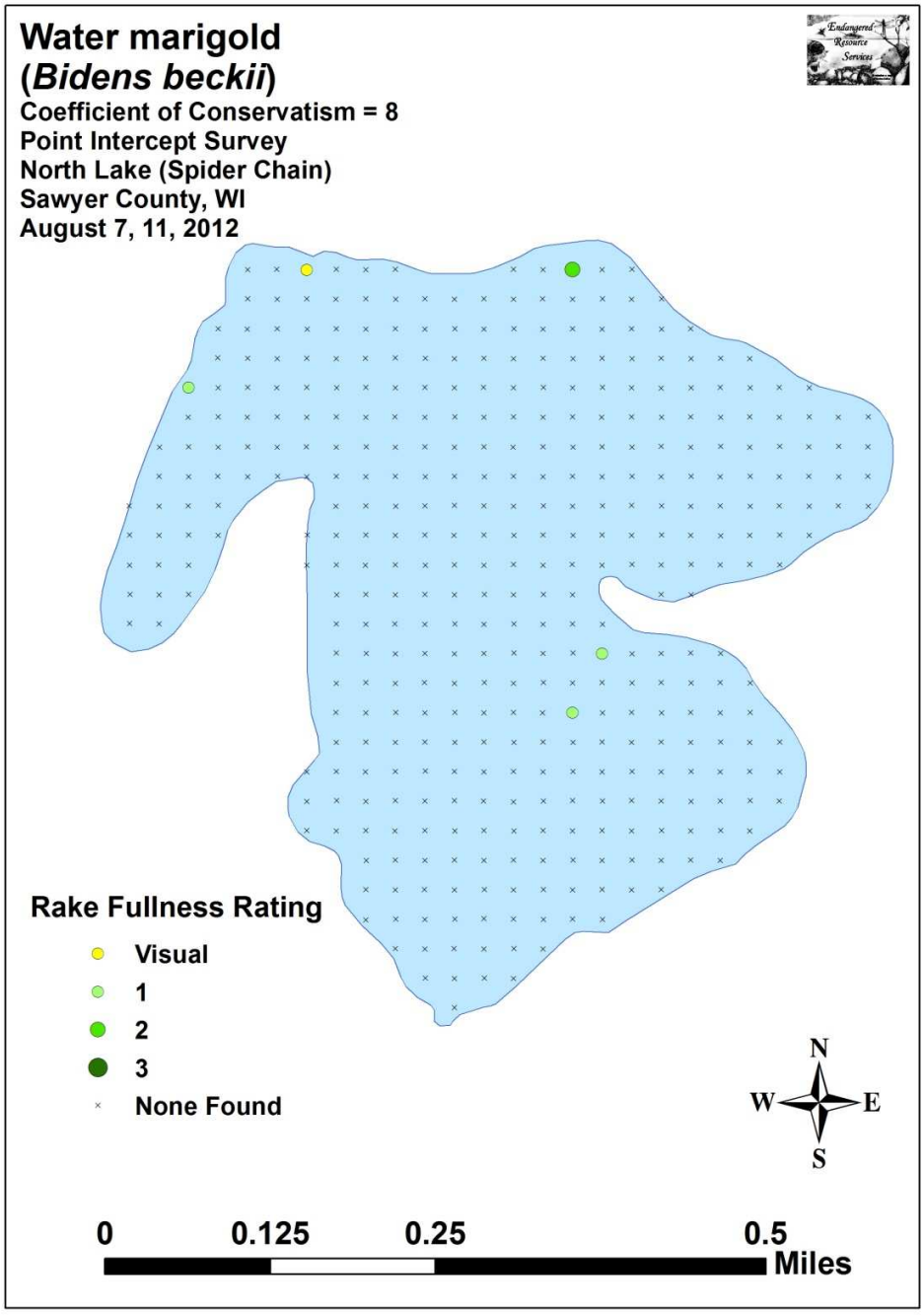
County/State: Sawyer County, Wisconsin **Date:** 8/8/12
Species: (*Utricularia minor*) **Small bladderwort**
Specimen Location: Spider Lake; N46.11636°, W91.21477°
Also found in: North and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-344
Habitat/Distribution: Muck bottoms in shallow water 0.25-1.5 meters deep. Relatively common in boggy bays in all three lakes.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Utricularia gibba*) Creeping bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort

County/State**:** Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Utricularia vulgaris*) **Common bladderwort**
Specimen Location: Clear Lake; N46.09947°, W91.22945°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-345
Habitat/Distribution: Muck bottoms in shallow water 0-2.5 meters deep. Relatively common in boggy bays in all four lakes.
Common Associates: (*Nuphar variegata*) Spatterdock, (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Utricularia gibba*) Creeping bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Vallisneria americana*) **Wild celery**
Specimen Location: Clear Lake; N46.09734°, W91.23062°
Also found in: Spider, North, and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-346
Habitat/Distribution: Found in 0.5-4.5 meters of water in almost any bottom conditions. Most plants were in sandy to sand/muck bottoms. Relatively common and widely distributed throughout all four lakes.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Ceratophyllum demersum*) Coontail, (*Najas flexilis*) Slender naiad, (*Elodea canadensis*) Common waterweed, (*Heteranthera dubia*) Water star-grass

County/State: Sawyer County, Wisconsin **Date:** 8/7/12
Species: (*Zizania palustris*) **Northern wild rice**
Specimen Location: North Lake; N46.11636°, W91.21477°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-347
Habitat/Distribution: Found in water <1m deep over thick organic muck. Uncommon; scattered individuals were interspersed between the lilypads in the eastern bay south of the peninsula on North Lake. Not seen anywhere else in the chain.
Common Associates: (*Nymphaea odorata*) White water lily, (*Nuphar variegata*) Spatterdock, (*Utricularia vulgaris*) Common bladderwort, (*Sparganium emersum*) Short-stemmed bur-reed, (*Utricularia gibba*) Creeping bladderwort

Appendix VII: North Lake P/I Density and Distribution Maps


Water marigold
(Bidens beckii)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
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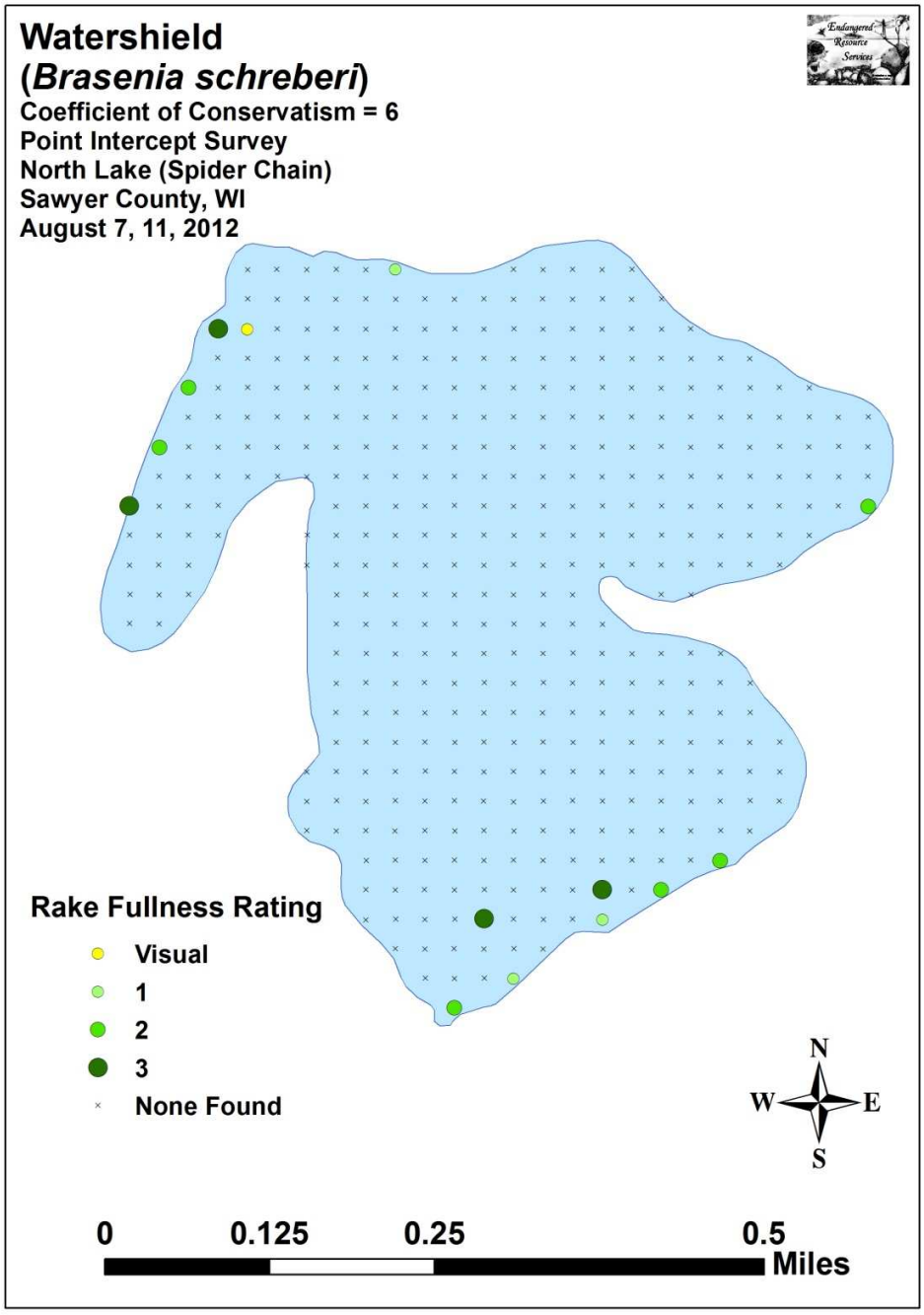
0
0.125
0.25
0.5
Miles


Watershield
(Brasenia schreberi)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
1
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3
None Found
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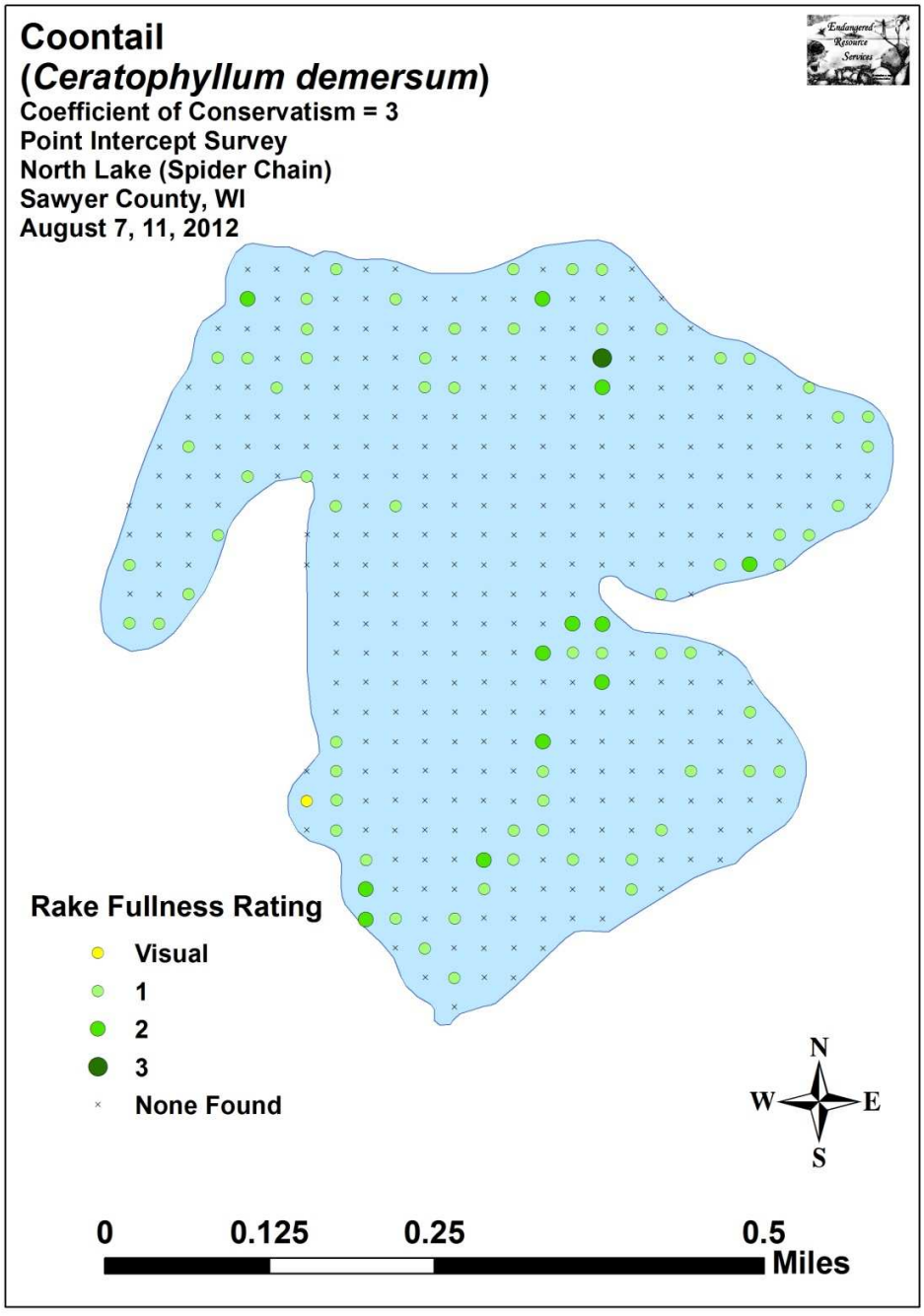
0.5
Miles


Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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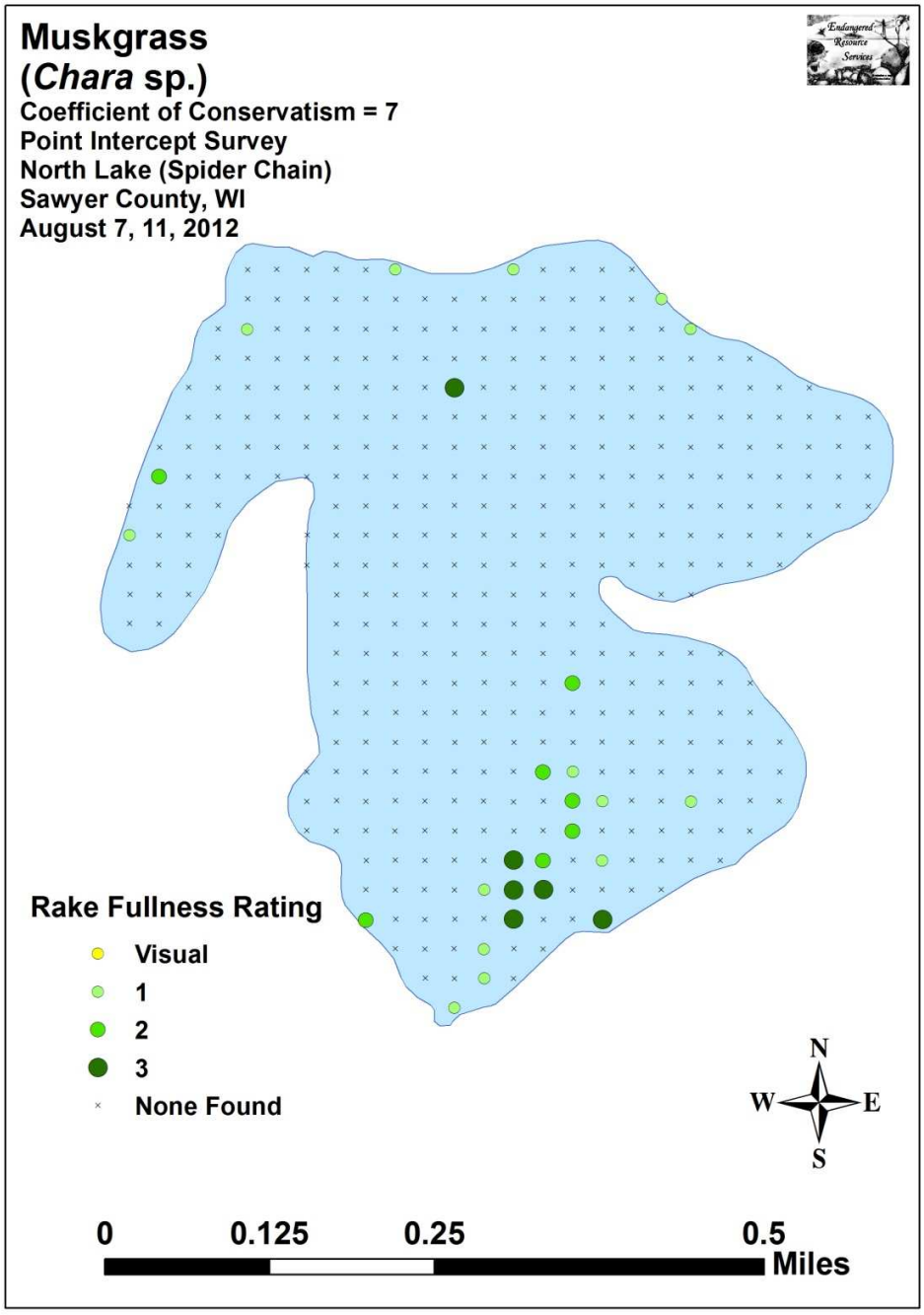
Miles


Muskgrass
(Chara sp.)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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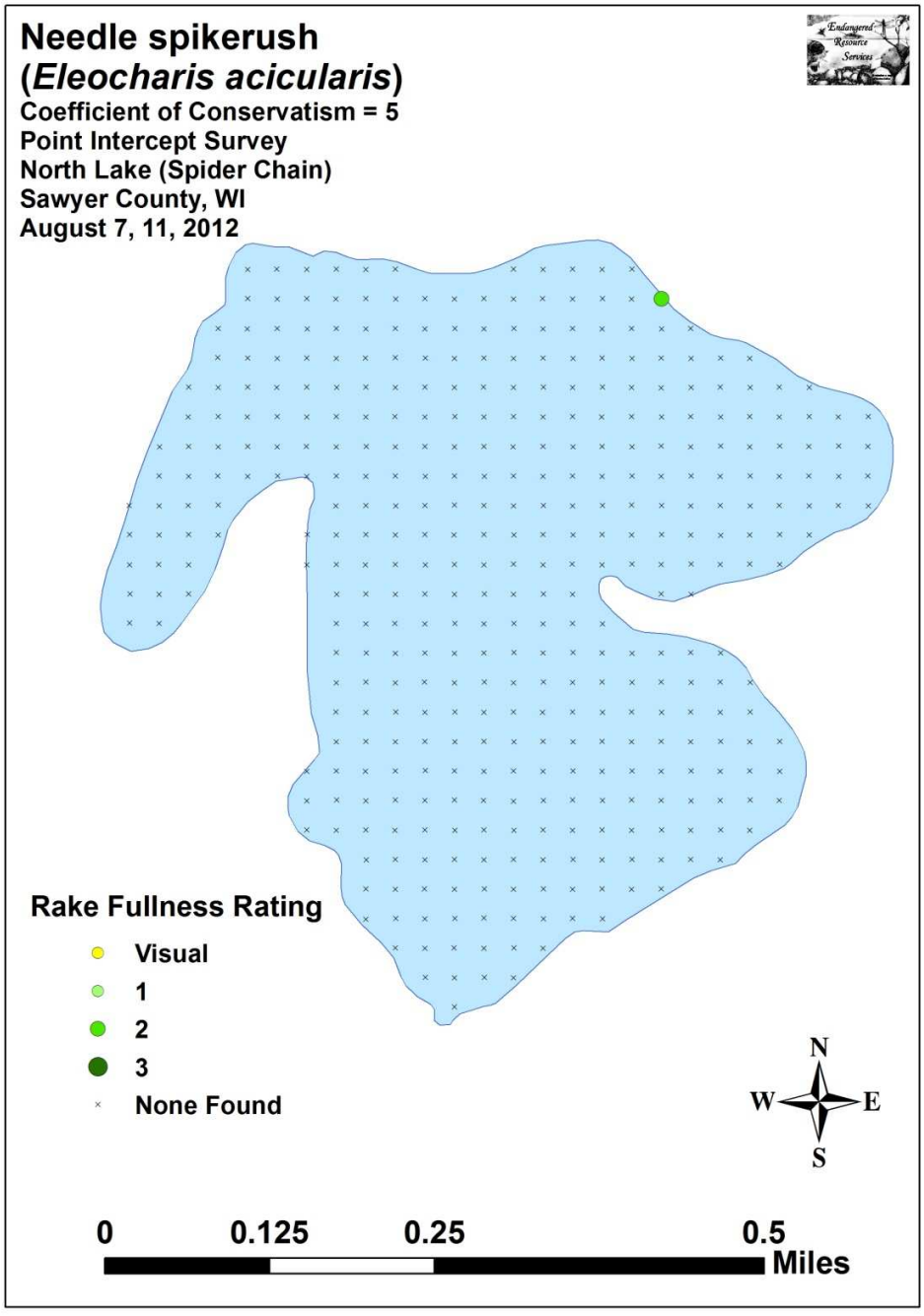
Miles


Needle spikerush
(Eleocharis acicularis)
Coefficient of Conservatism = 5
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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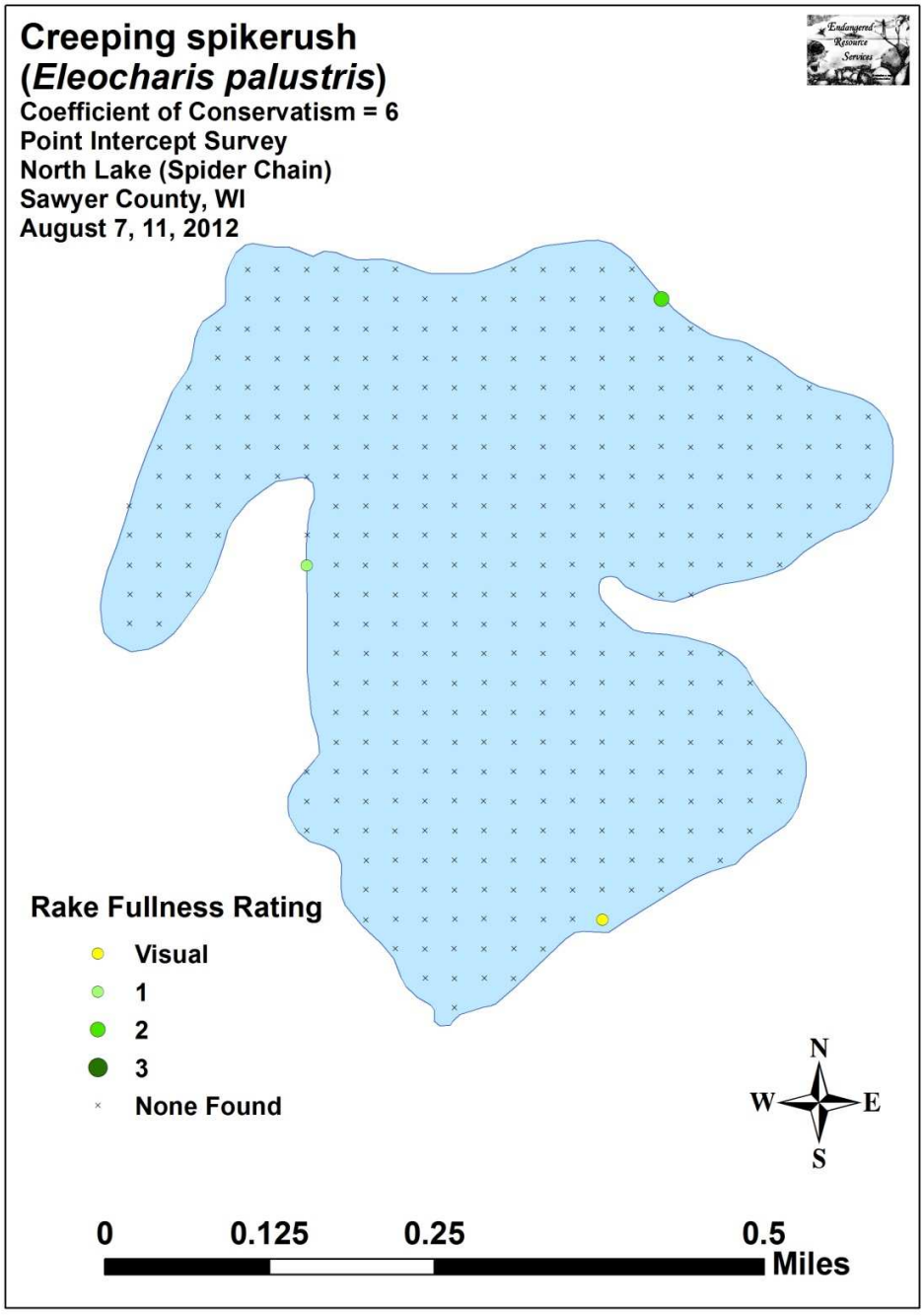
0.25
0.5
Miles


Creeping spikerush
(Eleocharis palustris)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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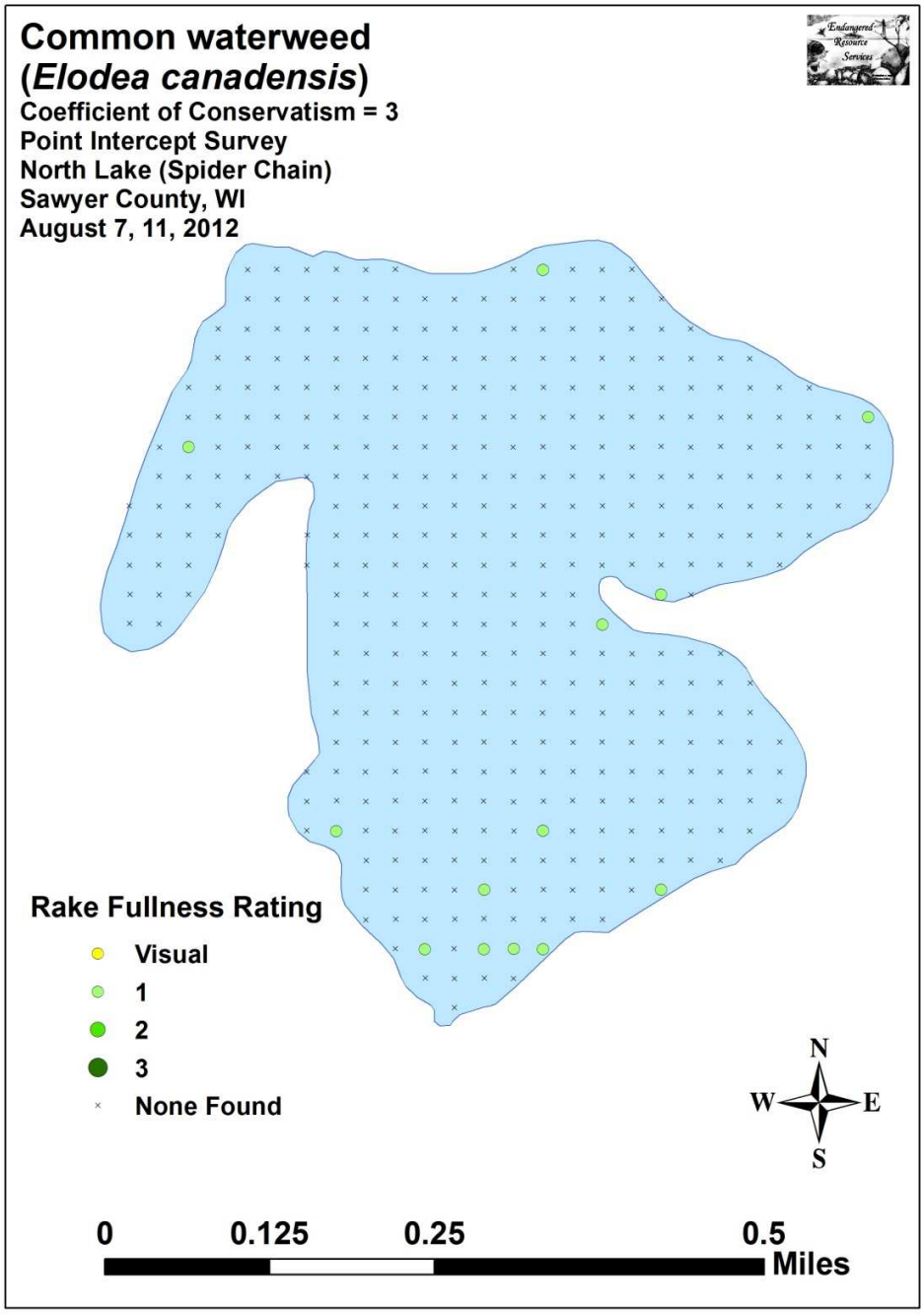
0.125
0.25
0.5
Miles


Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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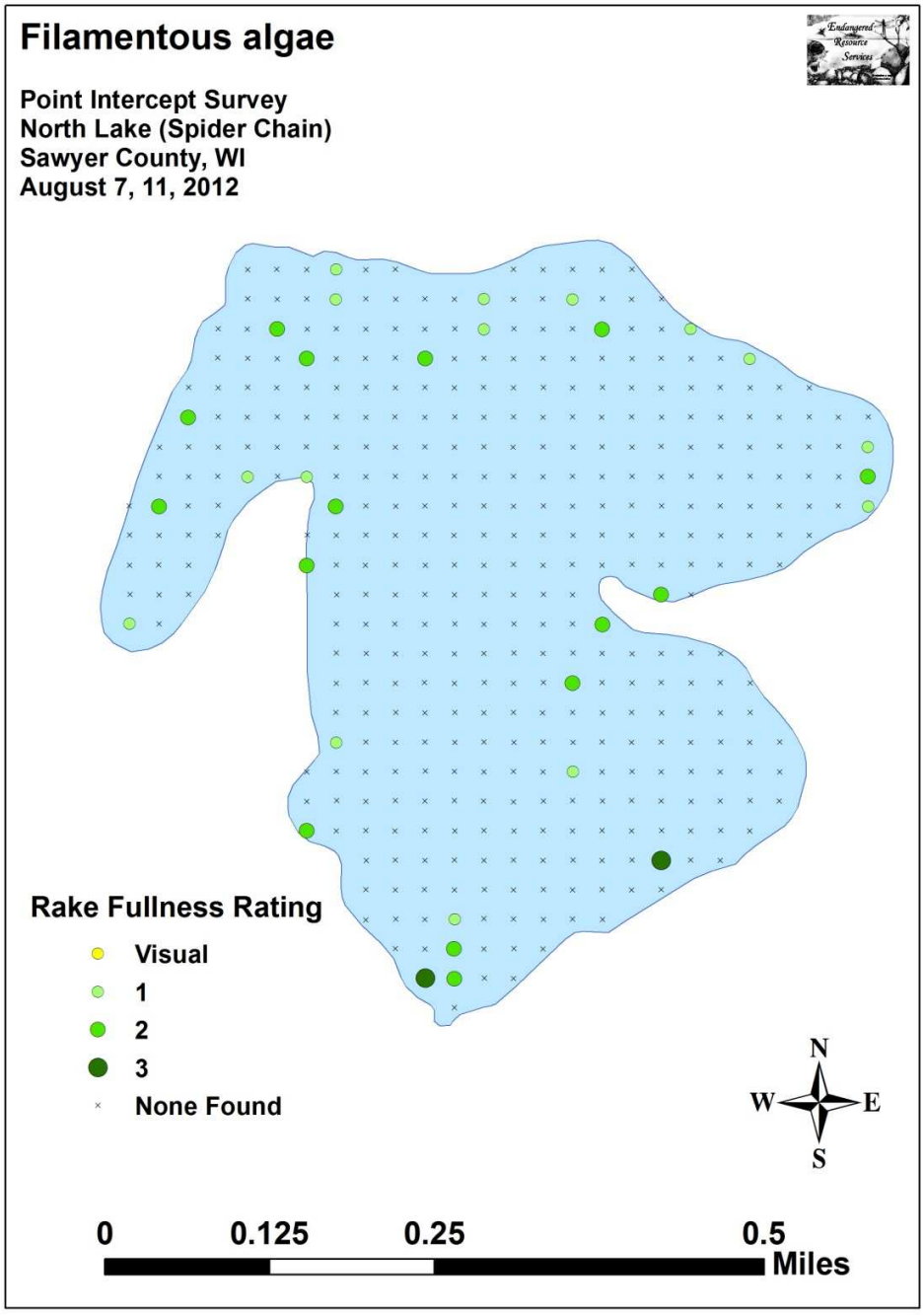
0.125
0.25
0.5
Miles


Filamentous algae
Endangered Resource Services
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Rake Fullness Rating
Visual
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None Found
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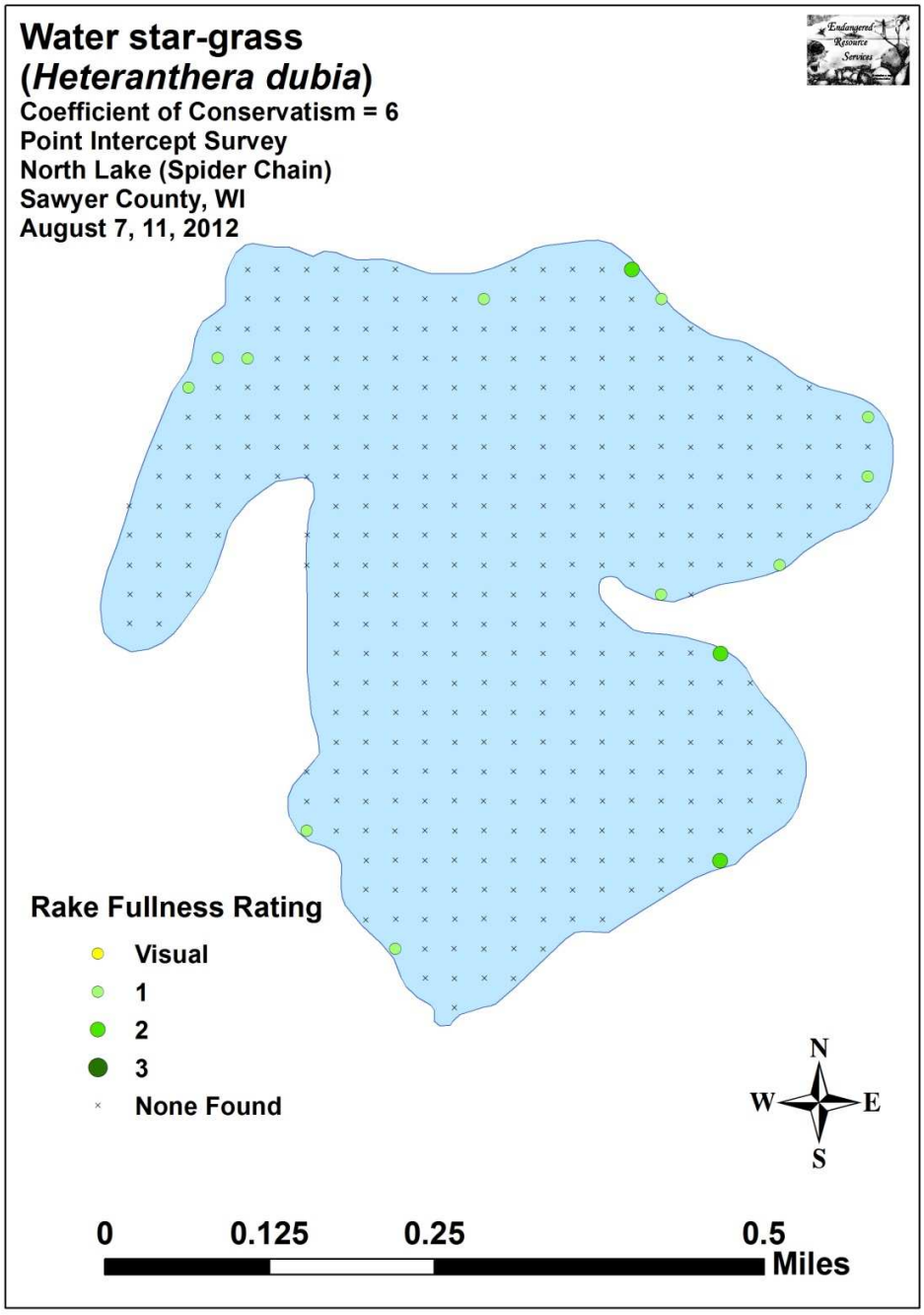
0.125
0.25
0.5
Miles


Water star-grass
(Heteranthera dubia)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
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0.125
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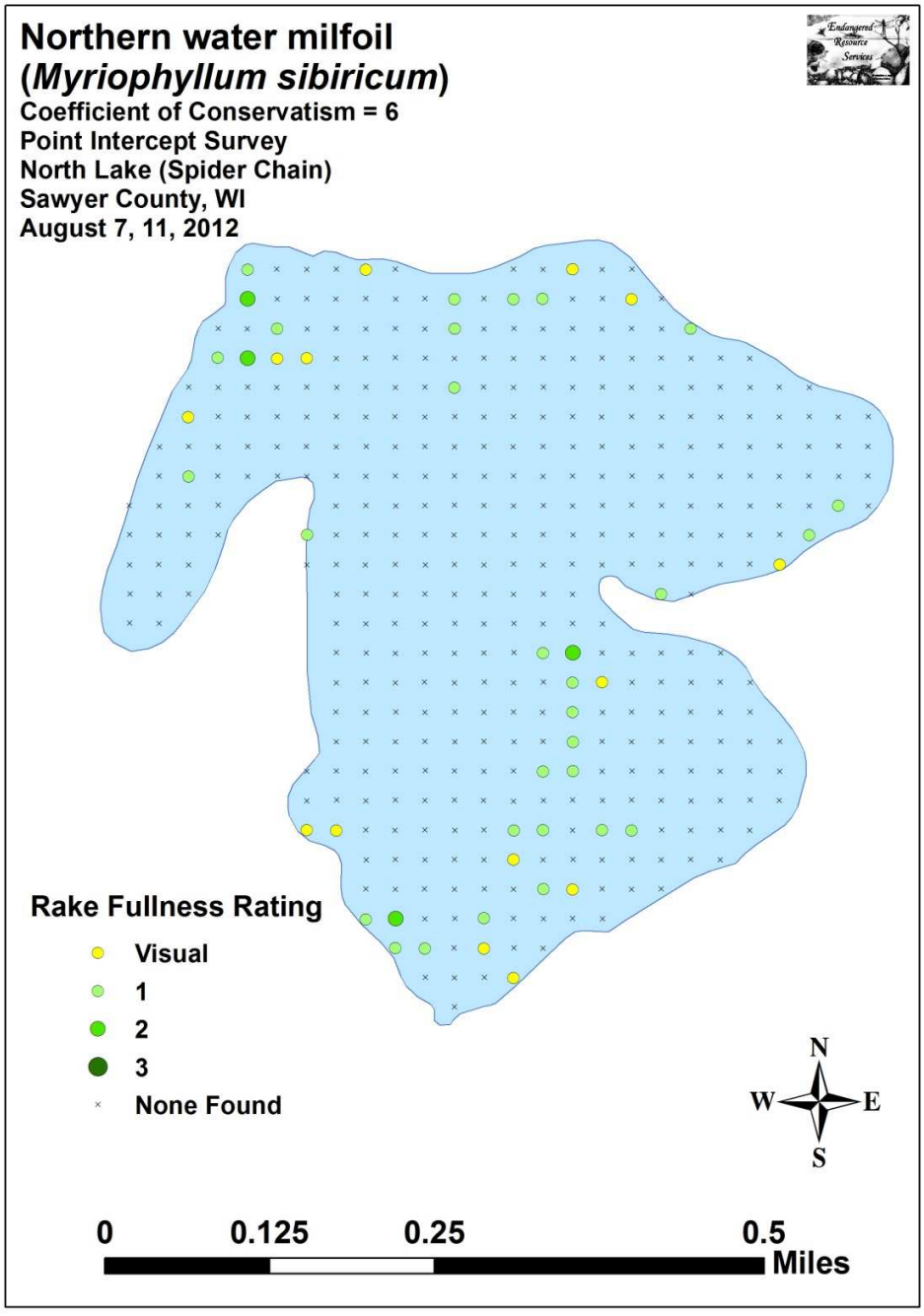
0.5
Miles


Northern water milfoil
(Myriophyllum sibiricum)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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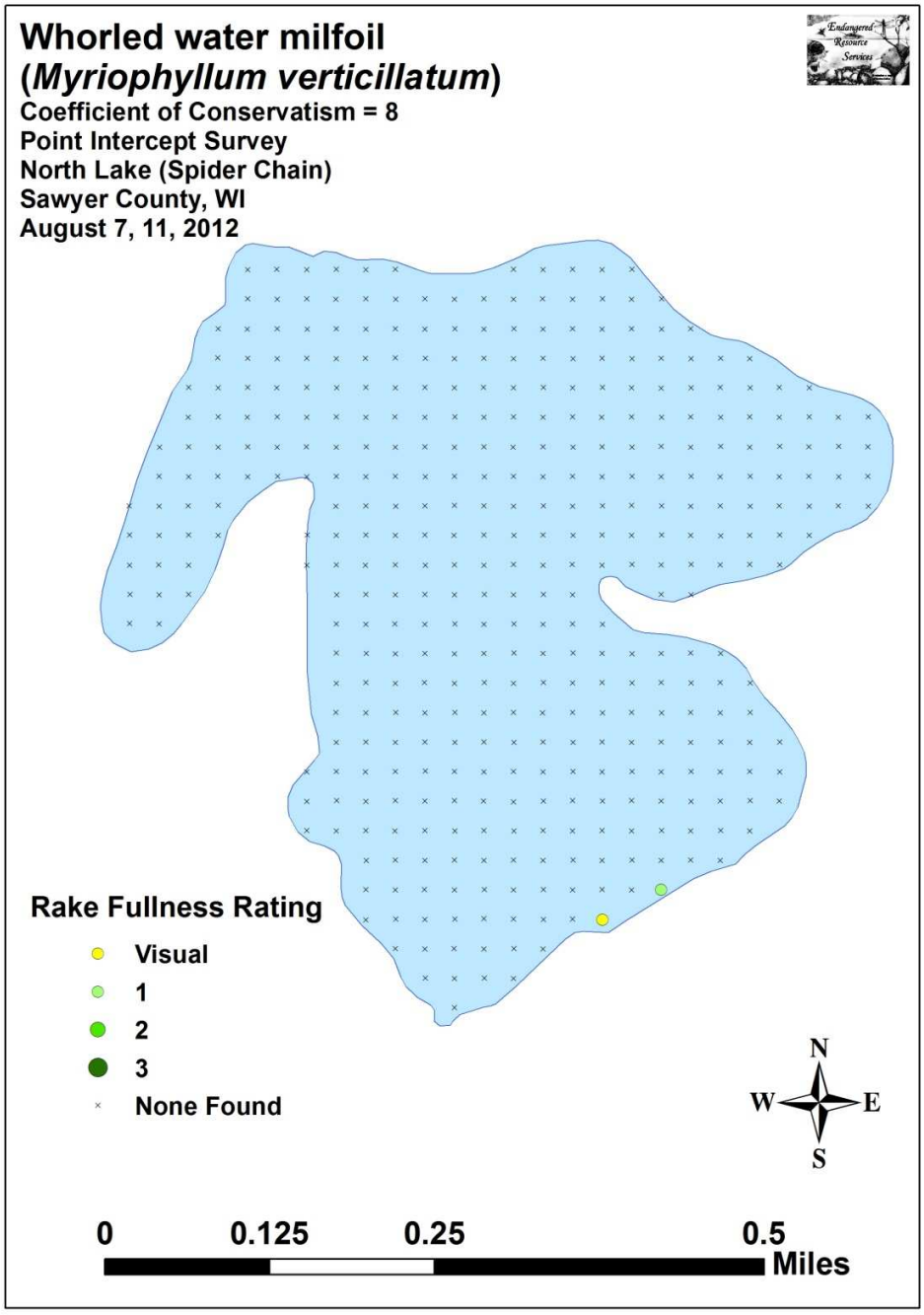
0.25
0.5
Miles


Whorled water milfoil
(Myriophyllum verticillatum)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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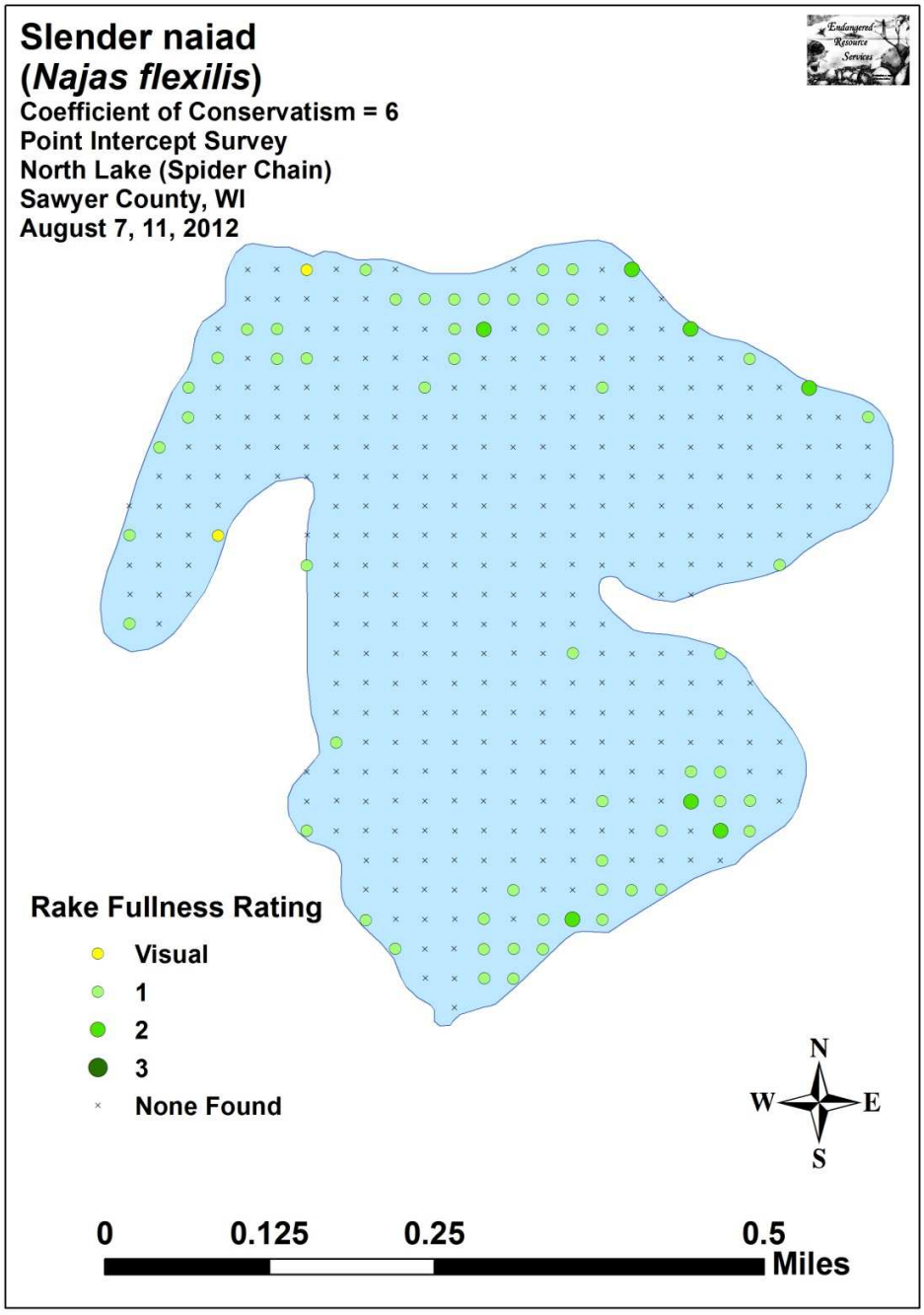
Miles


Slender naiad
(Najas flexilis)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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0.125
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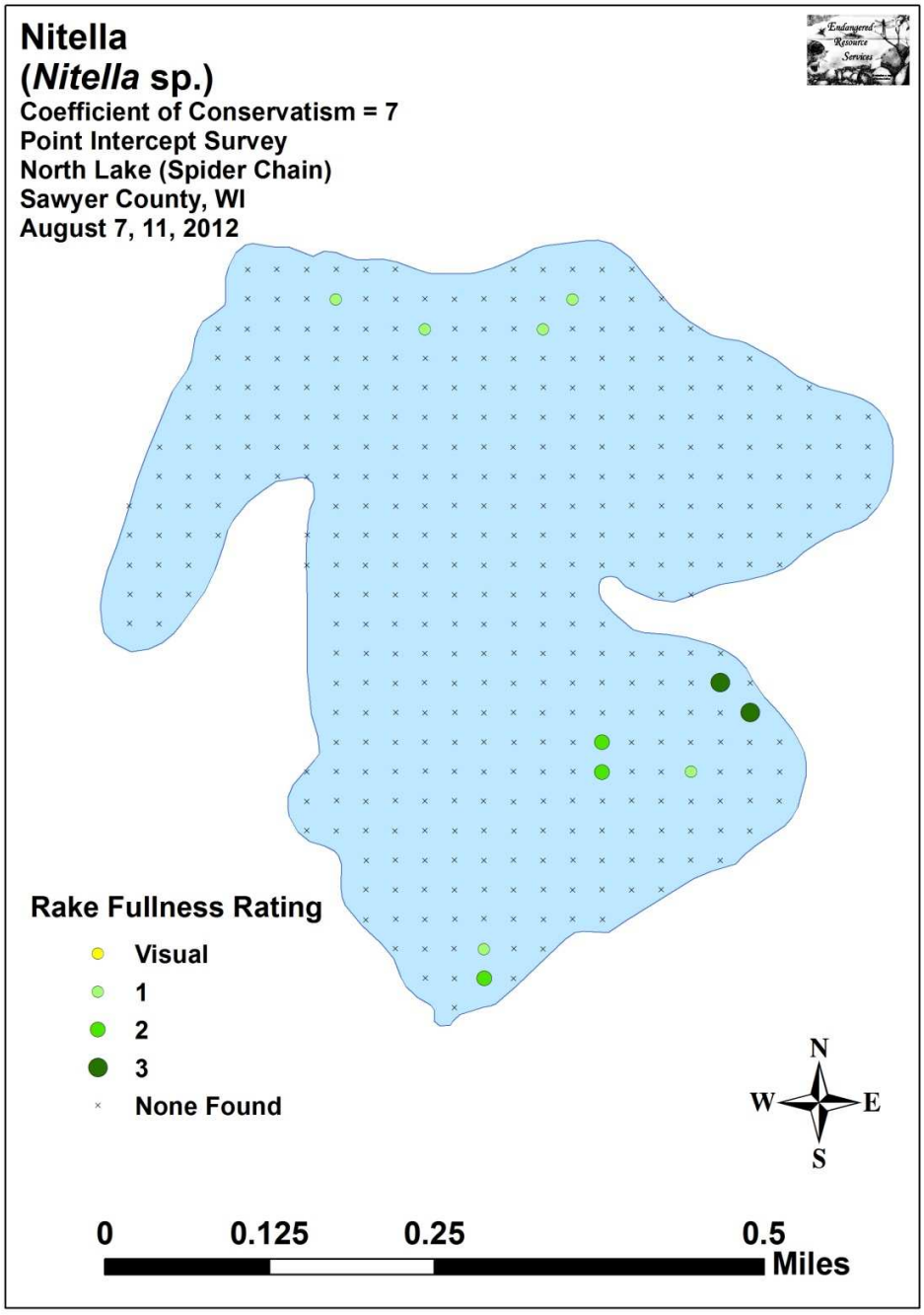
0.5
Miles


Nitella
(Nitella sp.)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
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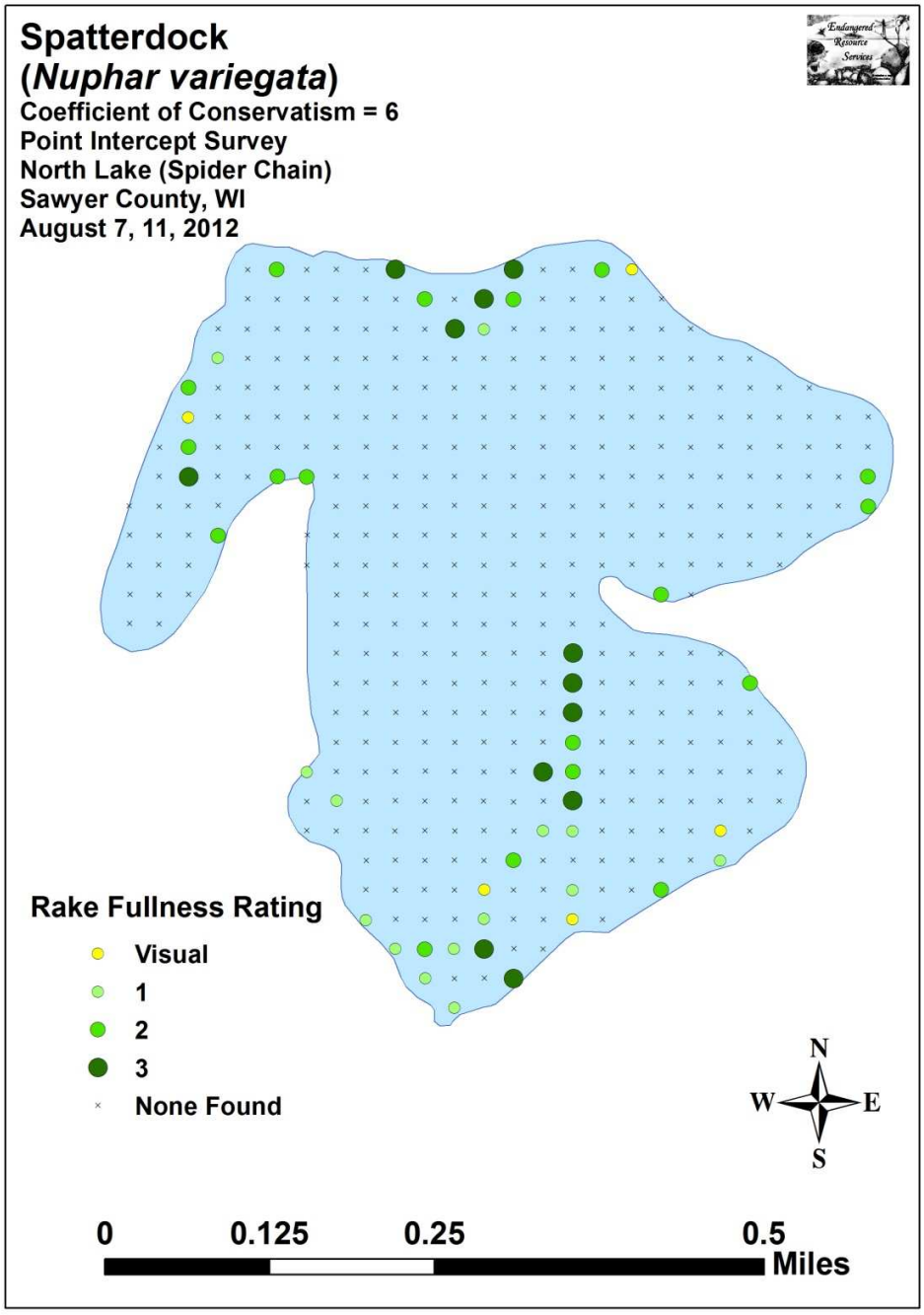
Miles


Spatterdock
(Nuphar variegata)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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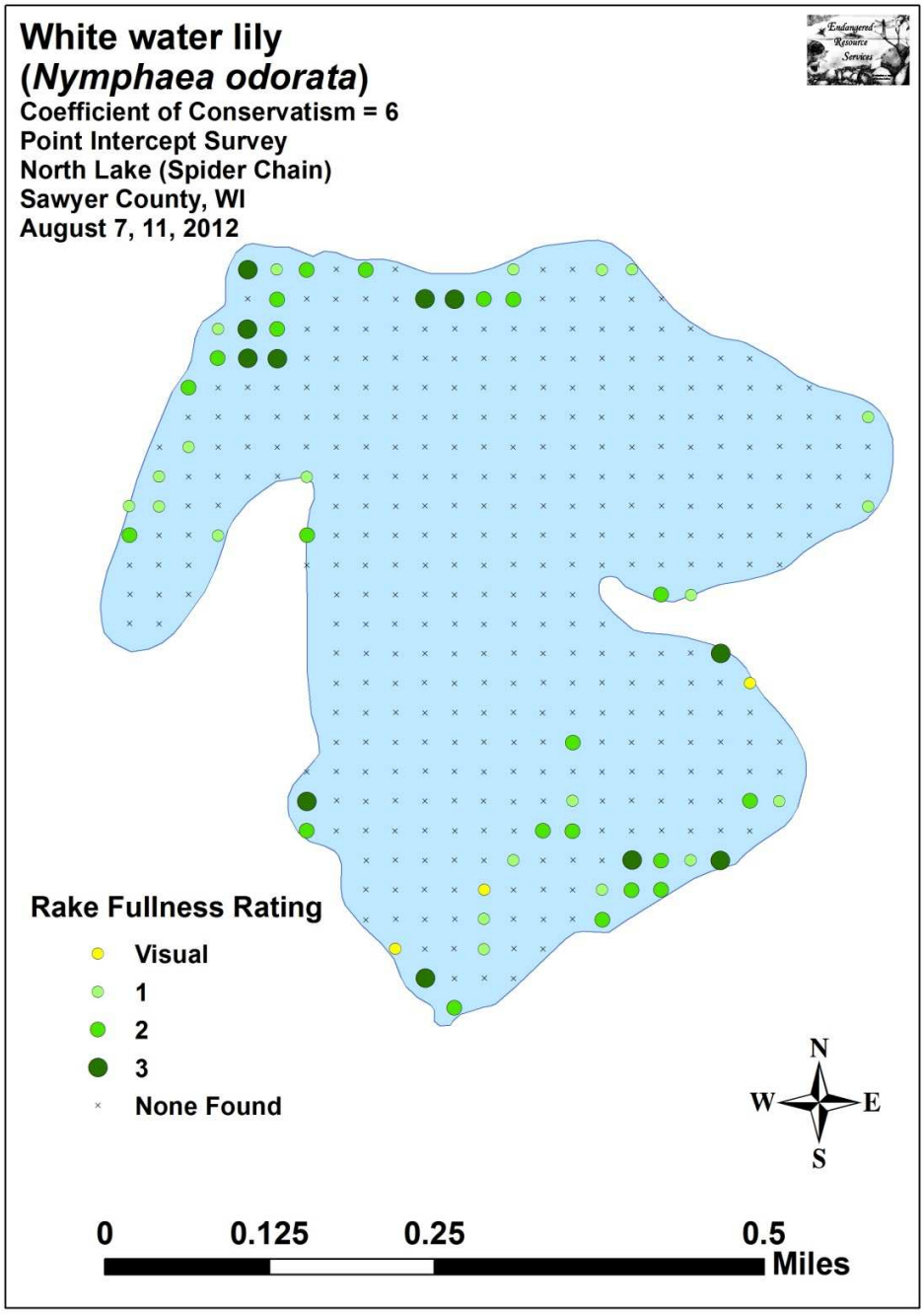
Miles


White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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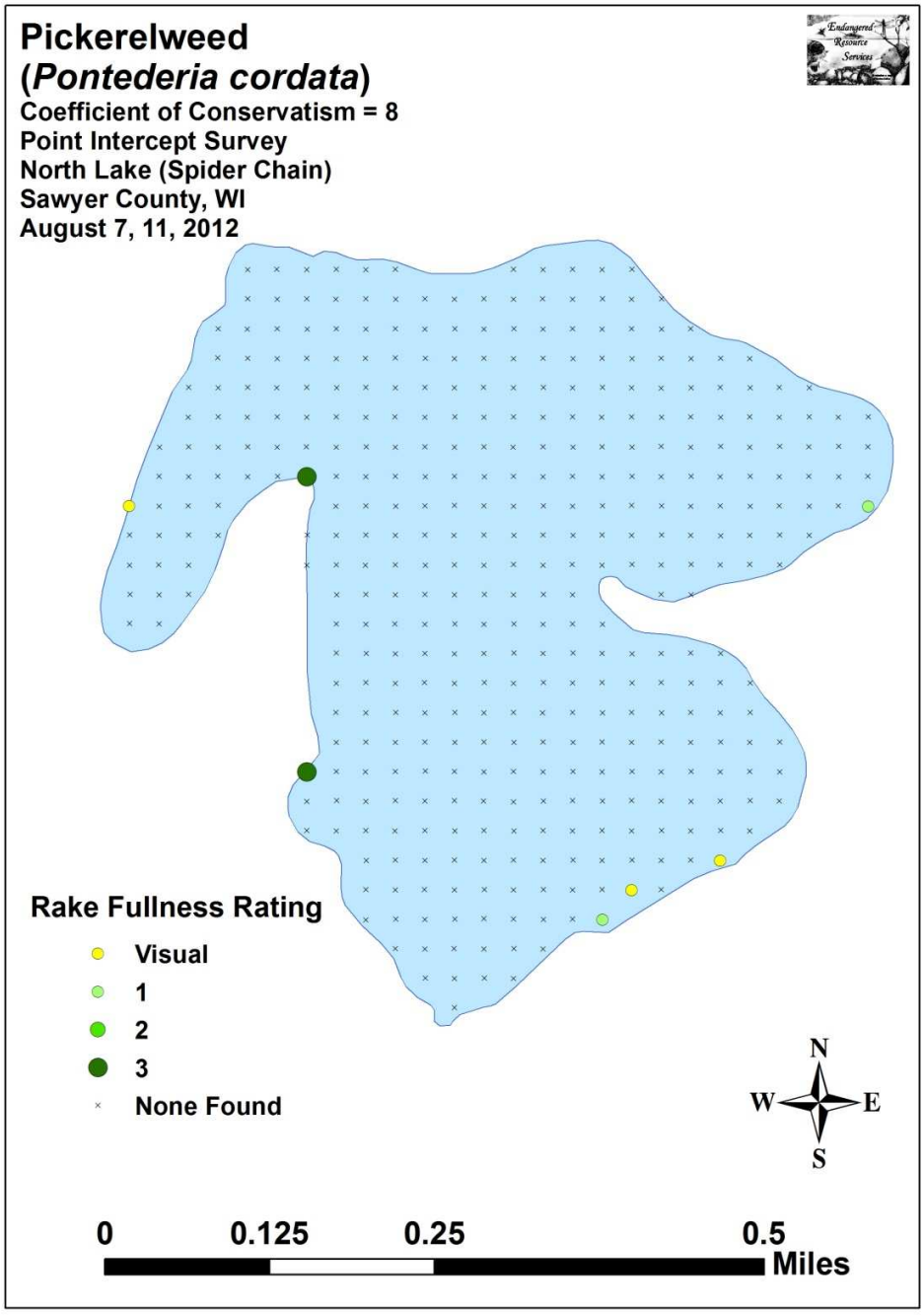
Pickerelweed
(Pontederia cordata)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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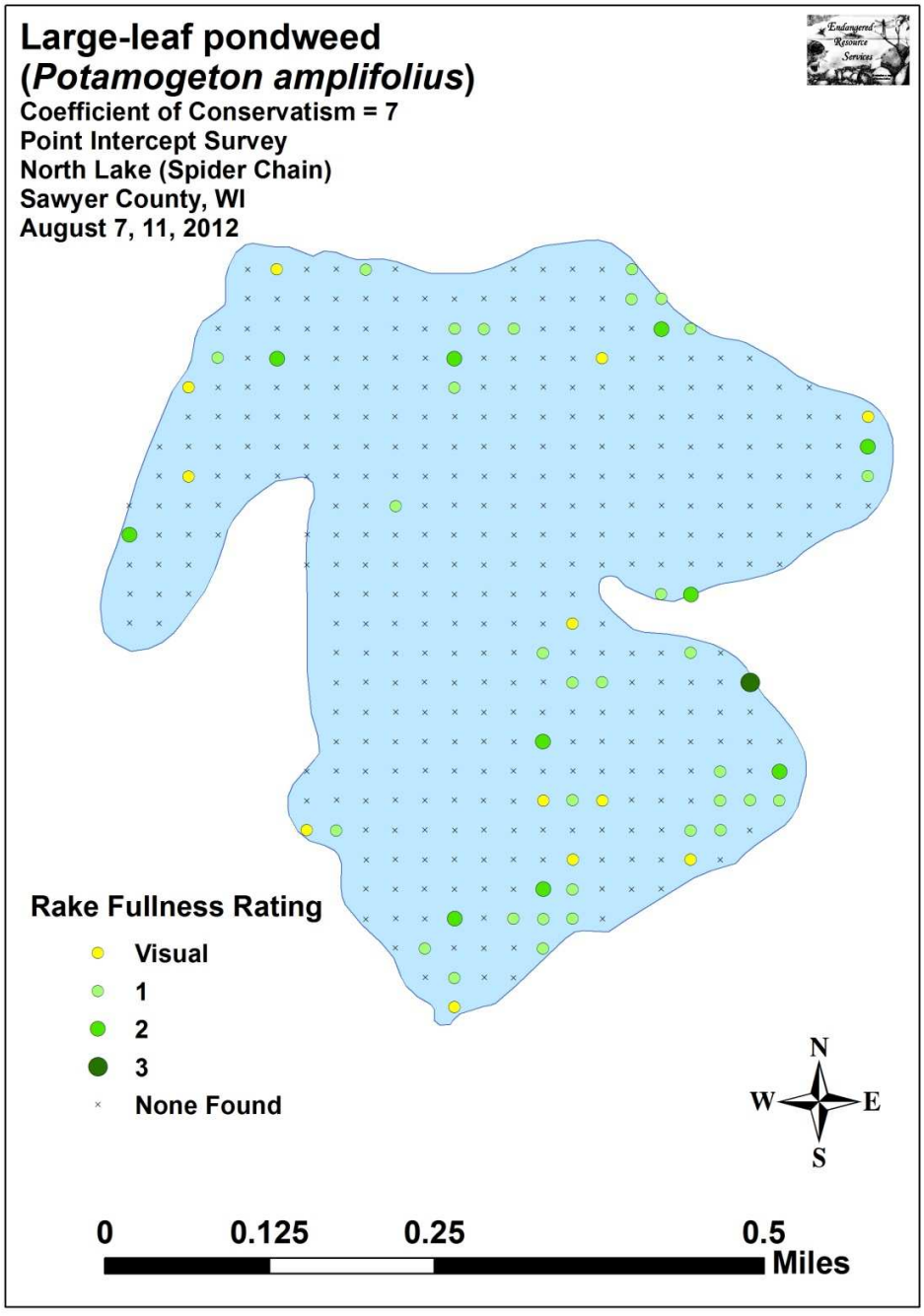
Miles


Large-leaf pondweed
(Potamogeton amplifolius)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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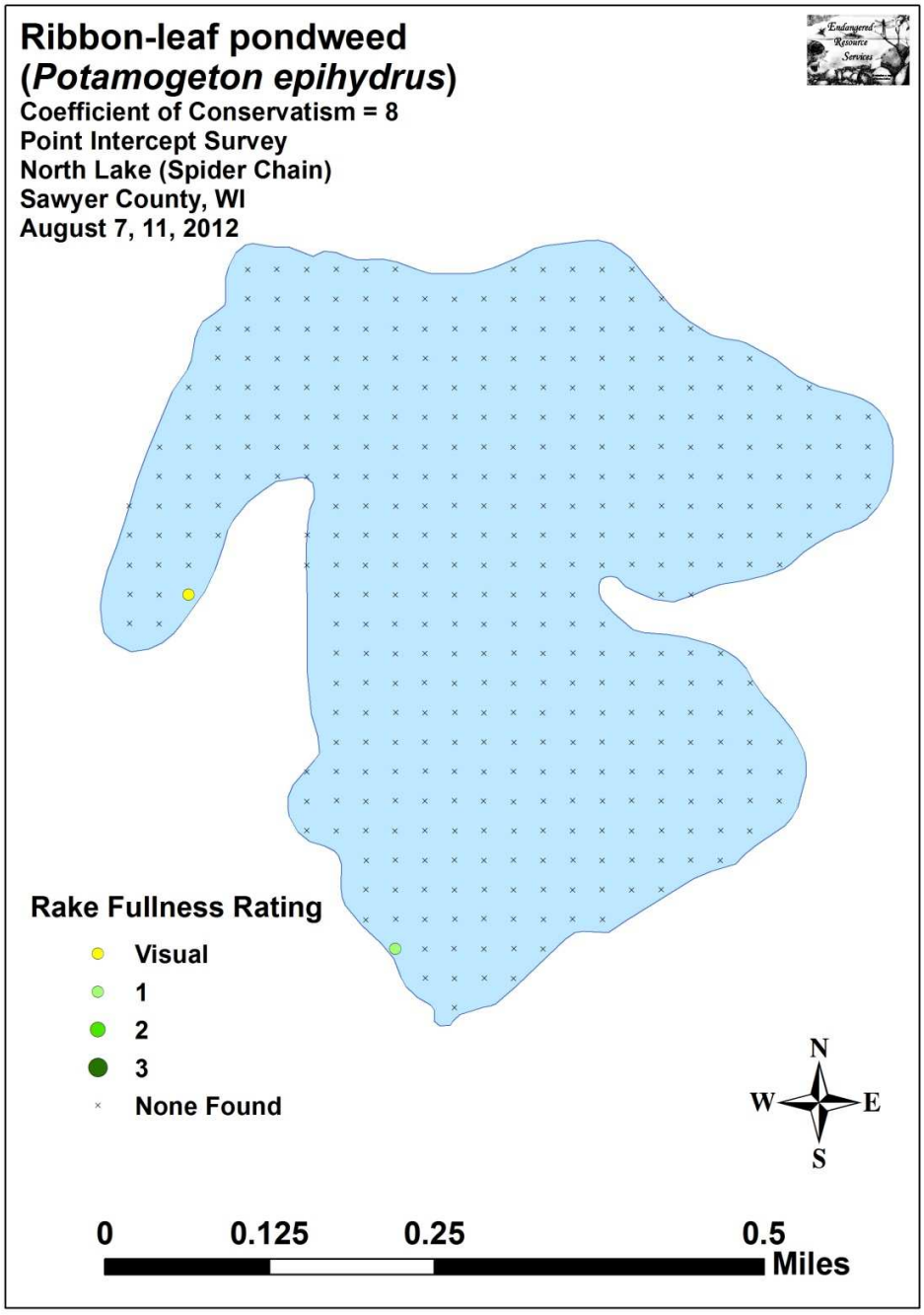
Miles


Ribbon-leaf pondweed
(Potamogeton epihydrus)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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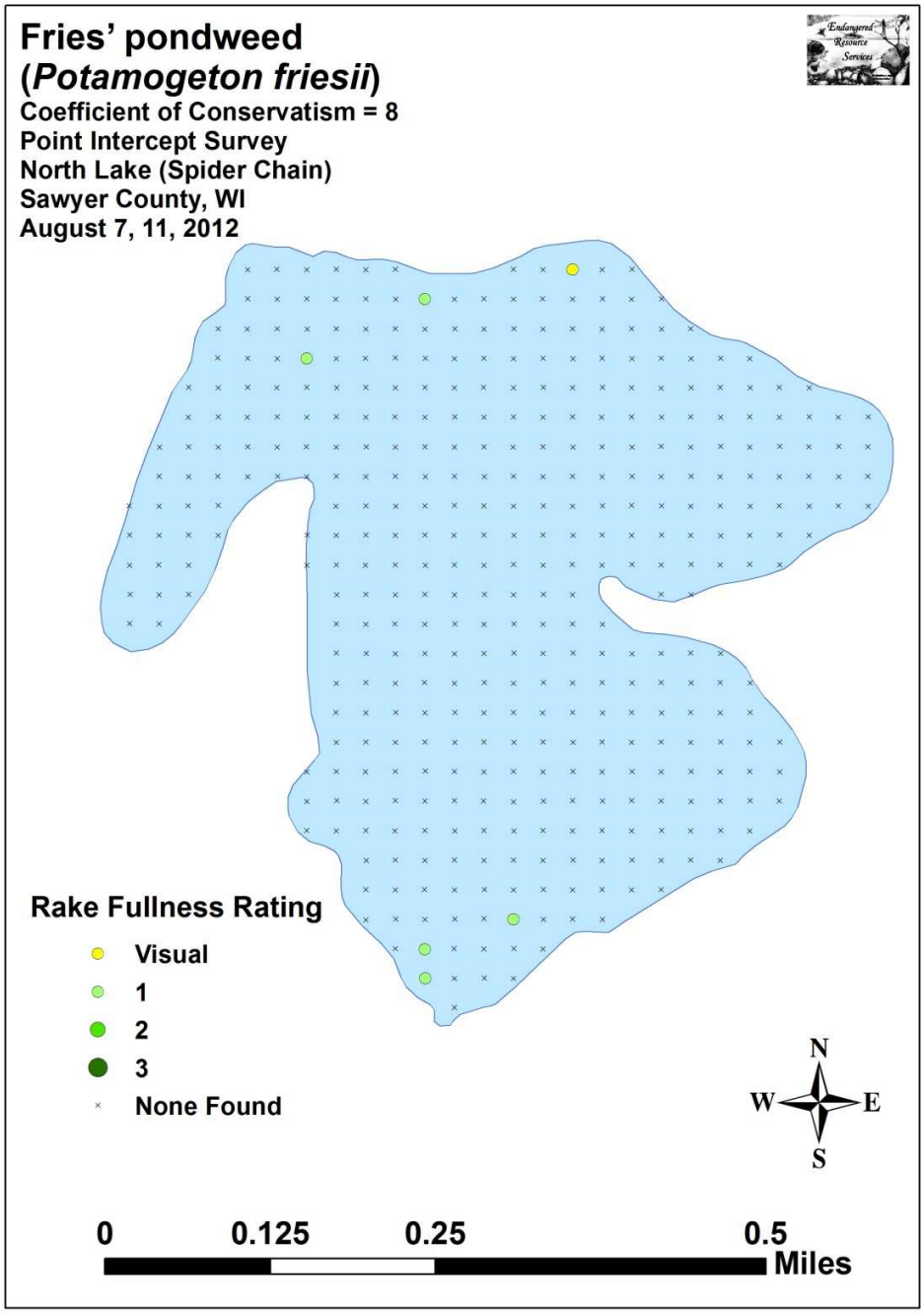
Miles


Fries' pondweed
(Potamogeton friesii)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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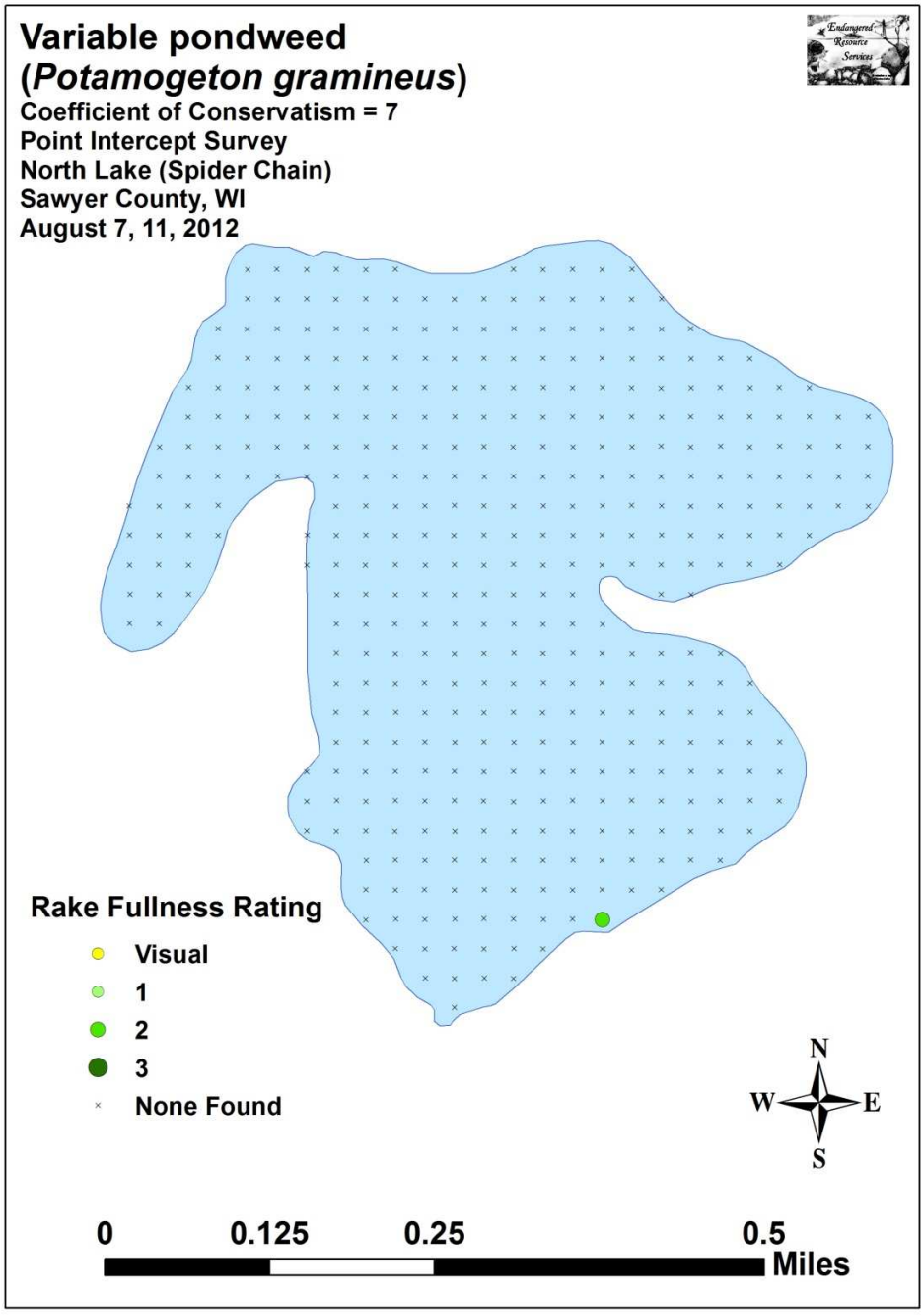
Miles


Variable pondweed
(Potamogeton gramineus)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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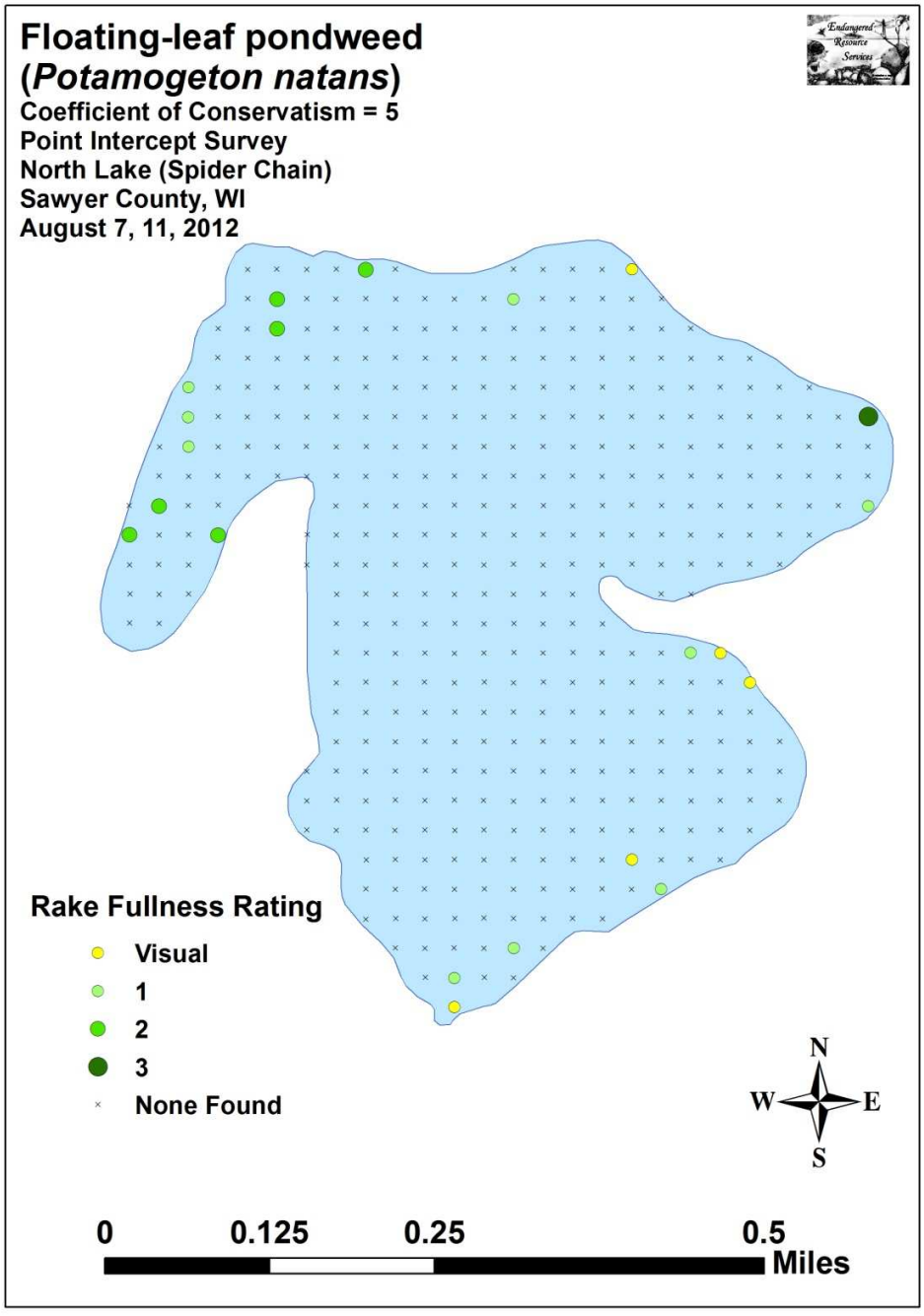
Floating-leaf pondweed
(Potamogeton natans)
Coefficient of Conservatism = 5
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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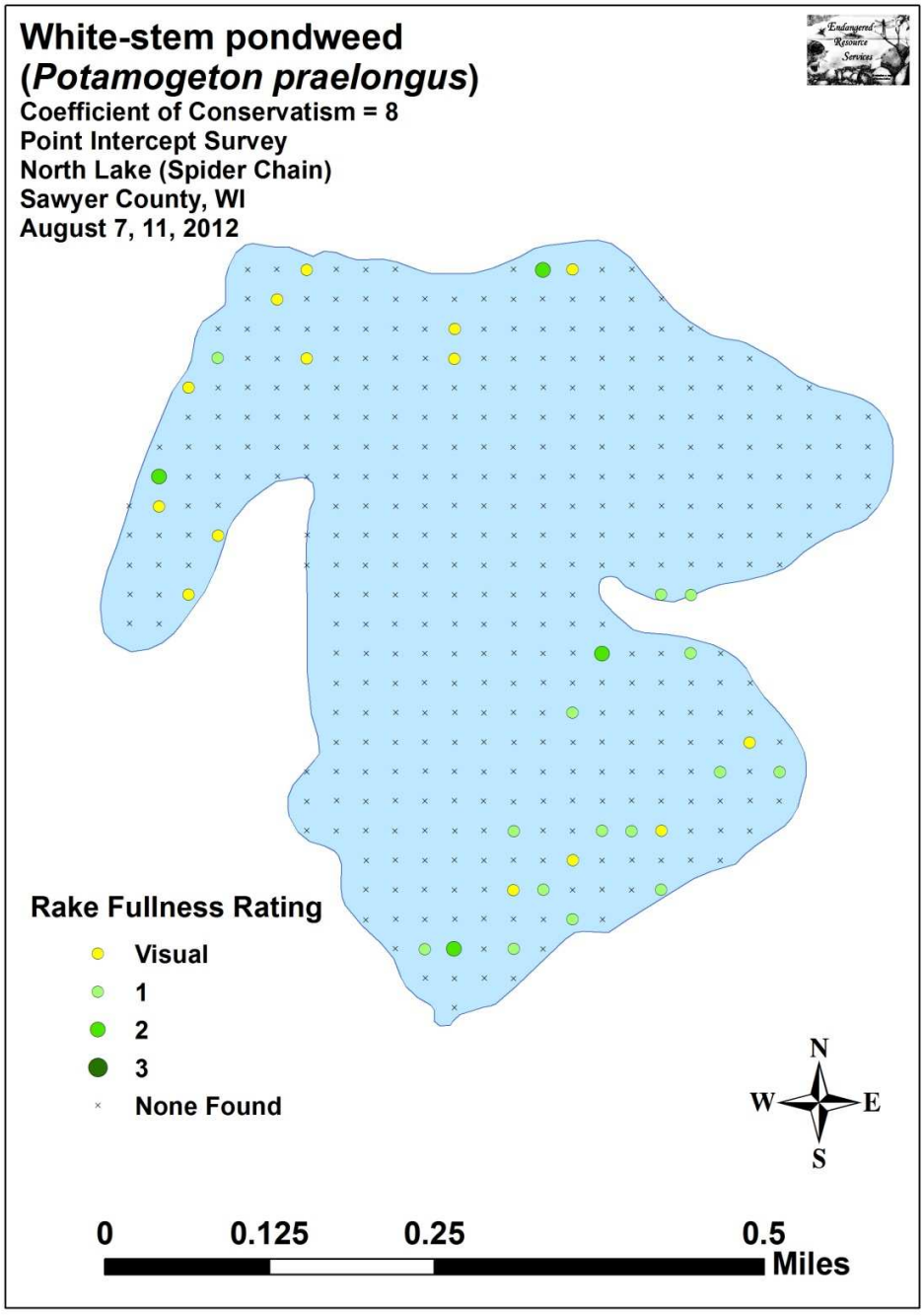
White-stem pondweed
(Potamogeton praelongus)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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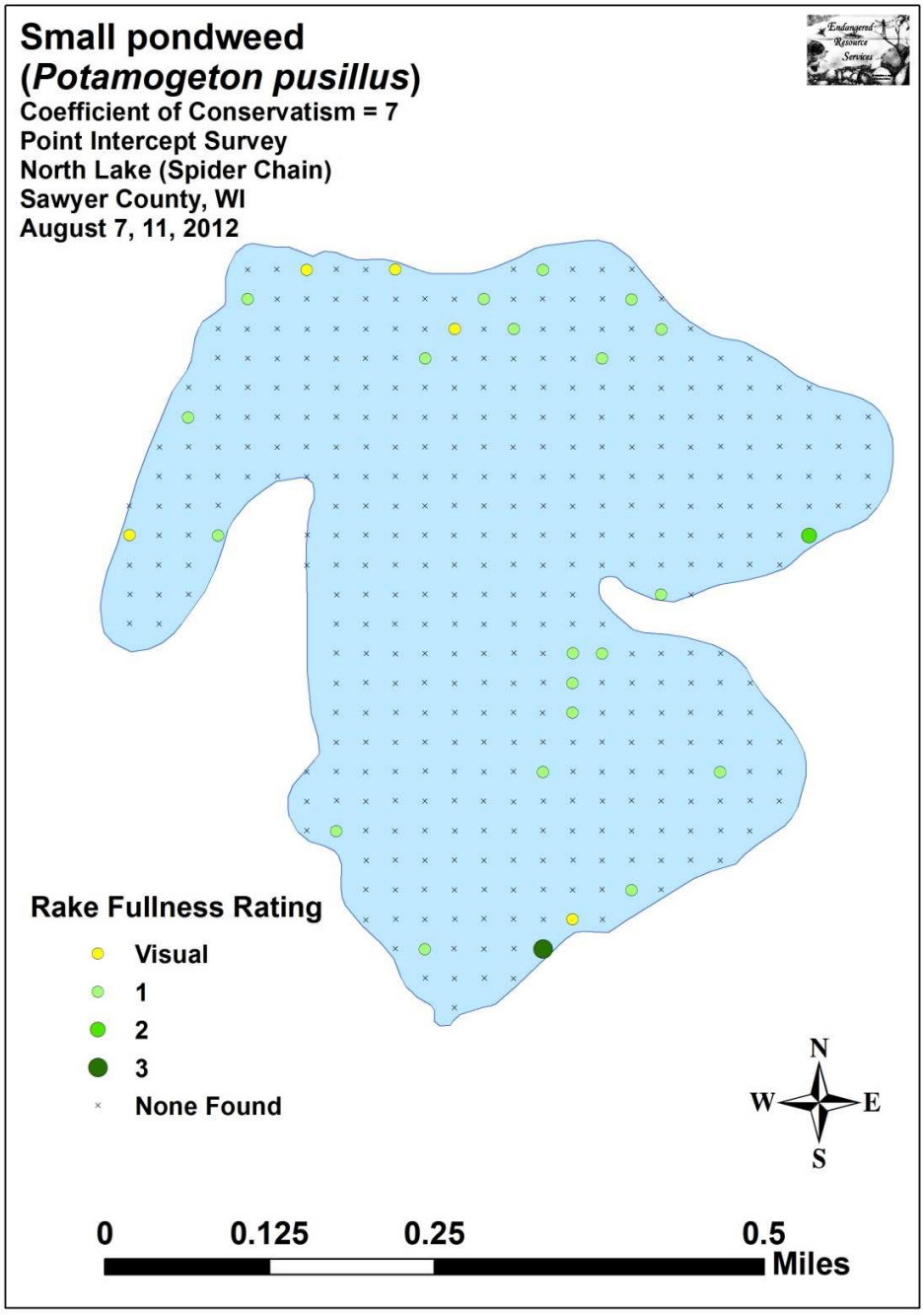
Small pondweed
(Potamogeton pusillus)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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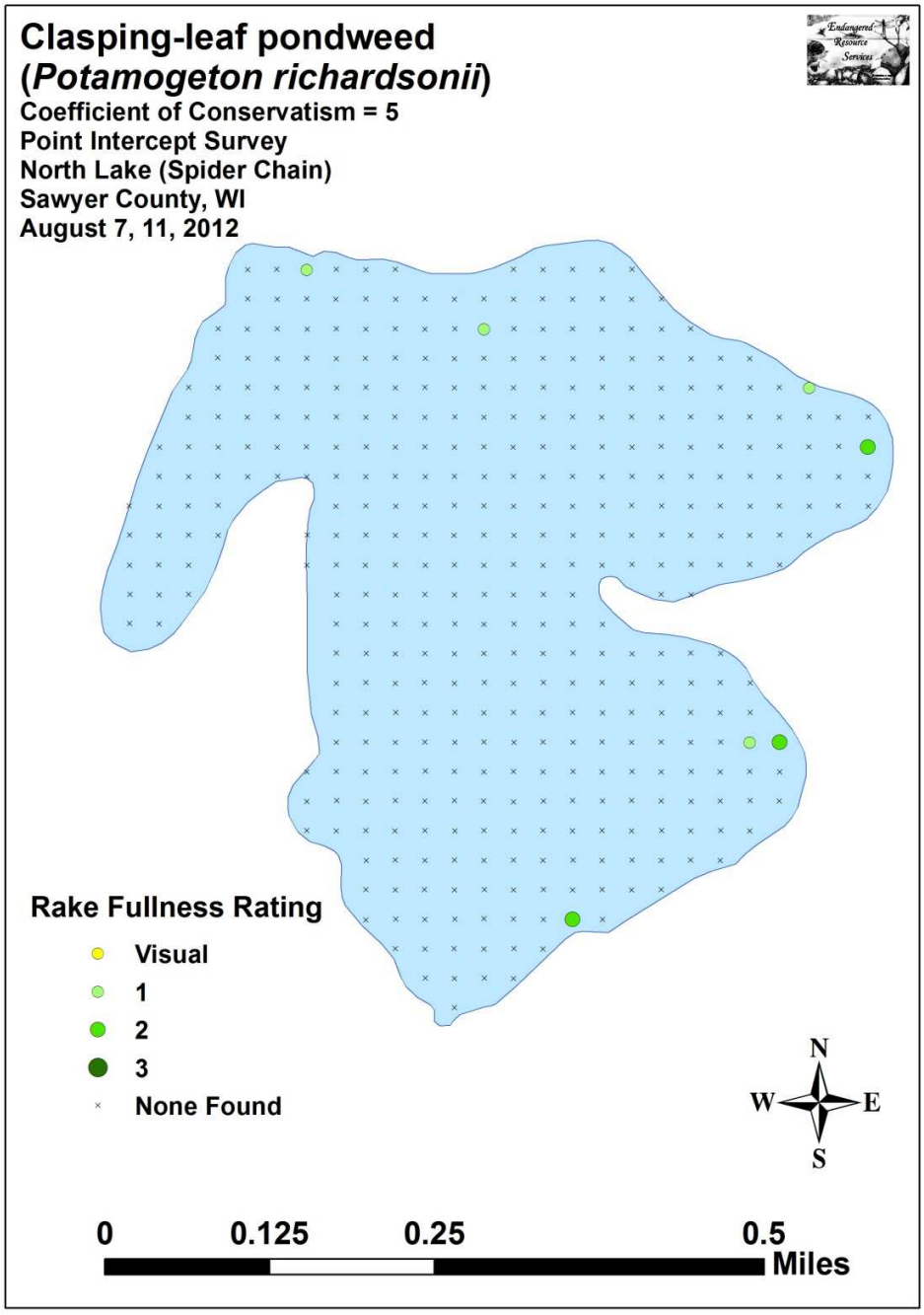
Clasping-leaf pondweed
(Potamogeton richardsonii)
Coefficient of Conservatism = 5
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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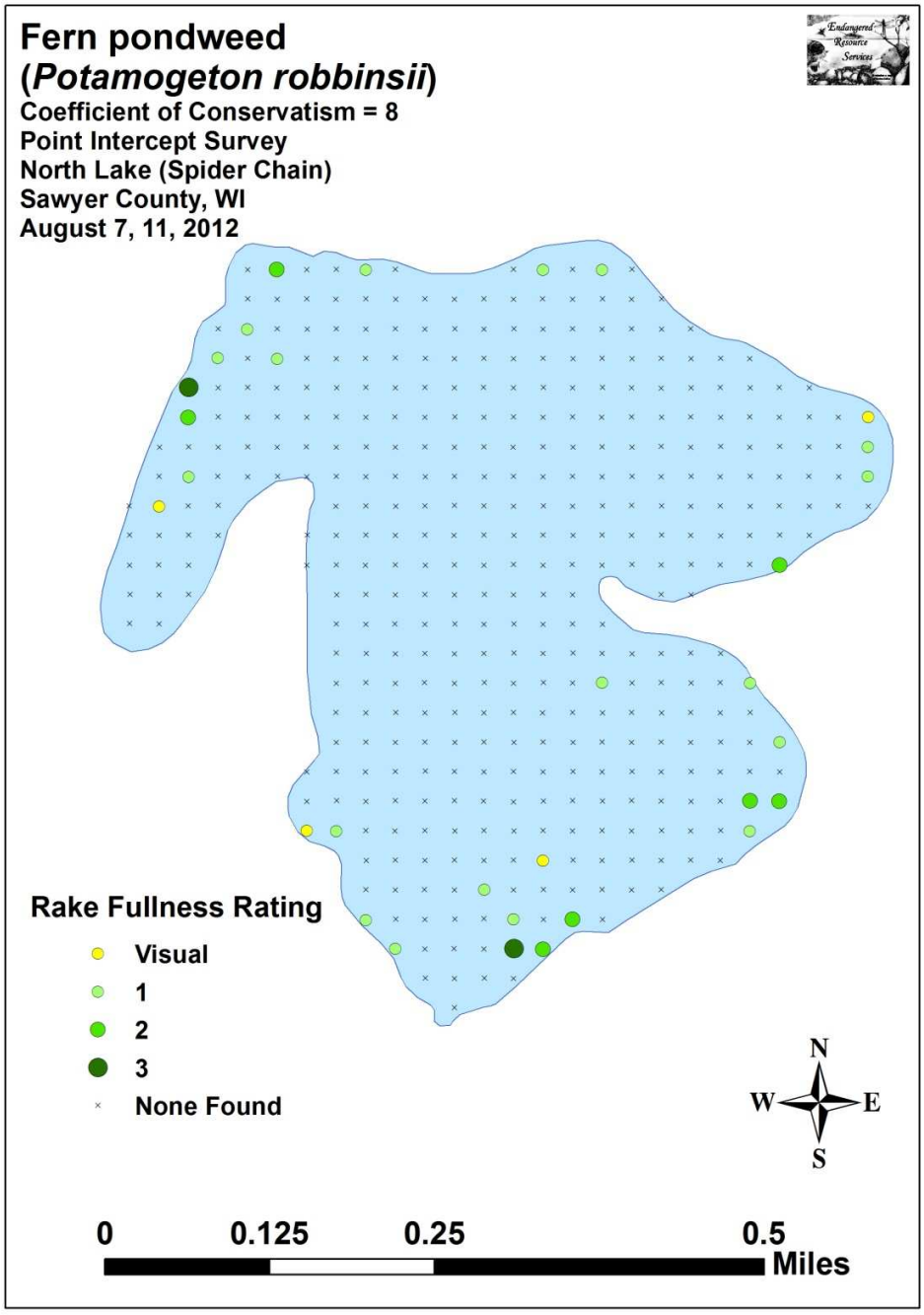
Fern pondweed
(Potamogeton robbinsii)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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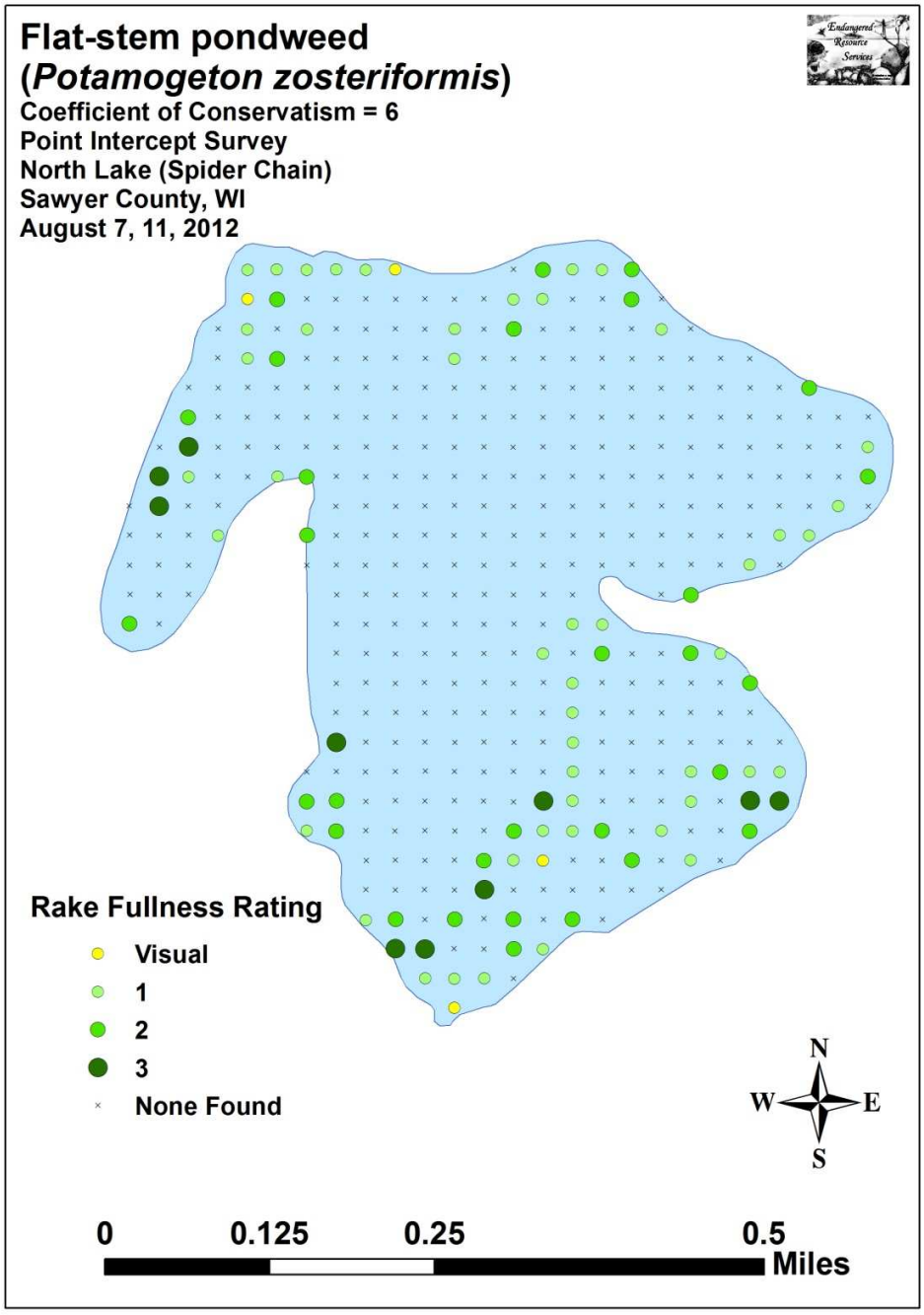
Flat-stem pondweed
(Potamogeton zosteriformis)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
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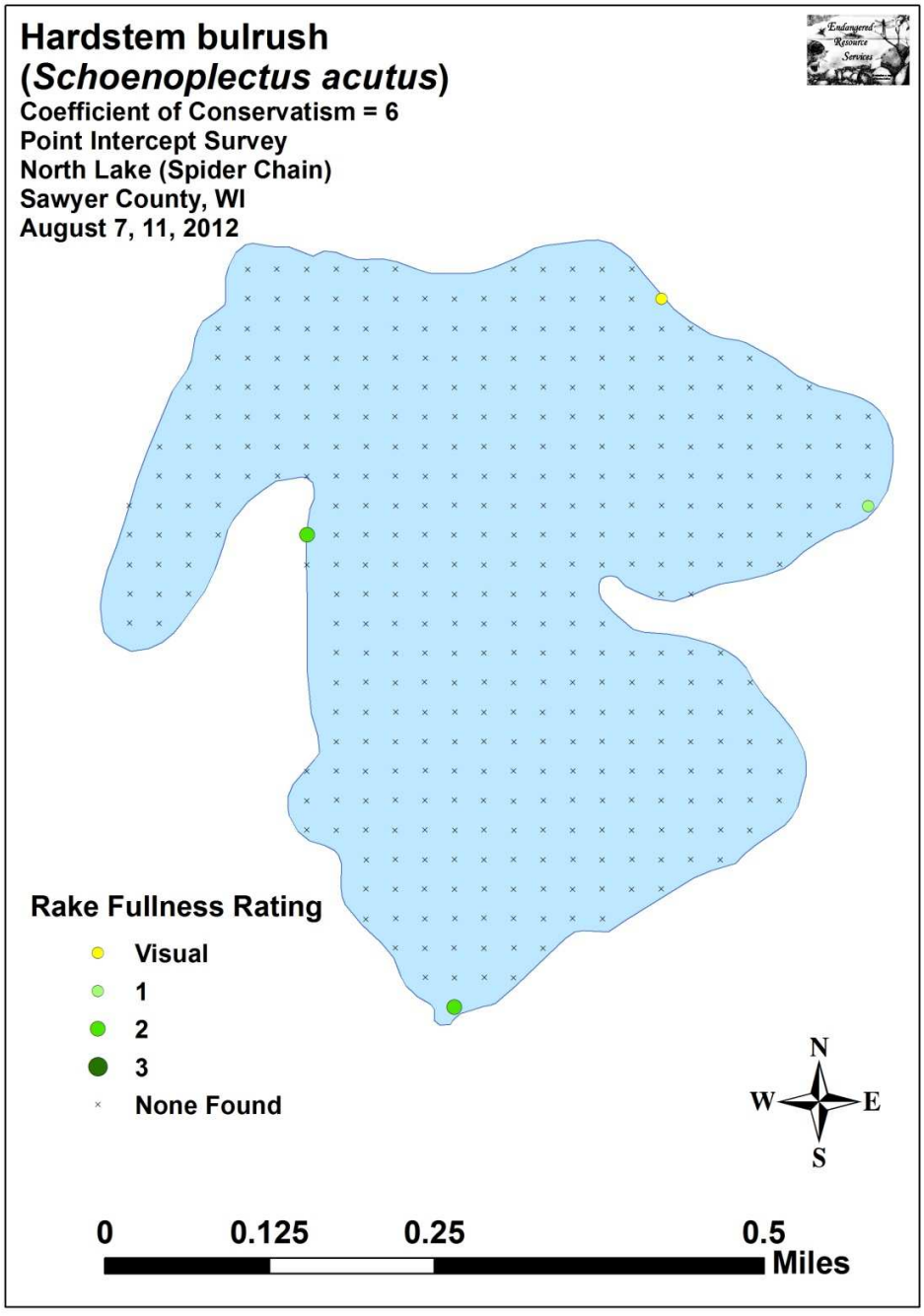
Hardstem bulrush
(Schoenoplectus acutus)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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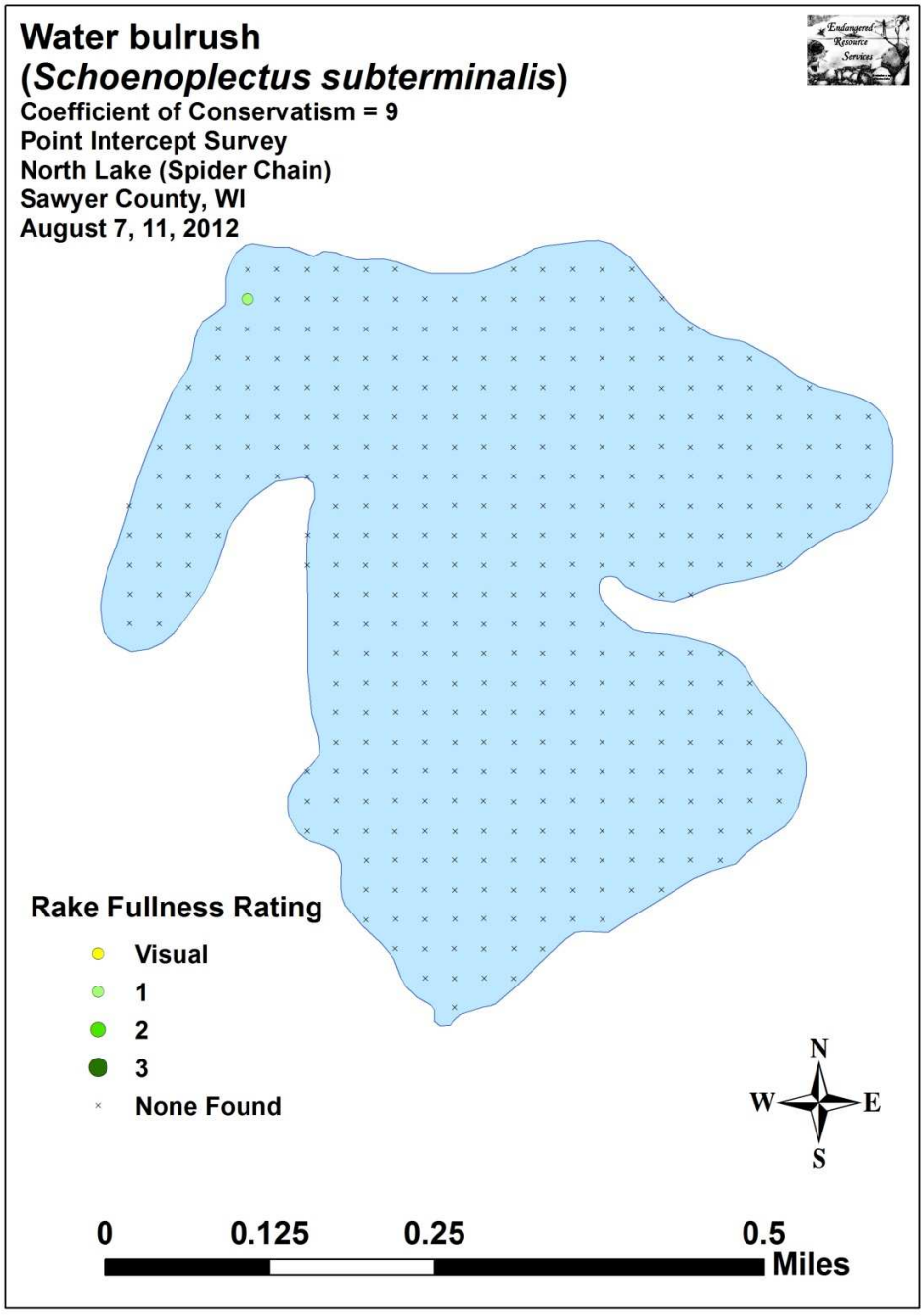
Water bulrush
(Schoenoplectus subterminalis)
Coefficient of Conservatism = 9
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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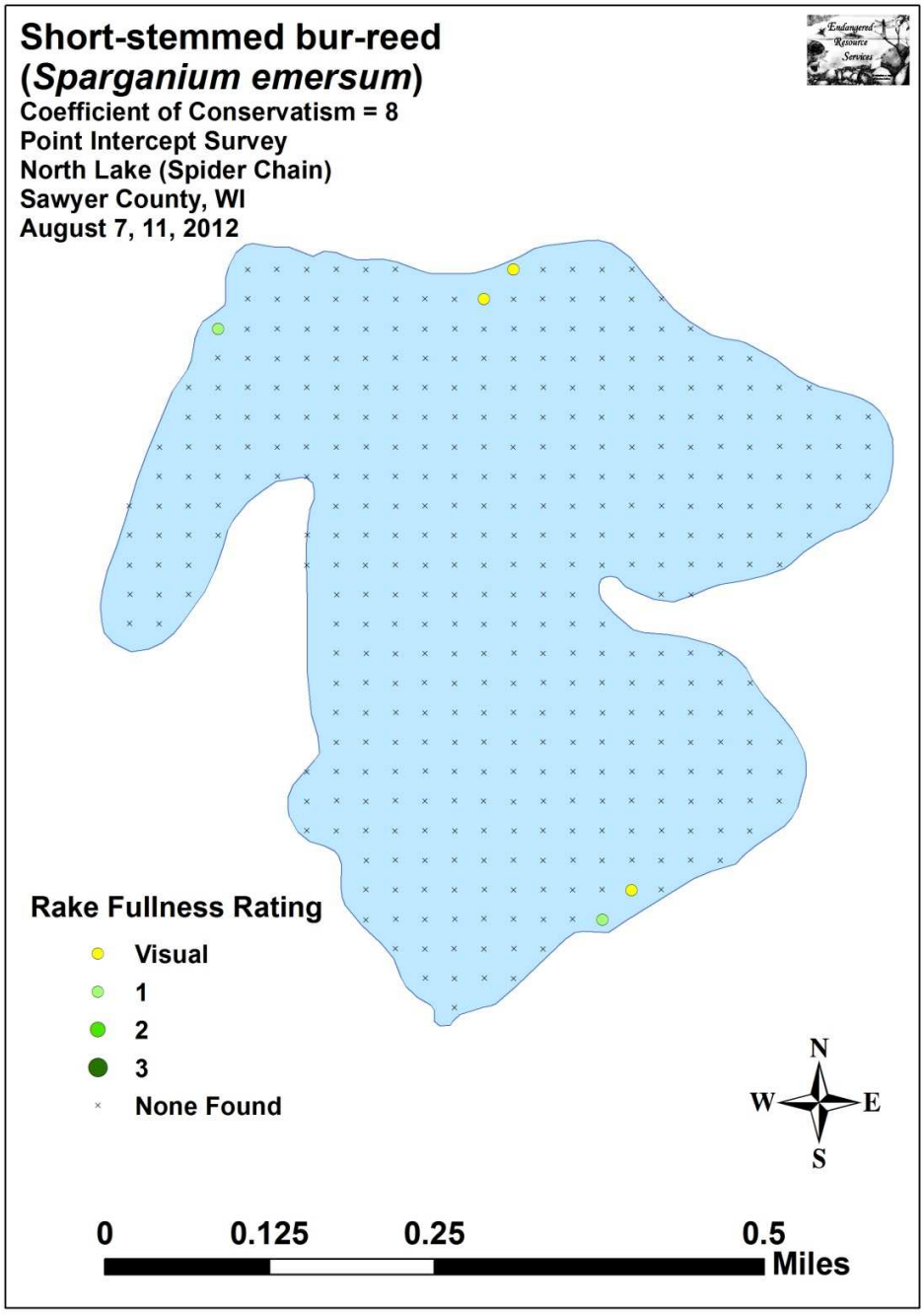
Miles


Short-stemmed bur-reed
(Sparganium emersum)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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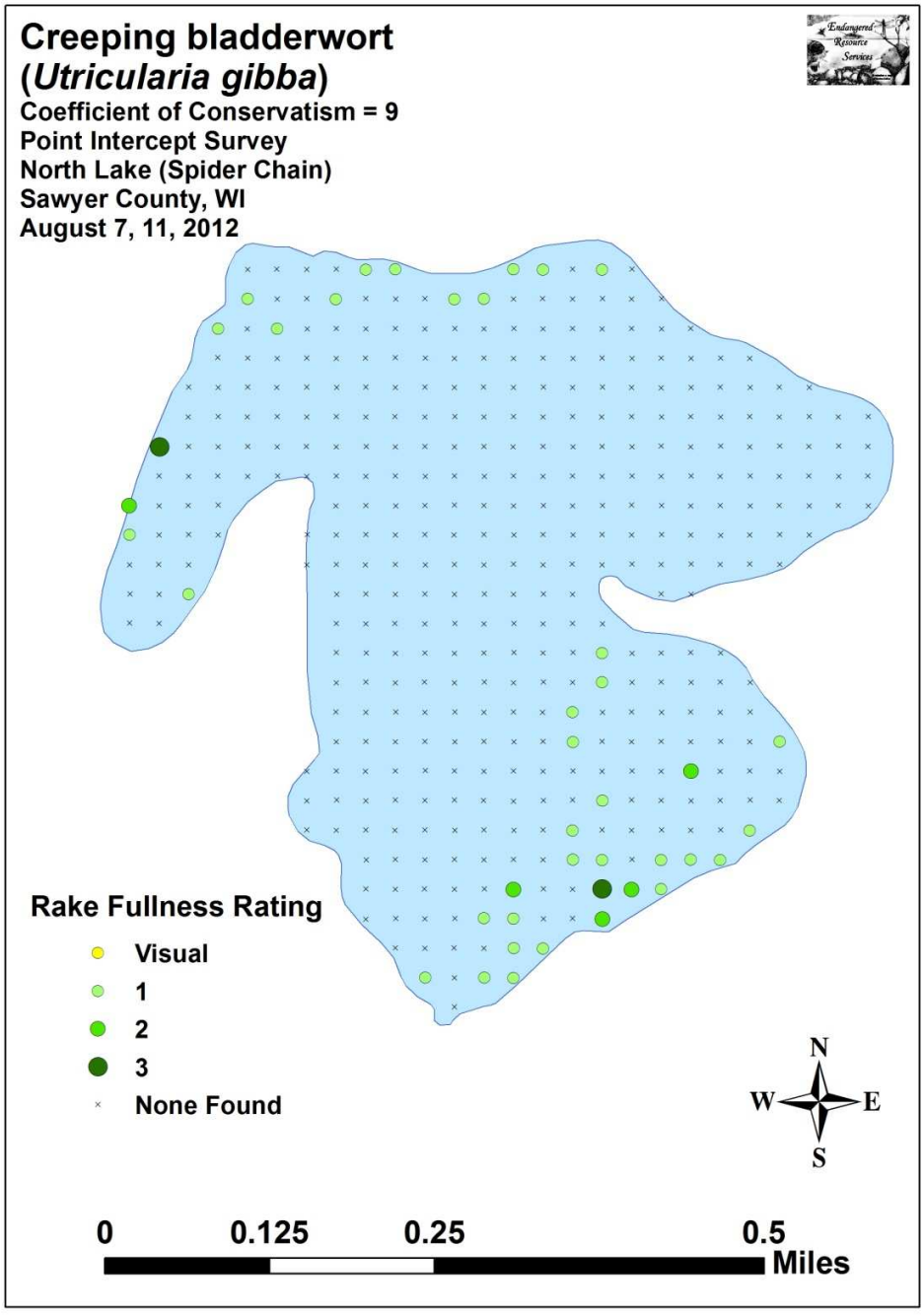
Miles


Creeping bladderwort
(Utricularia gibba)
Coefficient of Conservatism = 9
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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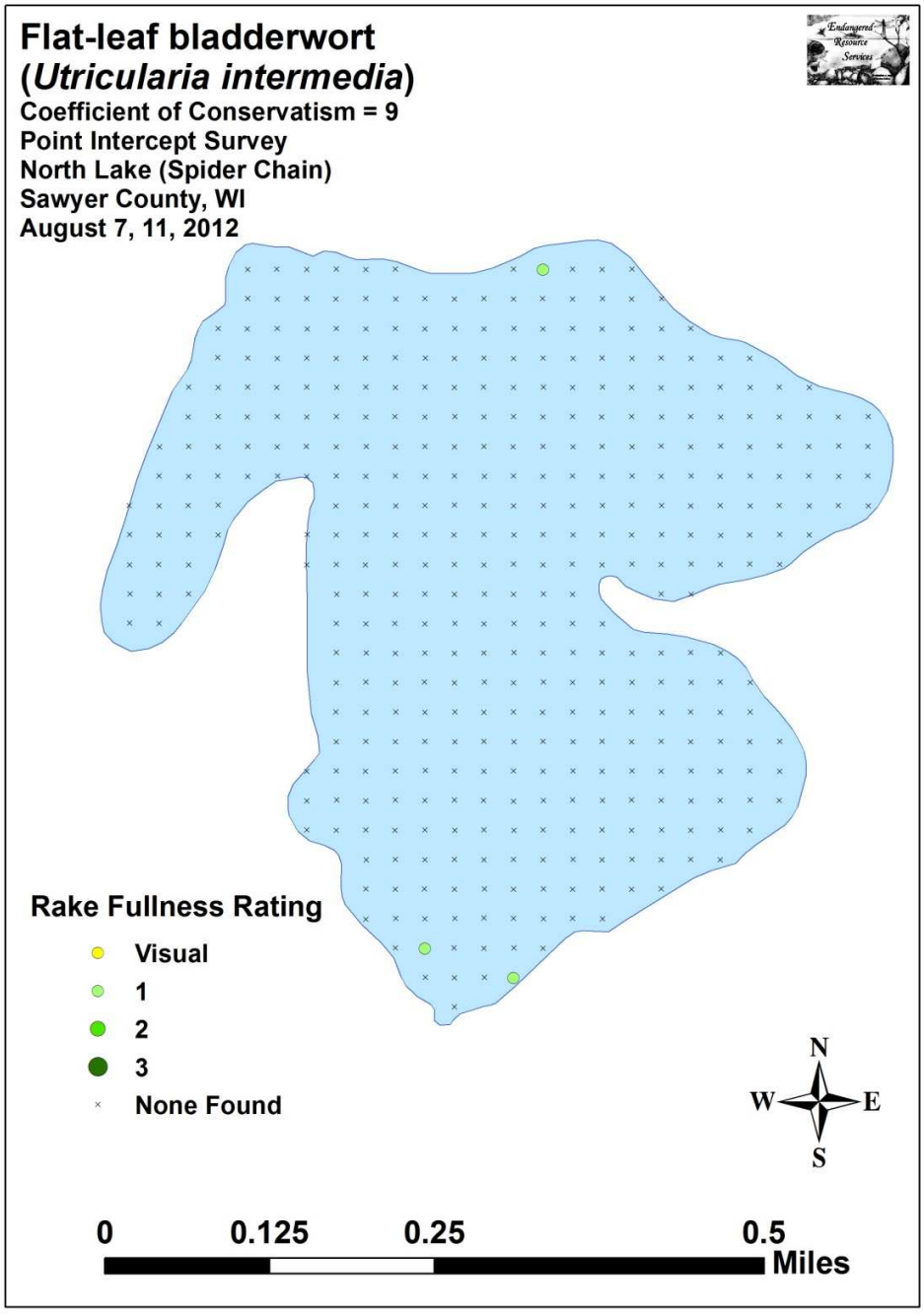
Flat-leaf bladderwort
(Utricularia intermedia)
Coefficient of Conservatism = 9
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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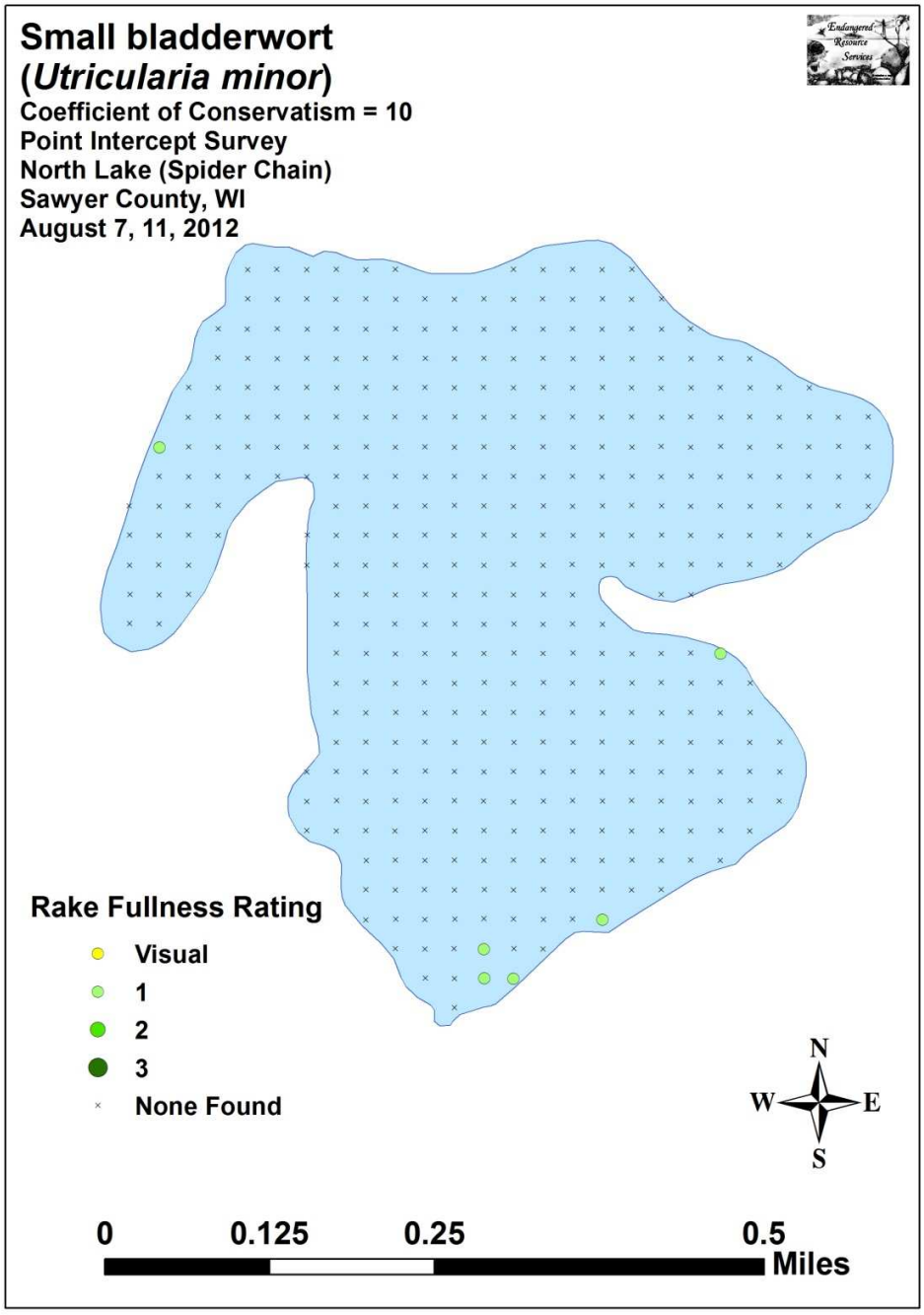
Small bladderwort
(Utricularia minor)
Coefficient of Conservatism = 10
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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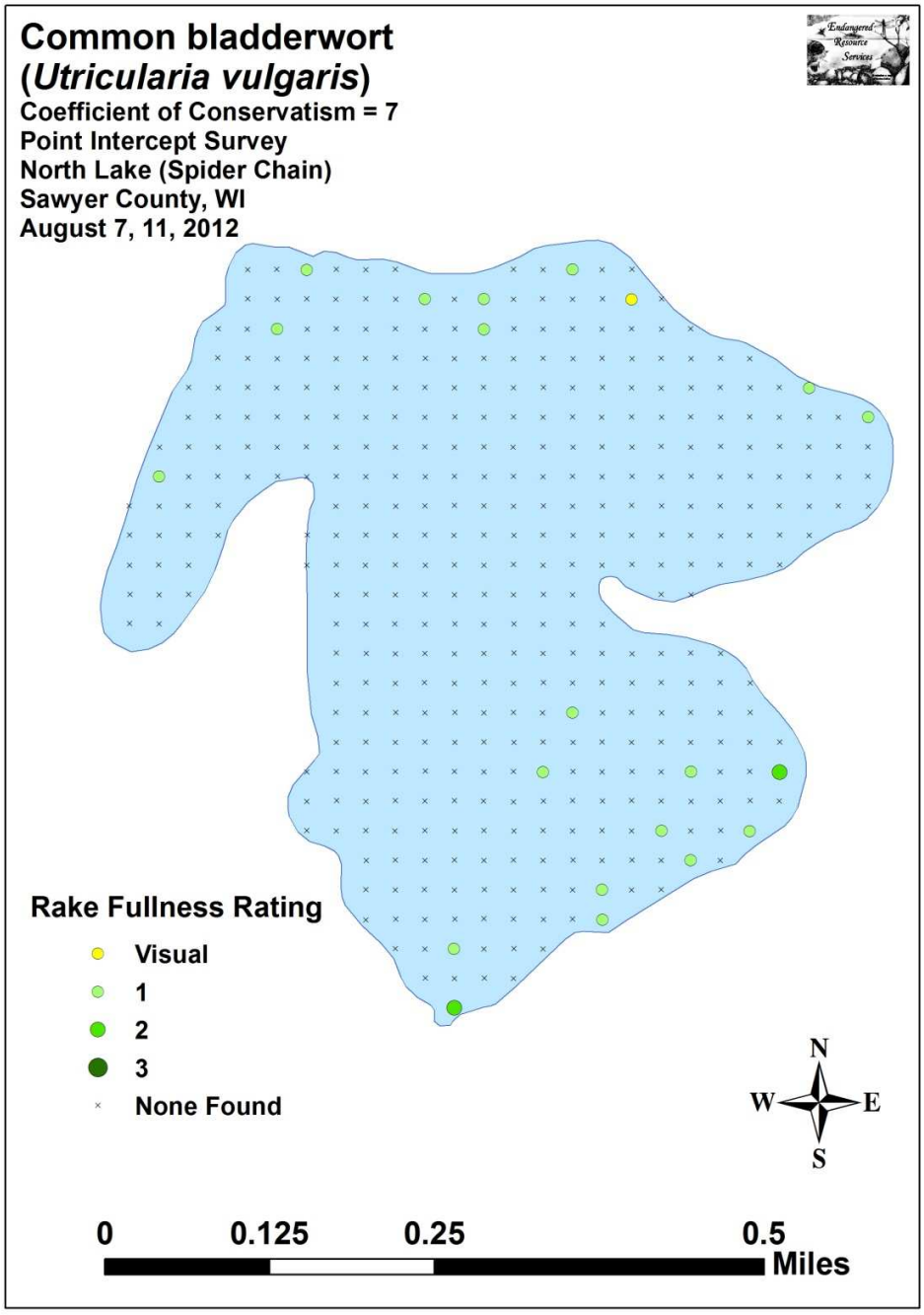
Miles


Common bladderwort
(Utricularia vulgaris)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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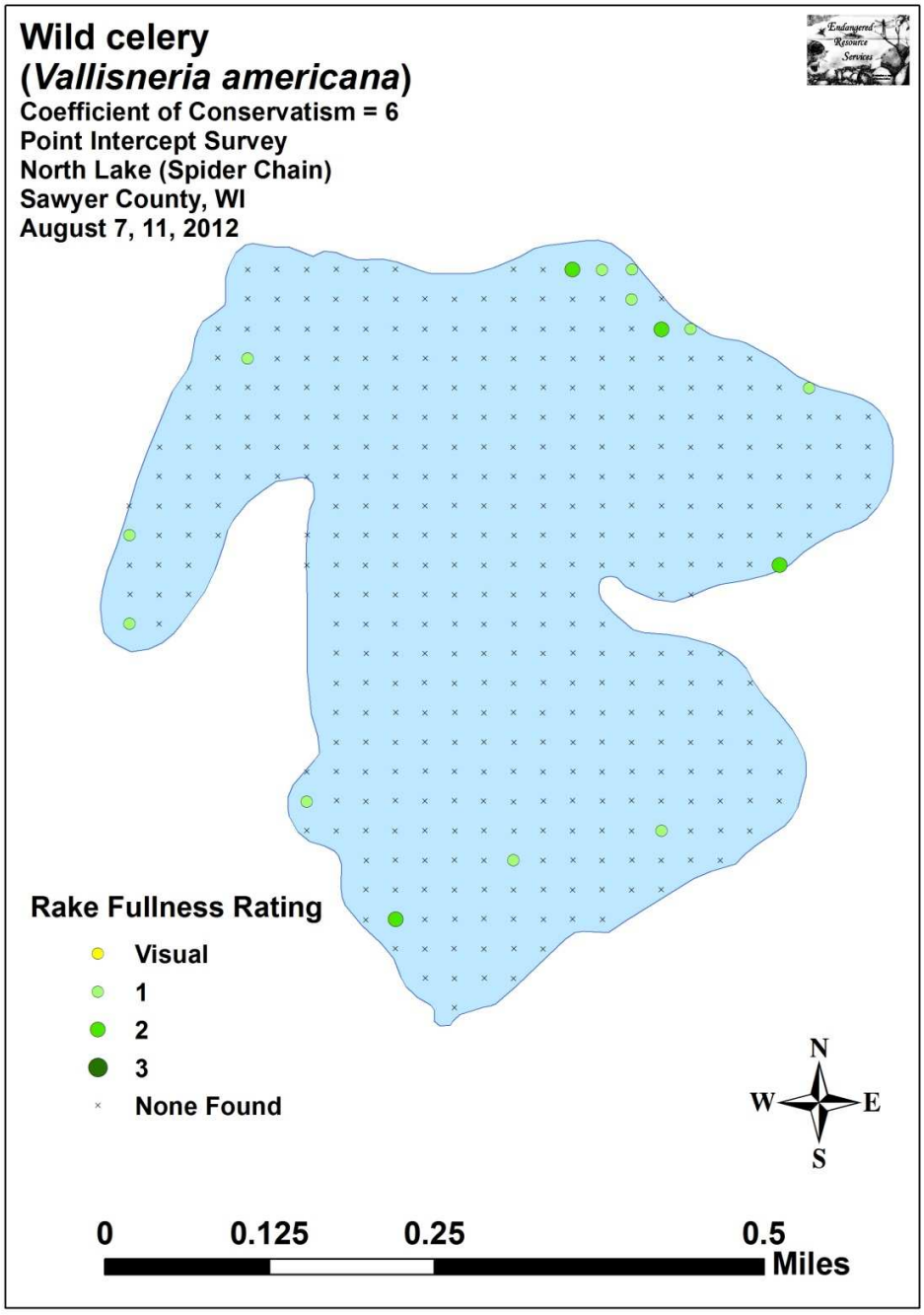
Wild celery
(Vallisneria americana)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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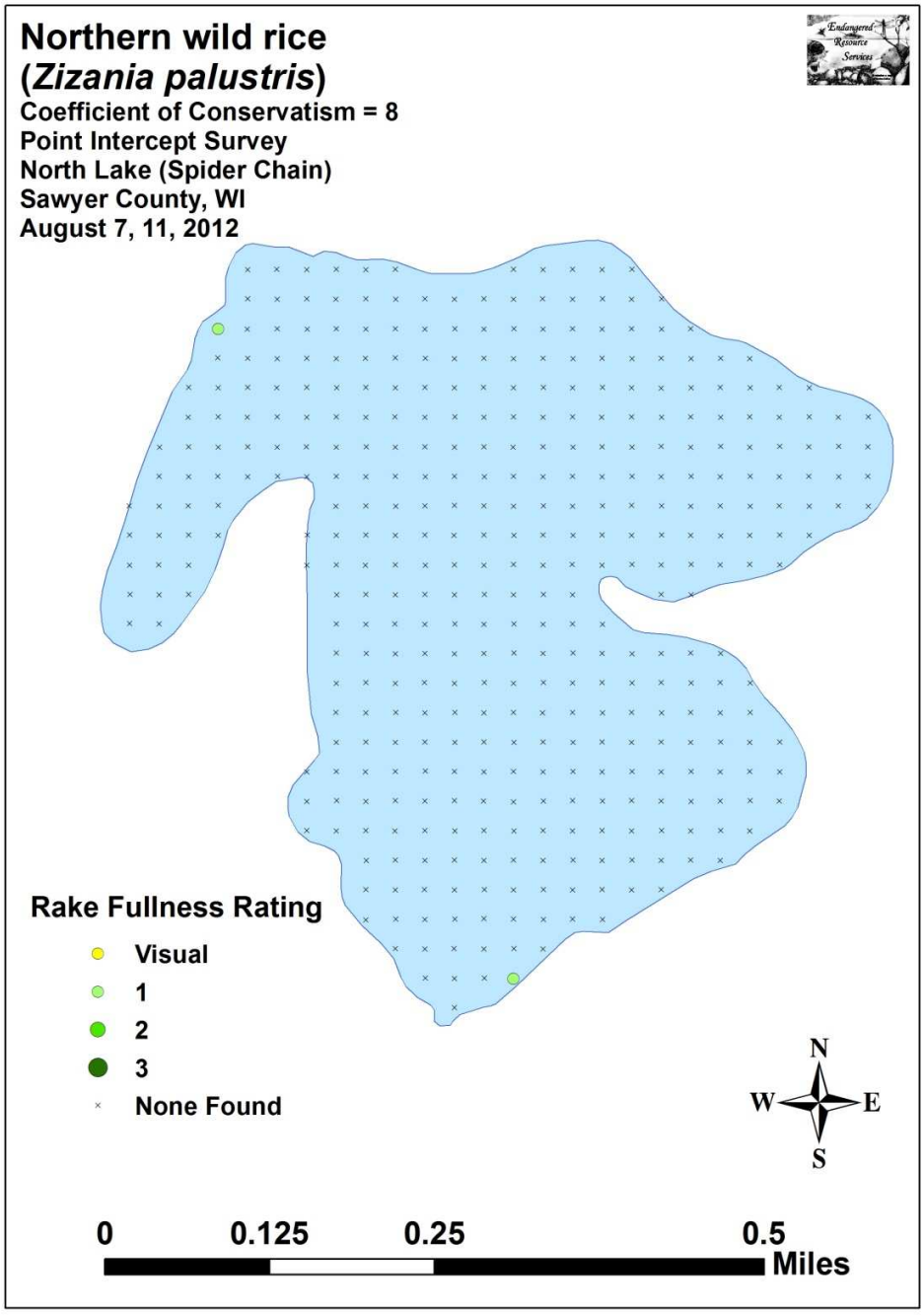
Northern wild rice
(Zizania palustris)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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Miles

Appendix VIII: Aquatic Exotic Invasive Plant Species Information

Curly-leaf pondweed

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

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

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

It becomes invasive in some areas because of its tolerance for low light and low water temperatures. These tolerances allow it to get a head start on and out compete native plants in the spring. In mid-summer, when most aquatic plants are growing, curly-leaf pondweed plants are dying off. Plant die-offs may result in a critical loss of dissolved oxygen. Furthermore, the decaying plants can increase nutrients which contribute to algal blooms, as well as create unpleasant stinking messes on beaches. Curly-leaf pondweed forms surface mats that interfere with aquatic recreation. (Taken in its entirety from WDNR, 2012 http://dnr.wi.gov/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, 2012 http://dnr.wi.gov/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, 2012 http://dnr.wi.gov/invasives/fact/reed_canary.htm)

Purple loosestrife
(Photo Courtesy Brian M. Collins)

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

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

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

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

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

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

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

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

Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displaced, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size, and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways. (Taken in its entirety from WDNR, 2012 http://dnr.wi.gov/invasives/fact/loosestrife.htm)

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

Aquatic:
organisms that live in or frequent water.

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

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

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

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

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

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

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

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

Limnology:
the study of inland lakes and waters.

Littoral:

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

Macrophytes:

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

Nutrients:

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

Organic Matter:

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

Photosynthesis:

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

Phytoplankton:

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

Plankton:

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

ppm:

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

Richness:

number of species in a particular community or habitat.

Rooted Aquatic Plants:

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

Runoff:

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

Secchi Disc:

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

Seepage lakes:

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

Turbidity:

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

Watershed:

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

Zooplankton:

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

Appendix X: Raw Data Spreadsheets