Curly-leaf pondweed (*Potamogeton crispus*) Point-intercept and Bed Mapping Surveys, and Warm-water Macrophyte Point-intercept Survey North Lake – Spider Chain - WBIC: 2436000 Sawyer County, Wisconsin

North Lake Aerial Photo (2015)

Yellow Iris Cluster – North Lake 6/16/17

Project Initiated by:

Spider Chain of Lakes Association, and the
Wisconsin Department of Natural Resources

Pickerelweed Bed along Undeveloped Shoreline on North Lake – 8/1/17

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ABSTRACT

North Lake (WBIC 2436000) is a 132 acre drainage lake located in north-central Sawyer County, WI. In 2005, Curly-leaf pondweed (*Potamogeton crispus*) (CLP), an exotic invasive plant species, was discovered in the Spider Chain. After two initial herbicide treatments in 2010 and 2011, the Wisconsin Department of Natural Resources (WDNR) and the Spider Chain of Lakes Association (SCLA), under the direction of Dave Blumer (then Short, Elliot, Hendrickson, Inc. – now Lake Education and Planning Services, LLC), requested the original point-intercept surveys in 2012 as a prerequisite to developing the chain's initial Aquatic Plant Management Plan. As a prerequisite to updating this plan in 2018 and to compare how the lake's vegetation may have changed since the last point-intercept surveys, the SCLA and the WDNR authorized CLP density and bed mapping surveys on June 16th, and a full point-intercept survey for all aquatic macrophytes on August 1, 2017. As in 2012, we found no evidence of CLP during the spring survey on North Lake. We did, however, find a few clusters of Yellow iris (*Iris pseudacorus*), another exotic species, along the northeast shoreline of the southeast bay. During the August 2017 full point-intercept survey, we found macrophytes growing at 157 points which approximated to 39.0% of the entire lake bottom and 70.1% of the 14.0ft littoral zone. This was a non-significant decline (p=0.35) from the 2012 survey when we found plants growing at 170 points (42.2% of the bottom and 79.8% of the then 13.5ft littoral zone). Overall diversity was exceptionally high with a Simpson Index value of 0.93 – identical to 2012. Species richness was moderate with 46 species found growing in and immediately adjacent to the water (up from 39 species in 2012). There was an average of 4.17 native species/site with native vegetation – a non-significant increase (p=0.28) from 4.02/site in 2012. Total rake fullness experienced a non-significant decline (p=0.26) from a moderate 2.18 in 2012 to 2.13 in 2017. Coontail (*Ceratophyllum demersum*), Flat-stem pondweed (*Potamogeton zosteriformis*), Slender naiad (*Najas flexilis*), and White water lily (*Nymphaea odorata*) were the most common macrophyte species in 2017. They were found at 49.04%, 49.04%, 40.76%, and 34.39% of sites with vegetation, and accounted for 41.59% of the total relative frequency. In 2012, Flat-stem pondweed, Coontail, Slender naiad, and White water lily were also the most common species (51.18%, 47.06%, 37.06%, and 31.18% of survey points with vegetation /41.37% of the total relative frequency. Lakewide, from 2012-2017, ten species showed significant changes in distribution: Large-leaf pondweed (*Potamogeton amplifolius*) and Creeping bladderwort (*Utricularia gibba*) suffered highly significant declines; Wild celery (*Vallisneria americana*) experienced a moderately significant decline; and Floating-leaf pondweed (*Potamogeton natans*) and Clasping-leaf pondweed (*Potamogeton richardsonii*) demonstrated significant declines. Conversely, Nitella (*Nitella* sp.) showed a highly significant increase; Small pondweed (*Potamogeton pusillus*) and Fries' pondweed (*Potamogeton friesii*) saw moderately significant increases; and Northern water-milfoil (*Myriophyllum sibiricum*) and Leafy pondweed (*Potamogeton foliosus*) had significant increases. In addition to these changes in distribution, several important species also saw significant changes in density: Flat-stem pondweed experienced a significant decline in mean rake fullness **(p=0.02)**, and Large-leaf pondweed suffered a highly significant decline **(p<0.001)**. However, Northern water-milfoil showed evidence of expanding into these same areas as it saw a significant increase **(p=0.03)** in density. In 2012, Northern wild rice (*Zizania palustris*) was limited to at most a few 100 plants scattered around the northwest and southeast bays. In 2017, we saw a total of just six plants all of which occurred in the northwest bay. The 34 native index species found in the rake during the August 2017 survey (identical to 2012) produced a near average mean Coefficient of Conservatism of 6.6 (down from 6.8 in 2012). The Floristic Quality Index of 38.8 (down from 39.8 in 2012) was, however, well above the median FQI for this part of the state. Filamentous algae were present at 28 points (down from 32 in 2012). Their mean rake fullness of 1.41 represented a moderately significant decline **(p=0.001)** from a mean rake of 1.71 in 2012. Other than Yellow iris, we saw no evidence of any other exotic species growing in or adjacent to the lake. Working to help limit algal growth by reducing nutrient inputs along the lakeshore, and manually removing Yellow iris anywhere it is found are management ideas for the SCLA to consider as they work to update their Aquatic Plant Management Plan.

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INTRODUCTION:

North Lake (WBIC 2436000) is a 132 acre 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 (*Larix laricina*) bogs, and the tannins they produce stain the water brown. The lake is eutrophic in nature with Secchi readings from 1989-2017 averaging 7.5ft (WDNR 2017). This fair water clarity produced a littoral zone that reached approximately 14.0ft throughout the 2017 growing season. 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).

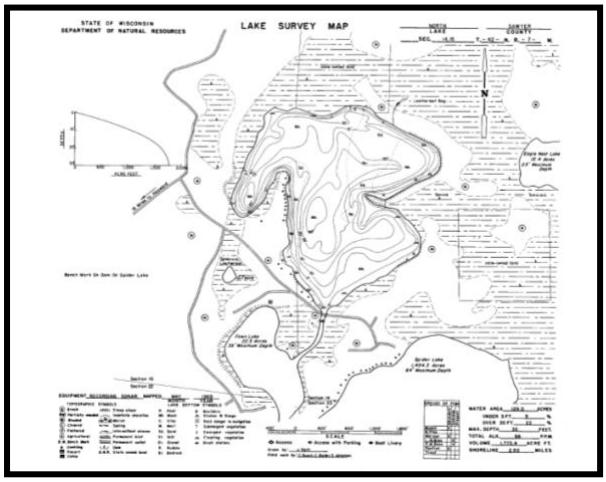


Figure 1: North Lake Bathymetric Map

BACKGROUND AND STUDY RATIONALE:

The Spider Chain of Lakes Association (SCLA) has historically conducted aquatic plants surveys as a way of documenting the lakes' long-term health. The surveys also provide an opportunity to look for new exotic invasive species such as Eurasian water-milfoil (*Myriophyllum spicatum*) – a species which has invaded many other lakes in the Hayward area, but has never been found in the Spider Chain. Curly-leaf pondweed (*Potamogeton crispus*) (CLP), another exotic species, was first documented in the Spider Lakes in 2005 (WDNR 2017). Herbicides were initially applied to CLP beds in 2010 and 2011, and the SCLA), under the direction of Dave Blumer (then Short, Elliot, Hendrickson, Inc. – now Lake Education and Planning Services, LLC), and the Wisconsin Department of Natural Resources (WDNR) authorized the first CLP and full point-intercept surveys on the chain in 2012 to develop both a better understanding of the level of infestation as well as to gather baseline information on the lakes' native plants. These surveys found CLP was largely confined to Big Spider with a single small bed found in Little Spider. Fortunately, at that time no CLP was found in Clear, Fawn, or North Lakes. The data from these surveys was used to develop an initial WDNR approved Aquatic Plant Management Plan (APMP) which outlined the further use of herbicides to control CLP. However, because the initial applications produced little change in CLP coverage and because the cost to expand the program was deemed too expensive, the SCLA decided to abandon herbicide treatments altogether and take a wait-and-see approach.

Per WDNR expectations, plant surveys are normally repeated every five to seven years to remain current (Pamela Toshner/Alex Smith, WDNR – pers. comm.). In anticipation of updating their plan in 2018, the SCLA and WDNR authorized three lakewide surveys on North Lake in 2017. On June 16th, we conducted an early-season CLP point-intercept survey and a littoral zone CLP bed mapping survey, and on August 1st we completed a warm-water point-intercept survey of all macrophytes. The surveys' objectives were to document the current levels of CLP; determine if Eurasian water-milfoil or any other new exotic plants had invaded the lake; and to compare data from the original 2012 surveys with the 2017 data to identify any significant changes in the lake's vegetation over this time. This report is the summary analysis of these three field surveys.

METHODS:

Curly-leaf Pondweed Point-intercept Survey:

Using a standard formula that takes into account the shoreline shape and distance, water clarity, depth, and total acreage, Michelle Nault (WDNR) generated the original 403 point sampling grid for North Lake (Appendix I) in 2012. Using this same grid in 2017, we completed a density survey where we sampled for Curly-leaf pondweed at each littoral point in the lake. We located survey points using a handheld mapping GPS unit (Garmin 76CSx) and used a rake to sample an approximately 2.5ft section of the bottom. When found, CLP was assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 2). We also noted visual sightings of CLP within six feet of the sample point.

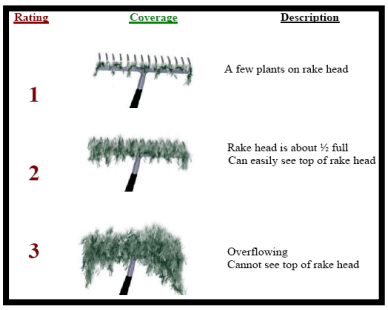


Figure 2: Rake Fullness Ratings (UWEX 2010)

Curly-leaf Pondweed Bed Mapping Survey:

During the bed mapping survey, we searched the lake's entire visible littoral zone. By definition, a "bed" was determined to be any area where we visually estimated that CLP made up >50% of the area's plants, was generally continuous with clearly defined borders, and was canopied, or close enough to being canopied that it would likely interfere with boat traffic. After we located a bed, we motored around the perimeter of the area taking GPS coordinates at regular intervals. We also estimated the rake density range and mean rake fullness of the bed (Figure 2), the maximum depth of the bed, whether it was canopied, and the impact it was likely to have on navigation (**none** – easily avoidable with a natural channel around or narrow enough to motor through/**minor** – one prop clear to get through or access open water/**moderate** – several prop clears needed to navigate through/**severe** – multiple prop clears and difficult to impossible to row through). These data were then mapped using ArcMap 9.3.1, and we used the WDNR's Forestry Tools Extension to determine the acreage of each bed to the nearest hundredth of an acre.

Warm-water Full Point-intercept Macrophyte Survey:

Prior to beginning the August point-intercept survey, we conducted a general boat survey of the lake to regain familiarity with the species present (Appendix II). All plants found were identified (Voss 1996, Boreman et al. 1997; Chadde 2002; Crow and Hellquist 2012; Skawinski 2014), and a data sheet was built from the species present. We again located each survey point with a GPS, recorded a depth reading with a metered pole or hand held sonar (Vexilar LPS-1), 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 all 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 (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 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. We use a 20ft pole rake and a 35ft 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 frequencies 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 (Tables 2 and 3).

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, North Central Hardwood Forests, Driftless Area and Southeastern Wisconsin Till Plain. He recommended making comparisons of lakes within ecoregions to determine the target lake's relative diversity and health. North Lake is in the Northern Lakes and Forests Ecoregion (Tables 4 and 5).

**** 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.**

Comparison to Past Surveys: We compared data from our 2012 and 2017 warm-water point-intercept surveys (Figure 10) (Tables 2 and 3) to see if there were any significant changes in the lake's vegetation. For individual plant species as well as count data, we used the Chi-square analysis on the WDNR Pre/Post survey worksheet. For comparing averages (mean species/point and mean rake fullness/point), we used t-tests. Differences were considered significant at $p < 0.05$, moderately significant at $p < 0.01$ and highly significant at $p < 0.001$ (UWEX 2010). It should be noted that when comparing the warm-water point-intercept surveys, we used the number of littoral points with plants (170 in 2012/157 in 2017) as the basis for "sample points".

RESULTS:

Curly-leaf Pondweed Point-intercept and Bed Mapping Surveys:

As in 2012, our 2016 early-season survey found no evidence of Curly-leaf pondweed or Eurasian water-milfoil in North Lake. However, we did find a large cluster of Yellow iris (*Iris pseudacorus*) near a dock (see report cover photo) as well as several smaller clusters along the adjacent shorelines (Figure 3). This exotic invasive species was not seen anywhere on the lake during the original 2012 surveys, and likely represents a new and recent introduction (Appendix III).

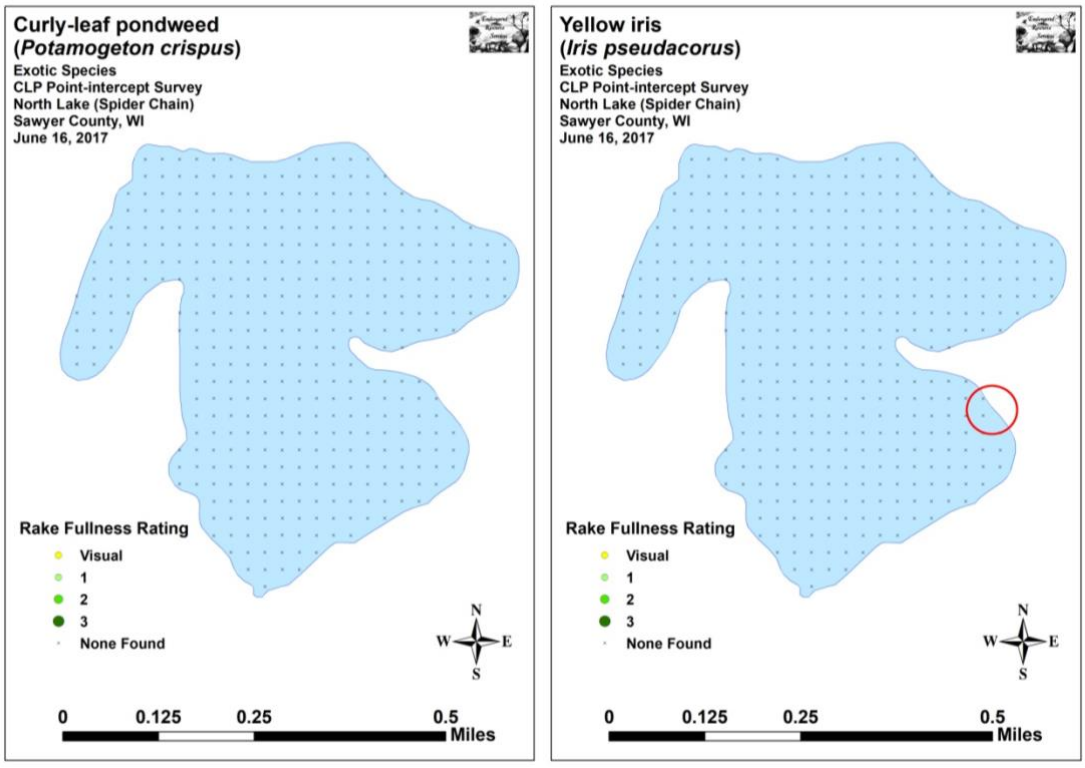


Figure 3: 2017 Late Spring Curly-leaf Pondweed and Yellow Iris Density and Distribution

Warm-water Full Point-intercept Macrophyte Survey:

Depth readings taken at North Lake's 403 points revealed a highly varied underwater topography with numerous small bowls that bottomed out at 20-30ft, a small hump that topped out at 6ft in the north bay, and a shallow 4-6ft deep 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).

Of the 234 points that were shallow enough to conduct a rake survey, we found nutrient-rich organic muck dominated the lake bottom (211 points – 90.2%). Most pure sand areas (11 points – 4.7%) were located along the western shoreline, while most rock-bottomed areas (12 points – 5.1%) were found on the shallow north/south gravel bar and on the sunken island in the center of the north bay (Figure 4) (Appendix IV).

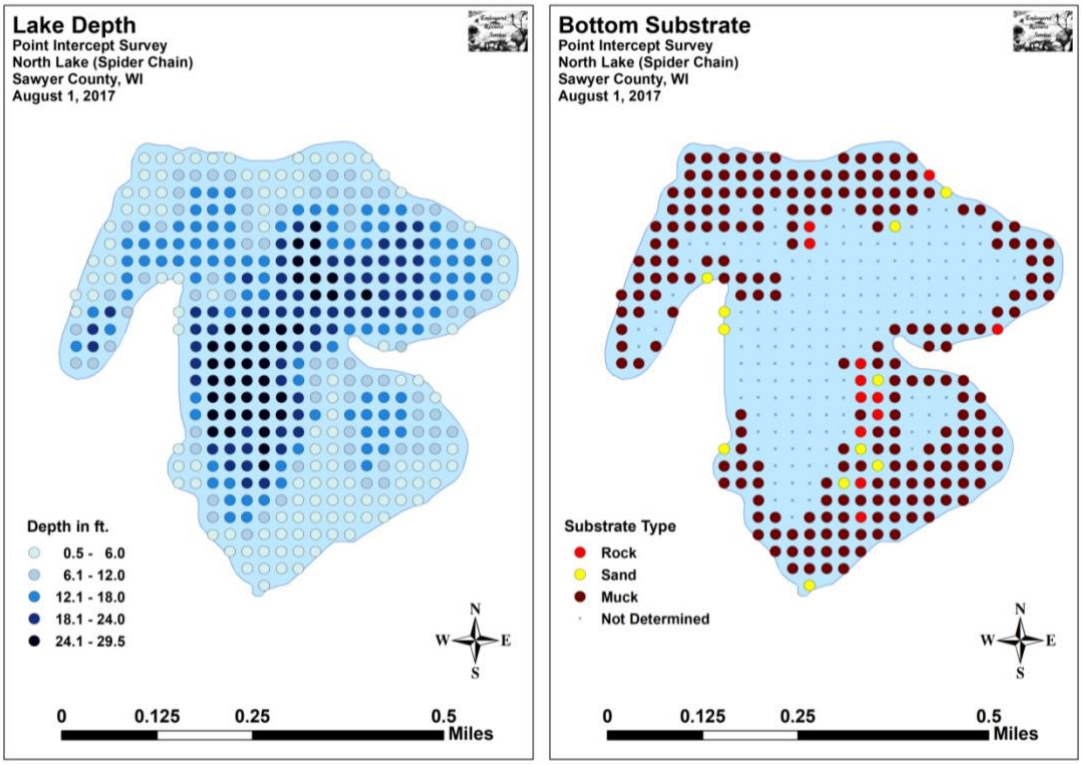


Figure 4: Lake Depth and Bottom Substrate

In 2017, we found plants growing to 14.0ft (up from 13.5ft in 2012) (Table 1) (Figure 5). The 157 points with vegetation (approximately 39.0% of the entire lake bottom and 70.1% of the littoral zone) was a non-significant decline (p=0.35) from the 2012 survey when we found plants growing at 170 points (42.2% of the bottom and 79.8% of the littoral zone). Growth in 2017 was slightly skewed to deeper water as the mean plant depth of 5.5ft was greater than the median depth of 4.5ft (nearly identical to 2012 when the mean was 5.6ft and the median was 4.5ft) (Appendix V).

Table 1: Aquatic Macrophyte P/I Survey Summary Statistics
North Lake – Spider Chain, Sawyer County
August 7, 11, 2012 and August 1, 2017

Summary Statistics:	2012	2017
Total number of points sampled	403	403
Total number of sites with vegetation	170	157
Total number of sites shallower than the maximum depth of plants	213	224
Frequency of occurrence at sites shallower than maximum depth of plants	79.8	70.1
Simpson Diversity Index	0.93	0.93
Maximum depth of plants (ft)	13.5	14.0
Mean depth of plants (ft)	5.6	5.5
Median depth of plants (ft)	4.5	4.5
Average number of all species per site (shallower than max depth)	3.21	2.92
Average number of all species per site (veg. sites only)	4.02	4.17
Average number of native species per site (shallower than max depth)	3.21	2.92
Average number of native species per site (sites with native veg. only)	4.02	4.17
Species richness	34	34
Species richness (including visuals)	34	38
Species richness (including visuals and boat survey)	39	46
Mean rake fullness (veg. sites only)	2.18	2.13

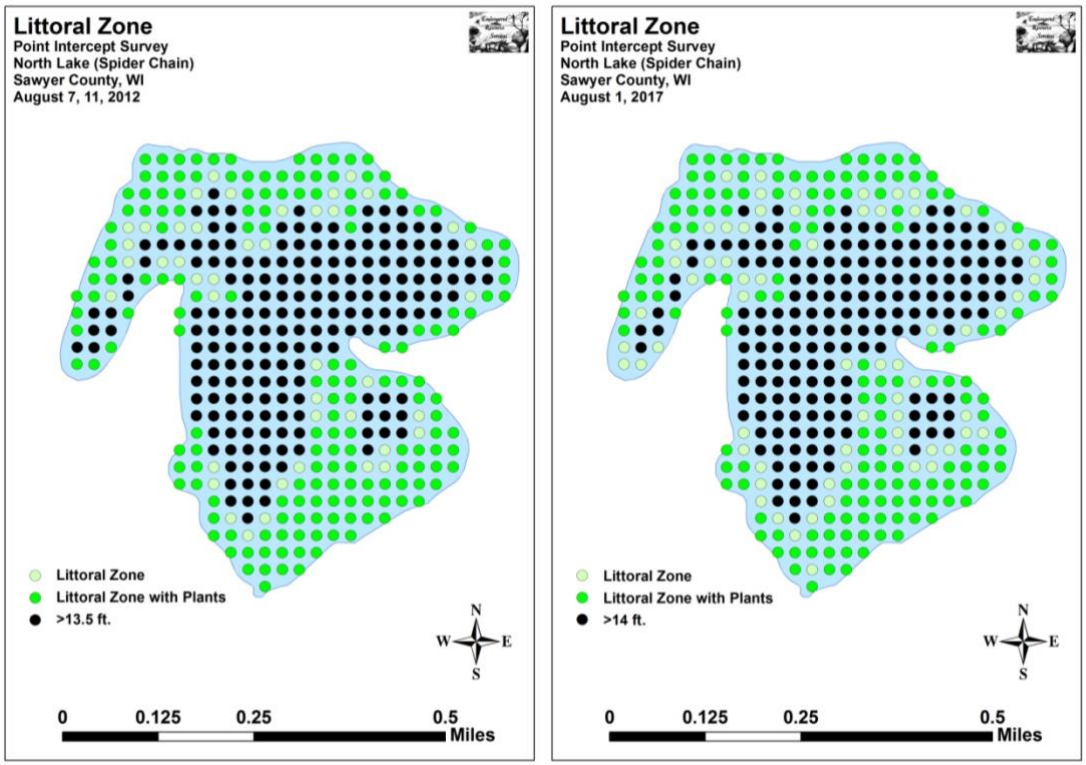


Figure 5: 2012 and 2017 Littoral Zone

Plant diversity was exceptionally high in 2017 with a Simpson Index value of 0.93 – identical to 2012. Species richness was moderate with 34 species found in the rake (also identical to 2012). This total increased to 46 species when including visuals and plants seen during the boat survey – up from 39 in 2012. Along with the increase in overall richness, mean native species richness at sites with vegetation experienced a non-significant increase (p=0.28) from 4.02 species/site in 2012 to 4.17/site in 2017 (Figure 6) (Appendix V).

Total rake fullness experienced a non-significant decline (p=0.26) from a moderate 2.18 in 2012 to 2.13 in 2017 (Figure 7) (Appendix V). Visual analysis of both the richness and density maps showed the lake appeared to be little changed since the 2012 survey.

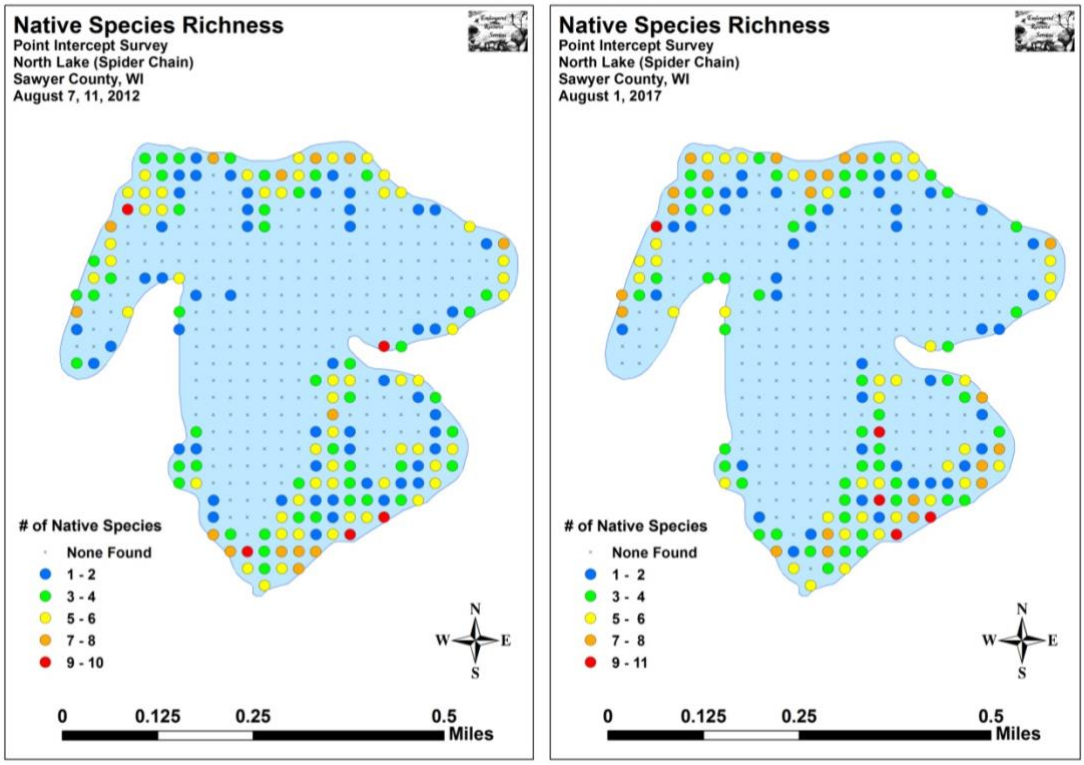


Figure 6: 2012 and 2017 Native Species Richness

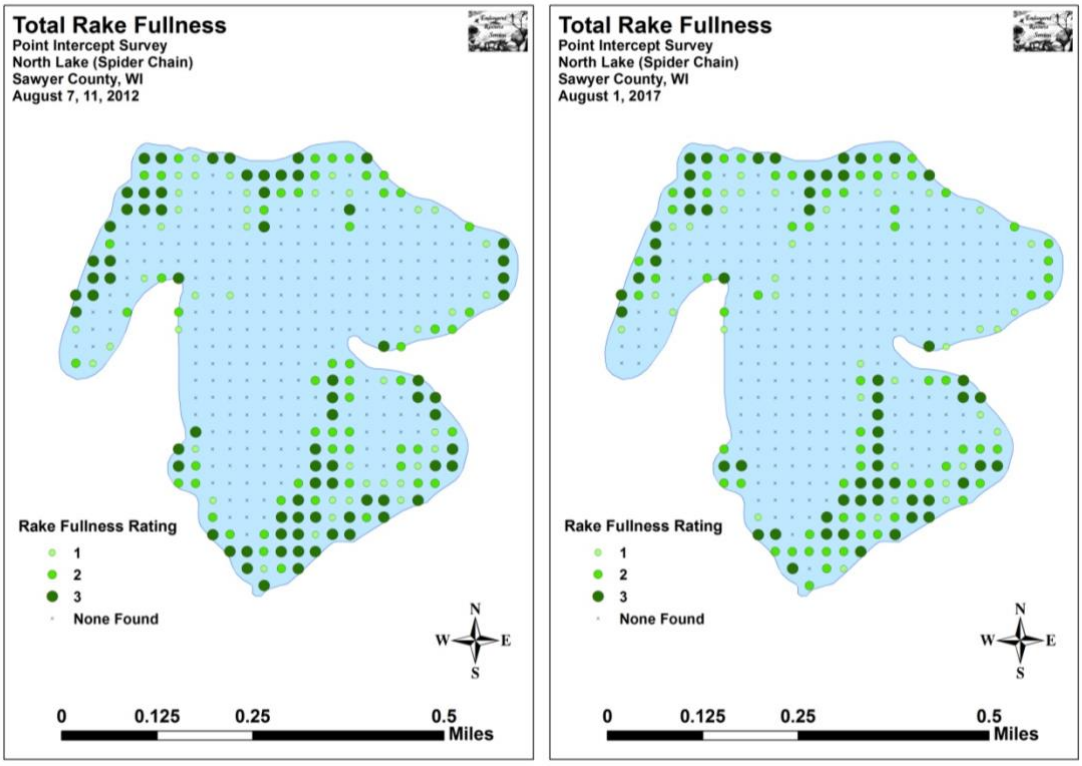


Figure 7: 2012 and 2017 Total Rake Fullness

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 Wild calla (*Calla palustris*), Bottle brush sedge (*Carex comosa*), Yellow iris, Short-stemmed bur-reed (*Sparganium emersum*), Water bulrush (*Schoenoplectus subterminalis*), Softstem bulrush (*Schoenoplectus tabernaemontani*), Broad-leaved cattail (*Typha latifolia*), and, rarely, Northern wild rice (*Zizania palustris*). 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)

Yellow iris (Berg 2017)

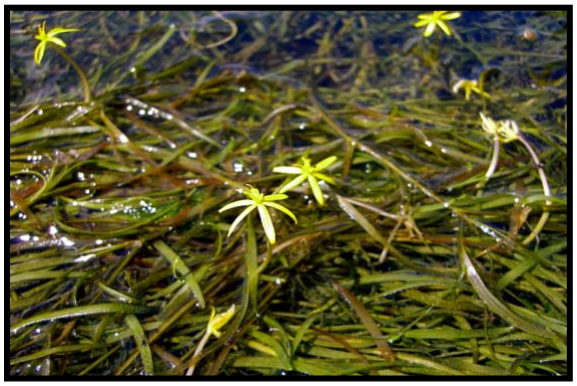
Narrow-leaved woolly sedge (O'Brien 2011)

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 Muskgrass (*Chara* sp.), Needle spikerush (*Eleocharis acicularis*), Spiny-spored quillwort (*Isoetes echinospora*), Slender naiad (*Najas flexilis*), Water star-grass (*Heteranthera dubia*), Northern water-milfoil (*Myriophyllum sibiricum*), Fries' pondweed (*Potamogeton friesii*), Variable pondweed (*Potamogeton gramineus*), Clasping-leaf pondweed (*Potamogeton richardsonii*), Crested arrowhead (*Sagittaria cristata*), Sago pondweed (*Stuckenia pectinata*), and Wild celery (*Vallisneria americana*). 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)



Water star-grass (Mueller 2010)

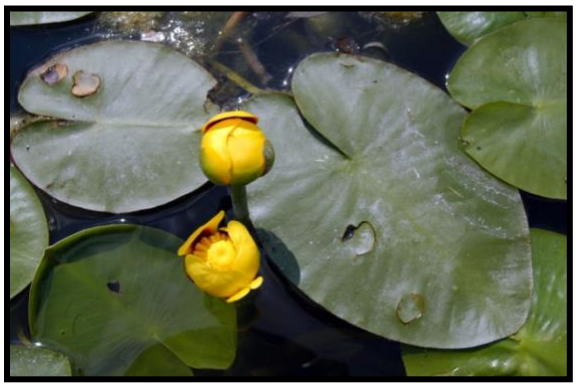
Northern water-milfoil (Berg 2007)

Fries pondweed (Koshere 2002)

Clasping-leaf pondweed (Cameron 2013)

In shallow areas that had more nutrient-rich organic muck, we found floating-leaf species like Watershield (*Brasenia schreberi*), Spatterdock (*Nuphar variegata*), White-water lily (*Nymphaea odorata*), Water smartweed (*Polygonum amphibium*), 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.

Watershield (Gmelin 2009)



Spatterdock (CBG 2014)

White water lily (Falkner 2009)

Water smartweed (Someya 2009)

Large-leaf pondweed (Fewless 2010)

Ribbon-leaf pondweed (Petroglyph 2007)

Growing among the floating-leaf canopy, we frequently also encountered Whorled water-milfoil (*Myriophyllum verticillatum*), Water bulrush (*Schoenoplectus subterminalis*), 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)

Water bulrush (Haines 2013)

Creeping bladderwort (Stahn 2008)

Flat-leaf bladderwort (Koshere 2002)

Common bladderwort flowers among lilypads (Hunt 2010)

Bladders for catching plankton and insect larvae (Wontolla 2007)

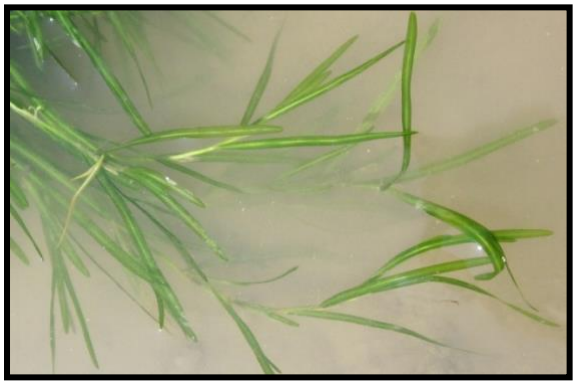
Deeper areas from 5-10ft over thicker muck were generally dominated by broader-leaved species such as Coontail (*Ceratophyllum demersum*), Common waterweed (*Elodea canadensis*), Nitella (*Nitella* sp.), Large-leaf pondweed (*Potamogeton amplifolius*), Illinois pondweed (*Potamogeton illinoensis*), White-stem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

Coontail (Hassler, 2011)

Common waterweed (Fischer, 2011)

Large-leaf pondweed (Martin 2002)

White-stem pondweed (Fewless 2005)



Small pondweed (Villa 2011)

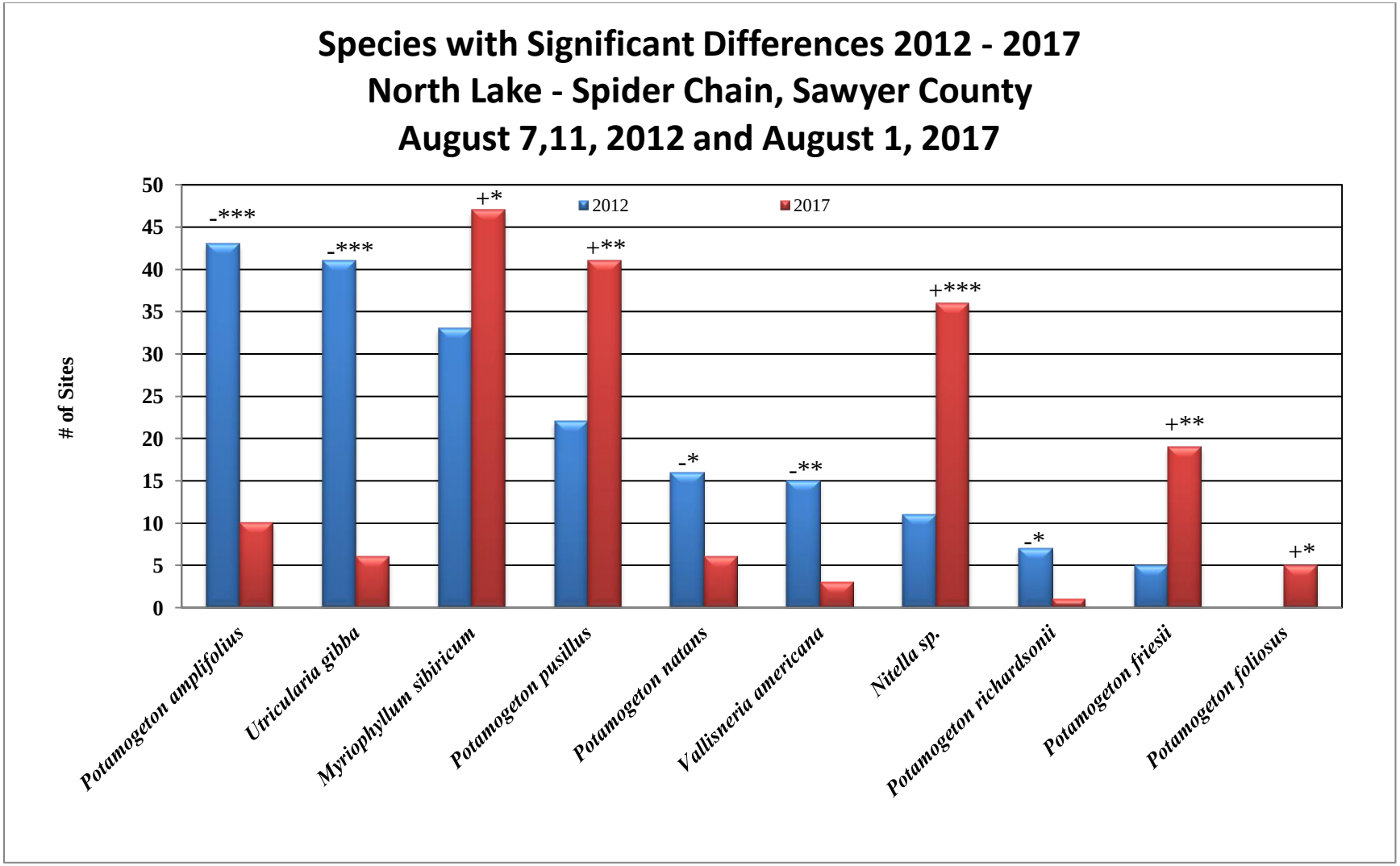
Flat-stem pondweed (Fewless 2004)

Comparison of Native Macrophyte Species in 2012 and 2017:

In August 2012, Flat-stem pondweed, Coontail, Slender naiad, and White water lily were the most common macrophyte species. They were present at 51.18%, 47.06%, 37.06%, and 31.18% of survey points with vegetation respectively, and accounted for 41.37% of the total relative frequency (Table 2). Spatterdock (6.43), Large-leaf pondweed (6.29), Creeping bladderwort (5.99), Northern water-milfoil (4.82), Muskgrass (3.95), and Fern pondweed (3.95) also had relative frequency over 3.0 (Maps for all species found in August 2012 are located in Appendix VI).

In 2017, we again found that Coontail, Flat-stem pondweed, Slender naiad, and White water lily were the four most common species. Present at 49.04%, 49.04%, 40.76%, and 34.39% of sites with vegetation, they accounted for 41.59% of the total relative frequency (Table 3). Northern water-milfoil (7.19), Spatterdock (6.88), Small pondweed (6.27), Nitella (5.50), Muskgrass (4.74), Fern pondweed (4.59), and Common waterweed (3.06) were the other species with relative frequencies of more than 3.0 (Species accounts for all species found in the Spider Chain 2012 and 2017, and maps for all plants found in North Lake in August 2017 can be found in Appendixes VII and VIII).

Lakewide, ten species showed significant changes in distribution from 2012 to 2017 (Figure 8). Large-leaf pondweed and Creeping bladderwort suffered highly significant declines; Wild celery experienced a moderately significant decline; and Floating-leaf pondweed and Clasping-leaf pondweed demonstrated significant declines. Conversely, Nitella showed a highly significant increase; Small pondweed and Fries' pondweed saw moderately significant increases; and Northern water-milfoil and Leafy pondweed had significant increases.



Significant differences = * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 8: Macrophytes Showing Significant Changes from 2012-2017

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes
North Lake – Spider Chain, 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 – Spider Chain, 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

Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
North Lake – Spider Chain, Sawyer County
August 1, 2017

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sightings
Ceratophyllum demersum	Coontail	77	11.77	49.04	34.38	1.19	9
Potamogeton zosteriformis	Flat-stem pondweed	77	11.77	49.04	34.38	1.38	11
Najas flexilis	Slender naiad	64	9.79	40.76	28.57	1.13	1
Nymphaea odorata	White water lily	54	8.26	34.39	24.11	1.72	14
Myriophyllum sibiricum	Northern water-milfoil	47	7.19	29.94	20.98	1.32	15
Nuphar variegata	Spatterdock	45	6.88	28.66	20.09	2.07	10
Potamogeton pusillus	Small pondweed	41	6.27	26.11	18.30	1.22	12
Nitella sp.	Nitella	36	5.50	22.93	16.07	1.47	0
Chara sp.	Muskgrass	31	4.74	19.75	13.84	1.81	0
Potamogeton robbinsii	Fern pondweed	30	4.59	19.11	13.39	1.23	0
	Filamentous algae	28	*	17.83	12.50	1.18	0
Elodea canadensis	Common waterweed	20	3.06	12.74	8.93	1.25	1
Potamogeton friesii	Fries' pondweed	19	2.91	12.10	8.48	1.42	8
Heteranthera dubia	Water star-grass	15	2.29	9.55	6.70	1.13	4
Utricularia vulgaris	Common bladderwort	15	2.29	9.55	6.70	1.13	8
Potamogeton praelongus	White-stem pondweed	13	1.99	8.28	5.80	1.23	6
Brasenia schreberi	Watershield	12	1.83	7.64	5.36	1.42	0
Potamogeton amplifolius	Large-leaf pondweed	10	1.53	6.37	4.46	1.10	9
Potamogeton natans	Floating-leaf pondweed	6	0.92	3.82	2.68	1.00	3
Utricularia gibba	Creeping bladderwort	6	0.92	3.82	2.68	1.17	0
Pontederia cordata	Pickerelweed	5	0.76	3.18	2.23	2.00	3
Potamogeton foliosus	Leafy pondweed	5	0.76	3.18	2.23	1.40	3
Sparganium emersum	Short-stemmed bur-reed	5	0.76	3.18	2.23	1.00	5

* Excluded from Rel. Freq. Calc.

Table 3 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
North Lake – Spider Chain, Sawyer County
August 1, 2017

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sightings
Eleocharis palustris	Creeping spikerush	3	0.46	1.91	1.34	1.33	2
Myriophyllum verticillatum	Whorled water-milfoil	3	0.46	1.91	1.34	1.00	2
Vallisneria americana	Wild celery	3	0.46	1.91	1.34	1.00	1
Bidens beckii	Water marigold	2	0.31	1.27	0.89	1.00	3
Potamogeton illinoensis	Illinois pondweed	2	0.31	1.27	0.89	1.00	0
Stuckenia pectinata	Sago pondweed	2	0.31	1.27	0.89	1.00	0
Potamogeton epihydrus	Ribbon-leaf pondweed	1	0.15	0.64	0.45	1.00	0
Potamogeton richardsonii	Clasping-leaf pondweed	1	0.15	0.64	0.45	1.00	3
Schoenoplectus acutus	Hardstem bulrush	1	0.15	0.64	0.45	2.00	1
Utricularia intermedia	Flat-leaf bladderwort	1	0.15	0.64	0.45	3.00	0
Utricularia minor	Small bladderwort	1	0.15	0.64	0.45	1.00	0
Zizania palustris	Northern wild rice	1	0.15	0.64	0.45	1.00	0
Polygonum amphibium	Water smartweed	**	**	**	**	**	1
Potamogeton gramineus	Variable pondweed	**	**	**	**	**	1
Sagittaria cristata	Crested arrowhead	**	**	**	**	**	1
Schoenoplectus subterminalis	Water bulrush	**	**	**	**	**	2
Carex comosa	Bottle brush sedge	***	***	***	***	***	***
Carex lasiocarpa	Narrow-leaved woolly sedge	***	***	***	***	***	***
Eleocharis acicularis	Needle spikerush	***	***	***	***	***	***
Equisetum fluviatile	Water horsetail	***	***	***	***	***	***
Iris pseudacorus	Yellow iris	***	***	***	***	***	***
Isoetes echinospora	Spiny-spored quillwort	***	***	***	***	***	***
Schoenoplectus tabernaemontani	Softstem bulrush	***	***	***	***	***	***
Typha latifolia	Broad-leaved cattail	***	***	***	***	***	***

** Visual Only *** Boat Survey Only

Flat-stem pondweed, the most common species in both 2012 and 2017, occurred throughout much of the littoral zone where it occasionally formed moderate to high density beds (Figure 9). Although its decline in distribution was not significant (p=0.70) (87 points in 2012/77 points in 2017), the accompanying drop in density from a mean rake fullness of 1.57 in 2012 to 1.38 in 2017 was significant **(p=0.02)**.

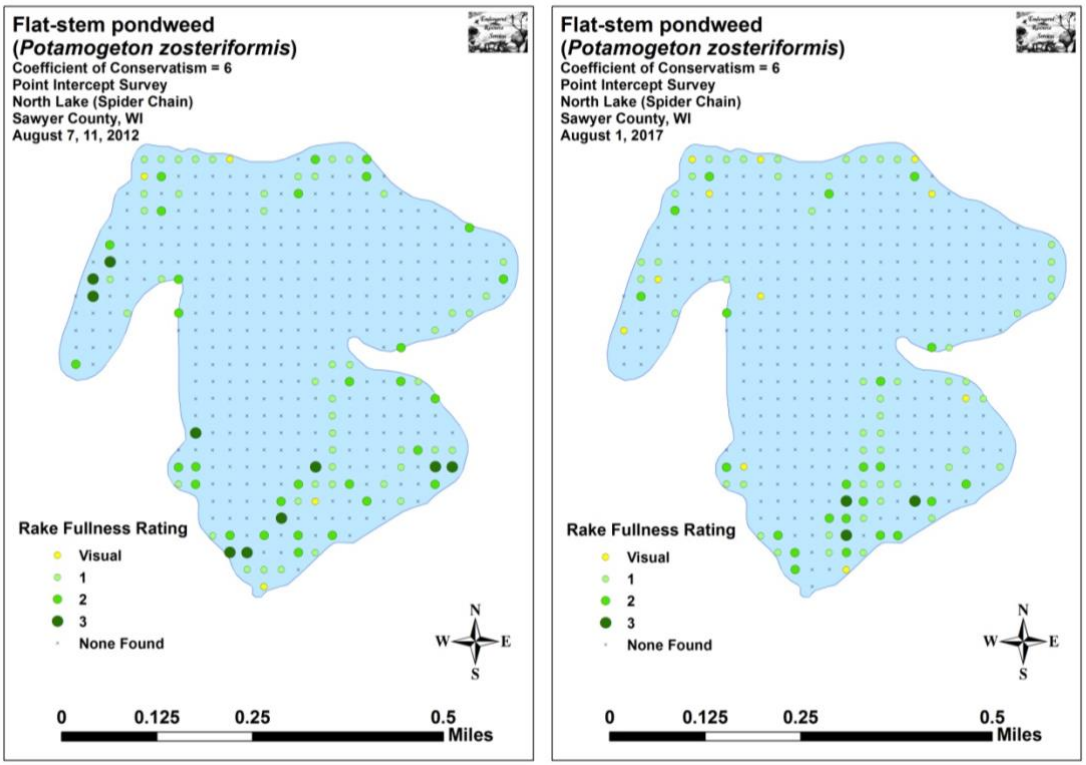


Figure 9: 2012 and 2017 Flat-stem Pondweed Density and Distribution

After being the second most widely distributed species in 2012, Coontail tied for the top spot in 2017. Both its distribution (80 sites in 2012/77 sites in 2017), and its density (mean rake fullness of 1.18 in 2012/1.19 in 2017) were little changed (Figure 10). Similarly, Slender naiad, White water lily (Figure 11), and Spatterdock (the third, fourth, and fifth most common species in both years) were almost unchanged in both density and distribution. However, Large-leaf pondweed, an important broad-leaved habitat producing species that was the sixth most common species in 2012 (43 sites), experienced a highly significant decline **(p<0.001)** and fell to just the seventeenth most common species in 2017 (10 sites). It also experienced a nearly significant decline (p=0.09) in mean rake fullness from 1.28 in 2012 to 1.10 in 2017 (Figure 12). Interestingly, Northern water-milfoil, a species known to have dramatic boom/bust population cycles, appeared to fill in some areas previously dominated by Large-leaf pondweed. It experienced a significant increase in distribution **(p=0.03)** and rose from the eight most common species in 2012 (33 sites) to the fifth most common in 2017 (47 sites). Its expansion in density from a mean rake fullness of 1.12 in 2012 to 1.32 in 2017 was also significant **(p=0.03)** (Figure 13).

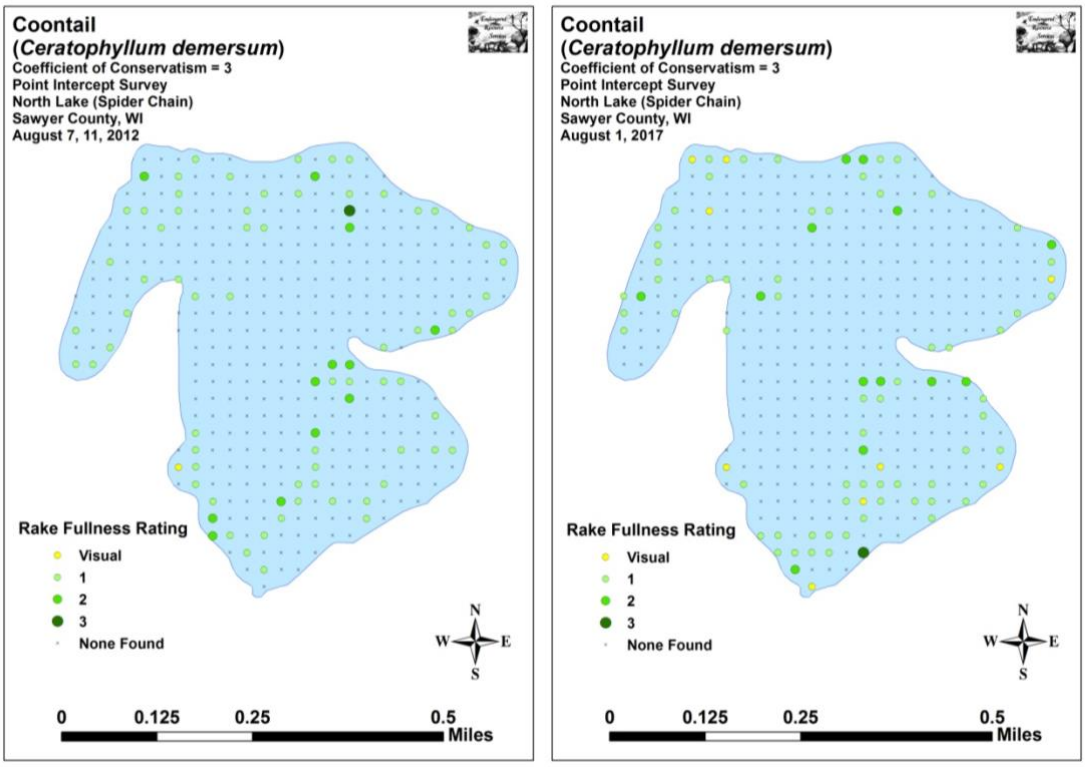


Figure 10: 2012 and 2017 Coontail Density and Distribution

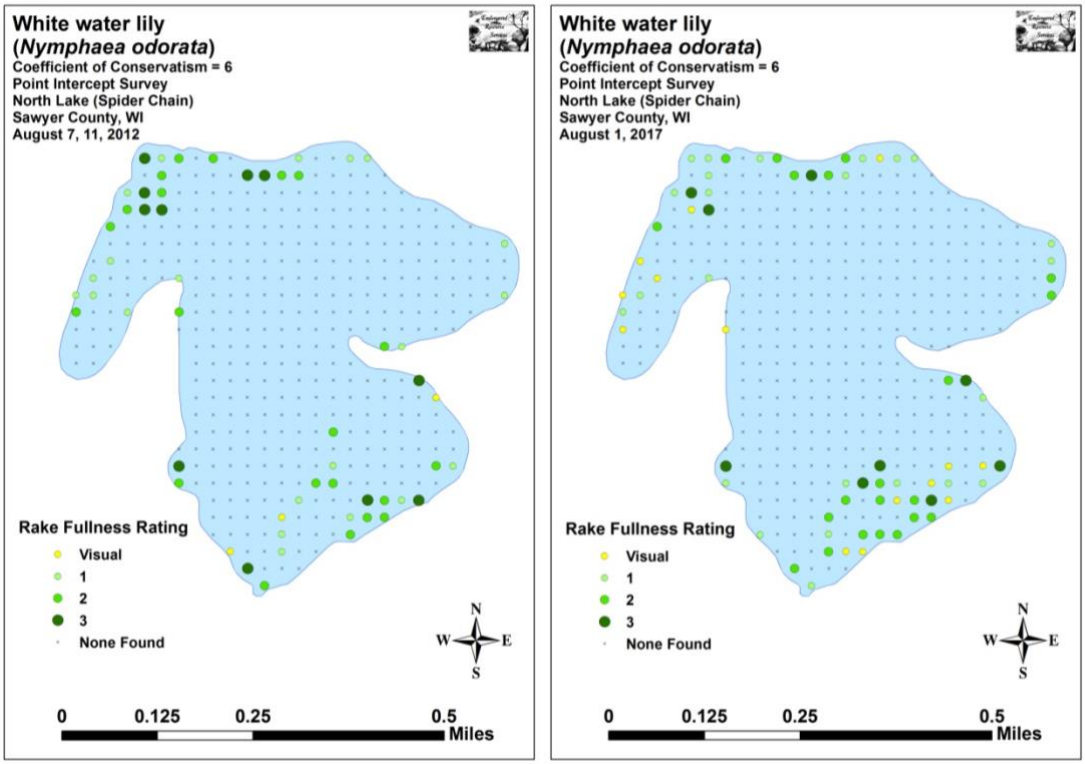


Figure 11: 2012 and 2017 White Water Lily Density and Distribution

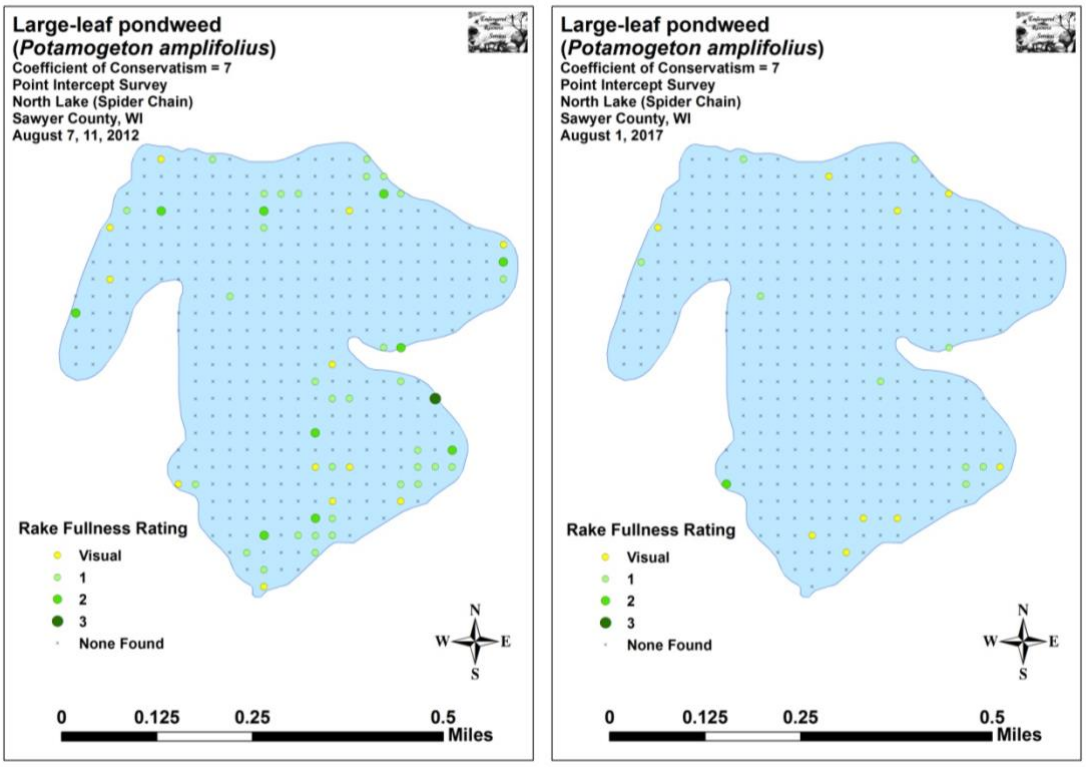


Figure 12: 2012 and 2017 Large-leaf Pondweed Density and Distribution

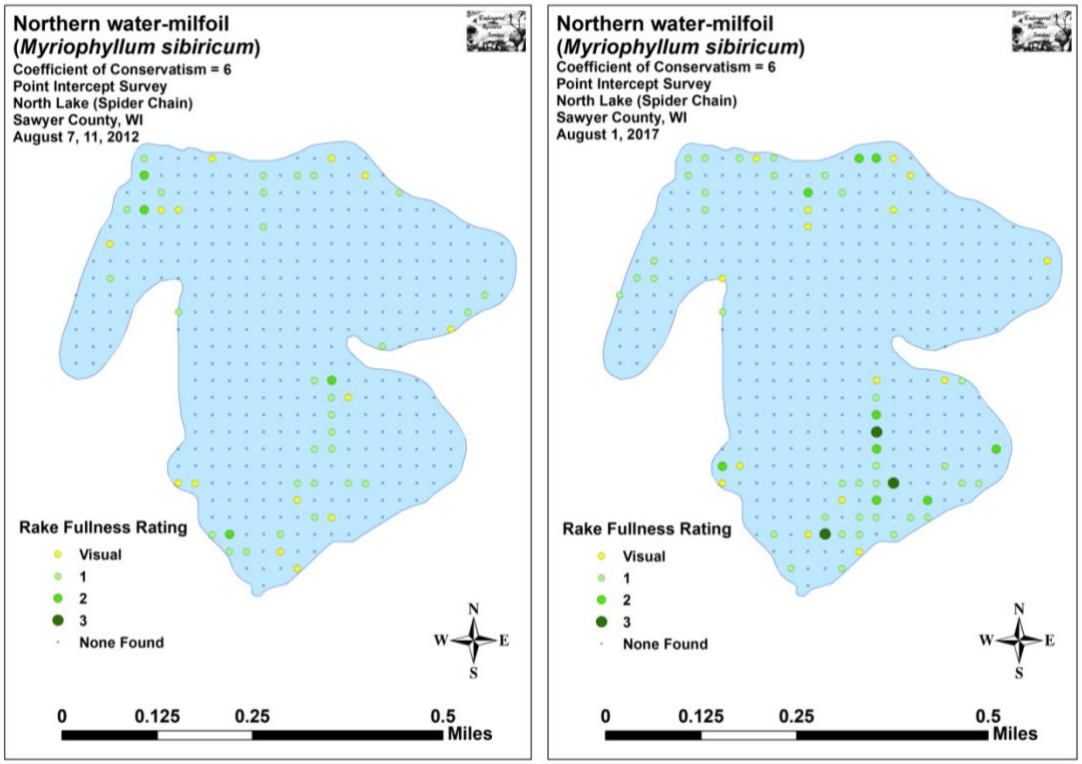


Figure 13: 2012 and 2017 Northern Water-milfoil Density and Distribution

Comparison of Northern Wild Rice in 2012 and 2017:

Northern wild rice, a plant of significant wildlife and cultural value, was present at two points in 2012 with both samples containing a single plant (Figure 14). At that time, we estimated the lake's entire rice population contained perhaps no more than a few 100 widely scattered individuals that were growing on and among the floating muck bogs in the southeast and northwest bays. Consequently, there was no place on the lake that was fit for human harvest. During the 2017 survey, we found a single rice plant at a single point in the northwest bay. We noted there were only six other plants near the point, and we found no surviving members from the population in the southeast bay. This decline suggests the species is in real danger of disappearing from the lake entirely.

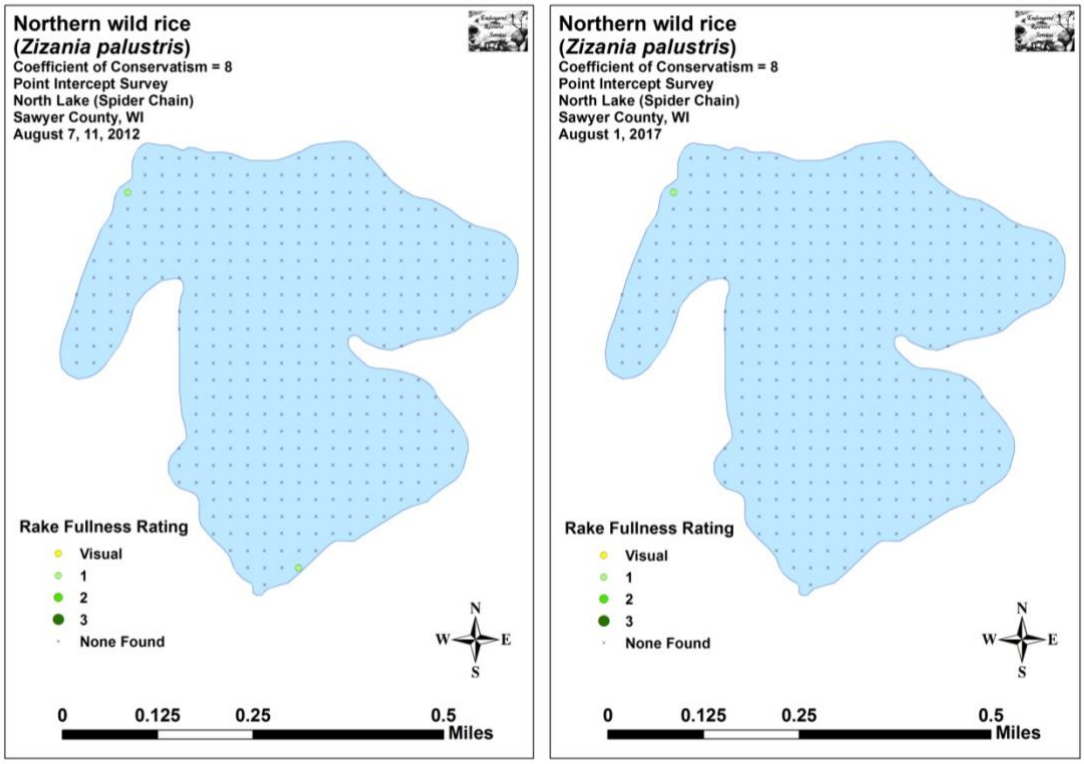


Figure 14: 2012 and 2017 Northern Wild Rice Density and Distribution

Comparison of Floristic Quality Indexes in 2012 and 2017:

In 2012, we identified a total of 34 **native index species** in the rake during the point-intercept survey (Table 4). They produced a mean Coefficient of Conservatism of 6.8 and a Floristic Quality Index of 39.8.

Table 4: Floristic Quality Index of Aquatic Macrophytes
North Lake – Spider Chain, 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		**39.8**

In 2017, we again identified a total of 34 **native index plants** in the rake during the point-intercept survey. They produced a mean Coefficient of Conservatism of 6.6 and a Floristic Quality Index of 38.8 (Table 5). Nichols (1999) reported an average mean C for the Northern Lakes and Forest Region of 6.7 putting North Lake nearly 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).

Table 5: Floristic Quality Index of Aquatic Macrophytes
North Lake – Spider Chain, Sawyer County
August 1, 2017

Species	Common Name	C
Bidens beckii	Water marigold	8
Brasenia schreberi	Watershield	6
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
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 foliosus	Leafy pondweed	6
Potamogeton friesii	Fries' pondweed	8
Potamogeton illinoensis	Illinois pondweed	6
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Schoenoplectus acutus	Hardstem bulrush	6
Sparganium emersum	Short-stemmed bur-reed	8
Stuckenia pectinata	Sago pondweed	3
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		**6.6**
FQI		**38.8**

Comparison of Filamentous Algae in 2012 and 2017:

Filamentous algae, normally associated with excessive nutrients in the water column, were present at 28 survey points in 2017. Although this was a non-significant decline (p=0.82) in distribution from the 32 points they were found at in 2012, the decline in mean rake fullness from 1.71 in 2010 to 1.41 in 2017 was moderately significant **(p=0.001)** (Figure 15).

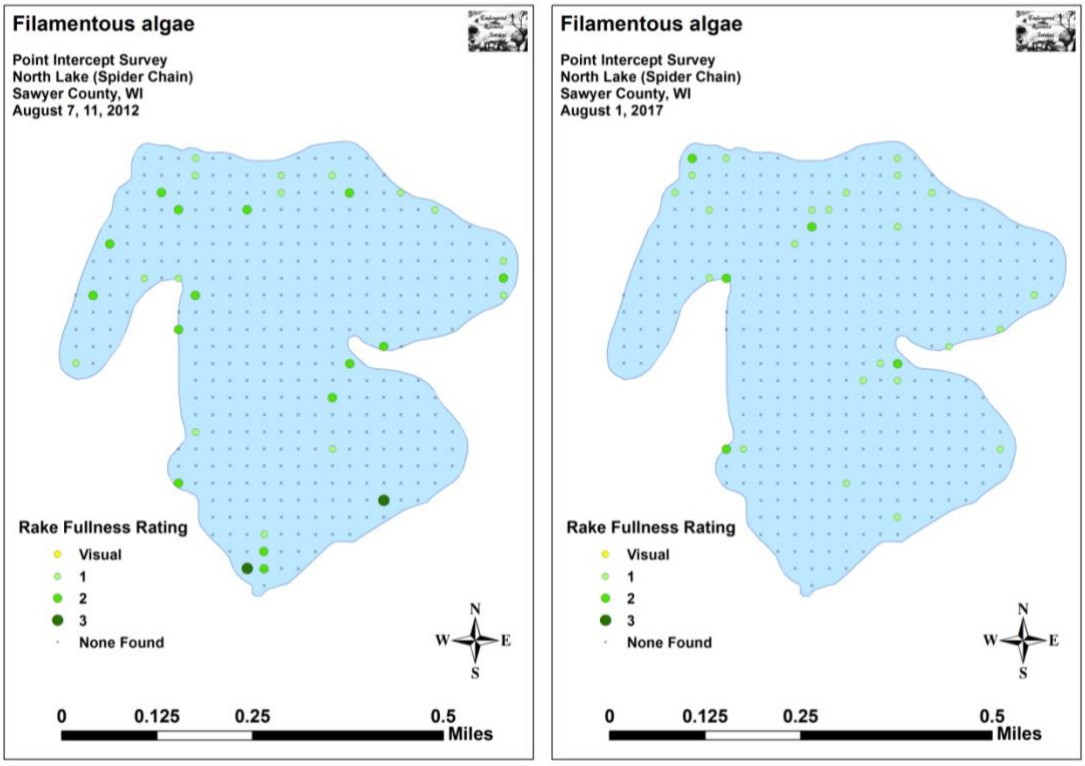


Figure 15: 2012 and 2017 Filamentous Algae Density and Distribution

Other Exotic Plant Species:

As with the June survey, we did **NOT** find any evidence of Eurasian water-milfoil or Curly-leaf pondweed in North Lake. We also didn't see any Purple loosestrife or Narrow-leaved cattail – two other exotic species found elsewhere in the system during the 2017 surveys. However, Yellow iris clusters were still scattered along the shoreline although it appeared at least a few of the smaller ones had been removed by volunteers (For more information on a sampling of aquatic exotic invasive plant species, see Appendix IX).

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:

Water Clarity, Nutrient Inputs, Algae and the Role of Native Plants:

Like trees in a forest, a lake's native macrophytes 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 aquatic invertebrates and the lake's fish populations. Because of this, preserving them is critical to maintaining the lake's overall health. Unfortunately, when phosphorus and nitrogen levels exceed what the lake's plants can utilize, it tends to promote algae blooms which impact sensitive native species as well as general lake esthetics. Filamentous algae were more prevalent in North Lake than anywhere else in the Spider Chain in both 2012 and 2017; however, there was no obvious correlation between our data and residences on the lake. This suggests that at least some of the nutrients that are feeding this algal growth are from a natural source like phosphorus recycling in organic sediments.

Soil erosion and runoff can also be significant contributors to a lake's overall nutrient load. Because of this, all lake residents have the opportunity to help reduce runoff by evaluating how their shoreline practices may be impacting the lake. Simple things like establishing or maintaining their own buffer strip of native vegetation along the lakeshore to prevent erosion, building rain gardens, bagging grass clippings, switching to a phosphorus-free fertilizer or preferably 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 the amount of nutrients entering the lake. Hopefully, a greater understanding of how all property owners can have lake-wide impacts will result in more people taking appropriate conservation actions to not only help improved water clarity and quality, but also to benefit the lake's native plant species.

Yellow Iris:

The presence and apparent rapid spread of Yellow iris in the Spider Chain is troubling. Unlike Purple loosestrife where imported Galerucella beetles have proven effective at decreasing established populations, there are currently no biological control agents for Yellow iris. Because of this, we STRONGLY encourage residents to continue to eliminate plants on their property before a minor problem becomes a significant one. Iris plants and pods should be bagged to prevent seed dispersal, and then disposed of well away from the lake or any other wetland. June is the best time to look for this species as the bright yellow fleur-de-lis are most common at this time (Figure 16). At other times of the year when it is not in bloom, its leaves could be confused with Northern blue flag (*Iris versicolor*) – a native and non-invasive iris species.

Figure 16: Yellow Iris Flower/Iris Cluster and Seed Pods Hanging in Water

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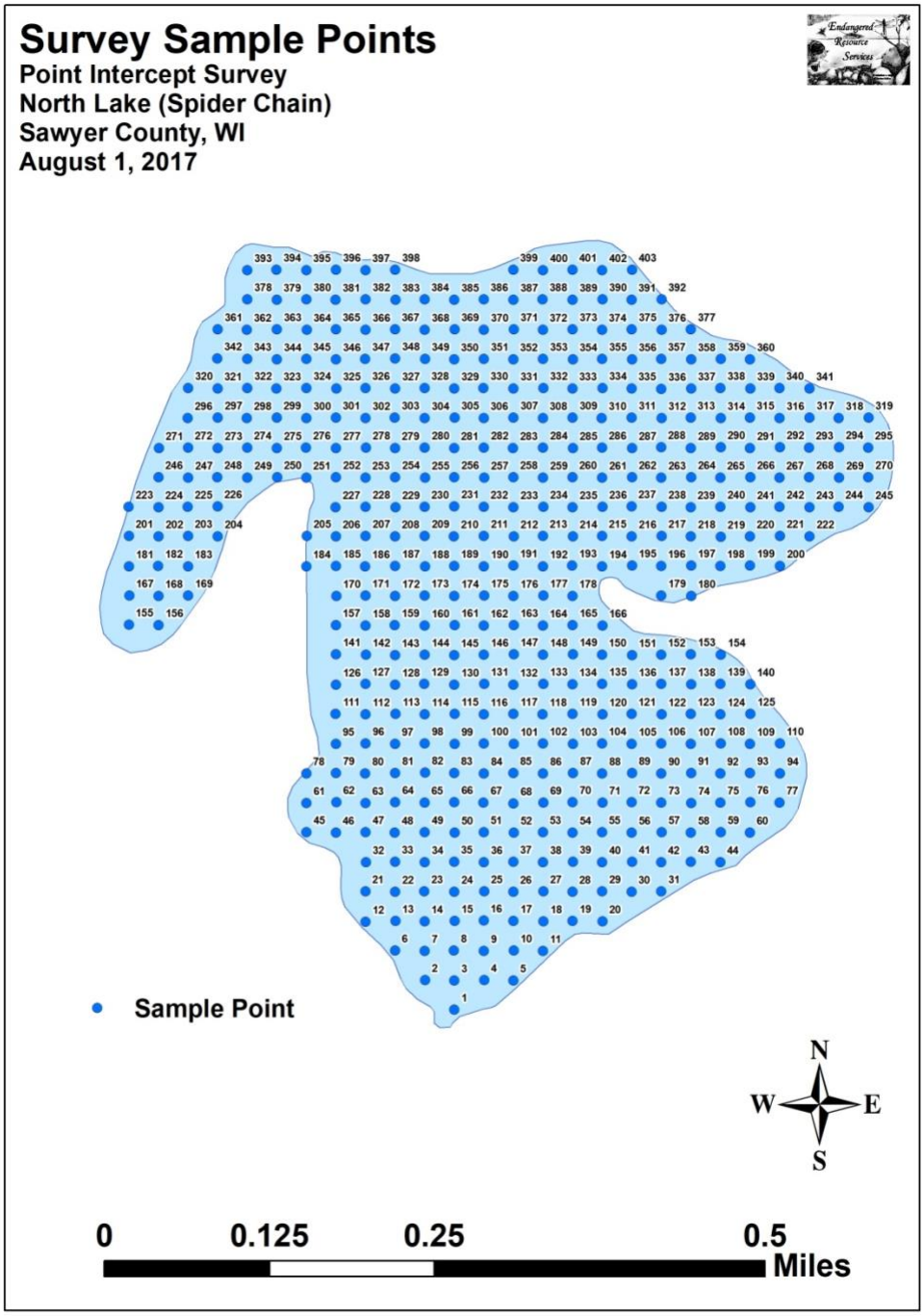
WDNR. [online]. 2010. Eurasian Water-milfoil fact sheet. http://dnr.wi.gov/invasives/fact/milfoil.htm (2010, August).

WDNR. [online]. 2010. Purple loosestrife fact sheet. http://dnr.wi.gov/invasives/fact/loosestrife.htm (2010, August).

WDNR. [online]. 2010. Reed canary grass fact sheet. http://dnr.wi.gov/invasives/fact/reed_canary.htm (2010, August).

Appendix I: Survey Sample Points Map

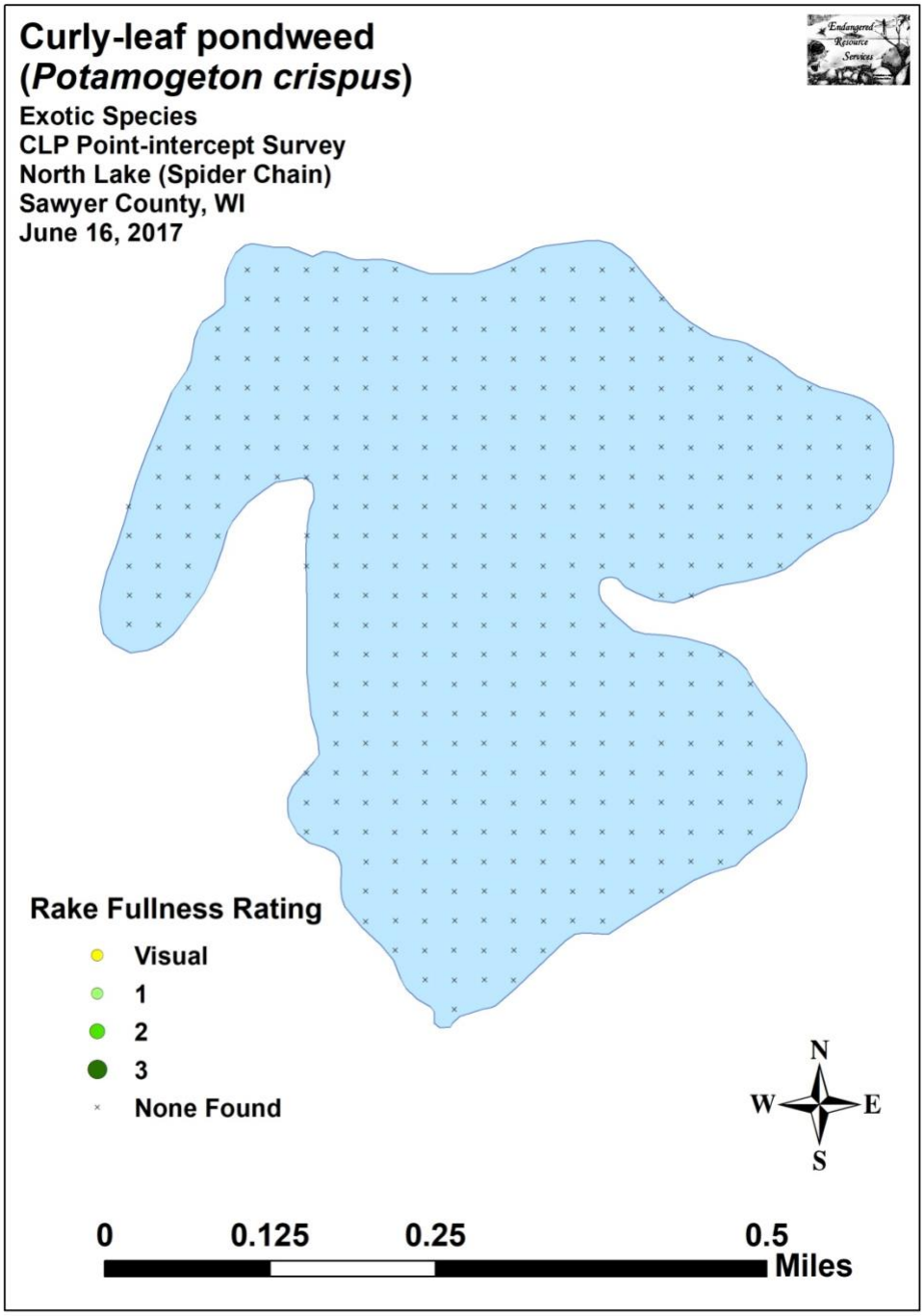

Survey Sample Points
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Sample Point
N
W
E
S
0
0.125
0.25
0.5
Miles

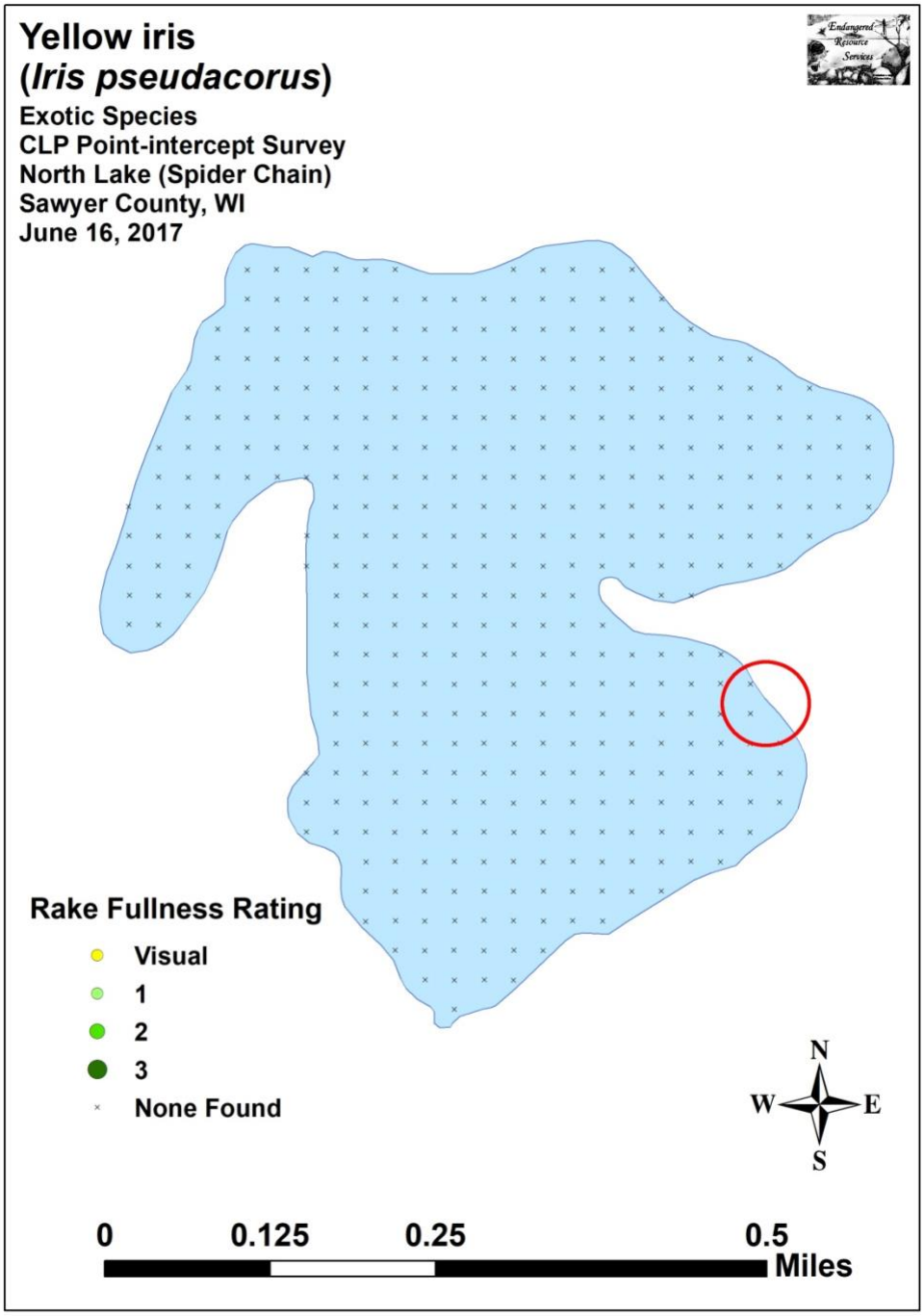
Appendix II: Boat and Vegetative Survey Data Sheets

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

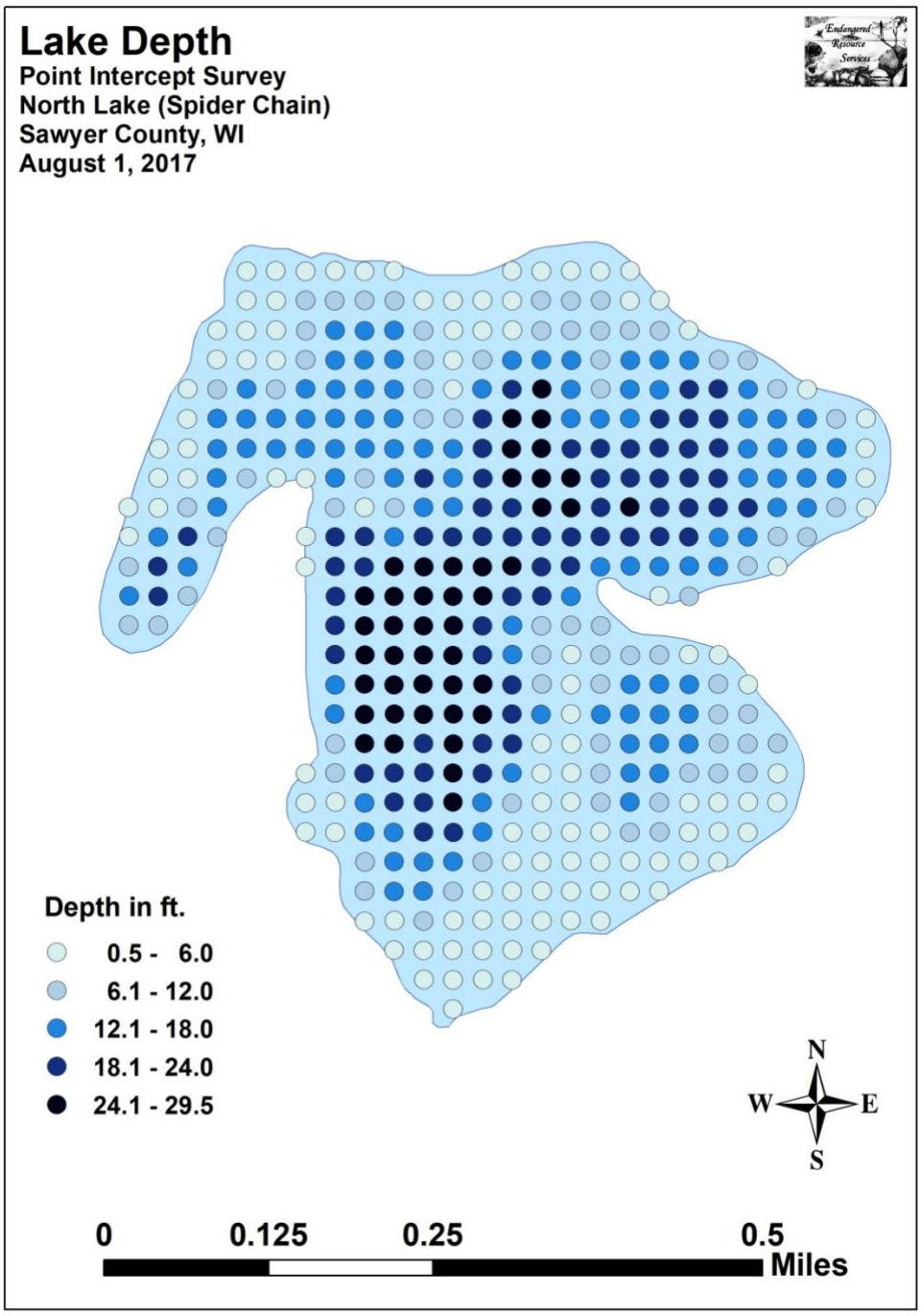
Observers for this lake: names and hours worked by each:																										
Lake:									WBIC									County						Date:	
Site #	Depth (ft)	Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	Total Rake Fullness	EWM	CLP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1																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

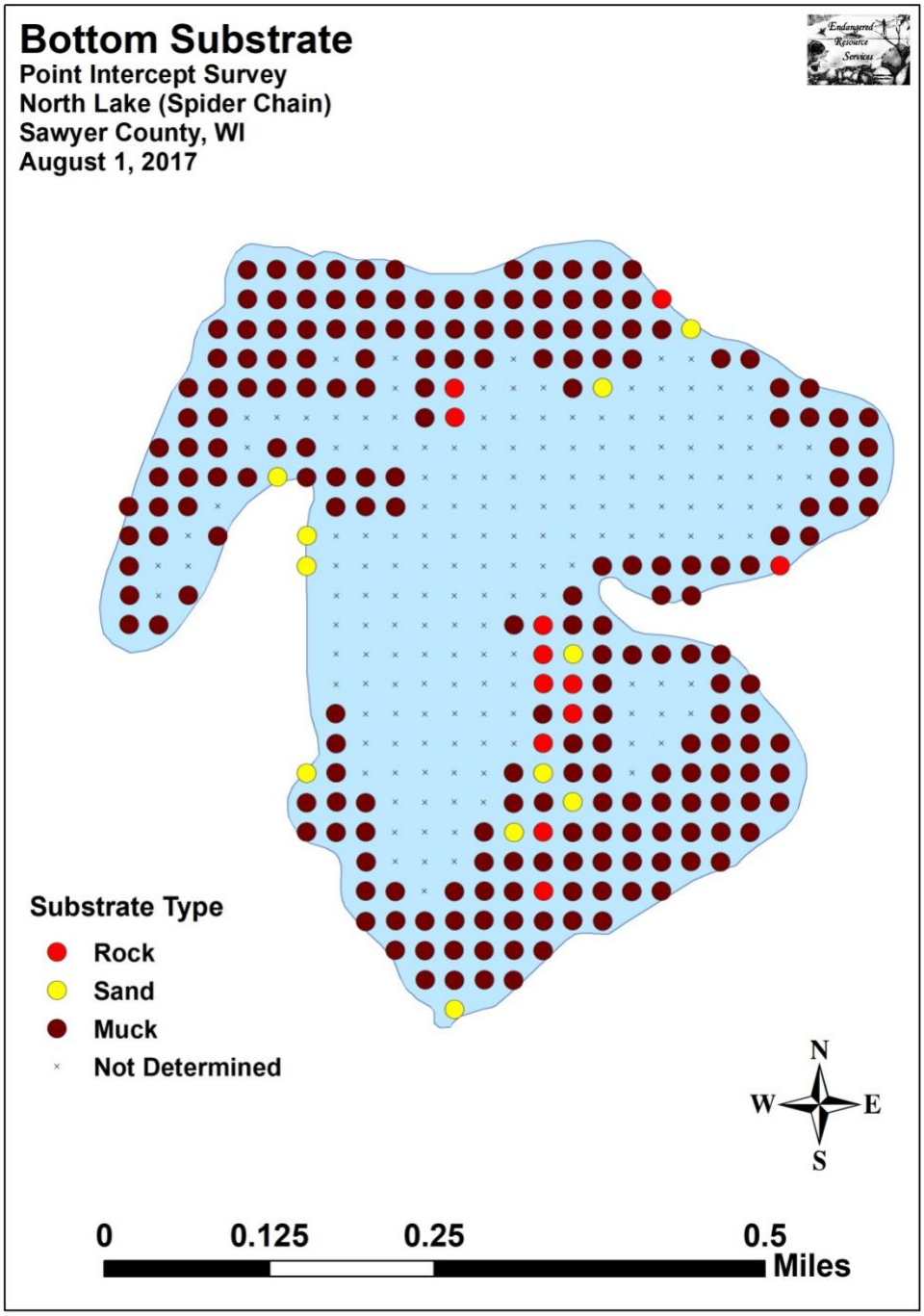
Appendix III: 2017 Early-season Curly-leaf Pondweed and Yellow Iris Density and Distribution Maps


Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
CLP Point-intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
June 16, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

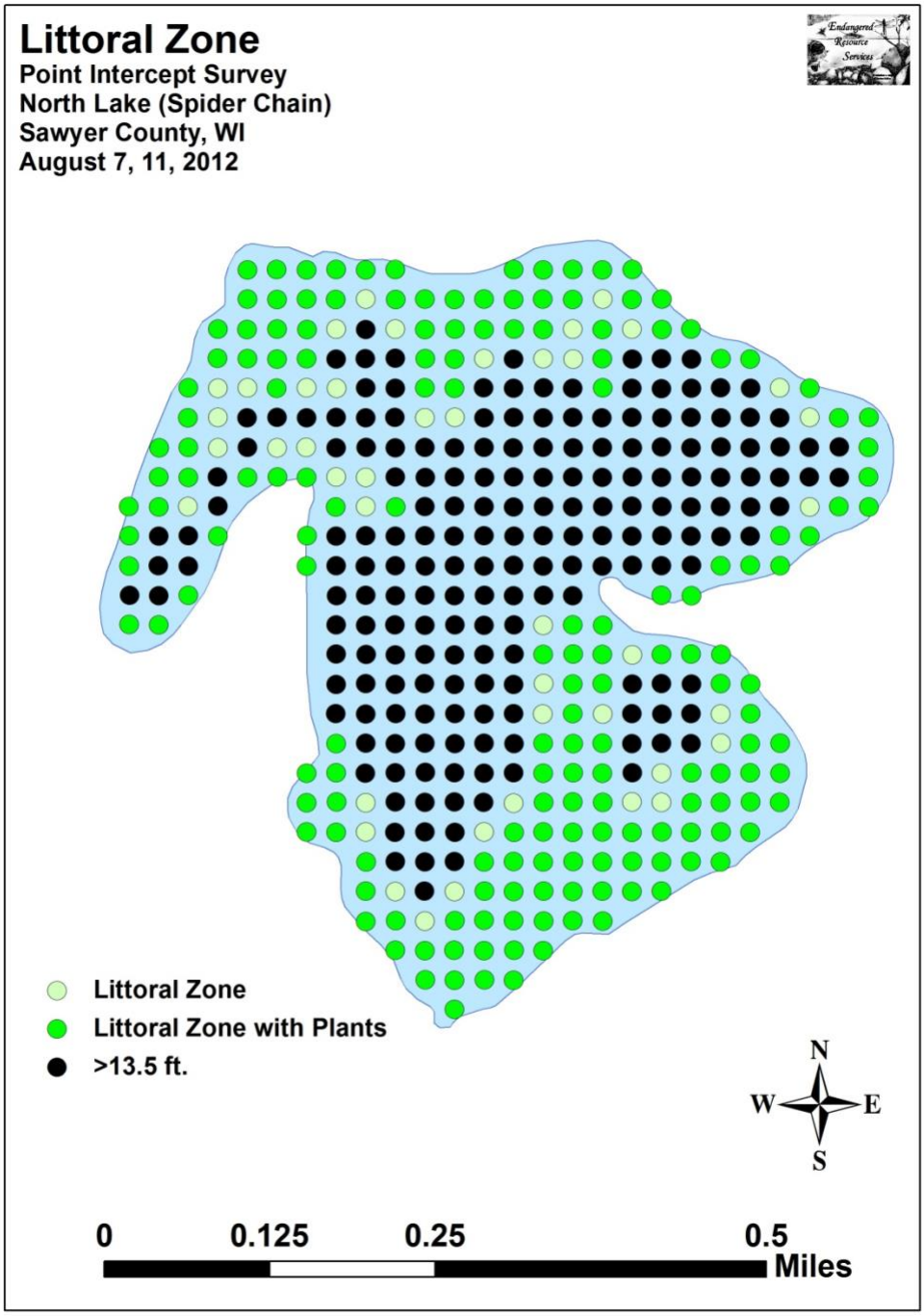

Yellow iris
(Iris pseudacorus)
Exotic Species
CLP Point-intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
June 16, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

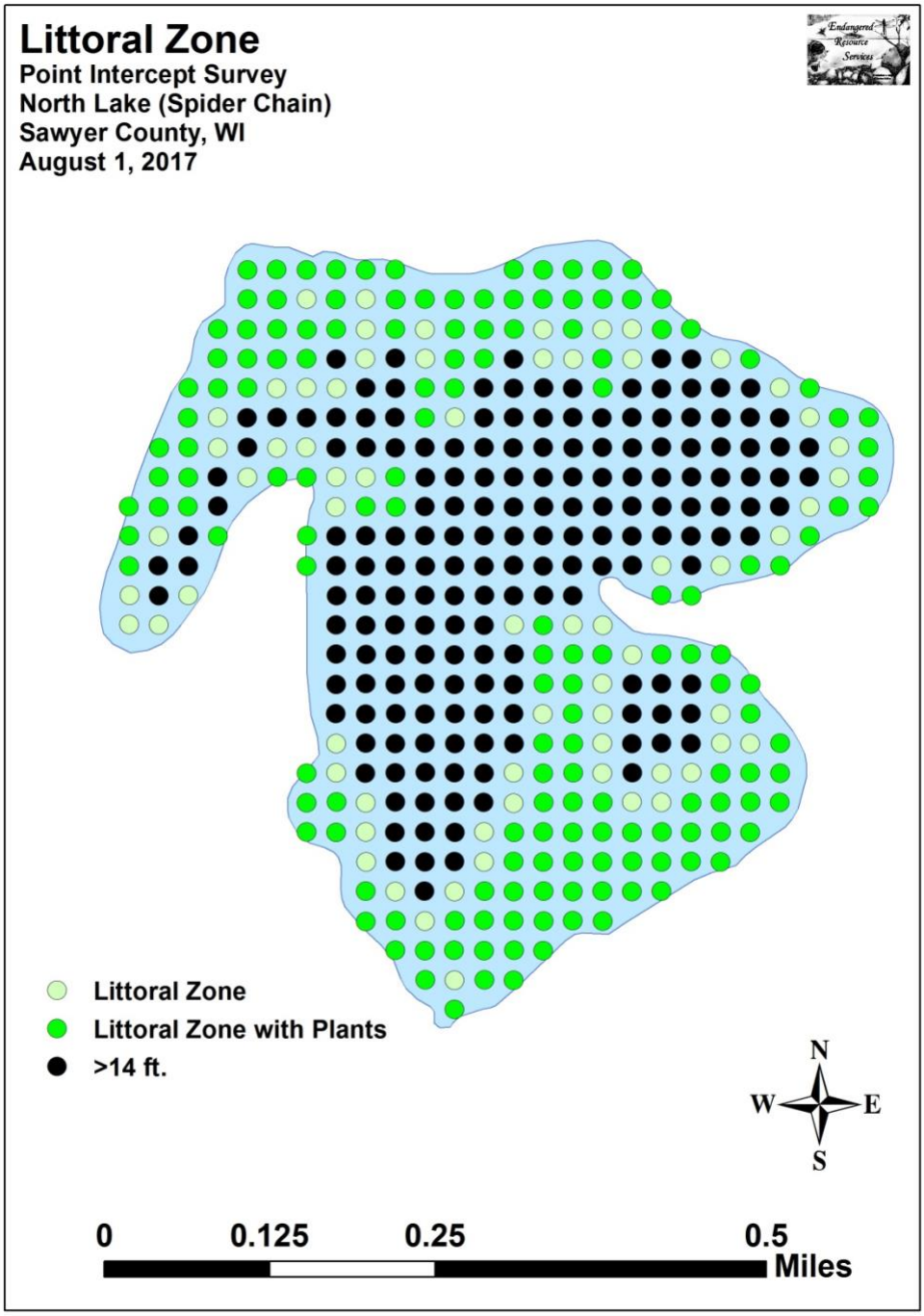
Appendix IV: Habitat Variable Maps

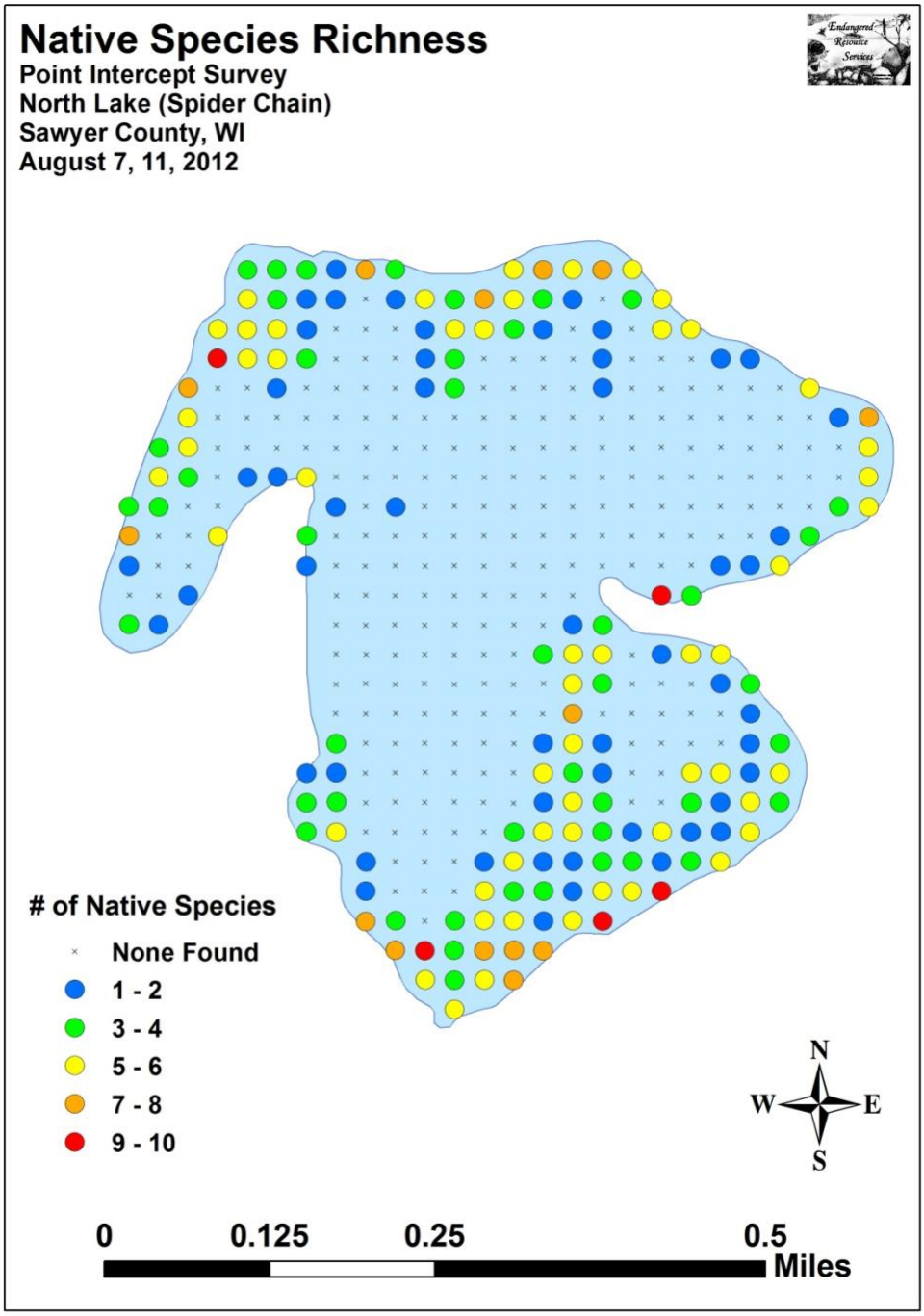

Lake Depth
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Depth in ft.
0.5 - 6.0
6.1 - 12.0
12.1 - 18.0
18.1 - 24.0
24.1 - 29.5
N
W
E
S
0
0.125
0.25
0.5
Miles

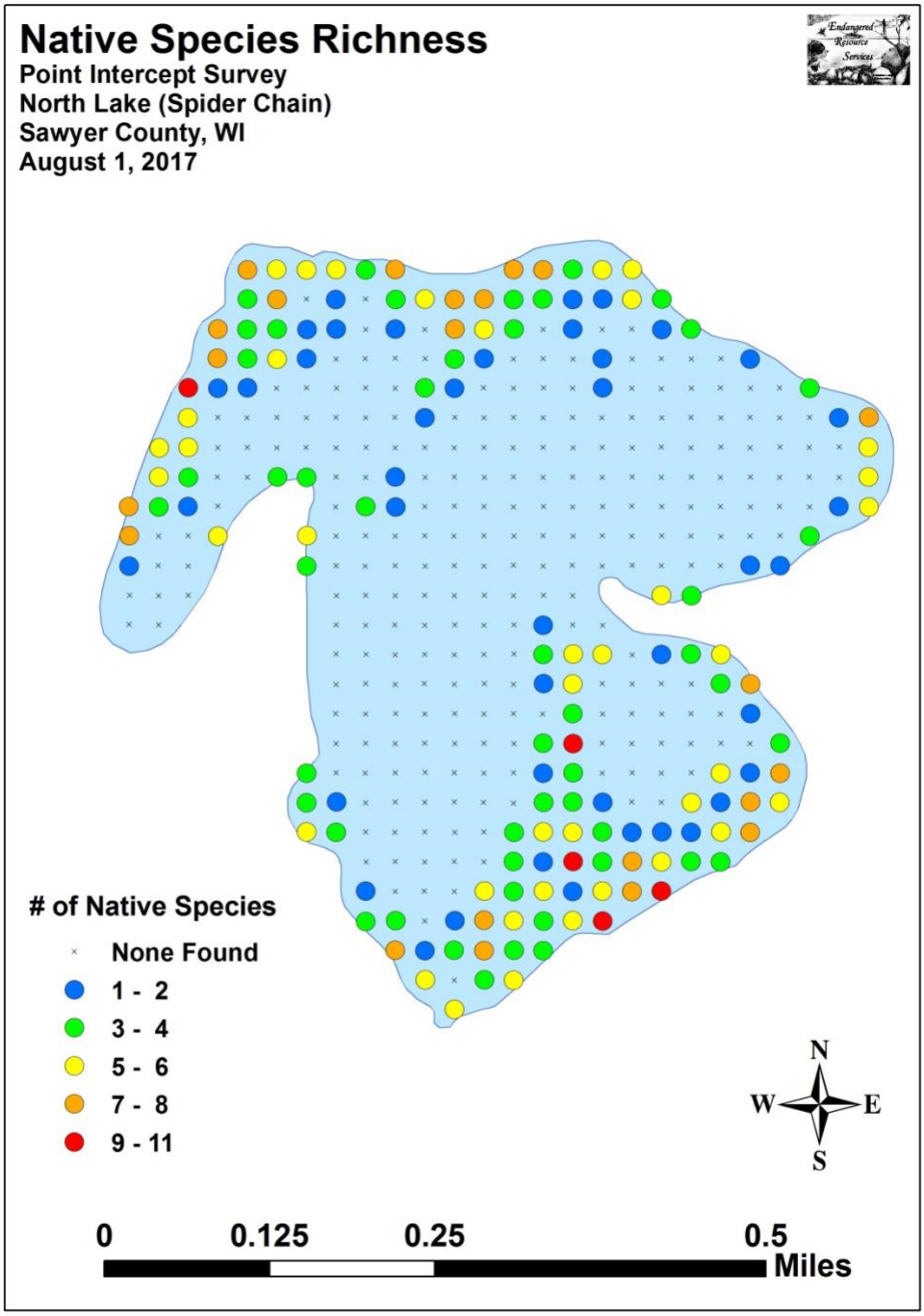

Bottom Substrate
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Substrate Type
Rock
Sand
Muck
Not Determined
N
W
E
S
0
0.125
0.25
0.5
Miles

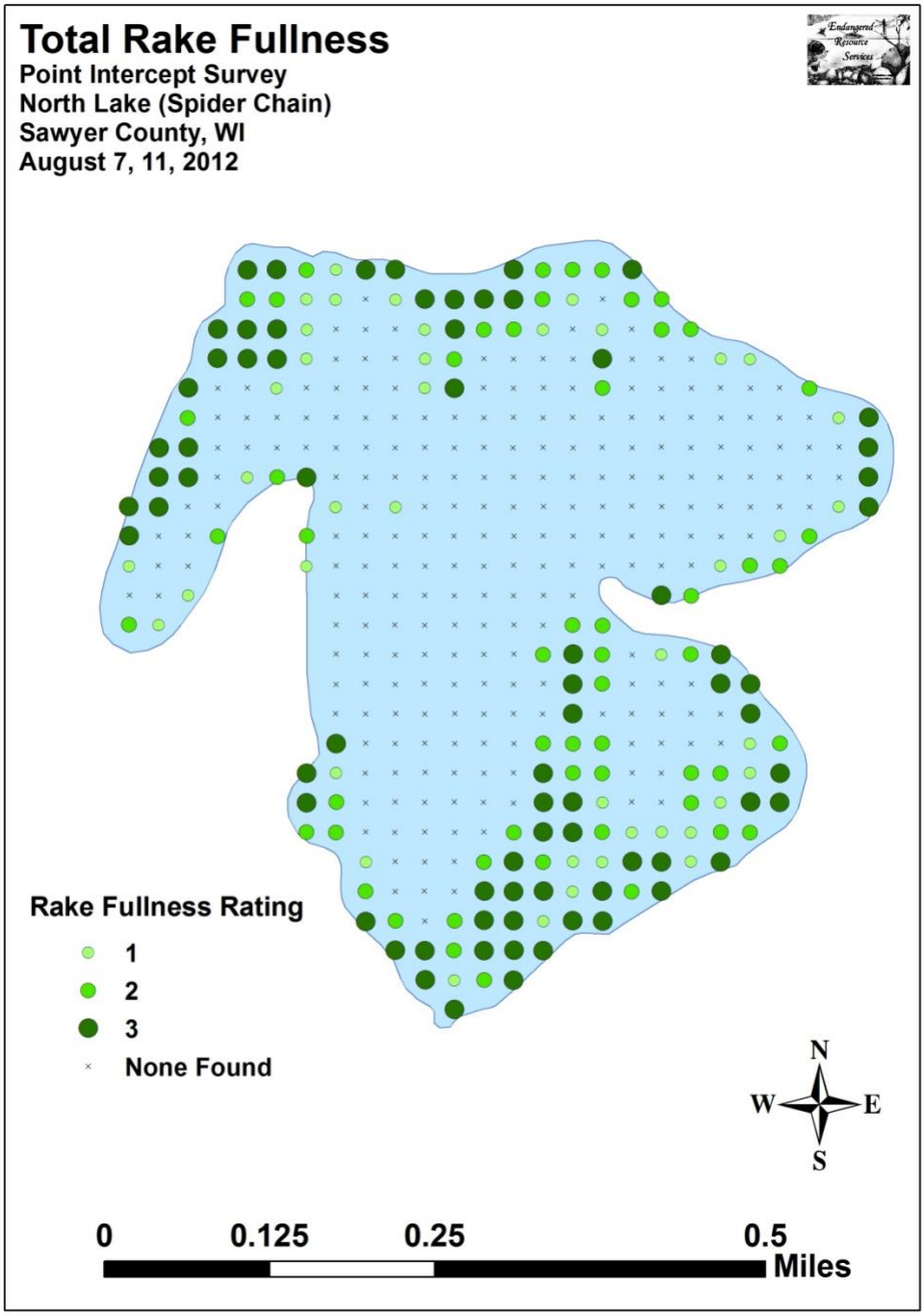
Appendix V: 2012 and 2017 Littoral Zone, Native Species Richness and Total Rake Fullness Maps

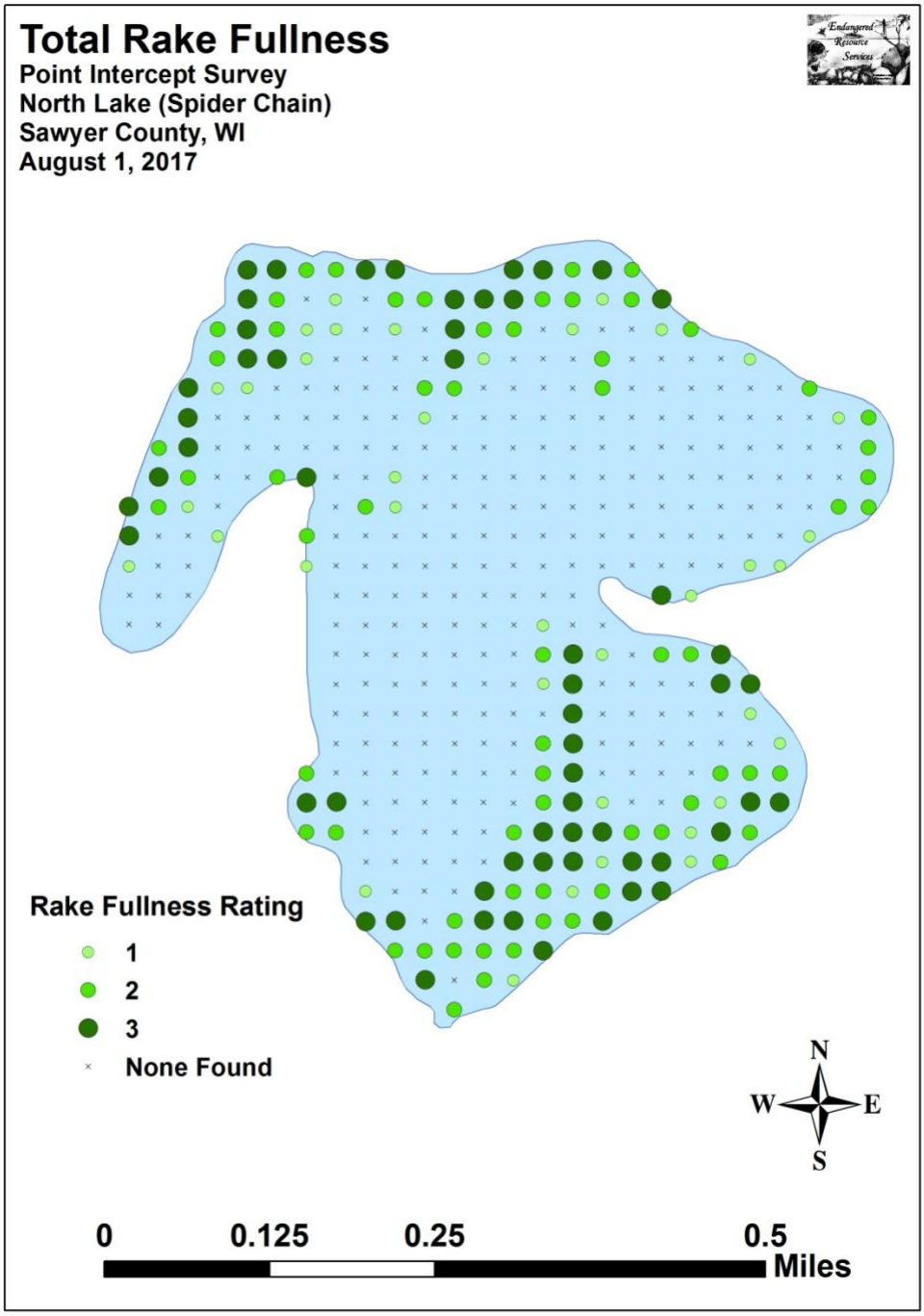

Littoral Zone
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Littoral Zone
Littoral Zone with Plants
>13.5 ft.
N
W
E
S
0
0.125
0.25
0.5
Miles


Littoral Zone
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Littoral Zone
Littoral Zone with Plants
>14 ft.
N
W
E
S
0
0.125
0.25
0.5
Miles

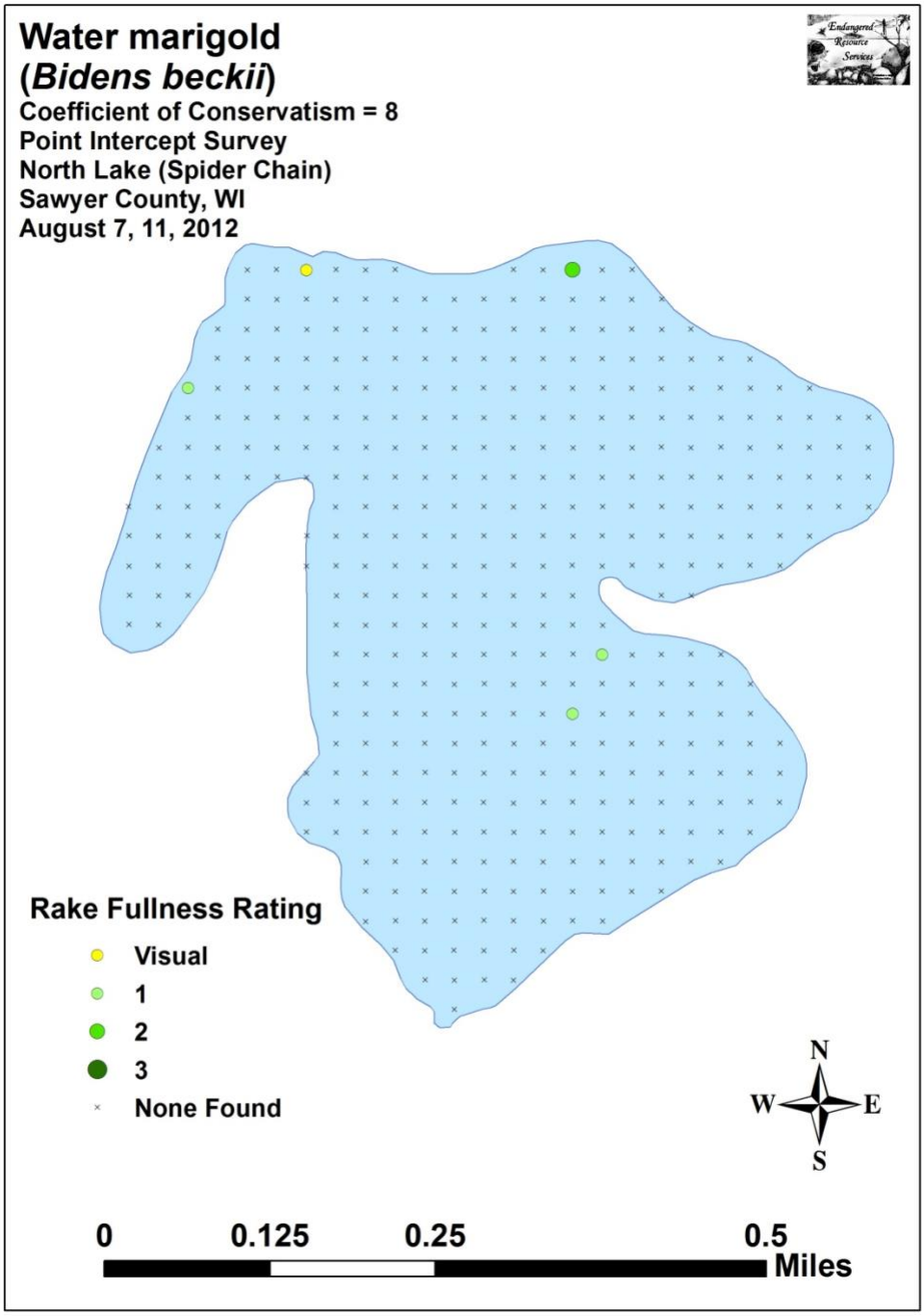

Native Species Richness
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 8
9 - 10
N
W
E
S
0
0.125
0.25
0.5
Miles

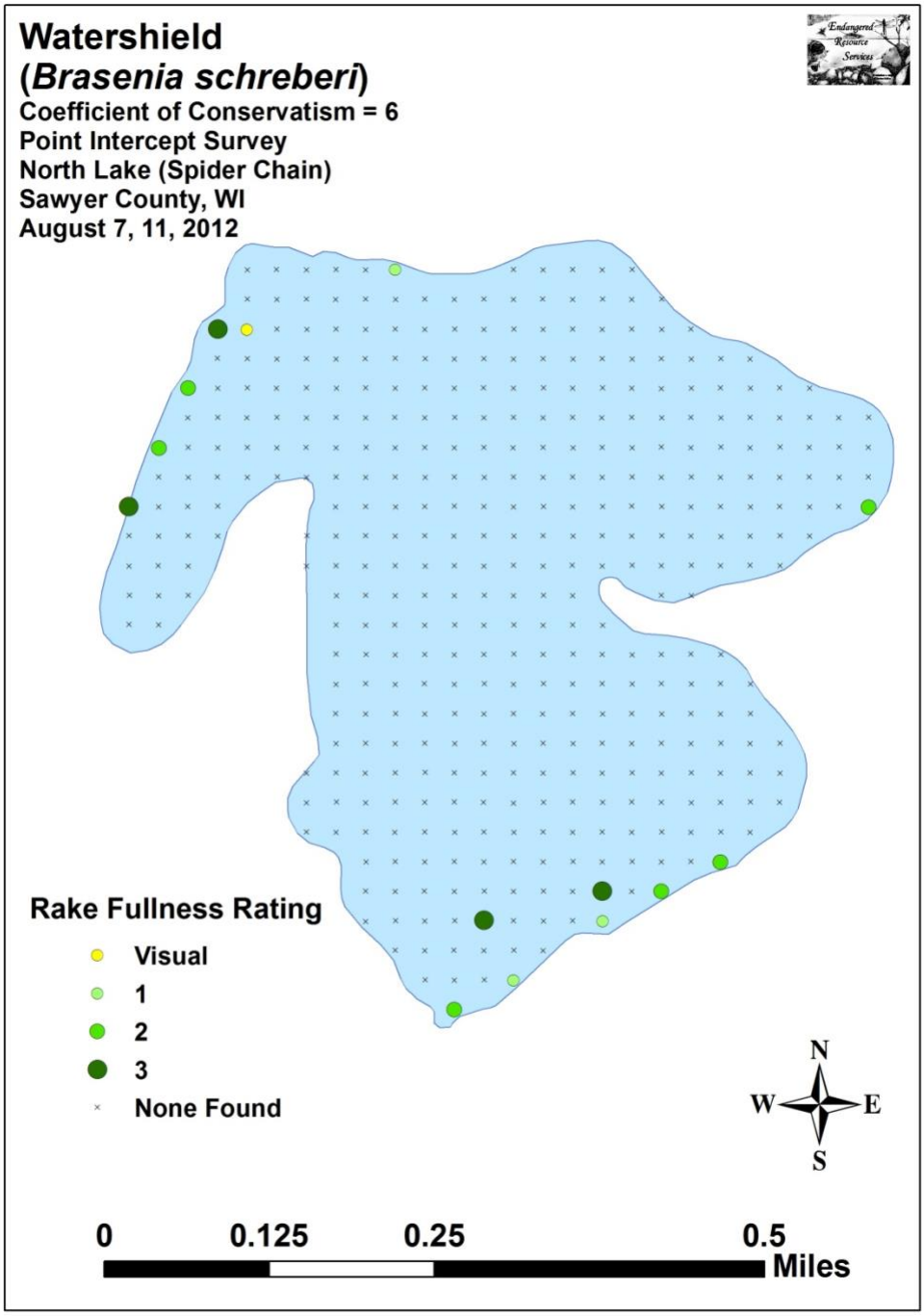

Native Species Richness
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 8
9 - 11
N
W
E
S
0
0.125
0.25
0.5
Miles

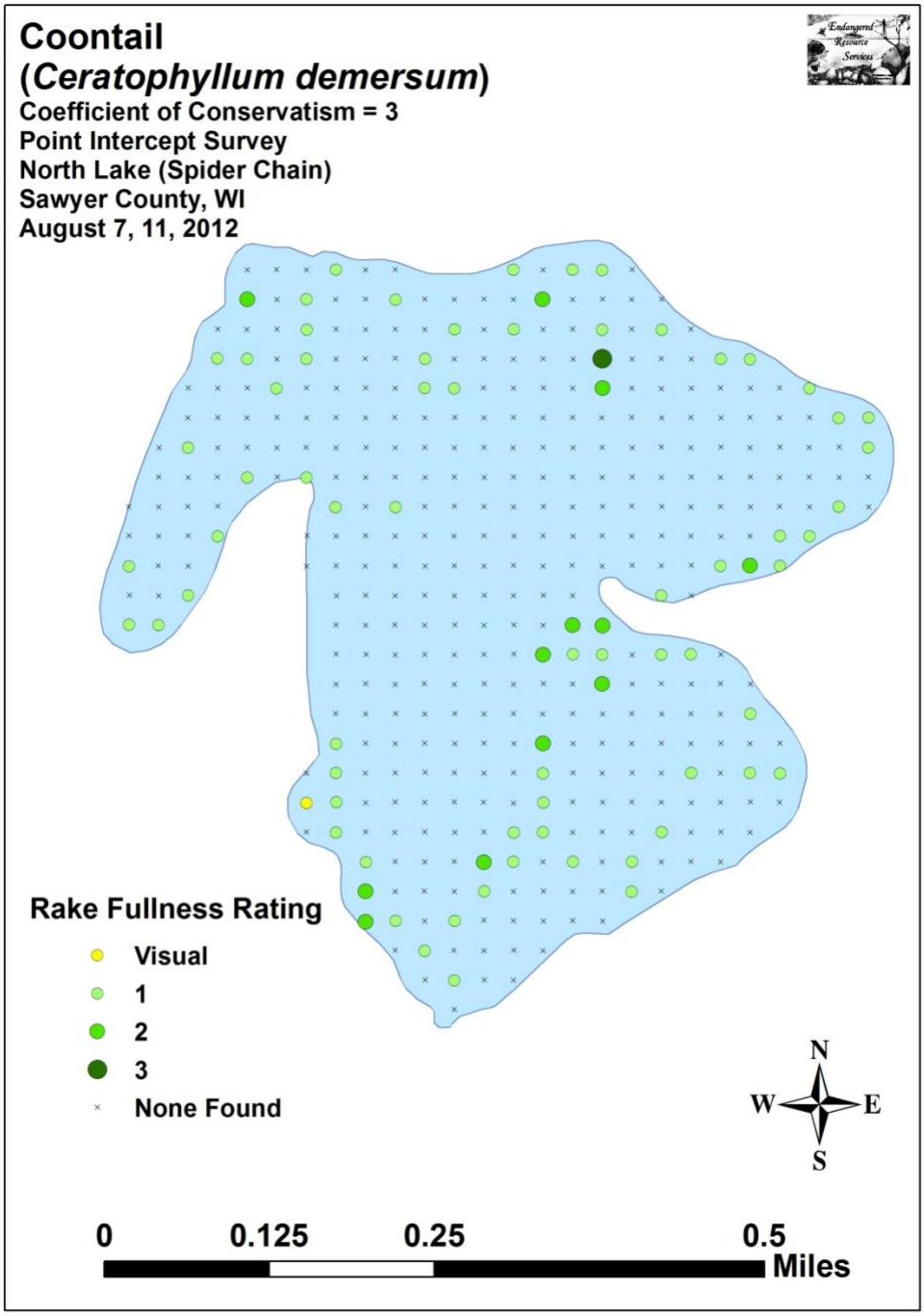

Total Rake Fullness
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

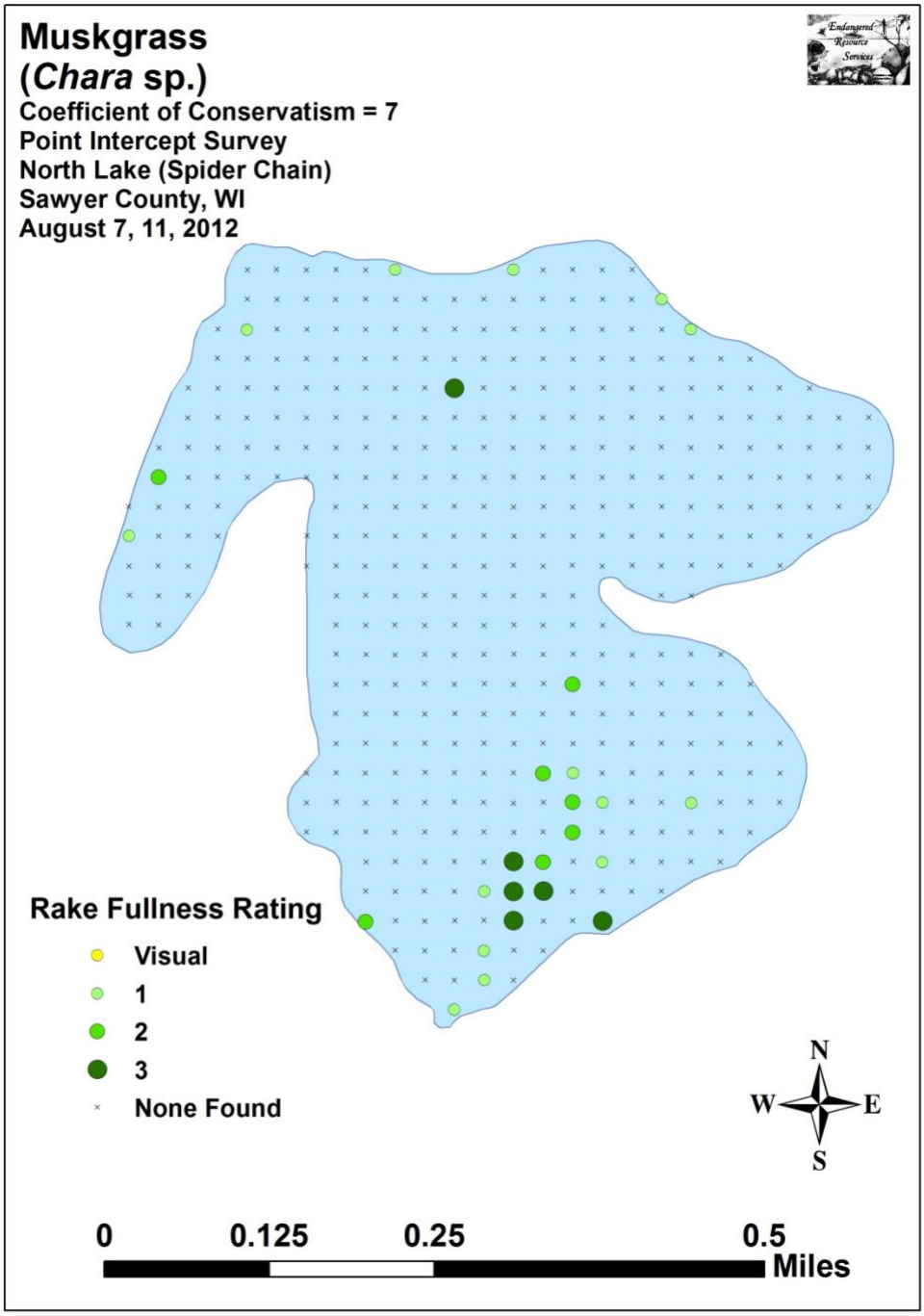

Total Rake Fullness
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

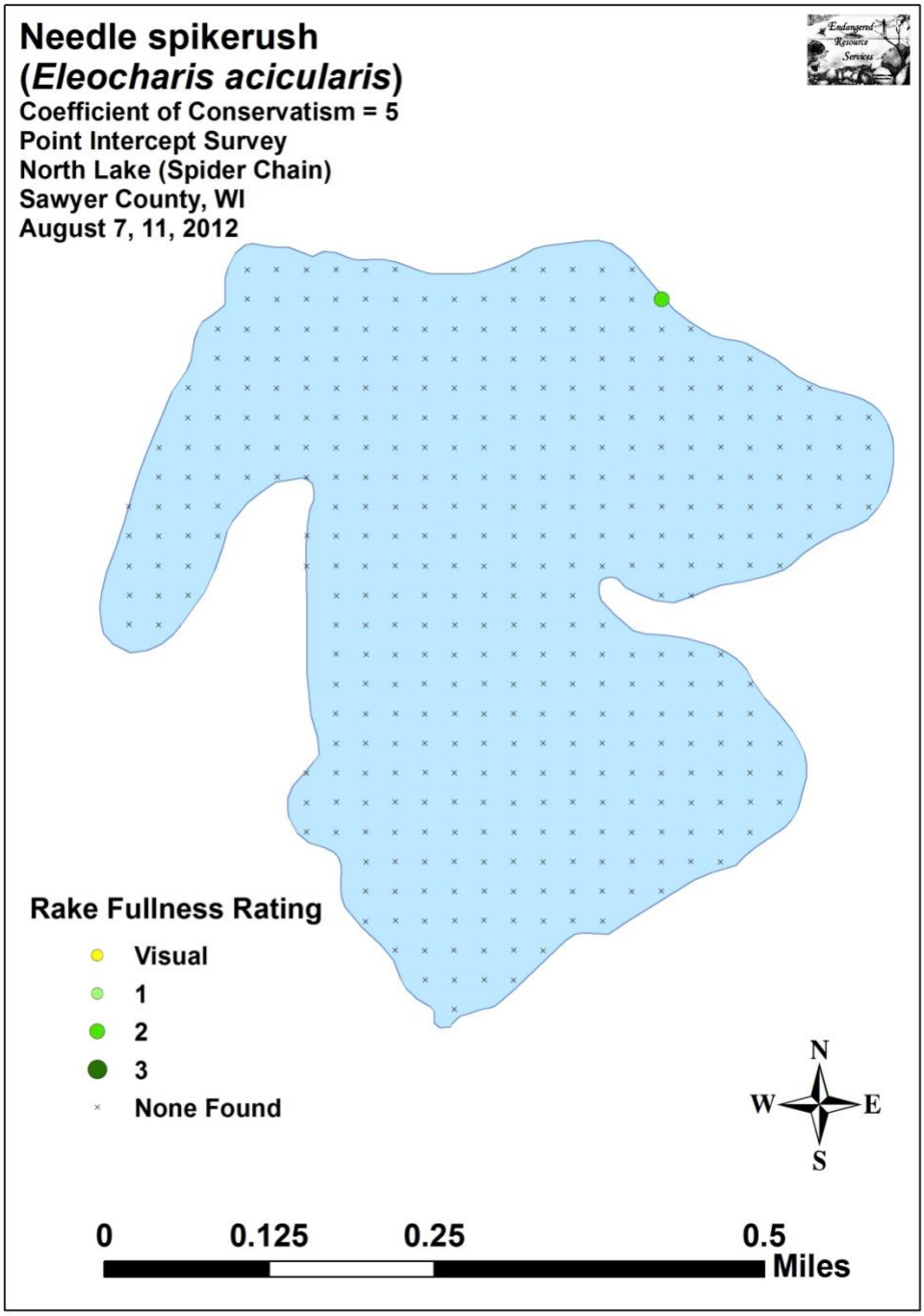
Appendix VI: August 2012 Species Density and Distribution Maps

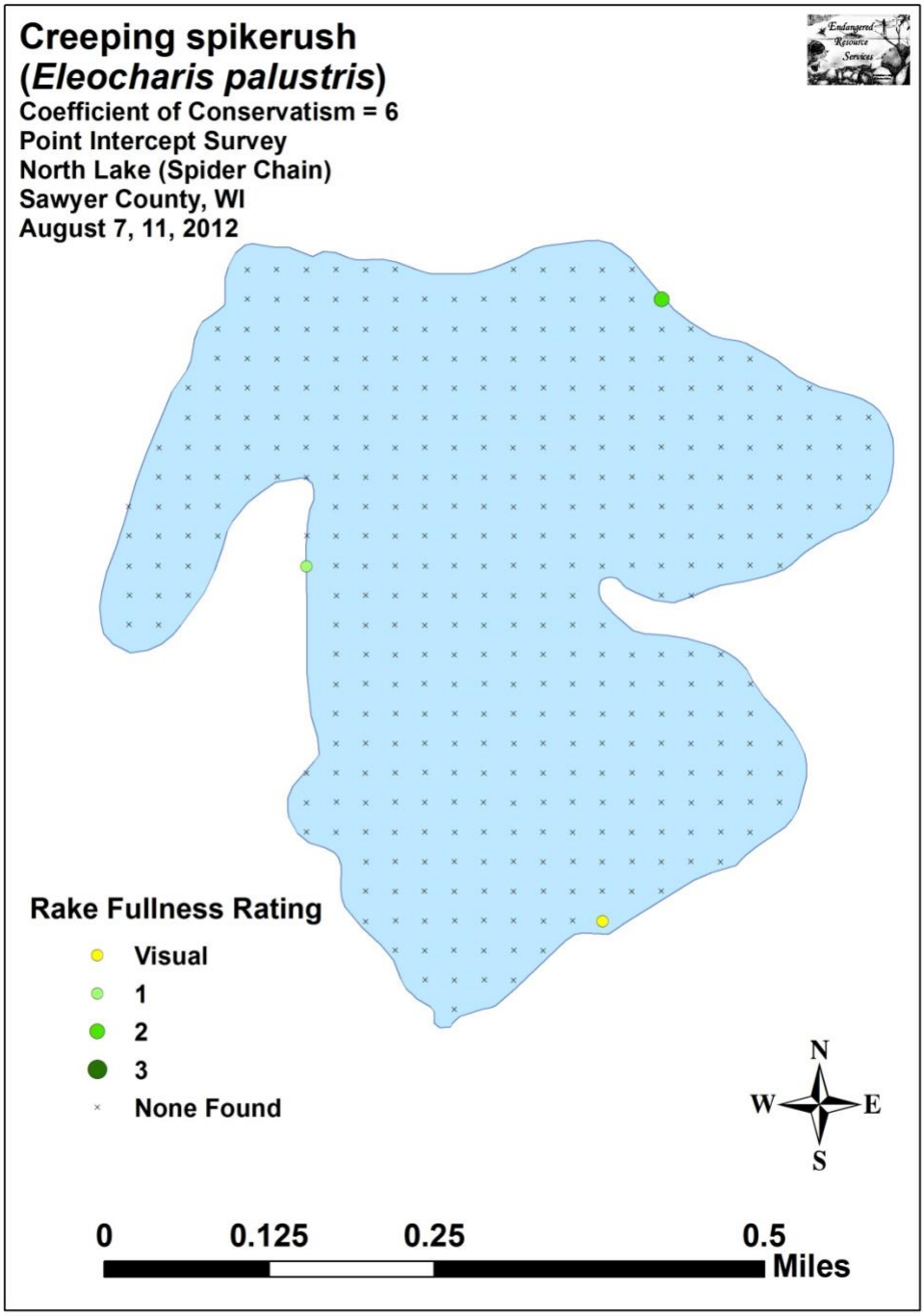

Water marigold
(Bidens beckii)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

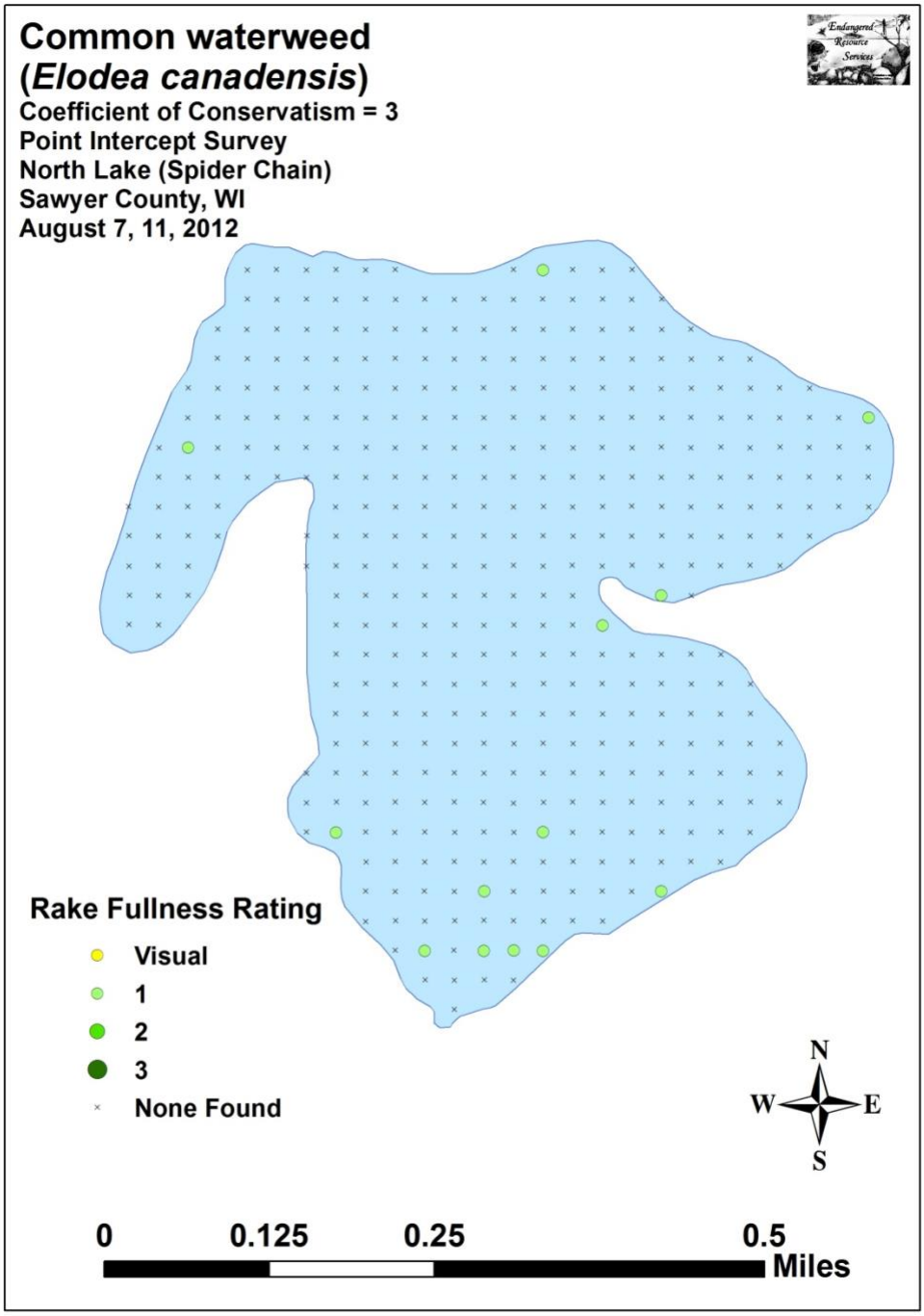

Watershield
(Brasenia schreberi)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

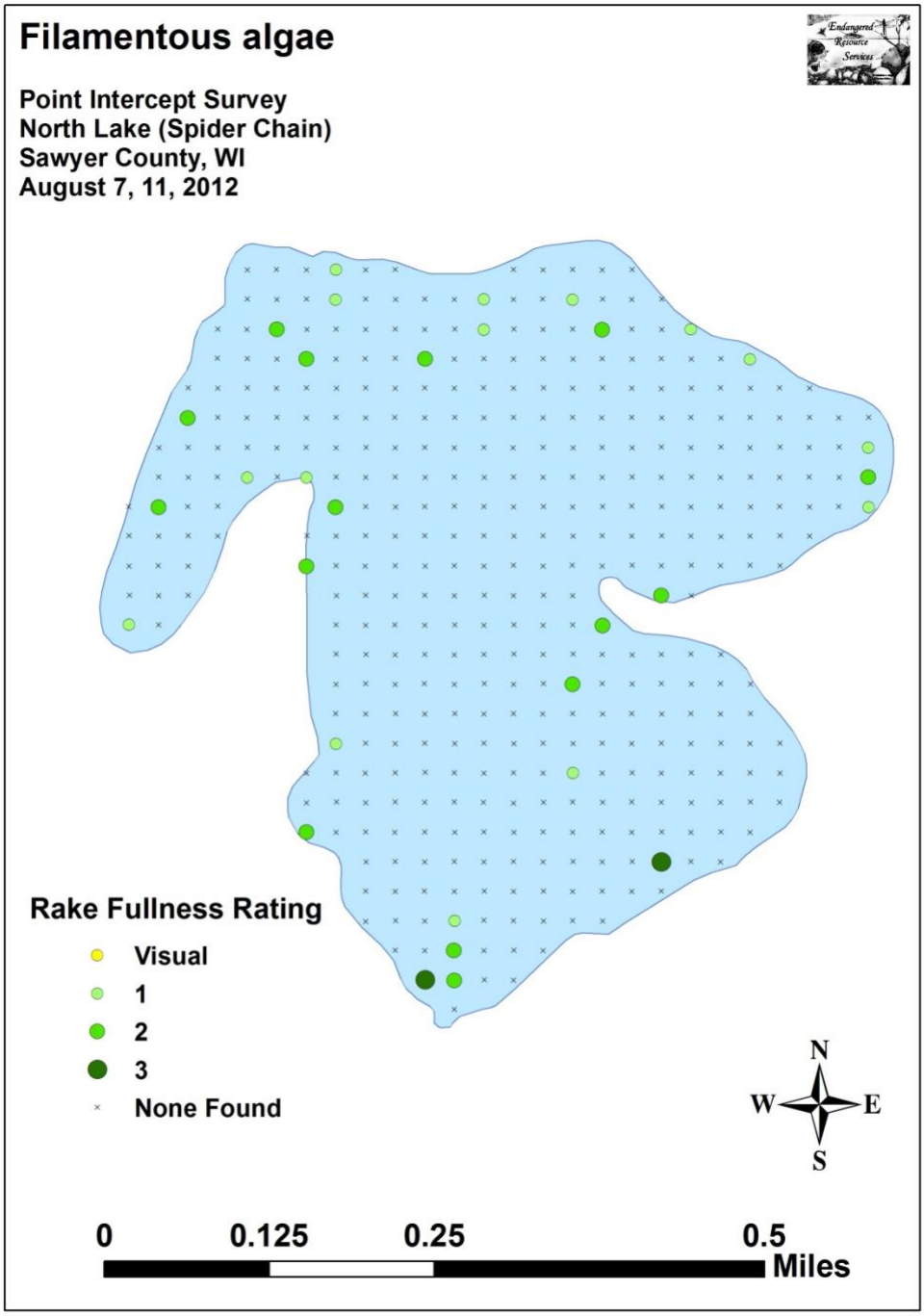

Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

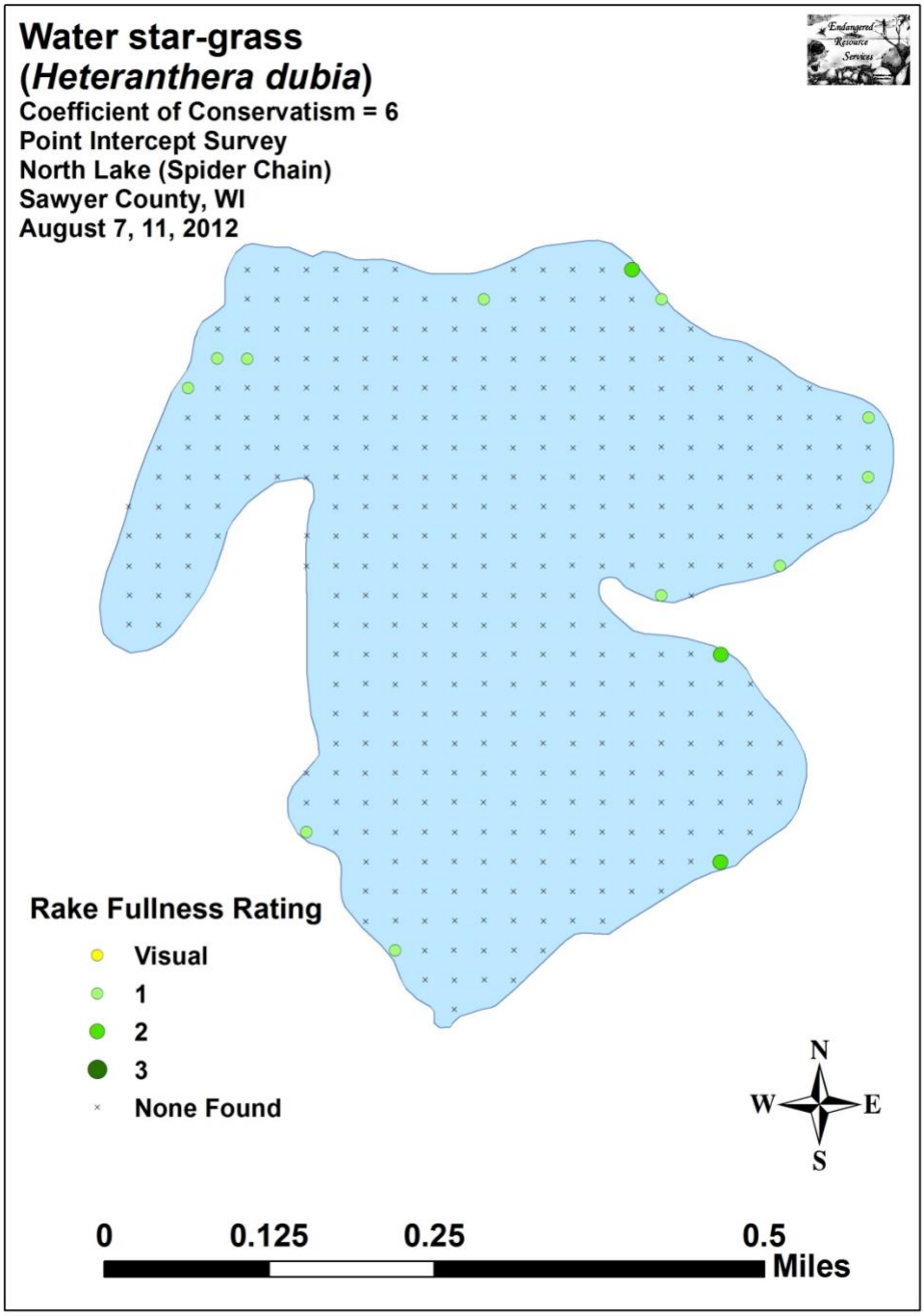

Muskgrass
(Chara sp.)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

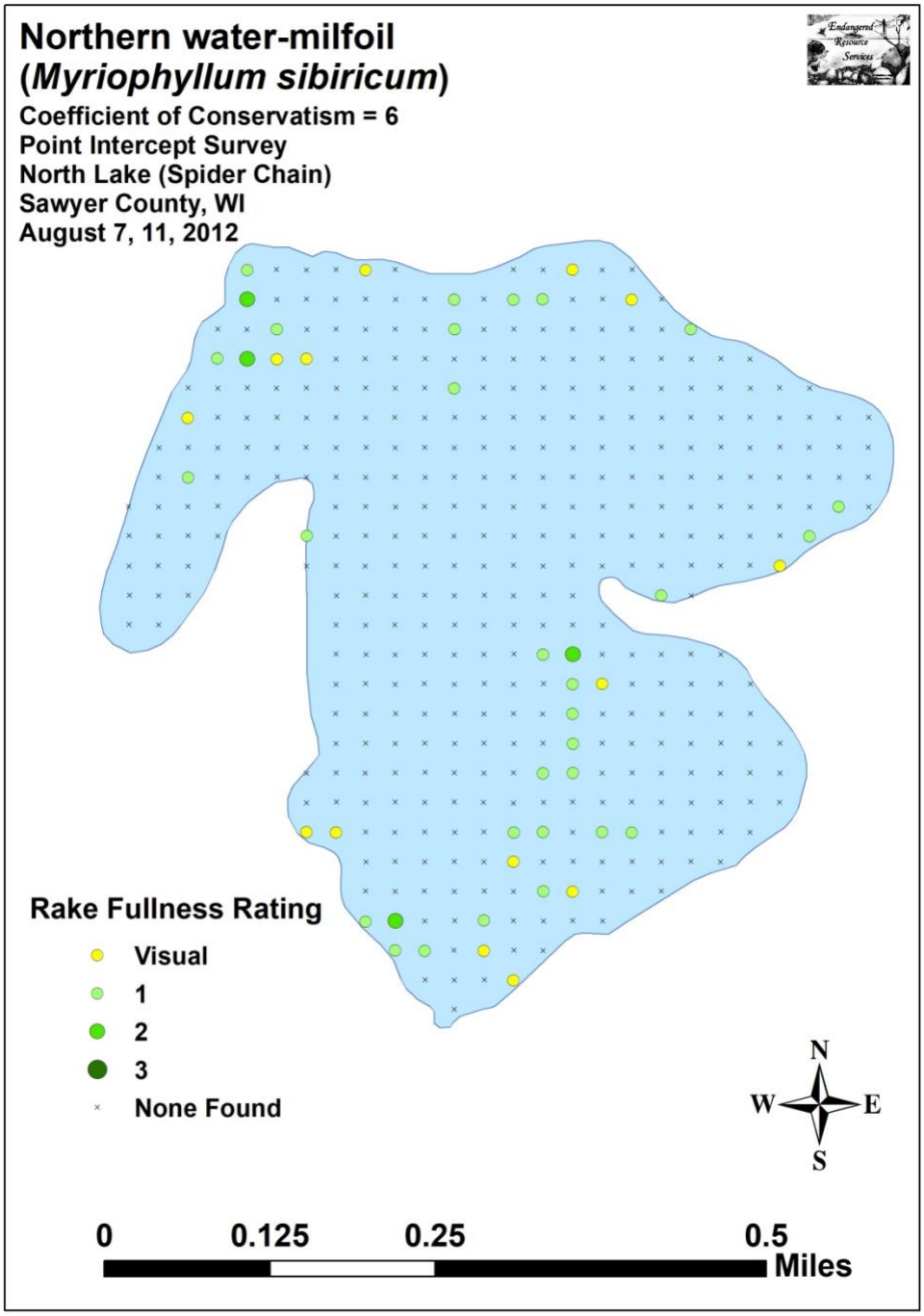

Needle spikerush
(Eleocharis acicularis)
Coefficient of Conservatism = 5
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

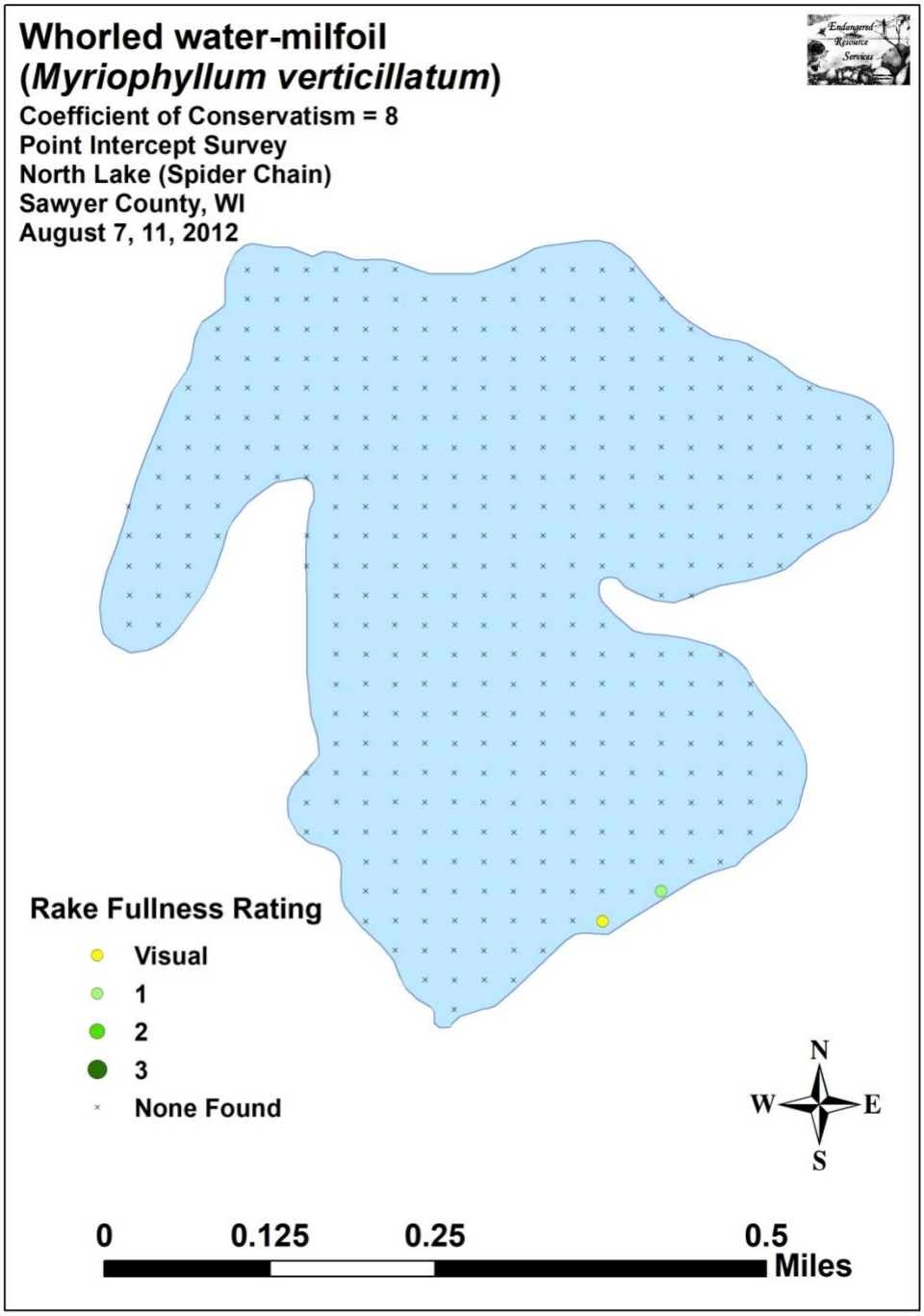

Creeping spikerush
(Eleocharis palustris)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

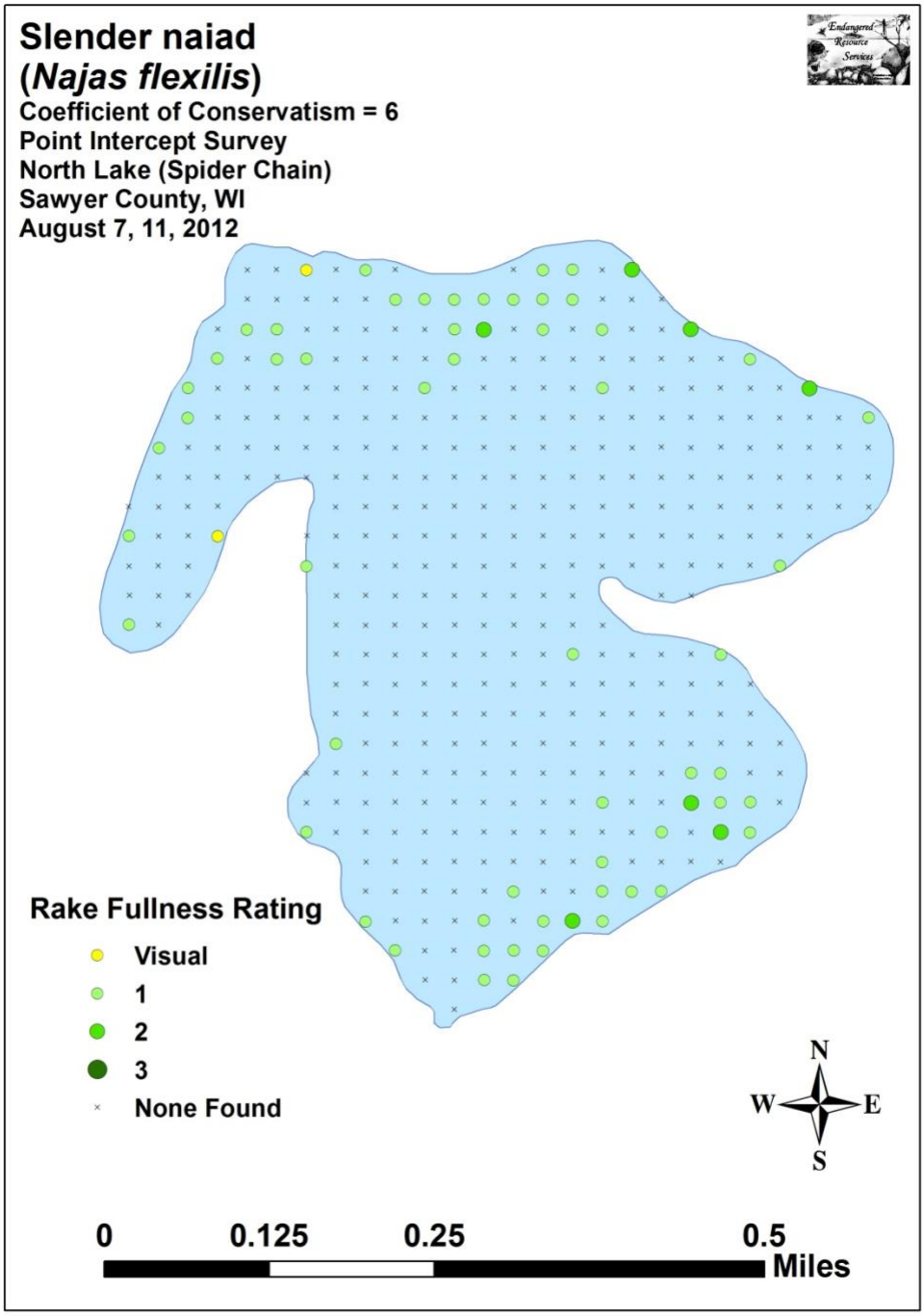

Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

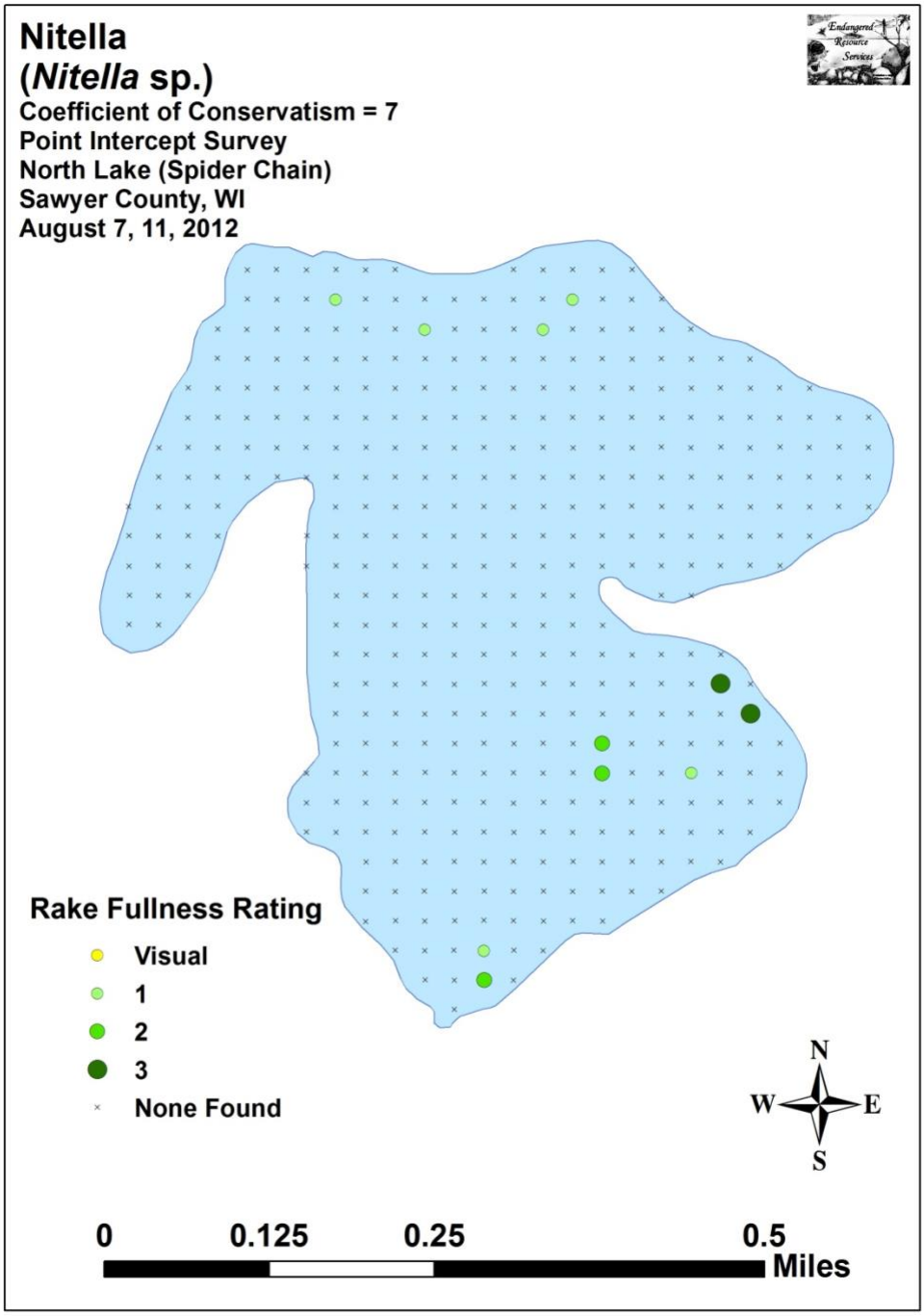

Filamentous algae
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

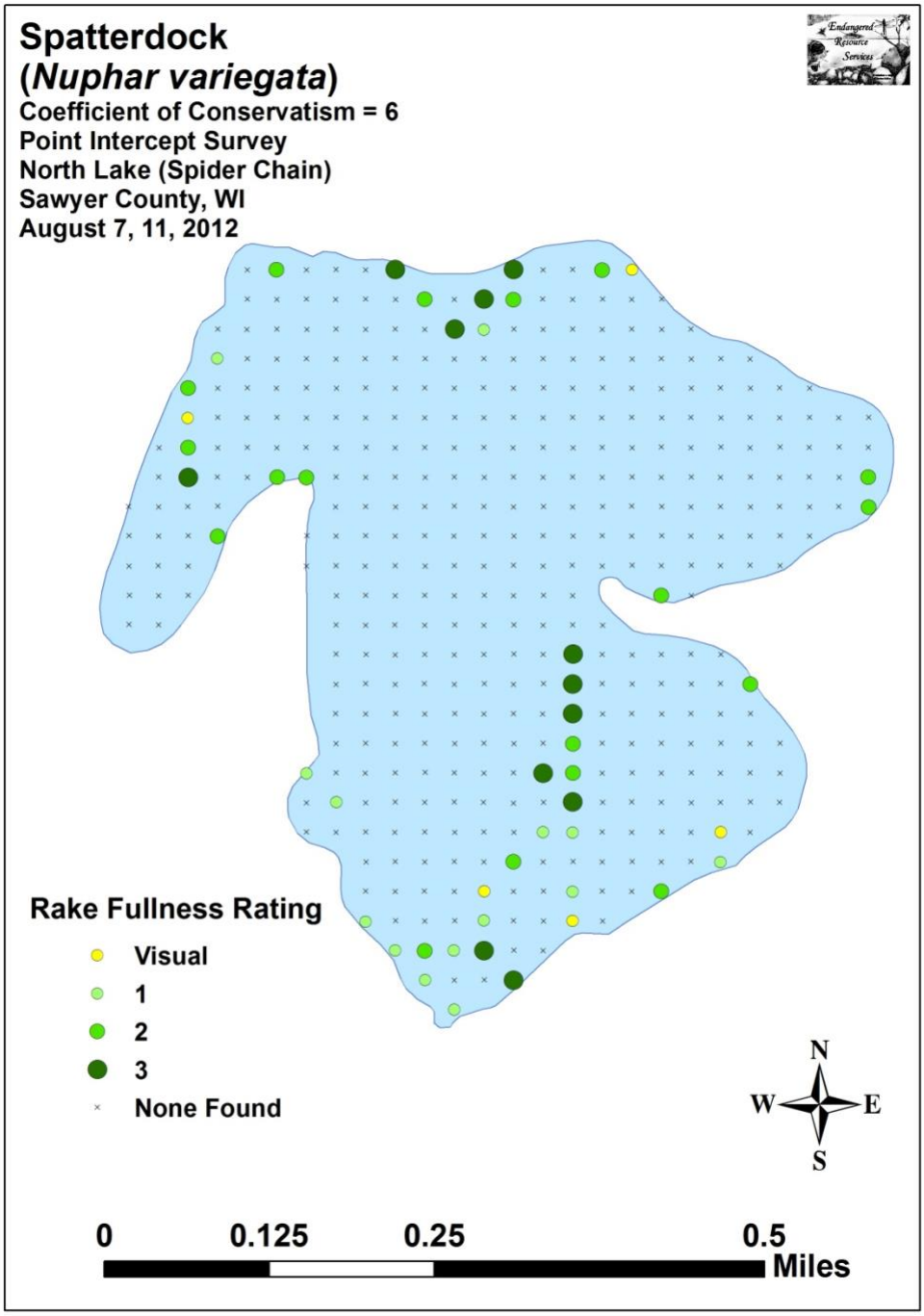

Water star-grass
(Heteranthera dubia)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

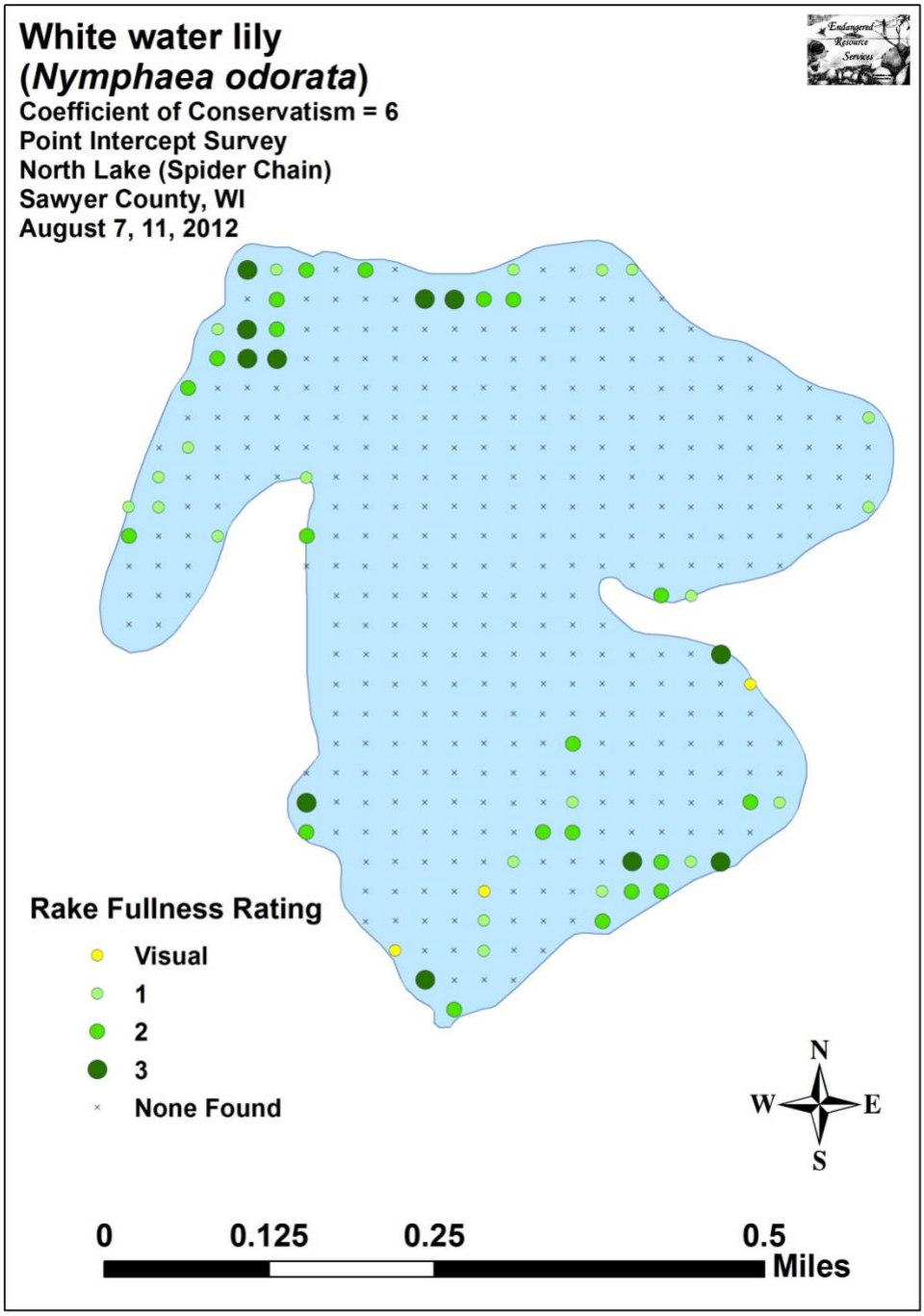

Northern water-milfoil
(Myriophyllum sibiricum)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

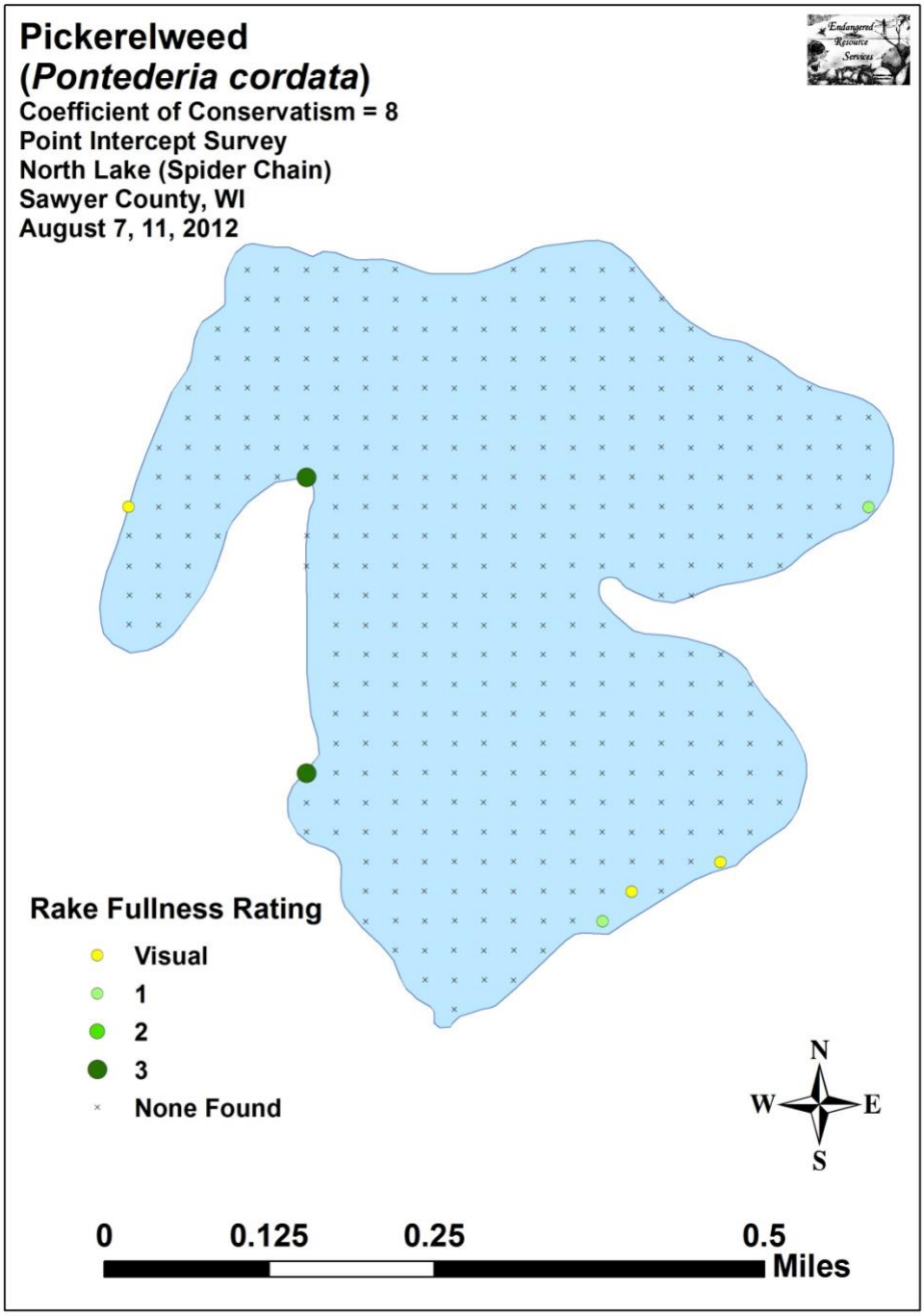

Whorled water-milfoil
(Myriophyllum verticillatum)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

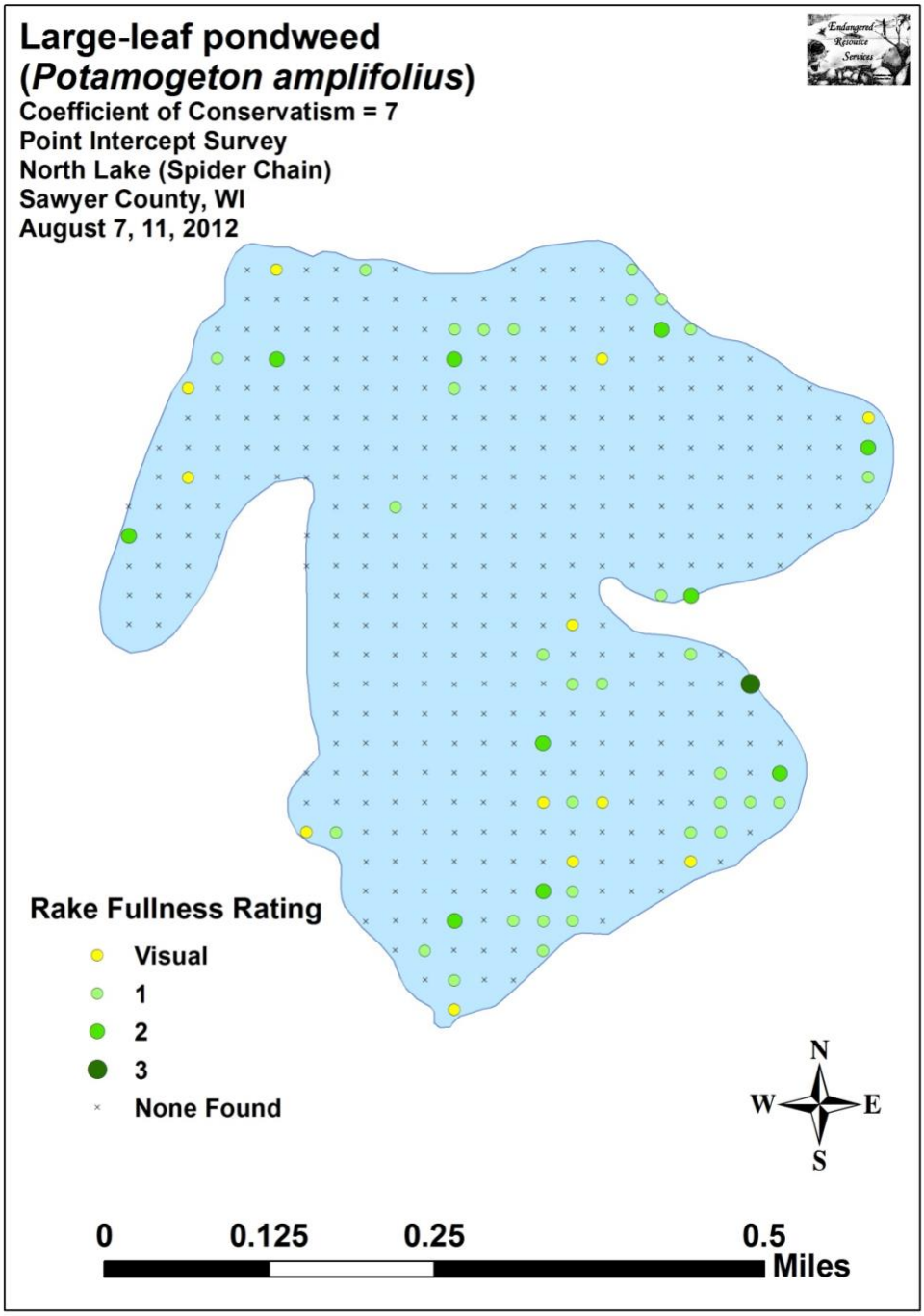

Slender naiad
(Najas flexilis)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


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
W
E
S
0
0.125
0.25
0.5
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
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


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
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Large-leaf pondweed
(Potamogeton amplifolius)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Rake Fullness Rating
Visual
1
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None Found
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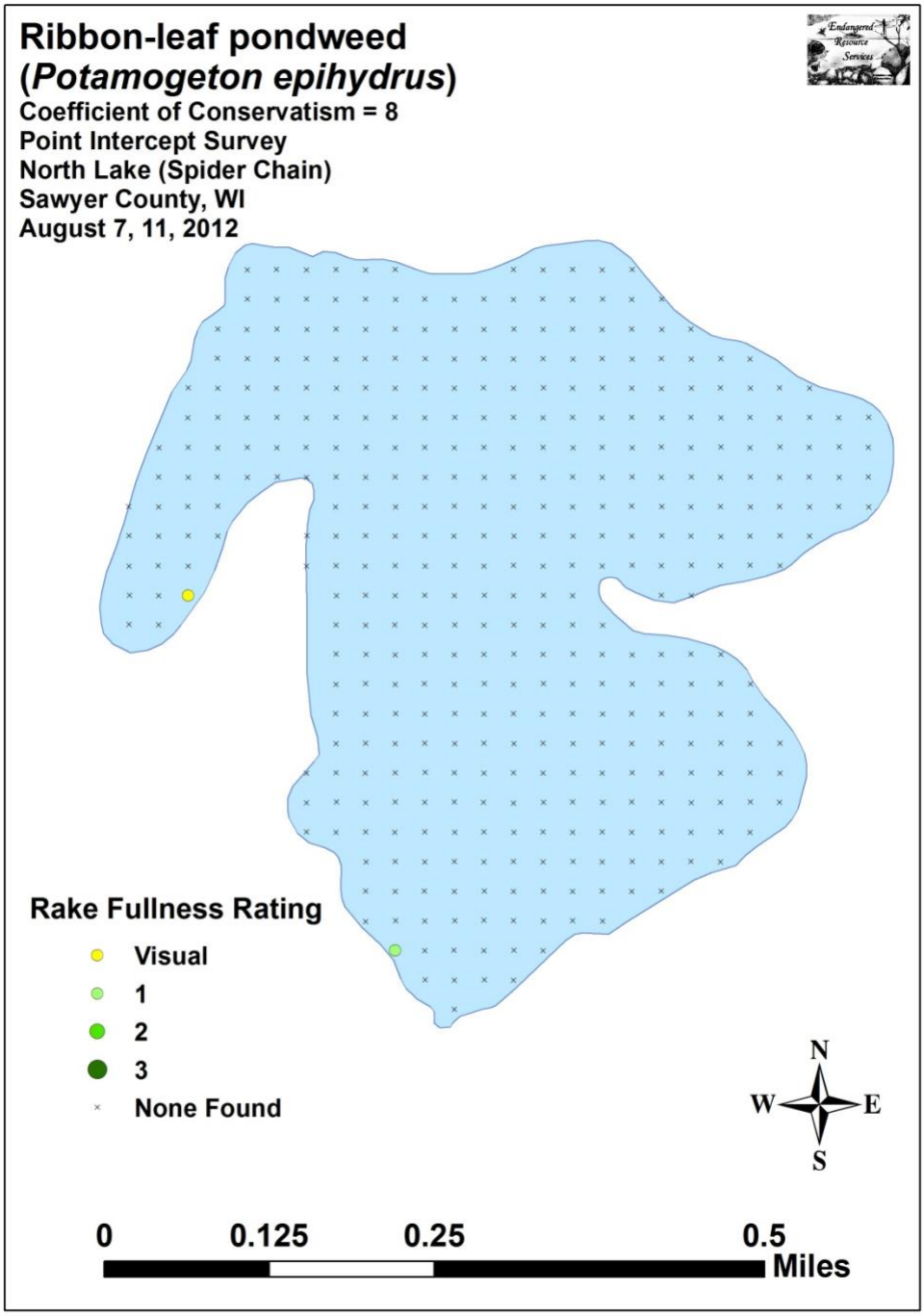
0.125
0.25
0.5
Miles


Ribbon-leaf pondweed
(Potamogeton epihydrus)
Coefficient of Conservatism = 8
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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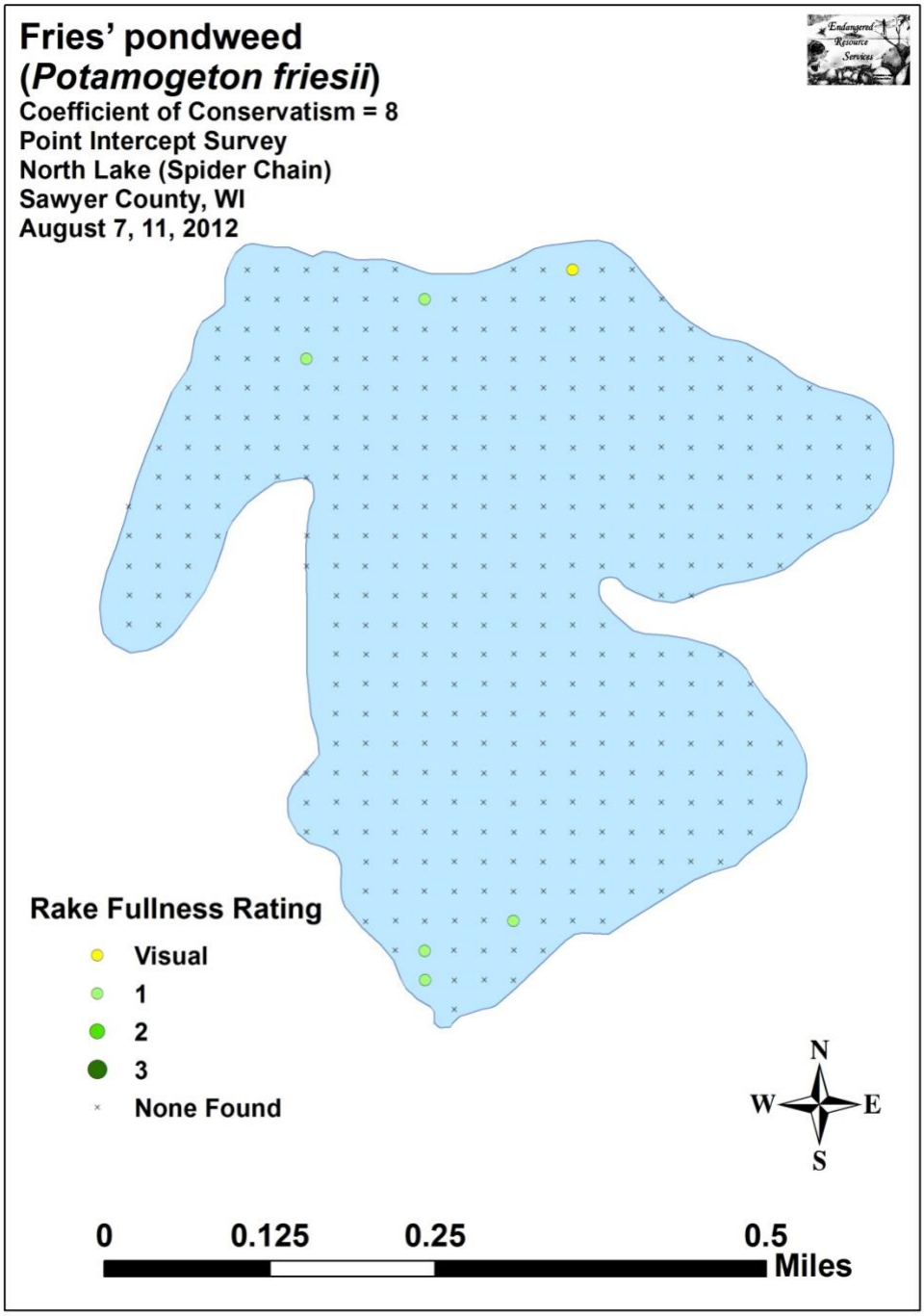
Miles


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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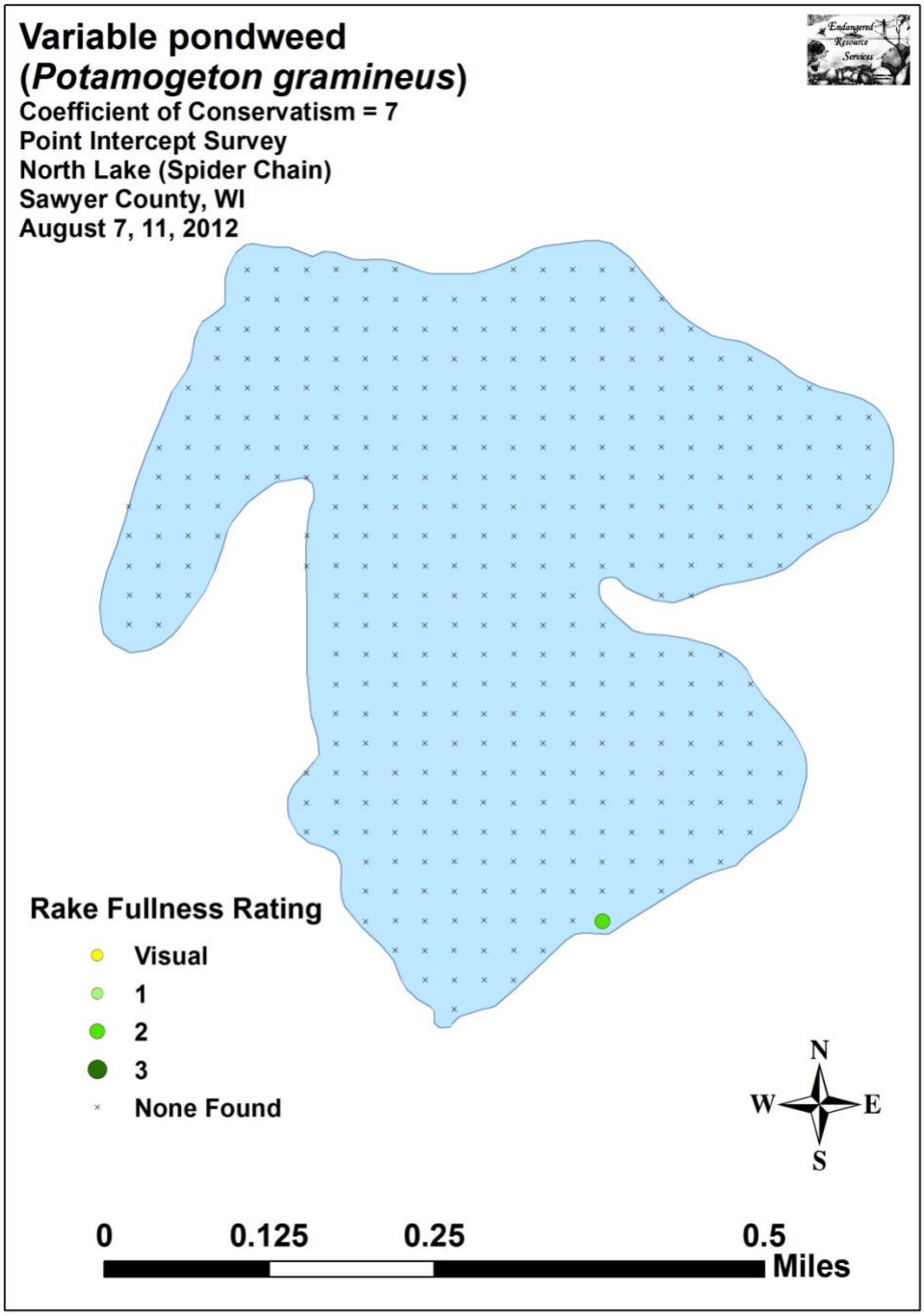
Miles


Variable pondweed
(Potamogeton gramineus)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 7, 11, 2012
Rake Fullness Rating
Visual
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None Found
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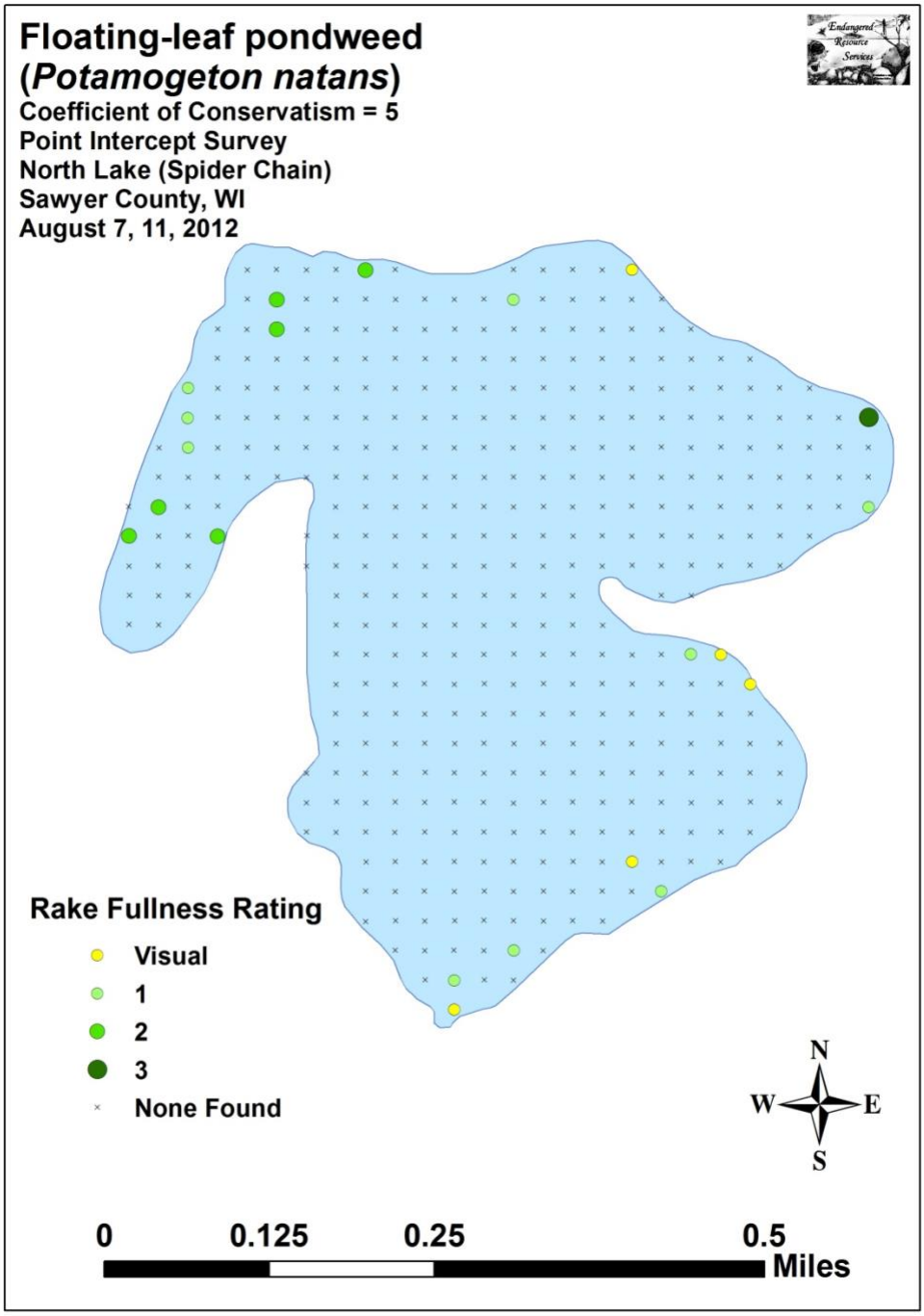
Miles


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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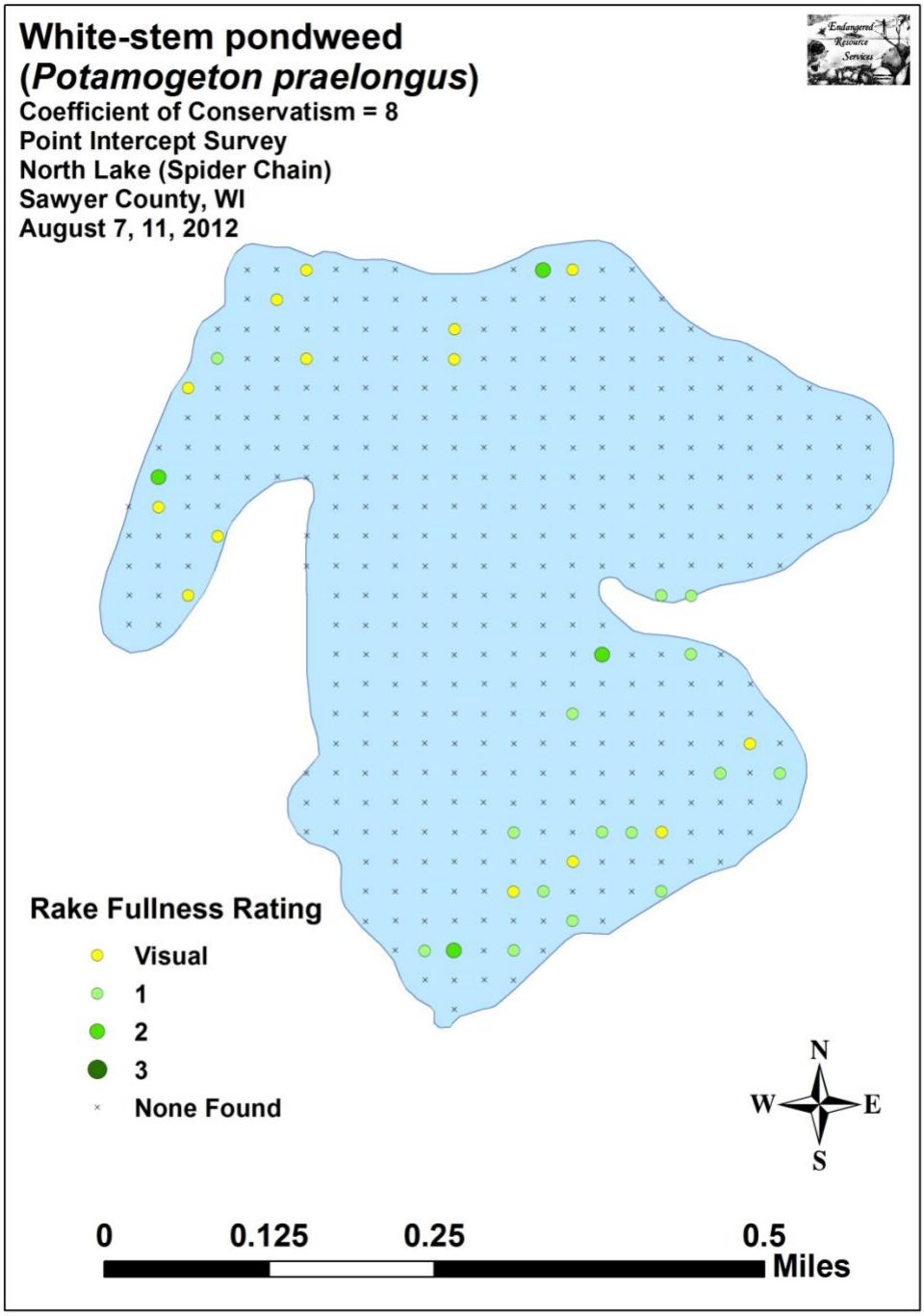
Miles


White-stem pondweed
(Potamogeton praelongus)
Coefficient of Conservatism = 8
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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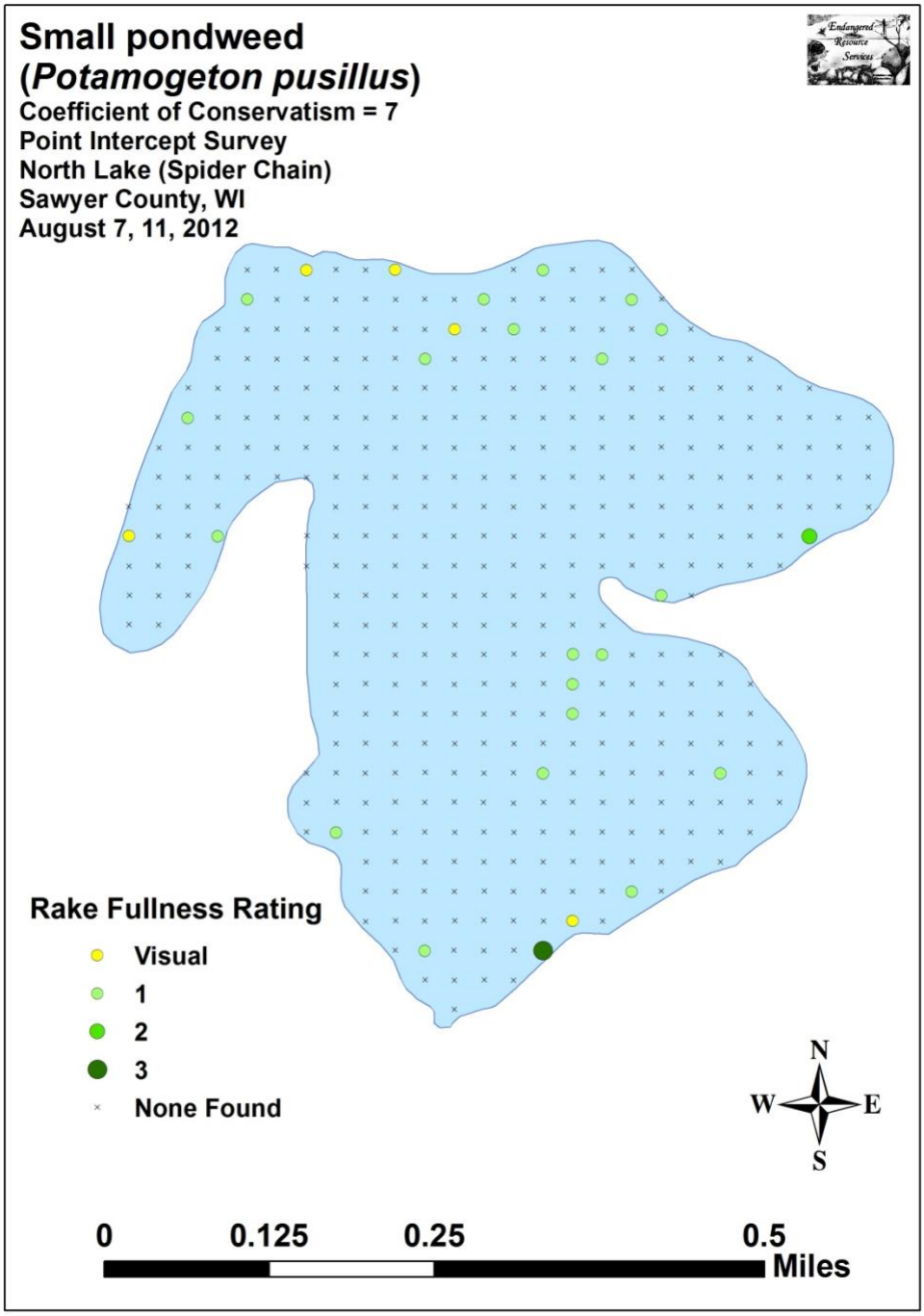
Miles


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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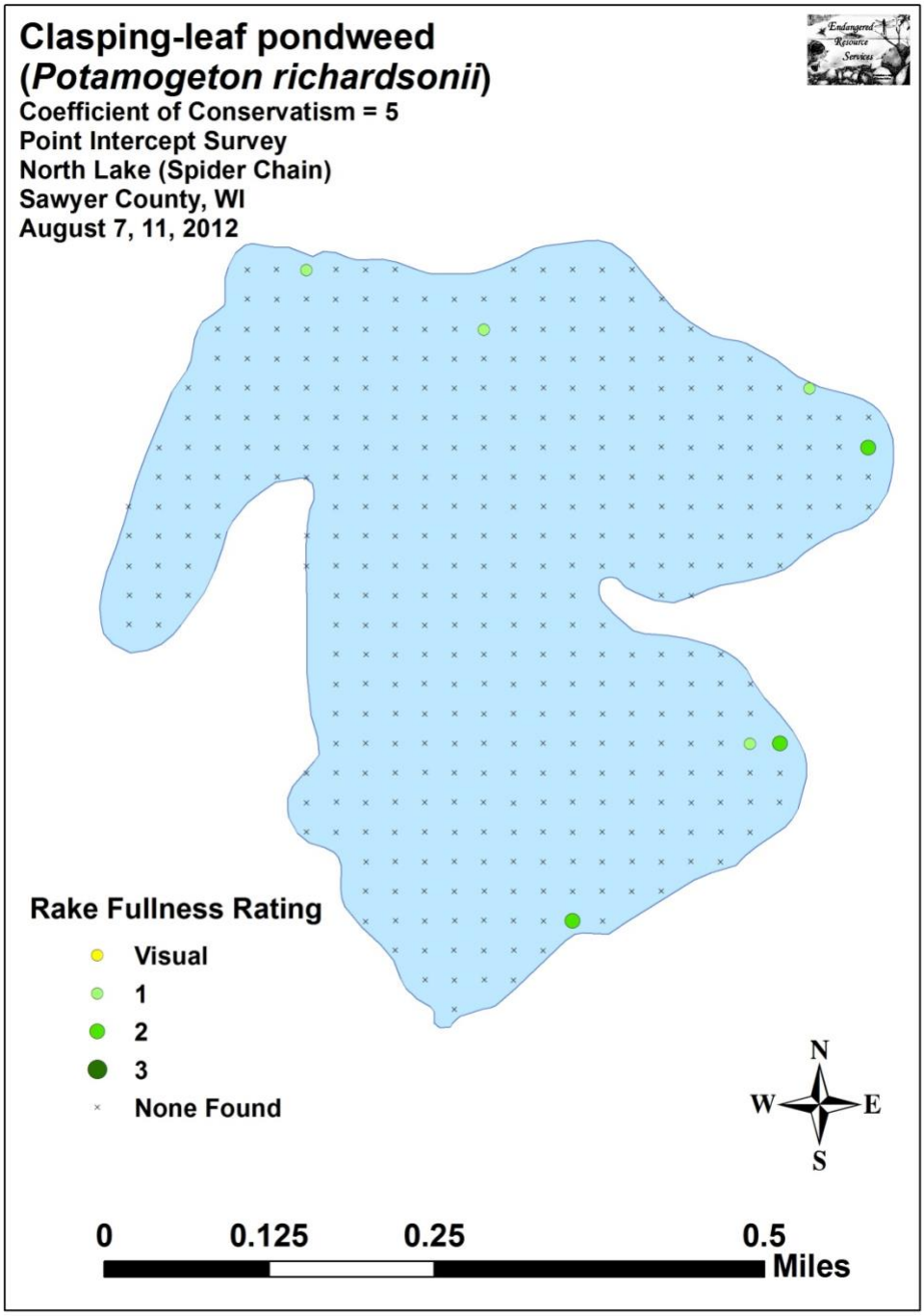
Miles


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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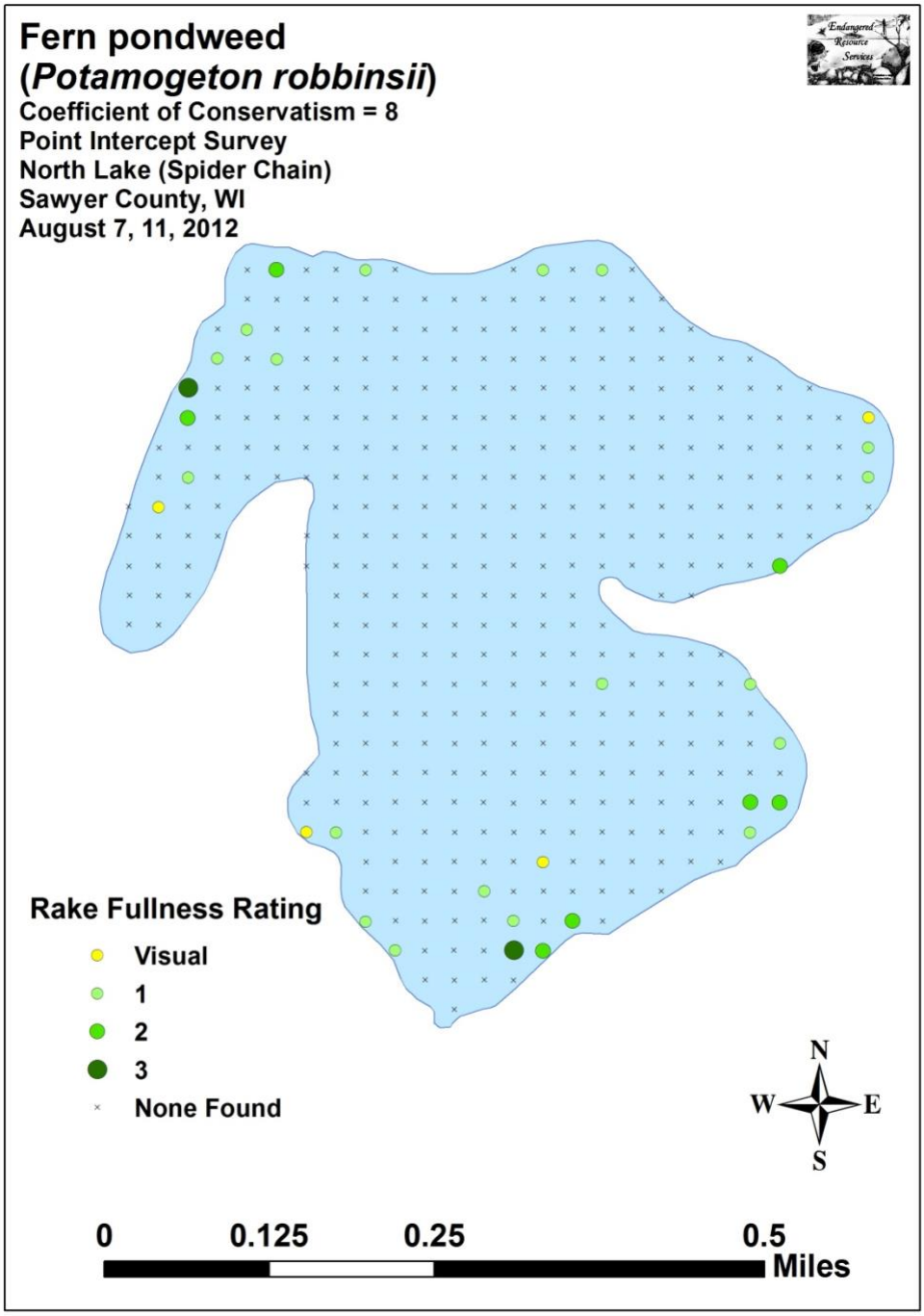
Miles


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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None Found
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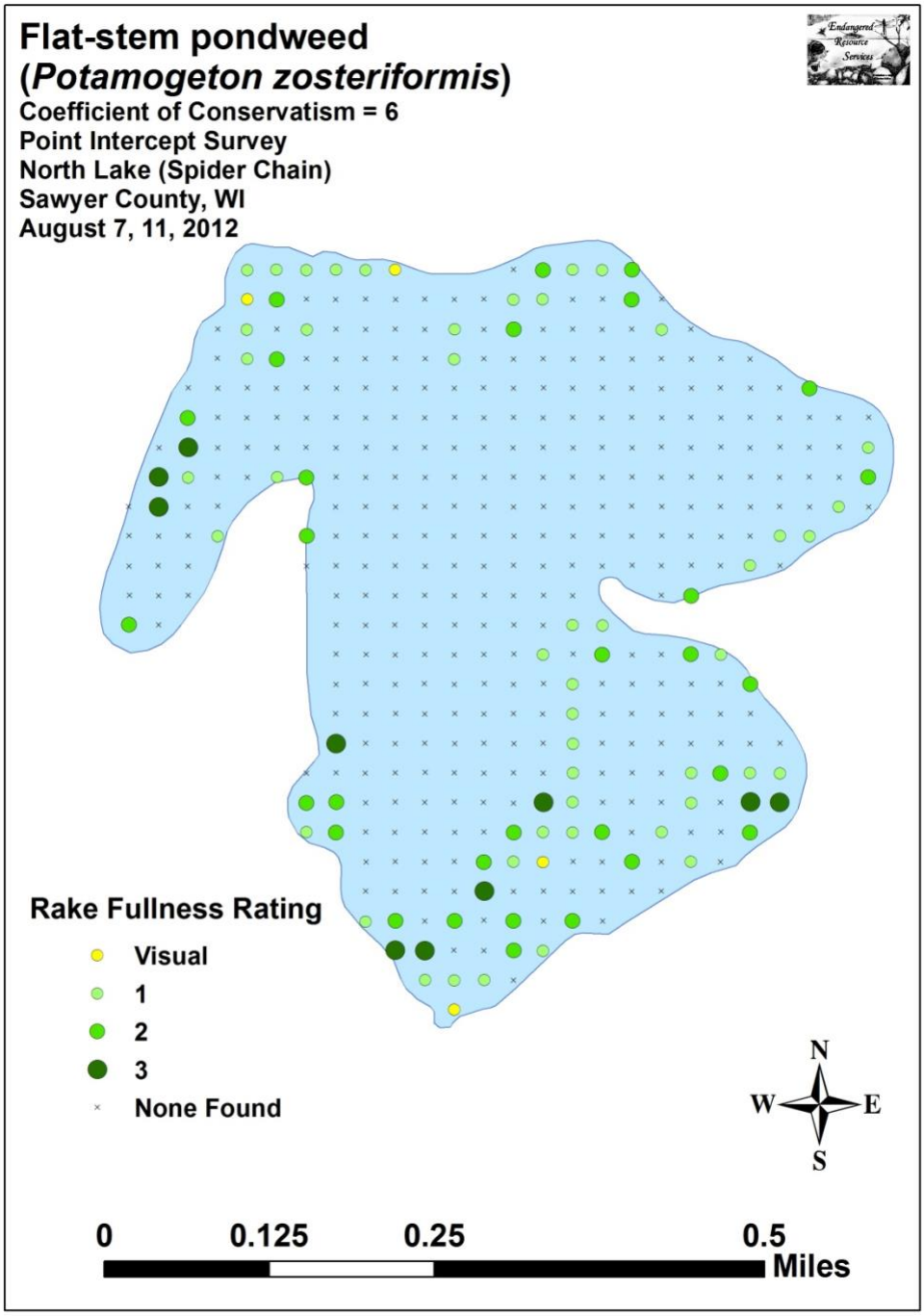
Miles


Flat-stem pondweed
(Potamogeton zosteriformis)
Coefficient of Conservatism = 6
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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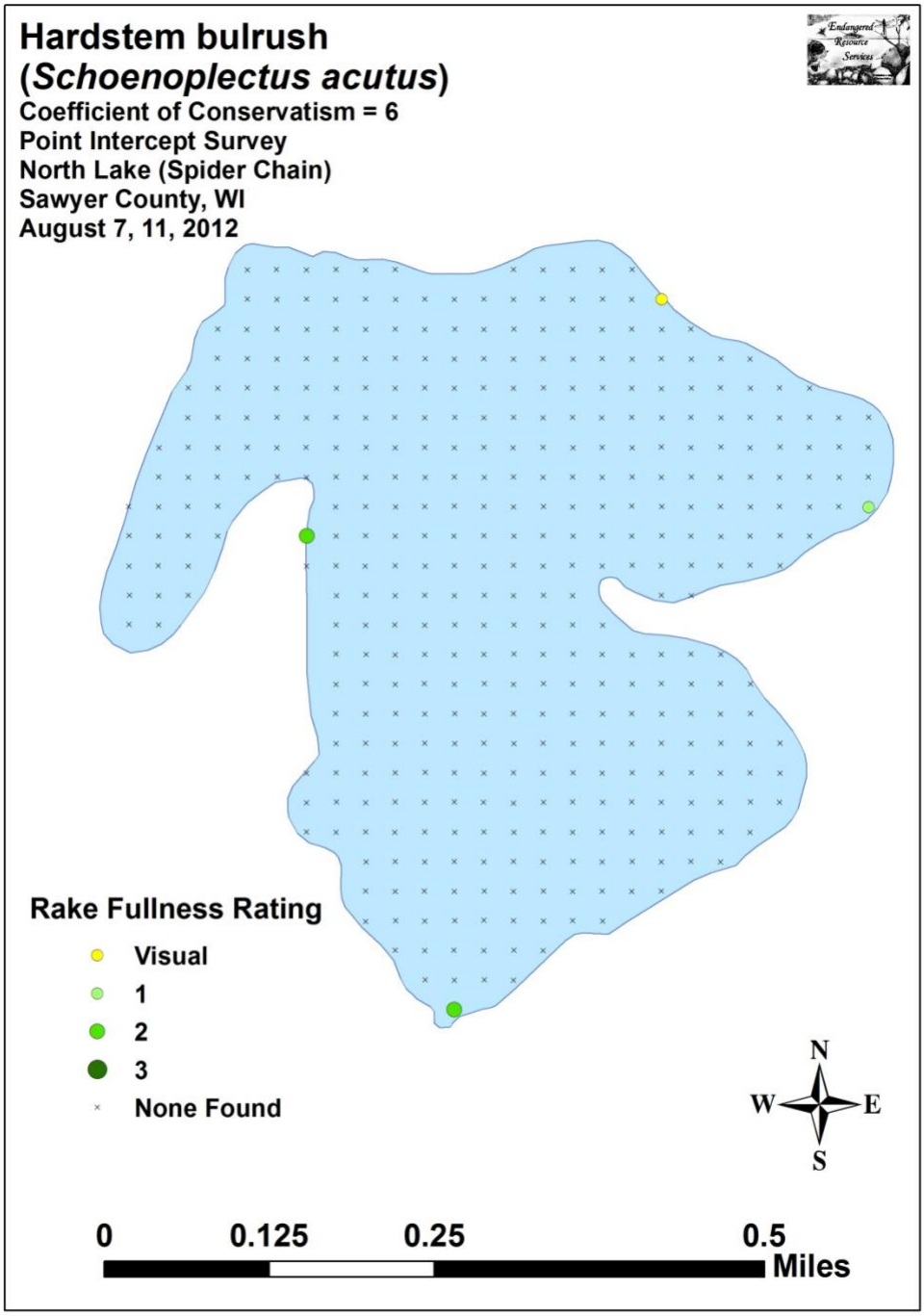
Miles


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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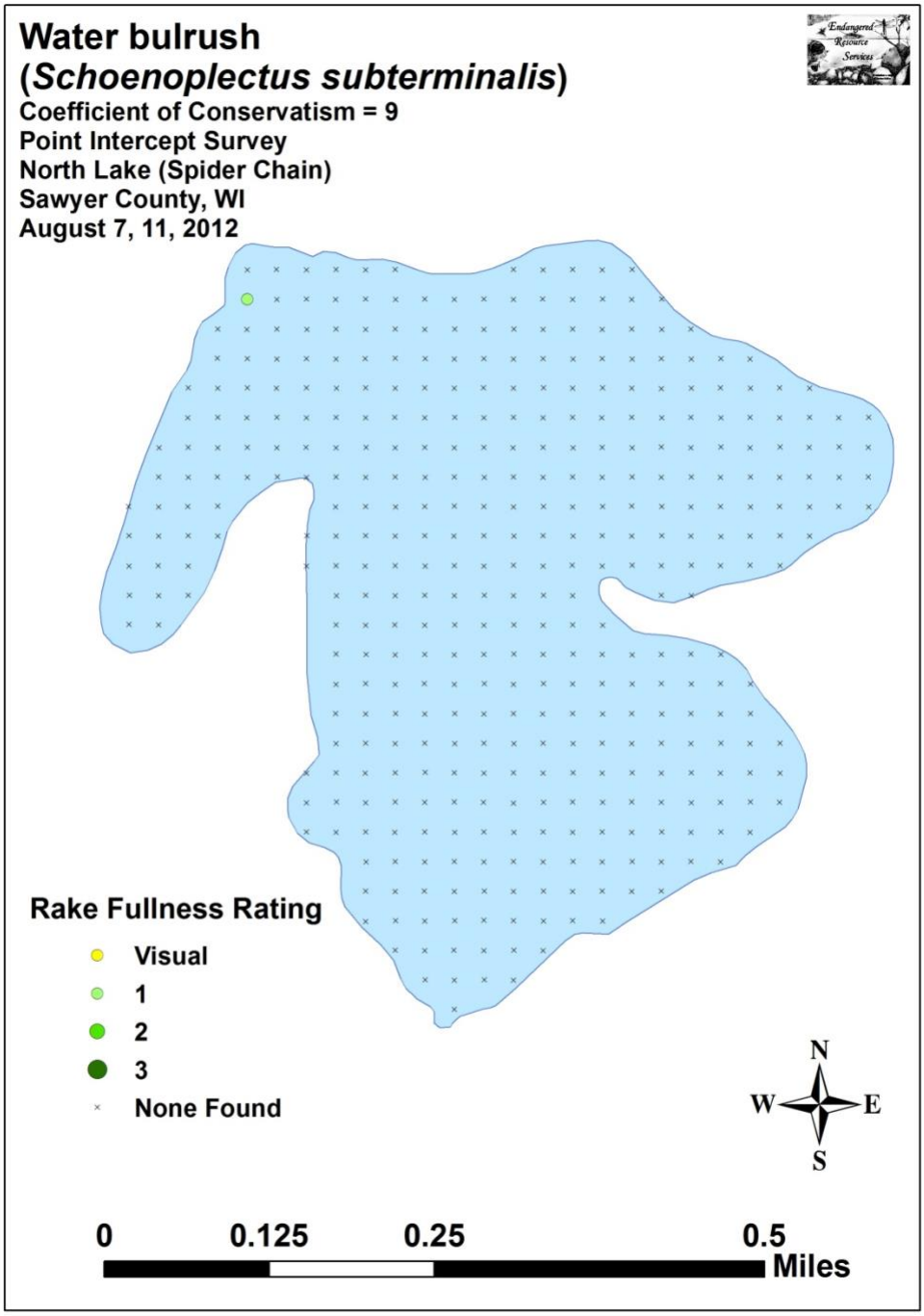
Miles


Water bulrush
(Schoenoplectus subterminalis)
Coefficient of Conservatism = 9
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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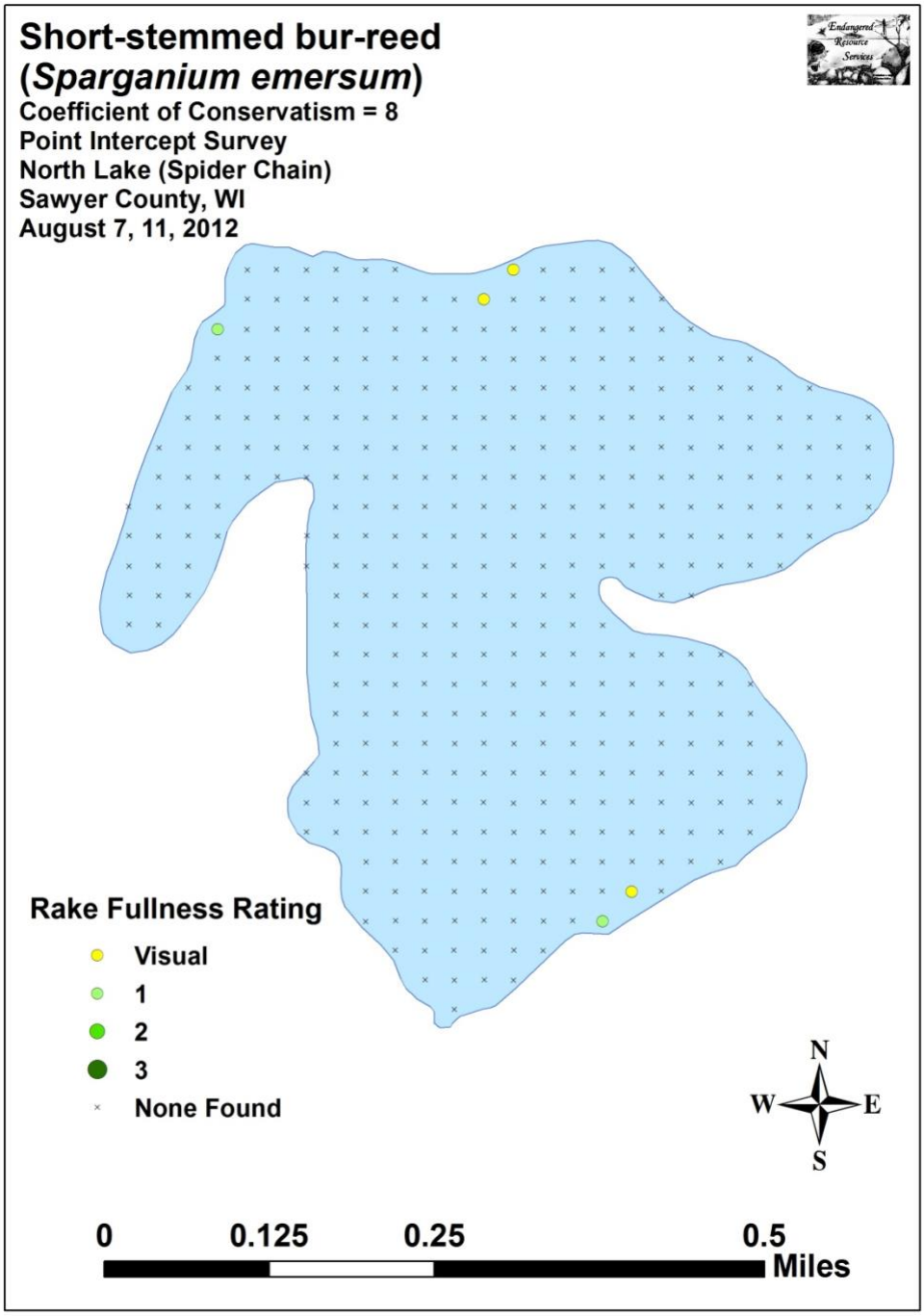
Miles


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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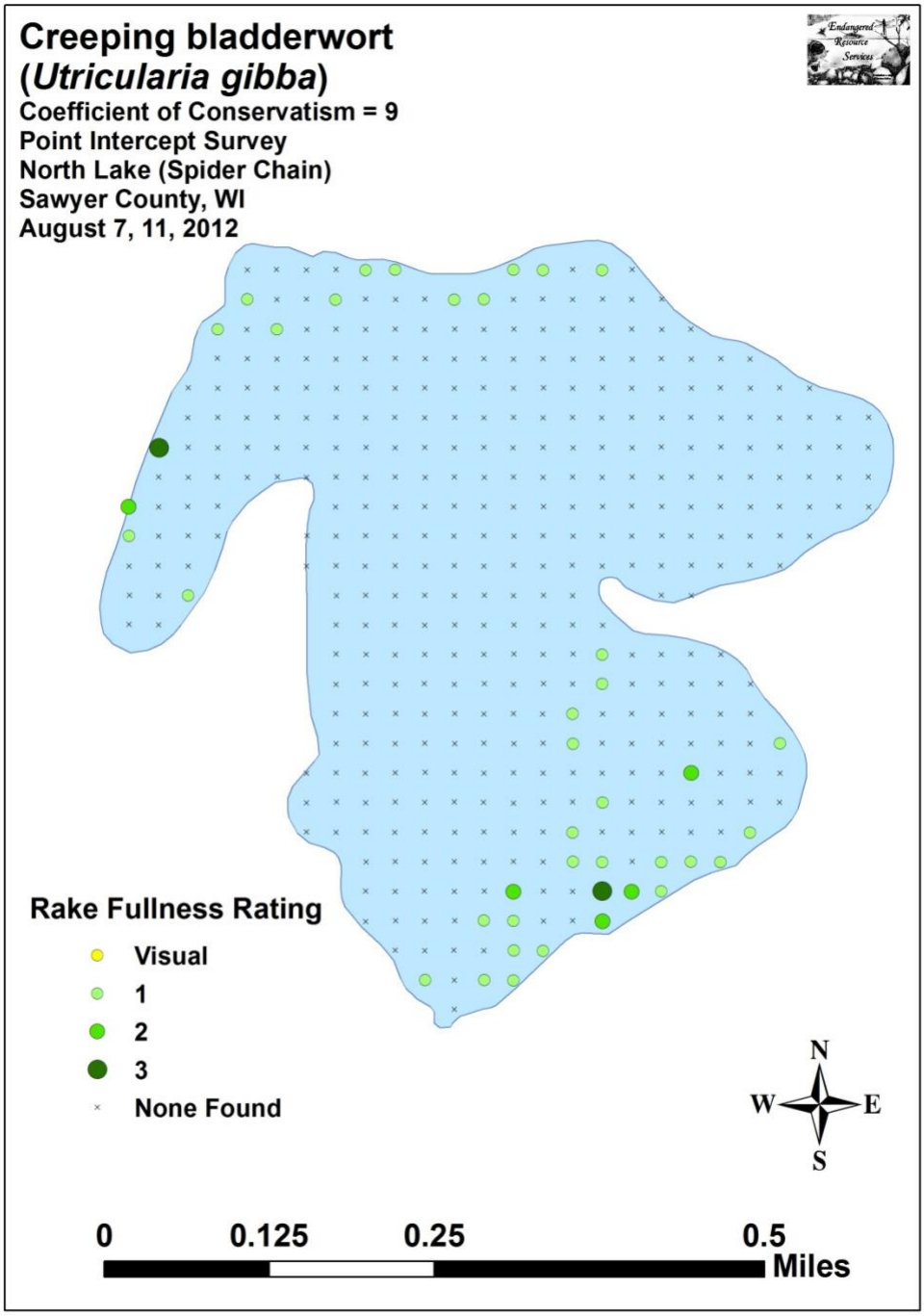
Miles


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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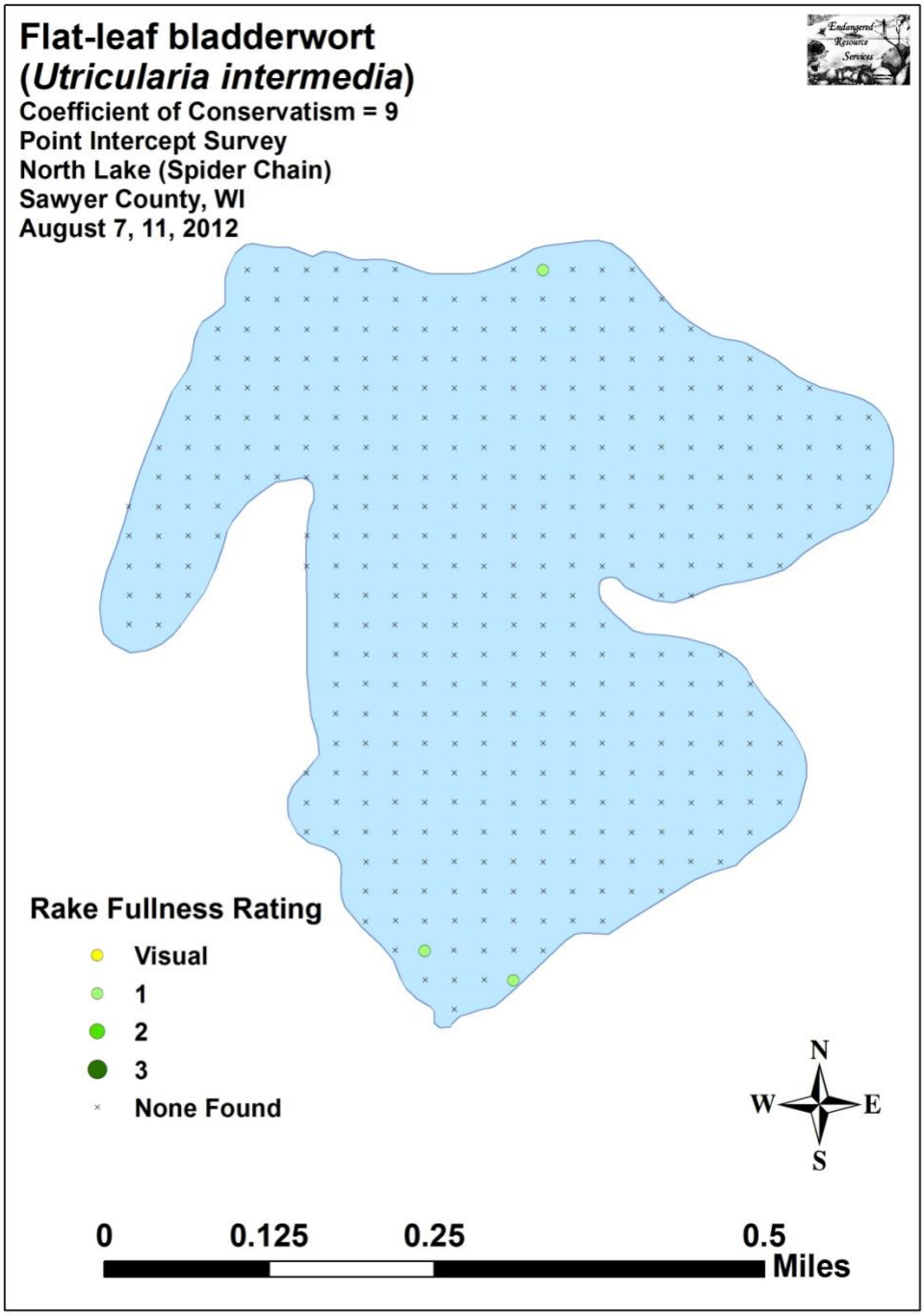
Miles


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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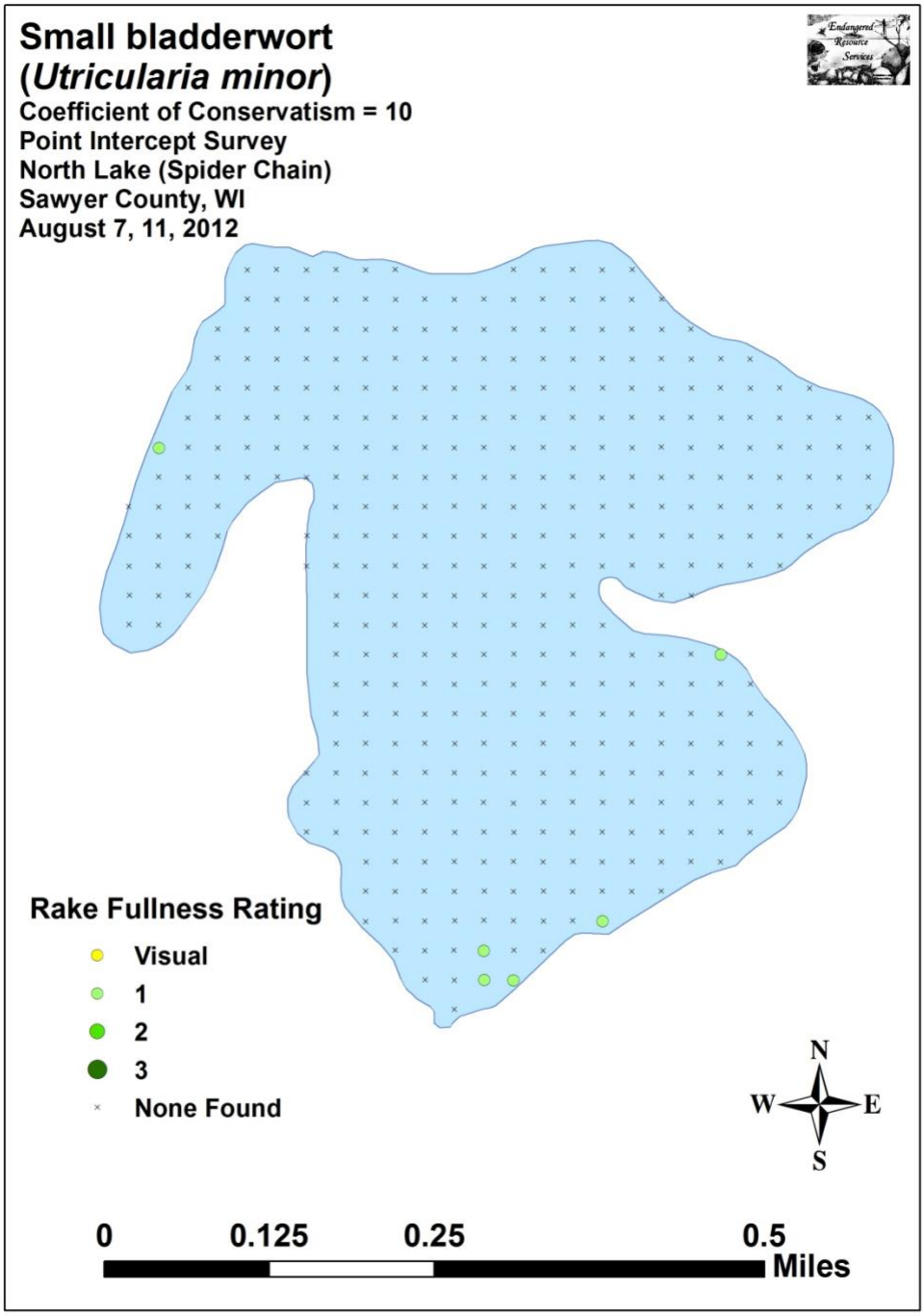
Miles


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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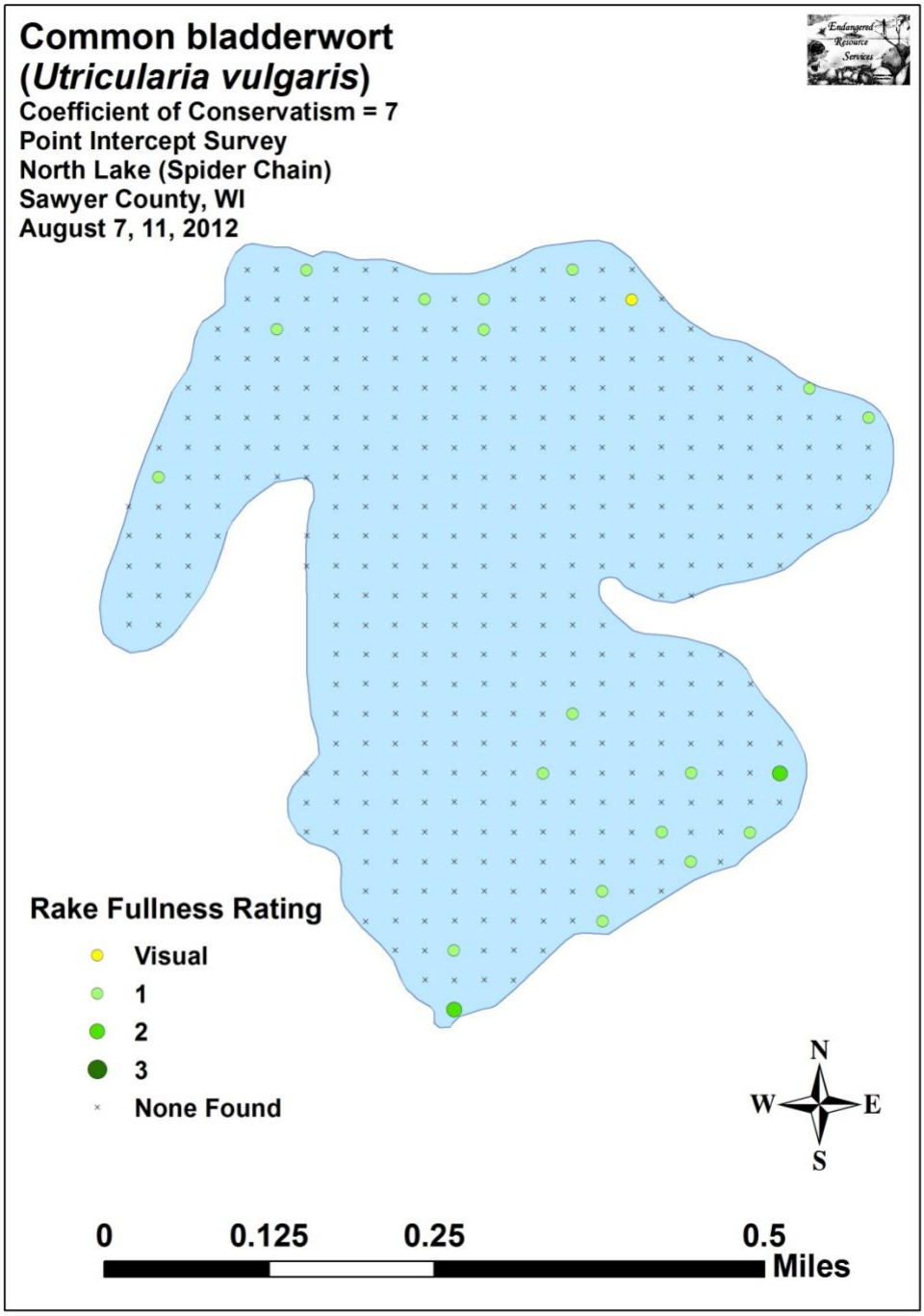
Miles


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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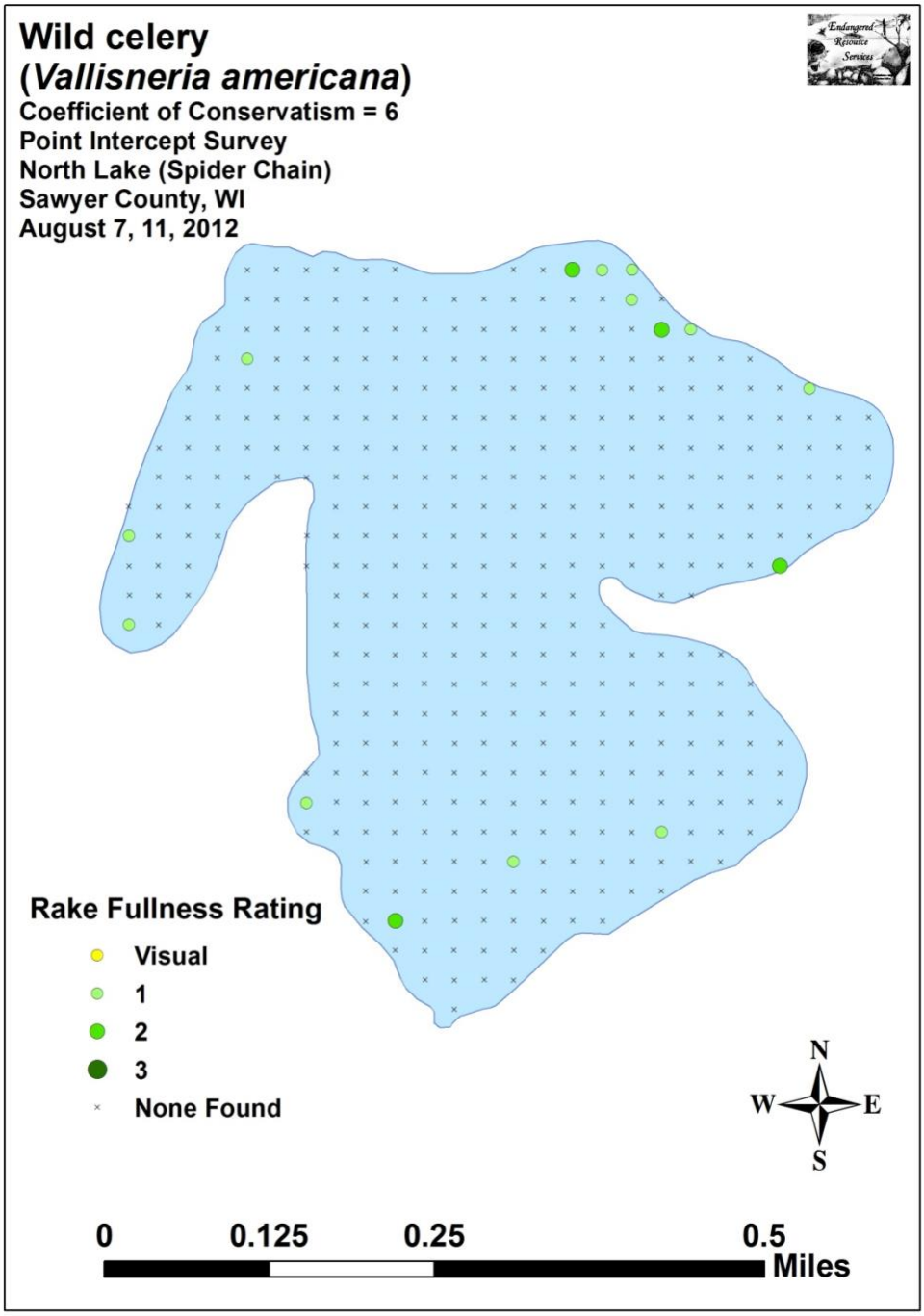
Miles


Wild celery
(Vallisneria americana)
Coefficient of Conservatism = 6
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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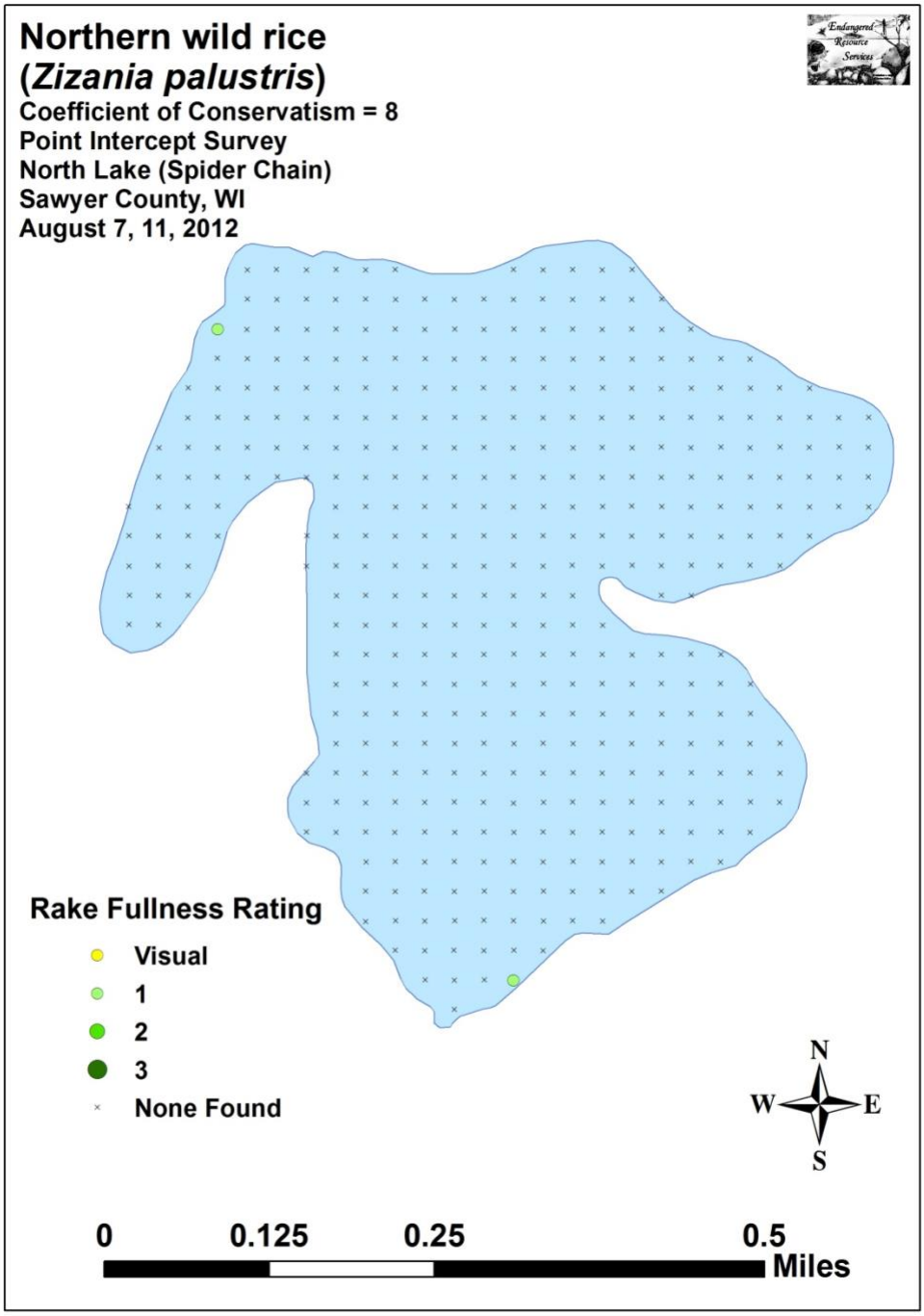
Miles


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 VII: 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 lacustris*) **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 Lakes
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:** 8/4/17
Species: (*Iris pseudacorus*) **Yellow iris**
Specimen Location: Spider Lake; N46.07486°, W91.23793°
Also found in: Clear and North Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2017-011
Habitat/Distribution: Firm sand and muck bottom at the shoreline. Common and spreading on both Big and Little Spider. Much less common on North Lake and Clear Lakes.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Schoenoplectus tabernaemontani*) Softstem bulrush

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:** 8/4/17
Species: (*Typha angustifolia*) **Narrow-leaved cattail**
Specimen Location: Clear Lake; N46.09305°, W91.23599°
Also found in: Spider Lake
Collected/Identified by: Matthew S. Berg Col. #: MSB-2017-012
Habitat/Distribution: Sand and sandy muck soil in and out of the water <0.25 meter deep. Uncommon south of Butternut Island and in the north bay of Big Spider.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Leersia oryzoides*) Rice cut-grass, (*Schoenoplectus tabernaemontani*) Softstem bulrush

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

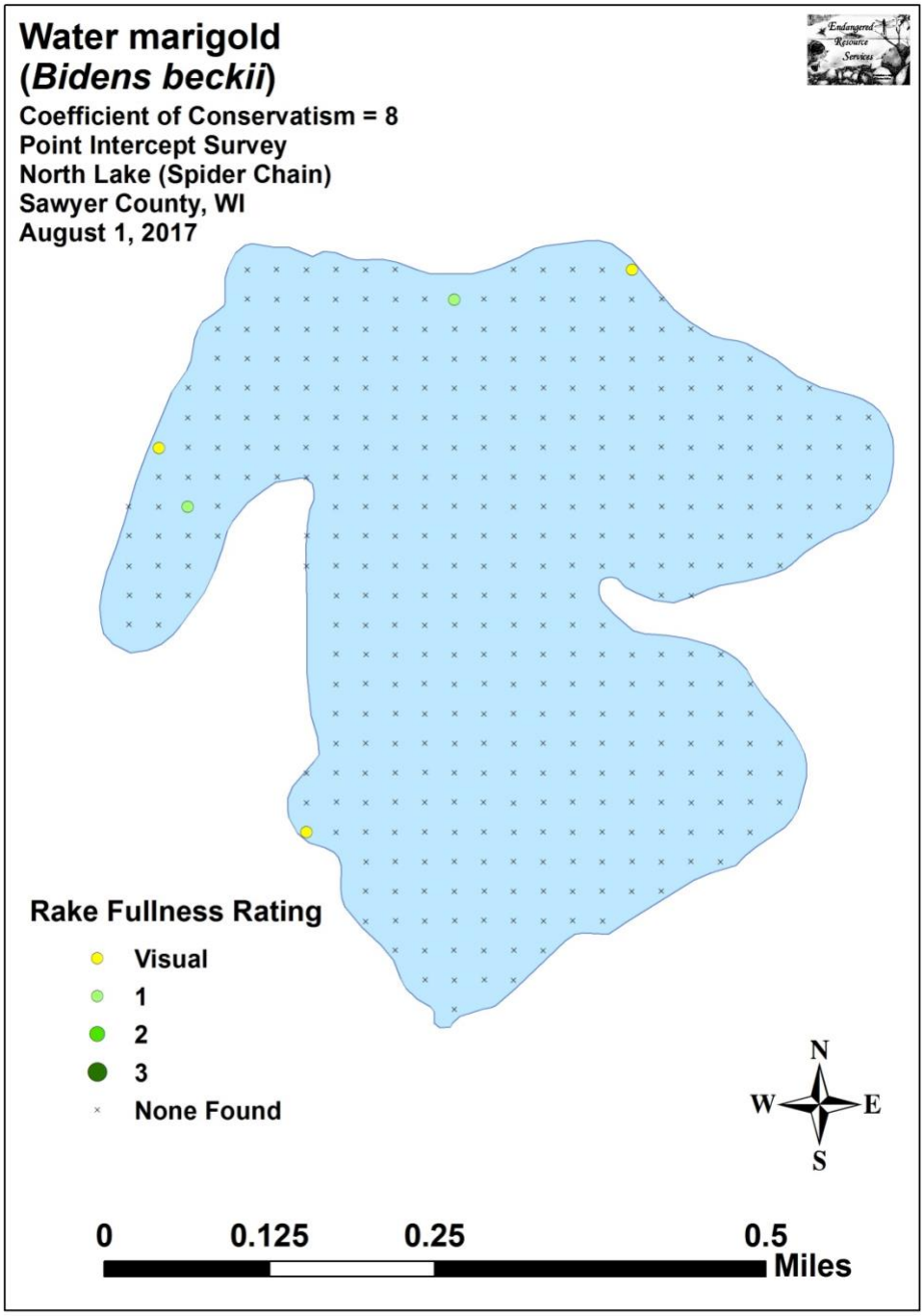
County/State: Sawyer County, Wisconsin **Date:** 8/8/12
Species: (*Utricularia minor*) **Small bladderwort**
Specimen Location: Spider Lake; N46.11636°, W91.21477°
Also found in: North and Fawn Lakes
Collected/Identified by: Matthew S. Berg Col. #: MSB-2012-344
Habitat/Distribution: Muck bottoms in shallow 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 VIII: August 2017 Species Density and Distribution Maps


Water marigold
(Bidens beckii)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
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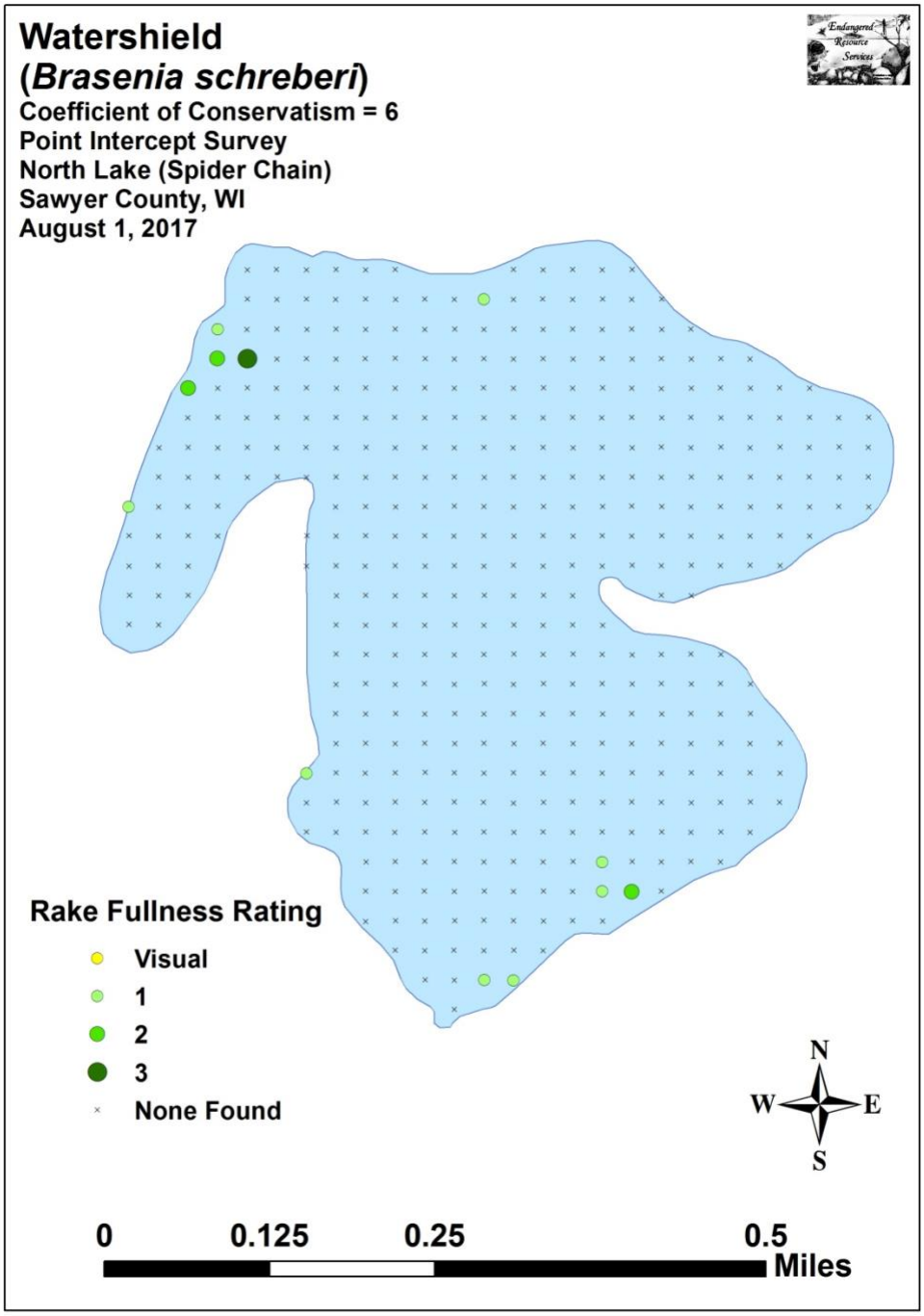
0
0.125
0.25
0.5
Miles


Watershield
(Brasenia schreberi)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
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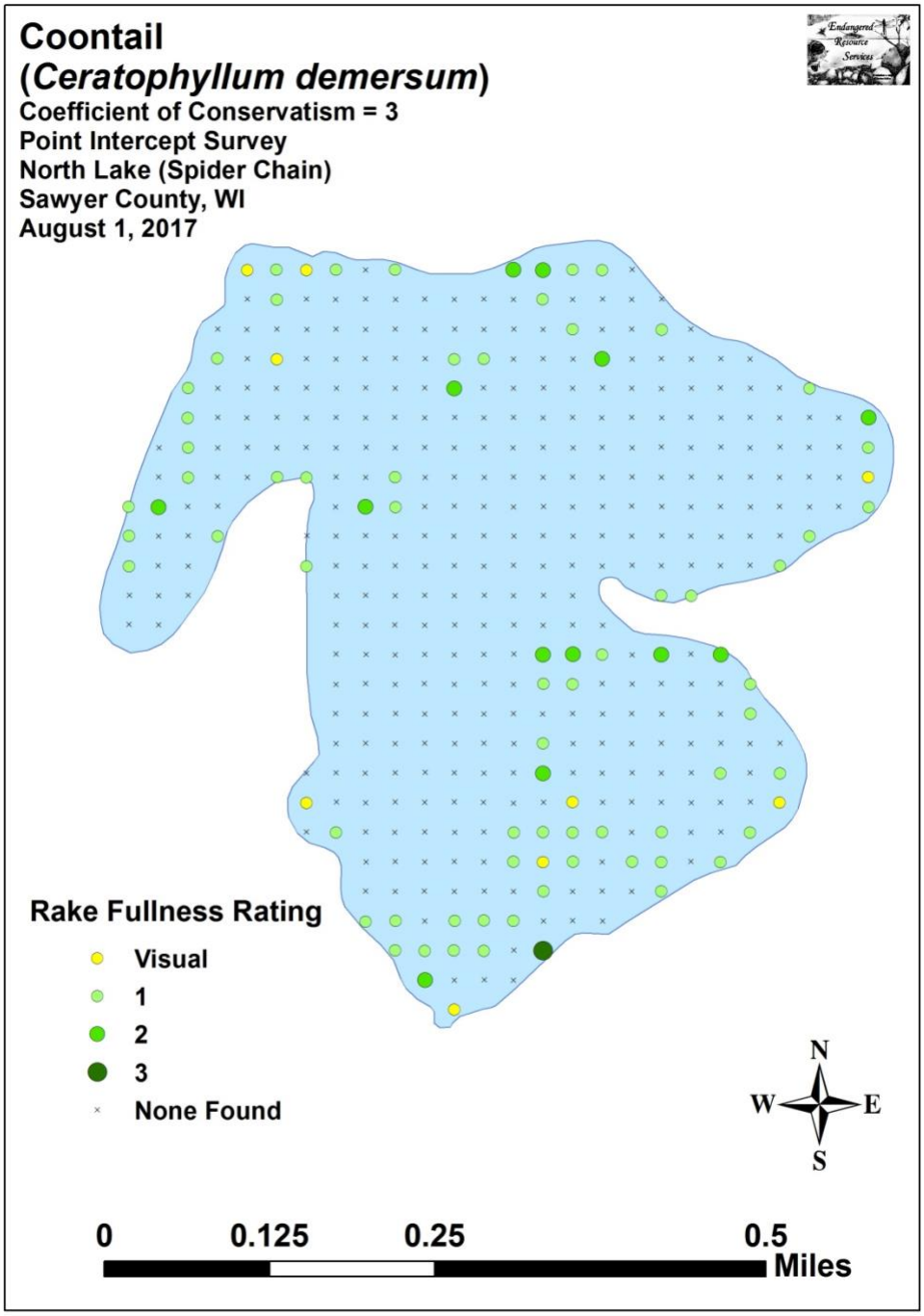
0.125
0.25
0.5
Miles


Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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0.125
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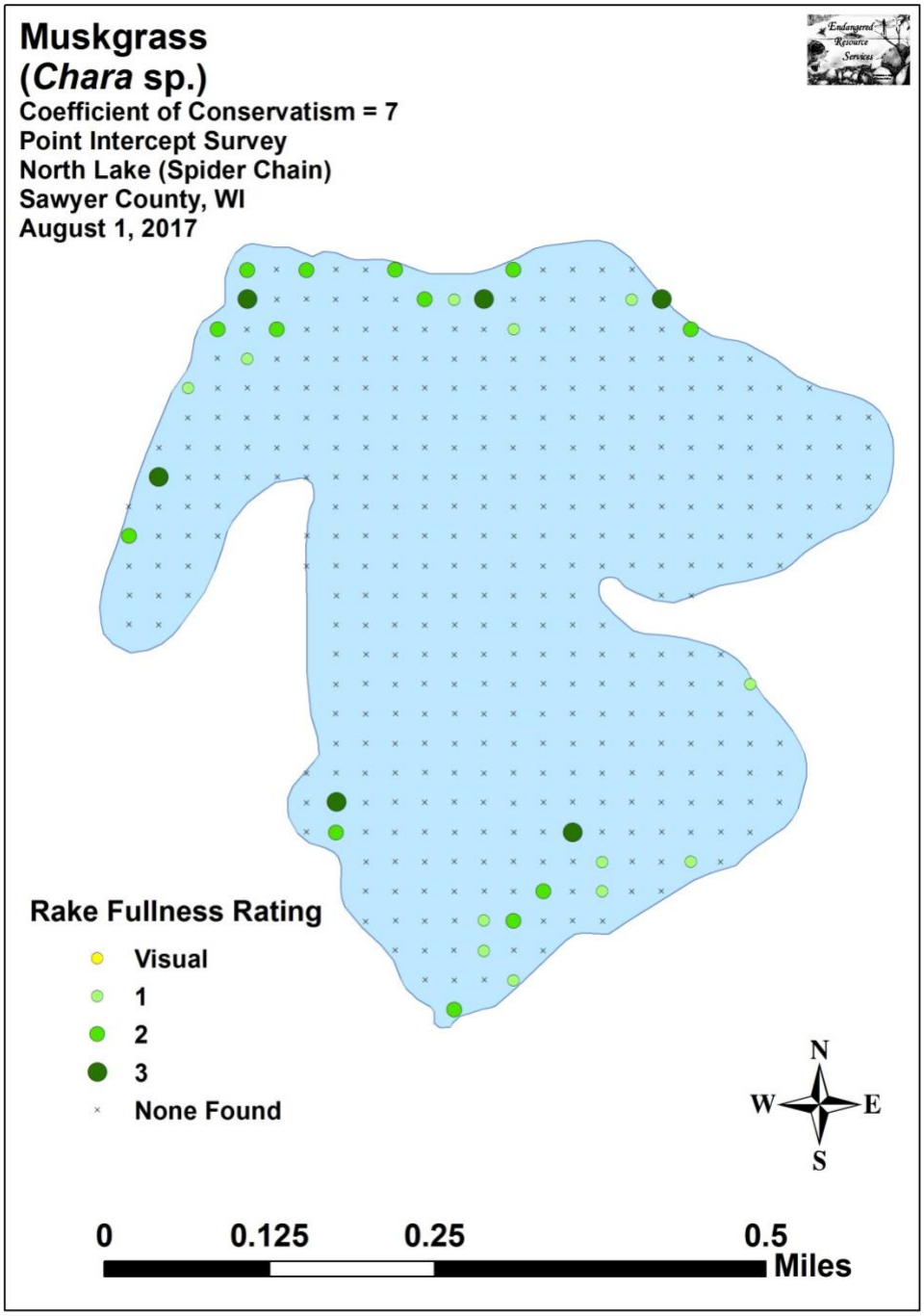
Miles


Muskgrass
(Chara sp.)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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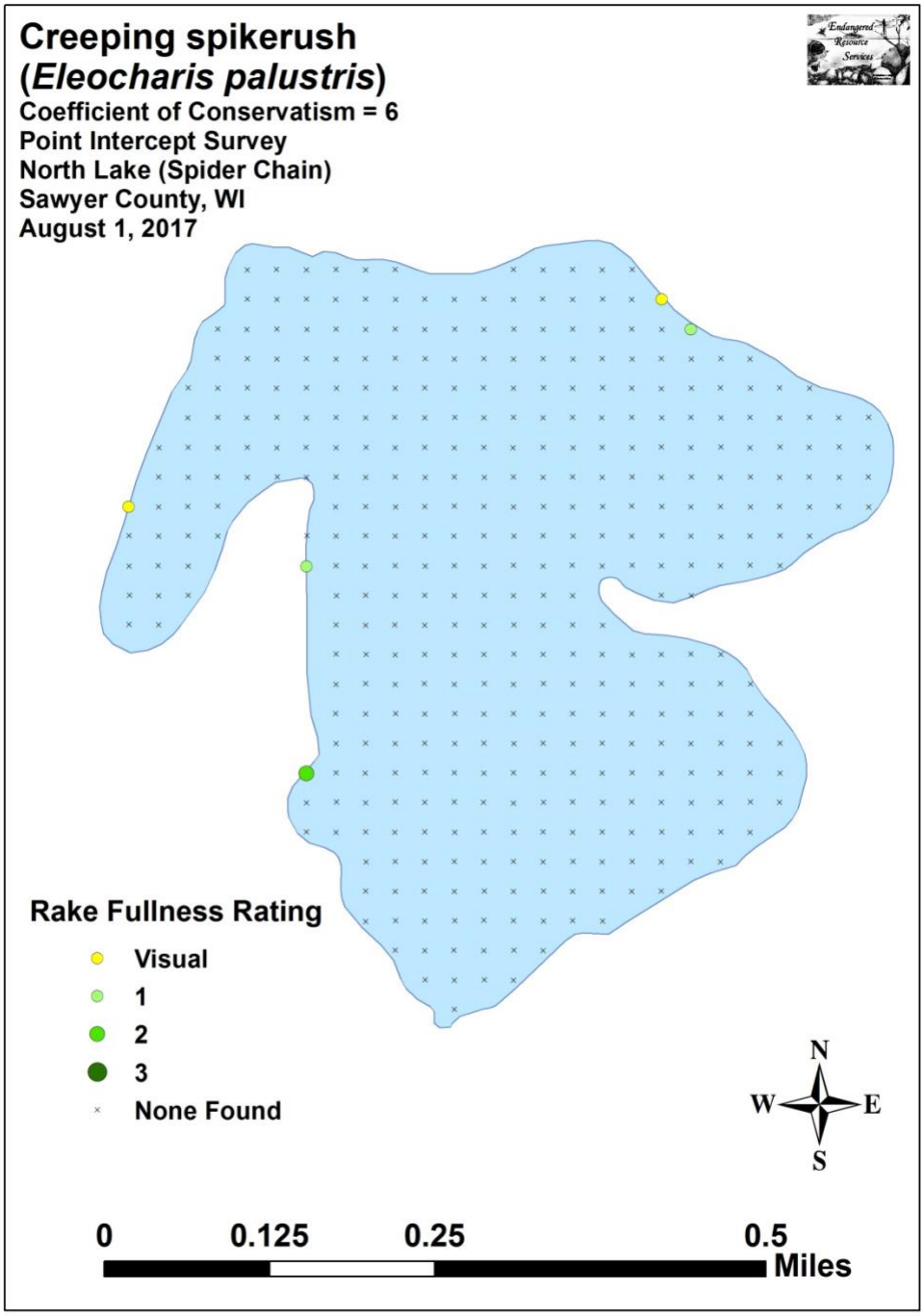
Miles


Creeping spikerush
(Eleocharis palustris)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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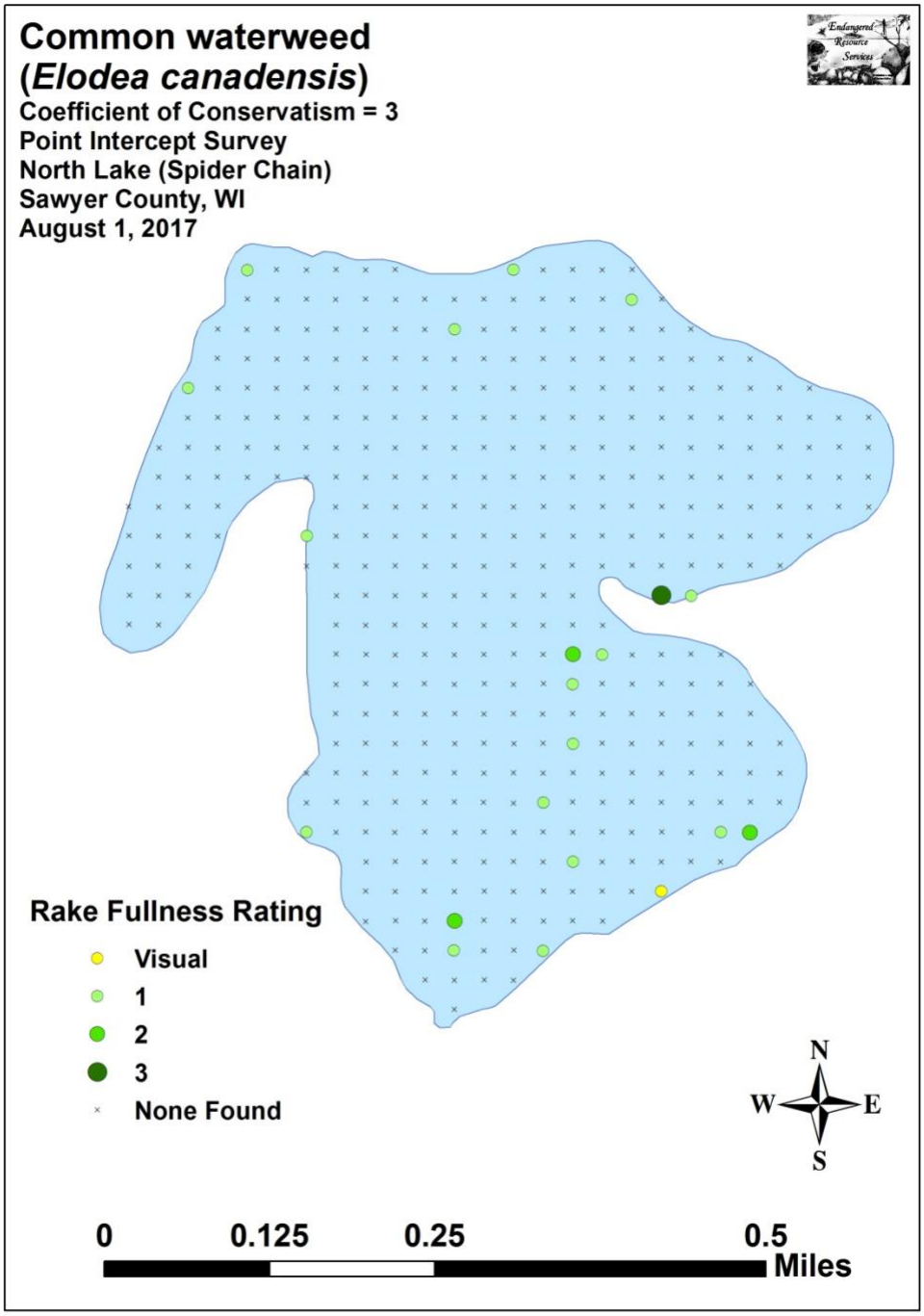
Miles


Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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0.125
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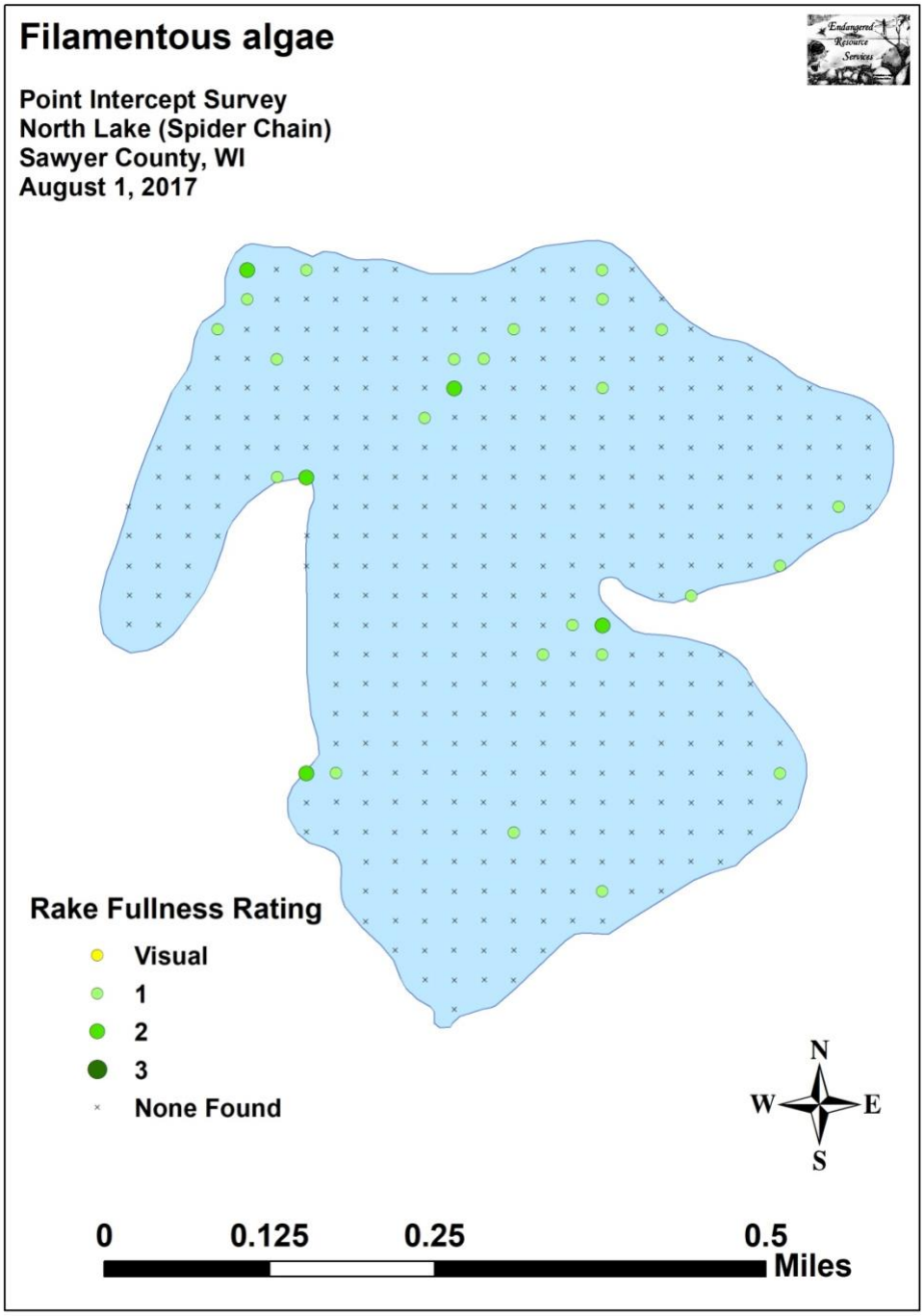
Miles


Filamentous algae
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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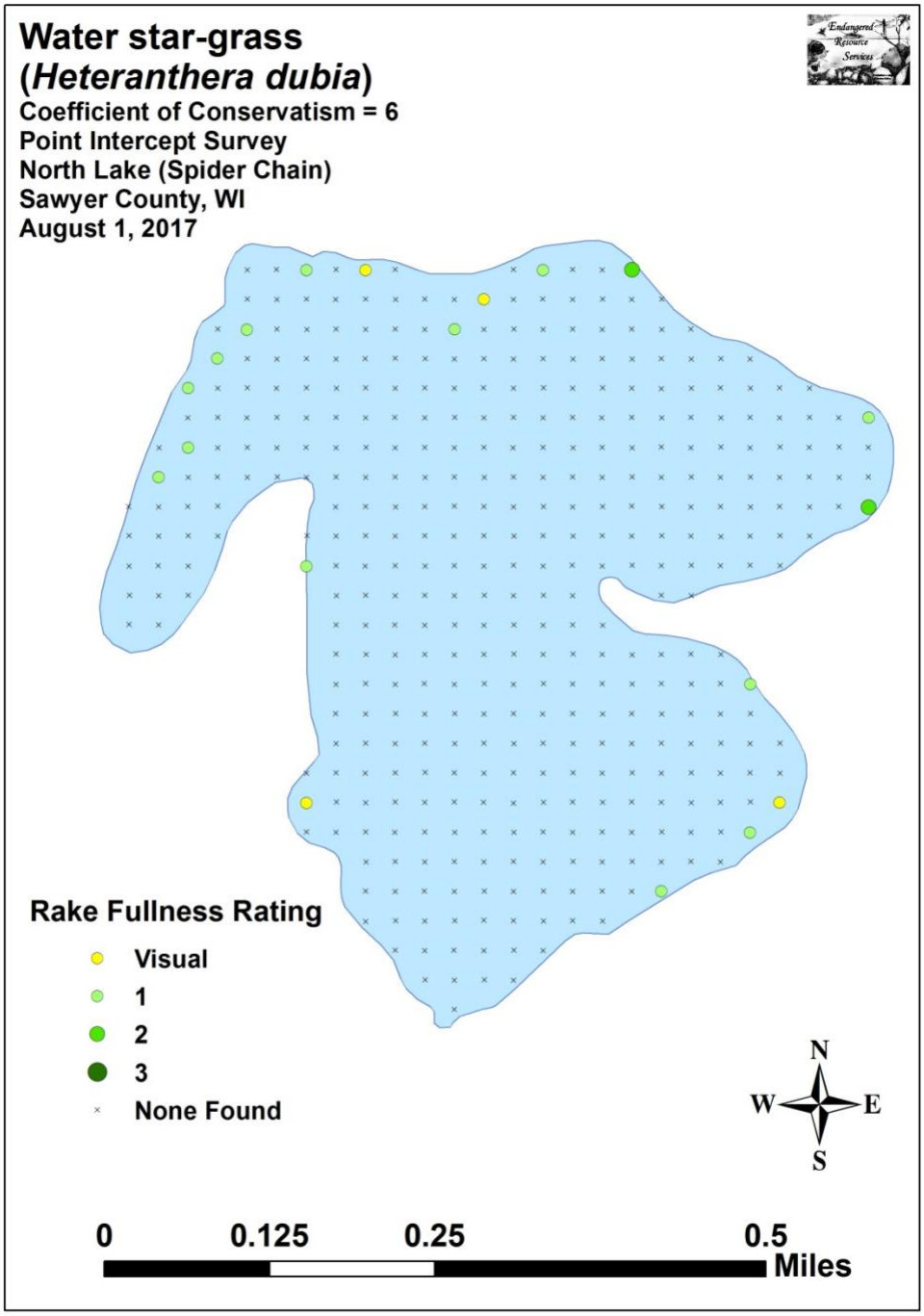
Miles


Water star-grass
(Heteranthera dubia)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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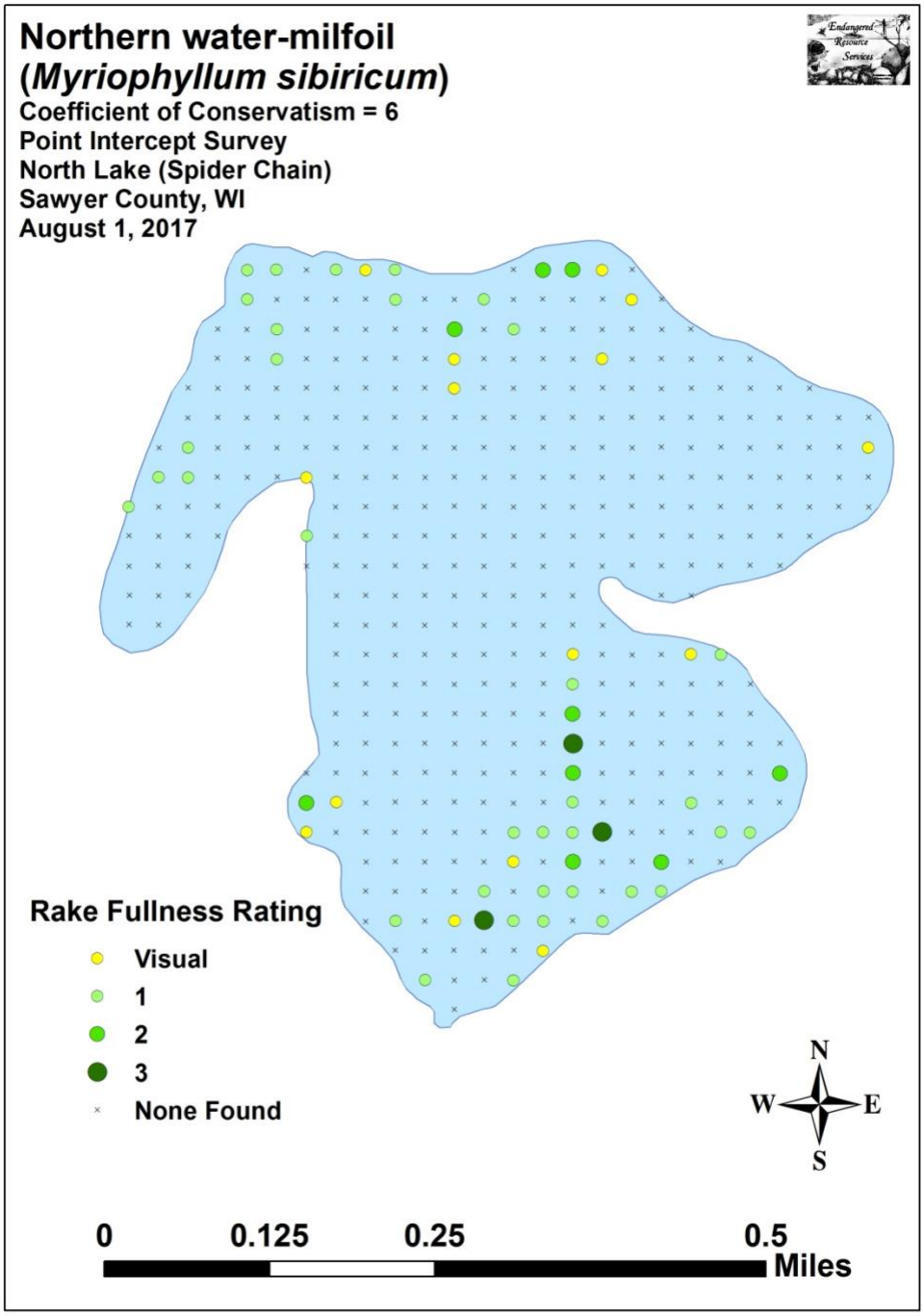
Miles


Northern water-milfoil
(Myriophyllum sibiricum)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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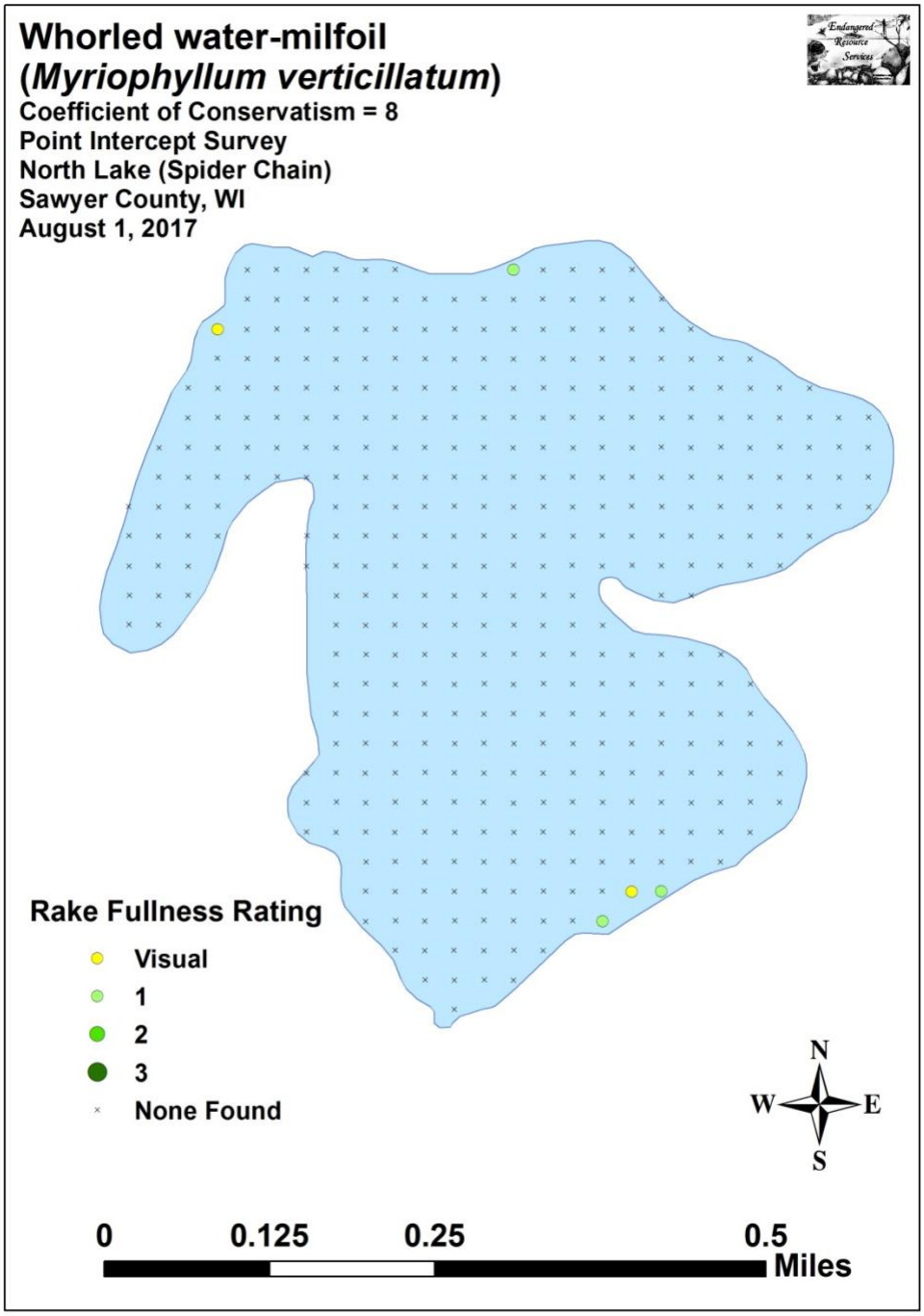
Miles


Whorled water-milfoil
(Myriophyllum verticillatum)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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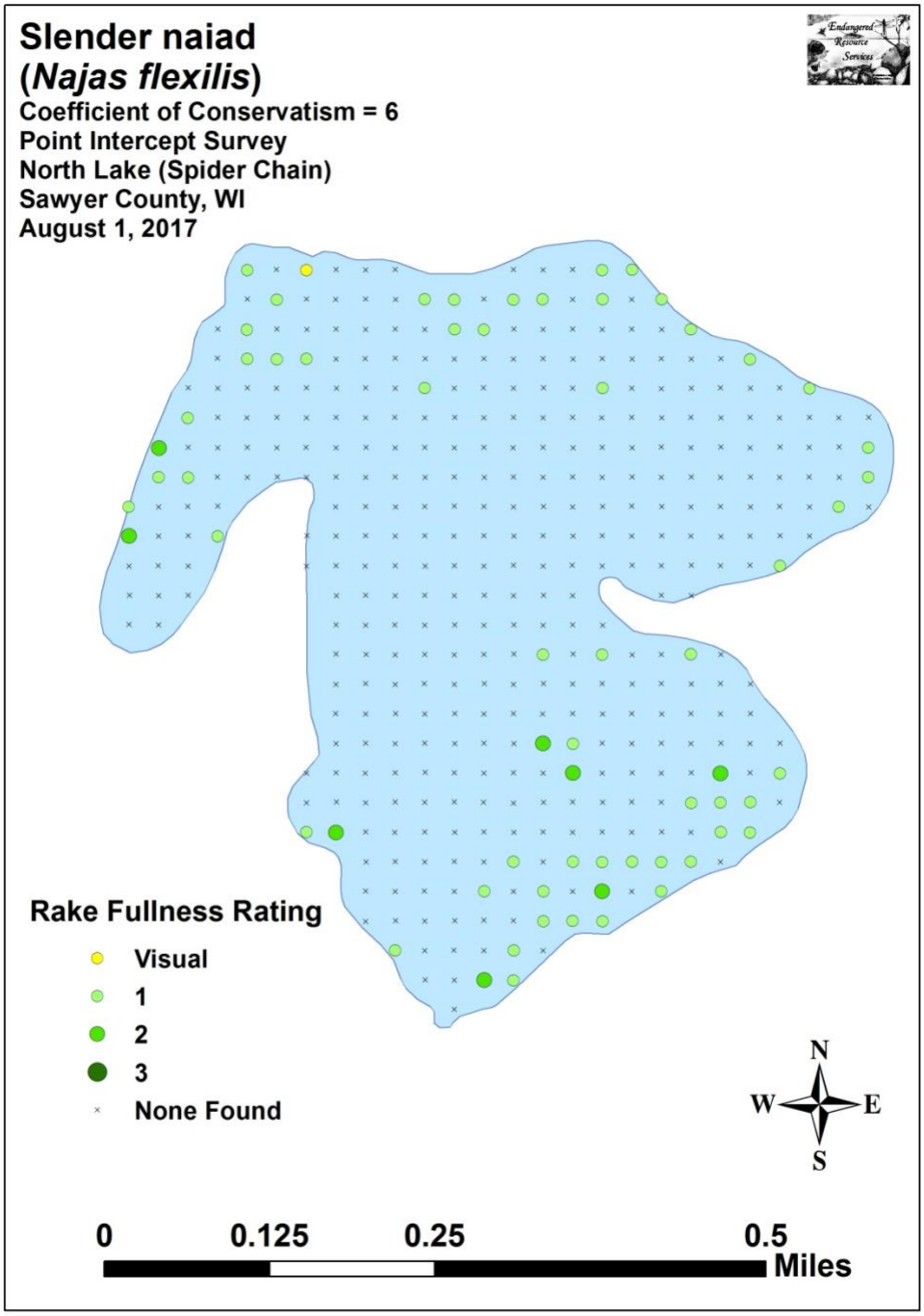
Miles


Slender naiad
(Najas flexilis)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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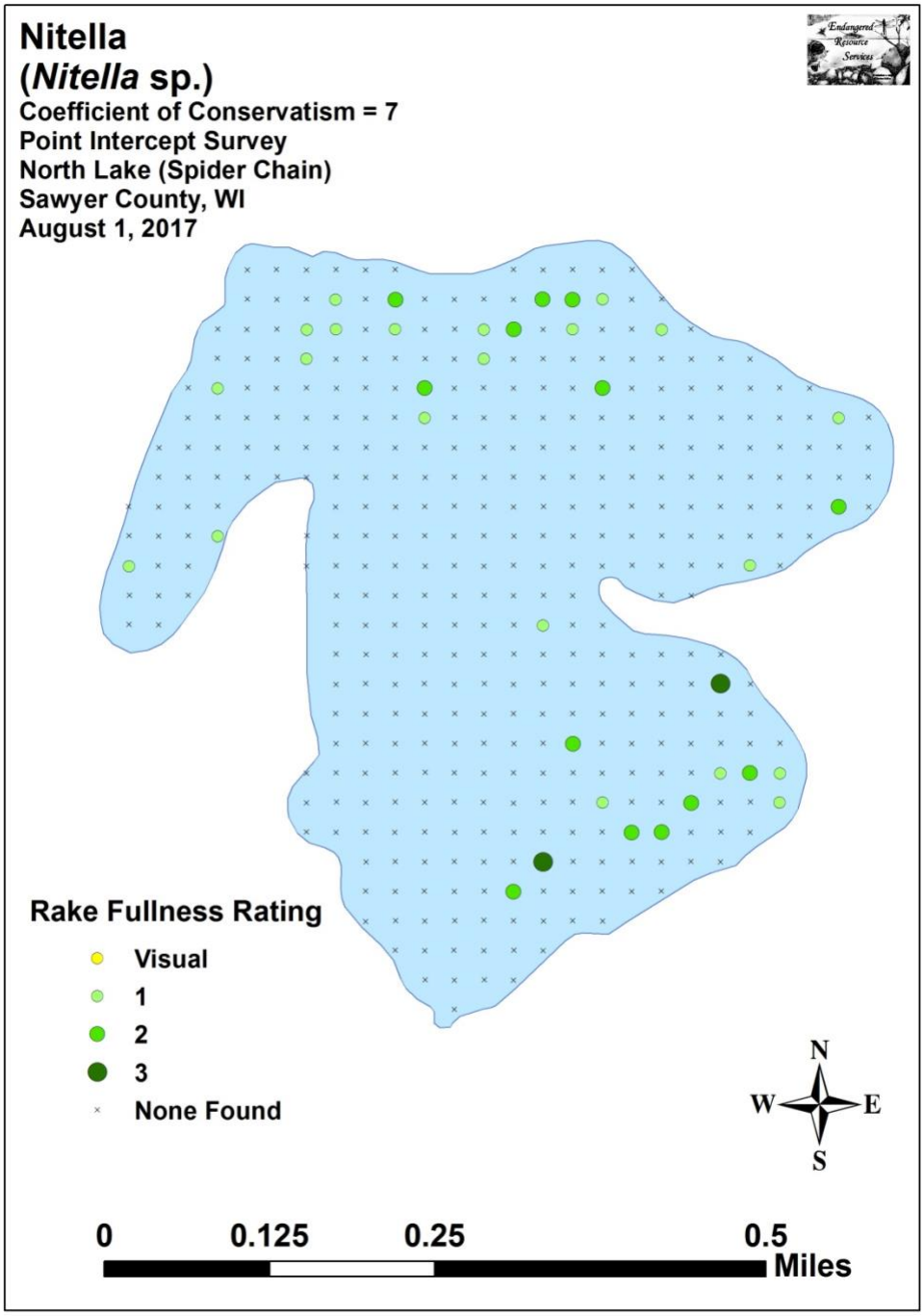
Miles


Nitella
(*Nitella* sp.)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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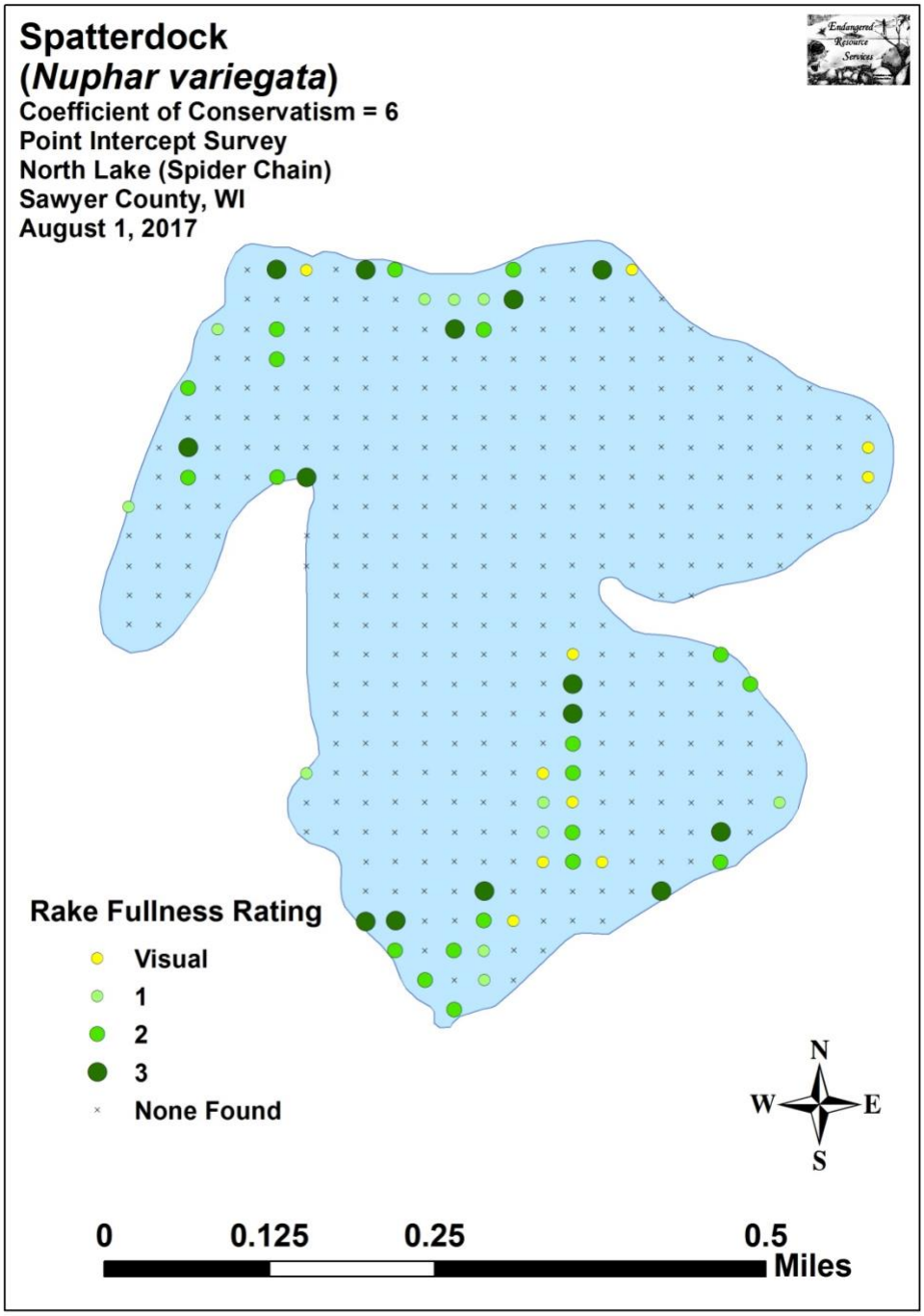
Miles


Spatterdock
(Nuphar variegata)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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0.125
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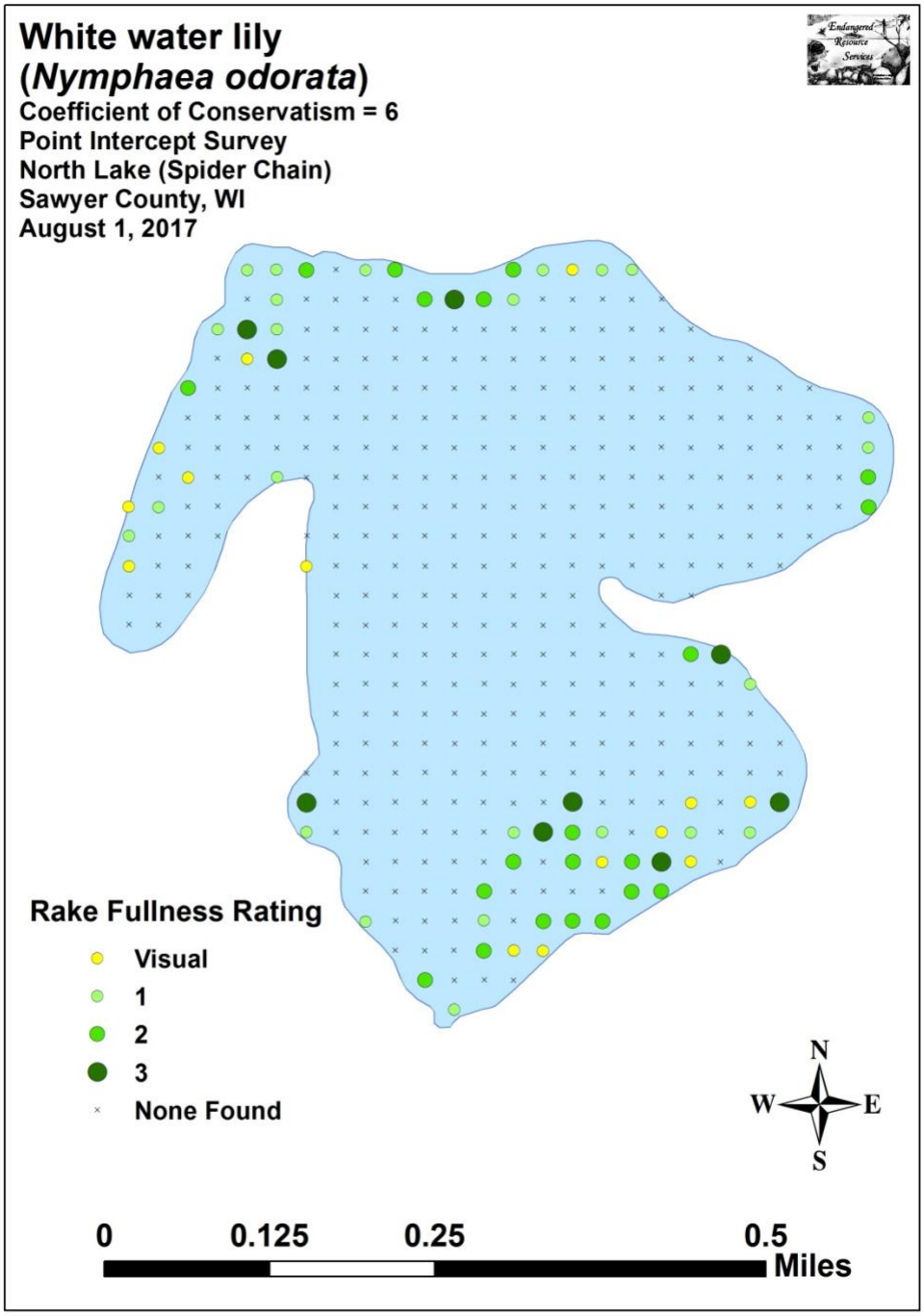
Miles


White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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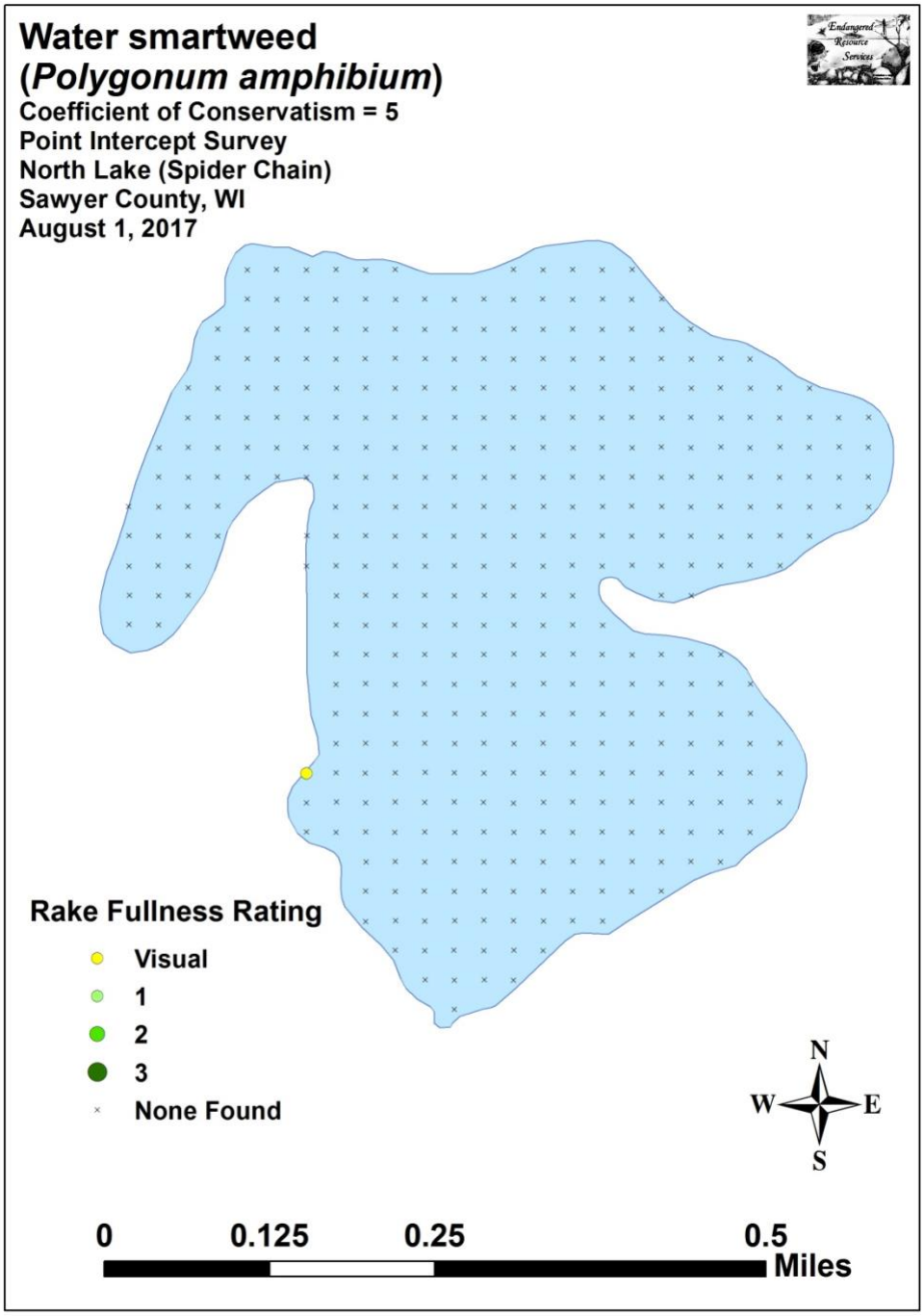
Miles


Water smartweed
(Polygonum amphibium)
Coefficient of Conservatism = 5
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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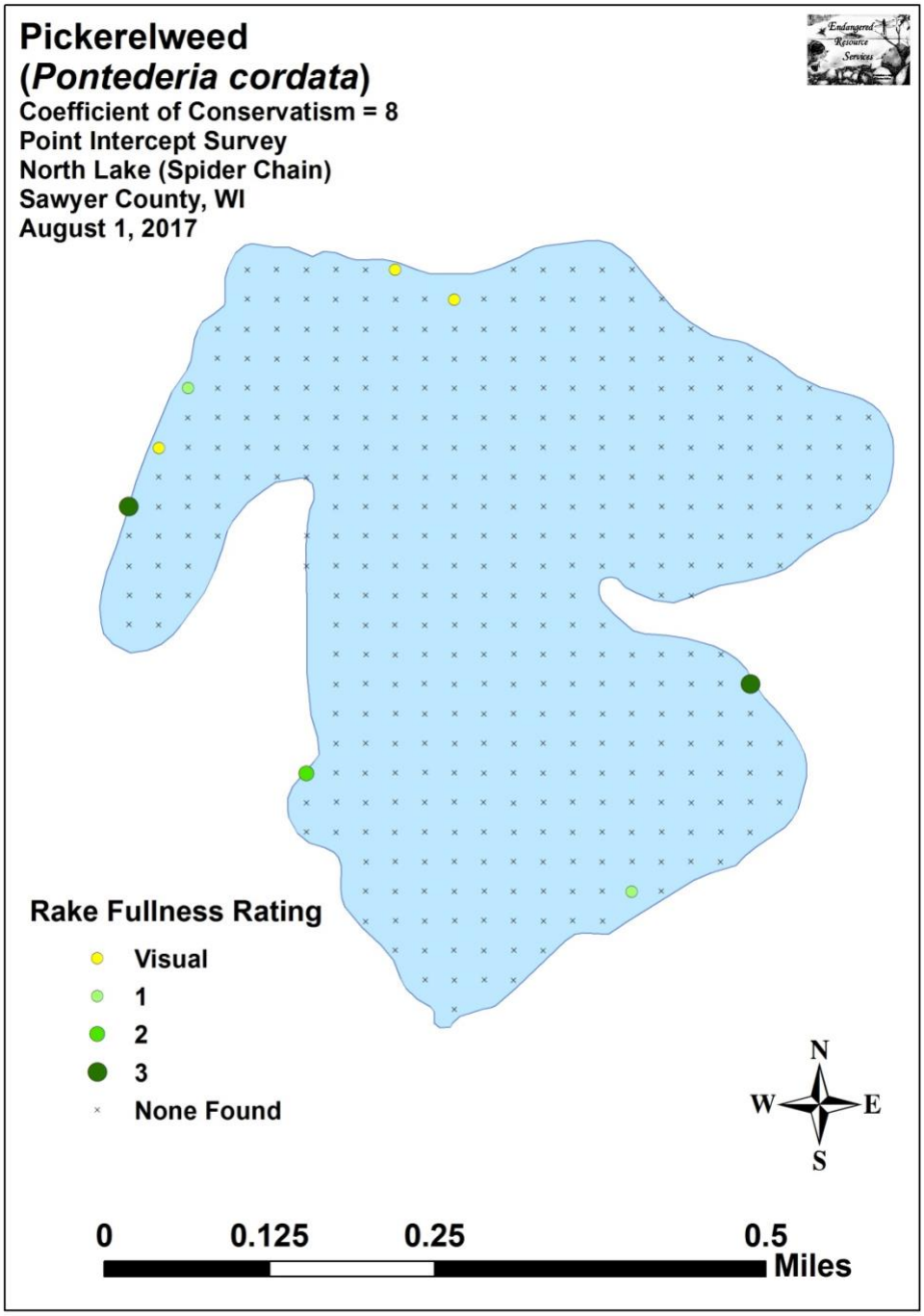
0.5
Miles


Pickerelweed
(Pontederia cordata)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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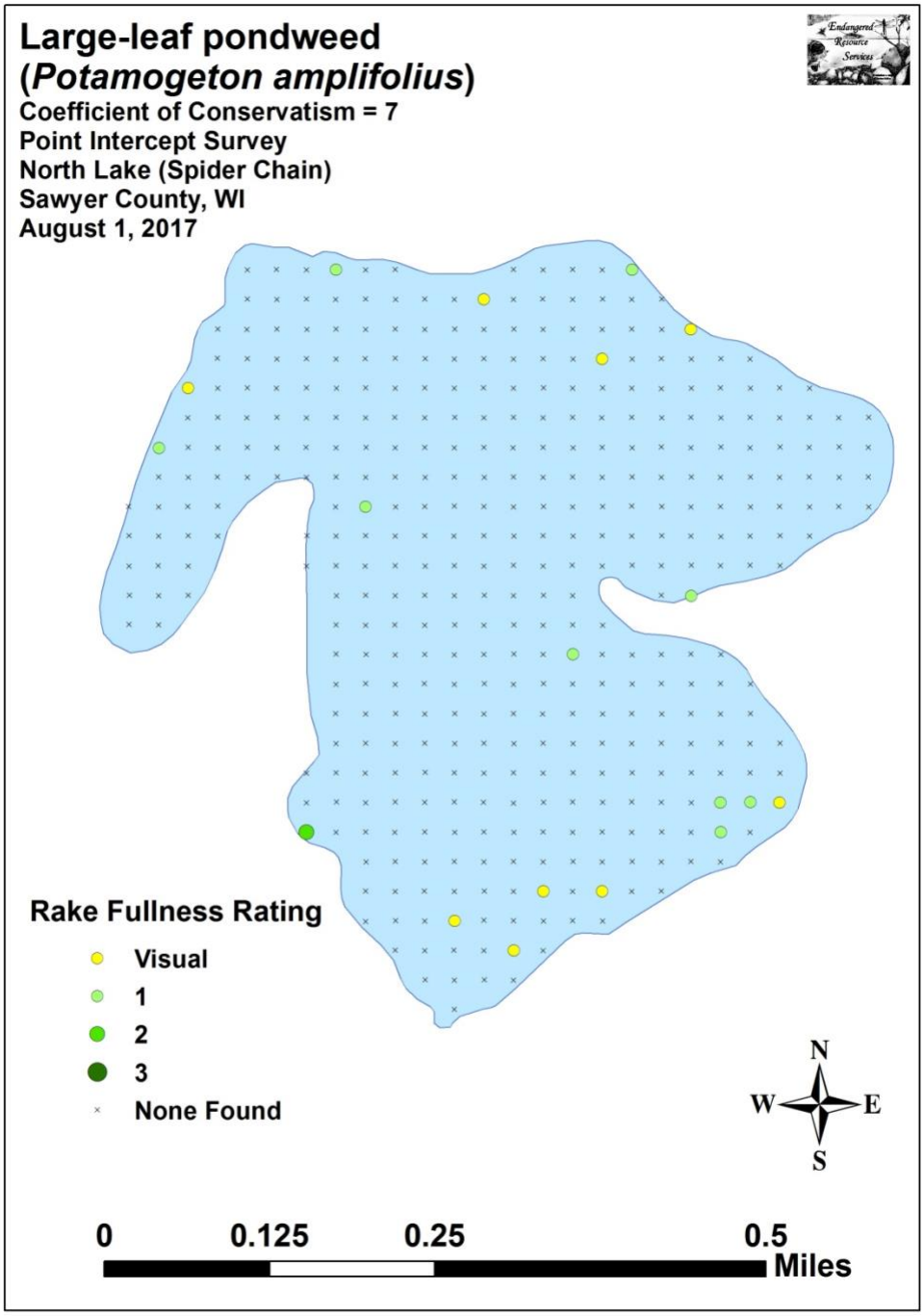
Miles


Large-leaf pondweed
(Potamogeton amplifolius)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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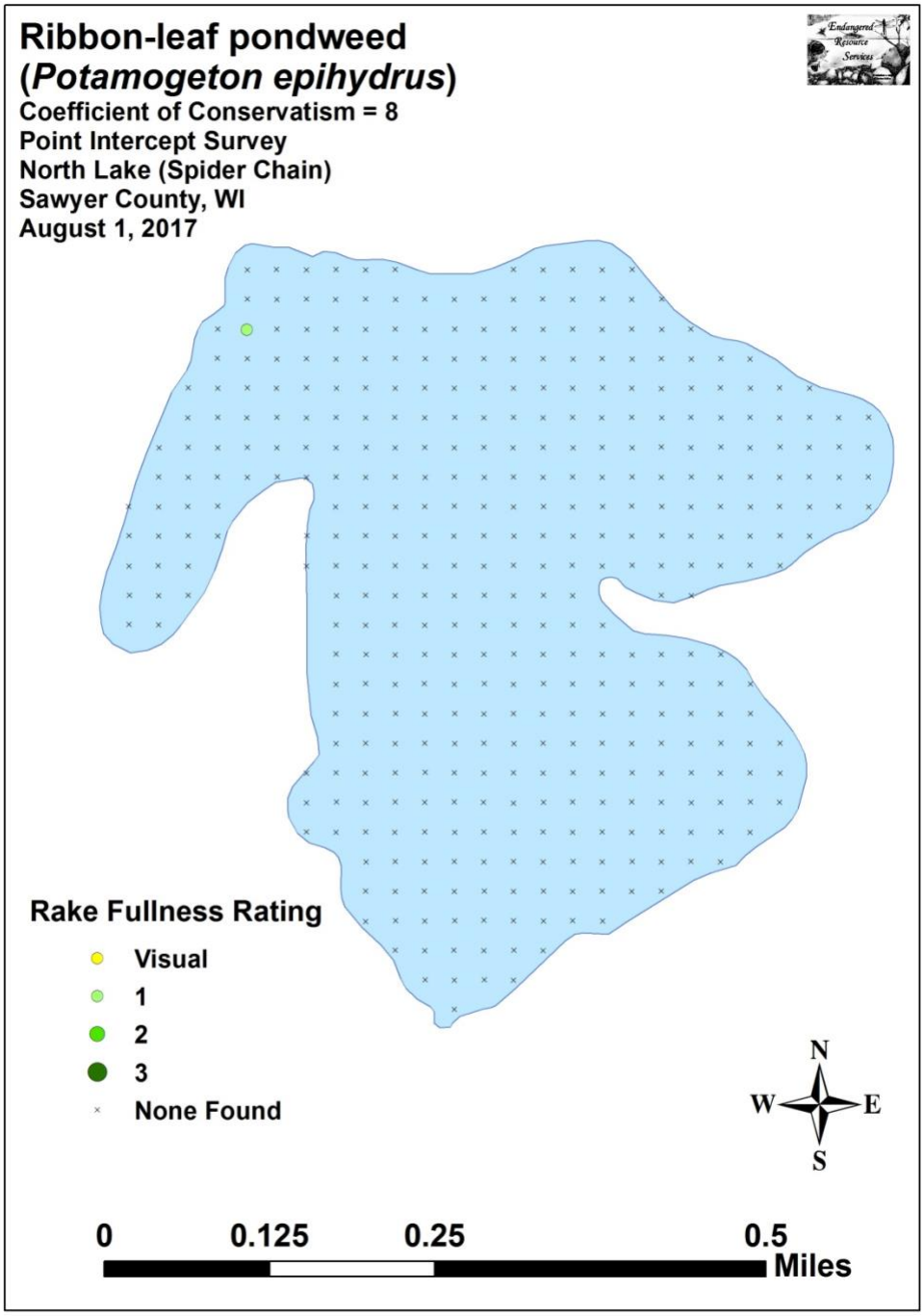
Miles


Ribbon-leaf pondweed
(Potamogeton epihydrus)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
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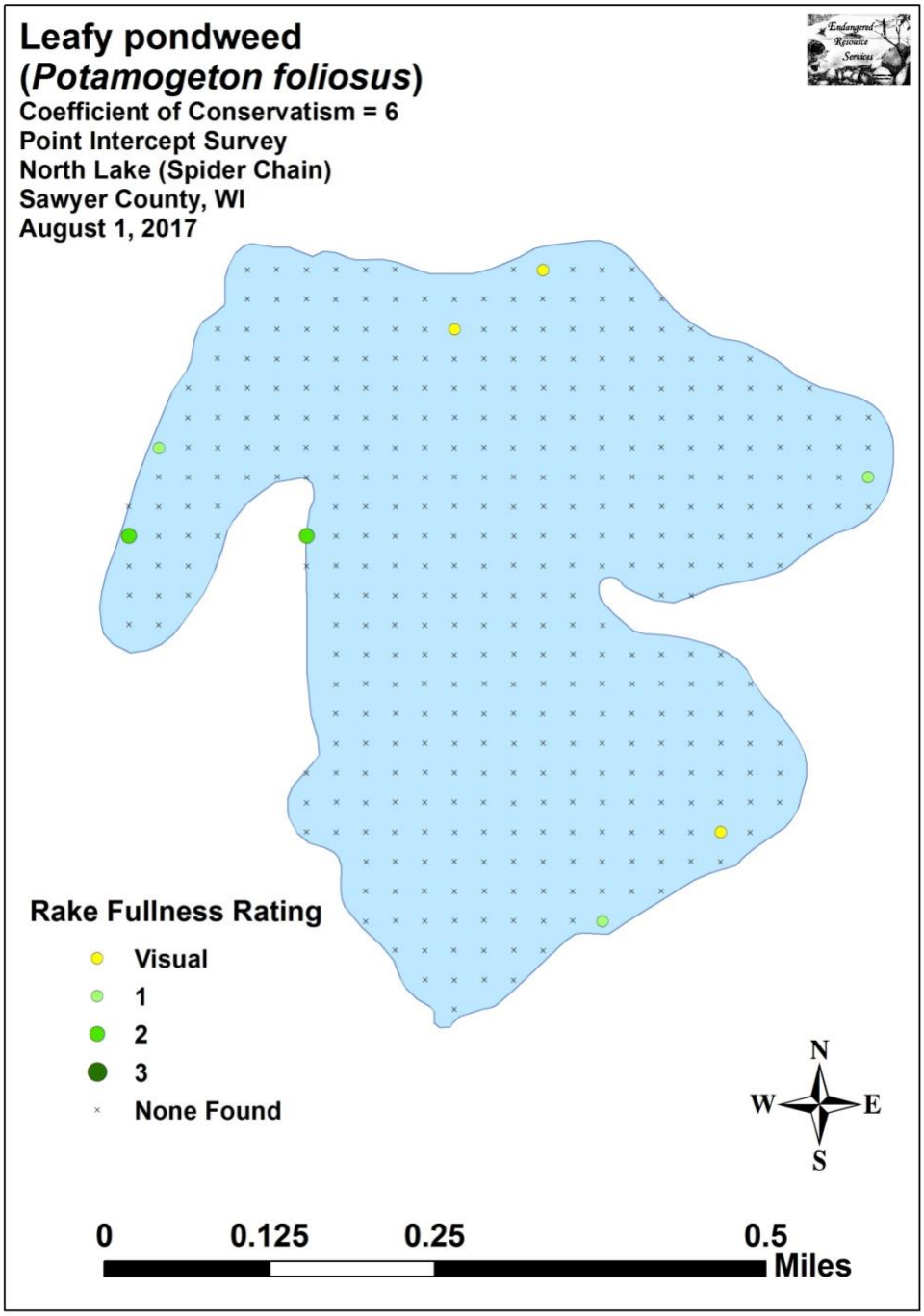
0.125
0.25
0.5
Miles


Leafy pondweed
(Potamogeton foliosus)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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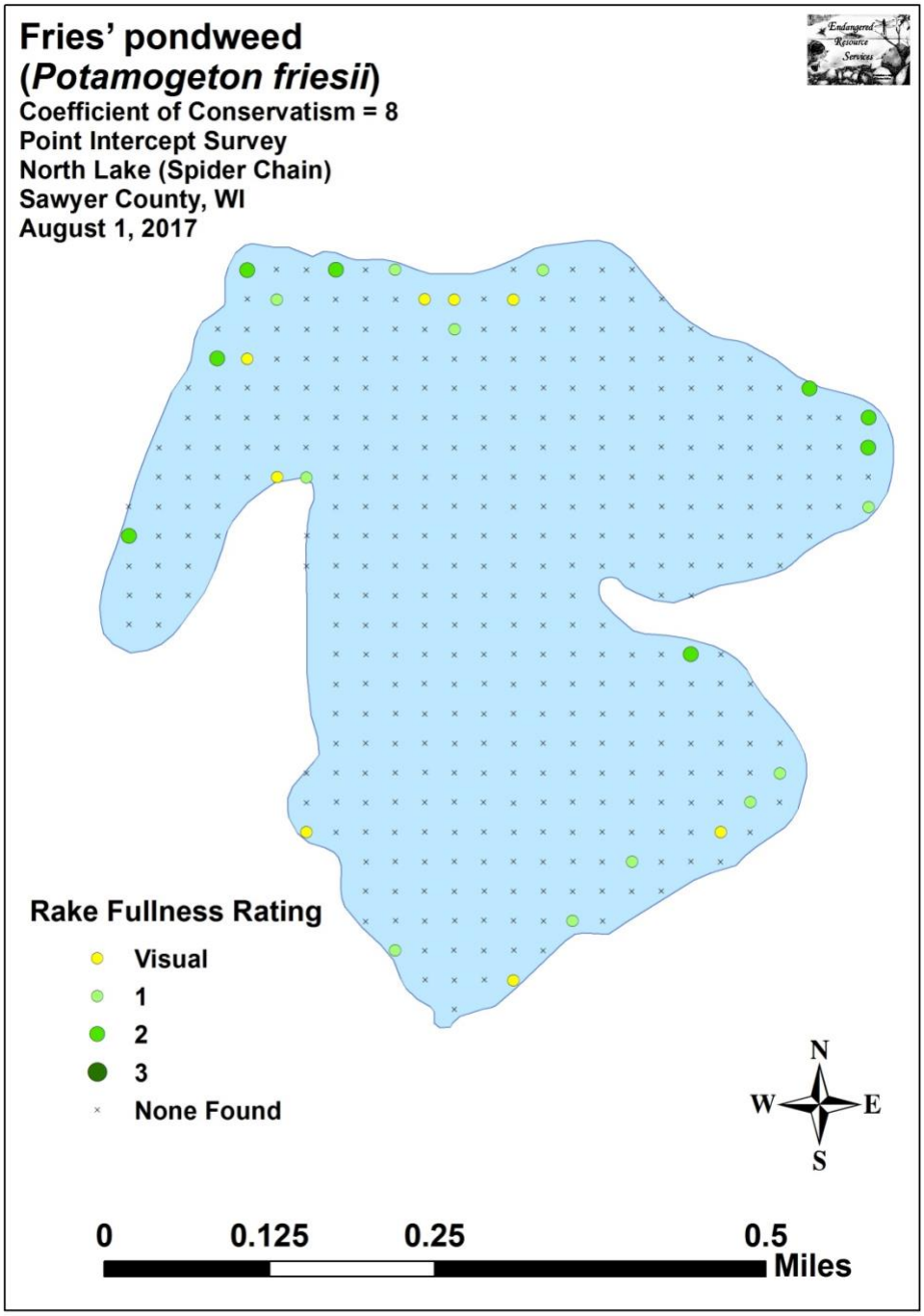
Miles


Fries' pondweed
(Potamogeton friesii)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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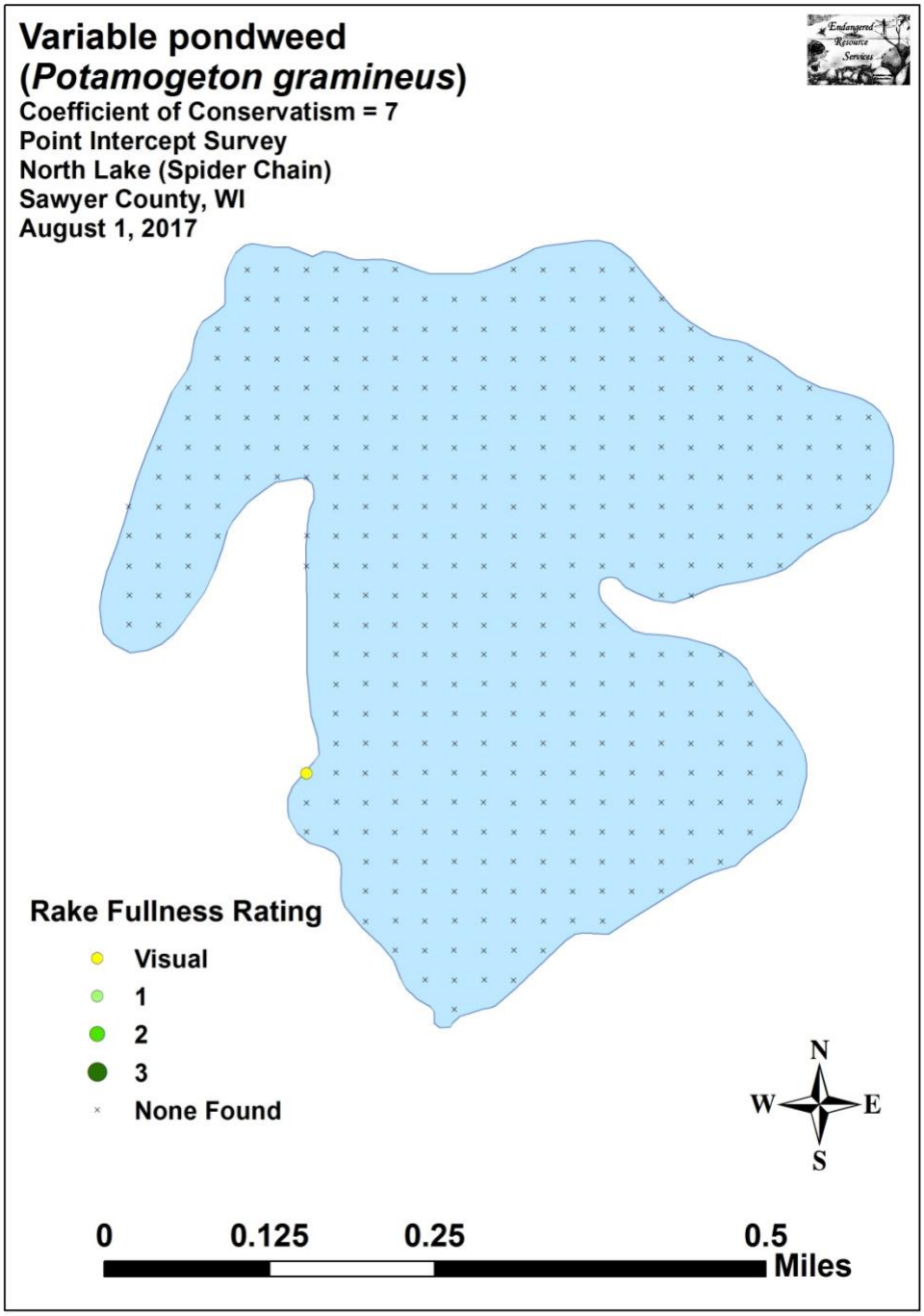
Miles


Variable pondweed
(Potamogeton gramineus)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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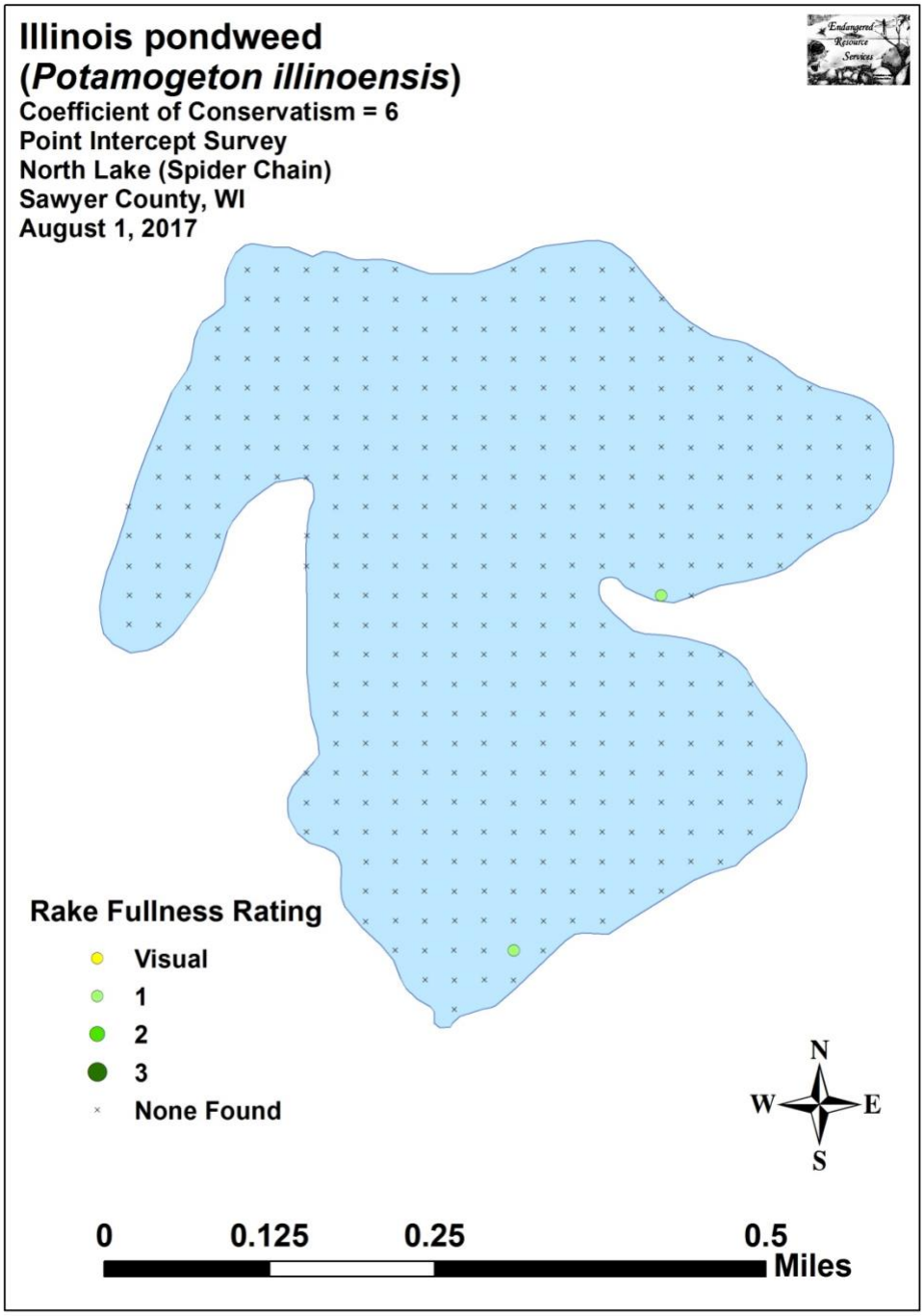
Miles


Illinois pondweed
(Potamogeton illinoensis)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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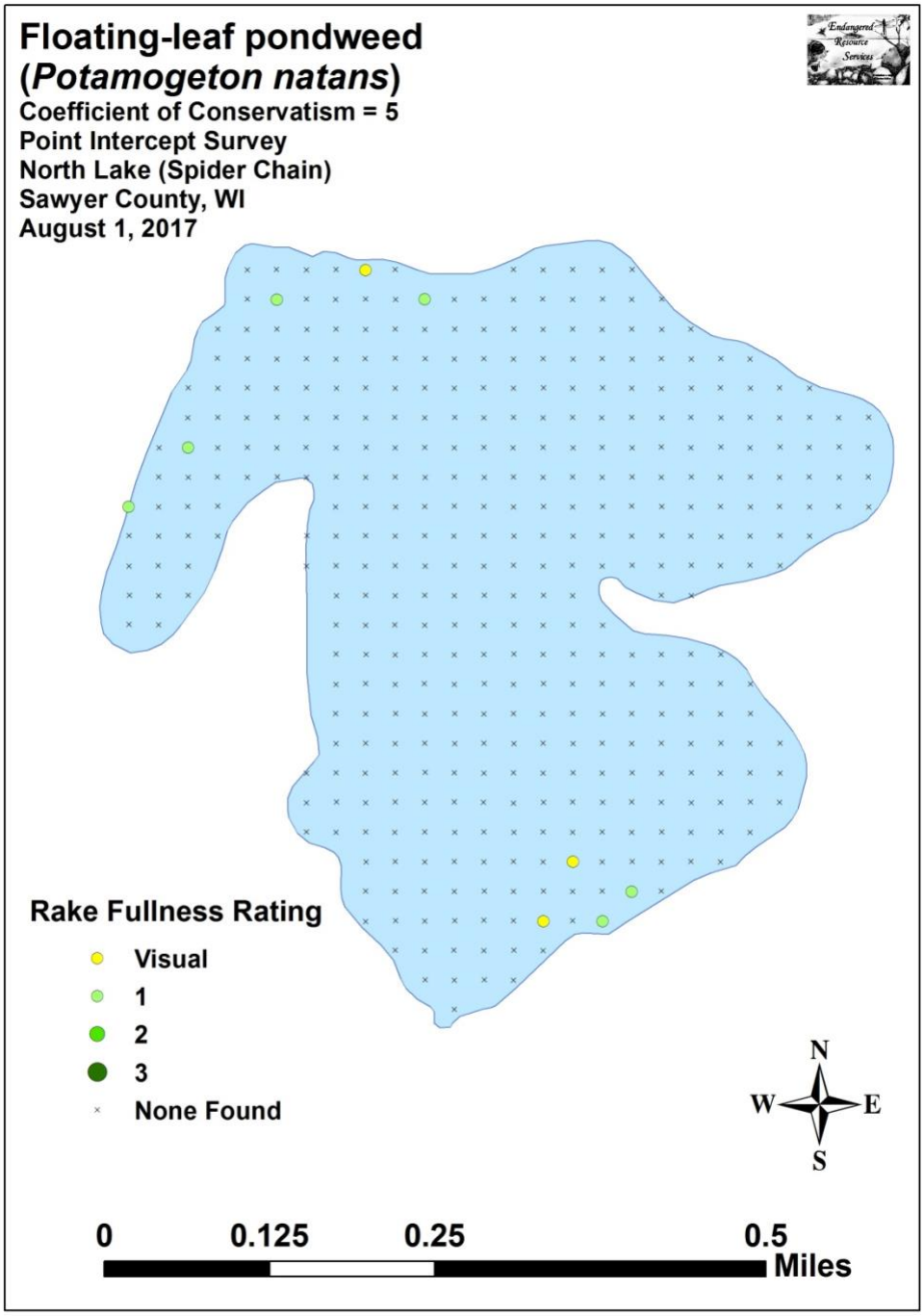
Miles


Floating-leaf pondweed
(Potamogeton natans)
Coefficient of Conservatism = 5
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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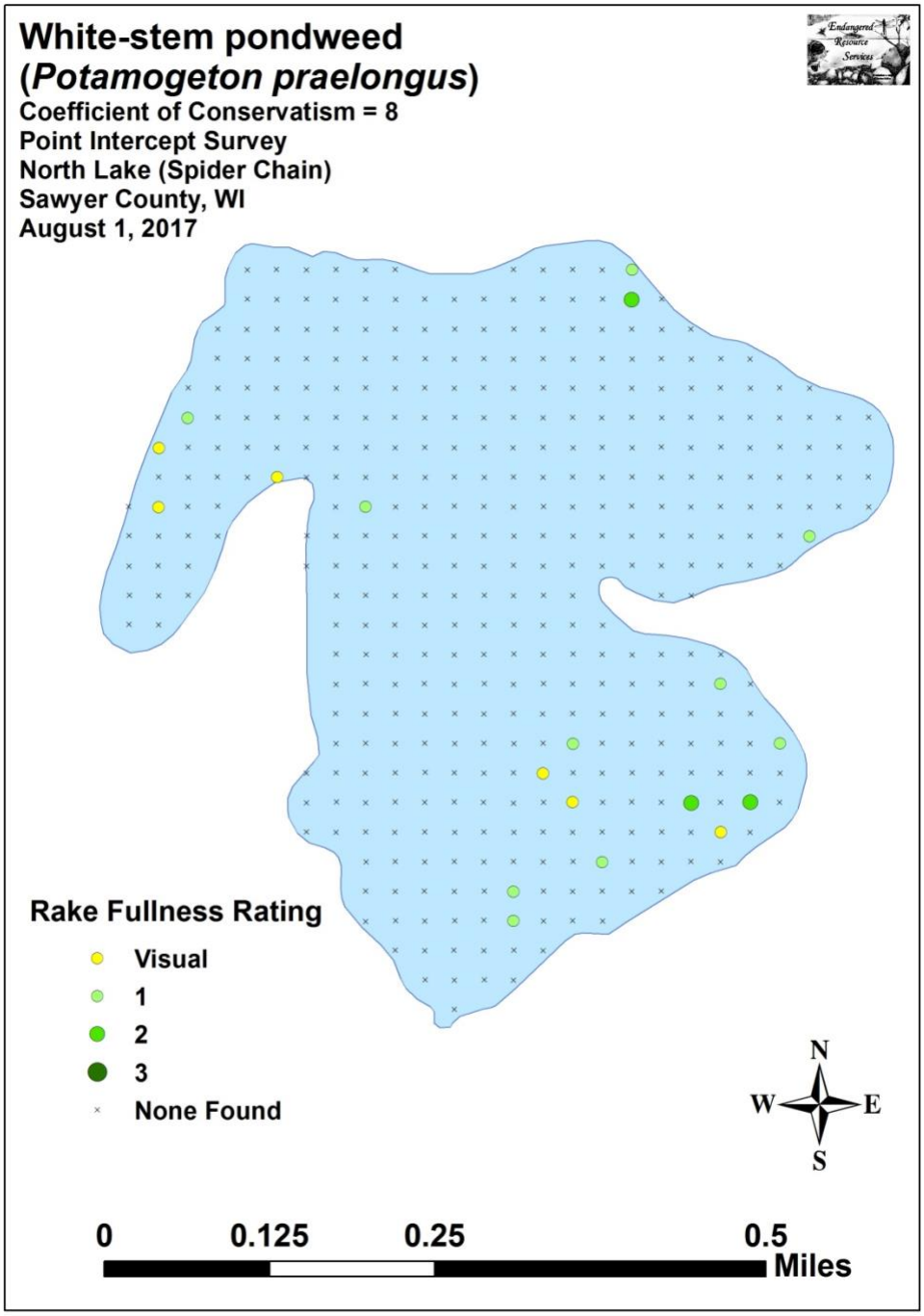
White-stem pondweed
(Potamogeton praelongus)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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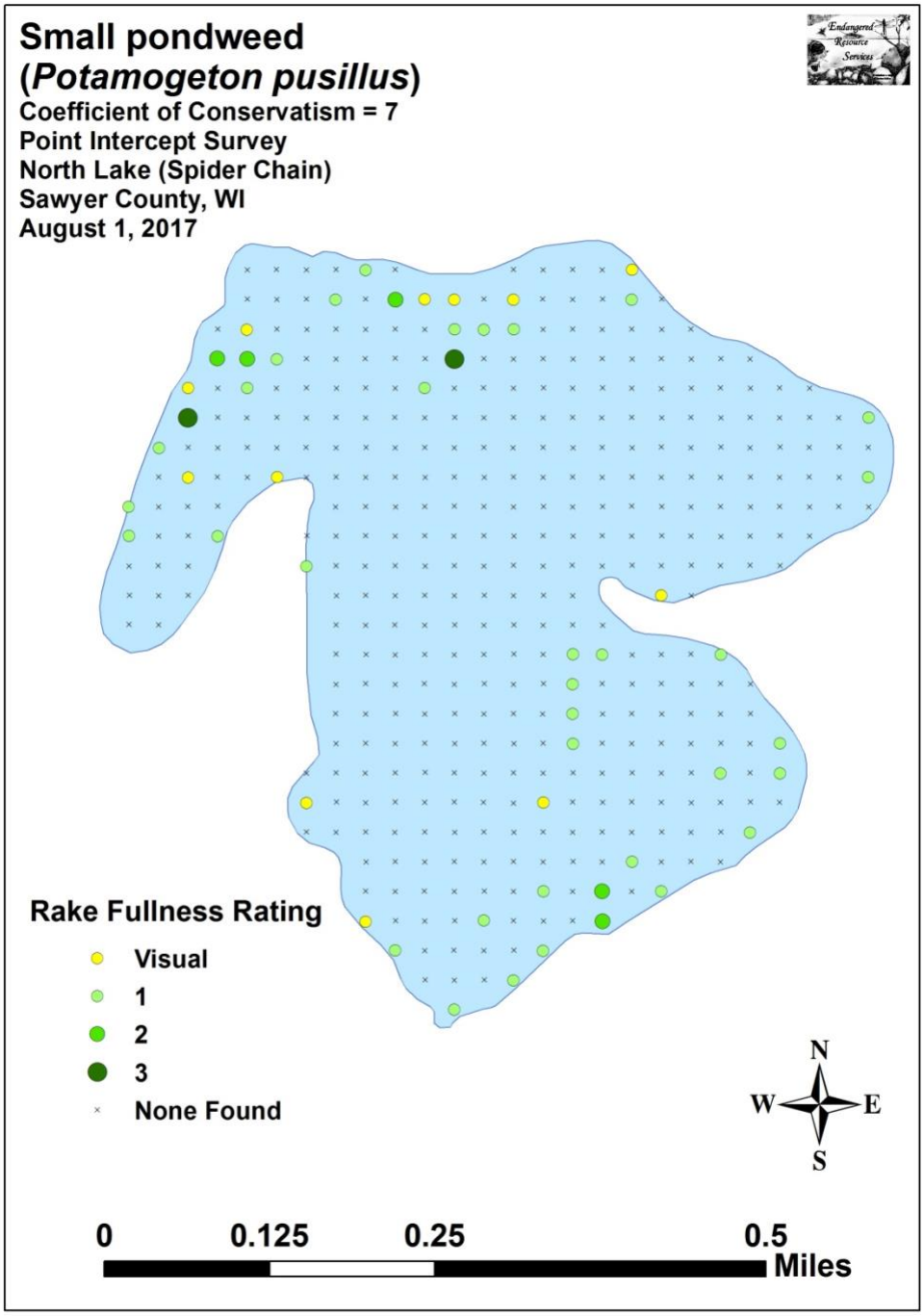
Miles


Small pondweed
(Potamogeton pusillus)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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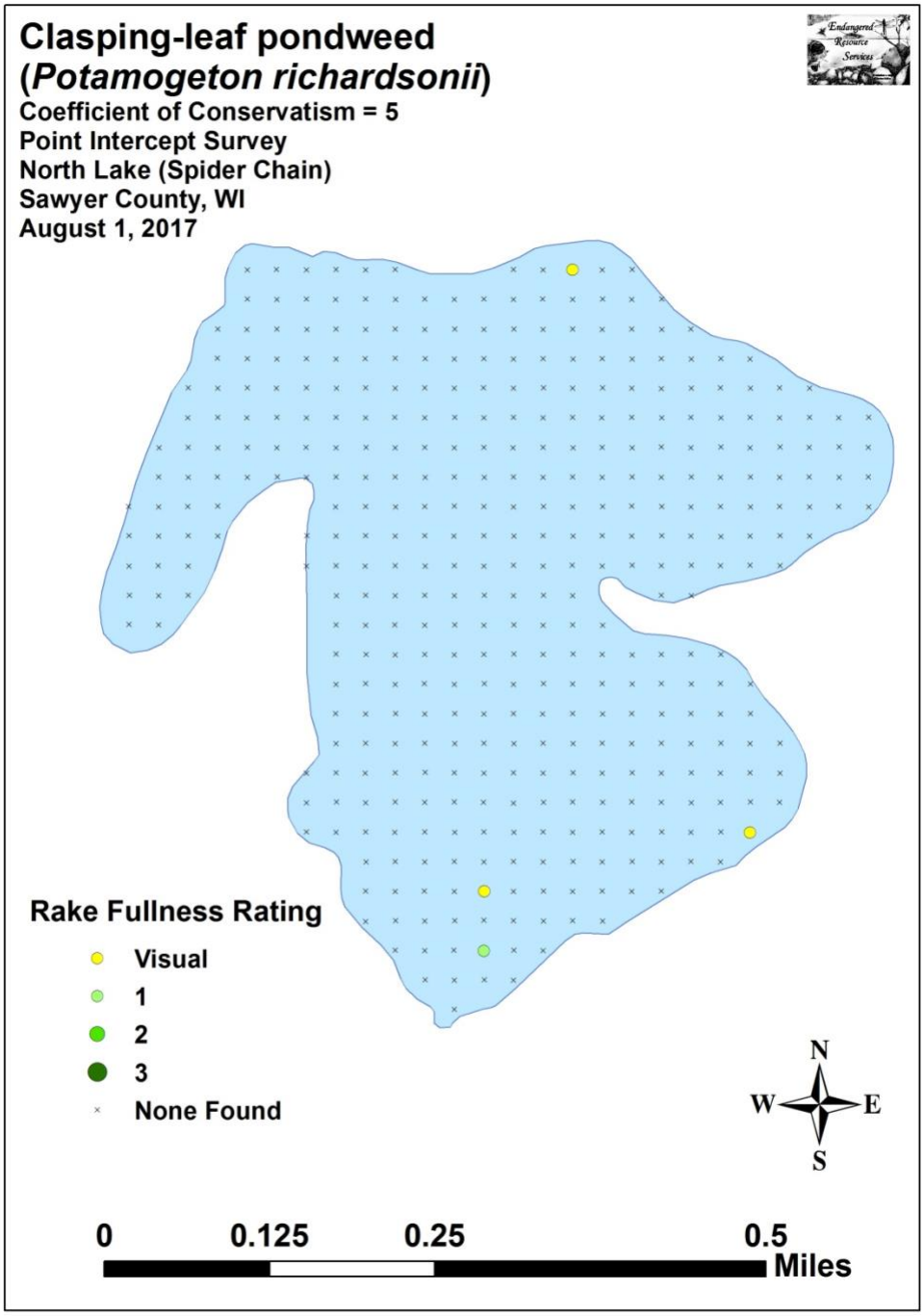
Miles


Clasping-leaf pondweed
(Potamogeton richardsonii)
Coefficient of Conservatism = 5
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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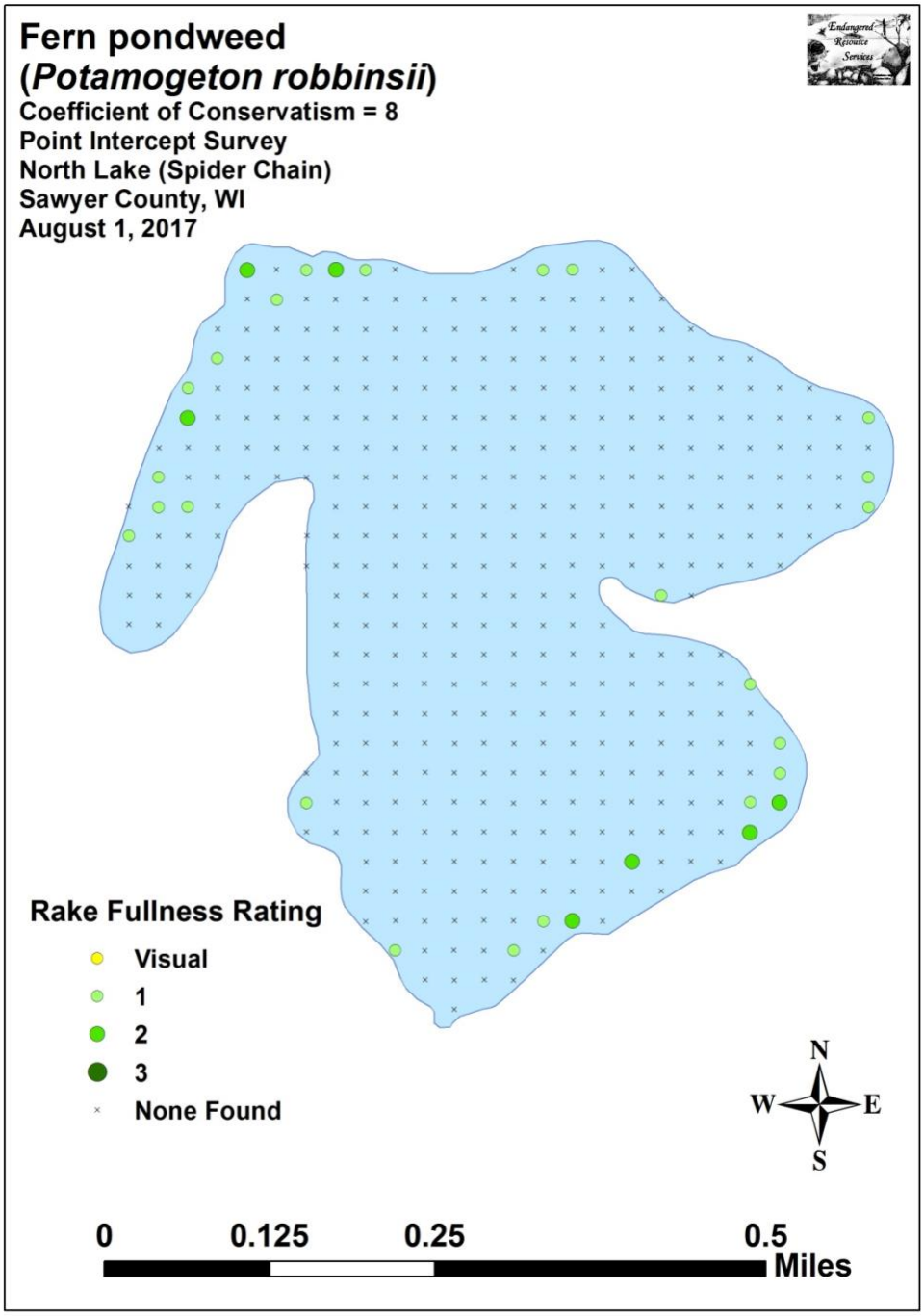
Miles


Fern pondweed
(Potamogeton robbinsii)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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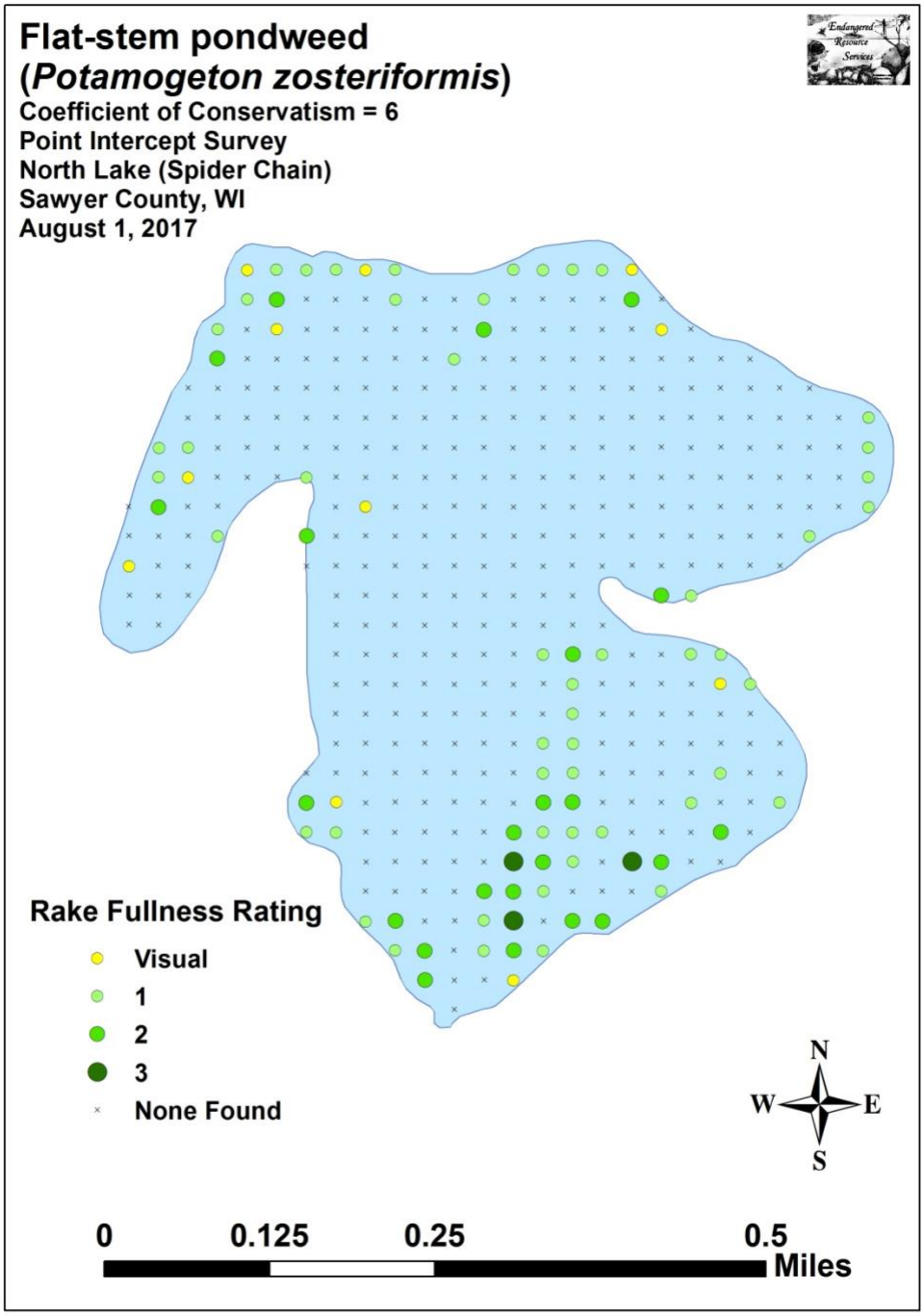
Miles


Flat-stem pondweed
(Potamogeton zosteriformis)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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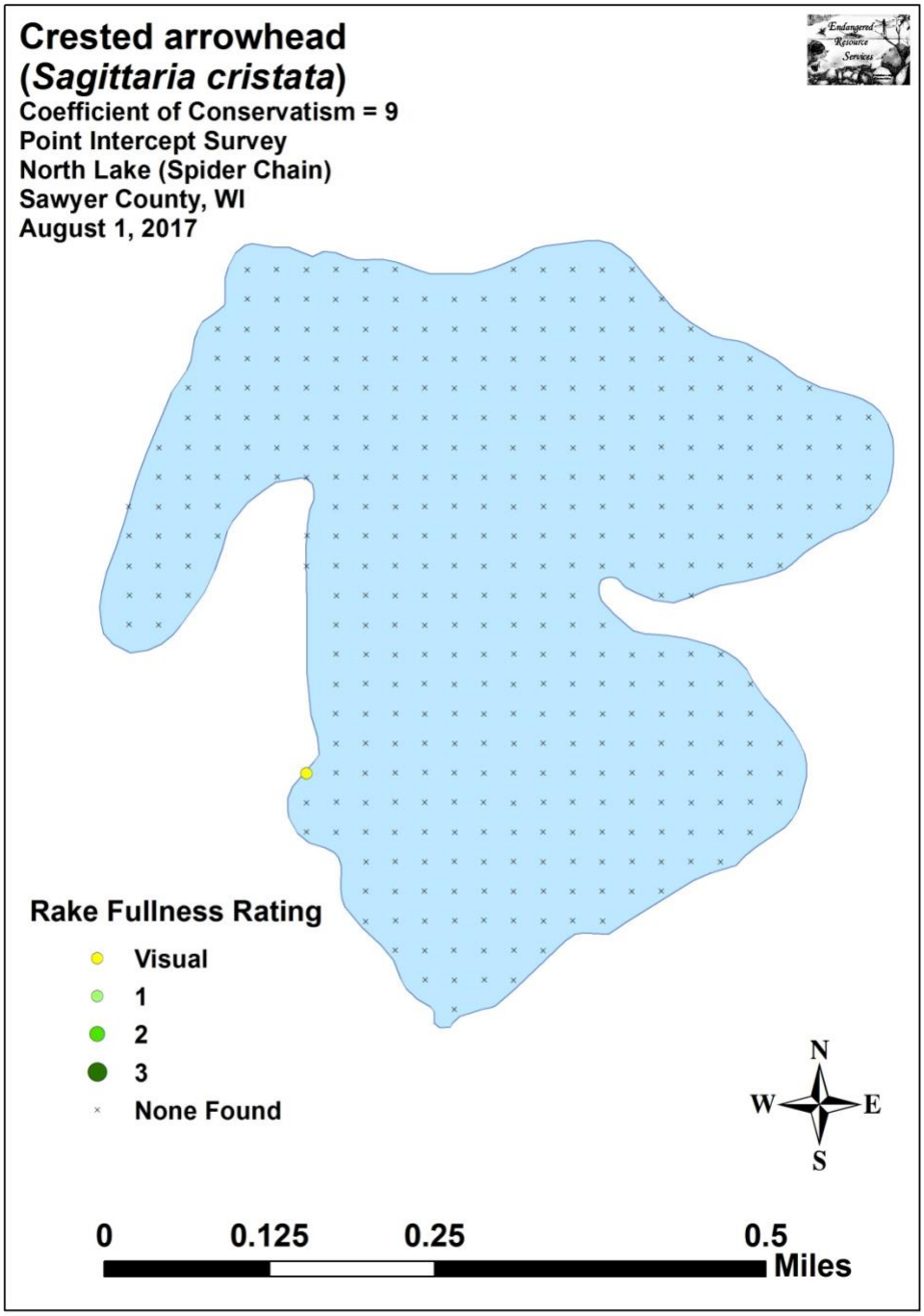
Miles


Crested arrowhead
(Sagittaria cristata)
Coefficient of Conservatism = 9
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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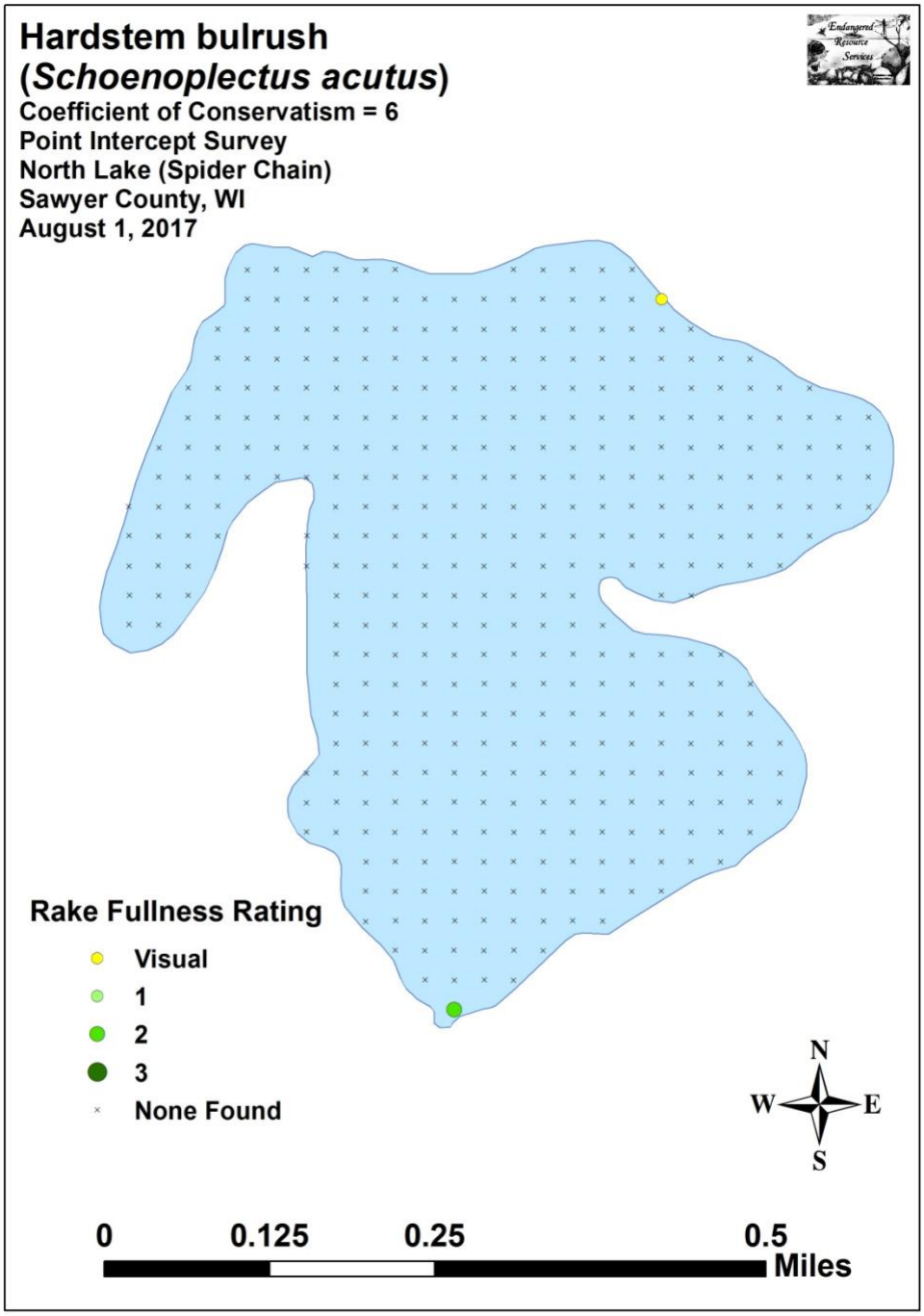
Miles


Hardstem bulrush
(Schoenoplectus acutus)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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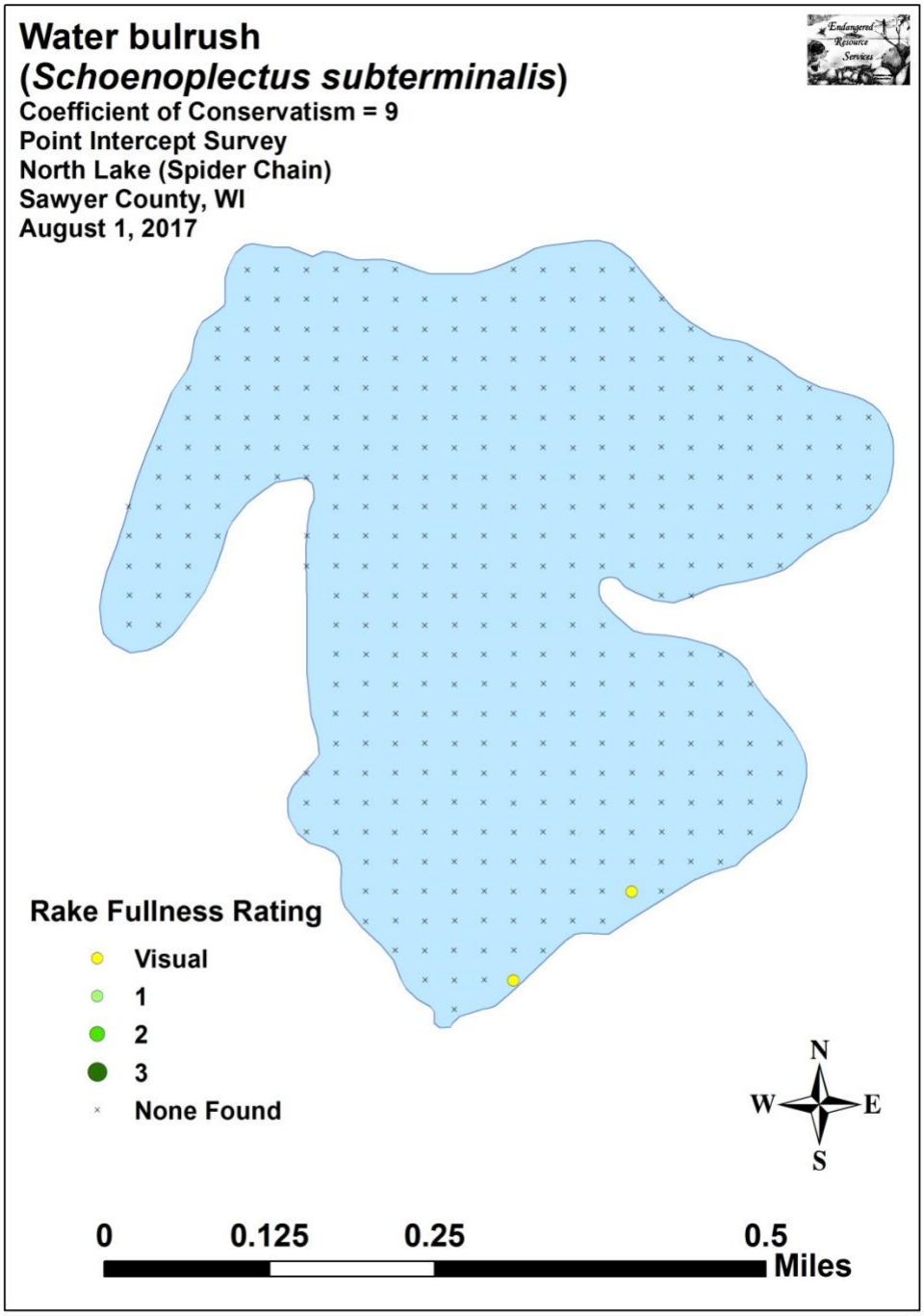
Miles


Water bulrush
(Schoenoplectus subterminalis)
Coefficient of Conservatism = 9
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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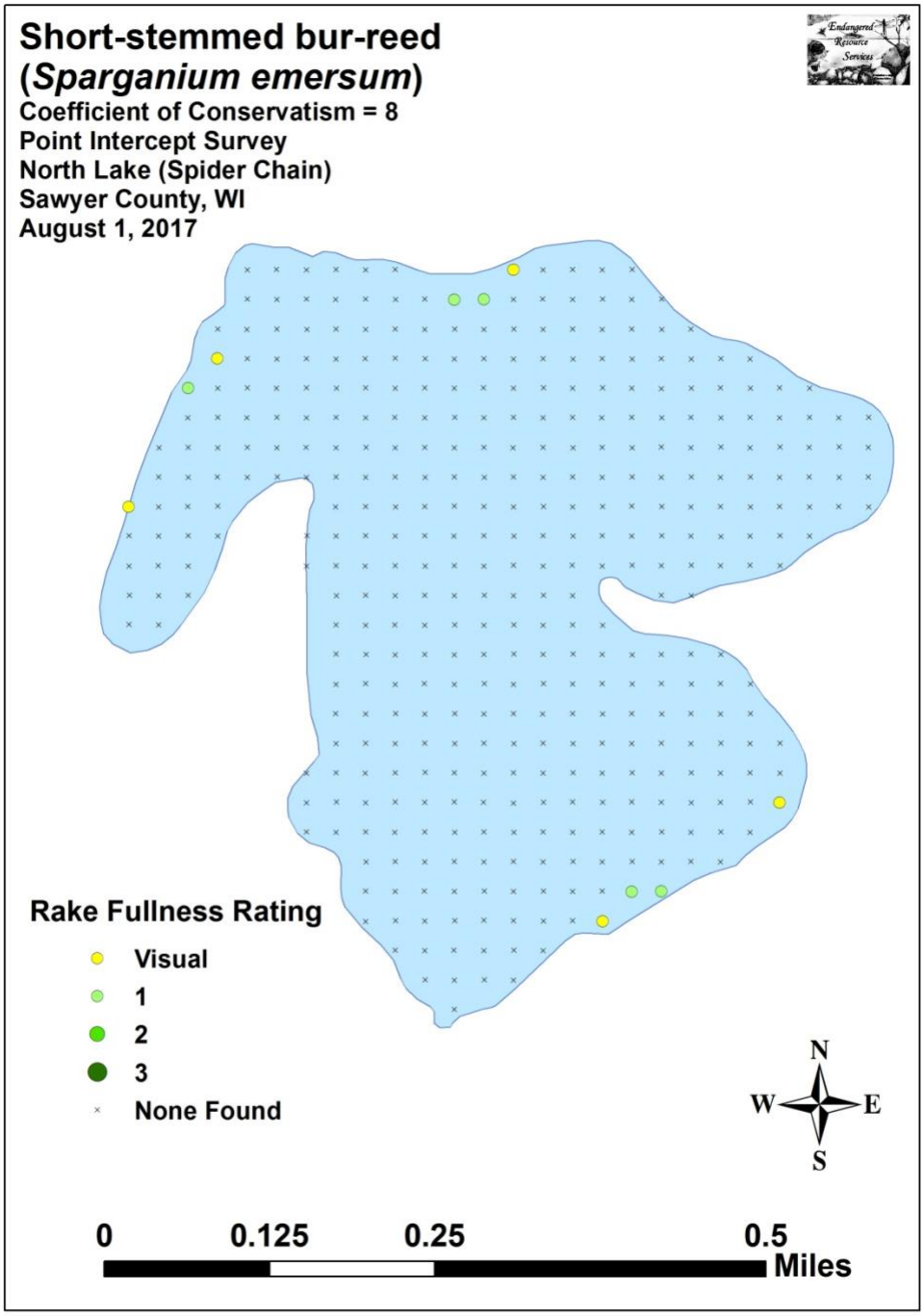
Miles


Short-stemmed bur-reed
(Sparganium emersum)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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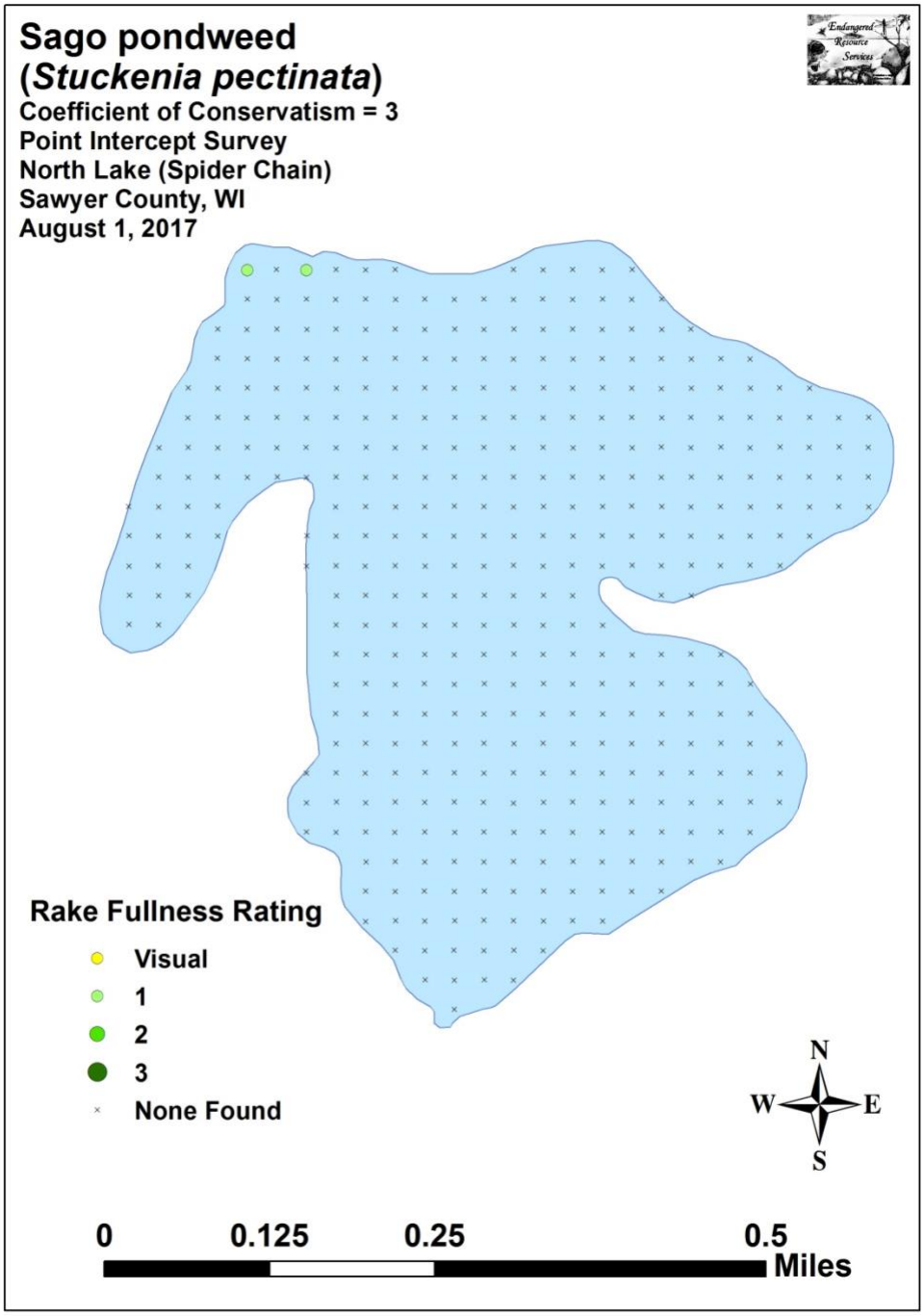
Miles


Sago pondweed
(Stuckenia pectinata)
Coefficient of Conservatism = 3
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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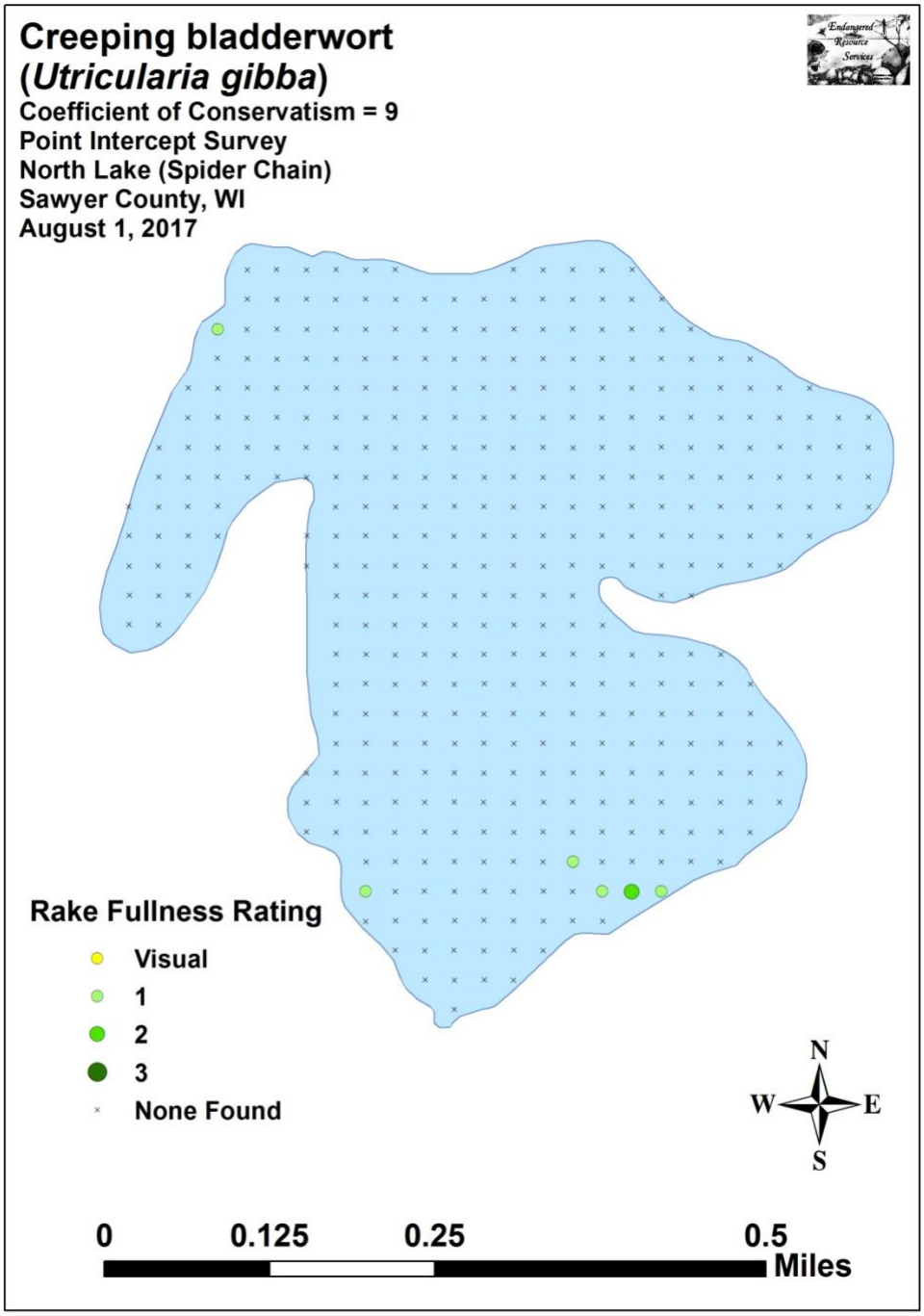
Miles


Creeping bladderwort
(Utricularia gibba)
Coefficient of Conservatism = 9
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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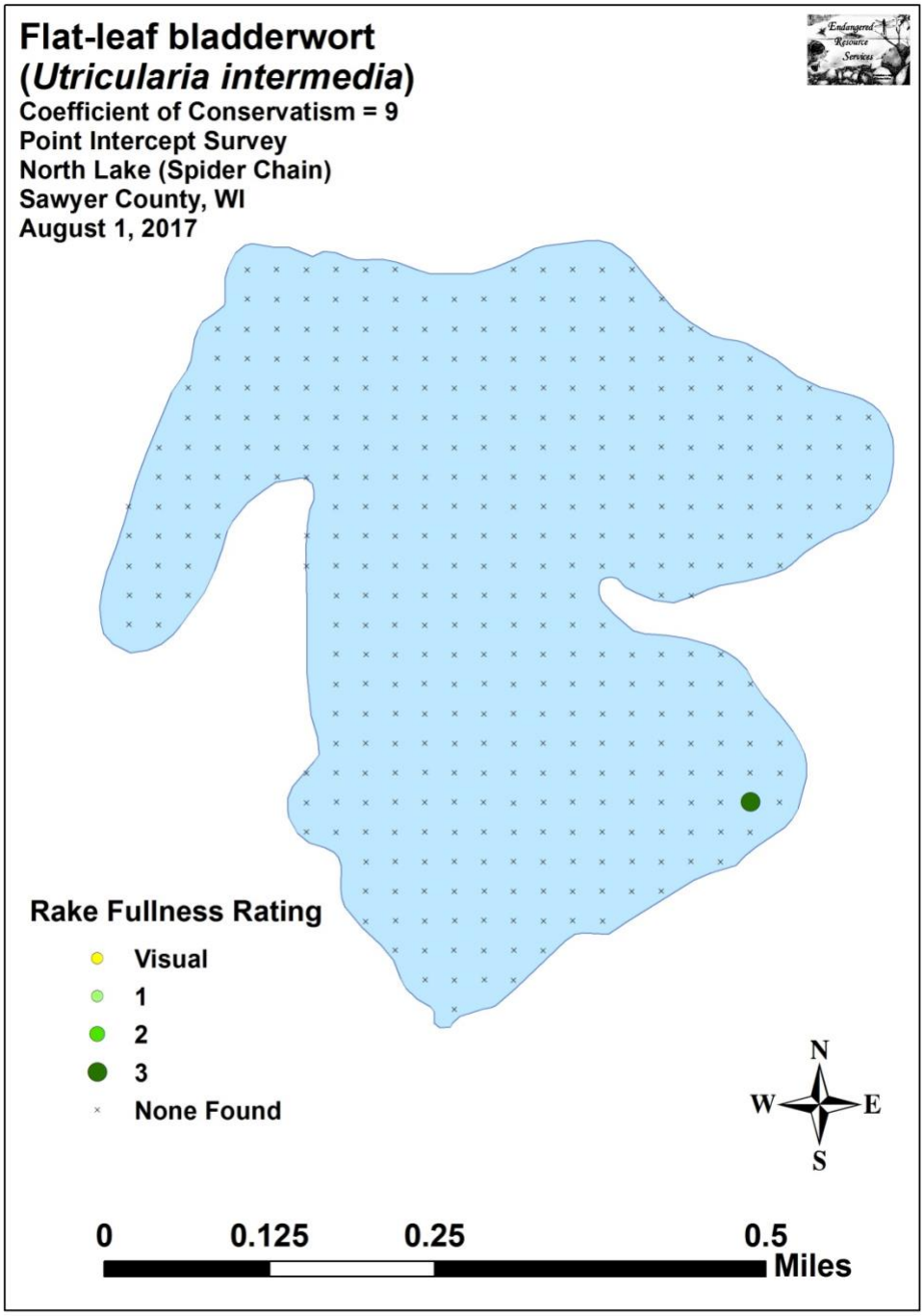
Miles


Flat-leaf bladderwort
(Utricularia intermedia)
Coefficient of Conservatism = 9
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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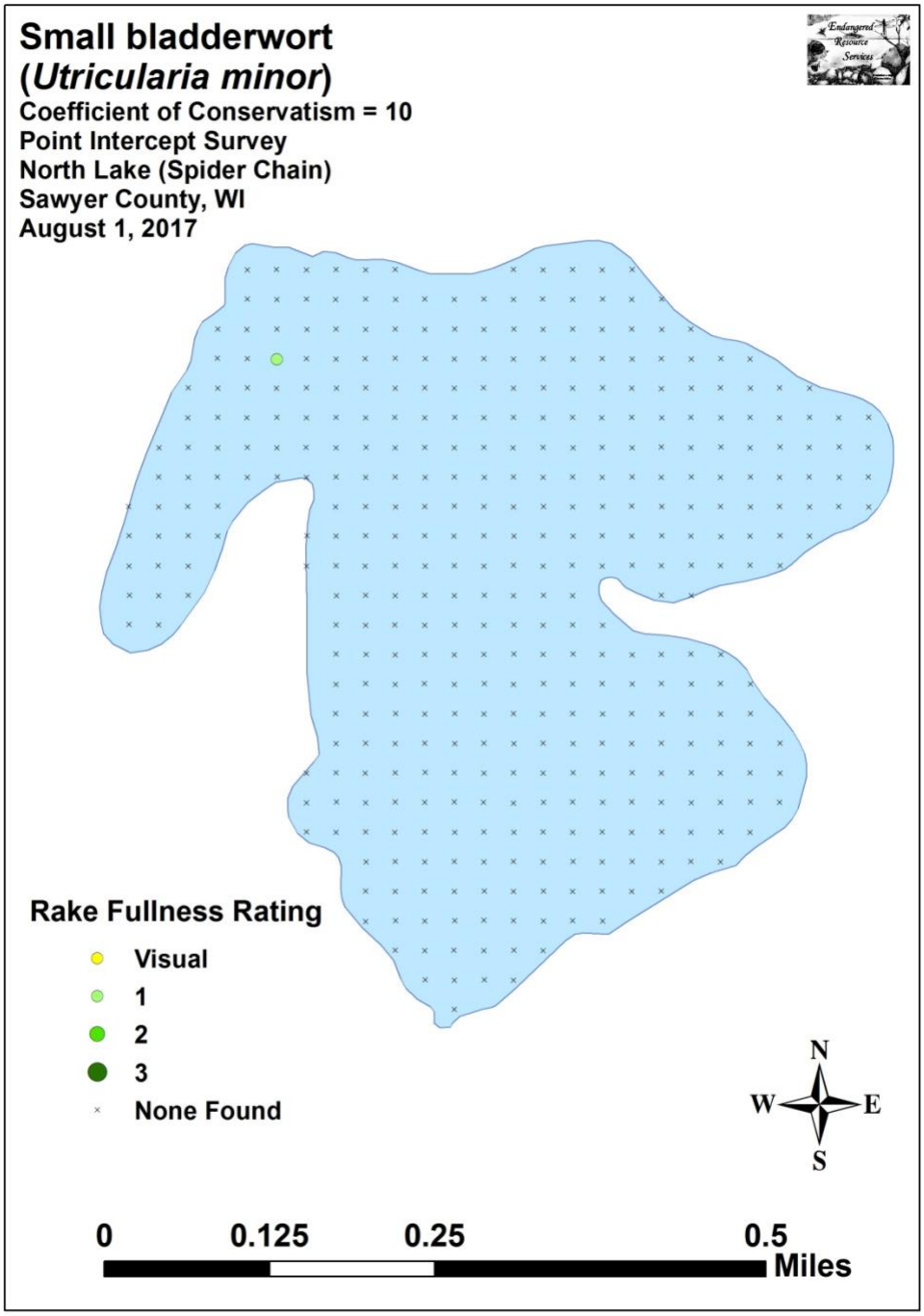
Miles


Small bladderwort
(Utricularia minor)
Coefficient of Conservatism = 10
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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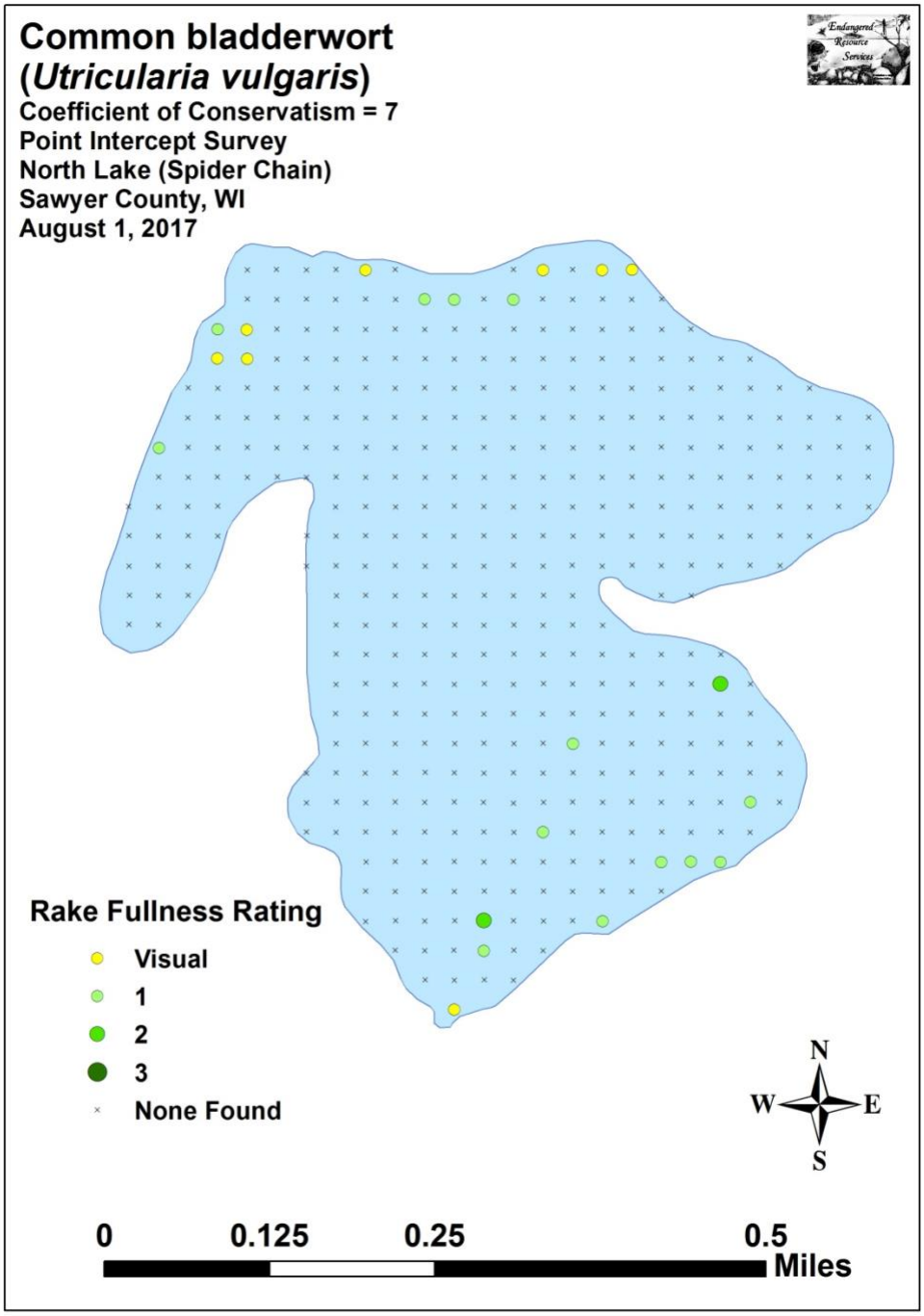
Miles


Common bladderwort
(Utricularia vulgaris)
Coefficient of Conservatism = 7
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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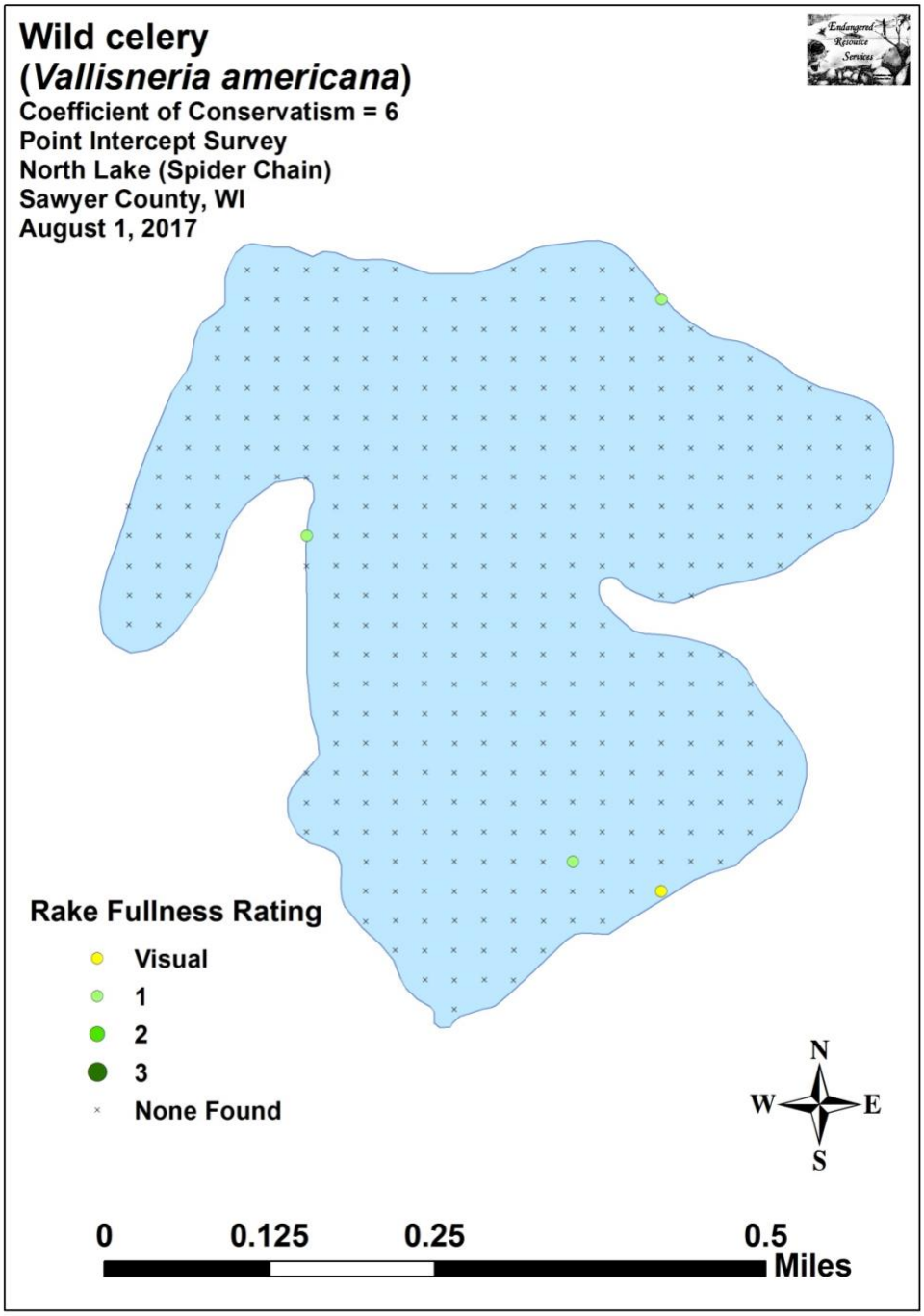
Miles


Wild celery
(Vallisneria americana)
Coefficient of Conservatism = 6
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Rake Fullness Rating
Visual
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None Found
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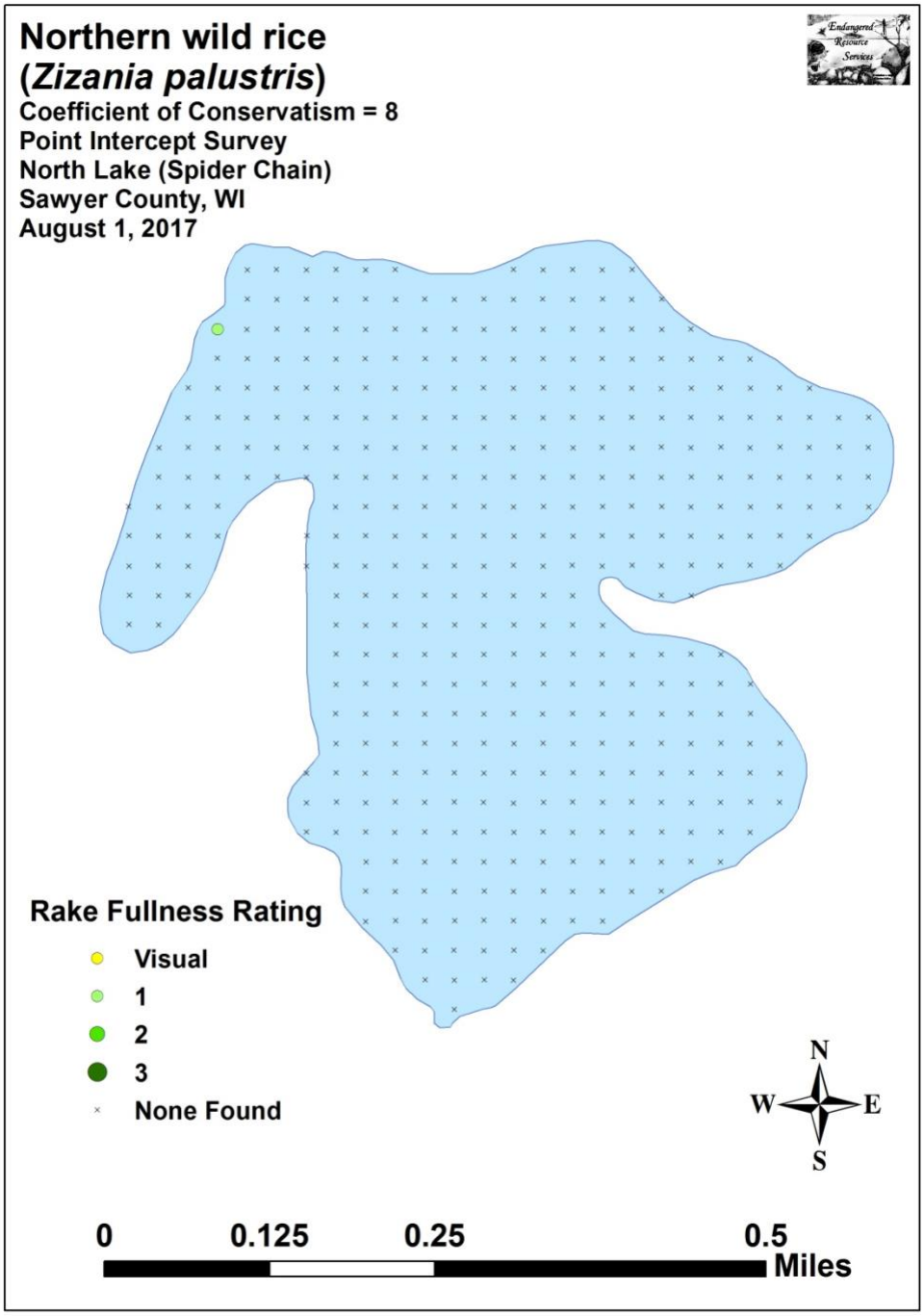
Miles


Northern wild rice
(Zizania palustris)
Coefficient of Conservatism = 8
Point Intercept Survey
North Lake (Spider Chain)
Sawyer County, WI
August 1, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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Appendix IX: Aquatic Exotic Invasive Plant Species Information

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, 2010 http://www.dnr.state.wi.us/invasives/fact/milfoil.htm)

Curly-leaf pondweed

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

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

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

It becomes invasive in some areas because of its tolerance for low light and low water temperatures. These tolerances allow it to get a head start on and out compete native plants in the spring. In mid-summer, when most aquatic plants are growing, curly-leaf pondweed plants are dying off. Plant die-offs may result in a critical loss of dissolved oxygen. Furthermore, the decaying plants can increase nutrients which contribute to algal blooms, as well as create unpleasant stinking messes on beaches. Curly-leaf pondweed forms surface mats that interfere with aquatic recreation. (Taken in its entirety from WDNR, 2010 http://www.dnr.state.wi.us/invasives/fact/curlyleaf_pondweed.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, 2010 http://www.dnr.state.wi.us/invasives/fact/reed_canary.htm)

Purple loosestrife
(Photo Courtesy Brian M. Collins)

DESCRIPTION: Purple loosestrife is a perennial herb 3-7 feet tall with a dense bushy growth of 1-50 stems. The stems, which range from green to purple, die back each year. Showy flowers vary from purple to magenta, possess 5-6 petals aggregated into numerous long spikes, and bloom from 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, 2010 http://www.dnr.state.wi.us/invasives/fact/loosestrife.htm)

Appendix X: 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 XI: 2017 Raw Data Spreadsheets