Cold-water Aquatic Invasive Species Shoreline Survey and Warm-water Point-intercept Macrophyte Survey
Little Sissabagama Lake - WBIC: 2394100
Sawyer County, Wisconsin

Little Sissabagama aerial photo (2015)

White water lily bed - Little Sissabagama Lake – 8/8/22

Project Initiated by:

Little Sissabagama Lake Shoreowners Association and the
Wisconsin Department of Natural Resources

Typical rake of Fern pondweed – the dominant species in the lake

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June 16 and August 8, 2022

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ABSTRACT

Little Sissabagama Lake (WBIC 2394100) is a 308-acre stratified seepage lake in southwest Sawyer County, WI. The lake is mesotrophic in nature with Secchi readings averaging 10.9ft from 1986-2022. A desire to determine if exotic species such as Curly-leaf pondweed (*Potamogeton crispus*) (CLP) or Eurasian water-milfoil (*Myriophyllum spicatum*) (EWM) had invaded the lake; and to establish baseline data on the richness, diversity, abundance, and distribution of other native aquatic plant populations prompted members of the Little Sissabagama Lake Shoreowners Association (LSLSA) and the Wisconsin Department of Natural Resources (WDNR) to authorize a meandering cold-water Aquatic Invasive Species (AIS) shoreline survey on June 16, 2022, and a warm-water point-intercept survey of all aquatic plants on August 8, 2022. The spring survey found no evidence of CLP or EWM in the lake. In August, we found macrophytes growing at 455 of 989 survey points. This extrapolated to 46.0% of the total lake bottom and 82.7% of the 17.5ft littoral zone. Overall diversity was very high with a Simpson Index value of 0.89. Richness was also moderately high with 44 species found in the rake. This total increased to 51 species when including visuals and plants found during the boat survey. Several of these species were uncommon to rare in Wisconsin, highly localized along undeveloped shorelines, and known to be sensitive to habitat modification making them potentially vulnerable to future shoreline development. Localized richness was moderate as we calculated a mean native species at sites with native vegetation of 2.25 species/site. We found the biomass at sites with vegetation was a moderately high mean total rake fullness of 2.20. Fern pondweed (*Potamogeton robbinsii*), Watershield (*Brasenia schreberi*), White water lily (*Nymphaea odorata*), and Large purple bladderwort (*Utricularia purpurea*) were the most widely-distributed macrophyte species. They were present at 60.22%, 27.03%, 21.32%, and 12.31% of sites with vegetation; and, collectively, they accounted for 53.76% of the total relative frequency. The 41 native index species found in the rake during the point-intercept survey produced a mean Coefficient of Conservatism of 7.4 and a Floristic Quality Index of 47.5. When compared to other lakes in the Northern Lakes and Forest Ecoregion, both of these values were much higher than the average mean C of 6.7 and the median FQI of 24.3. Filamentous algae were present at nine points with a mean rake fullness of 1.33, and most of these points were concentrated in the northeast bays where there were obvious sediment inflows from roadside culverts and steep hillsides. We found no evidence of any exotic plant species in or adjacent to the lake. Future management considerations include preserving the lake's high quality and sensitive native plant communities; working to maintain water clarity and limit nutrient inputs along the lakeshore by such things as establishing buffer strips of native vegetation, eliminating fertilizer applications, bagging grass clippings, removing pet waste, disposing of fire pit ash away from the lake, maintaining septic systems, and avoiding motor startups in shallow water; identifying and mitigating the sources of erosion in the northeast bays; considering adding a secondary sign at the landing to warn about Aquatic Invasive Species (AIS); conducting monthly monitoring at the boat landing and/or at least annual lake-wide meandering littoral zone surveys to look for AIS; and developing an Aquatic Plant Management Plan that clarifies a response if a new AIS is introduced into the lake.

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INTRODUCTION:

Little Sissabagama Lake (WBIC 2394100) is a 308-acre stratified seepage lake in southwest Sawyer County, Wisconsin in the Towns of Sand Lake and Edgewater (T38N R9W S17-20). It reaches a maximum depth of 75ft in the central basin southeast of the lake's biggest island and has an average depth of approximately 20ft. The lake is mesotrophic in nature with summer Secchi readings averaging 10.9ft from 1986-2022 (WDNR 2022). This good clarity produced a littoral zone that extended to 17.5ft in 2022. The bottom is dominated by sand and gravel with the only pure muck substrates occurring in sheltered side bays (Hopke et al. 1963) (Figure 1).

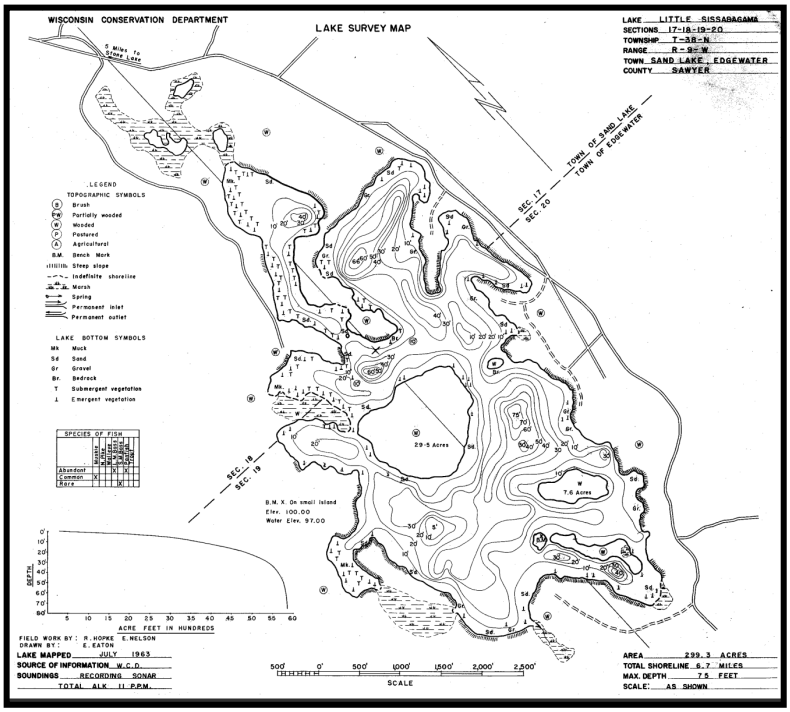


Figure 1: Little Sissabagama Lake Bathymetric Map

BACKGROUND AND STUDY RATIONALE:

The Little Sissabagama Lake Shoreowners Association (LSLSA) and the Wisconsin Department of Natural Resources (WDNR) authorized a meandering cold-water Aquatic Invasive Species (AIS) shoreline survey on June 16, 2022, and a warm-water point-intercept survey of all aquatic plants on August 8, 2022. The August survey used the WDNR's statewide guidelines for conducting systematic point-intercept macrophyte sampling. These methods ensure that all sampling in the state will be conducted in the same manner thus allowing data to be compared across time and space. The immediate goals of the spring survey were to determine if any exotic species such as Curly-leaf pondweed (*Potamogeton crispus*) (CLP) or Eurasian water-milfoil (*Myriophyllum spicatum*) (EWM) had invaded the lake, while the August survey was used to established data on the richness, diversity, abundance, distribution, and density of native aquatic plant populations. These data provide a baseline for long-term monitoring of the lake's macrophyte community as well as a way to measure any impacts on the lake's plants if an exotic species is introduced or active management occurs in the future.

METHODS:

Cold-water Meandering AIS Shoreline Survey:

During the June survey, we searched the visible littoral zone along the lake's entire shoreline. We paid special attention to the areas around docks as this is where Eurasian water-milfoil brought in on props is most likely to establish. We also focused on the sand to sandy muck transition in the 8-12ft bathymetric ring as this is the habitat most likely to support Curly-leaf pondweed.

Warm-water Full Point-intercept Macrophyte Survey:

Prior to beginning the August point-intercept survey, we conducted a general boat survey to gain familiarity with the lake's macrophytes. All plants found were identified (Voss 1996, Boreman et al. 1997; Chadde 2012; Crow and Hellquist 2005; Skawinski 2019), a datasheet was built from the species present, and two vouchers were collected to be pressed and mounted for herbarium specimens – one to be retained by the lake association, and one to be sent to the state herbarium the University of Wisconsin - Stevens Point for identification confirmation (Appendix I).

Using a standard formula that takes into account the shoreline shape and distance, islands, water clarity, depth, and total acreage, Michelle Nault (WDNR) generated a 990-point sampling grid for Little Sissabagama Lake (Appendix II). Using this grid, we completed a density survey where we sampled for plants at each point in and adjacent to the lake's littoral zone. We located each survey point using a handheld mapping GPS unit (Garmin 76CSx) and used a rake to sample an approximately 2.5ft section of the bottom. 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, and a depth reading was taken using a metered pole or handheld sonar.

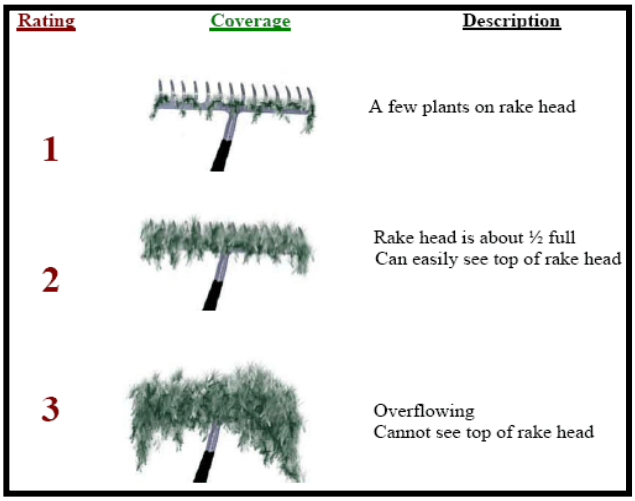


Figure 2: Rake Fullness Ratings (UWEX 2010)

DATA ANALYSIS:

We entered all data collected into the standard WDNR aquatic plant management spreadsheet (Appendix I) (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 or kayak.

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. Although 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 WDNR 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 (Table 2).

Relative frequency example:

Suppose that we sample 100 points and found four 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 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. Little Sissabagama Lake is in the Northern Lakes and Forests Ecoregion (Table 3).

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

RESULTS:

Cold-water Meandering AIS Shoreline Survey:

On June 16th, we surveyed transects covering 13.8km (8.6 miles) along the entire shoreline of the lake (Figure 3). We saw no evidence of Eurasian water-milfoil, Curly-leaf pondweed, Yellow iris (*Iris pseudacorus*), or any other exotic species.

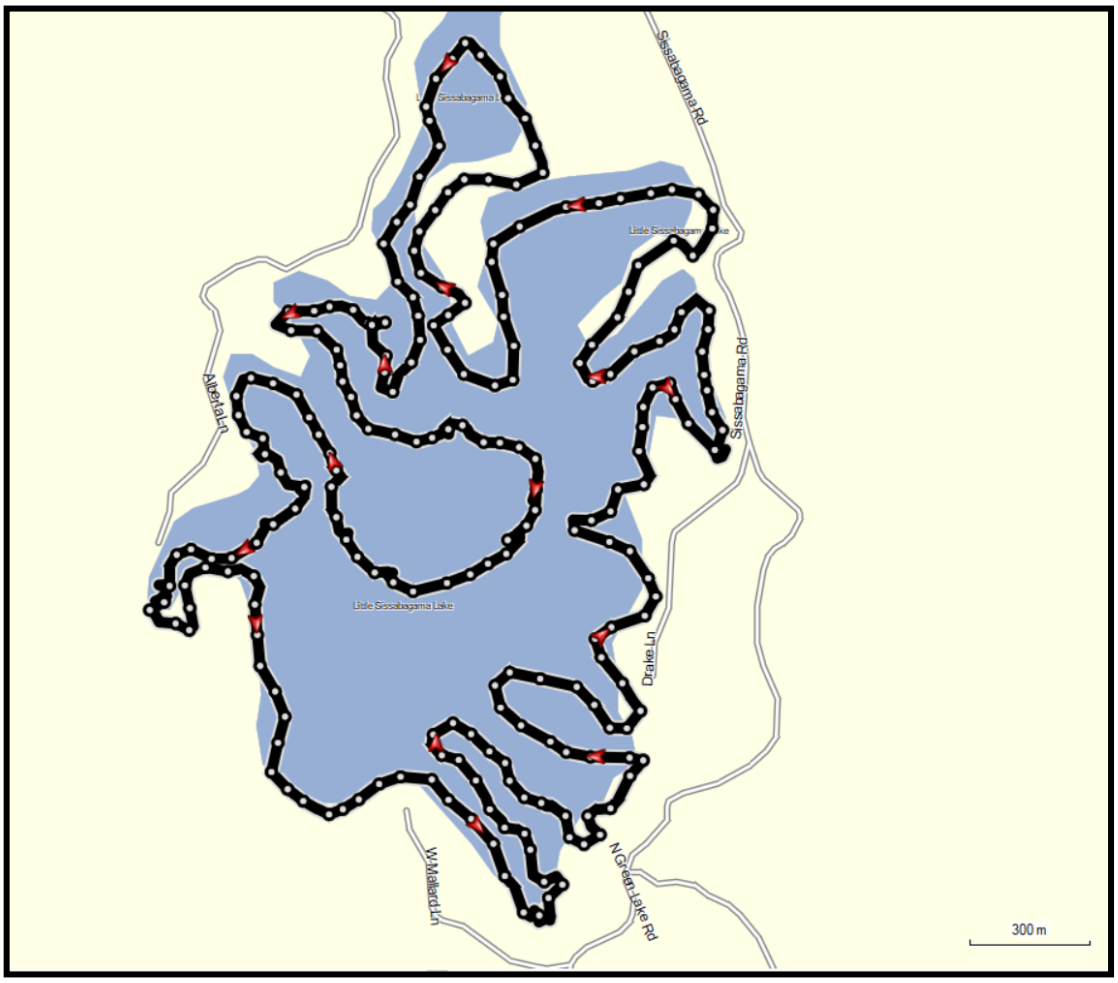


Figure 3: June 16, 2022 AIS Shoreline Survey Transects

Warm-water Full Point-intercept Macrophyte Survey:

Depth readings taken at Little Sissabagama Lake's 989 survey points – one point was terrestrial – (Appendix II) revealed a varied underwater topography (Figure 4). Sunken islands, bars, and saddles are scattered throughout, and they often occur at the entrances to the lake's numerous side bays most of which have their own deep hole. Other notable features included the north bay's relatively shallow entrance channel west of the northern isthmus, narrow deepwater trenches between the southern islands, and four separate deep holes that pockmark the southern main basin (Appendix III).

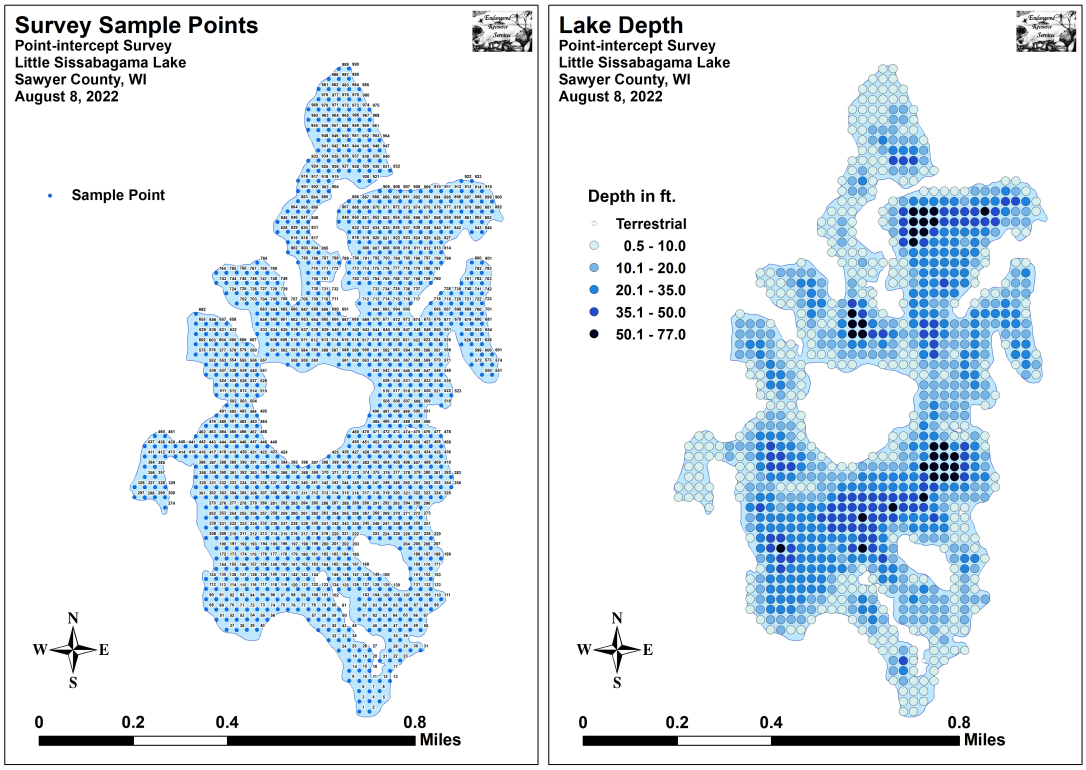


Figure 4: Survey Sample Points and Lake Depth

Of the 569 points where we could determine the bottom substrate, we categorized 56.9% as sandy or organic muck (324 points), 30.1% as pure sand (171 points), and 13.0% as rock (74 points) (Figure 5) (Appendix III). The majority of areas along the immediate shoreline were pure sand or a mix of sand and gravel. With increasing depth, most areas tended to have a very thin layer of soft sandy muck over a pure sand base; however, we didn't classify these points as muck unless it was obviously more than a few inches thick.

We found plants growing at 455 points (Table 1). This extrapolated to 46.0% of the total lake bottom and 82.7% of the 17.5ft littoral zone (Figure 5) (Appendix IV). Overall plant colonization was evenly distributed throughout this zone as both the mean and median depths of growth were 7.5ft (Figure 6).

Table 1: Aquatic Macrophyte P/I Survey Summary Statistics
Little Sissabagama Lake – Sawyer County, Wisconsin
August 8, 2022

Summary Statistics:

Total number of points sampled	989
Total number of sites with vegetation	455
Total number of sites shallower than the maximum depth of plants	550
Frequency of occurrence at sites shallower than maximum depth of plants	82.7
Simpson Diversity Index	0.89
Number of sites sampled using rake on Rope (R)	0
Number of sites sampled using rake on Pole (P)	569
Maximum depth of plants (ft)	17.5
Mean depth of plants (ft)	7.5
Median depth of plants (ft)	7.5
Average number of all species per site (shallower than max depth)	1.86
Average number of all species per site (veg. sites only)	2.25
Average number of native species per site (shallower than max depth)	1.86
Average number of native species per site (sites with native veg. only)	2.25
Species richness	44
Species richness (including visuals)	49
Species richness (including visuals and boat survey)	51
Mean total rake fullness (veg. sites only)	2.20

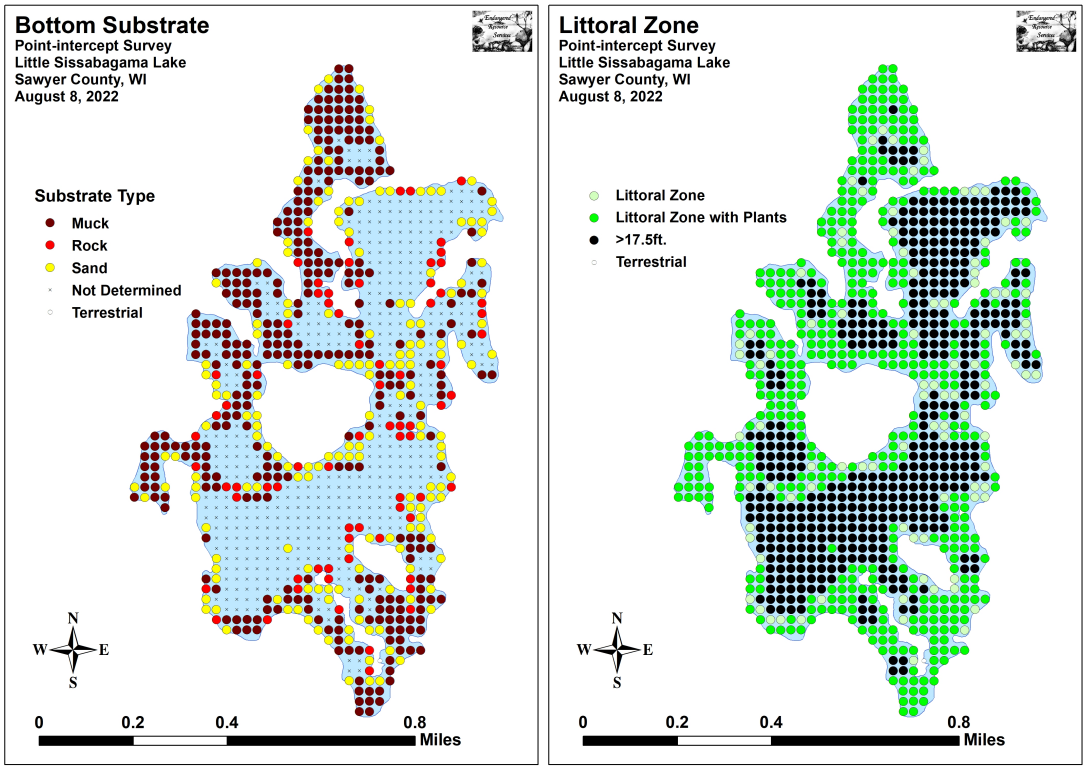


Figure 5: Bottom Substrate and Littoral Zone

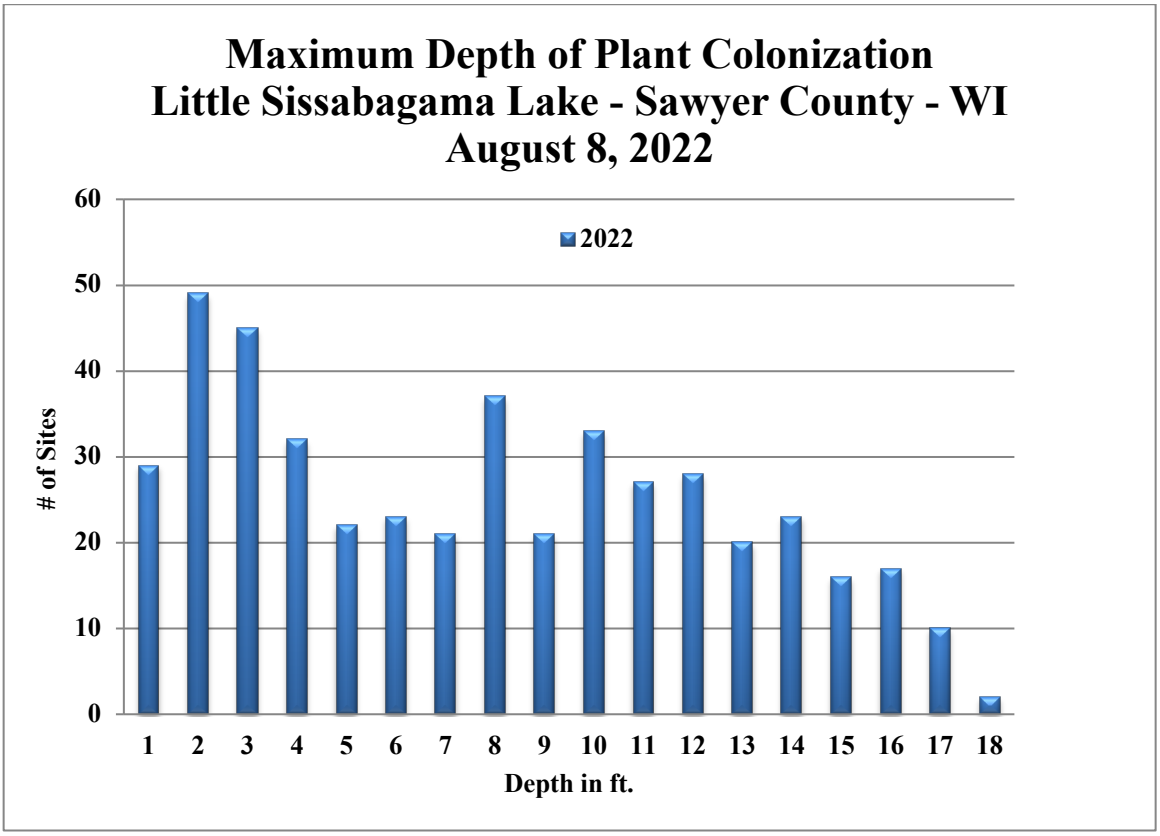


Figure 6: Plant Colonization Depth Chart

Plant diversity was very high with a Simpson Index value of 0.89. Richness was also moderately high with 44 species found in the rake. This total increased to 51 species when including visuals and plants seen during the boat survey. We noted that several of these species are uncommon to rare in Wisconsin, highly localized along undeveloped shorelines, and known to be sensitive to habitat modification. Because of this, they are potentially vulnerable to future shoreline development.

Localized richness was moderate as we calculated a mean native species at sites with native vegetation of 2.25 species/site. We noted that most high richness areas were nearshore, and we found that few deepwater sites had more than two species present (Figure 7) (Appendix IV).

We determined the biomass at sites with vegetation was a moderately high mean total rake fullness of 2.20. Visual analysis of the map showed most nearshore areas had dense plant growth, while most areas over 10ft had moderate to low plant densities (Figure 7) (Appendix IV).

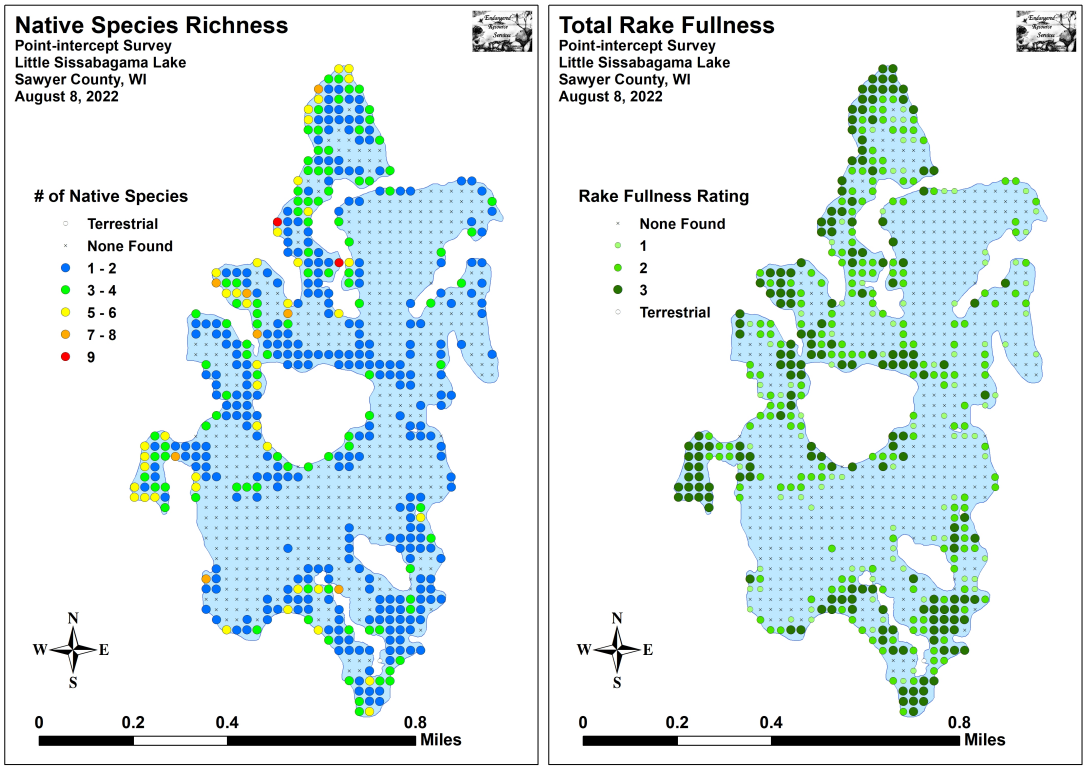


Figure 7: Native Species Richness and Total Rake Fullness

Little Sissabagama Lake Plant Community:

The Little Sissabagama Lake ecosystem is home to a rich and diverse plant community that includes many species that are regionally uncommon to rare. This community can be subdivided into four distinct zones (emergent, shallow submergent, floating-leaf, and deep submergent) with each zone having its own characteristic functions in the aquatic ecosystem. Depending on the local bottom type (rock, sand, nutrient-poor sandy muck, or nutrient-rich organic muck), these zones often had somewhat different species present.

In shallow areas, beds of emergent plants prevent erosion by stabilizing the shoreline, 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.

At the immediate shoreline, Fringed sedge (*Carex crinita*) was common around undeveloped edges of the lake. In this environment, we also found scattered patches of Northern blue flag (*Iris versicolor*), Common rush (*Juncus effusus*), and Broad-leaved cattail (*Typha latifolia*).

Fringed sedge (Patterson 2022)

Northern blue flag (Tracey 2007)

Common rush (Eggers 2008)

Broad-leaved cattail (Raymond 2011)

Along rocky shorelines and over shallow gravel flats, the emergent community was dominated by Creeping spikerush (*Eleocharis palustris*). Rarely, we also found Softstem bulrush (*Schoenoplectus tabernaemontani*) in this environment.

Creeping spikerush (Legler 2016)

Softstem bulrush (Schwarz 2011)

As the substrate transitioned to sand and sandy muck, these species were joined by Three-way sedge (*Dulichium arundinaceum*), Water horsetail (*Equisetum fluviatile*), Pickerelweed (*Pontederia cordata*), and Torrey's three-square bulrush (*Schoenoplectus torreyi*) (only the fourth record of this species ever documented in Sawyer County).

Three-way sedge (GMNRI 2016)

Water horsetail (Dziak 2005)

Pickerelweed (Texas A&M 2012)

Torrey's three-square bulrush (Rothrock 2018)

In the northern and western bays where the muck had more organic matter, we also documented Wild calla (*Calla palustris*), Star sedge (*Carex echinata*), Narrow-leaved woolly sedge (*Carex lasiocarpa*), Common yellow lake sedge (*Carex utriculata*), Bald spikerush (*Eleocharis erythropoda*), Common arrowhead (*Sagittaria latifolia*), Water bulrush (*Schoenoplectus subterminalis*), and Woolgrass (*Scirpus cyperinus*).

Wild calla (Pierce 2001)

Star sedge (Pokorny 2013)

Narrow-leaved wooly sedge (Navratil 2016)

Common yellow lake sedge (Lavin 2011)

Bald spikerush (Schipper 2019)

Common arrowhead (Young 2006)

Water bulrush (Dziuk 2016)

Woolgrass (Colby 2012)

Firm sand and gravel dominated the majority of the lake's eastern nearshore environment (<4ft deep), as well as around the large central island and on exposed points. These areas naturally tend to have low total biomass as the nutrient-poor substrate provides habitat most suited to fine-leaved "isoetid" species. In this environment, we often found Needle spikerush (*Eleocharis acicularis*), Spiny-spored quillwort (*Isoetes echinospora*), Brown-fruited rush (*Juncus pelocarpus*), Dwarf water-milfoil (*Myriophyllum tenellum*), Northern naiad (*Najas gracillima*), and Grass-leaved arrowhead (*Sagittaria graminea*).

Needle spikerush (Fewless 2005)

Spiny-spored quillwort (Haines 2012)

Brown-fruited rush (Koshere 2002)

Dwarf water-milfoil (Koshere 2002)

Northern naiad (Kallor 2016)

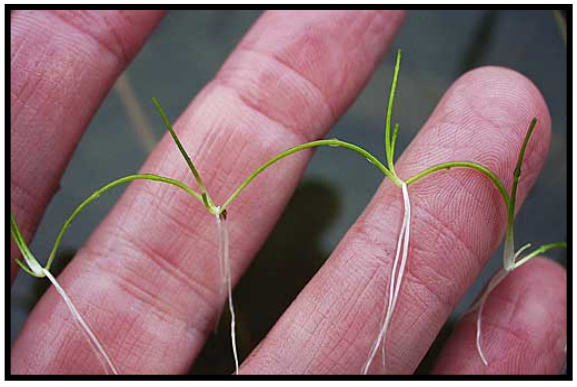
Grass-leaved arrowhead (Cameron 2019)

In the most pristine shoreline areas on the lake, these shallow sandy habitats also supported an often limited number of uncommon to rare species. These plants, which are extremely sensitive to human disturbance, included Waterwort (*Elatine minima*), Pipewort (*Eriocaulon aquaticum*), Water lobelia (*Lobelia dortmanna*), and Creeping spearwort (*Ranunculus flammula*). All of these "turf" species, along with the emergents, stabilize the bottom and prevent wave action erosion.

Waterwort (Fewless 2005)

Pipewort (Fewless 2005)

Water lobelia in bloom (Penskar 2011)



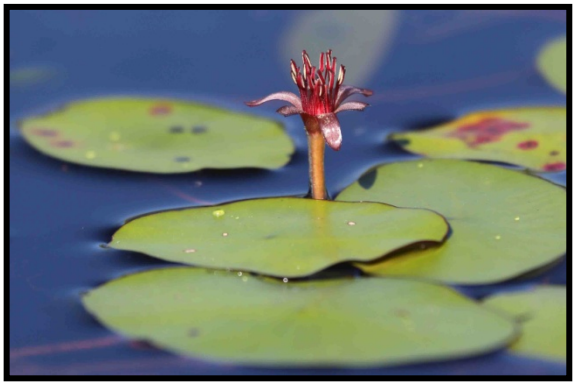
Creeping spearwort with arching "stolons" (Fewless 2005)

Nearshore nutrient-poor substrates seldom provide habitat for floating-leaf species, but Water-thread pondweed (*Potamogeton diversifolius*) (the only record of this state species of special concern ever documented in Sawyer County) with its small leaves and Narrow-leaved bur-reed (*Sparganium angustifolium*) with its long ribbon-like leaves were occasionally found growing in these areas.

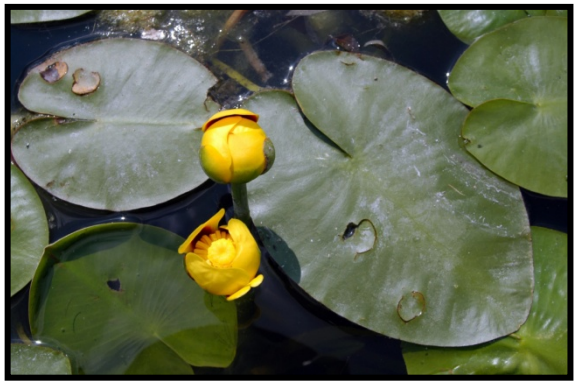
Water-thread pondweed (Cameron 2019)

Narrow-leaved bur-reed (Schouh 2006)

When these shallow areas had at least a thin layer of sandy or organic muck, they were often dominated by the floating-leaf species Watershield (*Brasenia schreberi*), Spatterdock (*Nuphar variegata*), White-water lily (*Nymphaea odorata*), and Water smartweed (*Polygonum amphibium*).



Watershield (WED 2019)

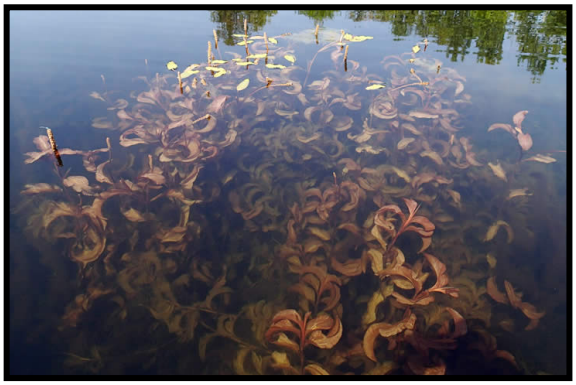


Spatterdock (CBG 2014)

White water lily (Falkner 2009)

Water smartweed (Someya 2009)

Other species that occasionally or regularly produce floating leaves in this zone included Large-leaf pondweed (*Potamogeton amplifolius*), Water-thread pondweed, Floating-leaf pondweed (*Potamogeton natans*), Oakes' pondweed (*Potamogeton oakesianus*), and Short-stemmed bur-reed (*Sparganium emersum*). The protective canopy cover this entire group provides is often utilized by panfish and bass.



Large-leaf pondweed (Dziuk 2018)

Floating-leaf pondweed (Petroglyph 2007)

Oakes' pondweed (Cameron 2020)

Short-stemmed bur-reed (Cameron 2016)

Primarily in the far corners of the western bays, we documented a few scattered Small duckweed (*Lemna minor*) and Large duckweed (*Spirodela polyrhiza*) drifting between these larger floating-leaf species. More typical of nutrient-rich systems, the "duckweeds" were predictably rare in Little Sissabagama Lake.

Small duckweed (Kramer 2013)

Large duckweed (Thomas 2014)

Growing in gaps in the floating-leaf canopy and among the dominant pondweeds, we found a few scattered patches of Slender waterweed (*Elodea nuttallii*), Nitella (*Nitella* sp.), and Wild celery (*Vallisneria americana*) in sandy muck areas. In the northern and western bays where the substrate was a more nutrient-rich organic muck, these species were replaced by aquatic moss, Spiny hornwort (*Ceratophyllum echinatum*), and Farwell's water-milfoil (*Myriophyllum farwellii*). The roots, shoots, and seeds of all these shallow-submergent species are heavily utilized by waterfowl for food, and 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.

Slender waterweed (Fischer 2011)

Nitella (Schou 2003)

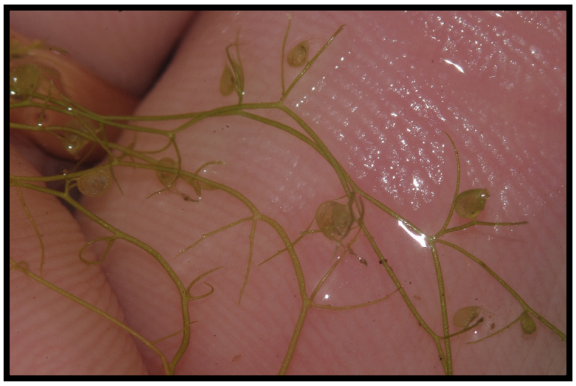
Wild celery (Dalvi 2009)

Aquatic moss (Coring 2010)

Spiny hornwort (Chayka 2019)

Farwell's water-milfoil (Dziuk 2015)

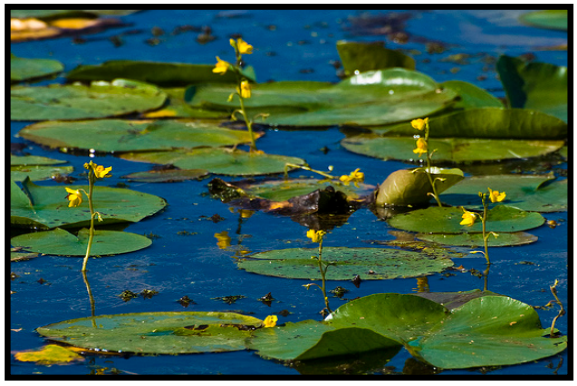
Floating among and entangled in the shallow-submergent and floating-leaf species, we also encountered large numbers of bladderworts; especially in the northern and western bays. Rather than drawing nutrients up through roots like other plants, these carnivores trap zooplankton and minute insects in their bladders, digest their prey, and use the nutrients to further their growth. This group included Creeping bladderwort (*Utricularia gibba*), Flat-leaf bladderwort (*Utricularia intermedia*), Large purple bladderwort (*Utricularia purpurea*), and Common bladderwort (*Utricularia vulgaris*).



Creeping bladderwort (Eyewed 2010)

Flat-leaf bladderwort (Woods 2012)

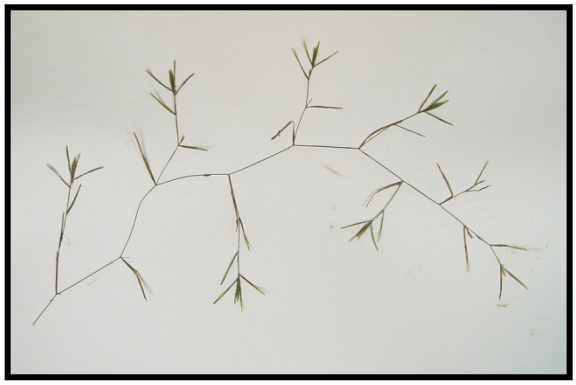
Large purple bladderwort among Watershield (Dziuk 2013)



Common bladderwort flowers among lilypads (Hunt 2010)

Deeper areas over sandy and organic muck were dominated by three species: Large-leaf pondweed, Small pondweed (*Potamogeton pusillus*), and, the most common species on the entire lake, Fern pondweed (*Potamogeton robbinsii*). Predatory fish like the lake's Musky (*Esox masquinongy*) are often found along the edges of these beds waiting in ambush.

Large-leaf pondweed (Dziuk 2018)



Small pondweed (Cameron 2013)

Fern pondweed (Apipp 2011)

Typical Fern/Large-leaf pondweed dominated plant community

Plant Community Dominance:

When considering the lake as a whole, Fern pondweed, Watershield, White water lily, and Large purple bladderwort were the most widely distributed macrophyte species (Figure 8). They were present at 60.22%, 27.03%, 21.32%, and 12.31% of survey points with vegetation respectively; and, collectively, they accounted for 53.76% of the total relative frequency (Table 2). Northern naiad (4.99%), Creeping bladderwort (4.99%), and Water-thread pondweed (4.01%) were the only other species with relative frequencies over 4.00% (Maps and species accounts for all plants are located in Appendixes V and VI).

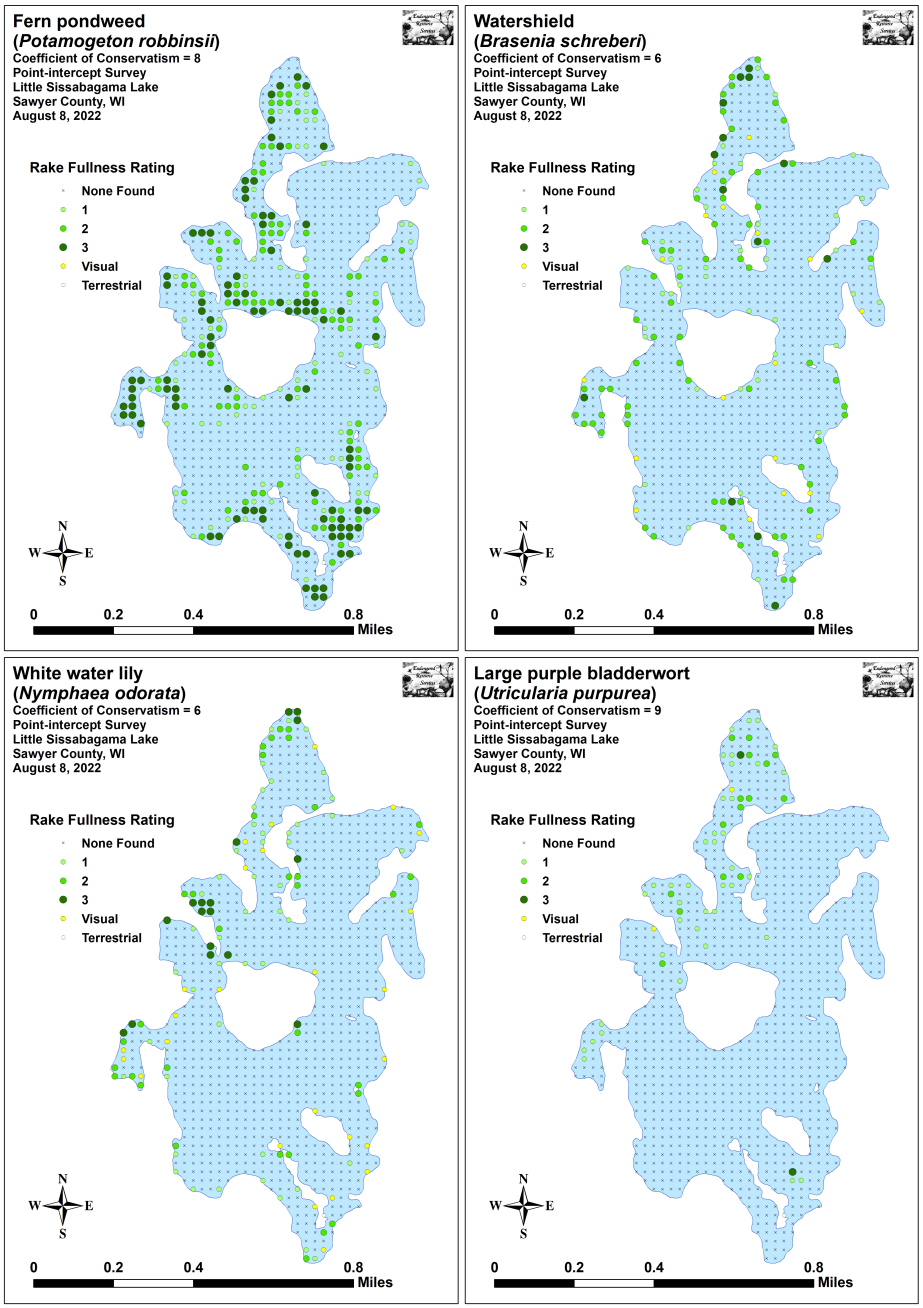


Figure 8: Little Sissabagama Lake's Most Common Species

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Little Sissabagama Lake – Sawyer County, Wisconsin
August 8, 2022

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Potamogeton robbinsii	Fern pondweed	274	26.78	60.22	49.82	2.07	0
Brasenia schreberi	Watershield	123	12.02	27.03	22.36	1.79	18
Nymphaea odorata	White water lily	97	9.48	21.32	17.64	1.69	26
Utricularia purpurea	Large purple bladderwort	56	5.47	12.31	10.18	1.34	2
Najas gracillima	Northern naiad	51	4.99	11.21	9.27	1.53	0
Utricularia gibba	Creeping bladderwort	51	4.99	11.21	9.27	1.08	0
Potamogeton diversifolius	Water-thread pondweed	41	4.01	9.01	7.45	1.27	8
Pontederia cordata	Pickerelweed	39	3.81	8.57	7.09	1.54	15
	Aquatic moss	28	*	6.15	5.09	1.43	0
Myriophyllum tenellum	Dwarf water-milfoil	27	2.64	5.93	4.91	1.89	1
Potamogeton natans	Floating-leaf pondweed	26	2.54	5.71	4.73	1.19	9
Sagittaria graminea	Grass-leaved arrowhead	19	1.86	4.18	3.45	1.16	3
Eleocharis acicularis	Needle spikerush	18	1.76	3.96	3.27	1.28	2
Isoetes echinospora	Spiny-spored quillwort	15	1.47	3.30	2.73	1.27	0
Potamogeton pusillus	Small pondweed	15	1.47	3.30	2.73	1.33	0
Dulichium arundinaceum	Three-way sedge	14	1.37	3.08	2.55	1.43	11
Potamogeton amplifolius	Large-leaf pondweed	14	1.37	3.08	2.55	1.29	6
Sparganium angustifolium	Narrow-leaved bur-reed	14	1.37	3.08	2.55	1.36	5
Ceratophyllum echinatum	Spiny hornwort	9	0.88	1.98	1.64	1.22	0
Potamogeton oakesianus	Oakes' pondweed	9	0.88	1.98	1.64	1.11	2
	Filamentous algae	9	*	1.98	1.64	1.33	0
Juncus pelocarpus f. *submersus*	Brown-fruited rush	8	0.78	1.76	1.45	2.13	1
Nuphar variegata	Spatterdock	8	0.78	1.76	1.45	1.50	1
Schoenoplectus torreyi	Torrey’s three-square bulrush	8	0.78	1.76	1.45	1.00	2

*Excluded from relative frequency analysis

Table 2 (continued): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Little Sissabagama Lake – Sawyer County, Wisconsin
August 8, 2022

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Utricularia vulgaris	Common bladderwort	8	0.78	1.76	1.45	1.00	1
Vallisneria americana	Wild celery	8	0.78	1.76	1.45	1.13	0
Eriocaulon aquaticum	Pipewort	7	0.68	1.54	1.27	1.86	5
Elodea nuttallii	Slender waterweed	6	0.59	1.32	1.09	1.17	0
Schoenoplectus subterminalis	Water bulrush	6	0.59	1.32	1.09	1.33	1
Sparganium emersum	Short-stemmed bur-reed	6	0.59	1.32	1.09	1.17	1
Utricularia intermedia	Flat-leaf bladderwort	6	0.59	1.32	1.09	1.00	0
Lobelia dortmanna	Water lobelia	5	0.49	1.10	0.91	1.20	3
Elatine minima	Waterwort	4	0.39	0.88	0.73	1.00	0
Eleocharis palustris	Creeping spikerush	4	0.39	0.88	0.73	1.25	7
Ranunculus flammula	Creeping spearwort	4	0.39	0.88	0.73	1.25	1
Carex utriculata	Common yellow lake sedge	3	0.29	0.66	0.55	1.00	2
Eleocharis erythropoda	Bald spikerush	3	0.29	0.66	0.55	2.33	2
Equisetum fluviatile	Water horsetail	3	0.29	0.66	0.55	1.00	5
Lemna minor	Small duckweed	3	0.29	0.66	0.55	1.00	1
Calla palustris	Wild calla	2	0.20	0.44	0.36	2.50	0
Nitella sp.	Nitella	2	0.20	0.44	0.36	1.00	0
Polygonum amphibium	Water smartweed	2	0.20	0.44	0.36	1.50	2
Spirodela polyrhiza	Large duckweed	2	0.20	0.44	0.36	1.00	0
Myriophyllum farwellii	Farwell's water-milfoil	1	0.10	0.22	0.18	1.00	0
Sagittaria latifolia	Common arrowhead	1	0.10	0.22	0.18	1.00	1
Scirpus cyperinus	Woolgrass	1	0.10	0.22	0.18	1.00	0
Carex crinita	Fringed sedge	**	**	**	**	**	3
Carex lasiocarpa	Narrow-leaved woolly sedge	**	**	**	**	**	1

**Visual only

Table 2 (continued): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Little Sissabagama Lake – Sawyer County, Wisconsin
August 8, 2022

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Iris versicolor	Northern blue flag	**	**	**	**	**	2
Juncus effusus	Common rush	**	**	**	**	**	2
Typha latifolia	Broad-leaved cattail	**	**	**	**	**	1
Carex echinata	Star sedge	***	***	***	***	***	***
Schoenoplectus tabernaemontani	Softstem bulrush	***	***	***	***	***	***

Visual only * Boat survey only

Floristic Quality Index:

We identified a total of 41 **native index plants** in the rake during the point-intercept survey. They produced a mean Coefficient of Conservatism of 7.4 and a Floristic Quality Index of 47.5 (Table 3). Nichols (1999) reported an average mean C for the Northern Lakes and Forest Region of 6.7 putting Little Sissabagama Lake well above average for this part of the state. The FQI was also nearly double the region's median FQI of 24.3 (Nichols 1999). Fifteen highly sensitive index plants of note included Wild calla (C = 9), Spiny hornwort (C = 10), Three-way sedge (C = 9), Waterwort (C = 9), Pipewort (C = 9), Water lobelia (C = 10), Dwarf-water milfoil (C = 10), ***Oakes' pondweed (C = 10), Creeping spearwort (C = 9), Grass-leaved arrowhead (C = 9), Water bulrush (C = 9), Narrow-leaved bur-reed (C = 9), Creeping bladderwort (C = 9), Flat-leaf bladderwort (C = 9), and Large purple bladderwort (C = 9). Two other high-value species found – Narrow-leaved wooly sedge (C = 9) and ***Torrey's three-square bulrush (C = 9) – are not included in the index.

Table 3: Floristic Quality Index of Aquatic Macrophytes
Little Sissabagama Lake – Sawyer County, Wisconsin
August 8, 2022

Species	Common Name	C
Brasenia schreberi	Watershield	6
Calla palustris	**Wild calla**	**9**
Ceratophyllum echinatum	**Spiny hornwort**	**10**
Dulichium arundinaceum	**Three-way sedge**	**9**
Elatine minima	**Waterwort**	**9**
Eleocharis acicularis	Needle spikerush	5
Eleocharis erythropoda	Bald spikerush	3
Eleocharis palustris	Creeping spikerush	6
Elodea nuttallii	Slender waterweed	7
Equisetum fluviatile	Water horsetail	7
Eriocaulon aquaticum	**Pipewort**	**9**
Isoetes echinospora	Spiny-spored quillwort	8
Juncus pelocarpus	Brown-fruited rush	8
Lemna minor	Small duckweed	4
Lobelia dortmanna	**Water lobelia**	**10**
Myriophyllum farwellii	Farwell's water-milfoil	8
Myriophyllum tenellum	**Dwarf water-milfoil**	**10**
Najas gracillima	Northern naiad	7
Nitella sp.	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Polygonum amphibium	Water smartweed	5
Pontederia cordata	Pickerelweed	8
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton diversifolius	Water-thread pondweed***	8
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton oakesianus	**Oakes' pondweed*** **	**10**

Table 3 (continued): Floristic Quality Index of Aquatic Macrophytes
Little Sissabagama Lake – Sawyer County, Wisconsin
August 8, 2022

Species	Common Name	C
Potamogeton pusillus	Small pondweed	7
Potamogeton robbinsii	Fern pondweed	8
Ranunculus flammula	**Creeping spearwort**	**9**
Sagittaria graminea	**Grass-leaved arrowhead**	**9**
Sagittaria latifolia	Common arrowhead	3
Schoenoplectus subterminalis	**Water bulrush**	**9**
Sparganium angustifolium	**Narrow-leaved bur-reed**	**9**
Sparganium emersum	Short-stemmed bur-reed	8
Spirodela polyrhiza	Large duckweed	5
Utricularia gibba	**Creeping bladderwort**	**9**
Utricularia intermedia	**Flat-leaf bladderwort**	**9**
Utricularia purpurea	**Large purple bladderwort**	**9**
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
N		**41**
Mean C		**7.4**
FQI		**47.5**

*** Water-thread pondweed, Oakes' pondweed, and Torrey's three-square bulrush are all **Wisconsin State Species of Special Concern** - those species about which some problem of abundance or distribution is suspected but not yet proved. The main purpose of this category is to focus attention on certain species before they become threatened or endangered.

Filamentous Algae:

Filamentous algae are normally associated with excessive nutrients in the water column from such things as runoff, internal nutrient recycling, and failed septic systems. We found these algae at nine points with a mean rake fullness of 1.33. Interestingly, most points with algae were concentrated in the northeast bays where there were obvious sediment inflows from roadside culverts and steep hillsides (Figure 9).

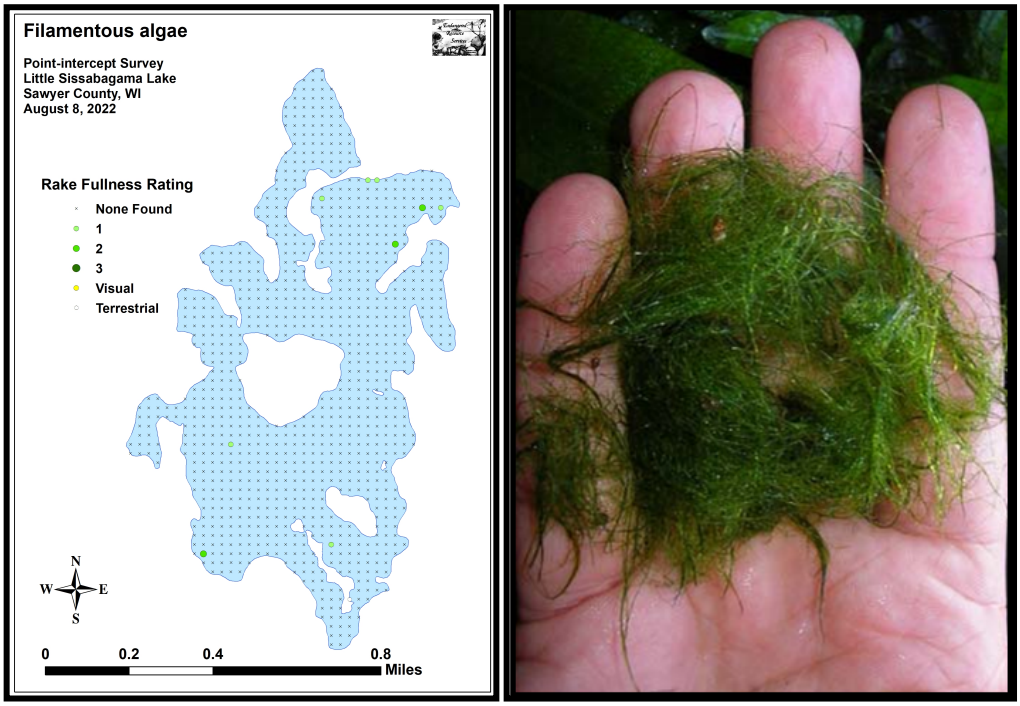


Figure 9: Filamentous Algae Density and Distribution

Exotic Plant Species:

We did NOT find any evidence of Eurasian water-milfoil, Curly-leaf pondweed, or any other exotic plant in Little Sissabagama Lake during either survey. By all accounts, the lake's plant community appears to be pristine and intact (For more information on a sampling of aquatic exotic plant species, see Appendix VII).

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:
Water Clarity, Nutrient Inputs, and the Role of Native Macrophytes:

Little Sissabagama Lake has a truly exceptional native plant community that is dominated by high-value species that are both sensitive to human impacts and regionally uncommon to rare. Like trees in a forest, a lake's plants are the basis of the aquatic ecosystem. They capture the sun's energy and turn it into usable food, "clean" the water of excess nutrients, and provide habitat for other organisms like aquatic invertebrates and the lake's fish populations. Because of this, preserving them is critical to maintaining the lake's overall health.

When phosphorus and nitrogen in a lake's water column increase to levels beyond what macrophytes can absorb, filamentous and floating algae tend to proliferate leading to declines in both water clarity and quality. Over the past 35+ years, water quality data collected by Little Sissabagama Lake volunteers shows a history of consistently good clarity. This is probably not a coincidence. Rather, it is likely at least partially tied to the work done by conservation-minded people. Their native vegetation buffers along much of the lake's shoreline helps cut down on soil erosion and nutrient runoff into the lake which would otherwise promote algae growth and decrease clarity. Despite this positive news, the lake's relatively small size means even a slight increase in nutrient inputs could negatively impact clarity. Because of this, residents should continually evaluate how their shoreline practices may be impacting the lake. Simple things like establishing a buffer strip of native vegetation along the lakeshore if one isn't already present (Figure 10), bagging grass clippings, eliminating fertilizer near the lake, collecting pet waste, disposing of ash from fire pits away from the lakeshore, maintaining septic systems, and avoiding stirring up sediments with motor start-ups in shallow water can all significantly reduce the amount of nutrients entering the lake's water column. Likewise, working to identify and limit external nutrient sources like the runoff entering through the culverts in the north bays could positively impact the lake. Hopefully, a greater understanding of how even individual property owners can have lake-wide impacts will result in even more people taking appropriate conservation actions and thus ensure continued water clarity and quality for all.

Figure 10: Model Natural Shoreline on a Nearby Northwest Wisconsin Lake

Aquatic Invasive Species Prevention:

Aquatic Invasive Species such as Eurasian water-milfoil, Curly-leaf pondweed, Purple loosestrife (*Lythrum salicaria*), and Yellow iris are an increasing problem in and along the lakes of northern Wisconsin in general, and several nearby lakes in Sawyer County in particular. Working to prevent their introduction into Little Sissabagama Lake with proactive measures is strongly encouraged. The semi-private landing likely cuts down on overall in/out boat traffic and likely makes a Clean Boats/Clean Waters landing monitor plan unnecessary. However, with no monitoring plan in place, improving the signage at the boat landing could offer a layer of protection against AIS by providing education, reeducation, and reminders of the potential negative impacts of AIS to lake property owners and visitors alike.

With no monitoring program in place, a small standard WDNR AIS sign is currently serving as the "guardian of the lake". Adding a secondary sign that is located at the waterline is a potential actionable item for the LSLSA to consider. Hopefully, a simple bright sign will increase the chances that visitors will remember to check their boat carefully before launching (Figure 11).

Figure 11: Potential Secondary Sign to be Placed Near the Water's Edge

In the future, conducting monthly visual inspections around the boat landing throughout the growing season and/or at least one annual meandering shoreline survey of the lake's entire visible littoral zone are further suggestions to consider as these surveys can result in early detection if an AIS is introduced into the lake. The sooner an infestation is detected, the greater the chances it can be successfully and economically controlled. Finally, developing an Aquatic Plant Management Plan prior to an infestation would help streamline an appropriate response if/when an infestation of EWM or some other AIS occurs.

Management Considerations Summary:

- Preserve the many high-value and sensitive native plants on Little Sissabagama Lake and the critical habitat they provide for the whole lake ecosystem.
- Work to maintain water clarity and suppress algal growth by limiting nutrient inputs.
- Specifically, avoid mowing down to the lakeshore and reduce or, if possible, eliminate grass clipping runoff, fertilizer applications, and other sources of nutrients like pet waste and fire pit ashes near the lakeshore.
- Maintain septic systems and avoid motor startups in shallow water.
- Encourage shoreline restoration and the establishment of native vegetation buffer strips along the lakeshore to further prevent runoff and erosion.
- Identify and work to mitigate external nutrient sources; especially in the northeast bays where obvious erosion is occurring.
- Consider adding a second small bright sign at the water line to remind people to clean their boats prior to launching at the semi-private landing.
- Consider carrying out monthly landing inspections and/or at least one annual meandering shoreline survey of the lake's entire visible littoral zone to look for new AIS.
- Complete an Aquatic Plant Management Plan that clarifies a potential response to a new AIS, such as Eurasian water-milfoil, if one becomes established in the lake.

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Appendix I: Boat and Vegetative Survey Datasheets

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																									
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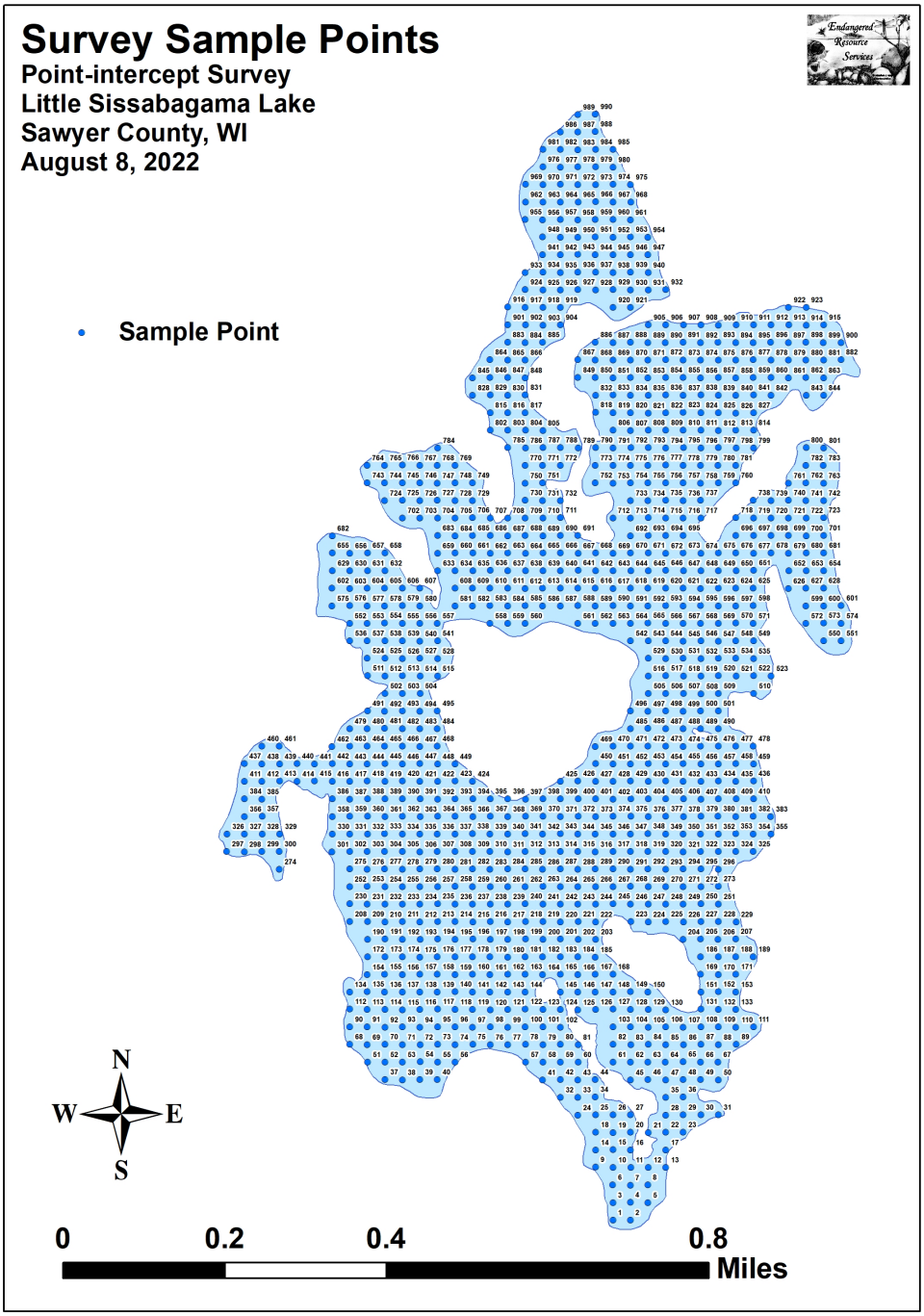
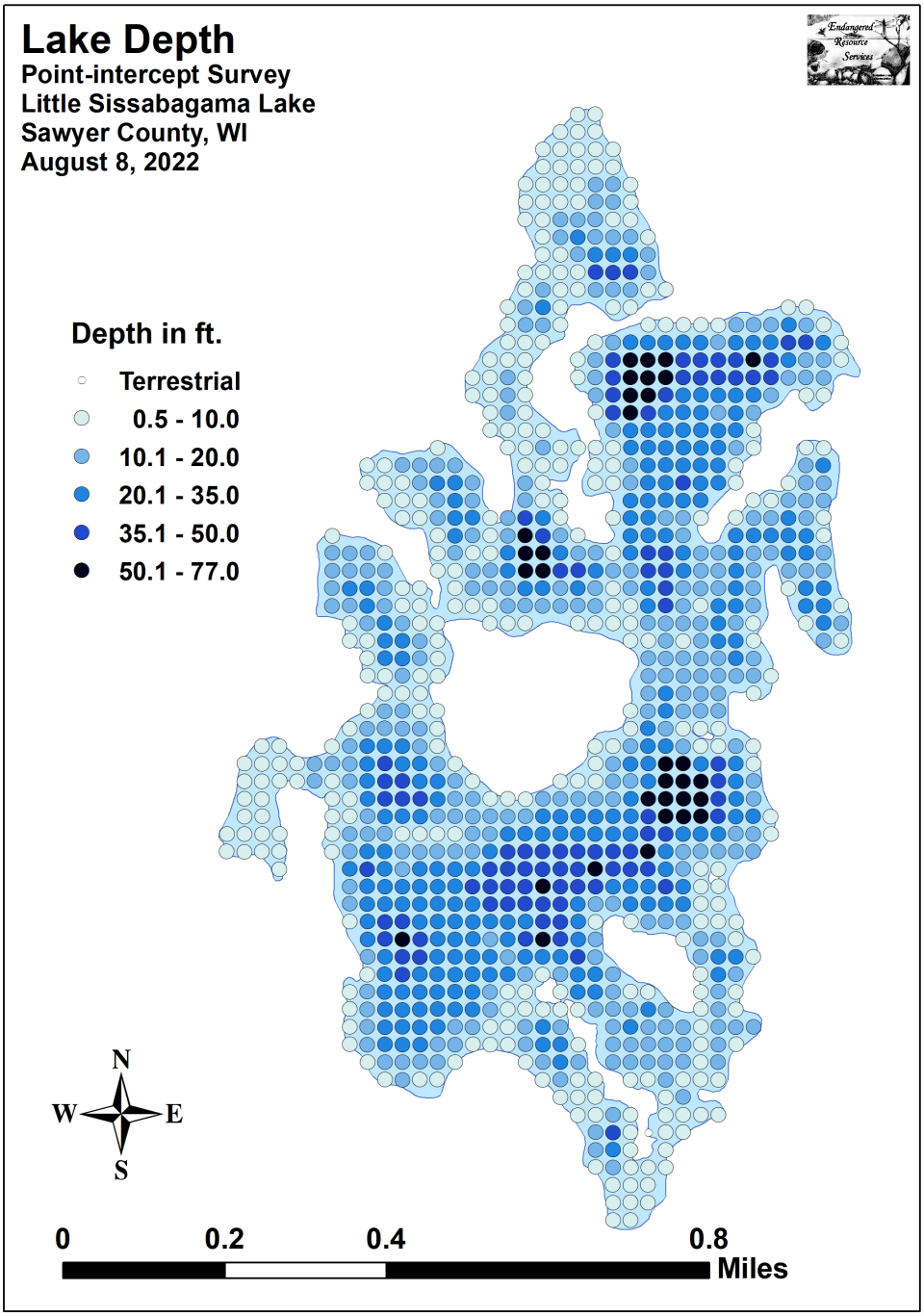
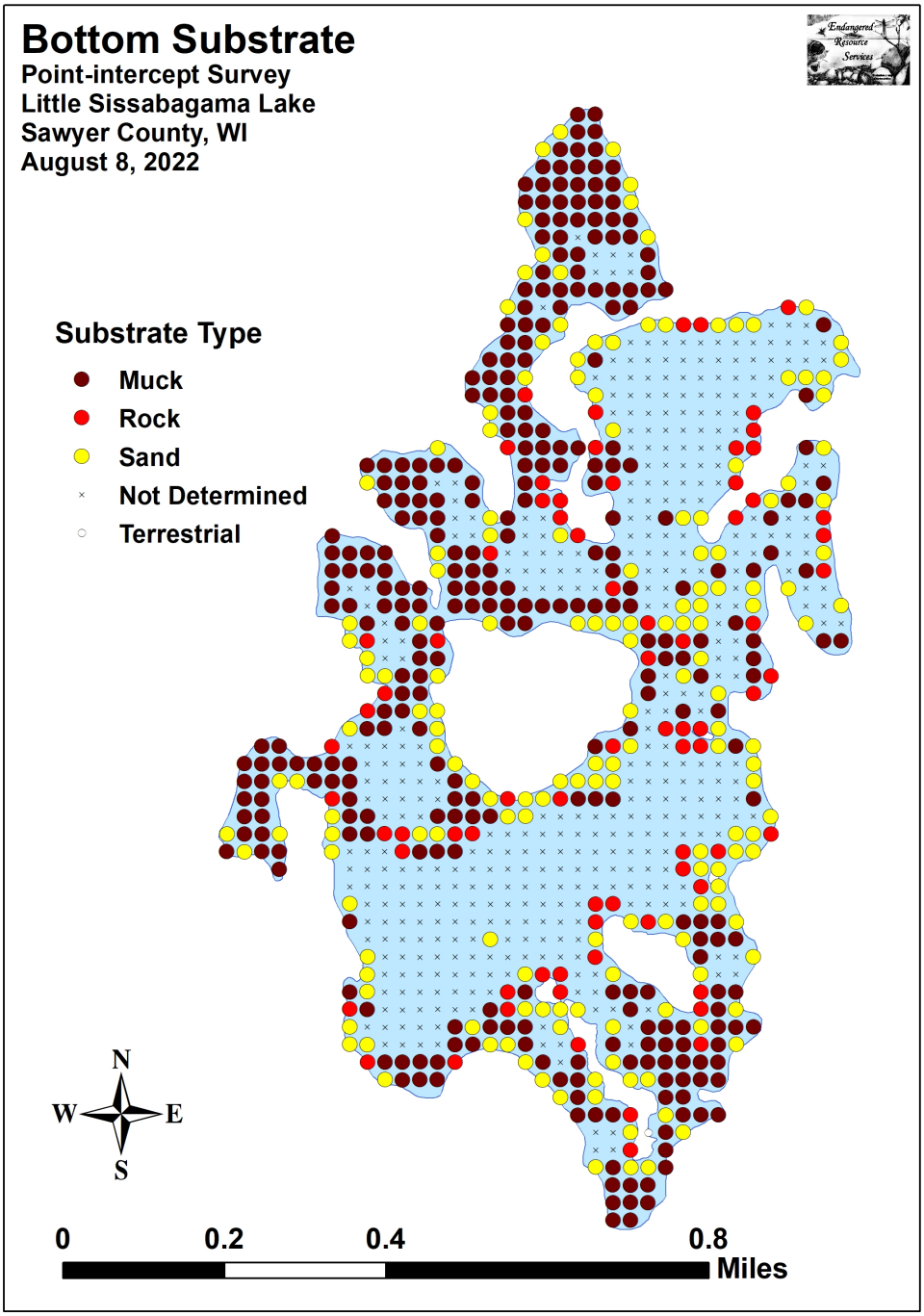
20																									

Appendix II: Point-intercept Survey Sample Points Map

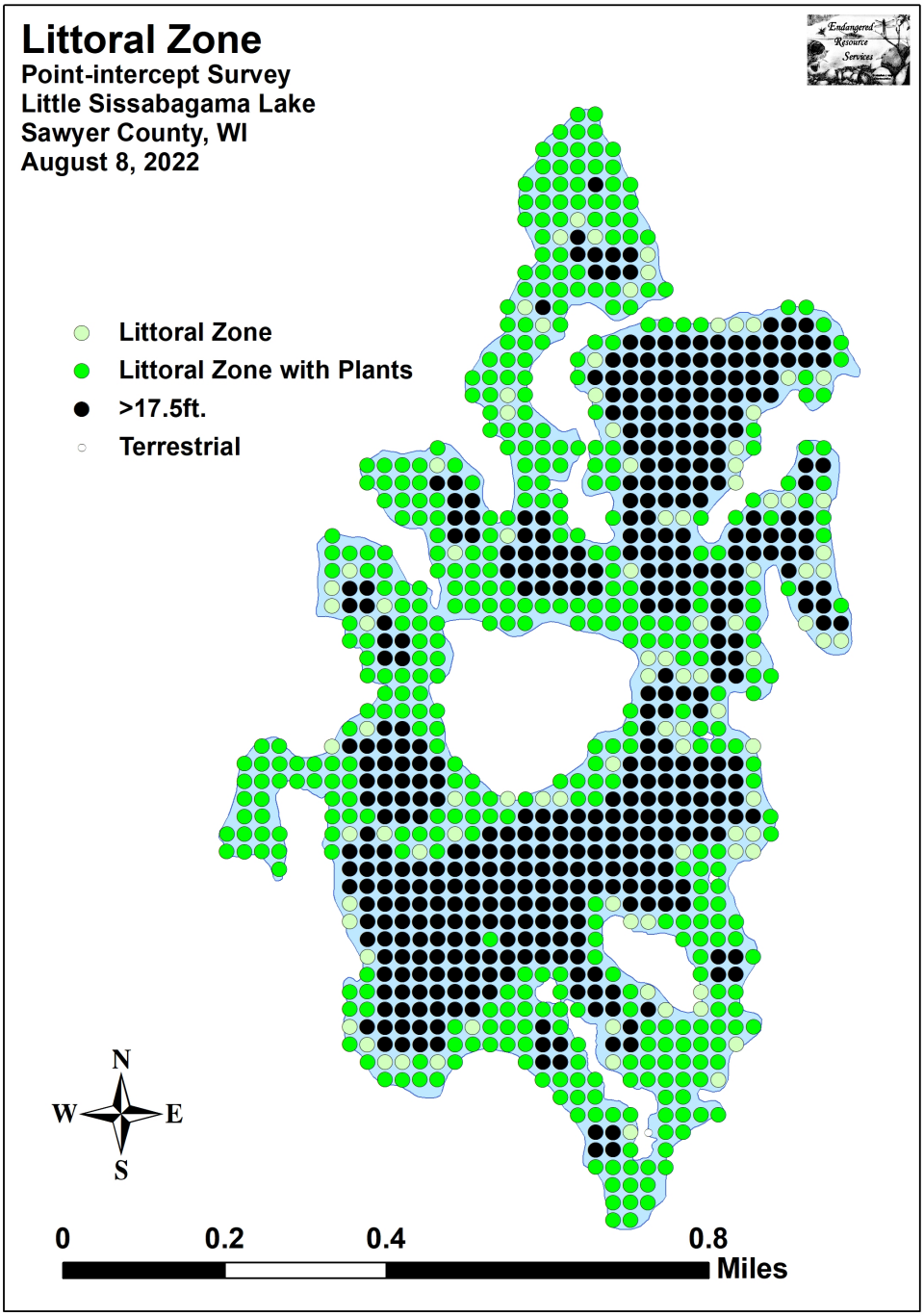

Survey Sample Points
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Sample Point
N
W
E
S
0
0.2
0.4
0.8
Miles

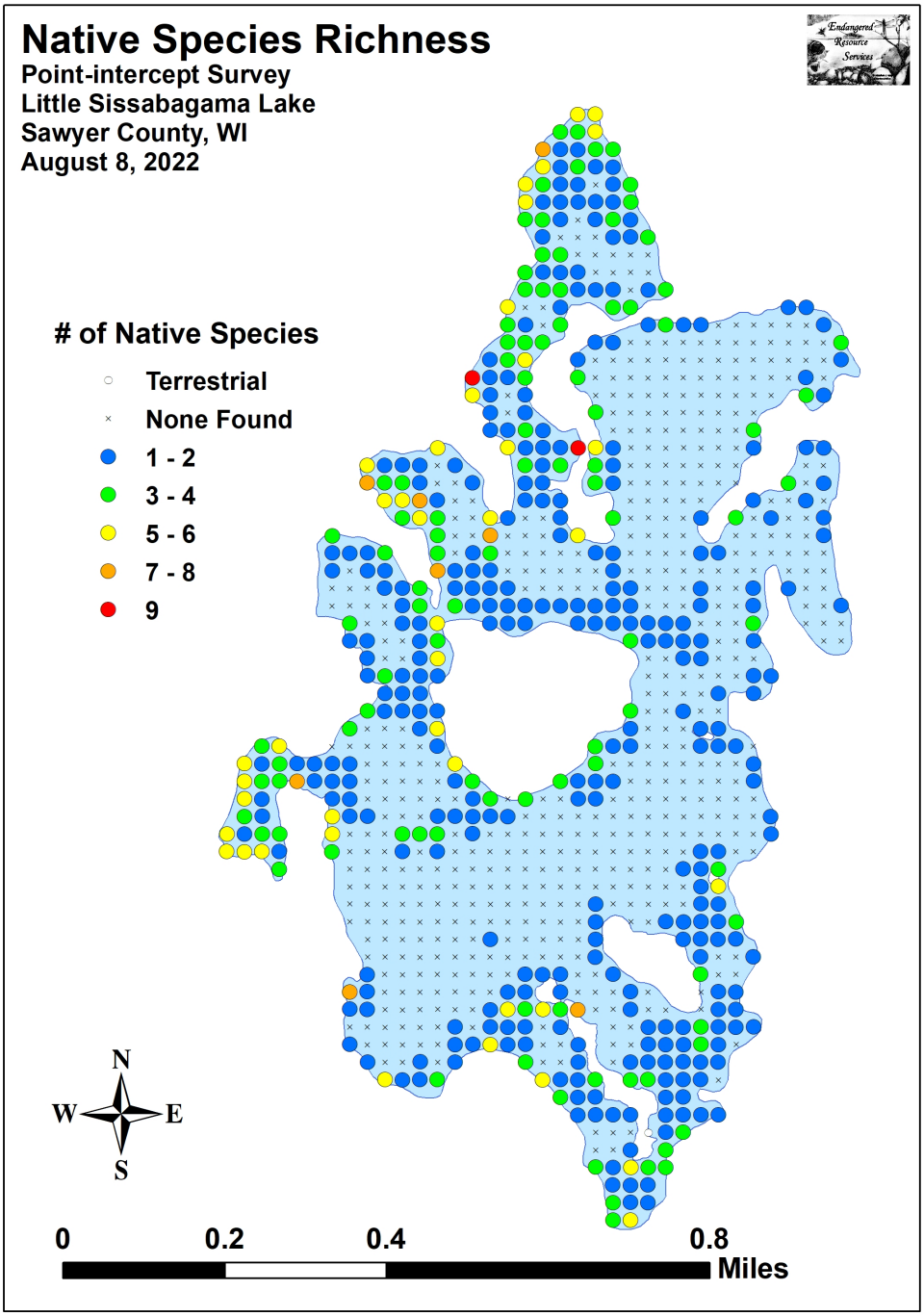
Appendix III: Habitat Variable Maps

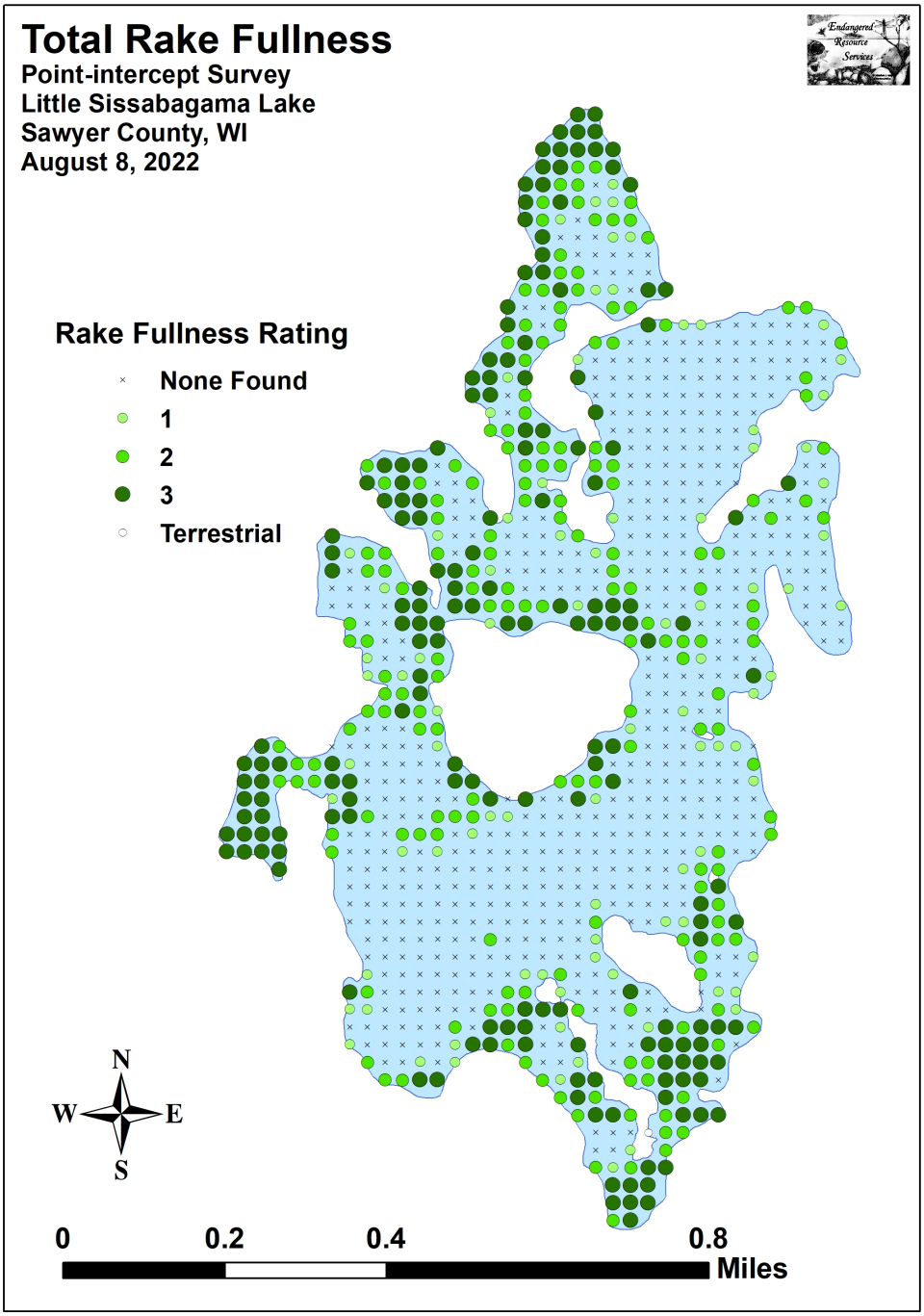

Lake Depth
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Depth in ft.
Terrestrial
0.5 - 10.0
10.1 - 20.0
20.1 - 35.0
35.1 - 50.0
50.1 - 77.0
N
W
E
S
0
0.2
0.4
0.8
Miles


Bottom Substrate
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Substrate Type
Muck
Rock
Sand
Not Determined
Terrestrial
N
W
E
S
0
0.2
0.4
0.8
Miles

Appendix IV: Littoral Zone, Native Species Richness, and Total Rake Fullness Maps


Littoral Zone
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Littoral Zone
Littoral Zone with Plants
>17.5ft.
Terrestrial
N
W
E
S
0
0.2
0.4
0.8
Miles


Native Species Richness
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
# of Native Species
Terrestrial
None Found
1 - 2
3 - 4
5 - 6
7 - 8
9
N
W
E
S
0
0.2
0.4
0.8
Miles


Total Rake Fullness
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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Terrestrial
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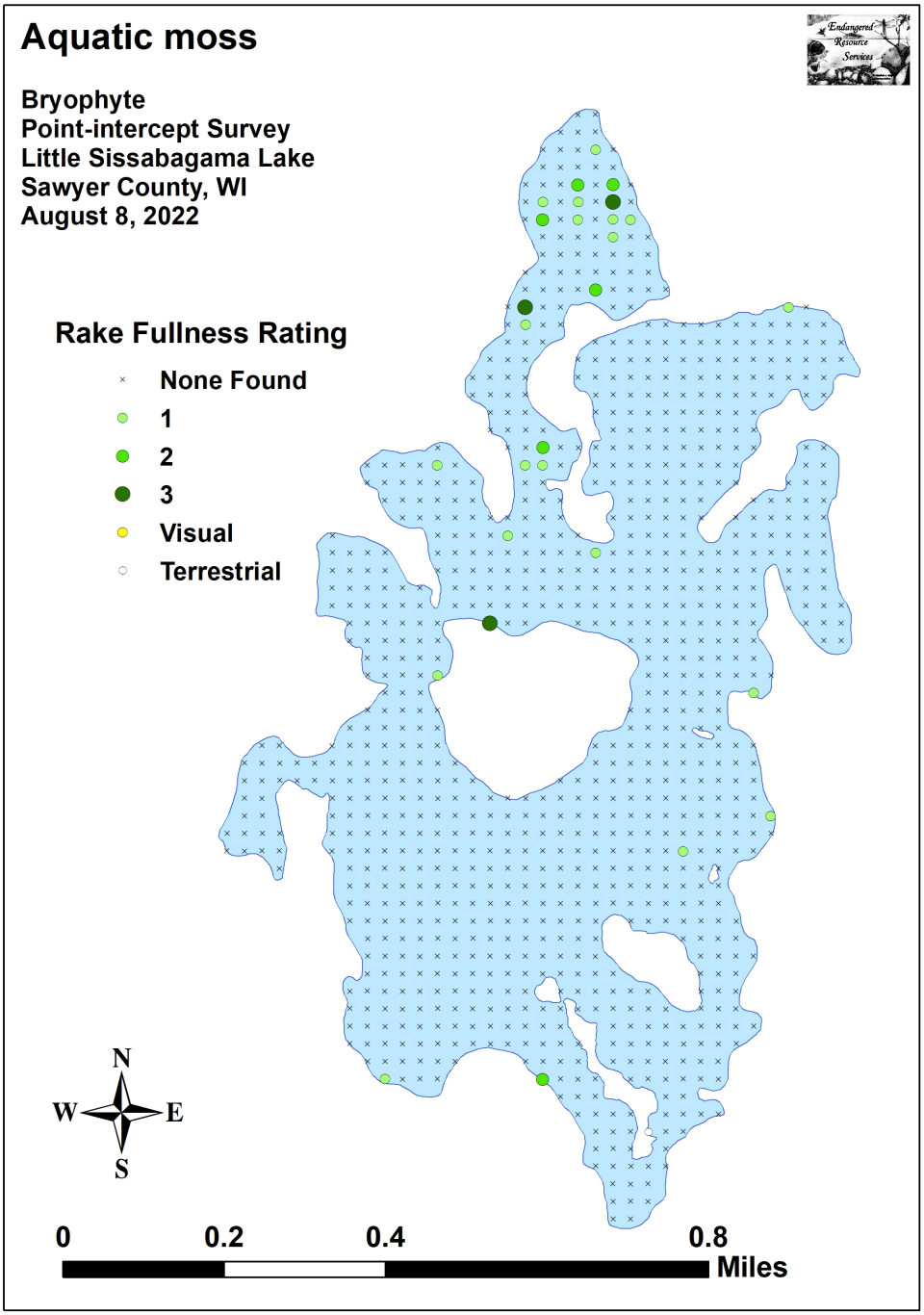
Miles

Appendix V: Native Species Density and Distribution Maps


Aquatic moss
Bryophyte
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
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Visual
Terrestrial
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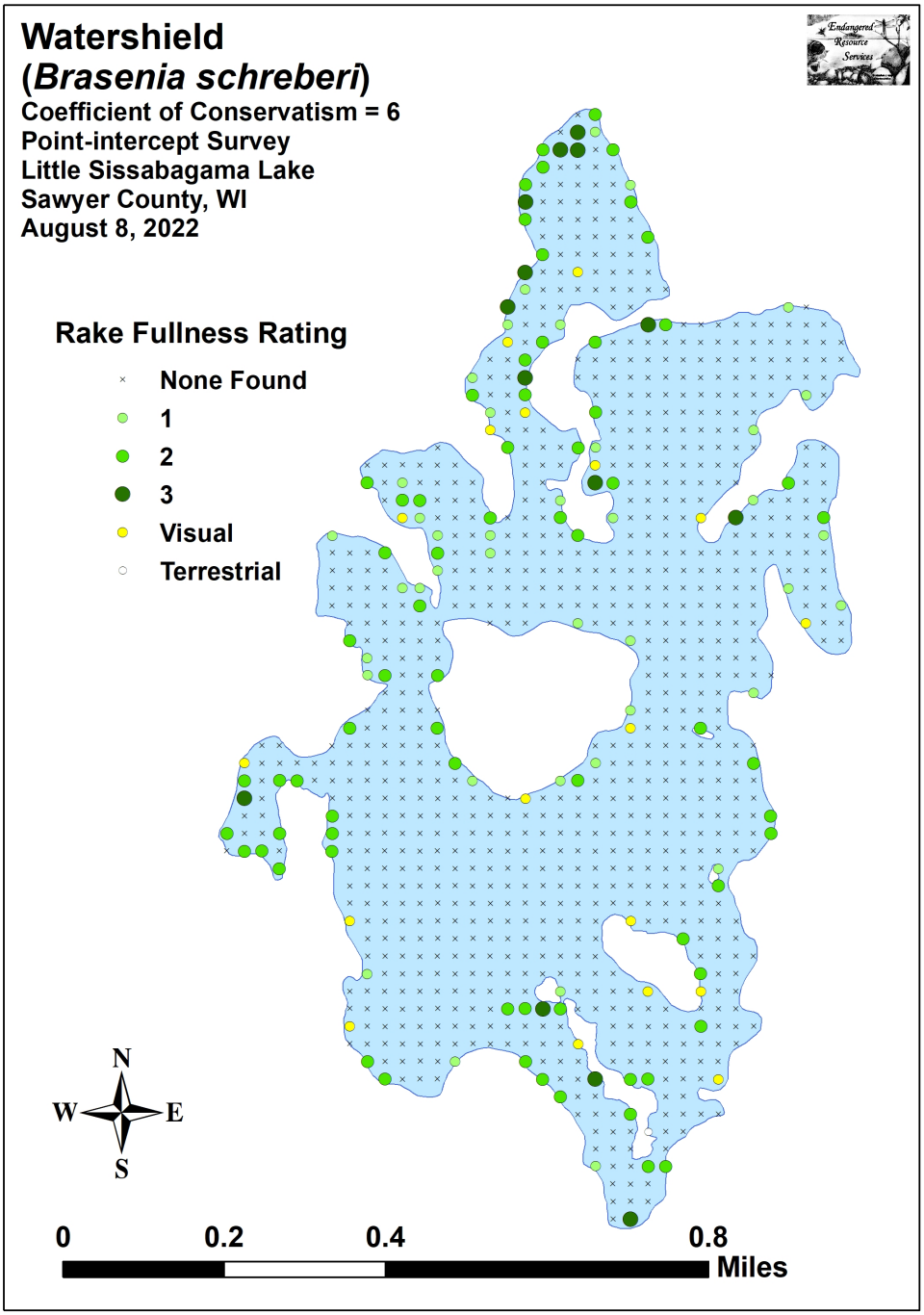
Miles


Watershield
(Brasenia schreberi)
Coefficient of Conservatism = 6
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
None Found
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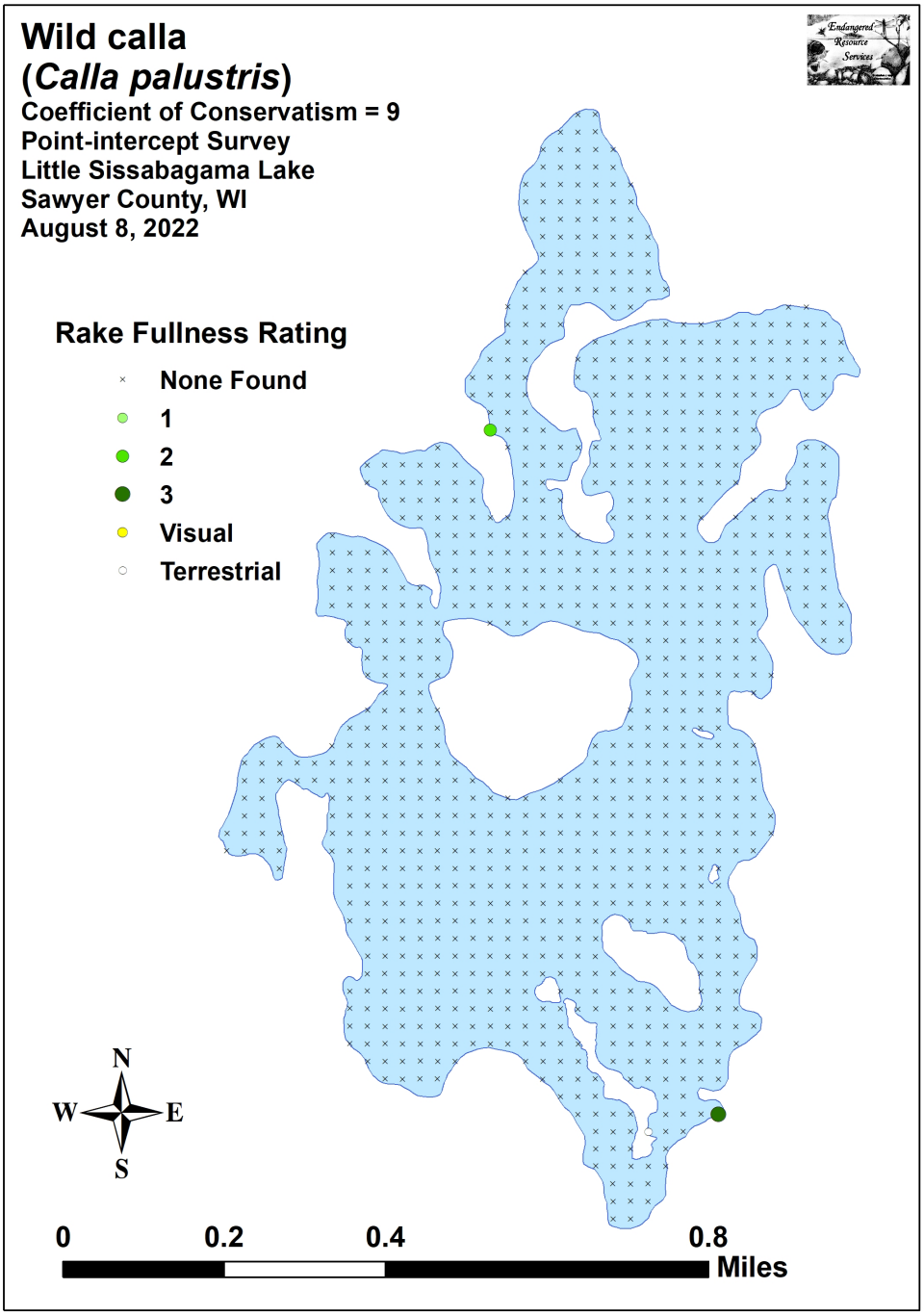
Miles


Wild calla
(Calla palustris)
Coefficient of Conservatism = 9
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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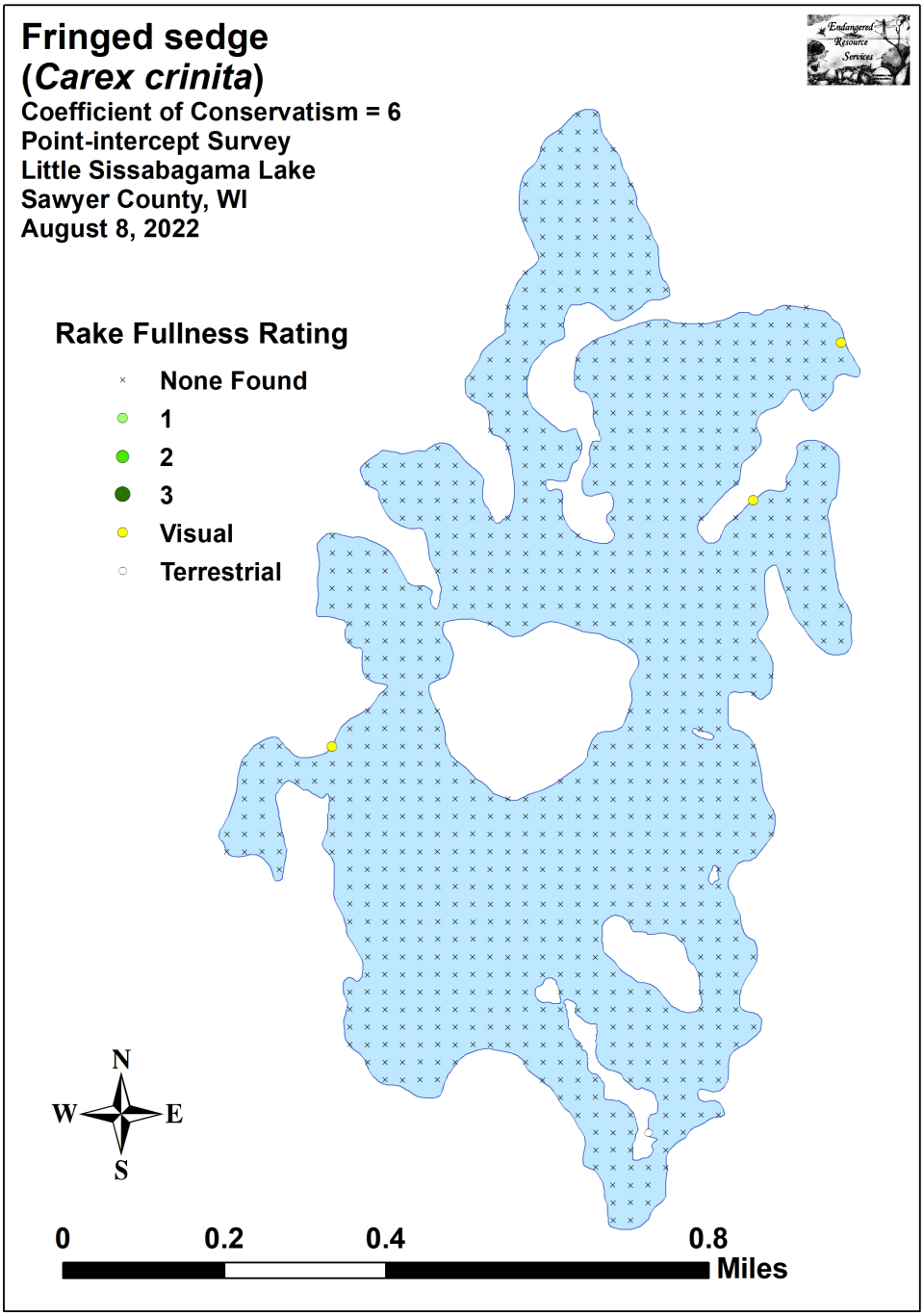
Miles


Fringed sedge
(Carex crinita)
Coefficient of Conservatism = 6
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
None Found
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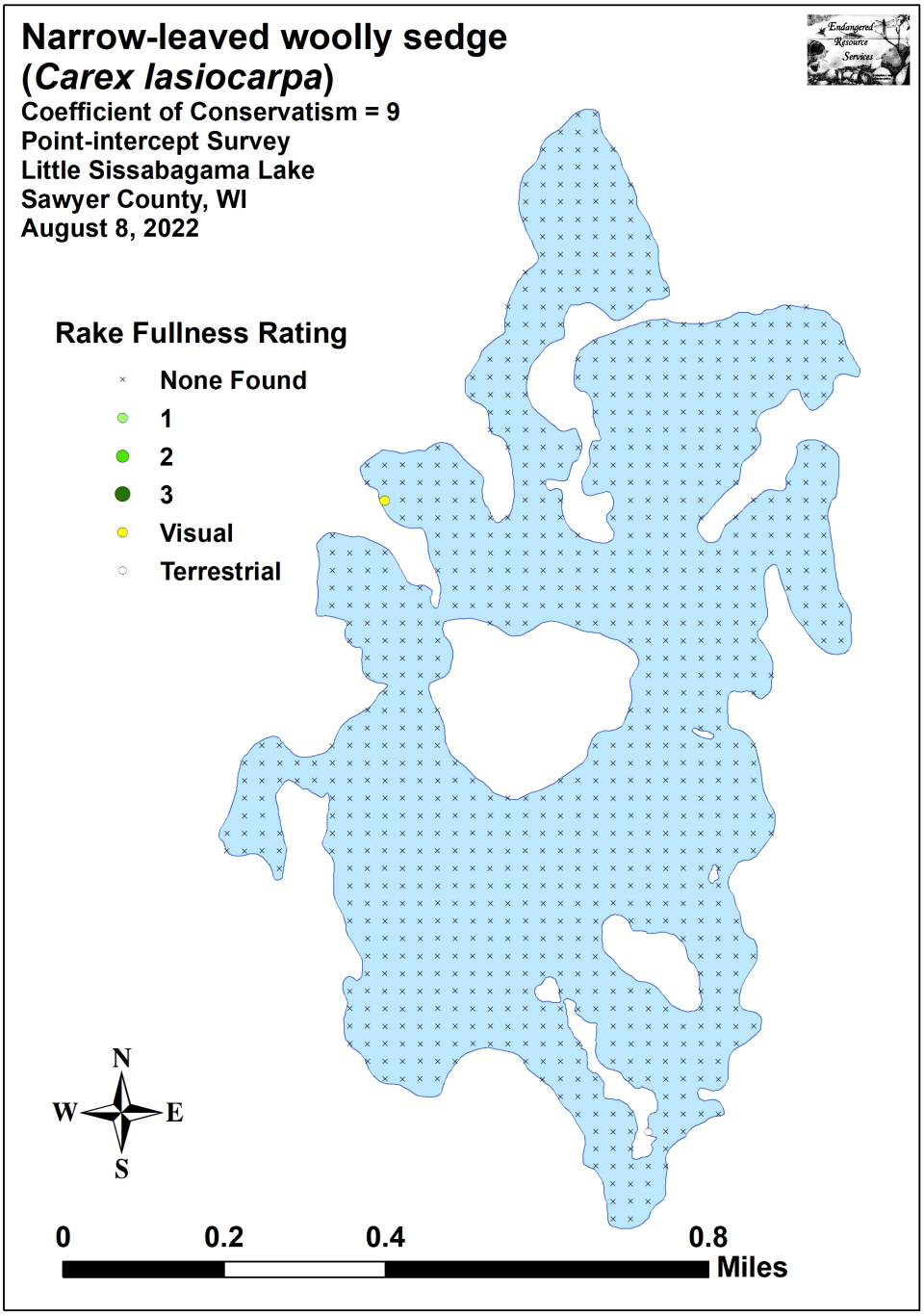
Miles


Narrow-leaved woolly sedge
(Carex lasiocarpa)
Coefficient of Conservatism = 9
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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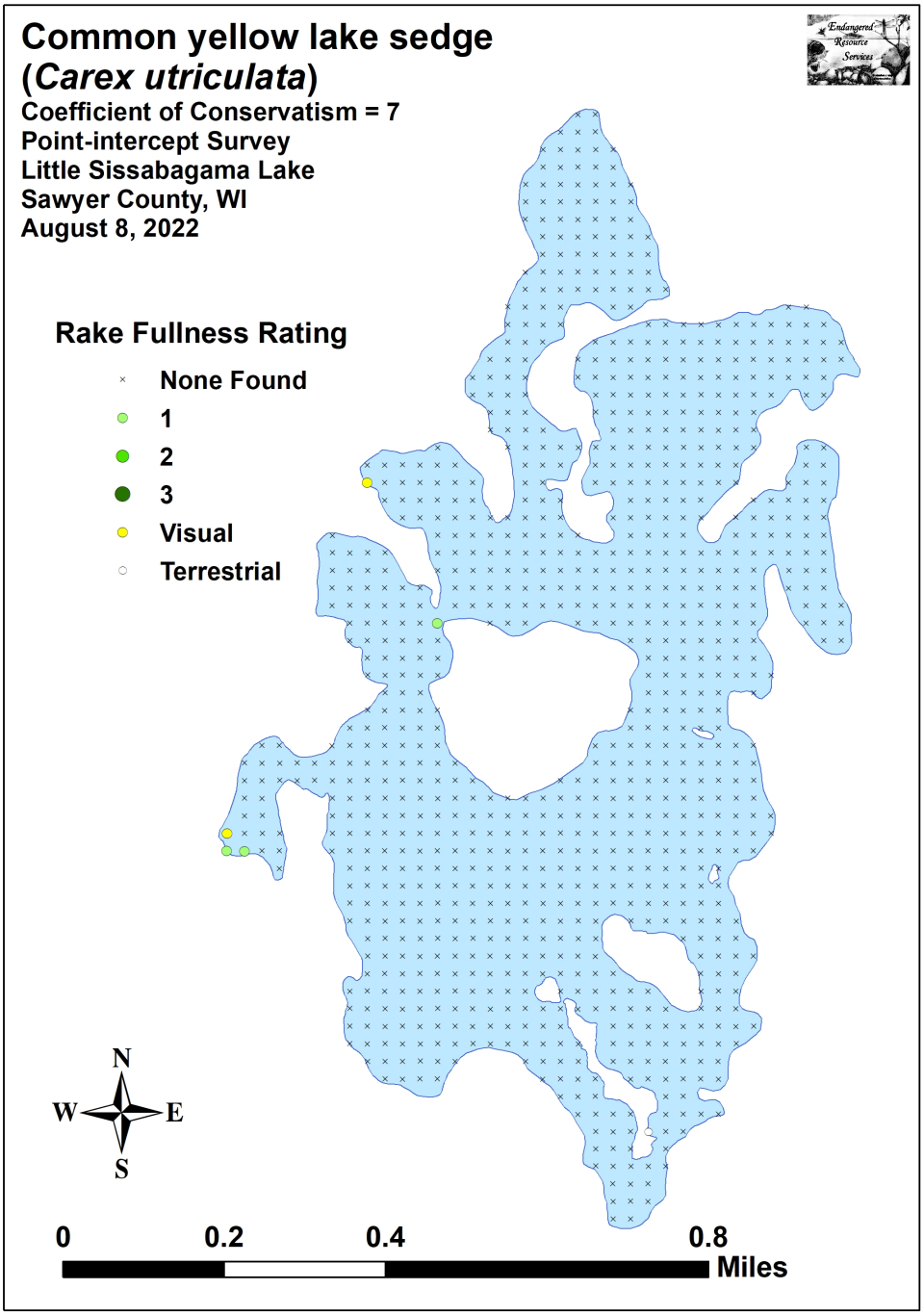
Miles


Common yellow lake sedge
(Carex utriculata)
Coefficient of Conservatism = 7
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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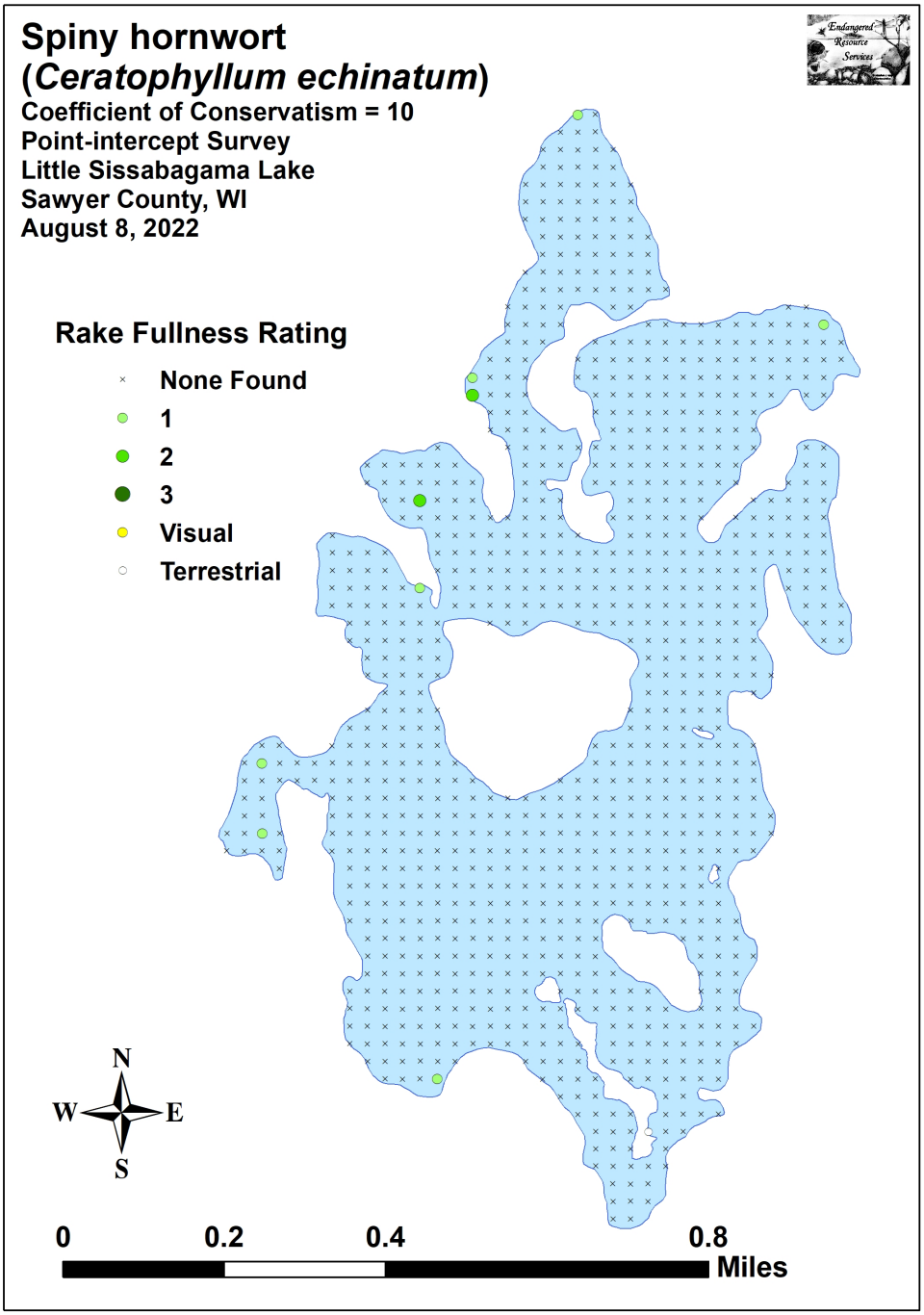
Spiny hornwort
(Ceratophyllum echinatum)
Coefficient of Conservatism = 10
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
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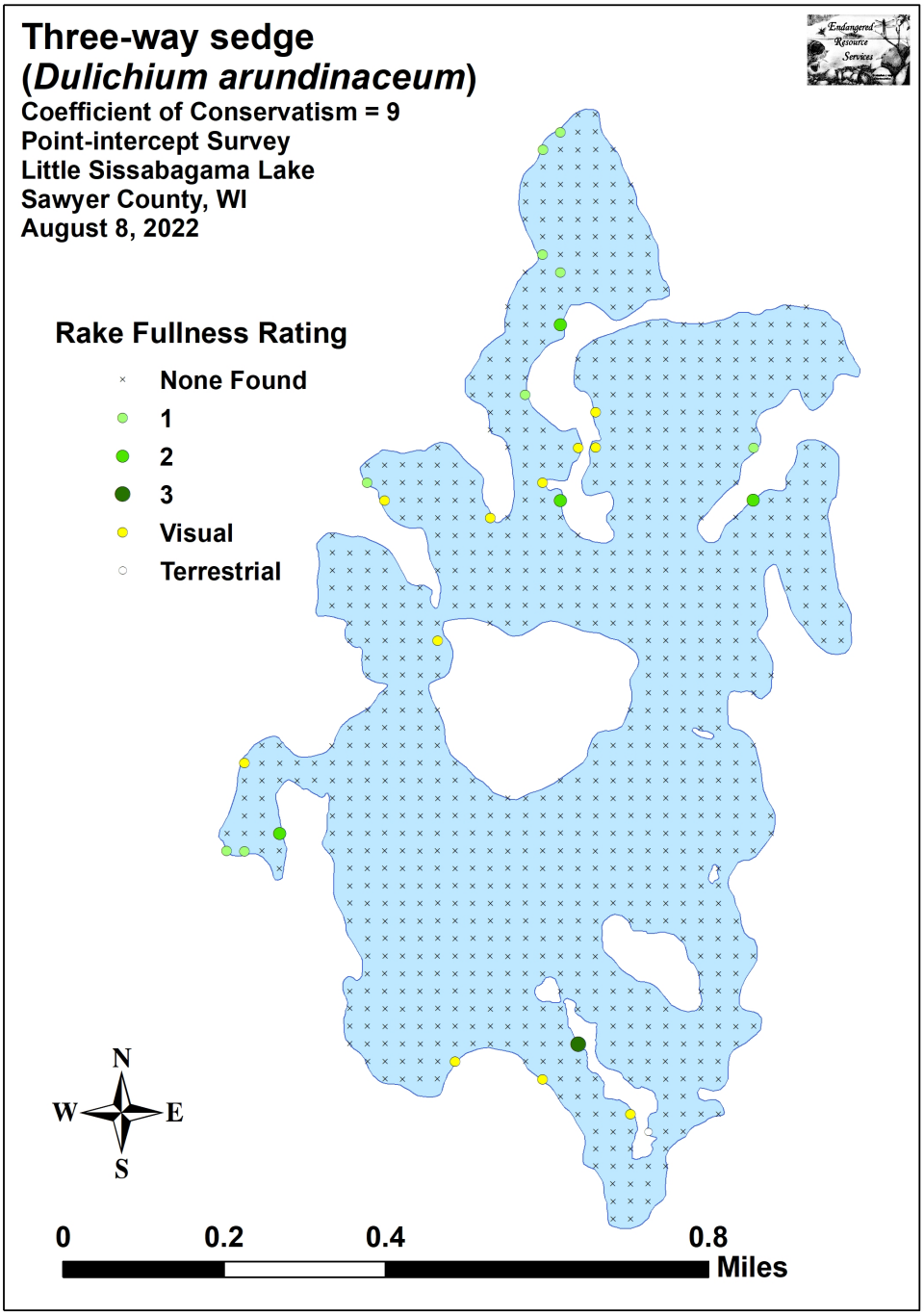
Miles


Three-way sedge
(Dulichium arundinaceum)
Coefficient of Conservatism = 9
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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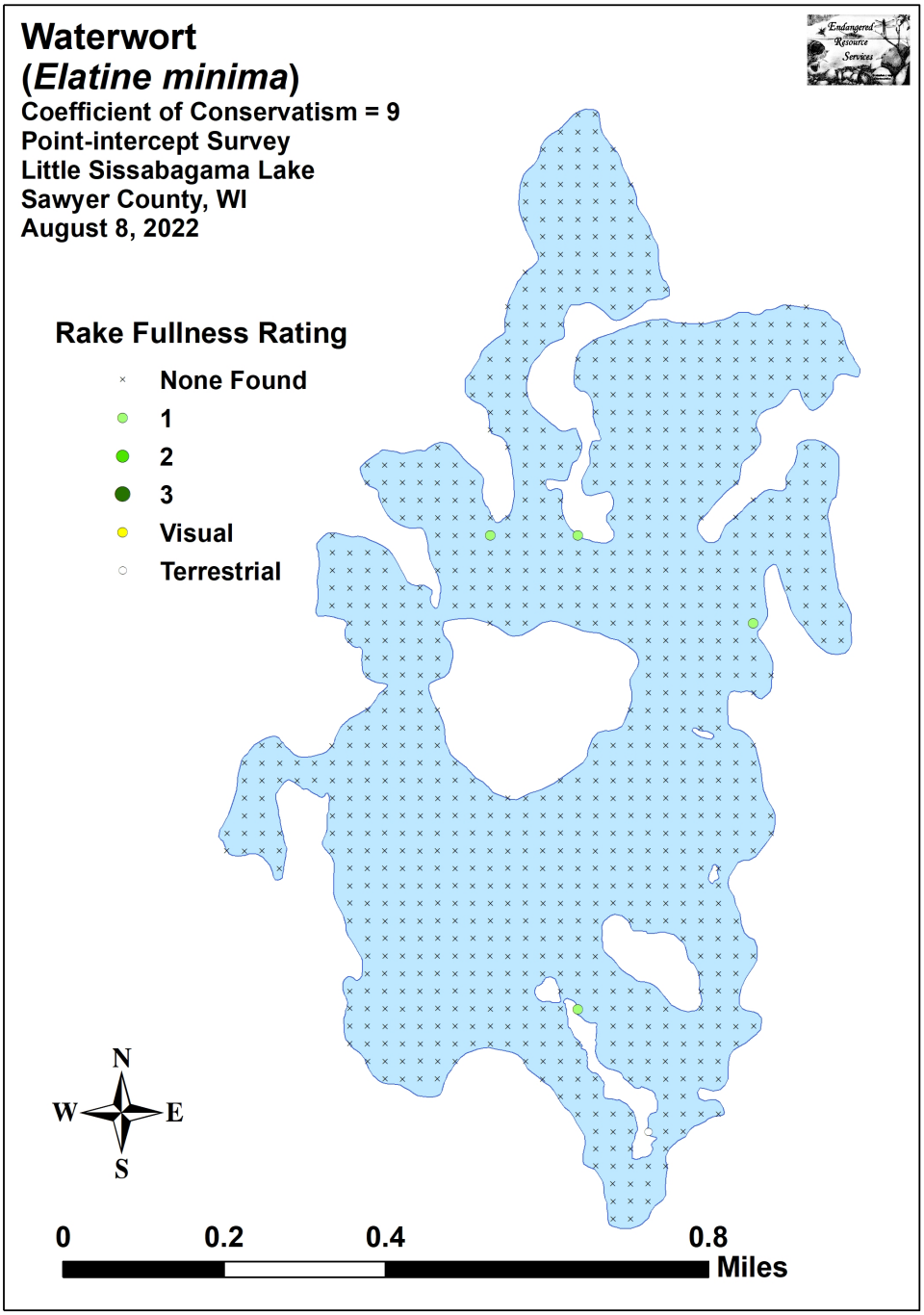
Miles


Waterwort
(Elatine minima)
Coefficient of Conservatism = 9
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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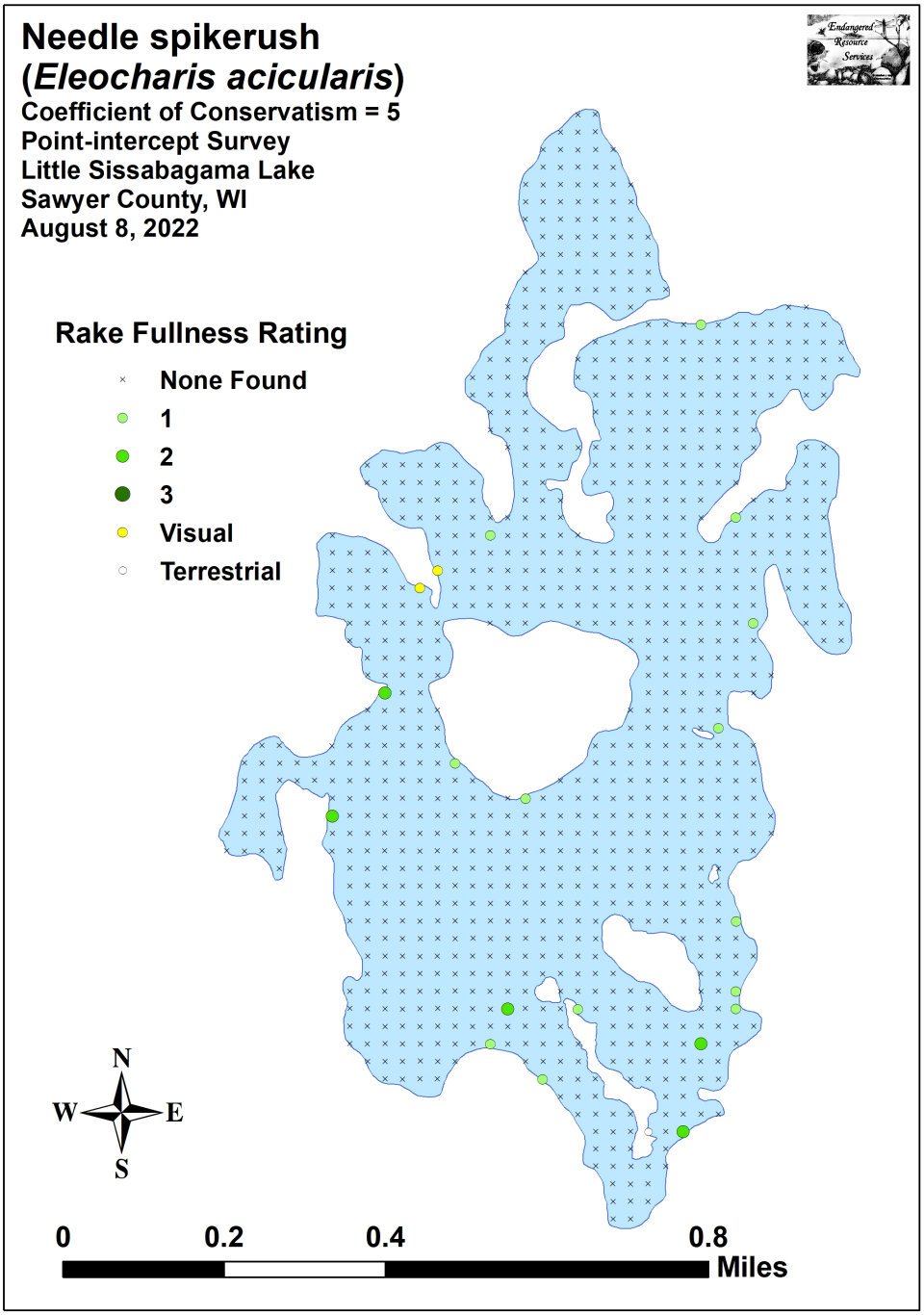
Miles


Needle spikerush
(Eleocharis acicularis)
Coefficient of Conservatism = 5
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
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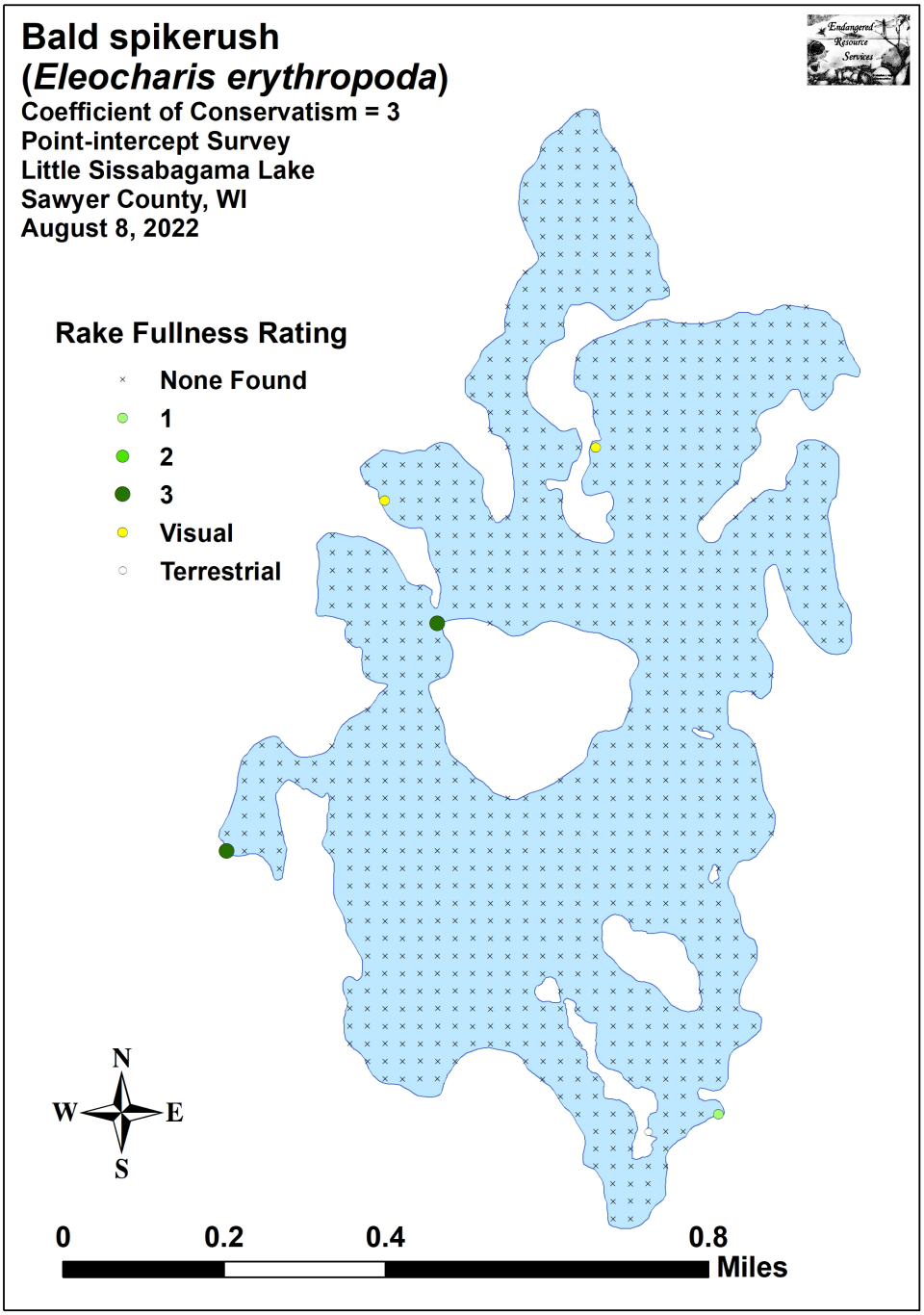
Miles


Bald spikerush
(Eleocharis erythropoda)
Coefficient of Conservatism = 3
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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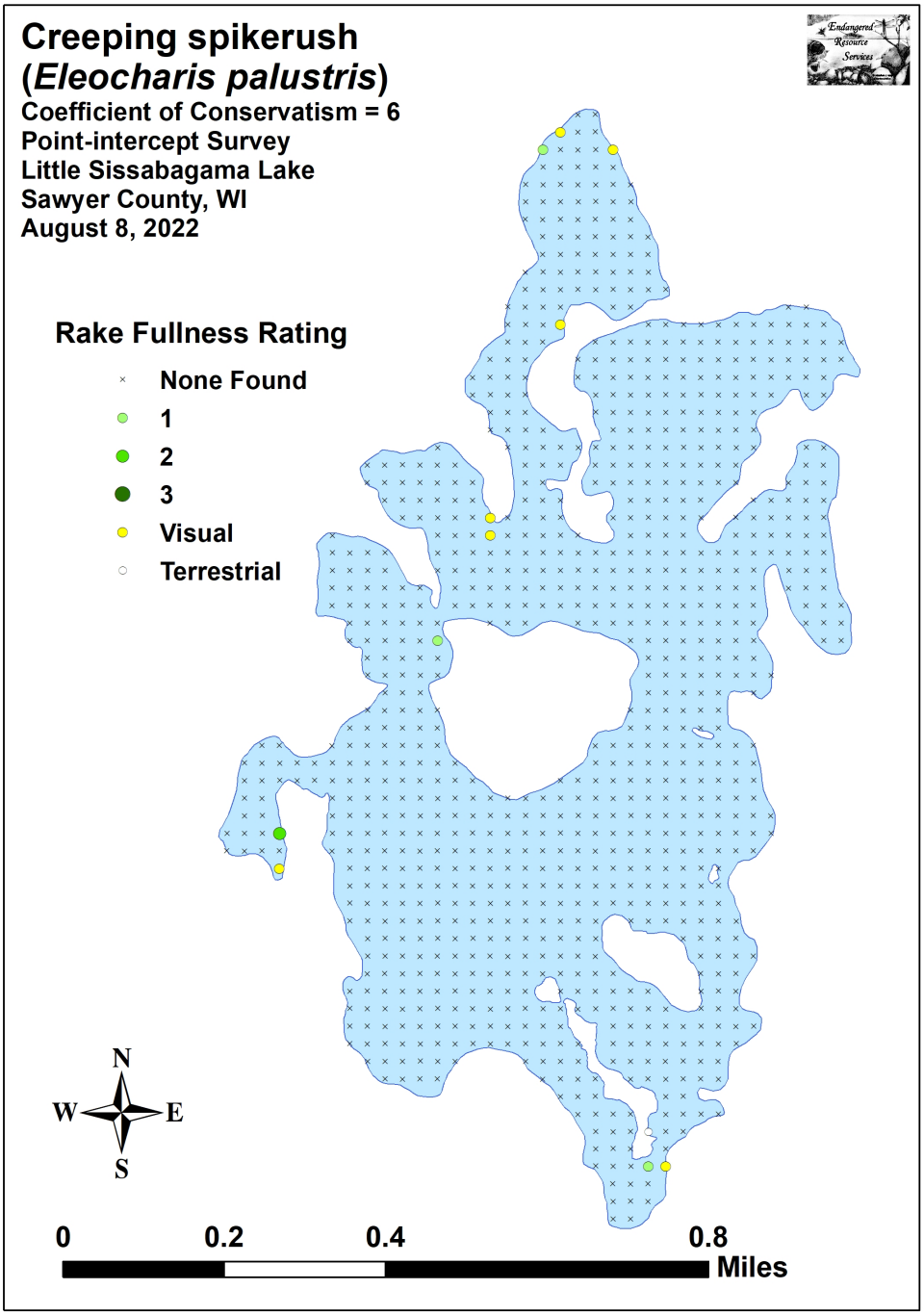
Miles


Creeping spikerush
(Eleocharis palustris)
Coefficient of Conservatism = 6
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
None Found
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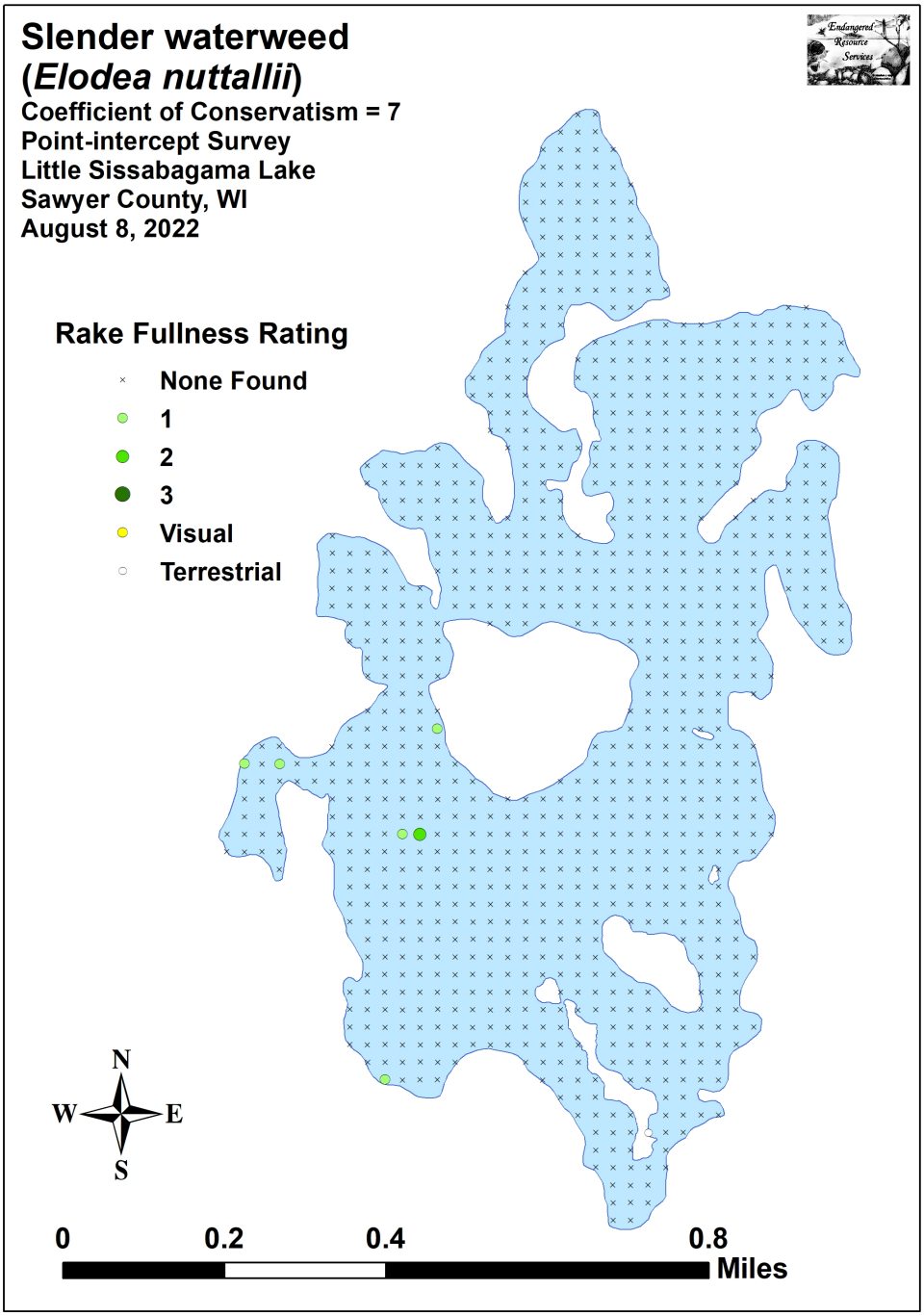
Slender waterweed
(Elodea nuttallii)
Coefficient of Conservatism = 7
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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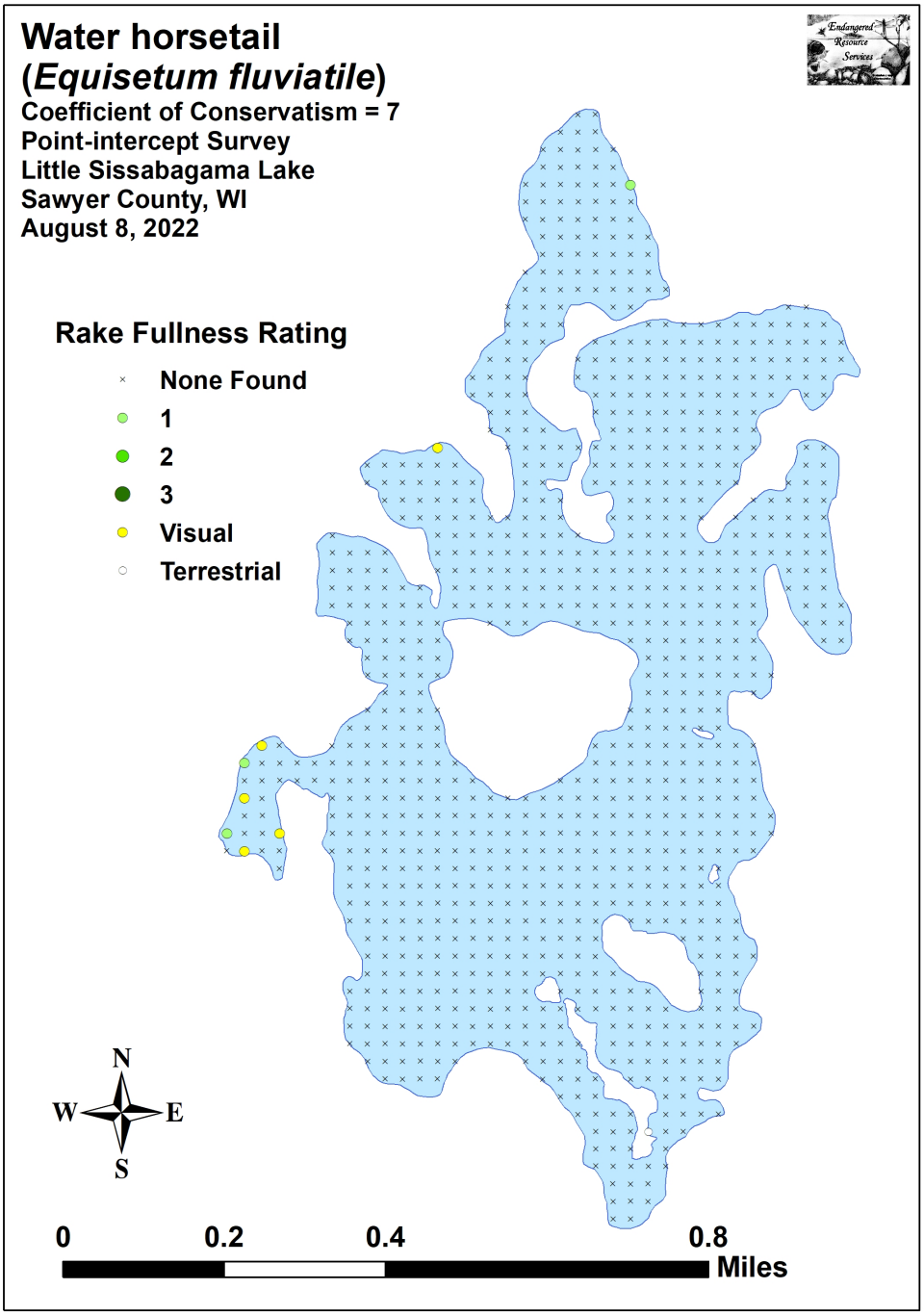
Miles


Water horsetail
(Equisetum fluviatile)
Coefficient of Conservatism = 7
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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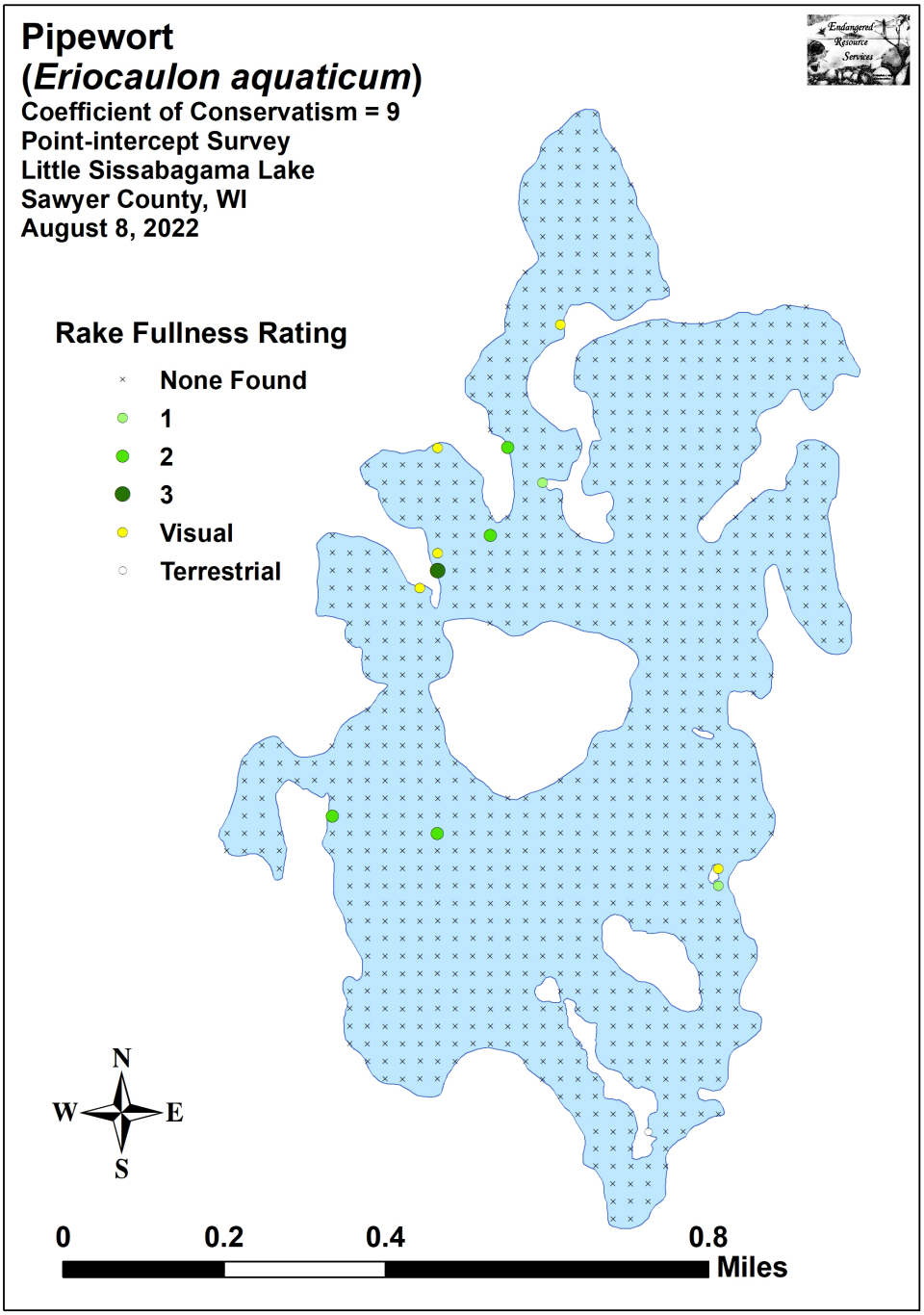
Pipewort
(Eriocaulon aquaticum)
Coefficient of Conservatism = 9
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
None Found
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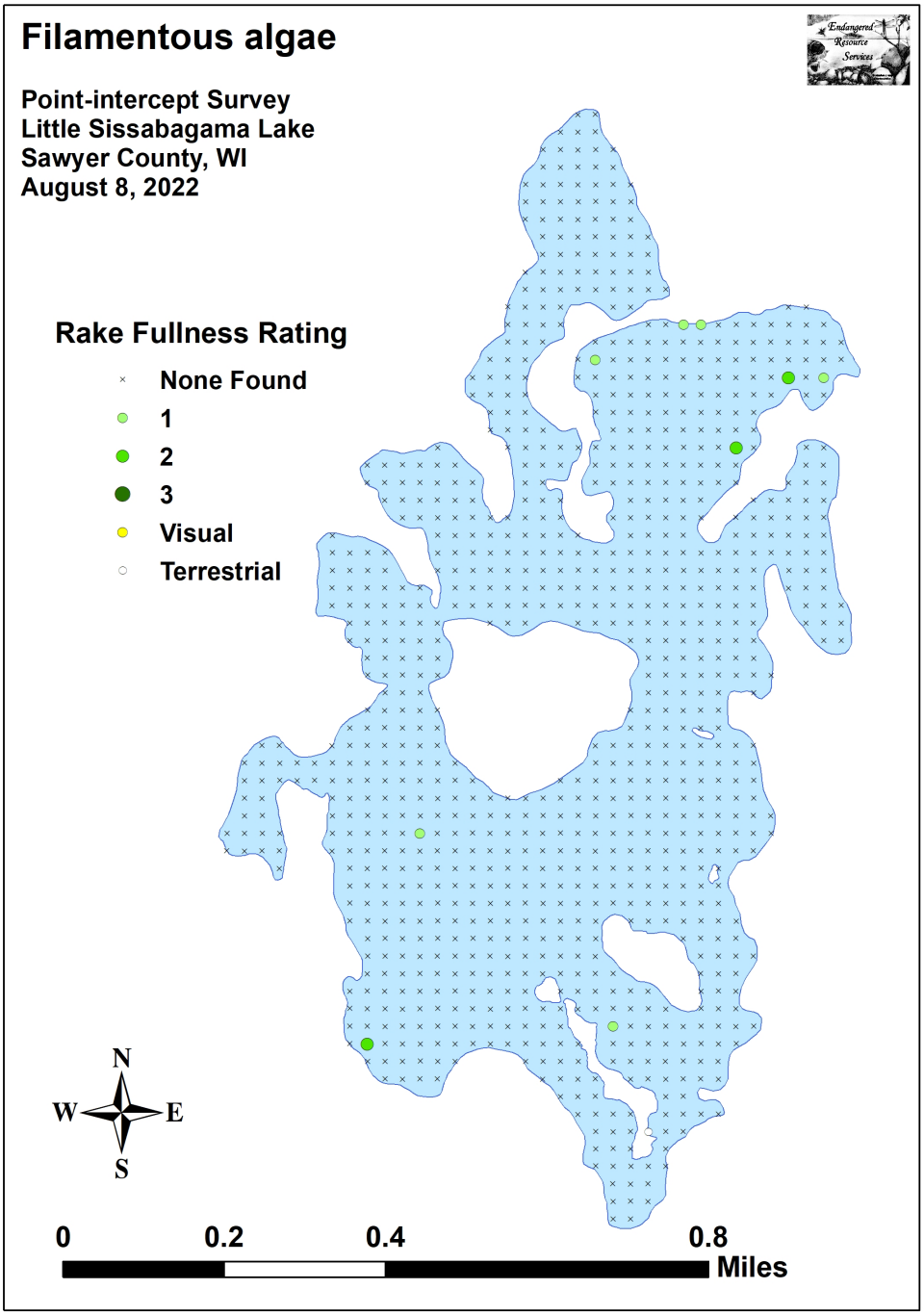
Miles


Filamentous algae
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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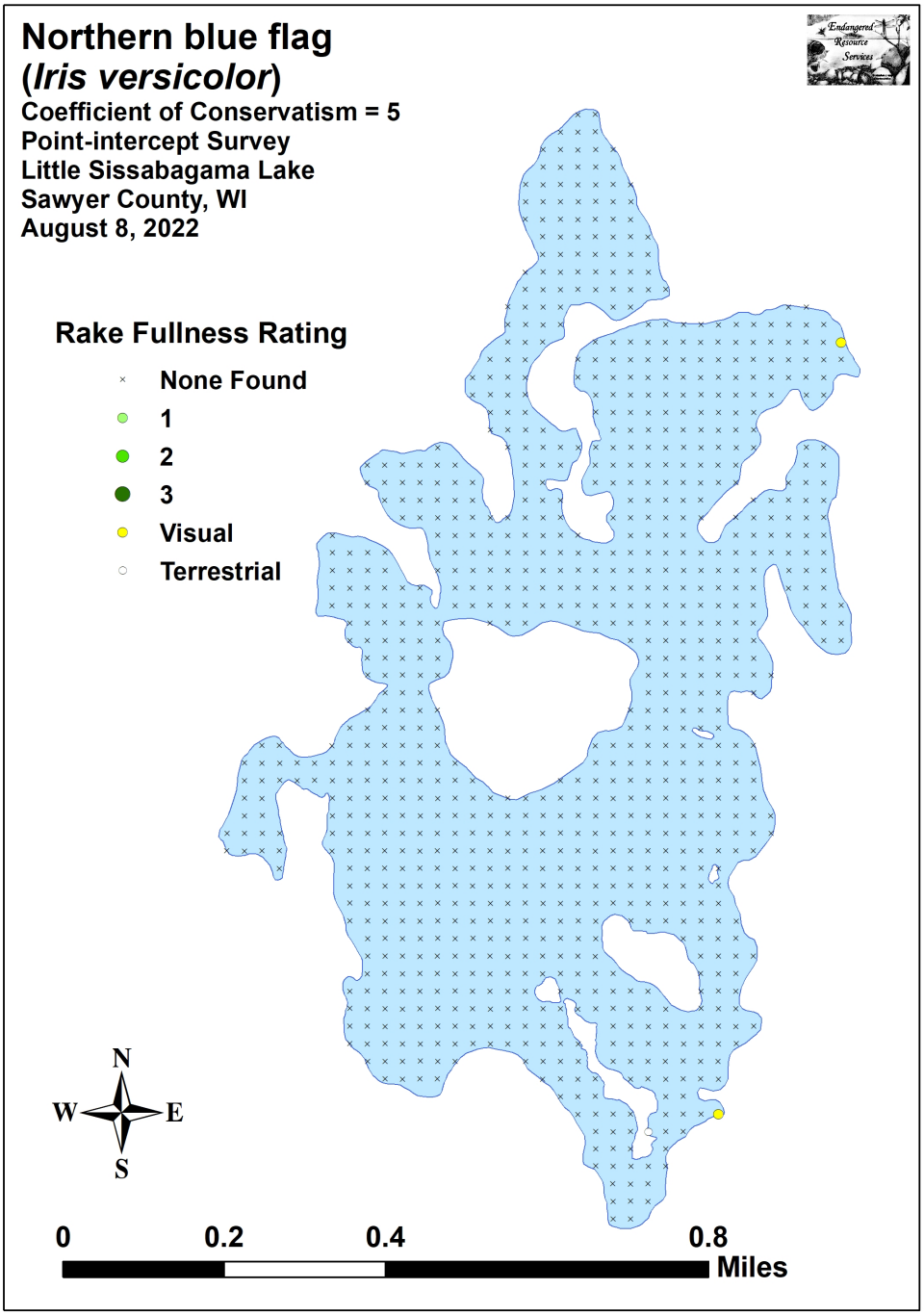
Miles


Northern blue flag
(Iris versicolor)
Coefficient of Conservatism = 5
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
None Found
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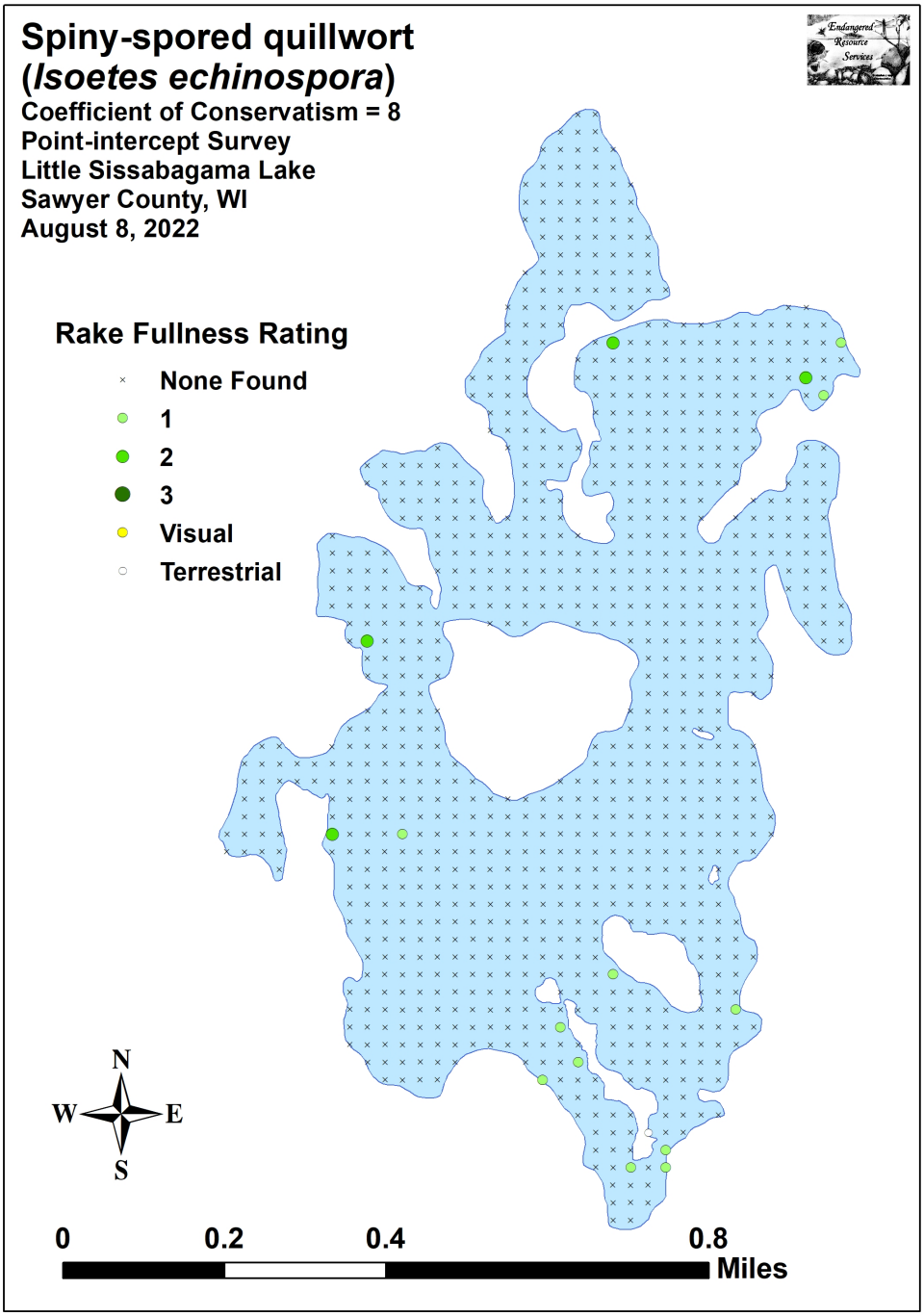
Spiny-spored quillwort
(Isoetes echinospora)
Coefficient of Conservatism = 8
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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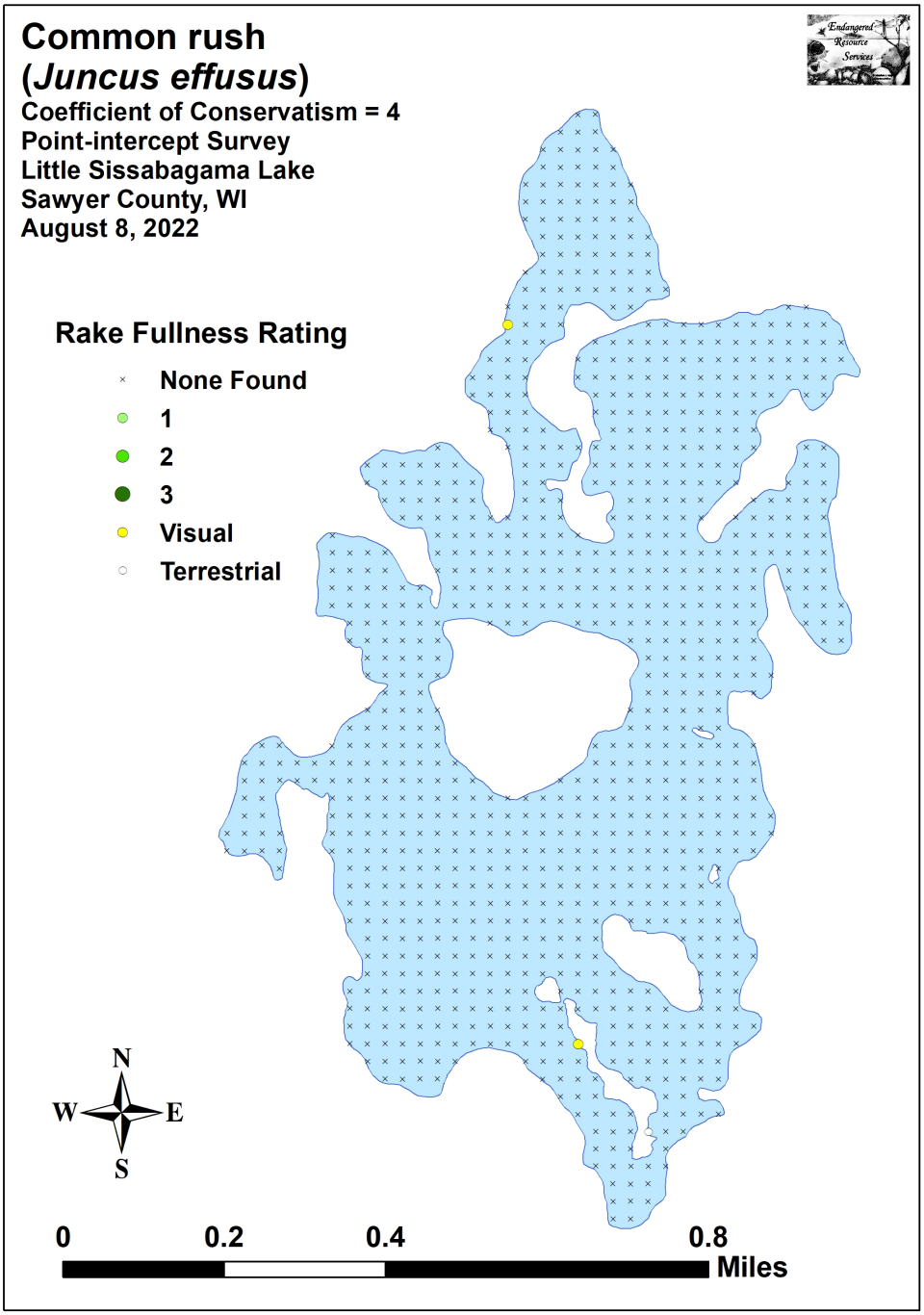
Common rush
(Juncus effusus)
Coefficient of Conservatism = 4
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
None Found
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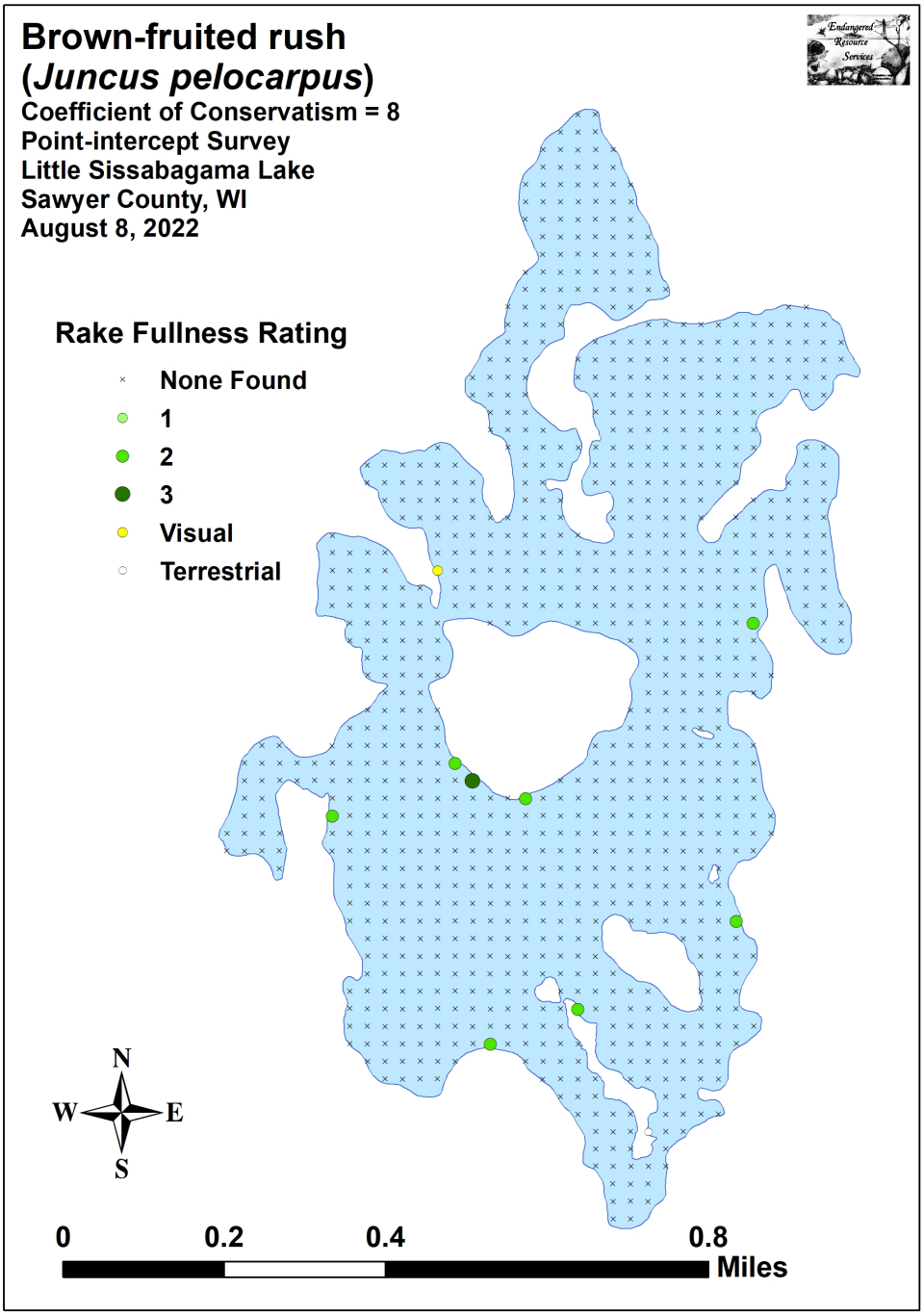
Brown-fruited rush
(Juncus pelocarpus)
Coefficient of Conservatism = 8
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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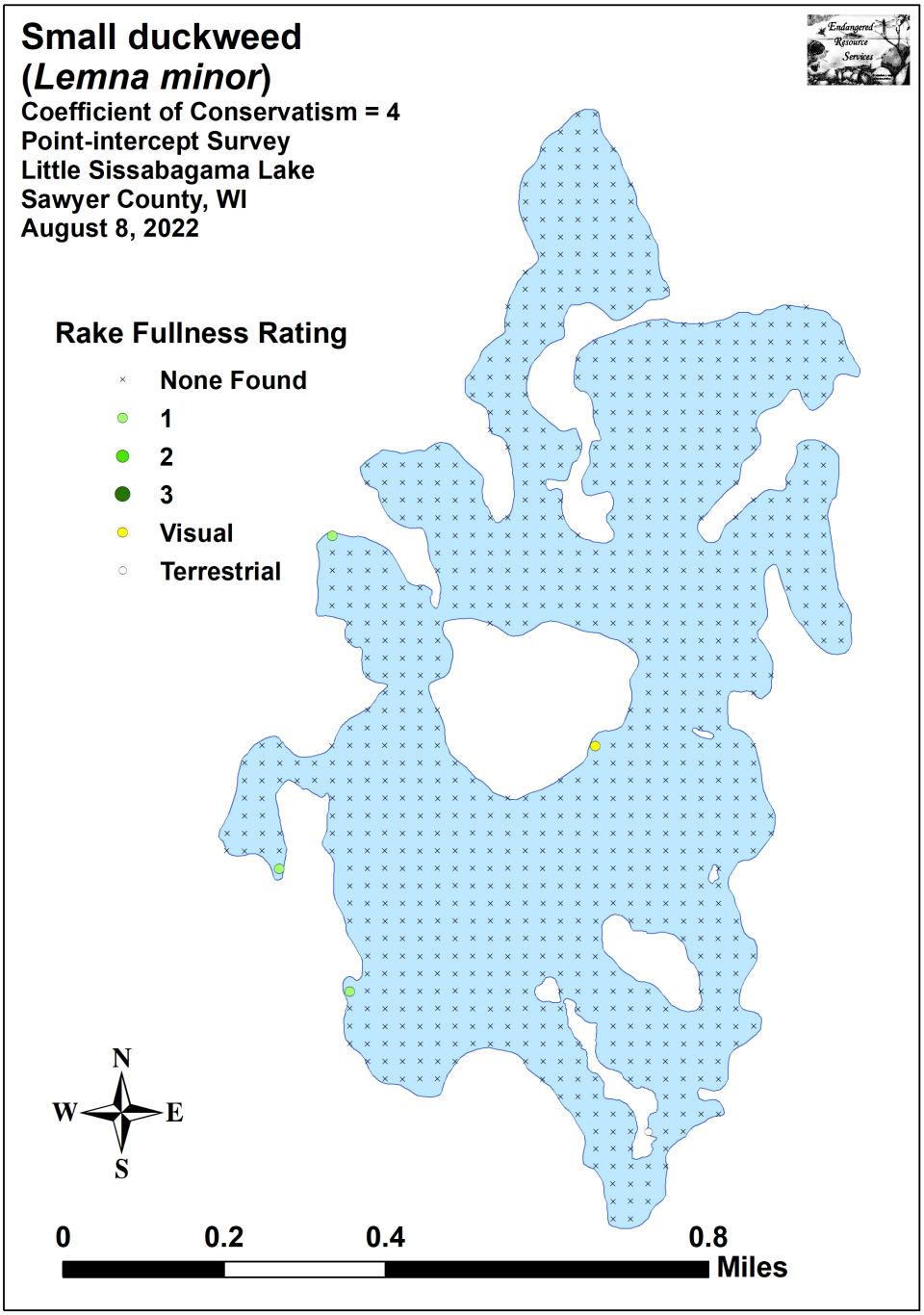
Small duckweed
(Lemna minor)
Coefficient of Conservatism = 4
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
None Found
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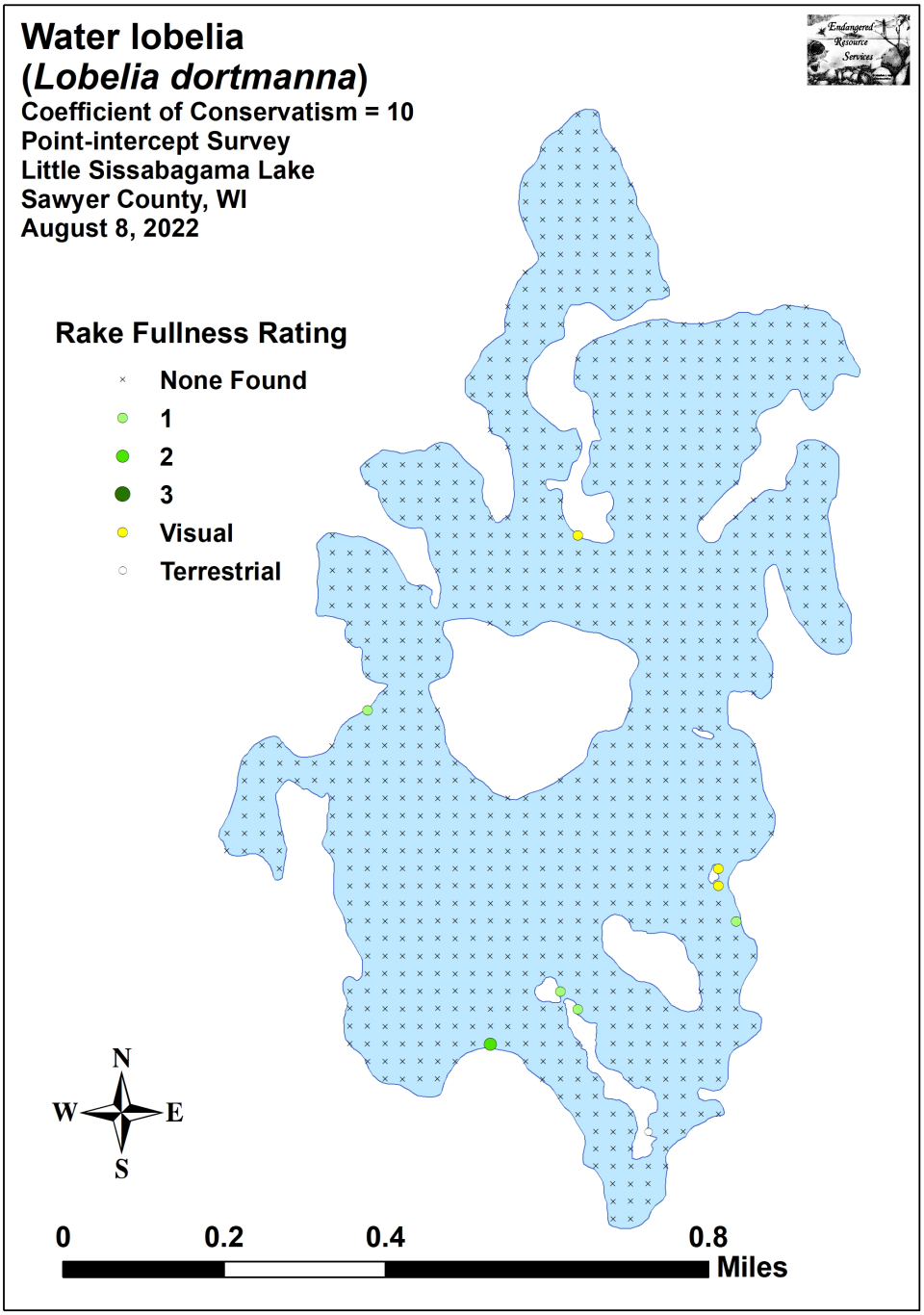
Water lobelia
(Lobelia dortmanna)
Coefficient of Conservatism = 10
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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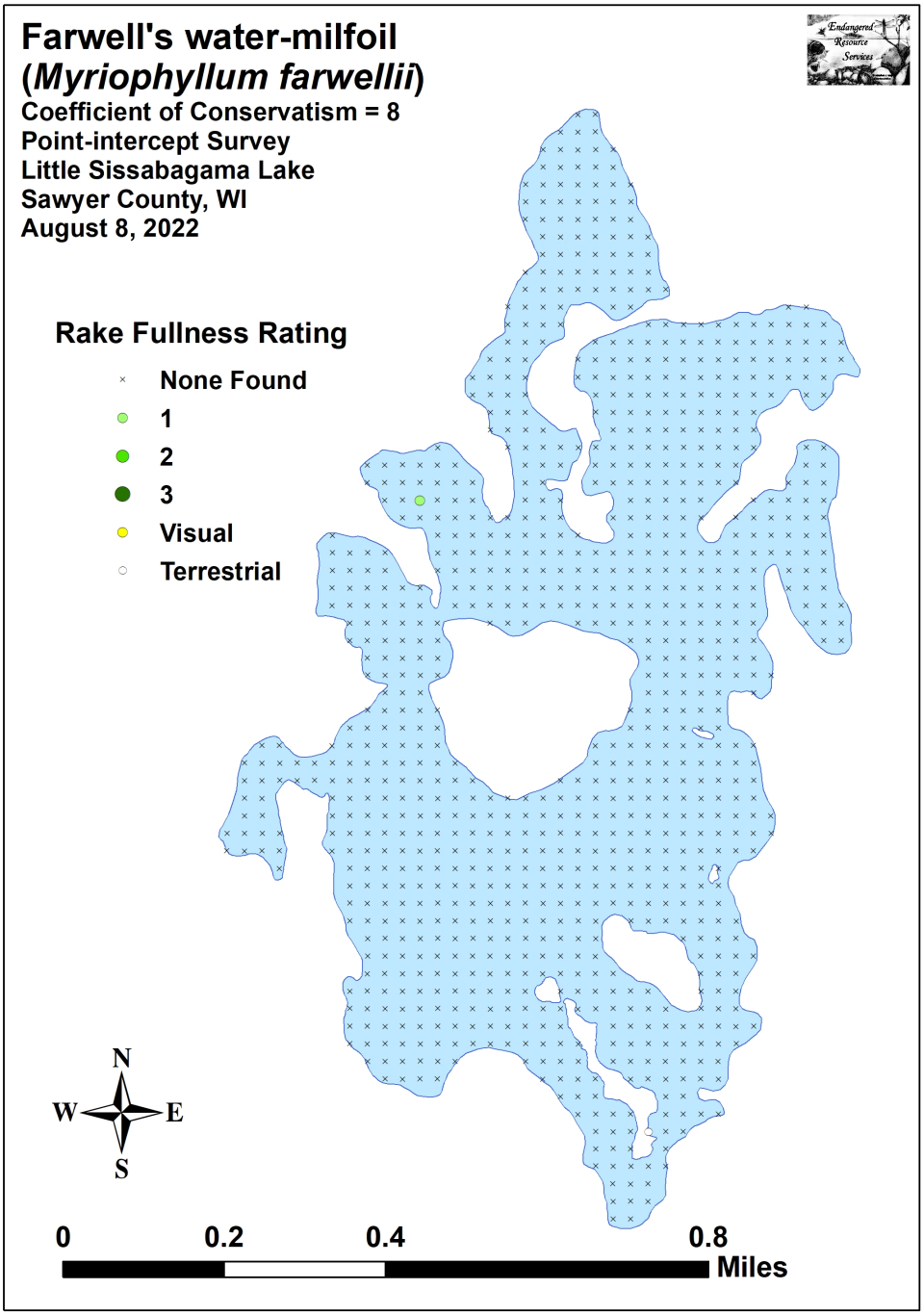
Farwell's water-milfoil
(Myriophyllum farwellii)
Coefficient of Conservatism = 8
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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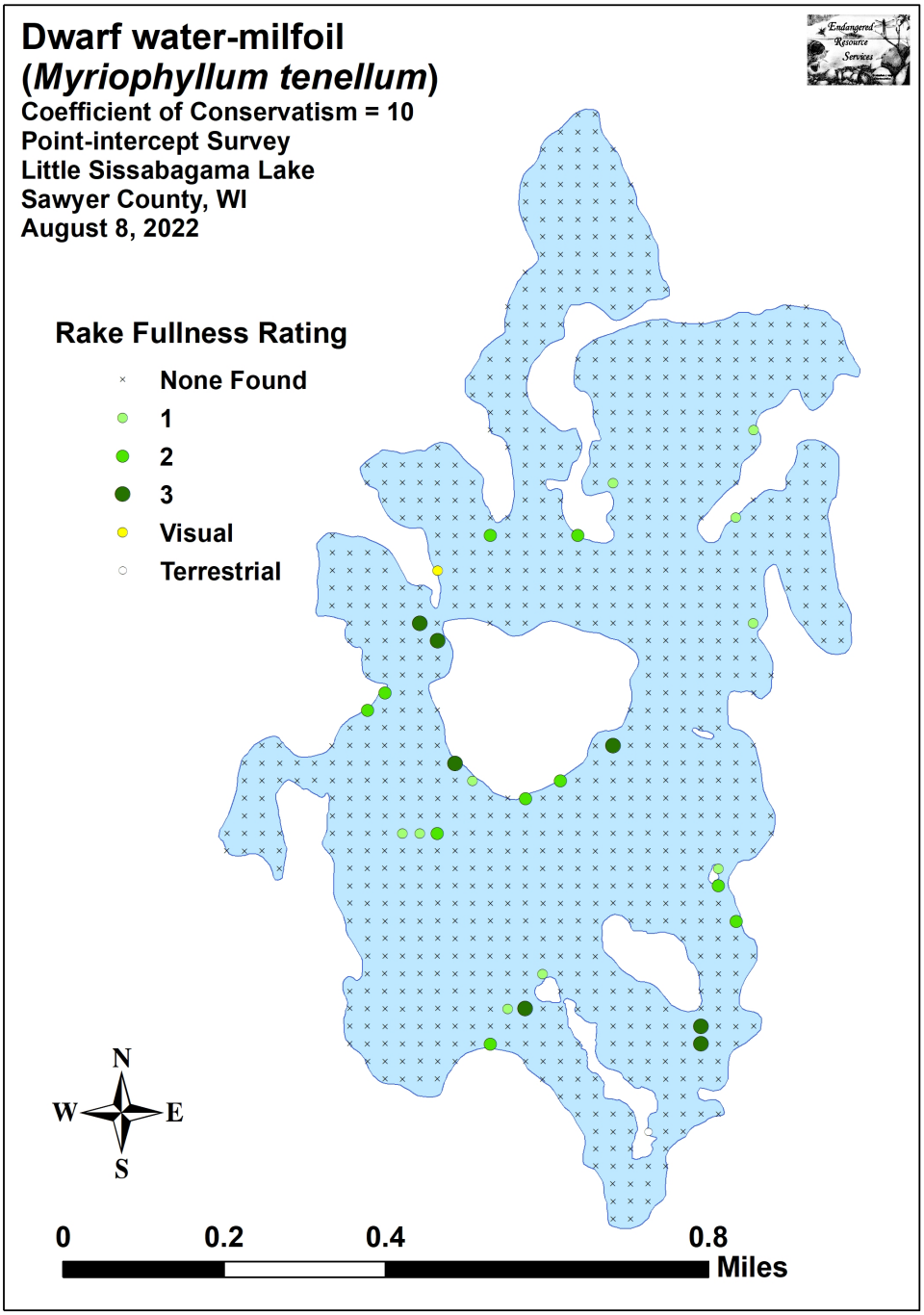
Dwarf water-milfoil
(Myriophyllum tenellum)
Coefficient of Conservatism = 10
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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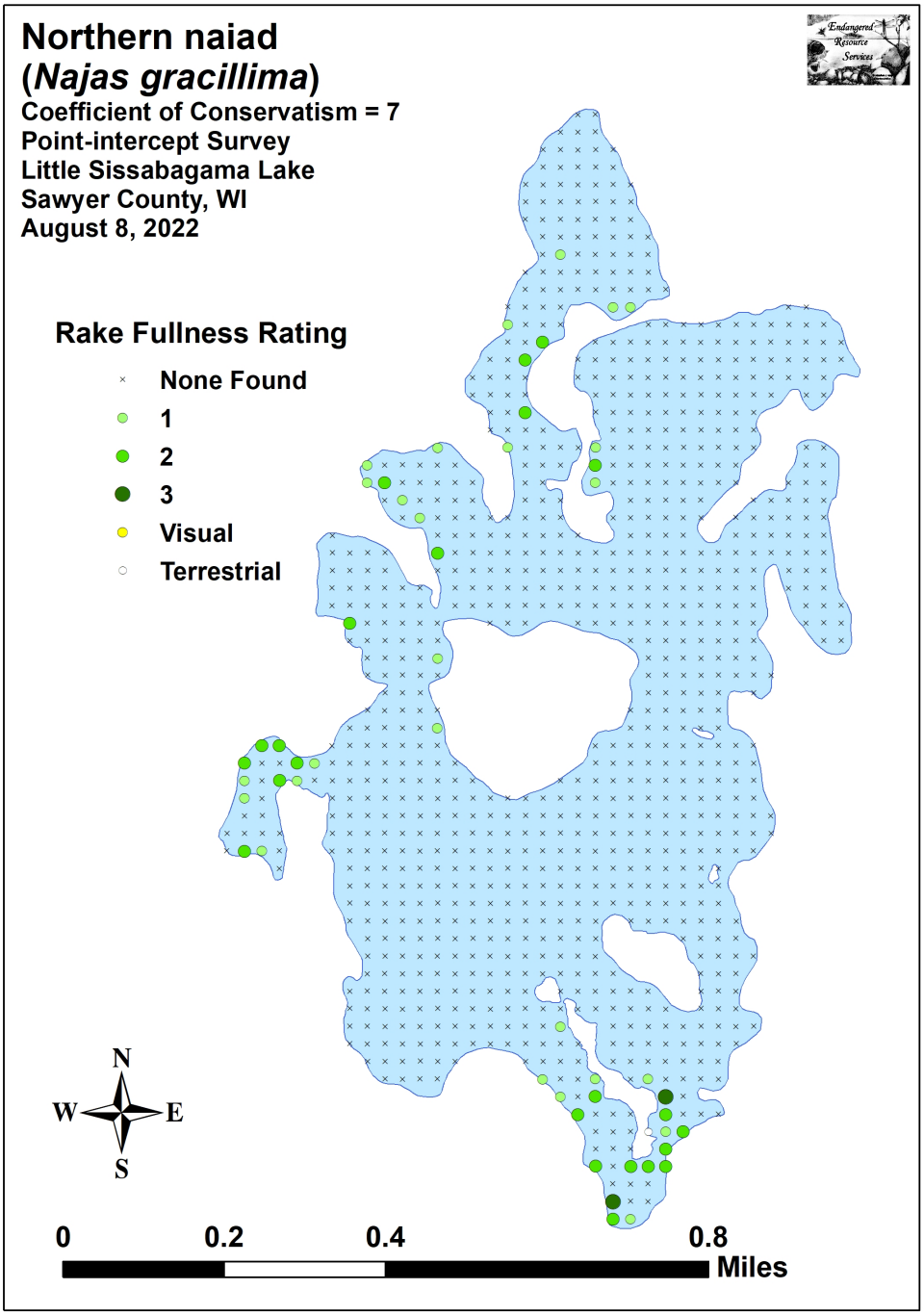
Northern naiad
(Najas gracillima)
Coefficient of Conservatism = 7
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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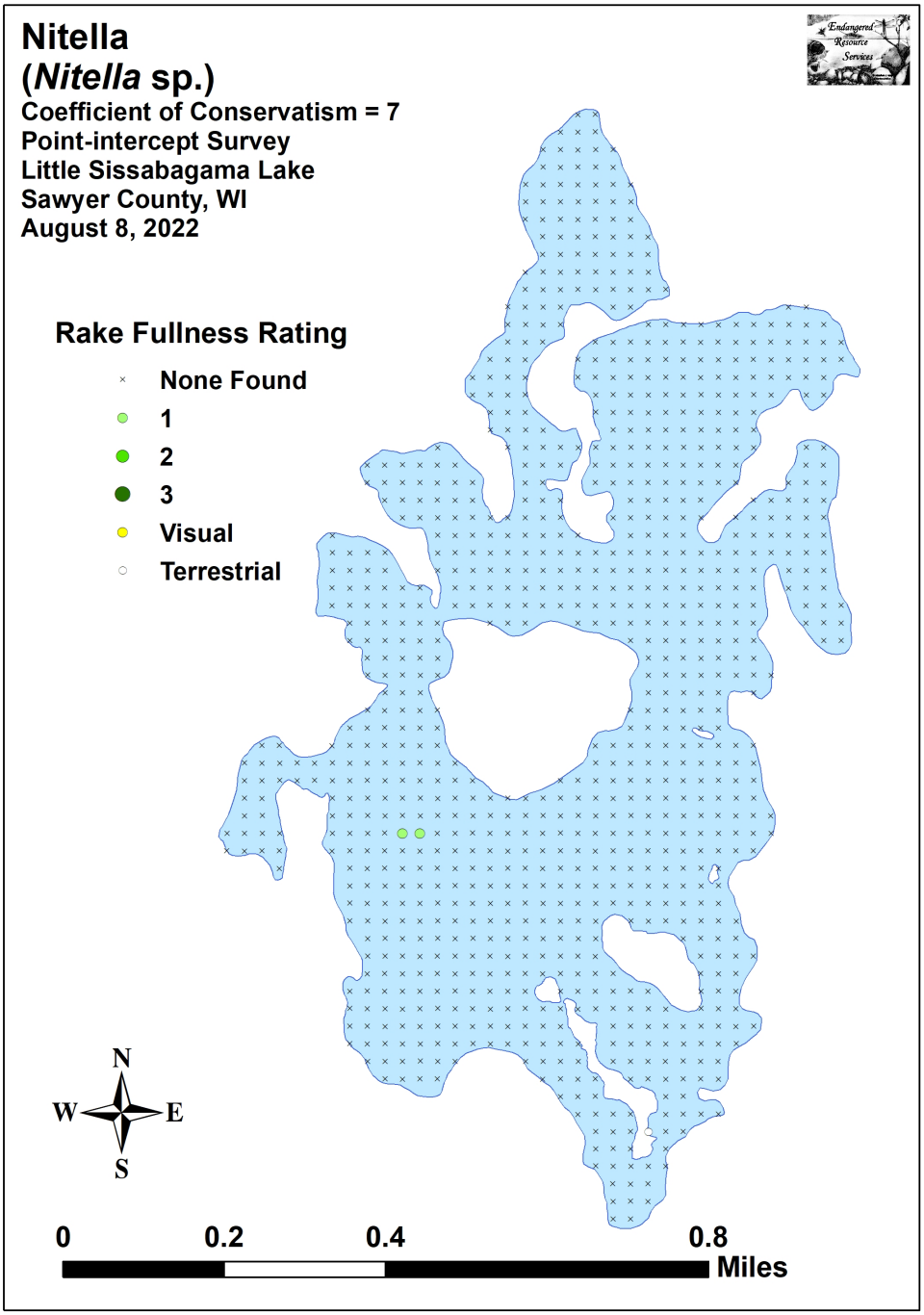
Nitella
(Nitella sp.)
Coefficient of Conservatism = 7
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
None Found
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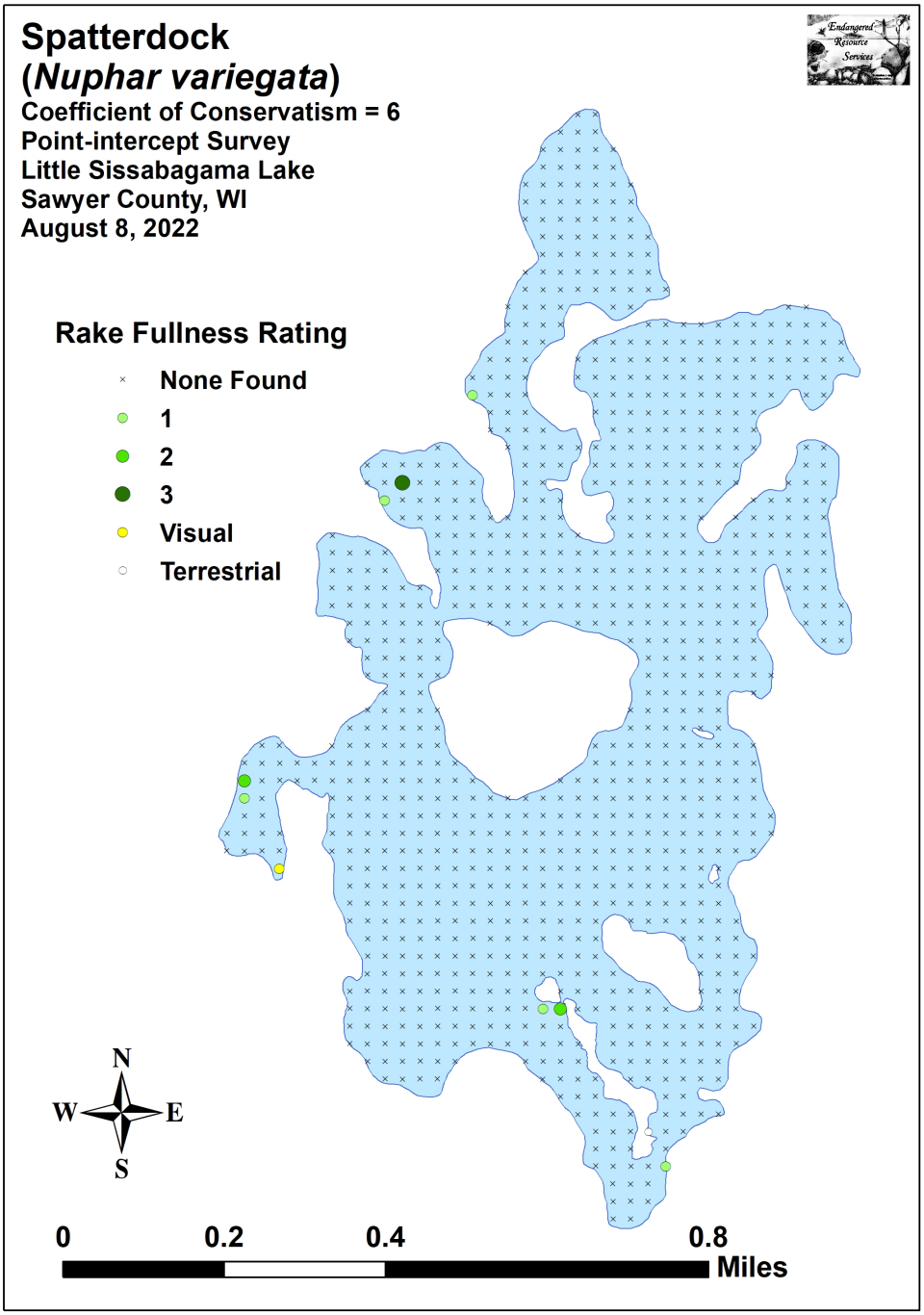
Spatterdock
(Nuphar variegata)
Coefficient of Conservatism = 6
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
None Found
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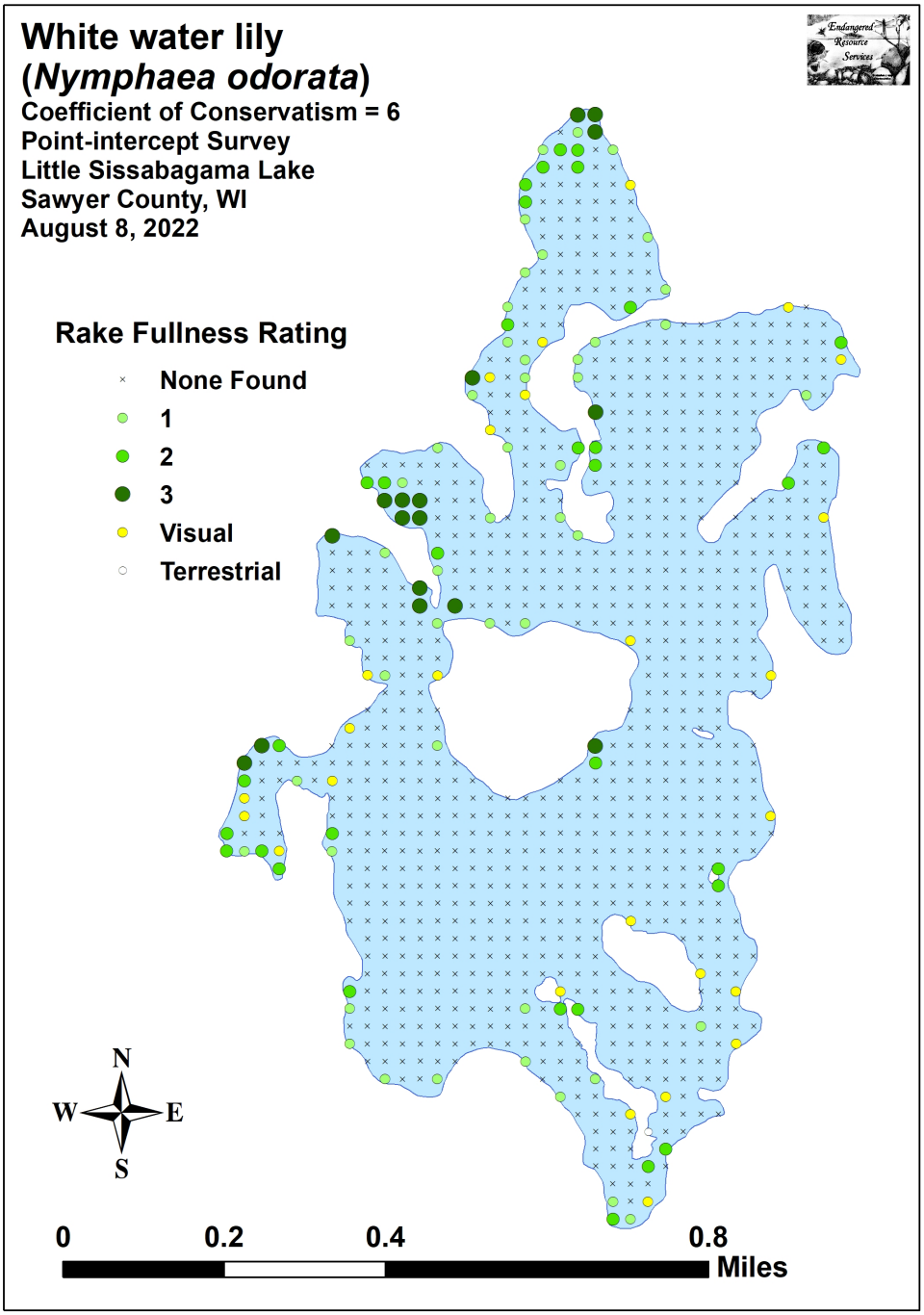
White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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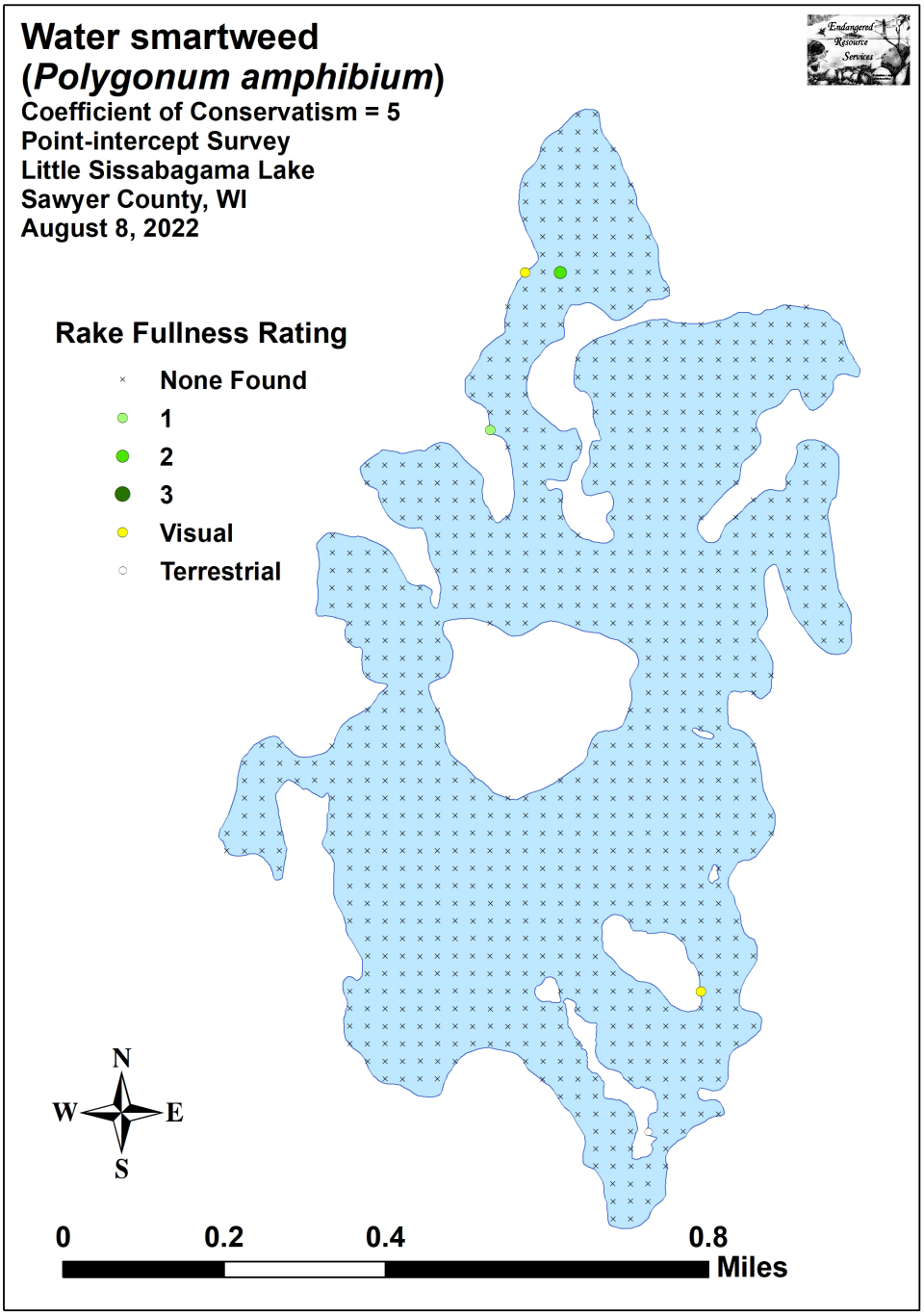
Water smartweed
(Polygonum amphibium)
Coefficient of Conservatism = 5
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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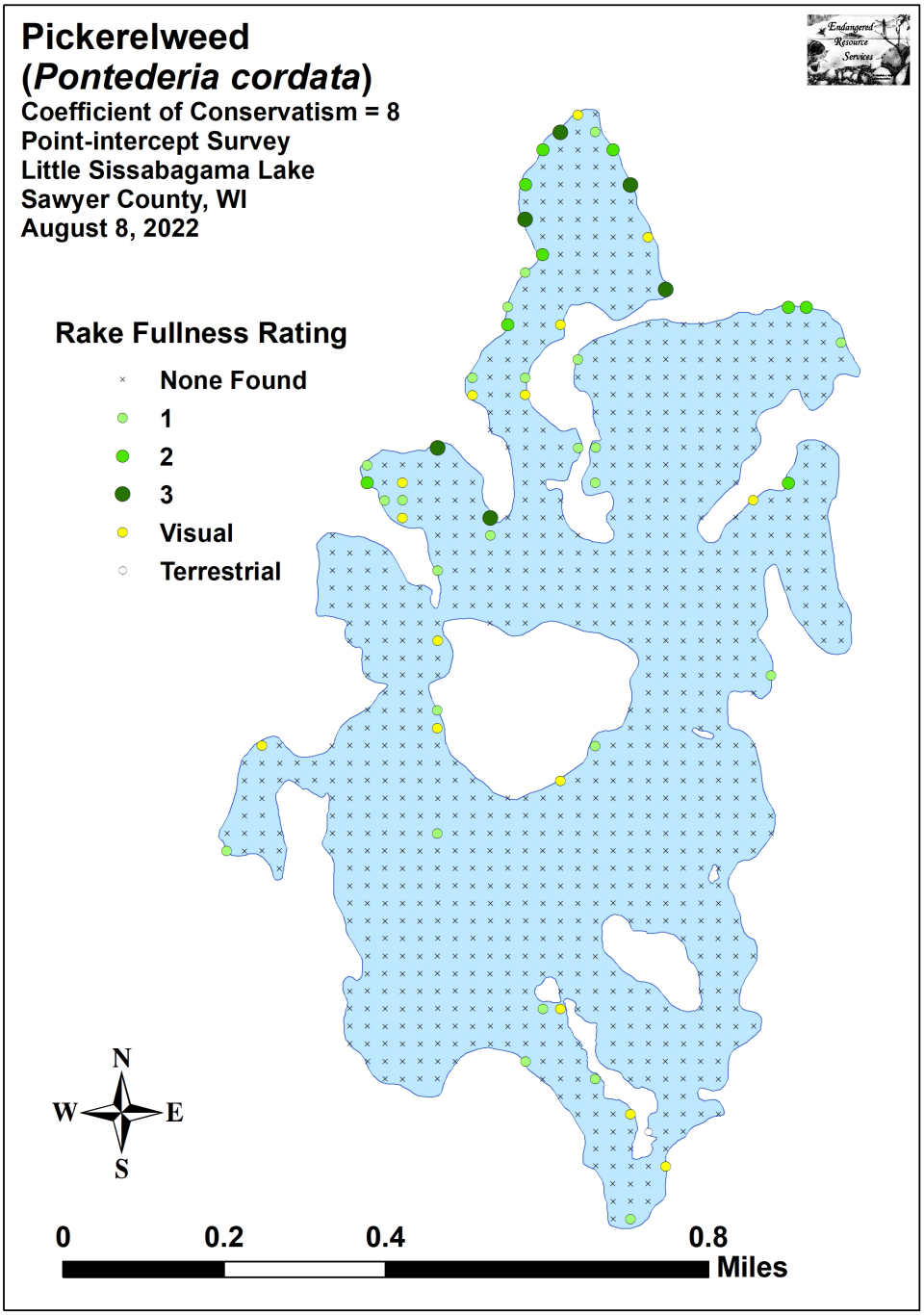
Pickerelweed
(Pontederia cordata)
Coefficient of Conservatism = 8
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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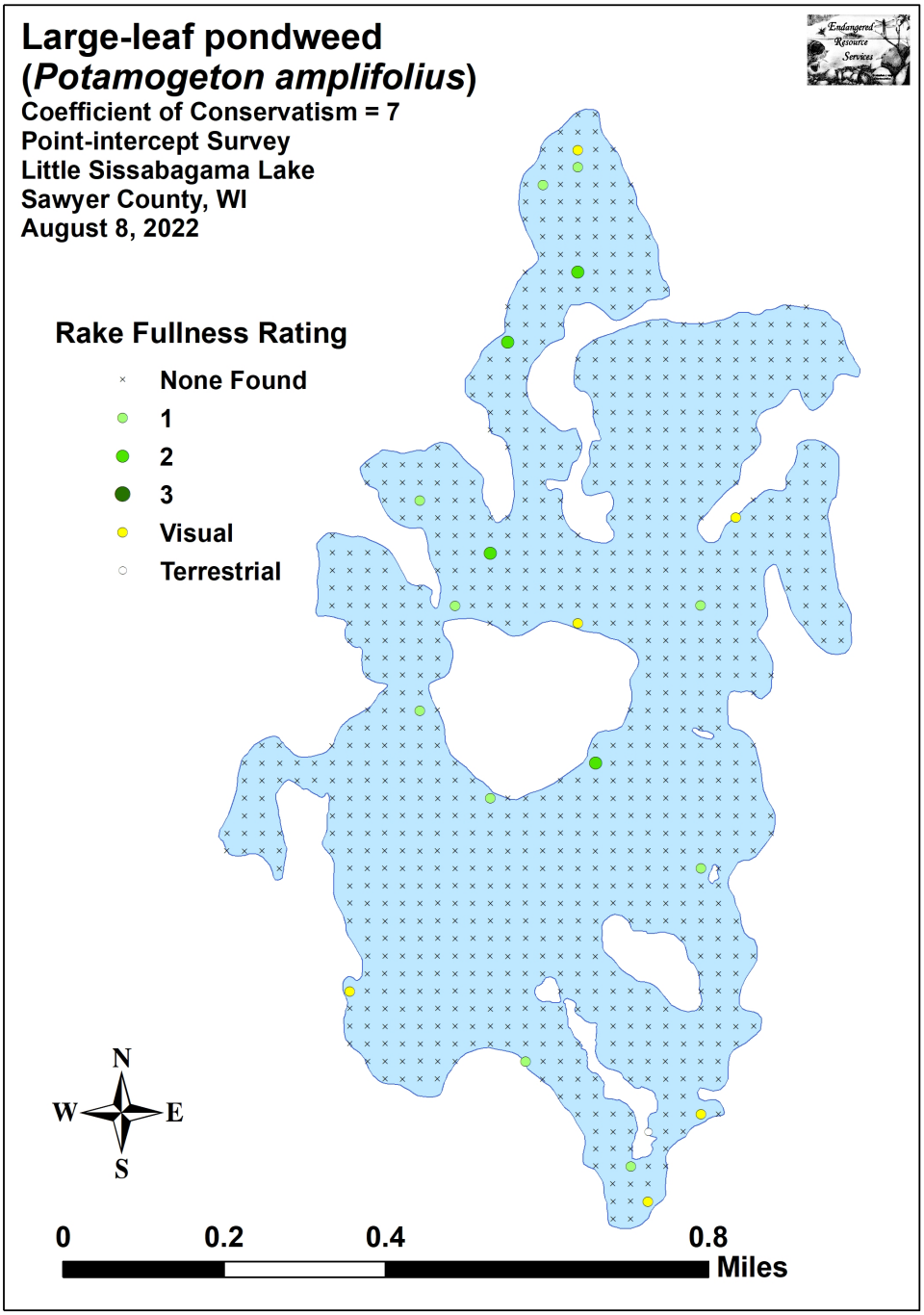
Large-leaf pondweed
(Potamogeton amplifolius)
Coefficient of Conservatism = 7
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
None Found
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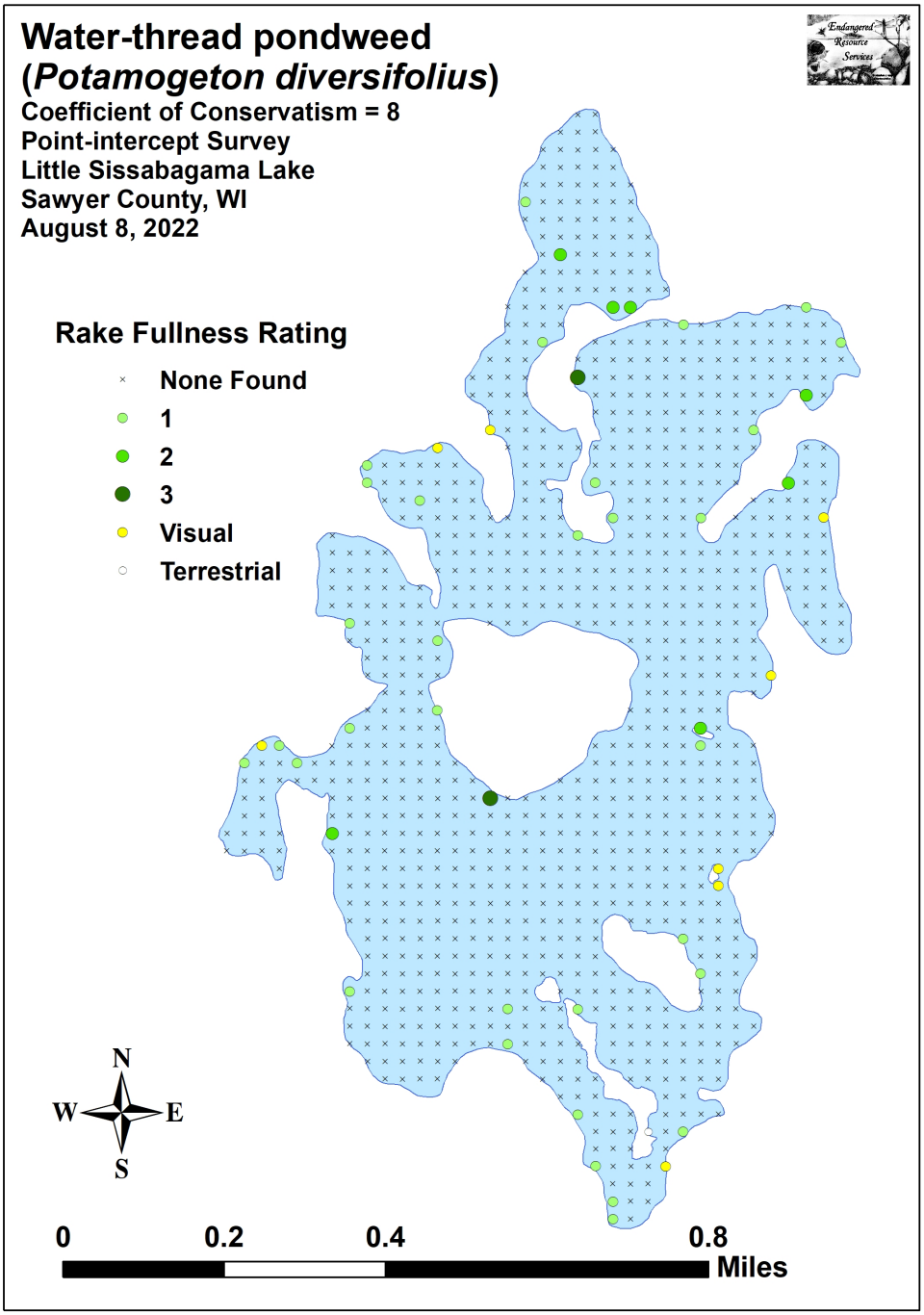
Water-thread pondweed
(Potamogeton diversifolius)
Coefficient of Conservatism = 8
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
1
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Visual
Terrestrial
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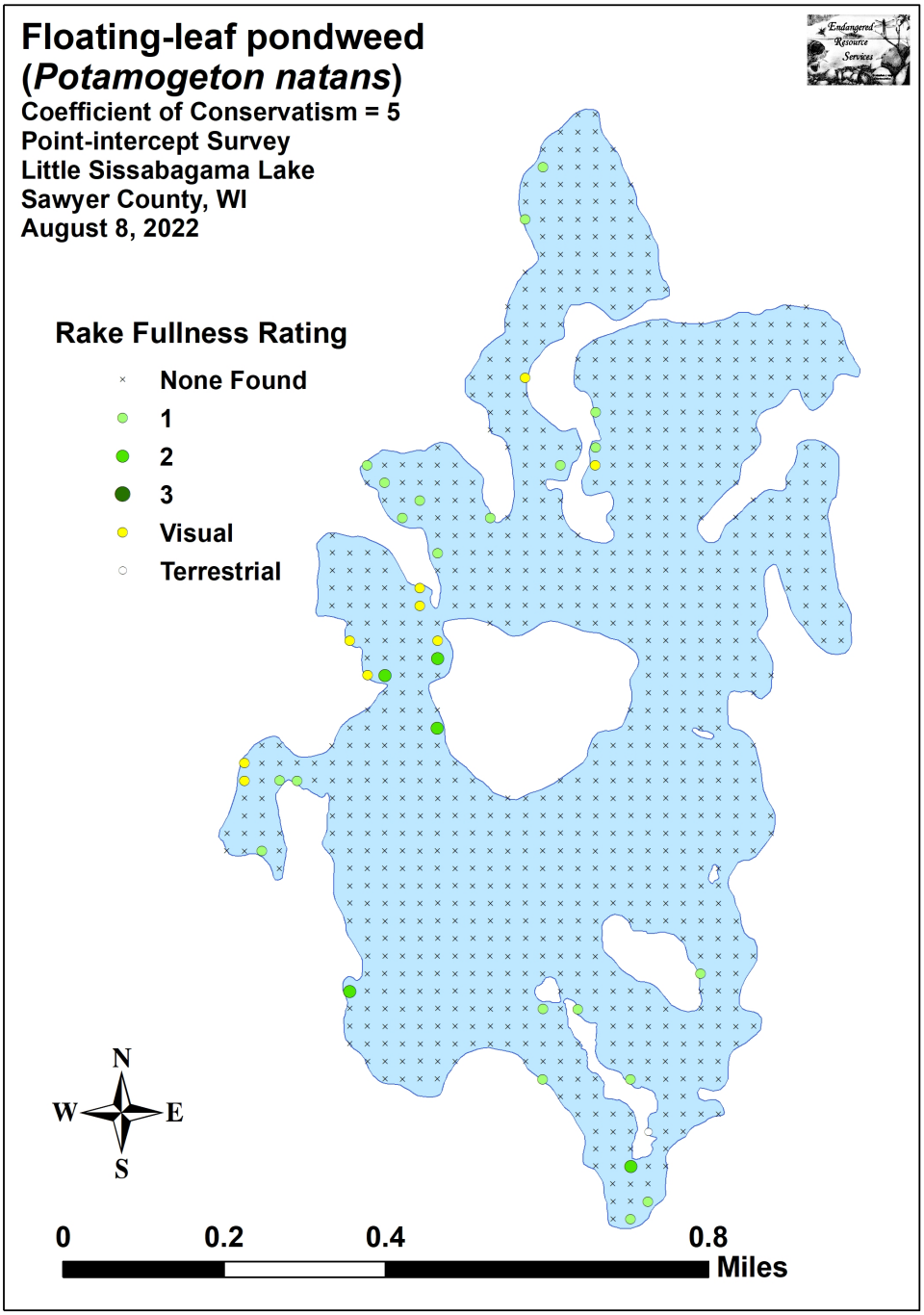
0.2
0.4
0.8
Miles


Floating-leaf pondweed
(Potamogeton natans)
Coefficient of Conservatism = 5
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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Visual
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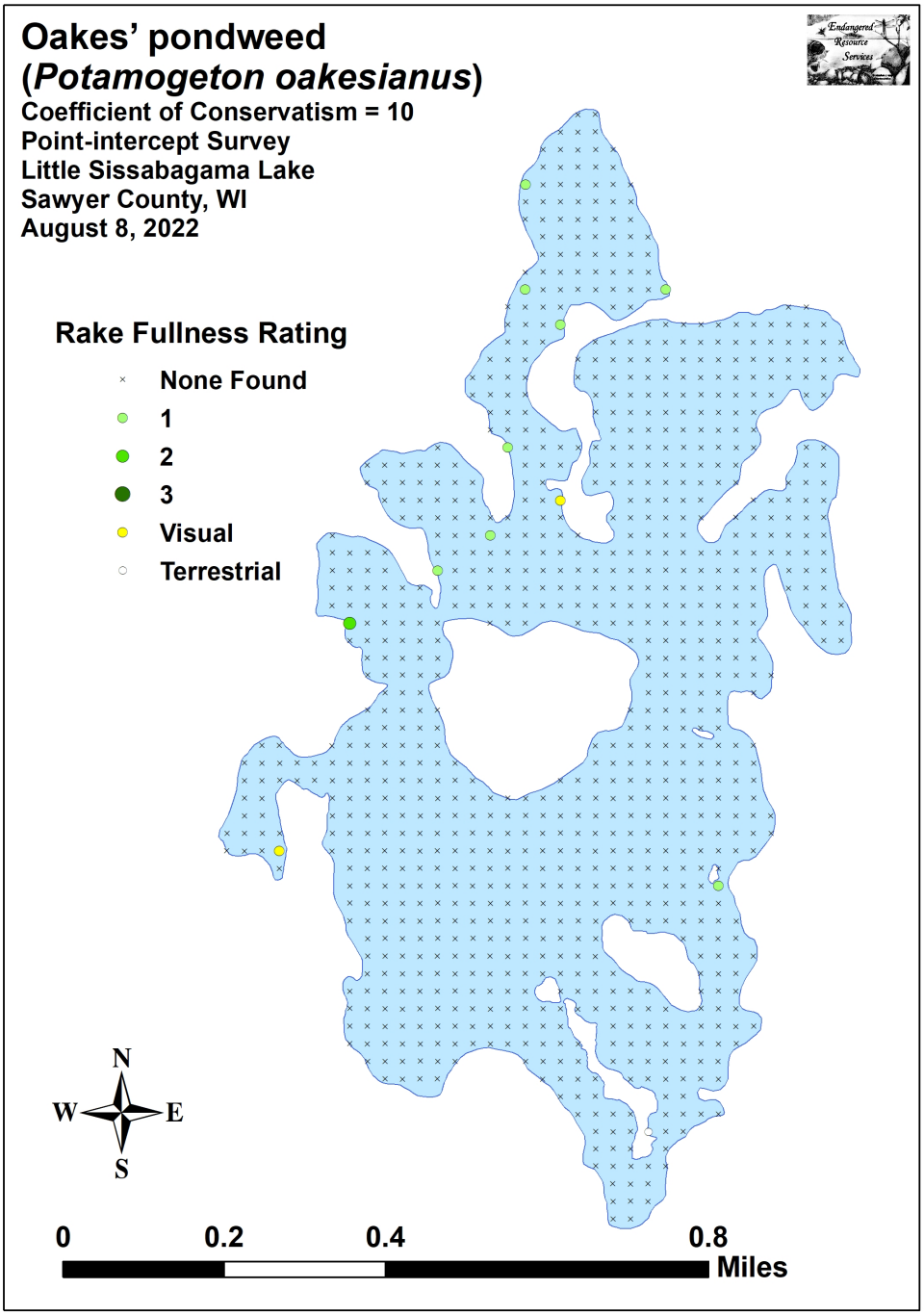
Miles


Oakes' pondweed
(Potamogeton oakesianus)
Coefficient of Conservatism = 10
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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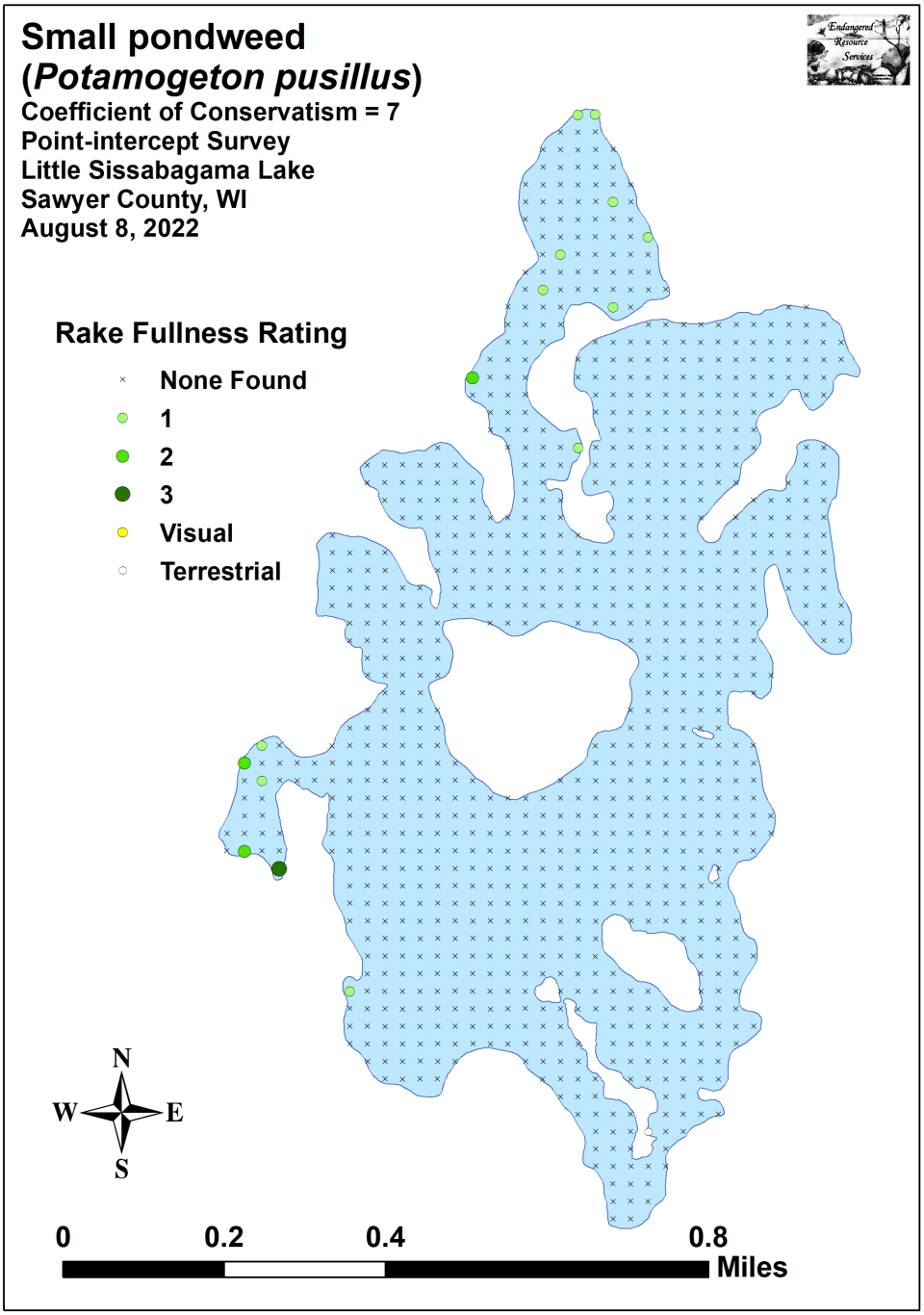
Miles


Small pondweed
(Potamogeton pusillus)
Coefficient of Conservatism = 7
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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Terrestrial
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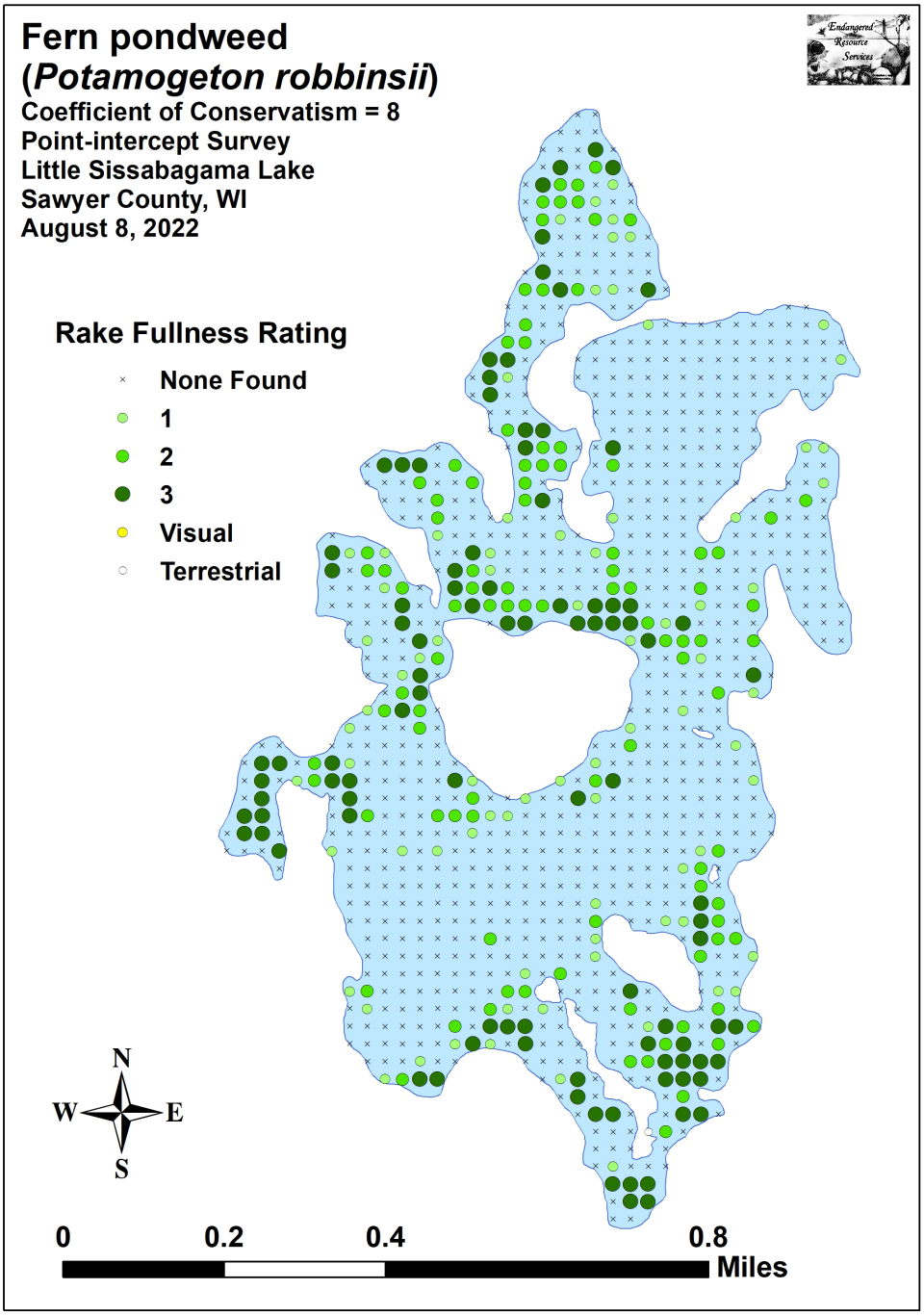
Miles


Fern pondweed
(Potamogeton robbinsii)
Coefficient of Conservatism = 8
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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Terrestrial
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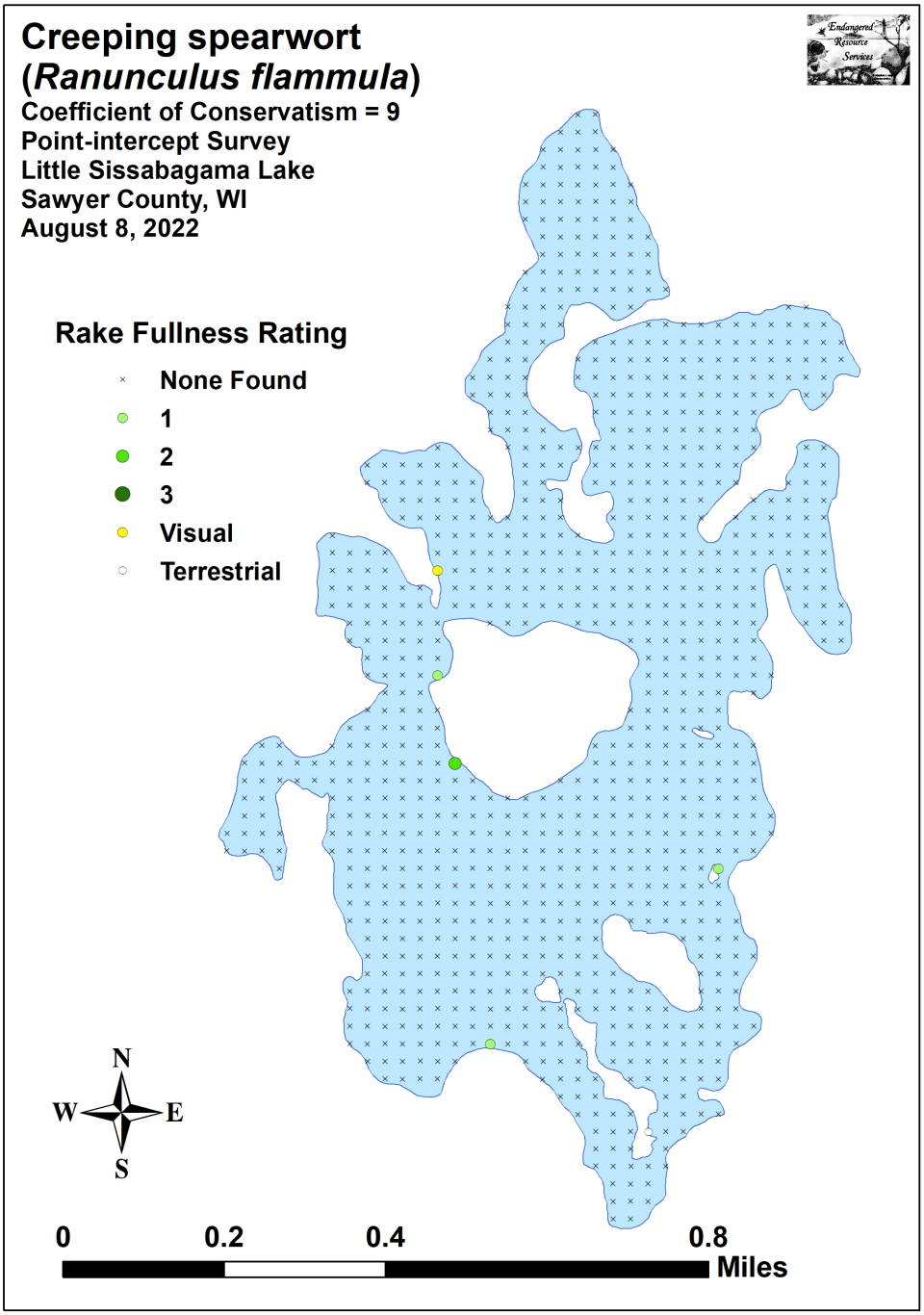
Miles


Creeping spearwort
(Ranunculus flammula)
Coefficient of Conservatism = 9
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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Terrestrial
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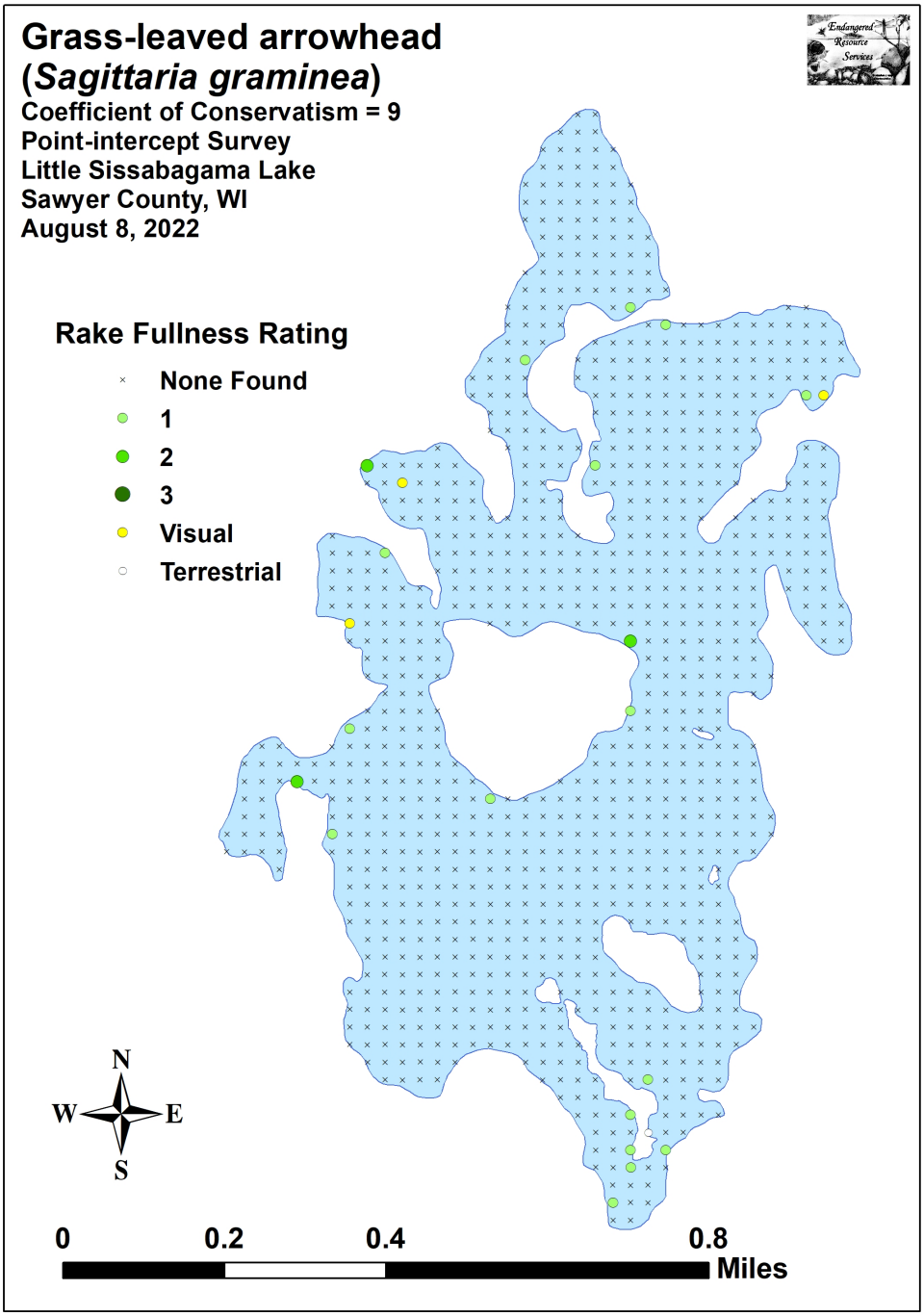
Miles


Grass-leaved arrowhead
(Sagittaria graminea)
Coefficient of Conservatism = 9
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
None Found
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Visual
Terrestrial
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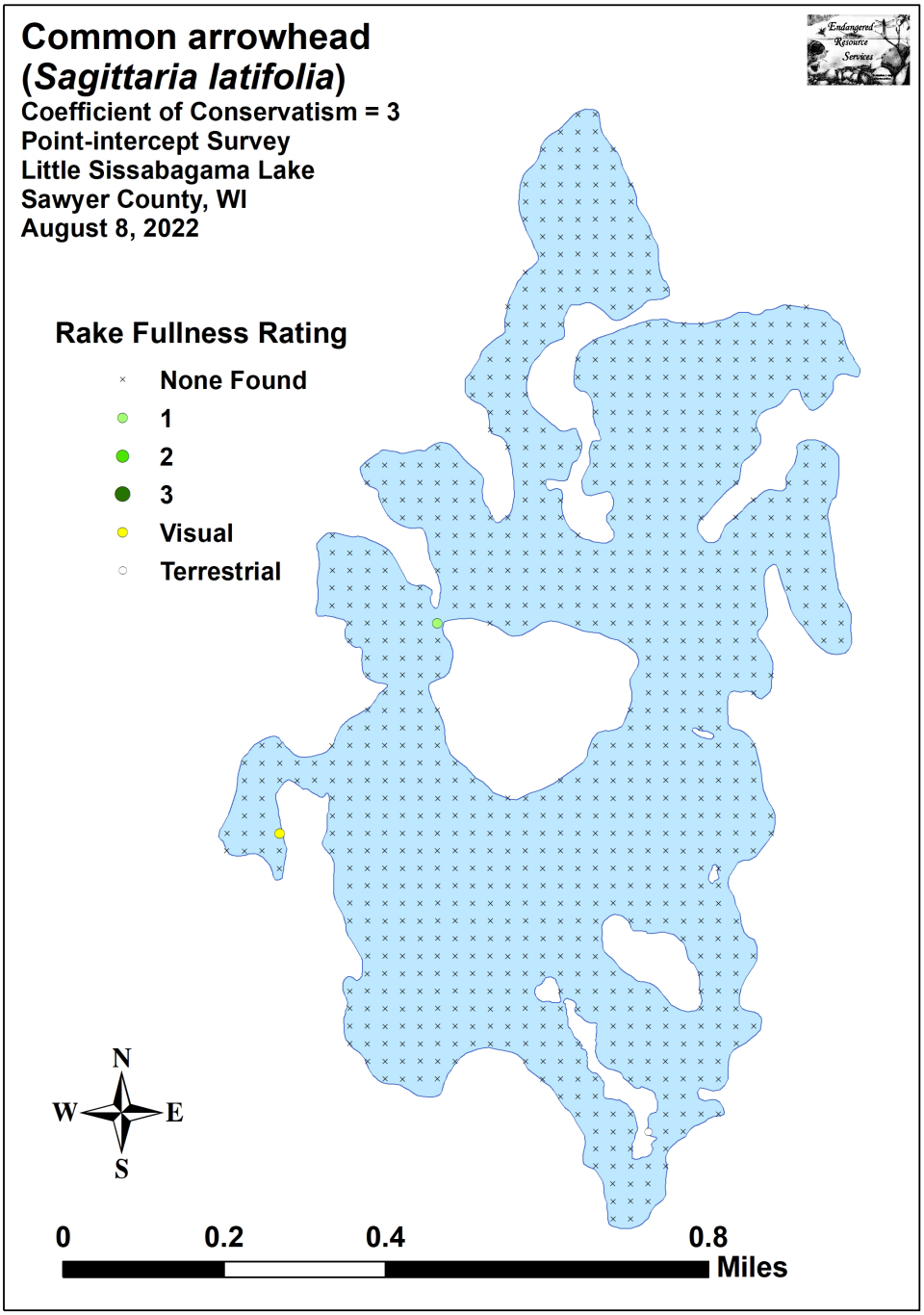
Miles


Common arrowhead
(Sagittaria latifolia)
Coefficient of Conservatism = 3
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
None Found
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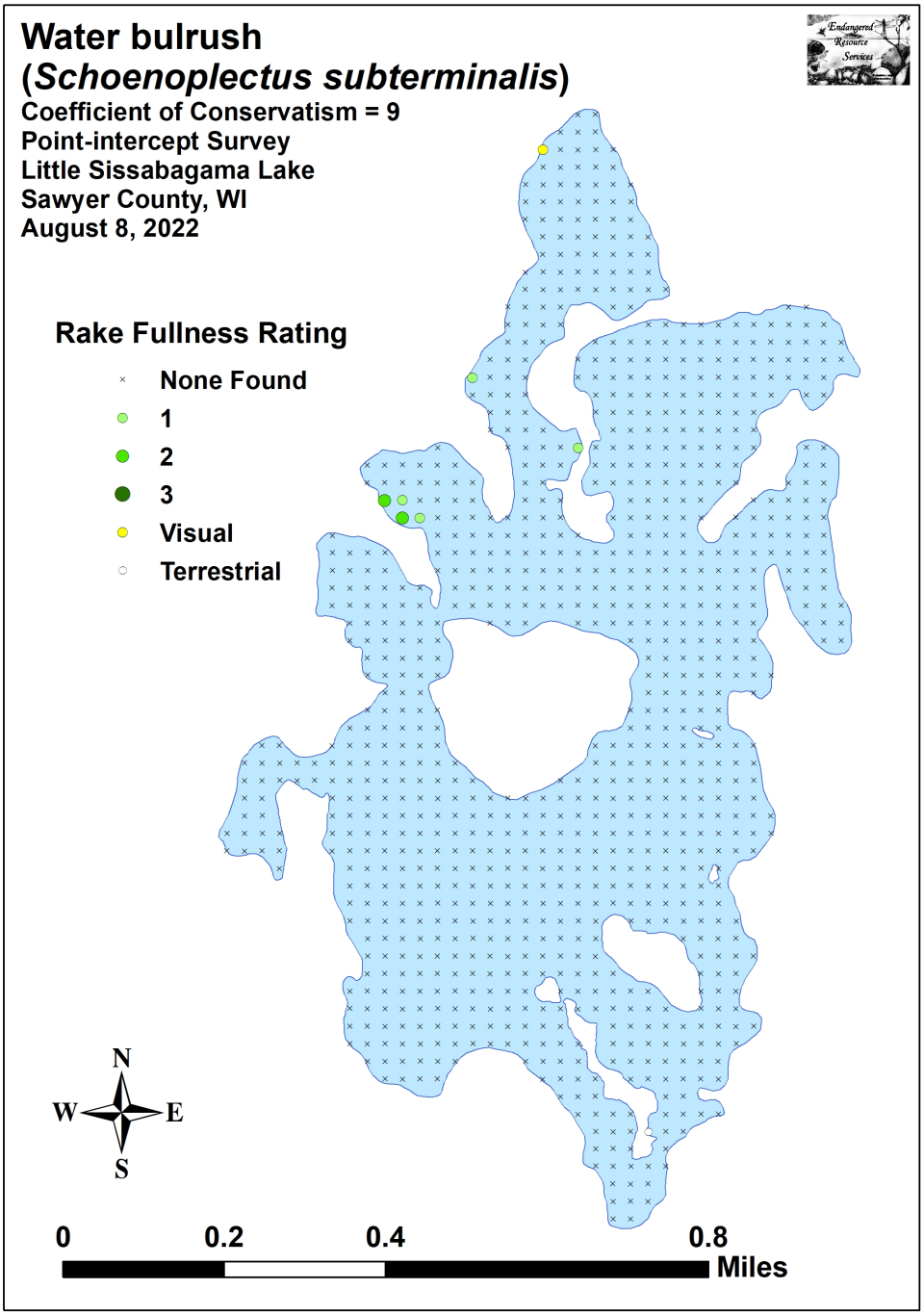
Miles


Water bulrush
(Schoenoplectus subterminalis)
Coefficient of Conservatism = 9
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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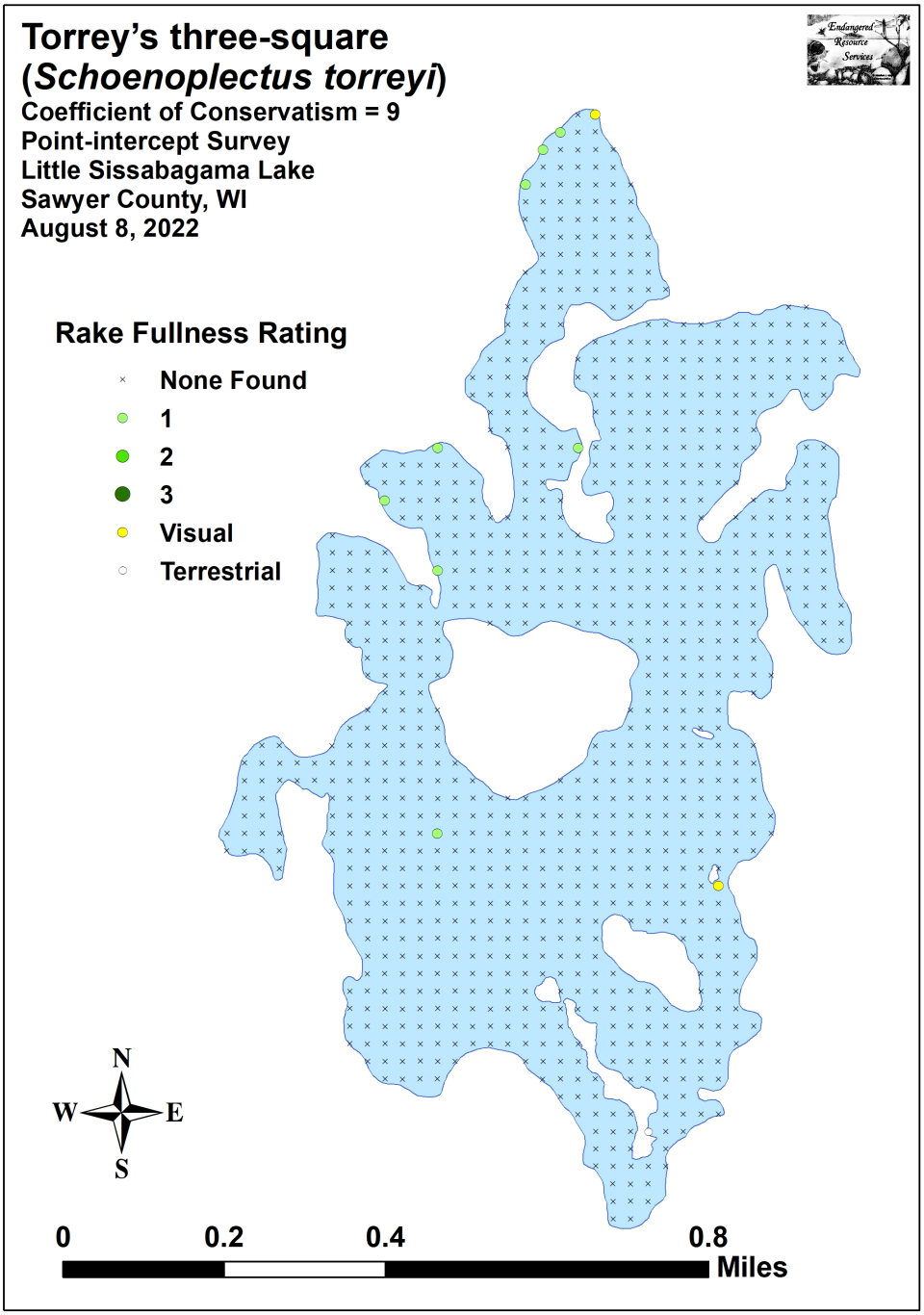
Miles


Torrey's three-square
(Schoenoplectus torreyi)
Coefficient of Conservatism = 9
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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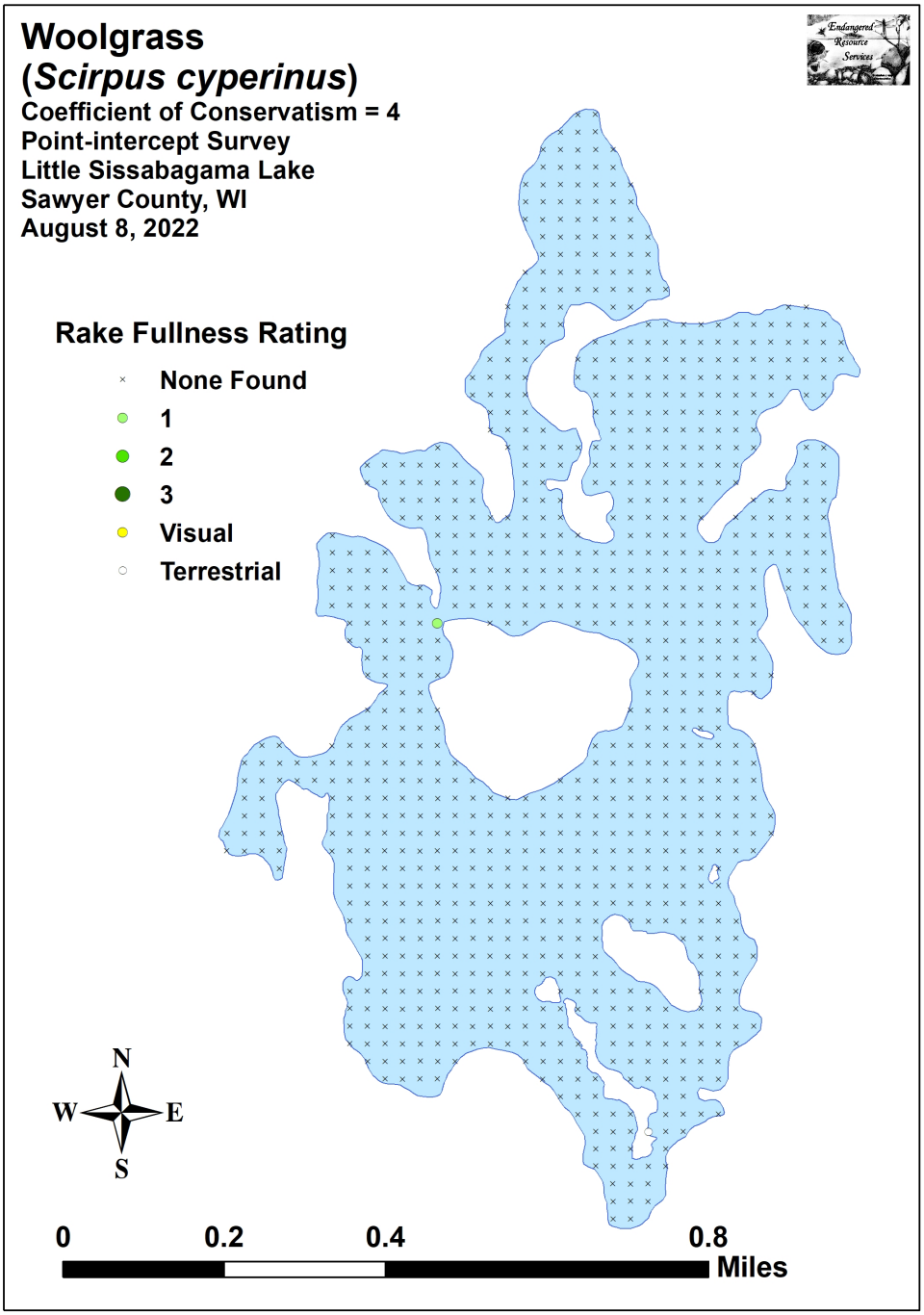
Miles


Woolgrass
(Scirpus cyperinus)
Coefficient of Conservatism = 4
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Rake Fullness Rating
None Found
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Visual
Terrestrial
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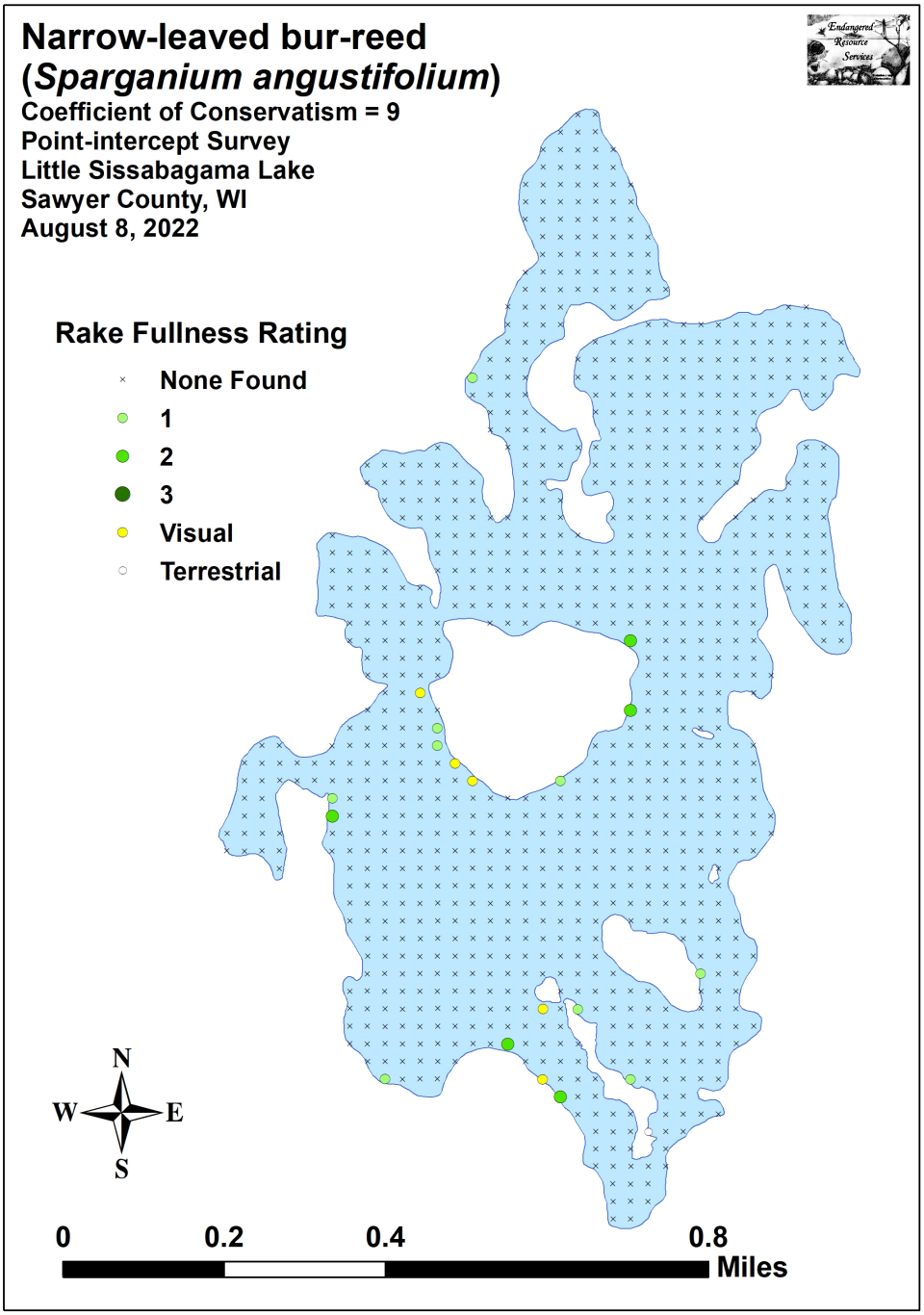
Miles


Narrow-leaved bur-reed
(Sparganium angustifolium)
Coefficient of Conservatism = 9
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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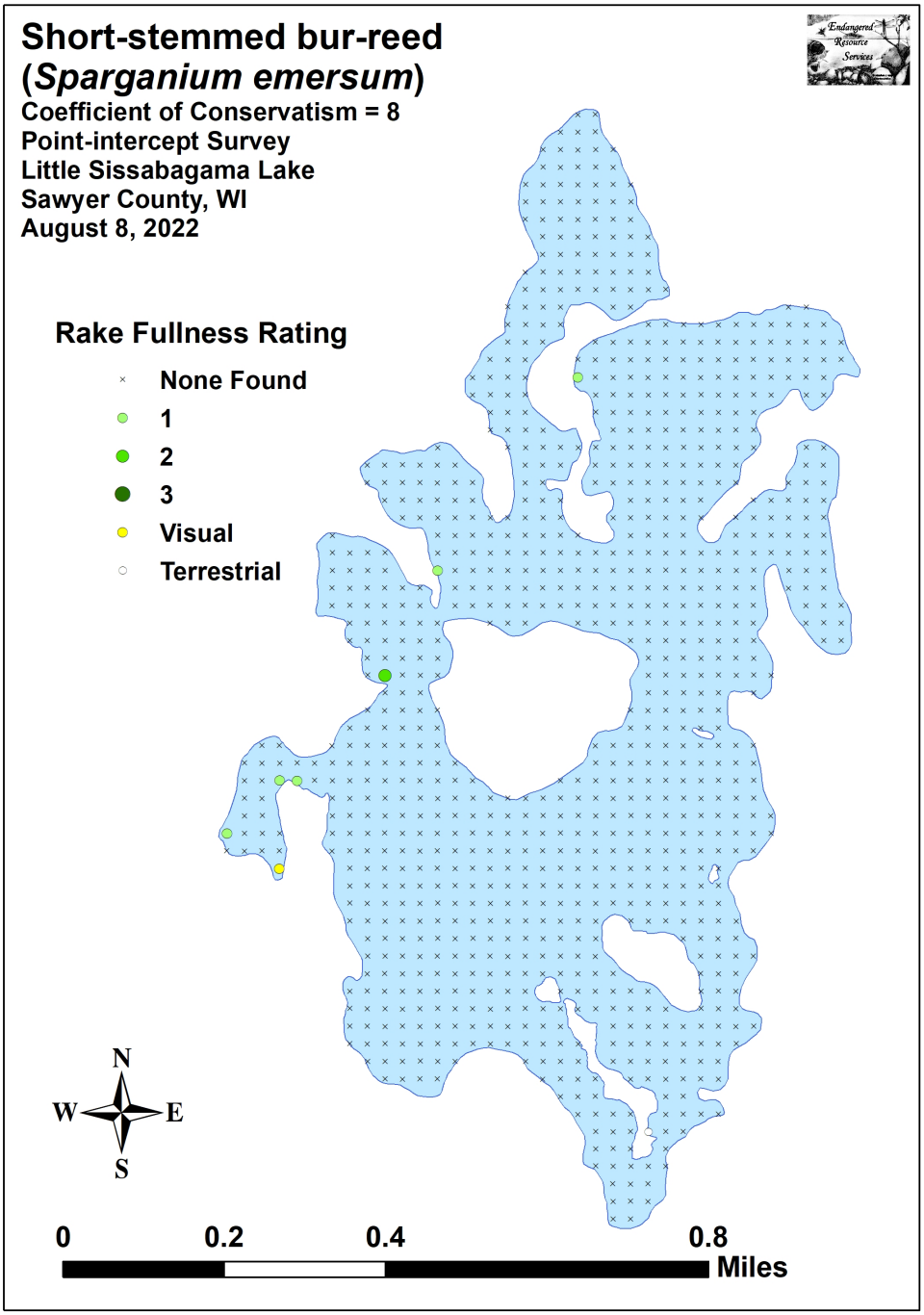
Short-stemmed bur-reed
(Sparganium emersum)
Coefficient of Conservatism = 8
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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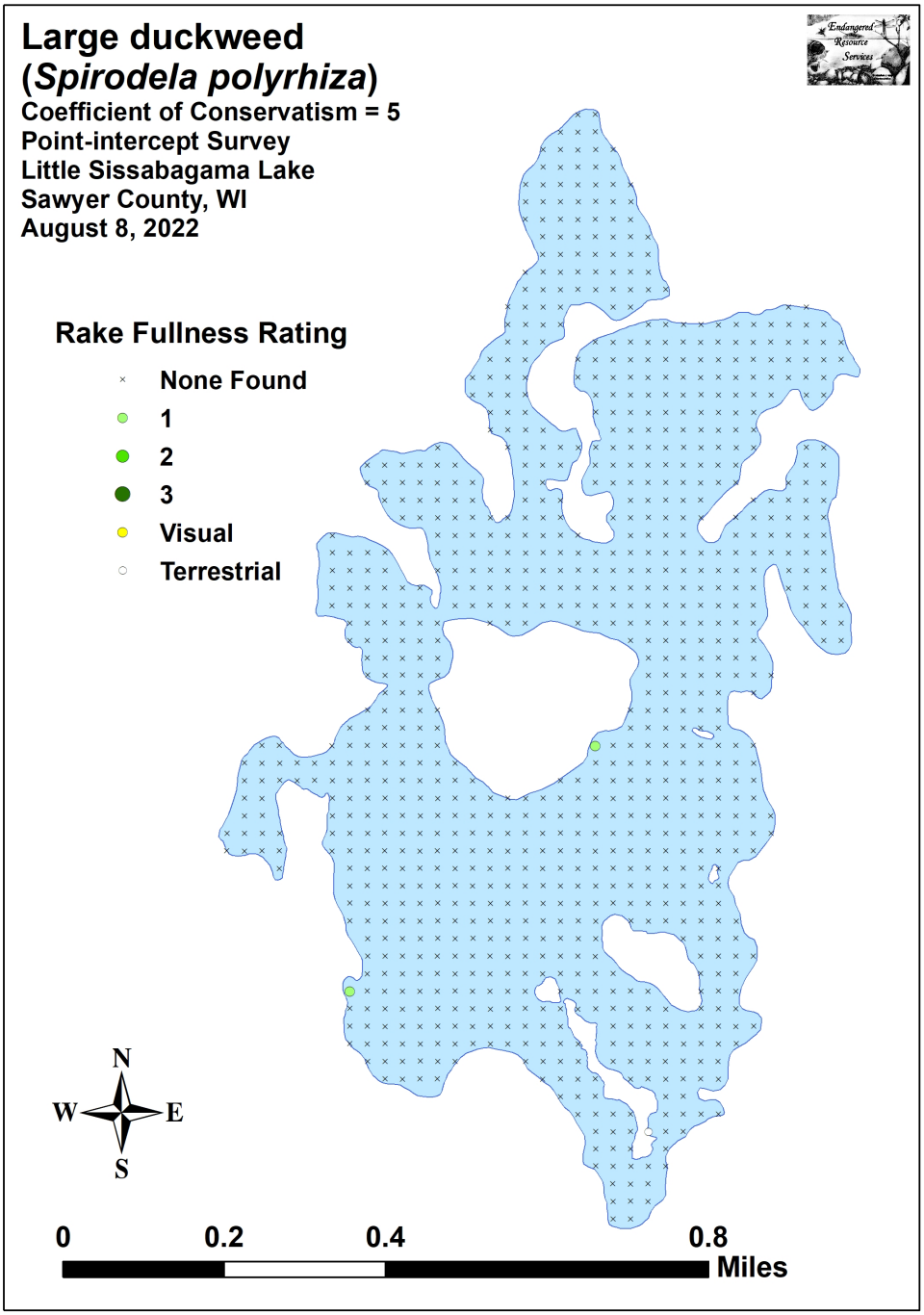
Miles


Large duckweed
(Spirodela polyrhiza)
Coefficient of Conservatism = 5
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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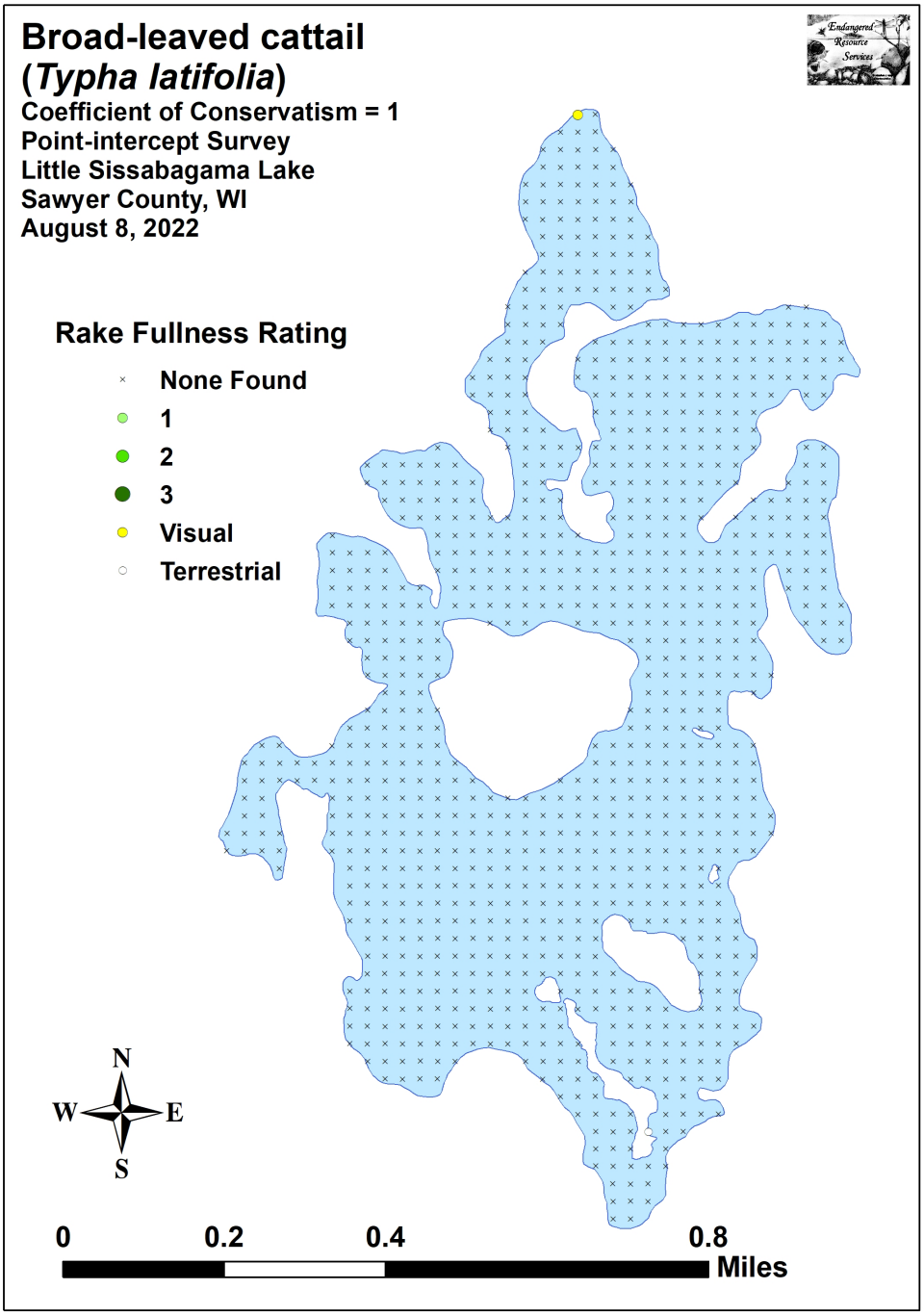
Miles


Broad-leaved cattail
(Typha latifolia)
Coefficient of Conservatism = 1
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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Terrestrial
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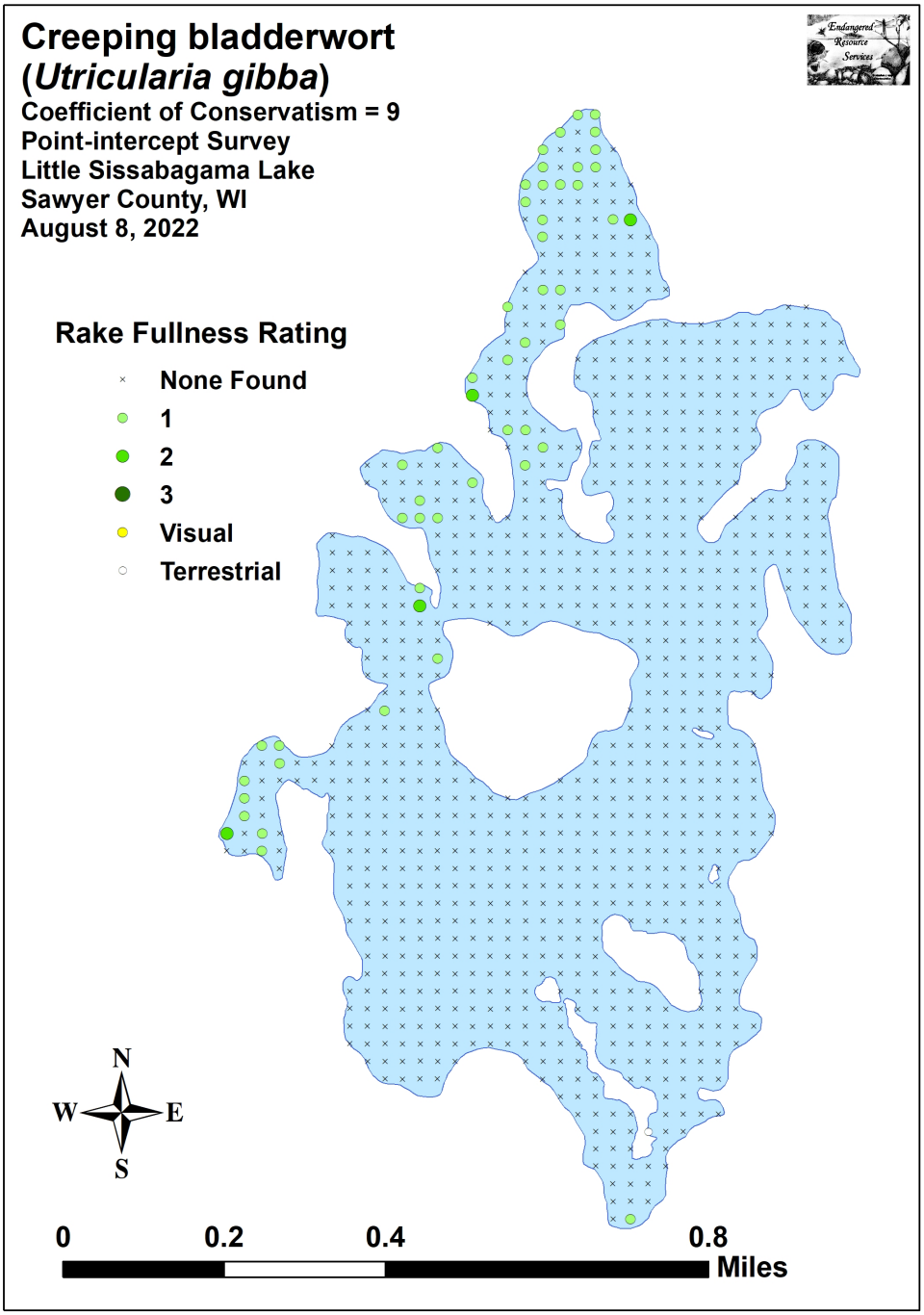
Miles


Creeping bladderwort
(Utricularia gibba)
Coefficient of Conservatism = 9
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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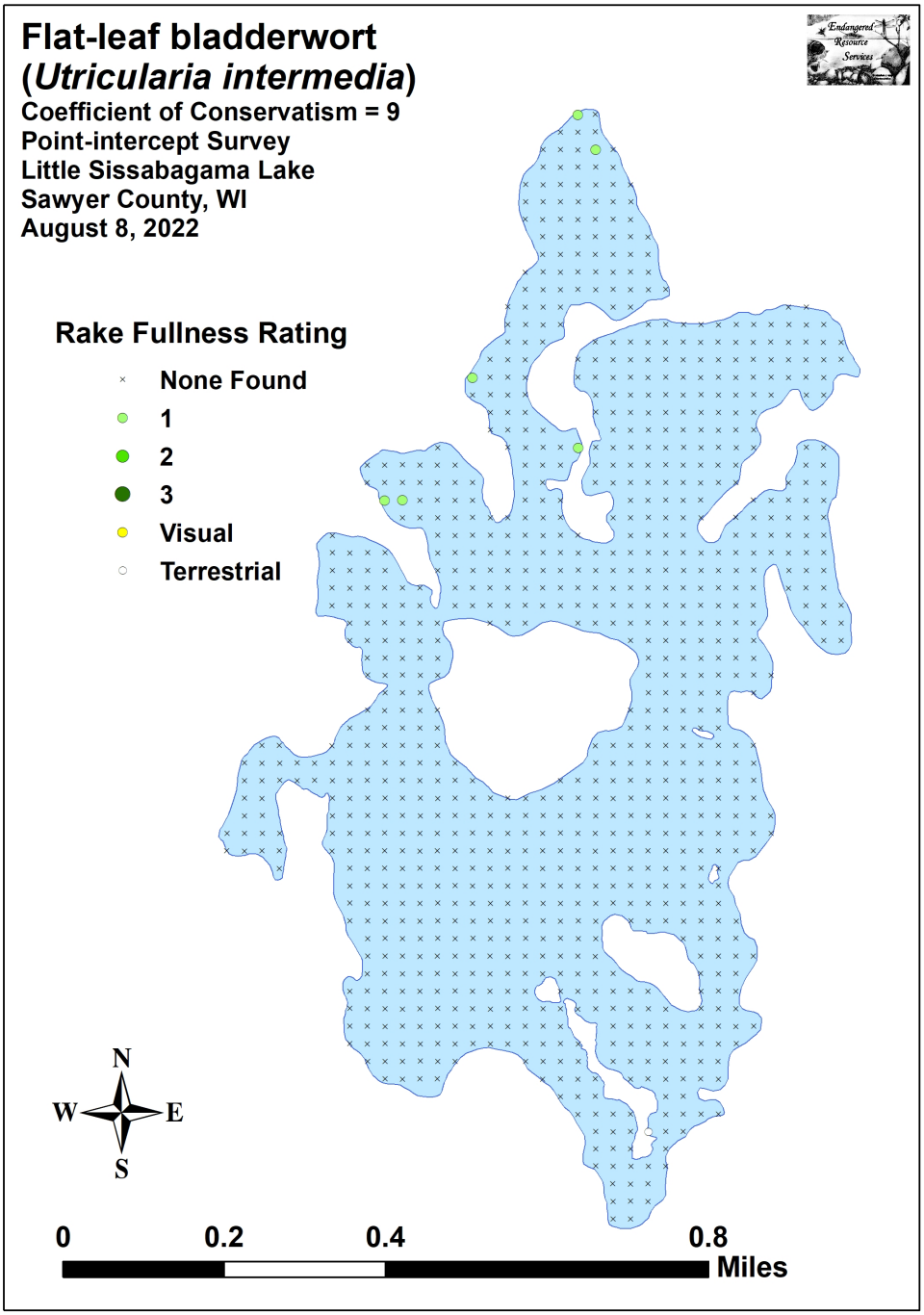
Miles


Flat-leaf bladderwort
(Utricularia intermedia)
Coefficient of Conservatism = 9
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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Terrestrial
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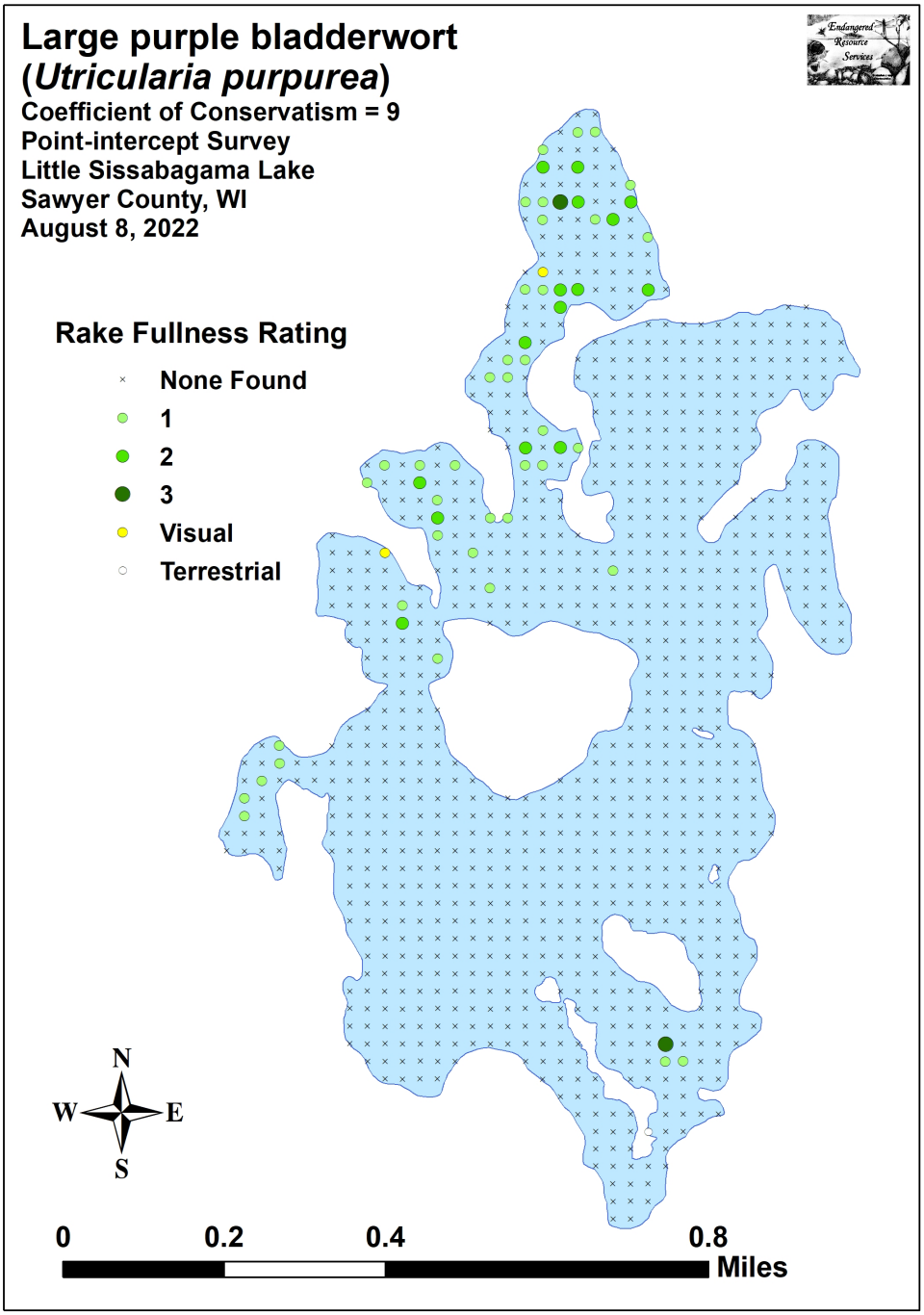
Miles


Large purple bladderwort
(Utricularia purpurea)
Coefficient of Conservatism = 9
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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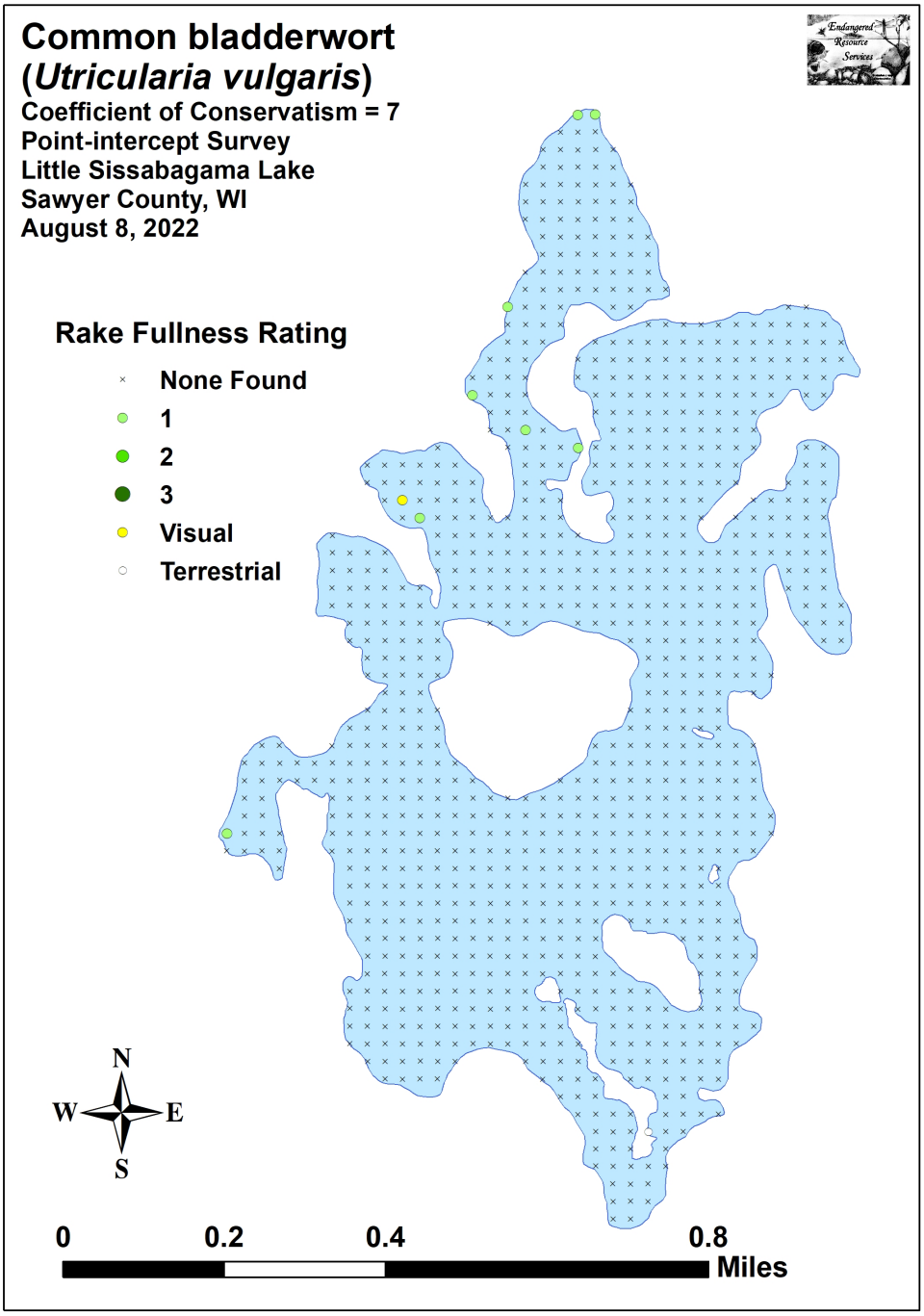
Miles


Common bladderwort
(Utricularia vulgaris)
Coefficient of Conservatism = 7
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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Terrestrial
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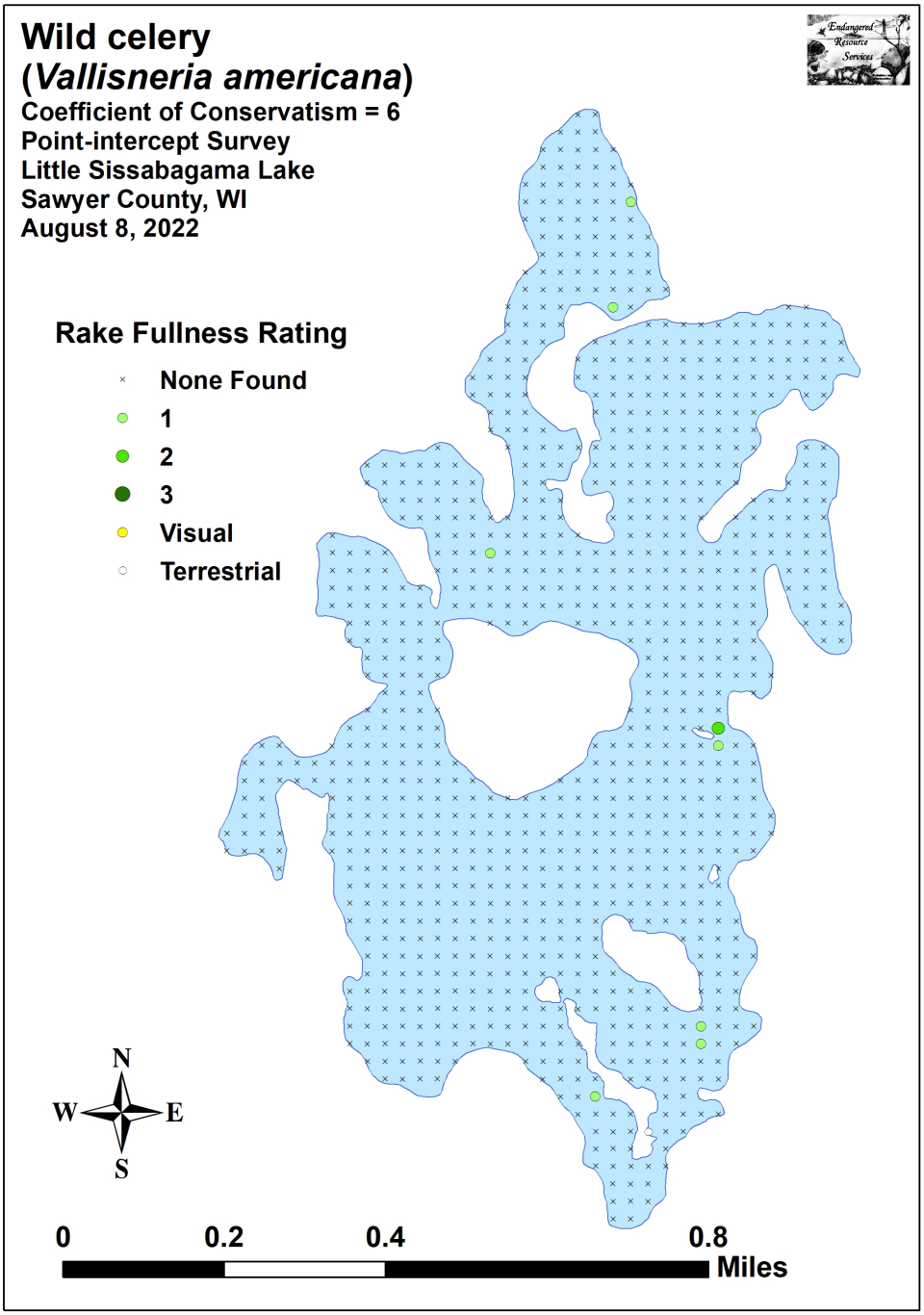
Miles


Wild celery
(Vallisneria americana)
Coefficient of Conservatism = 6
Point-intercept Survey
Little Sissabagama Lake
Sawyer County, WI
August 8, 2022
Endangered Resource Services
Rake Fullness Rating
None Found
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Miles

Appendix VI: Plant Species Accounts

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: Aquatic Moss
Specimen Location: Little Sissabagama Lake; N45.77102°, W91.51541°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-050
Habitat/Distribution: Found in water <4.0 meters deep over organic and sandy muck. Common and occasionally abundant in the northern and western bays – scattered elsewhere.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Utricularia gibba*) Creeping bladderwort, (*Utricularia purpurea*) Large purple bladderwort

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Brasenia schreberi*) **Watershield**
Specimen Location: Little Sissabagama Lake; N45.76235°, W91.52297°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-051
Habitat/Distribution: Found in water 2.0 meters deep over generally sandy substrates. Abundant throughout.
Common Associates: (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Potamogeton diversifolius*) Water-thread pondweed, (*Potamogeton natans*) Floating-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Utricularia gibba*) Creeping bladderwort, (*Utricularia purpurea*) Large purple bladderwort

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Calla palustris*) **Wild calla**
Specimen Location: Little Sissabagama Lake; N45.76235°, W91.52297°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-052
Habitat/Distribution: Found at the shoreline in <0.25m of water over sandy and organic muck. Relatively common on the edges of boggy wetlands in the lake's western and northern bays.
Common Associates: (*Carex echinata*) Star sedge, (*Carex utriculata*) Common yellow lake sedge, (*Dulichium arundinaceum*) Three-way sedge, (*Eleocharis erythropoda*) Bald spikerush, (*Scirpus cyperinus*) Woolgrass, (*Schoenoplectus tabernaemontani*) Softstem bulrush

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Carex crinita*) **Fringed Sedge**
Specimen Location: Little Sissabagama Lake; N45.76347°, W91.52637°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-053
Habitat/Distribution: Sandy shorelines at the water's edge. The dominant sedge on the lake, scattered plants were found along the majority of the lakeshore.
Common Associates: (*Carex utriculata*) Common yellow lake sedge, (*Iris versicolor*) Northern blue flag, (*Scirpus cyperinus*) Woolgrass

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Carex echinata*) **Star sedge**
Specimen Location: Little Sissabagama Lake; N45.76347°, W91.52637°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-054
Habitat/Distribution: Found on organic muck shorelines. Uncommon; only plants seen were in the lake's western bays next to floating muck mats.
Common Associates: (*Carex lasiocarpa*) Narrow-leaved woolly sedge, (*Carex utriculata*) Common yellow lake sedge, (*Dulichium arundinaceum*) Three-way sedge, (*Eleocharis erythropoda*) Bald spikerush, (*Scirpus cyperinus*) Woolgrass

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Carex lasiocarpa*) **Narrow-leaved woolly sedge**
Specimen Location: Little Sissabagama Lake; N45.76208°, W91.52925°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-055
Habitat/Distribution: Found at the shoreline in <0.25m of water over sandy and organic muck. Relatively common on the edges of boggy wetlands in the lake's western and northern bays.
Common Associates: (*Carex echinata*) Star sedge, (*Carex utriculata*) Common yellow lake sedge, (*Dulichium arundinaceum*) Three-way sedge, (*Eleocharis erythropoda*) Bald spikerush, (*Scirpus cyperinus*) Woolgrass

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Carex utriculata*) **Common yellow lake sedge**
Specimen Location: Little Sissabagama Lake; N45.76208°, W91.52925°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-056
Habitat/Distribution: Found at the shoreline in <0.25m of water over sand and sandy muck. Relatively common on wetland edges of the lake's western and northern bays. Widest leaves only 4mm suggesting *C. vesicaria*, but leaf sheaths not red or ladder-fibrillose as would be expected in that species.
Common Associates: (*Carex echinata*) Star sedge, (*Carex lasiocarpa*) Narrow-leaved woolly sedge, (*Dulichium arundinaceum*) Three-way sedge, (*Eleocharis erythropoda*) Bald spikerush, (*Scirpus cyperinus*) Woolgrass

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Ceratophyllum echinatum*) **Spiny hornwort**
Specimen Location: Little Sissabagama Lake; N45.76208°, W91.52925°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-057
Habitat/Distribution: Found in water <3.0 meters deep over organic muck. Uncommon, but widely scattered throughout – especially in the far corners of the northern bays.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Potamogeton natans*) Floating-leaf pondweed, (*Utricularia gibba*) Creeping bladderwort, (*Utricularia vulgaris*) Common bladderwort

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Dulichium arundinaceum*) **Three-way sedge**
Specimen Location: Little Sissabagama Lake; N45.76235°, W91.52297°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-058
Habitat/Distribution: Found in water <0.5 meter deep over rock and firm sand and muck. Common along the shoreline of much of the lake.
Common Associates: (*Brasenia schreberi*) Watershield, (*Eleocharis erythropoda*) Bald spikerush, (*Eleocharis palustris*) Creeping spikerush, (*Najas gracillima*) Northern naiad, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Elatine minima*) **Waterwort**
Specimen Location: Little Sissabagama Lake; N45.76683°, W91.52295°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-059
Habitat/Distribution: Found in water <1.0 meter deep over firm sand and gravel. Uncommon, but widely distributed in pristine undisturbed habitat.
Common Associates: (*Brasenia schreberi*) Watershield, (*Eleocharis acicularis*) Needle spikerush, (*Eriocaulon aquaticum*) Pipewort, (*Juncus pelocarpus*) Brown-fruited rush, (*Lobelia dortmanna*) Water lobelia, (*Myriophyllum tenellum*) Dwarf water-milfoil

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Eleocharis acicularis*) **Needle spikerush**
Specimen Location: Little Sissabagama Lake; N45.76235°, W91.52297°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-060
Habitat/Distribution: Found in water <1.5 meters deep over firm sand and gravel. Relatively common throughout; especially around islands, and on gravel bars and exposed points.
Common Associates: (*Brasenia schreberi*) Watershield, (*Eriocaulon aquaticum*) Pipewort, (*Juncus pelocarpus*) Brown-fruited rush, (*Myriophyllum tenellum*) Dwarf water-milfoil, (*Sparganium angustifolium*) Narrow-leaved bur-reed

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Eleocharis erythropoda*) **Bald spikerush**
Specimen Location: Little Sissabagama Lake; N45.76208°, W91.52925°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-061
Habitat/Distribution: Found at the shoreline in <0.25m of water over organic muck. Scattered in boggy wetland edges in the lake's western and northern bays.
Common Associates: (*Carex echinata*) Star sedge, (*Carex utriculata*) Common yellow lake sedge, (*Dulichium arundinaceum*) Three-way sedge, (*Scirpus cyperinus*) Woolgrass

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Eleocharis palustris*) **Creeping spikerush**
Specimen Location: Little Sissabagama Lake; N45.76235°, W91.52297°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-062
Habitat/Distribution: Found in water <1 meter deep over sand and rock substrates. Scattered beds occurred along shorelines throughout.
Common Associates: (*Brasenia schreberi*) Watershield, (*Dulichium arundinaceum*) Three-way sedge, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Elodea nuttallii*) **Slender waterweed**
Specimen Location: Little Sissabagama Lake; N45.76144°, W91.52506°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-063
Habitat/Distribution: Found in water <3.0 meters deep over a variety of substrates. Uncommon; the only plants found scattered throughout the western bays and on the sunken island southwest of the large central island. All leaves measured <1.0mm in width and >6.0mm in length excluding *E. canadensis*.
Common Associates: (*Myriophyllum tenellum*) Dwarf water-milfoil, (*Nitella* sp.) Nitella, (*Potamogeton robbinsii*) Fern pondweed

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Equisetum fluviatile*) **Water horsetail**
Specimen Location: Little Sissabagama Lake; N45.76208°, W91.52925°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-064
Habitat/Distribution: Found in <1.0 meter of water over firm sand and sandy muck. Relatively common in scattered small beds in the northern and western bay.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Potamogeton diversifolius*) Water-thread pondweed, (*Potamogeton natans*) Floating-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Utricularia gibba*) Creeping bladderwort

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Eriocaulon aquaticum*) **Pipewort**
Specimen Location: Little Sissabagama Lake; N45.76208°, W91.52925°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-065
Habitat/Distribution: Found in water <1.5 meters deep over firm sand and gravel. Relatively common throughout the southern half of the lake; especially around islands and on exposed points.
Common Associates: (*Brasenia schreberi*) Watershield, (*Eleocharis acicularis*) Needle spikerush, (*Juncus pelocarpus*) Brown-fruited rush, (*Myriophyllum tenellum*) Dwarf water-milfoil, (*Ranunculus flammula*) Creeping spearwort

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Iris versicolor*) **Northern blue flag**
Specimen Location: Little Sissabagama Lake; N45.76347°, W91.52637°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-066
Habitat/Distribution: Found in water <0.25 meter deep over firm sand and muck at the immediate shoreline. Scattered clusters occurred throughout.
Common Associates: (*Carex crinita*) Fringed sedge, (*Carex utriculata*) Common yellow lake sedge

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Isoetes echinospora*) **Spiny-spored quillwort**
Specimen Location: Little Sissabagama Lake; N45.76946°, W91.51447°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-067
Habitat/Distribution: Found in water <3.5 meters deep over firm sand and gravel. Relatively common throughout, especially in the eastern bays and flats.
Common Associates: (*Brasenia schreberi*) Watershield, (*Najas gracillima*) Northern naiad, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Potamogeton diversifolius*) Water-thread pondweed

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Juncus effusus*) **Common rush**
Specimen Location: Little Sissabagama Lake; N45.76235°, W91.52297°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-068
Habitat/Distribution: Found in water <0.25 meter deep over firm organic and sandy muck at the immediate shoreline. Uncommon in widely scattered locations.
Common Associates: (*Calla palustris*) Wild calla, (*Eleocharis palustris*) Creeping spikerush, (*Pontederia cordata*) Pickerelweed, (*Schoenoplectus tabernaemontani*) Softstem bulrush

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Juncus pelocarpus*) **Brown-fruited rush**
Specimen Location: Little Sissabagama Lake; N45.76235°, W91.52297°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-069
Habitat/Distribution: Found in water <2.0 meters deep over firm sand and gravel. Relatively common throughout; especially around islands and on exposed points.
Common Associates: (*Brasenia schreberi*) Watershield, (*Eleocharis acicularis*) Needle spikerush, (*Eriocaulon aquaticum*) Pipewort, (*Lobelia dortmanna*) Water lobelia, (*Myriophyllum tenellum*) Dwarf water-milfoil, (*Ranunculus flammula*) Creeping spearwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Lemna minor*) **Small duckweed**
Specimen Location: Little Sissabagama Lake; N45.76308°, W91.52015°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-070
Habitat/Distribution: Rare; scattered individuals were found among floating-leaf species in the far ends of bays with organic muck.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Potamogeton natans*) Small pondweed, (*Spirodela polyrhiza*) Large duckweed

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Lobelia dortmanna*) **Water lobelia**
Specimen Location: Little Sissabagama Lake; N45.76235°, W91.52297°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-071
Habitat/Distribution: Found in water <2.0 meters deep over firm sand and gravel. Relatively common throughout; especially around islands and on exposed points.
Common Associates: (*Brasenia schreberi*) Watershield, (*Eleocharis acicularis*) Needle spikerush, (*Eriocaulon aquaticum*) Pipewort, (*Juncus pelocarpus*) Brown-fruited rush, (*Myriophyllum tenellum*) Dwarf water-milfoil, (*Ranunculus flammula*) Creeping spearwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Myriophyllum farwellii*) **Farwell's water-milfoil**
Specimen Location: Little Sissabagama Lake; N45.76742°, W91.52567°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-072
Habitat/Distribution: Found in water <1.5 meters deep over organic muck. Rare; scattered plants were found floating in the boat-landing bay.
Common Associates: (*Brasenia schreberi*) Watershield, (*Ceratophyllum echinatum*) Spiny hornwort, (*Nymphaea odorata*) White water lily, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton diversifolius*) Water-thread pondweed, (*Potamogeton natans*) Floating-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Utricularia gibba*) Creeping bladderwort

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Myriophyllum tenellum*) **Dwarf water-milfoil**
Specimen Location: Little Sissabagama Lake; N45.76235°, W91.52297°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-073
Habitat/Distribution: Found in water <2.0 meters deep over firm sand and gravel. Common throughout; especially around islands and on exposed points.
Common Associates: (*Brasenia schreberi*) Watershield, (*Eleocharis acicularis*) Needle spikerush, (*Eriocaulon aquaticum*) Pipewort, (*Juncus pelocarpus*) Brown-fruited rush, (*Lobelia dortmanna*) Water lobelia, (*Ranunculus flammula*) Creeping spearwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Najas gracillima*) **Northern naiad**
Specimen Location: Little Sissabagama Lake; N45.75490°, W91.51948°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-074
Habitat/Distribution: Found in water <3.0 meters deep over organic and sandy muck. Common and widespread throughout, especially in the southeast bays.
Common Associates: (*Brasenia schreberi*) Watershield, (*Pontederia cordata*) Pickerelweed, (*Potamogeton diversifolius*) Water-thread pondweed, (*Potamogeton natans*) Floating-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Utricularia gibba*) Creeping bladderwort, (*Utricularia vulgaris*) Common bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Nitella* sp.) **Nitella**
Specimen Location: Little Sissabagama Lake; N45.76145°, W91.52461°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-075
Habitat/Distribution: Found in water <2.0 meters deep over firm sand and gravel. Rare; only plants seen were on the sunken island southwest of the large central island.
Common Associates: (*Elodea nuttallii*) Slender waterweed, (*Myriophyllum tenellum*) Dwarf water-milfoil

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Nuphar variegata*) **Spatterdock**
Specimen Location: Little Sissabagama Lake; N45.76208°, W91.52925°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-076
Habitat/Distribution: Found in water <1.5 meters deep over firm sand. Common to abundant along the shorelines of the northern bays; scattered elsewhere.
Common Associates: (*Brasenia schreberi*) Watershield, (*Dulichium arundinaceum*) Three-way sedge, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Nymphaea odorata*) **White water lily**
Specimen Location: Little Sissabagama Lake; N45.76742°, W91.52567°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-077
Habitat/Distribution: Found in water <1.5 meters deep over organic and sandy muck. The dominant floating-leaf species in the lake – beds were common throughout, especially in the northern bays.
Common Associates: (*Brasenia schreberi*) Watershield, (*Pontederia cordata*) Pickerelweed, (*Potamogeton diversifolius*) Water-thread pondweed, (*Potamogeton natans*) Floating-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Utricularia gibba*) Creeping bladderwort, (*Utricularia vulgaris*) Common bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Polygonum amphibium*) **Water smartweed**
Specimen Location: Little Sissabagama Lake; N45.76585°, W91.52518°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-078
Habitat/Distribution: Found in water <1.0 meter deep over firm sand. Regular beds occurred in the north bay – especially around the island. Elsewhere, plants were only scattered.
Common Associates: (*Brasenia schreberi*) Watershield, (*Dulichium arundinaceum*) Three-way sedge, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Pontederia cordata*) **Pickerelweed**
Specimen Location: Little Sissabagama Lake; N45.76554°, W91.52472°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-079
Habitat/Distribution: Found in water <1.5 meters deep over firm sand. Common to abundant along the shorelines of the northern bays; scattered elsewhere.
Common Associates: (*Brasenia schreberi*) Watershield, (*Dulichium arundinaceum*) Three-way sedge, (*Najas gracillima*) Northern naiad, (*Nymphaea odorata*) White water lily

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Potamogeton amplifolius*) **Large-leaf pondweed**
Specimen Location: Little Sissabagama Lake; N45.76208°, W91.52925°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-080
Habitat/Distribution: Found in water from 1-3 meters deep over variable substrate. Small low-density beds were relatively common and scattered throughout the lake.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Potamogeton natans*) Floating-leaf pondweed, (*Potamogeton robbinsii*) Fern pondweed

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Potamogeton diversifolius)* **Water-thread pondweed**
Specimen Location: Little Sissabagama Lake; N45.76838°, W91.52434°
Collected/Identified by: Matthew S. Berg/Paul Skawinski Col. #: MSB-2022-081
Habitat/Distribution: Found in water <2.5 meters deep over sandy and organic muck. Common in shoreline areas throughout the lake. Leaves were 0.3-0.4mm in width, had acute tips and lacunar bands along the midvein, and lacked nodal glands. Nutlets had coiled embryos, a prominent keel with intermittent protruding spikes as well as smaller secondary spikes in rows on either side of the keel.
Common Associates: (*Brasenia schreberi*) Watershield, (*Najas gracillima*) Northern naiad, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Potamogeton natans*) **Floating-leaf pondweed**
Specimen Location: Little Sissabagama Lake; N45.76208°, W91.52925°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-082
Habitat/Distribution: Found in water <2.0 meters deep over sandy and organic muck. Relatively common in scattered shoreline areas throughout.
Common Associates: (*Brasenia schreberi*) Watershield, (*Najas gracillima*) Northern naiad, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Utricularia gibba*) Creeping bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Potamogeton oakesianus*) **Oakes' pondweed**
Specimen Location: Little Sissabagama Lake; N45.76683°, W91.52295°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-083
Habitat/Distribution: Found in water <2.0 meters deep over mostly organic muck. Relatively common in widely-scattered small patches on boggy shorelines of the northern and western bays. Leaves were <6cm in length, stems had red spots, and the base of leaves were not cordate. Plants graded into the more common *P. natans* which may indicate some level of hybridization.
Common Associates: (*Brasenia schreberi*) Watershield, (*Dulichium arundinaceum*) Three-way sedge, (*Myriophyllum farwellii*) Farwell's water-milfoil, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Utricularia gibba*) Creeping bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Potamogeton pusillus*) **Small pondweed**
Specimen Location: Little Sissabagama Lake; N45.76843°, W91.52074°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-084
Habitat/Distribution: Found in water <4.0 meters deep over sandy and organic muck. Scattered beds occurred in boggy areas of the northern and western bays. Flower stalks had three distinct whorls, nutlets were smooth with a pronounced lateral beak, and leaves had nodal glands.
Common Associates: (*Brasenia schreberi*) Watershield, (*Najas gracillima*) Northern naiad, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Potamogeton diversifolius*) Water-thread pondweed, (*Potamogeton natans*) Floating-leaf pondweed, (*Potamogeton oakesianus*) Oakes' pondweed

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Potamogeton robbinsii*) **Fern pondweed**
Specimen Location: Little Sissabagama Lake; N45.76208°, W91.52925°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-085
Habitat/Distribution: Found in water from 1-5 meters deep in all substrates. Abundant; the dominant species throughout the lake.
Common Associates: (*Brasenia schreberi*) Watershield, (*Myriophyllum tenellum*) Dwarf water-milfoil, (*Nuphar variegata*) Spatterdock, (*Nymphaea odorata*) White water lily, (*Utricularia gibba*) Creeping bladderwort, (*Utricularia purpurea*) Large purple bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Ranunculus flammula*) **Creeping spearwort**
Specimen Location: Little Sissabagama Lake; N45.76618°, W91.52428°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-086
Habitat/Distribution: Found in water <1.0 meter deep over firm sand. Scattered patches occurred primarily in the southern half of the lake, especially around islands and on exposed points.
Common Associates: (*Elatine minima*) Waterwort, (*Eleocharis acicularis*) Needle spikerush, (*Eriocaulon aquaticum*) Pipewort, (*Juncus pelocarpus*) Brown-fruited rush, (*Lobelia dortmanna*) Water lobelia, (*Myriophyllum tenellum*) Dwarf water-milfoil

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Sagittaria graminea*) **Grass-leaved arrowhead**
Specimen Location: Little Sissabagama Lake; N45.76235°, W91.52297°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-087
Habitat/Distribution: Found in water <2.0 meters deep over firm sand and sandy muck. Relatively common throughout. No plants were fertile, but we noted none of the sterile individuals had corms, and they were connected by rhizomes which excluded *S. cristata*.
Common Associates: (*Brasenia schreberi*) Watershield, (*Nymphaea odorata*) White water lily, (*Potamogeton diversifolius*) Water-thread pondweed

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Sagittaria latifolia*) **Common arrowhead**
Specimen Location: Little Sissabagama Lake; N45.76140°, W91.52820°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-088
Habitat/Distribution: Found in water <0.25 meter deep over firm sand and muck. Scattered beds occurred in shoreline areas in the northern and western bays.
Common Associates: (*Calla palustris*) Wild calla, (*Eleocharis erythropoda*) Bald spikerush, (*Iris versicolor*) Northern blue flag

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Schoenoplectus subterminalis*) **Water bulrush**
Specimen Location: Little Sissabagama Lake; N45.76743°, W91.52522°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-089
Habitat/Distribution: Found in water <1.5 meters deep over organic muck. Relatively common in boggy areas of the north bays.
Common Associates: (*Nuphar variegata*) Spatterdock, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Potamogeton oakesianus*) Oakes' pondweed, (*Utricularia gibba*) Creeping bladderwort, (*Utricularia purpurea*) Large purple bladderwort

County/State: Sawyer County, Wisconsin **Date:** 6/16/22
Species: (*Schoenoplectus tabernaemontani*) **Softstem bulrush**
Specimen Location: Little Sissabagama Lake; N45.76235°, W91.52297°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-090
Habitat/Distribution: Found over firm muck and sand at the shoreline. Uncommon; a few widely-scattered plants occurred in boggy areas of the western bays and along the western shoreline of the large central island.
Common Associates: (*Calla palustris*) Wild calla, (*Carex lasiocarpa*) Narrow-leaved woolly sedge, (*Juncus effusus*) Common rush, (*Sagittaria latifolia*) Common arrowhead, (*Typha latifolia*) Broad-leaved cattail

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Schoenoplectus torreyi*) **Torrey's three-square bulrush**
Specimen Location: Little Sissabagama Lake; N45.76838°, W91.52434°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-091
Habitat/Distribution: Found in water <1 meter deep over sand and sandy muck. Relatively common in shoreline areas of the north bays and scattered around the islands.
Common Associates: (*Brasenia schreberi*) Watershield, (*Dulichium arundinaceum*) Three-way sedge, (*Eleocharis erythropoda*) Bald spikerush, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Utricularia gibba*) Creeping bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Scirpus cyperinus*) **Woolgrass**
Specimen Location: Little Sissabagama Lake; N45.76523°, W91.52426°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-092
Habitat/Distribution: Found over firm muck and sand at the immediate shoreline. Scattered plants occurred in boggy areas of the northern and western bays.
Common Associates: (*Carex lasiocarpa*) Narrow-leaved woolly sedge, (*Eleocharis erythropoda*) Bald spikerush, (*Juncus effusus*) Common rush, (*Sagittaria latifolia*) Common arrowhead, (*Typha latifolia*) Broad-leaved cattail

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Sparganium angustifolium*) **Narrow-leaved bur-reed**
Specimen Location: Little Sissabagama Lake; N45.76308°, W91.52015°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-093
Habitat/Distribution: Found in water <1.5 meters deep over firm sandy muck. Relatively common; especially around the central island.
Common Associates: (*Brasenia schreberi*) Watershield, (*Najas gracillima*) Northern naiad, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Potamogeton natans*) Floating-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Sparganium emersum*) **Short-stemmed bur-reed**
Specimen Location: Little Sissabagama Lake; N45.76969°, W91.52078°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-094
Habitat/Distribution: Found in water <1.5 meters deep over firm sandy muck. Scattered beds occurred throughout the northern and western bays. Despite extensive searching, we did not find any individuals in flower. ID based on the KEELED floating leaves (which eliminates S. *fluctuans*).
Common Associates: (*Brasenia schreberi*) Watershield, (*Najas gracillima*) Northern naiad, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Potamogeton natans*) Floating-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Spirodela polyrhiza*) **Large duckweed**
Specimen Location: Little Sissabagama Lake; N45.76308°, W91.52015°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-095
Habitat/Distribution: Rare; a few individuals were found among floating-leaf species at widely scattered points in the southern half of the lake.
Common Associates: (*Lemna minor*) Small duckweed, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Potamogeton diversifolius*) Water-thread pondweed, (*Potamogeton natans*) Floating-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Typha latifolia*) **Broad-leaved cattail**
Specimen Location: Little Sissabagama Lake; N45.76795°, W91.52315°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-096
Habitat/Distribution: Uncommon over firm muck and sand at the shoreline. Scattered beds occurred in the northern bays.
Common Associates: (*Carex lasiocarpa*) Narrow-leaved woolly sedge, (*Eleocharis erythropoda*) Bald spikerush, (*Juncus effusus*) Common rush

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Utricularia gibba*) **Creeping bladderwort**
Specimen Location: Little Sissabagama Lake; N45.76838°, W91.52434°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-097
Habitat/Distribution: Found in water <3.0 meters deep over organic and sandy muck. Common entangled in other species; especially in the northern and western bays.
Common Associates: (*Brasenia schreberi*) Watershield, (*Najas gracillima*) Northern naiad, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Utricularia purpurea*) Large purple bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Utricularia intermedia*) **Flat-leaf bladderwort**
Specimen Location: Little Sissabagama Lake; N45.76838°, W91.52434°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-098
Habitat/Distribution: Found in water <2.0 meters deep over organic muck. Uncommon, but widely scattered throughout the northern bays.
Common Associates: (*Brasenia schreberi*) Watershield, (*Ceratophyllum echinatum*) Spiny hornwort, (*Nymphaea odorata*) White water lily, (*Potamogeton pusillus*) Small pondweed, (*Utricularia gibba*) Creeping bladderwort, (*Schoenoplectus subterminalis*) Water bulrush

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Utricularia purpurea*) **Large purple bladderwort**
Specimen Location: Little Sissabagama Lake; N45.76838°, W91.52434°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-099
Habitat/Distribution: Found in water <4.0 meters deep over organic and sandy muck. Common and widespread in the northern and western bays; rare elsewhere.
Common Associates: (*Brasenia schreberi*) Watershield, (*Najas gracillima*) Northern naiad, (*Nymphaea odorata*) White water lily, (*Pontederia cordata*) Pickerelweed, (*Potamogeton robbinsii*) Fern pondweed, (*Utricularia gibba*) Creeping bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Utricularia vulgaris*) **Common bladderwort**
Specimen Location: Little Sissabagama Lake; N45.76208°, W91.52925°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-100
Habitat/Distribution: Found in water <3.0 meters deep over organic muck. Uncommon, but widely scattered throughout – especially in the far corners of the northern bays.
Common Associates: (*Brasenia schreberi*) Watershield, (*Ceratophyllum echinatum*) Spiny hornwort, (*Nymphaea odorata*) White water lily, (*Potamogeton diversifolius*) Water-thread pondweed, (*Utricularia gibba*) Creeping bladderwort

County/State: Sawyer County, Wisconsin **Date:** 8/8/22
Species: (*Vallisneria americana*) **Wild celery**
Specimen Location: Little Sissabagama Lake; N45.76344°, W91.51701°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2022-101
Habitat/Distribution: Found in water <2.5 meters deep over sand and gravel substrates. Uncommon, but widely scattered throughout.
Common Associates: (*Eleocharis acicularis*) Needle spikerush, (*Myriophyllum tenellum*) Dwarf water-milfoil, (*Najas gracillima*) Northern naiad

Appendix VII: 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 water-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 water-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, blue-joint 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 berms 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

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 VIII: 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 IX: Raw Data Spreadsheet

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