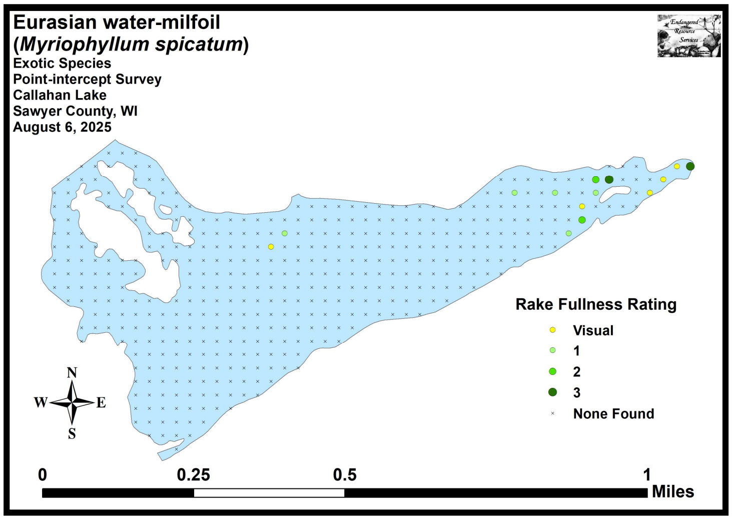
Warm-water Point-intercept Macrophyte Survey
Callahan Lake (WBIC: 2434700)
Sawyer County, Wisconsin

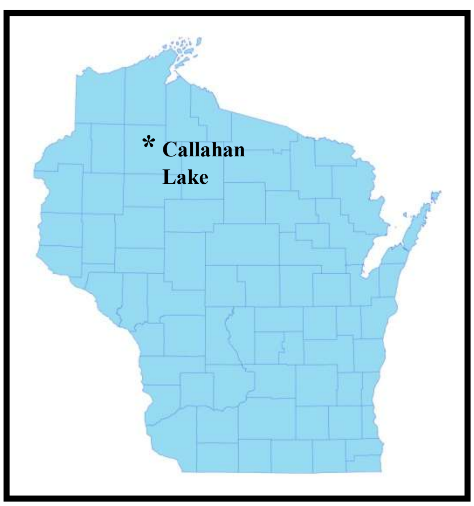


2025 Eurasian Water-milfoil Density and Distribution

Eurasian water-milfoil (Berg 2007)

Project Initiated by:

The Callahan and Mud Lakes Protective Association,
Lake Education and Planning Services, LLC, and the
Wisconsin Department of Natural Resources (Grant ACEI35725)



Dense rake of Flat-stem pondweed near the 2025 treatment area – 8/6/25

Survey Conducted by and Report Prepared by:

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August 6, 2025

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ABSTRACT

Callahan Lake (WBIC 2434700) is a 138-acre drainage lake located in north-central Sawyer County, WI. Following the discovery of Eurasian water-milfoil (*Myriophyllum spicatum*) (EWM) in 2005, Jeremy Williamson (JW) conducted the lake's original point-intercept survey in 2008, and Ayres Associates developed the lake's original Wisconsin Department of Natural Resources (WDNR) approved Aquatic Plant Management Plan (APMP) which outlined herbicide applications to control the infestation. Using data from our point-intercept survey in 2021, Lake Education and Planning Services, LLC (LEAPS – Dave Blumer) updated and expanded the plan to include manual removal with diver assisted suction harvesting (DASH). As a prerequisite to reupdating their plan in 2026, the CMLPA – again under the direction of LEAPS – and the WDNR requested a warm-water point-intercept survey of all aquatic macrophytes on August 6, 2025. During the 2025 survey, we found plants growing at 275 sites which approximated to 63.5% of the entire lake bottom and 77.2% of the 14.5ft littoral zone. This was a moderately significant increase **(p=0.002)** compared to our 2020 survey when we found plants at 230 points (53.0% of the bottom/76.4% of the then 13.5ft littoral zone). Plant diversity was very high in 2025 with a Simpson Index value of 0.90 – up a tick from 0.89 in 2020. Total species richness was, however, only moderate with 30 species found in the rake (up from 26 in 2020). This total jumped to 39 species when including visuals and plants found during the boat survey (up from 36 in 2020). There was an average of 2.92 native species/site with native vegetation – a nearly significant increase (p=0.06) from 2.74 species/site in 2020. Total biomass was a moderate mean total rake fullness of 2.05 - a non-significant decline (p=0.24) from a mean rake of 2.10 in 2020. In 2020, Fern pondweed (*Potamogeton robbinsii*), Flat-stem pondweed (*Potamogeton zosteriformis*), Wild celery (*Vallisneria americana*), and Coontail (*Ceratophyllum demersum*) were the most common macrophytes. Present at 49.57%, 47.83%, 36.09%, and 24.35% of sites with vegetation, they accounted for 56.02% of the total relative frequency. The 2025 survey found Flat-stem pondweed, Fern pondweed, Large-leaf pondweed (*Potamogeton amplifolius*), and Wild celery were the most widely-distributed species (48.73%, 48.00%, 30.91%, and 29.09% of survey points with vegetation/53.28% of the total relative frequency). Lakewide, from 2020-2025, eight species showed significant changes in distribution. Eurasian water-milfoil **(p=0.04)**, Vasey's pondweed (*Potamogeton vaseyi*) **(p=0.04)**, and Whorled water-milfoil (*Myriophyllum verticillatum*) **(p=0.01)** underwent significant declines. Conversely, Common waterweed (*Elodea canadensis*) and aquatic moss experienced highly significant increases **(p<0.001)**; and Large-leaf pondweed **(p=0.03)**, White-stem pondweed (*Potamogeton praelongus*) **(p=0.01)**, and Nitella (*Nitella* sp.) **(p=0.04)** saw significant increases. The 29 native index species found in the rake during the August 2025 survey (up from 25 in 2020) produced a just below average mean Coefficient of Conservatism of 6.6 (identical to 2020). The Floristic Quality Index of 35.7 (up from 33.2 in 2020) was, however, much higher than the median FQI for this part of the state. Filamentous algae were present at 37 points with a mean rake fullness of 1.14 – a non-significant increase (p=0.86) in distribution, but a moderately significant decline **(p=0.002)** in density compared to 2020 when these algae were found at 30 points with a mean rake of 1.50. In 2008, JW reported EWM at 64 points (15.1% of surveyed points) with 13 additional visual sightings. Seven of these points had a rake fullness of 3, 15 were a 2 (5.2% of surveyed points had a significant infestation), and 42 were a 1 (mean rake fullness of 1.45). In 2020, we found EWM in the rake at 17 points (3.9% of the entire lake bottom/5.6% of the littoral zone) with 12 additional visual sightings. We rated one point a rake fullness of 3, five were a 2 (1.4% of the entire lake/2.0% of the littoral zone had a significant infestation), and 11 were a 1 for a mean rake fullness of 1.41. Our 2025 survey found EWM in the rake at nine points (2.1% of the lake/3.3% of the littoral one) with five additional visual records. Two points rated a 3, two points were a 2 (0.9% of the lake/1.1% of the littoral zone had a significant infestation), and the remaining five points were a 1 resulting in a mean rake fullness of 1.67. Compared to 2020, this suggested that EWM had undergone a further significant decline **(p=0.04)** in distribution. Although the mean density increased, this was not significant (p=0.22). None of the individual densities showed significant changes when broken out by rake fullness, but visual sightings also saw a significant decline **(p=0.04)**. Other than EWM, we saw no evidence of any other exotic plants. Continuing to manage EWM in a way that minimizes its impact on Callahan Lake's native plants; and proactively working to limit nutrient inputs around the lake which can fuel algal as well as milfoil growth are likely management priorities for the CMLPA as they move forward in updating their APMP.

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INTRODUCTION:

Callahan Lake (WBIC 2434700) is a 138-acre drainage lake created by an 8ft dam on the north fork of the Chief River in north-central Sawyer County, Wisconsin in the Town of Round Lake (T41N R7W S33/34). It has a maximum depth of 18ft and an average depth of 11ft. The lake is mesotrophic in nature, and water clarity is good with summer Secchi readings averaging 10.2ft in 2021 – the last year data was available (WDNR 2025). The lake's bottom substrate is primarily sand along the shoreline before transitioning to a sandy muck at most depths over 7ft (Bush et al. 1968) (Figure 1).

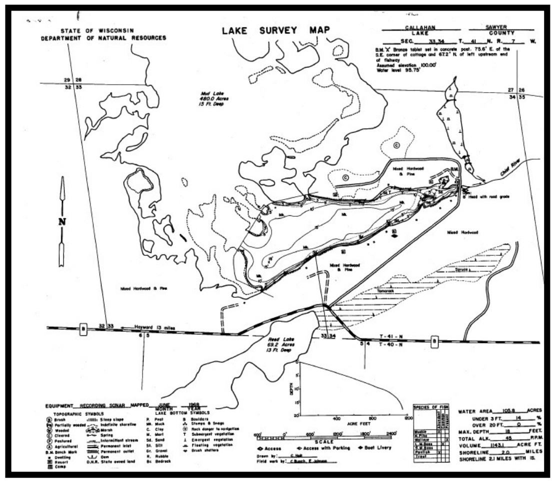


Figure 1: Callahan Lake Bathymetric Map

BACKGROUND AND STUDY RATIONALE:

Eurasian water-milfoil (*Myriophyllum spicatum*) (EWM) is an exotic invasive plant species that was first identified in Callahan Lake in the fall of 2005. Following an initial whole lake point-intercept survey in 2008 (J. Williamson), the Callahan and Mud Lakes Protective Association (CMLPA) and the Sawyer County Land and Water Conservation Department (SCLWC - K. Maki) used a 2009 Wisconsin Department of Natural Resources (WDNR) rapid response grant to hire Ayres Associates to write the lakes' original Aquatic Plant Management Plan (APMP) that called for herbicide applications to control the infestation (Kleczewski 2009). Using data gathered from our 2020 and 2021 late-summer EWM bed mapping surveys and our 2021 whole lake point-intercept surveys, Dave Blumer (Lake Education and Planning Services, LLC - LEAPS) updated this plan in 2022. In addition to continued small-scale herbicide treatments, the new APMP outlined manual removal efforts that included diver assisted suction harvesting (DASH).

Per WDNR expectations (Pamela Toshner/Alex Smith, WDNR – pers. comm.), whole-lake plant surveys on actively managed lakes are normally repeated every five to seven years to remain current. In anticipation of updating their plan in 2026, the CMLPA – again under the direction of LEAPS – applied for and received a WDNR grant (ACEI35725) to help cover the cost of surveys and the APMP review. In order to quantify the current levels of both EWM and the lake's native macrophyte community and to compare those results to our 2020 survey to determine if any changes had occurred over that time, the CMLPA, LEAPS, and the WDNR authorized a warm-water full point-intercept survey. This report is the summary analysis of that survey conducted on August 6, 2025.

METHODS:
Warm-water Full Point-intercept Macrophyte Survey:

Using a standard formula that takes into account the shoreline shape and distance, water clarity, depth, islands, and total lake acres, the WDNR generated the 434-point sampling grid for Callahan Lake that was used for both the 2020 and 2025 surveys (Appendix I). Prior to beginning the August point-intercept survey, we conducted a general boat survey of the entire system to gain familiarity with the lakes' macrophytes (Appendix II). All plants found were identified (Voss 1996, Boreman et al. 1997; Chadde 2002; Crow and Hellquist 2006; Skawinski 2019), and a datasheet was built from the species present.

During the survey, we located each point with a GPS (Garmin 76CSx), recorded a depth reading with a metered pole, and took a rake sample. All plants on the rake, as well as any that were dislodged by the rake, were identified and assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 2). We also recorded visual sightings of all plants within six feet of the sample point not found in the rake. In addition to a rake rating for each species, a total rake fullness rating was also noted. Substrate (bottom) type was assigned at each site where the bottom was visible or it could be reliably determined using the rake.

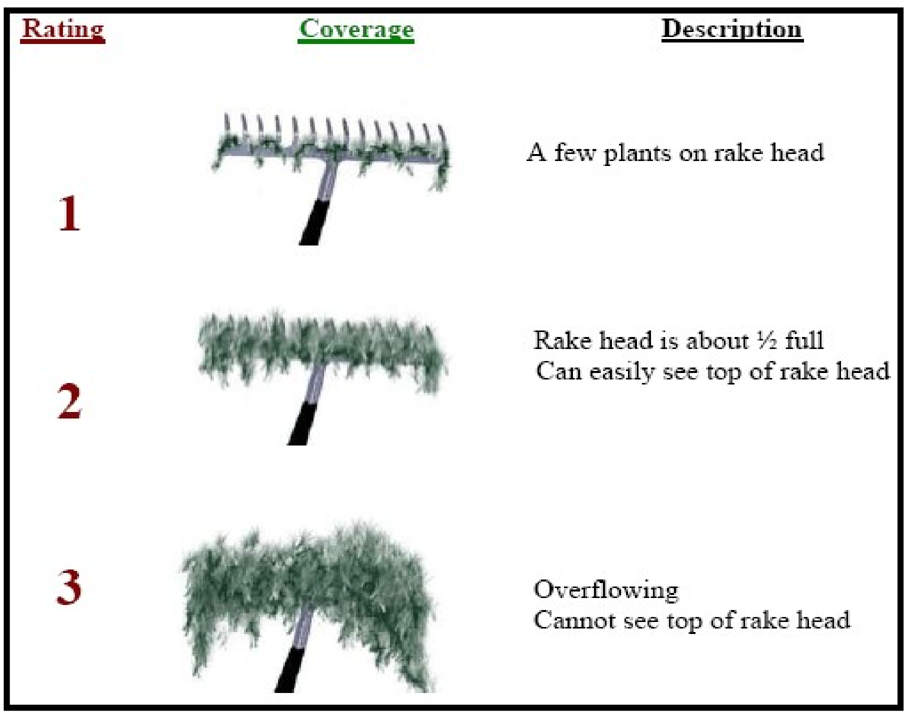


Figure 2: Rake Fullness Ratings (UWEX 2010)

DATA ANALYSIS:

In an effort to visualize the changes on the lake since our first point-intercept survey in 2020, we included summary statistics and maps in the 2025 report. During the 2025 survey, we entered all data collected into the standard WDNR aquatic plant management spreadsheet (Appendix II) (UWEX 2010). From this, we calculated the following:

Total number of sites visited: This included the total number of points on the lake that were accessible to be surveyed by boat 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. While some species can tolerate very low light conditions, others are only found near the surface. In general, the diversity of the plant community decreases with increased depth.

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

Number of sites sampled using rope/pole rake: This indicates which rake type was used to take a sample. We use a 20ft pole rake and a 35ft rope rake for sampling.

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

Species richness: This value indicates the number of different plant species found in and directly adjacent to (on the waterline) the lake. Species richness alone only counts those plants found in the rake survey. The other two values include those seen at a sample point during the survey but not found in the rake, and those that were only seen during the initial boat survey or inter-point. **Note: Per 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 of the total rake fullness of all species found in the rake at each point. It only takes into account those sites with vegetation (Table 1).

<u>Relative frequency:</u> This value shows a species' frequency relative to all other species. It is expressed as a percentage, and the total of all species' relative frequencies will add up to 100%. Organizing species from highest to lowest relative frequency value gives us an idea of which species are most important within the macrophyte community (Tables 2 and 3).

Relative frequency example:

Suppose that we sample 100 points and found 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. Callahan Lake is in the Northern Lakes and Forests Ecoregion (Tables 4 and 5).

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

Comparisons to the Past Survey: We compared data from our 2020 and 2025 surveys to see if there were any significant changes in the lake's vegetation (Tables 2 and 3) (Figures 8 and 17). For individual plant species as well as count data, we used the Chi-square analysis on the WDNR Pre/Post survey worksheet. For comparing averages (mean species/point and mean rake fullness/point), we used t-tests. Differences were considered significant at $p<0.05$, moderately significant at $p<0.01$ and highly significant at $p<0.001$ (UWEX 2010). It should be noted that we used the number of littoral points (301 in 2020/356 in 2025) as the basis for "sample points" in the comparison.

RESULTS:

Warm-water Full Point-intercept Macrophyte Survey:

Depth readings taken at Callahan Lake's 433 accessible points (one point was out of water on a muck bog) (Appendix I) revealed most of the shorelines drop off sharply into 10+ feet of water. This relatively steep-sided elongated bowl then slopes more gradually into a 15ft+ flat that bottoms out at 18ft on the far western edge of the 15ft bathymetric ring (Figure 3) (Appendix III).

Sandy and organic muck areas dominated the lake bottom and accounted for 94.0% (408 points) of the survey sites. Most of the pure sand areas (5.8% - 25 points) occurred along the immediate shoreline, and, especially along the eastern inlet channel in the lake's northwest corner, we also found a few widely-scattered patches of gravel and cobble in these nearshore areas (0.2% - one point) (Figure 3) (Appendix III).

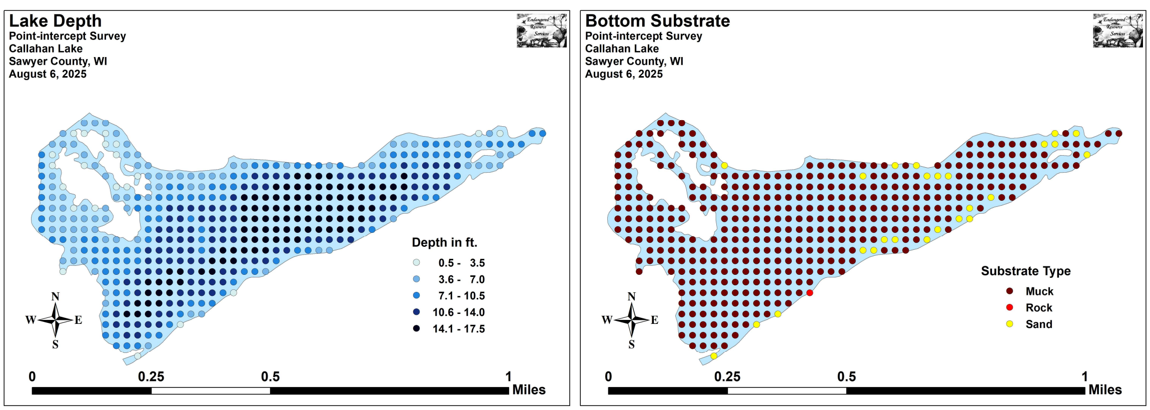


Figure 3: Lake Depth and Bottom Substrate

In 2025, we found plants growing to 14.5ft (up from 13.5ft in 2020) (Table 1). The 275 points with vegetation (approximately 63.5% of the entire lake bottom and 77.2% of the littoral zone) represented a moderately significant increase **(*p*=0.002)** in plant coverage compared to our 2020 survey when we found plants at 230 points (53.0% of the bottom/76.4% of the littoral zone) (Figure 4) (Appendix IV).

Table 1: Aquatic Macrophyte P/I Survey Summary Statistics Callahan Lake - Sawyer County, Wisconsin August 9, 2020 and August 6, 2025

Summary Statistics:	2020	2025
Total number of points sampled	434	433
Total number of sites with vegetation	230	275
Total number of sites shallower than the max. depth of plants	301	356
Freq. of occurrence at sites shallower than max. depth of plants	76.4	77.2
Simpson Diversity Index	0.89	0.90
Maximum depth of plants (ft)	13.5	14.5
Mean depth of plants (ft)	7.9	8.0
Median depth of plants (ft)	8.0	8.0
Number of sites sampled using rake on Rope (R)	0	0
Number of sites sampled using rake on Pole (P)	434	433
Ave. number of all species per site (shallower than max depth)	2.15	2.27
Ave. number of all species per site (veg. sites only)	2.82	2.94
Ave. number of native species per site (shallower than max depth)	2.10	2.25
Ave. number of native species per site (sites with native veg. only)	2.74	2.92
Species richness	26	30
Species richness (including visuals)	33	37
Species richness (including visuals and boat survey)	36	40
Mean rake fullness (veg. sites only)	2.10	2.05

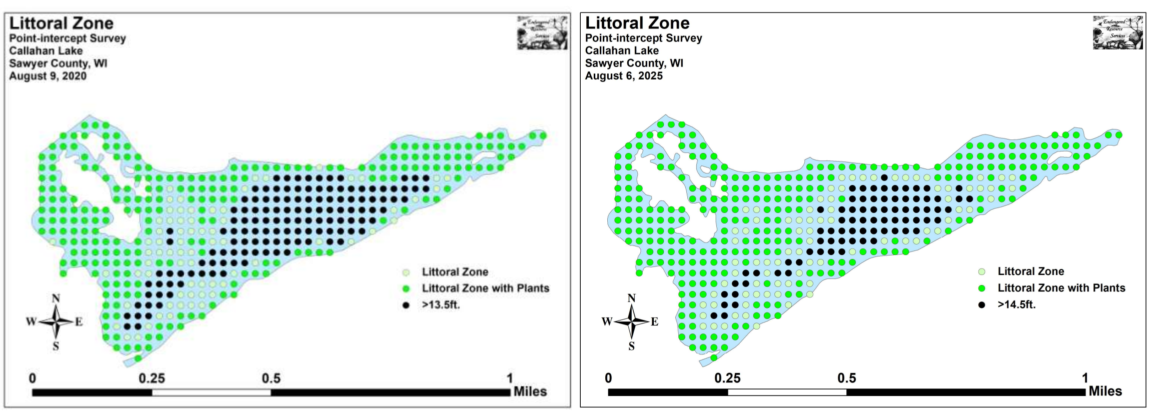


Figure 4: 2020 and 2025 Littoral Zone

Growth in 2025 was evenly distributed throughout the littoral zone as the mean and median depths were both 8.0ft. This was almost identical to 2020 when we calculated a mean of 7.9ft and median of 8.0ft (Figure 5).

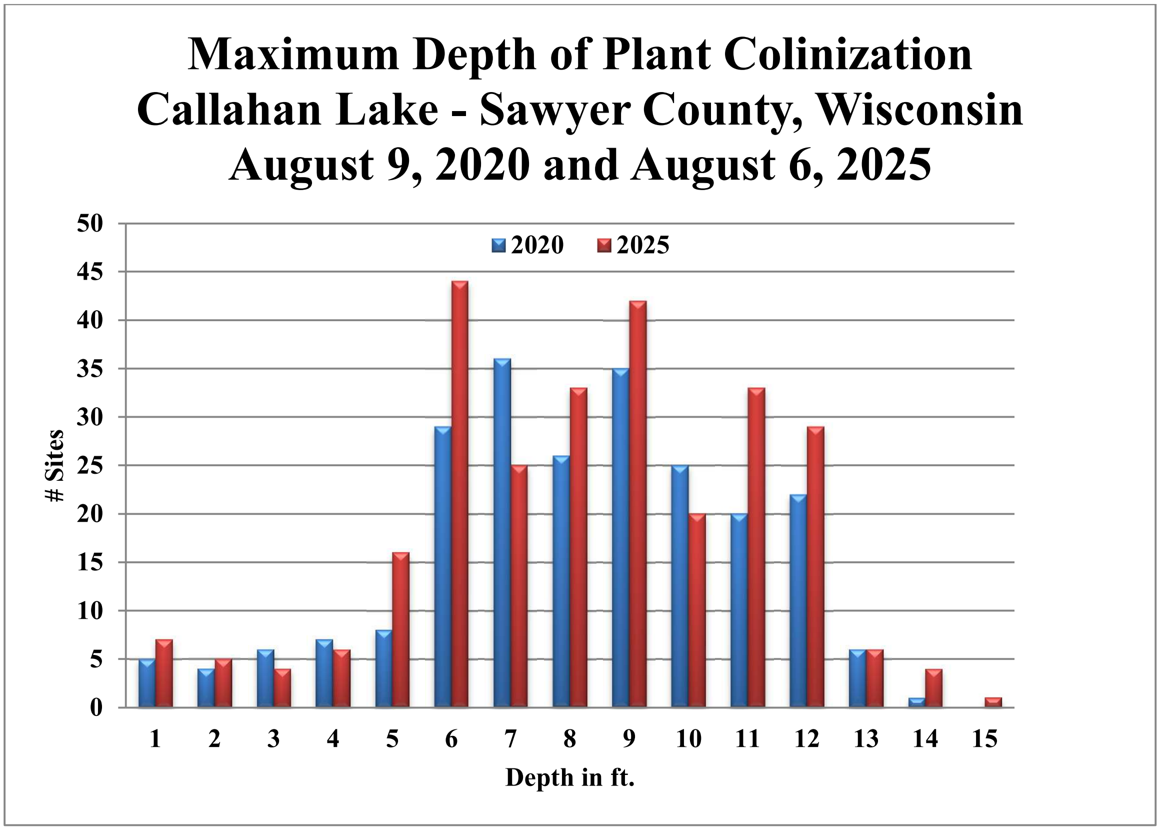


Figure 5: 2020 and 2025 Plant Colonization Depth Chart

Plant diversity was very high in 2025 with a Simpson Index value of 0.90 – up a tick from 0.89 in 2020. Total richness was, however, only moderate with 30 species found in the rake – up from 26 found in 2020. This total jumped to 39 species when including visuals and plants found during the boat survey – up from 36 in 2020.

Mean native species richness at sites with native vegetation experienced a nearly significant increase (p=0.06) from 2.74 species/site in 2020 to 2.92 species/site in 2025. Visual analysis of the maps suggested these increases were widespread; especially in areas with relatively shallow water (Figure 6) (Appendix IV).

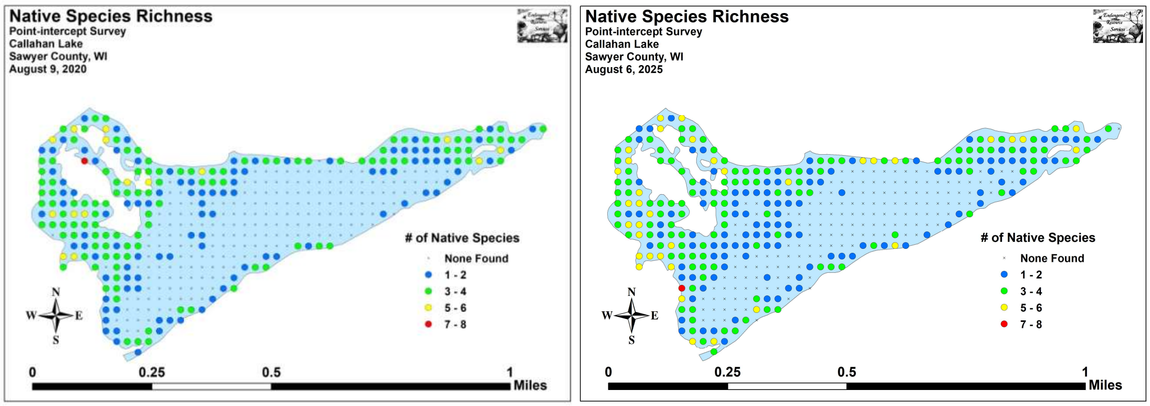


Figure 6: 2020 and 2025 Native Species Richness

Total biomass underwent a non-significant decline (p=0.24) from a moderate mean total rake fullness of 2.10 in 2020 to 2.05 in 2025. Visual analysis of the maps also suggested densities were little changed (Figure 7) (Appendix IV).

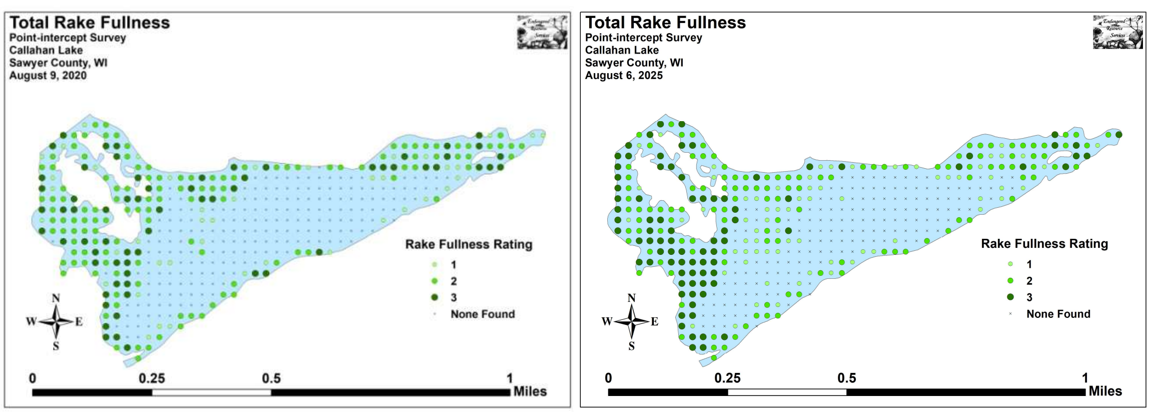


Figure 7: 2020 and 2025 Total Rake Fullness

Callahan Lake Plant Community:

The Callahan Lake ecosystem is home to a diverse plant community that is typical of mesotrophic lakes in northern Wisconsin that have tannic-stained water. 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 lake ecosystem. Depending on the local bottom type (sand, rock, sandy muck, or nutrient-rich organic muck), these zones often had somewhat different species present.

In pure sand areas at and just inland from the immediate shoreline, Bluejoint (*Calamagrostis canadensis*) was common around most of the lake. This species was replaced by Narrow-leaved woolly sedge (*Carex lasiocarpa*) on the bog islands where we also found Marsh cinquefoil (*Comarum palustre*), Bald spikerush (*Eleocharis erythropoda*), Northern blue flag (*Iris versicolor*), and Broad-leaved cattail (*Typha latifolia*) scattered among the sedges.

Bluejoint (Routledge 2013)

Narrow-leaved woolly sedge (Navratil 2016)

Marsh cinquefoil (Myrhatt 2012)

Bald spikerush (Schipper 2019)

Northern blue flag (Tracey 2007)

Broad-leaved cattail (Raymond 2011)

Shallow pure sand and boggy areas supported few emergents other than scattered Grass-leaved arrowhead (*Sagittaria graminea*) and Water bulrush (*Schoenoplectus subterminalis*). However, in the southwest bays and channels and near the lake outlet where there tended to be a layer of nutrient-poor muck over firm sand, we found occasionally dense beds of Three-way sedge (*Dulichium arundinacea*), Creeping spikerush (*Eleocharis palustris*), Pickerelweed (*Pontederia cordata*), and American bur-reed (*Sparganium americanum*).

Grass-leaved arrowhead (Cameron 2019)

Water bulrush (Dziuk 2016)

Three-way sedge (GMNRI 2016)

Creeping spikerush (Legler 2016)

Pickerelweed (Berg 2024)

American bur-reed (Hubick 2018)

A narrow ring of firm sand dominated the majority of the lake's nearshore (<6ft deep) environment. These areas naturally tend to have low total biomass as the nutrient-poor substrate provides habitat most suited to relatively fine-leaved submergent species such as Muskgrass (*Chara* sp.), Water star-grass (*Heteranthera dubia*), Slender naiad (*Najas flexilis*), Variable pondweed (*Potamogeton gramineus*), Clasping-leaf pondweed (*Potamogeton richardsonii*), Stiff pondweed (*Potamogeton strictifolius*), and Wild celery (*Vallisneria americana*). These species, along with the emergents, work to stabilize the bottom and prevent wave action erosion.

Muskgrass (Fischer 2018)

Water star-grass (Muller 2010)

Slender naiad (Cameron 2013)

Clasping-leaf pondweed (Cameron 2014)

Stiff pondweed (Cameron 2019)

Wild celery (Dalvi 2009)

Nearshore nutrient-poor substrates rarely provided habitat for floating-leaf species. In this environment, we found a few widely-scattered individuals of species that only occasionally produce floating-leaves like Large-leaf pondweed (*Potamogeton amplifolius*) and Variable pondweed. In areas with sandy muck, especially near the floating muck bogs, these species were joined by scattered beds of Floating-leaf pondweed (*Potamogeton natans*) and Vasey's pondweed (*Potamogeton vaseyi*).

Large-leaf pondweed (Fewless 2010)

Variable pondweed with floating leaves (Koshere 2002)

Floating-leaf pondweed (Petroglyph 2007)

Vasey's pondweed (Cameron 2016)

In the most nutrient-rich substrates near the lake outlet and scattered throughout the western bays, we found occasionally dense beds containing Watershield (*Brasenia schreberi*), Spatterdock (*Nuphar variegata*), White water lily (*Nymphaea odorata*), and Water smartweed (*Polygonum amphibium*). The protective canopy cover this entire group provides is often utilized by panfish and bass.

Watershield (WED 2019)

Spatterdock (CBG 2014)

White water lily (Falkner 2009)

Water smartweed (Someya 2009)

Floating between and attached to the larger species in this environment, we found a few scattered Forked duckweed (*Lemna trisulca*). We also documented scattered Creeping bladderwort (*Utricularia gibba*) and Common bladderwort (*Utricularia vulgaris*). Rather than drawing nutrients up through roots like other plants, the carnivorous bladderworts trap zooplankton and minute insects in their bladders, digest their prey, and use the nutrients to further their growth.

Forked duckweed (Curtis 2010)

Bladders for catching plankton and insect larvae (Wontolla 2007)

Creeping bladderwort showing bladders for catching prey (Eyewed 2010)

Common bladderwort flowers among lilypads (Hunt 2010)

Sandy muck areas in water over 6ft deep supported stands of Water marigold (*Bidens beckii*), Northern water-milfoil (*Myriophyllum sibiricum*), Eurasian water-milfoil, Slender naiad, Large-leaf pondweed, Leafy pondweed (*Potamogeton foliosus*), White-stem pondweed (*Potamogeton praelongus*), Small pondweed (*Potamogeton pusillus*), Vasey's pondweed, and Wild celery. The roots, shoots, and seeds of all these submergent species are heavily utilized by both resident and migratory waterfowl for food. They also provide important habitat for the lake's fish throughout their lifecycles; as well as support a myriad of invertebrates like scuds, dragonfly and mayfly nymphs, and snails.

Water marigold (Dziuk 2012)

Northern water-milfoil (Berg 2007)

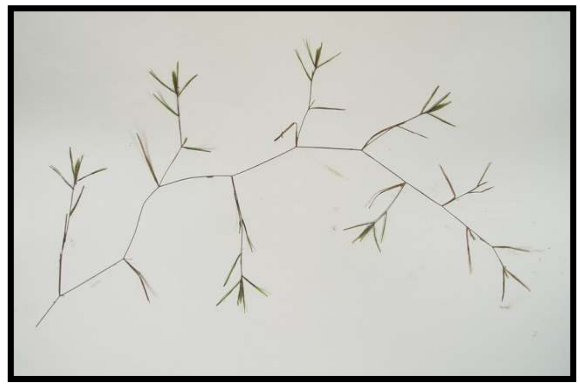
Eurasian water-milfoil (Berg 2007)

Large-leaf pondweed (Dziuk 2018)


Leafy pondweed (Skowinski 2009)


Leafy pondweed close-up of keeled seeds (Kleinman 2009)


White-stem pondweed (Fewless 2005)


Small pondweed (Cameron 2021)

Especially on the outer edges of the littoral zone, this habitat also supported Coontail (*Ceratophyllum demersum*), Common waterweed (*Elodea canadensis*), Fern pondweed (*Potamogeton robbinsii*), and Flat-stem pondweed (*Potamogeton zosteriformis*). Predatory fish like the lake's Musky are often found along the edges of these deepwater beds waiting in ambush.


Coontail (Hassler 2011)


Common waterweed (Pinkka 2013)

Fern pondweed (Apipp 2011)

Flat-stem pondweed (Dziuk 2019)

The very outer edges of the littoral zone also supported scattered patches of aquatic moss and Nitella (*Nitella flexilis*) - a type of colonial algae that looks like a higher plant. Although individuals of both are small, in their preferred zone of growth, these species occasionally formed dense "underwater haystacks" that provide excellent habitat for invertebrates as well as fish.

Aquatic moss leaves magnified 5X (Kleinman 2010)

Nitella (Schou 2003)

Comparison of Native Macrophyte Species in 2020 and 2025:

During our 2020 survey, we identified Fern pondweed, Flat-stem pondweed, Wild celery, and Coontail as the most widely-distributed species (Table 2). They were present at 49.57%, 47.83%, 36.09%, and 24.35% of survey points with vegetation respectively; and, collectively, they accounted for 56.02% of the total relative frequency. Slender naiad (8.49%), Large-leaf pondweed (7.87%), Small pondweed (5.56%), and Common waterweed (4.63%) also had relative frequencies over 4.00% (Density and distribution maps for all native plants identified in 2020 are located in Appendix V).

During our 2025 survey, we found Flat-stem pondweed, Fern pondweed, Large-leaf pondweed, and Wild celery were the most common species (Table 3). Present at 48.73%, 48.00%, 30.91%, and 29.09% of sites with vegetation, they accounted for 53.28% of the total relative frequency. Common waterweed (9.77%), Slender naiad (7.17%), Coontail (5.81%), and Small pondweed (5.56%) also had relative frequencies over 4.00% (Density and distribution maps for all plants found in 2025 are located in Appendix VI).

Lakewide, eight species showed significant changes in distribution from 2020 to 2025. Eurasian water-milfoil **(p=0.04)**, Vasey's pondweed **(p=0.04)**, and Whorled water-milfoil **(p=0.01)** underwent significant declines. Conversely, Common waterweed and aquatic moss experienced highly significant increases **(p<0.001)**; and Large-leaf pondweed **(p=0.03)**, White-stem pondweed **(p=0.01)**, and Nitella **(p=0.04)** saw significant increases (Figure 8).

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Callahan Lake - Sawyer County, Wisconsin
August 9, 2020

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Potamogeton robbinsii	Fern pondweed	114	17.59	49.57	37.87	1.60	0
Potamogeton zosteriformis	Flat-stem pondweed	110	16.98	47.83	36.54	1.65	16
Vallisneria americana	Wild celery	83	12.81	36.09	27.57	1.77	3
Ceratophyllum demersum	Coontail	56	8.64	24.35	18.60	1.46	2
Najas flexilis	Slender naiad	55	8.49	23.91	18.27	1.65	0
Potamogeton amplifolius	Large-leaf pondweed	51	7.87	22.17	16.94	1.35	5
Potamogeton pusillus	Small pondweed	36	5.56	15.65	11.96	1.42	0
Elodea canadensis	Common waterweed	30	4.63	13.04	9.97	1.13	0
	Filamentous algae	30	*	13.04	9.97	1.50	0
Myriophyllum spicatum	**Eurasian water-milfoil**	**17**	**2.62**	**7.39**	**5.65**	**1.41**	**12**
Bidens beckii	Water marigold	15	2.31	6.52	4.98	1.60	3
Potamogeton gramineus	Variable pondweed	12	1.85	5.22	3.99	1.50	4
Potamogeton vaseyi	Vasey's pondweed	12	1.85	5.22	3.99	1.25	0
Myriophyllum sibiricum	Northern water-milfoil	9	1.39	3.91	2.99	1.11	6
Chara sp.	Muskgrass	8	1.23	3.48	2.66	1.13	0
Nuphar variegata	Spatterdock	8	1.23	3.48	2.66	1.63	7
Nymphaea odorata	White water lily	7	1.08	3.04	2.33	1.43	3
Myriophyllum verticillatum	Whorled water-milfoil	5	0.77	2.17	1.66	1.60	0
Potamogeton praelongus	White-stem pondweed	5	0.77	2.17	1.66	1.40	5
Potamogeton richardsonii	Clasping-leaf pondweed	5	0.77	2.17	1.66	1.20	10
Utricularia vulgaris	Common bladderwort	3	0.46	1.30	1.00	1.33	1
Heteranthera dubia	Water star-grass	2	0.31	0.87	0.66	1.00	0
	Aquatic moss	1	*	0.43	0.33	1.00	0
Brasenia schreberi	Watershield	1	0.15	0.43	0.33	1.00	1
Pontederia cordata	Pickerelweed	1	0.15	0.43	0.33	3.00	0
Potamogeton epihydrus	Ribbon-leaf pondweed	1	0.15	0.43	0.33	1.00	1

* Excluded from relative frequency analysis **Exotic species in bold**

Table 2 (continued): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Callahan Lake - Sawyer County, Wisconsin
August 9, 2020

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Potamogeton natans	Floating-leaf pondweed	1	0.15	0.43	0.33	1.00	1
Utricularia gibba	Creeping bladderwort	1	0.15	0.43	0.33	1.00	0
Carex lasiocarpa	Narrow-leaved woolly sedge	**	**	**	**	**	1
Comarum palustre	Marsh cinquefoil	**	**	**	**	**	1
Iris versicolor	Northern blue flag	**	**	**	**	**	1
Myriophyllum heterophyllum	Various-leaved water-milfoil	**	**	**	**	**	1
Sagittaria graminea	Grass-leaved arrowhead	**	**	**	**	**	1
Schoenoplectus subterminalis	Water bulrush	**	**	**	**	**	1
Sparganium americanum	American bur-reed	**	**	**	**	**	1
Calamagrostis canadensis	Bluejoint	***	***	***	***	***	***
Eleocharis acicularis	Needle spikerush	***	***	***	***	***	***
Polygonum amphibium	Water smartweed	***	***	***	***	***	***

** Visual only   *** Boat survey only

Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Callahan Lake - Sawyer County, Wisconsin
August 6, 2025

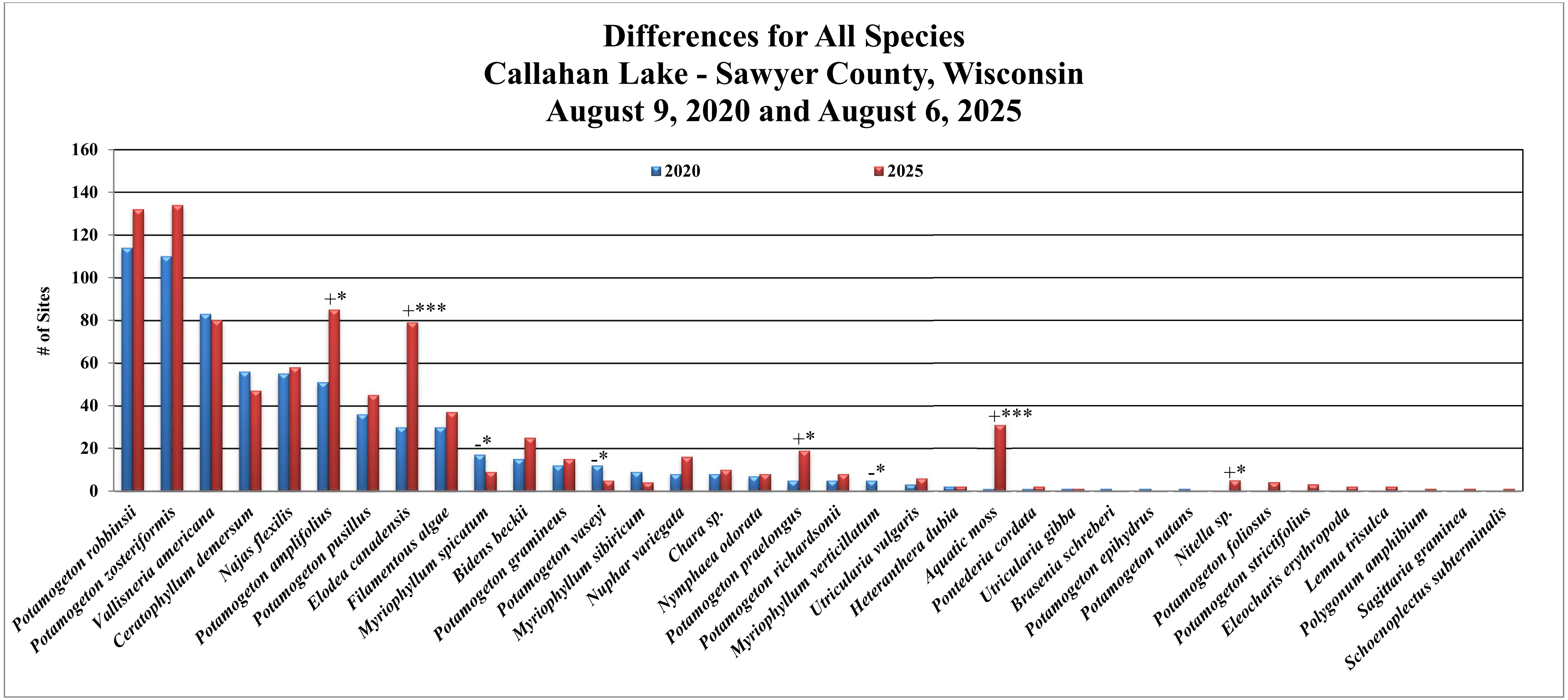
Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Potamogeton zosteriformis	Flat-stem pondweed	134	16.56	48.73	37.64	1.53	10
Potamogeton robbinsii	Fern pondweed	132	16.32	48.00	37.08	1.77	0
Potamogeton amplifolius	Large-leaf pondweed	85	10.51	30.91	23.88	1.41	15
Vallisneria americana	Wild celery	80	9.89	29.09	22.47	1.44	4
Elodea canadensis	Common waterweed	79	9.77	28.73	22.19	1.29	0
Najas flexilis	Slender naiad	58	7.17	21.09	16.29	1.33	0
Ceratophyllum demersum	Coontail	47	5.81	17.09	13.20	1.26	0
Potamogeton pusillus	Small pondweed	45	5.56	16.36	12.64	1.18	0
	Filamentous algae	37	*	13.45	10.39	1.14	0
	Aquatic moss	31	*	11.27	8.71	1.19	0
Bidens beckii	Water marigold	25	3.09	9.09	7.02	1.24	1
Potamogeton praelongus	White-stem pondweed	19	2.35	6.91	5.34	1.11	14
Nuphar variegata	Spatterdock	16	1.98	5.82	4.49	1.38	8
Potamogeton gramineus	Variable pondweed	15	1.85	5.45	4.21	1.47	3
Chara sp.	Muskgrass	10	1.24	3.64	2.81	1.20	0
Myriophyllum spicatum	**Eurasian water-milfoil**	**9**	**1.11**	**3.27**	**2.53**	**1.67**	**5**
Nymphaea odorata	White water lily	8	0.99	2.91	2.25	2.13	6
Potamogeton richardsonii	Clasping-leaf pondweed	8	0.99	2.91	2.25	1.13	10
Utricularia vulgaris	Common bladderwort	6	0.74	2.18	1.69	1.00	0
Nitella sp.	Nitella	5	0.62	1.82	1.40	1.00	0
Potamogeton vaseyi	Vasey's pondweed	5	0.62	1.82	1.40	1.00	0
Myriophyllum sibiricum	Northern water-milfoil	4	0.49	1.45	1.12	1.00	3
Potamogeton foliosus	Leafy pondweed	4	0.49	1.45	1.12	1.50	0
Potamogeton strictifolius	Stiff pondweed	3	0.37	1.09	0.84	1.33	0
Eleocharis erythropoda	Bald spikerush	2	0.25	0.73	0.56	1.50	0
Heteranthera dubia	Water star-grass	2	0.25	0.73	0.56	1.50	0

* Excluded from relative frequency analysis **Exotic species in bold**

Table 3 (continued): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Callahan Lake - Sawyer County, Wisconsin
August 6, 2025

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Lemna trisulca	Forked duckweed	2	0.25	0.73	0.56	1.00	0
Pontederia cordata	Pickerelweed	2	0.25	0.73	0.56	1.50	3
Polygonum amphibium	Water smartweed	1	0.12	0.36	0.28	1.00	0
Sagittaria graminea	Grass-leaved arrowhead	1	0.12	0.36	0.28	1.00	0
Schoenoplectus subterminalis	Water bulrush	1	0.12	0.36	0.28	3.00	0
Utricularia gibba	Creeping bladderwort	1	0.12	0.36	0.28	1.00	0
Brasenia schreberi	Watershield	**	**	**	**	**	5
Carex lasiocarpa	Narrow-leaved woolly sedge	**	**	**	**	**	1
Comarum palustre	Marsh cinquefoil	**	**	**	**	**	1
Dulichium arundinaceum	Three-way sedge	**	**	**	**	**	1
Eleocharis palustris	Creeping spikerush	**	**	**	**	**	1
Potamogeton natans	Floating-leaf pondweed	**	**	**	**	**	1
Typha latifolia	Broad-leaved cattail	**	**	**	**	**	1
Calamagrostis canadensis	Bluejoint	***	***	***	***	***	***
Iris versicolor	Northern blue flag	***	***	***	***	***	***
Sparganium americanum	American bur-reed	***	***	***	***	***	***

** Visual only   *** Boat survey only



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

Figure 8: 2020 – 2025 Macrophyte Differences for All Species

Present throughout the lake, Fern pondweed was the most widely-distributed macrophyte in 2020 (114 sites/mean rake fullness of 1.60). Although it fell to the second-ranked species in 2025, we documented a non-significant expansion (p=0.83) in distribution to 132 sites, and a significant increase **(p=0.03)** in density to a mean rake fullness of 1.77. Because pondweeds (*Potamogeton* sp.) are not assumed to be susceptible to 2,4-D or ProcellaCor (the two herbicides that have been used the most on the lake), these increases are not unexpected. Visual analysis of the maps also showed most high-density pondweed rakes occurred within the 2025 treatment area (Figure 9).

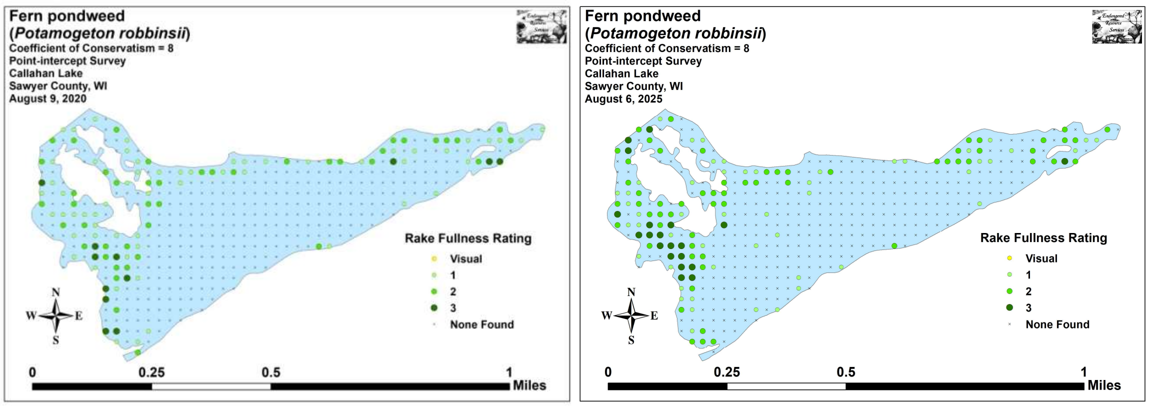


Figure 9: 2020 and 2025 Fern Pondweed Density and Distribution

Flat-stem pondweed was the second most common species in 2020 (110 sites - mean rake 1.65). In 2025, it underwent a non-significant increase (p=0.77) in distribution (134 sites) and became the most common species in the overall community. Its density, however, fell to a mean rake fullness of 1.53 – a nearly significant decline (p=0.06). Visual analysis of the maps showed most of these losses occurred on the eastern half of the lake (Figure 10).

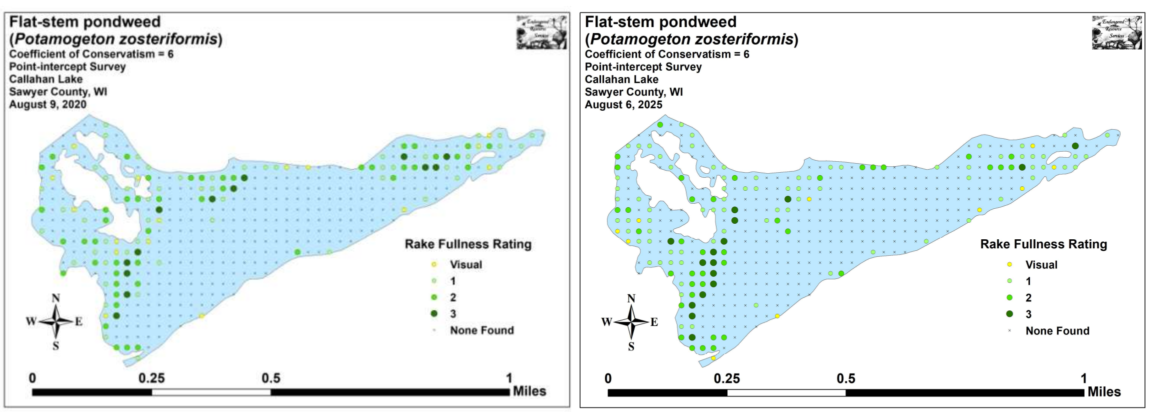


Figure 10: 2020 and 2025 Flat-stem Pondweed Density and Distribution

In 2020, Wild celery was the third most common species in the lake when it was present at 83 sites with a mean rake fullness of 1.77. Although the 2025 survey found it was almost unchanged in distribution (80 sites), it fell back to become the fourth-ranked species and suffered a highly significant decline **(*p*<0.001)** in density (mean rake fullness of 1.44). Visual analysis of the maps suggested these losses were widespread (Figure 11).

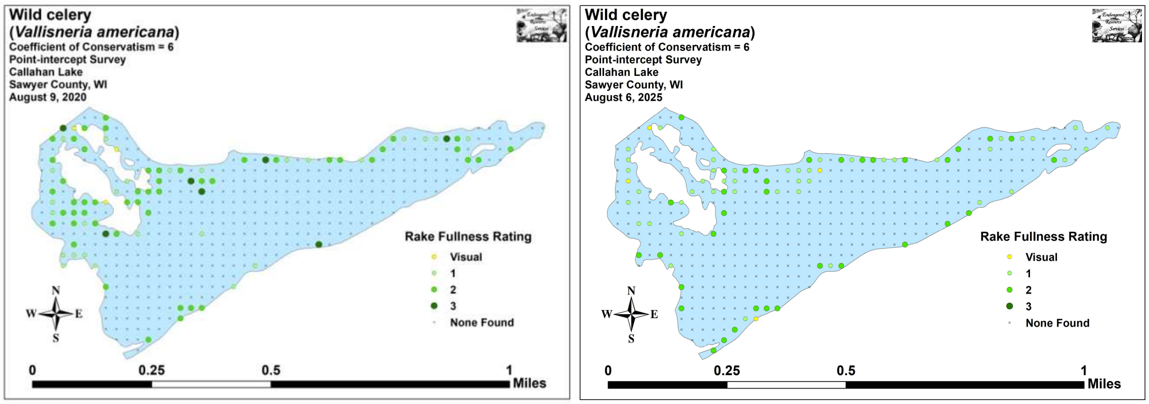


Figure 11: 2020 and 2025 Wild Celery Density and Distribution

Coontail, the fourth most widely-distributed species in 2020 and the seventh most in 2025, saw a nearly significant decline (*p*=0.06) in distribution (56 sites in 2020/47 sites in 2025) and a significant decline **(*p*=0.04)** in density (mean rake fullness of 1.46 in 2020/1.26 in 2025). A species that is sensitive to both 2,4-D and ProcellaCor, we found it was almost entirely restricted to sheltered bays and channels of the lake's west side (Figure 12).

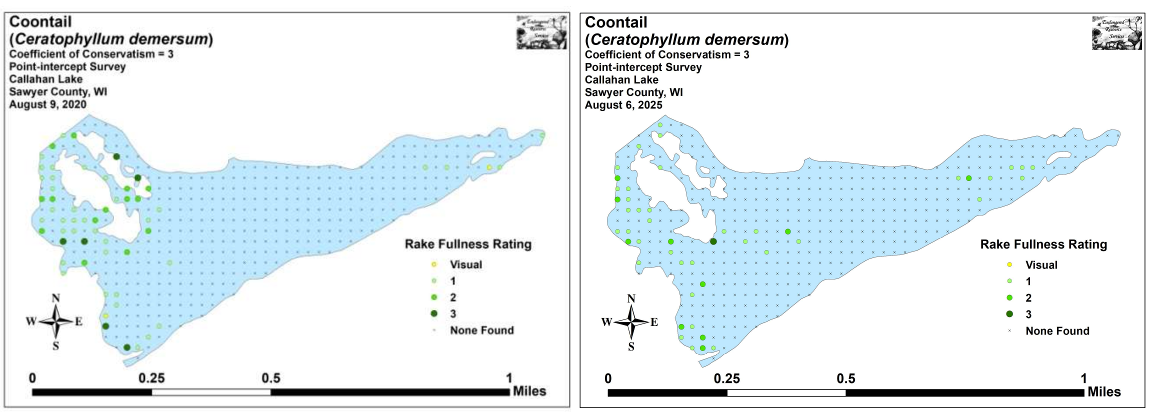
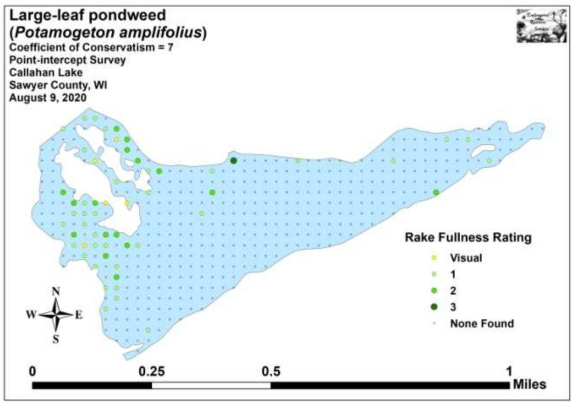


Figure 12: 2020 and 2025 Coontail Density and Distribution

Large-leaf pondweed is an important habitat-producing species often known as "cabbage" or "musky weed". It jumped from the sixth most common species in 2020 (51 sites – mean rake 1.35) to the third most common in 2025 (85 sites – mean rake 1.41) – a significant increase **(*p*=0.03)** in distribution and a non-significant increase (*p*=0.26) in density. Visual analysis of the maps suggested these increases were widespread (Figure 13).



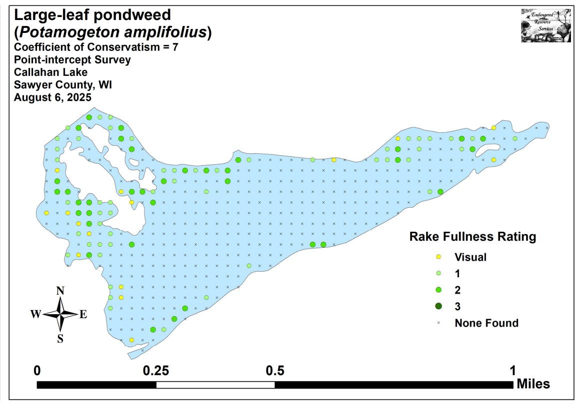
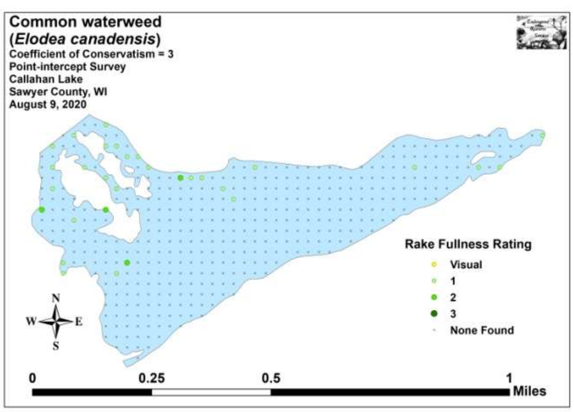


Figure 13: 2020 and 2025 Large-leaf Pondweed Density and Distribution

Common waterweed was the eight most common macrophyte in 2020, but it jumped to the fifth most common in 2025 after more than doubling its distribution from 30 sites to 79 sites – a highly significant increase **(*p*<0.001)**. It also underwent a significant increase **(*p*=0.03)** in density from a mean rake fullness of 1.13 in 2020 to a mean rake of 1.29 in 2025. Because this species can rapidly reproduce vegetatively, it can quickly take advantage of voids left by herbicide treatments (Figure 14).



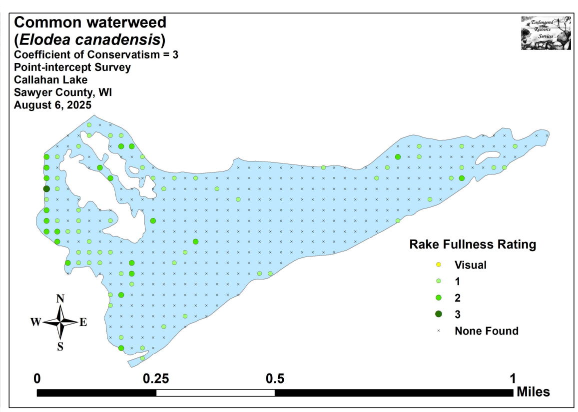


Figure 14: 2020 and 2025 Common Waterweed Density and Distribution

Comparison of Floristic Quality Indexes in 2020 and 2025:

In 2020, we found a total of 25 **native index plants** in the rake during the point-intercept survey. They produced a mean Coefficient of Conservatism of 6.6 and a Floristic Quality Index of 33.2 (Table 4).

Table 4: Floristic Quality Index of Aquatic Macrophytes Callahan Lake - Sawyer County, Wisconsin August 9, 2020

Species	Common Name	C
Bidens beckii	Water marigold	8
Brasenia schreberi	Watershield	6
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Myriophyllum sibiricum	Northern water-milfoil	6
Myriophyllum verticillatum	Whorled water-milfoil	8
Najas flexilis	Slender naiad	6
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Pontederia cordata	Pickerelweed	8
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton epihydrus	Ribbon-leaf pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton vaseyi	**Vasey's pondweed**	**10**
Potamogeton zosteriformis	Flat-stem pondweed	6
Utricularia gibba	**Creeping bladderwort**	**9**
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
N		**25**
Mean C		**6.6**
FQI		**33.2**

The 2025 survey documented 29 **native index plants** in the rake during the point-intercept survey. They produced a mean Coefficient of Conservatism of 6.6 and a Floristic Quality Index of 35.7 (Table 5). Nichols (1999) reported an average mean C for the Northern Lakes and Forest Region of 6.7 putting Callahan Lake just below average for this part of the state. The FQI value was, however, much higher than the median FQI of 24.3 for the Northern Lakes and Forest Region (Nichols 1999). Four extremely sensitive high value index plants of note included Grass-leaved arrowhead (C = 9), Water bulrush (C = 9), Creeping bladderwort (C = 9), and the state Species of Special Concern*** Vasey's pondweed (C = 10). One other high value species found – Narrow-leaved woolly sedge (C = 9) – is not included in the index.

*** *"Special Concern"* species are 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.

Table 5: Floristic Quality Index of Aquatic Macrophytes
Callahan Lake - Sawyer County, Wisconsin
August 6, 2025

Species	Common Name	C
Bidens beckii	Water marigold	8
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Eleocharis erythropoda	Bald spikerush	3
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Lemna trisulca	Forked duckweed	6
Myriophyllum sibiricum	Northern water-milfoil	6
Najas flexilis	Slender naiad	6
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 foliosus	Leafy pondweed	6
Potamogeton gramineus	Variable pondweed	7
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton strictifolius	Stiff pondweed	8
Potamogeton vaseyi	**Vasey's pondweed**	**10**
Potamogeton zosteriformis	Flat-stem pondweed	6
Sagittaria graminea	**Grass-leaved arrowhead**	**9**
Schoenoplectus subterminalis	**Water bulrush**	**9**
Utricularia gibba	**Creeping bladderwort**	**9**
Utricularia vulgaris	Common bladderwort	7

Table 5 (continued): Floristic Quality Index of Aquatic Macrophytes
Callahan Lake - Sawyer County, Wisconsin
August 6, 2025

Species	Common Name	C
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
N		**29**
Mean C		**6.6**
FQI		**35.7**

Comparison of Filamentous Algae in 2020 and 2025:

Filamentous algae are normally associated with excessive nutrients in the water column from such things as runoff, internal nutrient recycling, and failed septic systems. Our 2020 survey found them at 30 points. Of these, one rated a rake fullness of 3, 13 rated a 2, and the other 16 were a 1 for a mean rake fullness of 1.50. The 2025 survey found these algae at 37 points. None rated a rake fullness of 3, five were a 2, and the remaining 32 were a 1 – a mean rake fullness of 1.14. Although the increase in distribution wasn't significant (p=0.86), the decline in density was moderately significant **(p=0.002)**. Visual analysis of the maps showed these algae continued to be widespread (Figure 15).

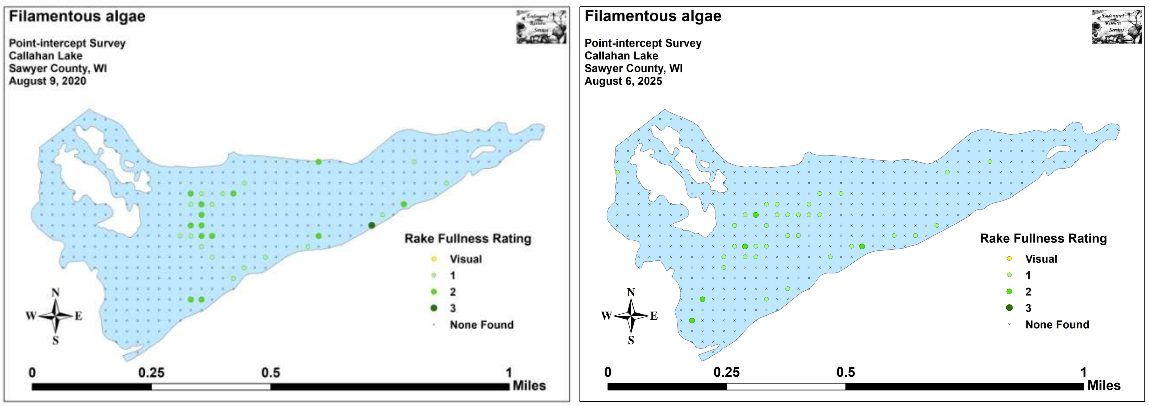


Figure 15: 2020 and 2025 Filamentous Algae Density and Distribution

Comparison of Eurasian Water-milfoil in 2008, 2020, and 2025:

The original 2008 survey found Eurasian water-milfoil at 64 points (15.1% of surveyed points) with 13 additional visual sightings (Figure 16) (Appendix VII). Seven of these points had a rake fullness of 3, 15 were a 2, and 42 were a 1. This produced a mean rake fullness of 1.45 and suggested that 5.2% of the surveyed points had a significant infestation (rake fullness of 2 or 3).

In 2020, we found EWM in the rake at 17 points (3.9% of the entire lake bottom and 5.6% of the littoral zone) with 12 additional visual sightings. We rated one point a rake fullness of 3, five were a 2 (1.4% of the entire lake and 2.0% of the littoral zone had a significant infestation), and 11 were a 1 for a mean rake fullness of 1.41. Compared to the 2008 survey, this suggested EWM had undergone a highly significant decline in total distribution and rake fullness 1 **(p<0.001)**; and a significant decline in rake fullness 2 **(p=0.03)** and rake fullness 3 **(p=0.04)** (Figure 17). However, the decline in mean density was not significant (p=0.41).

Our 2025 survey found EWM in the rake at nine points (2.1% of the lake/3.3% of the littoral zone) with five additional visual records. Two points rated a 3, two points were a 2 (0.9% of the lake/1.1% of the littoral zone had a significant infestation), and the remaining five points were a 1 resulting in a mean rake fullness of 1.67. When compared to our 2020 survey, this suggested that EWM had undergone a further significant decline **(p=0.04)** in distribution. Although the mean density increased, this was not significant (p=0.22). None of the individual densities showed significant changes when broken out by rake fullness, but visual sightings also saw a significant decline **(p=0.04)** (Figure 17).

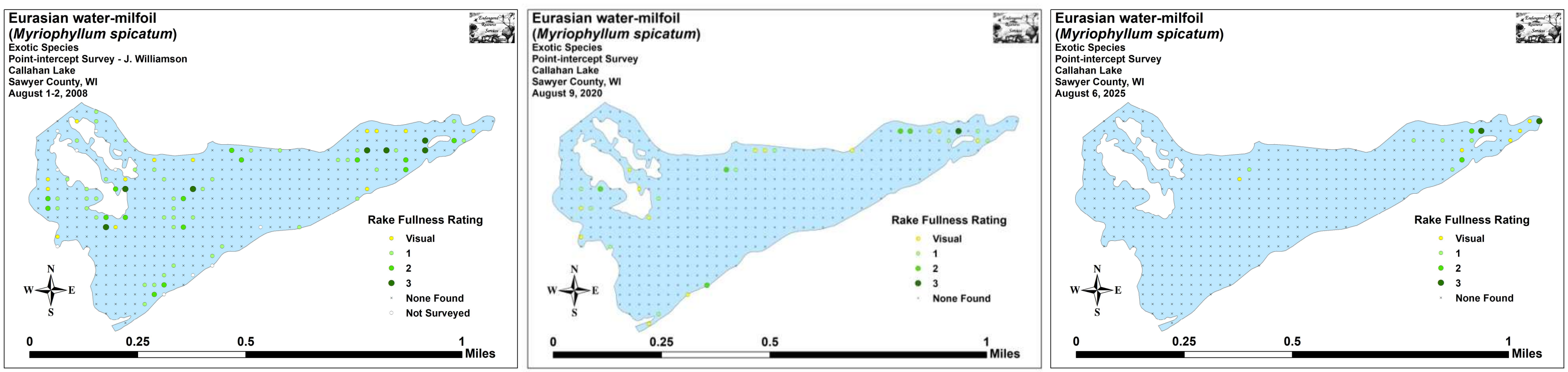


Figure 16: 2008, 2020, and 2025 Eurasian Water-milfoil Density and Distribution

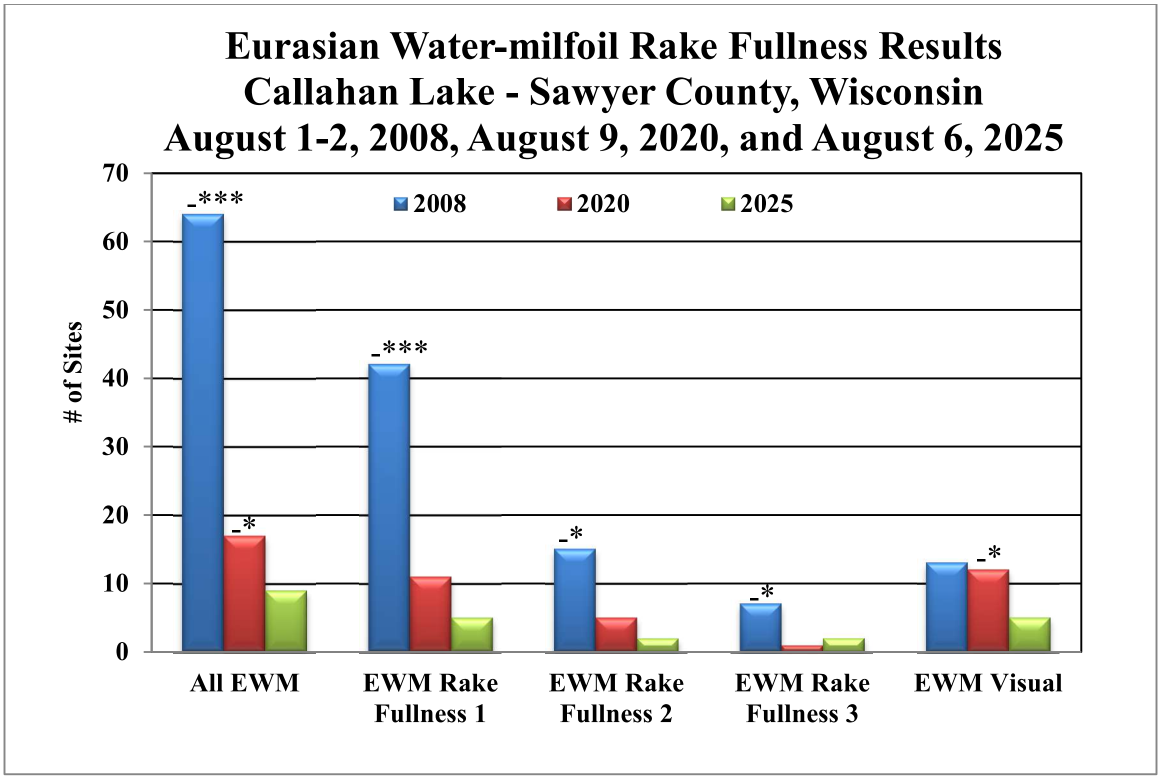


Figure 17: 2008 – 2025 Changes in Eurasian Water-milfoil Rake Fullness

Other Exotic Plant Species:

We saw no evidence of any other exotic plant species on Callahan Lake. However, there were abundant stands of Hybrid cattail (*Typha* X *glauca*) on the north and west shorelines of Mud Lake, and it's likely this species will continue to spread in the system (For more information on a sampling of aquatic exotic invasive plant species, see Appendix VIII).

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:

Water Clarity, Nutrient Inputs, and the Role of Native Macrophytes:

Like trees in a forest, a lake's native plants support the entire aquatic ecosystem. Because of this, preserving them is critical to maintaining a healthy environment moving forward. As the basis of the food pyramid, they provide habitat for other aquatic organisms, are important food sources for waterfowl and other wildlife, stabilize the shoreline, and work to improve water clarity by absorbing excess nutrients from the water. In lakes without a healthy population of these rooted plants or when nutrients in the 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.

Soil erosion and runoff can be significant contributors to a lake's overall nutrient load. Although the majority of property owners on the lake are practicing sound shoreline conservation, there is always room for improvement. By consciously working to limit runoff, residents can proactively cut the amount of phosphorus and nitrogen entering the system. This is an important management goal because, when levels of these nutrients increase in the water column, they tend to promote excessive plant growth (like milfoil) and algae blooms that negatively impact sensitive plant species as well as general lake esthetics.

Simple things like establishing or maintaining a buffer strip of native vegetation along the lakeshore to prevent erosion, building rain gardens, bagging grass clippings, switching to a phosphorus-free fertilizer or preferably eliminating fertilizer near the lake altogether, collecting pet waste, and disposing of the ash from fire pits away from the lakeshore can all significantly reduce the amount of nutrients entering the lake. Hopefully, a greater understanding of how all property owners can have lake-wide impacts will result in more people taking appropriate conservation actions to not only help maintain water clarity and quality, but also to benefit the lake's sensitive native plant species which depend on these pristine conditions.

Eurasian Water-milfoil Management:

Eurasian water-milfoil is widespread in the Mud/Callahan system making eradication an unrealistic expectation. Although EWM was found throughout Callahan Lake, past active management has dramatically reduced it from an estimated 55 acres covering 39.86% of the lake's surface area in 2008 (Kleczewski 2009). Following the herbicide treatment and follow-up DASH work in 2025, **EWM levels were down 96.58%** compared to this presumed highwater mark.

Past management of Eurasian water-milfoil in Callahan Lake has come at a high economic cost, and, as herbicides are non-selective, has also likely had significant impacts on the aquatic plant community. With this in mind, working to control its spread in the most cost-effective manner possible, while simultaneously minimizing its impact on the lake's aquatic ecosystem, will likely continue to be important goals for the CMLPA as they update their management plan. Ultimately, the amount of EWM growth the CMLPA and WDNR are comfortable with will determine how much, if any, active management occurs in Callahan Lake in 2026. Likewise, what if any future monitoring will occur on the lake is a conversation that needs to occur.

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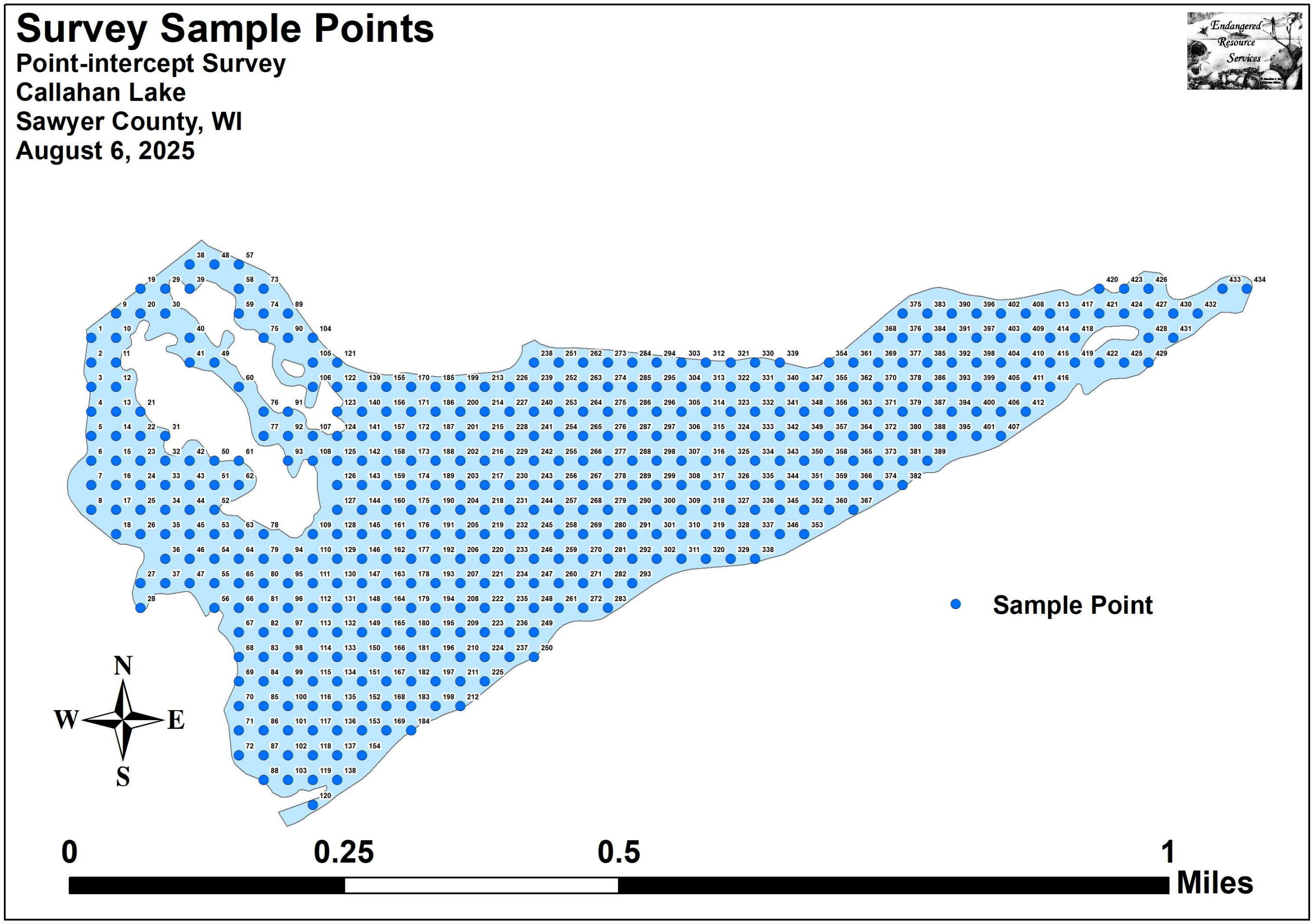
Appendix I: Survey Sample Points Map

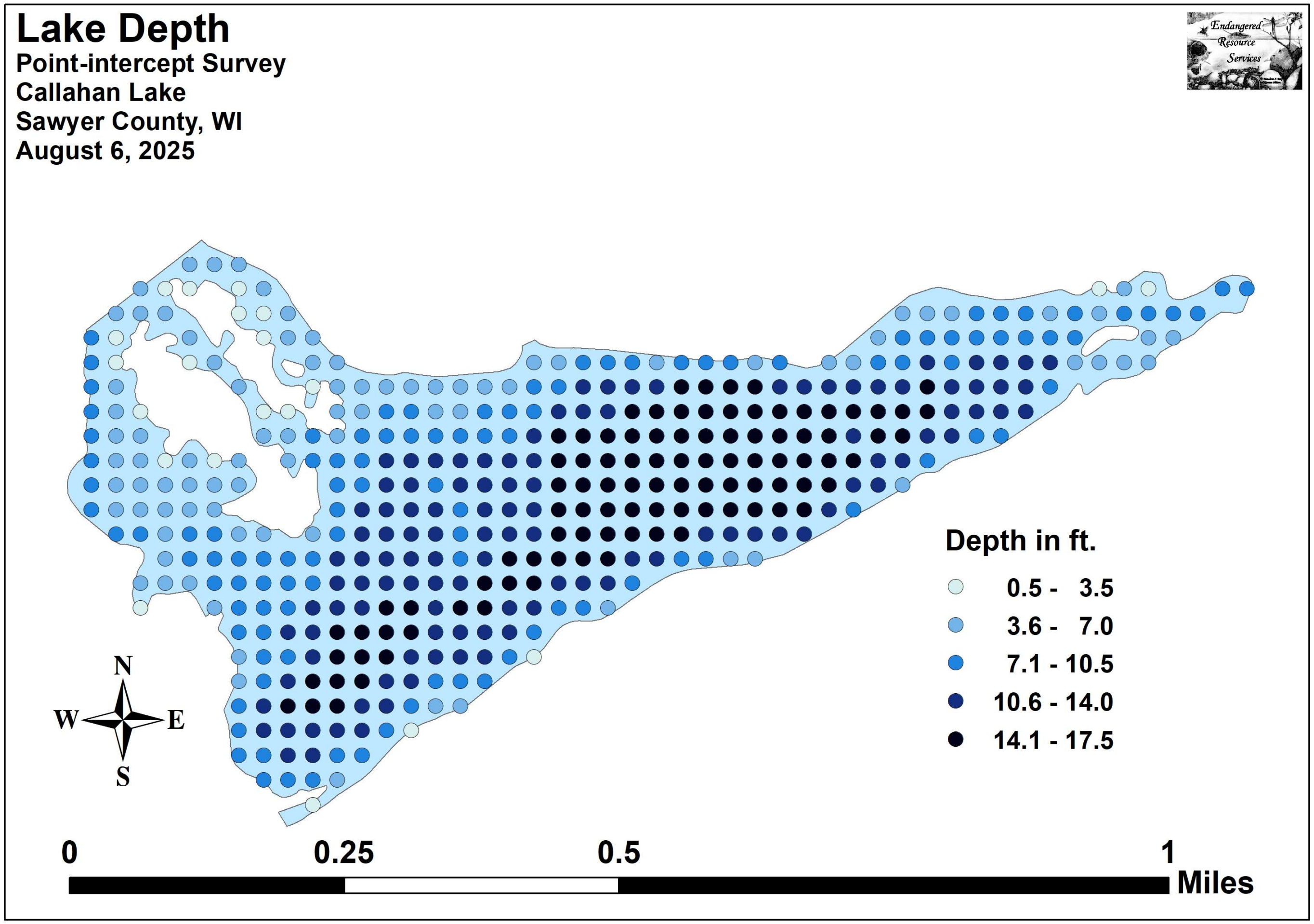

Survey Sample Points
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Sample Point
N
W
E
S
0
0.25
0.5
1
Miles

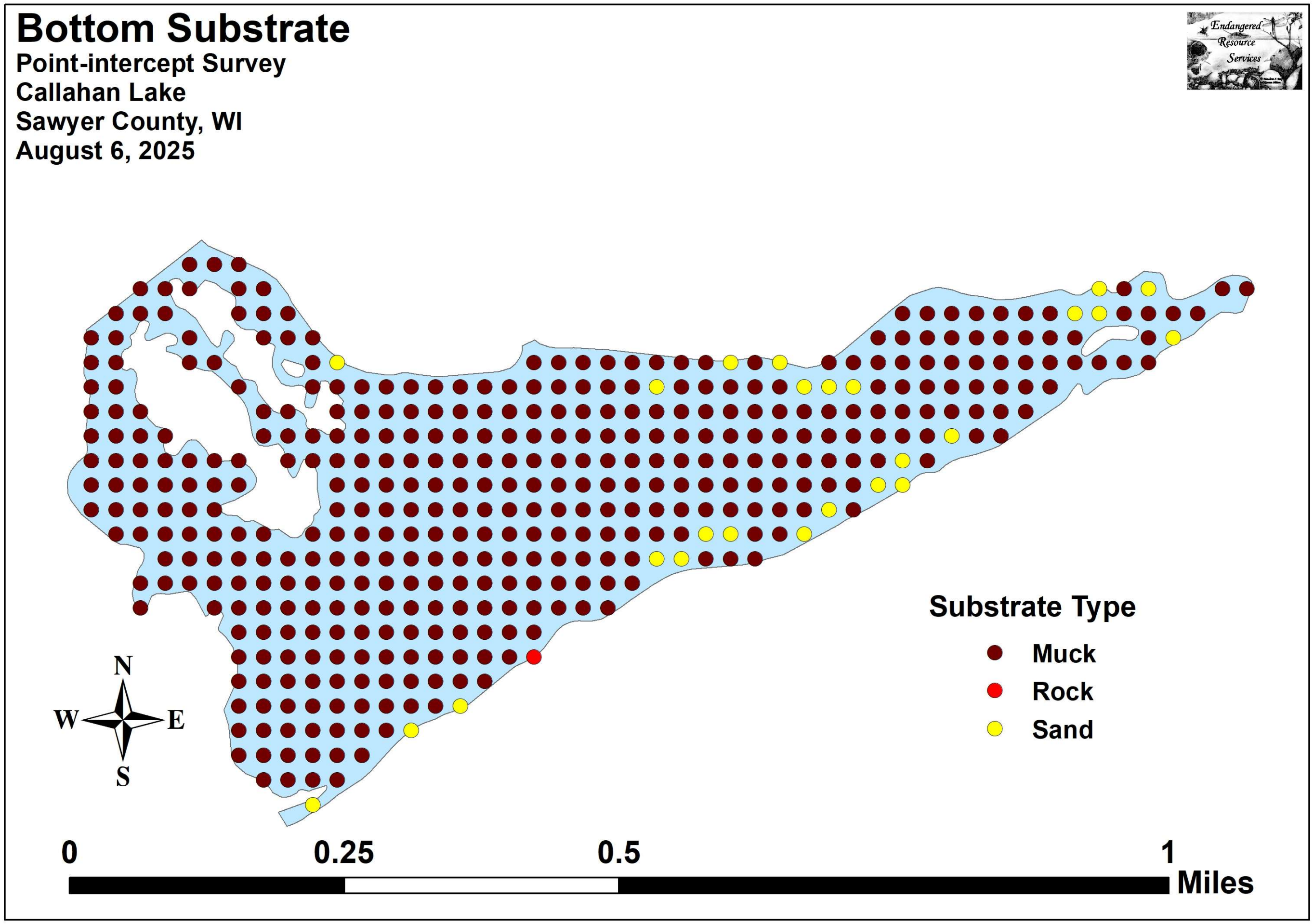
Appendix II: Boat and Vegetative Survey Datasheets

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

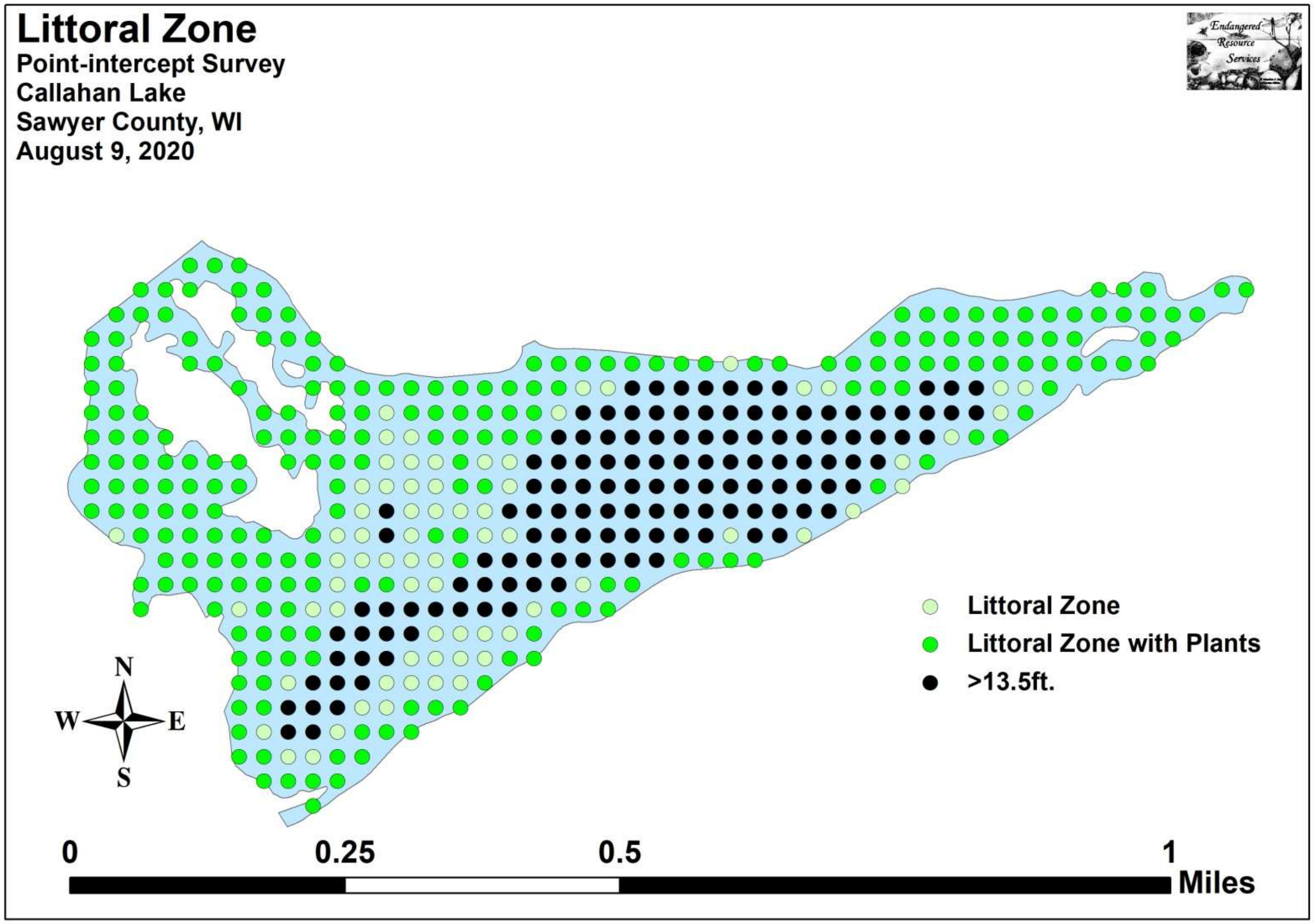
Observers for this lake: names and hours worked by each:																									
Lake:									WBIC									County						Date:	
Site #	Depth (ft)	Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	Total Rake Fullness	EWM	CLP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1																	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

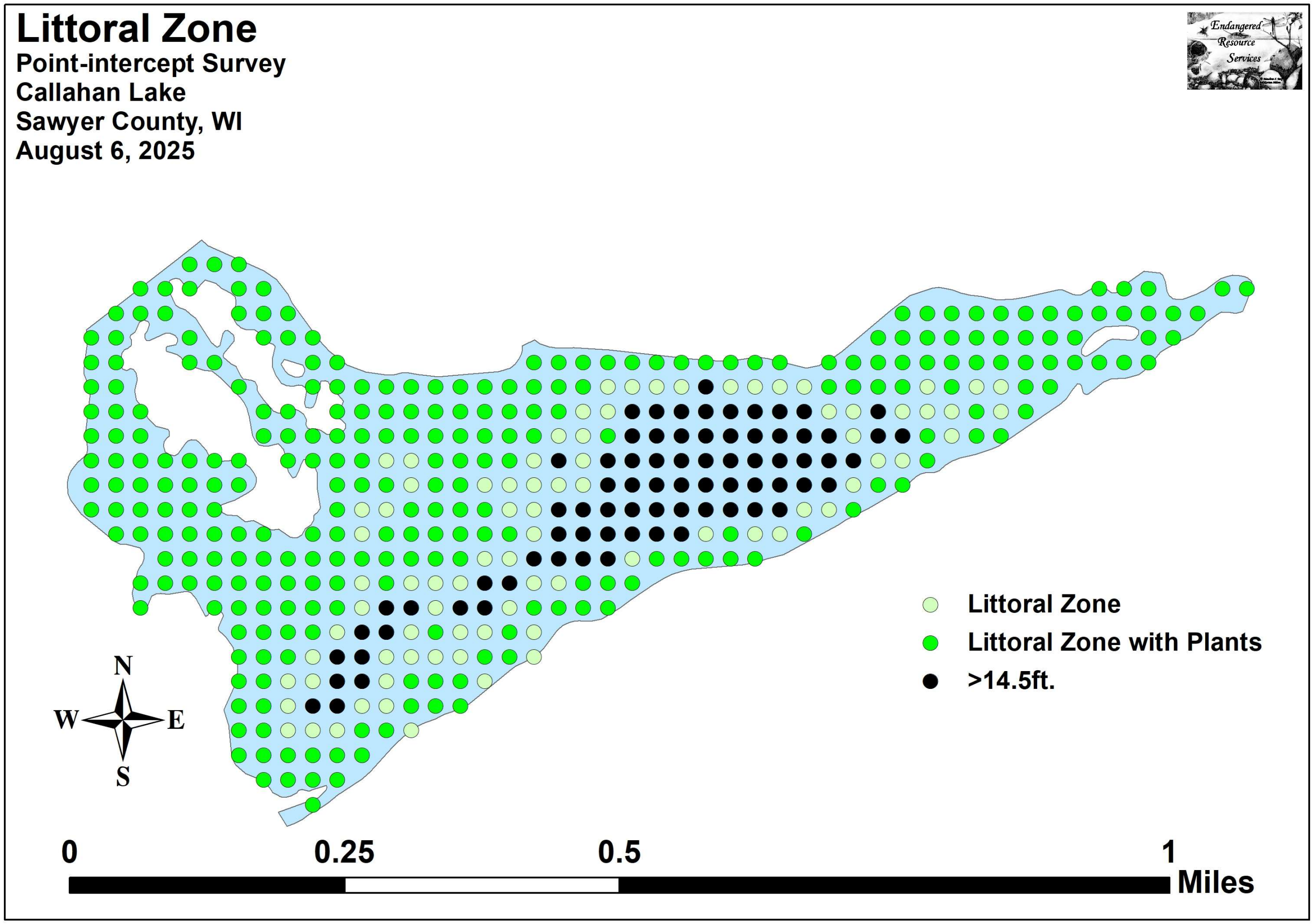
Appendix III: Habitat Variable Maps


Lake Depth
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Depth in ft.
0.5 - 3.5
3.6 - 7.0
7.1 - 10.5
10.6 - 14.0
14.1 - 17.5
N
W
E
S
0
0.25
0.5
1
Miles

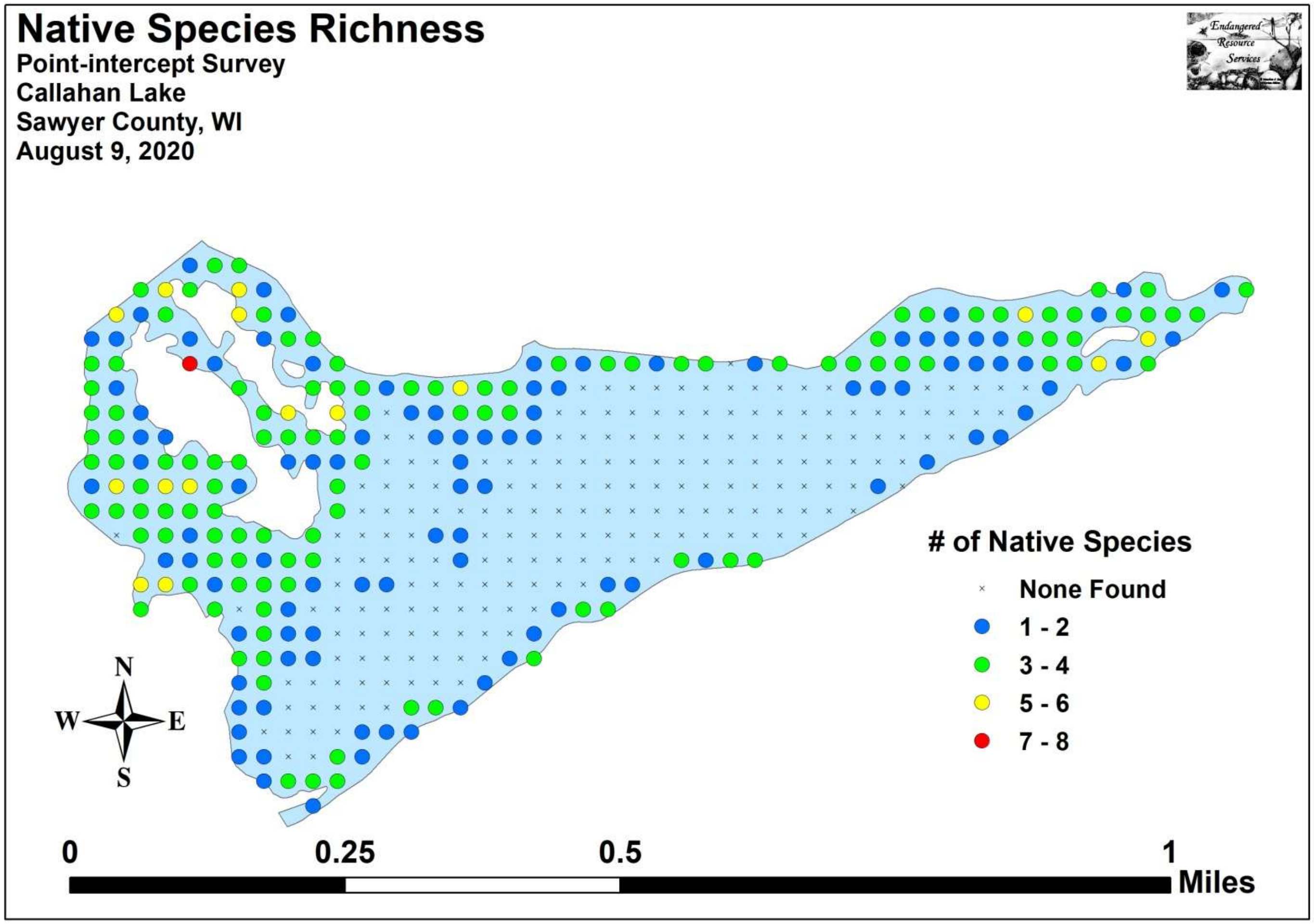

Bottom Substrate
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Substrate Type
Muck
Rock
Sand
N
W
E
S
0
0.25
0.5
1
Miles

Appendix IV: 2020 and 2025 Littoral Zone, Native Species Richness, and Total Rake Fullness Maps

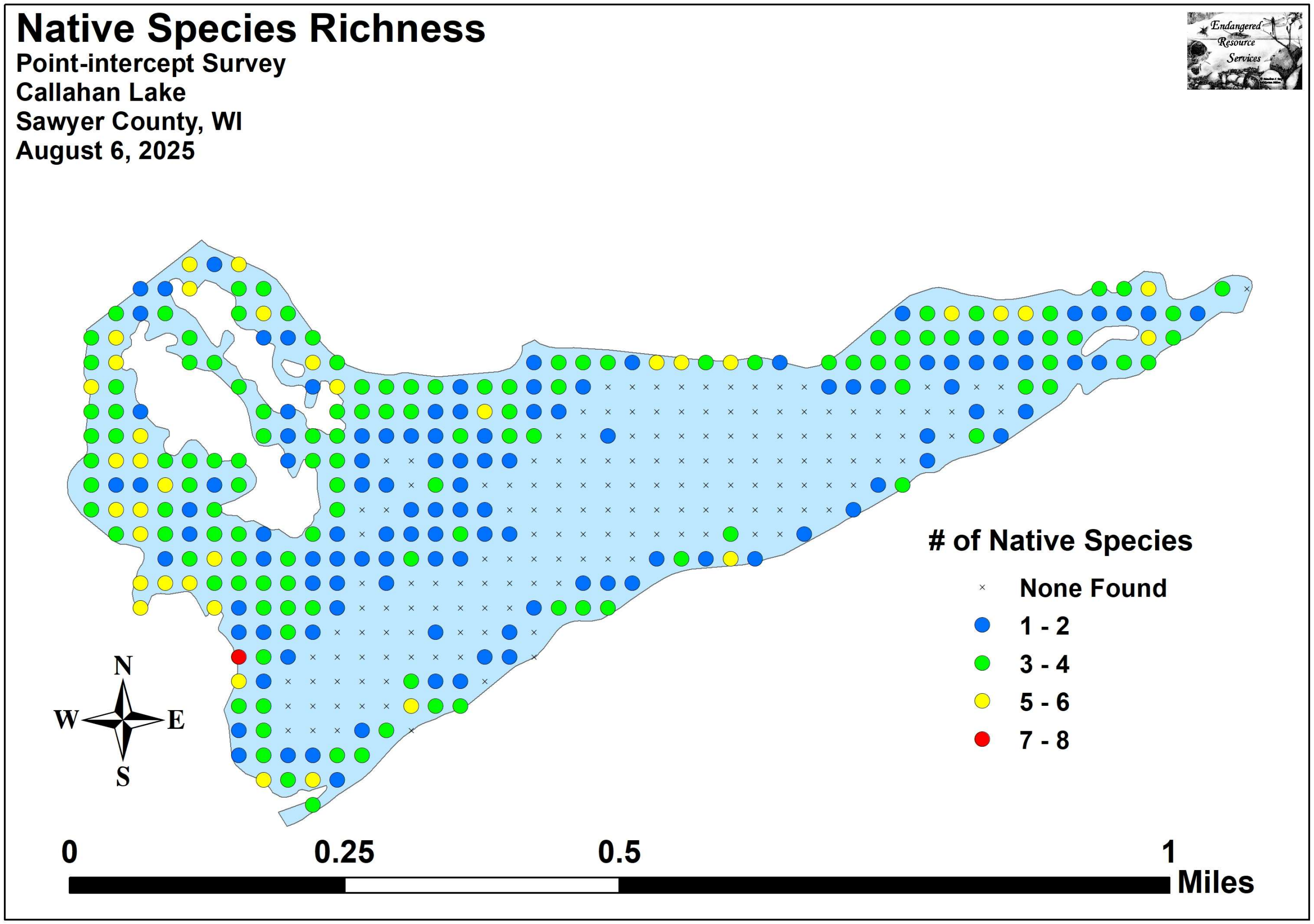

Littoral Zone
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Littoral Zone
Littoral Zone with Plants
>13.5ft.
N
W
E
S
0
0.25
0.5
1
Miles



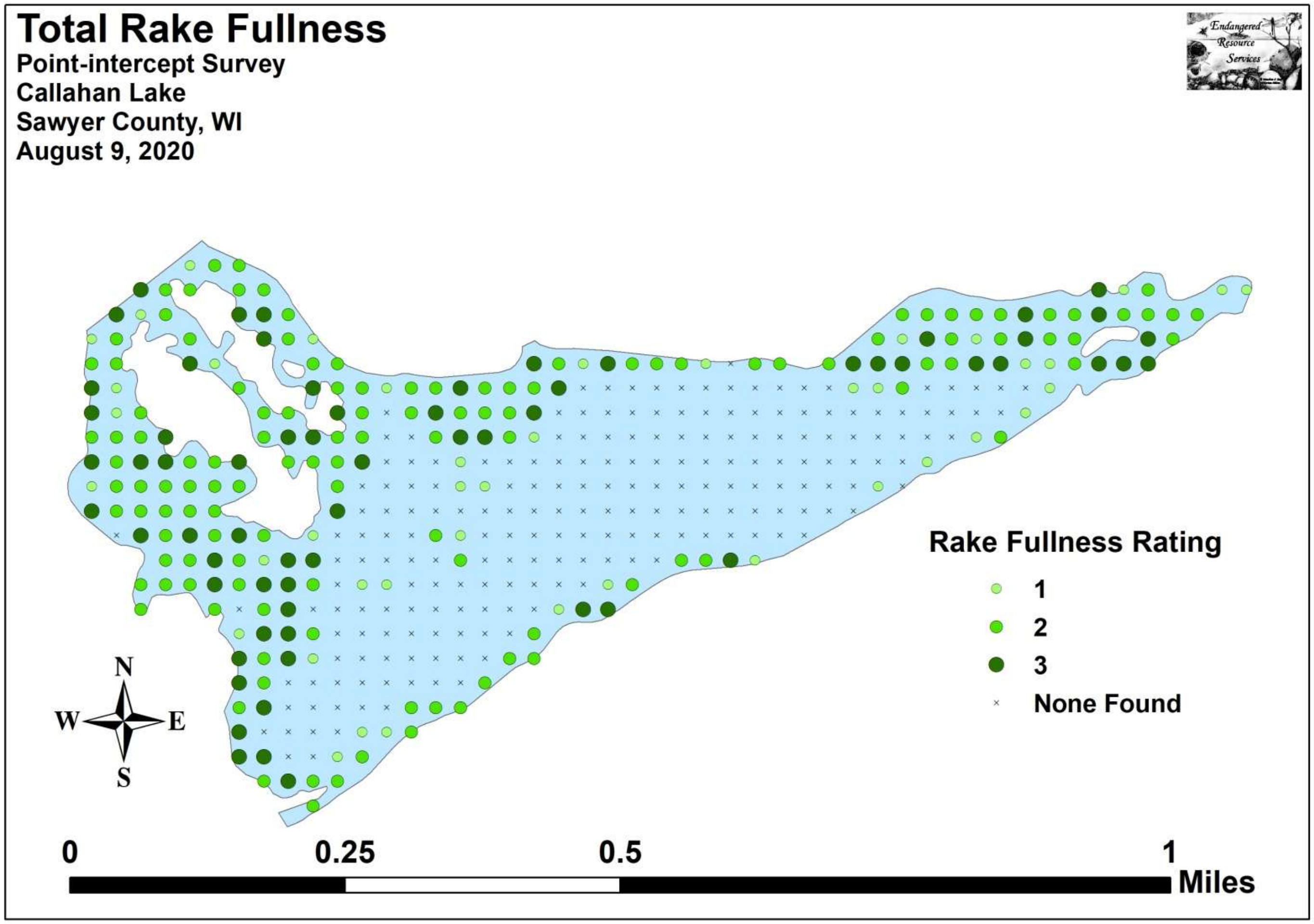
Littoral Zone
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Littoral Zone
Littoral Zone with Plants
>14.5ft.
N
W
E
S
0
0.25
0.5
1
Miles

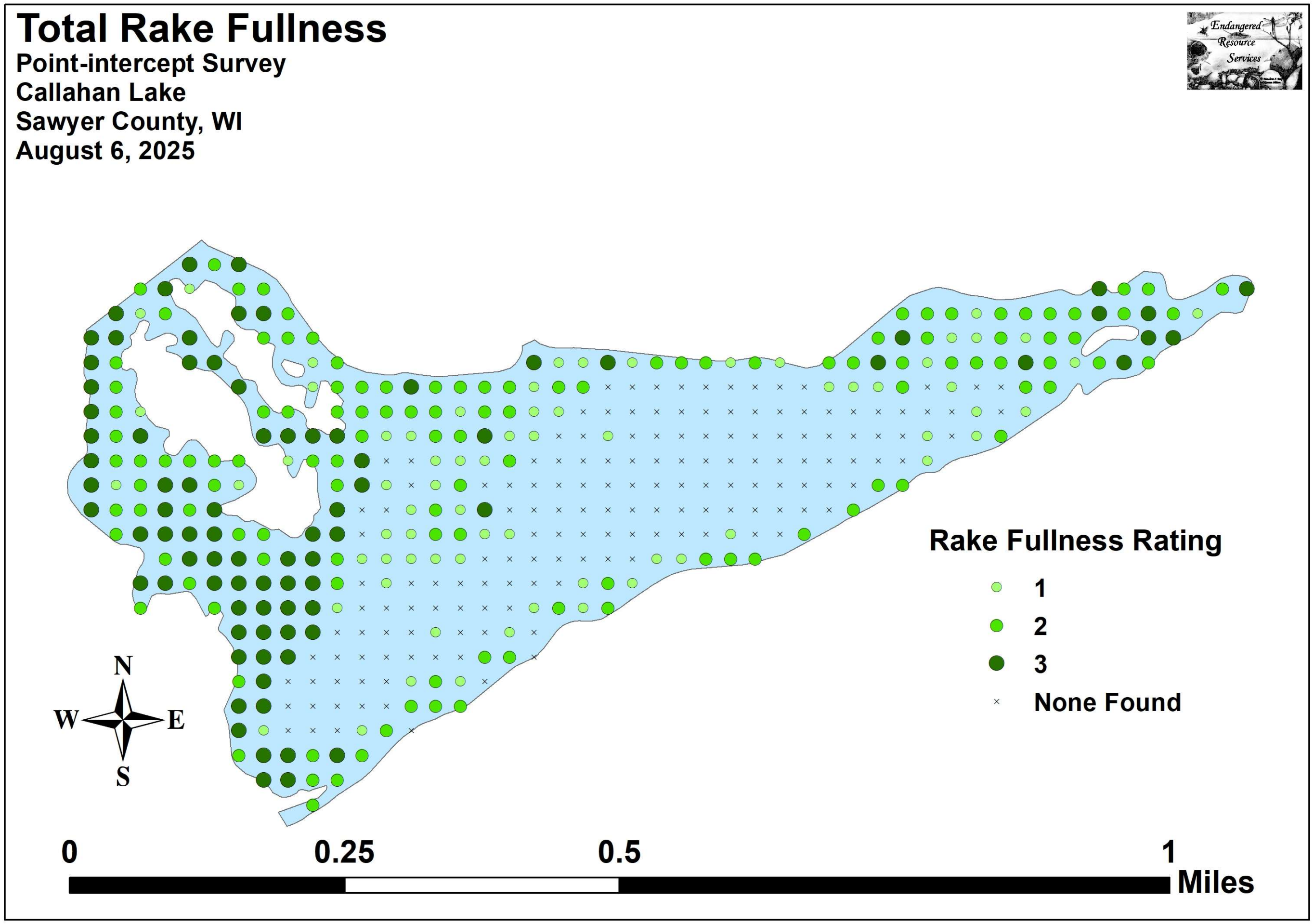


Native Species Richness
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 8
N
W
E
S
0
0.25
0.5
1
Miles

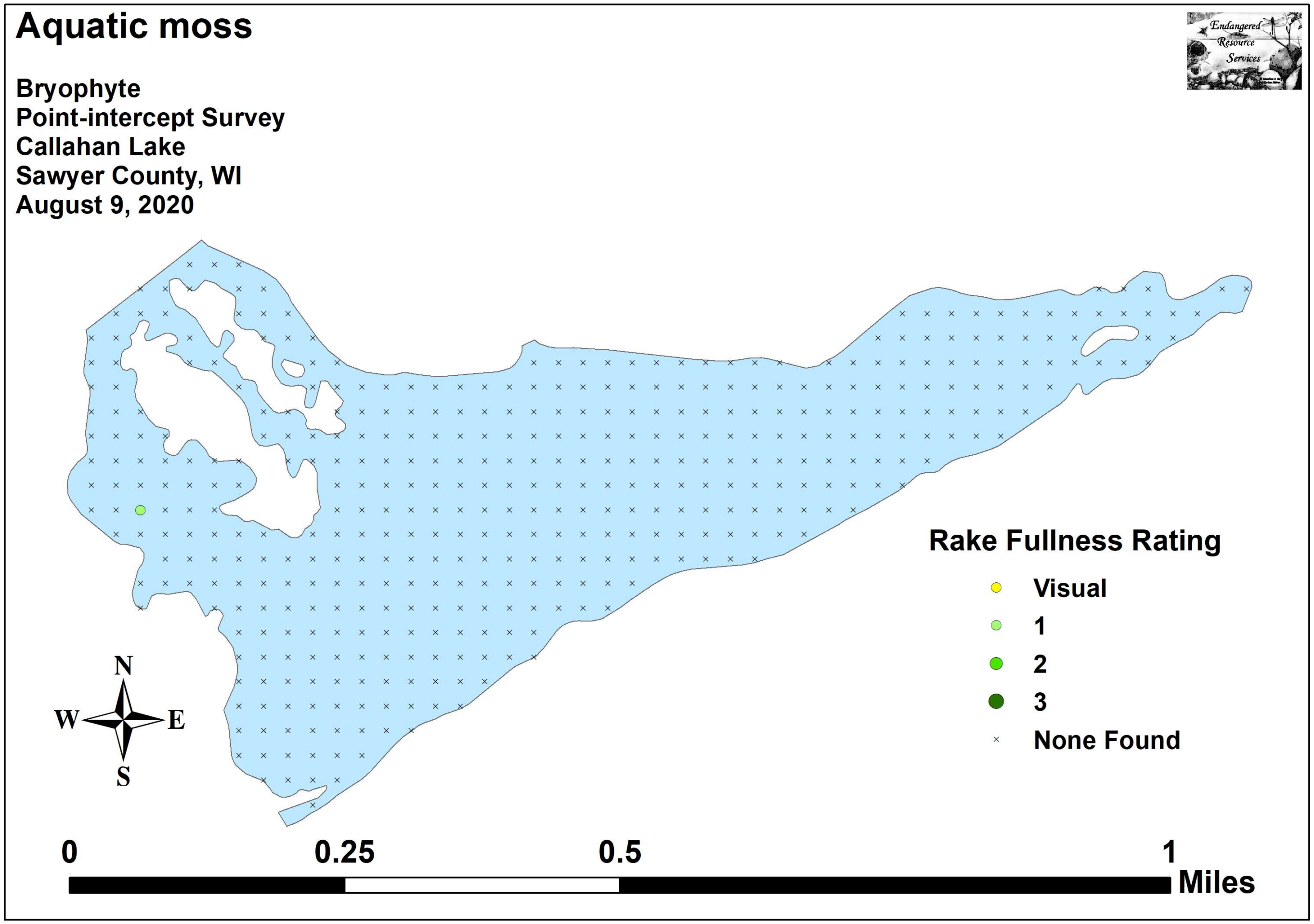


Native Species Richness
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 8
N
W
E
S
0
0.25
0.5
1
Miles

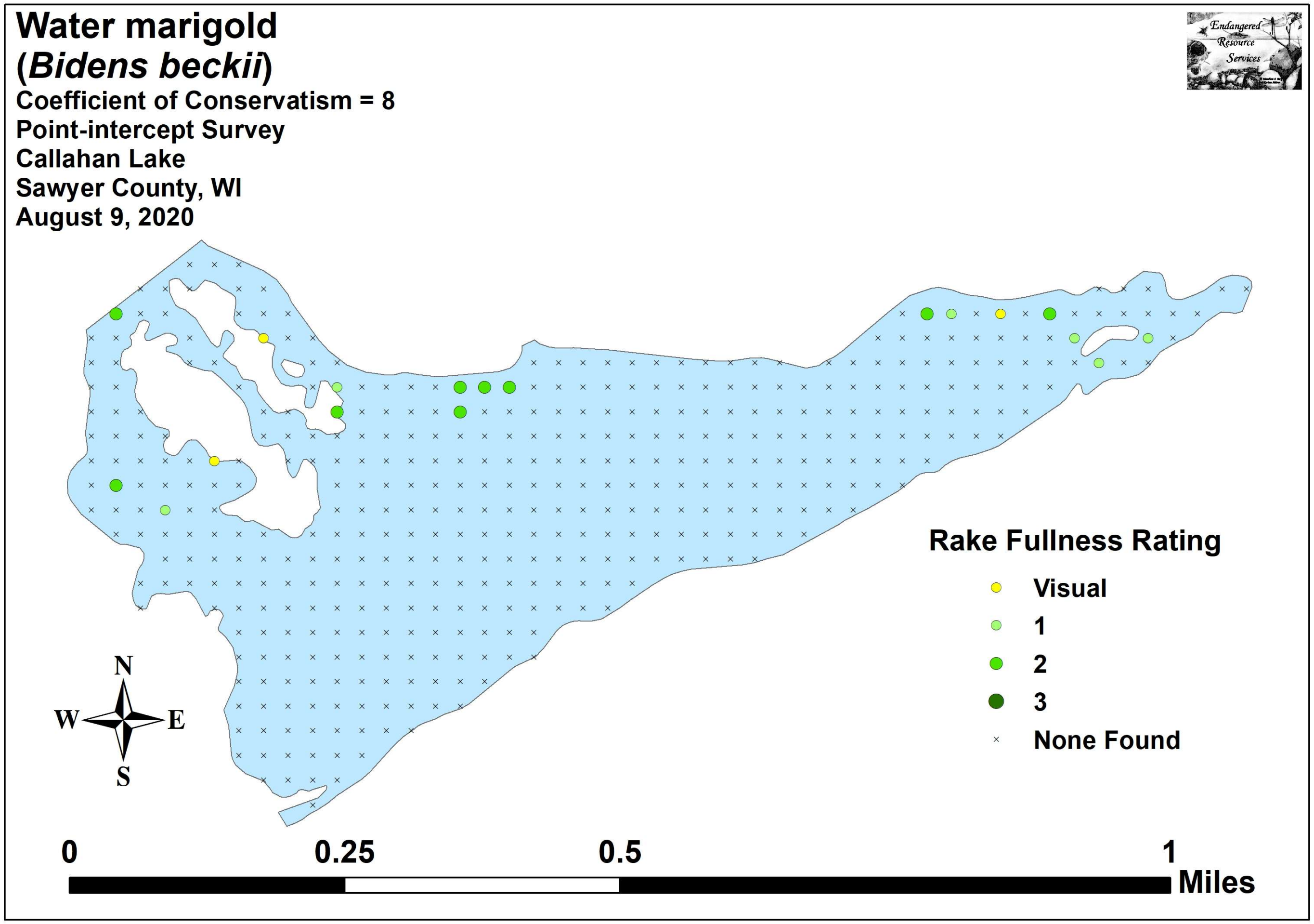

Total Rake Fullness
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

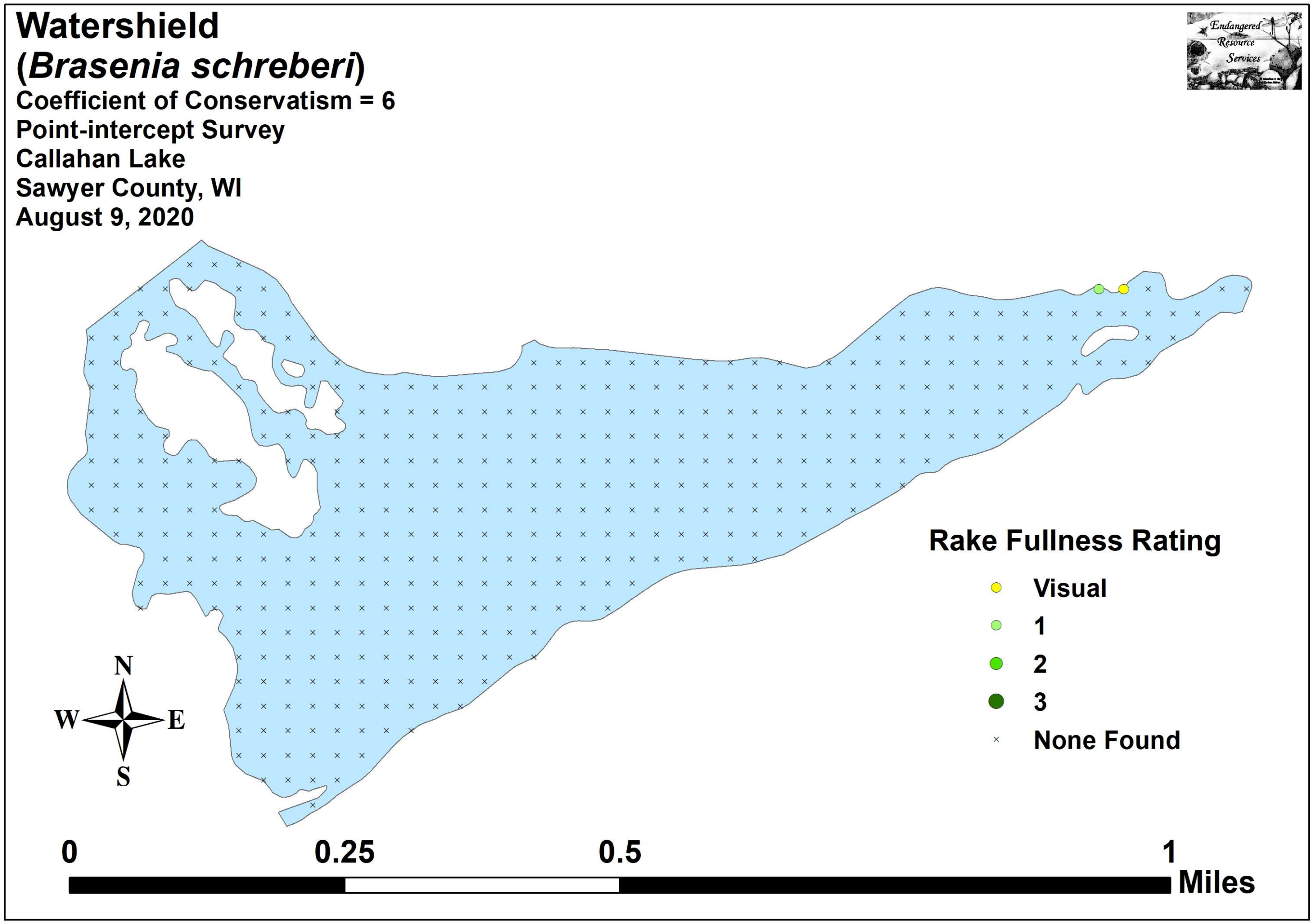

Total Rake Fullness
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

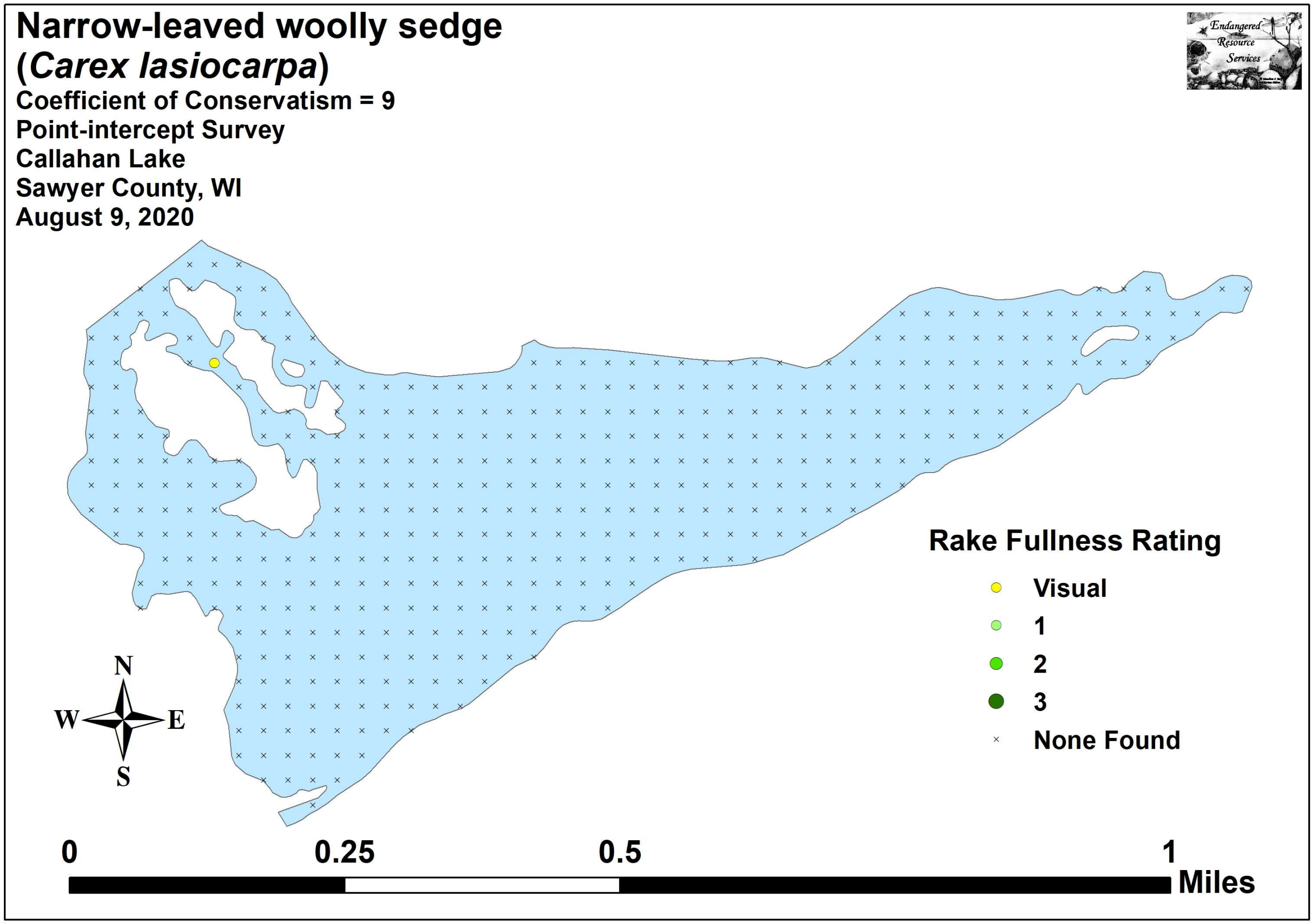
Appendix V: August 2020 Native Species Density and Distribution Maps

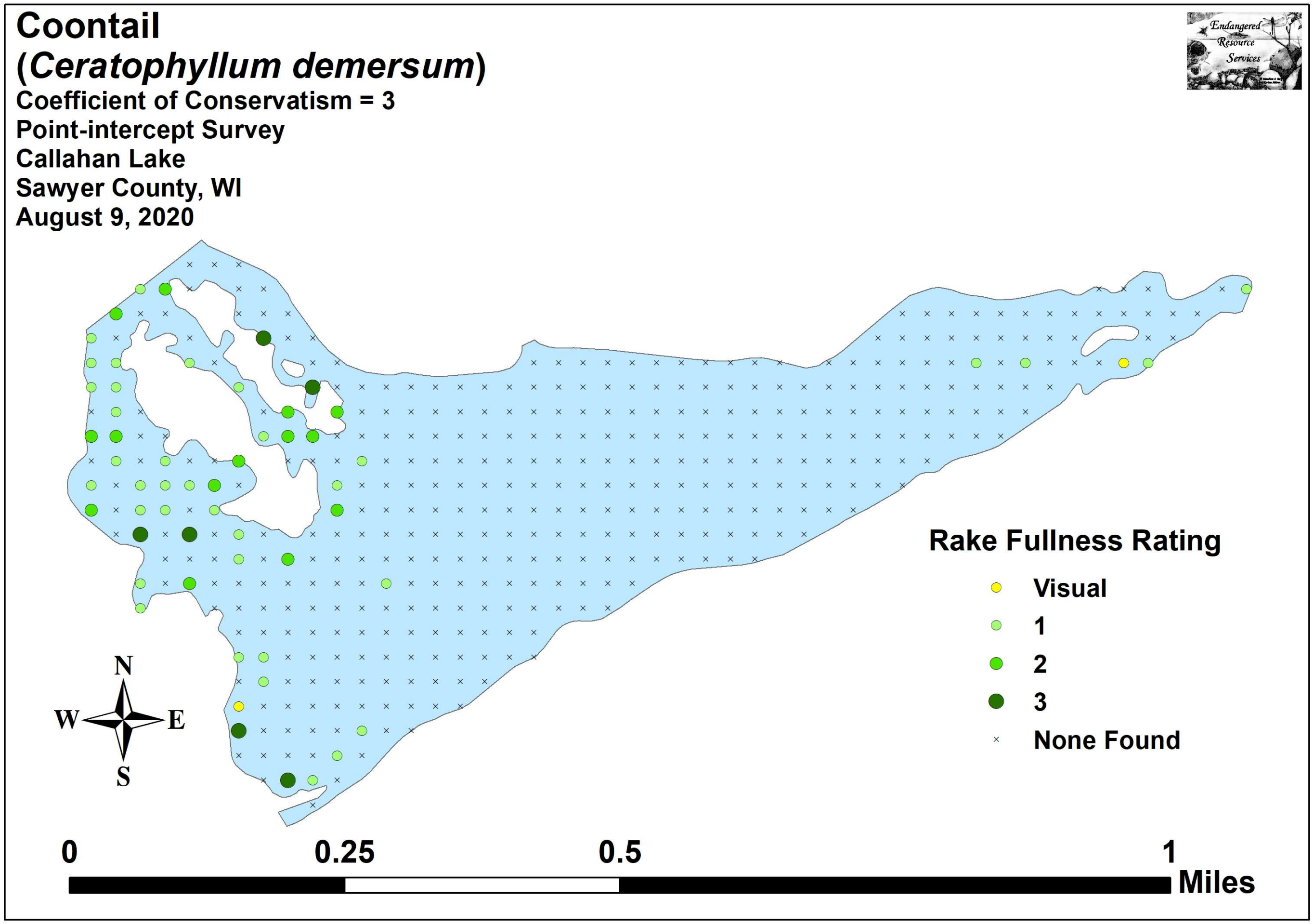


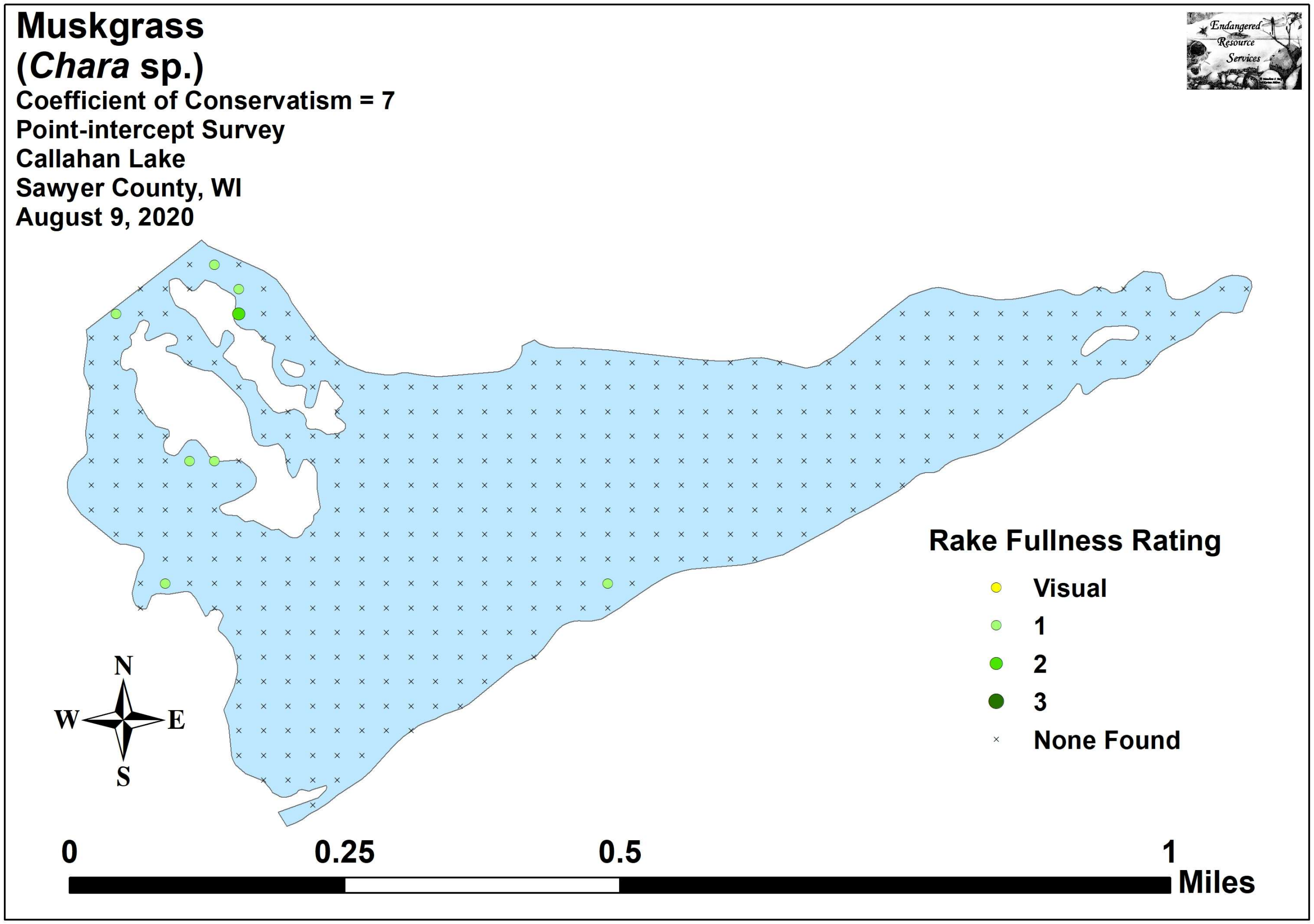
Aquatic moss
Bryophyte
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

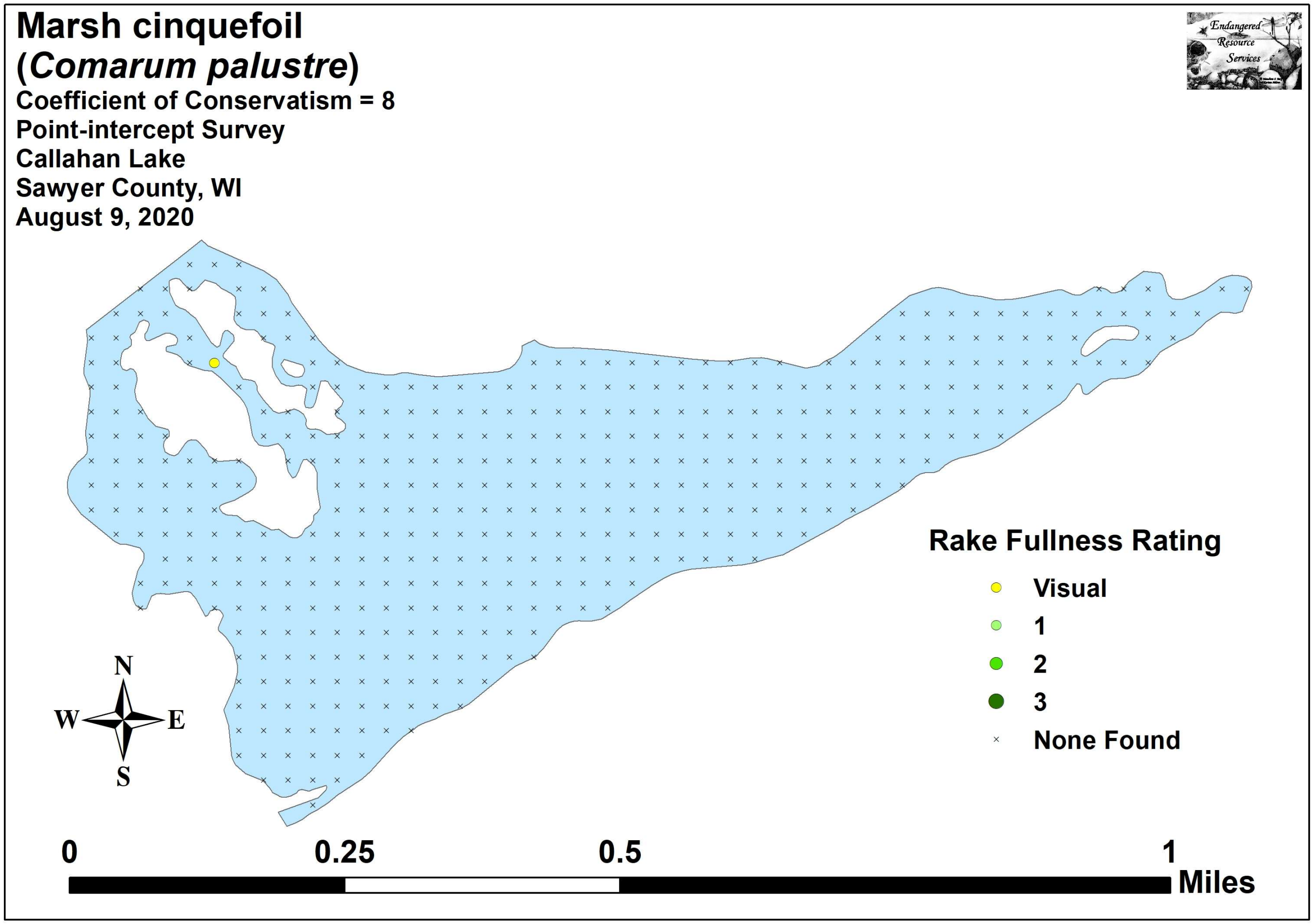

Water marigold
(Bidens beckii)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

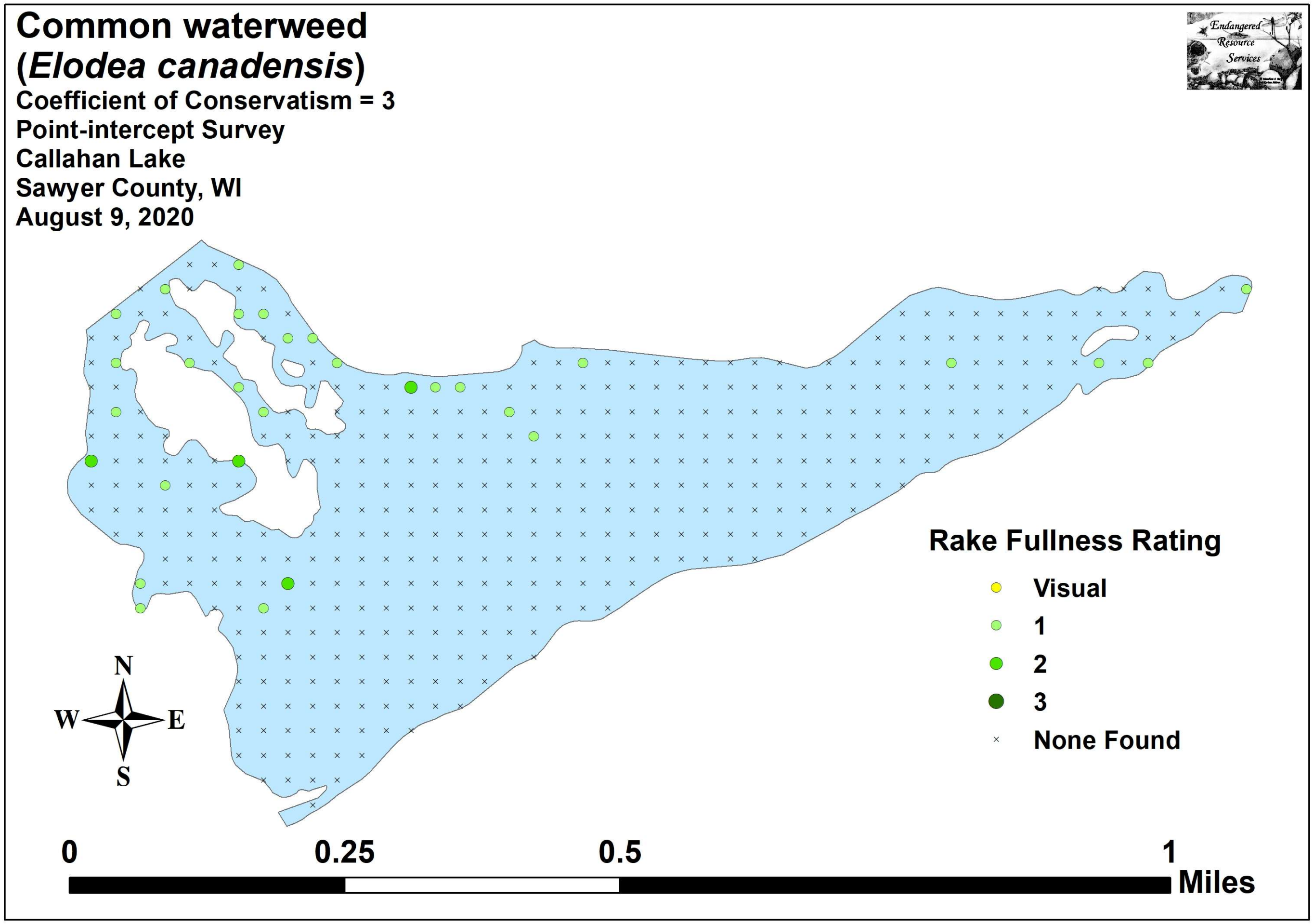

Watershield
(*Brasenia schreberi*)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

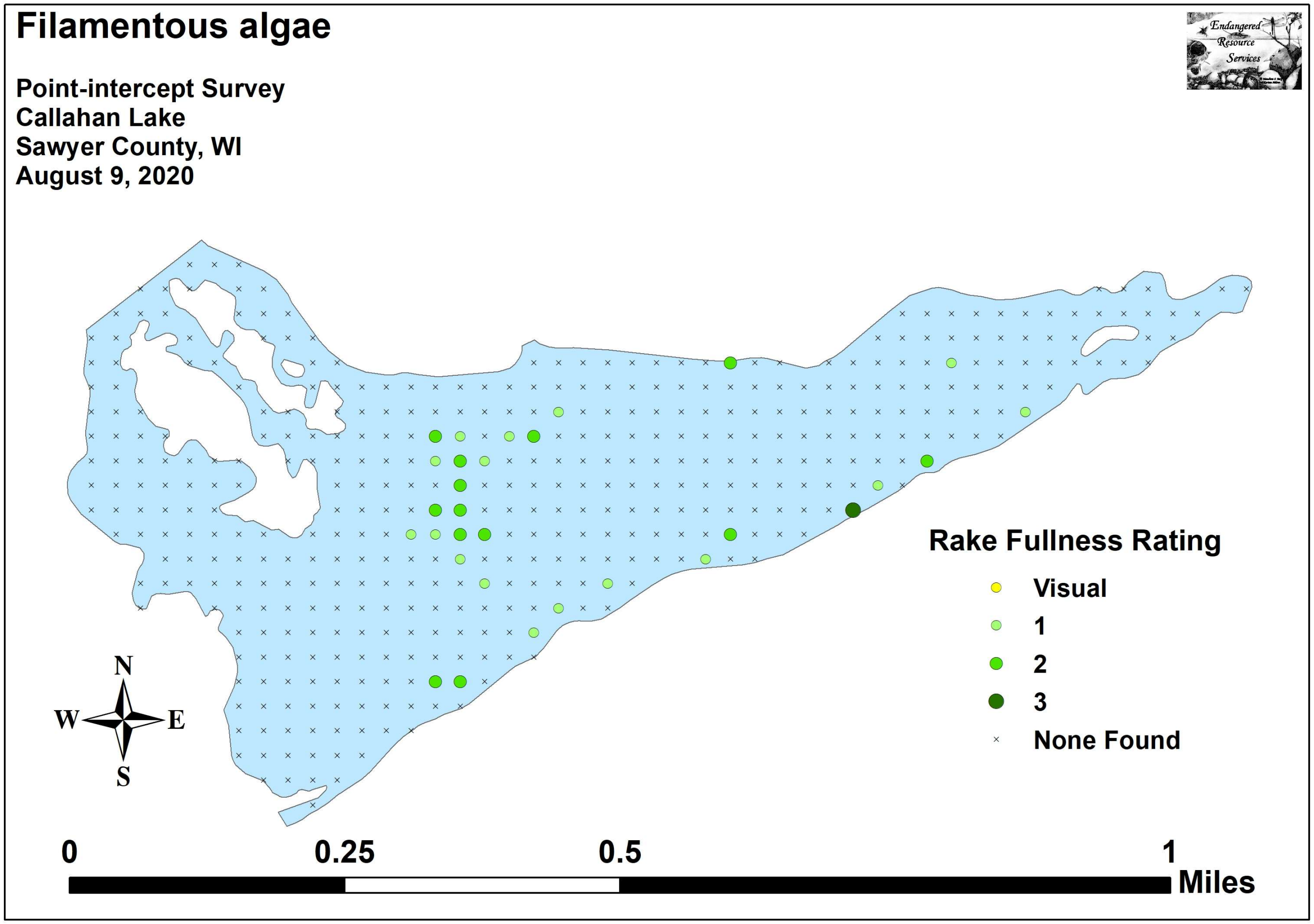

Narrow-leaved woolly sedge
(*Carex lasiocarpa*)
Coefficient of Conservatism = 9
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

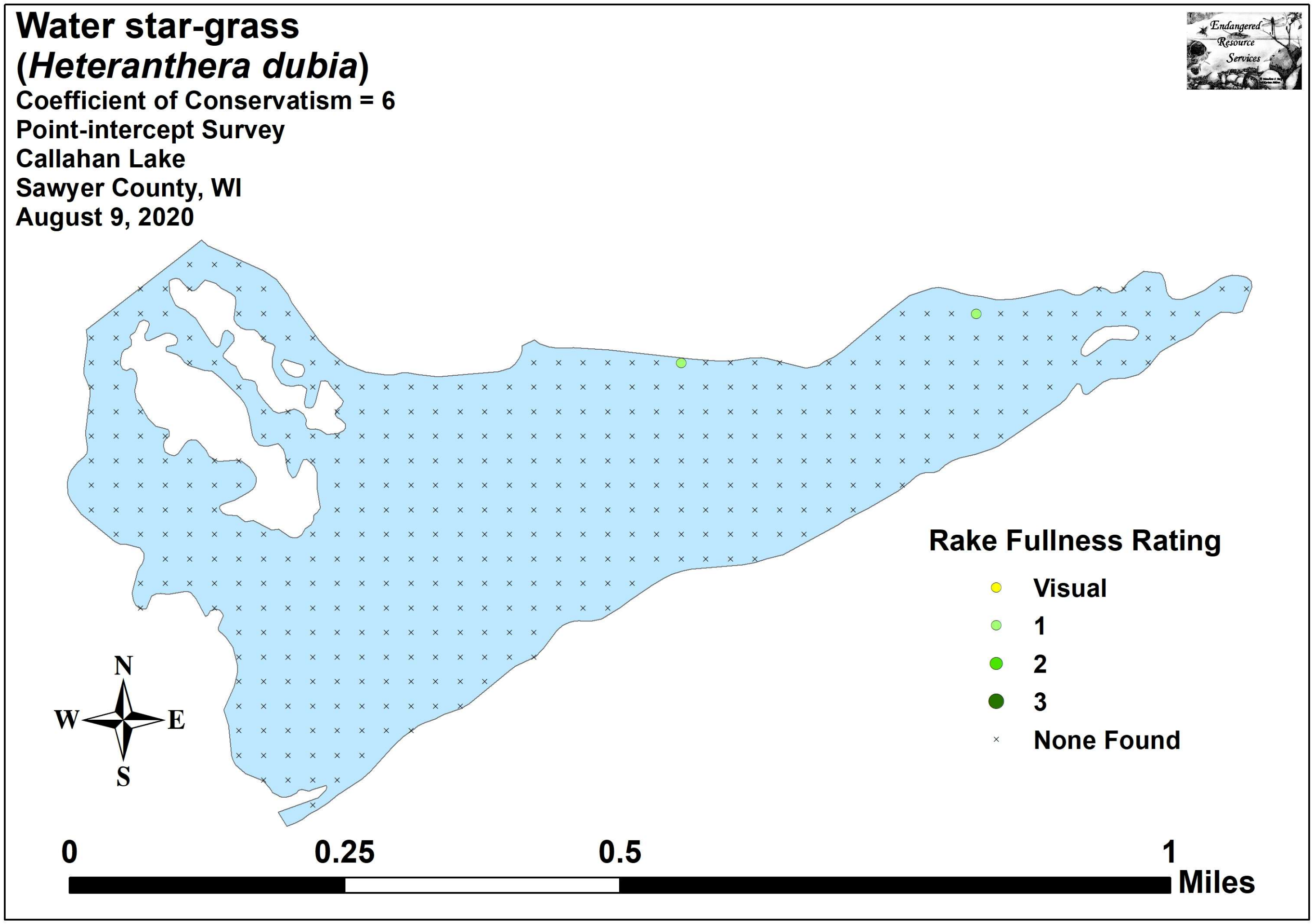

Coontail
(*Ceratophyllum demersum*)
Coefficient of Conservatism = 3
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

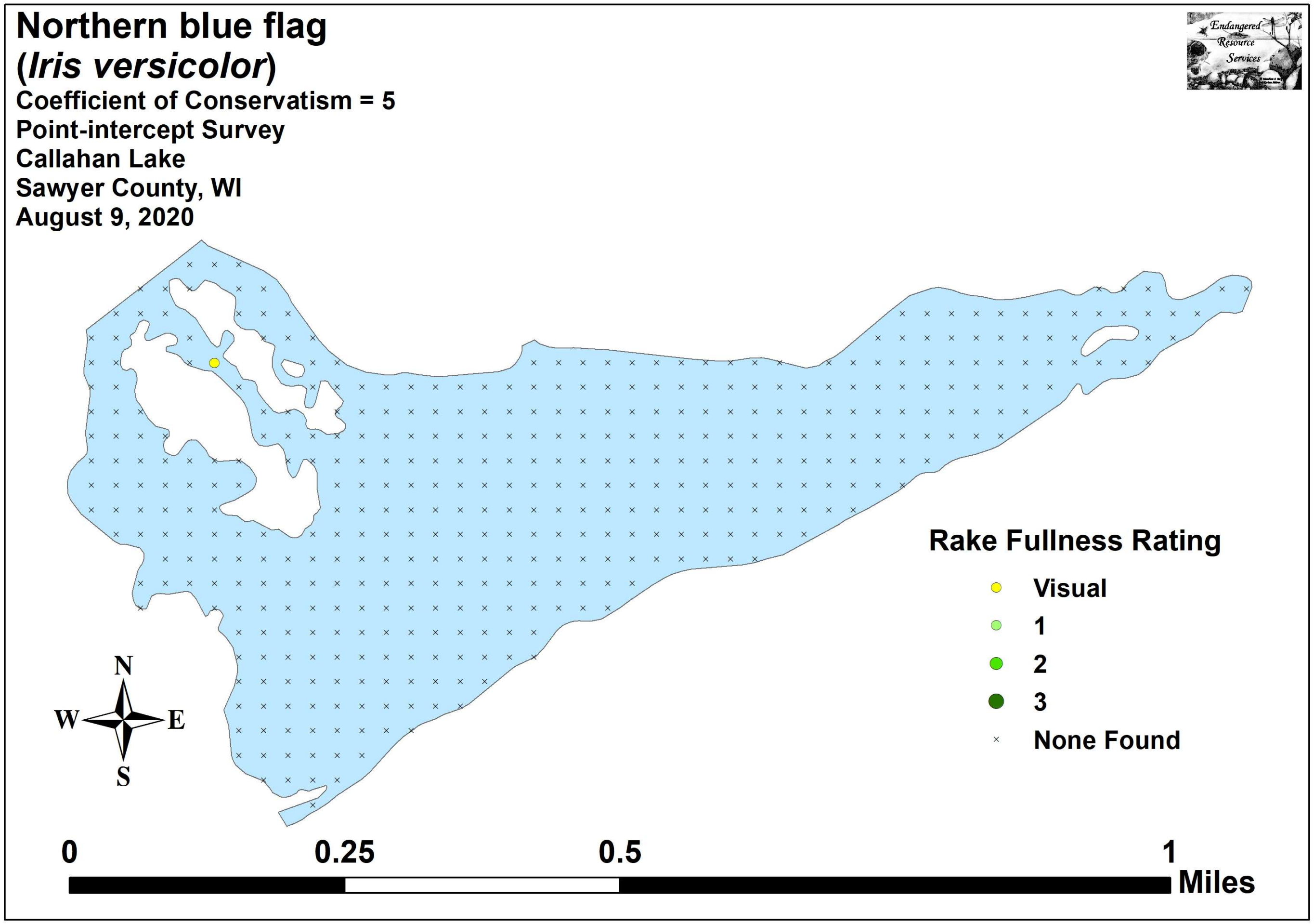

Muskgrass
(Chara sp.)
Coefficient of Conservatism = 7
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

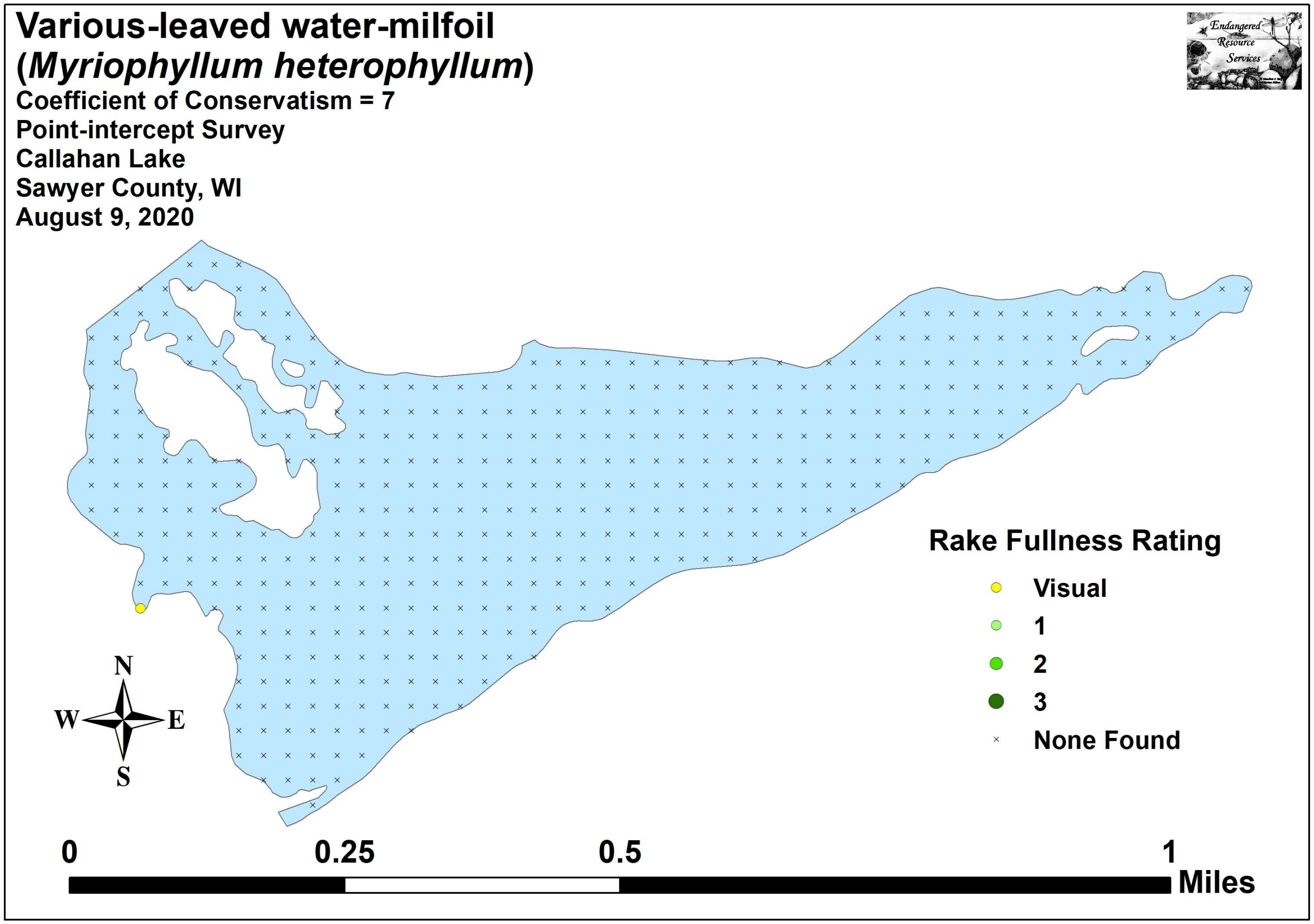

Marsh cinquefoil
(Comarum palustre)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

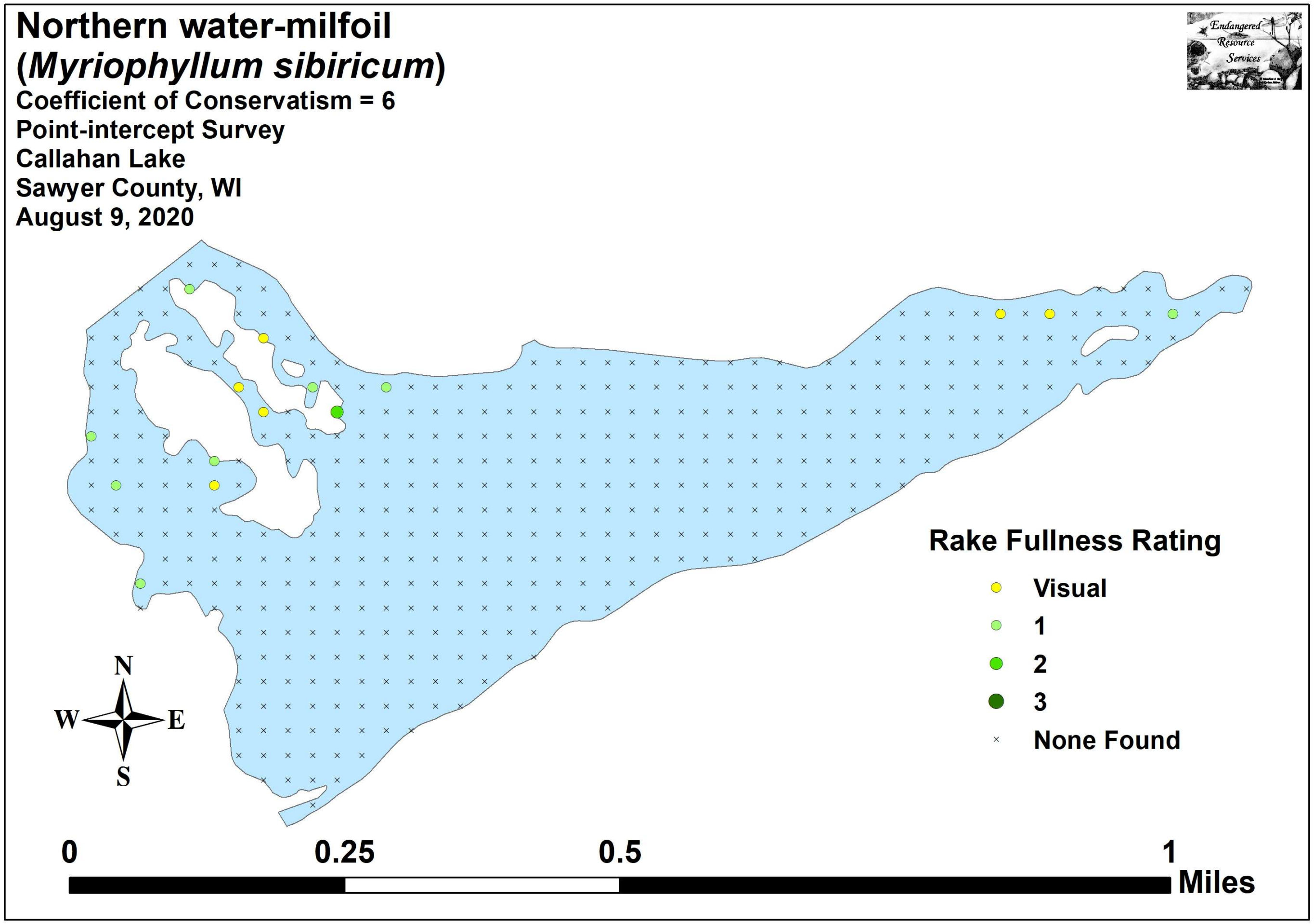

Common waterweed
(*Elodea canadensis*)
Coefficient of Conservatism = 3
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

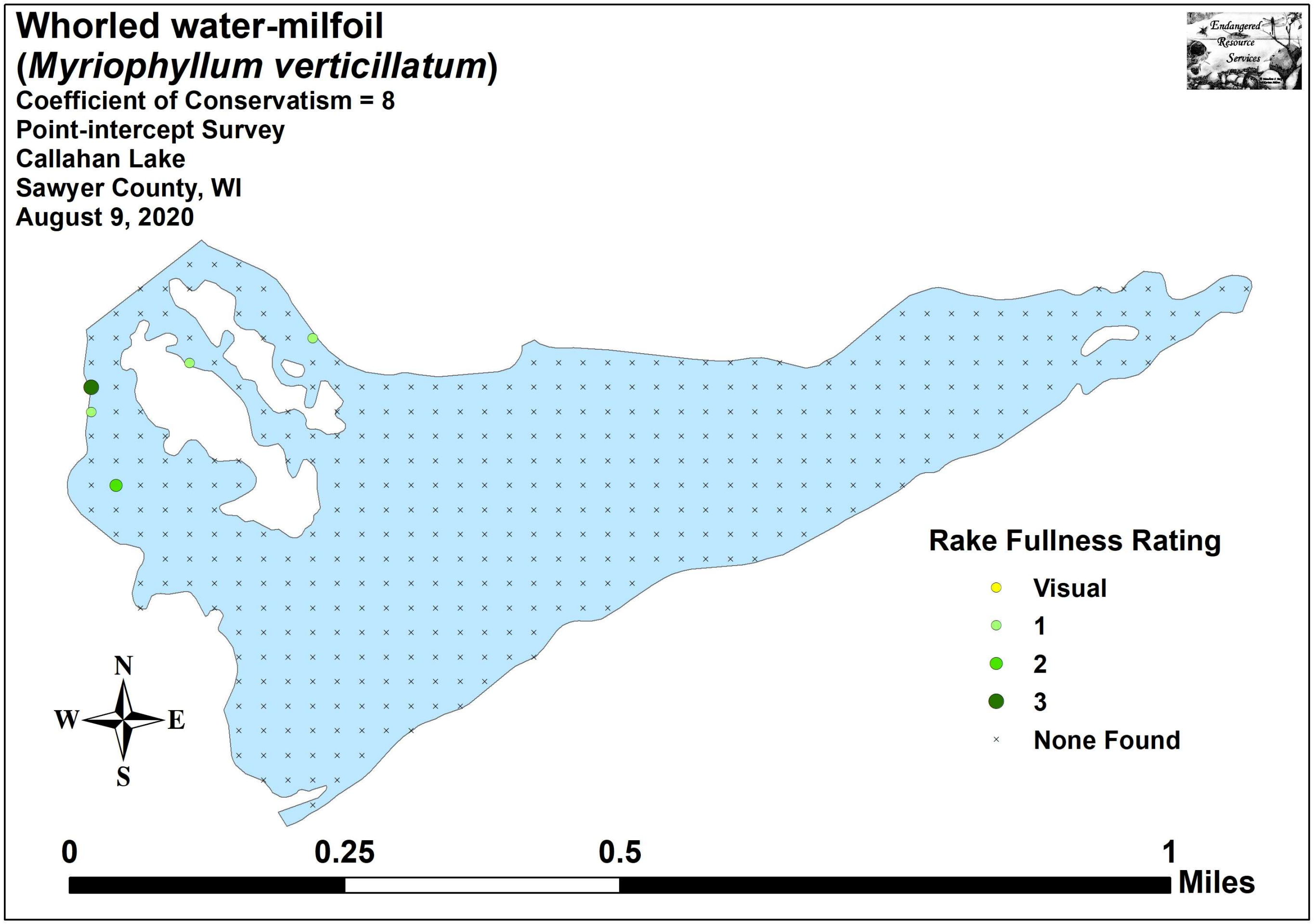

Filamentous algae
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

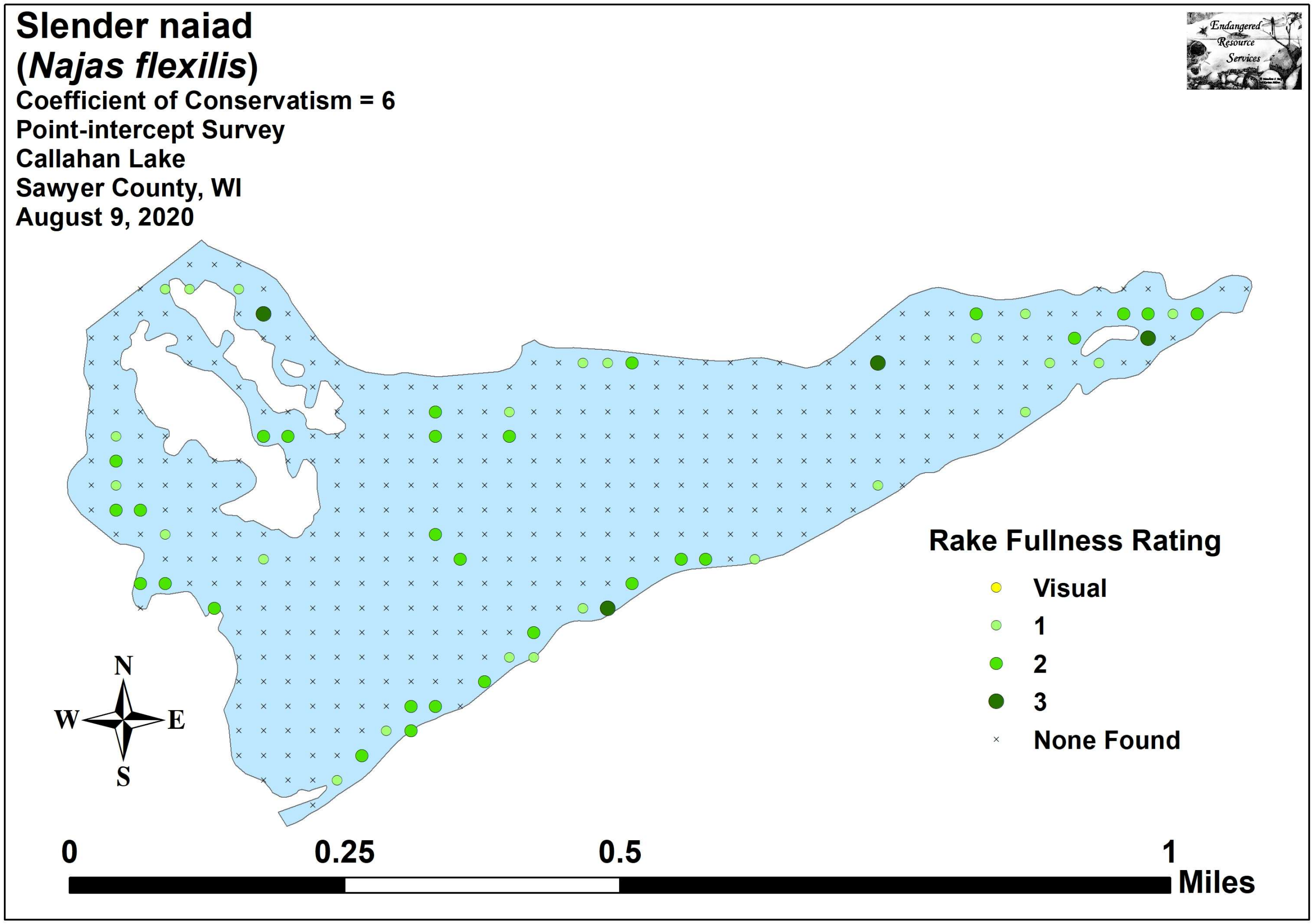

Water star-grass
(*Heteranthera dubia*)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

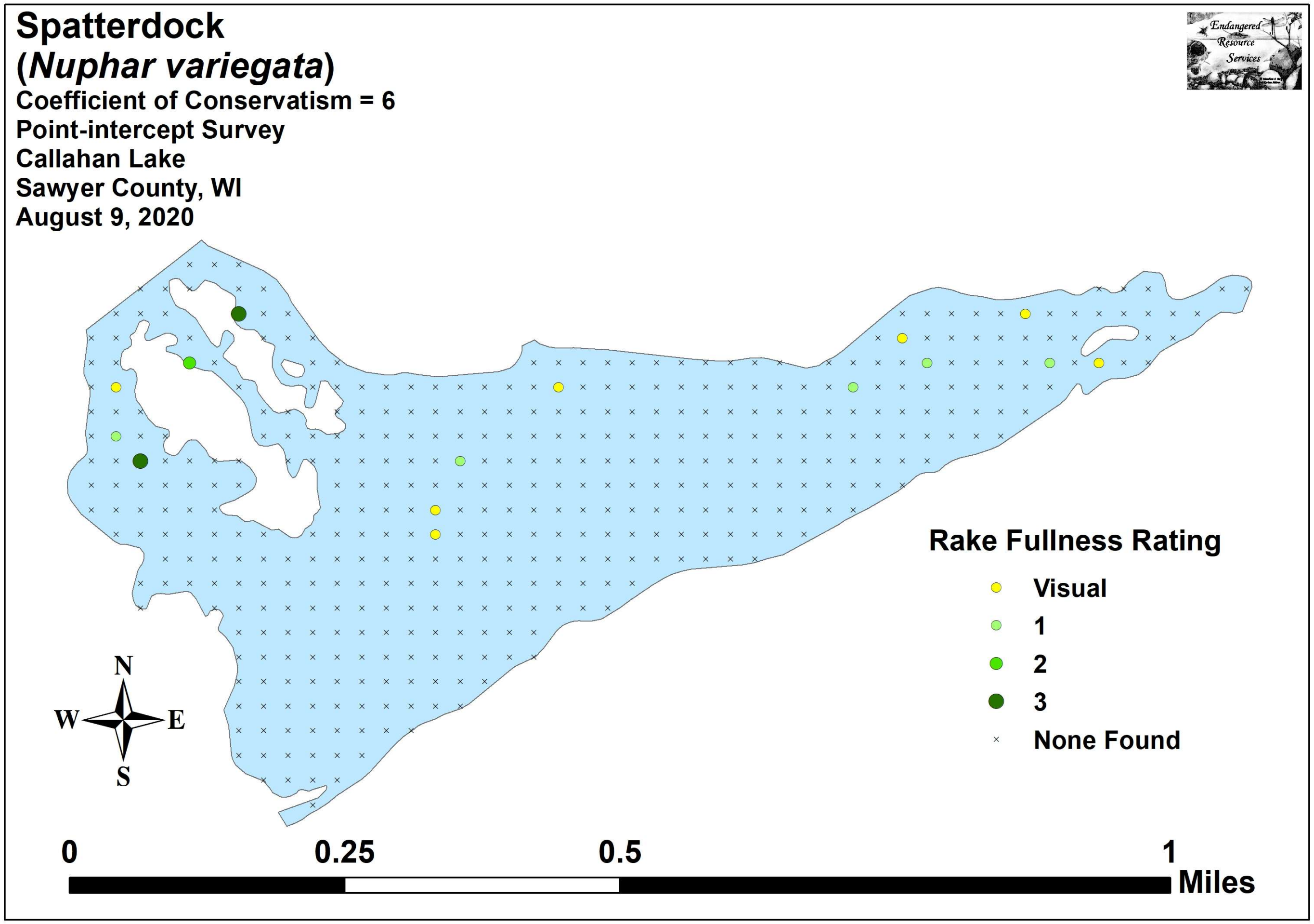

Northern blue flag
(*Iris versicolor*)
Coefficient of Conservatism = 5
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Various-leaved water-milfoil
(Myriophyllum heterophyllum)
Coefficient of Conservatism = 7
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

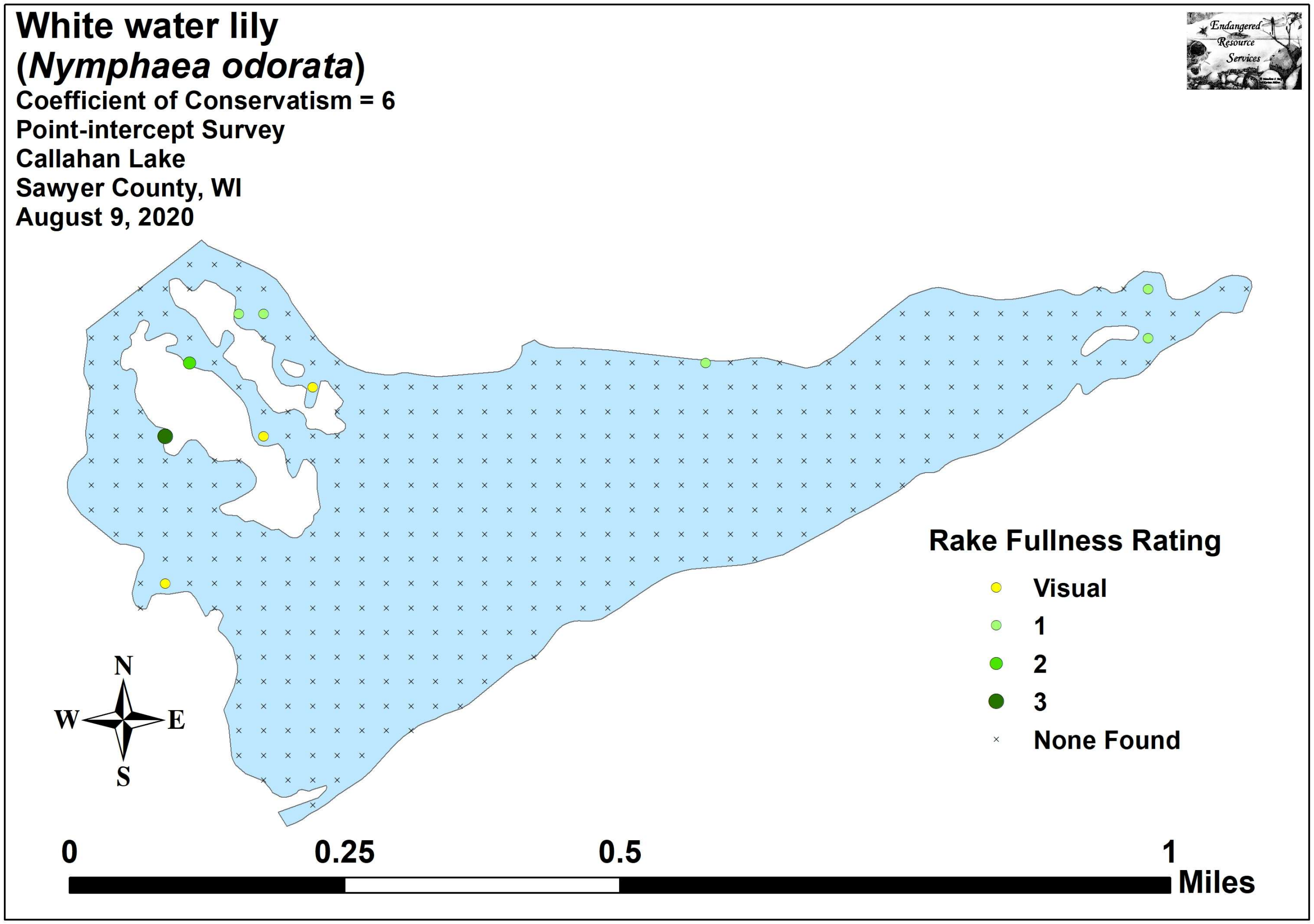

Northern water-milfoil
(Myriophyllum sibiricum)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Whorled water-milfoil
(Myriophyllum verticillatum)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

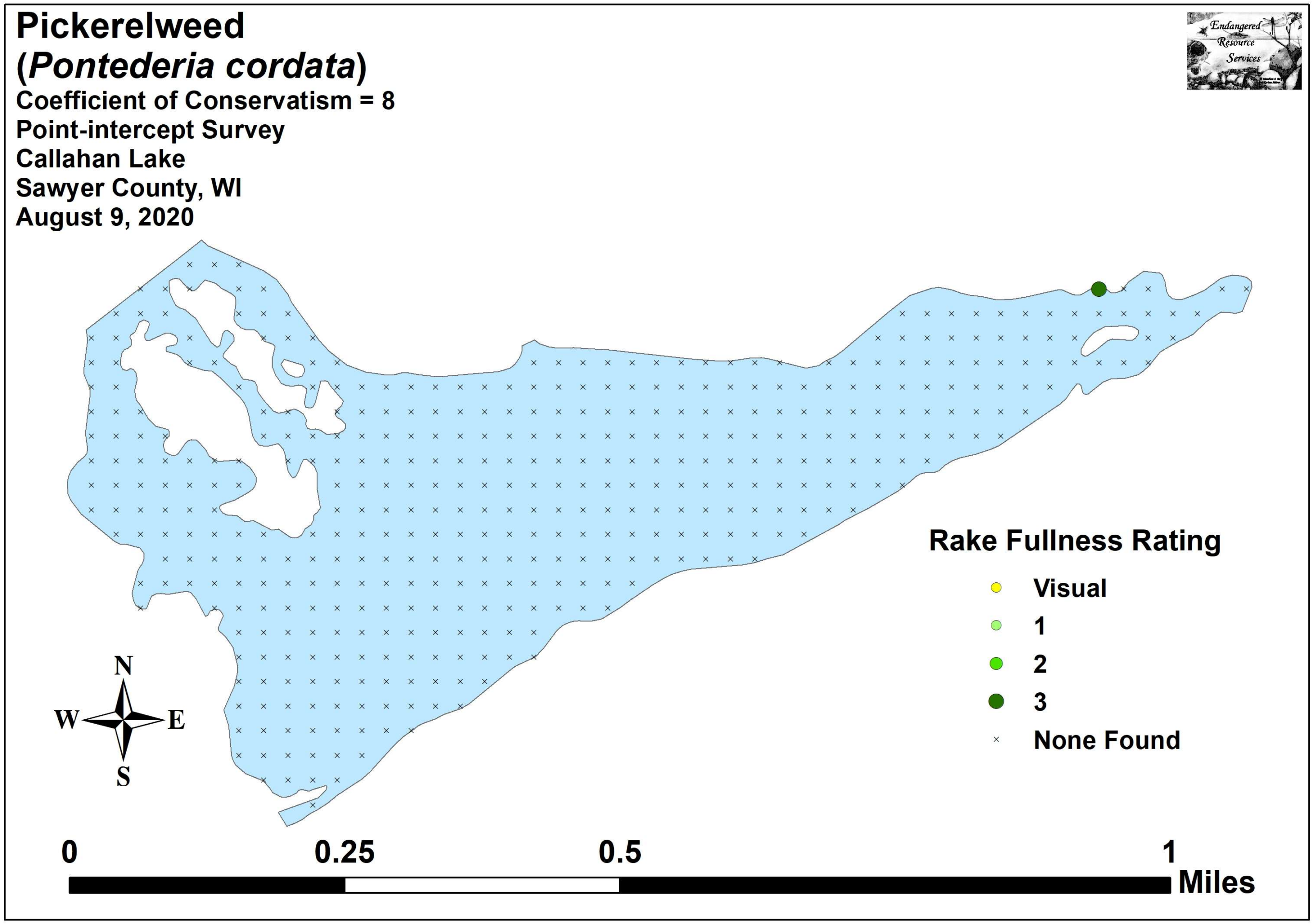

Slender naiad
(Najas flexilis)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles



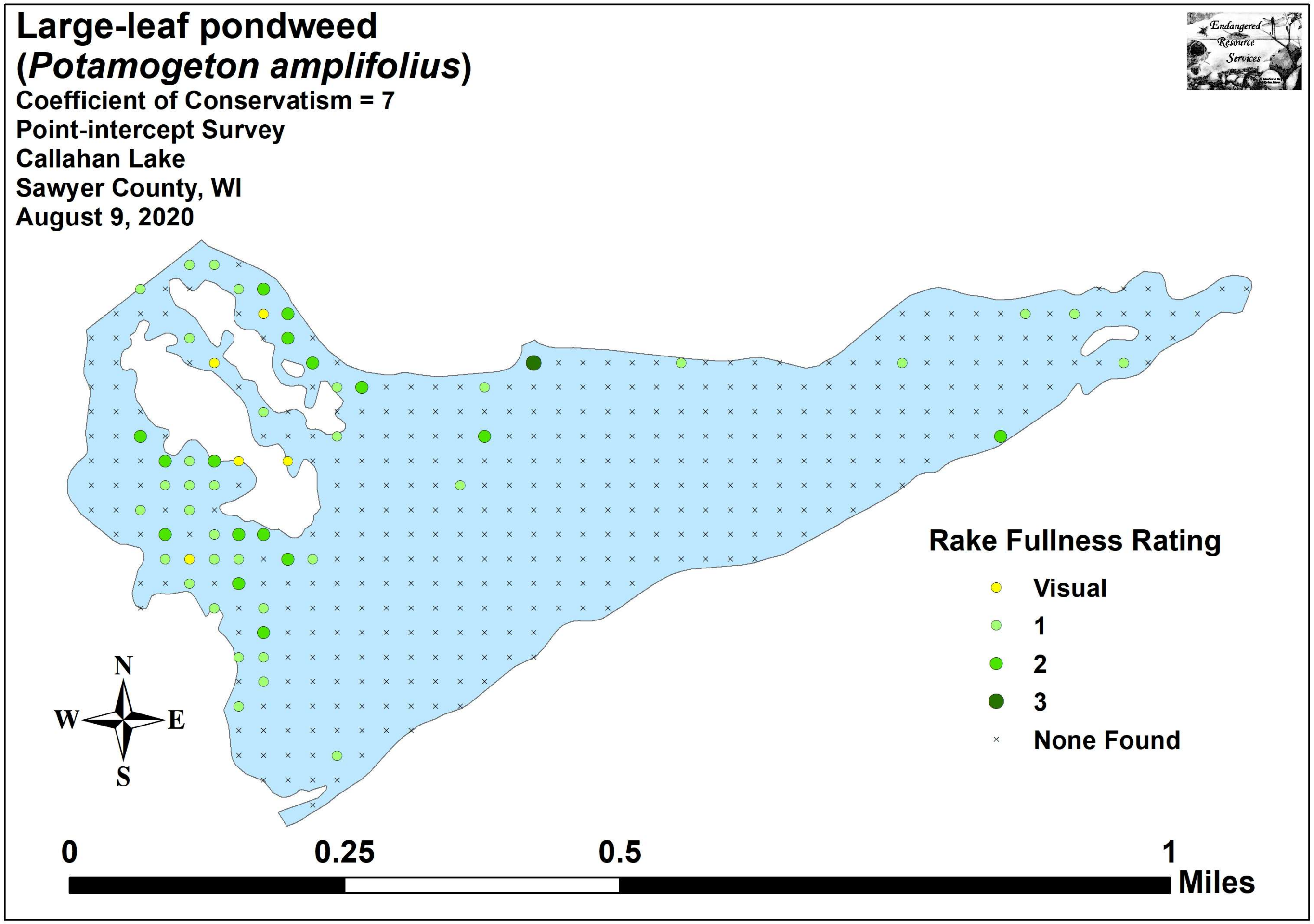
Spatterdock
(*Nuphar variegata*)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles



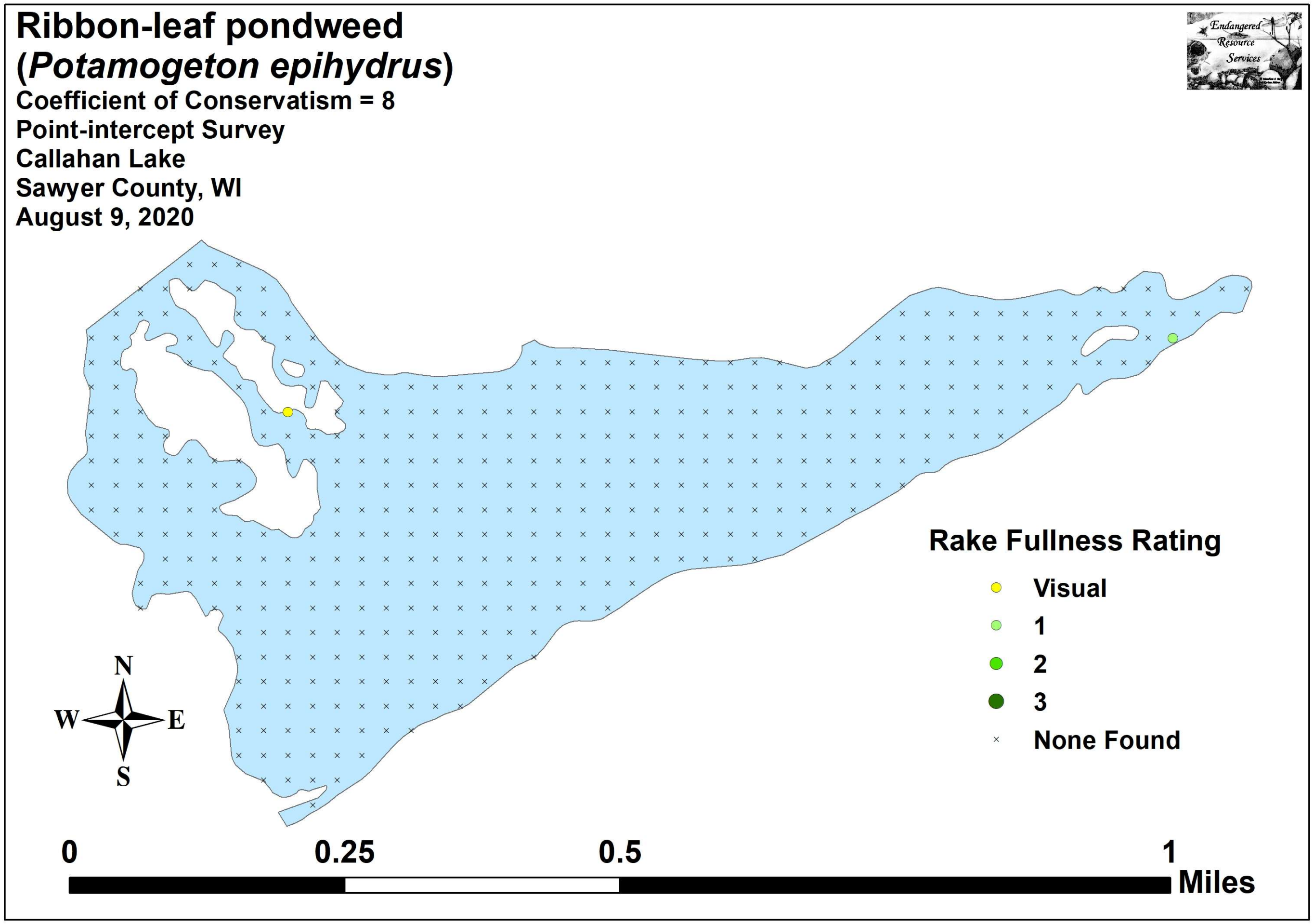
White water lily
(*Nymphaea odorata*)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

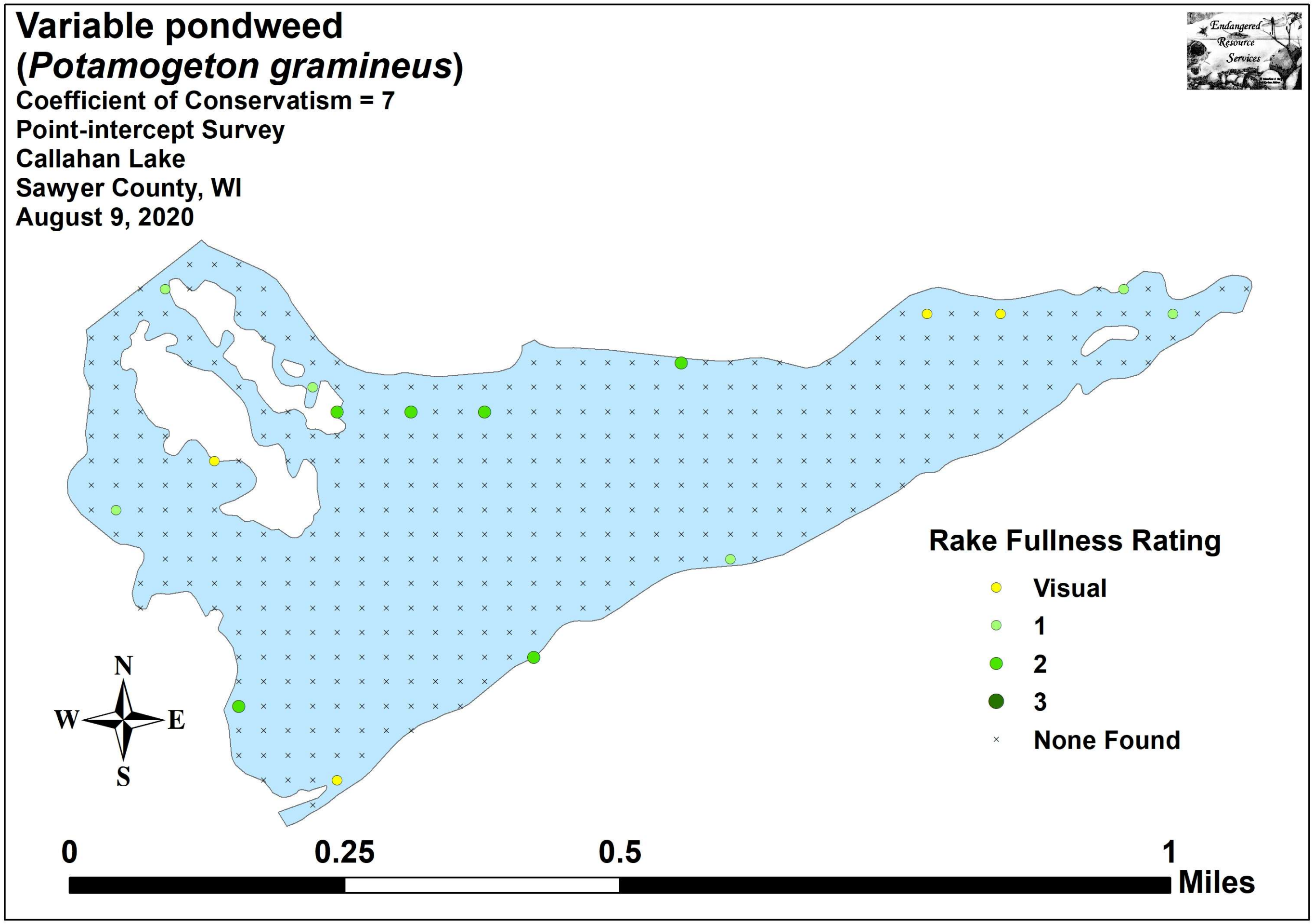


Pickerelweed
(*Pontederia cordata*)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

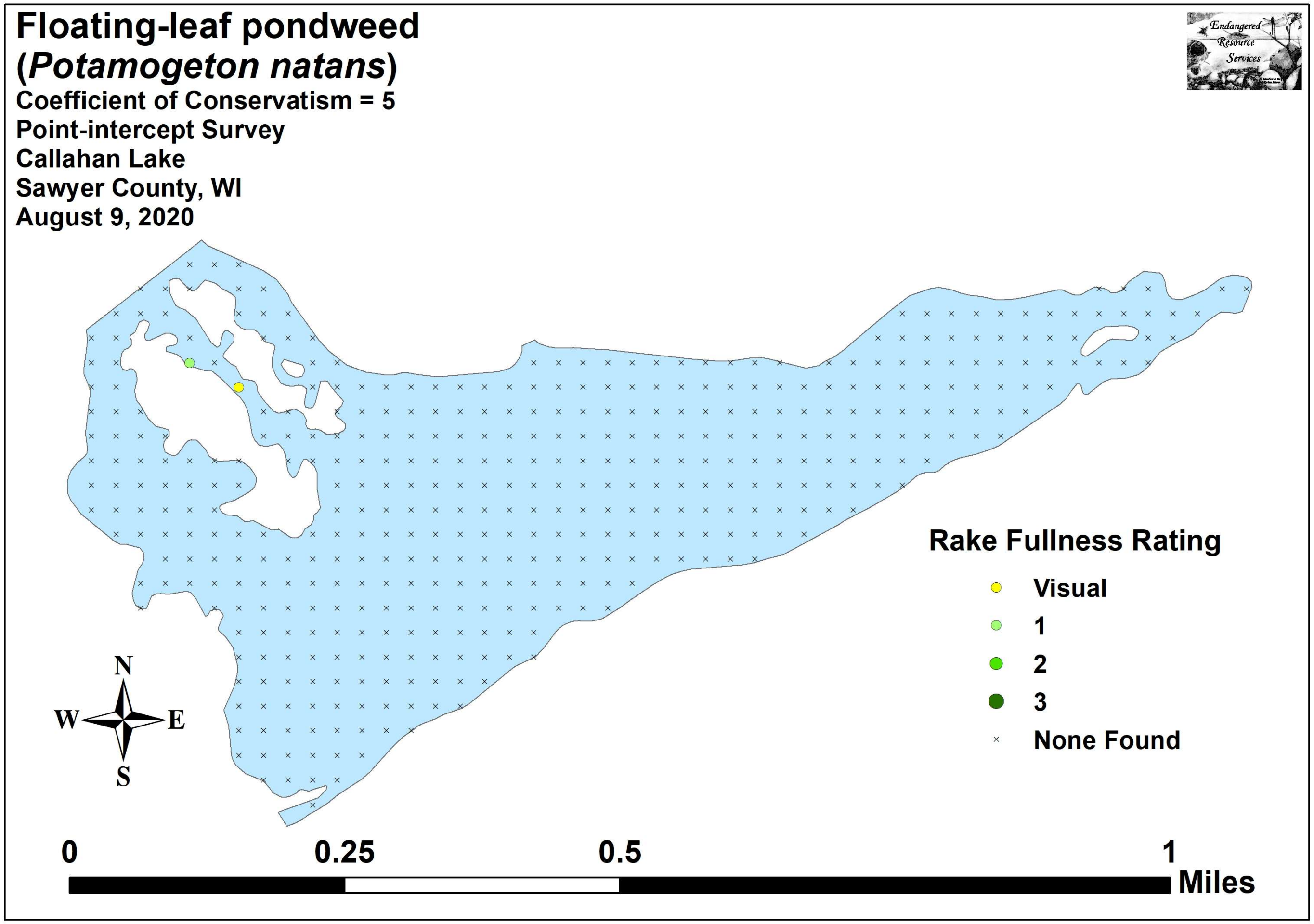


Large-leaf pondweed
(Potamogeton amplifolius)
Coefficient of Conservatism = 7
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Ribbon-leaf pondweed
(Potamogeton epihydrus)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles



Variable pondweed
(*Potamogeton gramineus*)
Coefficient of Conservatism = 7
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Floating-leaf pondweed
(*Potamogeton natans*)
Coefficient of Conservatism = 5
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
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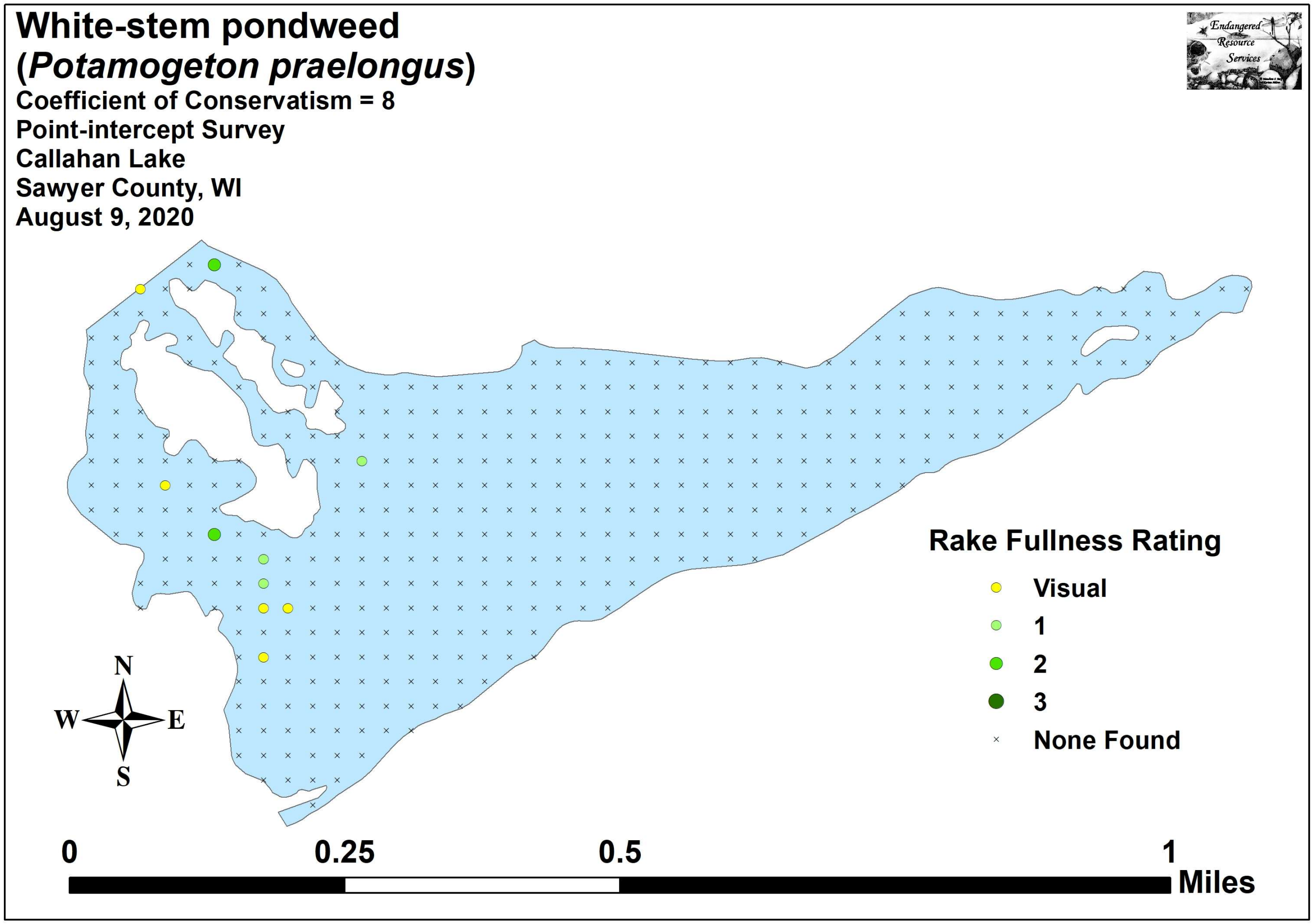
White-stem pondweed
(*Potamogeton praelongus*)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
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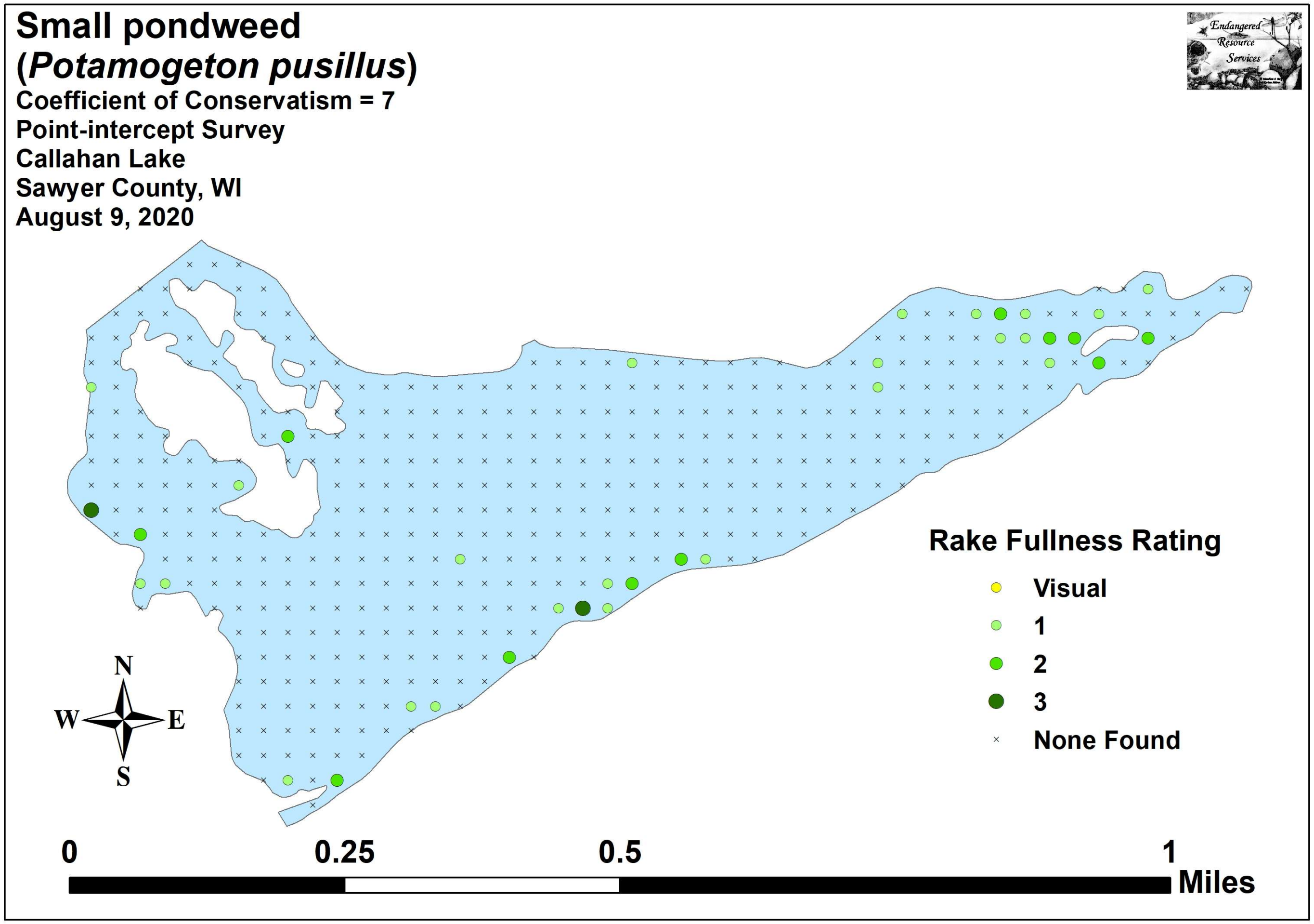
Small pondweed
(Potamogeton pusillus)
Coefficient of Conservatism = 7
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
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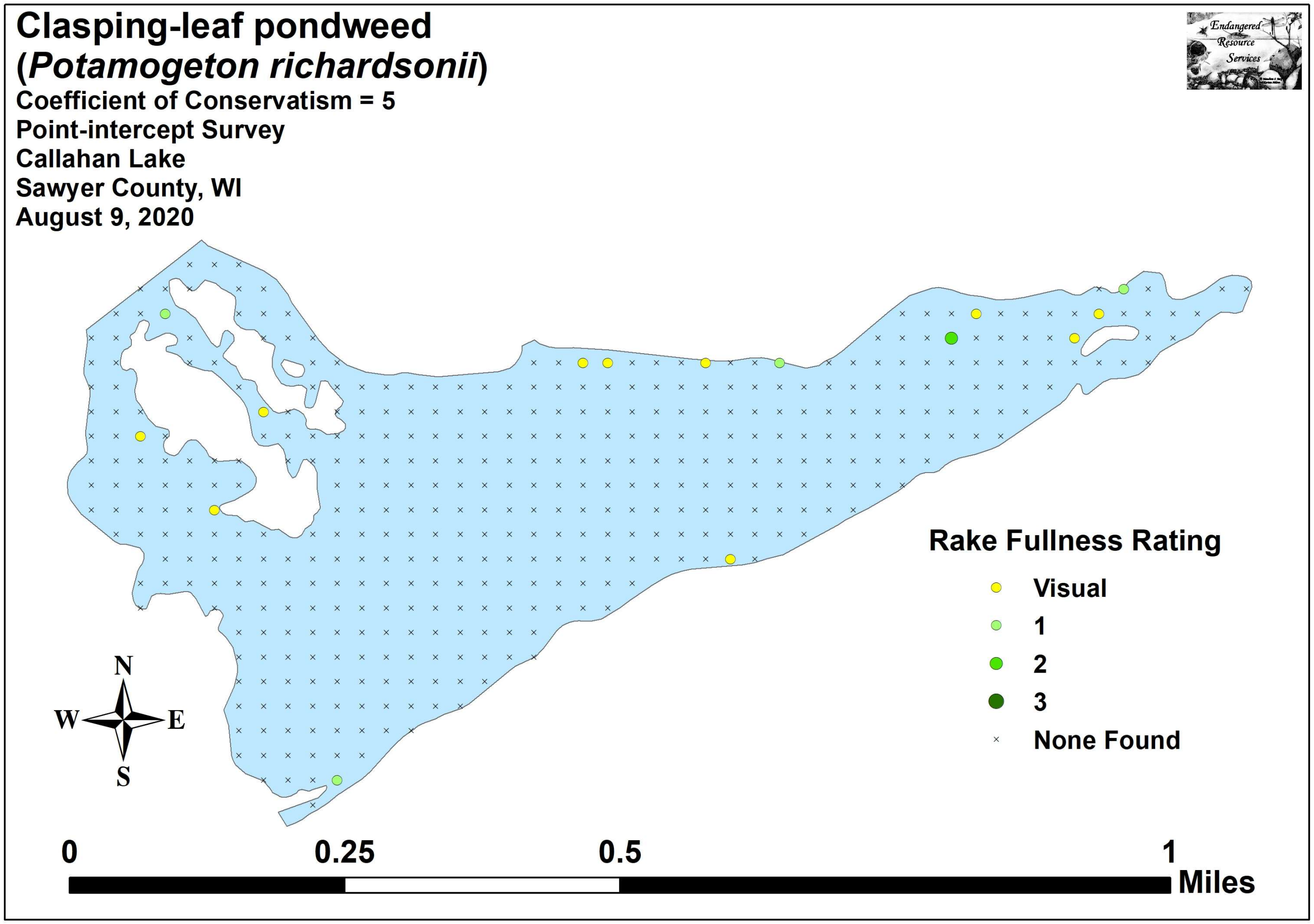
Clasping-leaf pondweed
(Potamogeton richardsonii)
Coefficient of Conservatism = 5
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
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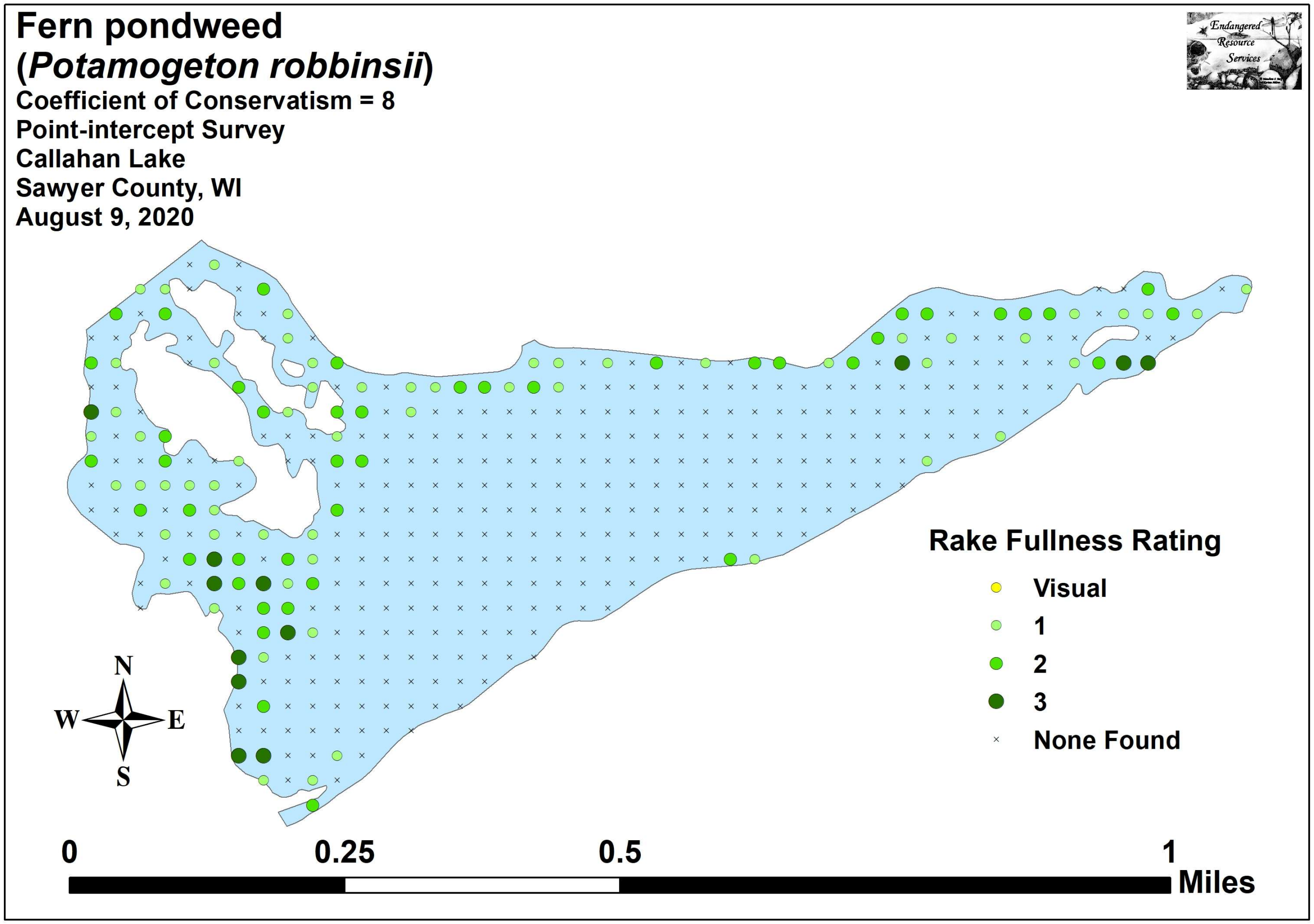
Fern pondweed
(Potamogeton robbinsii)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
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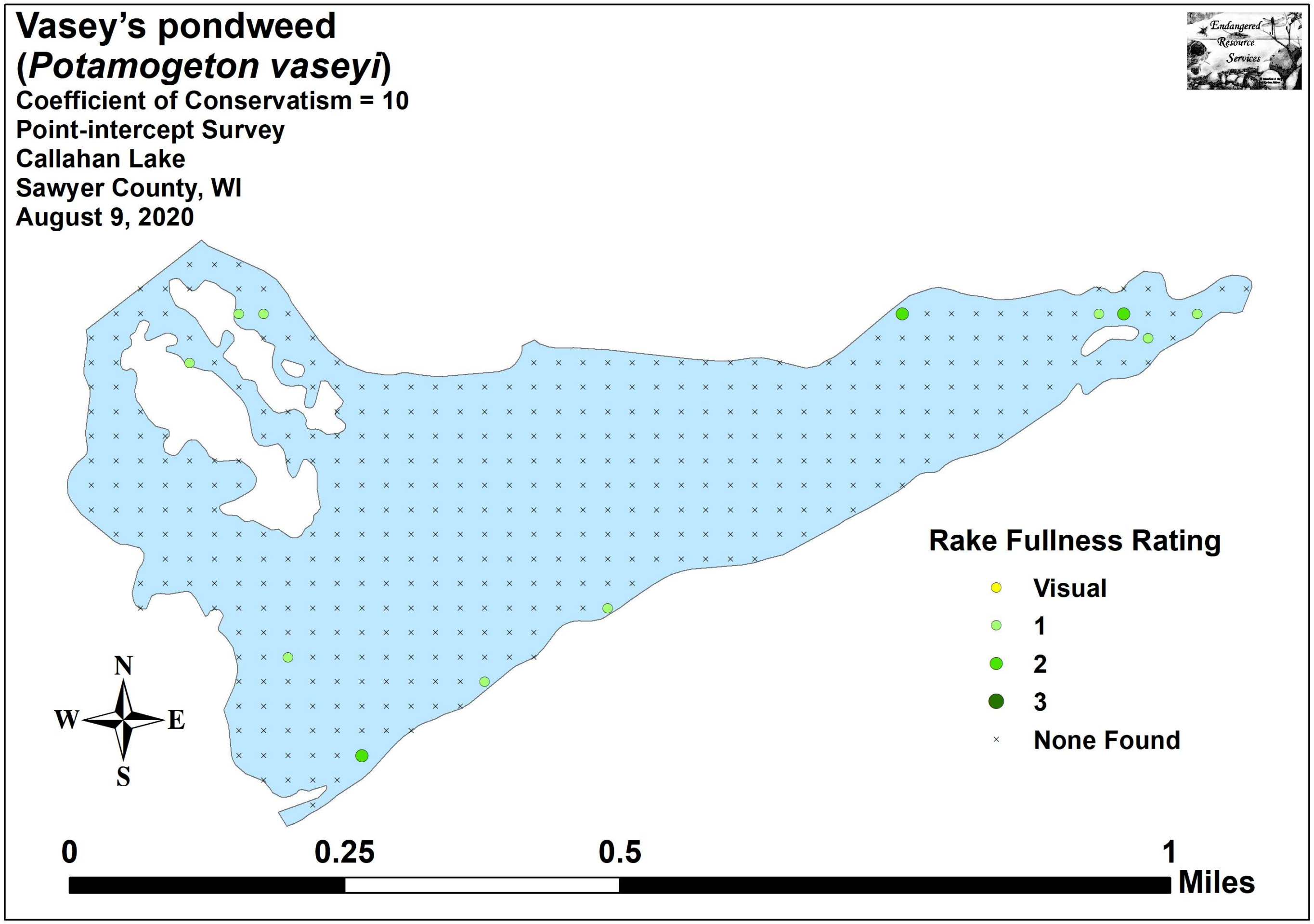
Vasey's pondweed
(Potamogeton vaseyi)
Coefficient of Conservatism = 10
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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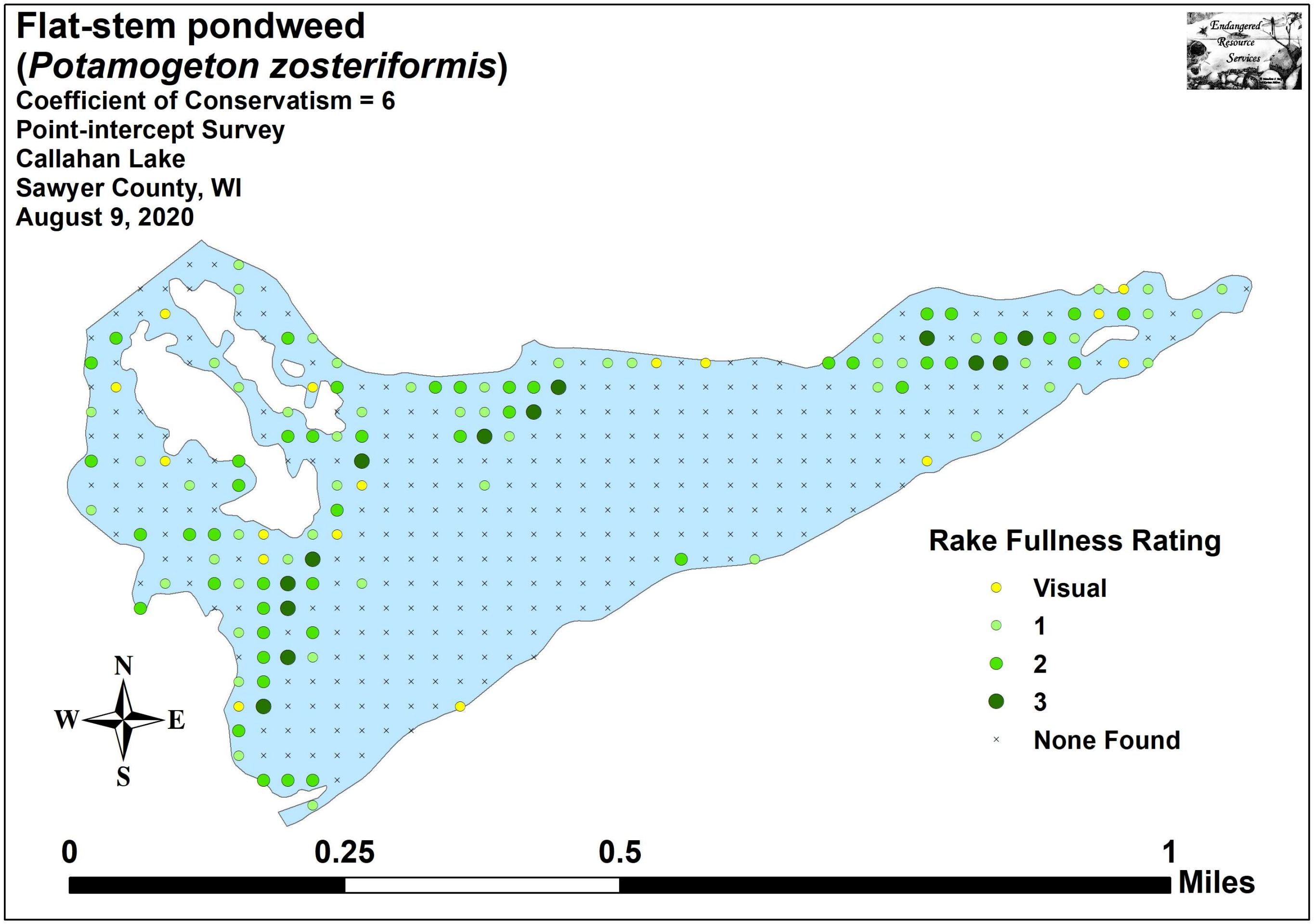
Flat-stem pondweed
(*Potamogeton zosteriformis*)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
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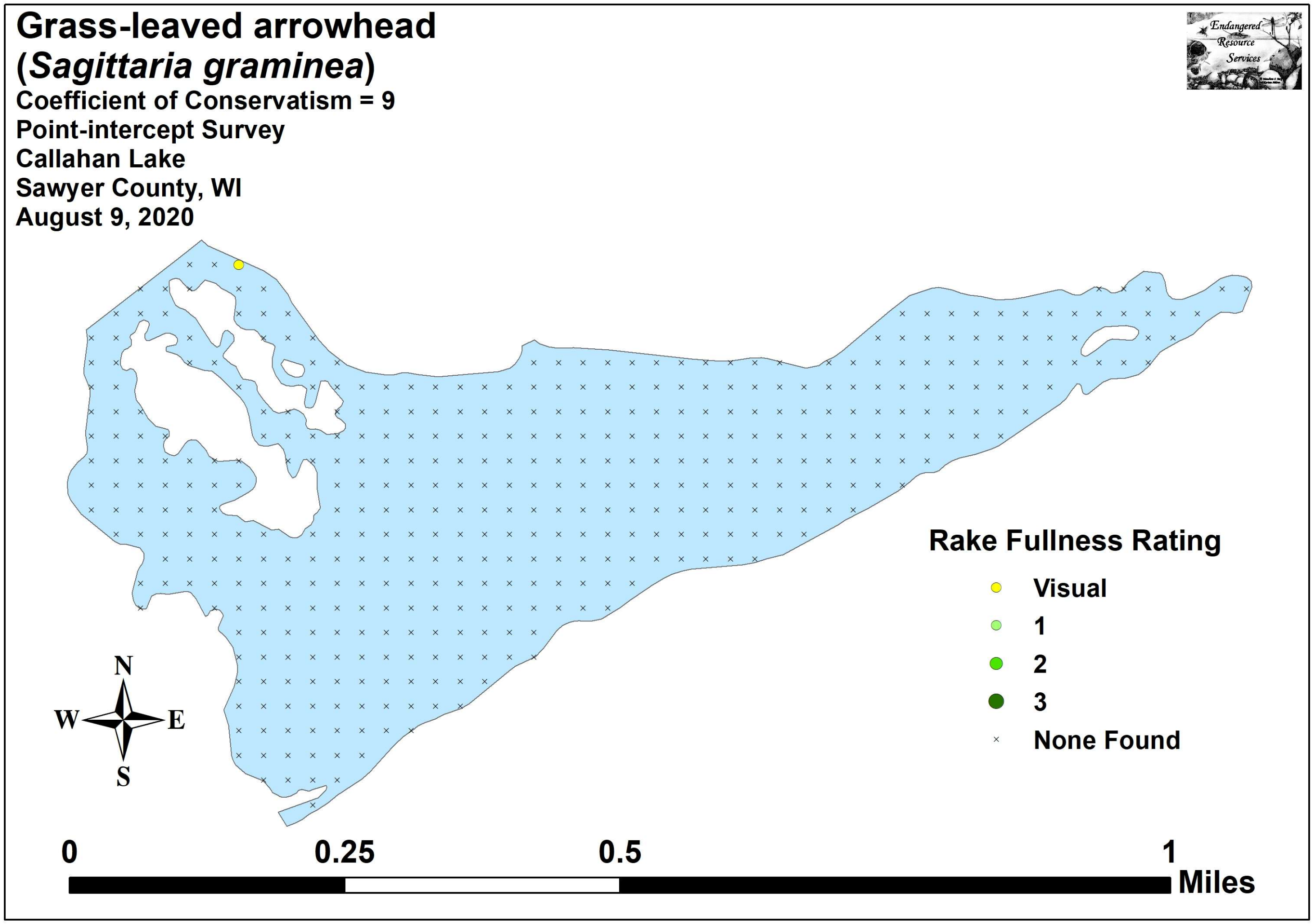
Grass-leaved arrowhead
(Sagittaria graminea)
Coefficient of Conservatism = 9
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
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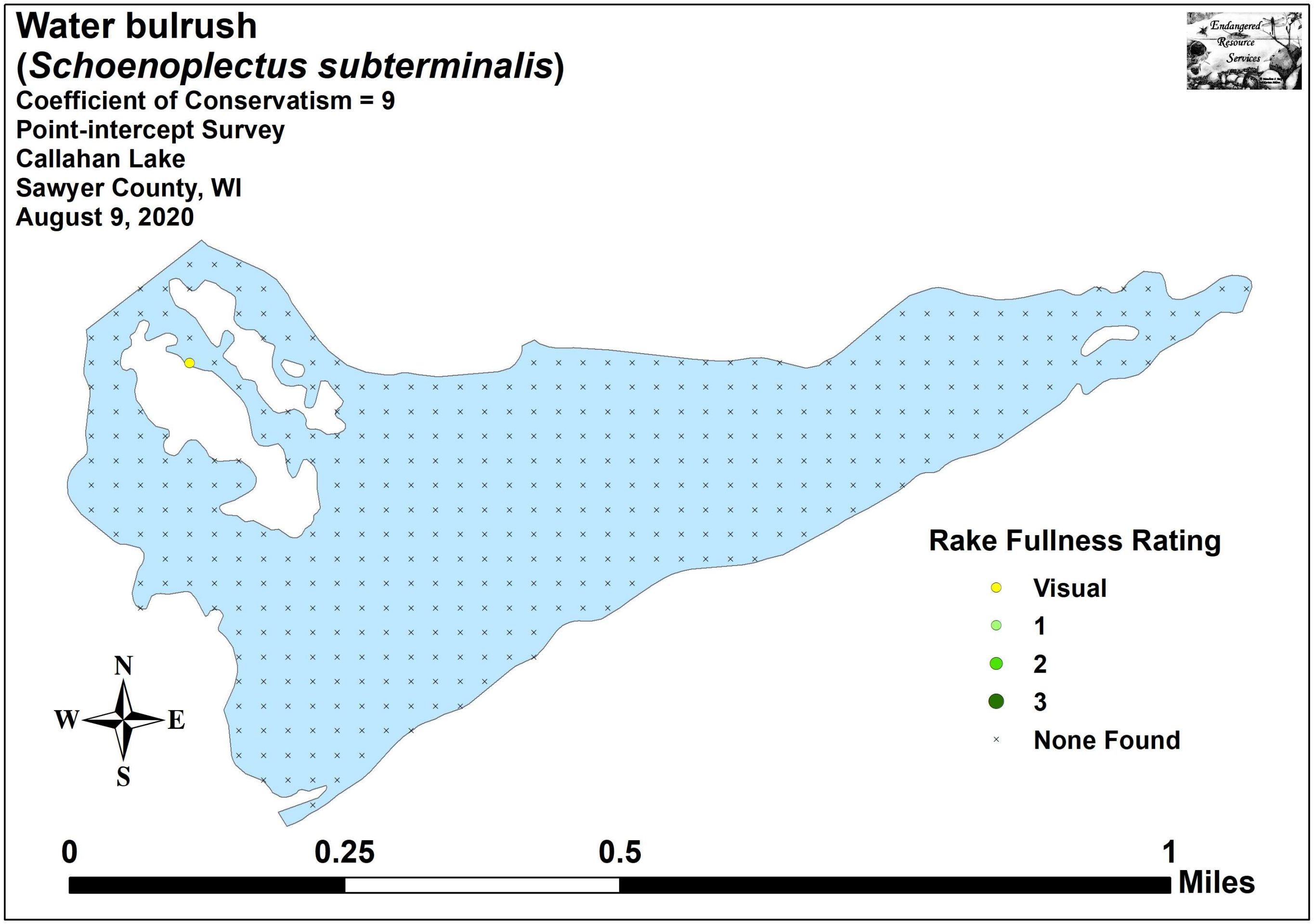
Water bulrush
(*Schoenoplectus subterminalis*)
Coefficient of Conservatism = 9
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
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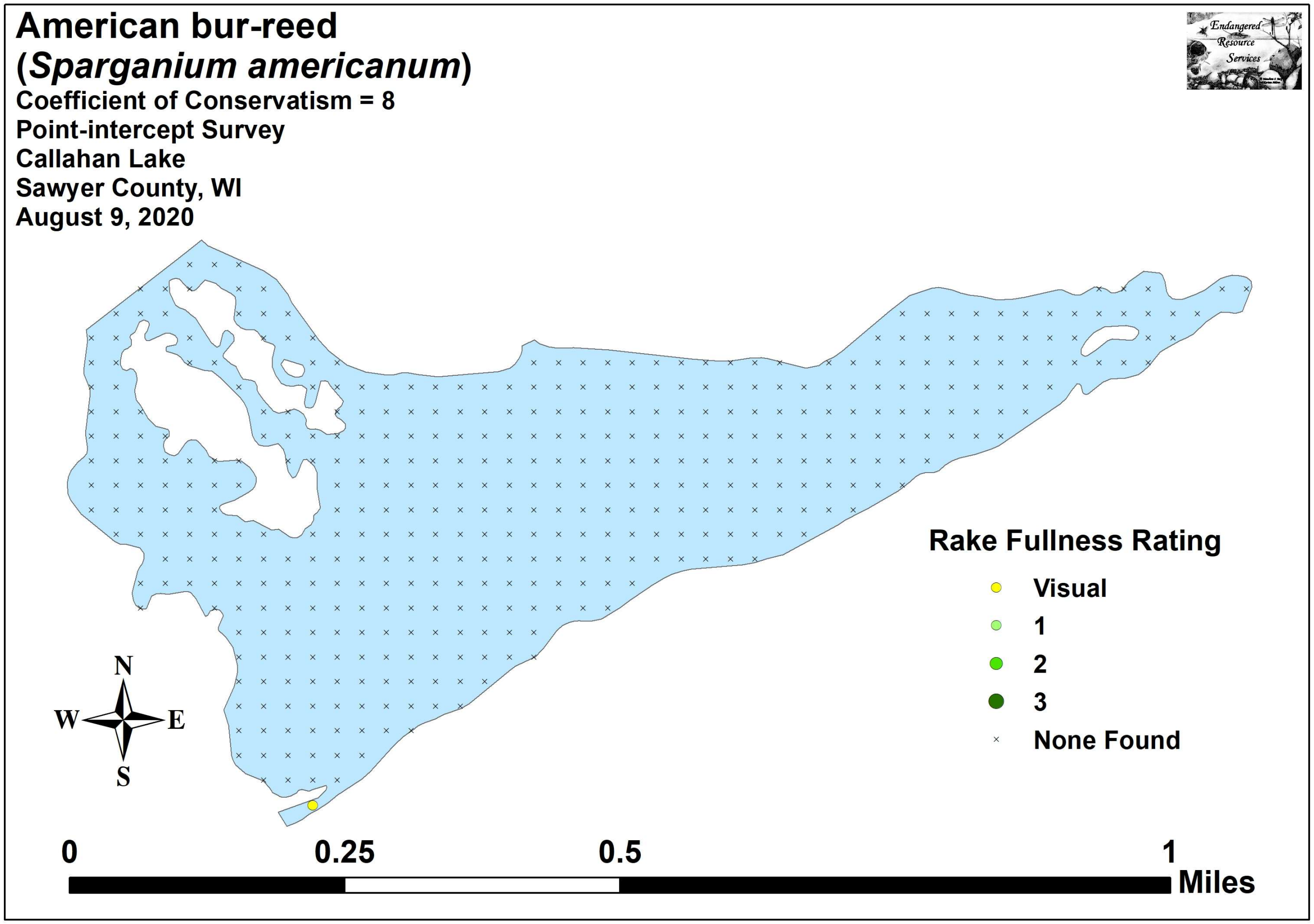
American bur-reed
(Sparganium americanum)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
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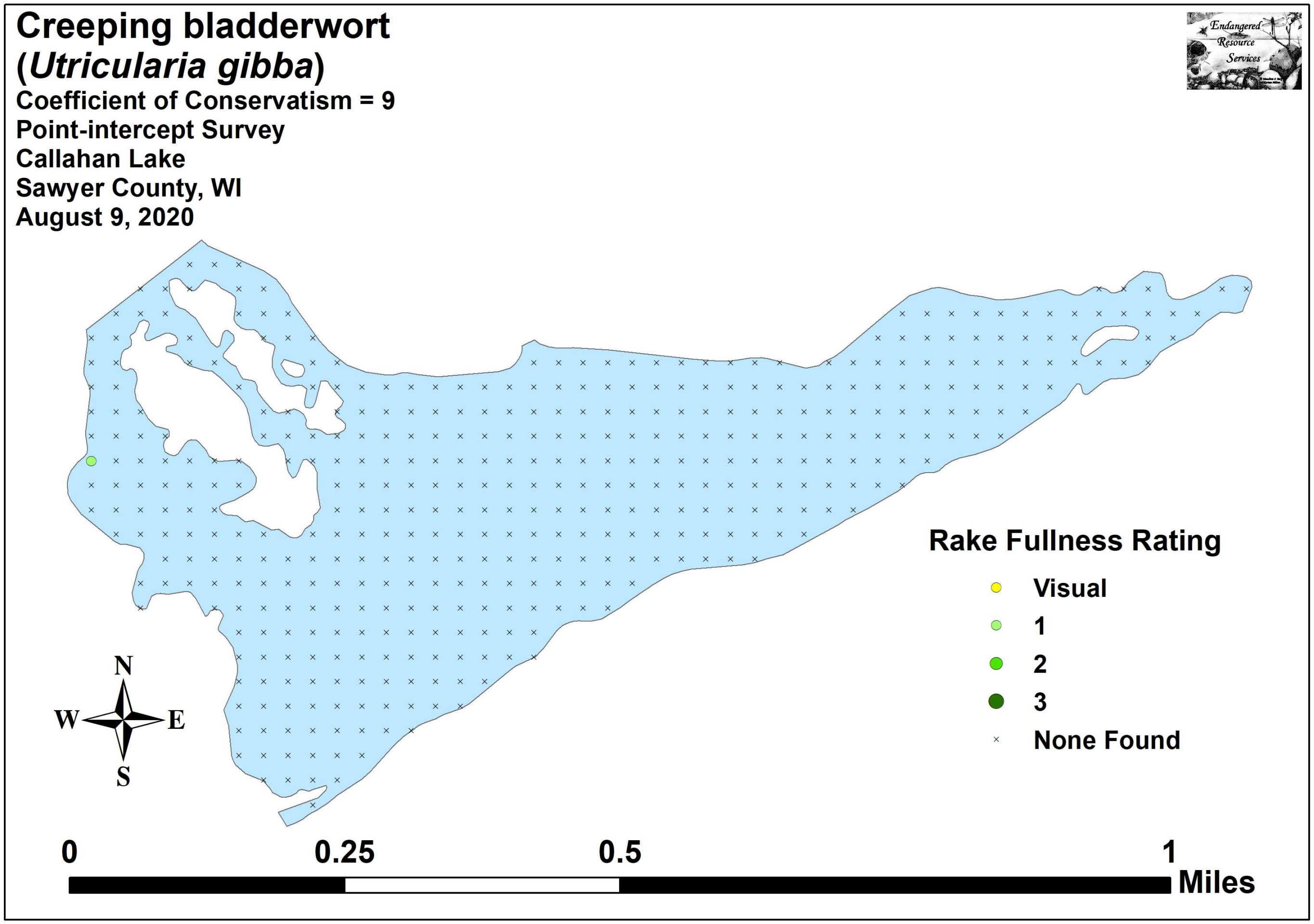
Creeping bladderwort
(*Utricularia gibba*)
Coefficient of Conservatism = 9
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
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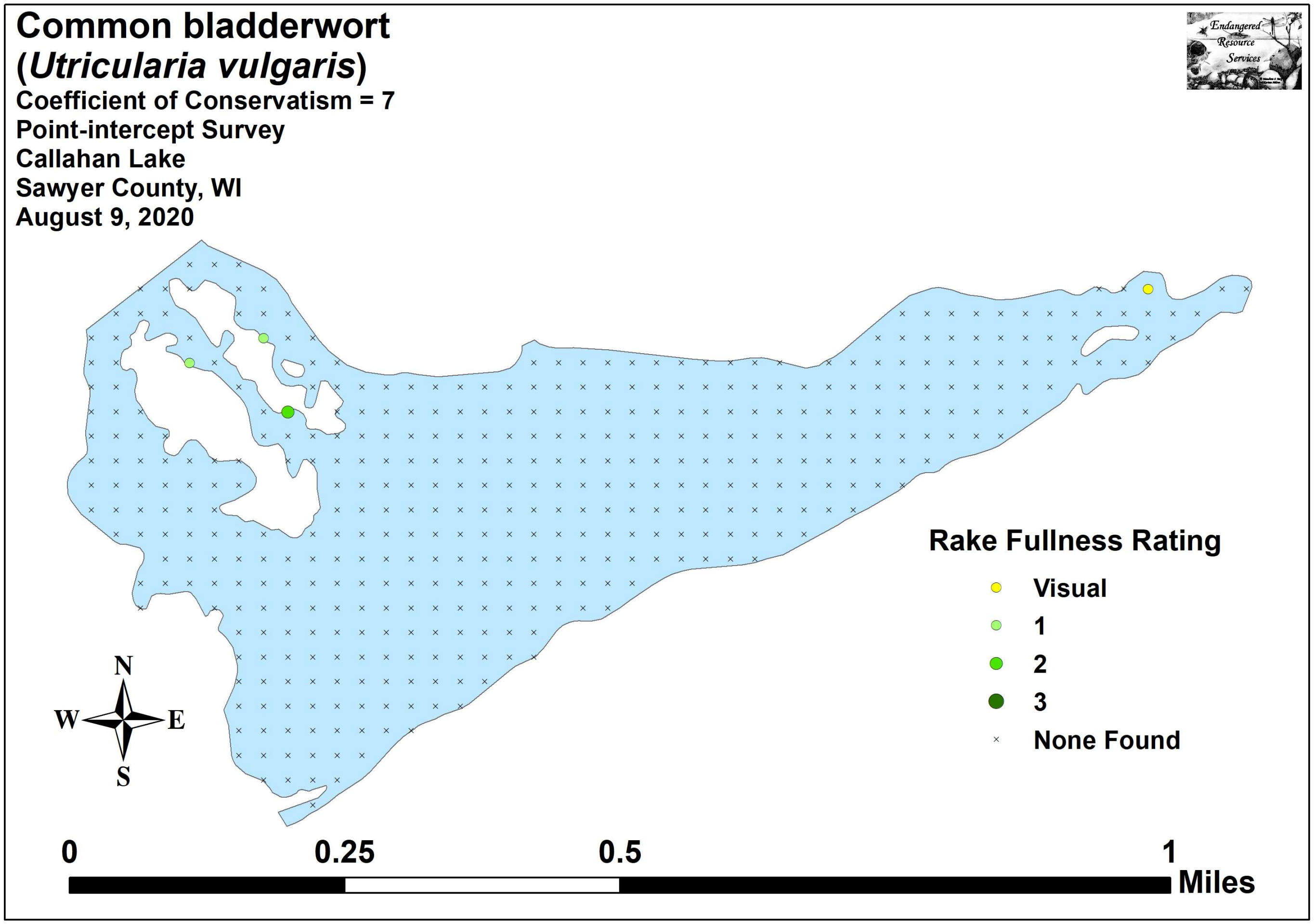
Common bladderwort
(*Utricularia vulgaris*)
Coefficient of Conservatism = 7
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
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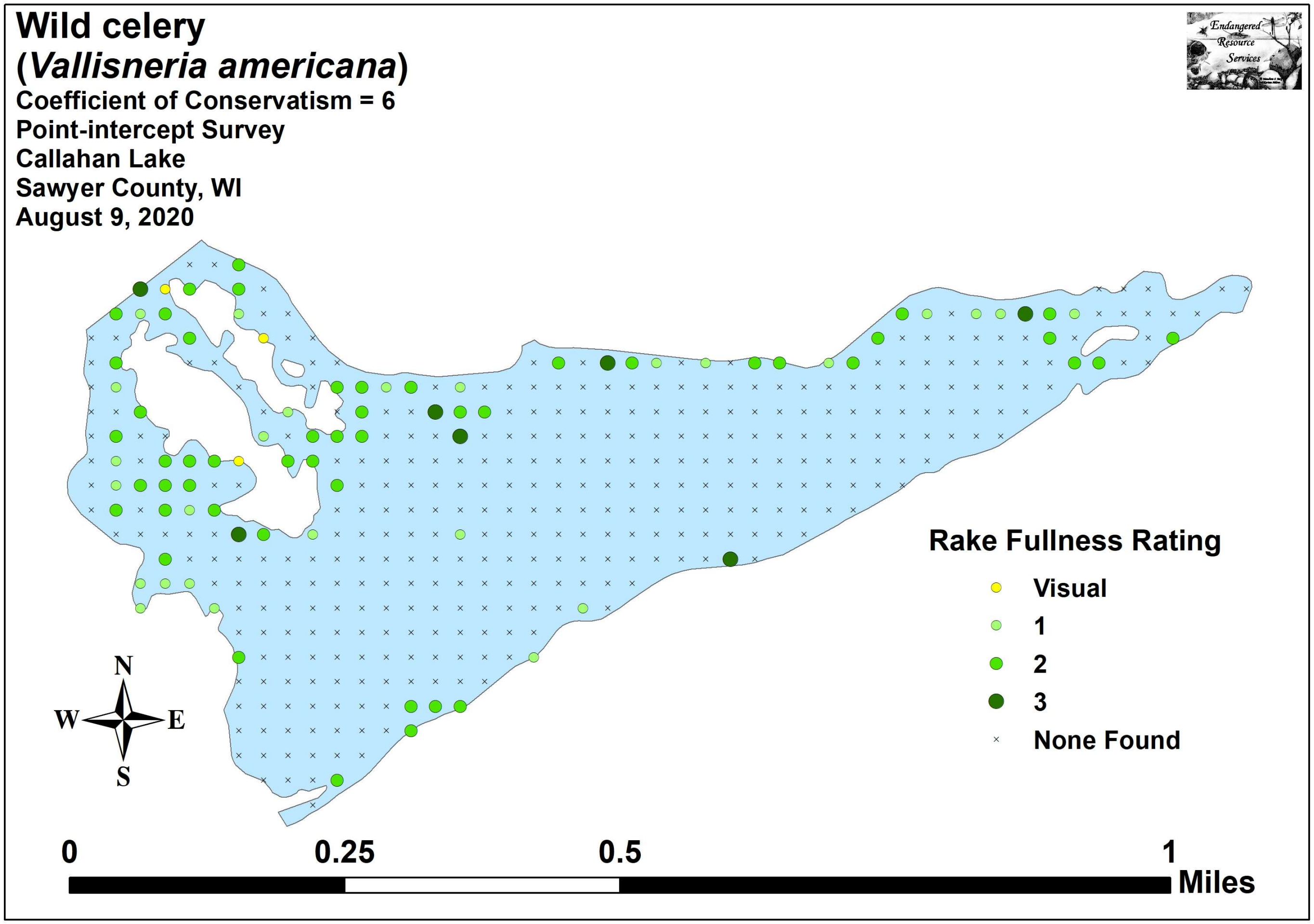
Wild celery
(Vallisneria americana)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
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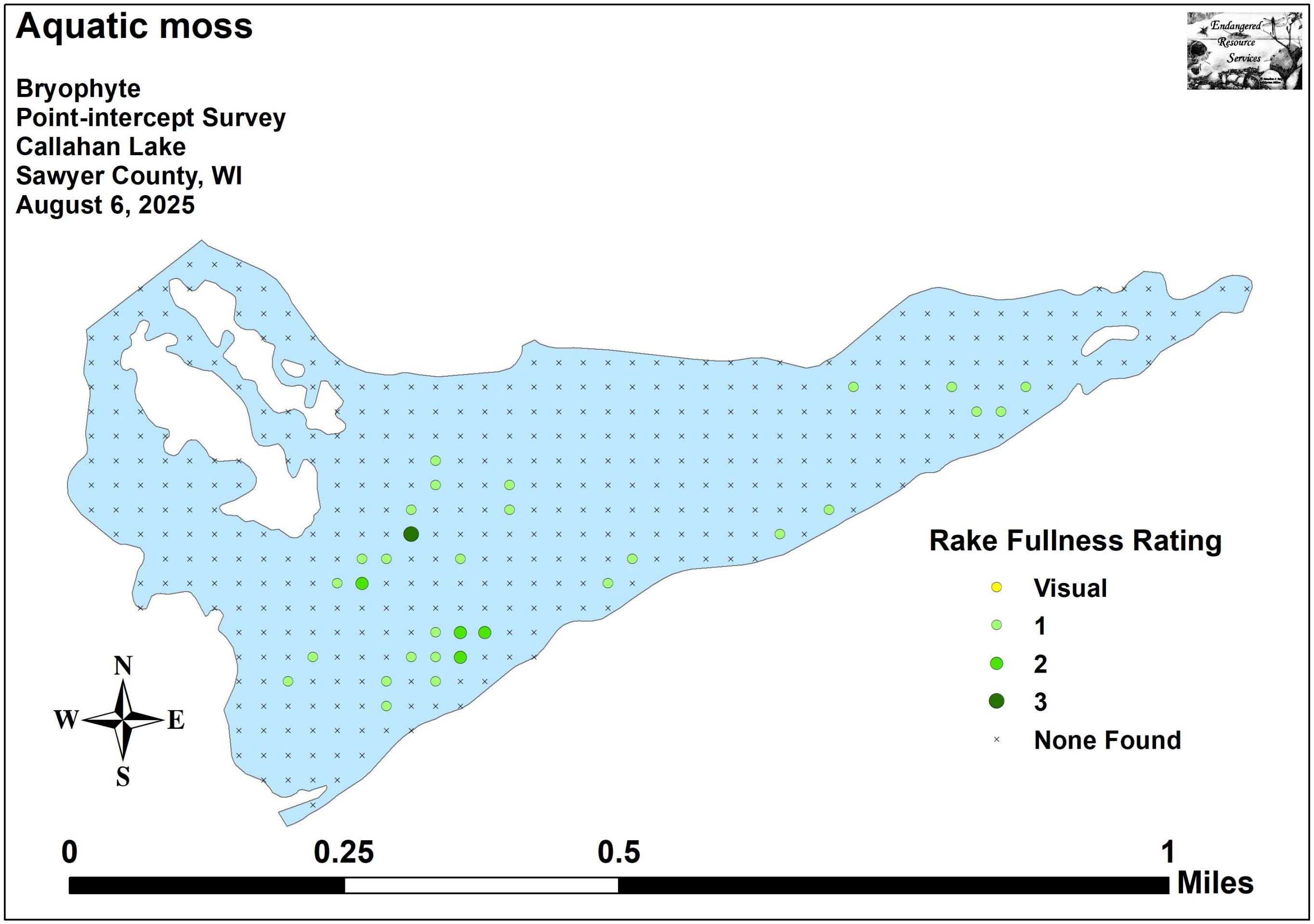
Appendix VI: August 2025 Native Species Density and Distribution Maps


Aquatic moss
Bryophyte
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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None Found
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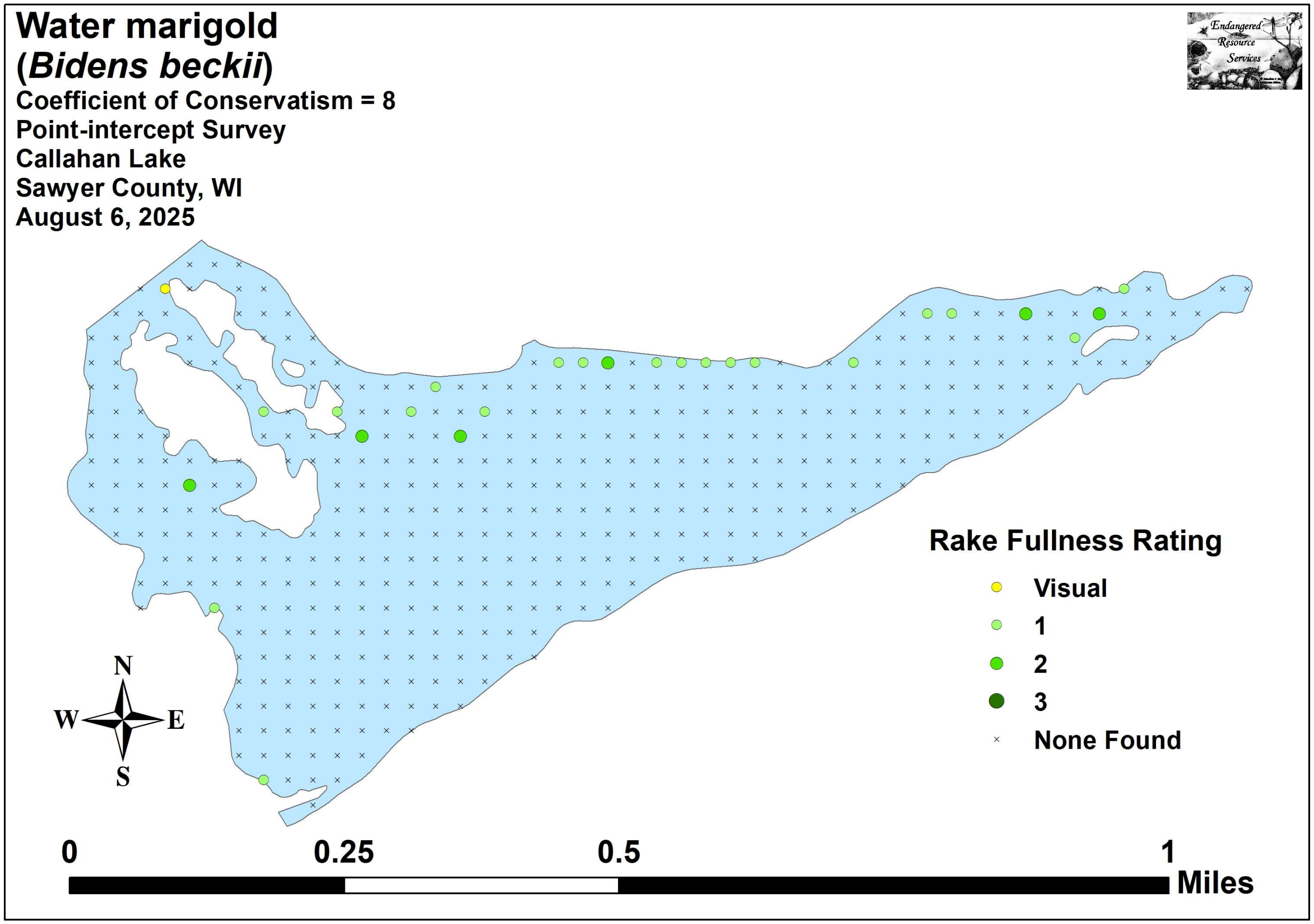
Water marigold
(*Bidens beckii*)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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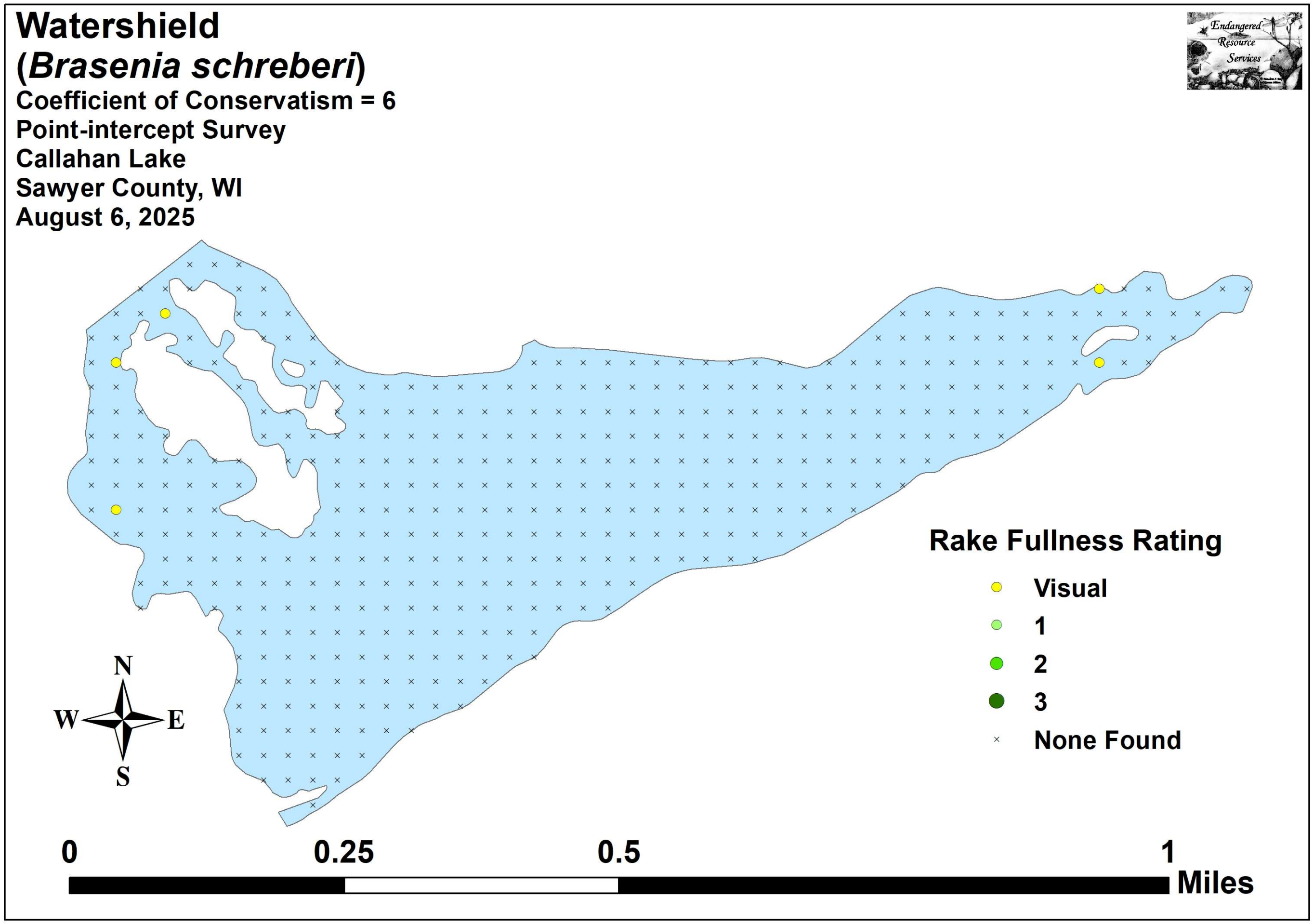
Watershield
(Brasenia schreberi)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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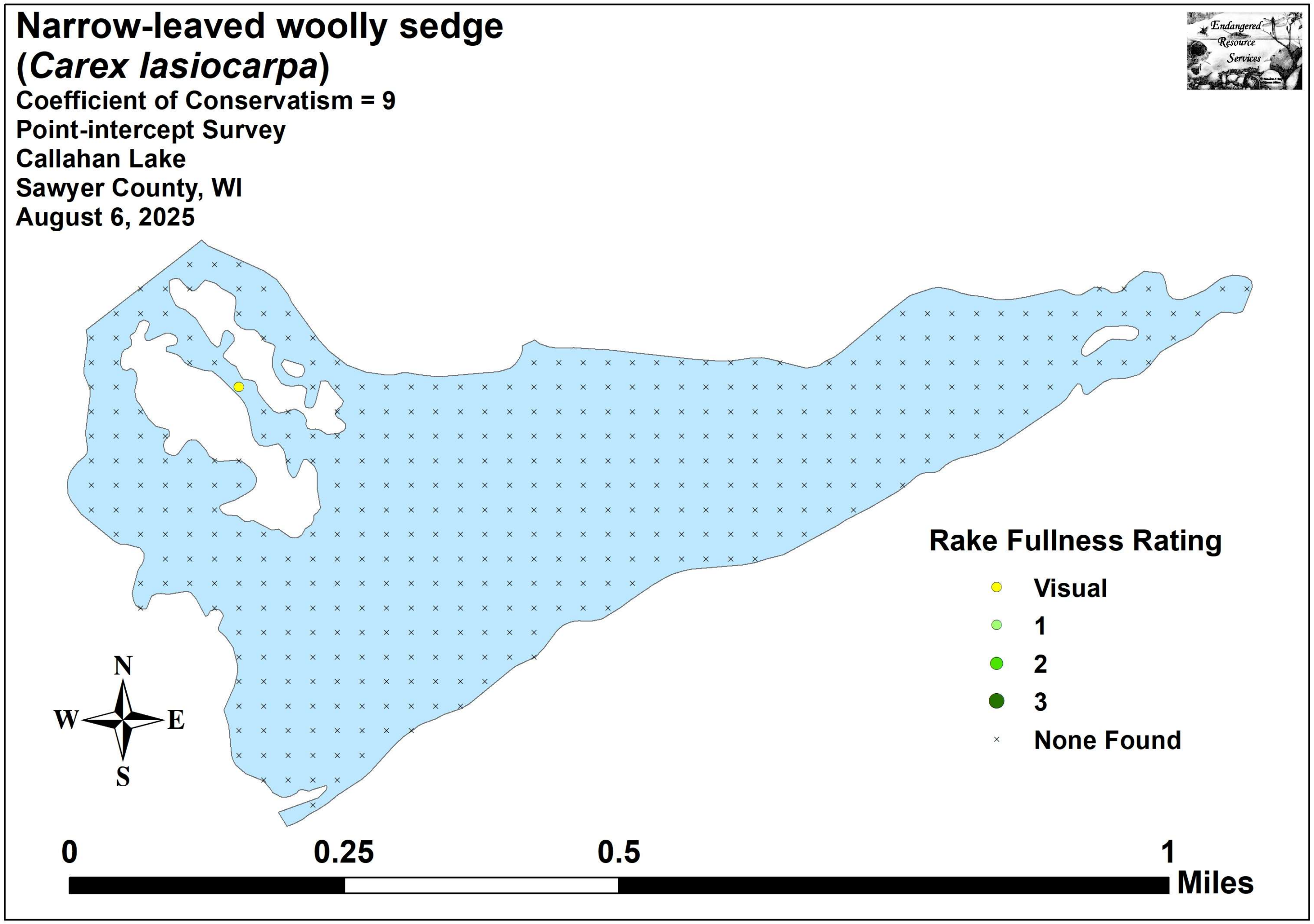

Narrow-leaved woolly sedge
(Carex lasiocarpa)
Coefficient of Conservatism = 9
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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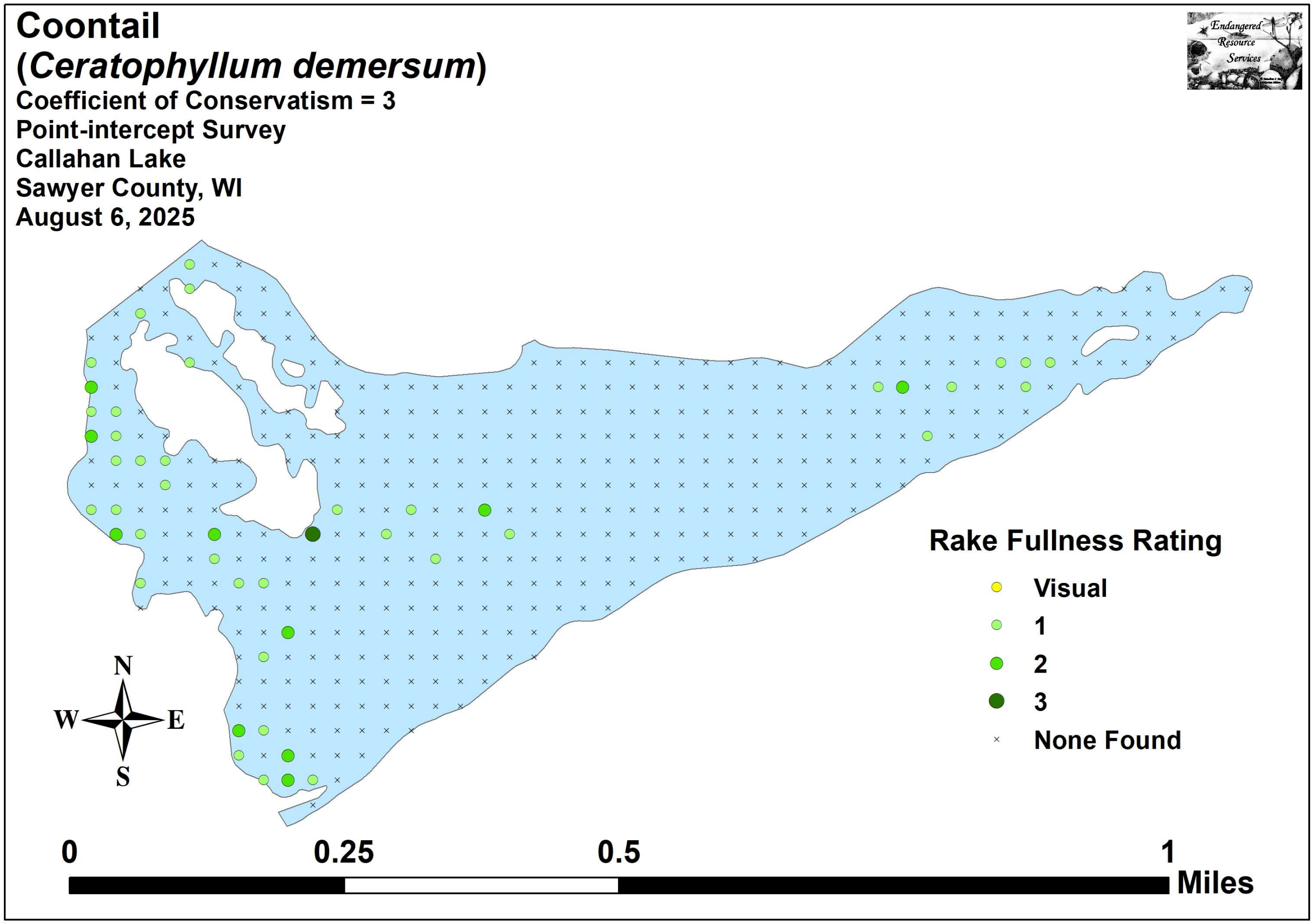

Coontail
(*Ceratophyllum demersum*)
Coefficient of Conservatism = 3
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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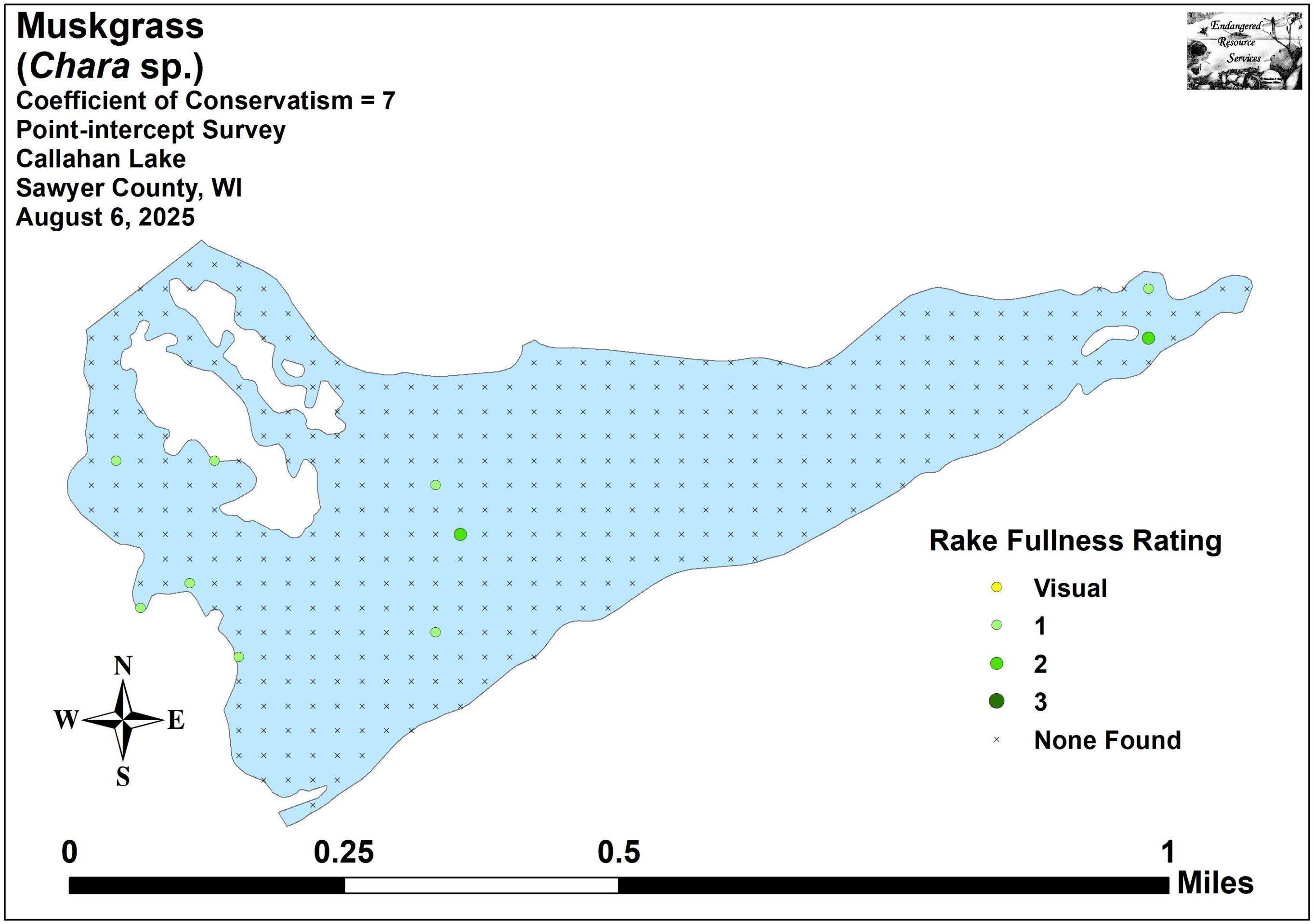
Muskgrass
(*Chara* sp.)
Coefficient of Conservatism = 7
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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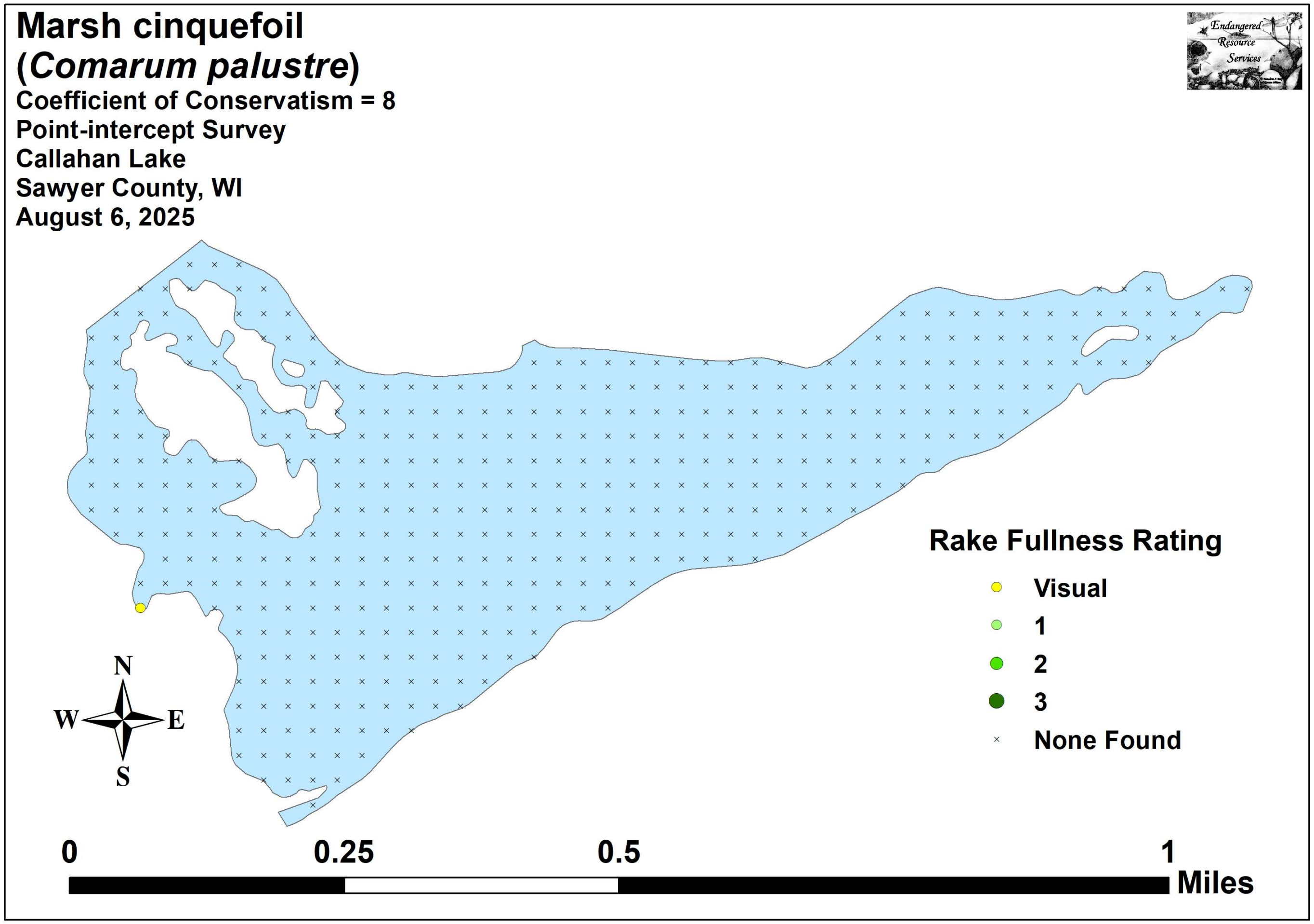

Marsh cinquefoil
(*Comarum palustre*)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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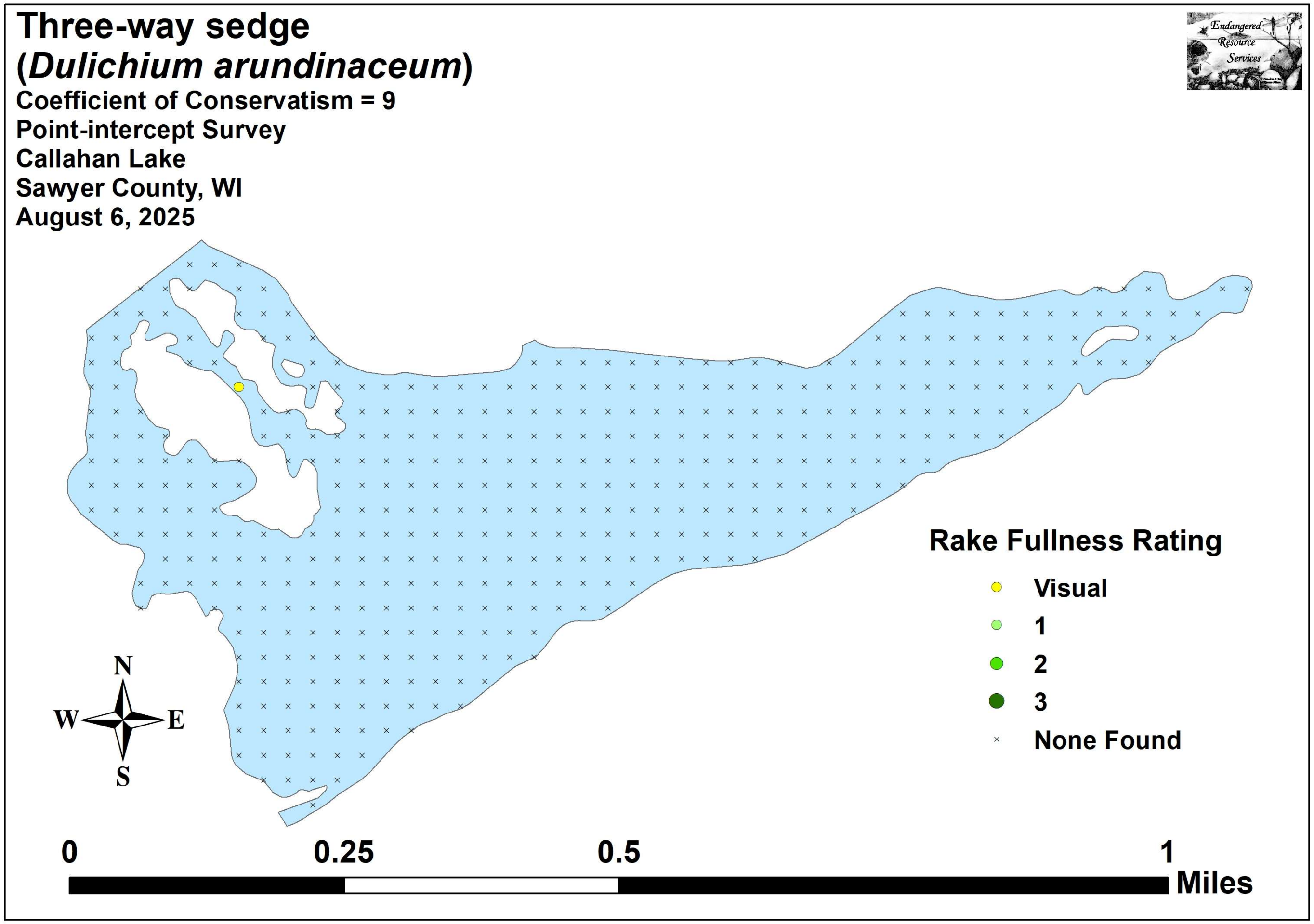

Three-way sedge
(*Dulichium arundinaceum*)
Coefficient of Conservatism = 9
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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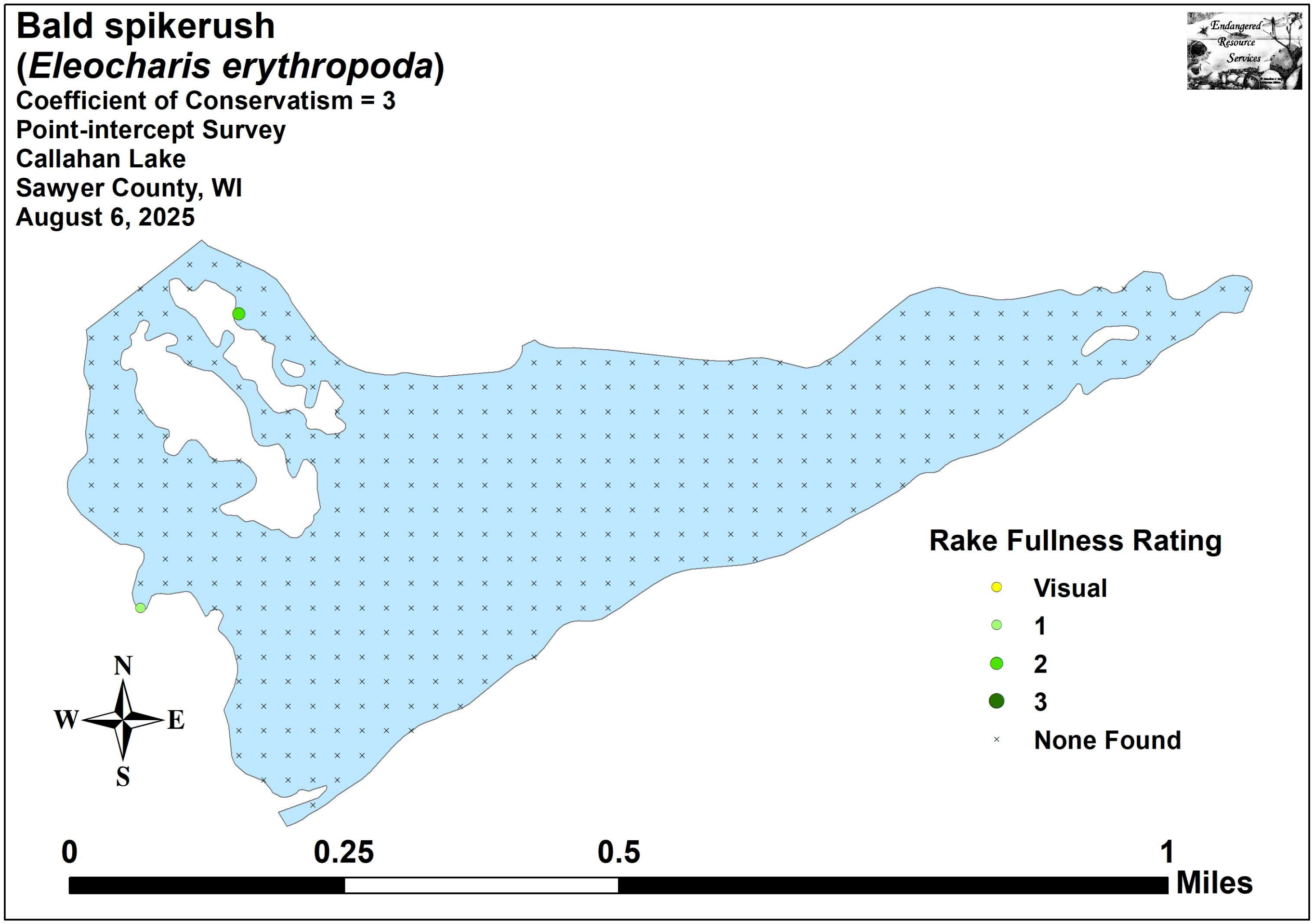
Bald spikerush
(Eleocharis erythropoda)
Coefficient of Conservatism = 3
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Rake Fullness Rating
Visual
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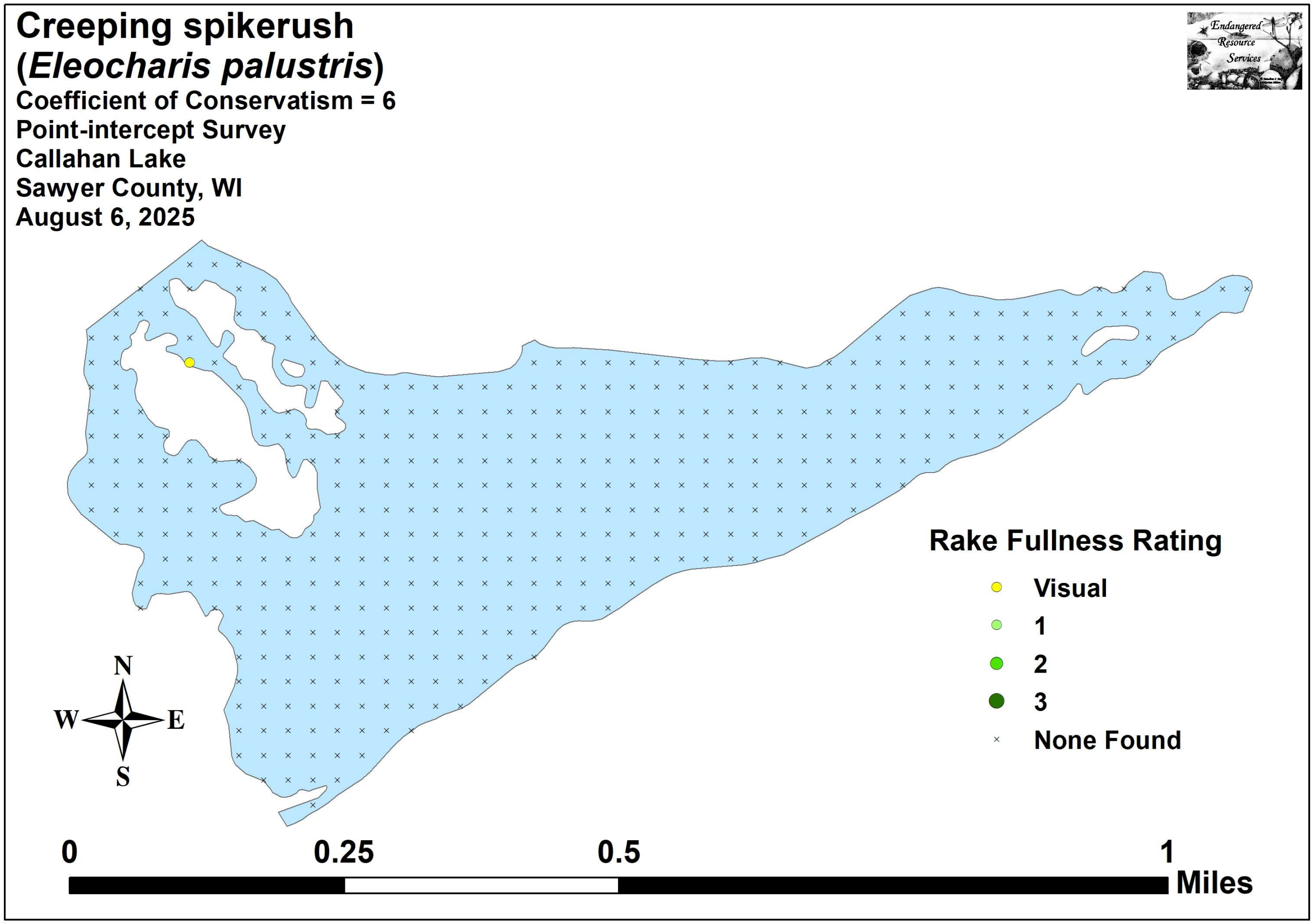
Creeping spikerush
(Eleocharis palustris)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Rake Fullness Rating
Visual
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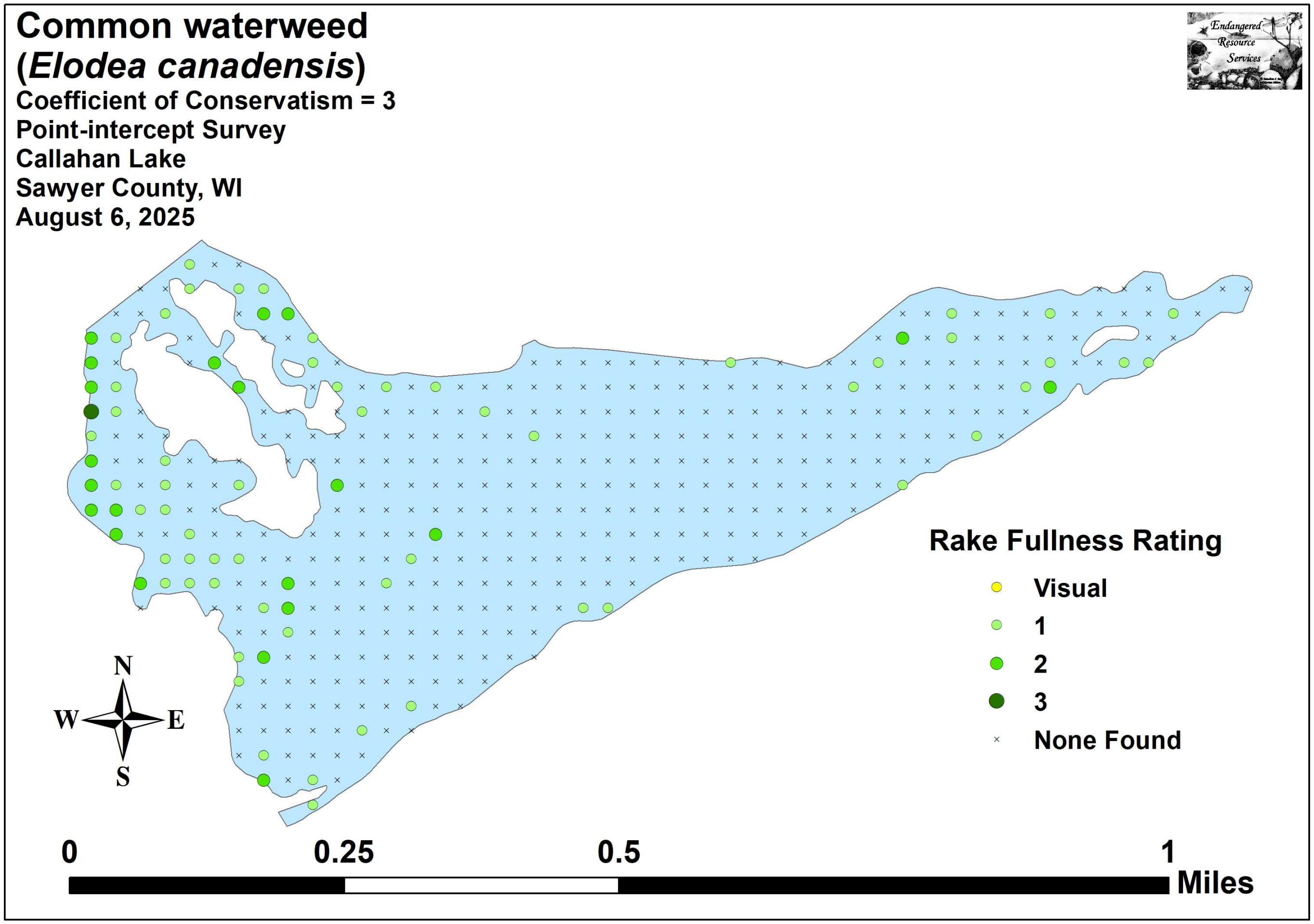
Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
Visual
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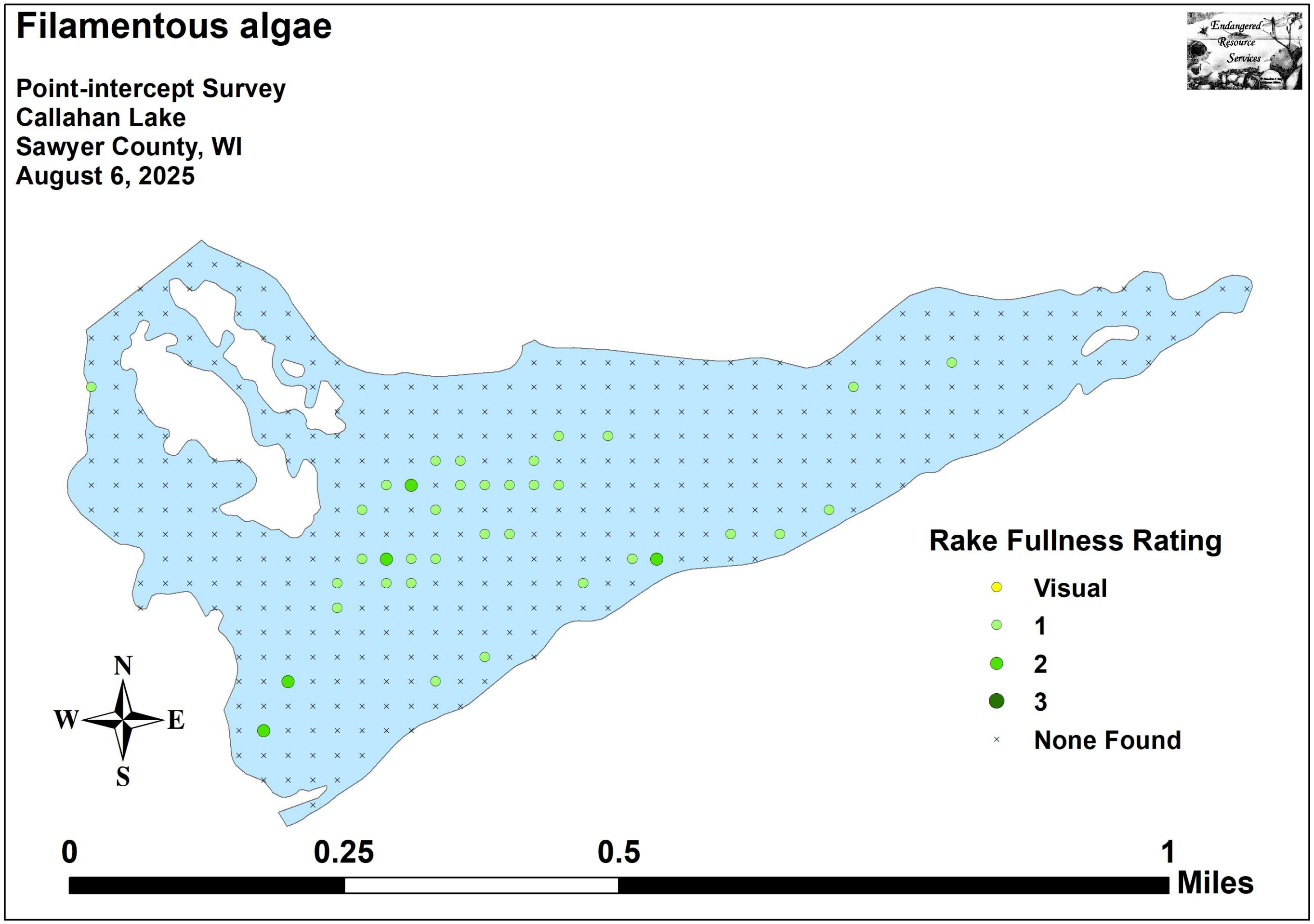
Filamentous algae
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
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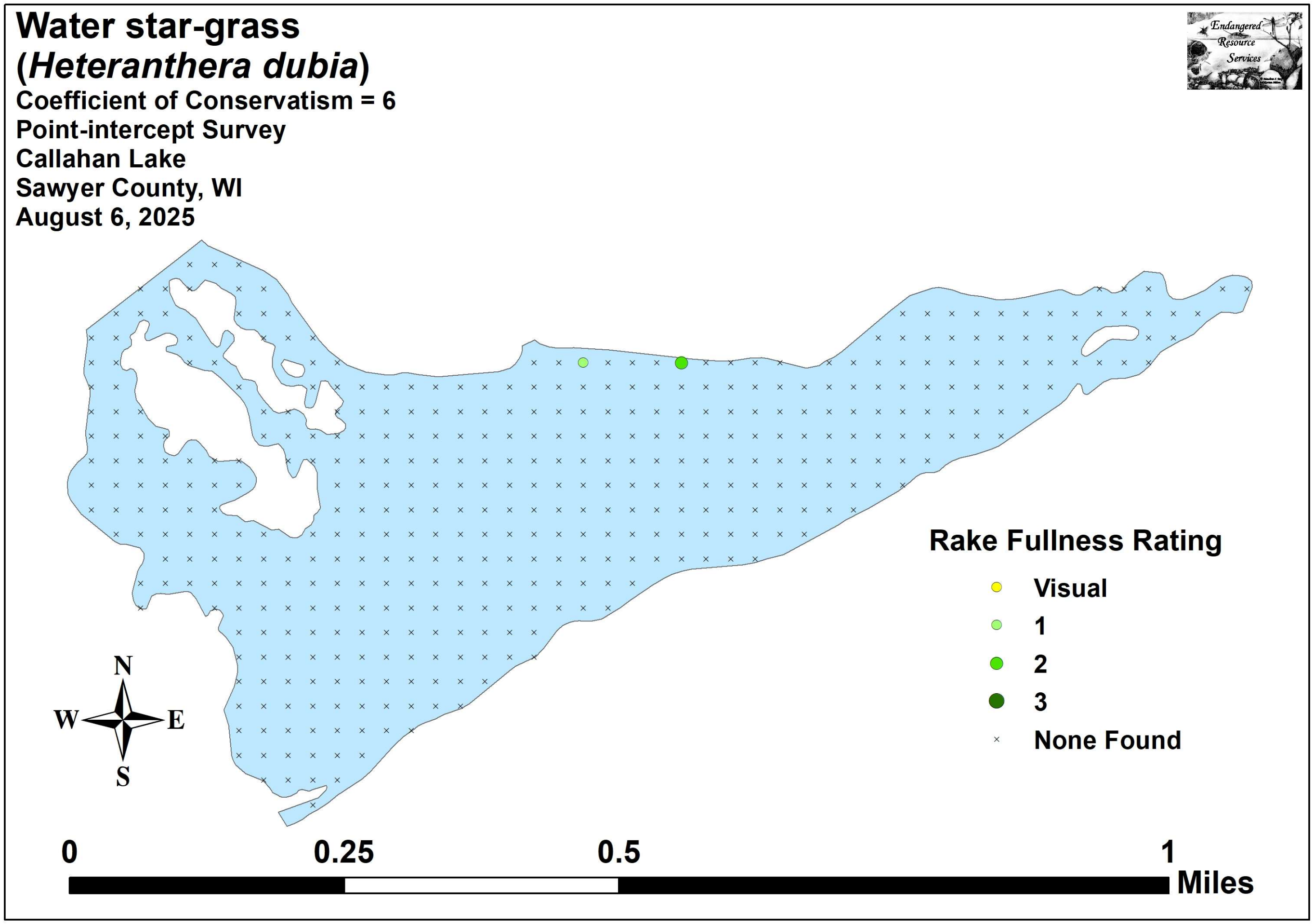
Water star-grass
(Heteranthera dubia)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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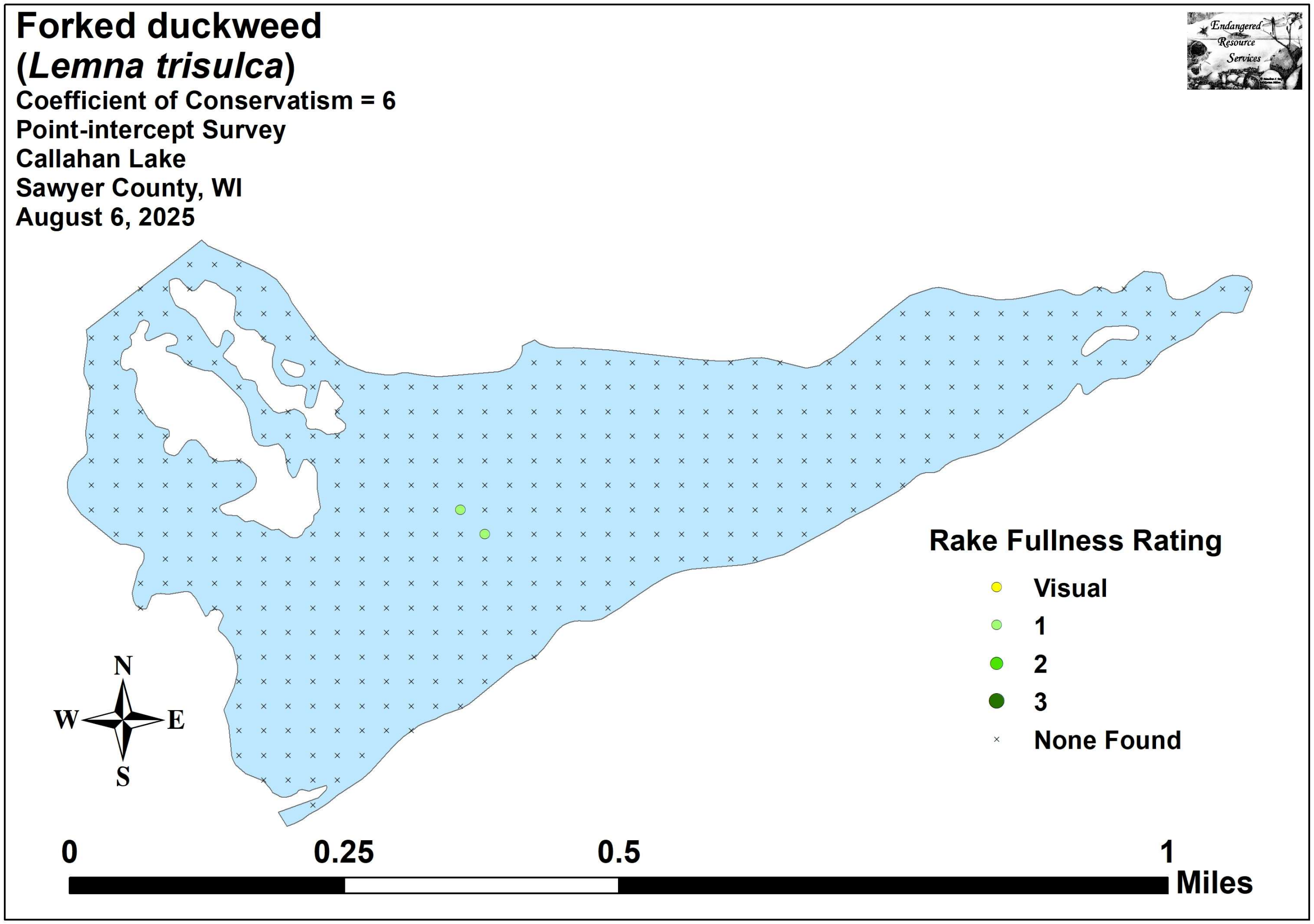
Forked duckweed
(*Lemna trisulca*)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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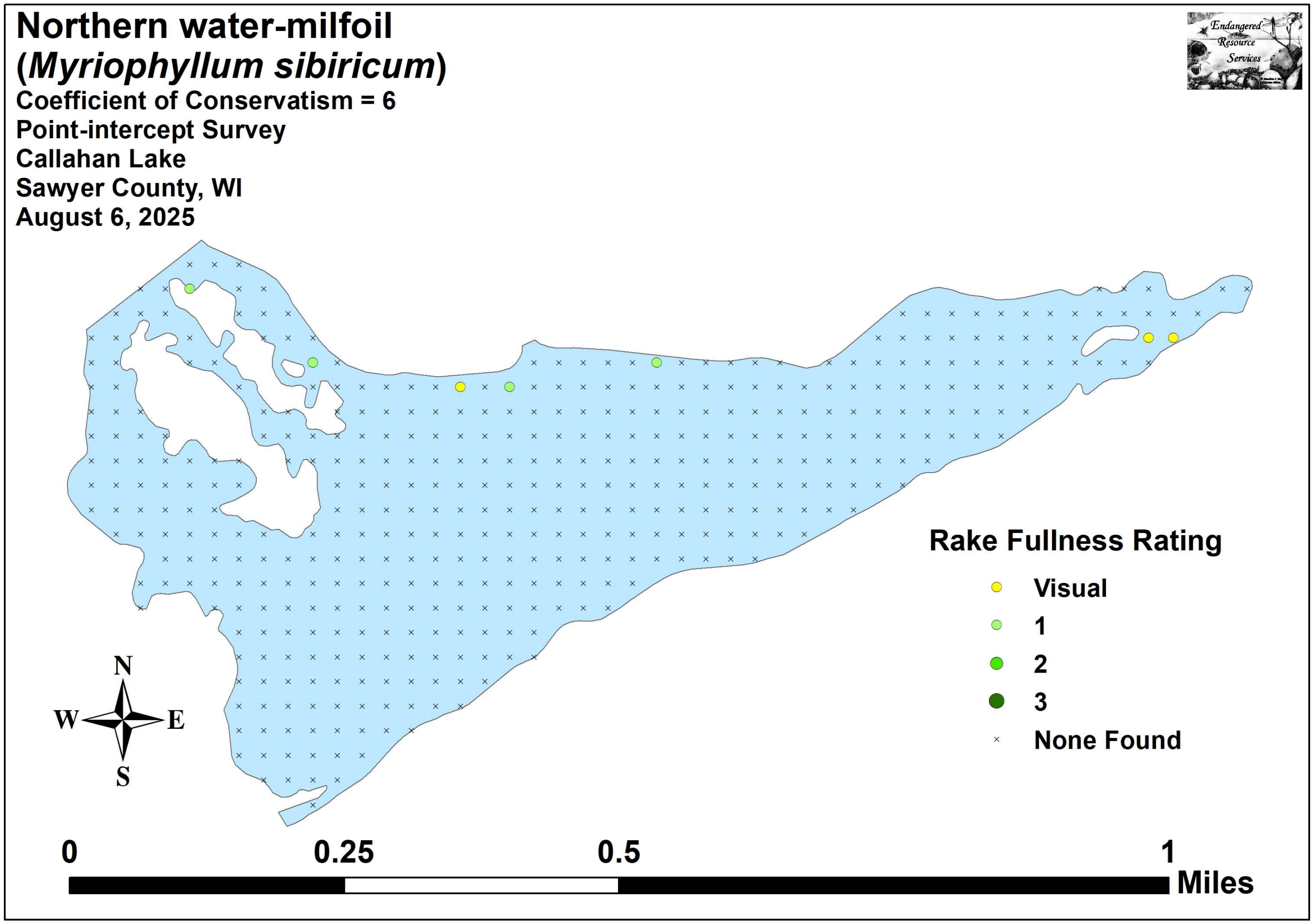
Northern water-milfoil
(Myriophyllum sibiricum)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
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Visual
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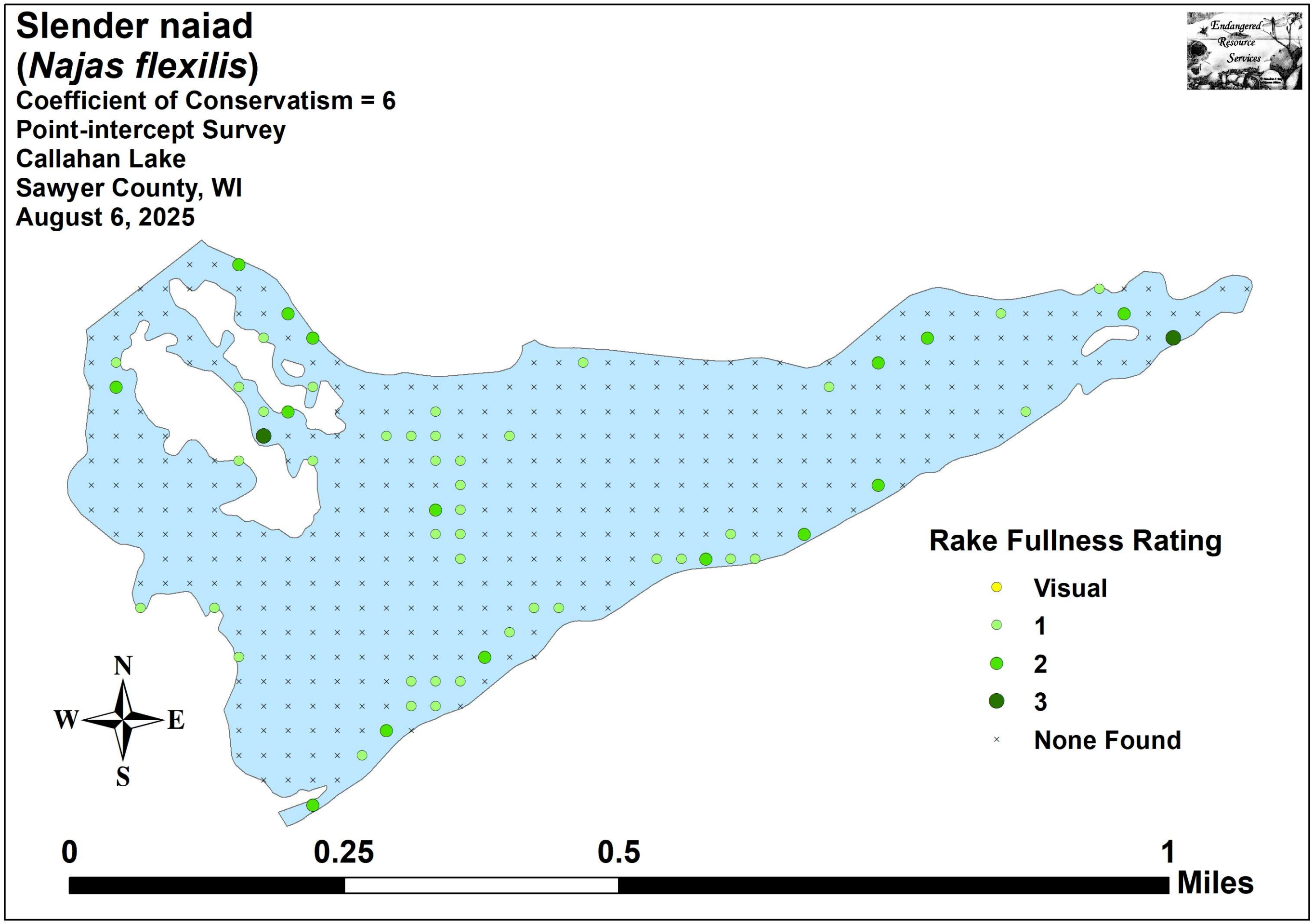

Slender naiad
(*Najas flexilis*)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
Visual
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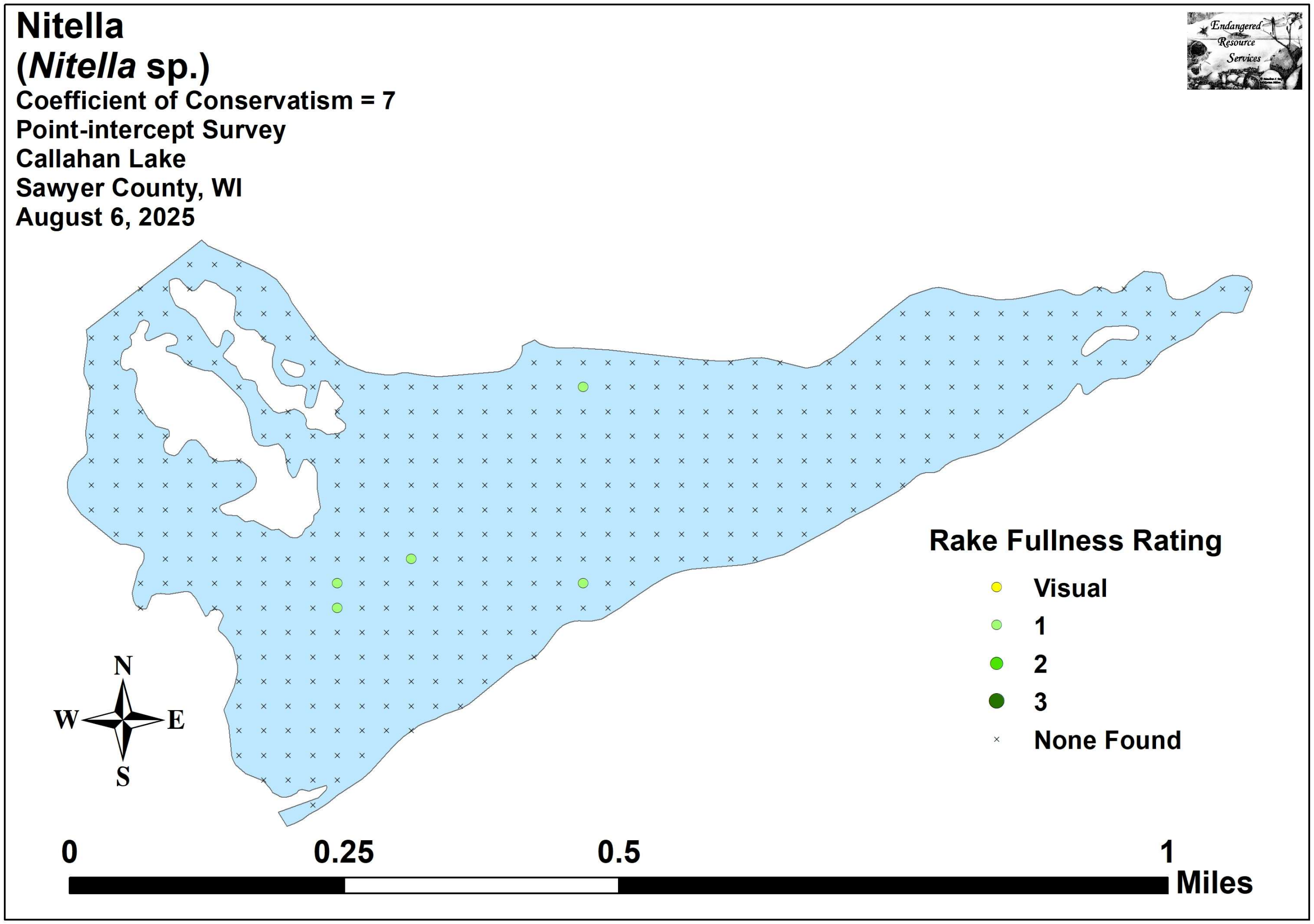
Nitella
(*Nitella* sp.)
Coefficient of Conservatism = 7
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Rake Fullness Rating
Visual
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None Found
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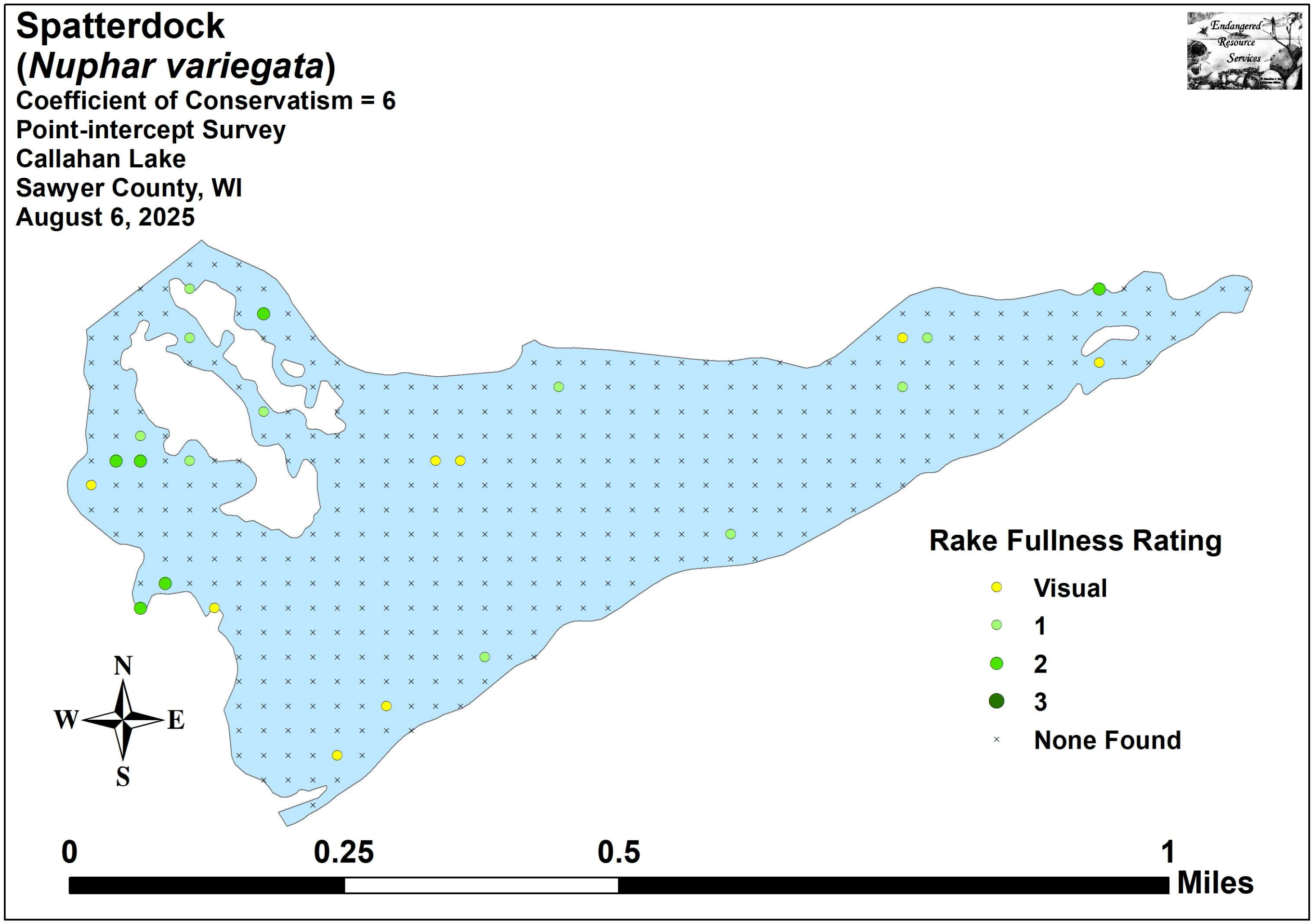
Spatterdock
(*Nuphar variegata*)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
Visual
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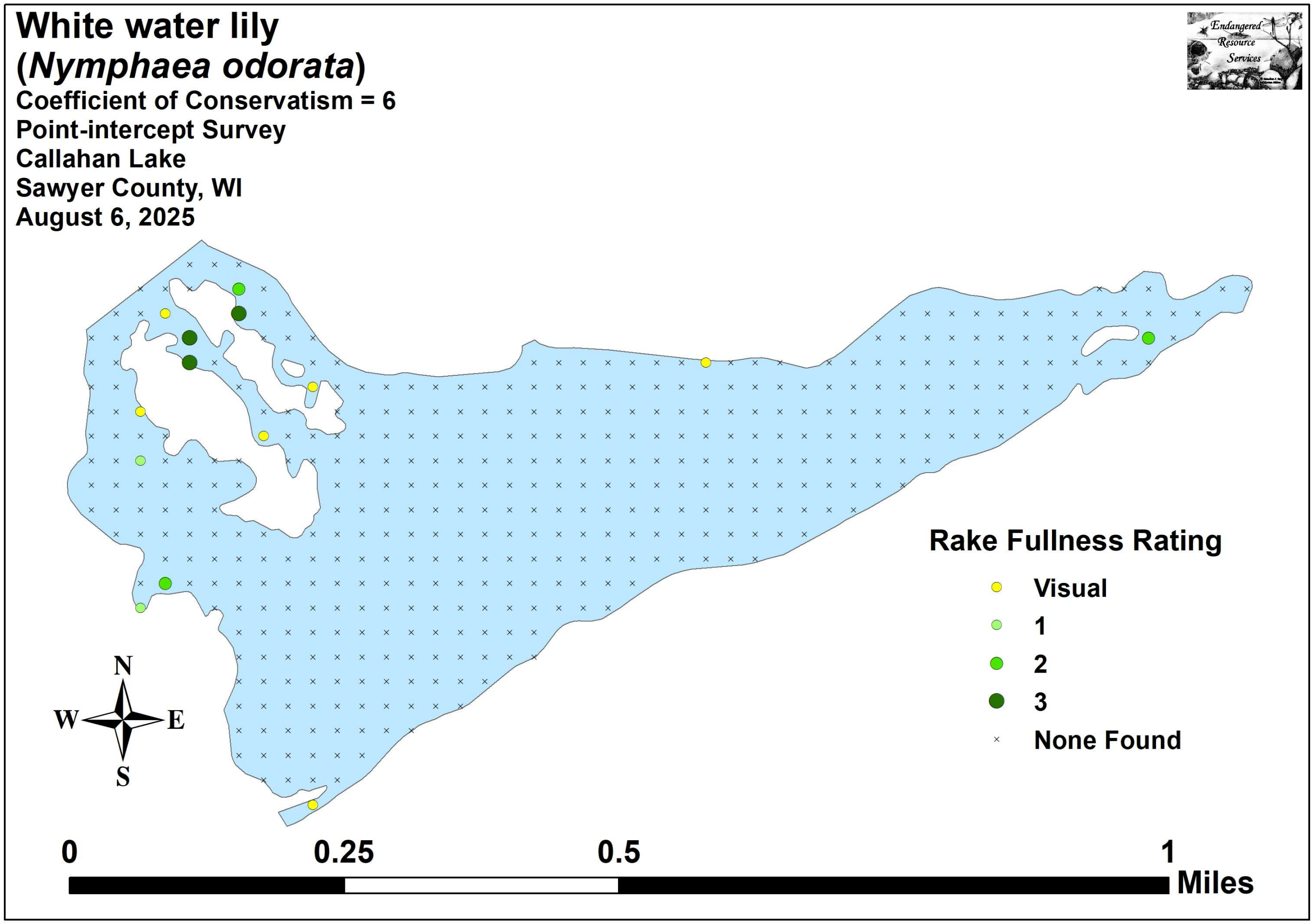
White water lily
(*Nymphaea odorata*)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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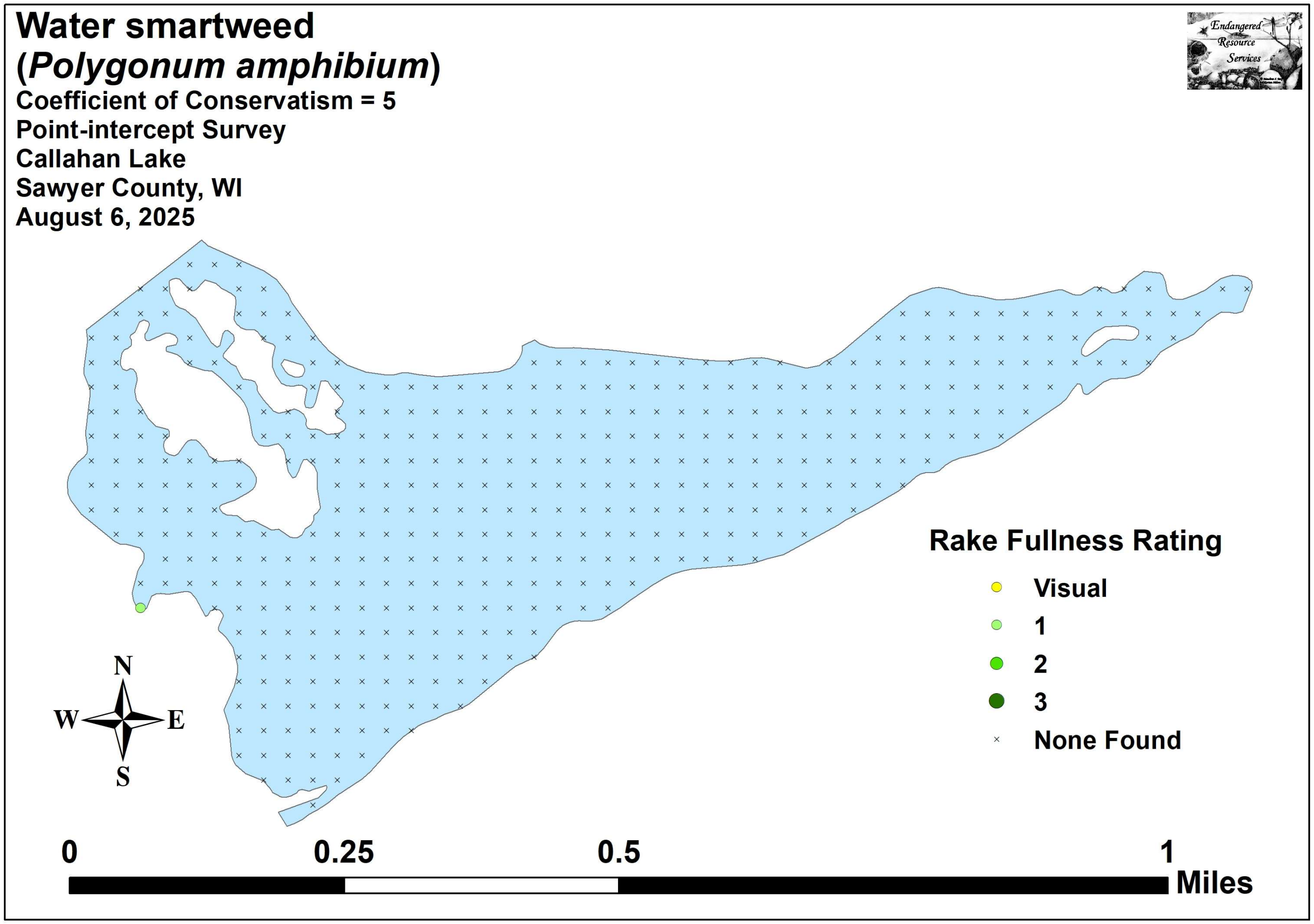
Water smartweed
(Polygonum amphibium)
Coefficient of Conservatism = 5
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
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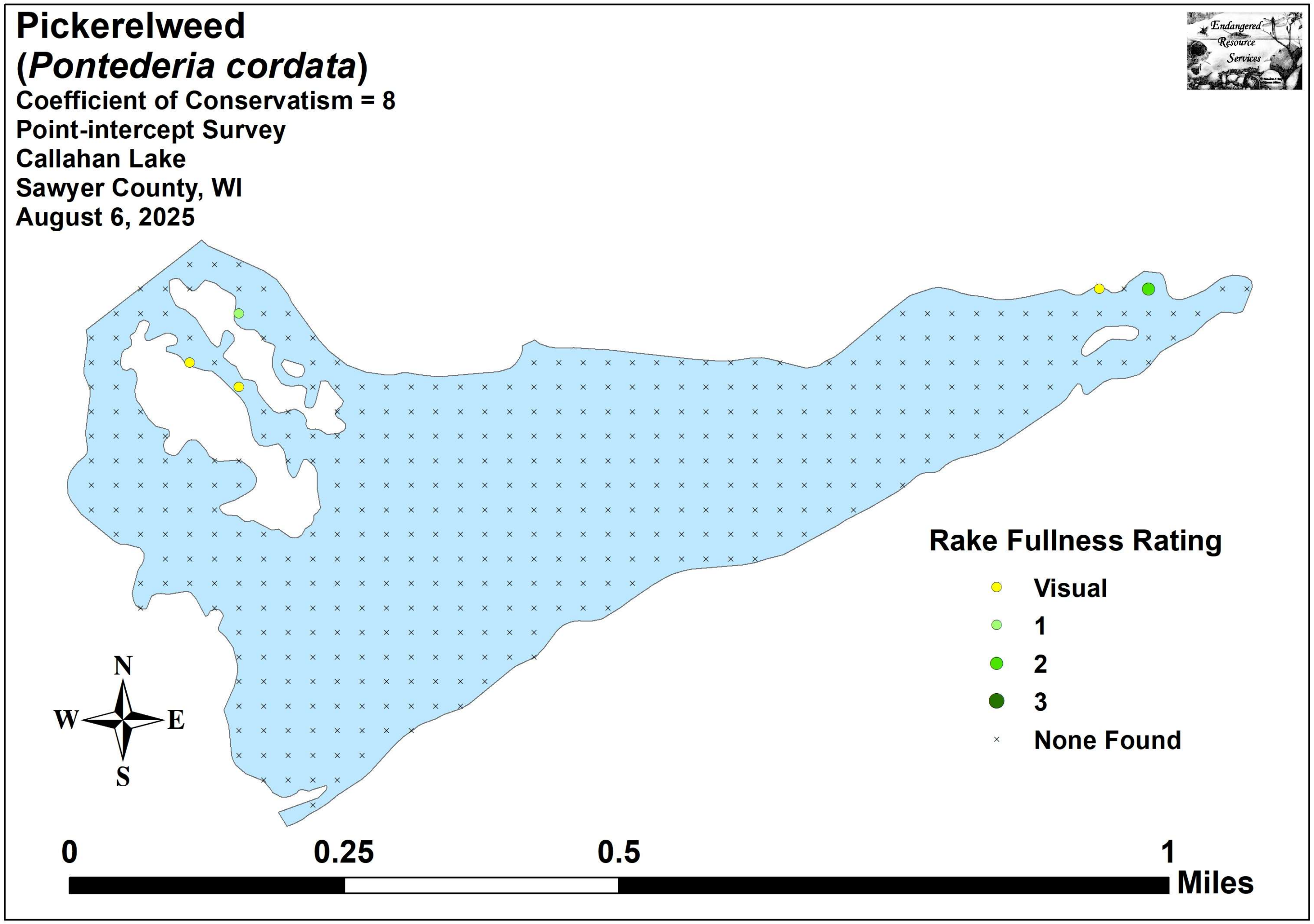
Pickerelweed
(*Pontederia cordata*)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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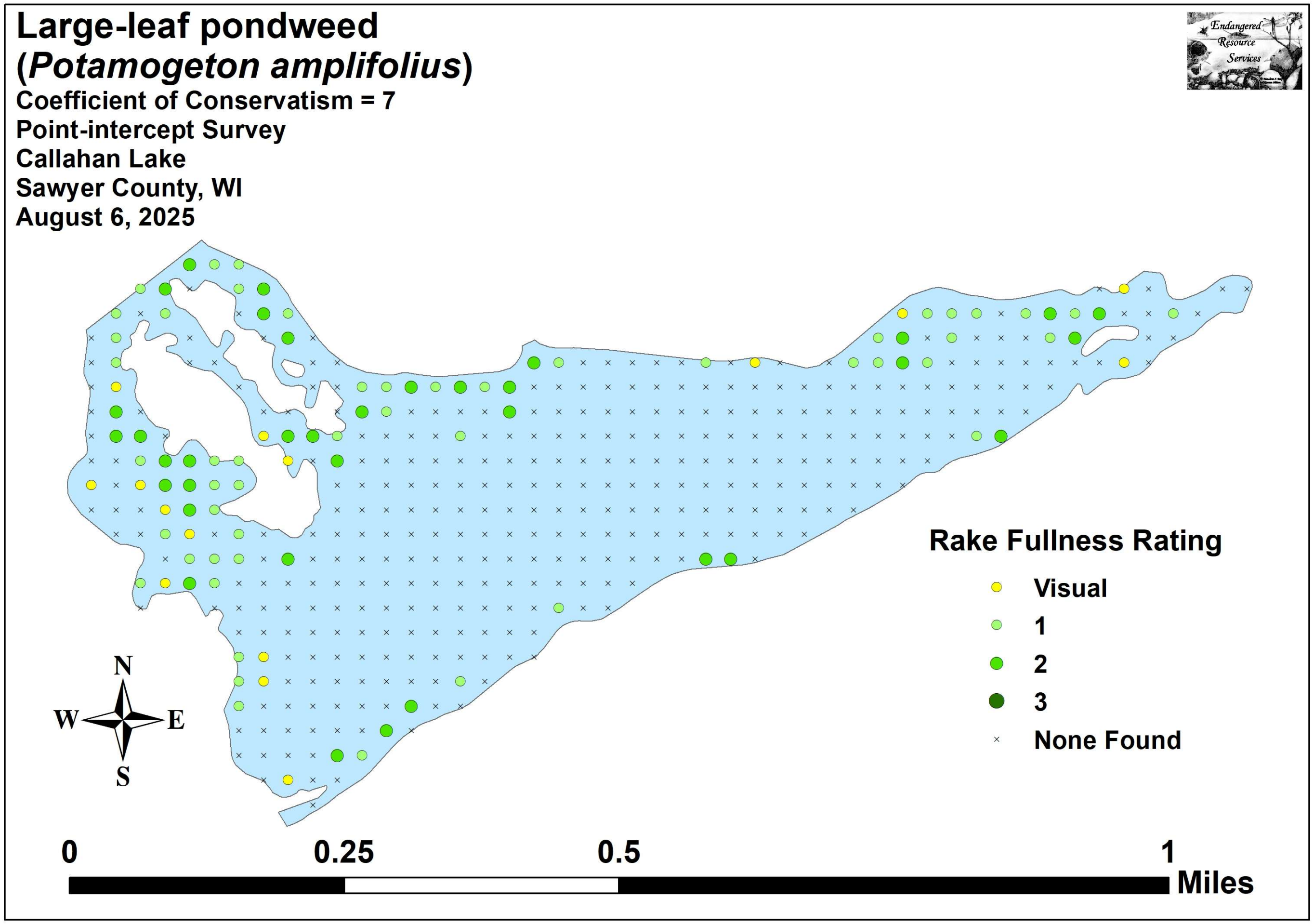
Large-leaf pondweed
(*Potamogeton amplifolius*)
Coefficient of Conservatism = 7
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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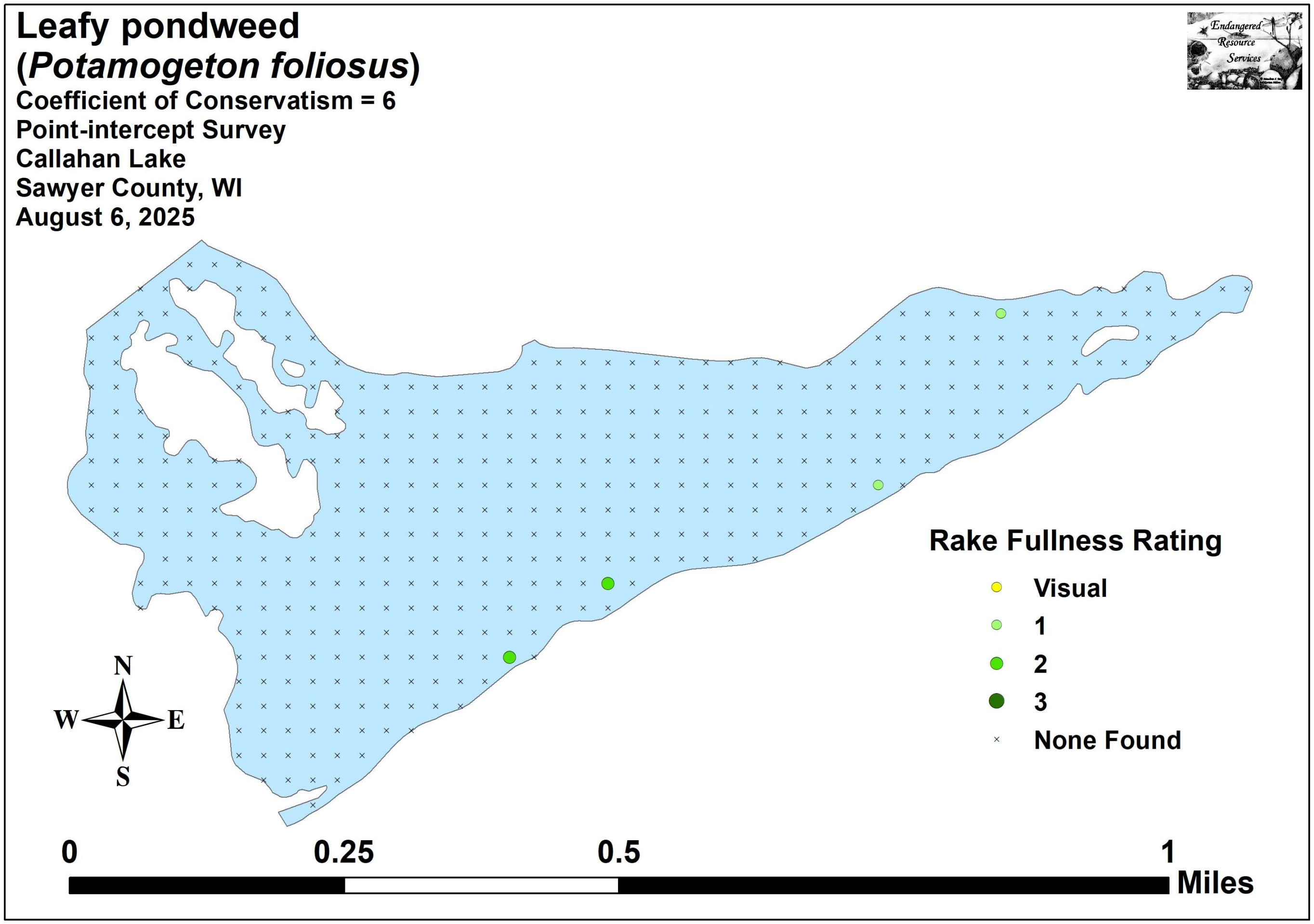
Leafy pondweed
(*Potamogeton foliosus*)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Rake Fullness Rating
Visual
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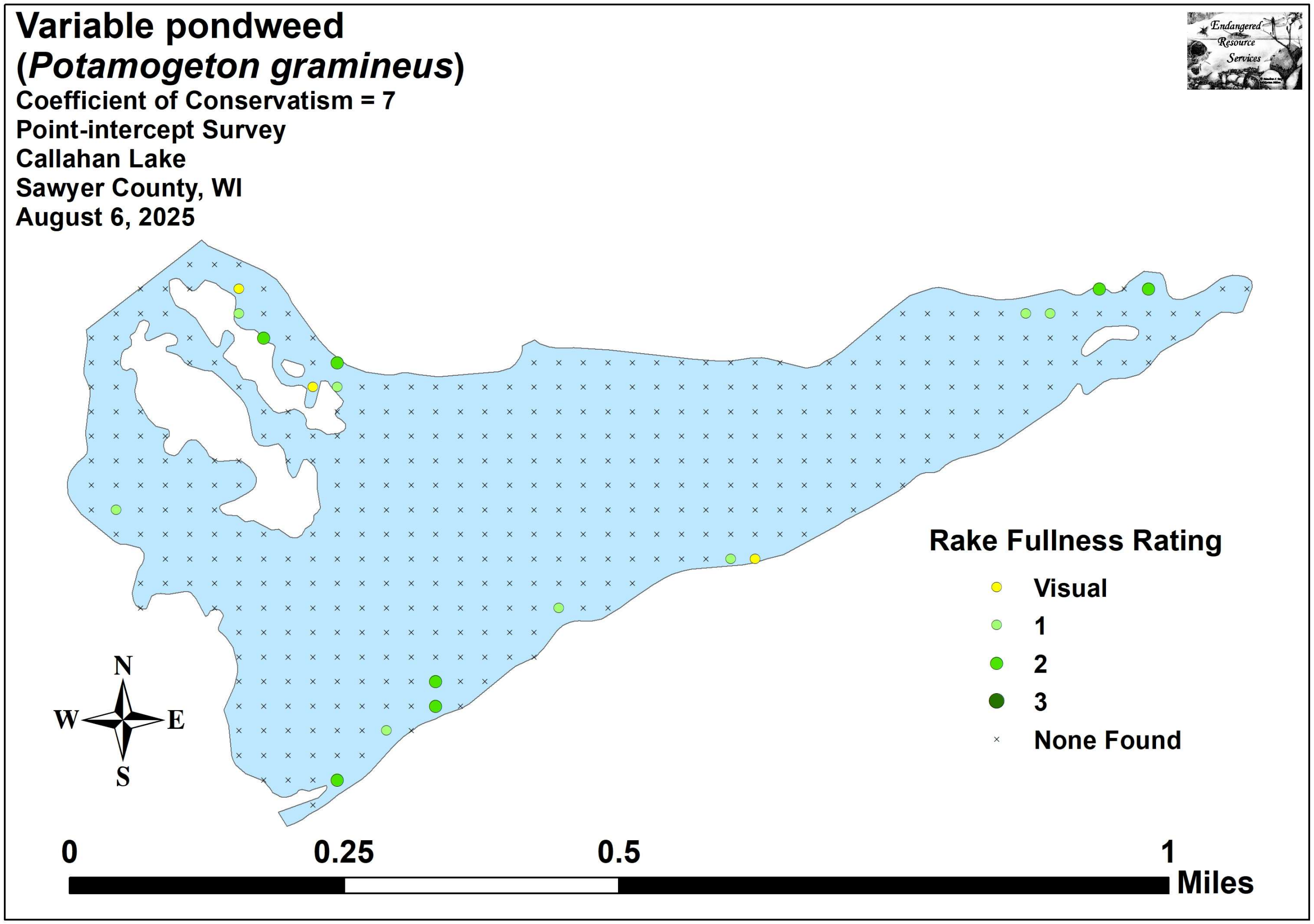
Variable pondweed
(Potamogeton gramineus)
Coefficient of Conservatism = 7
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
Visual
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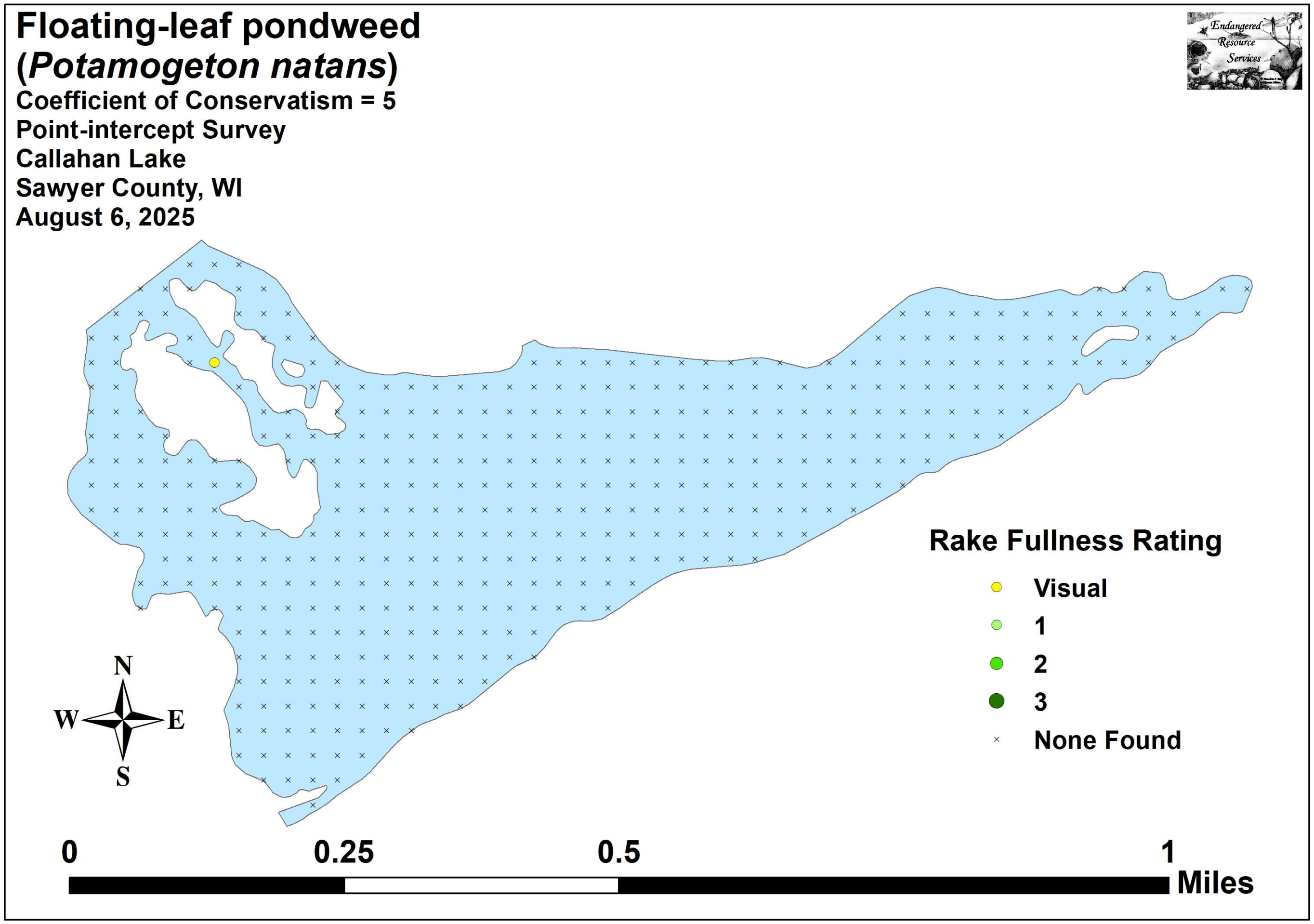
Floating-leaf pondweed
(Potamogeton natans)
Coefficient of Conservatism = 5
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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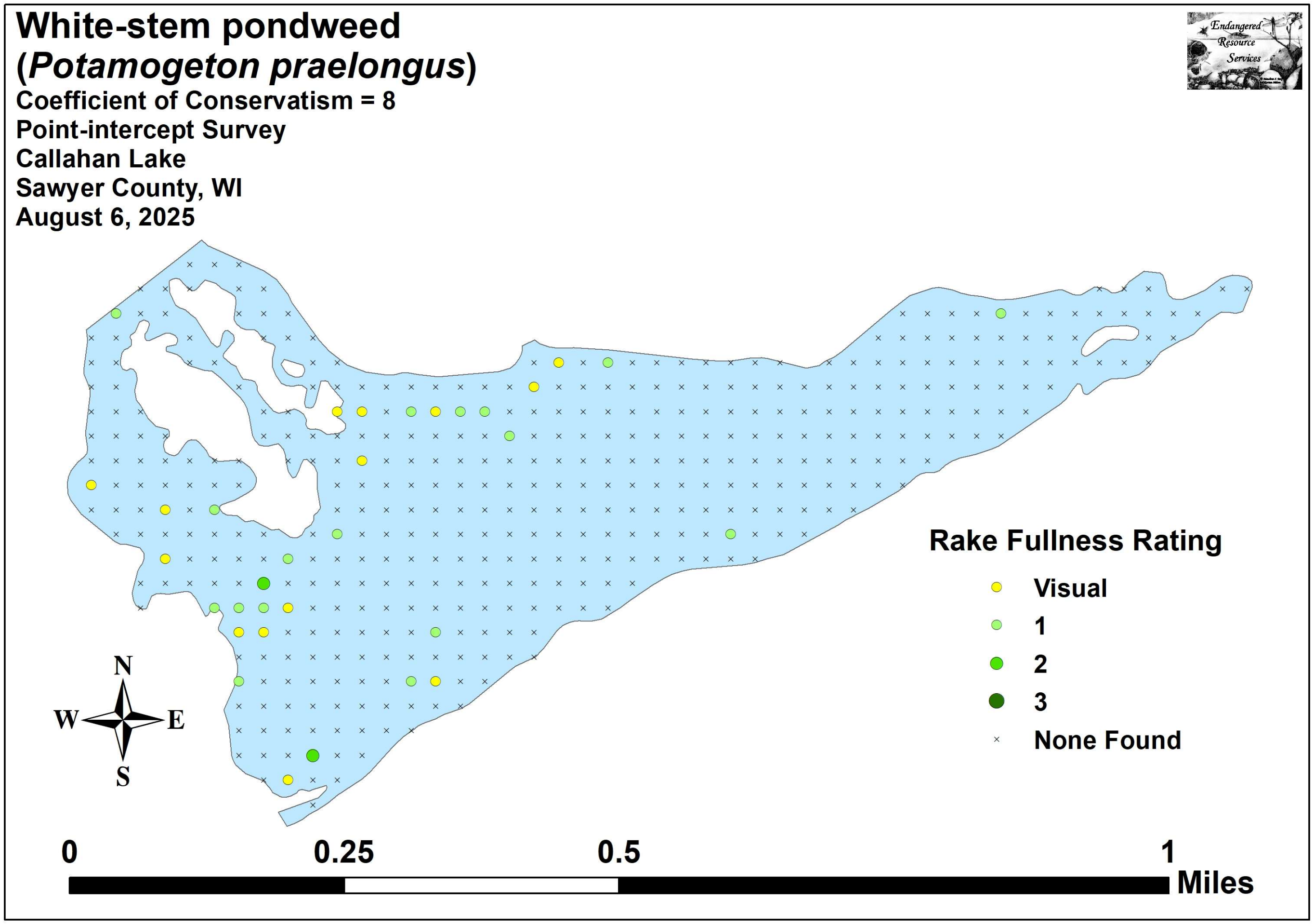
Miles


White-stem pondweed
(*Potamogeton praelongus*)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Rake Fullness Rating
Visual
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None Found
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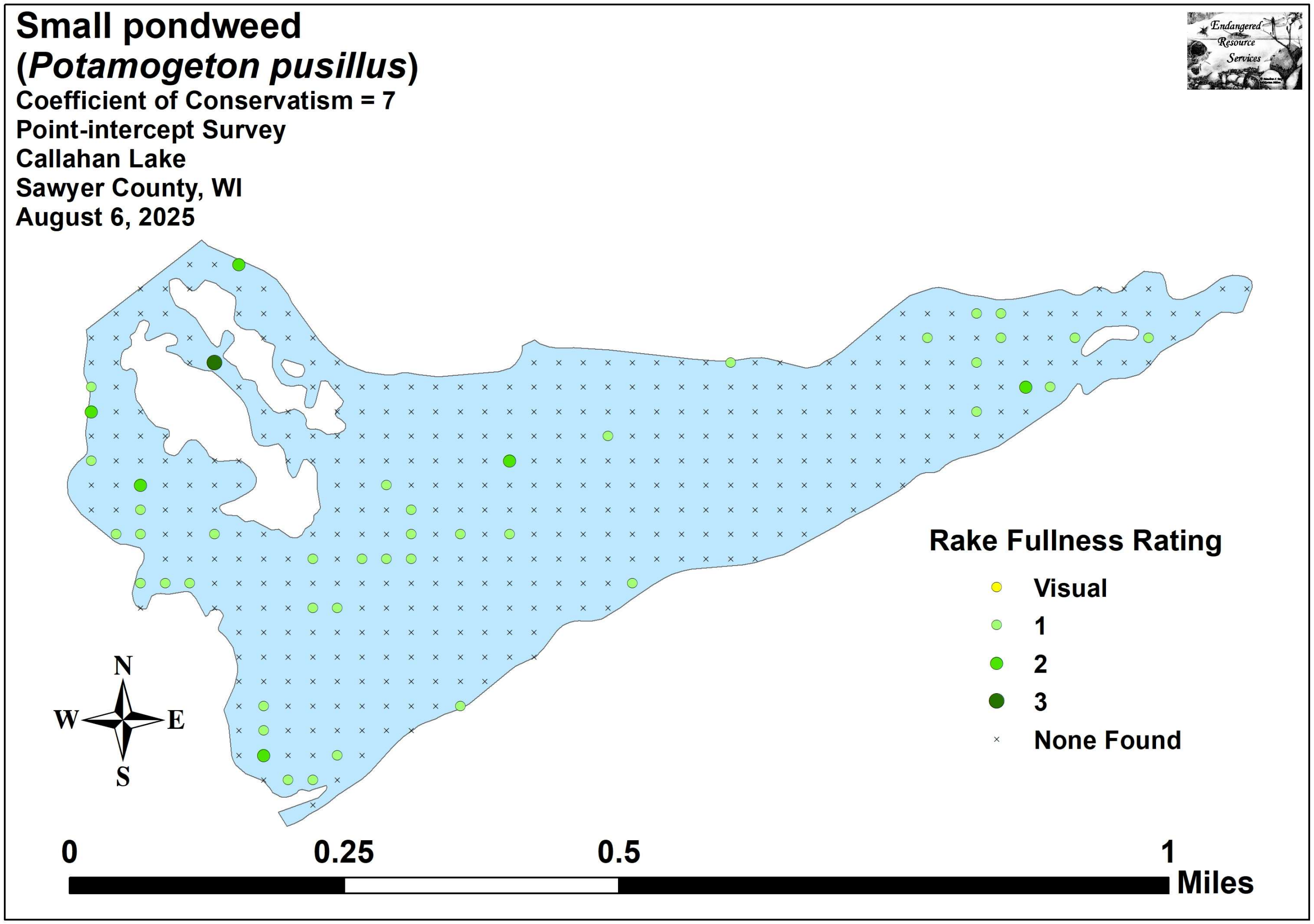
Small pondweed
(*Potamogeton pusillus*)
Coefficient of Conservatism = 7
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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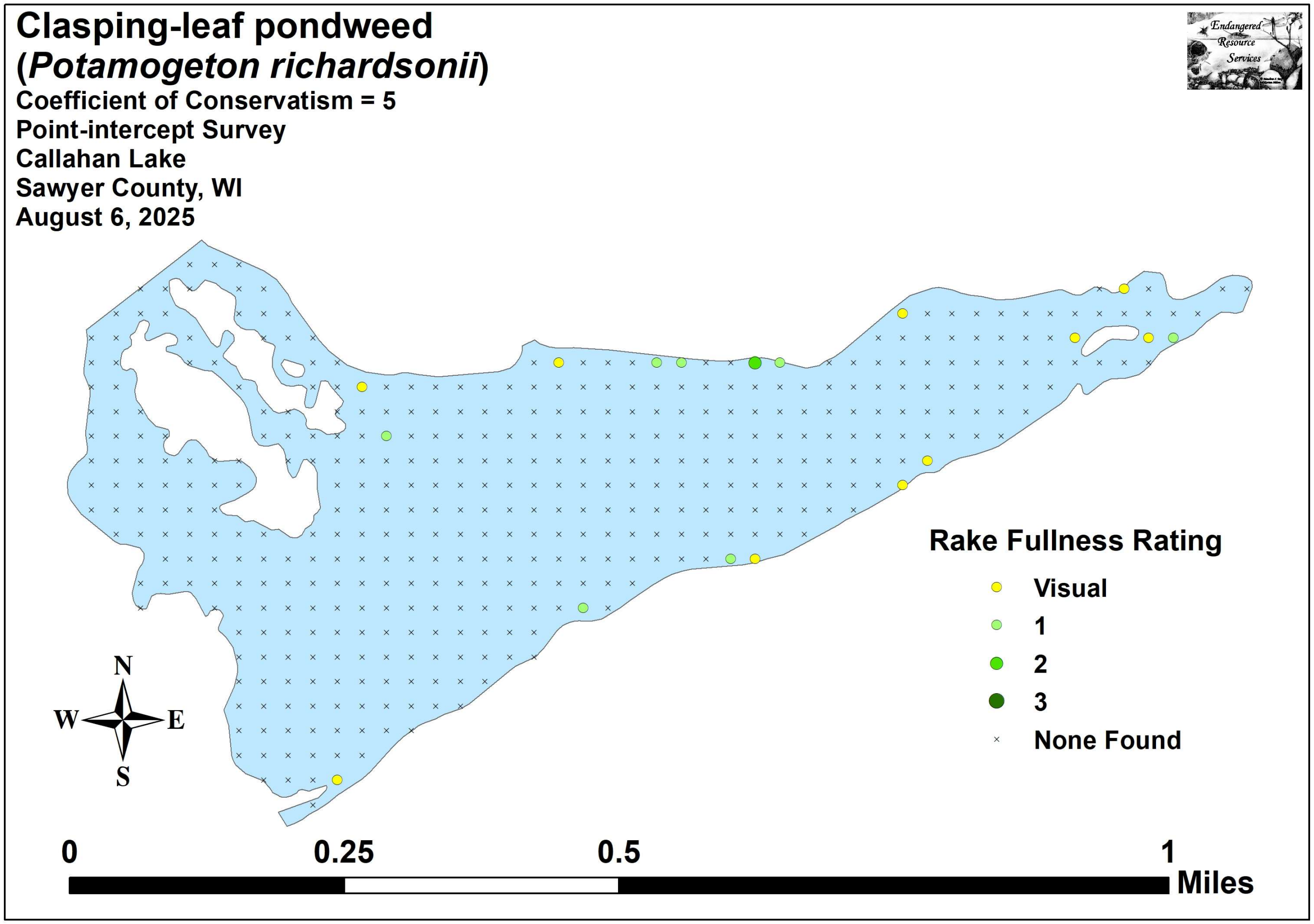

Clasping-leaf pondweed
(*Potamogeton richardsonii*)
Coefficient of Conservatism = 5
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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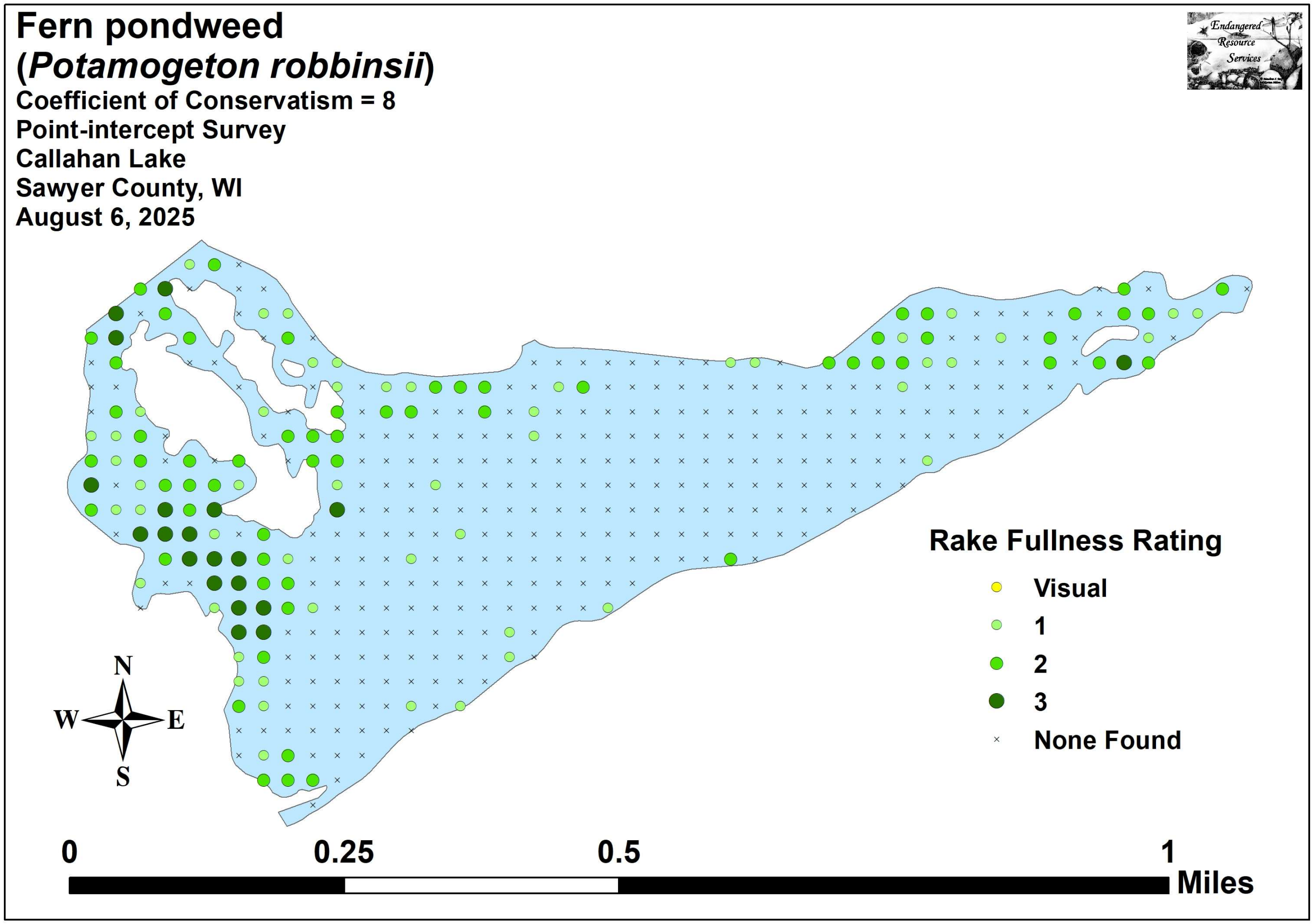
Fern pondweed
(Potamogeton robbinsii)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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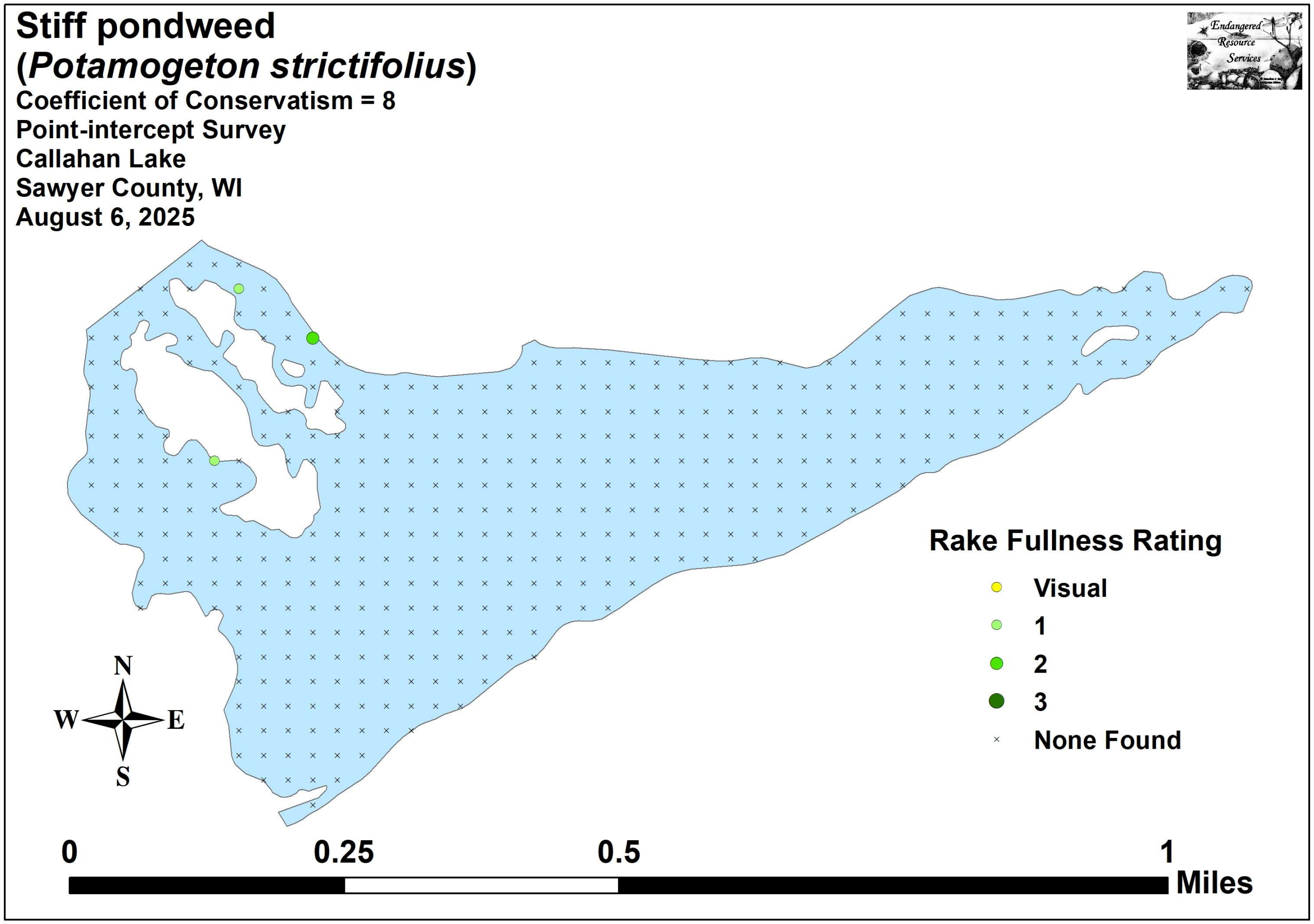
Stiff pondweed
(Potamogeton strictifolius)
Coefficient of Conservatism = 8
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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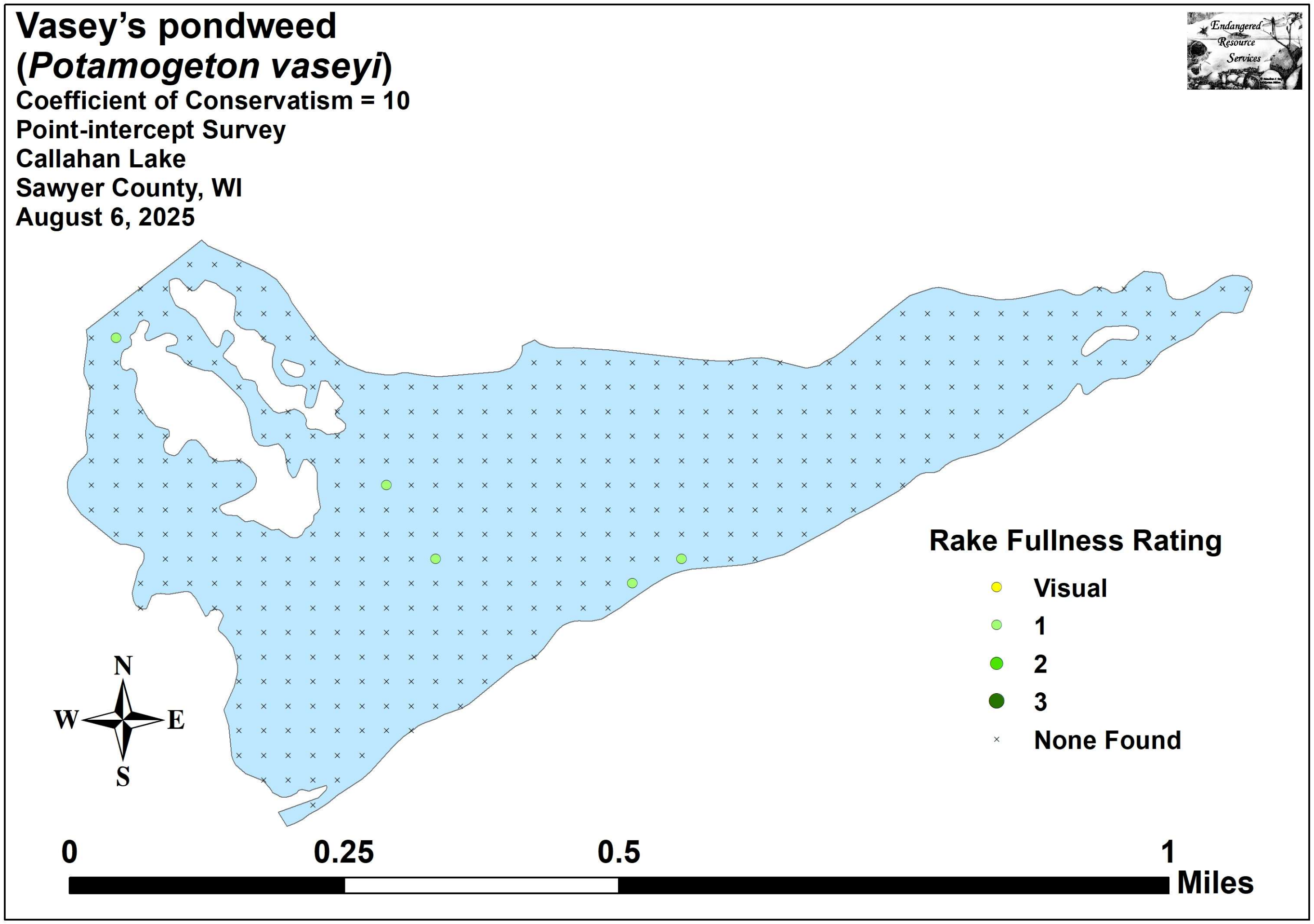
Vasey's pondweed
(*Potamogeton vaseyi*)
Coefficient of Conservatism = 10
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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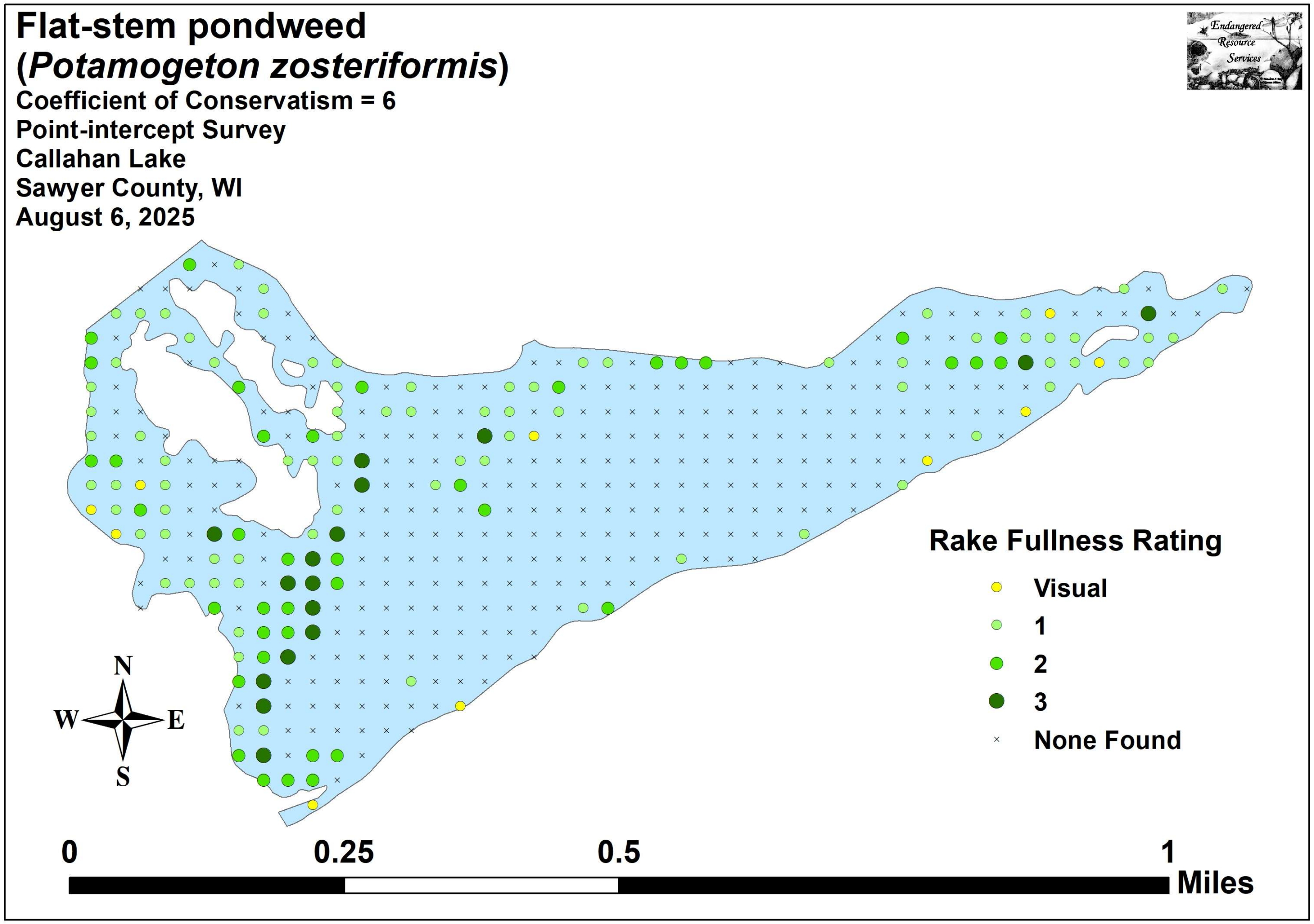
Flat-stem pondweed
(Potamogeton zosteriformis)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
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None Found
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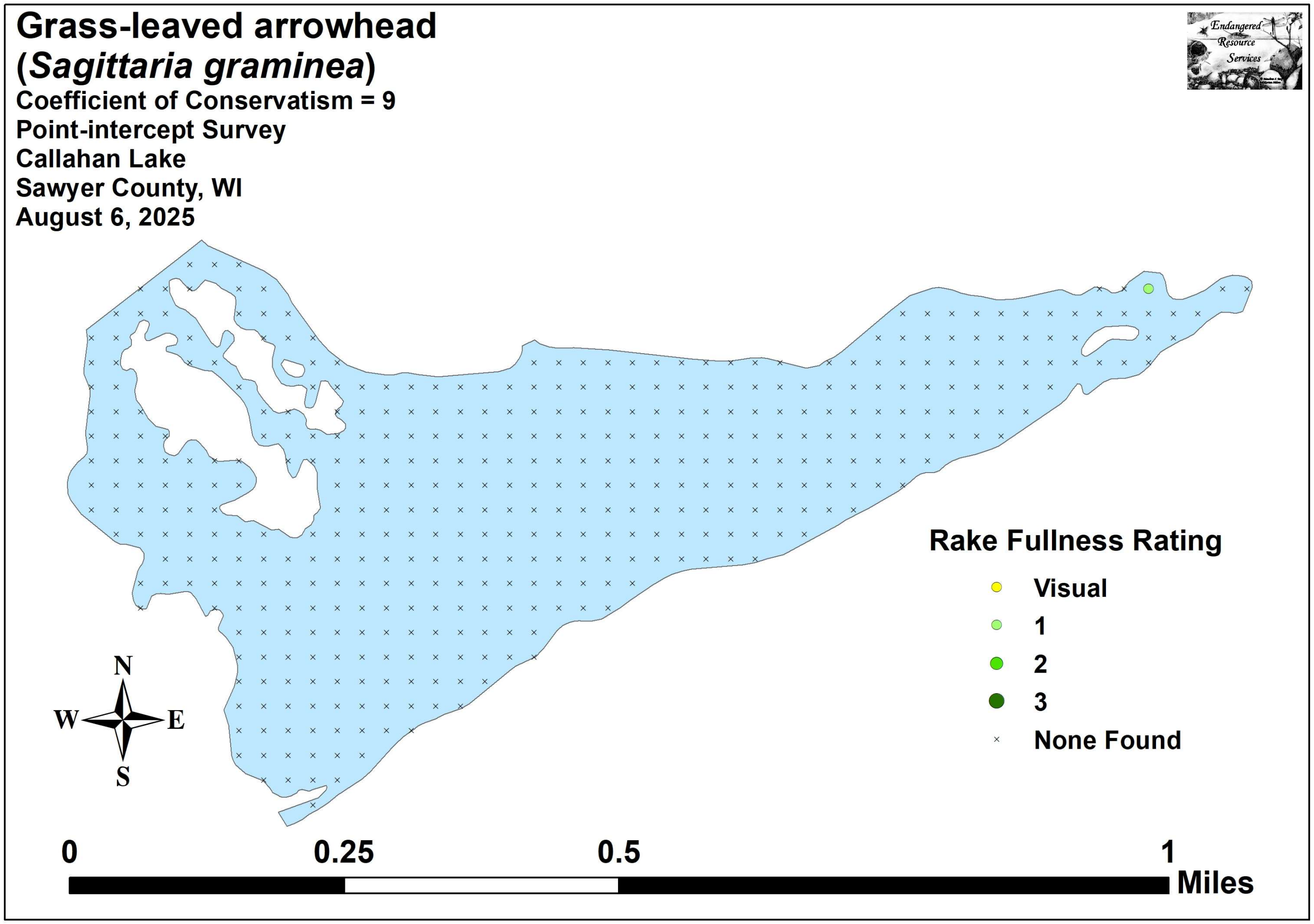
Grass-leaved arrowhead
(Sagittaria graminea)
Coefficient of Conservatism = 9
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
Visual
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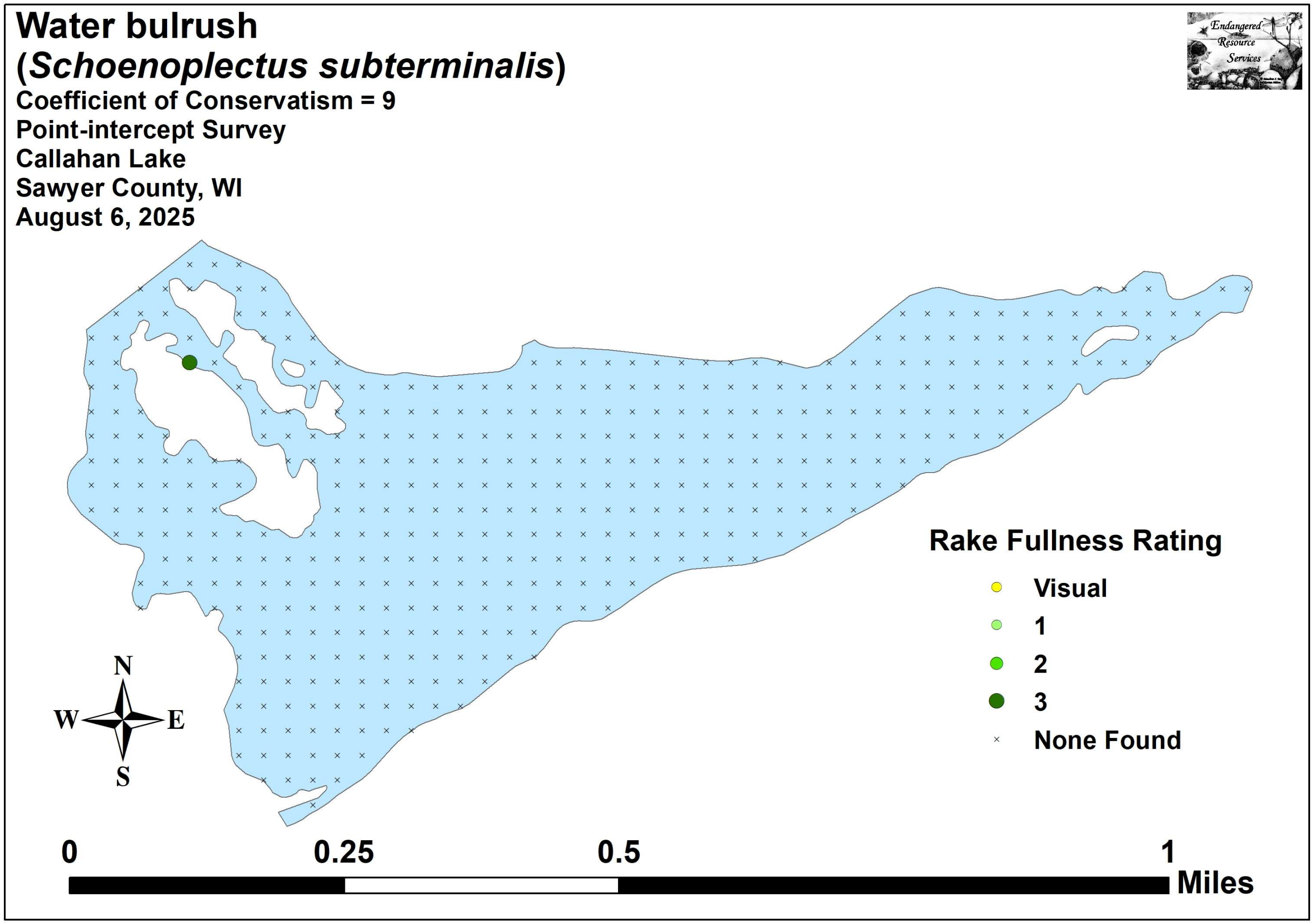
Water bulrush
(Schoenoplectus subterminalis)
Coefficient of Conservatism = 9
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Rake Fullness Rating
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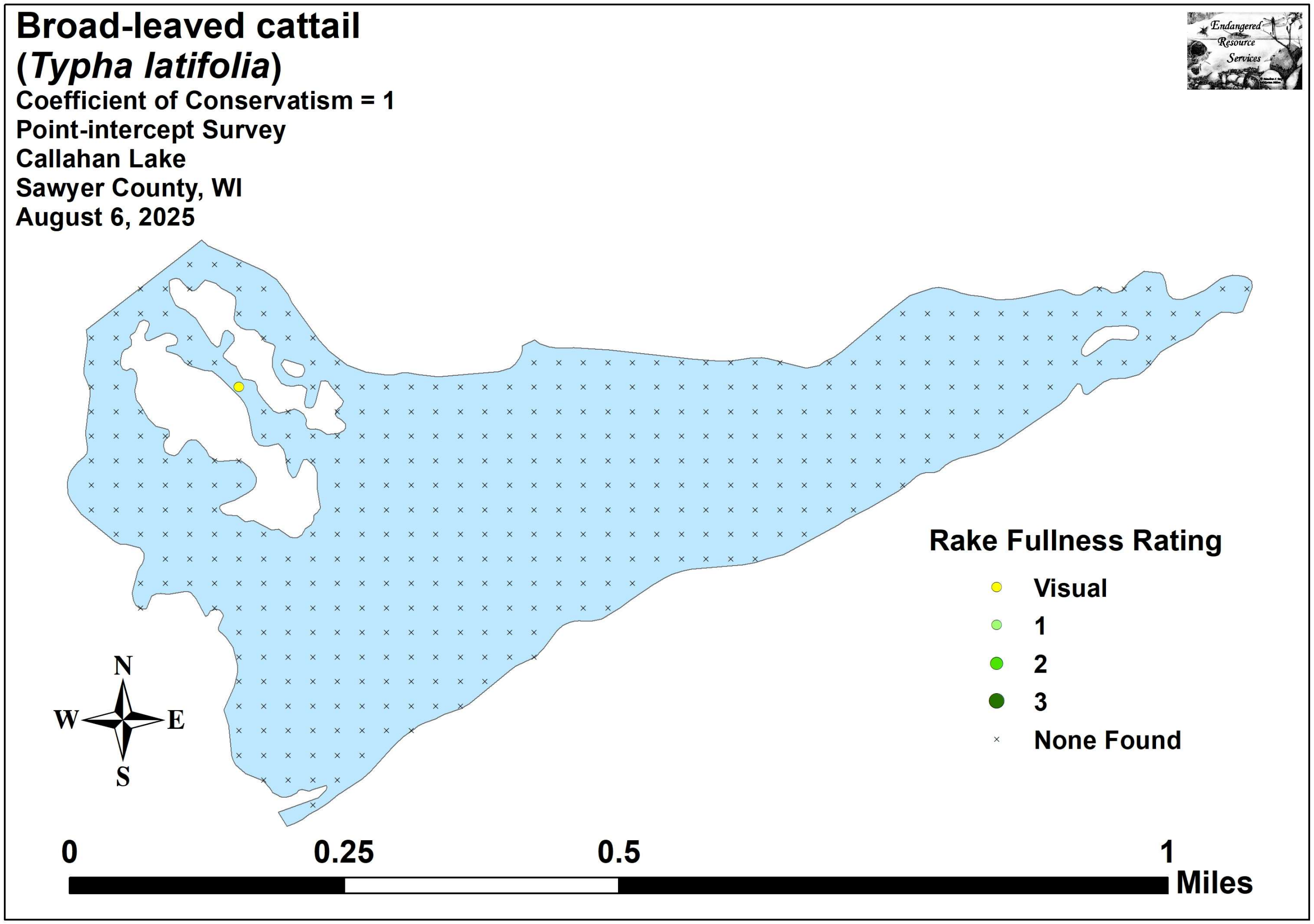
Endangered Resource Services


Broad-leaved cattail
(Typha latifolia)
Coefficient of Conservatism = 1
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Rake Fullness Rating
Visual
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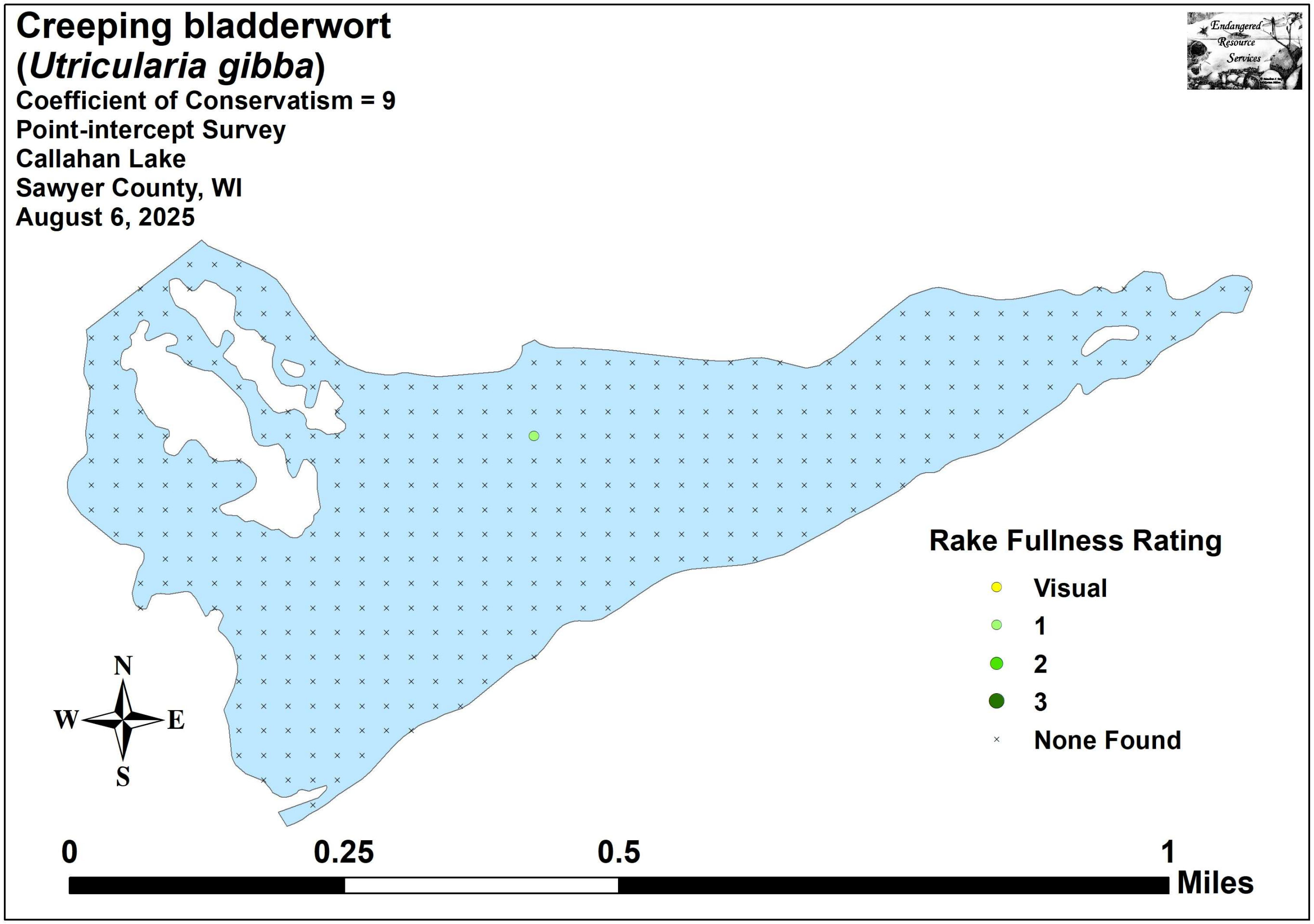
Creeping bladderwort
(*Utricularia gibba*)
Coefficient of Conservatism = 9
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
Visual
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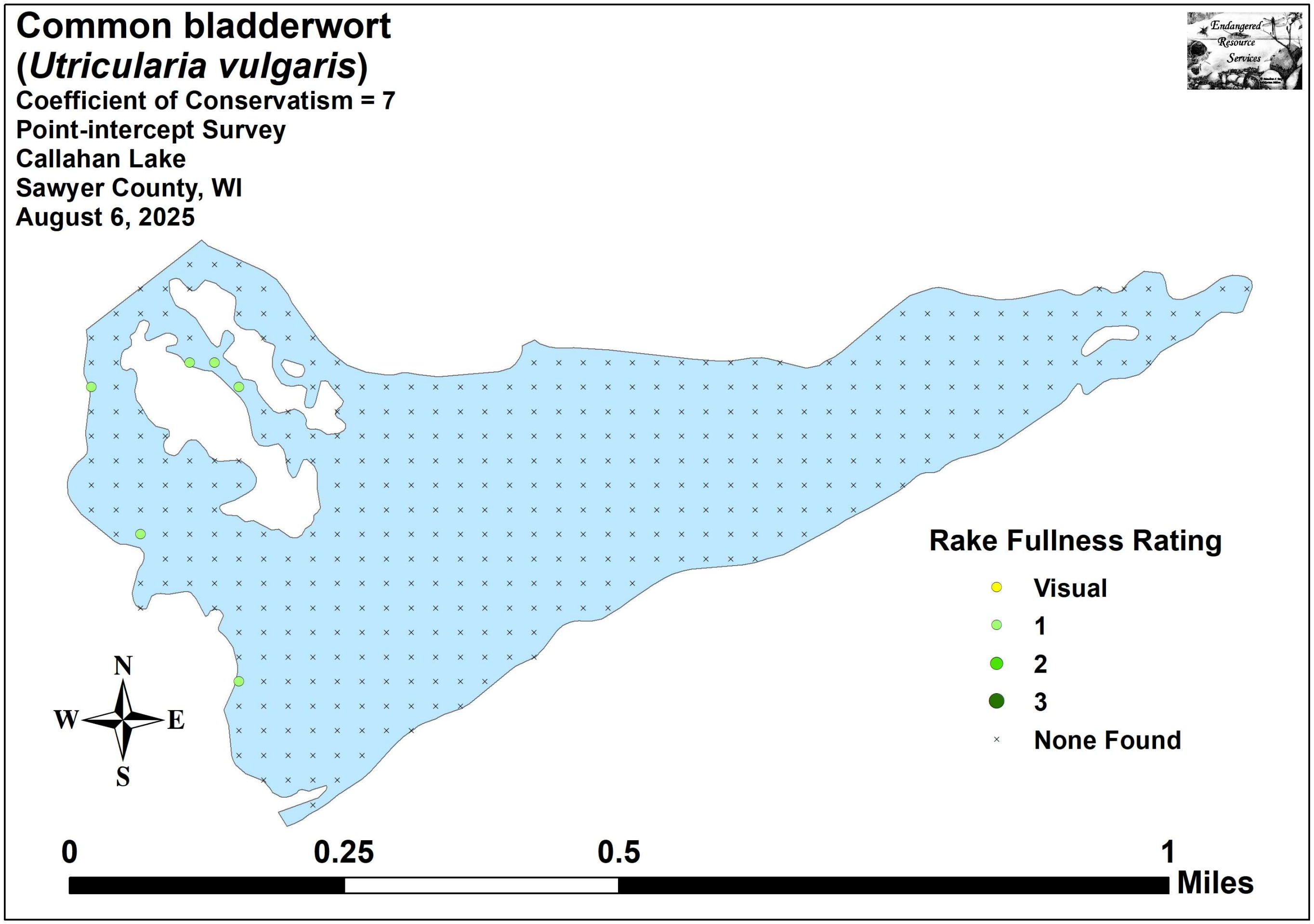
Common bladderwort
(*Utricularia vulgaris*)
Coefficient of Conservatism = 7
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
Visual
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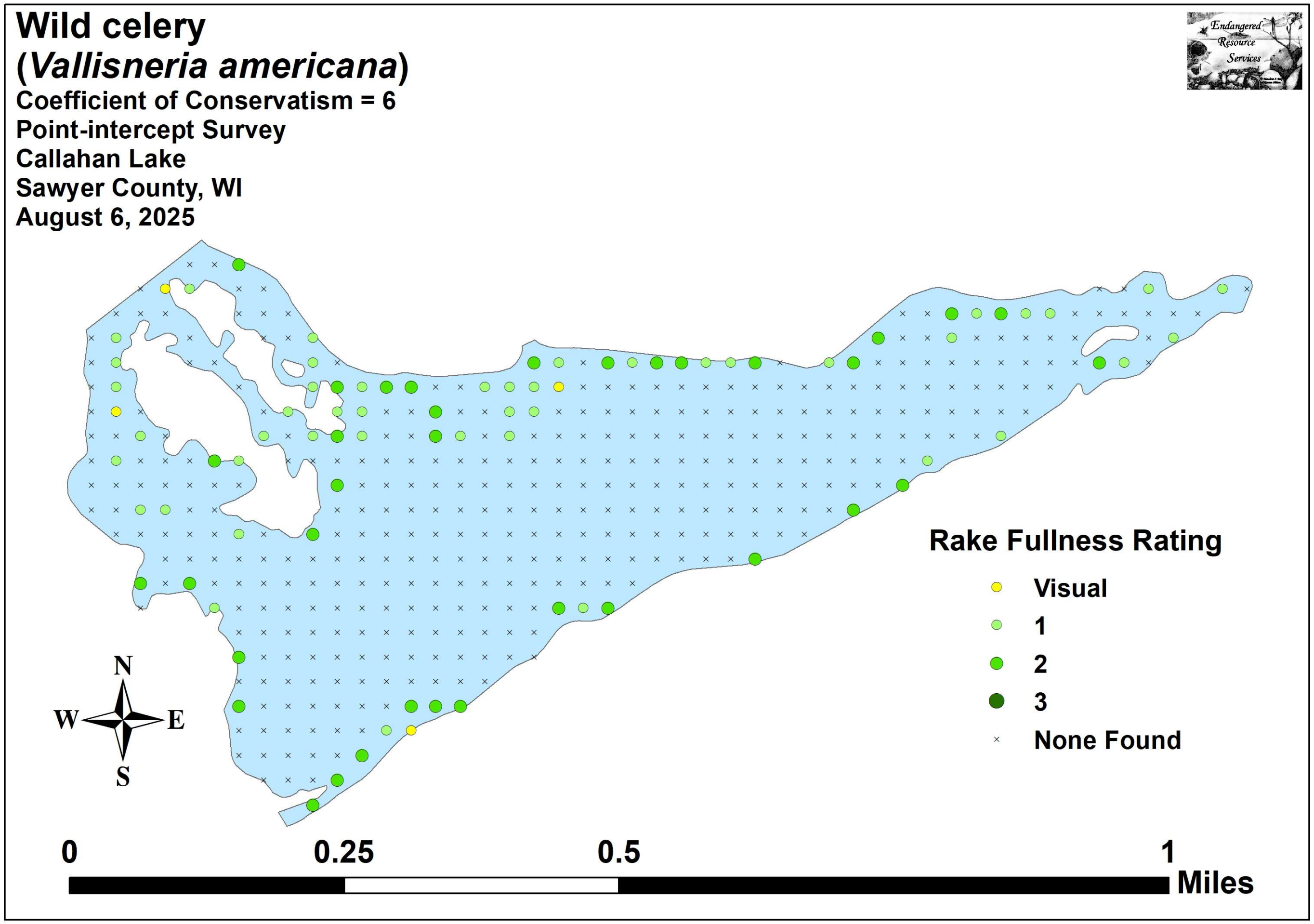

Wild celery
(*Vallisneria americana*)
Coefficient of Conservatism = 6
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
Visual
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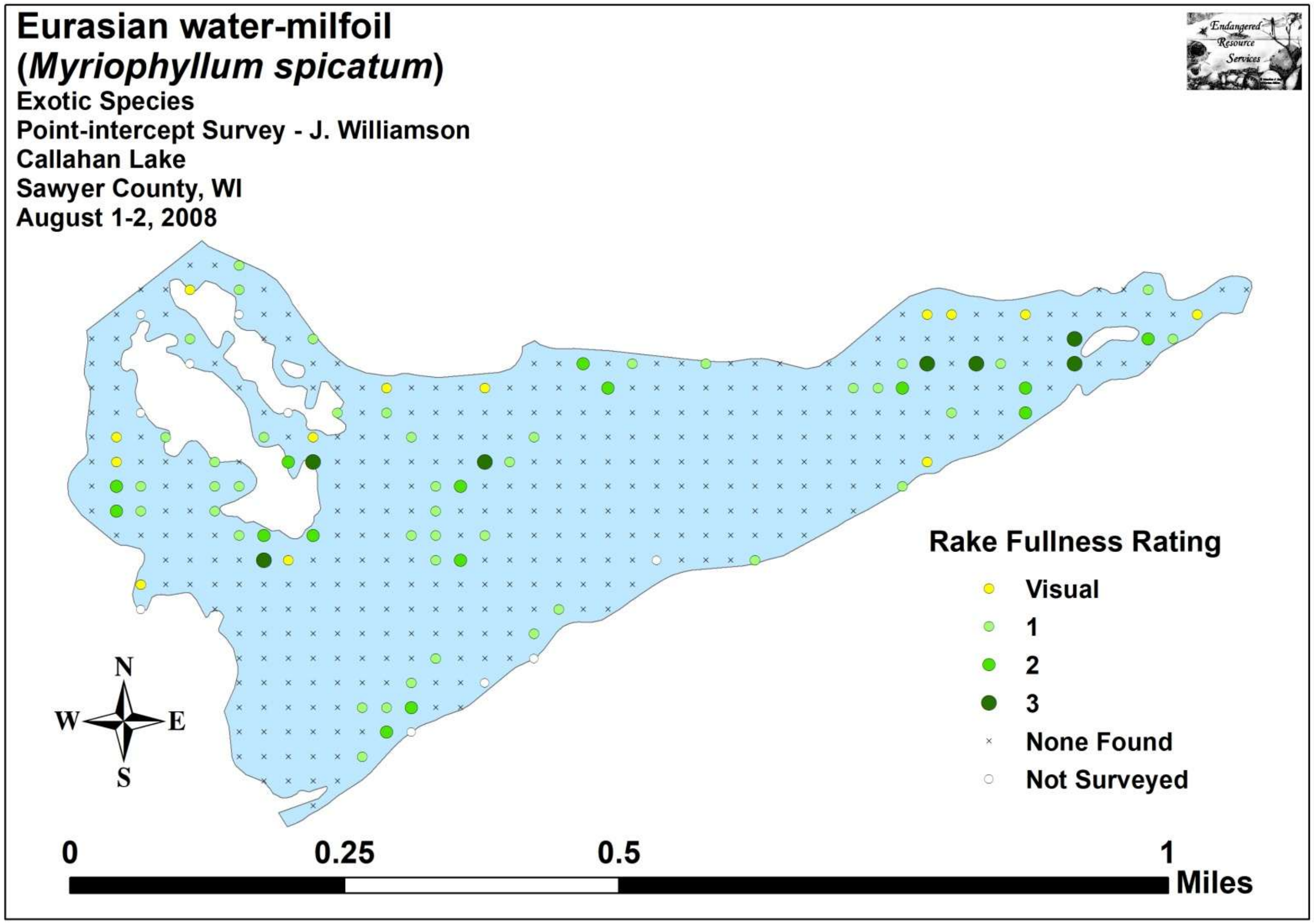
Appendix VII: August 208, 2020, and 2025 Eurasian Water-milfoil Density and Distribution Maps


Eurasian water-milfoil
(Myriophyllum spicatum)
Exotic Species
Point-intercept Survey - J. Williamson
Callahan Lake
Sawyer County, WI
August 1-2, 2008
Endangered Resource Services
Rake Fullness Rating
Visual
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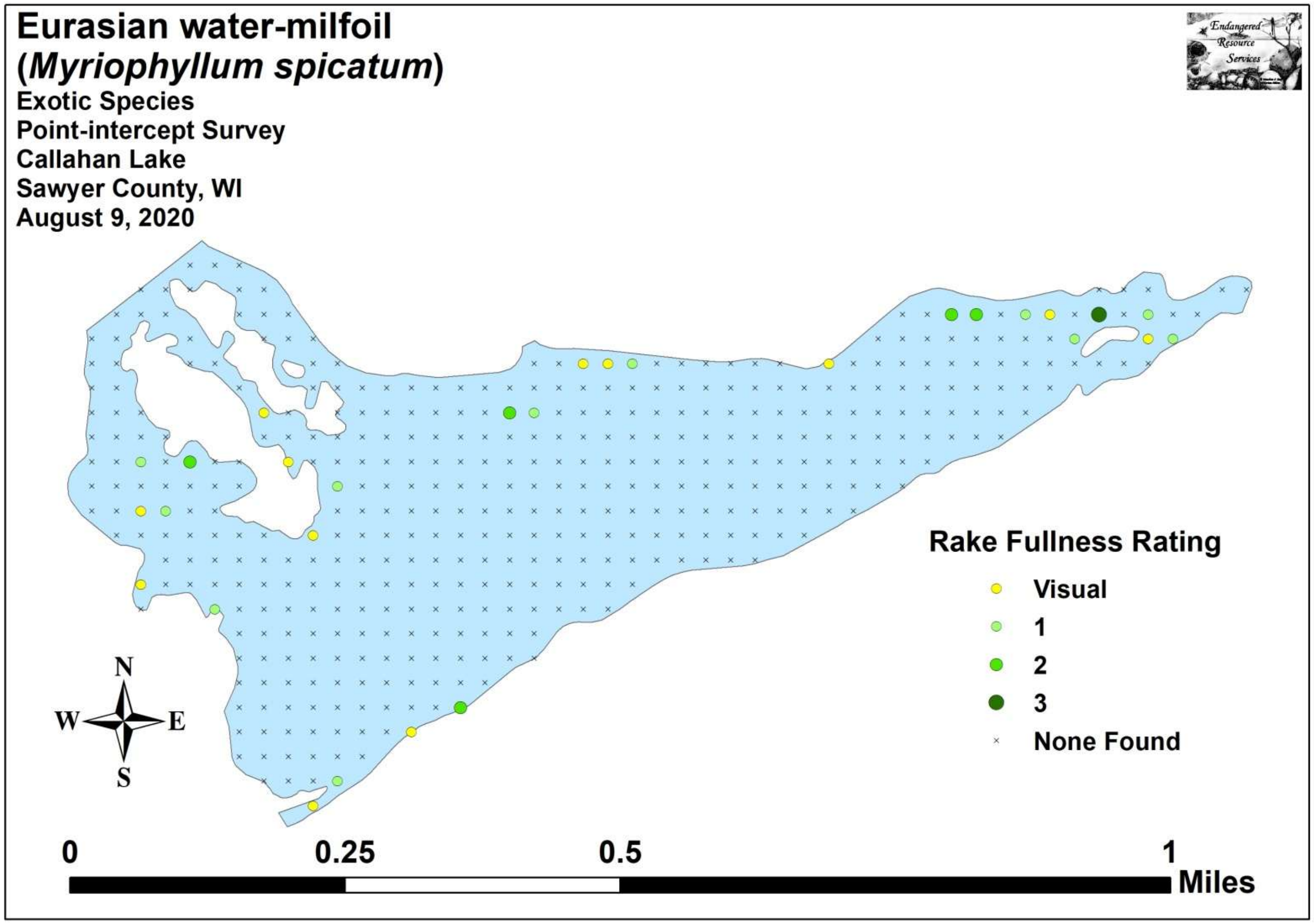
Eurasian water-milfoil
(*Myriophyllum spicatum*)
Exotic Species
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 9, 2020
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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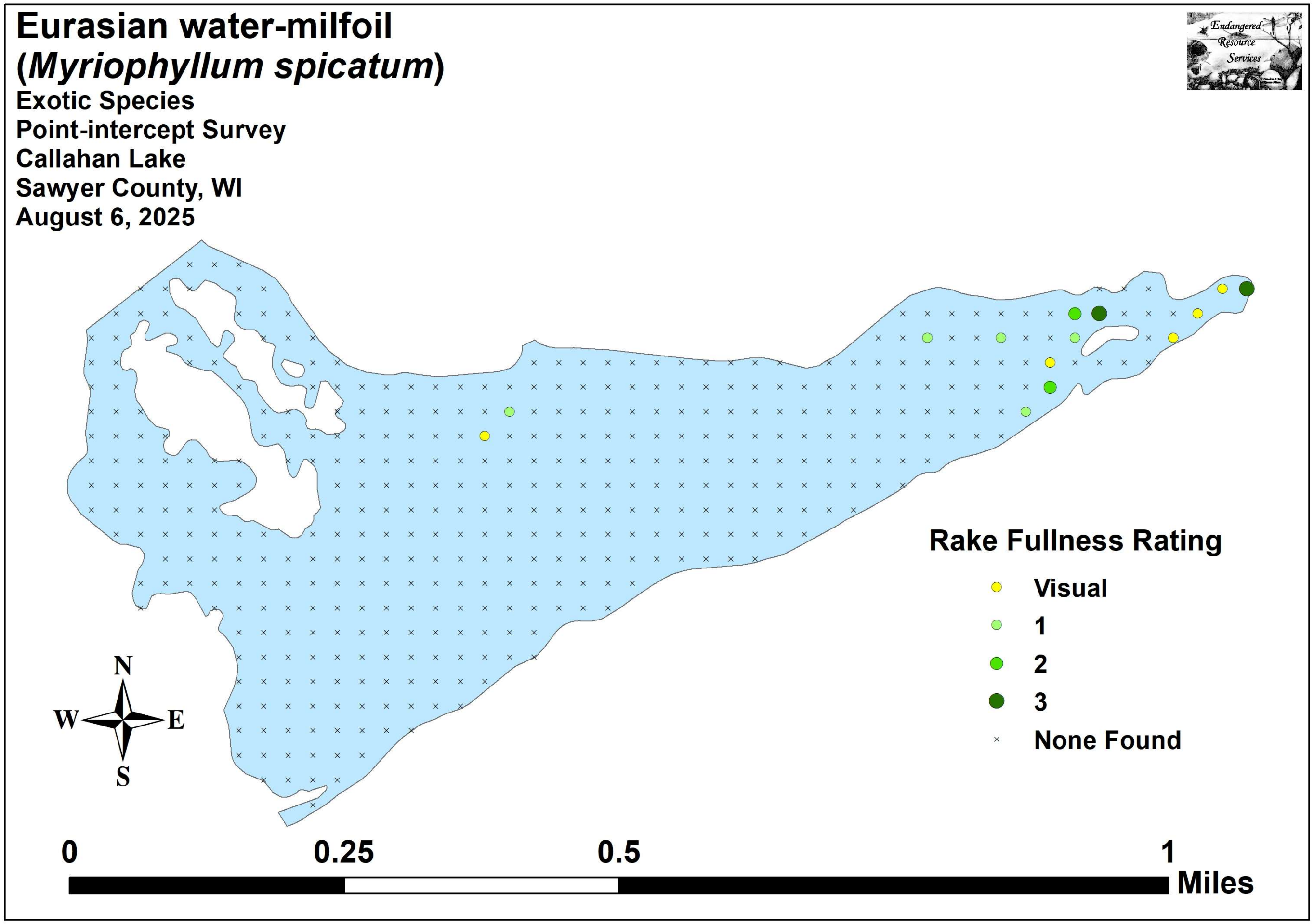
Miles


Eurasian water-milfoil
(*Myriophyllum spicatum*)
Exotic Species
Point-intercept Survey
Callahan Lake
Sawyer County, WI
August 6, 2025
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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Appendix VIII: 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 water-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 water-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 lakebed). 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, 2009 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, 2009 http://www.dnr.state.wi.us/invasives/fact/curlyleaf_pondweed.htm)

Reed canary grass

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

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

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

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

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

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

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

Purple loosestrife
(Photo Courtesy Brian M. Collins)

DESCRIPTION: Purple loosestrife is a perennial herb 3-7 feet tall with a dense bushy growth of 1-50 stems. The stems, which range from green to purple, die back each year. Showy flowers vary from purple to magenta, possess 5-6 petals aggregated into numerous long spikes, and bloom from 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 IX: Glossary of Biological Terms
(Adapted from UWEX 2010)

Aquatic:

organisms that live in or frequent water.

Cultural Eutrophication:

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

Dissolved Oxygen (DO):

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

Diversity:

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

Drainage lakes:

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

Ecosystem:

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

Eutrophication:

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

Exotic:

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

Habitat:

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

Limnology:

the study of inland lakes and waters.

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

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

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

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

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

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

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

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

Richness:

number of species in a particular community or habitat.

Rooted Aquatic Plants:

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

Runoff:

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

Secchi Disc:

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

Seepage lakes:

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

Turbidity:

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

Watershed:

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

Zooplankton:

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

Appendix X: 2020 and 2025 Raw Data Spreadsheets

CallahanLakeSawyerCoWIBIC243470PISurvey892020MBergERSLLC.xlsx

CallahanLakeSawyerCoWIBIC243470PISurvey862025MBergERSLLC.xlsx