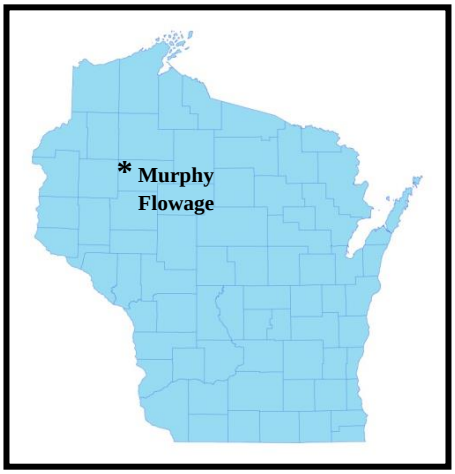
Cold-water Aquatic Invasive Species Shoreline Survey and Warm-water Point-intercept Macrophyte Survey
Murphy Flowage - WBIC: 2110900
Rusk County, Wisconsin

View from the Murphy Flowage landing – 6/5/23

Murphy Flowage aerial photo (2020)

Project Initiated by:

The Red Cedar Lakes Association, Lake Education and Planning Services, LLC, and the Wisconsin Department of Natural Resources (Grant ACEI 22419)



Typical dense canopied Fern pondweed on the Murphy Flowage - 7/31/23

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June 5 and July 31, 2023

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ABSTRACT

The Murphy Flowage (WBIC 2110900) is a 169-acre impoundment of Hemlock Creek in northwest Rusk County, WI. A desire to determine if exotic species such as Curly-leaf pondweed (*Potamogeton crispus*) (CLP) or Eurasian water-milfoil (*Myriophyllum spicatum*) (EWM) had invaded the flowage; and to establish baseline data on the richness, diversity, abundance, and distribution of other native aquatic plant populations prompted members of the Red Cedar Lakes Association (RCLA) and the Wisconsin Department of Natural Resources (WDNR) to authorize a meandering cold-water Aquatic Invasive Species (AIS) shoreline survey on June 5, 2023, and a warm-water point-intercept survey of all aquatic plants on July 31, 2023. The spring survey found no sign of EWM, but it did locate a few scattered CLP plants in both the Hemlock and Lawler Creek Inlets. In July, we found macrophytes growing at 410 of 438 survey points (one point was terrestrial). This extrapolated to 93.6% of the total lake bottom (all points were littoral) having at least some plant coverage. Overall diversity was very high with a Simpson Index value of 0.89. Richness was also relatively high for such a small waterbody with 40 species found in the rake. This total increased to 59 species when including visuals and plants found during the boat survey. Localized richness was also moderate high as we calculated a mean native species at sites with native vegetation of 3.50 species/site. We found the biomass at sites with vegetation was an exceptionally high mean total rake fullness of 2.77. Fern pondweed (*Potamogeton robbinsii*), Coontail (*Ceratophyllum demersum*), Large duckweed (*Spirodela polyrhiza*), and White water lily (*Nymphaea odorata*) were the most widely-distributed macrophyte species. They were present at 77.80%, 56.34%, 35.37%, and 33.17% of survey points with vegetation respectively; and, collectively, they accounted for 57.75% of the total relative frequency. The 39 native index species found in the rake during the point-intercept survey produced a mean Coefficient of Conservatism of 6.4 and a Floristic Quality Index of 39.9. When compared to other lakes in the Northern Lakes and Forest Ecoregion, the flowage was slightly below the average mean C of 6.7, but well above the median FQI of 24.3. Filamentous algae were present at 265 points with a mean rake fullness of 1.60. In general, the further upstream on the flowage, the higher the algal density. Other than CLP, Reed canary grass (*Phalaris arundinacea*) and Hybrid cattail (*Typha* X *glauca*) were the only non-native species we found. Future management considerations include preserving the flowage's excellent native plant communities; conducting monthly monitoring at the public boat landing and/or at least annual flowage-wide meandering shoreline surveys to look for AIS; developing an Aquatic Plant Management Plan that clarifies a response if a new AIS is introduced into the flowage; and considering adding a secondary sign at the landing to warn about AIS.

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INTRODUCTION:

The Murphy Flowage (WBIC 2110900) is a 169-acre impoundment of Hemlock Creek in northwest Rusk County, Wisconsin in the Town of Wilson (T36N R9W S27-29). It reaches a maximum depth of 14ft on the west side immediately behind the dam and has an average depth of approximately 4.5ft. A single summer Secchi reading of 7.0ft was taken in 2002 (WDNR 2023). This fair clarity produced a littoral zone that extended to 13.0ft in 2023. The bottom is dominated by gravel and sand along the immediate shoreline, sand and sandy muck in the downstream third of the flowage, and organic muck in the upstream areas and creek inlets (Dunham et al. 1965) (Figure 1).

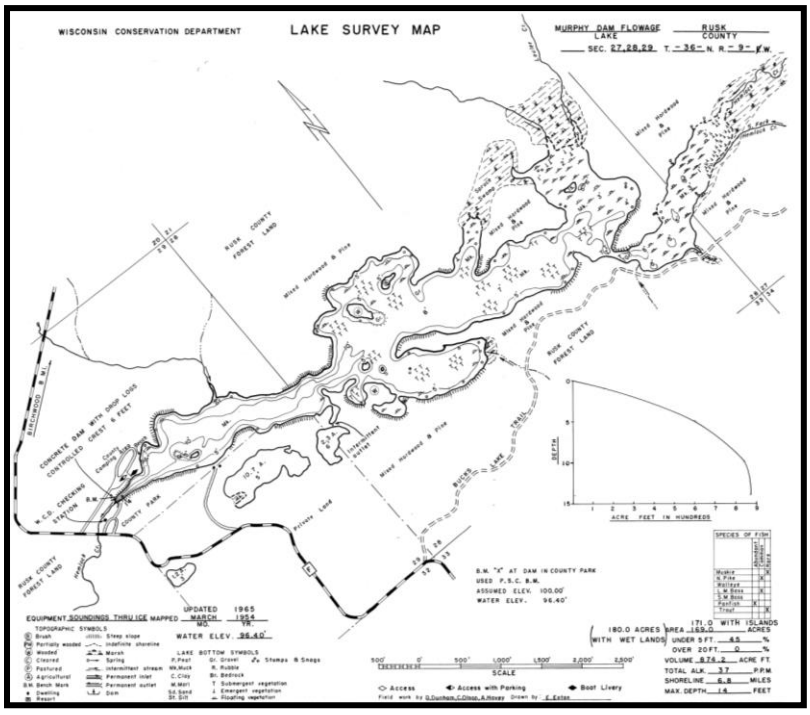


Figure 1: Murphy Flowage Bathymetric Map

BACKGROUND AND STUDY RATIONALE:

The Red Cedar Lakes Association (RCLA) and the Wisconsin Department of Natural Resources (WDNR) authorized a meandering cold-water Aquatic Invasive Species (AIS) shoreline survey on June 5, 2023, and a warm-water point-intercept survey of all aquatic plants on July 31, 2023. The July survey used the WDNR's statewide guidelines for conducting systematic point-intercept macrophyte sampling. These methods ensure that all sampling in the state will be conducted in the same manner thus allowing data to be compared across time and space. The immediate goals of the spring survey were to determine if any exotic species such as Curly-leaf pondweed (*Potamogeton crispus*) (CLP) or Eurasian water-milfoil (*Myriophyllum spicatum*) (EWM) had invaded the flowage, while the July survey was used to established data on the richness, diversity, abundance, distribution, and density of native aquatic plant populations. These data provide a baseline for long-term monitoring of the flowage's macrophyte community as well as a way to measure any impacts on the flowage's plants if an exotic species is introduced or active management occurs in the future.

METHODS:

Cold-water Meandering AIS Shoreline Survey:

During the June survey, we searched the visible littoral zone along the lake's entire shoreline. We paid special attention to the areas around the landings as this is where Eurasian water-milfoil brought in on props is most likely to establish. We also focused on the sand to sandy muck transition in the 8-10ft bathymetric ring as this is the habitat most likely to support Curly-leaf pondweed.

Warm-water Full Point-intercept Macrophyte Survey:

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

Using a standard formula that takes into account the shoreline shape and distance, water clarity, depth, and total acreage, Michelle Nault (WDNR) generated a 439-point sampling grid for the Murphy Flowage (Appendix II). Using this grid, we completed a density survey where we sampled for plants at each point. We located each survey point using a handheld mapping GPS unit (Garmin 76CSx) and used a rake to sample an approximately 2.5ft section of the bottom. All plants on the rake, as well as any that were dislodged by the rake, were identified and assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 2). We also recorded visual sightings of all plants within six feet of the sample point not found in the rake. In addition to a rake rating for each species, a total rake fullness rating was also noted. Substrate (bottom) type was assigned at each site where the bottom was visible or it could be reliably determined using the rake, and a depth reading was taken using a metered pole.

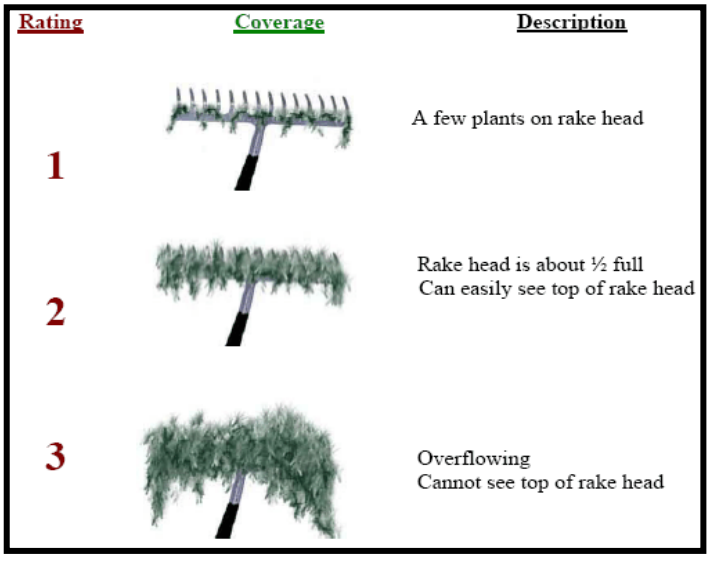


Figure 2: Rake Fullness Ratings (UWEX 2010)

DATA ANALYSIS:

We entered all data collected into the standard WDNR Aquatic Plant Management Spreadsheet (Appendix I) (UWEX 2010). From this, we calculated the following:

Total number of sites visited: This included the total number of points on the flowage 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 flowage has plant coverage.

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

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

Frequency of occurrence example:

Plant A is sampled at 70 out of 700 total littoral points = 70/700 = .10 = 10%

This means that Plant A's frequency of occurrence = 10% when considering the entire littoral zone.

Plant A is sampled at 70 out of 350 total points with vegetation = 70/350 = .20 = 20%

This means that Plant A's frequency of occurrence = 20% when only considering the sites in the littoral zone that have vegetation.

From these frequencies, we can estimate how common each species was at depths where plants were able to grow, and at points where plants actually were growing.

Note the second value will be greater as not all the points (in this example, only ½) had plants growing at them.

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

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

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

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

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

Species richness: This value indicates the number of different plant species found in and directly adjacent to (on the waterline) the flowage. Species richness alone only counts those plants found in the rake survey. The other two values include those seen at a sample point during the survey but not found in the rake, and those that were only seen during the initial boat survey or inter-point. **Note: Per WDNR protocol, filamentous algae, freshwater sponges, aquatic moss and the aquatic liverworts *Riccia fluitans* and *Ricciocarpus natans* are excluded from these totals.**

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

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

Relative frequency example:

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

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

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

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

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

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

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

RESULTS:

Cold-water Meandering AIS Shoreline Survey:

On June 5th, we surveyed transects covering 8.6km (5.3 miles) along the entire shoreline of the flowage that was navigable by boat (Figure 3). The only fully aquatic exotic species we found were a few individual Curly-leaf pondweed plants located in both the Hemlock and Lawler Creek Inlets.

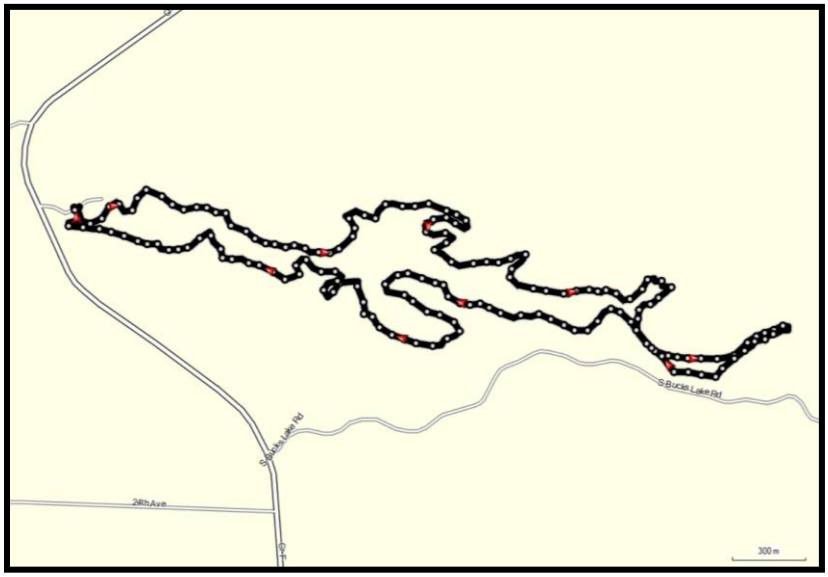


Figure 3: June 5, 2023 AIS Shoreline Survey Transects

Warm-water Full Point-intercept Macrophyte Survey:

Depth readings taken at the Murphy Flowage's 438 survey points – one point was terrestrial – (Appendix II) revealed a gradual increase in depth moving upstream to downstream. Nearest the dam, most shoreline areas dropped off sharply into 5ft+ before sloping more gradually into the 10ft+ channel. Upstream shorelines also tended to drop off quickly, but they bottomed out at between 4 and 8ft creating relatively uniform broad flats with the exception of the creek channel which meandered through them (Figure 4) (Appendix III).

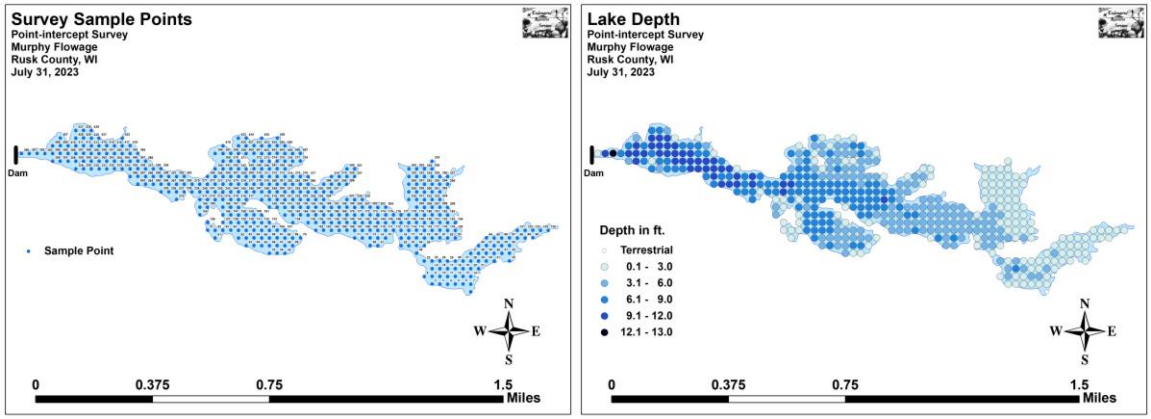


Figure 4: Survey Sample Points and Lake Depth

We categorized the bottom substrate as 83.1% organic and sandy muck (364 points), 14.2% pure sand (62 points), and 2.7% rock (12 points) (Figure 5) (Appendix III). The majority of areas along the immediate shoreline were pure sand or a mix of sand and gravel. With increasing depth, most areas tended to have a very thin layer of soft sandy muck over a pure sand base; however, we didn't classify these points as muck unless it was obviously more than a few inches thick. Upstream areas, especially in the bays with creek inlets, tended to have thicker, more nutrient-rich organic muck.

We found plants growing at 410 points (Table 1). As the entire flowage fell into the 13.0ft littoral zone, this extrapolated to 93.6% of the total lake bottom having plants present (Figure 5) (Appendix IV). Overall plant colonization was slightly skewed to shallow water as the mean depth of 4.6ft was less than the median depth of 5.0ft (Figure 6).

Table 1: Aquatic Macrophyte P/I Survey Summary Statistics
Murphy Flowage – Rusk County, Wisconsin
July 31, 2023

Summary Statistics:

Total number of points sampled	438
Total number of sites with vegetation	410
Total number of sites shallower than the maximum depth of plants	438
Frequency of occurrence at sites shallower than maximum depth of plants	93.6
Simpson Diversity Index	0.89
Number of sites sampled using rake on Rope (R)	0
Number of sites sampled using rake on Pole (P)	438
Maximum depth of plants (ft)	13.0
Mean depth of plants (ft)	4.6
Median depth of plants (ft)	5.0
Average number of all species per site (shallower than max depth)	3.29
Average number of all species per site (veg. sites only)	3.51
Average number of native species per site (shallower than max depth)	3.28
Average number of native species per site (sites with native veg. only)	3.50
Species richness	40
Species richness (including visuals)	46
Species richness (including visuals and boat survey)	59
Mean total rake fullness (veg. sites only)	2.77

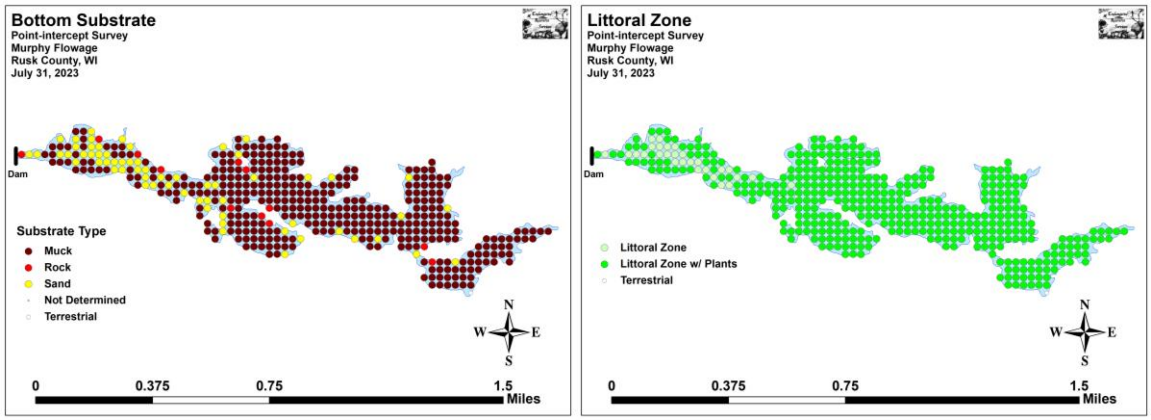


Figure 5: Bottom Substrate and Littoral Zone

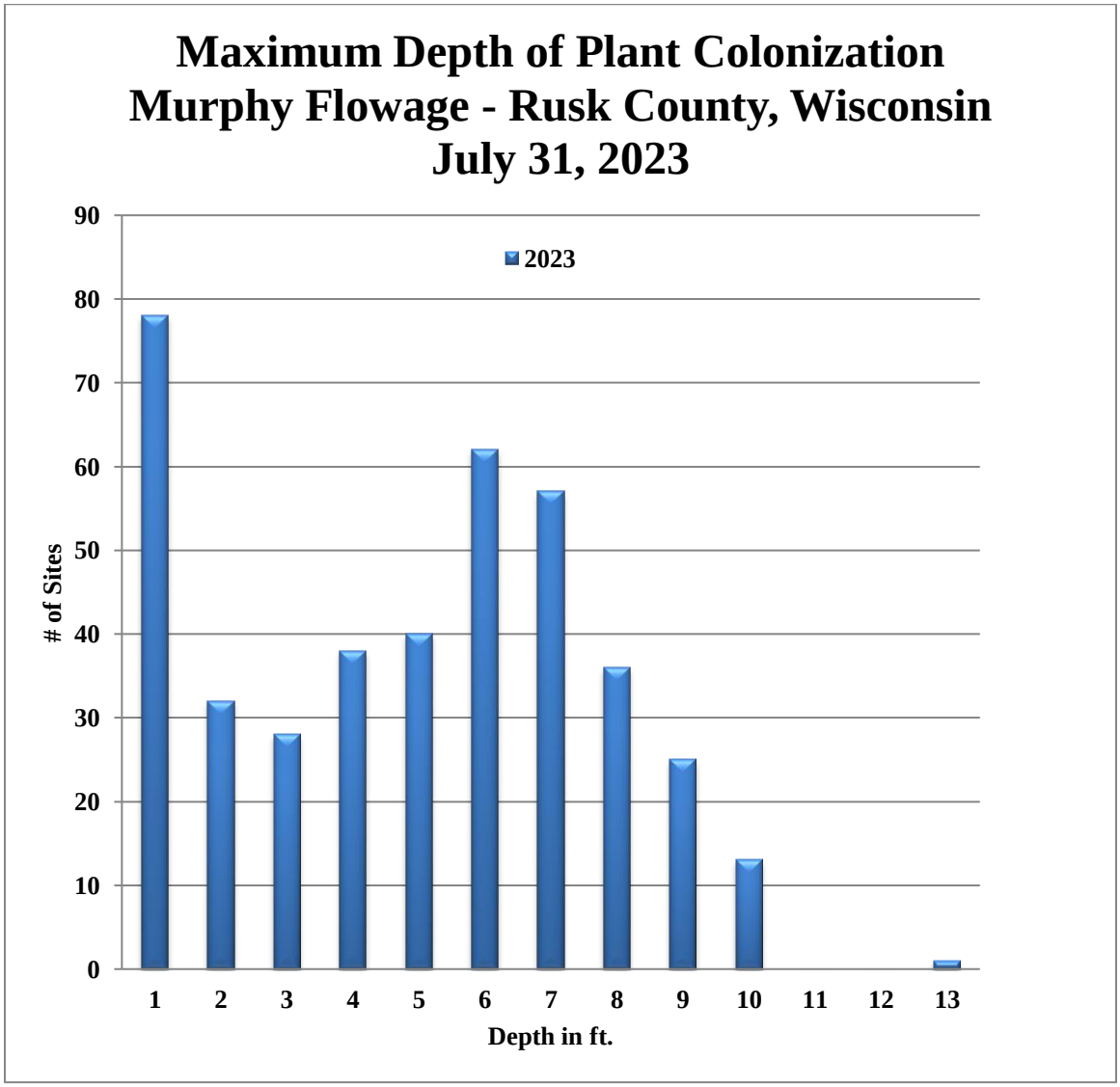


Figure 6: Plant Colonization Depth Chart

Plant diversity was very high with a Simpson Index value of 0.89. Richness was also relatively high for such a small waterbody with 40 species found in the rake. This total increased to 59 species when including visuals and plants seen during the boat survey.

Localized richness was moderately high as we calculated a mean native species at sites with native vegetation of 3.50 species/site. We noted that almost all points in the shallow muck flats in the Lawler and Hemlock Creek Inlet bays, as well as the boggy areas at the far ends of the south-central bay, had at least five species present in the rake. Conversely, we found that few samples taken in over 6ft had more than two species in the rake (Figure 7) (Appendix IV).

We determined the biomass at sites with vegetation was an exceptionally high mean total rake fullness of 2.77. Visual analysis of the map showed that almost all areas shallower than 9ft were dominated by dense vegetation, and plant beds were canopied in most areas that were shallower than 6ft (Figure 7) (Appendix IV).

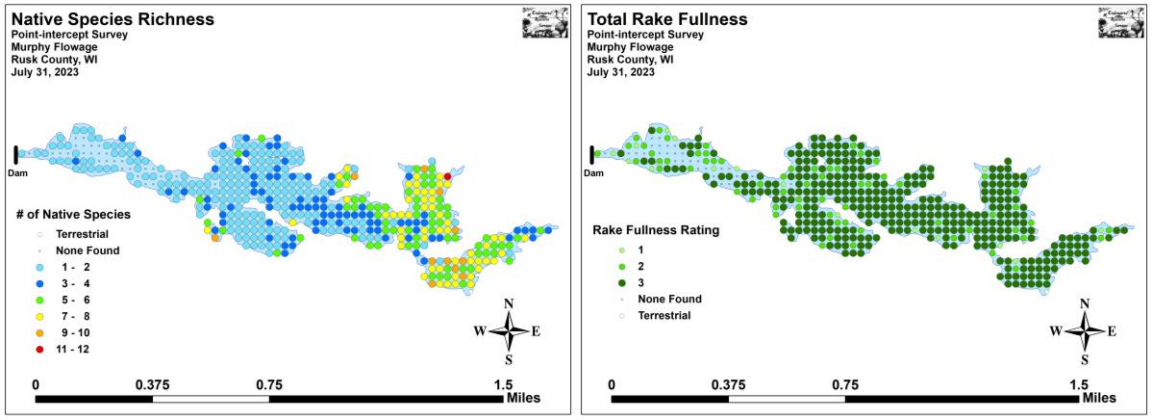


Figure 7: Native Species Richness and Total Rake Fullness

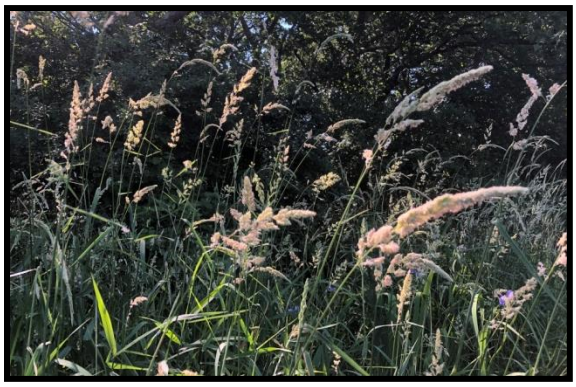
Murphy Flowage Plant Community:

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

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

At the immediate shoreline, Bluejoint (*Calamagrostis canadensis*) was common around forested edges of the lake. In this environment and extending into adjoining wetlands, we also found scattered patches of the similar looking exotic species Reed canary grass (*Phalaris arundinacea*). These partially shaded areas also supported clusters of Bottle brush sedge (*Carex comosa*) and Fringed sedge (*Carex crinita*).

Bluejoint (Routledge 2013)



Reed canary grass (Berg 2019)

Bottle brush sedge (Penta 2010)

Fringed sedge (Patterson 2022)

Along rocky and sandy shorelines and over shallow gravel flats, the emergent community was dominated by American bur-reed (*Sparganium americanum*) with scattered patches of Sessile fruited-arrowhead (*Sagittaria rigida*) mixed in.

American bur-reed (Hubick 2018)

Sessile-fruited arrowhead (Chayka 2013)

As the substrate transitioned to sandy and organic muck, these species were joined by Three-way sedge (*Dulichium arundinaceum*), Bald spikerush (*Eleocharis erythropoda*), Common arrowhead (*Sagittaria latifolia*), Softstem bulrush (*Schoenoplectus tabernaemontani*), Woolgrass (*Scirpus cyperinus*), and Broad-leaved cattail (*Typha latifolia*).

Three-way sedge (GMNRI 2016)

Bald spikerush (Schipper 2019)

Common arrowhead (Young 2010)

Softstem bulrush (Schwarz 2011)

Woolgrass (Colby 2012)

Broad-leaved cattail (Raymond 2011)

Growing over thick organic muck in the Lawler and Hemlock Creek Inlets, we found a few patches of Sweet-flag (*Bolboschoenus fluviatile*) and Hybrid cattail (*Typha* X *glauca*).

Sweet-flag (Hough 2014)

Hybrid cattail (Berg 2020)

On floating muck bogs in these areas, we also documented Wild calla (*Calla palustris*), Marsh cinquefoil (*Comarum palustre*), Blunt spikerush (*Eleocharis obtusa*), and Marsh purslane (*Ludwigia palustris*).

Wild calla (Pierce 2001)

Marsh cinquefoil (Myrhatt 2012)

Blunt spikerush (Cameron 2012)

Marsh purslane (Haines 2023)

On the boggy margins and floating bogs of the south-central bays, we documented a diverse sedge community. Common species included Gray bog sedge (*Carex canadensis*), Bog panicled sedge (*Carex diandra*), Lake sedge (*Carex lacustris*), Narrow-leaved wooly sedge (*Carex lasiocarpa*), Broad-leaved wooly sedge (*Carex pellita*), False bottle brush sedge (*Carex pseudocyperus*), and Common tussock sedge (*Carex stricta*).

Gray bog sedge (Berkley 2020)

Bog panicled sedge (Licher 2013)

Lake sedge (Dziuk 2016)

Narrow-leaved wooly sedge (Navratil 2016)

Broad-leaved woolly sedge (Hilty 2016)

False bottle brush sedge (Husveth 2016)

Common tussock sedge (Dziuk 2015)

Along sandy and rocky shorelines, the sediment seldom provided enough nutrients to support floating-leaf species. In this environment in the south-central bays, we found a very limited number of Spiral-fruited pondweed (*Potamogeton spirillus*) and Vasey's pondweed (*Potamogeton vaseyi*) which occasionally produced small floating-leaves if they were growing over substrate with at least a thin layer of muck.

Spiral-fruited pondweed (Cameron 2019)

Vasey's pondweed (Cameron 2016)

In flowing waters in the Lawler and Hemlock Creek Inlets, Common water starwort (*Callitriche palustris*), Alpine pondweed (*Potamogeton alpinus*), Ribbon-leaf pondweed (*Potamogeton epihydrus*), and Short-stemmed bur-reed (*Sparganium emersum*) also occasionally produced floating leaves.

Common water-starwort (Cameron 2014)

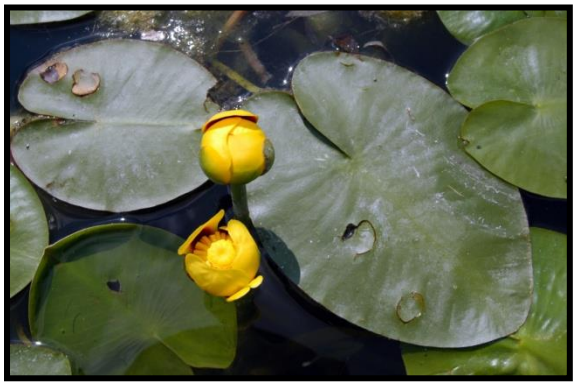
Alpine pondweed (Holm 2016)

Ribbon-leaf pondweed (Petroglyph 2007)

Short-stemmed bur-reed (Cameron 2016)

In calm areas in up to 4ft of water, the floating-leaf community was dominated by Watershield (*Brasenia schreberi*), Spatterdock (*Nuphar variegata*), White water lily (*Nymphaea odorata*), and Water smartweed (*Polygonum amphibium*). Scattered among these dominant species, we also found small beds of Large-leaf pondweed (*Potamogeton amplifolius*) and Floating-leaf pondweed (*Potamogeton natans*). 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)

Large-leaf pondweed (Dziuk 2018)

Floating-leaf pondweed (Petroglyph 2007)

Growing among these floating-leaf and emergent species, especially in the upstream areas near the creek inlets, we also found floating "duckweeds". They included Small duckweed (*Lemna minor*), Slender riccia (*Riccia fluitans*), Large duckweed (*Spirodela polyrhiza*), and Common watermeal (*Wolffia columbiana*).

Small duckweed (Kramer 2013)

Slender riccia (Barth 2018)

Large duckweed (Thomas 2016)

Small duckweed and Common watermeal (Kieron 2010)

Especially in boggy areas, this environment also supported a variety of carnivorous plants including Creeping bladderwort (*Utricularia gibba*), Flat-leaf bladderwort (*Utricularia intermedia*), and Common bladderwort (*Utricularia vulgaris*). Rather than drawing nutrients up through roots like other plants, bladderworts trap zooplankton and minute insects in their bladders, digest their prey, and use the nutrients to further their growth.

Creeping bladderwort (Eyewed 2010)

Flat-leaf bladderwort (Woods 2012)

Common bladderwort flowers among lilypads (Hunt 2010)

Bladders for catching plankton and insect larvae (Wontolla 2007)

In the shallow flowing water in the creek inlets, we found a very few scattered patches of Muskgrass (*Chara* sp.) and Nitella (*Nitella* sp. likely *flexilis*). These "Charophytes" are a type of colonial algae that look like higher plants.

Muskgrass (Fischer 2018)

Nitella (Schou 2003)

The soft silt and organic muck in the creek inlets also supported expansive submergent beds of Water marigold (*Bidens beckii*), while species like Curly-leaf pondweed, Leafy pondweed (*Potamogeton foliosus*), and Blunt-leaf pondweed (*Potamogeton obtusifolius*) were much rarer.

Water marigold (Dziuk 2012)

Curly-leaf pondweed (USGS 2019)

Leafy pondweed (Skowinski 2009)

Blunt-leaf pondweed (Djuik 2013)

In shallow areas with more nutrient-poor sandy muck, we also found limited numbers of generally narrow-leaved species like Water star-grass (*Heteranthera dubia*), Northern water-milfoil (*Myriophyllum sibiricum*), Slender naiad (*Najas flexilis*), and White water crowfoot (*Ranunculus aquatilis*). 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 star-grass (Muller 2010)

Northern water-milfoil (Berg 2007)

Slender naiad (Apipp 2009)

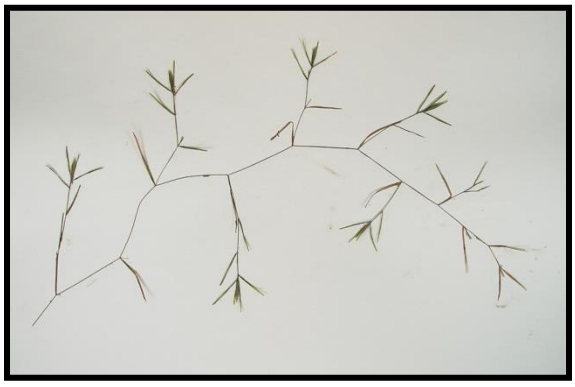
White water crowfoot (Wasser 2014)

Almost all areas on the flowage over 4ft were dominated by Fern pondweed (*Potamogeton robbinsii*) with lesser amounts of Coontail (*Ceratophyllum demersum*), Common waterweed (*Elodea canadensis*), Large-leaf pondweed, Small pondweed (*Potamogeton pusillus*), Clasping-leaf pondweed (*Potamogeton richardsonii*), and Flat-stem pondweed (*Potamogeton zosteriformis*). Predatory fish like the lake's Northern pike (*Esox lucius*) are often found along the edges of these rich beds waiting in ambush.

Fern pondweed (Apipp 2011)

Coontail (Hassler 2011)

Common waterweed (Pinkka 2013)



Small pondweed (Cameron 2013)

Clasping-leaf pondweed (Cameron 2014)

Flat-stem pondweed (Dziuk 2019)

Plant Community Dominance:

When considering the flowage as a whole, Fern pondweed, Coontail, Large duckweed, and White water lily were the most widely-distributed macrophyte species (Figure 8). They were present at 77.80%, 56.34%, 35.37%, and 33.17% of survey points with vegetation respectively; and, collectively, they accounted for 57.75% of the total relative frequency (Table 2). Small duckweed (8.41%), Common watermeal (7.85%), and Common waterweed (4.49%) were the only other species with relative frequencies over 4.00% (Native species maps and species accounts for all plants are located in Appendixes V and VI).

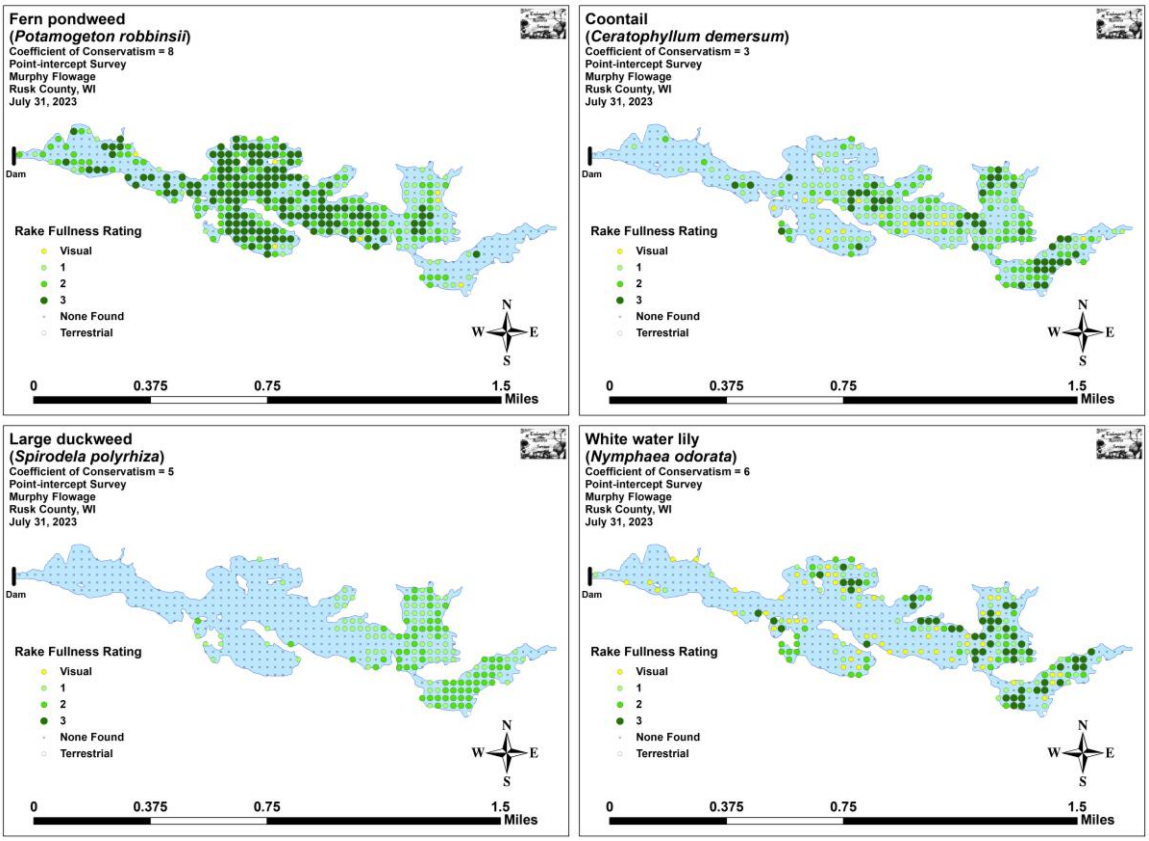


Figure 8: Murphy Flowage's Most Common Species

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Murphy Flowage –Rusk County, Wisconsin
July 31, 2023

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Potamogeton robbinsii	Fern pondweed	319	22.17	77.80	72.83	2.31	7
	Filamentous algae	265	*	64.63	60.50	1.60	0
Ceratophyllum demersum	Coontail	231	16.05	56.34	52.74	1.73	16
Spirodela polyrhiza	Large duckweed	145	10.08	35.37	33.11	1.46	0
Nymphaea odorata	White water lily	136	9.45	33.17	31.05	2.07	53
Lemna minor	Small duckweed	121	8.41	29.51	27.63	1.19	0
Wolffia columbiana	Common watermeal	113	7.85	27.56	25.80	1.02	0
Elodea canadensis	Common waterweed	88	6.12	21.46	20.09	1.43	2
Nuphar variegata	Spatterdock	45	3.13	10.98	10.27	2.22	5
Potamogeton pusillus	Small pondweed	37	2.57	9.02	8.45	1.32	3
Potamogeton natans	Floating-leaf pondweed	34	2.36	8.29	7.76	1.12	11
Bidens beckii	Water marigold	17	1.18	4.15	3.88	1.65	7
Sparganium americanum	American bur-reed	17	1.18	4.15	3.88	2.18	14
Utricularia vulgaris	Common bladderwort	17	1.18	4.15	3.88	1.12	5
Potamogeton zosteriformis	Flat-stem pondweed	16	1.11	3.90	3.65	1.13	5
Potamogeton amplifolius	Large-leaf pondweed	13	0.90	3.17	2.97	1.46	5
Brasenia schreberi	Watershield	10	0.69	2.44	2.28	1.30	7
Polygonum amphibium	Water smartweed	9	0.63	2.20	2.05	1.56	9
Potamogeton richardsonii	Clasping-leaf pondweed	9	0.63	2.20	2.05	1.56	3
Heteranthera dubia	Water star-grass	8	0.56	1.95	1.83	1.25	4
Ranunculus aquatilis	White water crowfoot	7	0.49	1.71	1.60	1.29	1
Utricularia gibba	Creeping bladderwort	7	0.49	1.71	1.60	1.29	0
Ludwigia palustris	Marsh purslane	4	0.28	0.98	0.91	1.25	2
Myriophyllum sibiricum	Northern water-milfoil	4	0.28	0.98	0.91	1.00	2

*Excluded from relative frequency analysis

Table 2 (continued): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Murphy Flowage –Rusk County, Wisconsin
July 31, 2023

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Phalaris arundinacea	**Reed canary grass**	**4**	**0.28**	**0.98**	**0.91**	**1.75**	**3**
Potamogeton epihydrus	Ribbon-leaf pondweed	4	0.28	0.98	0.91	1.50	4
Potamogeton foliosus	Leafy pondweed	4	0.28	0.98	0.91	1.25	2
Callitriche palustris	Common water-starwort	2	0.14	0.49	0.46	1.50	1
Eleocharis erythropoda	Bald spikerush	2	0.14	0.49	0.46	2.00	1
Najas flexilis	Slender naiad	2	0.14	0.49	0.46	1.00	0
Potamogeton vaseyi	Vasey's pondweed	2	0.14	0.49	0.46	1.00	0
Typha latifolia	Broad-leaved cattail	2	0.14	0.49	0.46	2.00	3
Utricularia intermedia	Flat-leaf bladderwort	2	0.14	0.49	0.46	1.00	0
Calla palustris	Wild calla	1	0.07	0.24	0.23	2.00	0
Chara sp.	Muskgrass	1	0.07	0.24	0.23	3.00	0
Dulichium arundinaceum	Three-way sedge	1	0.07	0.24	0.23	2.00	1
Eleocharis obtusa	Blunt spikerush	1	0.07	0.24	0.23	2.00	1
Potamogeton alpinus	Alpine pondweed	1	0.07	0.24	0.23	2.00	2
Riccia fluitans	Slender riccia	1	*	0.24	0.23	1.00	0
Sagittaria rigida	Sessile-fruited arrowhead	1	0.07	0.24	0.23	1.00	1
Schoenoplectus tabernaemontani	Softstem bulrush	1	0.07	0.24	0.23	3.00	1
Sparganium emersum	Short-stemmed bur-reed	1	0.07	0.24	0.23	1.00	1
Carex comosa	Bottle brush sedge	**	**	**	**	**	5
Comarum palustre	Marsh cinquefoil	**	**	**	**	**	1
Potamogeton crispus	**Curly-leaf pondweed**	****	****	****	****	****	**1**
Potamogeton spirillus	Spiral-fruited pondweed	**	**	**	**	**	1
Sagittaria latifolia	Common arrowhead	**	**	**	**	**	1
Scirpus cyperinus	Woolgrass	**	**	**	**	**	3

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

Table 2 (continued): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Murphy Flowage –Rusk County, Wisconsin
July 31, 2023

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Acorus americanus	Sweet-flag	***	***	***	***	***	***
Calamagrostis canadensis	Bluejoint	***	***	***	***	***	***
Carex canescens	Gray bog sedge	***	***	***	***	***	***
Carex crinita	Fringed sedge	***	***	***	***	***	***
Carex diandra	Bog panicled sedge	***	***	***	***	***	***
Carex lacustris	Lake sedge	***	***	***	***	***	***
Carex lasiocarpa	Narrow-leaved wooly sedge	***	***	***	***	***	***
Carex pellita	Broad-leaved wooly sedge	***	***	***	***	***	***
Carex pseudocyperus	False bottle brush sedge	***	***	***	***	***	***
Carex stricta	Common tussock sedge	***	***	***	***	***	***
Nitella sp. likely *flexilis*	Nitella	***	***	***	***	***	***
Potamogeton obtusifolius	Blunt-leaf pondweed	***	***	***	***	***	***
Typha X glauca	**Hybrid cattail**	*******	*******	*******	*******	*******	*******

*** Boat survey only **Exotic species in bold**

Floristic Quality Index:

We identified a total of 39 **native index plants** in the rake during the point-intercept survey. They produced a mean Coefficient of Conservatism of 6.4 and a Floristic Quality Index of 39.9 (Table 3). Nichols (1999) reported an average mean C for the Northern Lakes and Forest Region of 6.7 putting the Murphy Flowage slightly below average for this part of the state. The FQI was, however, well above the region's median FQI of 24.3 (Nichols 1999). Six highly sensitive index plants of note included Wild calla (C = 9), Three-way sedge (C = 9), Alpine pondweed (C = 9), Vasey's pondweed*** (C = 9), Creeping bladderwort (C = 9), and Flat-leaf bladderwort (C = 9). Two other high-value species found during the boat survey included Narrow-leaved wooly sedge (C = 9) and Blunt-leaf pondweed (C = 9).

*** Vasey's pondweed is a **Wisconsin State Species of Special Concern** - a 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 3: Floristic Quality Index of Aquatic Macrophytes Murphy Flowage – Rusk County, Wisconsin July 31, 2023

Species	Common Name	C
Bidens beckii	Water marigold	8
Brasenia schreberi	Watershield	6
Calla palustris	**Wild calla**	**9**
Callitriche palustris	Common water-starwort	8
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Dulichium arundinaceum	**Three-way sedge**	**9**
Eleocharis erythropoda	Bald spikerush	3
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Lemna minor	Small duckweed	4
Ludwigia palustris	Marsh purslane	4
Myriophyllum sibiricum	Northern water-milfoil	6
Najas flexilis	Slender naiad	6
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Polygonum amphibium	Water smartweed	5
Potamogeton alpinus	**Alpine pondweed**	**9**
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton epihydrus	Ribbon-leaf pondweed	8
Potamogeton foliosus	Leafy pondweed	6
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton 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

Table 3 (continued): Floristic Quality Index of Aquatic Macrophytes
Murphy Flowage –Rusk County, Wisconsin
July 31, 2023

Species	Common Name	C
Ranunculus aquatilis	White water crowfoot	8
Riccia fluitans	Slender riccia	7
Sagittaria rigida	Sessile-fruited arrowhead	8
Schoenoplectus tabernaemontani	Softstem bulrush	4
Sparganium americanum	American bur-reed	8
Sparganium emersum	Short-stemmed bur-reed	8
Spirodela polyrhiza	Large duckweed	5
Typha latifolia	Broad-leaved cattail	1
Utricularia gibba	**Creeping bladderwort**	**9**
Utricularia intermedia	**Flat-leaf bladderwort**	**9**
Utricularia vulgaris	Common bladderwort	7
Wolffia columbiana	Common watermeal	5
N		**39**
Mean C		**6.4**
FQI		**39.9**

Filamentous Algae:

Filamentous algae are normally associated with excessive nutrients in the water column from such things as runoff, internal nutrient recycling, and failed septic systems. We found these algae at 265 points with a mean rake fullness of 1.60. In general, the further upstream on the flowage, the higher the algal density. We noted that sheltered areas off the main channel also tended to have significant amounts of these algae (Figure 9).

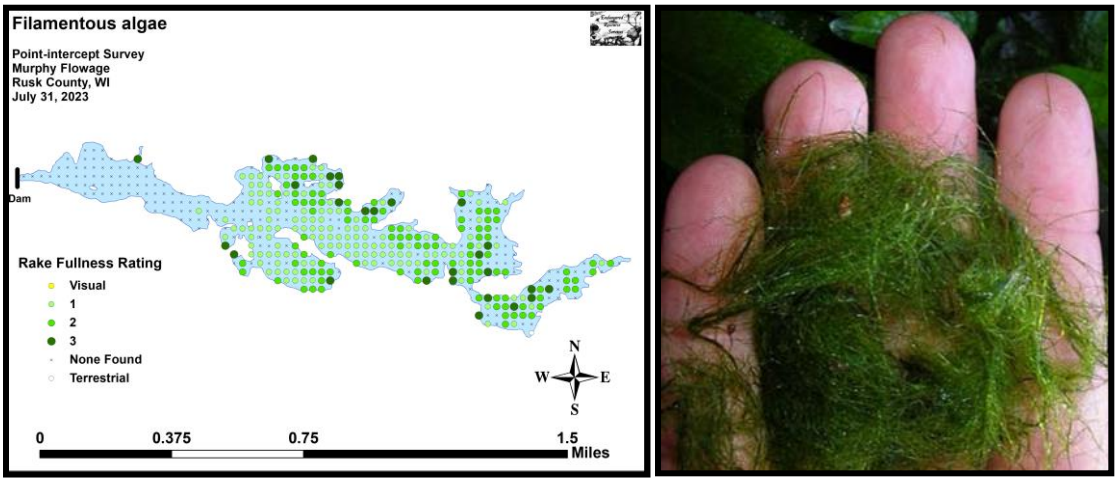


Figure 9: Filamentous Algae Density and Distribution

Exotic Plant Species:

We found three exotic plant species growing in and adjacent to the Murphy Flowage: Reed canary grass, Curly-leaf pondweed, and Hybrid cattail (Appendix VII). Reed canary grass was scattered along much of the flowage's shoreline and become especially abundant in the wetlands surrounding Lawler and Hemlock Creeks (Figure 10). A ubiquitous plant in the state, there is likely little that can be done about it.

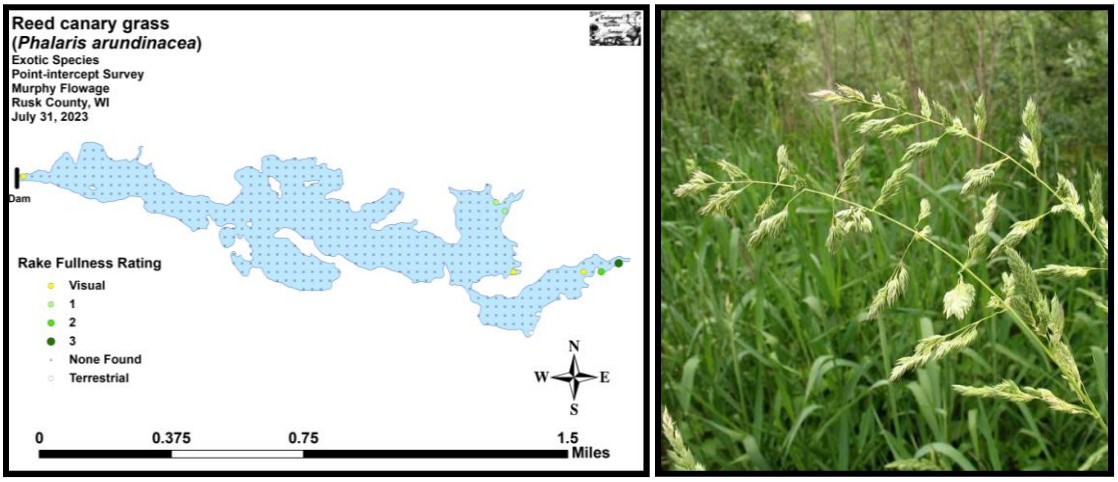


Figure 10: Reed Canary Grass Density and Distribution and Inflorescence

Curly-leaf pondweed was present in both the Lawler and Hemlock Creek Inlets (Figure 11). Despite being an exotic species that is often invasive in human modified environments, it was extremely rare on the flowage, and we struggled to find enough individuals to even make voucher specimens. Because of the pristine nature of the flowage, it seems unlikely that it will ever be common enough to require management.

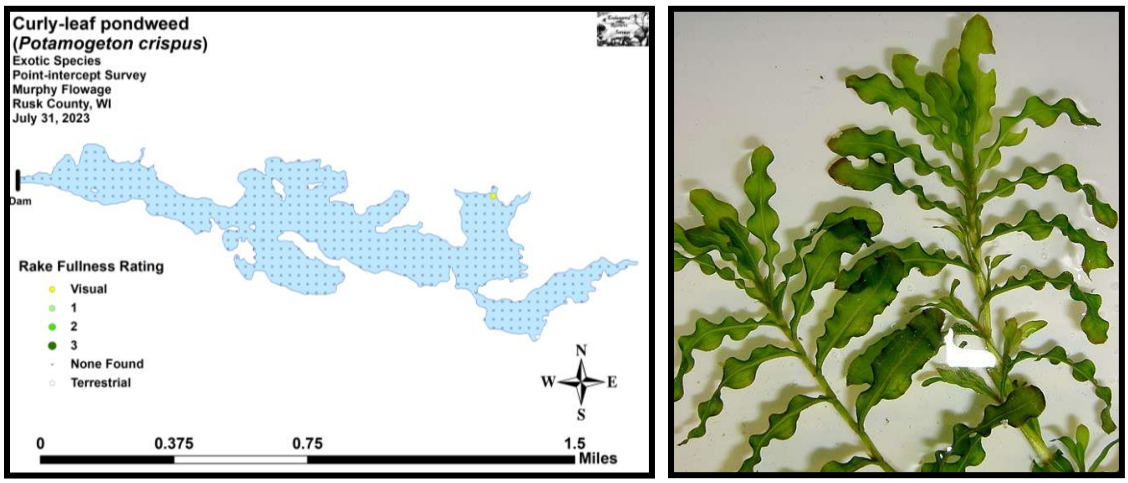


Figure 11: Curly-leaf Pondweed Density and Distribution and Typical Plants Found

Native to southern but not northern Wisconsin, Narrow-leaved cattail (*Typha angustifolia*) and its hybrids with Broad-leaved cattail are becoming increasingly common in northern Wisconsin where they also tend to be invasive. Although not present in the rake at any point, a few patches of these exotic cattails were growing west of the Lawler Creek Inlet (Figure 12).

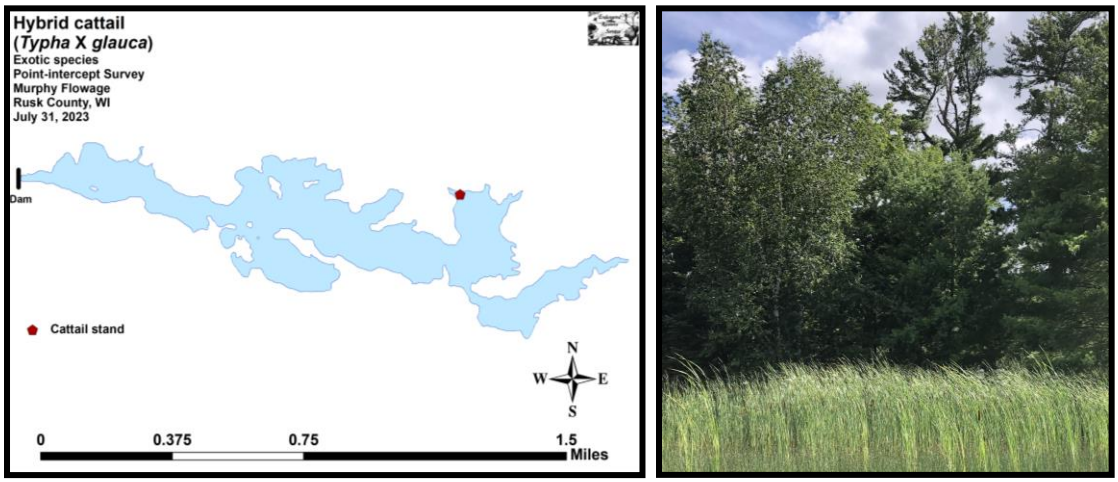


Figure 12: Hybrid Cattail Distribution and Typical Cluster

Besides having narrower leaves, the exotics can be told from our native cattails by having a relatively narrower and longer “hotdog-shaped” tan female cattail flower, whereas our native species tends to produce a fatter and shorter “bratwurst-shaped” dark chocolate colored female flower. Narrow-leaved cattail and its hybrids also have a male flower that is separated from the female flower by a thin green stem while the native Broad-leaved cattail has its male and female flowers connected (Figure 13) (Exotic species maps and additional information on a sampling of aquatic exotic invasive plant species can be found in Appendix VII).

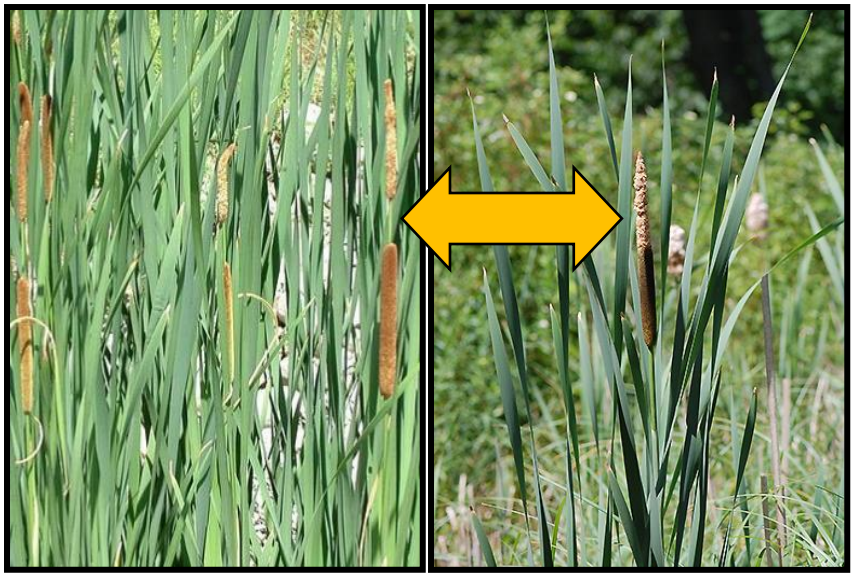


Figure 13: Exotic Hybrid and Native Broad-leaved Cattail Identification

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:

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

The Murphy Flowage has an excellent native plant community that is dominated by high-value species. Like trees in a forest, the flowage's plants are the basis of the aquatic ecosystem. They capture the sun's energy and turn it into usable food, "clean" the water of excess nutrients, and provide habitat for other organisms like aquatic invertebrates and the flowage's fish populations. Because of this, preserving them is critical to maintaining the flowage's overall health.

When phosphorus and nitrogen in a lake's water column increase to levels beyond what macrophytes can absorb, filamentous and floating algae tend to proliferate leading to declines in both water clarity and quality. With minimal development along the flowage's shorelines, it's likely the high algae levels we documented are caused by upstream runoff or from internal loading. Ultimately, determining the source of these nutrients and developing a plan to address them would likely require a comprehensive watershed study.

Aquatic Invasive Species Prevention:

Aquatic Invasive Species such as Eurasian water-milfoil, Curly-leaf pondweed, Purple loosestrife (*Lythrum salicaria*), and Yellow iris (*Iris pseudacorus*) are an increasing problem in and along the lakes of northern Wisconsin in general, and several nearby lakes in Rusk and Sawyer Counties in particular. Working to prevent their introduction into the Murphy Flowage with proactive measures is strongly encouraged. With this in mind, the Red Cedar Lakes Association might consider conducting monthly monitoring at the public boat landing and/or at least annual flowage-wide meandering shoreline surveys to look for AIS. Developing an Aquatic Plant Management Plan that clarifies a response if a new AIS is introduced into the lake is also strongly encouraged.

With no landing monitoring program in place, a small standard WDNR AIS sign is currently serving as the "guardian of the lake". Adding a secondary sign that is located at the waterline is another potential actionable item for the RCLA to consider. Hopefully, a simple bright sign will increase the chances that visitors will remember to check their boat carefully before launching (Figure 14).

Figure 14: Potential Secondary Sign to be Placed Near the Water's Edge

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Appendix I: Boat and Vegetative Survey Datasheets

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

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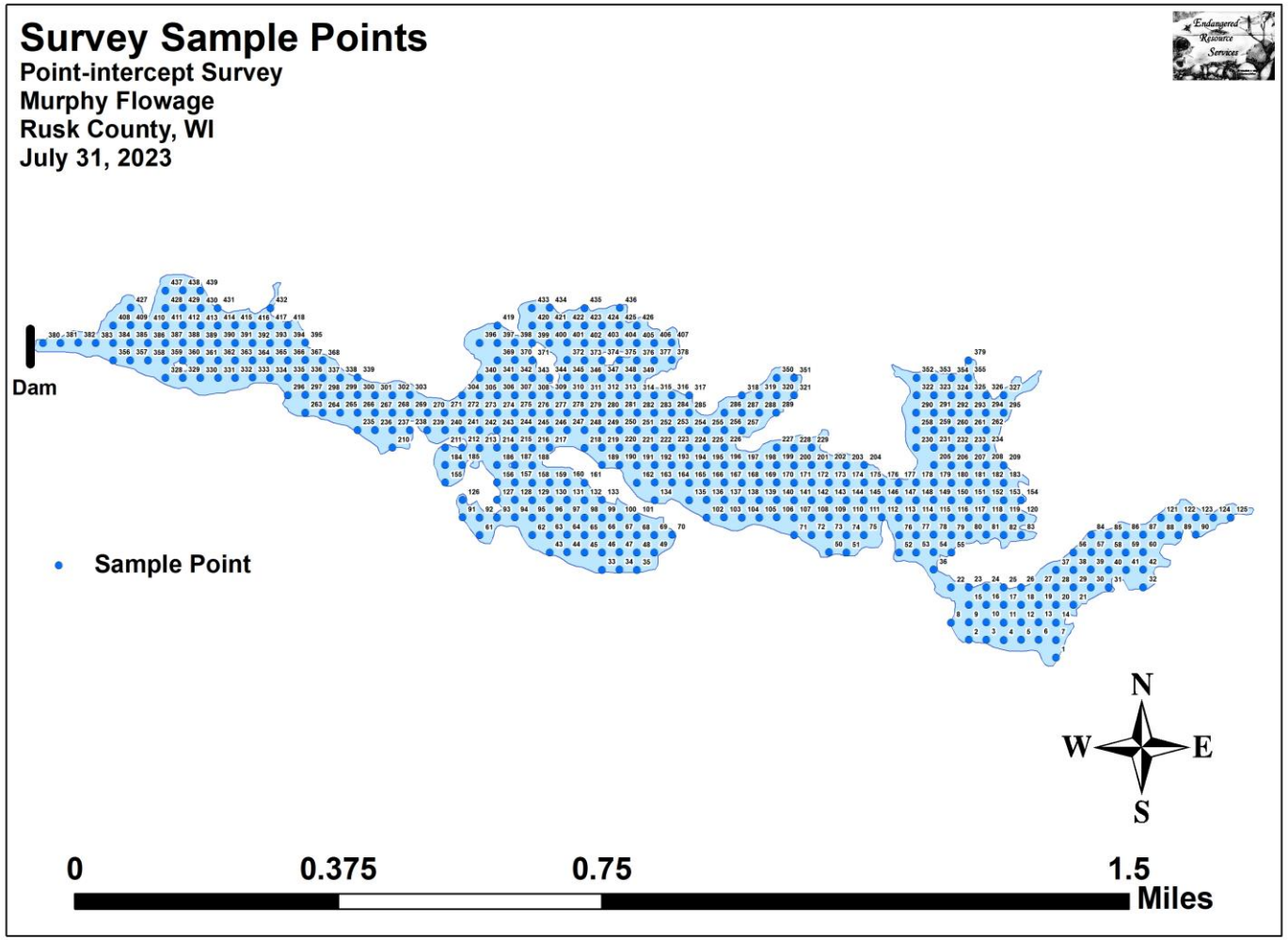
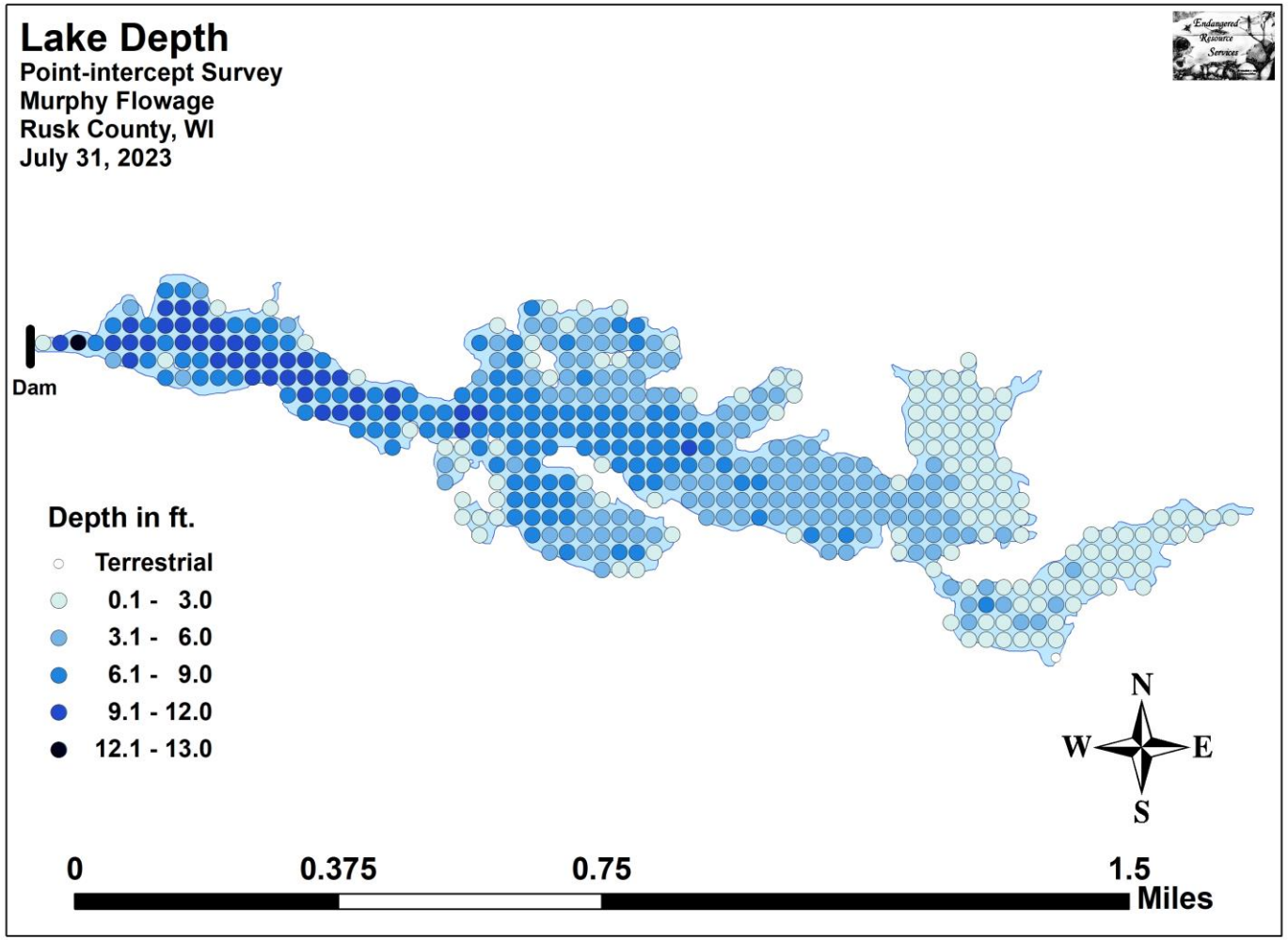
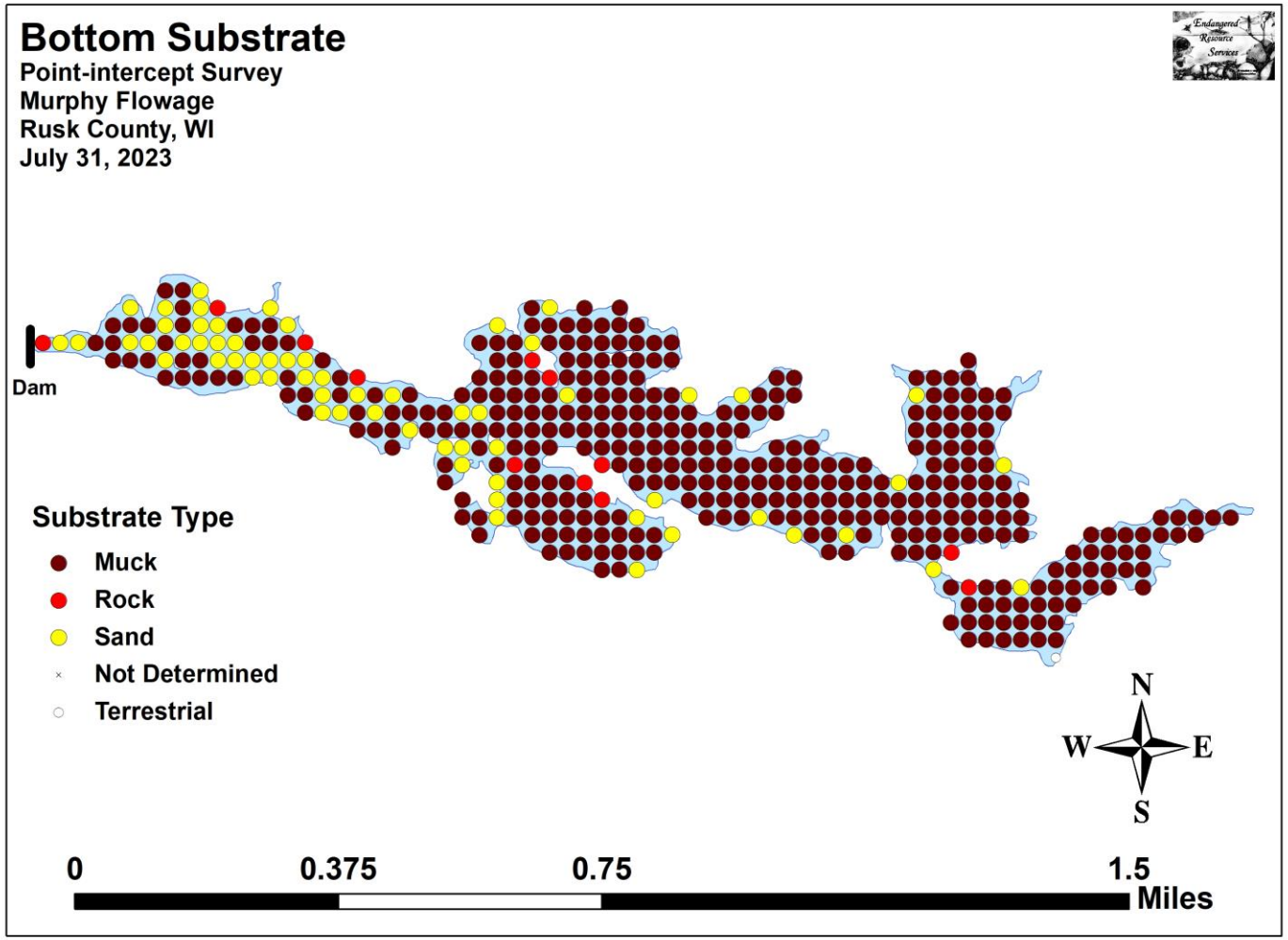
19																									
20																									

Appendix II: Point-intercept Survey Sample Points Map

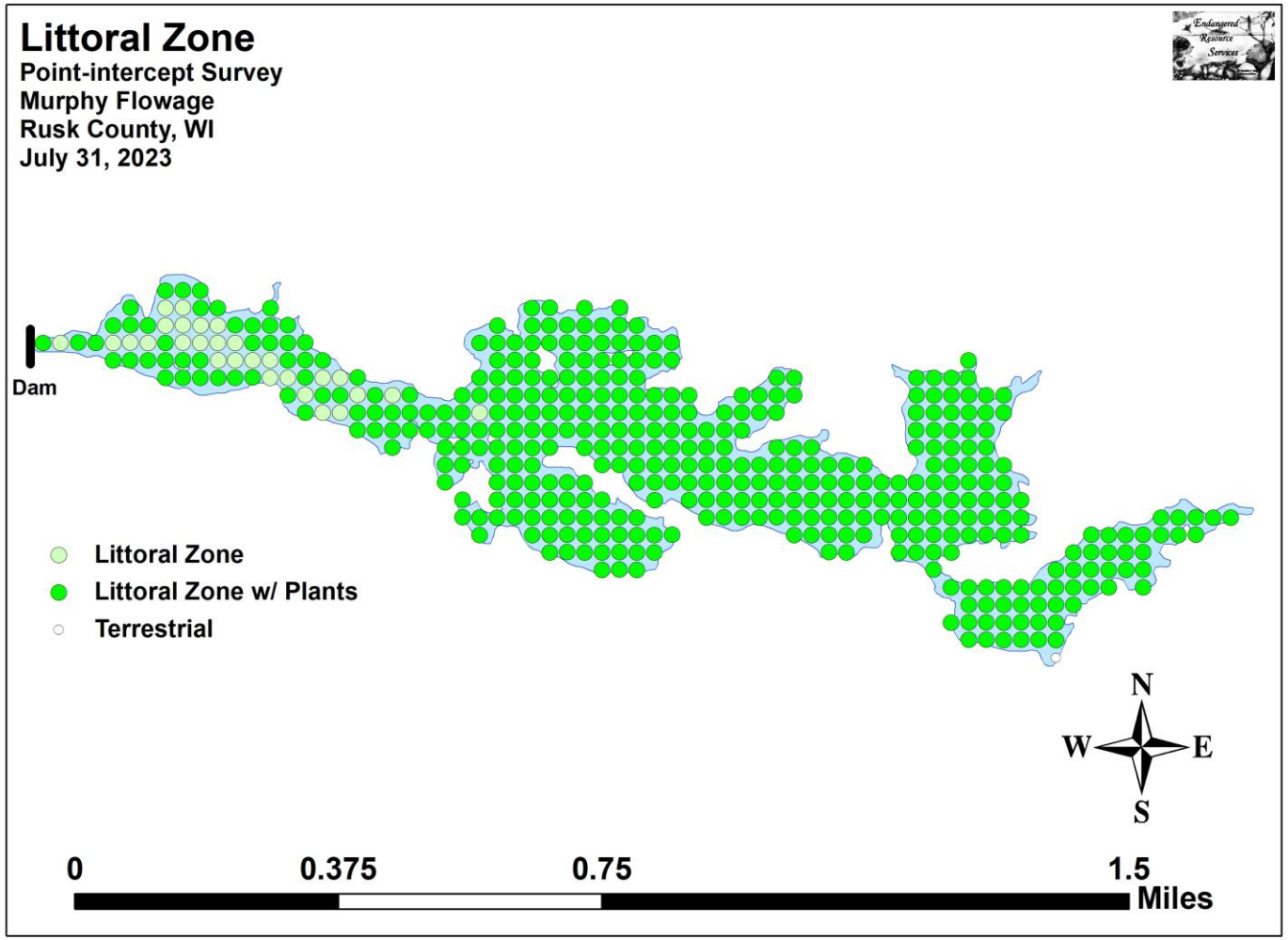

Survey Sample Points
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Sample Point
N
W
E
S
0
0.375
0.75
1.5
Miles

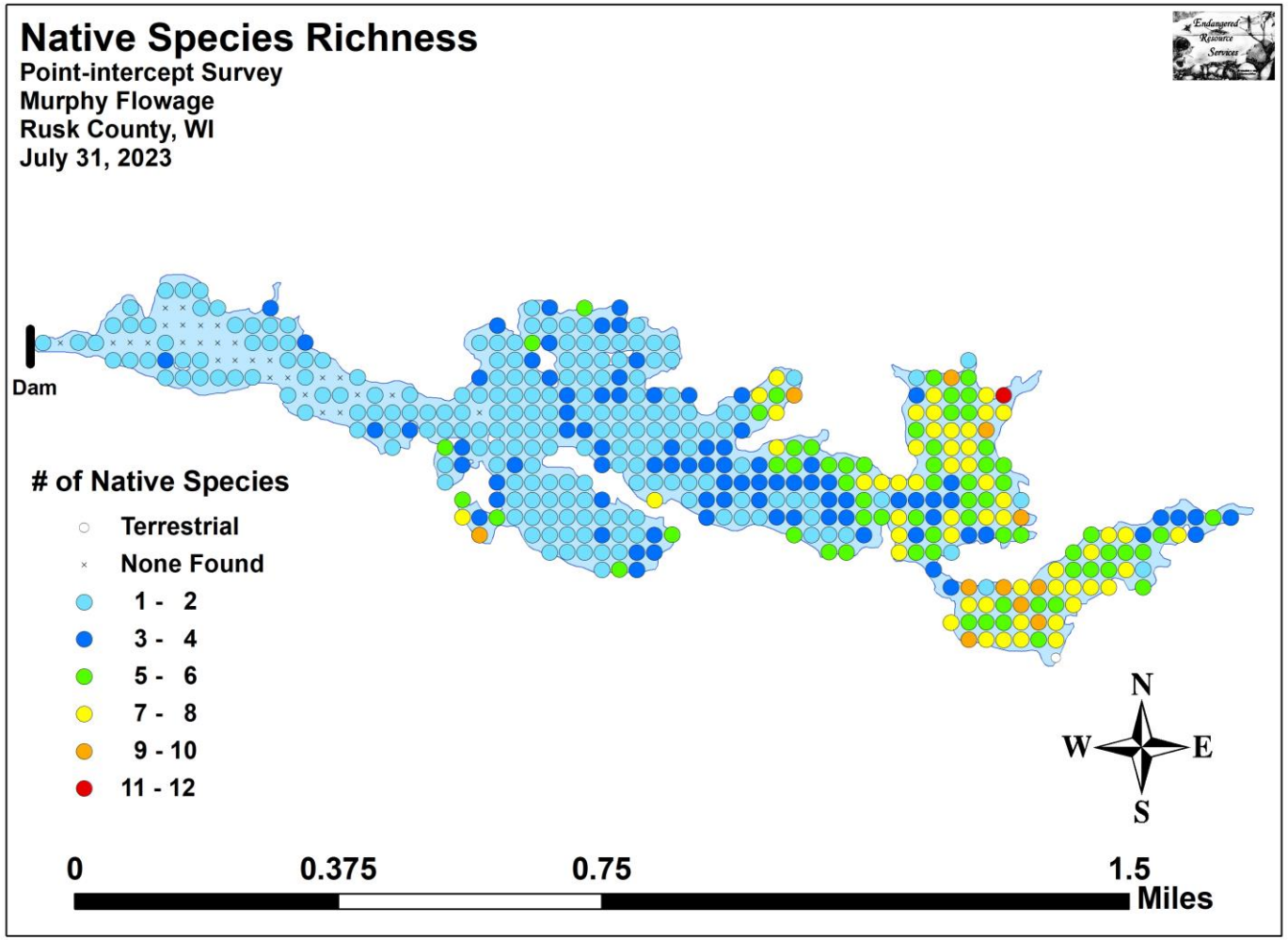
Appendix III: Habitat Variable Maps

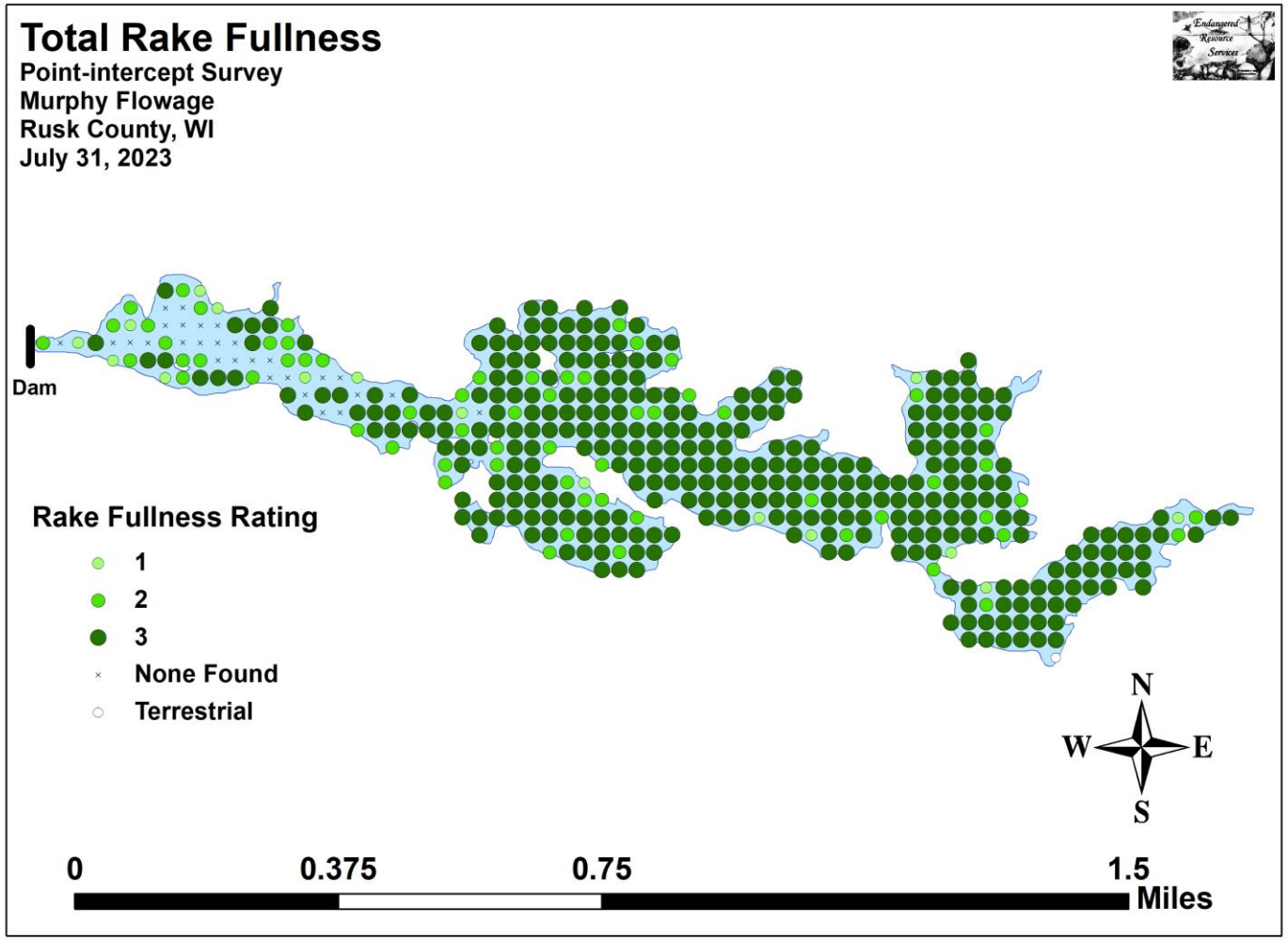

Lake Depth
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Depth in ft.
Terrestrial
0.1 - 3.0
3.1 - 6.0
6.1 - 9.0
9.1 - 12.0
12.1 - 13.0
N
W
E
S
0
0.375
0.75
1.5
Miles


Bottom Substrate
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Substrate Type
Muck
Rock
Sand
Not Determined
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles

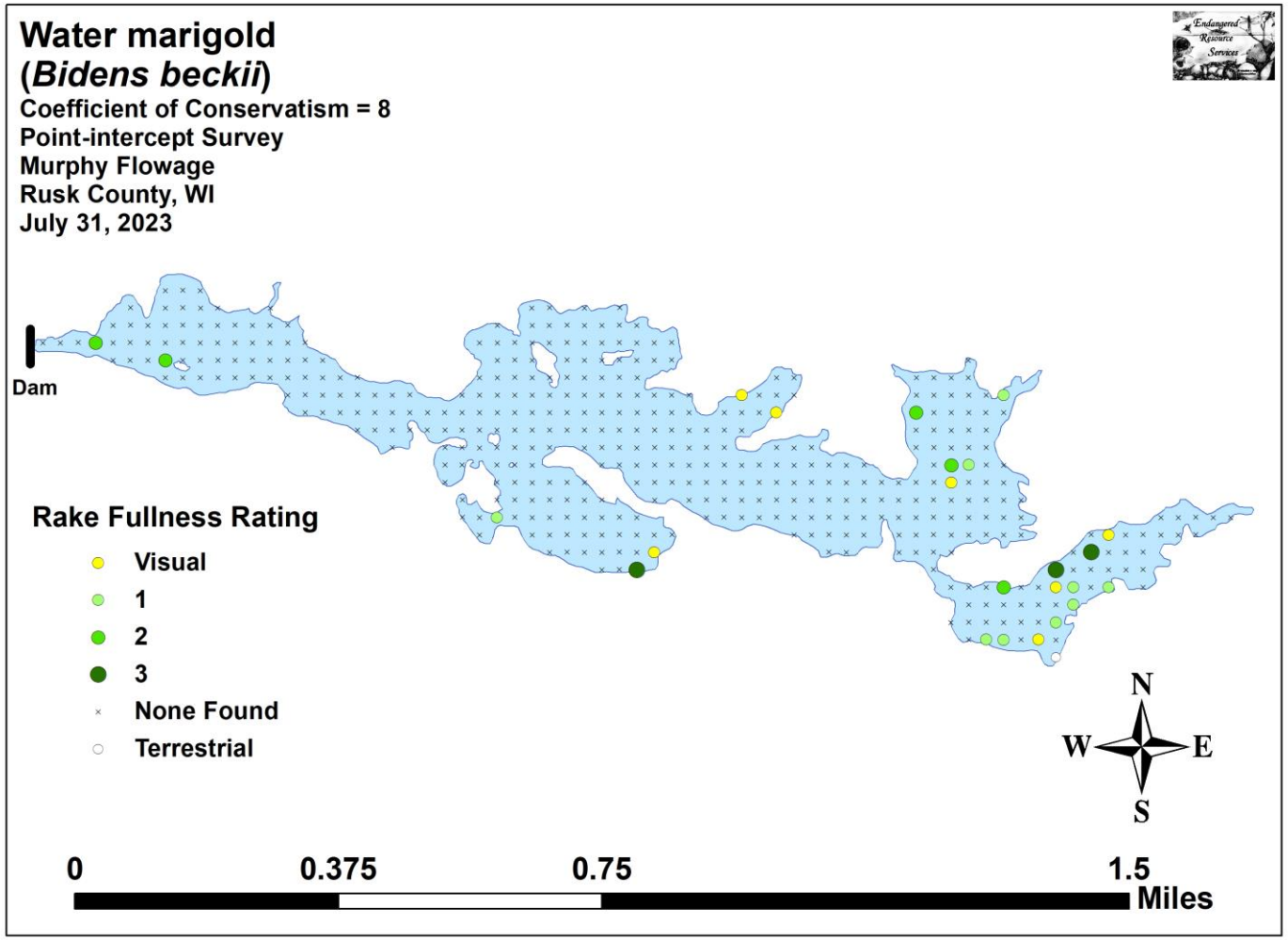
Appendix IV: Littoral Zone, Native Species Richness, and Total Rake Fullness Maps


Littoral Zone
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Littoral Zone
Littoral Zone w/ Plants
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles


Native Species Richness
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
# of Native Species
Terrestrial
None Found
1 - 2
3 - 4
5 - 6
7 - 8
9 - 10
11 - 12
N
W
E
S
0
0.375
0.75
1.5
Miles


Total Rake Fullness
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
1
2
3
None Found
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles

Appendix V: Native Species Density and Distribution Maps


Water marigold
(Bidens beckii)
Coefficient of Conservatism = 8
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
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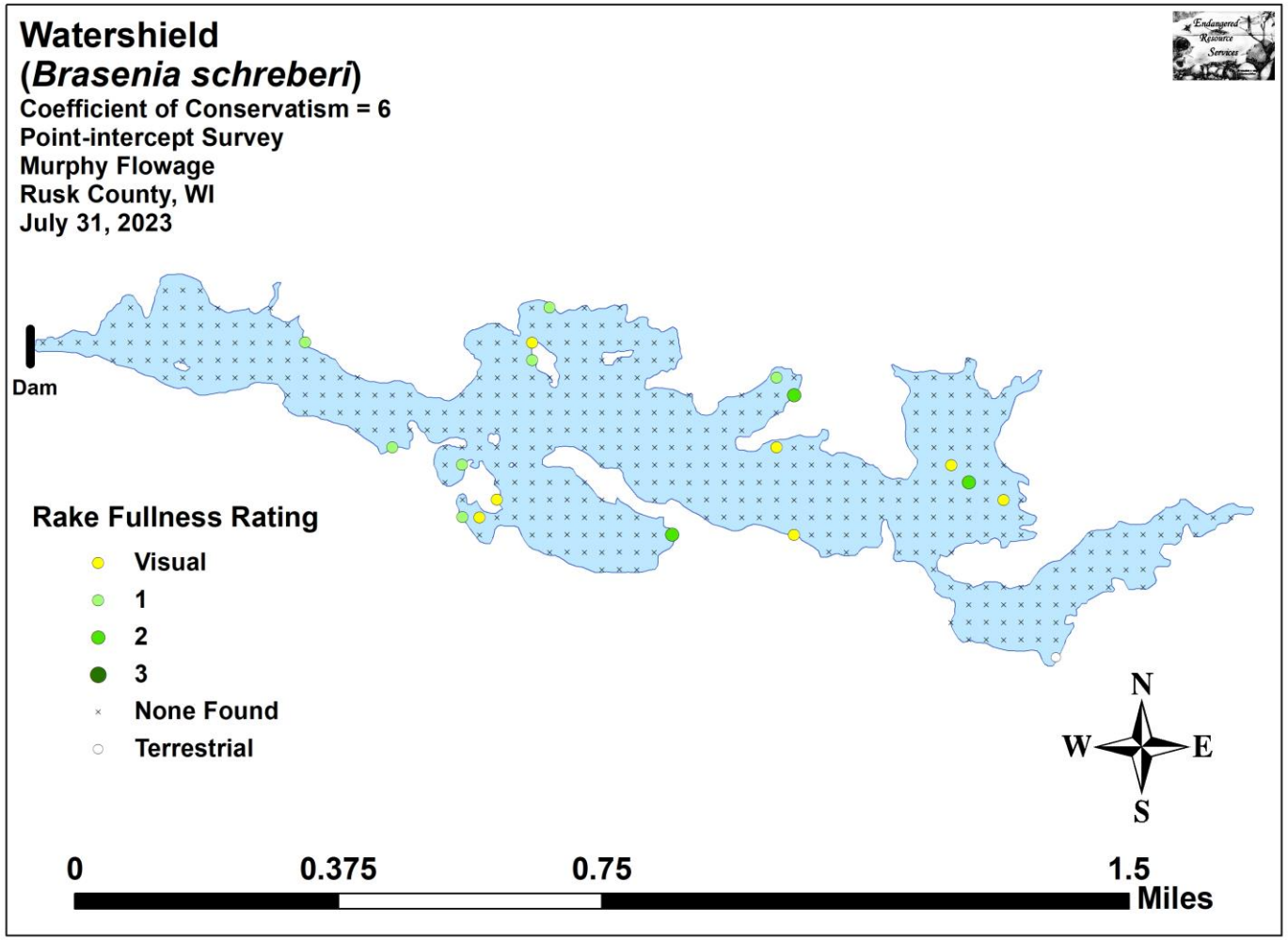
0.375
0.75
1.5
Miles


Watershield
(Brasenia schreberi)
Coefficient of Conservatism = 6
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
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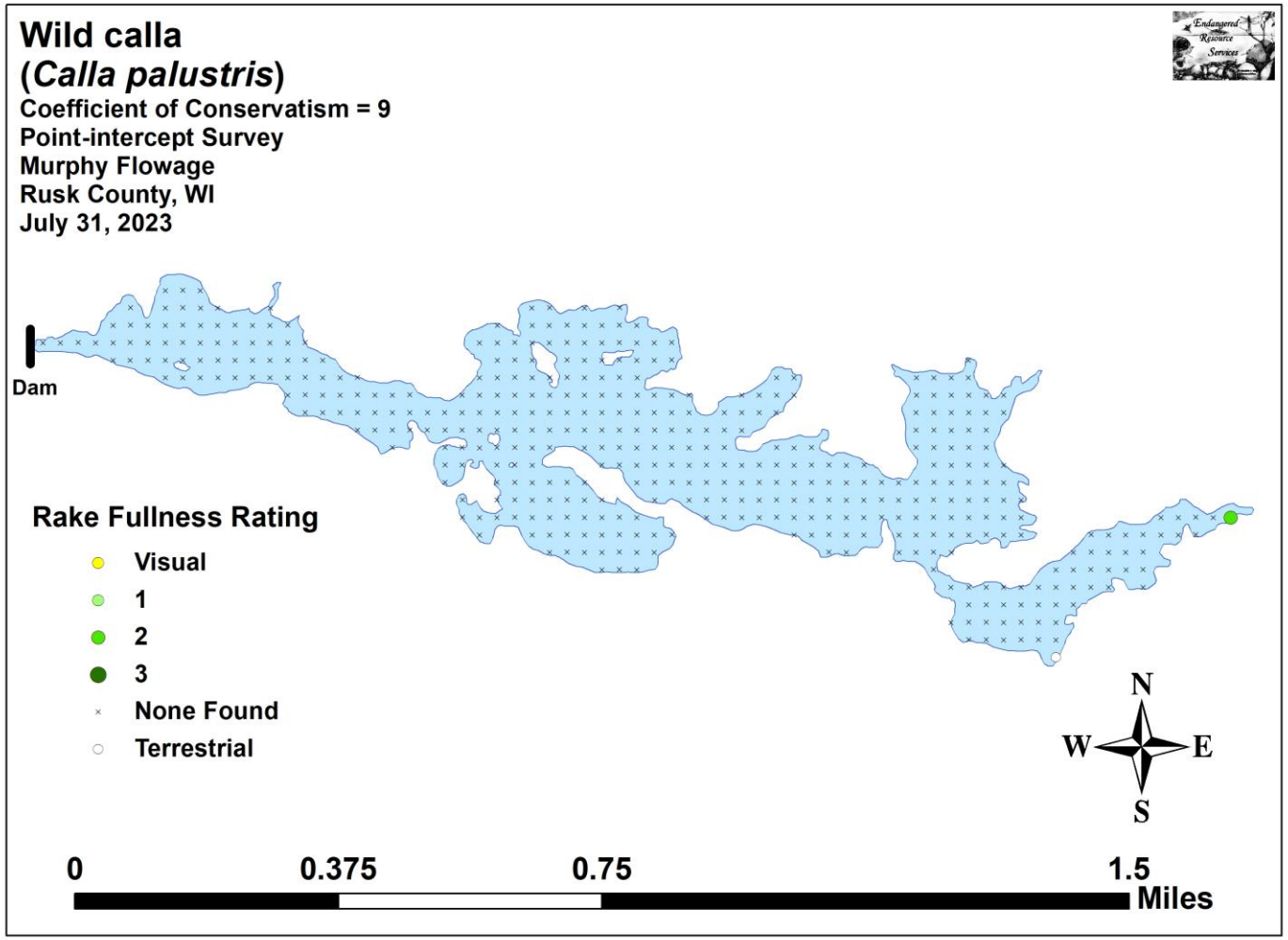
0.375
0.75
1.5
Miles


Wild calla
(Calla palustris)
Coefficient of Conservatism = 9
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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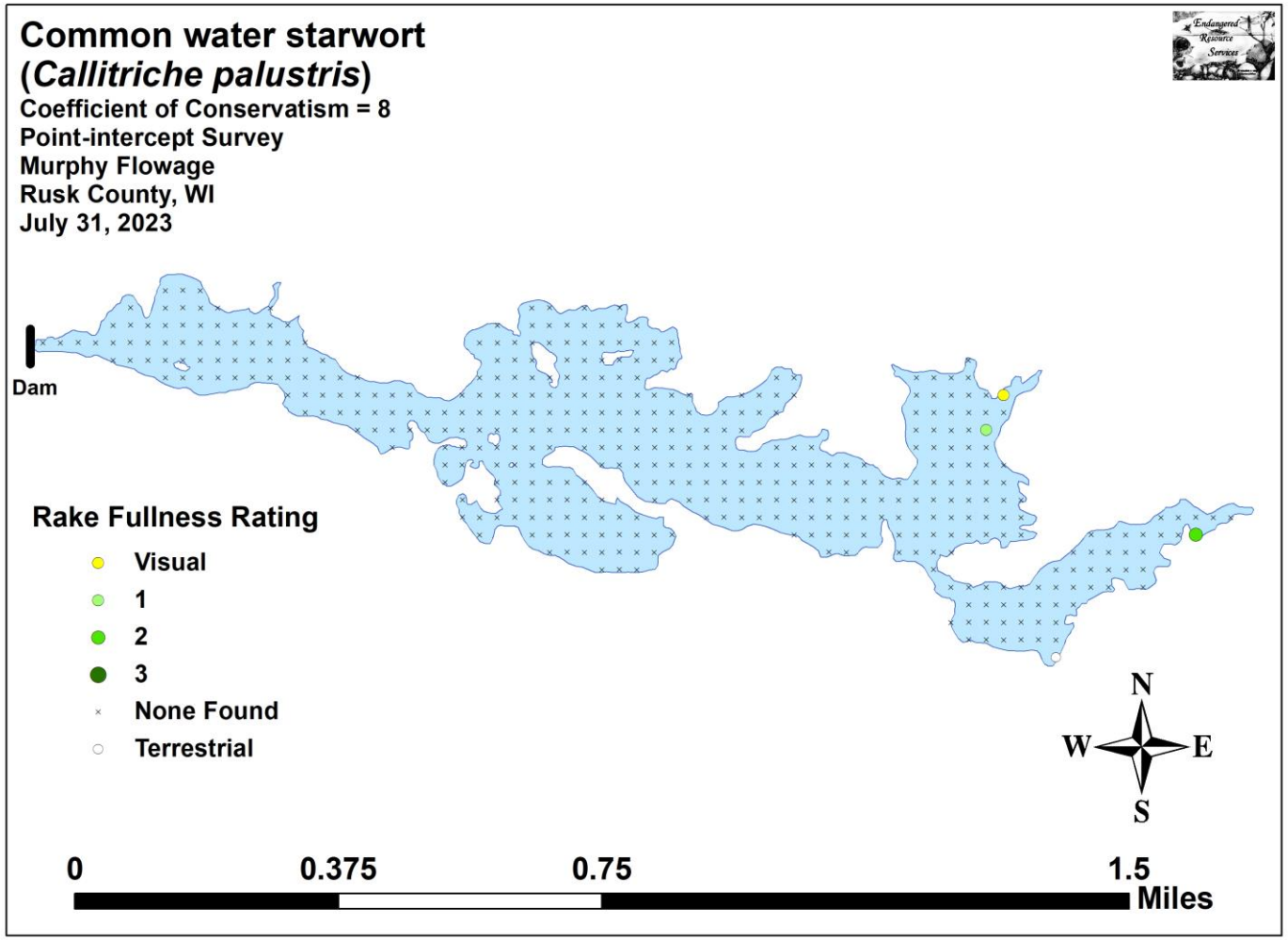
Miles


Common water starwort
(Callitriche palustris)
Coefficient of Conservatism = 8
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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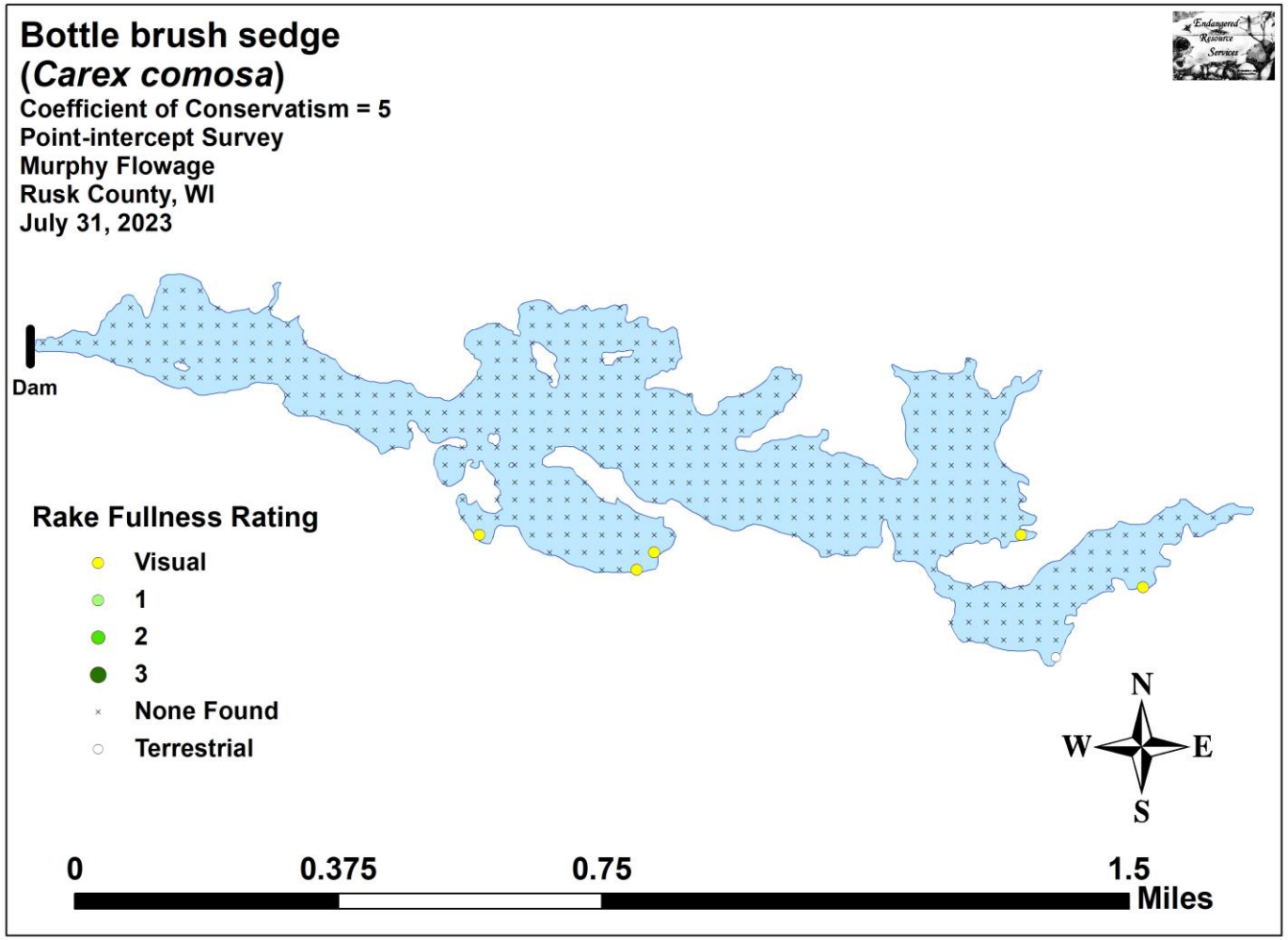
Miles


Bottle brush sedge
(Carex comosa)
Coefficient of Conservatism = 5
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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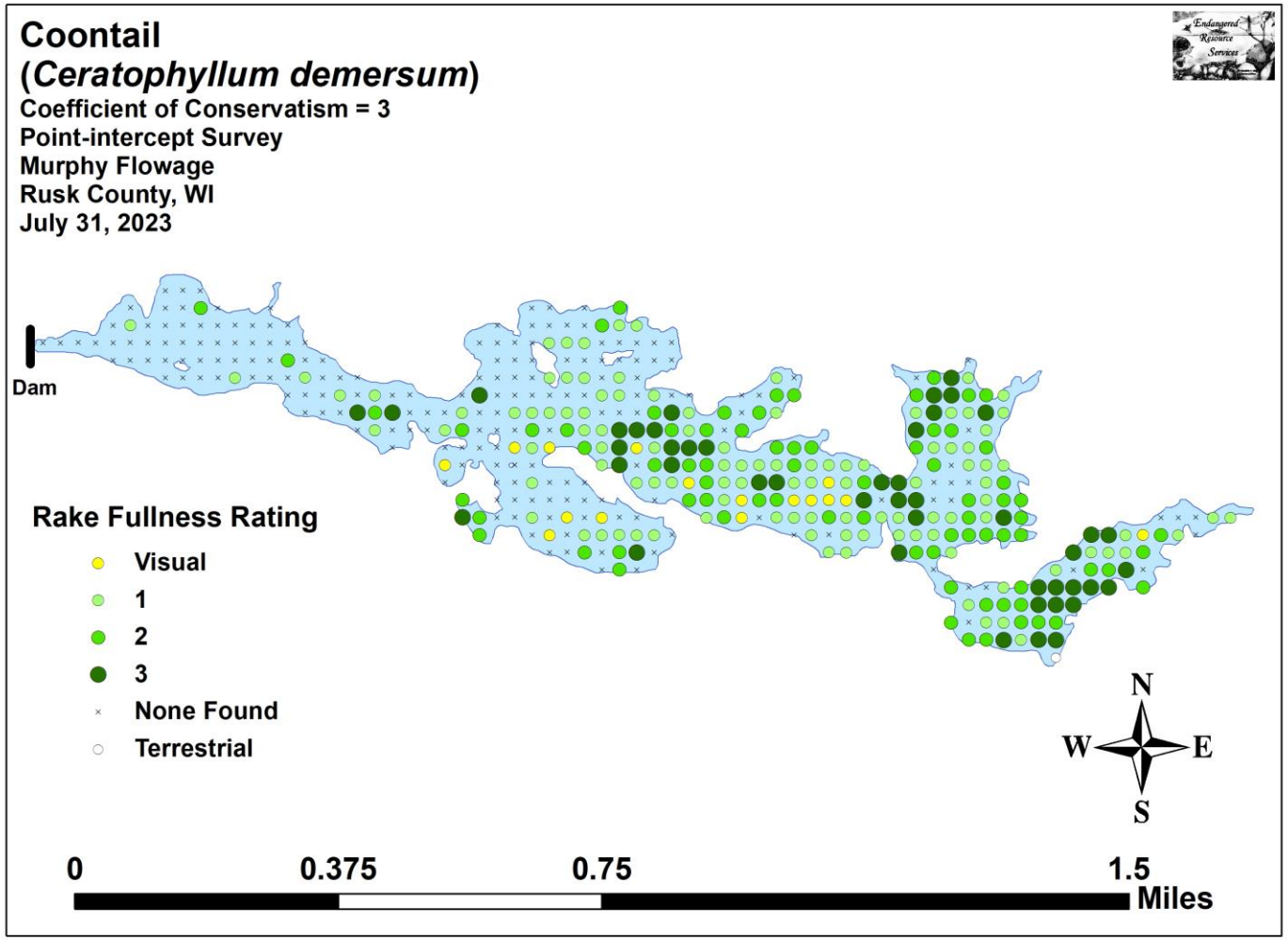
Miles


Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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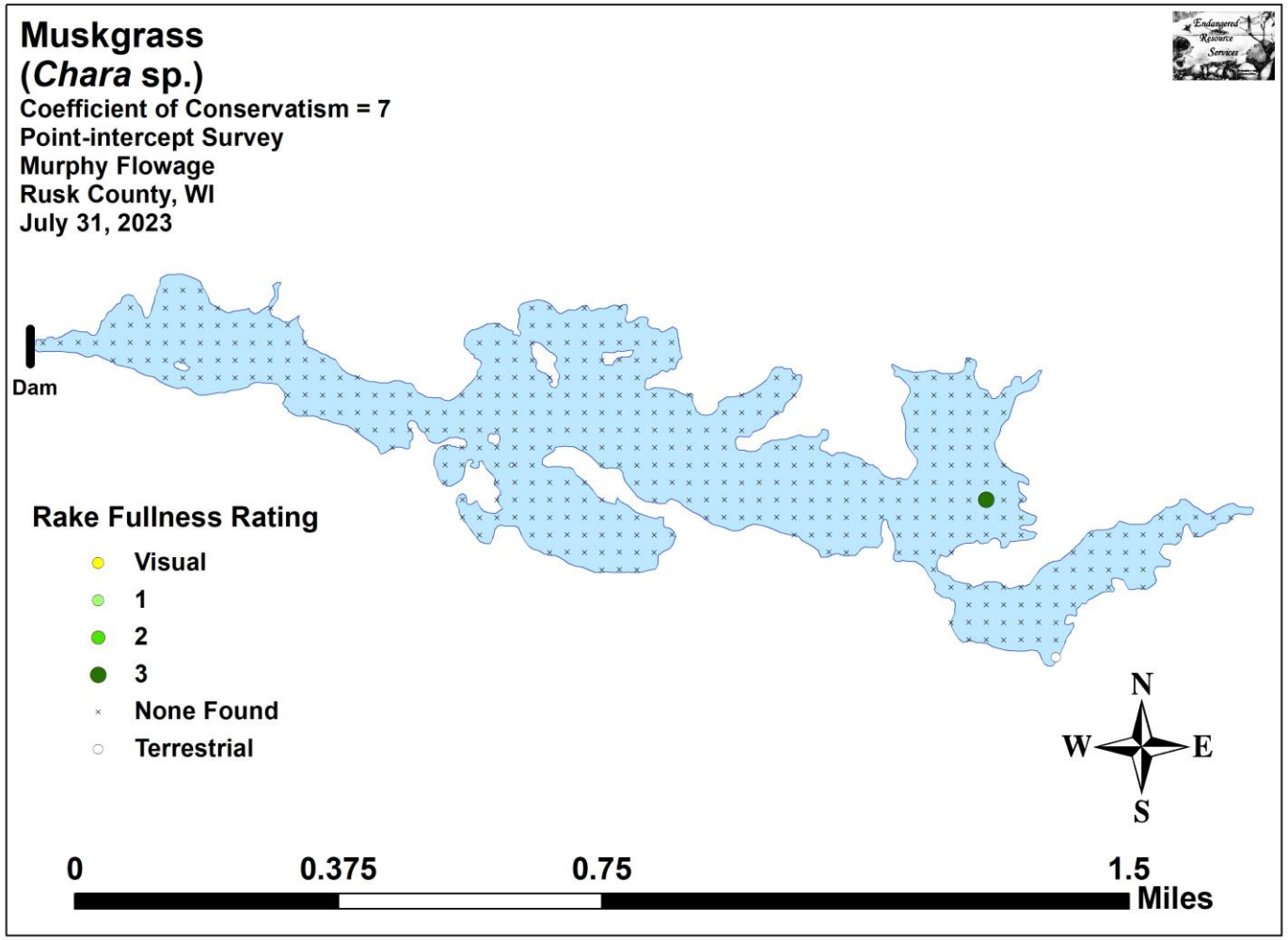
Miles


Muskgrass
(Chara sp.)
Coefficient of Conservatism = 7
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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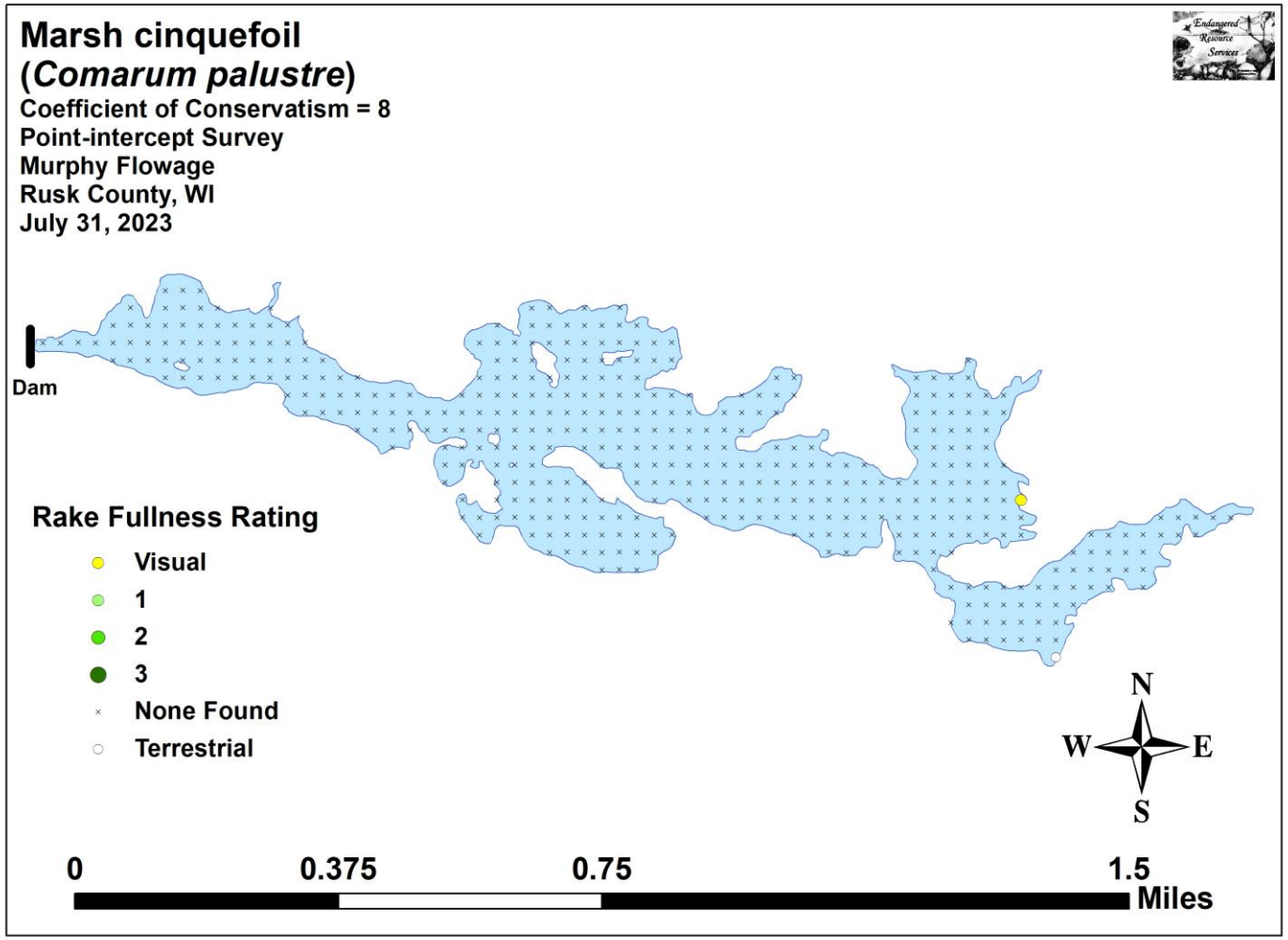
Miles


Marsh cinquefoil
(Comarum palustre)
Coefficient of Conservatism = 8
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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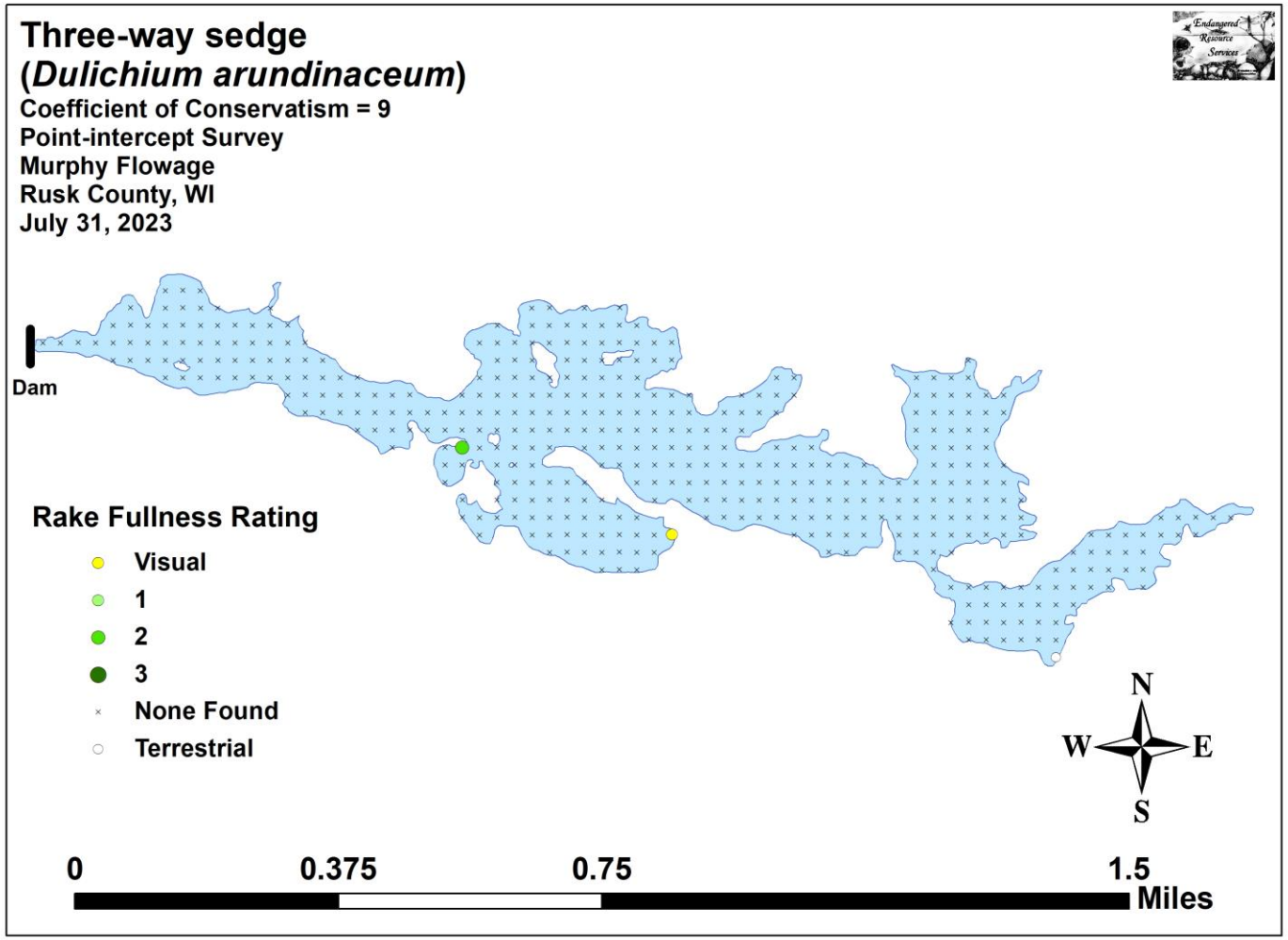
Miles


Three-way sedge
(Dulichium arundinaceum)
Coefficient of Conservatism = 9
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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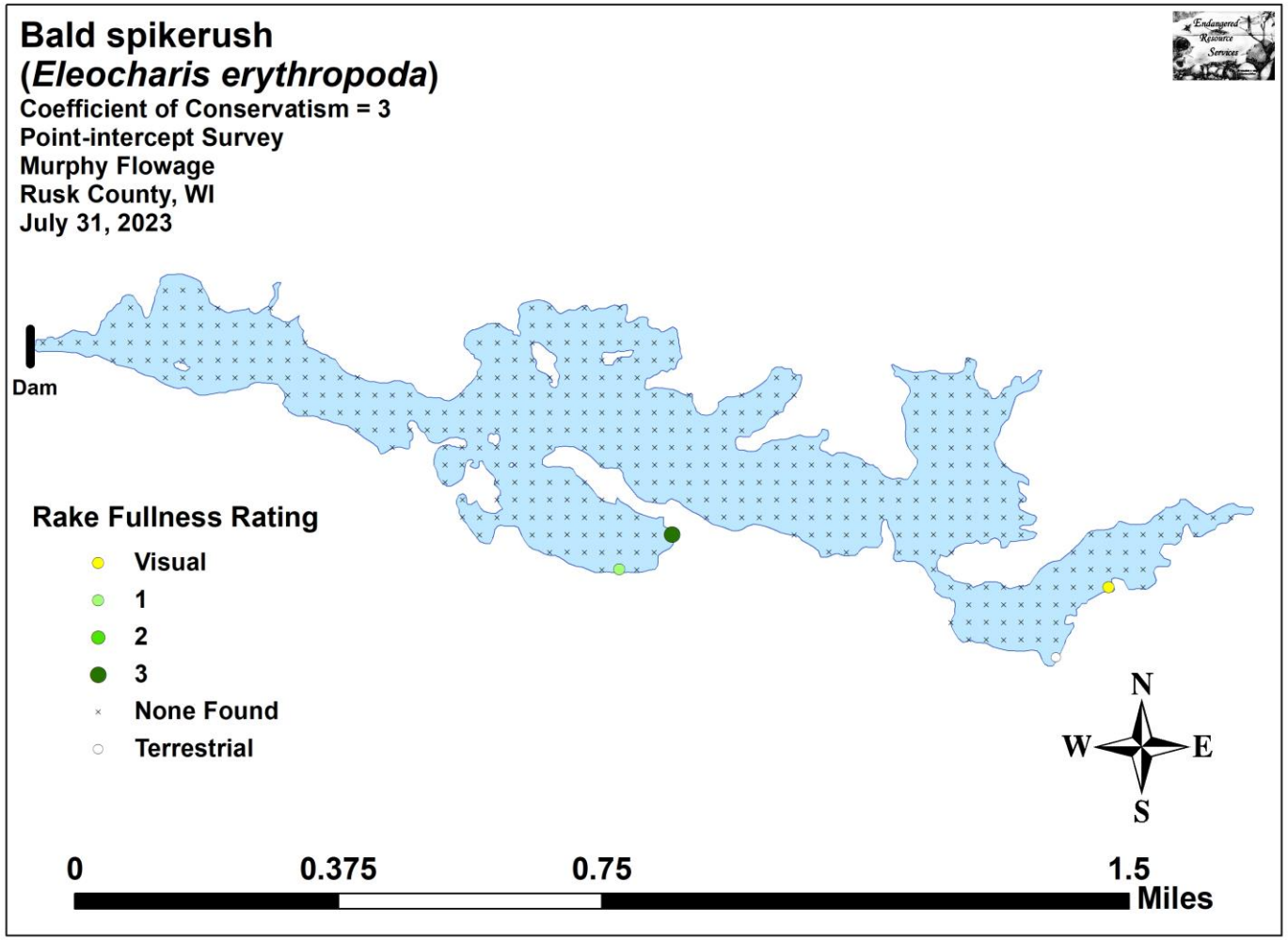
Miles


Bald spikerush
(Eleocharis erythropoda)
Coefficient of Conservatism = 3
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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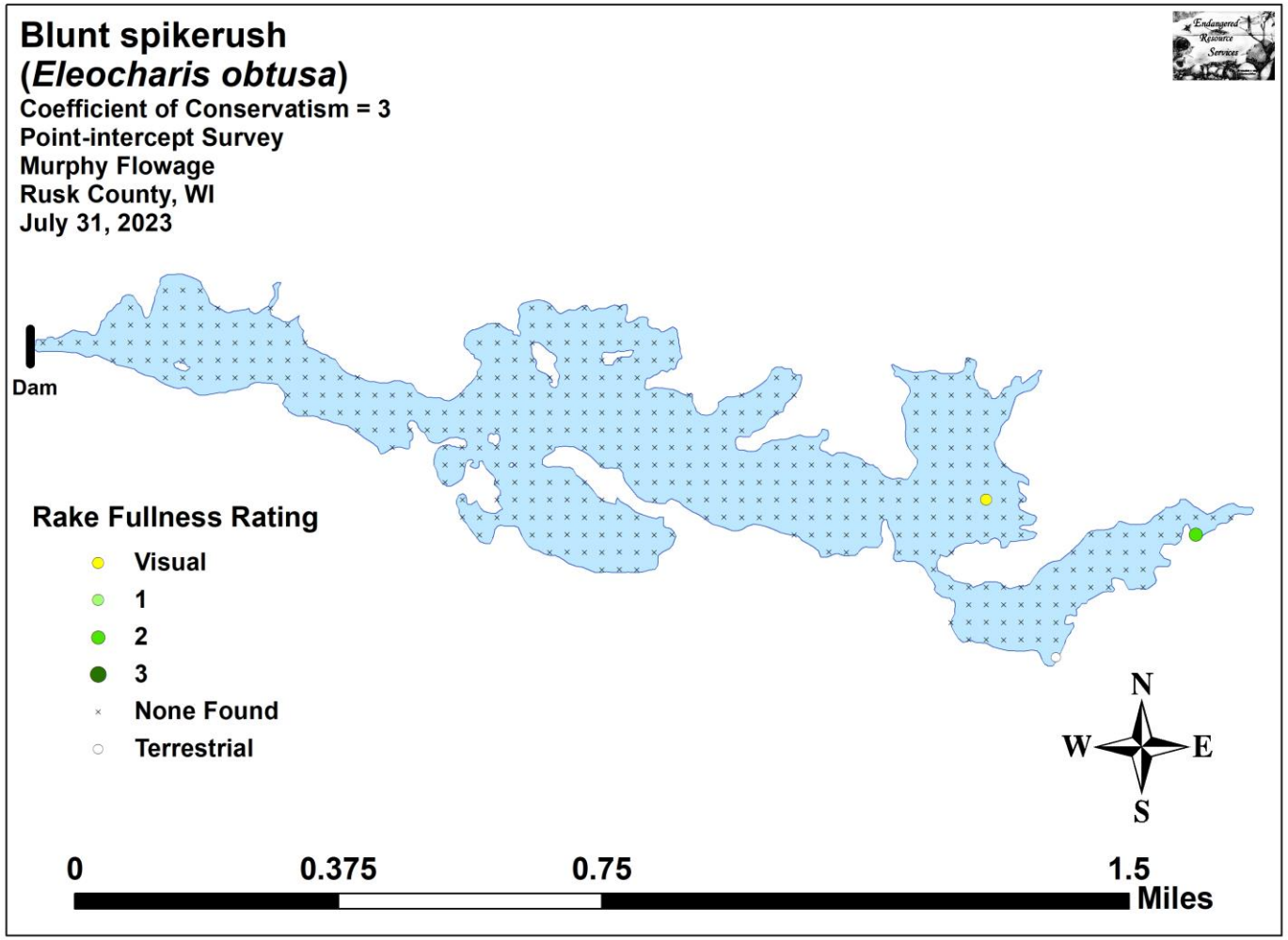
Miles


Blunt spikerush
(Eleocharis obtusa)
Coefficient of Conservatism = 3
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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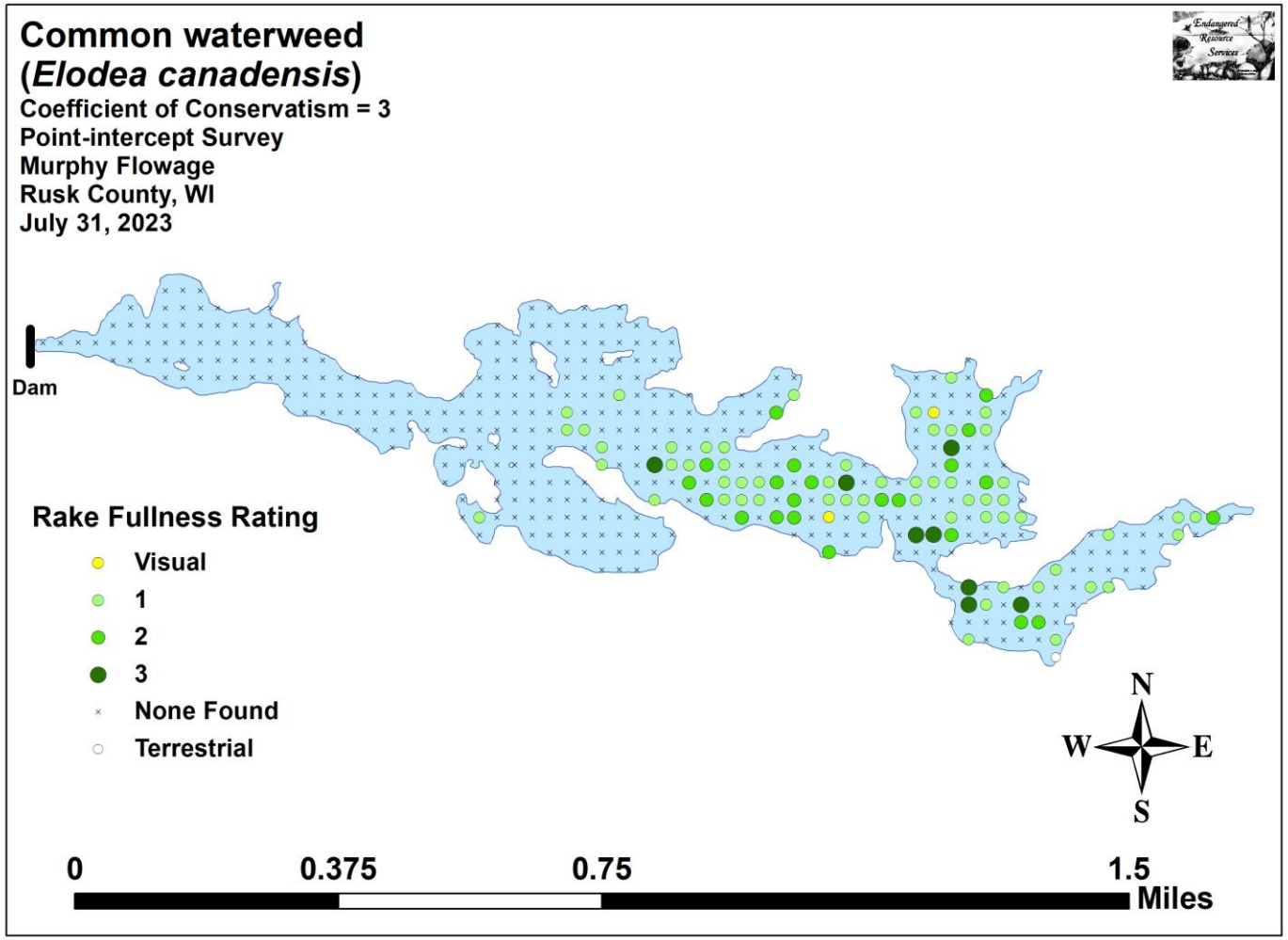
Miles


Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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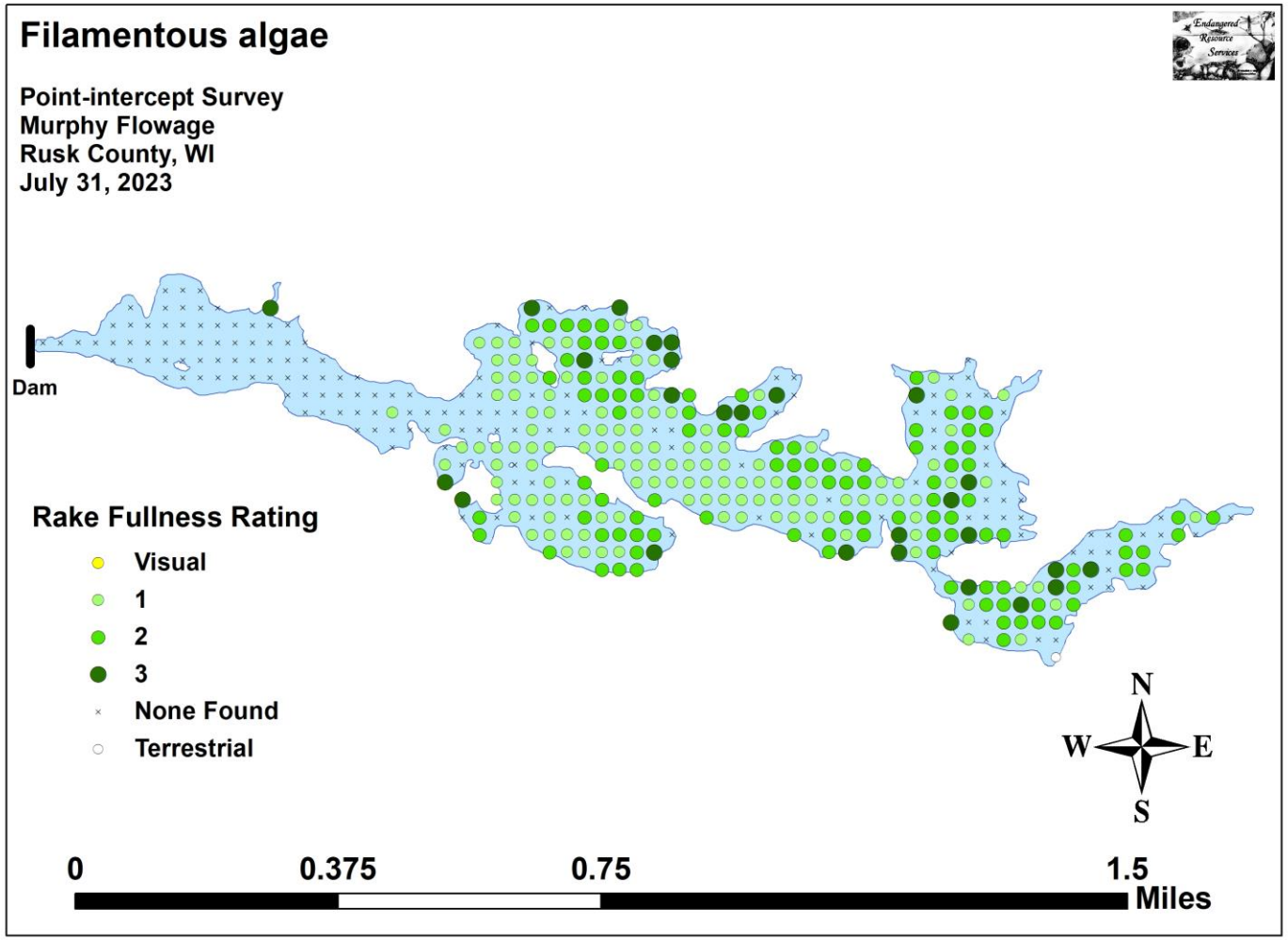
Miles


Filamentous algae
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
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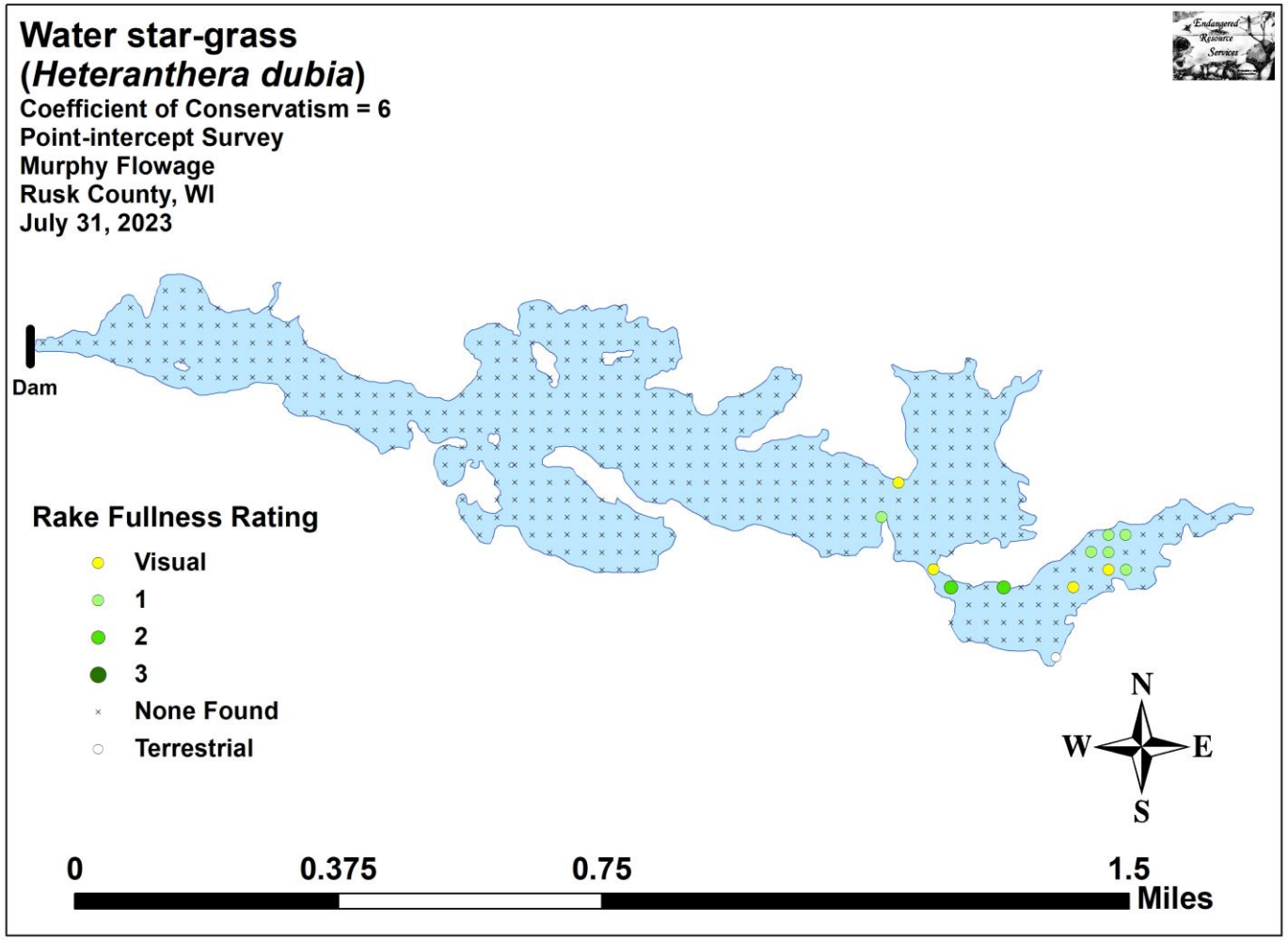
Miles


Water star-grass
(Heteranthera dubia)
Coefficient of Conservatism = 6
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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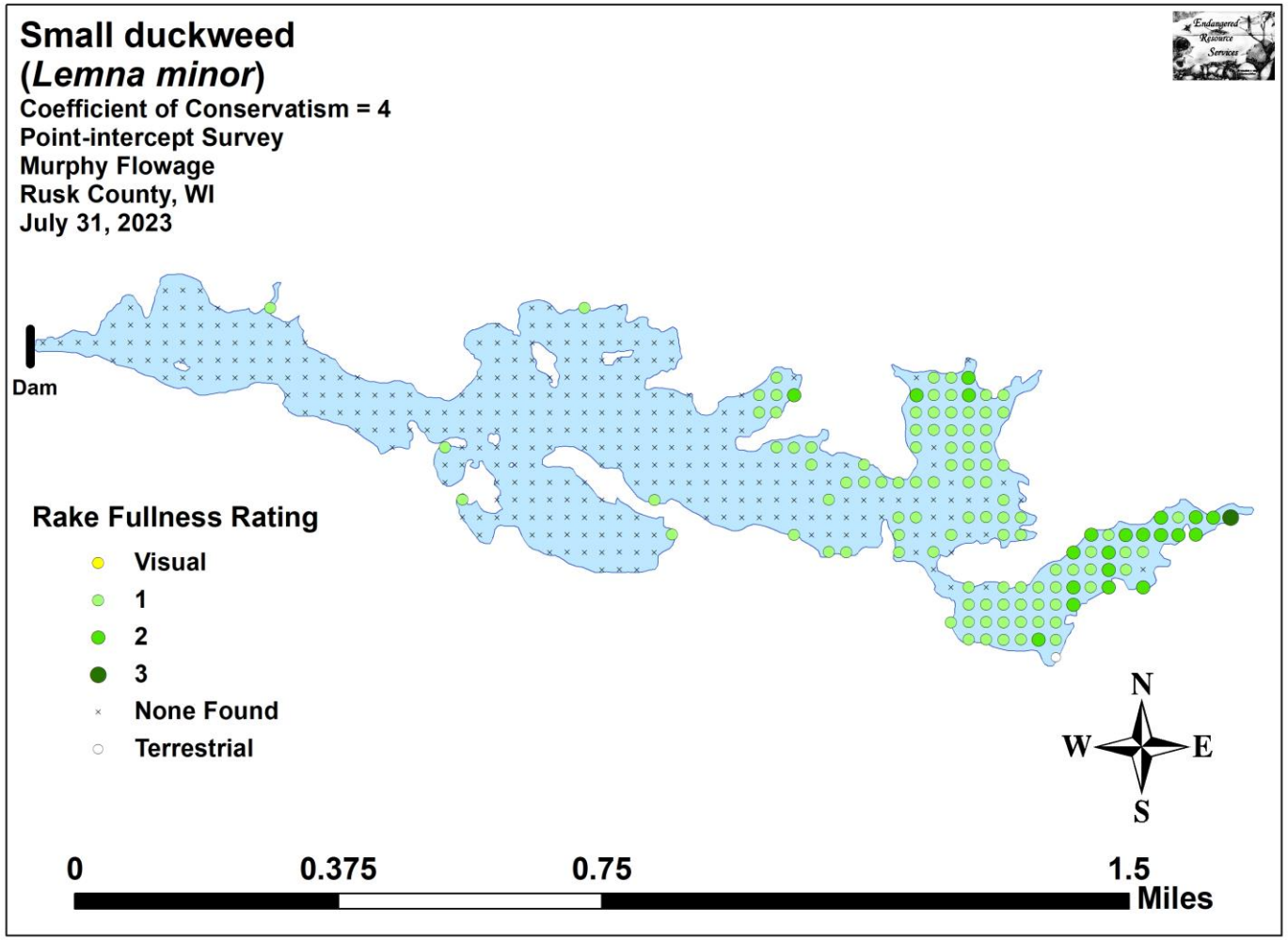
Miles


Small duckweed
(Lemna minor)
Coefficient of Conservatism = 4
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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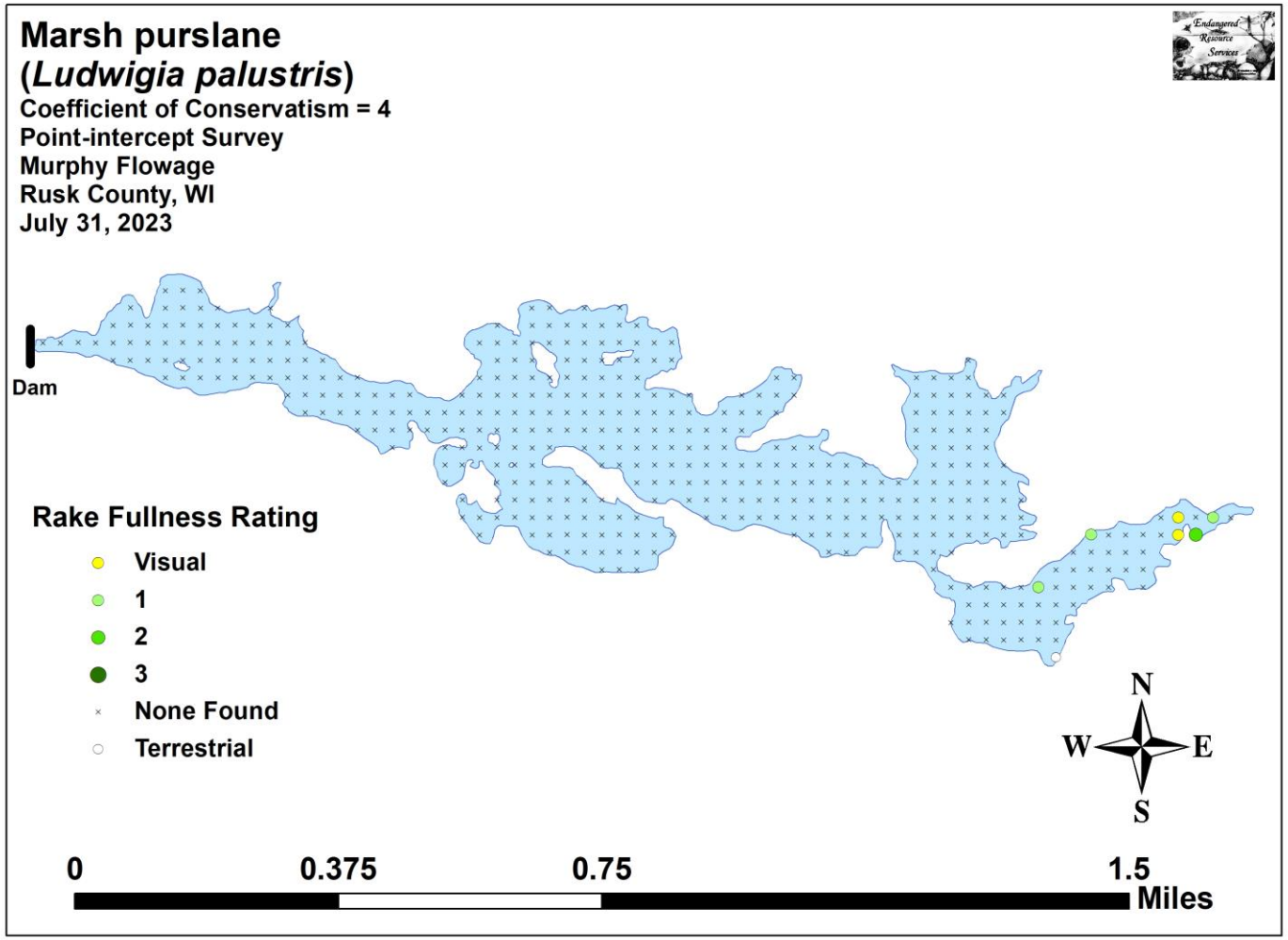
Miles


Marsh purslane
(Ludwigia palustris)
Coefficient of Conservatism = 4
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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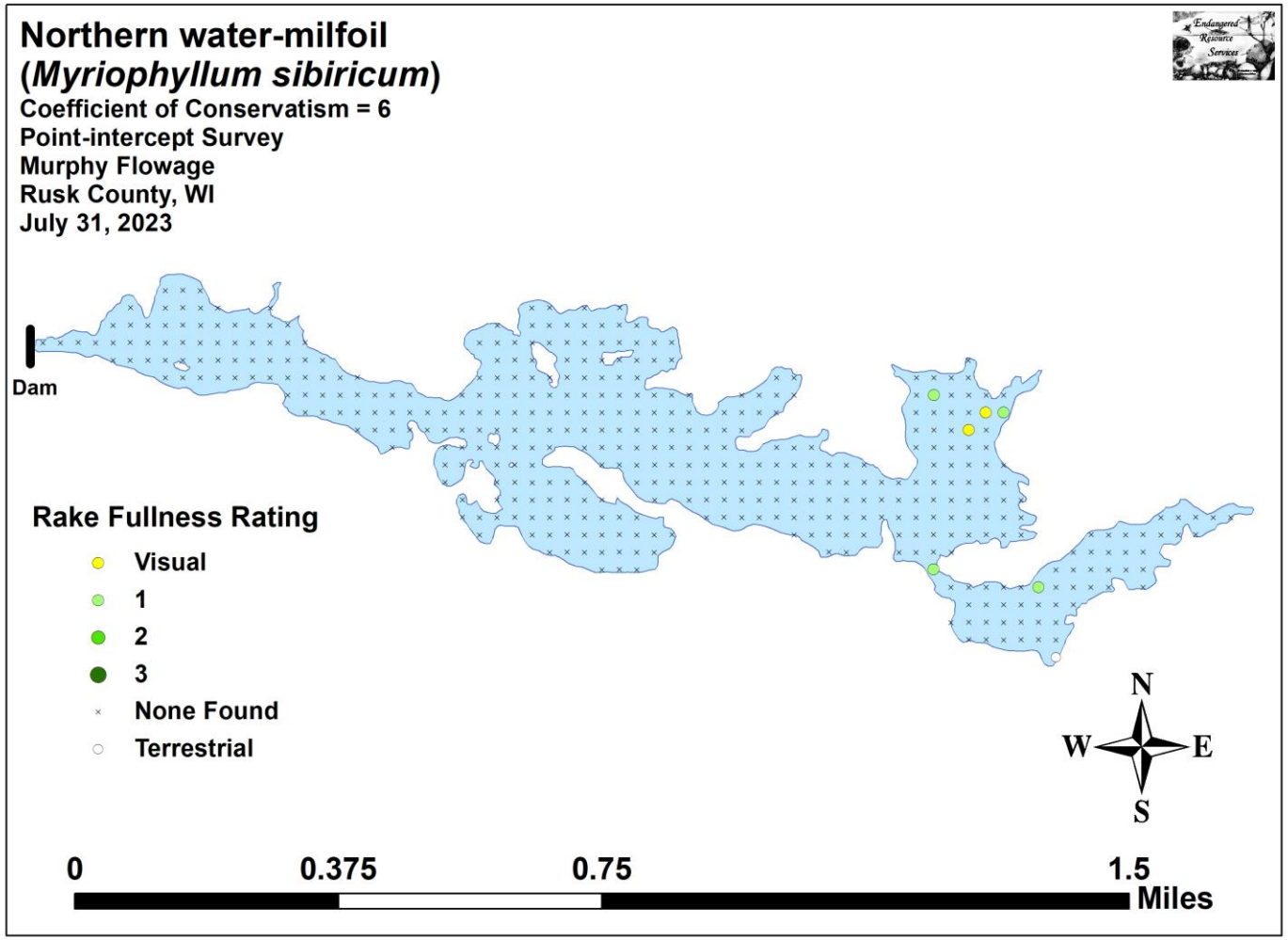
Miles


Northern water-milfoil
(Myriophyllum sibiricum)
Coefficient of Conservatism = 6
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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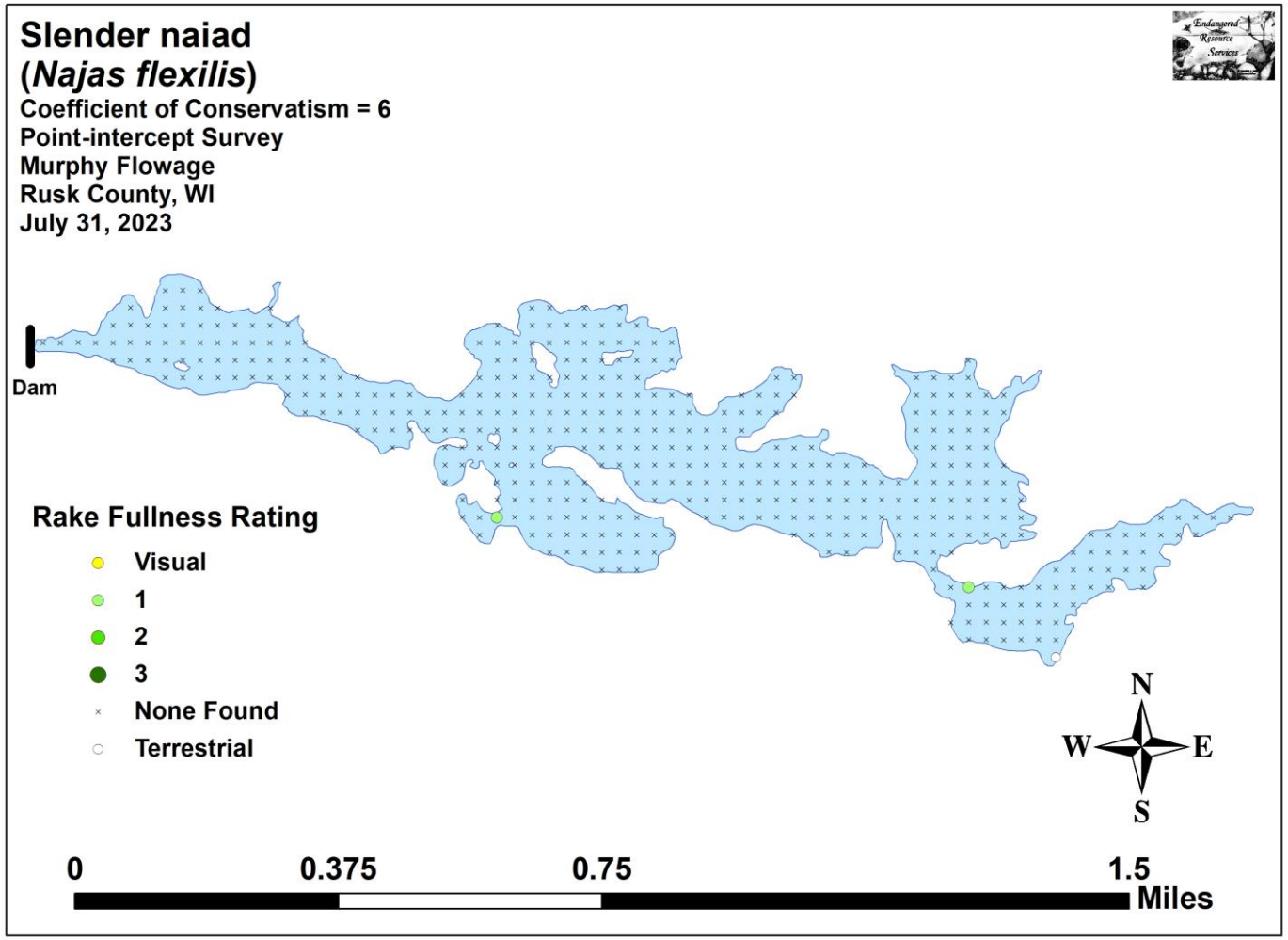
Miles


Slender naiad
(Najas flexilis)
Coefficient of Conservatism = 6
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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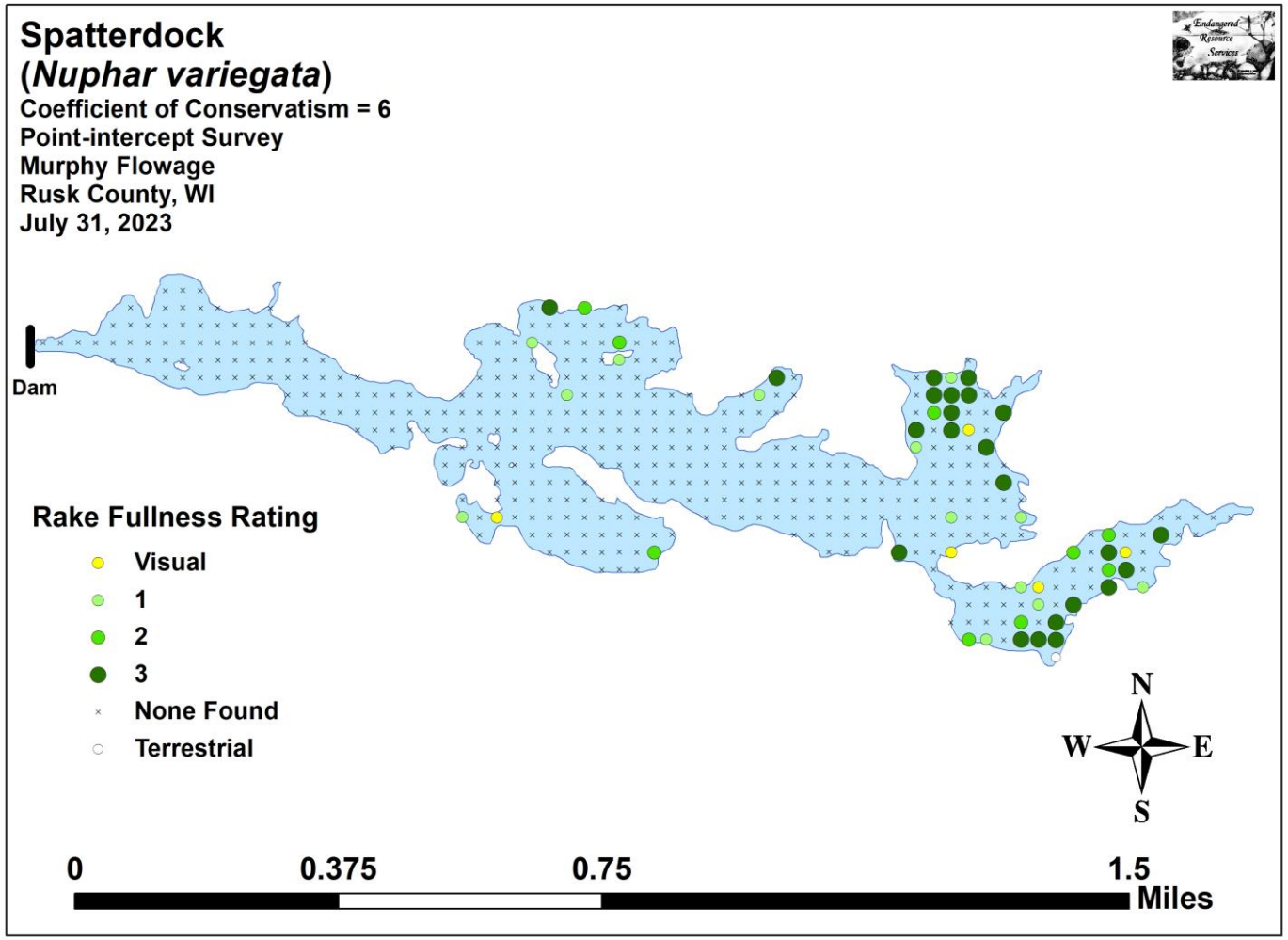
Miles


Spatterdock
(Nuphar variegata)
Coefficient of Conservatism = 6
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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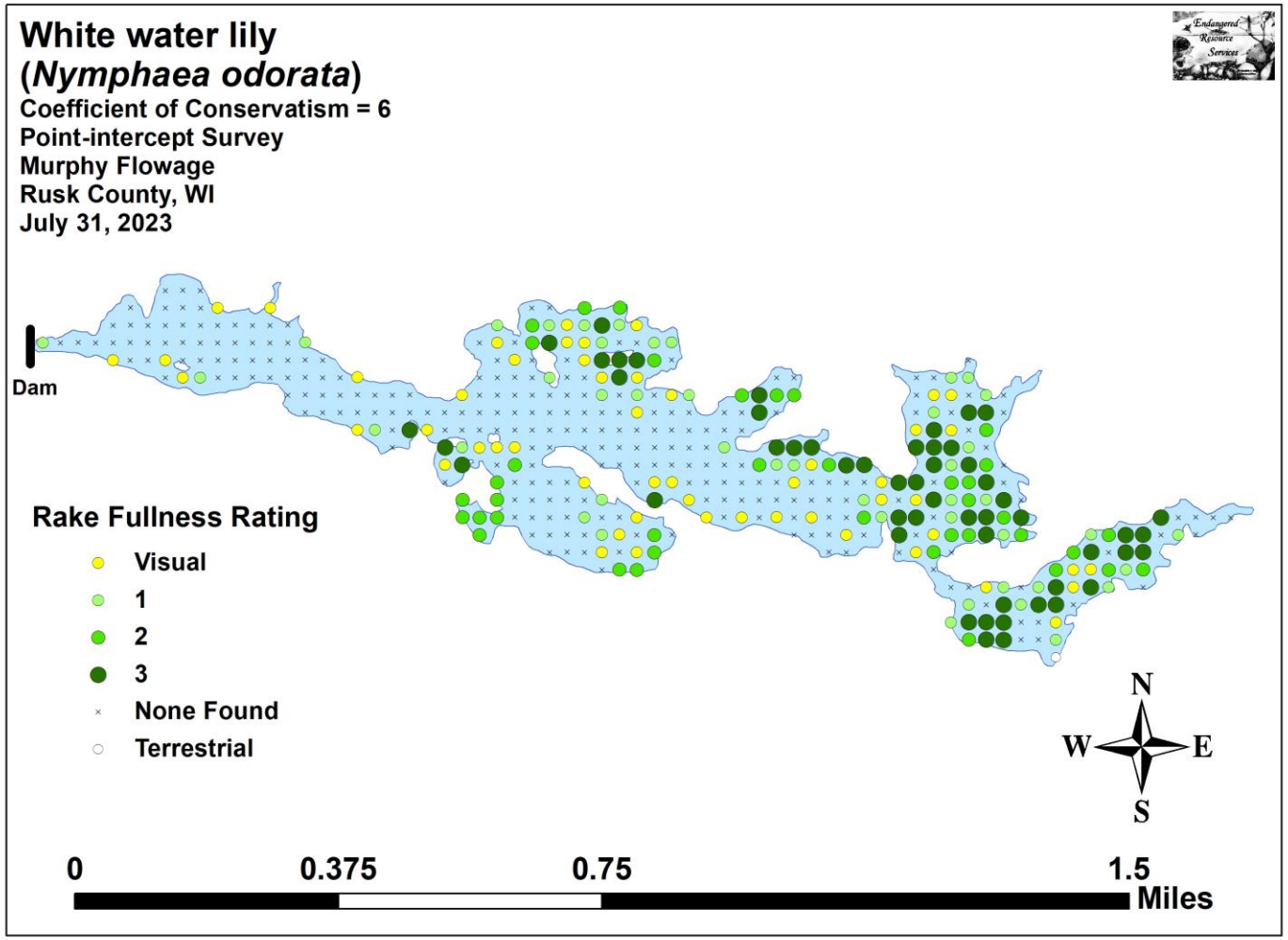
Miles


White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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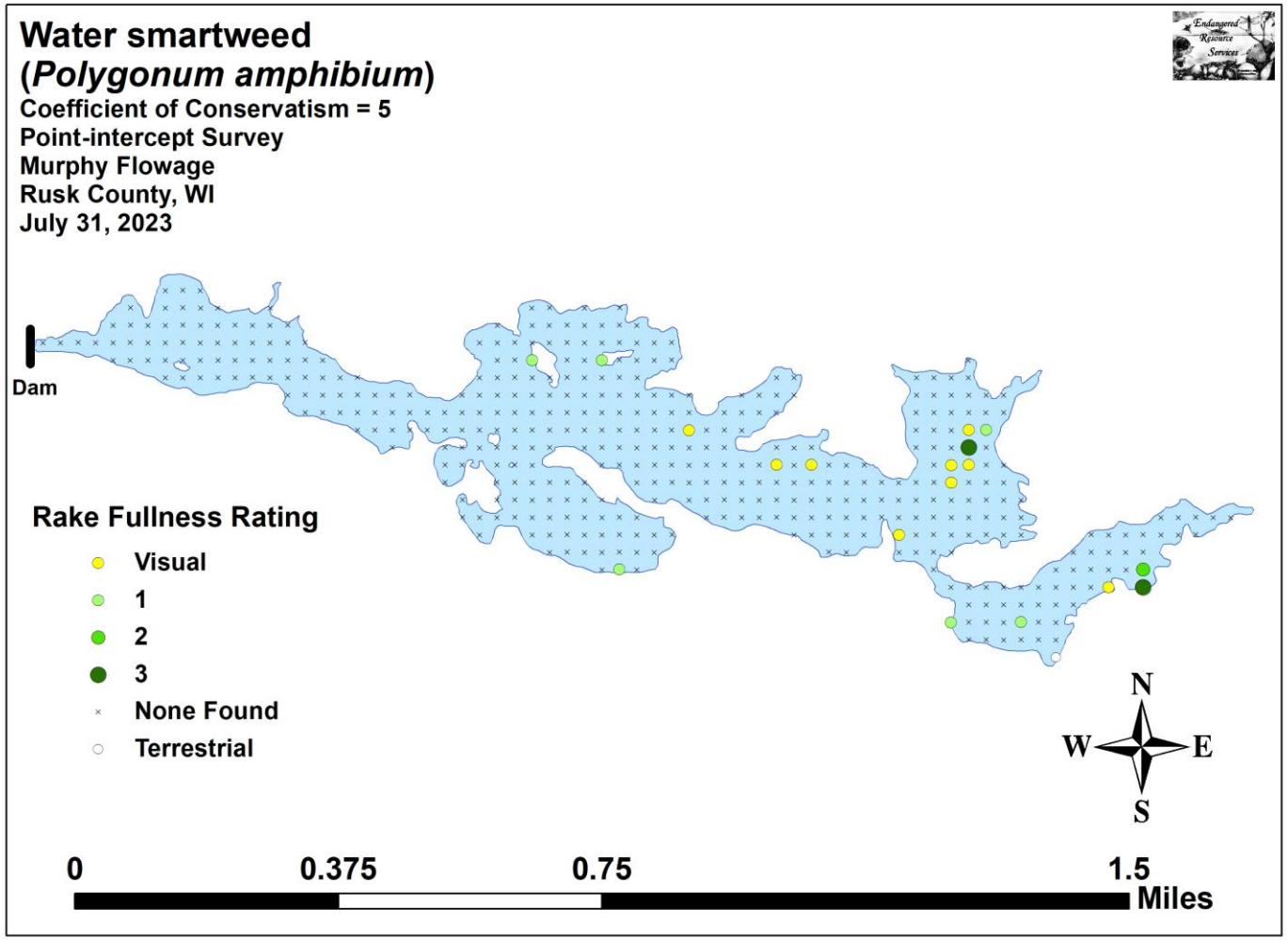
Miles


Water smartweed
(Polygonum amphibium)
Coefficient of Conservatism = 5
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
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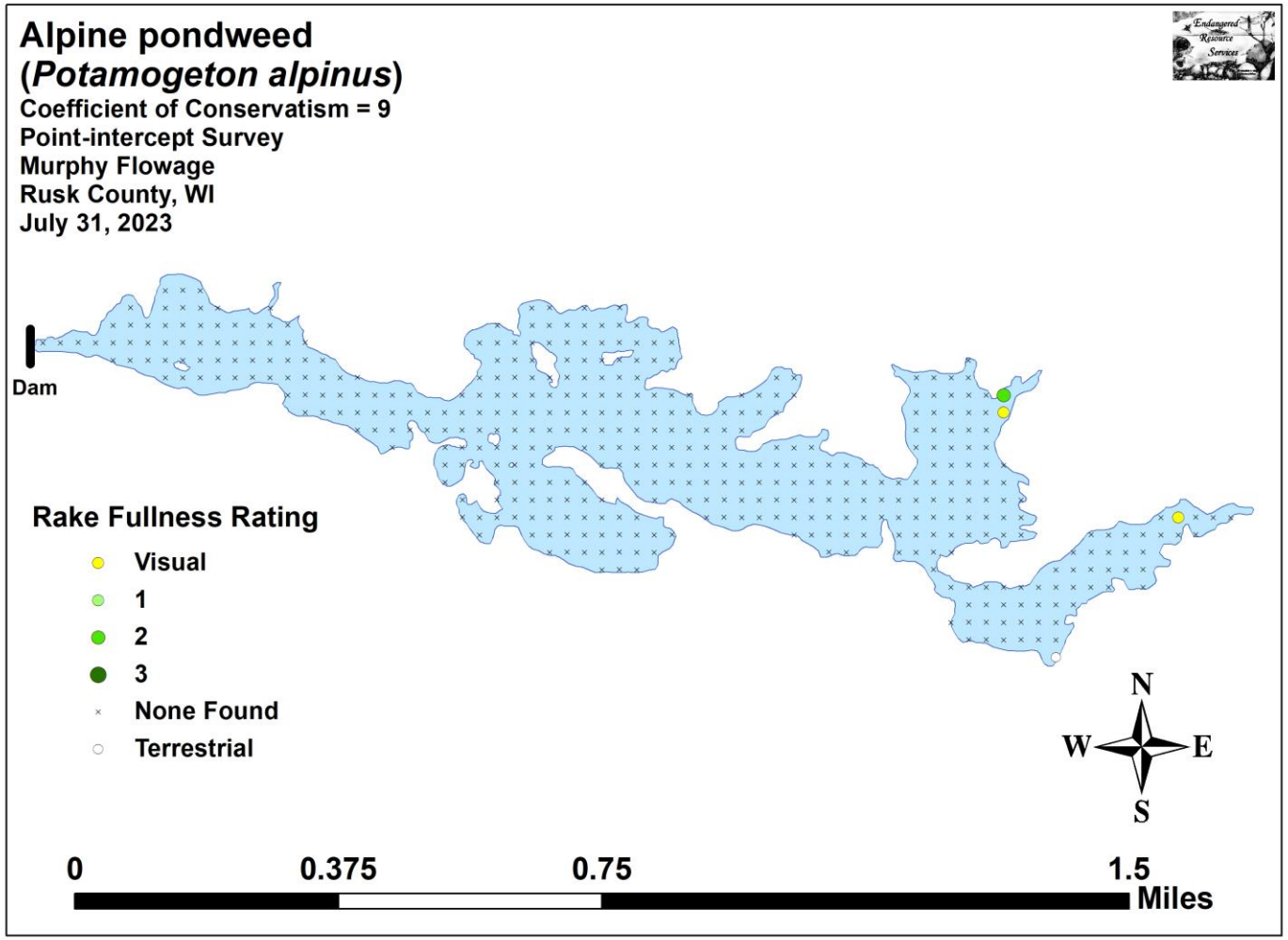
Miles


Alpine pondweed
(Potamogeton alpinus)
Coefficient of Conservatism = 9
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
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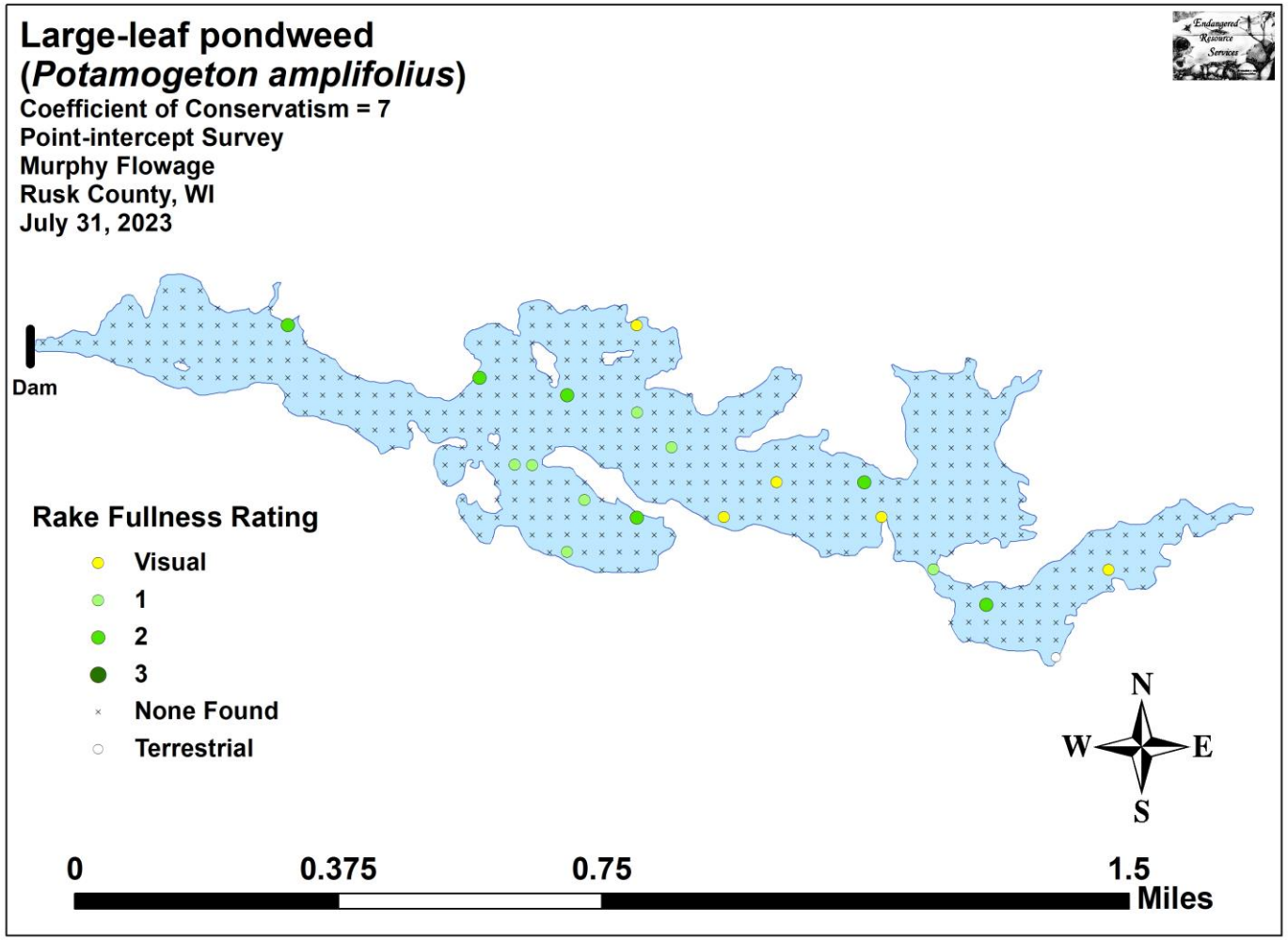
Large-leaf pondweed
(Potamogeton amplifolius)
Coefficient of Conservatism = 7
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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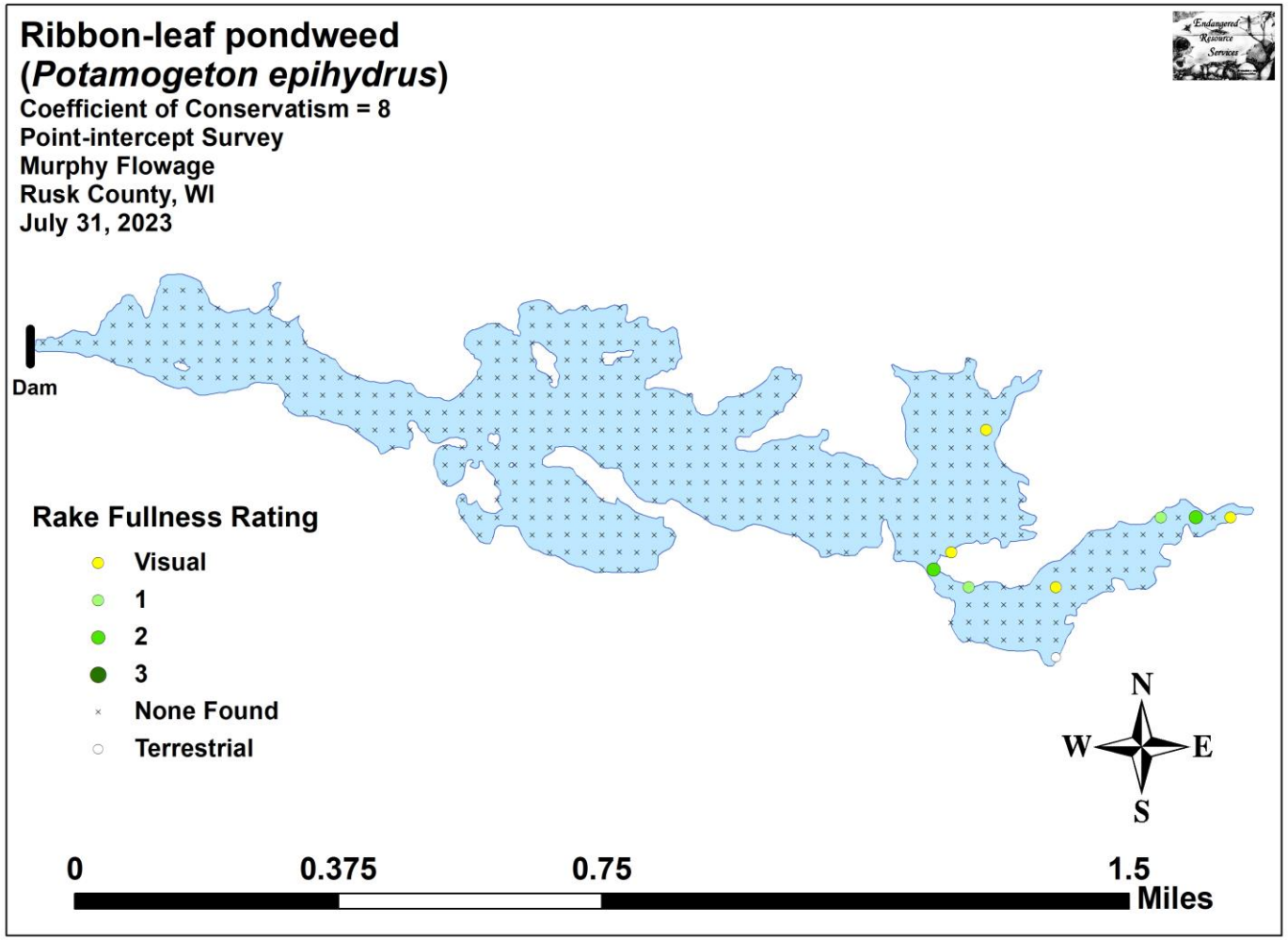
Miles


Ribbon-leaf pondweed
(Potamogeton epihydrus)
Coefficient of Conservatism = 8
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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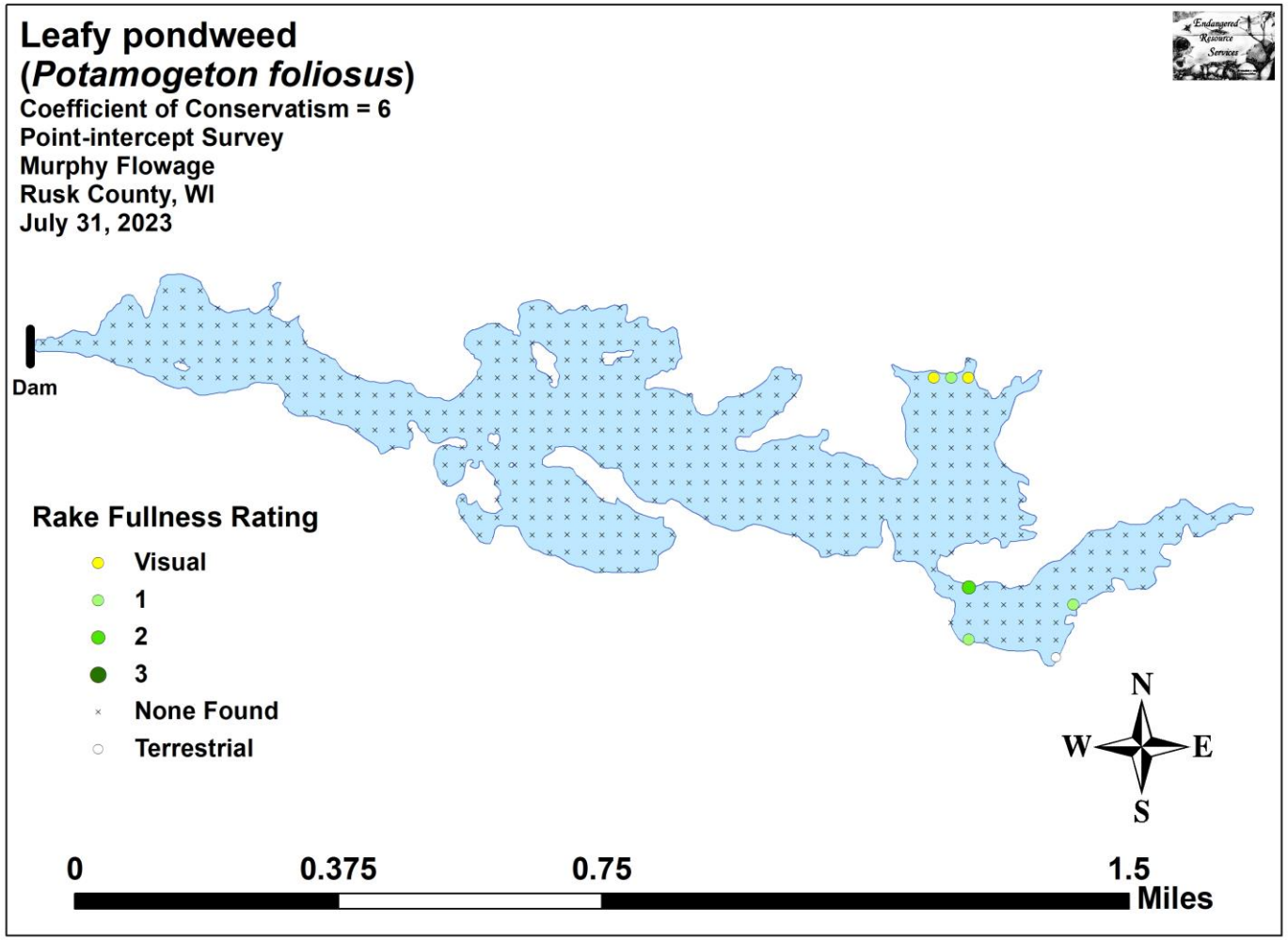
Miles


Leafy pondweed
(Potamogeton foliosus)
Coefficient of Conservatism = 6
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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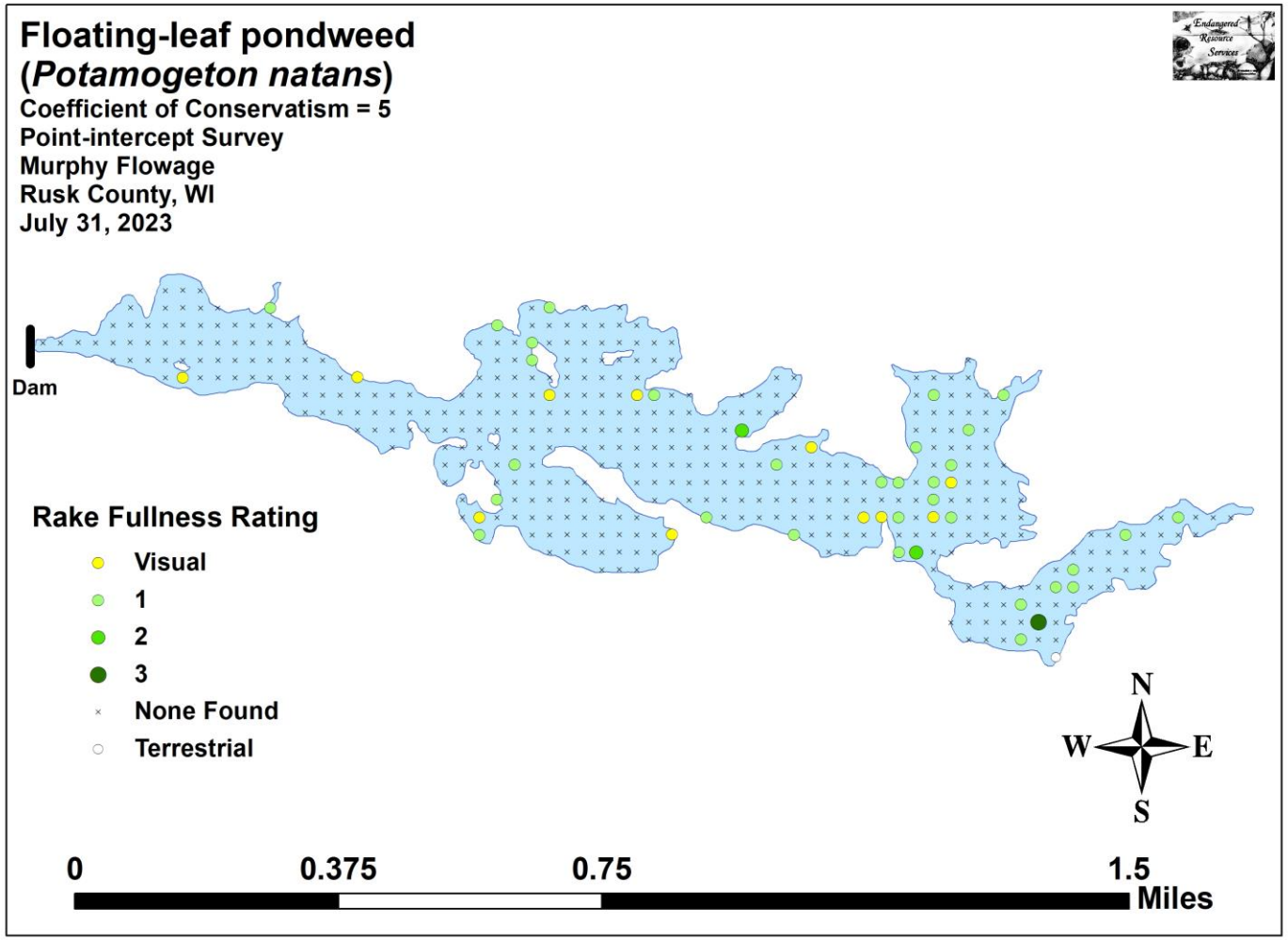
Miles


Floating-leaf pondweed
(Potamogeton natans)
Coefficient of Conservatism = 5
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
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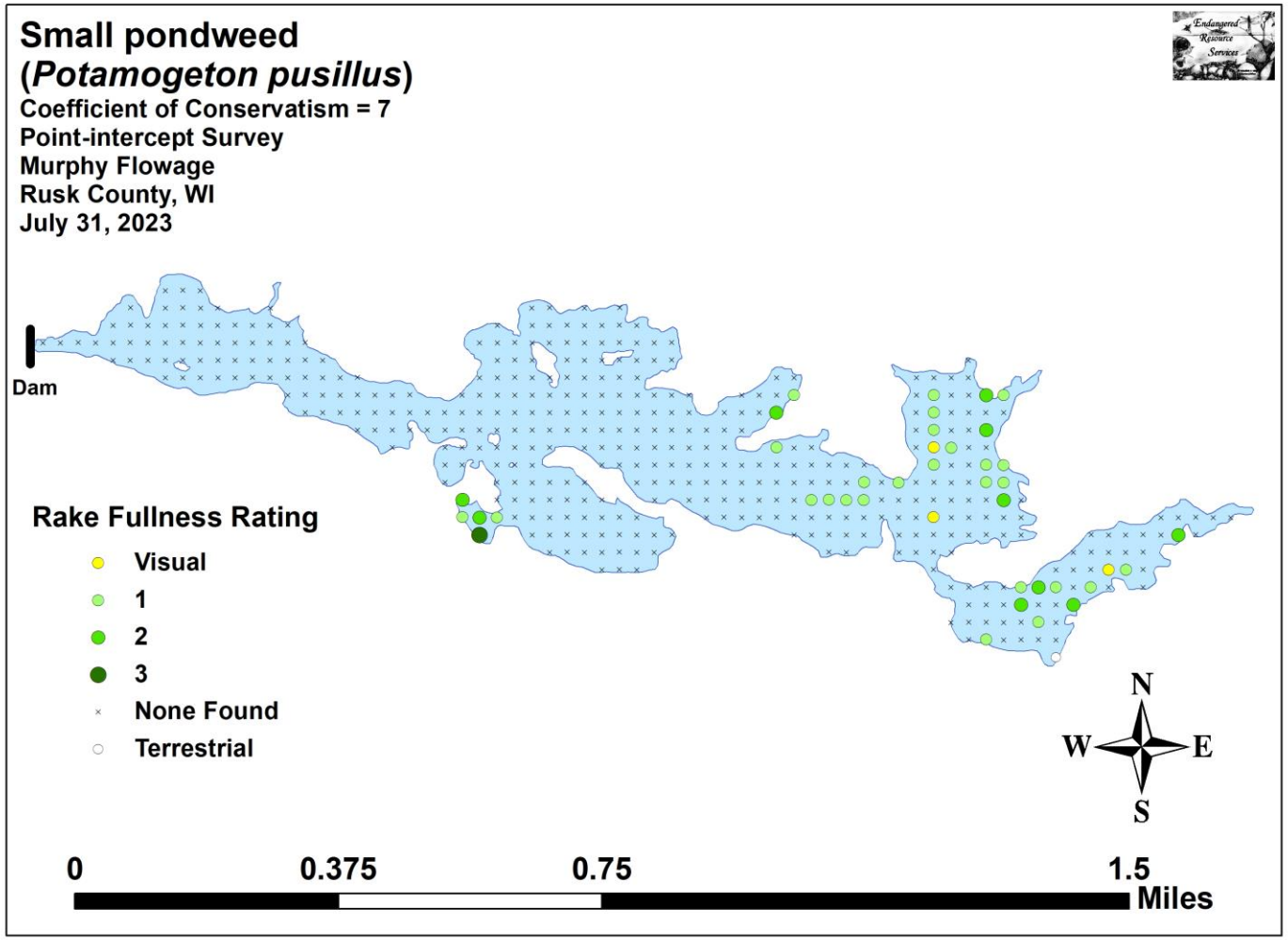
Miles


Small pondweed
(Potamogeton pusillus)
Coefficient of Conservatism = 7
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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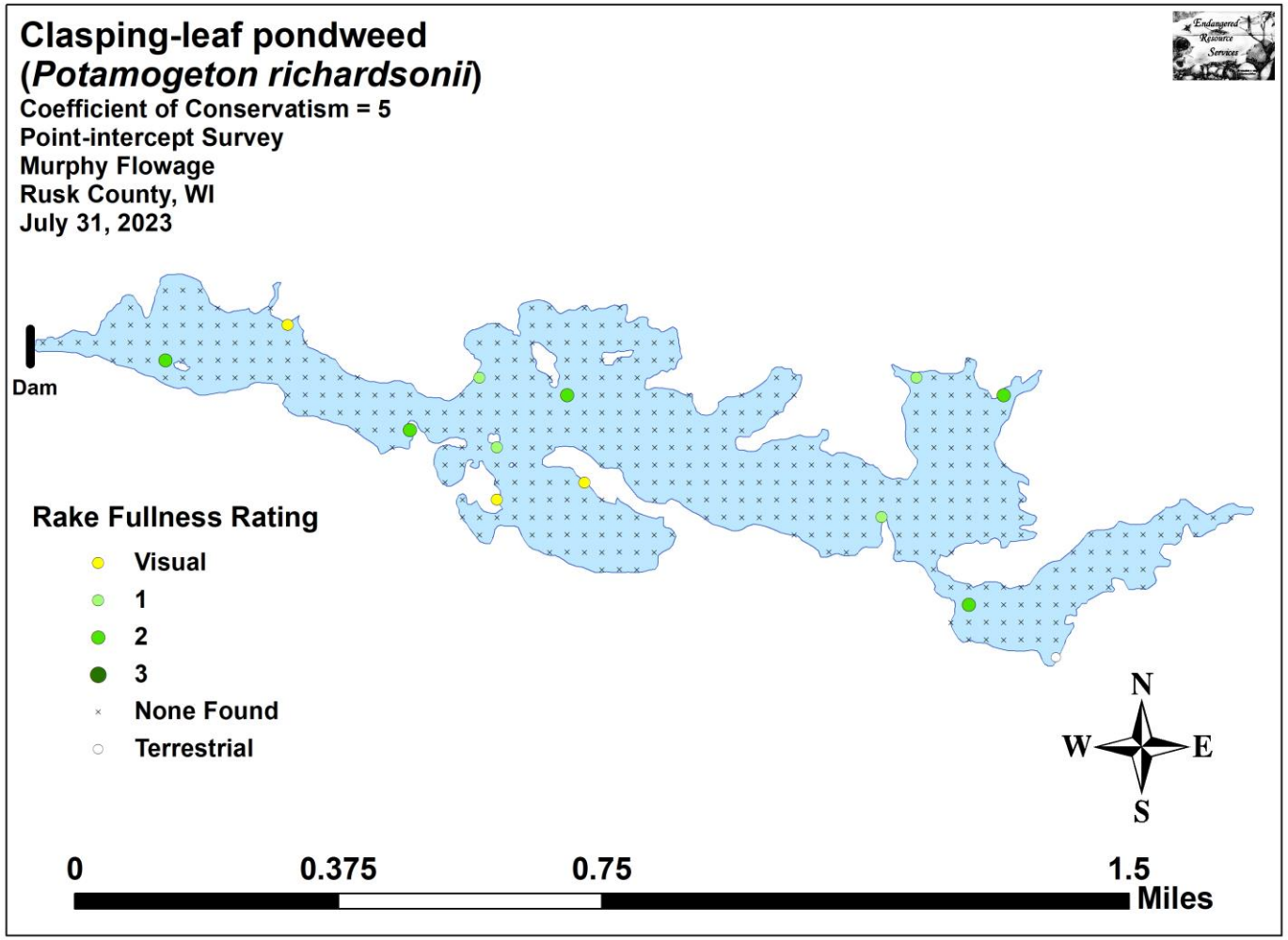
Miles


Clasping-leaf pondweed
(Potamogeton richardsonii)
Coefficient of Conservatism = 5
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
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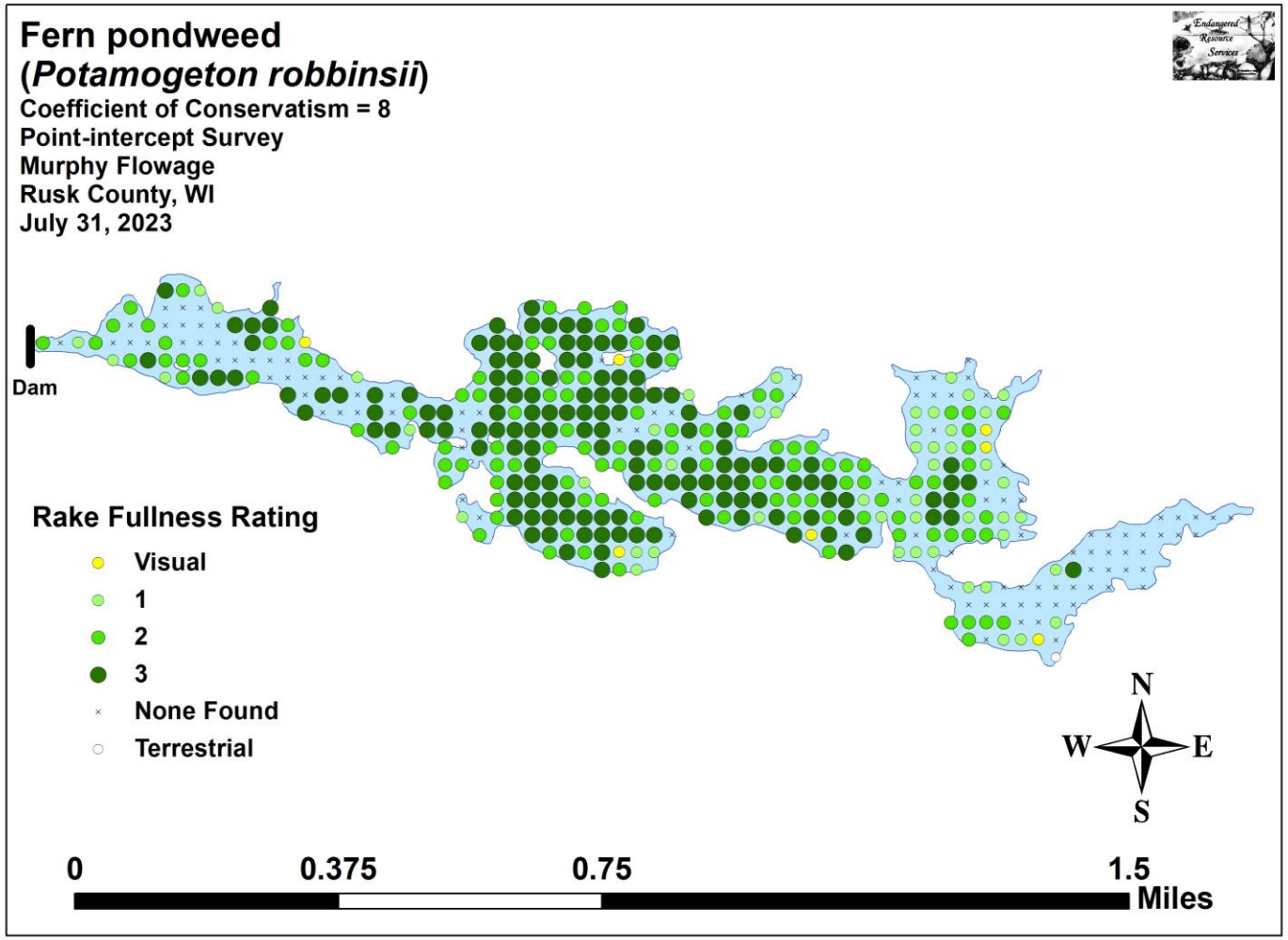
Miles


Fern pondweed
(Potamogeton robbinsii)
Coefficient of Conservatism = 8
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
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None Found
Terrestrial
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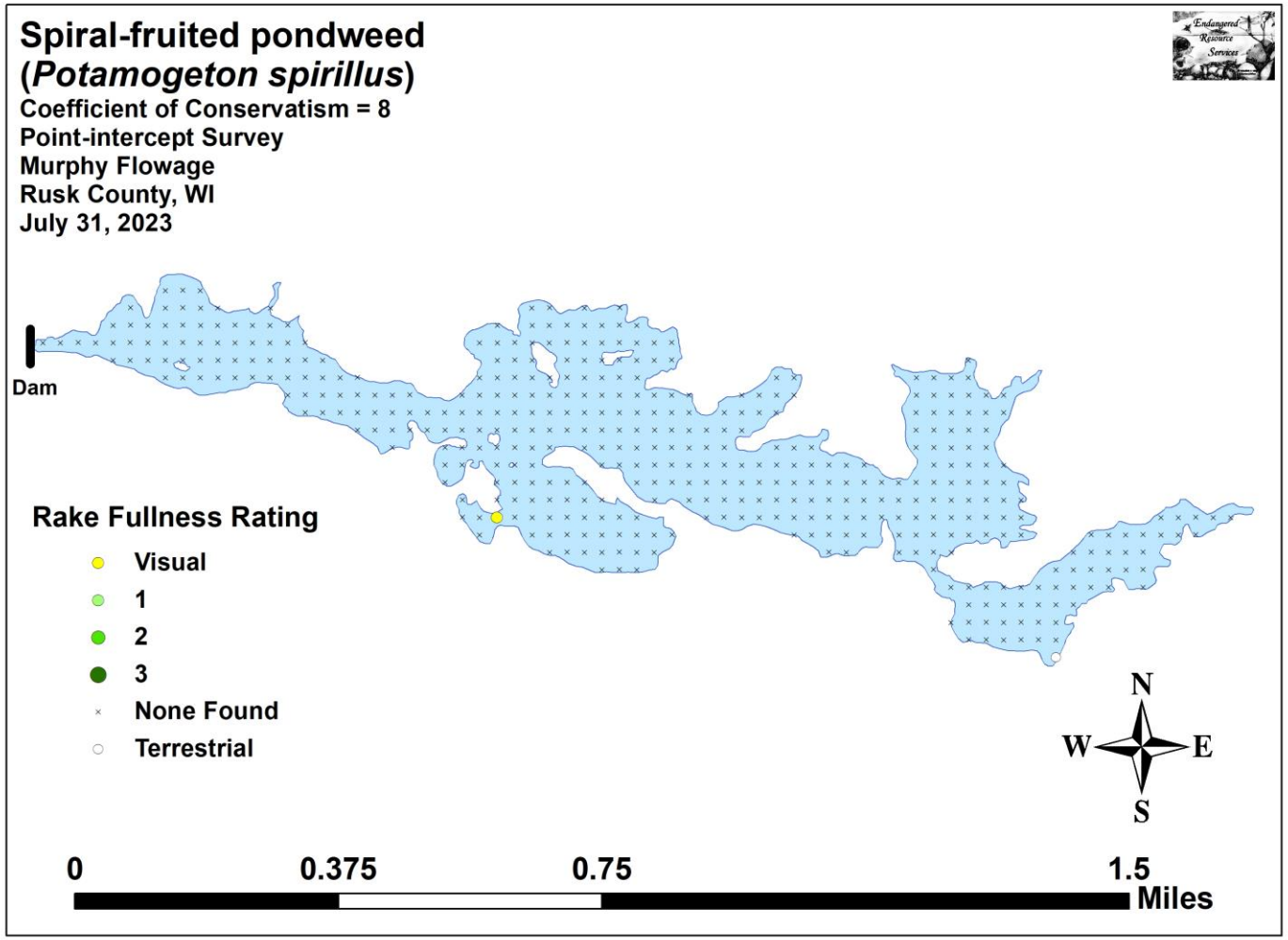
Miles


Spiral-fruited pondweed
(Potamogeton spirillus)
Coefficient of Conservatism = 8
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
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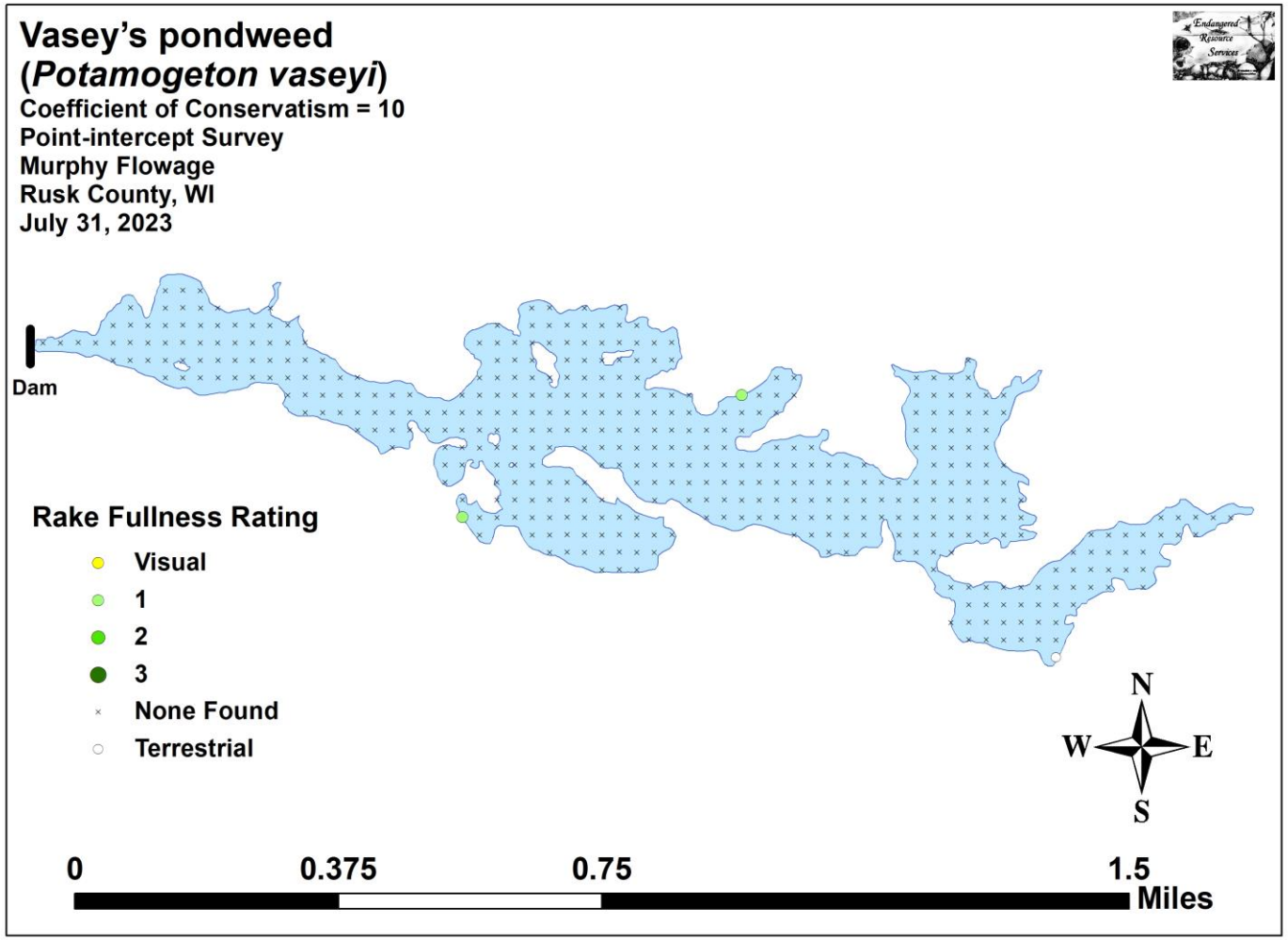
Miles


Vasey's pondweed
(Potamogeton vaseyi)
Coefficient of Conservatism = 10
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
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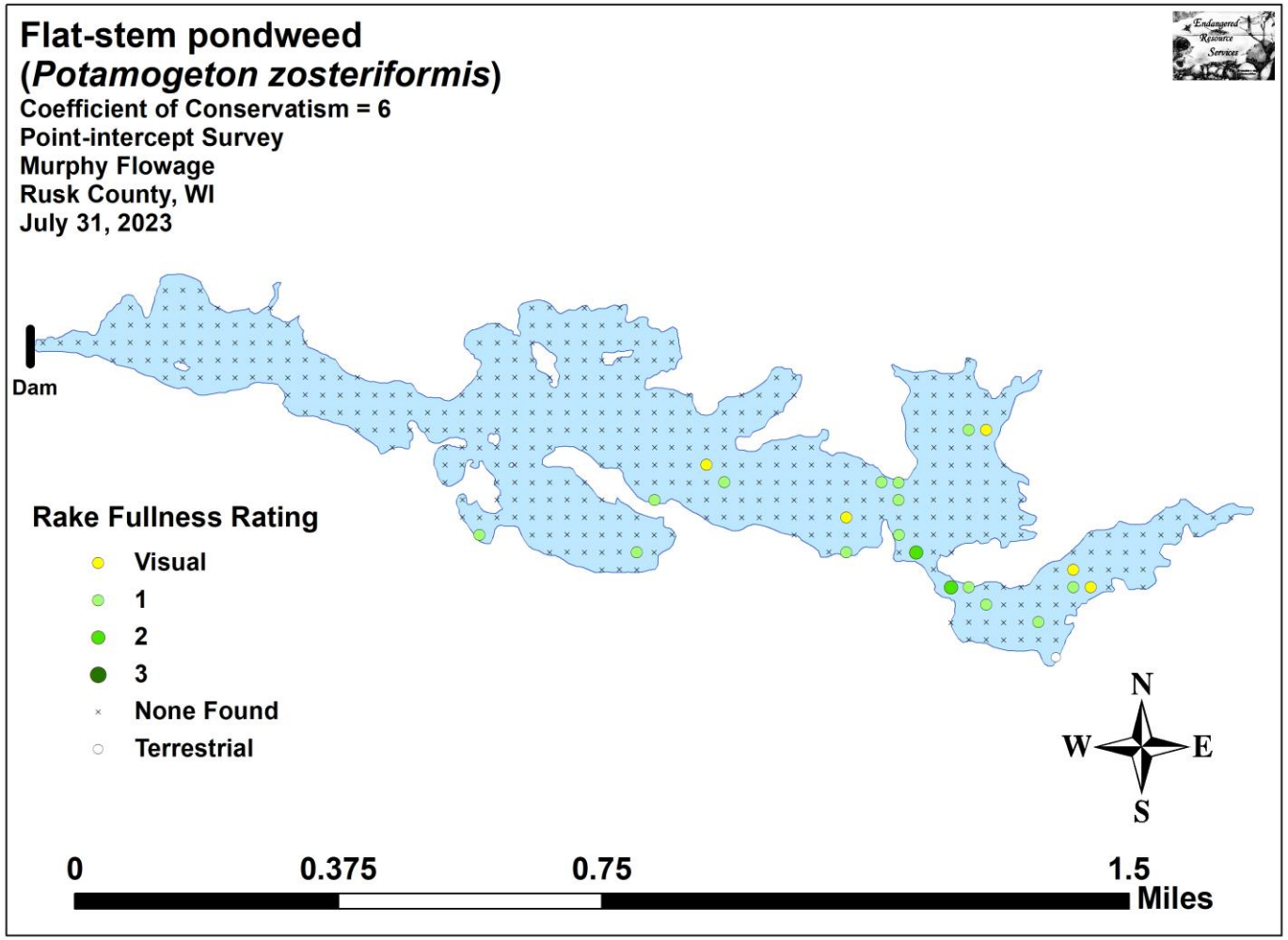
Miles


Flat-stem pondweed
(Potamogeton zosteriformis)
Coefficient of Conservatism = 6
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
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None Found
Terrestrial
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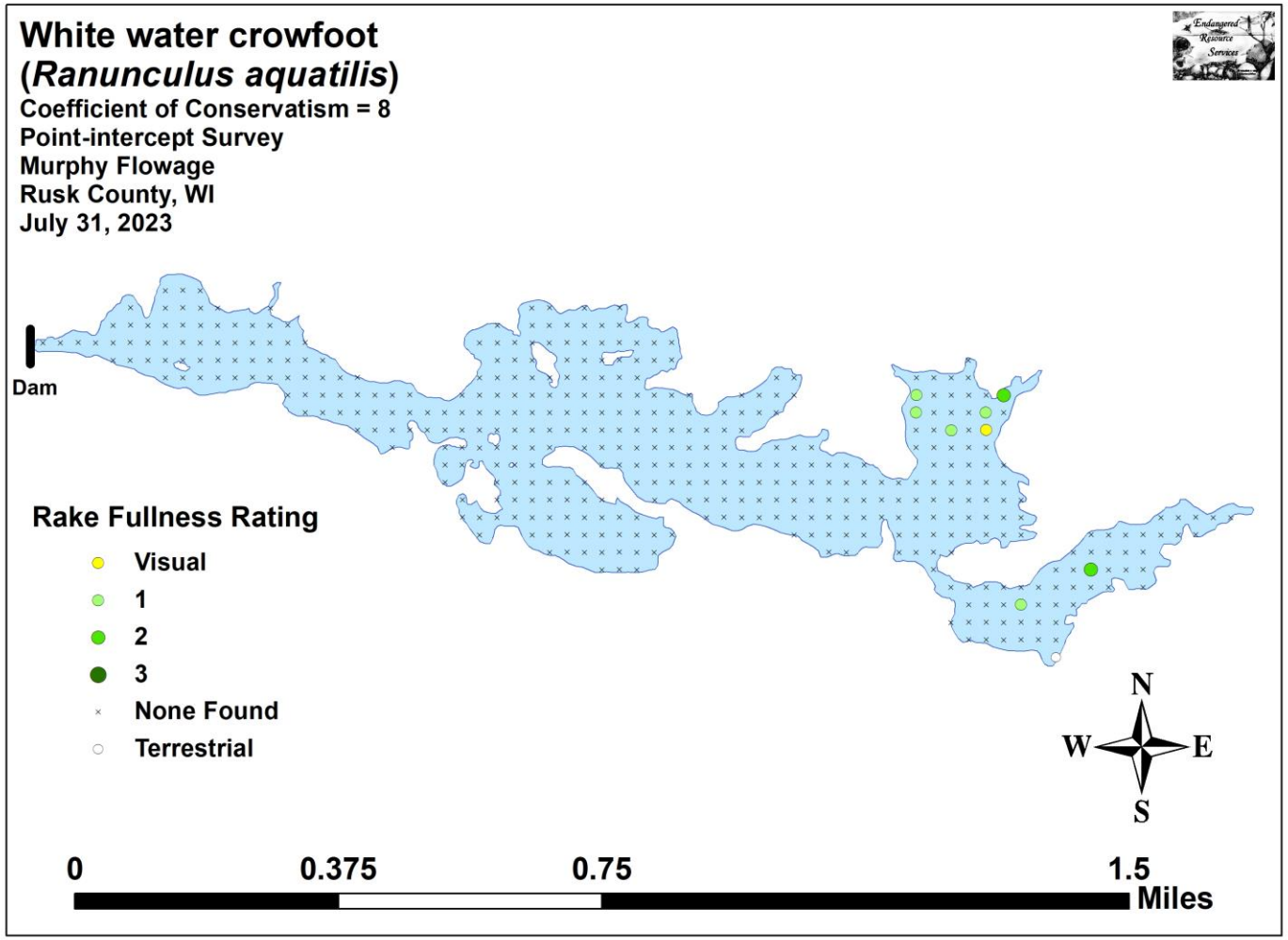
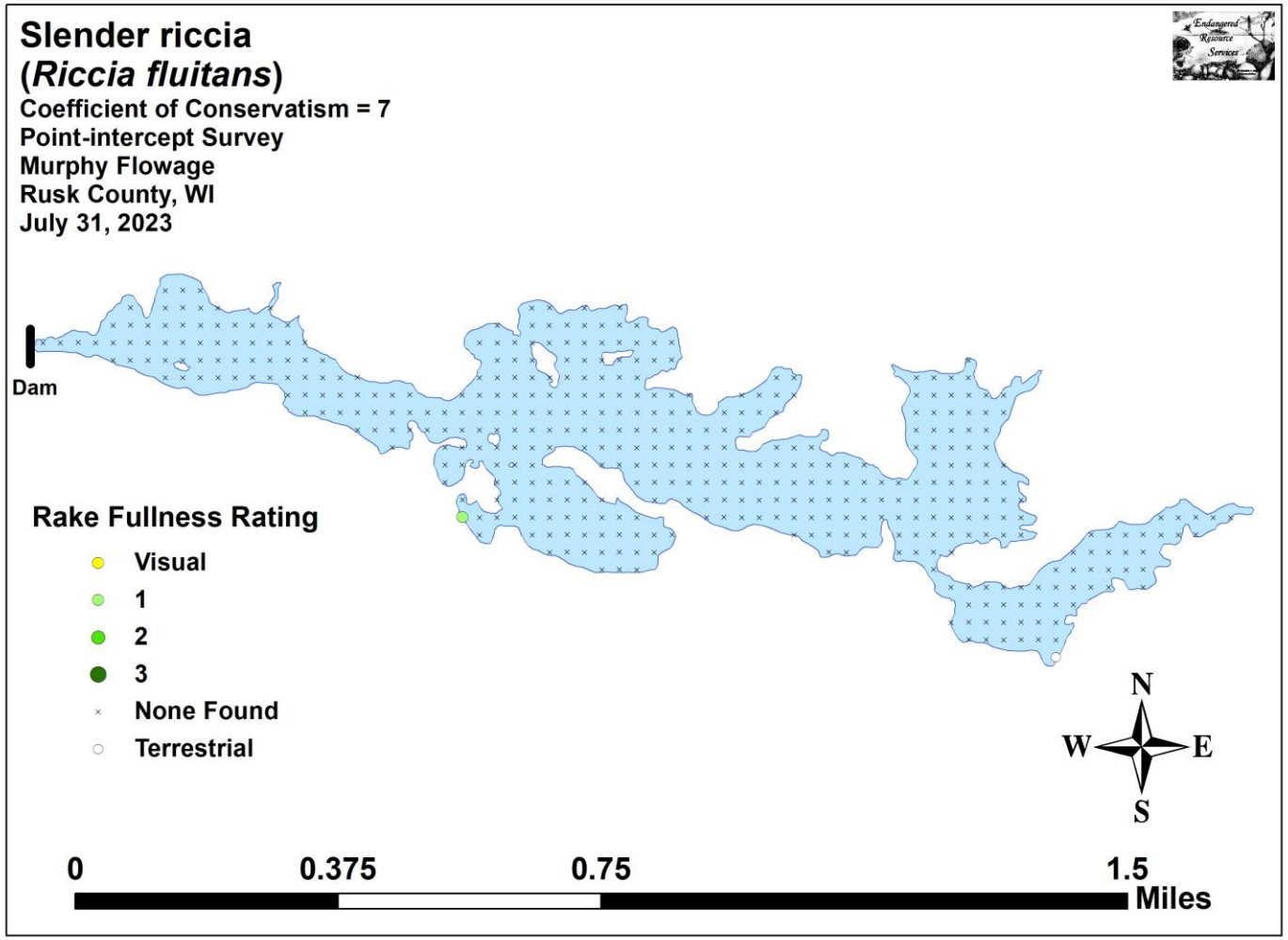
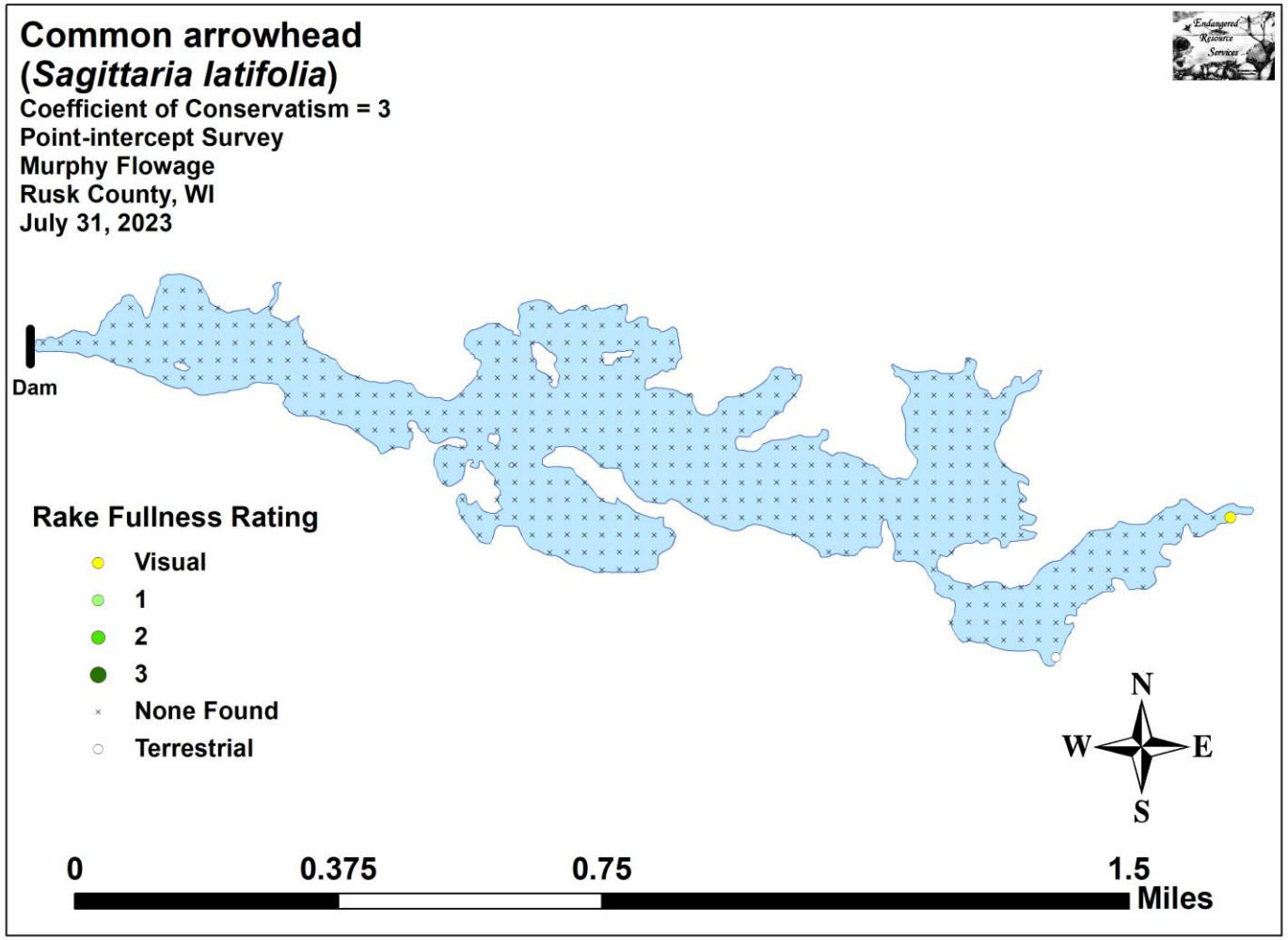
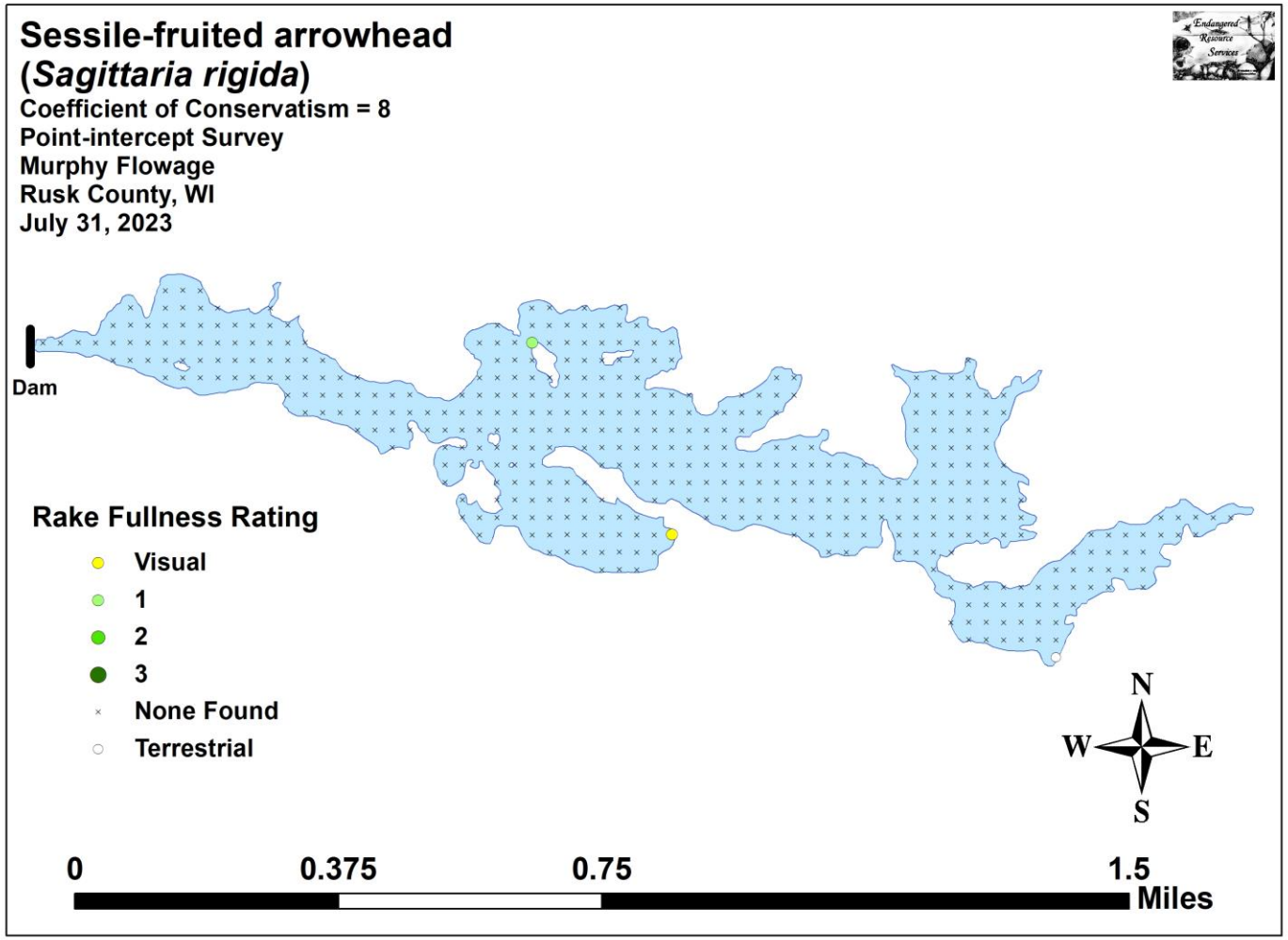
1.5
Miles


White water crowfoot
(Ranunculus aquatilis)
Coefficient of Conservatism = 8
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles


Slender riccia
(Riccia fluitans)
Coefficient of Conservatism = 7
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles


Common arrowhead
(Sagittaria latifolia)
Coefficient of Conservatism = 3
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles


Sessile-fruited arrowhead
(Sagittaria rigida)
Coefficient of Conservatism = 8
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
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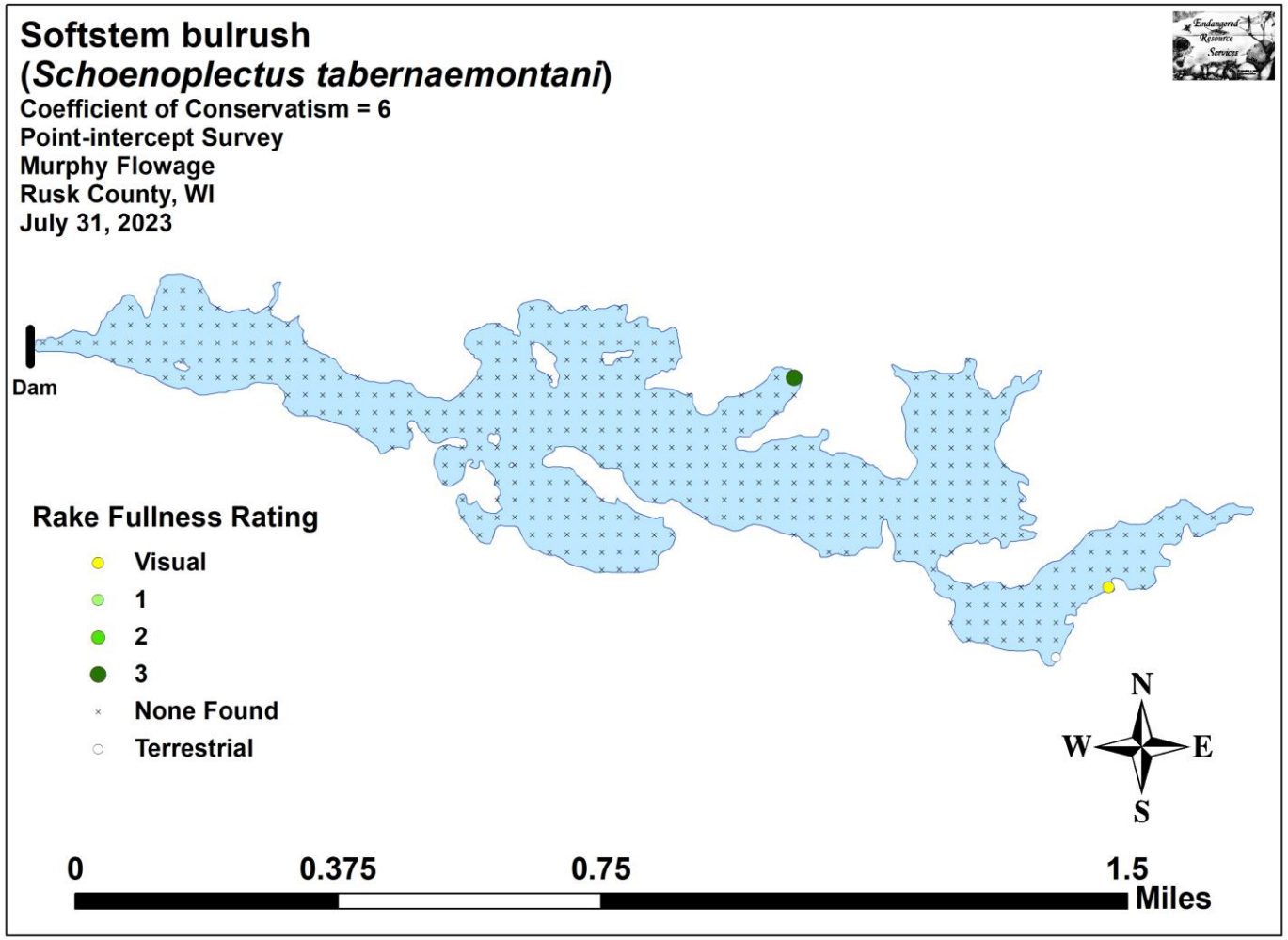
0.375
0.75
1.5
Miles


Softstem bulrush
(Schoenoplectus tabernaemontani)
Coefficient of Conservatism = 6
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
W
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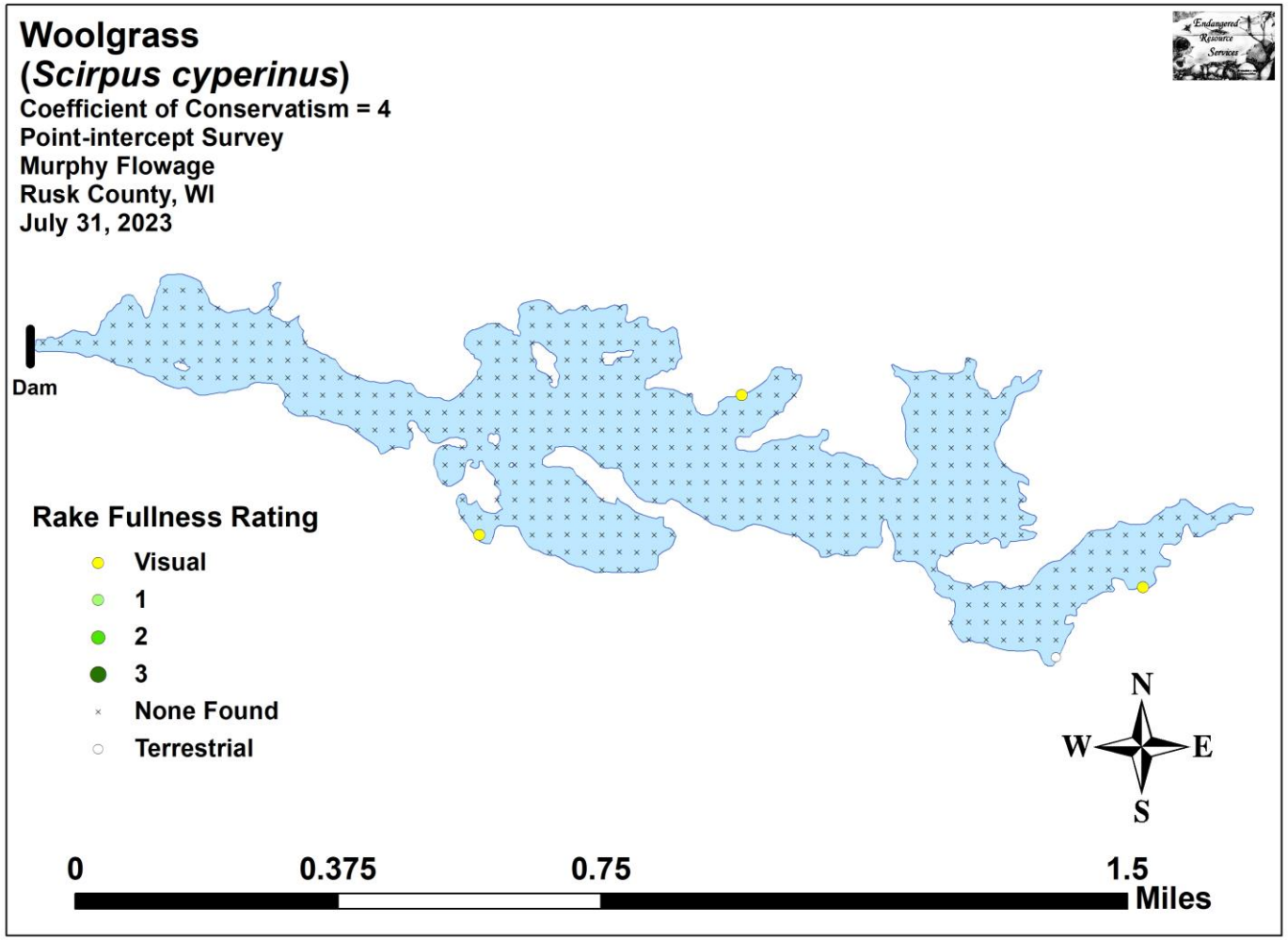
S
0
0.375
0.75
1.5
Miles


Woolgrass
(Scirpus cyperinus)
Coefficient of Conservatism = 4
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
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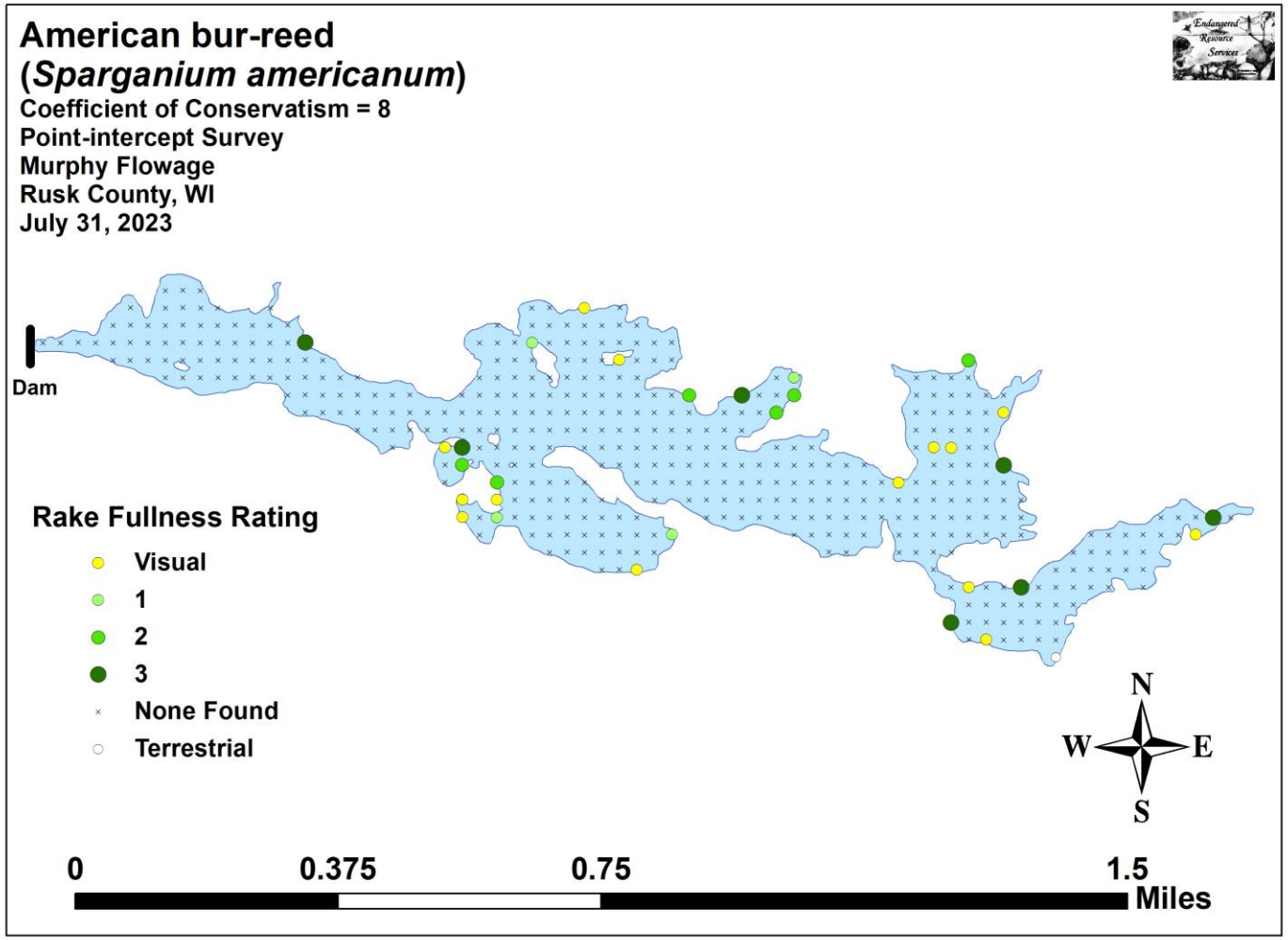
W
E
S
0
0.375
0.75
1.5
Miles


American bur-reed
(Sparganium americanum)
Coefficient of Conservatism = 8
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
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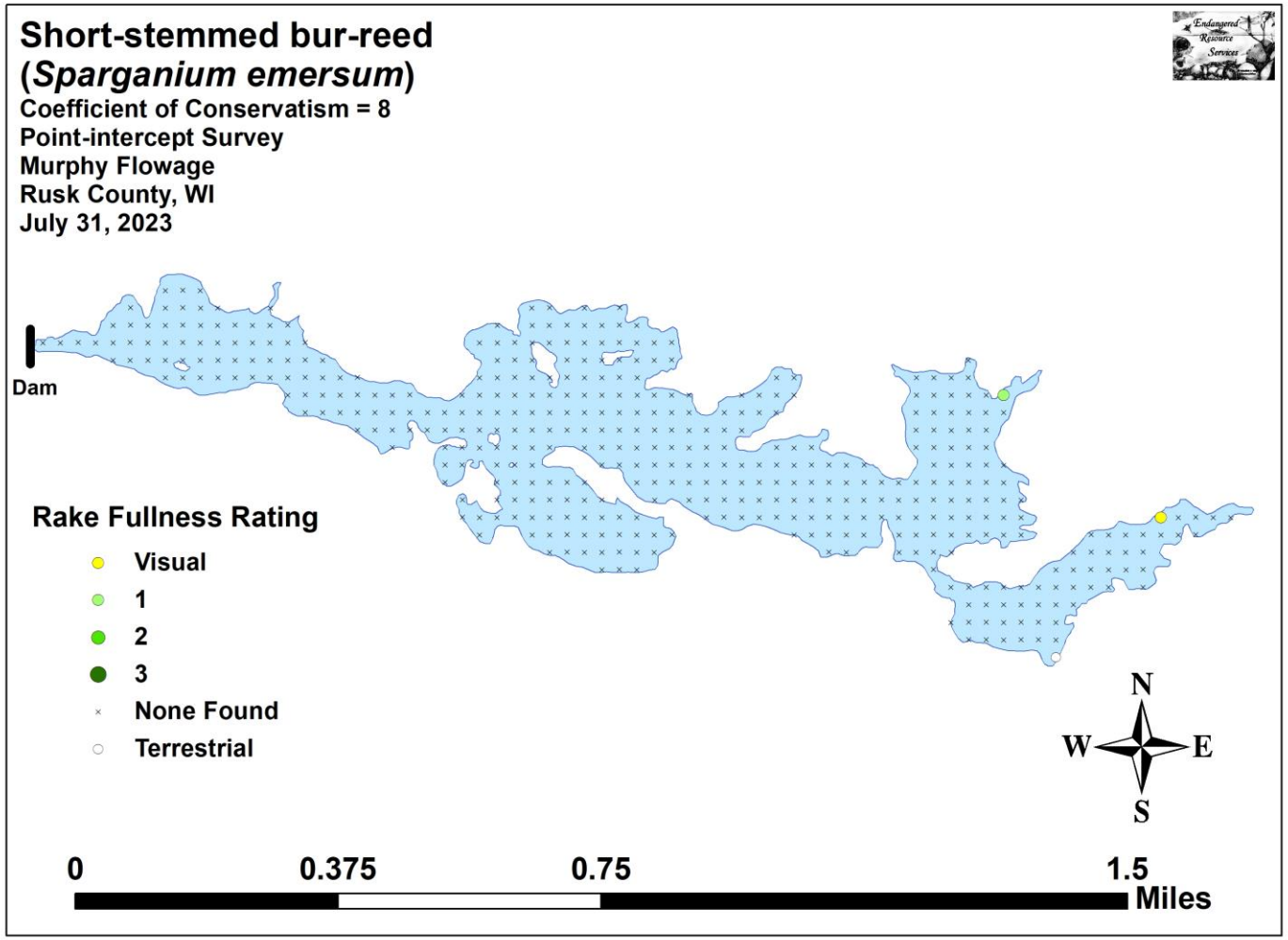
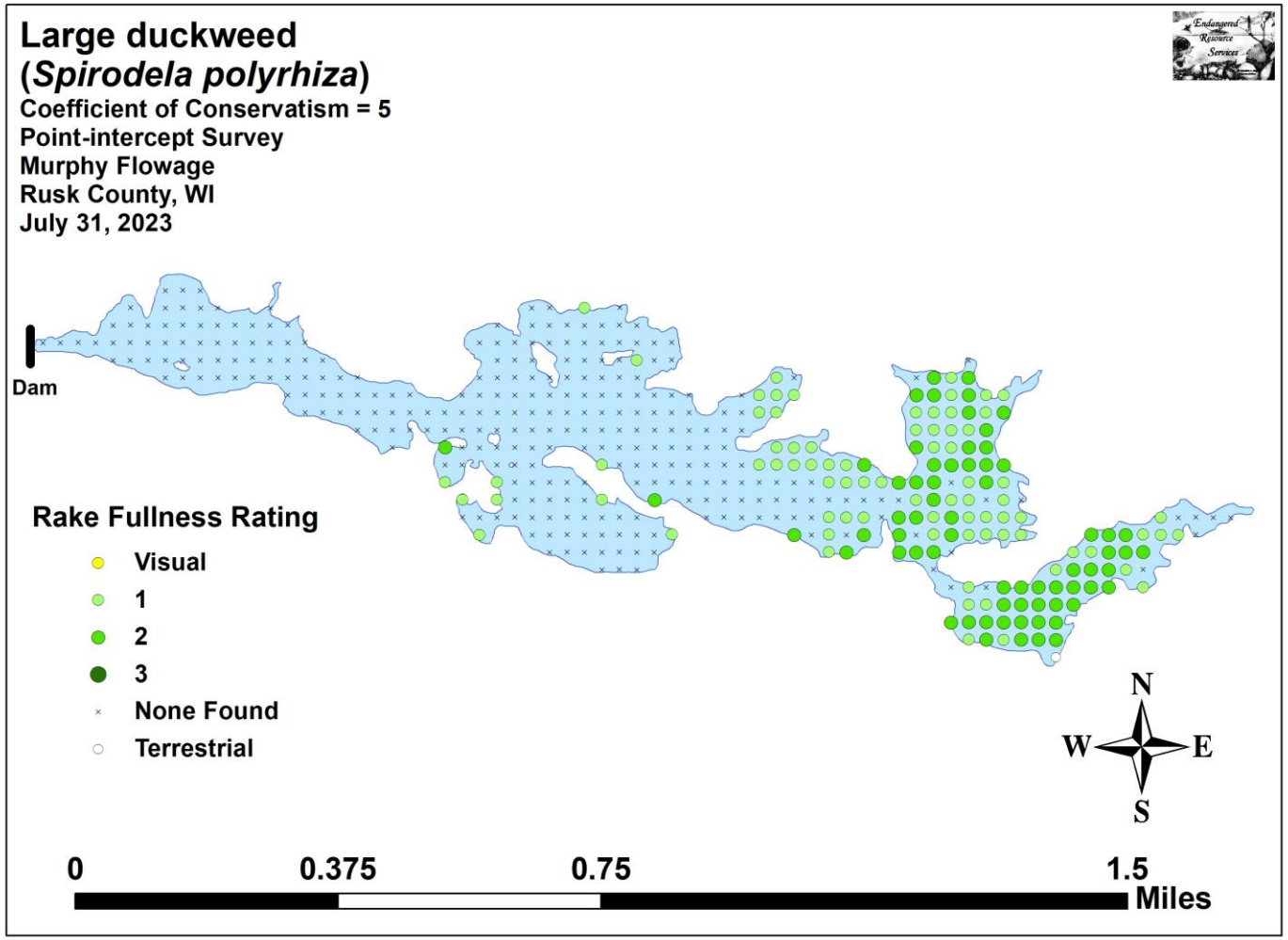
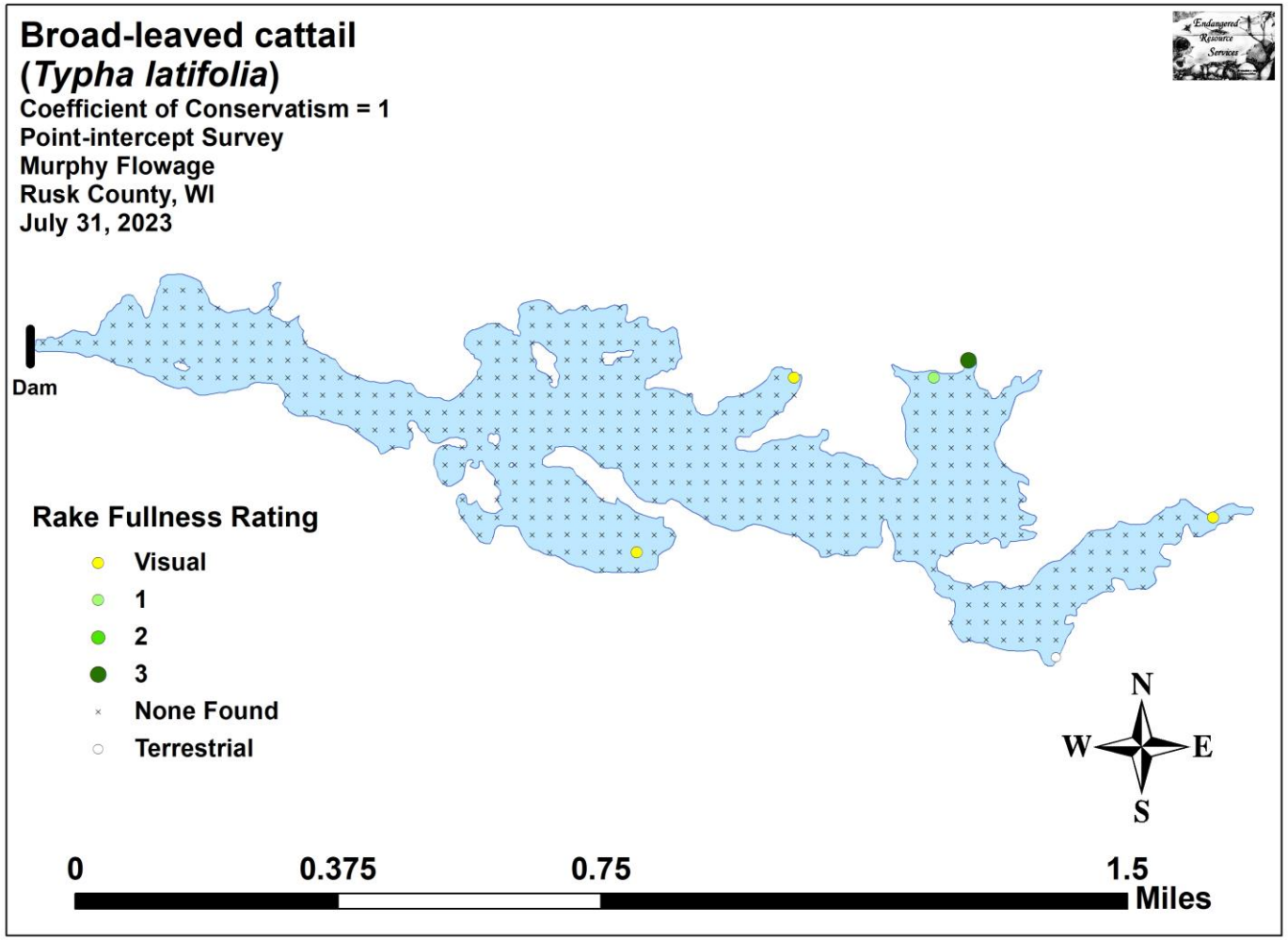
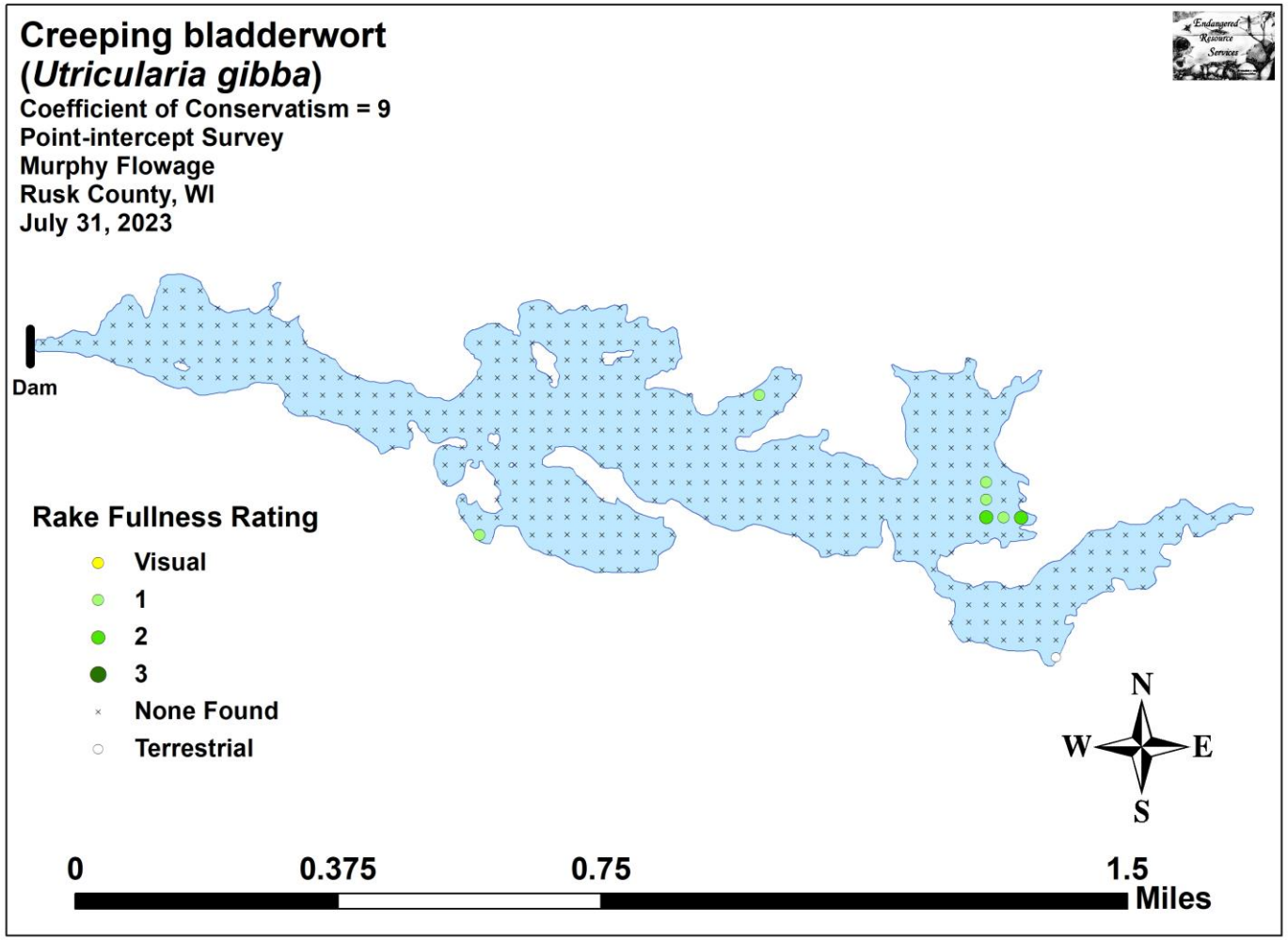
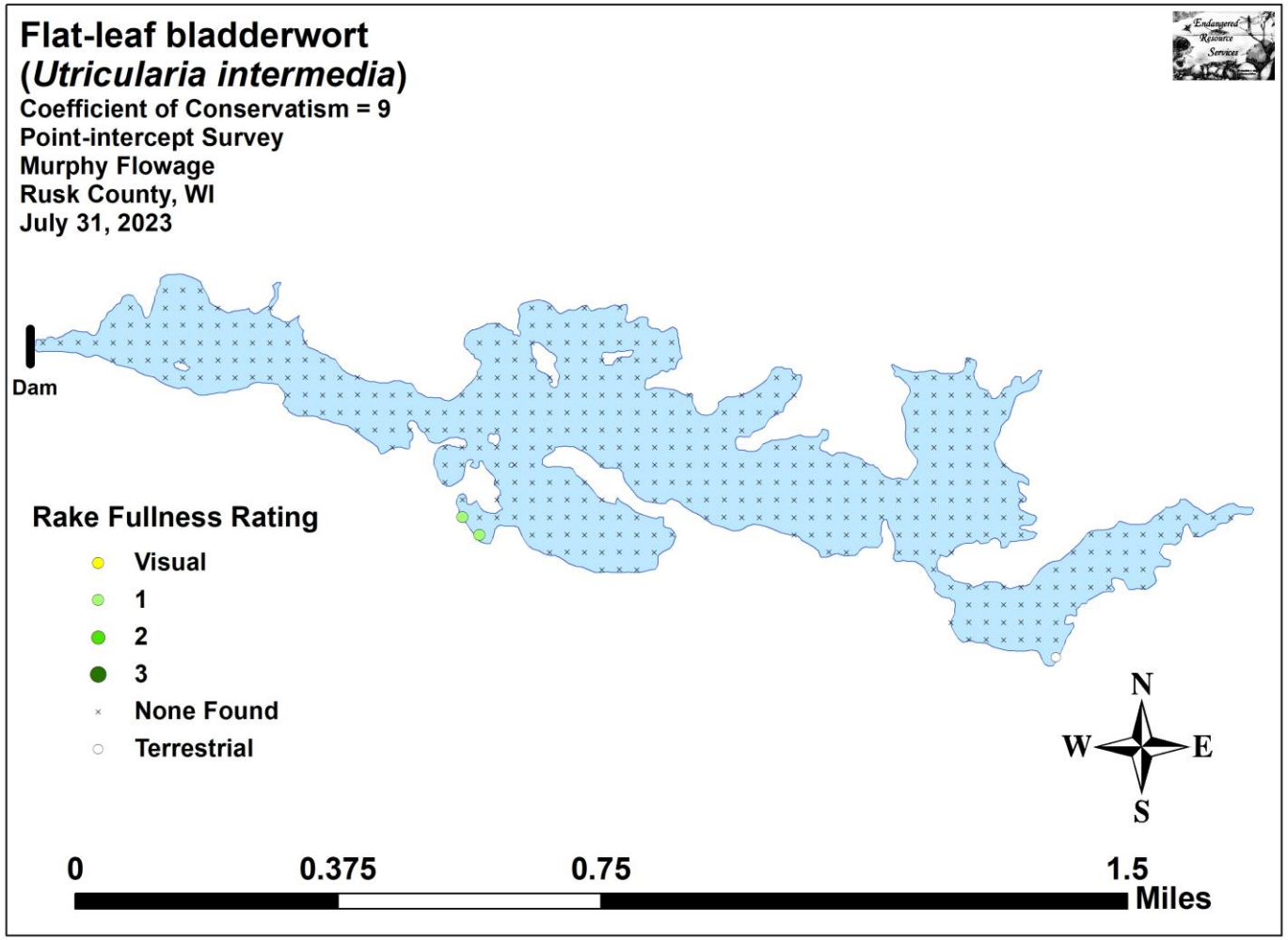
S
0
0.375
0.75
1.5
Miles

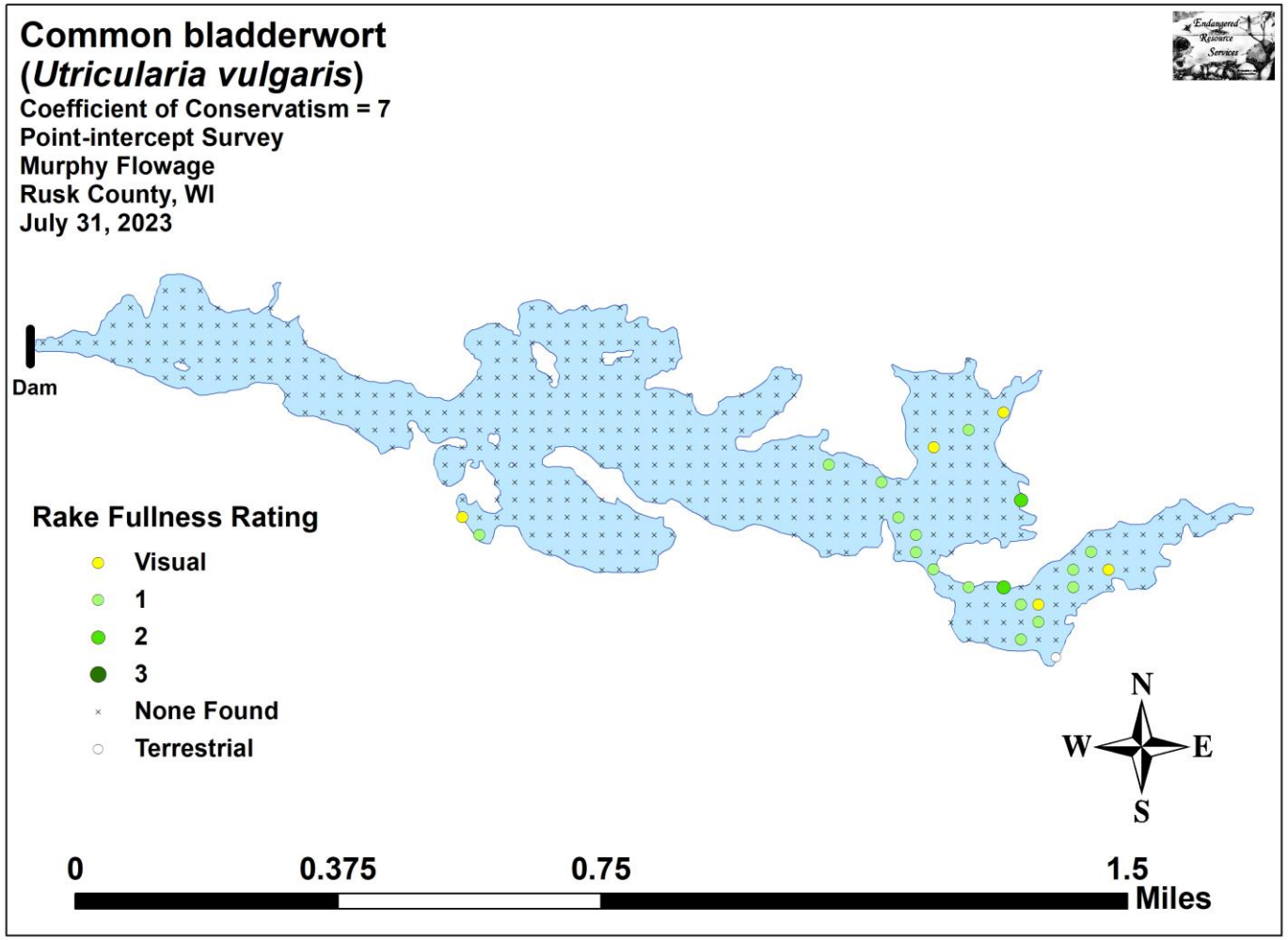

Short-stemmed bur-reed
(Sparganium emersum)
Coefficient of Conservatism = 8
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles

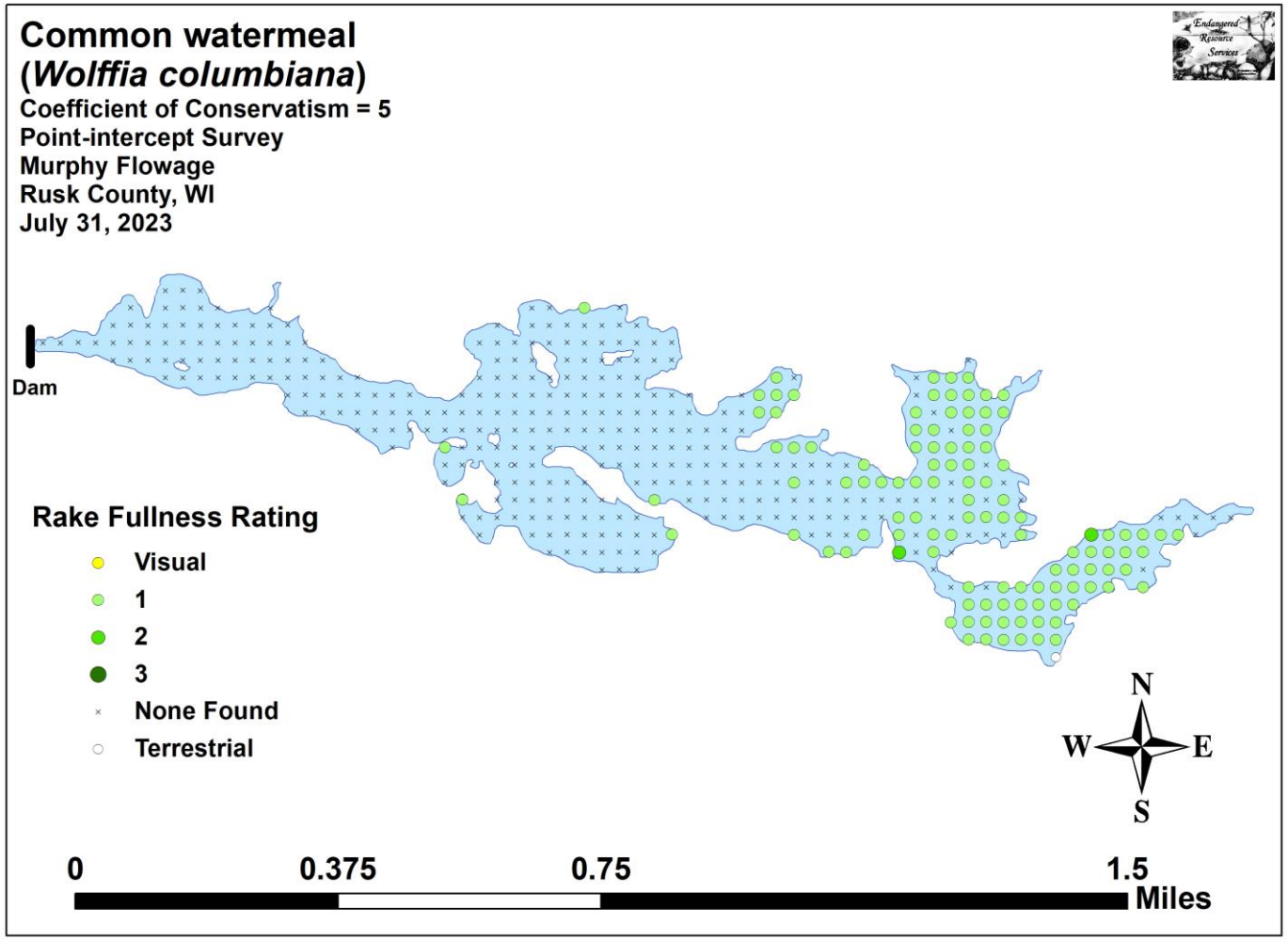

Large duckweed
(Spirodela polyrhiza)
Coefficient of Conservatism = 5
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles


Broad-leaved cattail
(Typha latifolia)
Coefficient of Conservatism = 1
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles


Creeping bladderwort
(Utricularia gibba)
Coefficient of Conservatism = 9
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles


Flat-leaf bladderwort
(Utricularia intermedia)
Coefficient of Conservatism = 9
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles


Common bladderwort
(Utricularia vulgaris)
Coefficient of Conservatism = 7
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles


Common watermeal
(Wolffia columbiana)
Coefficient of Conservatism = 5
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
W
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0
0.375
0.75
1.5
Miles

Appendix VI: Plant Species Accounts

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Acorus americanus*) **Sweet-flag**
Specimen Location: Murphy Flowage; N45.57436°, W91.48490°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-001
Habitat/Distribution: Found in water <0.25 meter deep over sandy muck near the Lawler Creek Inlet. Rare; only plants seen were growing in a cluster at the point.
Common Associates: (*Carex pseudocyperus*) False bottle brush sedge, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Typha* X *glauca*) Hybrid cattail

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Bidens beckii*) **Water marigold**
Specimen Location: Murphy Flowage; N45.57363°, W91.48540°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-002
Habitat/Distribution: Found in water <2.5 meters deep over sand and muck. Common and widely distributed. Plants were especially abundant in the Hemlock Creek Inlet.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Lemna minor*) Small duckweed, (*Nymphaea odorata*) White water lily, (*Potamogeton robbinsii*) Fern pondweed, (*Spirodela polyrhiza*) Large duckweed, (*Wolffia columbiana*) Common watermeal

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Brasenia schreberi*) **Watershield**
Specimen Location: Murphy Flowage; N45.57418°, W91.49823°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-003
Habitat/Distribution: Found in water <2.0 meters deep over firm sand and muck substrates. Relatively common scattered throughout the flowage's sheltered bays.
Common Associates: (*Nuphar variegata*) Spatterdock, (*Nymphaea odorata*) White water lily, (*Potamogeton natans*) Floating-leaf pondweed, (*Potamogeton robbinsii*) Fern pondweed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Calamagrostis canadensis*) **Bluejoint**
Specimen Location: Murphy Flowage; N45.57473°, W91.51106°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-004
Habitat/Distribution: Found at the shoreline around much of the flowage.
Common Associates: (*Carex crinita*) Fringed sedge, (*Phalaris arundinacea*) Reed canary grass

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Calla palustris*) **Wild calla**
Specimen Location: Murphy Flowage; N45.57159°, W91.47611°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-005
Habitat/Distribution: Found at the shoreline in <0.25m of water over organic muck. A few beds were growing in the Hemlock Creek Inlet – not seen anywhere else.
Common Associates: (*Ludwigia palustris*) Marsh purslane, (*Phalaris arundinacea*) Reed canary grass, (*Sagittaria latifolia*) Common arrowhead

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Callitriche palustris*) **Common water starwort**
Specimen Location: Murphy Flowage; N45.57330°, W91.48334°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-006
Habitat/Distribution: Found in <0.5m of water over soft silt and organic muck. Scattered beds were located in the Lawler and Hemlock Creek Inlets.
Common Associates: (*Potamogeton alpinus*) Alpine pondweed, (*Potamogeton crispus*) Curly-leaf pondweed, (*Potamogeton epihydrus*) Ribbon-leaf pondweed, (*Potamogeton obtusifolius*) Blunt-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Sparganium emersum*) Short-stemmed bur-reed

County/State: Rusk County, Wisconsin **Date:** 6/5/23
Species: (*Carex canescens*) **Gray bog sedge**
Specimen Location: Murphy Flowage; N45.57058°, W91.49377°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-007
Habitat/Distribution: Found at the shoreline in <0.25m of water over organic muck. Relatively common on the floating bogs in the flowage's south-central bays.
Common Associates: (*Carex diandra*) Bog panicled sedge, (*Carex pellita*) Broad-leaved woolly sedge, (*Typha latifolia*) Broad-leaved cattail

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Carex comosa*) **Bottle brush sedge**
Specimen Location: Murphy Flowage; N45.57436°, W91.48490°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-008
Habitat/Distribution: Found at the shoreline in <0.25 m of water over muck. Clusters of plants were scattered along the shoreline of bays throughout.
Common Associates: (*Phalaris arundinacea*) Reed canary grass, (*Sagittaria latifolia*) Common arrowhead, (*Scirpus cyperinus*) Woolgrass

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Carex crinita*) **Fringed sedge**
Specimen Location: Murphy Flowage; N45.57473°, W91.51106°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-009
Habitat/Distribution: Relatively common – primarily found scattered along the immediate shoreline on the the western half of the flowage.
Common Associates: (*Calamagrostis canadensis*) Bluejoint, (*Phalaris arundinacea*) Reed canary grass, (*Sagittaria latifolia*) Common arrowhead

County/State: Rusk County, Wisconsin **Date:** 6/5/23
Species: (*Carex diandra*) **Bog panicled sedge**
Specimen Location: Murphy Flowage; N45.57065°, W91.49344°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-010
Habitat/Distribution: Found at the shoreline in <0.25m of water over organic muck. Relatively common on the floating bogs in the flowage's south-central bays.
Common Associates: (*Carex canescens*) Gray bog sedge, (*Carex pellita*) Broad-leaved woolly sedge, (*Typha latifolia*) Broad-leaved cattail

County/State: Rusk County, Wisconsin **Date:** 6/5/23
Species: (*Carex lacustris*) **Lake sedge**
Specimen Location: Murphy Flowage; N45.57058°, W91.49377°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-011
Habitat/Distribution: Found at the shoreline in <0.25m of water over sand and sandy muck. Uncommon in scattered patches near the point – not seen anywhere else. Note red leaf sheaths and ladder-fibrillose fibers.
Common Associates: (*Dulichium arundinaceum*) Three-way sedge, (*Eleocharis erythropoda*) Bald spikerush, (*Scirpus cyperinus*) Woolgrass

County/State: Rusk County, Wisconsin **Date:** 6/5/23
Species: (*Carex lasiocarpa*) **Narrow-leaved woolly sedge**
Specimen Location: Murphy Flowage; N45.57146°, W91.49750°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-012
Habitat/Distribution: Found in water <0.25m deep on the floating bog that dominates the southwest side bay of the south-central bay – not seen anywhere else. Leaf tips wire-like with the widest part <2mm.
Common Associates: (*Dulichium arundinaceum*) Three-way sedge, (*Eleocharis erythropoda*) Bald spikerush, (*Scirpus cyperinus*) Woolgrass, (*Typha latifolia*) Broad-leaved cattail

County/State: Rusk County, Wisconsin **Date:** 6/5/23
Species: (*Carex pellita*) **Broad-leaved woolly sedge**
Specimen Location: Murphy Flowage; N45.57065°, W91.49344°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-013
Habitat/Distribution: Found at the shoreline in <0.25m of water over organic muck. Relatively common on the edges of boggy wetlands in the flowage's south-central bays. Leaf tips not wire-like as in *C. lasiocarpa*, and widest parts of leaf 2-3mm.
Common Associates: (*Carex diandra*) Bog panicled sedge, (*Carex canescens*) Broad-leaved woolly sedge, (*Typha latifolia*) Broad-leaved cattail

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Carex pseudocyperus*) **False bottle brush sedge**
Specimen Location: Murphy Flowage; N45.57435°, W91.48541°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-014
Habitat/Distribution: Found in water <0.25 meter deep over sandy muck near the Lawler Creek Inlet. Only plants seen were growing in a cluster at the point.
Common Associates: (*Acorus americanus*) Sweet-flag, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Typha* X *glauca*) Hybrid cattail

County/State: Rusk County, Wisconsin **Date:** 6/5/23
Species: (*Carex stricta*) **Common tussock sedge**
Specimen Location: Murphy Flowage; N45.57065°, W91.49344°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-015
Habitat/Distribution: Found at the shoreline in <0.25m of water over firm muck. Scattered near the point. An interesting specimen as the lowest subtending bract clearly longer than the inflorescence suggesting *C. aquatilis*; however, the specimen is ladder fibrillose. Potential hybrid?
Common Associates: (*Carex diandra*) Bog panicled sedge, (*Carex pellita*) Broad-leaved woolly sedge, (*Typha latifolia*) Broad-leaved cattail

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Ceratophyllum demersum*) **Coontail**
Specimen Location: Murphy Flowage; N45.57363°, W91.48540°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-016
Habitat/Distribution: Found in water <3.5 meters deep over sandy and organic muck. A dominant species found throughout the flowage.
Common Associates: (*Elodea canadensis*) Common waterweed, (*Nymphaea odorata*) White water lily, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Chara braunii*) **Braun's stonewort**
Specimen Location: Murphy Flowage; N45.57436°, W91.48490°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-017
Habitat/Distribution: Found in water <0.5 meter deep over soft silt. A single individual was found in the unnamed seep inlet due west of the Lawler Creek Inlet.
Common Associates: (*Potamogeton foliosus*) Leafy pondweed, (*Potamogeton pusillus*) Small pondweed, (*Nymphaea odorata*) White water lily

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Chara* sp.) **Muskgrass**
Specimen Location: Murphy Flowage; N45.57435°, W91.48541°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-018
Habitat/Distribution: Found in water <0.5 meter deep over muck. A single dense bed was found alongside a floating muck bog at the point.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Elodea canadensis*) Common waterweed, (*Nymphaea odorata*) White water lily, (*Utricularia gibba*) Creeping bladderwort, (*Utricularia vulgaris*) Common bladderwort

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Comarum palustre*) **Marsh cinquefoil**
Specimen Location: Murphy Flowage; N45.57187°, W91.48227°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-019
Habitat/Distribution: Found in water <0.25 meter deep over soft organic muck. Rare, not seen anywhere other than at the point.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Utricularia vulgaris*) Common bladderwort

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Dulichium arundinaceum*) **Three-way sedge**
Specimen Location: Murphy Flowage; N45.57150°, W91.48278°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-020
Habitat/Distribution: Found at the shoreline in <0.25m of water over sand. Relatively common in scattered locations throughout the flowage's sheltered bays.
Common Associates: (*Brasenia schreberi*) Watershield, (*Eleocharis erythropoda*) Bald spikerush, (*Nymphaea odorata*) White water lily, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Sparganium americanum*) American bur-reed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Eleocharis erythropoda*) **Bald spikerush**
Specimen Location: Murphy Flowage; N45.57102°, W91.49250°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-021
Habitat/Distribution: Found at the shoreline in <0.5 m of water over firm organic and sandy muck. Relatively common along the boggy shorelines of the flowage's bays.
Common Associates: (*Brasenia schreberi*) Watershield, (*Dulichium arundinaceum*) Three-way sedge, (*Nymphaea odorata*) White water lily, (*Polygonum amphibium*) Water smartweed, (*Sparganium americanum*) American bur-reed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Eleocharis obtusa*) **Blunt spikerush**
Specimen Location: Murphy Flowage; N45.57186°, W91.48330°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-022
Habitat/Distribution: Found on floating muck bogs in <0.25m of water. Rare; a few small clusters were found in the eastern bays. Distinguished from E. ovata by the achene tubercle covering the entire top of the achene and being less than half as tall as wide.
Common Associates: (*Chara* sp.) Muskgrass, (*Ludwigia palustris*) Marsh purslane, (*Utricularia gibba*) Creeping bladderwort

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Elodea canadensis*) **Common waterweed**
Specimen Location: Murphy Flowage; N45.57435°, W91.48541°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-023
Habitat/Distribution: Found in water <3.0 meters deep over muck. Plants were common and widely distributed, but seldom abundant.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Nymphaea odorata*) White water lily, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Heteranthera dubia*) **Water star-grass**
Specimen Location: Murphy Flowage; N45.57218°, W91.48587°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-024
Habitat/Distribution: Found in water <1.25 meters deep over sand and sandy muck. Relatively common in the bays near the Lawler and Hemlock Creek Inlets, but rare elsewhere.
Common Associates: (*Bidens beckii*) Water marigold, (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Nymphaea odorata*) White water lily, (*Polygonum amphibium*) Water smartweed, (*Ranunculus aquatilis*) White water crowfoot

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Lemna minor*) **Small duckweed**
Specimen Location: Murphy Flowage; N45.57435°, W91.48541°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-025
Habitat/Distribution: Common and widespread but seldom abundant. Most "duckweeds" were found floating over organic and sandy muck in the flowage's eastern bays.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Nymphaea odorata*) White water lily, (*Potamogeton robbinsii*) Fern pondweed, (*Spirodela polyrhiza*) Large duckweed, (*Wolffia columbiana*) Common watermeal

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Ludwigia palustris*) **Marsh purslane**
Specimen Location: Murphy Flowage; N45.57186°, W91.48330°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-026
Habitat/Distribution: Found in water <0.25 meter deep on floating muck bogs and exposed mud flats. Especially common in the Hemlock Creek Inlet.
Common Associates: (*Chara* sp.) Muskgrass, (*Eleocharis erythropoda*) Bald spikerush, (*Eleocharis obtusa*) Blunt spikerush, (*Utricularia gibba*) Creeping bladderwort

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Myriophyllum sibiricum*) **Northern water-milfoil**
Specimen Location: Murphy Flowage; N45.57402°, W91.48284°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-027
Habitat/Distribution: Found in water <1.0 meter deep over soft silt and muck in the Lawler and Hemlock Creek Inlets – not seen anywhere else.
Common Associates: (*Potamogeton alpinus*) Alpine pondweed, (*Potamogeton epihydrus*) Ribbon-leaf pondweed, (*Utricularia vulgaris*) Common bladderwort

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Najas flexilis*) **Slender naiad**
Specimen Location: Murphy Flowage; N45.57330°, W91.48334°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-028
Habitat/Distribution: Found in water <0.5 meter deep over sand and sandy muck. Rare – a few clusters were found in the Lawler and Hemlock Creek Inlets and the south-central bay.
Common Associates: (*Elodea canadensis*) Common waterweed, (*Nymphaea odorata*) White water lily, (*Potamogeton foliosus*) Leafy pondweed, (*Potamogeton spirillus*) Spiral-fruited pondweed, (*Sparganium americanum*) American bur-reed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Nitella* sp. likely *flexilis*) **Nitella**
Specimen Location: Murphy Flowage; N45.57435°, W91.48541°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-029
Habitat/Distribution: A few individuals were found entangled in other plants. Tentatively identified by the single forked dactyls.
Common Associates: (*Myriophyllum sibiricum*) Northern water-milfoil

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Nuphar variegata*) **Spatterdock**
Specimen Location: Murphy Flowage; N45.57400°, W91.48489°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-030
Habitat/Distribution: Found in water <1.5 meters deep over primarily firm muck and sand. Common to abundant; especially
Common Associates: (*Bidens beckii*) Water marigold, (*Ceratophyllum demersum*) Coontail, (*Nymphaea odorata*) White water lily, (*Polygonum amphibium*) Water smartweed, (*Potamogeton robbinsii*) Fern pondweed, (*Sparganium americanum*) American bur-reed, (*Spirodela polyrhiza*) Large duckweed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Nymphaea odorata*) **White water lily**
Specimen Location: Murphy Flowage; N45.57400°, W91.48489°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-031
Habitat/Distribution: Found in water <2 meters deep in sheltered muck-bottomed areas throughout the flowage – the dominant floating-leaf species.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Lemna minor*) Small duckweed, (*Nuphar variegata*) Spatterdock, (*Polygonum amphibium*) Water smartweed, (*Potamogeton natans*) Floating-leaf pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Sparganium americanum*) American bur-reed, (*Spirodela polyrhiza*) Large duckweed, (*Wolffia columbiana*) Common watermeal

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Phalaris arundinacea*) **Reed canary grass**
Specimen Location: Murphy Flowage; N45.57115°, W91.48225°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-032
Habitat/Distribution: Scattered along the shoreline and in adjacent wetlands with a few plants growing on muck bogs in water <0.25m deep.
Common Associates: (*Calamagrostis canadensis*) Bluejoint, (*Carex crinita*) Fringed sedge, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Sparganium americanum*) American bur-reed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Polygonum amphibium*) **Water smartweed**
Specimen Location: Murphy Flowage; N45.57218°, W91.48587°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-033
Habitat/Distribution: Found in water <1.5 meters deep over firm sand and muck. Scattered beds were common in sheltered bays throughout.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Lemna minor*) Small duckweed, (*Nymphaea odorata*) White water lily, (*Potamogeton natans*) Floating-leaf pondweed, (*Potamogeton robbinsii*) Fern pondweed,

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Potamogeton alpinus*) **Alpine pondweed**
Specimen Location: Murphy Flowage; N45.57402°, W91.48284°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-034
Habitat/Distribution: Found in water <0.5 meter deep over soft muck. Rare with only a few small patches found in the immediate Lawler and Hemlock Creek Inlets.
Common Associates: (*Callitriche palustris*) Common water starwort, (*Potamogeton crispus*) Curly-leaf pondweed, (*Potamogeton epihydrus*) Ribbon-leaf pondweed, (*Potamogeton obtusifolius*) Blunt-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Sparganium emersum*) Short-stemmed bur-reed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Potamogeton amplifolius*) **Large-leaf pondweed**
Specimen Location: Murphy Flowage; N45.57418°, W91.49823°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-035
Habitat/Distribution: Found in water from <3.0 meters deep over muck and sand. Most plants were located along the central channel.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Nymphaea odorata*) White water lily, (*Potamogeton natans*) Floating-leaf pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Potamogeton crispus*) **Curly-leaf pondweed**
Specimen Location: Murphy Flowage; N45.57437°, W91.48388°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-036
Habitat/Distribution: Found in water <0.5 meter deep over soft muck. Rare with only a few small patches found in the immediate Lawler and Hemlock Creek Inlets.
Common Associates: (*Callitriche palustris*) Common water starwort, (*Potamogeton alpinus*) Alpine pondweed, (*Potamogeton epihydrus*) Ribbon-leaf pondweed, (*Potamogeton obtusifolius*) Blunt-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Sparganium emersum*) Short-stemmed bur-reed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Potamogeton epihydrus*) **Ribbon-leaf pondweed**
Specimen Location: Murphy Flowage; N45.57330°, W91.48334°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-037
Habitat/Distribution: Found in water <1.0 meters deep over soft muck and sand. Uncommon with only a few small patches found in the Lawler and Hemlock Creek Inlets bays.
Common Associates: (*Callitriche palustris*) Common water starwort, (*Potamogeton alpinus*) Alpine pondweed, (*Potamogeton crispus*) Curly-leaf pondweed, (*Potamogeton obtusifolius*) Blunt-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Sparganium emersum*) Short-stemmed bur-reed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Potamogeton foliosus*) **Leafy pondweed**
Specimen Location: Murphy Flowage; N45.57436°, W91.48490°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-038
Habitat/Distribution: Found in water from <0.5 meter deep over muck. Clusters of plants were scattered in the Lawler and Hemlock Creek Inlet bays. Distinctly darker color, lack of nodal glands, and keeled fruit separated from *P. pusillus*.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Lemna minor*) Small duckweed, (*Nuphar variegata*) Spatterdock, (*Nymphaea odorata*) White water lily, (*Potamogeton pusillus*) Small pondweed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Potamogeton natans*) **Floating-leaf pondweed**
Specimen Location: Murphy Flowage; N45.57418°, W91.49823°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-039
Habitat/Distribution: Found in water <2.0 meters deep over firm sand and muck. Scattered beds were common in sheltered bays throughout.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Nymphaea odorata*) White water lily, (*Polygonum amphibium*) Water smartweed, (*Potamogeton robbinsii*) Fern pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Potamogeton obtusifolius*) **Blunt-leaf pondweed**
Specimen Location: Murphy Flowage; N45.57402°, W91.48284°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-040
Habitat/Distribution: Found in water <0.5 meter deep over soft muck. Rare with only a few small patches found in the immediate Lawler Creek Inlet.
Common Associates: (*Callitriche palustris*) Common water starwort, (*Potamogeton alpinus*) Alpine pondweed, (*Potamogeton crispus*) Curly-leaf pondweed, (*Potamogeton epihydrus*) Ribbon-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Sparganium emersum*) Short-stemmed bur-reed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Potamogeton pusillus*) **Small pondweed**
Specimen Location: Murphy Flowage; N45.57435°, W91.48541°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-041
Habitat/Distribution: Found in water <2.0 meters deep over organic and sandy muck. Scattered locations throughout; especially in sheltered bays. No individuals were in fruit, but all plants examined had distinct nodal glands which separated them from the less common *P. foliosus*.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Elodea canadensis*) Common waterweed, (*Nymphaea odorata*) White water lily, (*Potamogeton robbinsii*) Fern pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Potamogeton richardsonii*) **Clasping-leaf pondweed**
Specimen Location: Murphy Flowage; N45.57435°, W91.48541°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-042
Habitat/Distribution: Found in water <1.5 meters deep over sand and sandy muck. Relatively common, but seldom abundant with small patches of plants widely distributed throughout.
Common Associates: (*Nymphaea odorata*) White water lily, (*Polygonum amphibium*) Water smartweed, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Potamogeton robbinsii*) **Fern pondweed**
Specimen Location: Murphy Flowage; N45.57418°, W91.49823°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-043
Habitat/Distribution: Found throughout the littoral zone in all bottom types. The dominant species, canopied beds filled the water column in the majority of the eastern two-thirds of the flowage.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Elodea canadensis*) Common waterweed, (*Nymphaea odorata*) White water lily, (*Potamogeton amplifolius*) Large-leaf pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Potamogeton spirillus*) **Spiral-fruited pondweed**
Specimen Location: Murphy Flowage; N45.57131°, W91.49764°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-044
Habitat/Distribution: Found in water from <0.5 meter deep over sand. Only plants seen were in the narrow channel to the small southwest bay off the main south-central bay.
Common Associates: (*Bidens beckii*) Water marigold, (*Ceratophyllum demersum*) Coontail, (*Najas flexilis*) Slender naiad, (*Nymphaea odorata*) White water lily, (*Potamogeton pusillus*) Small pondweed, (*Sparganium americanum*) American bur-reed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Potamogeton vaseyi*) **Vasey's pondweed**
Specimen Location: Murphy Flowage; N45.57130°, W91.49866°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-045
Habitat/Distribution: Found in water from <1.0 meter deep over organic and sandy muck. Potentially much more common than the survey indicated. Almost all plants found had rotten floating-leaves and had already set the characteristic micro trident-shaped turions.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Nymphaea odorata*) White water lily, (*Potamogeton pusillus*) Small pondweed, (*Sparganium americanum*) American bur-reed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Potamogeton zosteriformis*) **Flat-stem pondweed**
Specimen Location: Murphy Flowage; N45.57218°, W91.48587°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-046
Habitat/Distribution: Found in water <2.5 meters deep over organic and sandy muck. Common throughout, but seldom abundant.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Elodea canadensis*) Common waterweed, (*Nymphaea odorata*) White water lily, (*Potamogeton robbinsii*) Fern pondweed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Ranunculus aquatilis*) **White water crowfoot**
Specimen Location: Murphy Flowage; N45.57363°, W91.48540°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-047
Habitat/Distribution: Found in water <1.0 meter deep over sand and sandy muck. in primarily muck and sand. Plants were found scattered around the channels in the Lawler and Hemlock Creek Inlets.
Common Associates: (*Callitriche palustris*) Common water starwort, (*Ceratophyllum demersum*) Coontail, (*Elodea canadensis*) Common waterweed, (*Heteranthera dubia*) Water star-grass

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Riccia fluitans*) **Slender riccia**
Specimen Location: Murphy Flowage; N45.57130°, W91.49866°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-048
Habitat/Distribution: Found in water <0.25 meter deep over muck. A few individuals were seen at the point – not found anywhere else.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Nymphaea odorata*) White water lily, (*Potamogeton pusillus*) Small pondweed, (*Utricularia intermedia*) Flat-leaf bladderwort

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Sagittaria latifolia*) **Common arrowhead**
Specimen Location: Murphy Flowage; N45.57473°, W91.51106°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-049
Habitat/Distribution: Found in water <0.25 meter deep over soft muck. Rare along both the Lawler and Hemlock Creek Inlets.
Common Associates: (*Calla palustris*) Wild calla, (*Eleocharis erythropoda*) Bald spikerush, (*Phalaris arundinacea*) Reed canary grass

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Sagittaria rigida*) **Sessile-fruited arrowhead**
Specimen Location: Murphy Flowage; N45.57102°, W91.49250°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-050
Habitat/Distribution: Found in water <0.25 meter deep over firm sand. A few small beds were scattered along the shoreline.
Common Associates: (*Brasenia schreberi*) Watershield, (*Eleocharis erythropoda*) Bald spikerush, (*Sparganium americanum*) American bur-reed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Scirpus cyperinus*) **Woolgrass**
Specimen Location: Murphy Flowage; N45.57130°, W91.49866°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-051
Habitat/Distribution: Found in water <0.25 meter deep over firm sand and muck. Plants were scattered along sunny shoreline and on floating bogs.
Common Associates: (*Carex canescens*) Gray bog sedge, (*Carex comosa*) Bottle brush sedge, (*Carex lacustris*) Lake sedge, (*Eleocharis erythropoda*) Bald spikerush

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Schoenoplectus tabernaemontani*) **Softstem bulrush**
Specimen Location: Murphy Flowage; N45.57435°, W91.48541°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-052
Habitat/Distribution: Found in water <0.25 meter deep over muck. A few individuals and small beds were found scattered in sheltered areas of the eastern bays.
Common Associates: (*Bidens beckii*) Water marigold, (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Sparganium americanum*) American bur-reed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Sparganium americanum*) **American bur-reed**
Specimen Location: Murphy Flowage; N45.57292°, W91.48486°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-053
Habitat/Distribution: Found in water <1.0 meter deep over firm muck, sand and rock. The dominant emergent, it ringed almost the entire flowage.
Common Associates: (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Typha latifolia*) Broad-leaved cattail

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Sparganium emersum*) **Short-stemmed bur-reed**
Specimen Location: Murphy Flowage; N45.57402°, W91.48284°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-054
Habitat/Distribution: Found in flowing water <1.0 meter deep over muck. A few individuals with floating-leaves and supra-axillary pistillate flower were found in both the Lawler and Hemlock Creek Inlets.
Common Associates: (*Callitriche palustris*) Common water starwort, (*Nymphaea odorata*) White water lily, (*Potamogeton alpinus*) Alpine pondweed, (*Potamogeton foliosus*) Leafy pondweed, (*Potamogeton obtusifolius*) Blunt-leaf pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Spirodela polyrhiza*) **Large duckweed**
Specimen Location: Murphy Flowage; N45.57435°, W91.48541°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-055
Habitat/Distribution: Common and widespread but seldom abundant. Most "duckweeds" were found floating over organic and sandy muck in the flowage's eastern bays.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Lemna minor*) Small duckweed, (*Nymphaea odorata*) White water lily, (*Wolffia columbiana*) Common watermeal

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Typha latifolia*) **Broad-leaved cattail**
Specimen Location: Murphy Flowage; N45.57064°, W91.49352°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-056
Habitat/Distribution: Found in water <0.25 meter deep over organic and sandy muck. A few small patches and individual plants were scattered around the shoreline; especially in the Lawler and Hemlock Creek Inlet bays and on the floating bogs in the south-central bay.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Nuphar variegata*) Spatterdock, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Sparganium americanum*) American bur-reed

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Typha X glauca*) **Hybrid cattail**
Specimen Location: Murphy Flowage; N45.57435°, W91.48541°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-057
Habitat/Distribution: Found in water <0.25 meter deep over sandy muck near the Lawler Creek Inlet. Rare; only plants seen were growing in a cluster at the point.
Common Associates: (*Acorus americanus*) Sweet-flag, (*Carex pseudocyperus*) False bottle brush sedge, (*Schoenoplectus tabernaemontani*) Softstem bulrush

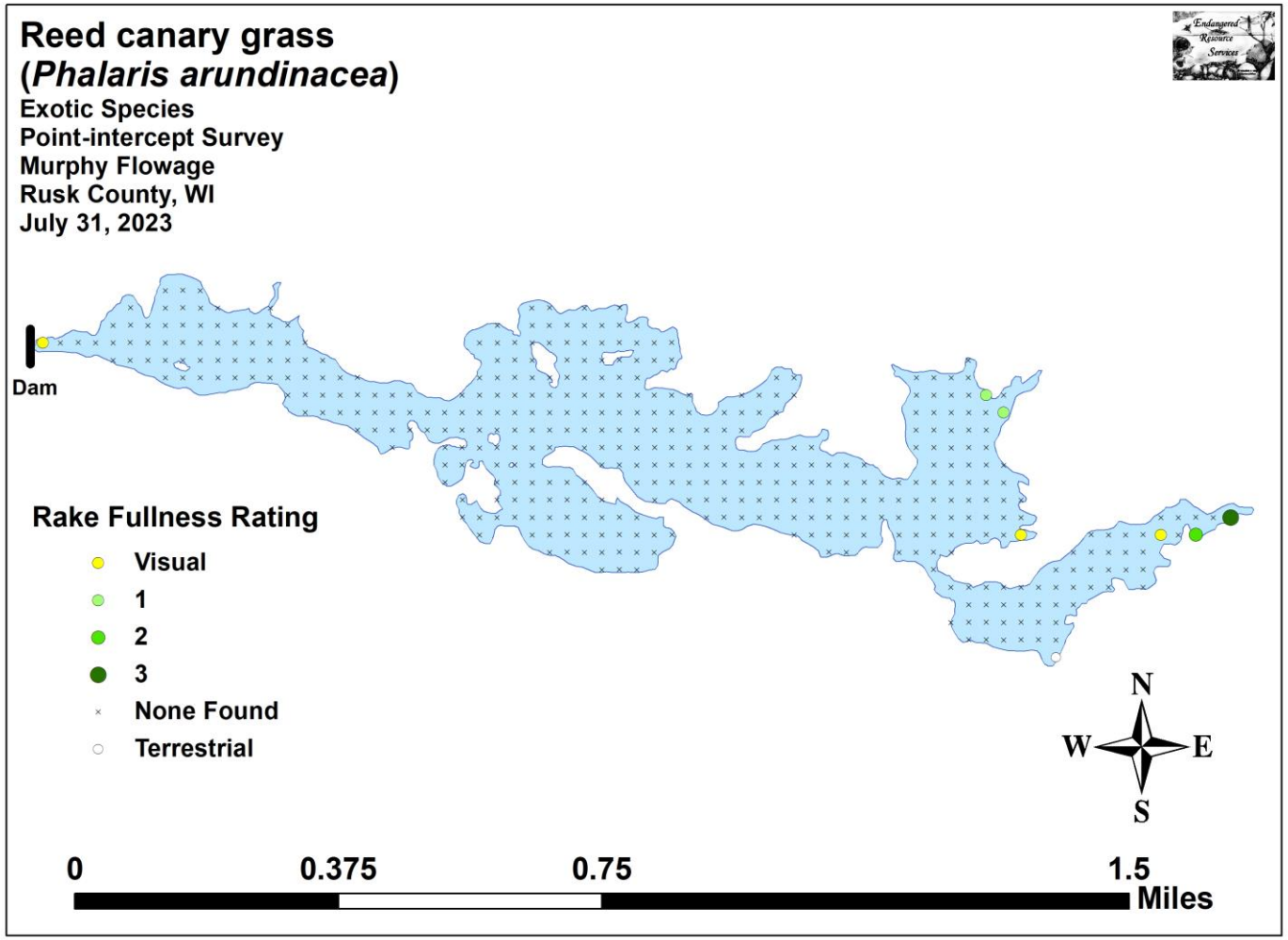
County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Utricularia gibba*) **Creeping bladderwort**
Specimen Location: Murphy Flowage; N45.57186°, W91.48330°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-058
Habitat/Distribution: Found in water <1.5 meters deep over muck in boggy bays. Stranded individuals were also in bloom on muck bogs.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Eleocharis erythropoda*) Bald spikerush, (*Elodea canadensis*) Common waterweed, (*Nymphaea odorata*) White water lily, (*Potamogeton robbinsii*) Fern pondweed, (*Utricularia vulgaris*) Common bladderwort

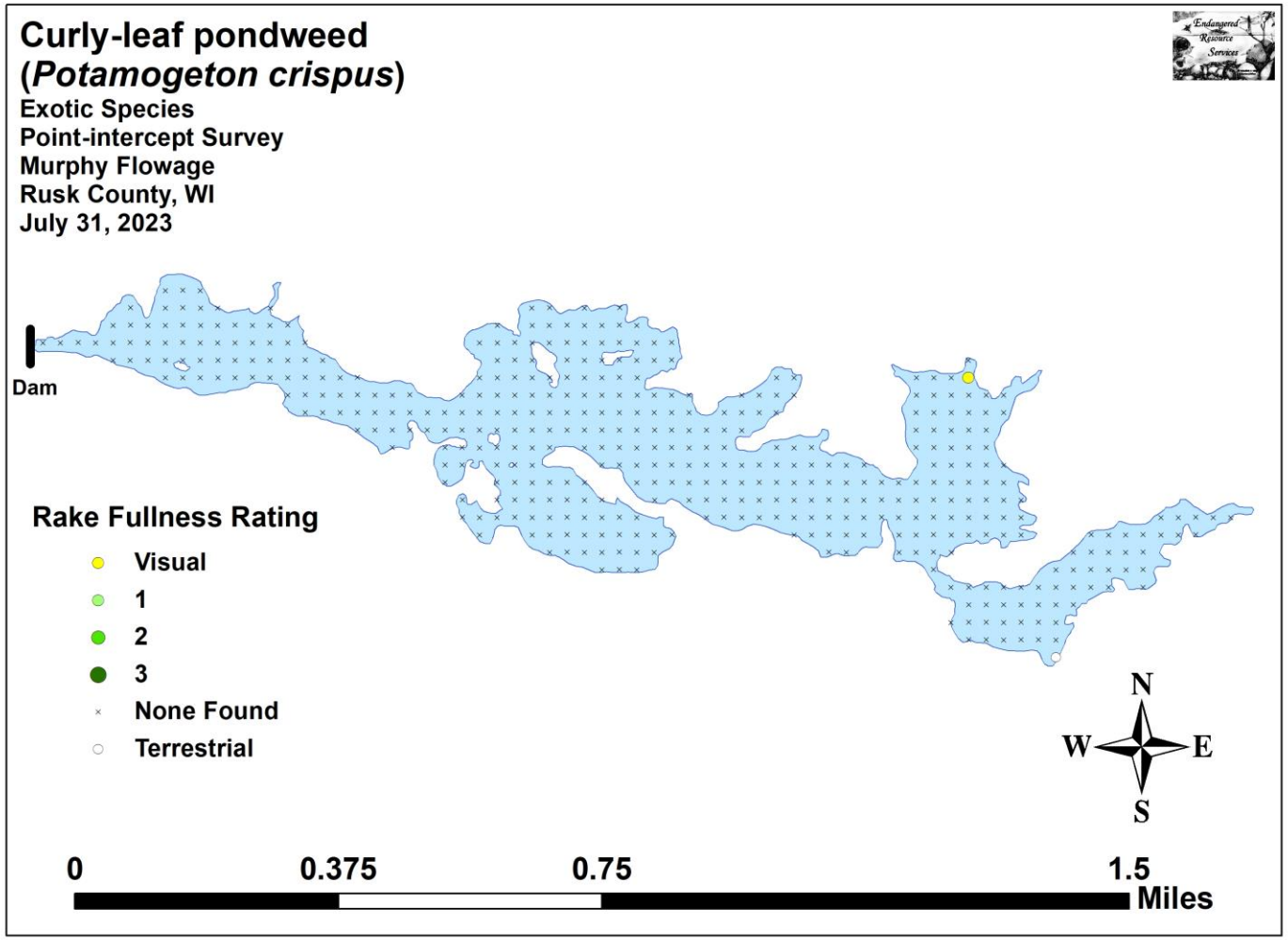
County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Utricularia intermedia*) **Flat-leaf bladderwort**
Specimen Location: Murphy Flowage; N45.57130°, W91.49866°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-059
Habitat/Distribution: Found in water <1.0 meters deep over organic muck. Only plants seen were in the small southwest bay off the main south-central bay next to floating bogs.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Nymphaea odorata*) White water lily, (*Potamogeton pusillus*) Small pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Potamogeton vaseyi*) Vasey's pondweed, (*Utricularia vulgaris*) Common bladderwort

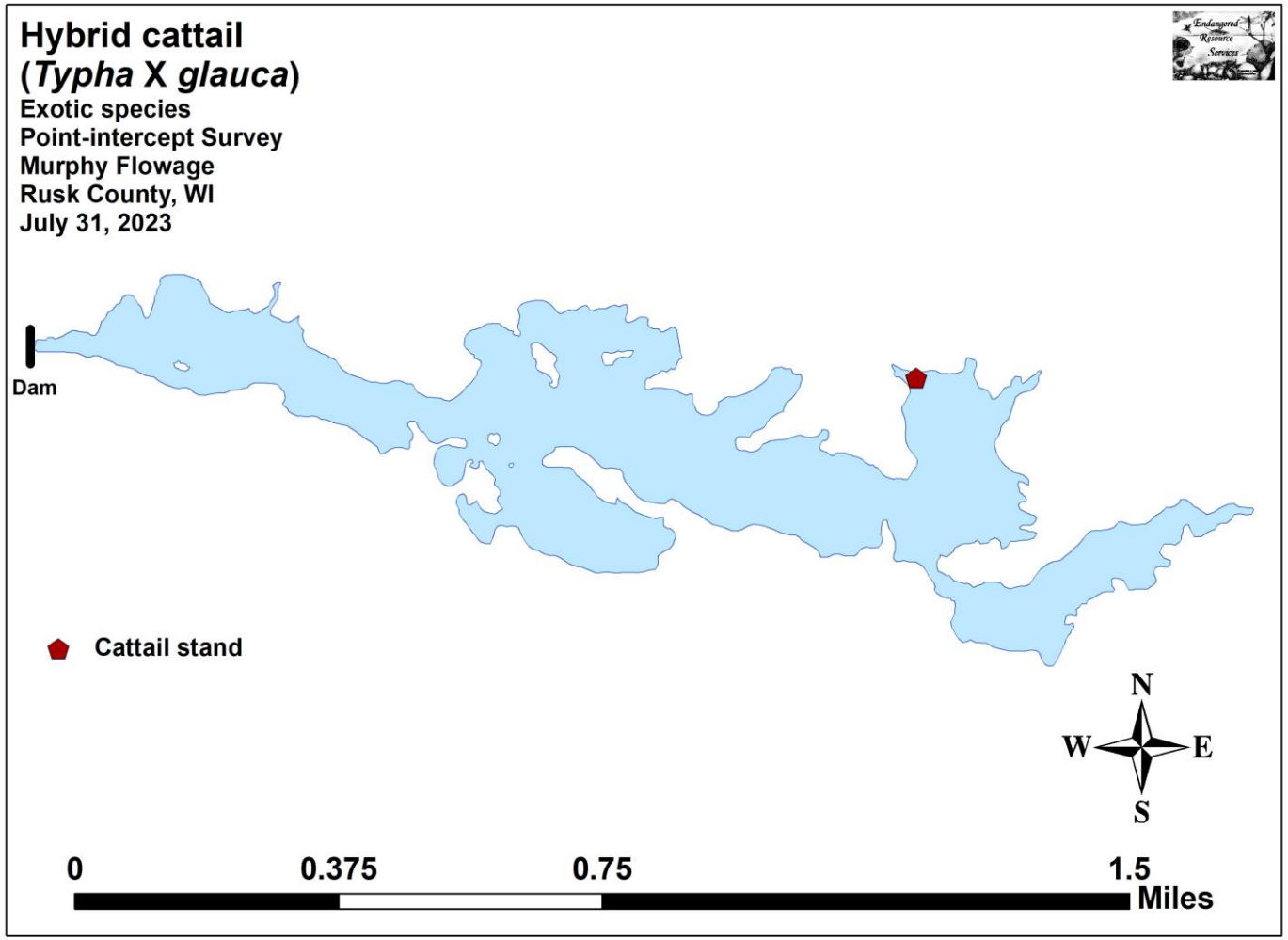
County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Utricularia vulgaris*) **Common bladderwort**
Specimen Location: Murphy Flowage; N45.57292°, W91.48486°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-060
Habitat/Distribution: Found in water <1.5 meters deep over sandy and organic muck. Most plants were scattered throughout the Lawler and Hemlock Creek Inlet bays and in the south-central bay.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Nymphaea odorata*) White water lily, (*Potamogeton natans*) Floating-leaf pondweed, (*Utricularia gibba*) Creeping bladderwort

County/State: Rusk County, Wisconsin **Date:** 7/31/23
Species: (*Wolffia columbiana*) **Common watermeal**
Specimen Location: Murphy Flowage; N45.57435°, W91.48541°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2023-061
Habitat/Distribution: Common and widespread but seldom abundant. Most “duckweeds” were found floating over organic and sandy muck in the flowage’s eastern bays.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Lemna minor*) Small duckweed, (*Nymphaea odorata*) White water lily, (*Potamogeton robbinsii*) Fern pondweed, (*Spirodela polyrhiza*) Large duckweed

Appendix VII: Exotic Species Density and Distribution Maps and Aquatic Exotic Invasive Plant Species Information


Reed canary grass
(Phalaris arundinacea)
Exotic Species
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles


Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Rake Fullness Rating
Visual
1
2
3
None Found
Terrestrial
N
W
E
S
0
0.375
0.75
1.5
Miles


Hybrid cattail
(Typha X glauca)
Exotic species
Point-intercept Survey
Murphy Flowage
Rusk County, WI
July 31, 2023
Endangered Resource Services
Dam
Cattail stand
N
W
E
S
0
0.375
0.75
1.5
Miles

Eurasian Water-milfoil

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

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

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

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

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

Dense stands of Eurasian water-milfoil also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead". Cycling of nutrients from sediments to the water column by Eurasian water-milfoil may lead to deteriorating water quality and algae blooms of infested lakes. (Taken in its entirety from WDNR, 2010 http://www.dnr.state.wi.us/invasives/fact/milfoil.htm)

Curly-leaf pondweed

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

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

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

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

Reed canary grass

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

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

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

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

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

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

This species prefers disturbed areas, but can easily move into native wetlands. Reed canary grass can invade a disturbed wetland in less than twelve years. Invasion is associated with disturbances including ditching of wetlands, stream channelization, deforestation of swamp forests, sedimentation, and intentional planting. The difficulty of selective control makes reed canary grass invasion of particular concern. Over time, it forms large, monotypic stands that harbor few other plant species and are subsequently of little use to wildlife. Once established, reed canary grass dominates an area by building up a tremendous seed bank that can eventually erupt, germinate, and recolonize treated sites. (Taken in its entirety from WDNR, 2010 http://www.dnr.state.wi.us/invasives/fact/reed_canary.htm)

Purple loosestrife
(Photo Courtesy Brian M. Collins)

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

This species may be confused with the native wing-angled loosestrife (*Lythrum alatum*) found in moist prairies or wet meadows. The latter has a winged, square stem and solitary paired flowers in the leaf axils. It is generally a smaller plant than the Eurasian loosestrife.

By law, purple loosestrife is a nuisance species in Wisconsin. It is illegal to sell, distribute, or cultivate the plants or seeds, including any of its cultivars.

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

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

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

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

Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displaced, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size, and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways. (Taken in its entirety from WDNR, 2010 http://www.dnr.state.wi.us/invasives/fact/loosestrife.htm)

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

Aquatic:

organisms that live in or frequent water.

Cultural Eutrophication:

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

Dissolved Oxygen (DO):

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

Diversity:

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

Drainage lakes:

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

Ecosystem:

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

Eutrophication:

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

Exotic:

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

Habitat:

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

Limnology:

the study of inland lakes and waters.

Littoral:

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

Macrophytes:

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

Nutrients:

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

Organic Matter:

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

Photosynthesis:

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

Phytoplankton:

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

Plankton:

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

ppm:

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

Richness:

number of species in a particular community or habitat.

Rooted Aquatic Plants:

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

Runoff:

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

Secchi Disc:

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

Seepage lakes:

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

Turbidity:

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

Watershed:

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

Zooplankton:

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

Appendix IX: Raw Data Spreadsheet

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