Aquatic Plant Point Intercept Report: Little Star Lake

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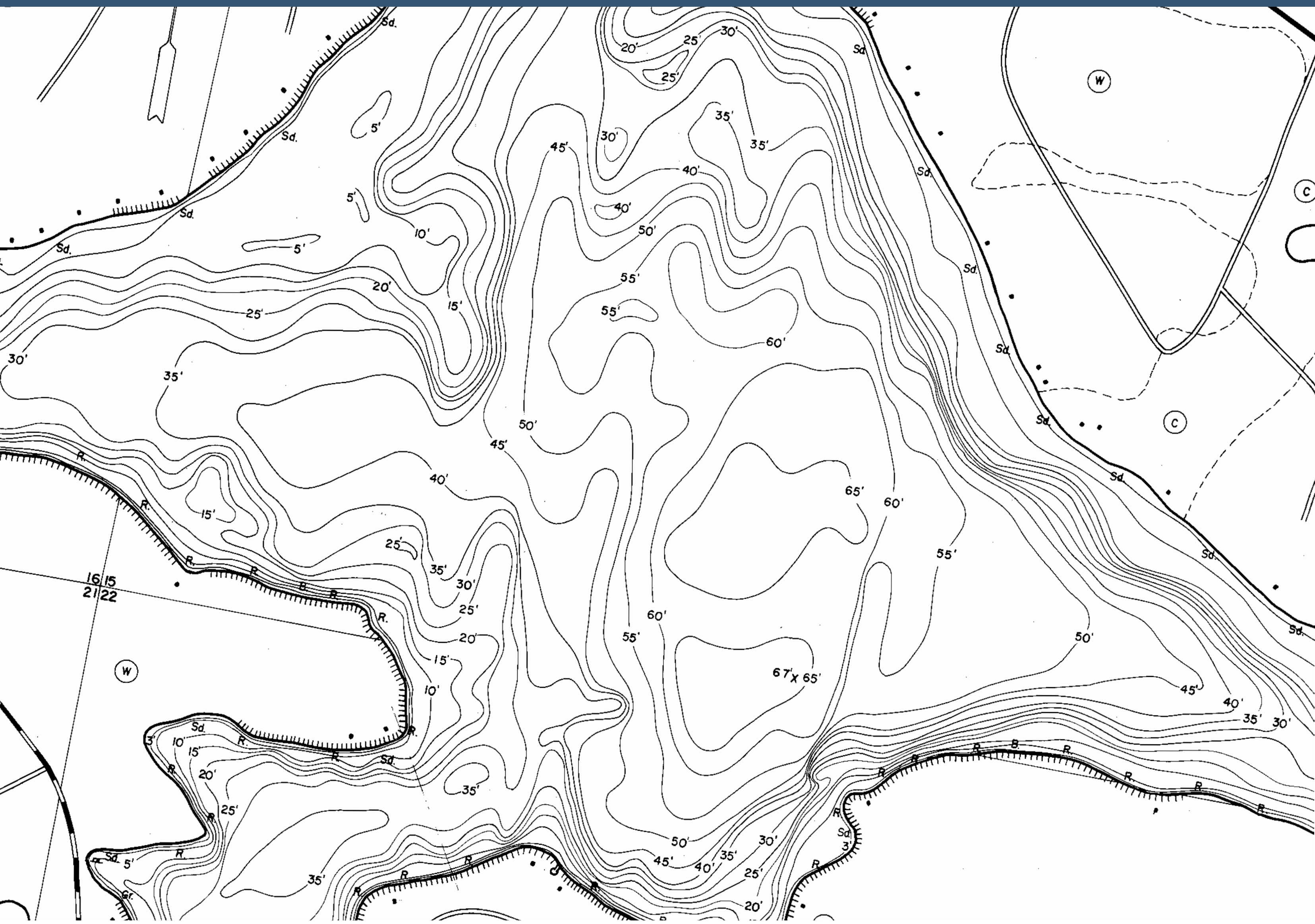

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INTRODUCTION

The following report presents the methods, results and analysis, and conclusion of the aquatic vegetation found in Little Star Lake in Vilas County (WBIC 2334300) through a point-intercept survey conducted by the North Lakeland Discovery Center (NLDC) in Manitowish Waters. The survey was funded by the Wisconsin Department of Natural Resources (WDNR) Surface Water Grant[1] in partnership with Manitowish Waters Lake Association and the town of Manitowish Waters. The point-intercept survey was conducted in late July of 2025 during peak aquatic vegetation growth.

The purpose of an aquatic plant point-intercept survey is to collect standardized data on the distribution and relative abundance of aquatic plant species within a lake ecosystem. This survey generates quantitative and qualitative, geo-referenced data that can be analyzed to establish a baseline condition for the lake. This baseline allows future changes related to water clarity, non-native species introduction, water level fluctuations, or lake management activities to be assessed over time. By providing objective, science-based information, point-intercept survey data supports effective and efficient lake management by reducing uncertainty and minimizing conflict during the planning process. Additionally, these data contribute to broader statewide efforts by enabling lake-to-lake comparisons, identifying management trends and successful strategies, and advancing overall understanding of aquatic plant communities in Wisconsin lakes.

Aquatic plants are vital to the overall health and function of lake ecosystems. They provide essential ecological services, including breeding and nursery habitat of aquatic organisms, water purification, oxygen production, and sediment stabilization. Aquatic plants also serve as food and shelter for many animals, including moose, deer, waterfowl, fish, turtles, amphibians, zooplankton, and macroinvertebrates. Despite these contributions, aquatic plants are sometimes perceived as a nuisance by lake users. While certain aquatic invasive species can negatively impact lake ecosystems, most native aquatic plants play a critical role in maintaining ecological balance and supporting healthy, resilient lake systems (Skawinski 2022).

Aquatic invasive species are organisms that occur outside of their native range and are primarily introduced through human activities. In northern Wisconsin, species such as curly-leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*) are present in many lakes. These species have the potential to spread and cause ecological or economic impacts, including recreational interference and reduced native plant diversity. However, scientific literature suggests that invasive species, specifically Eurasian watermilfoil, only in some cases reach nuisance levels while many other populations will often stagnate or decline on unmanaged lakes (Nichols 1999, Kujawa et al.

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[1] WDNR Grant #AEPP86325

2017). Point-intercept surveys are a tool for early detection of aquatic invasive species and for comparing the distribution and relative abundance of native and non-native plant species within a lake.

METHODS

The point-intercept method used on Little Star Lake was developed by the Wisconsin Department of Natural Resources (WDNR) named as the "Recommended Baseline Monitoring of Aquatic Plants in Wisconsin: Sampling Design, Field and Laboratory Procedures, Data Entry and Analysis, and Applications" document (Hauxwell 2010). The point-intercept survey was conducted using a geo-referenced sampling grid, developed by the WDNR, input into GPS devices. Using a canoe or small boat and a GPS, each point was sampled.

Field Sampling

At each site, the plant community is surveyed with a pole or rope rake sampler to determine species presence and rake fullness rating. The rake is dropped until it touches the lake bottom, spun around three times, then pulled up and given a rake fullness rating. This rating is an estimate of the total coverage of plants on the rake from 1-3. One is a few total plants, two is moderate total plants, and three is abundant total plants. When no plants were on the rake, the rake fullness rating was left blank Each aquatic plant species on the rake was identified and given a rake fullness rating based on its prevalence on the rake. The overall rake fullness and individual plant rake fullness were both recorded on the data sheet.

Aquatic plant species that were not pulled up on the rake but were visible within six feet of the point were recorded as visual sightings (V) on the data sheet. Boat observations (BO) were species observed that were not raked or visually recorded within six feet of a point. The depth at each point was determined by a depth finder or by foot markings on the rake or rope and recorded on the data sheet. The sediment type (mucky, sandy, or rocky) of the lake bottom was determined by the feel of the rake or when sediment was pulled up and was recorded. The three rakes used were a 7-foot pole rake, an extendable 8-foot pole rake, and a 25-foot rope rake. The pole rakes were used at depths of about 12 feet or less and the rope rake was used at depths that were unable to be reached by the pole rake. During this survey, a depth finder was equipped to the boat to speed up the process in determining the depths of sites that were greater than maximum depth of plants.

Sites that were inaccessible due to various reasons were recorded in categories labeled unnavigable, terrestrial, shallow, rocks, dock, swim area, temporary obstacle, or no information. Visual observations of species within the six feet range were recorded instead

(Hauxwell et al., 2010). Samples that were unidentifiable in the field were bagged and identified later using a microscope. Species that were found to be state endangered, threatened, or of special concern were collected and pressed to create an herbarium collection. Species of special concern are those that are becoming less common throughout its range and may soon become a threatened species. Threatened species are protected by law and are at risk of becoming endangered.

Data Analysis

The WDNR provides an Excel workbook called "The Aquatic Plant Survey Data Workbook" with formulas to generate statistics about the findings. All data collected on the field sheet from the survey is entered into the entry sheet of the Excel workbook. Any boat surveys are inputted into the boat survey sheet on the workbook. Once all data is entered, the statistics are automatically generated. The statistics sheet is broken down into individual species statistics and summary statistics. Individual species statistics include the frequency of occurrence of plants, relative frequency, number of sites with vegetation, average rake fullness, and number of visual sightings. The summary statistics include the total number of sites visited, total number of sites with vegetation, sites shallower than the maximum depth of plants, frequency of occurrence, Simpson's Diversity Index, maximum depth of plants, sites sampled using pole or rope rake, average number of species per site, and species richness, including visuals. A maximum depth of plant colonization graph is automatically generated from the maximum depth data (Hauxwell et al., 2010).

Frequency of occurrence at sites shallower than the maximum depth of plant growth takes into account how often a species was collected in rake samples relative to the total number of sites within the littoral zone, defined as the area up to the maximum depth at which plants were found during the survey. This metric may also be referred to as the littoral frequency of occurrence. Relative frequency of abundance is based on this littoral frequency of occurrence in proportion to all plants recorded in the survey. Therefore, the relative frequencies of all species sum to 100%.

The Simpson's Diversity Index is an estimator of community diversity. It is based on the relative frequency of plants on the lake, and it is not impacted by the visual plant data. The Simpson's Diversity Index is based on a scale of 0-1. The closer to 1, the more diverse the plant community (Hauxwell et al., 2010).

Finally, this sheet calculates the Floristic Quality Index (FQI), a metric used to evaluate how closely a sampled plant community resembles an undisturbed or minimally impacted community. In Wisconsin, the WDNR, local governments, and landowners increasingly rely on floristic quality to assess lake plant communities. FQI plays an important role in planning, zoning, sensitive area designation, and aquatic plant management decisions. Floristic quality provides a standardized method for evaluating plant community conditions, allowing for comparisons across regions and overtime. The floristic quality (*I*) = the average coefficient of conservatism (*C*) multiplied by the square root of the number of species in the lake ($\sqrt{N}$). All native species are included in the number of species. Conservatism (*C*) is the likelihood of a plant occurring in a landscape that is not relatively impacted by human settlement. The collection of values ranges from 0-10, 10 being the species that are most sensitive to disturbance. Plants are assigned a *C* value based on substrate preference, tolerance to turbidity, rooting strength, reproductive means, and water drawdown tolerance (Nichols 1999).

To understand the results, the *I*, *C,* and N are compared to state and regional values. Statewide, the median number of species per lake is 13, with ranges from 1-44 species. The *C* value had a median of six, with ranges from 2.0-9.5. Finally, the *I* value had a median value of 22.2, with ranges from 3.0-44.6. *As C* values can vary region to region, the state is broken into eight different ecoregions. This lake is within the Northern Lakes and Forests Ecoregion. The median number of species in this ecoregion is 13. The median *C* value is 6.7 and the median *I* is 24.3 (Nichols 1999). Little Star Lake's statistics will be compared to these values in the following sections of the report.

RESULTS

A total of 786 sites were visited on Little Star Lake, with vegetation present at 124 of those sites. At these sites, the dominant substrate was sand (Figure 1). 26 different species of aquatic plants, moss and algae were found which may include nonnative species or species listed as special conservation concern according to WDNR Natural Heritage Inventory (Table 1). Plants were found at depths up to 25 feet, while the most frequent depth of colonization was 4 feet (Figure 2). The average rake fullness rating was 1.18, indicating low plant density (Map 1). The frequency of occurrence of plants at sites shallower than maximum depth of plants was 39.37% of sites, with an average of .79 species per site that is shallower than maximum depth. The average number of all species was 2.02 per vegetated site (Map 2). In total, 23 plant species were collected using the rake method, and 26 species were documented when including visual sightings. The high Simpson Diversity Index of 0.90 reflects a well-balanced and diverse aquatic plant community in this lake. Lastly, the mean conservation coefficient (*C*) of this lake's aquatic plants is 6.78 with a Floristic Quality Assessment (FQI) of 32.53 (Figure 3).

Little Star Lake's previous aquatic plant point intercept survey was conducted by Onterra LLC in 2016, during which 19 species were documented. The mean conservation coefficient (C) was 6.47, with a Floristic Quality Assessment (FQI) of 26.68. Results may vary between years depending on environmental conditions and survey timing; however, both the 2016 and 2025 data fall within the "specific needs, moderate tolerance" category for conservation coefficient and the "high quality" category for FQI.

Table 1. Little Star Lake's aquatic plant species list recorded in 2025.

Community Category	*Scientific Name*	Common Name	Status in Wisconsi n	Observation Method 2025	Littoral Frequency of Occurrence %
Emergent	*Eleocharis acicularis*	Needle spikerush	Native	Rake	5.40%
Floating Leaf	*Nuphar variegata*	Spatterdock	Native	Visual	
Floating Leaf	*Nymphaea odorata*	White water lily	Native	Rake	0.95%
Submergent	*Bidens beckii (formerly Megalodonta)*	Water marigold	Native	Rake	3.49%
Submergent	*Ceratophyllum demersum*	Coontail	Native	Rake	0.63%
Submergent	*Ceratophyllum echinatum*	Spiny hornwort	Native	Rake	0.63%
Submergent	*Chara*	Muskgrasses	Native	Rake	0.63%
Submergent	*Elatine minima*	Waterwort	Native	Visual	2.54%
Submergent	*Elodea canadensis*	Common waterweed	Native	Rake	5.40%
Submergent	*Elodea nuttallii*	Slender waterweed	Native	Rake	0.95%
Submergent	*Isoetes echinospora*	Spiny-spored quillwort	Native	Visual	
Submergent	*Myriophyllum sibiricum*	Northern water-milfoil	Native	Rake	2.54%
Submergent	*Najas flexilis*	Slender naiad	Native	Rake	4.44%
Submergent	*Nitella*	Nitella	Native	Rake	1.90%
Submergent	*Potamogeton amplifolius*	Large-leaf pondweed	Native	Rake	7.62%
Submergent	*Potamogeton bicupulatus*	Snail-seed pondwwed	Native-Special Concern	Rake	0.32%
Submergent	*Potamogeton foliosus*	Leafy pondweed	Native	Rake	1.27%
Submergent	*Potamogeton gramineus*	Variable pondweed	Native	Rake	17.46%
Submergent	*Potamogeton obtusifolius*	Blunt-leaf pondweed	Native	Rake	0.32%
Submergent	*Potamogeton pusillus subsp. pusillus*	Small pondweed	Native	Rake	3.49%
Submergent	*Potamogeton richardsonii*	Clasping-leaf pondweed	Native	Rake	3.81%
Submergent	*Potamogeton robbinsii*	Fern pondweed	Native	Rake	7.62%
Submergent	*Potamogeton spirillus*	Spiral-fruited pondweed	Native	Rake	1.27%
Submergent	*Potamogeton vaseyi*	Vasey's pondweed	Native-Special Concern	Rake	1.90%
Submergent	*Potamogeton zosteriformis*	Flat-stem pondweed	Native	Rake	2.22%
Submergent	*Vallisneria americana*	Wild celery	Native	Rake	0.95%

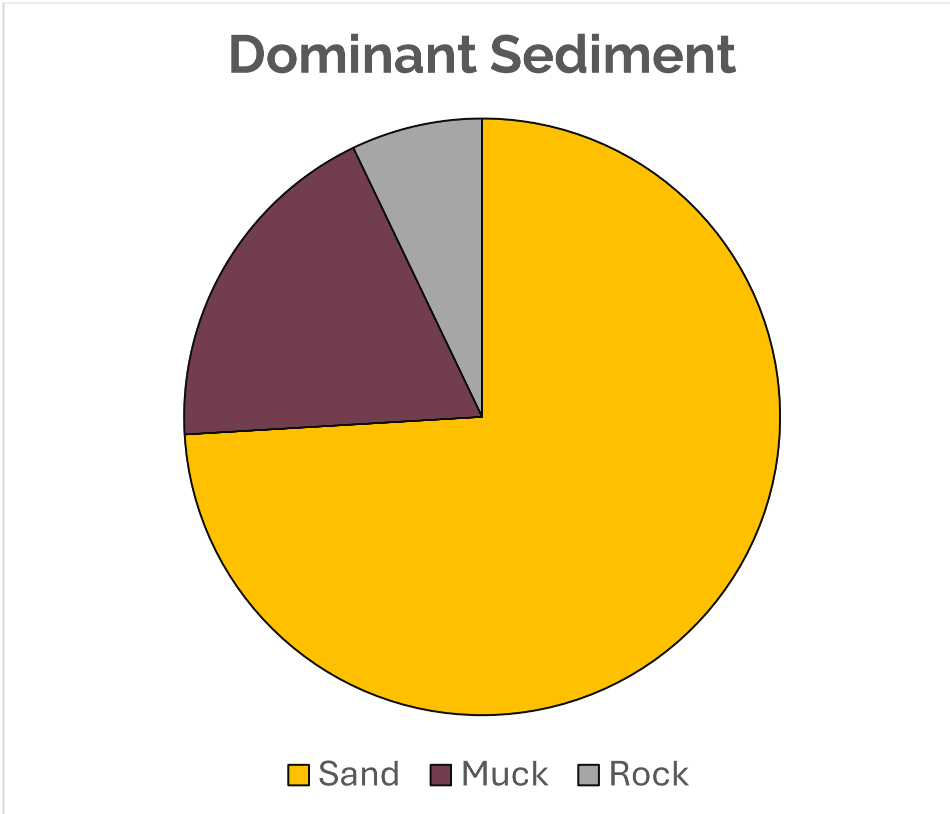

Figure 1. Little Star Lake's dominant sediment observed during 2025 survey.

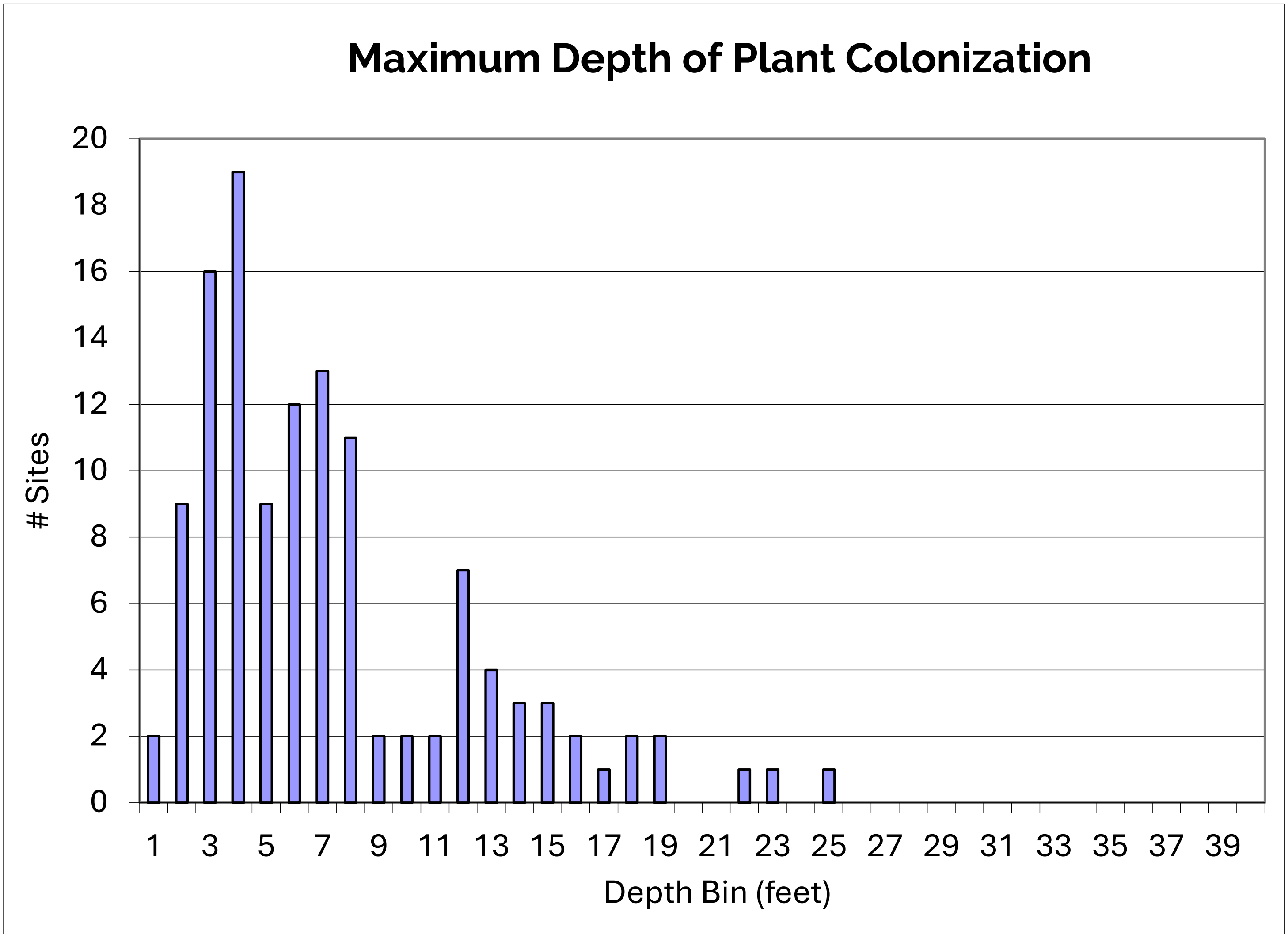

Figure 2. Little Star Lake's maximum depth of plant of plant colonization in 2025.

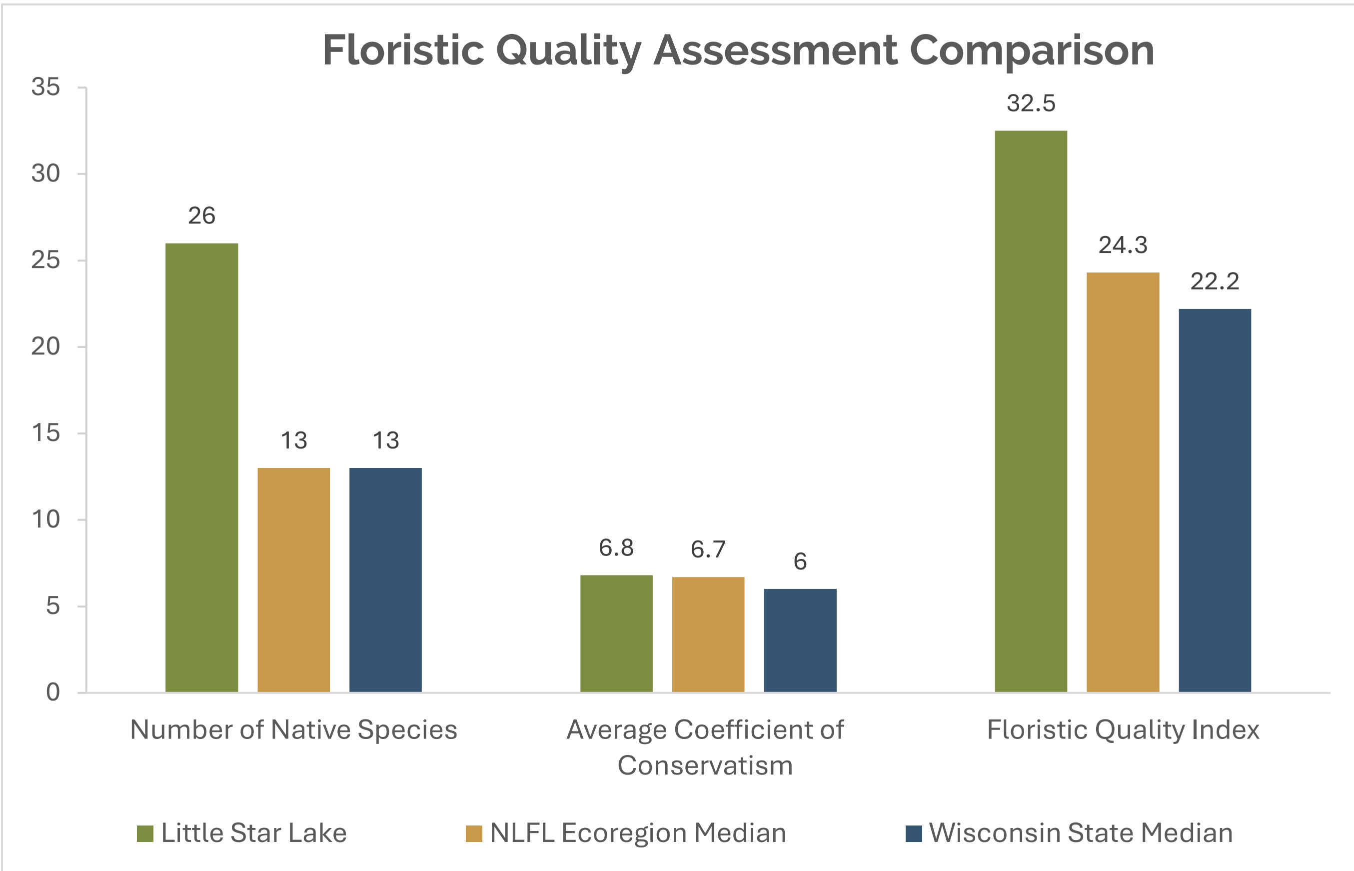

Figure 3. Floristic Quality Assessment and comparison of Little Star Lake.

Species Abundance

The four most relatively abundant plants on Little Star Lake are variable pondweed (*Potamogeton gramineus*), fern pondweed (*Potamogeton robbinsii*), large-leaf pondweed (*Potamogeton amplifolius*), and musgrasses (*Chara sp.*) (Figure 4). Variable pondweed had a relative frequency of 22% and its distribution is shown on Map 3. Fern pondweed had a relative frequency of 9.6% and its distribution is shown on Map 4. Large-leaf pondweed had a relative frequency of 9.6% and its distribution is shown on Map 5. Muskgrass (*Chara sp.)* also had a relative frequency of 9.6% and its distribution is shown on Map 6.

Variable pondweed (Potamogeton gramineus) is a submerged aquatic plant found throughout Wisconsin and much of the northern and western United States, typically growing in clear, shallow to moderately deep waters with firm sediments. Leaf size and shape can vary significantly within a single plant, a characteristic that gives the species its common name. It produces narrow, grass-like submerged leaves arranged spirally along the stem, often with free stipules, and may occasionally develop elliptical floating leaves. Fruit, tubers, and vegetation are consumed by waterfowl and mammals, while the plant's extensive branching provides habitat for invertebrates and foraging opportunities for fish (Borman et al. 1997; Skawinski 2022).

Fern pondweed (Potamogeton robbinsii) is a submerged aquatic plant found primarily in northern and eastern Wisconsin, growing in deeper waters with sandy or silty substrates. Its stiff, dark green-brown leaves are arranged closely in an alternating pattern along the stem, giving it a fern-like appearance. Unlike many pondweeds, it does not produce floating leaves. This species is sensitive to water quality degradation, thriving in unpolluted, low-nutrient environments. Fern pondweed provides habitat and food for a wide range of aquatic organisms, from invertebrates to waterfowl and fish, including northern pike (Borman et al. 1997; Skawinski 2022).

Large-leaf pondweed (Potamogeton amplifolius) is a submerged aquatic plant commonly found throughout Wisconsin and much of the United States, typically growing in soft sediments at depths ranging from 1 meter to several meters. This robust plant produces the broadest elliptical leaves of the pondweeds, which may fold symmetrically and contain numerous veins (25–37). Ovular floating leaves also have many veins with free stipules. Large-leaf pondweed reproduces both sexually through seeds and vegetatively via overwintering rhizomes. The plant provides excellent habitat and foraging areas for invertebrates, waterfowl, and fish like northern pike and other predatory species which gives it its nicknames of “bass weed” and “musky cabbage.” However, it is sensitive to water turbidity and physical damage from cutting, such as that caused by boat motors (Borman et al. 1997; Skawinski 2022)

Chara (Chara sp.) is a submerged alga, commonly called muskgrass, found throughout Wisconsin and much of the United States. It resembles vascular plants with its whorled, branching stems but lacks true leaves, roots, rhizomes, flowers, seeds, and vascular tissue, instead having rhizoids for anchoring and oogonia for reproduction. Chara structures often produce a skunky odor, giving it its common name. This species grows in deeper areas of calcium-rich or hard waters, forming dense mats of stiff, green, rough, calcium carbonated coated stems. Chara provides habitat for small aquatic animals, stabilizes sediments, and serves as a food source for waterfowl, while also supporting fish such as trout and bass that feed on the invertebrates it harbors (Borman et al. 1997; Skawinski 2022).

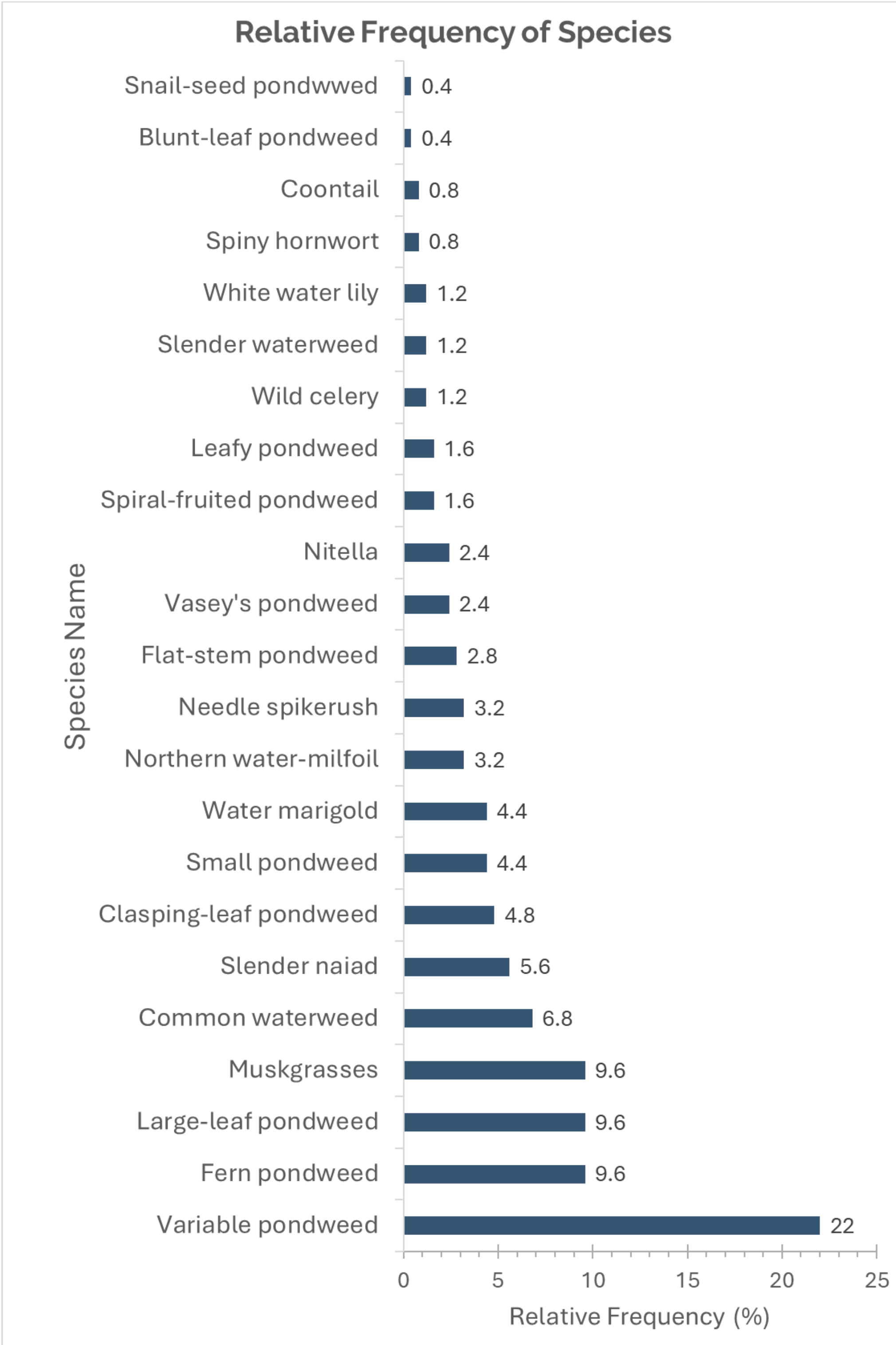

Figure 4. Little Star Lake's relative frequency of occurrence of aquatic plant species collected during the 2025 point-intercept survey.

CONCLUSION

The aquatic vegetation surveys conducted on Little Star Lake in the summer of 2025 provide a comprehensive understanding of the plant communities inhabiting this water body. Little Star Lake exhibited strong species richness and floristic quality with figures that exceeded both the regional and statewide median values, reflecting the ecological quality and overall health of the lake's aquatic plant community.

Analysis of the data collected from the plant point-intercept survey indicates that Little Star Lake supports a relatively healthy and diverse native plant assemblage, with no aquatic invasive species detected during the survey. However, a follow up survey did detect a few individual points of Eurasian watermilfoil within Little Star Lake. The lake's high Simpson's Diversity Index value of 0.90 demonstrates a well-balanced distribution of species. Little Star Lake's Floristic Quality Index (FQI) value of 32.53 is notably higher than both the statewide median (22.2) and the Northern Lakes and Forests Ecoregion median (24.3). Additionally, the mean coefficient of conservatism (C) value of 6.78 out of 10 suggests a plant community composed largely of species that are moderately to highly sensitive to disturbance, indicating strong floristic integrity and relatively low tolerance to environmental degradation. It is important to note that FQI values can be influenced by lake size and habitat heterogeneity (Bernthal 2003), both of which may contribute to the observed results.

Ultimately, these surveys not only fulfill their role in documenting species presence, distribution, and relative abundance, but also support Little Star Lake's broader goals of preserving water quality, biodiversity, and ecological integrity. Continued monitoring using standardized point-intercept methods will be essential to track long-term changes in the aquatic plant community, detect potential invasive species early, and inform effective, science-based lake stewardship and management efforts moving forward.

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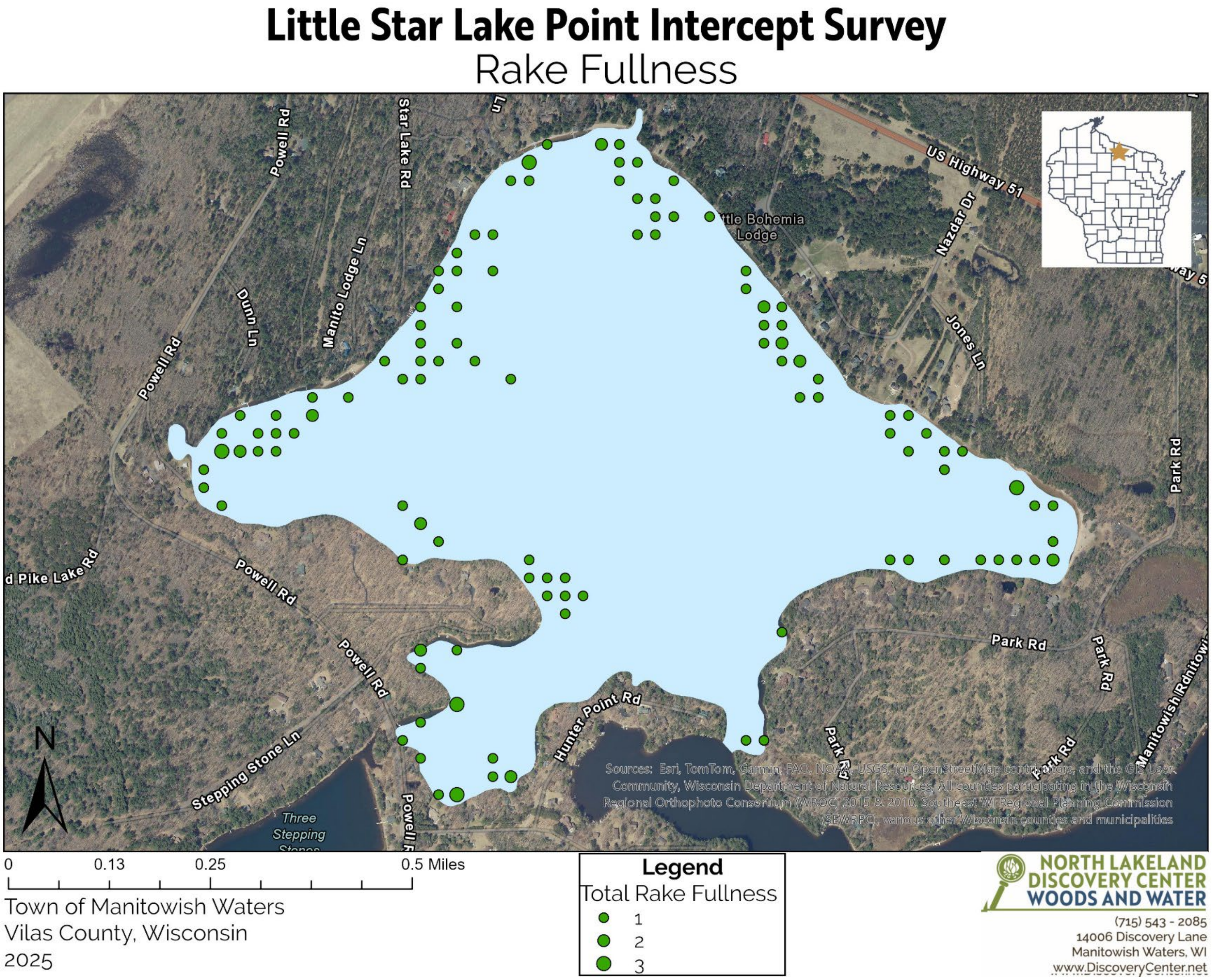
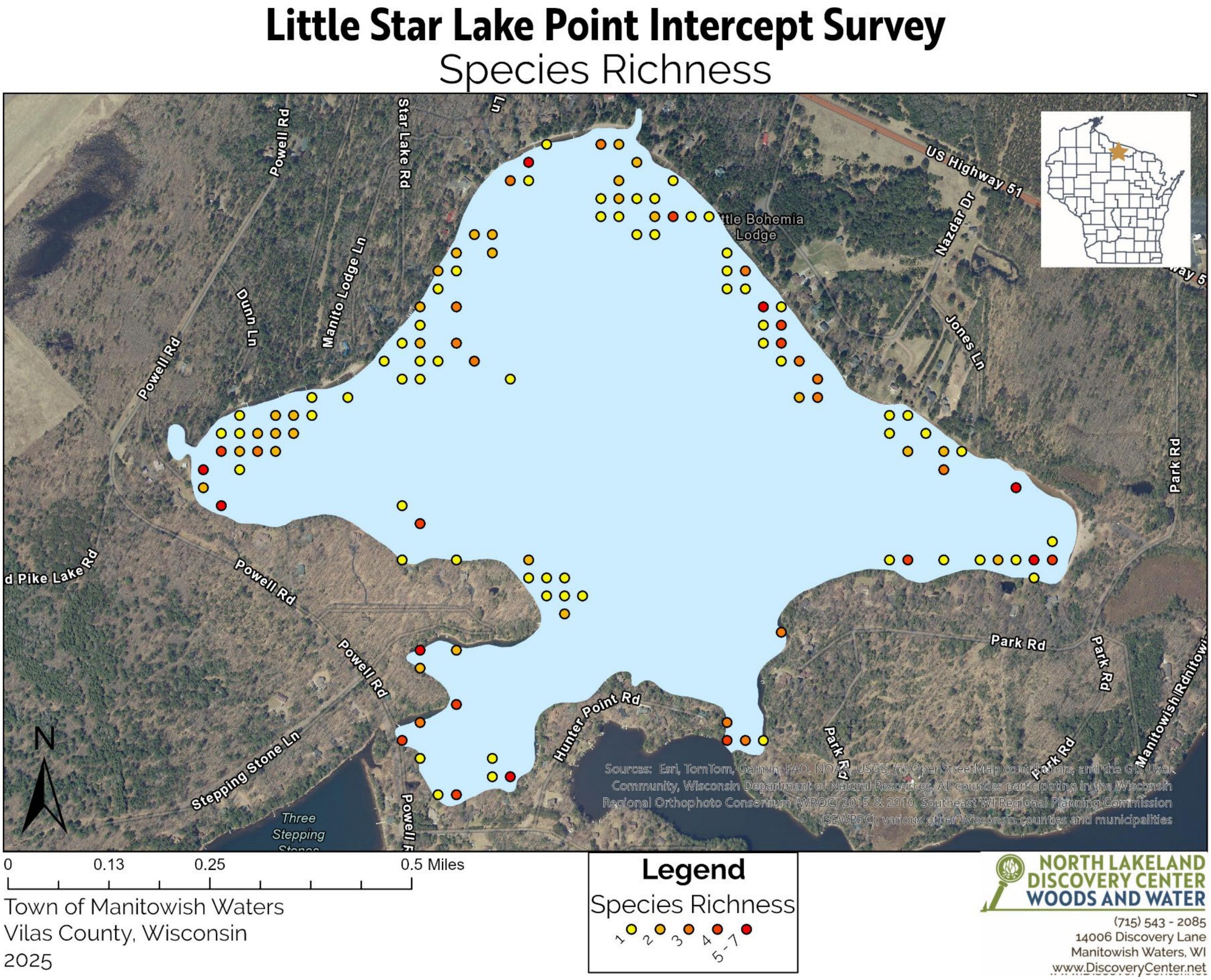
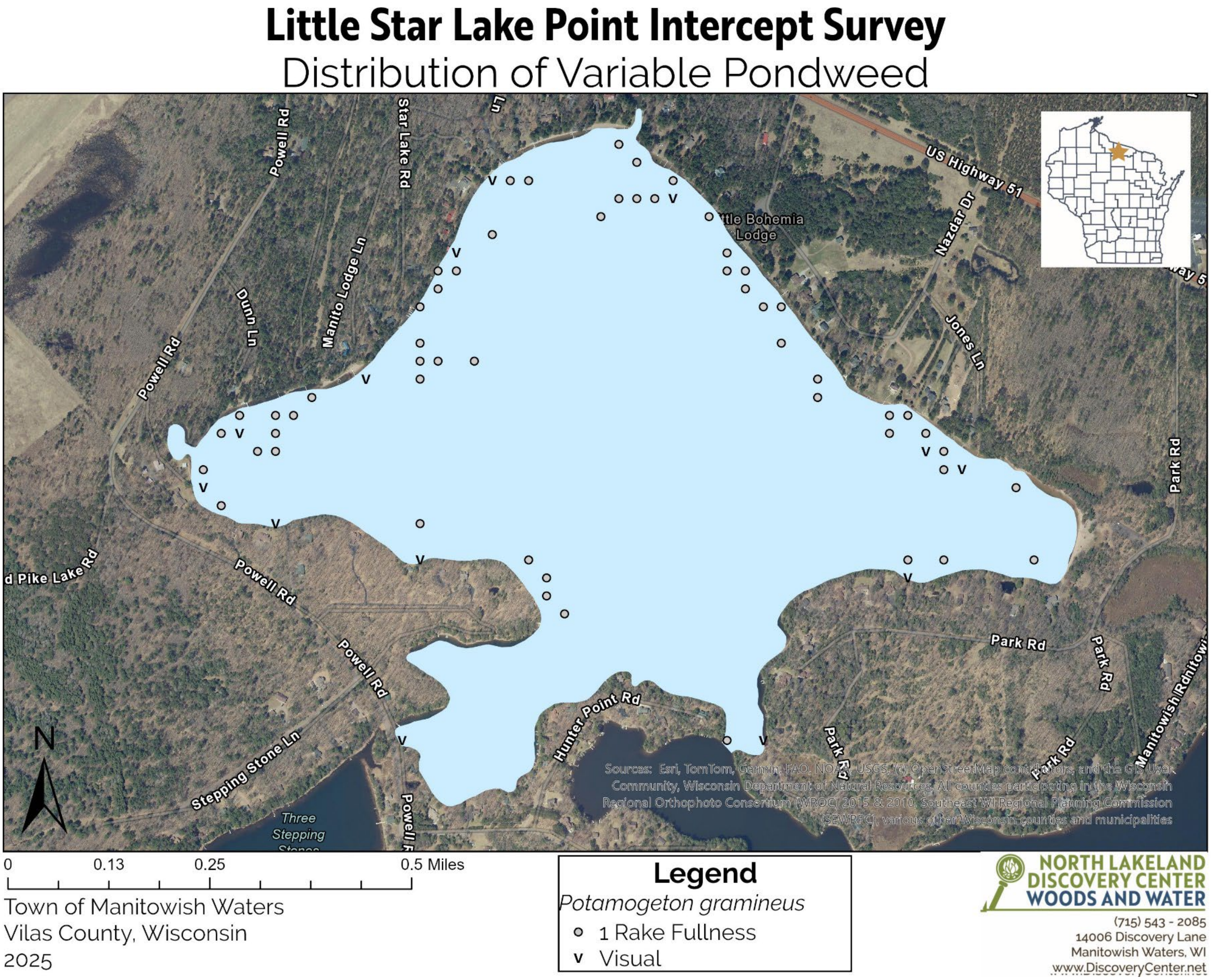
Map 1. Little Star Lake's total rake fullness



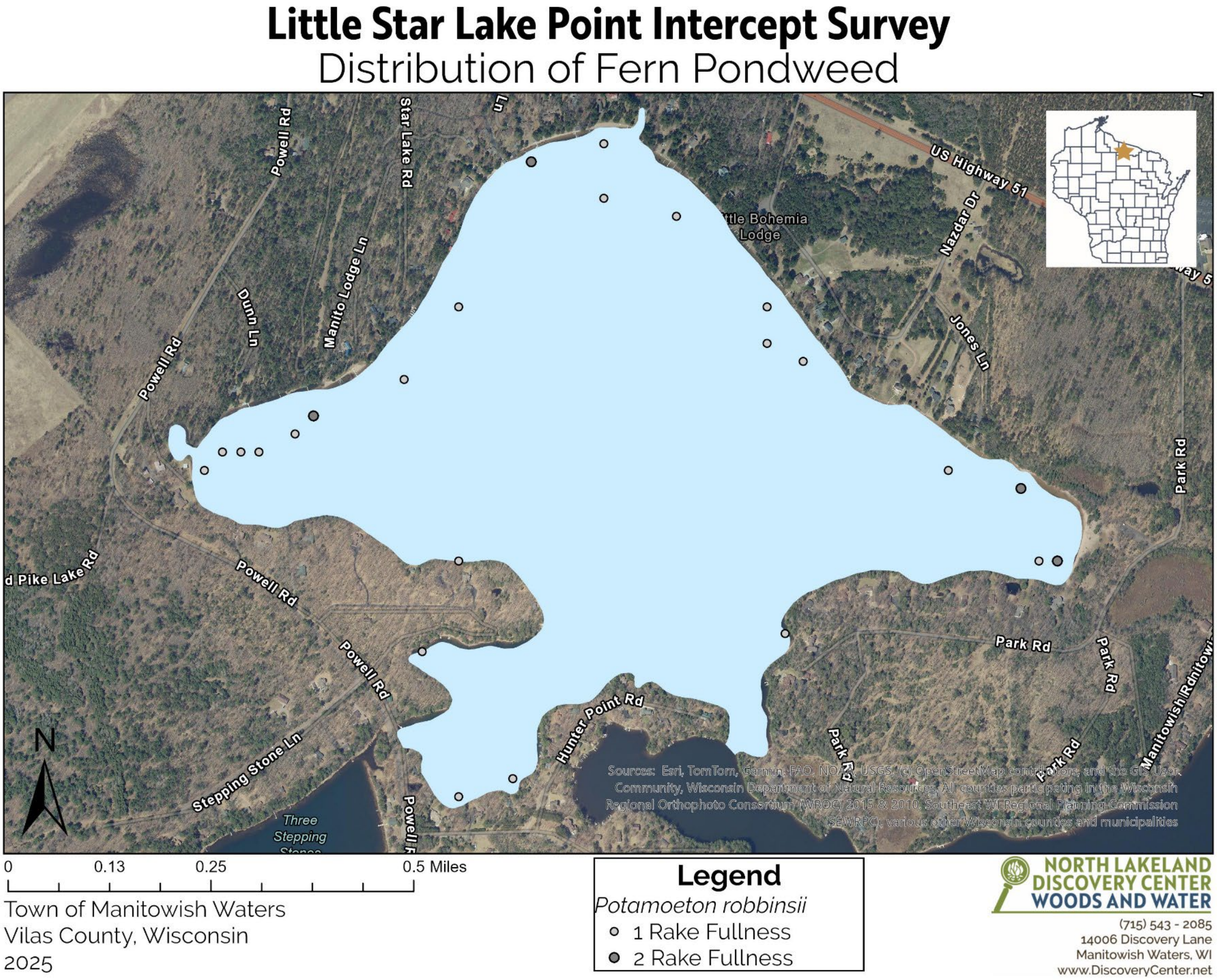
Map 2. Little Star Lake's species richness at each point.



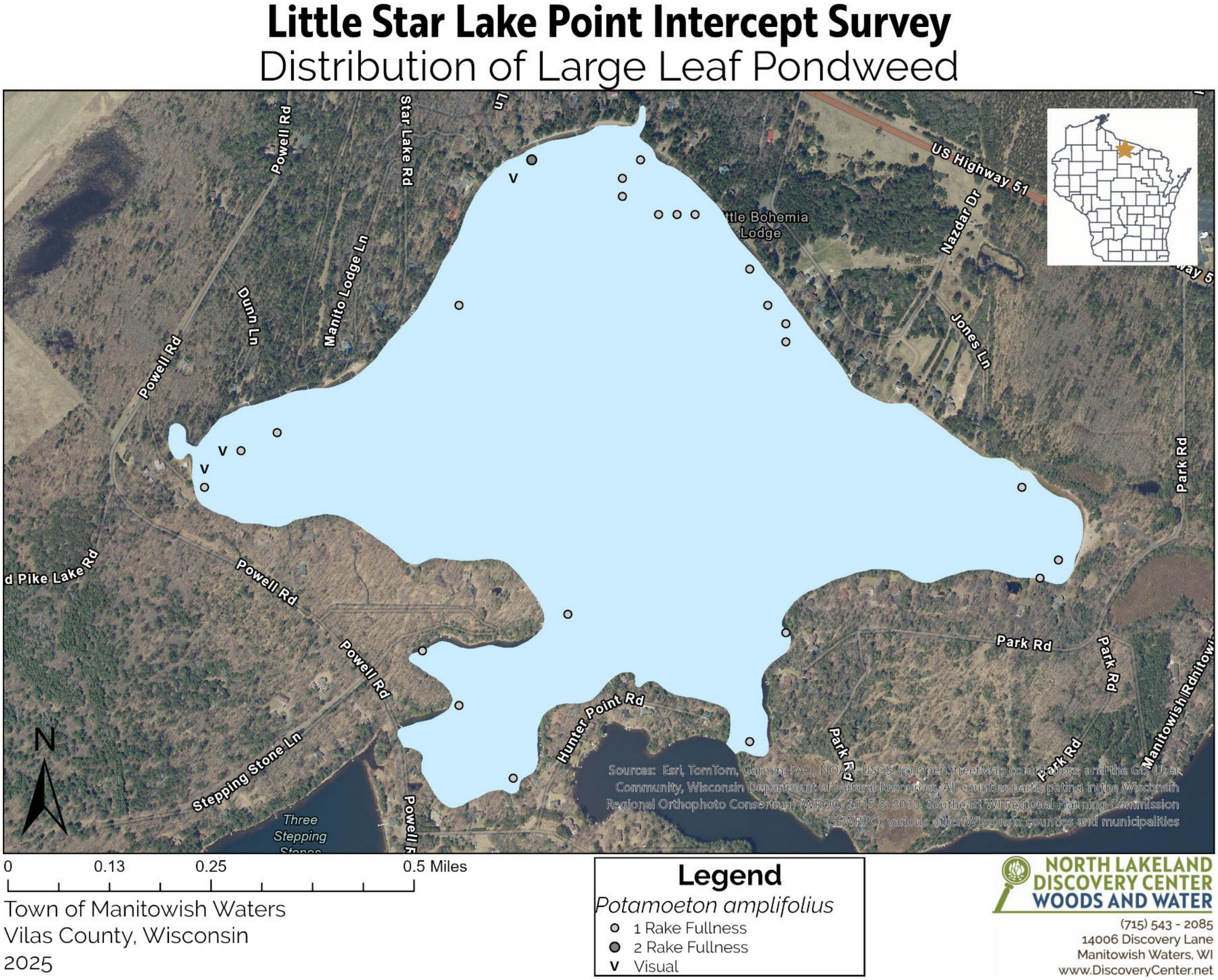
Map 3. Little Star Lake's distribution of variable pondweed.



Map 4. Little Star Lake's distribution of fern pondweed.



Map 5. Little Star Lake's distribution of large-leaf pondweed.



Map 6. Little Star Lake's distribution of muskgrass.