Warm-water Macrophyte Point-intercept Survey
Big Chetac Lake – WBIC: 2113300
Sawyer County, Wisconsin

Low density rice on the east shoreline of the "Bullpen" (Berg 2017)

Aerial photo Big Chetac Lake (2015)

Project Initiated by:

The Big Chetac Chain Lake Association, the Wisconsin Department of Natural Resources, and Lake Education and Planning Services, LLC

Decomposing CLP washing up along the south shore (Berg 2017)

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July 28-29, 2017

TABLE OF CONTENTS

ABSTRACT

Big Chetac Lake (WBIC 2113300) is a 1,920 acre stratified eutrophic drainage lake located in southwestern Sawyer County, WI. In 2010, the Big Chetac Chain Lake Association (BCCLA) developed an Aquatic Plant Management Plan that authorized chemical treatment of the lake's Curly-leaf pondweed (*Potamogeton crispus*) (CLP) infestation. The BCCLA treated 90.8 acres in 2013 and 2014, and 55.2 acres in 2015 (all in the north bay); however, in order to see how both CLP and the native vegetation would recover, no treatments occurred in 2016 or 2017. As a prerequisite to updating this plan in 2018 and to compare how the lake's vegetation had changed since the last point-intercept survey in 2014, the BCCLA, Lake Education and Planning Services, LLC, and the Wisconsin Department of Natural Resources authorized a full point-intercept survey for all aquatic plants from July 28-29, 2017. During the survey, we found macrophytes growing at 201 sites (20.7% of the entire lake bottom and in 57.1% of the 11.5 littoral zone). This was a moderately significant increase **(*p*=0.002)** from the 148 sites with plants in 2014 (15.3% of the lake and 30.0% of the then 14.5ft littoral zone), and a near return to the 269 points with vegetation (27.7% of the lake/68.6% of the then 12.5ft littoral zone) we documented during the original 2008 survey. Overall diversity was exceptionally high with a Simpson Index value of 0.93 – identical to 2014 and up slightly from 0.90 in 2008. Overall species richness was moderate with 52 species found growing in and immediately adjacent to the water – up from 48 in 2014 and 46 in 2008. We identified an average of 2.69 native species/site with native vegetation – a non-significant decline (*p*=0.10) from 2.71/site in 2014, but still higher than the 2.49/site in 2008. Mean total rake fullness at sites with vegetation experienced a non-significant decline (*p*=0.13) from a low/moderate 1.84 in 2014 to 1.74 in 2017 (both down from a moderate 2.02 in 2008). During the original July 2008 survey, Curly-leaf pondweed, Small pondweed (*Potamogeton pusillus*), Coontail (*Ceratophyllum demersum*), and Flat-stem pondweed (*Potamogeton zosteriformis*) were the most common macrophyte species. They were found at 48.70%, 48.33%, 42.38%, and 18.96% of survey points with vegetation and accounted for 57.73% of the total relative frequency. In 2014, Coontail, Curly-leaf pondweed, Small pondweed, and Slender naiad (*Najas flexilis*) were the most common species (40.54%, 38.51%, 25.00%, and 18.92% of sites with vegetation/45.96% of the total relative frequency). Lakewide, from 2008 to 2014, ten species and filamentous algae experienced significant changes in distribution all of which were declines. CLP, Small pondweed, Coontail, filamentous algae, Flat-stem pondweed, Forked duckweed (*Lemna trisulca*), and Fries' pondweed (*Potamogeton friesii*) suffered highly significant declines; Fern pondweed (*Potamogeton robbinsii*) saw a moderately significant decline; and Small duckweed (*Lemna minor*), Large duckweed (*Spirodela polyrhiza*), and White water crowfoot (*Ranunculus aquatilis*) experienced significant declines. In 2017, Common waterweed (*Elodea canadensis*), Coontail, Small pondweed, and Forked

duckweed were the most common macrophyte species. We found them at 37.81%, 31.34%, 24.38%, and 17.91% of survey points with vegetation, and they totaled 41.25% of the community's relative frequency. By 2017, many species that had shown dramatic declines in 2014 were beginning to recover. Twelve species and filamentous algae saw significant changes, and all but one of those was an increase. Filamentous algae, Flat-stem pondweed, Nitella (*Nitella* sp.), Forked duckweed, Northern water-milfoil (*Myriophyllum sibiricum*), Common waterweed, and Muskgrass (*Chara* sp.) populations all benefited from highly significant increases in distribution; Small pondweed and White water crowfoot enjoyed moderately significant increases; and Coontail, Fries' pondweed, and Water star-grass (*Heteranthera dubia*) had significant increases. Conversely, Curly-leaf pondweed experienced a highly significant decline. Although significant, this loss may simply have been due to the 2017 survey occurring at a later date in July when more of the CLP would have completed its annual senescence. In addition to these changes in distribution, Small pondweed suffered a highly significant decline **(p<0.001)** in density, while Common waterweed enjoyed a highly significant increase **(p<0.001)** in mean rake fullness. The 39 native index species found in the rake during the 2017 survey (up from 37 in 2014 and 34 in 2008) produced an above average mean Coefficient of Conservatism of 6.0 (up from 5.9 in 2014 and identical to 2008) and a Floristic Quality Index of 37.3 (up from 35.8 in 2014/34.8 in 2008) that was nearly double the median FQI for this part of the state. Northern wild rice (*Zizania palustris*) continues to be present in scattered mostly low density patches along the creek inlets in the Bullpen. In 2017, we found rice at three points with a mean rake fullness of 1.00 (identical to 2014/similar to two points in 2008 with a mean rake of 3.00). Filamentous algae were present at 72 points with a mean rake of 1.53 (up from 27 points/rake of 1.59 in 2014 and 59 points/rake of 1.76 in 2008). Curly-leaf pondweed was present in the rake at 16 points with a mean rake fullness of 1.00 (down from 57 in 2014/mean rake of 1.32 and 131 points in 2008/mean rake of 1.31). Despite the declines compared to 2008/2014, we still documented large floating mats of dead CLP along southern shorelines. We saw no evidence of Eurasian water-milfoil (*Myriophyllum spicatum*) in the lake. Other than CLP, we found three other exotic species growing in and immediately adjacent to the lake: Reed canary grass (*Phalaris arundinacea*) was present along shorelines throughout; Common forget-me-not (*Myosotis scorpioides*) occurred along cold water seeps; and Hybrid cattail (*Typha* X *glauca*) was displacing the native Broad-leaved cattail (*Typha latifolia*) and wild rice south of the Malviney Creek inlet in the Bullpen. Future management considerations include working to limit nutrient inputs wherever possible; evaluating the impact of chemical treatment on both CLP and native plants to help determine what type and how much (if any) future management will occur; and continuing the Clean Boats/Clean Waters watercraft inspection program to help prevent the introduction of Eurasian Water-milfoil or any other new Aquatic Invasive Species to the lake.

LIST OF FIGURES

LIST OF TABLES

Page #

INTRODUCTION:

Big Chetac Lake (WBIC 2113300) is a 1,920 acre stratified drainage lake in southwestern Sawyer County, Wisconsin in the Town of Edgewater (T37N R09W S19 NE NE). It reaches a maximum depth of 28ft in the narrows between the islands in the south basin and has an average depth of approximately 14ft (Figure 1). The lake is eutrophic to hypereutrophic (nutrient rich) in nature with summer Secchi readings from 1995-2017 averaging 3.0ft (WDNR 2017). This very poor water clarity produced a littoral zone that extended to approximately 11.5ft in the summer of 2017. The bottom substrate is predominately muck in the lake's side bays and throughout the north and south ends; and a mixture of sand and rock along exposed shorelines, the mid-lake narrows, and around the islands (Busch et al. 1967).

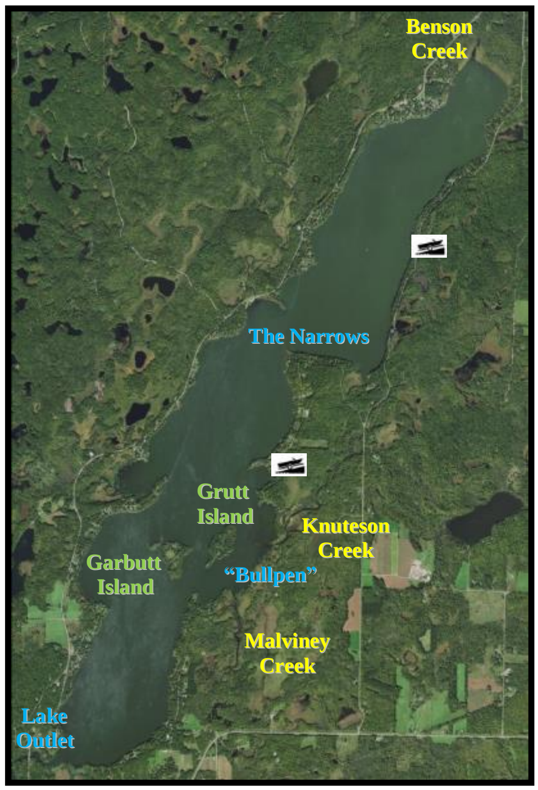


Figure 1: Big Chetac Lake Aerial Photo

BACKGROUND AND STUDY RATIONALE:

In 2008, concern over the lake's significant infestation of Curly-leaf pondweed (*Potamogeton crispus*) (CLP), an exotic invasive species, prompted the Big Chetac Chain Lake Association (BCCLA) to start developing a Wisconsin Department of Natural Resources (WDNR) approved Aquatic Plant Management Plan (APMP) which was completed and adopted in 2010. As a prerequisite to developing this plan, we completed two baseline macrophyte surveys: a spring CLP point-intercept survey and a summer full species point-intercept survey. The spring survey found CLP dominated approximately 30% of the lake's surface area, and, especially in the lake's muck bottom bays, almost always formed a solid canopied mat in up to 10ft of water, excluded most native plants, and often made boating difficult. Because of this, in 2013, the BCCLA applied for and received a three-year WDNR exotic species control grant to begin actively managing CLP chemically and manually. After evaluating the 2008 maps, it was decided to treat 90.8 acres in the north bay in both 2013 and 2014, and 55.2 acres in 2015; however, in order to see how both CLP and the native vegetation would recover, no treatments occurred in 2016 or 2017.

In anticipation of updating their APMP in 2018, the BCCLA, Lake Education and Planning Services, LLC, and the WDNR authorized a warm-water point-intercept survey of all macrophytes in the summer of 2017. The study objectives were to determine if EWM or any other new exotic plants had invaded the lake, quantify the current density and distribution of native plants species, and compare data from the 2008, 2014, and 2017 surveys to see how native species were responding following the cessation of the herbicide program. This report is the summary analysis of that field survey conducted from July 28-29, 2017.

METHODS:

Warm-water Full Point-intercept Macrophyte Survey:

Using a standard formula that takes into account the shoreline shape and distance, islands, water clarity, depth, and total lake acres, Jennifer Hauxwell (WDNR) generated the original 970 point sampling grid for Big Chetac Lake that was used in 2008, 2014, and 2017 (Appendix I). Prior to beginning the 2017 point-intercept survey, we conducted a general boat survey to regain familiarity with the lake's macrophytes (Appendix II). All plants found were identified (Voss 1996, Boreman et al. 1997; Chadde 2002; Crow and Hellquist 2013; Skawinski 2014), and a datasheet was built from the species present.

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

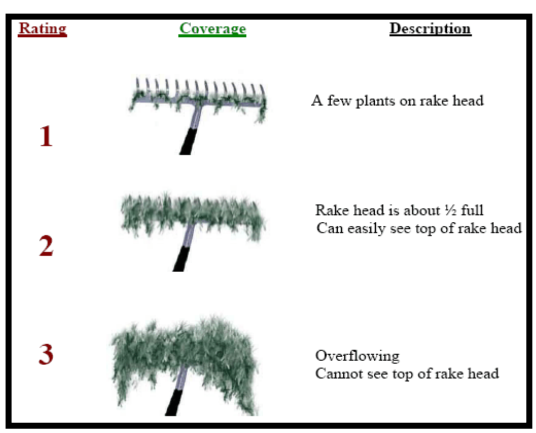


Figure 2: Rake Fullness Ratings (UWEX 2010)

DATA ANALYSIS:

We entered all data collected into the standard APM spreadsheet (Appendix II) (UWEX 2010). From this, we calculated the following:

Total number of sites visited: This included the total number of points on the lake that were accessible to be surveyed by boat.

Total number of sites with vegetation: These included all sites where we found vegetation after doing a rake sample. For example, if 20% of all sample sites have vegetation, it suggests that 20% of the lake has plant coverage.

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

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

Frequency of occurrence example:

Plant A is sampled at 70 out of 700 total littoral points = 70/700 = .10 = 10%
This means that Plant A's frequency of occurrence = 10% when considering the entire littoral zone.

Plant A is sampled at 70 out of 350 total points with vegetation = 70/350 = .20 = 20%
This means that Plant A's frequency of occurrence = 20% when only considering the sites in the littoral zone that have vegetation.

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

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

<u>Simpson's Diversity Index:</u> 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.

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

<u>Mean and median depth of plants:</u> 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.

<u>Number of sites sampled using rope/pole rake:</u> This indicates which rake type was used to take a sample. As is standard protocol, we use a 15ft pole rake and a 25ft rope rake for sampling.

<u>Average number of species per site:</u> 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.

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

<u>Average rake fullness:</u> 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 frequency will add up to 100%. Organizing species from highest to lowest relative frequency value gives us an idea of which species are most important within the macrophyte community (Tables 2-4).

Relative frequency example:

Suppose that we sample 100 points and found 5 species of plants with the following results:

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

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

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

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

Floristic Quality Index (FQI): This index measures the impact of human development on a lake's aquatic plants. The 124 species in the index are assigned a Coefficient of Conservatism (C) which ranges from 1-10. The higher the value assigned, the more likely the plant is to be negatively impacted by human activities relating to water quality or habitat modifications. Plants with low values are tolerant of human habitat modifications, and they often exploit these changes to the point where they may crowd out other species. The FQI is calculated by averaging the conservatism value for each native index species found in the lake during the point-intercept survey**, and multiplying it by the square root of the total number of plant species (N) in the lake ($FQI=(\Sigma(c1+c2+c3+\ldots cn)/N)*\sqrt{N}$). Statistically speaking, the higher the index value, the healthier the lake's macrophyte community is assumed to be. Nichols (1999) identified four eco-regions in Wisconsin: Northern Lakes and Forests, North Central Hardwood Forests, Driftless Area and Southeastern Wisconsin Till Plain. He recommended making comparisons of lakes within ecoregions to determine the target lake's relative diversity and health. Big Chetac Lake is in the North Central Hardwood Forests Ecoregion (Tables 5-7).

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

Comparison to Past Surveys: We compared data from our 2008, 2014, and 2017 warm-water point-intercept surveys (Figures 8 and 9) (Tables 2-4) to see if there were any significant changes in the lake's vegetation. Using the WDNR Pre/Post Survey Sheet, we determined 2008-2014 and 2014-2017 differences to be significant at $p<0.05$, moderately significant at $p<0.01$ and highly significant at $p<0.001$ (UWEX 2010). It should be noted that when comparing the warm-water point-intercept surveys, we used the number of littoral points as the basis for "sample points" (392 in 2008/493 in 2014/352 in 2017).

RESULTS:

Warm-water Full Point-intercept Macrophyte Survey:

Depth recordings taken at Big Chetac Lake's 970 points (Appendix I) showed the lake forms a series of three elongated bowls connected by deep channels. The north basin slopes gently from north to south with rapid east/west drop-offs into a 20+ft flat. The central and southern basins are bordered by numerous bays and slope more gradually to flats in the 12-20ft range. The notable exception is the deep channel that runs between Garbutt and Grutt Islands (Figure 3) (Appendix III).

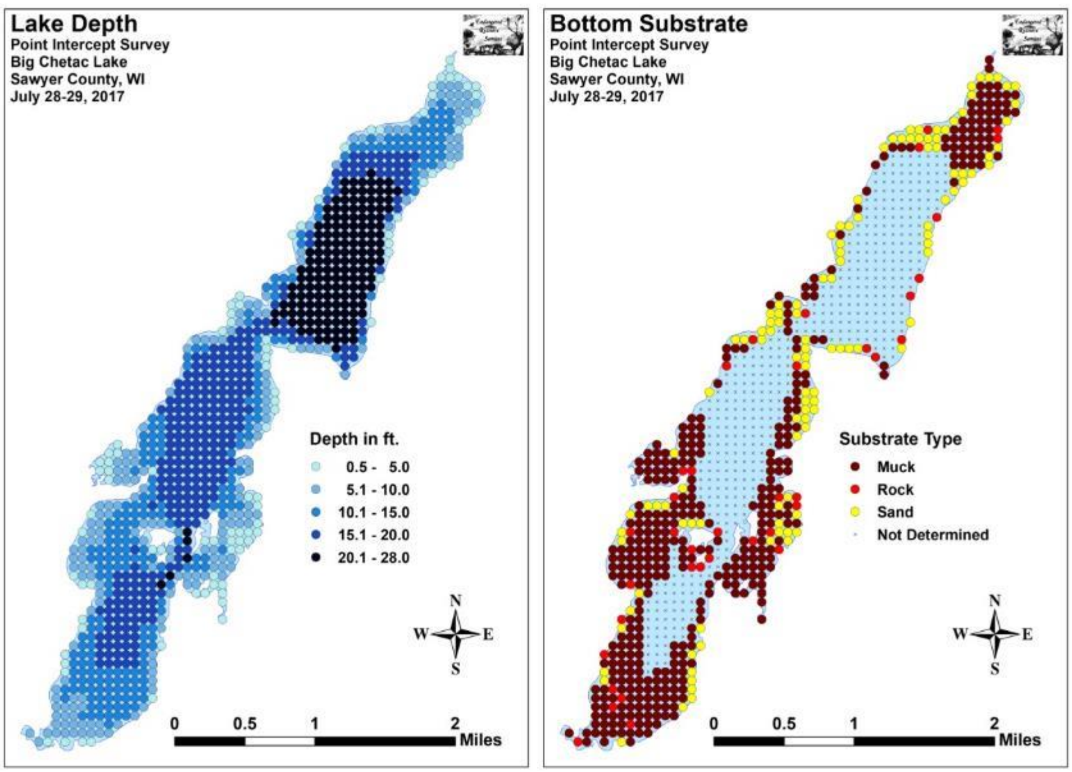


Figure 3: Lake Depth and Bottom Substrate

Of the 533 survey points where we could determine the substrate, 71.3% (380 points) were muck and sandy muck, 21.6% (115 points) were pure sand, and the remaining 7.1% (38 points) were rock (Figure 3). Nutrient-rich organic muck covered the majority of the lake's side bays and the midlake bowls, while most pure sand and rock substrate occurred immediately along the shoreline; especially around the northern half of the lake, in the Narrows, and surrounding the islands. (Appendix III).

At the time of the 2017 survey, Secchi disc readings were in the 2-3ft range. This very poor water clarity produced a littoral zone that extended to 11.5ft and included 352 survey points of which 201 had vegetation (20.7% of the lake bottom and 57.1% of the littoral zone) (Table 1). Although this was a highly significant decline **(p<0.001)** from 2014 when we found plants growing to 14.5ft (493 littoral points), it represented a moderately significant increase **(p=0.002)** from the 148 points with vegetation we found during that survey (15.3% of the lake bottom and 30.0% of the littoral zone). The 2017 values also represented a near return to vegetation levels seen in 2008 when we found plants growing at 269 points within the then 12.5ft littoral zone (27.7% of the bottom/68.6% of the littoral zone) (Figure 4) (Appendix IV). In addition to the recovery in vegetative points, we found that the mean and median depth of plant growth also increased from 5.4ft/5.0ft in 2014 to 5.9ft/ 6.0ft in 2017. This relatively uniform growth in the depth/colonization of the plant community was nearly identical to what we first observed in 2008 when the mean/median was also 5.9ft/6.0ft (Figure 5).

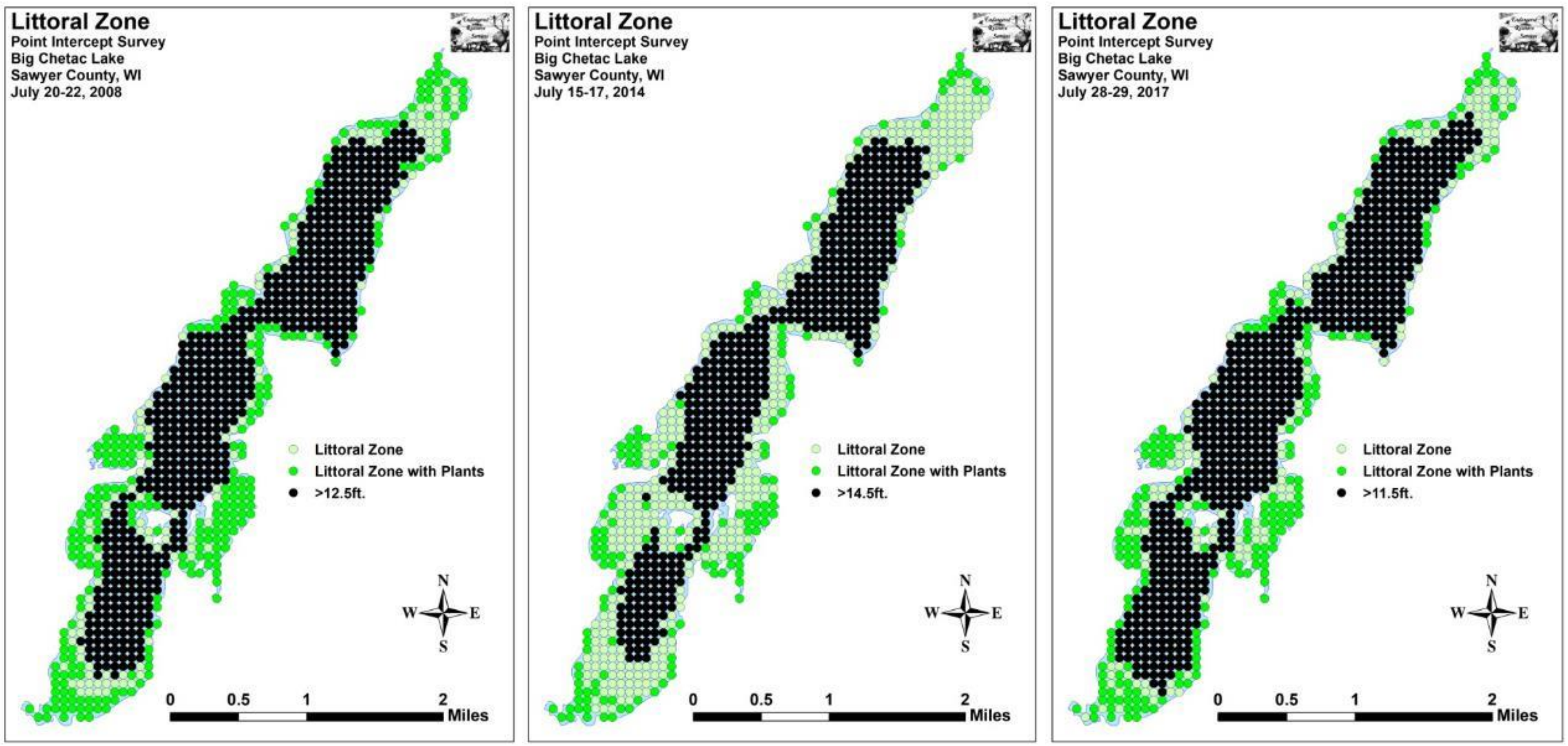


Figure 4: 2008, 2014, and 2017 Summer Littoral Zone

Table 1: Aquatic Macrophyte P/I Survey Summary Statistics
Big Chetac Lake, Sawyer Co.
July 20-22, 2008, July 15-17, 2014, and July 28-29, 2017

Summary Statistics:	**2008**	**2014**	**2017**	***p***
Total number of points sampled	970	970	970	n.s.
Total number of sites with vegetation	269	148	201	+**
Total number of sites shallower than the maximum depth of plants	392	493	352	-***
Frequency of occurrence at sites shallower than maximum depth of plants	68.6	30.0	57.1	+***
Simpson Diversity Index	0.90	0.93	0.93	n.s.
Maximum depth of plants (ft)	12.5	14.5	11.5	-***
Mean depth of plants (ft)	5.9	5.4	5.9	+n.s.
Median depth of plants (ft)	6.0	5.0	6.0	+n.s.
Average number of all species per site (shallower than max depth)	1.88	0.80	1.54	+***
Average number of all species per site (veg. sites only)	2.74	2.68	2.70	+n.s.
Average number of native species per site (shallower than max depth)	1.55	0.69	1.50	+***
Average number of native species per site (sites with native veg. only)	2.49	2.71	2.69	-n.s.
Species richness	35	39	39	n.s.
Species richness (including visuals)	40	42	45	+n.s.
Species richness (including visuals and boat survey)	46	48	52	+n.s.
Mean total rake fullness (veg. sites only)	2.02	1.84	1.74	-n.s.

n.s. = Not Significant - Significant differences = * p<0.05, ** p<0.01, *** p<0.001

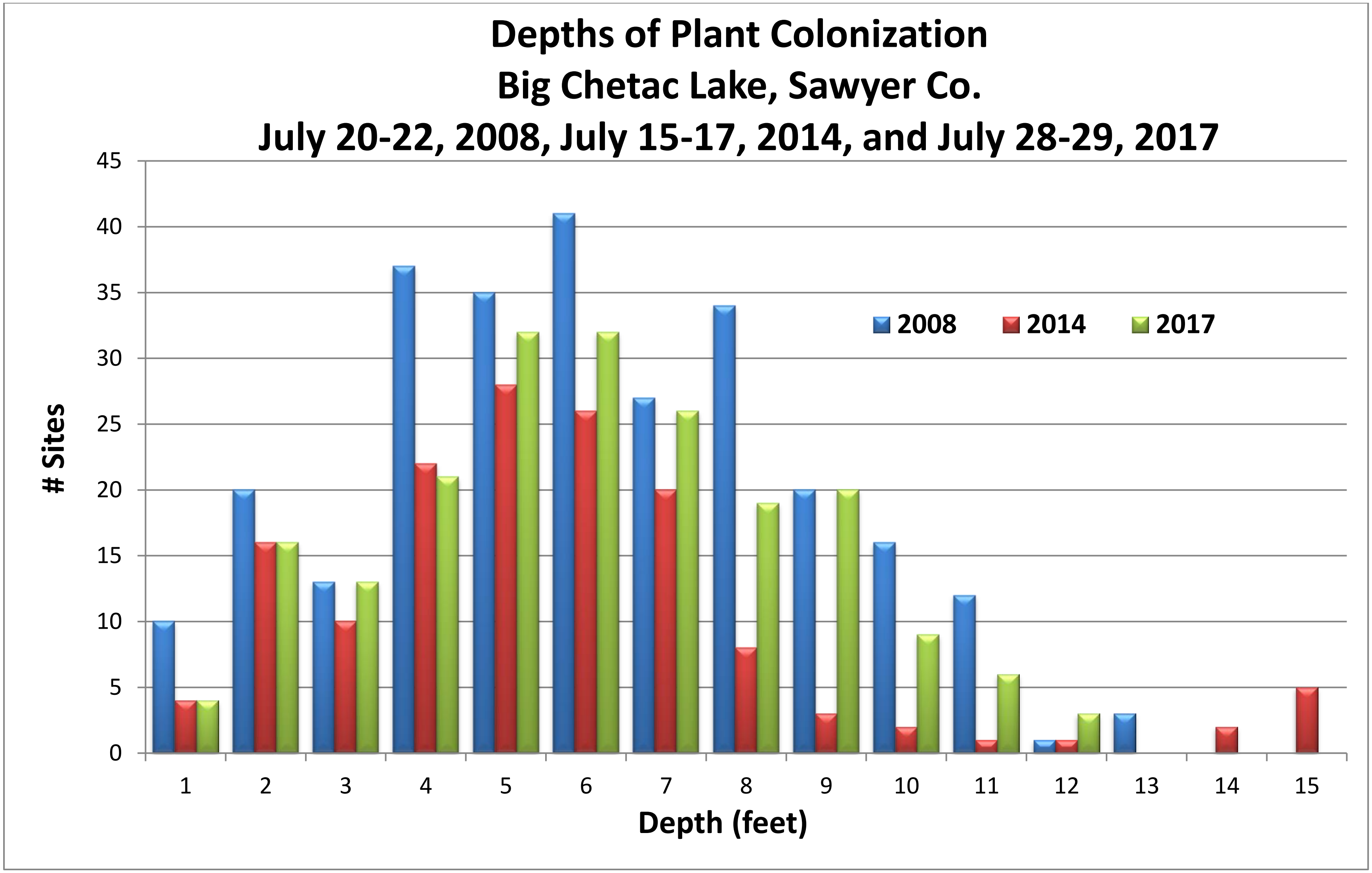


Figure 5: 2008, 2014, and 2017 Littoral Zone Plant Distribution

Overall diversity was again exceptionally high and almost unchanged from the previous surveys. In 2008, the Simpson Index value was 0.90; ticked up to 0.93 in 2014; and remained there in 2017. Overall richness was moderate and also little changed as we found 35 species in the rake in 2008, 39 in 2014, and 39 in 2017. When including visuals and the boat survey, these numbers jumped to 46/48/52 respectively. Localized richness, after increasing from 2.49 native species/site with native vegetation in 2008 to 2.71/site in 2014, experienced a non-significant decline (p=0.10) to 2.69/site in 2017. As in previous surveys, the bulk of the lake's species occurred near the creek inlets, in the herbicide control bay west of the main public boat landing, and in the Bullpen (Figure 6) (Appendix IV).

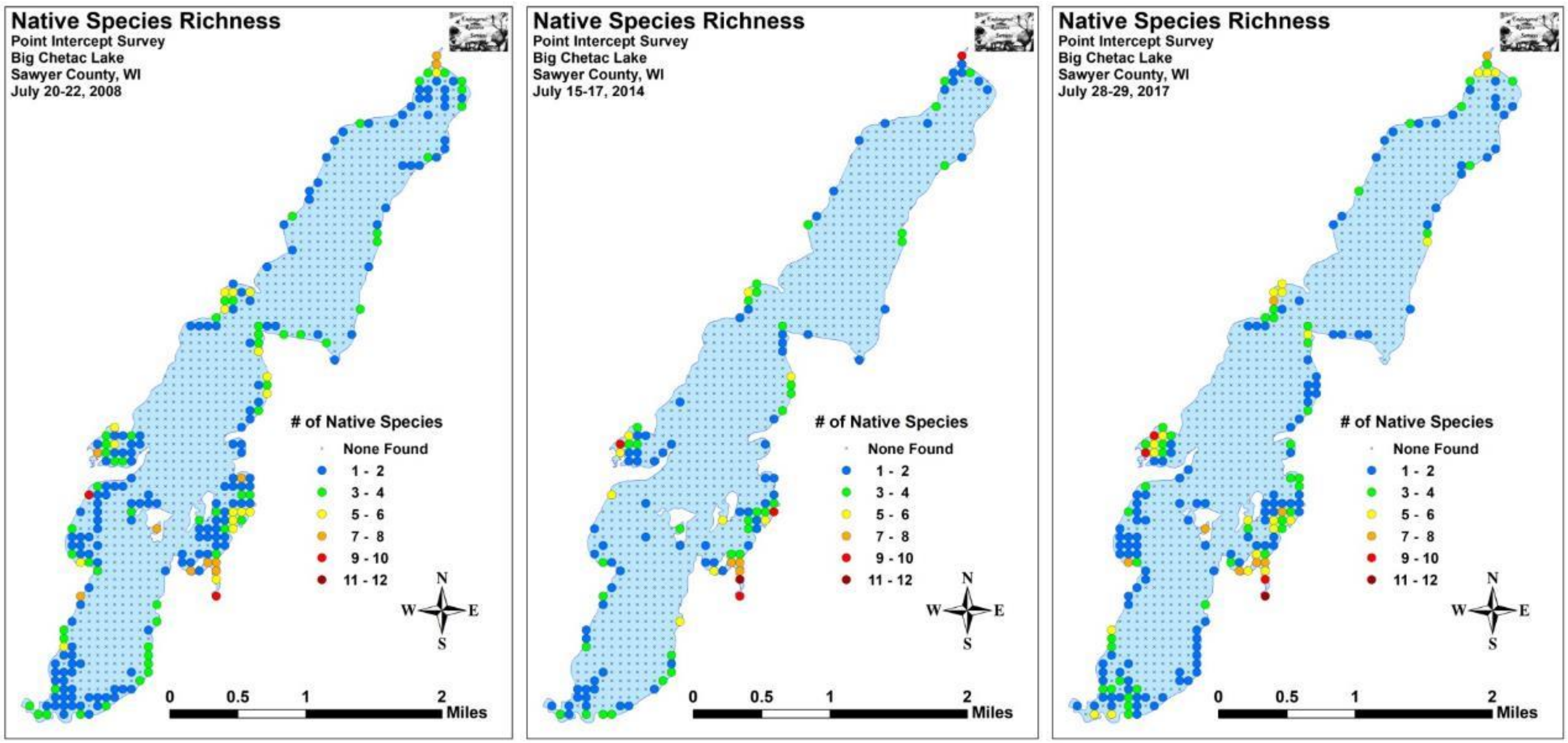


Figure 6: 2008, 2014, and 2017 Native Species Richness

The estimated 2008 baseline mean rake fullness at sites with vegetation was a moderate 2.02. It fell to a low/moderate 1.84 in 2014, and to 1.74 in 2017. This further decline wasn't significant (p=0.13), and it likely reflects the increase in low density deep water points as plants reestablish in these areas (Figure 7) (Appendix IV).

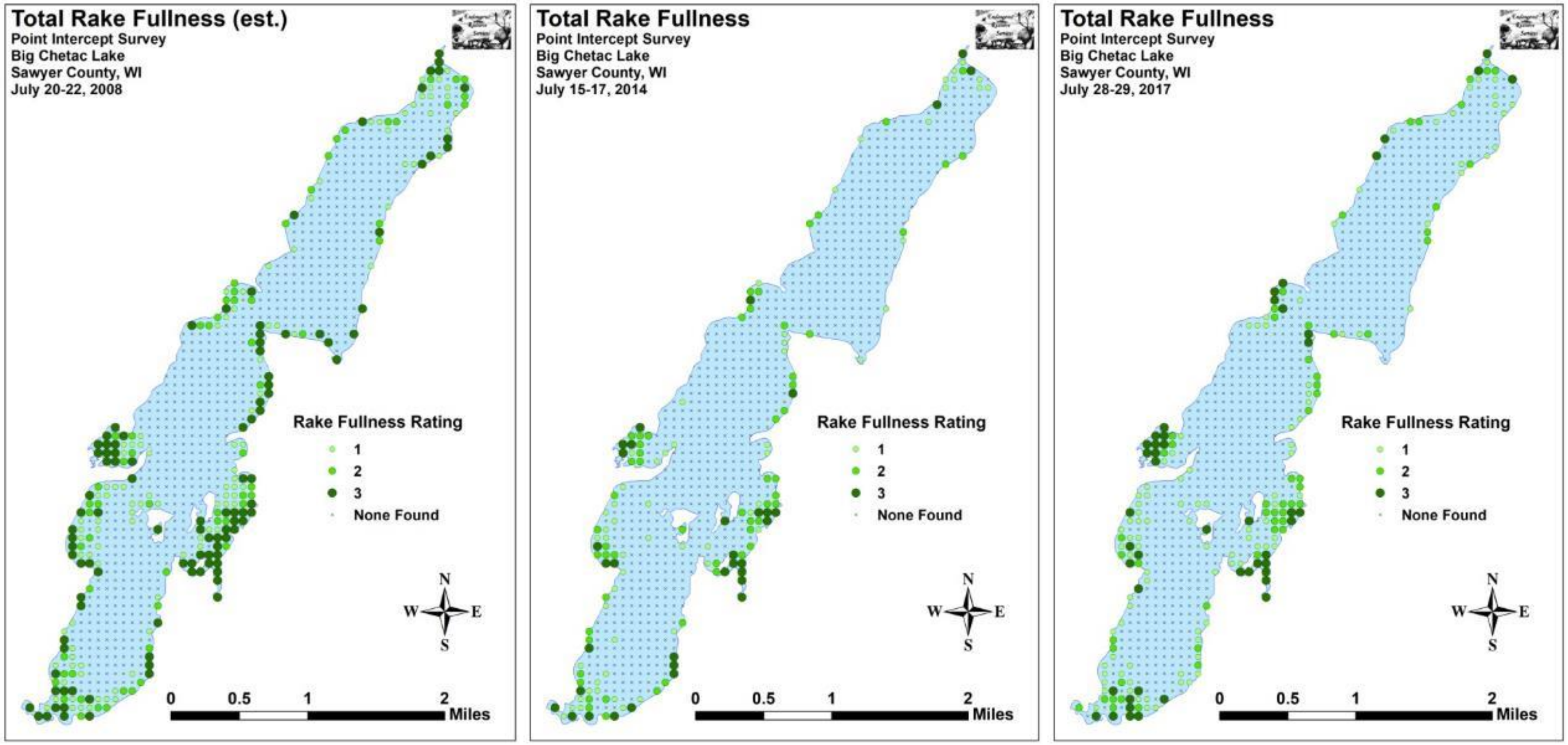


Figure 7: 2008, 2014, and 2017 Total Rake Fullness

Big Chetac Lake Plant Community:

The Big Chetac Lake ecosystem is home to a diverse plant community that is typical of high nutrient lakes. This community can be subdivided into four distinct zones (emergent, shallow submergent, floating-leaf, and deep submergent) with each zone having its own characteristic functions in the aquatic ecosystem. Depending on the local bottom type (sand, rock, 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 lakeshore, break up wave action, provide a nursery for baitfish and juvenile gamefish, offer shelter for amphibians, and give waterfowl and predatory wading birds like herons a place to hunt. These areas also provide important habitat for invertebrates like dragonflies and mayflies.

On sand and gravel bars in the southern half of the lake, the emergent community was dominated by Creeping spikerush (*Eleocharis palustris*), Hardstem bulrush (*Schoenoplectus acutus*), and Common reed (*Phragmites australis*). In shoreline areas with sandy muck, especially along the Knuteson Creek Inlet, we found beds of Pickerelweed (*Pontederia cordata*), Softstem bulrush (*Schoenoplectus tabernaemontani*), and Common bur-reed (*Sparganium eurycarpum*). When the soil was a more nutrient-rich organic muck, these species were replaced by Wild calla (*Calla palustris*), Bottle brush sedge (*Carex comosa*), Marsh cinquefoil (*Comarum palustre*), Three-way sedge (*Dulichium arundinaceum*), Bald spikerush (*Eleocharis erythropoda*), Common forget-me-not (*Myosotis scorpioides*), Common arrowhead (*Sagittaria latifolia*), Sessile-fruited arrowhead (*Sagittaria rigida*), Short-stemmed bur-reed (*Sparganium emersum*), and Broad-leaved cattail (*Typha latifolia*). These areas also supported patches of Reed canary grass (*Phalaris arundinacea*) and, in areas surrounding the creek inlets in the Bullpen, Northern wild rice (*Zizania palustris*).


Creeping spikerush (Cremlin 2009)


Pickerelweed and Hardstem bulrush (Berg 2011)


Softstem bulrush (Schwarz 2011)


Common bur-reed (Raymond 2011)

Wild calla (Pierce 2001)

Bottle brush sedge (Penta 2010)

Marsh cinquefoil (Myrhatt 2012)

Common arrowhead (Young 2008)

Short-stemmed bur-reed (Gmelin, 2009)

Broad-leaved cattail (Raymond 2011)

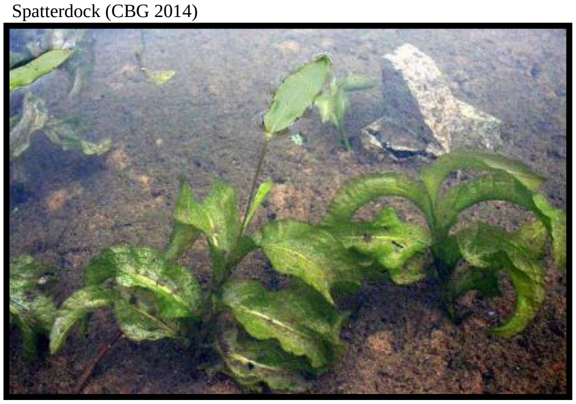
Northern wild rice along Malviney Ceek inlet (Berg 2017)

Northern wild rice (Pippen 2008)

Just beyond the emergents, in sheltered muck-bottomed areas in up to 5ft of water, the floating-leaf species Spatterdock and White-water lily were relatively common throughout the lake. However; high value native pondweeds with floating leaves like Large-leaf pondweed (*Potamogeton amplifolius*), Ribbon-leaf pondweed (*Potamogeton epihydrus*), Illinois pondweed (*Potamogeton illinoensis*), and Floating-leaf pondweed (*Potamogeton natans*) where almost exclusively found in the Bullpen in and around the creek inlets. The canopy cover they provide is often utilized by panfish and bass for protection.

Spatterdock (CBG 2014)

White water lily (Falkner 2009)



Large-leaf pondweed (Fewless 2010)

Ribbon-leaf pondweed (Petroglyph 2007)

Illinois pondweed (Hellquist 2014)

Floating-leaf pondweed (Sein 2014)

Growing amongst these floating-leaf species, we also noted the submergent species Coontail (*Ceratophyllum demersum*), Common waterweed (*Elodea canadensis*), Small pondweed (*Potamogeton pusillus*), and, in the creek inlets in the Bullpen, Water marigold (*Bidens beckii*) and Whorled water-milfoil (*Myriophyllum verticillatum*). In addition to these rooted plants, a large number of "duckweeds" were found floating among both the lilypads and the emergents.

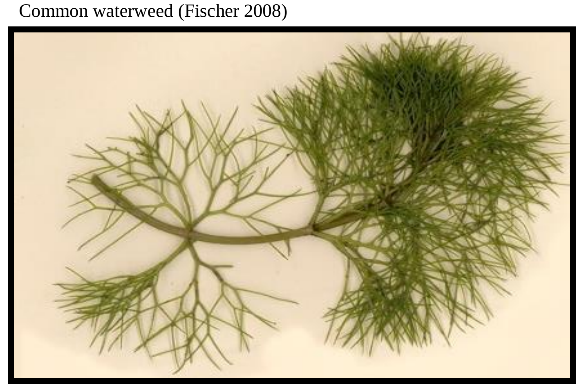
Forked duckweed (Curtis 2010)

Large duckweed (Thomas 2014)

Small duckweed and Common watermeal (Kieron 2010)

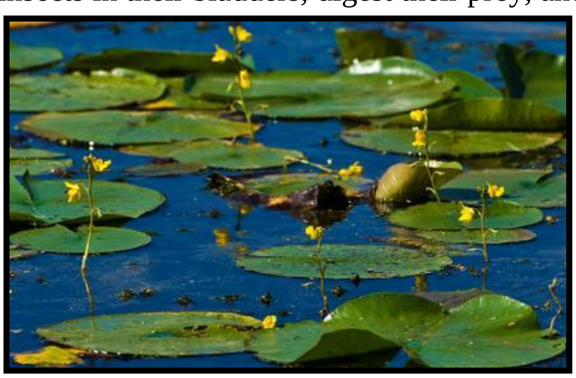
Common waterweed (Fischer 2008)

Whorled water-milfoil (Hill 2007)



Water marigold (Curtis 2010)

Along with the duckweeds, we also documented a limited number of Common bladderwort (*Utricularia vulgaris*) floating among the lilypads. Rather than drawing nutrients up through roots like other macrophytes, these carnivorous plants trap zooplankton and minute insects in their bladders, digest their prey, and use the nutrients to further their growth.



Common bladderwort flowers among lilypads (Hunt 2010)

Bladders for catching plankton and insect larvae (Wontolla 2007)

Sand and sandy muck bottomed habitats supported few floating-leaf species. In pure sand areas, in water up to 3ft deep, we noted the plant community was dominated by generally finer leaved submergent plants like Autumnal water-starwort (*Callitriche hermaphroditica*), Common water-starwort (*Callitriche palustris*), Muskgrass (*Chara* sp.), Slender naiad (*Najas flexilis*), White water crowfoot (*Ranunculus aquatilis*), and Sago pondweed (*Stuckenia pectinata*). These species tend to form a carpet that stabilizes the bottom.

Autumnal water-starwort (Shou 2012)

Common water-starwort (Cameron 2014)

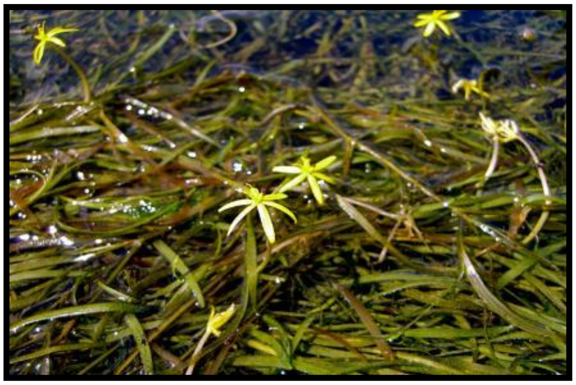
Muskgrass (Penuh 2008)

Slender naiad (Apipp 2009)

White water crowfoot (Wasser 2014)

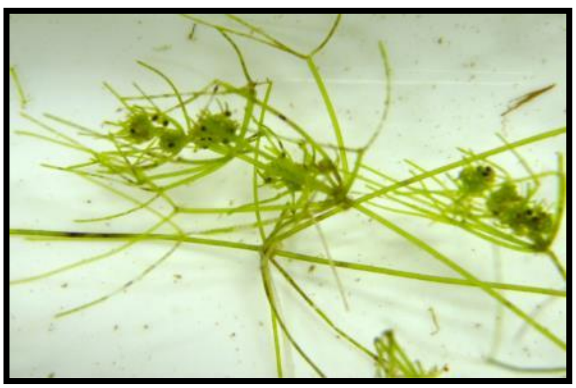
Sago pondweed (Hilty 2012)

Shallow sandy muck areas tended to support slightly broader-leaved species like Water star-grass (*Heteranthera dubia*), Northern water-milfoil (*Myriophyllum sibiricum*), Nitella (*Nitella* sp.), Fries' pondweed (*Potamogeton friesii*), Clasping-leaf pondweed (*Potamogeton richardsonii*), and Wild celery (*Vallisneria americana*). The roots, shoots, and seeds of these 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 a myriad of invertebrates like scuds, dragonfly and mayfly nymphs, and snails.



Water star-grass (Mueller 2010)

Northern water-milfoil (Berg 2008)



Nitella (Green 2002)

Fries pondweed (Koshere 2002)

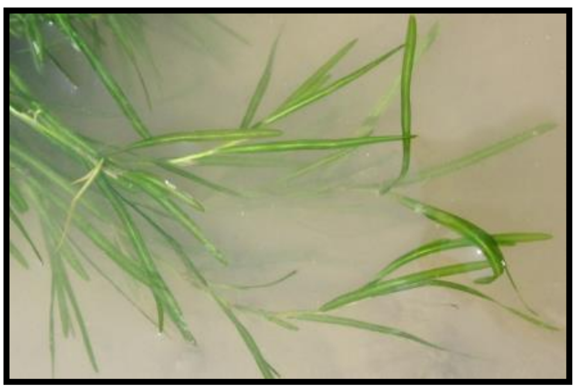
Clasping-leaf pondweed (Cameron 2014)

Wild celery (Dalvi 2009)

Floating-leaf and many shallow submergent species disappeared on Big Chetac Lake in most water over 4ft. These deeper areas from 5-11.5ft were dominated by Coontail, Curly-leaf pondweed, White-stem pondweed (*Potamogeton praelongus*), Small pondweed, Fern pondweed (*Potamogeton robbinsii*), and Flat-stem pondweed (*Potamogeton zosteriformis*). Predatory fish like the lake's northern pike are often found along the edges of these beds waiting in ambush.


Coontail (Hassler 2011)


Curly-leaf pondweed (Peroti 2012)


Small pondweed (Villa 2011)


White-stem pondweed (Fewless 2005)


Fern pondweed (Apipp 2011)


Flat-stem pondweed (Fewless 2004)

Comparison of the 2008, 2014, and 2017 Surveys:

In July 2008, Curly-leaf pondweed, Small pondweed, Coontail, and Flat-stem pondweed were the most common macrophyte species (Table 2). They were found at 48.70%, 48.33%, 42.38%, and 18.96% of survey points with vegetation and accounted for 57.73% of the total relative frequency. Forked duckweed (*Lemna trisulca*) (6.64) and Fries' pondweed (4.88) were the only other species with relative frequencies over 4.0 (Maps for all species found in July 2008 can be found in the attached CD).

Our July 2014 survey found Coontail, Curly-leaf pondweed, Small pondweed, and Slender naiad were the most common species (Table 3). Present at 40.54%, 38.51%, 25.00%, and 18.92% of sites with vegetation, they covered 45.96% of the total relative frequency. Wild celery (5.56), White water lily (4.55), Small duckweed (*Lemna minor*) (4.29), and Large duckweed (*Spirodela polyrhiza*) (4.04) also had relative frequencies above 4.0 (Maps for all plants found in July 2014 and species accounts for all species can be found in Appendixes V and VI).

From 2008 to 2014, ten species and filamentous algae experienced significant changes in distribution all of which were declines (Figure 8). Specifically, Curly-leaf pondweed, Small pondweed, Coontail, filamentous algae, Flat-stem pondweed, Forked duckweed, and Fries' pondweed suffered highly significant declines; Fern pondweed saw a moderately significant decline; and Small duckweed, Large duckweed, and White water crowfoot experienced significant declines. We noted that most of the species that experienced the biggest contractions in range were either species that start growing early in the spring prior to herbicide application (Curly-leaf pondweed, Small pondweed, Flat-stem pondweed, and Fries' pondweed) or ones that overwinter as vegetation (Coontail and Fern pondweed). Conversely, species that primarily use seeds, spores, rhizomes, or tubers (Slender naiad, Wild celery, White-water lily, Nitella, Sago pondweed, Spatterdock, and Clasping-leaf pondweed) tended to be almost unchanged in their distribution.

During the July 2017 survey, Common waterweed, Coontail, Small pondweed, and Forked duckweed were the most common species (Table 4). We found them at 37.81%, 31.34%, 24.38%, and 17.91% of survey points with vegetation, and they totaled 41.25% of the community's relative frequency. Nitella (6.45), Flat-stem pondweed (5.34), Small duckweed (4.05), and Wild celery (4.05) also had frequencies over 4.0% (Density and distribution maps for all plants found in 2014 can be found in Appendix VII).

By 2017, many species that had shown dramatic declines in 2014 were beginning to recover. Twelve species and filamentous algae saw significant changes, and all but one of those was an increase. Filamentous algae, Flat-stem pondweed, Nitella, Forked duckweed, Northern water-milfoil, Common waterweed, and Muskgrass populations all benefited from highly significant increases in distribution; Small pondweed and White water crowfoot enjoyed moderately significant increases; and Coontail, Fries' pondweed, and Water star-grass had significant increases. Conversely, Curly-leaf pondweed experienced a highly significant decline, although this loss may simply have been due to the 2017 survey occurring at a later date in July when more of the CLP would have completed its annual senescence (Figure 9).

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Big Chetac Lake, Sawyer County
July 20-22, 2008

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Potamogeton crispus	Curly-leaf pondweed	131	17.75	48.70	33.42	1.31	0
Potamogeton pusillus	Small pondweed	130	17.62	48.33	33.16	1.41	0
Ceratophyllum demersum	Coontail	114	15.45	42.38	29.08	1.98	2
	Filamentous algae	59	*	21.93	15.05	1.76	0
Potamogeton zosteriformis	Flat-stem pondweed	51	6.91	18.96	13.01	1.31	2
Lemna trisulca	Forked duckweed	49	6.64	18.22	12.50	1.29	1
Potamogeton friesii	Fries' pondweed	36	4.88	13.38	9.18	1.92	1
Lemna minor	Small duckweed	25	3.39	9.29	6.38	1.12	0
Spirodela polyrhiza	Large duckweed	25	3.39	9.29	6.38	1.16	0
Najas flexilis	Slender naiad	24	3.25	8.92	6.12	1.75	0
Potamogeton robbinsii	Fern pondweed	22	2.98	8.18	5.61	1.59	0
Vallisneria americana	Wild celery	16	2.17	5.95	4.08	1.50	2
Nymphaea odorata	White water lily	15	2.03	5.58	3.83	1.87	8
Nitella sp.	Nitella	13	1.76	4.83	3.32	1.77	0
Stuckenia pectinata	Sago pondweed	12	1.63	4.46	3.06	2.17	0
Nuphar variegata	Spatterdock	10	1.36	3.72	2.55	2.10	2
Myriophyllum sibiricum	Northern water-milfoil	9	1.22	3.35	2.30	1.44	2
Potamogeton richardsonii	Clasping-leaf pondweed	9	1.22	3.35	2.30	1.56	5
Elodea canadensis	Common waterweed	6	0.81	2.23	1.53	1.50	1
Chara sp.	Muskgrass	5	0.68	1.86	1.28	1.60	0
Potamogeton natans	Floating-leaf pondweed	5	0.68	1.86	1.28	1.80	0
Ranunculus aquatilis	White water crowfoot	5	0.68	1.86	1.28	1.20	0
Heteranthera dubia	Water star-grass	3	0.41	1.12	0.77	1.00	0
Potamogeton praelongus	White-stem pondweed	3	0.41	1.12	0.77	1.33	2

* Excluded from the Relative Frequency Calculation

Table 2 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Big Chetac Lake, Sawyer County
July 20-22, 2008

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Sagittaria rigida	Sessile-fruited arrowhead	3	0.41	1.12	0.77	2.00	2
Utricularia vulgaris	Common bladderwort	3	0.41	1.12	0.77	1.00	0
Callitriche hermaphroditica	Autumnal water-starwort	2	0.27	0.74	0.51	2.00	0
Callitriche palustris	Common water-starwort	2	0.27	0.74	0.51	1.00	0
Typha latifolia	Broad-leaved cattail	2	0.27	0.74	0.51	3.00	0
Zizania palustris	Northern wild rice	2	0.27	0.74	0.51	3.00	2
Calla palustris	Wild calla	1	0.14	0.37	0.26	2.00	0
Carex comosa	Bottle brush sedge	1	0.14	0.37	0.26	1.00	0
Eleocharis erythropoda	Bald spikerush	1	0.14	0.37	0.26	2.00	0
Potamogeton illinoensis	Illinois pondweed	1	0.14	0.37	0.26	2.00	0
Schoenoplectus acutus	Hardstem bulrush	1	0.14	0.37	0.26	2.00	0
Schoenoplectus tabernaemontani	Softstem bulrush	1	0.14	0.37	0.26	2.00	0
	Aquatic moss	1	*	0.37	0.26	3.00	0
Bidens beckii	Water marigold	**	**	**	**	**	1
Myriophyllum verticillatum	Whorled water-milfoil	**	**	**	**	**	2
Potamogeton epihydrus	Ribbon-leaf pondweed	**	**	**	**	**	1
Potamogeton vaseyi	Vasey's pondweed	**	**	**	**	**	2
Utricularia intermedia	Flat-leaf bladderwort	**	**	**	**	**	2
Dulichium arundinaceum	Three-way sedge	***	***	***	***	***	***
Eleocharis palustris	Creeping spikerush	***	***	***	***	***	***
Phalaris arundinacea	Reed canary grass	***	***	***	***	***	***
Pontederia cordata	Pickerelweed	***	***	***	***	***	***
Comarum palustre	Marsh cinquefoil	***	***	***	***	***	***
Sparganium emersum	Short-stemmed bur-reed	***	***	***	***	***	***

* Excluded from the Relative Frequency Calculation ** Visual Only *** Boat Survey Only

Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Big Chetac Lake, Sawyer County
July 15-17, 2014

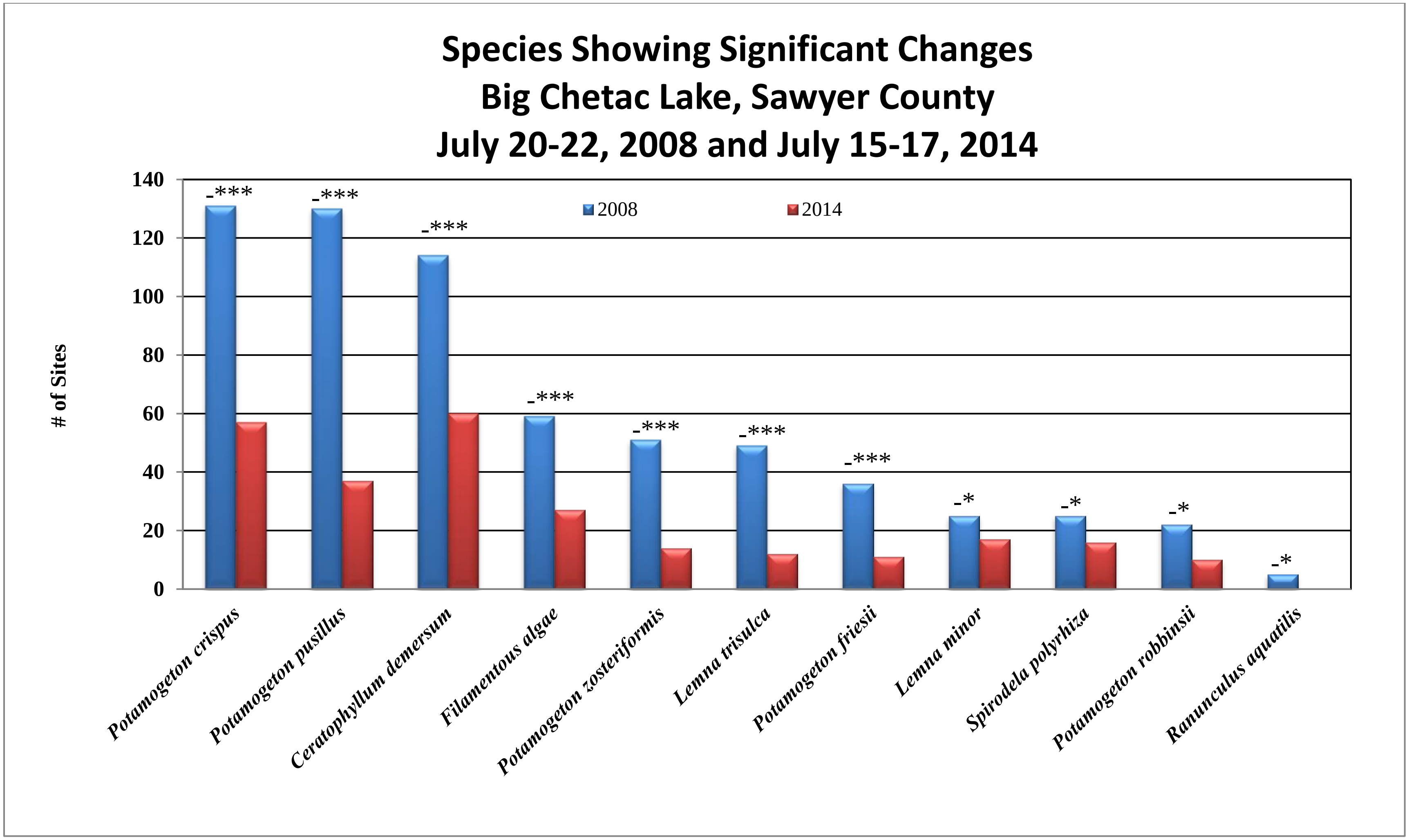
Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Ceratophyllum demersum	Coontail	60	15.15	40.54	12.17	1.53	2
Potamogeton crispus	Curly-leaf pondweed	57	14.39	38.51	11.56	1.32	8
Potamogeton pusillus	Small pondweed	37	9.34	25.00	7.51	1.46	6
Najas flexilis	Slender naiad	28	7.07	18.92	5.68	1.18	0
	Filamentous algae	27	*	18.24	5.48	1.59	0
Vallisneria americana	Wild celery	22	5.56	14.86	4.46	1.68	0
Nymphaea odorata	White water lily	18	4.55	12.16	3.65	1.94	6
Lemna minor	Small duckweed	17	4.29	11.49	3.45	1.24	0
Spirodela polyrhiza	Large duckweed	16	4.04	10.81	3.25	1.31	0
Stuckenia pectinata	Sago pondweed	15	3.79	10.14	3.04	1.67	2
Potamogeton zosteriformis	Flat-stem pondweed	14	3.54	9.46	2.84	1.07	1
Nitella sp.	Nitella	13	3.28	8.78	2.64	1.46	1
Lemna trisulca	Forked duckweed	12	3.03	8.11	2.43	1.00	0
Nuphar variegata	Spatterdock	11	2.78	7.43	2.23	2.36	6
Potamogeton friesii	Fries' pondweed	11	2.78	7.43	2.23	1.55	1
Potamogeton robbinsii	Fern pondweed	10	2.53	6.76	2.03	1.10	0
Potamogeton richardsonii	Clasping-leaf pondweed	8	2.02	5.41	1.62	1.38	5
Myriophyllum sibiricum	Northern water-milfoil	5	1.26	3.38	1.01	1.60	2
Elodea canadensis	Common waterweed	4	1.01	2.70	0.81	1.00	2
Eleocharis erythropoda	Bald spikerush	3	0.76	2.03	0.61	2.33	0
Myriophyllum verticillatum	Whorled water-milfoil	3	0.76	2.03	0.61	2.00	0
Sparganium emersum	Short-stemmed bur-reed	3	0.76	2.03	0.61	1.33	0
Utricularia vulgaris	Common bladderwort	3	0.76	2.03	0.61	1.00	1
Zizania palustris	Northern wild rice	3	0.76	2.03	0.61	1.00	0

* Excluded from the Relative Frequency Calculation

Table 3 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Big Chetac Lake, Sawyer County
July 15-17, 2014

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Calla palustris	Wild calla	2	0.51	1.35	0.41	1.00	0
Carex comosa	Bottle brush sedge	2	0.51	1.35	0.41	2.00	2
Heteranthera dubia	Water star-grass	2	0.51	1.35	0.41	1.50	0
Potamogeton natans	Floating-leaf pondweed	2	0.51	1.35	0.41	1.50	2
Potamogeton praelongus	White-stem pondweed	2	0.51	1.35	0.41	1.50	0
Sagittaria latifolia	Common arrowhead	2	0.51	1.35	0.41	1.00	0
Typha latifolia	Broad-leaved cattail	2	0.51	1.35	0.41	1.00	2
Bidens beckii	Water marigold	1	0.25	0.68	0.20	2.00	0
Callitriche hermaphroditica	Autumnal water-starwort	1	0.25	0.68	0.20	1.00	0
Chara sp.	Muskgrass	1	0.25	0.68	0.20	1.00	0
Comarum palustre	Marsh cinquefoil	1	0.25	0.68	0.20	1.00	0
Potamogeton amplifolius	Large-leaf pondweed	1	0.25	0.68	0.20	1.00	0
Potamogeton illinoensis	Illinois pondweed	1	0.25	0.68	0.20	2.00	0
Schoenoplectus acutus	Hardstem bulrush	1	0.25	0.68	0.20	2.00	0
Schoenoplectus tabernaemontani	Softstem bulrush	1	0.25	0.68	0.20	1.00	2
Wolffia columbiana	Common watermeal	1	0.25	0.68	0.20	1.00	0
Potamogeton epihydrus	Ribbon-leaf pondweed	**	**	**	**	**	1
Ranunculus aquatilis	White water crowfoot	**	**	**	**	**	2
Sagittaria rigida	Sessile-fruited arrowhead	**	**	**	**	**	4
Dulichium arundinaceum	Three-way sedge	***	***	***	***	***	***
Eleocharis palustris	Creeping spikerush	***	***	***	***	***	***
Phalaris arundinacea	Reed canary grass	***	***	***	***	***	***
Phragmites australis	Common reed	***	***	***	***	***	***
Pontederia cordata	Pickerelweed	***	***	***	***	***	***
Sparganium eurycarpum	Common bur-reed	***	***	***	***	***	***

** Visual Only   *** Boat Survey Only



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

Figure 8: Macrophytes Showing Significant Changes from 2008-2014

Table 4: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Big Chetac Lake, Sawyer County
July 28-29, 2017

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Elodea canadensis	Common waterweed	76	14.00	37.81	21.59	1.32	4
	Filamentous algae	72	*	35.82	20.45	1.53	0
Ceratophyllum demersum	Coontail	63	11.60	31.34	17.90	1.67	13
Potamogeton pusillus	Small pondweed	49	9.02	24.38	13.92	1.08	2
Lemna trisulca	Forked duckweed	36	6.63	17.91	10.23	1.08	0
Nitella sp.	Nitella	35	6.45	17.41	9.94	1.17	0
Potamogeton zosteriformis	Flat-stem pondweed	29	5.34	14.43	8.24	1.21	13
Lemna minor	Small duckweed	22	4.05	10.95	6.25	1.14	0
Vallisneria americana	Wild celery	22	4.05	10.95	6.25	1.41	0
Najas flexilis	Slender naiad	20	3.68	9.95	5.68	1.30	1
Nymphaea odorata	White water lily	19	3.50	9.45	5.40	2.42	2
Spirodela polyrhiza	Large duckweed	19	3.50	9.45	5.40	1.11	0
Myriophyllum sibiricum	Northern water-milfoil	18	3.31	8.96	5.11	1.39	4
Potamogeton friesii	Fries' pondweed	18	3.31	8.96	5.11	1.33	0
Potamogeton crispus	Curly-leaf pondweed	16	2.95	7.96	4.55	1.00	2
Chara sp.	Muskgrass	13	2.39	6.47	3.69	1.62	0
Potamogeton richardsonii	Clasping-leaf pondweed	12	2.21	5.97	3.41	1.42	1
Nuphar variegata	Spatterdock	11	2.03	5.47	3.13	2.18	2
Potamogeton robbinsii	Fern pondweed	10	1.84	4.98	2.84	1.30	2
Stuckenia pectinata	Sago pondweed	9	1.66	4.48	2.56	1.33	1
Heteranthera dubia	Water star-grass	7	1.29	3.48	1.99	1.00	0
Potamogeton praelongus	White-stem pondweed	6	1.10	2.99	1.70	1.67	8
Ranunculus aquatilis	White water crowfoot	5	0.92	2.49	1.42	1.60	0
Utricularia vulgaris	Common bladderwort	4	0.74	1.99	1.14	1.00	0

* Excluded from the Relative Frequency Calculation

Table 4 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Big Chetac Lake, Sawyer County
July 28-29, 2017

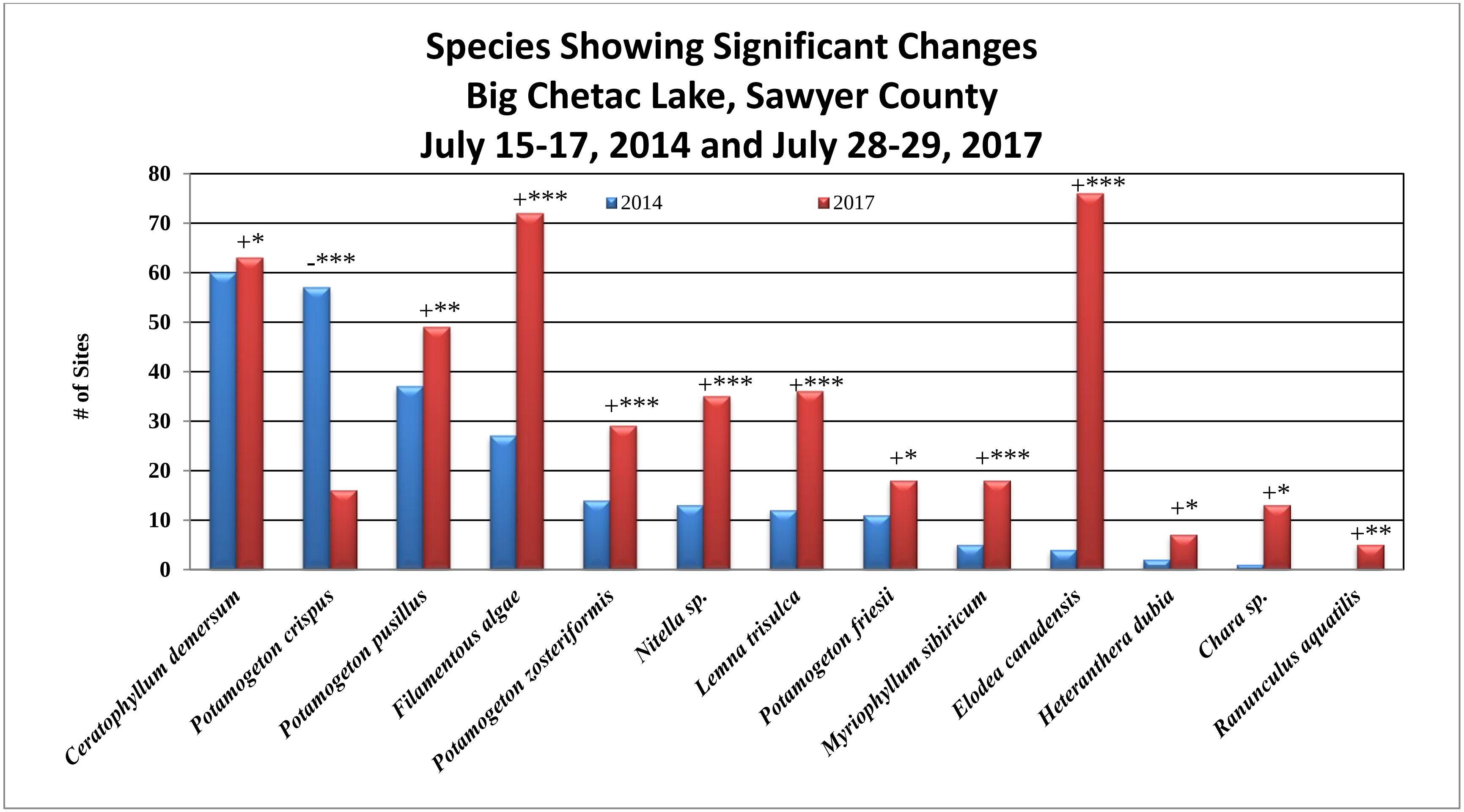
Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Zizania palustris	Northern wild rice	3	0.55	1.49	0.85	1.00	3
Carex comosa	Bottle brush sedge	2	0.37	1.00	0.57	1.00	0
Eleocharis erythropoda	Bald spikerush	2	0.37	1.00	0.57	3.00	0
Myriophyllum verticillatum	Whorled water-milfoil	2	0.37	1.00	0.57	2.00	2
Pontederia cordata	Pickerelweed	2	0.37	1.00	0.57	1.50	2
Potamogeton natans	Floating-leaf pondweed	2	0.37	1.00	0.57	1.50	0
Sagittaria rigida	Sessile-fruited arrowhead	2	0.37	1.00	0.57	1.00	5
	Aquatic moss	2	*	1.00	0.57	2.00	0
Callitriche hermaphroditica	Autumnal water-starwort	1	0.18	0.50	0.28	3.00	0
Eleocharis acicularis	Needle spikerush	1	0.18	0.50	0.28	1.00	0
Potamogeton epihydrus	Ribbon-leaf pondweed	1	0.18	0.50	0.28	3.00	0
Potamogeton illinoensis	Illinois pondweed	1	0.18	0.50	0.28	3.00	0
Riccia fluitans	Slender riccia	1	*	0.50	0.28	1.00	1
Schoenoplectus acutus	Hardstem bulrush	1	0.18	0.50	0.28	1.00	0
Typha latifolia	Broad-leaved cattail	1	0.18	0.50	0.28	2.00	1
Typha X *glauca*	Hybrid cattail	1	0.18	0.50	0.28	1.00	0
Utricularia intermedia	Flat-leaf bladderwort	1	0.18	0.50	0.28	1.00	0
Wolffia columbiana	Common watermeal	1	0.18	0.50	0.28	1.00	0
Bidens beckii	Water marigold	**	**	**	**	**	2
Comarum palustre	Marsh cinquefoil	**	**	**	**	**	1
Eleocharis robbinsii	Robbins' spikerush	**	**	**	**	**	1
Sagittaria latifolia	Common arrowhead	**	**	**	**	**	1
Schoenoplectus tabernaemontani	Softstem bulrush	**	**	**	**	**	2
Sparganium emersum	Short-stemmed bur-reed	**	**	**	**	**	1

* Excluded from the Relative Frequency Calculation   ** Visual Only

Table 4 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Big Chetac Lake, Sawyer County
July 28-29, 2017

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Calla palustris	Wild calla	***	***	***	***	***	***
Callitriche palustris	Common water-starwort	***	***	***	***	***	***
Eleocharis palustris	Creeping spikerush	***	***	***	***	***	***
Myosotis scorpioides	Common forget-me-not	***	***	***	***	***	***
Phalaris arundinacea	Reed canary grass	***	***	***	***	***	***
Potamogeton obtusifolius	Blunt-leaf pondweed	***	***	***	***	***	***
Sparganium eurycarpum	Common bur-reed	***	***	***	***	***	***

*** Boat Survey Only



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

Figure 9: Macrophytes Showing Significant Changes from 2014-2017

Small pondweed was the most widely distributed native species in 2008 (130 sites with a mean rake of 1.41) (Figure 10). Although the 2014 survey found it suffering a highly significant decline **(p<0.001)** in range to 37 points, its mean rake fullness of 1.46 was nearly unchanged. In 2017, we documented a moderately significant increase **(p=0.002)** in distribution; however, it also suffered a highly significant decline in mean rake fullness **(p<0.001)** to 1.08. This may be because most rake samples in the northern half of the lake that contained this species had one or two individual stems. Visual analysis of the maps showed this species also declined in the southern half of the lake.

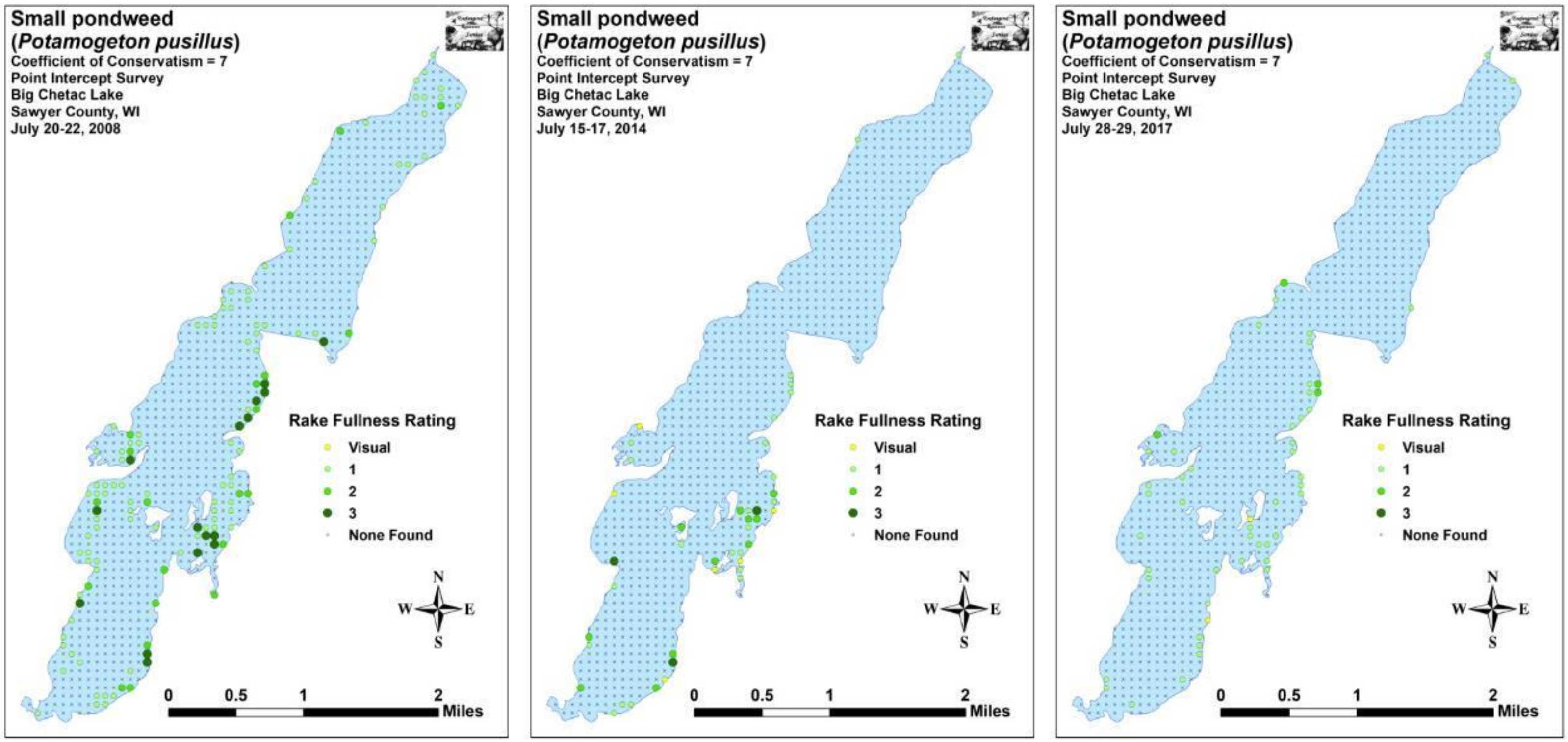


Figure 10: 2008, 2014, and 2017 Small Pondweed Density and Distribution

Coontail was the second most common native species in 2008 (114 sites with a mean rake fullness of 1.98) (Figure 11). Despite becoming the most common species overall in 2014, it suffered highly significant declines **(p<0.001)** in both distribution and density (60 sites/mean rake of 1.53) as the plant was almost eliminated from the northern half of the lake. During the 2017 survey, we found it was the second most common plant, and it increased in both distribution (63 sites) and density (mean rake of 1.60); however, neither increase was significant.

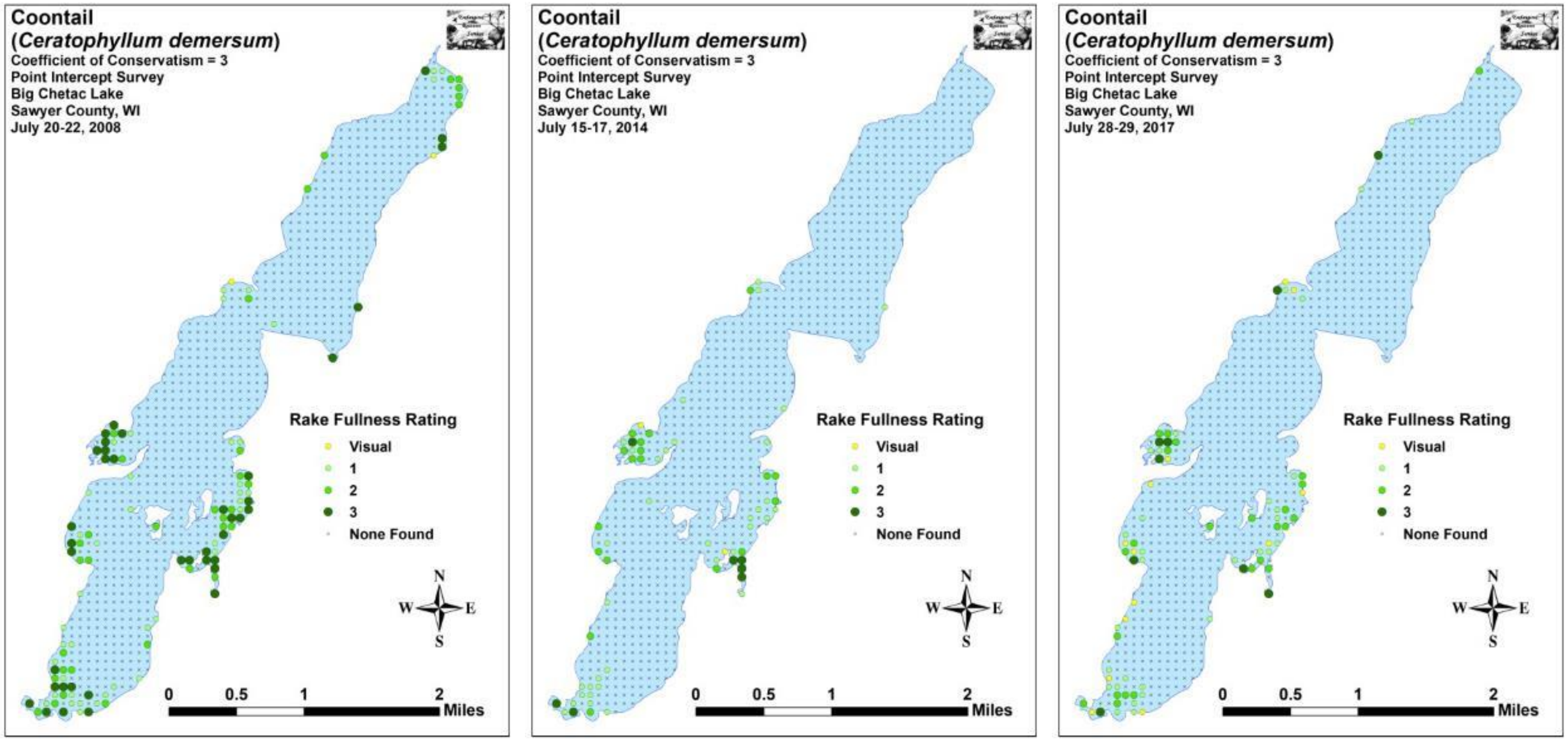


Figure 11: 2008, 2014, and 2017 Coontail Density and Distribution

Present at 51 sites, Flat-stem pondweed had a mean rake of 1.31 and was the third most common native species in 2008 (Figure 12). With the exceptions of the Bullpen and the untreated herbicide control bay directly west of the main public boat landing, this species disappeared from most parts of the lake in 2014, and it fell to the ninth most common native plant in the community. We found it at just 14 points with a mean rake fullness of 1.07 with both of these values representing highly significant declines **(p<0.001)** over 2008. In 2017, the species jumped back into sixth place in the native community after it experienced a highly significant **(p<0.001)** rebound in distributions (29 sites); however, the increase in density (mean rake of 1.21) was not significant (p=0.12). We still found only a few individual plants in the northern half of the lake, but the species appeared to have made a strong comeback throughout most of the southern half. This was especially true in the Bullpen and near the outlet.

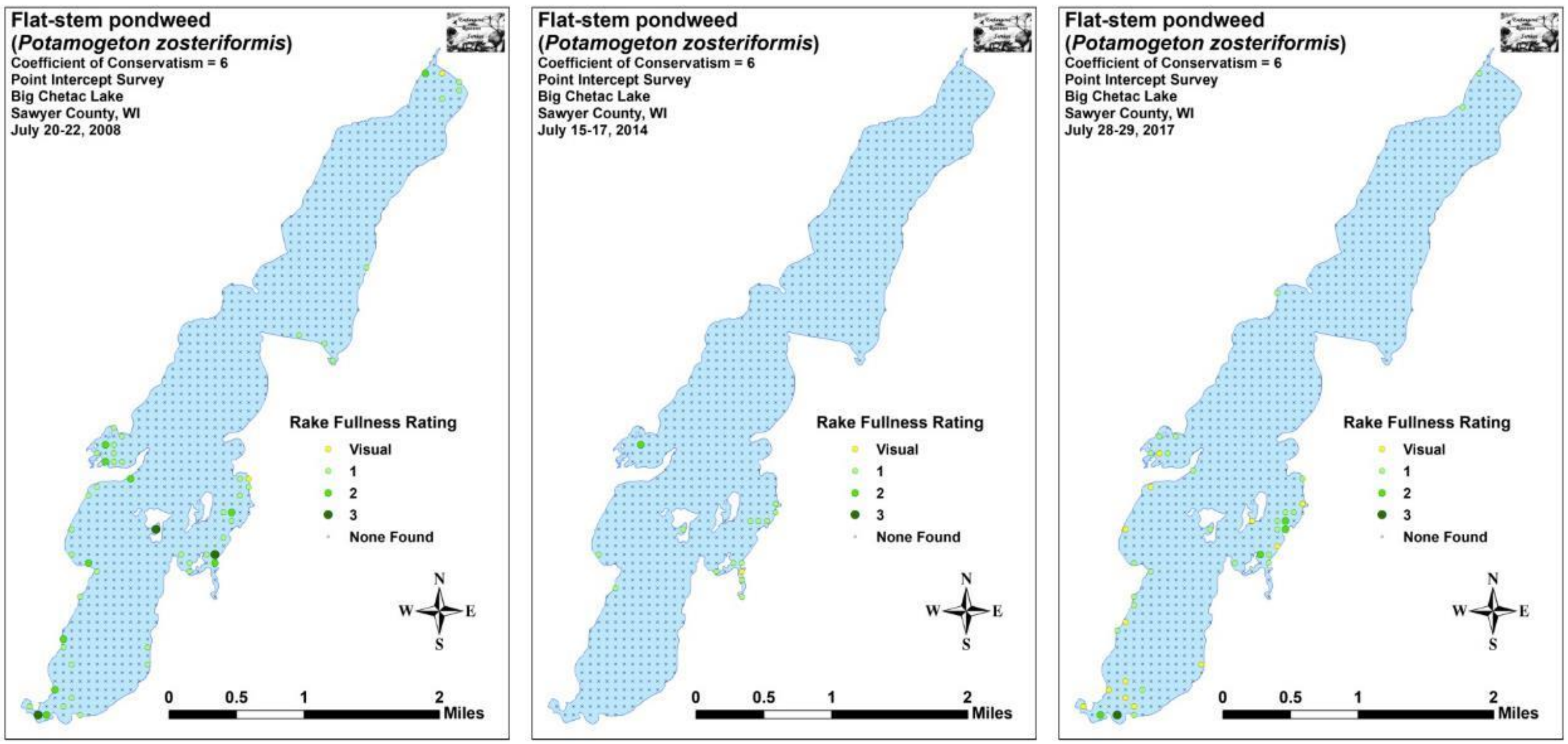


Figure 12: 2008, 2014, and 2017 Flat-stem Pondweed Density and Distribution

Historically, we found Common waterweed was actually a rather uncommon species in the lake (Figure 13). In 2008, it was present at six points with a mean rake fullness of 1.50 and ranked as only the 18th most widely distributed macrophyte. During the 2012 survey, this declined to just four points with a mean rake fullness of 1.00, and it was again the 18th ranked species. By 2017, its population had exploded, and it covered most muck-bottomed areas of the south third of the lake. Present at 76 sites with a mean rake fullness of 1.32, this highly significant increase in both distribution and density **(p<0.001)** was, although not expected, not unlike other lakes we've worked on with this species. Although it is not an exotic, it can act like one as it has the ability to quickly spread in nutrient-rich environments when populations of other species fall.

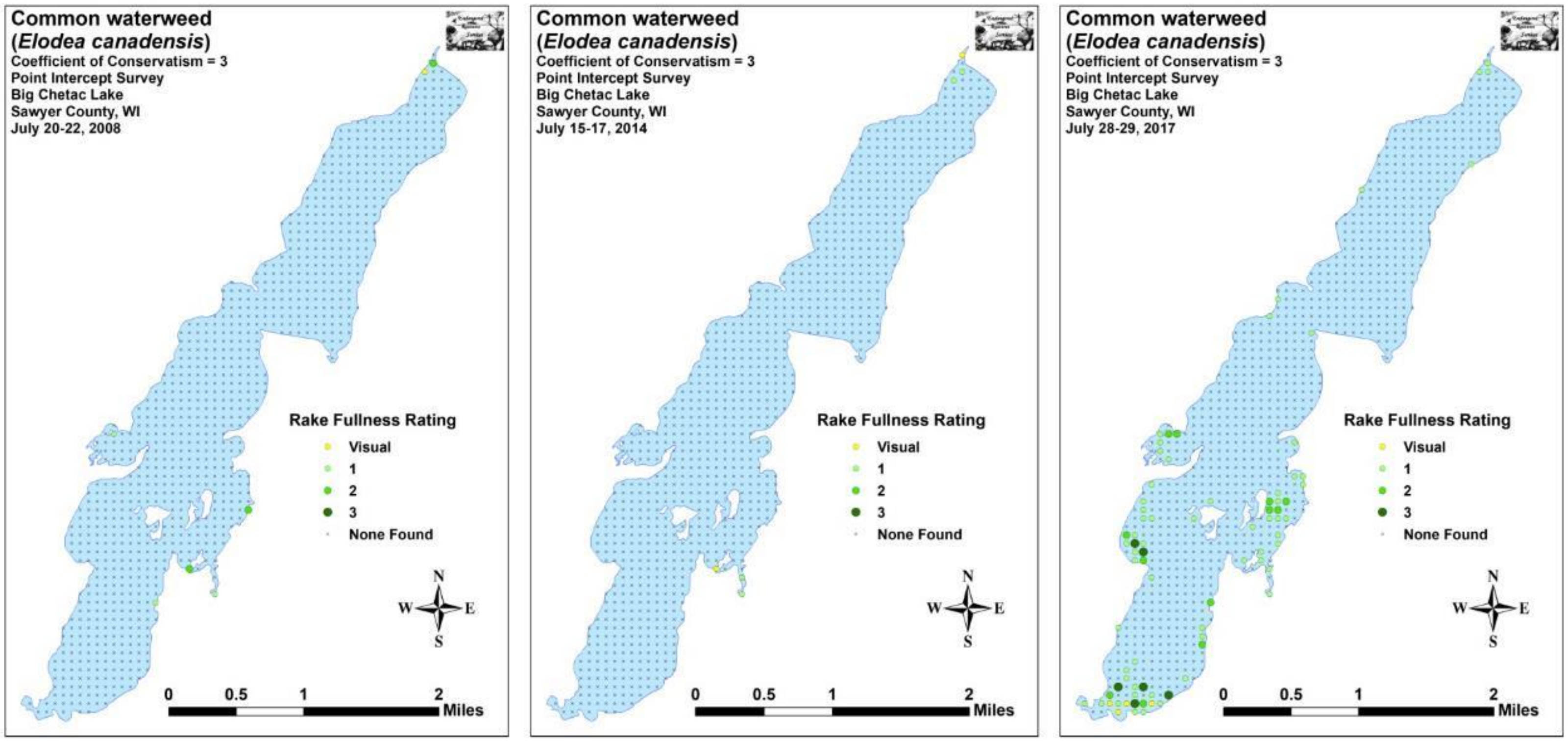


Figure 13: 2008, 2014, and 2017 Common Waterweed Density and Distribution

Comparison of Floristic Quality Indexes:

In 2008, we identified a total of 34 **native index species** in the rake during the point-intercept survey (Table 5). They produced a mean Coefficient of Conservatism of 6.0 and a Floristic Quality Index of 34.8.

Table 5: Floristic Quality Index of Aquatic Macrophytes
Big Chetac Lake, Sawyer County
July 20-22, 2008

Species	Common Name	C
Calla palustris	Wild calla	9
Callitriche hermaphroditica	Autumnal water-starwort	9
Callitriche palustris	Common water-starwort	8
Carex comosa	Bottle brush sedge	5
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Eleocharis erythropoda	Bald spikerush	3
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Lemna minor	Small duckweed	4
Lemna trisulca	Forked duckweed	6
Myriophyllum sibiricum	Northern water-milfoil	6
Najas flexilis	Slender naiad	6
Nitella sp.	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Potamogeton friesii	Fries' pondweed	8
Potamogeton illinoensis	Illinois pondweed	6
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Ranunculus aquatilis	White water crowfoot	8
Sagittaria rigida	Sessile-fruited arrowhead	8
Schoenoplectus acutus	Hardstem bulrush	6
Schoenoplectus tabernaemontani	Softstem bulrush	4
Spirodela polyrhiza	Large duckweed	5
Stuckenia pectinata	Sago pondweed	3
Typha latifolia	Broad-leaved cattail	1
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
Zizania palustris	Northern wild rice	8
N		**34**
Mean C		**6.0**
FQI		**34.8**

The 2014 survey found 37 **native index plants** on the rake during the point- intercept survey. They produced a mean Coefficient of Conservatism of 5.9 and a Floristic Quality Index of 35.8 – both of these values were nearly identical to the 2008 survey (Table 6).

Table 6: Floristic Quality Index of Aquatic Macrophytes Big Chetac Lake, Sawyer County July 15-17, 2014

Species	Common Name	C
Bidens beckii	Water marigold	8
Calla palustris	Wild calla	9
Callitriche hermaphroditica	Autumnal water-starwort	9
Carex comosa	Bottle brush sedge	5
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Eleocharis erythropoda	Bald spikerush	3
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Lemna minor	Small duckweed	4
Lemna trisulca	Forked duckweed	6
Myriophyllum sibiricum	Northern water-milfoil	6
Myriophyllum verticillatum	Whorled water-milfoil	8
Najas flexilis	Slender naiad	6
Nitella sp.	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton friesii	Fries' pondweed	8
Potamogeton illinoensis	Illinois pondweed	6
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Sagittaria latifolia	Common arrowhead	3
Schoenoplectus acutus	Hardstem bulrush	6
Schoenoplectus tabernaemontani	Softstem bulrush	4
Sparganium emersum	Short-stemmed bur-reed	8
Spirodela polyrhiza	Large duckweed	5
Stuckenia pectinata	Sago pondweed	3
Typha latifolia	Broad-leaved cattail	1
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
Wolffia columbiana	Common watermeal	5
Zizania palustris	Northern wild rice	8
N		**37**
Mean C		**5.9**
FQI		**35.8**

During the 2017 survey, we identified a total of 39 **native index species** in the rake. They produced a mean Coefficient of Conservatism of 6.0 and a Floristic Quality Index of 37.3 (Table 7). Nichols (1999) reported an average mean C for the North Central Hardwood Forests Region of 5.6 putting Big Chetac Lake above average for this part of the state. The FQI was also nearly double the median FQI of 20.9 for the North Central Hardwood Forests Region (Nichols 1999). Perhaps more importantly, each of these values represented an increase over the 2014 survey.

Table 7: Floristic Quality Index of Aquatic Macrophytes Big Chetac Lake, Sawyer County July 28-29, 2017

Species	Common Name	C
Callitriche hermaphroditica	Autumnal water-starwort	9
Carex comosa	Bottle brush sedge	5
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Eleocharis acicularis	Needle spikerush	5
Eleocharis erythropoda	Bald spikerush	3
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Lemna minor	Small duckweed	4
Lemna trisulca	Forked duckweed	6
Myriophyllum sibiricum	Northern water-milfoil	6
Myriophyllum verticillatum	Whorled water-milfoil	8
Najas flexilis	Slender naiad	6
Nitella sp.	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Pontederia cordata	Pickerelweed	8
Potamogeton epihydrus	Ribbon-leaf pondweed	8
Potamogeton friesii	Fries' pondweed	8
Potamogeton illinoensis	Illinois pondweed	6
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Ranunculus aquatilis	White water crowfoot	8
Riccia fluitans	Slender riccia	7
Sagittaria rigida	Sessile-fruited arrowhead	8
Schoenoplectus acutus	Hardstem bulrush	6
Spirodela polyrhiza	Large duckweed	5
Stuckenia pectinata	Sago pondweed	3
Typha latifolia	Broad-leaved cattail	1
Typha X *glauca*	Hybrid cattail	1
Utricularia intermedia	Flat-leaf bladderwort	9

Table 7 (cont'): Floristic Quality Index of Aquatic Macrophytes
Big Chetac Lake, Sawyer County
July 15-17, 2014

Species	Common Name	C
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
Wolffia columbiana	Common watermeal	5
Zizania palustris	Northern wild rice	8
N		**39**
Mean C		**6.0**
FQI		**37.3**

Northern Wild Rice:

Wild rice, a plant of significant wildlife and cultural value, is present in scattered patches along the creek inlets in the Bullpen (Figure 14). Most areas support only low to moderate density plants, and we have never document any areas that were big enough or dense enough that they would offer profitable human harvest. Outside of this area, we have never observed wild rice growing anywhere else in the system.

The 2008 survey found a bed of rice in the nearly inaccessible bay south of the Malviney Creek inlet that was moderate to high density. The only two survey points in the lake with rice occurred here, and each had a rake fullness of 3. This shallow bay still had rice in 2014 and 2017, but the area has largely been taken over by water lilies and cattails (Figure 15). In 2014 and 2017, we found rice at three points, but each sample consisted of a single plant so the mean rake fullness was 1.00 for each survey (Figure 16).

Figure 14: Panorama of Northern Wild Rice in Malviney Creek Inlet Facing Northwest into the Bullpen – 7/28/17

Figure 15: Rice Remnants in Bays Southwest of Malviney Creek Inlet – 7/28/17

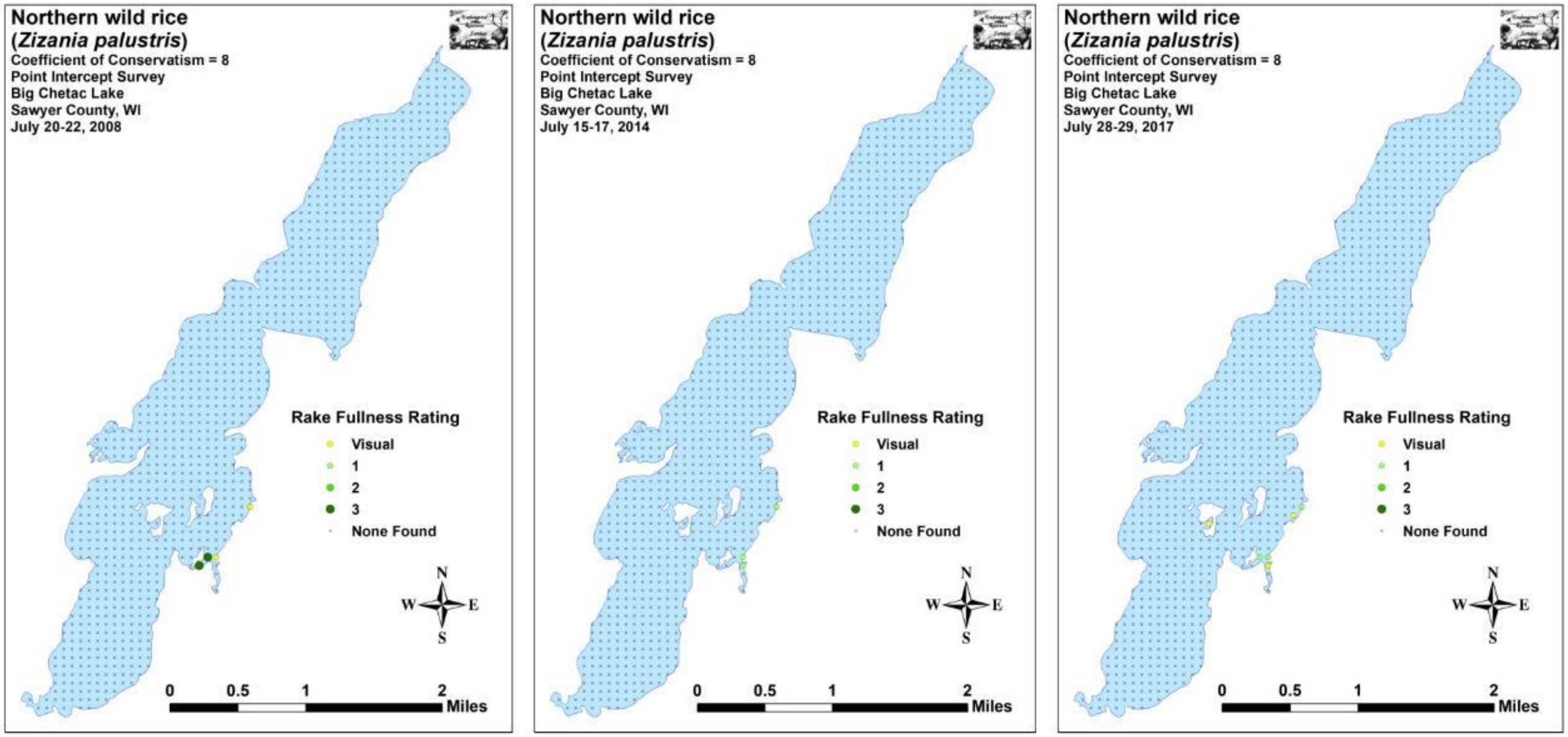


Figure 16: 2008, 2014, and 2017 Northern Wild Rice Density and Distribution

Filamentous Algae:

Filamentous algae are normally associated with excessive nutrients in the water column. In 2008, we found them at 59 points with a mean rake fullness of 1.76 (Figure 17). Following a highly significant decline in distribution to 27 point with a mean rake fullness of 1.59 in 2014, we documented a highly significant rebound in algal distribution **(*p*=<.001)** to 72 points in 2017. Although the mean rake fullness in 2017 declined to 1.53, this change in density was not significant (*p*=0.31).

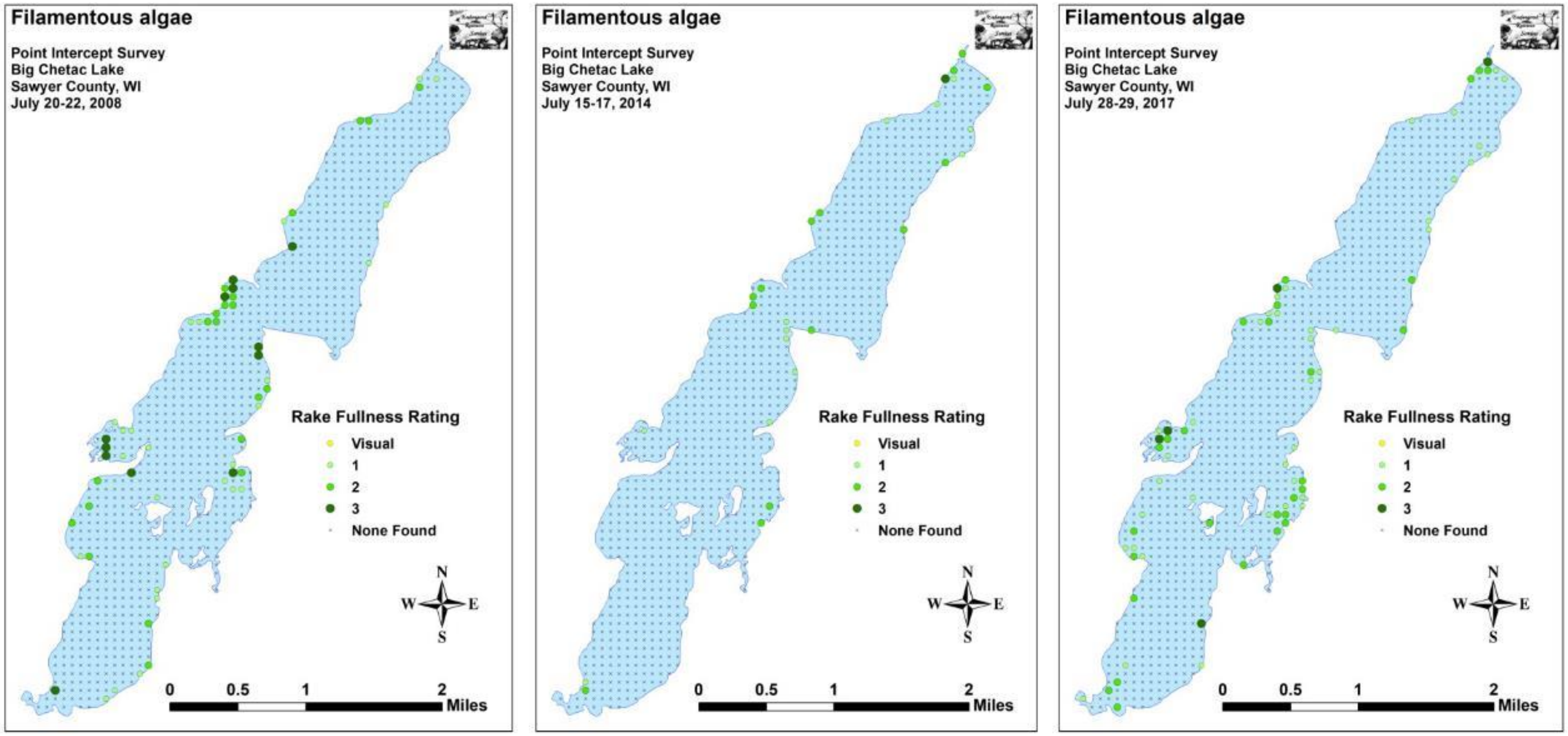


Figure 17: 2008, 2014, and 2017 Filamentous Algae Density and Distribution

Summer Curly-leaf Pondweed:

In 2008, Curly-leaf pondweed was the most common species encountered during the July survey when it was present at 131 sites with a mean rake fullness of 1.31 (Figure 18). Despite occurring a week earlier, the 2014 survey found CLP had undergone a highly significant reduction in distribution **(*p*<0.001)** to 57 points, and almost no plants were observed in the north half of the lake. The mean rake fullness, however, was essentially unchanged at 1.32. In 2017, we found CLP experienced a further reduction in distribution (16 sites) and density (1.00) both of which were highly significant **(*p*<0.001)**. Although this further decline might seem like a positive, we believe the 2017 results are likely at least partially due to the later date of the survey as mats of dead CLP were found floating throughout the southern half of the lake indicating the plant is likely still very much invasive and negatively impacting water quality and navigation on the lake (Figure 19).

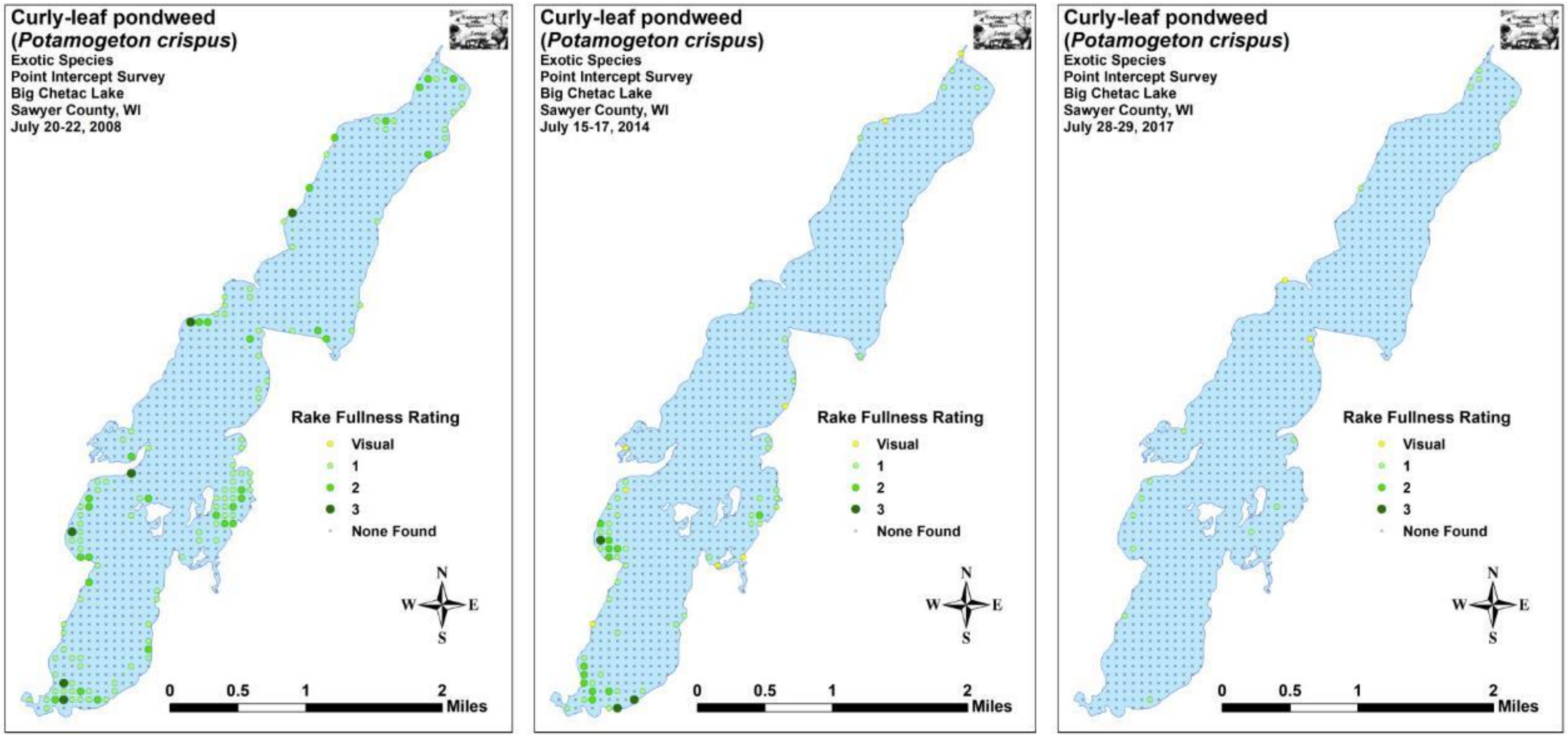


Figure 18: 2008, 2014, and 2017 July Curly-leaf Pondweed Density and Distribution

Figure 19: Floating Mats of Dead CLP along the South Shoreline – 7/28/17

Other Exotic Species:

We found no evidence of Eurasian water-milfoil in Big Chetac Lake during the survey. However, we did document three other exotic species growing in and around the lake: Common forget-me-not, Reed canary grass, and Hybrid cattail. Common forget-me-not was only present along the shoreline in areas with the cold-water seeps/springs that it requires (Figure 20). Although it can be invasive, it is unlikely to become an issue on the lake as there is little of this type of habitat for it to expand into.

Despite only being recorded during the boat survey, Reed canary grass was often a dominant plant just beyond the lakeshore in adjacent wetlands and next to mowed or otherwise disturbed shoreline areas. A ubiquitous plant in the state, there's likely little that can be done about it.

Figure 20: Common Forget-me-not and Reed Canary Grass

Native to southern but not northern Wisconsin, Narrow-leaved cattail and its hybrids with Broad-leaved cattail are becoming increasingly common in northern Wisconsin where they also tend to be invasive. We found a few small stands of Narrow-leaved cattail/Hybrid cattail scattered around the bays south of the Malviney Creek inlet on the south end of the Bullpen. Although not yet a dominant species, they appeared to be expanding in shallow water and crowding out other emergent species including the wild rice (Figure 21).

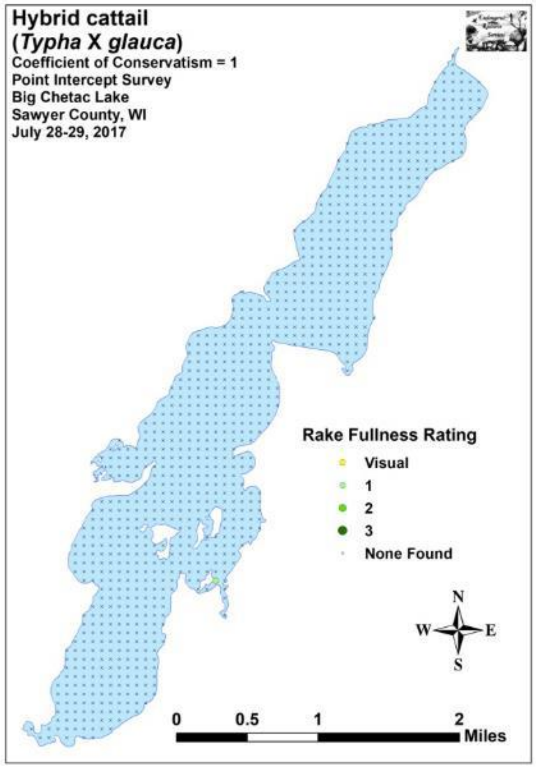


Figure 21: Hybrid Cattail Density and Distribution

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 22) (For more information on a sampling of aquatic exotic invasive plant species, see Appendix VIII).

Figure 22: Exotic Hybrid and Native Broad-leaved Cattail Identification

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:

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

Like trees in a forest, a lake's native plants are the basis of the aquatic ecosystem. They capture the sun's energy and turn it into usable food, "clean" the water of excess nutrients, and provide habitat for other organisms like aquatic invertebrates and the lake's fish populations. Because of this, preserving them is critical to maintaining the lake's overall health. Unfortunately, when phosphorus and nitrogen levels exceed what the lake's macrophytes can utilize, it tends to promote algae blooms which impact these sensitive species as well as general lake esthetics.

Although phosphorus recycling from organic sediments and release from decaying Curly-leaf pondweed can be major contributor to a lake's overall nutrient load, soil erosion and nutrient inputs from along the immediate lakeshore can also have significant impacts. Because of this, all lake residents have the opportunity to help reduce runoff by evaluating how their shoreline practices may be affecting the lake. Simple things like establishing or maintaining their own buffer strip of native vegetation along the lake shore to prevent erosion, building rain gardens, bagging grass clippings, switching to a phosphorus-free fertilizer or preferably eliminating fertilizer near the lake altogether, collecting pet waste, and disposing of the ash from fire pits away from the lakeshore can all significantly reduce the amount of nutrients entering the ecosystem. Hopefully, a greater understanding of how all property owners can have lakewide impacts will result in more people taking appropriate conservation actions to not only help improve water clarity and quality, but also to benefit the lake's important habitat producing native plant species.

Curly-leaf Pondweed Management:

Following the baseline 2008, midtreatment 2014, and posttreatment 2017 full lake point-intercept surveys; three years of intensive pre and posttreatment surveys; and five sediment turion surveys before, during and after treatments, there is a wealth of data about Big Chetac Lake's plants. These studies can now be used to predict what impact any future herbicide treatments are likely to have both on controlling Curly-leaf pondweed, as well as the lake's native plants. By utilizing this information to help weigh costs and benefits, the lake's shareholders can better work together to craft a new management plan and determine what, if any, active management will occur in the future.

Eurasian Water Milfoil:

Eurasian water milfoil continues to expand in Sawyer County, and most lakes with EWM have public landings with significant in/out boat traffic. Because of this, we believe it is important that the lake continues its Clean Boats/Clean Waters program to inspect the high volume of incoming watercraft. We also think that conducting monthly transect surveys near the lake's boat landings throughout the growing season and at least one annual meandering shoreline survey of the lake's entire visible littoral zone are ideas worth considering. These practices decrease the likelihood EWM will be introduced into the lake and could allow for early detection if EWM or another Aquatic Invasive Species is introduced. The sooner an AIS is detected, generally, the greater the chances it can be successfully and economically controlled.

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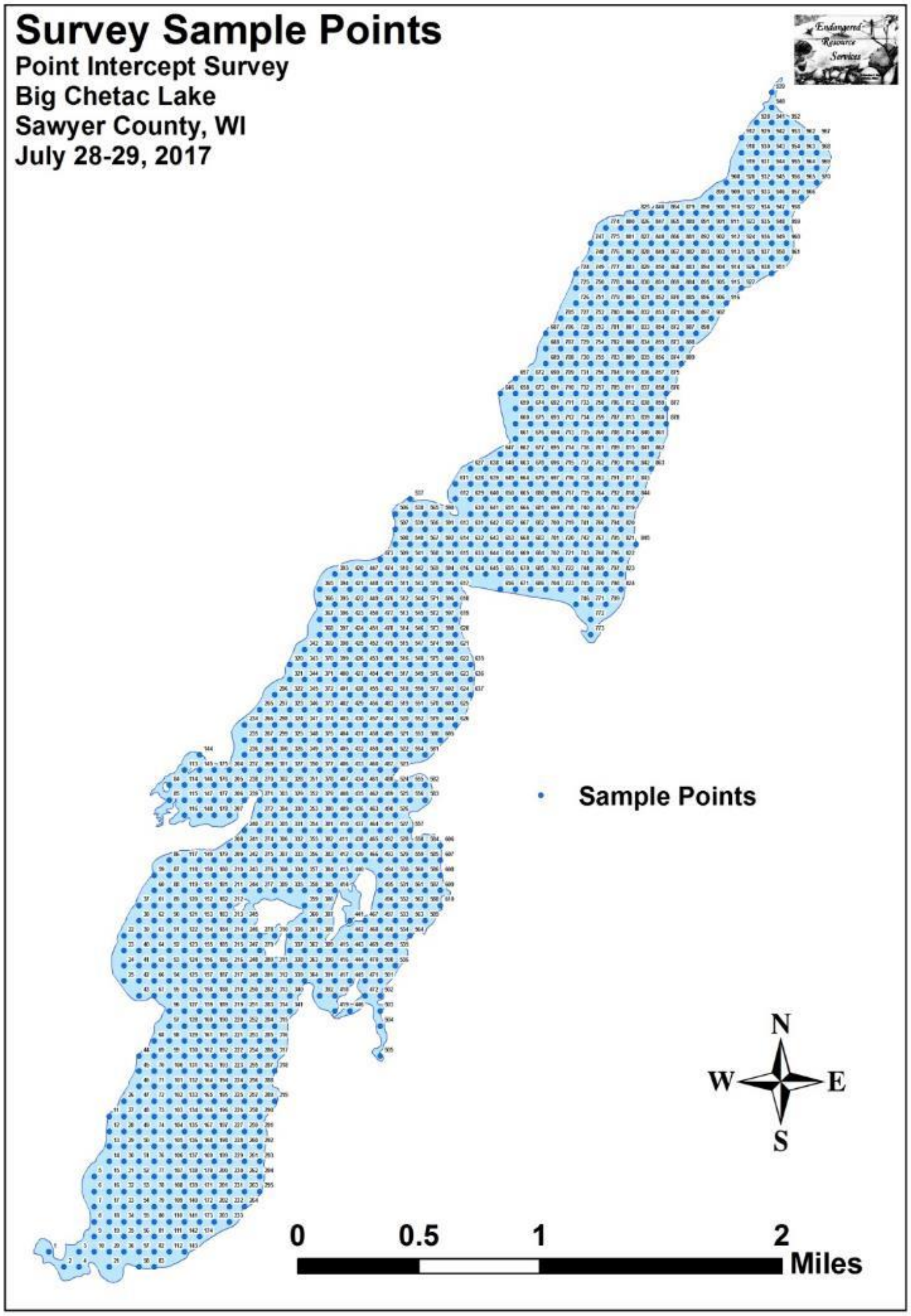
Appendix I: Big Chetac Lake Survey Sample Points Map


Survey Sample Points
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Sample Points
N
W
E
S
0
0.5
1
2
Miles

Appendix II: Boat and Vegetative Survey Data Sheets

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

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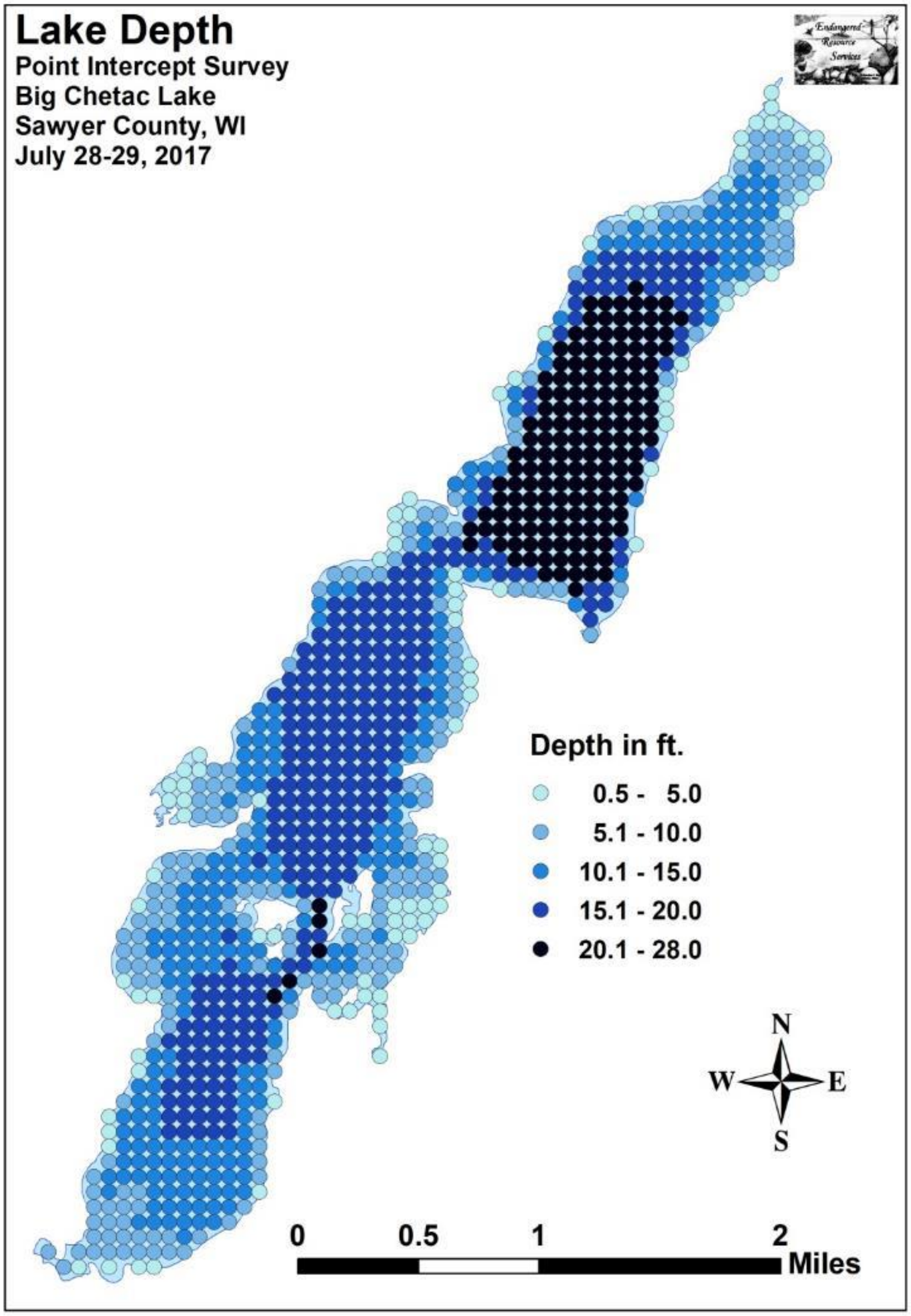
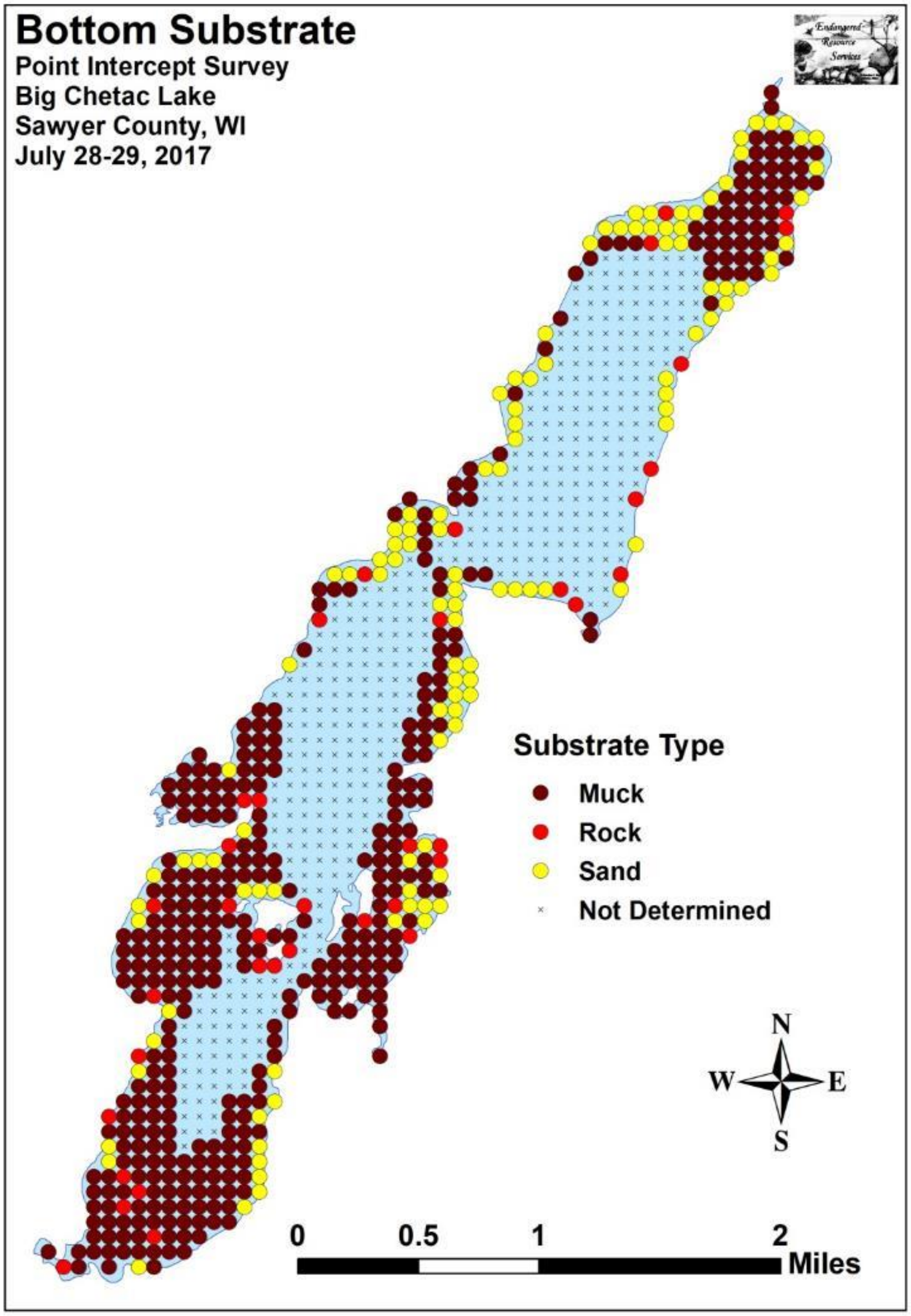
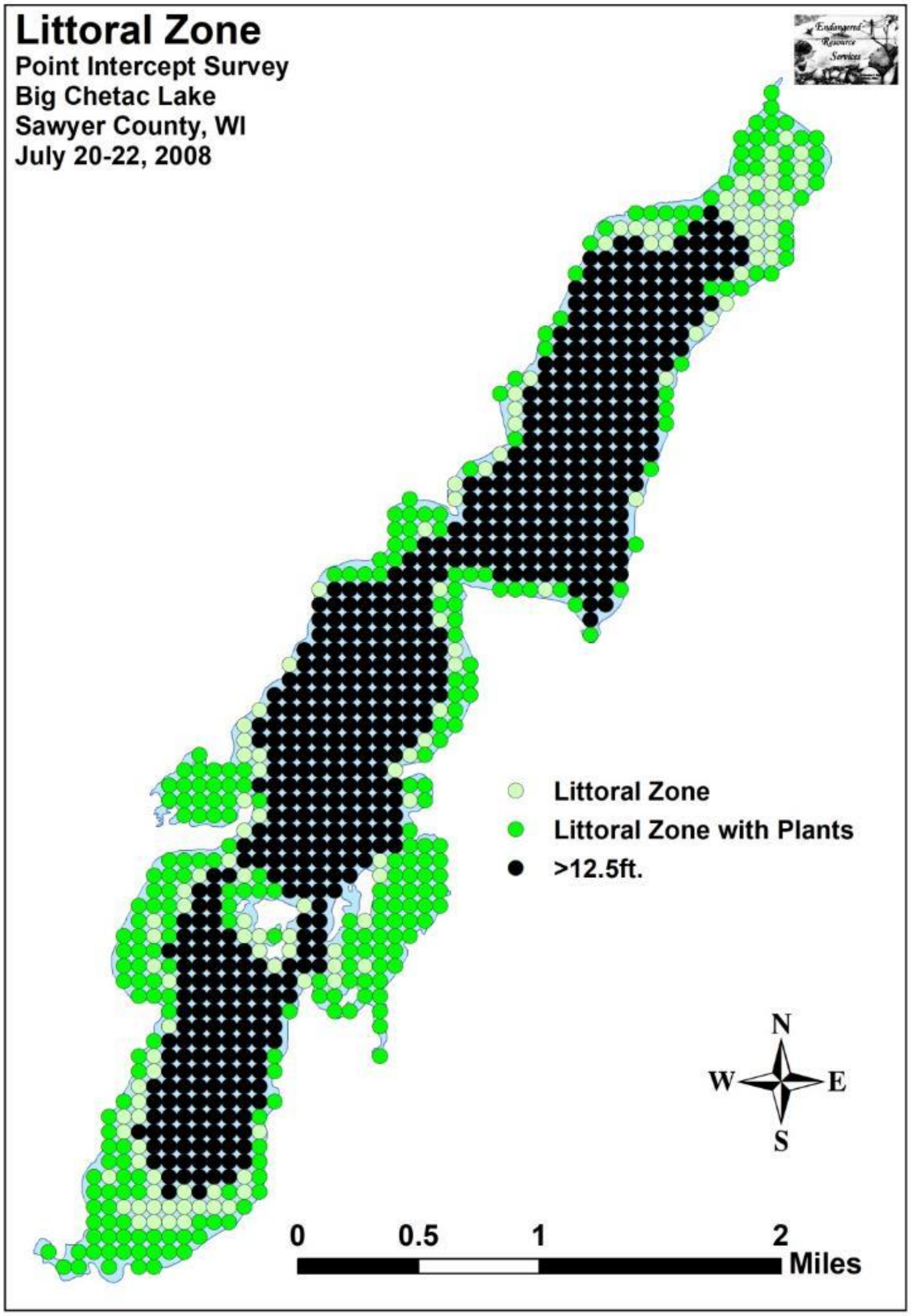
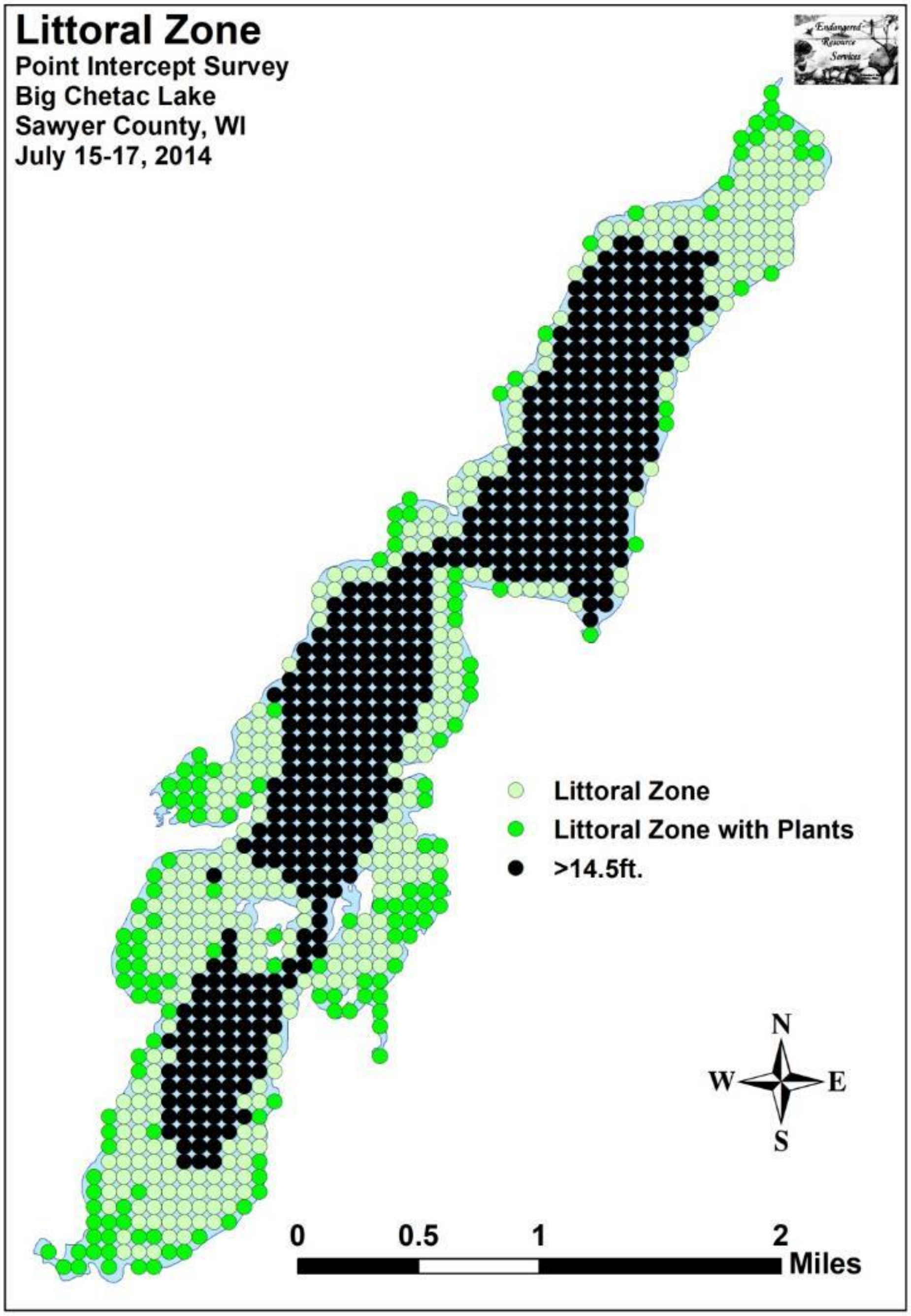
Appendix III: Habitat Variable Maps

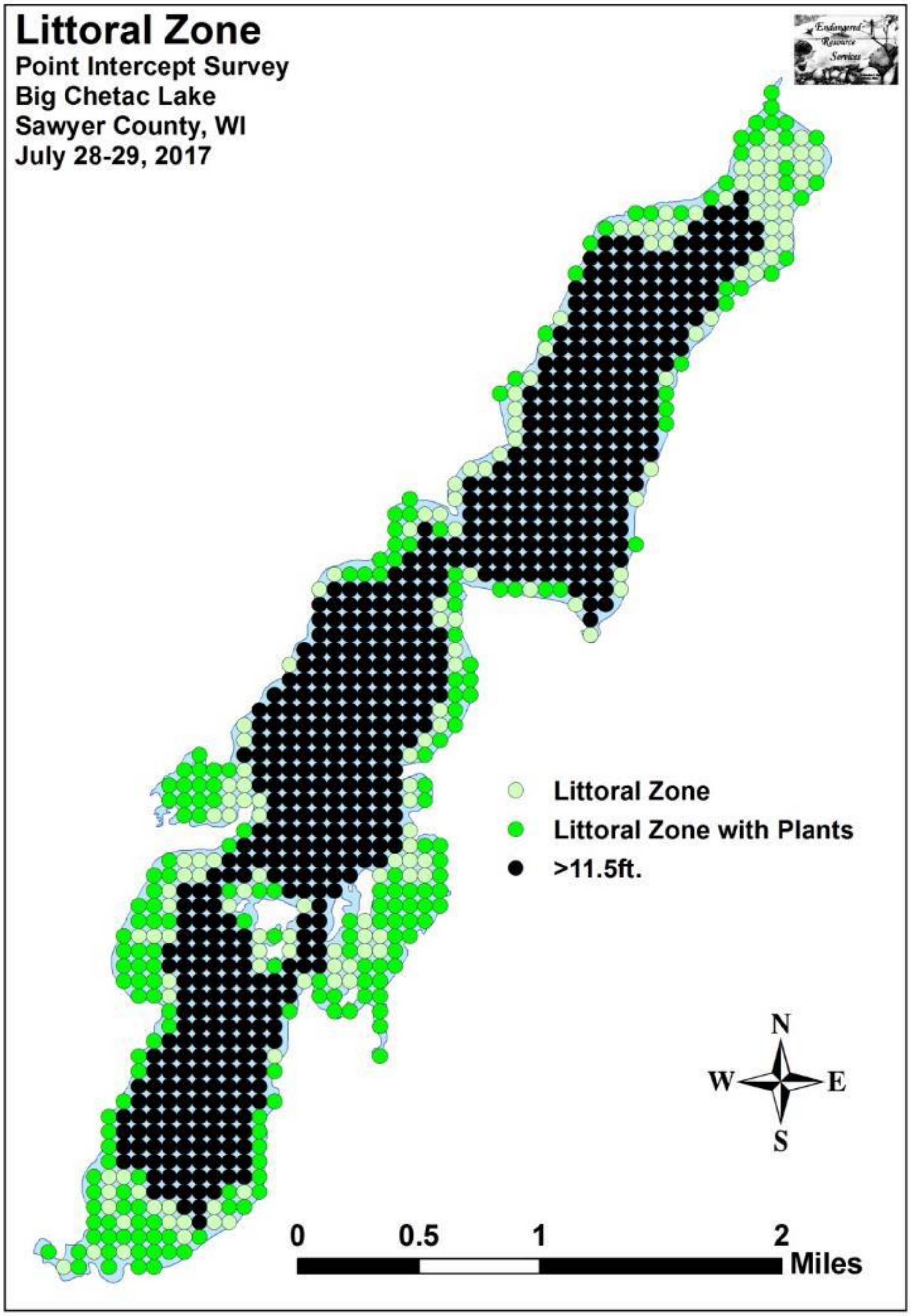

Lake Depth
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Depth in ft.
0.5 - 5.0
5.1 - 10.0
10.1 - 15.0
15.1 - 20.0
20.1 - 28.0
N
W
E
S
0
0.5
1
2
Miles

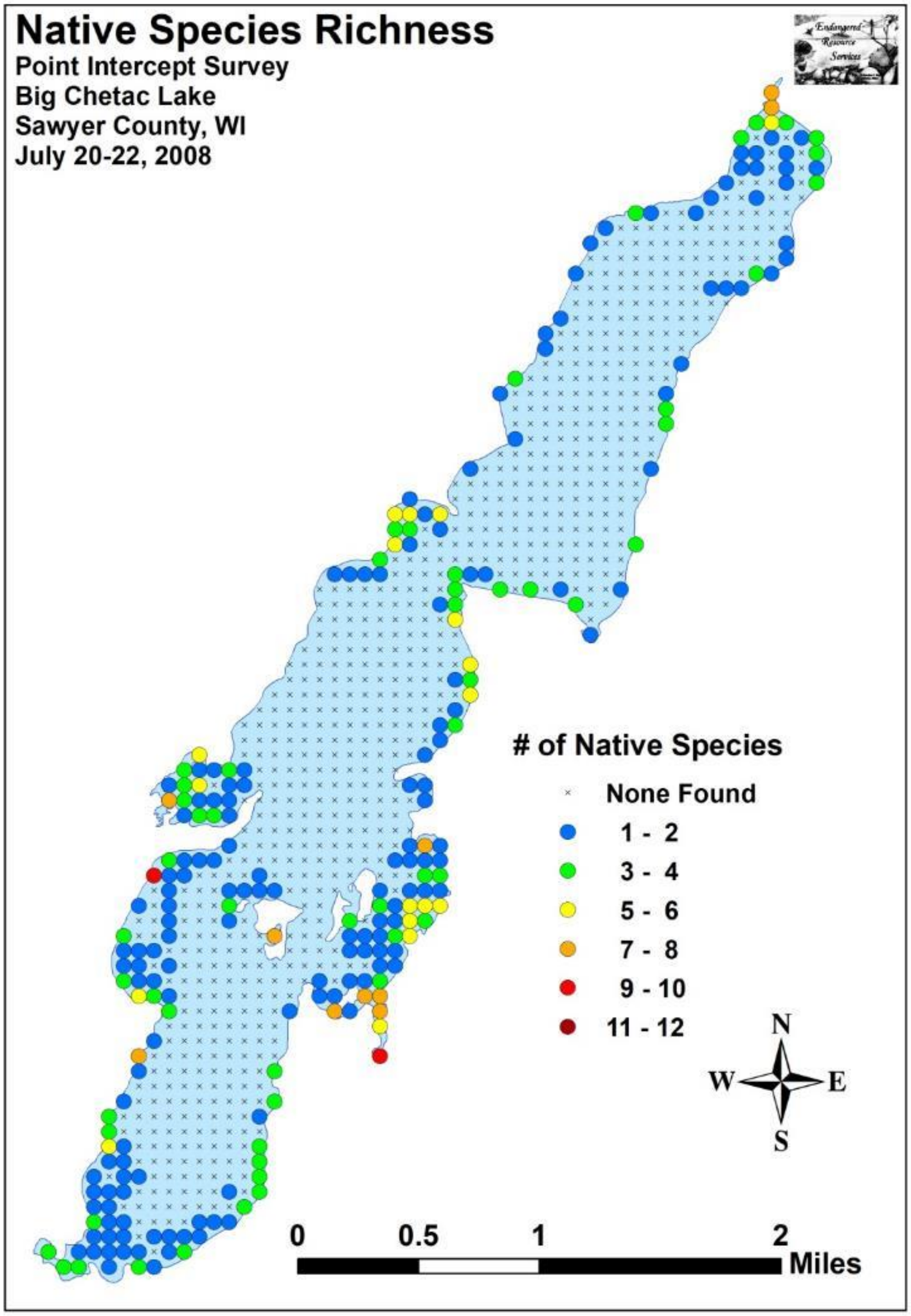

Bottom Substrate
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Substrate Type
Muck
Rock
Sand
Not Determined
N
W
E
S
0
0.5
1
2
Miles

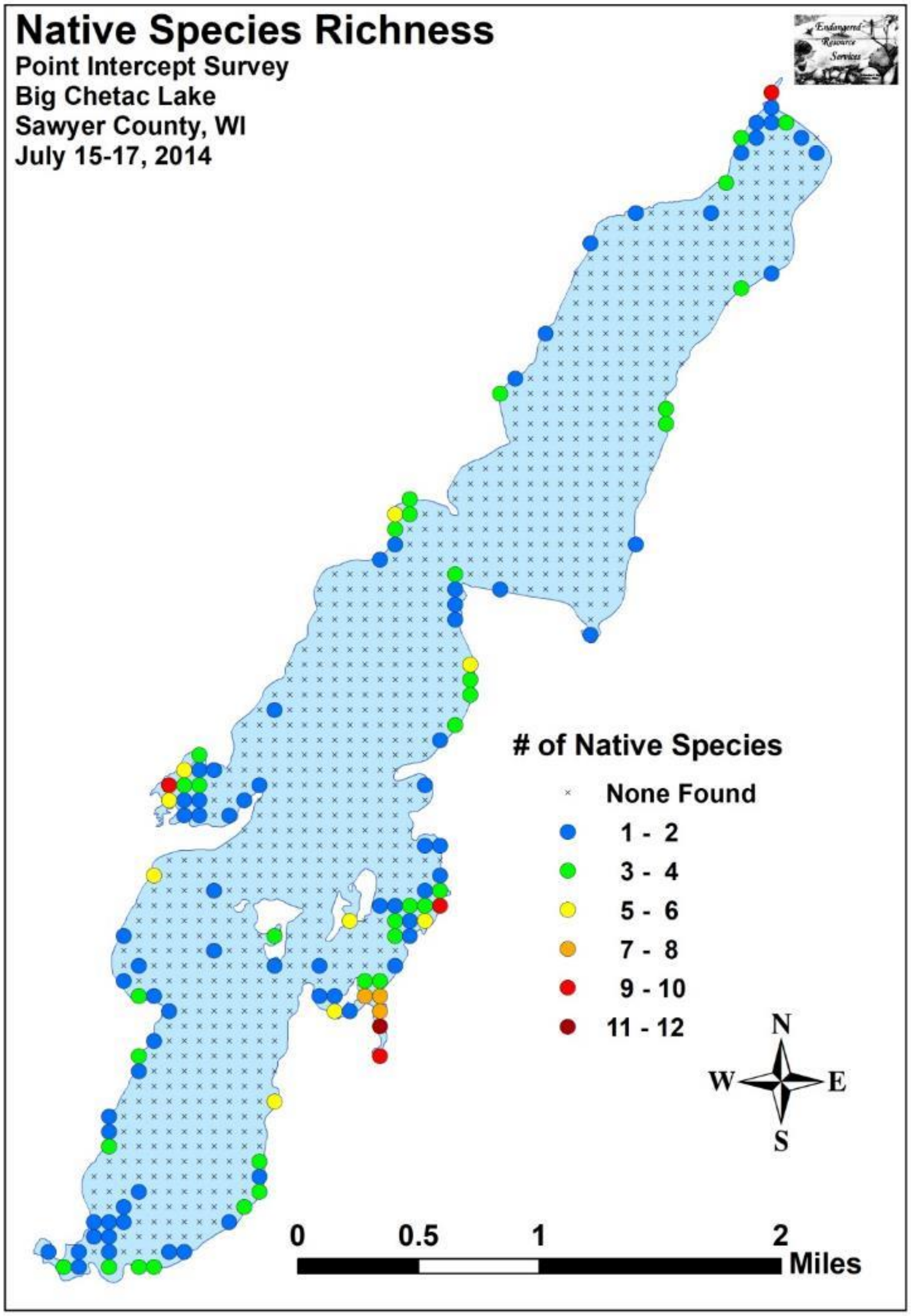
Appendix IV: 2008, 2014, and 2017 Littoral Zone, Native Species Richness, and Total Rake Fullness Maps

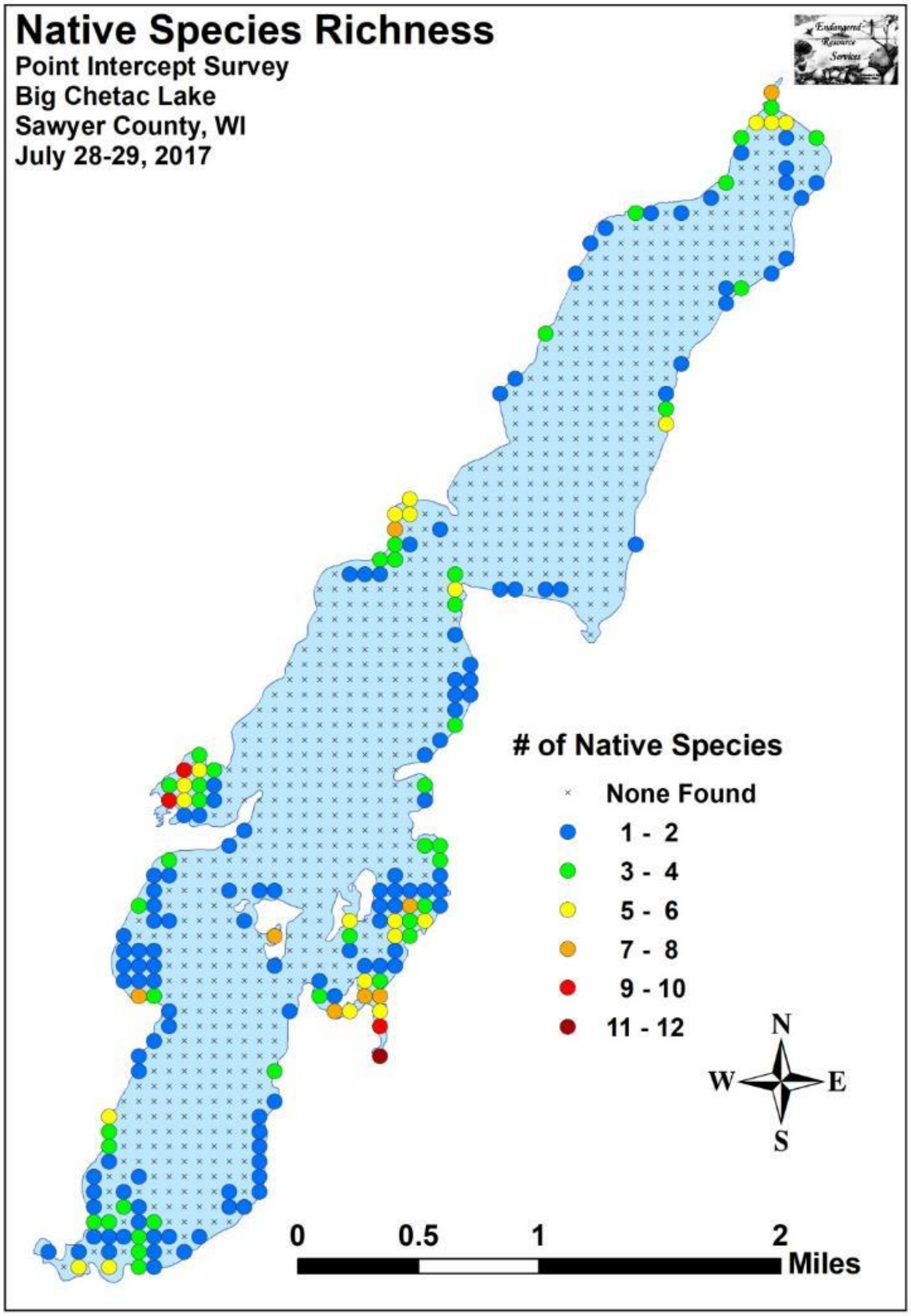

Littoral Zone
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 20-22, 2008
Littoral Zone
Littoral Zone with Plants
>12.5ft.
N
W
E
S
0
0.5
1
2
Miles


Littoral Zone
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Littoral Zone
Littoral Zone with Plants
>14.5ft.
N
W
E
S
0
0.5
1
2
Miles

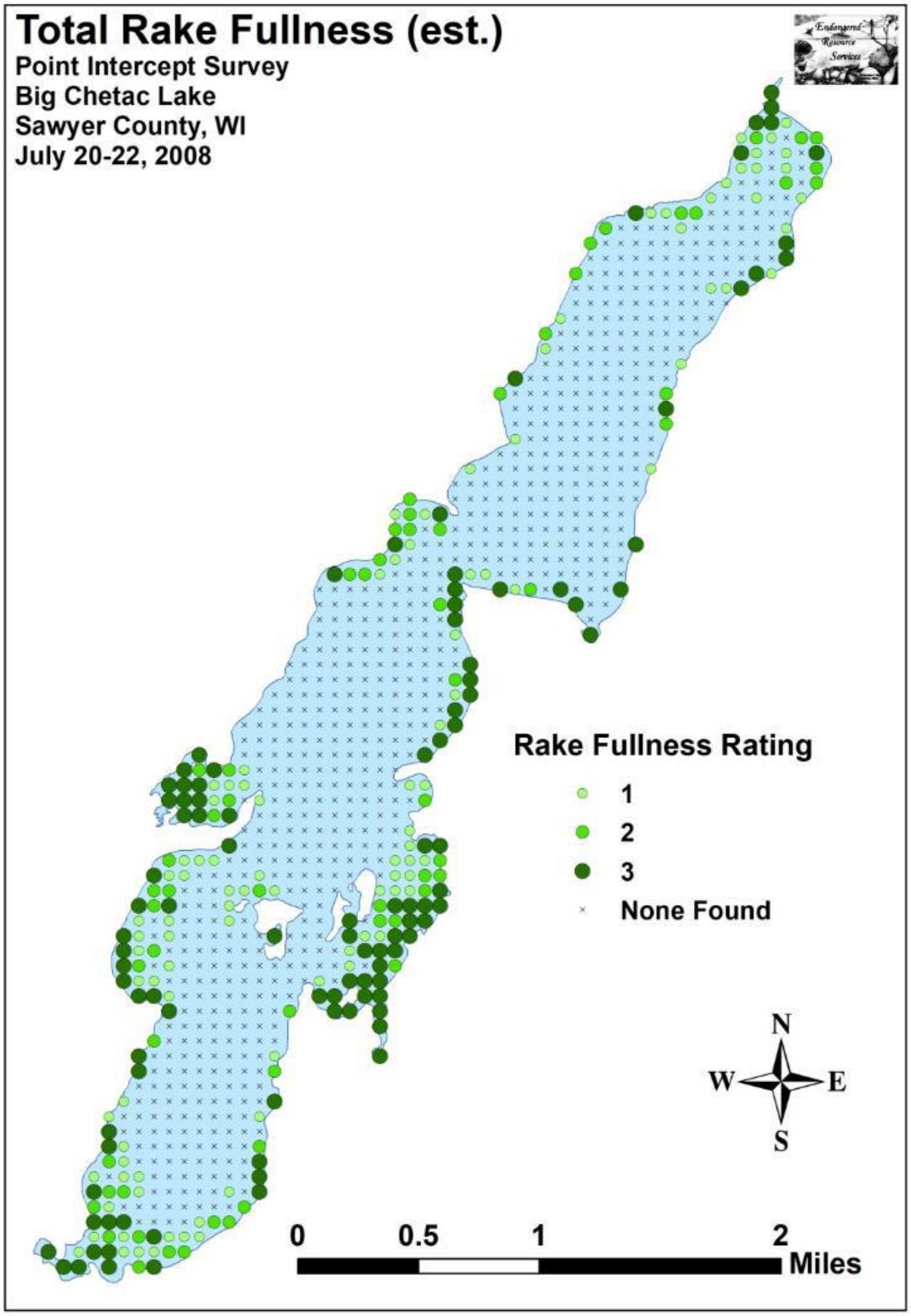

Littoral Zone
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Littoral Zone
Littoral Zone with Plants
>11.5ft.
N
W
E
S
0
0.5
1
2
Miles

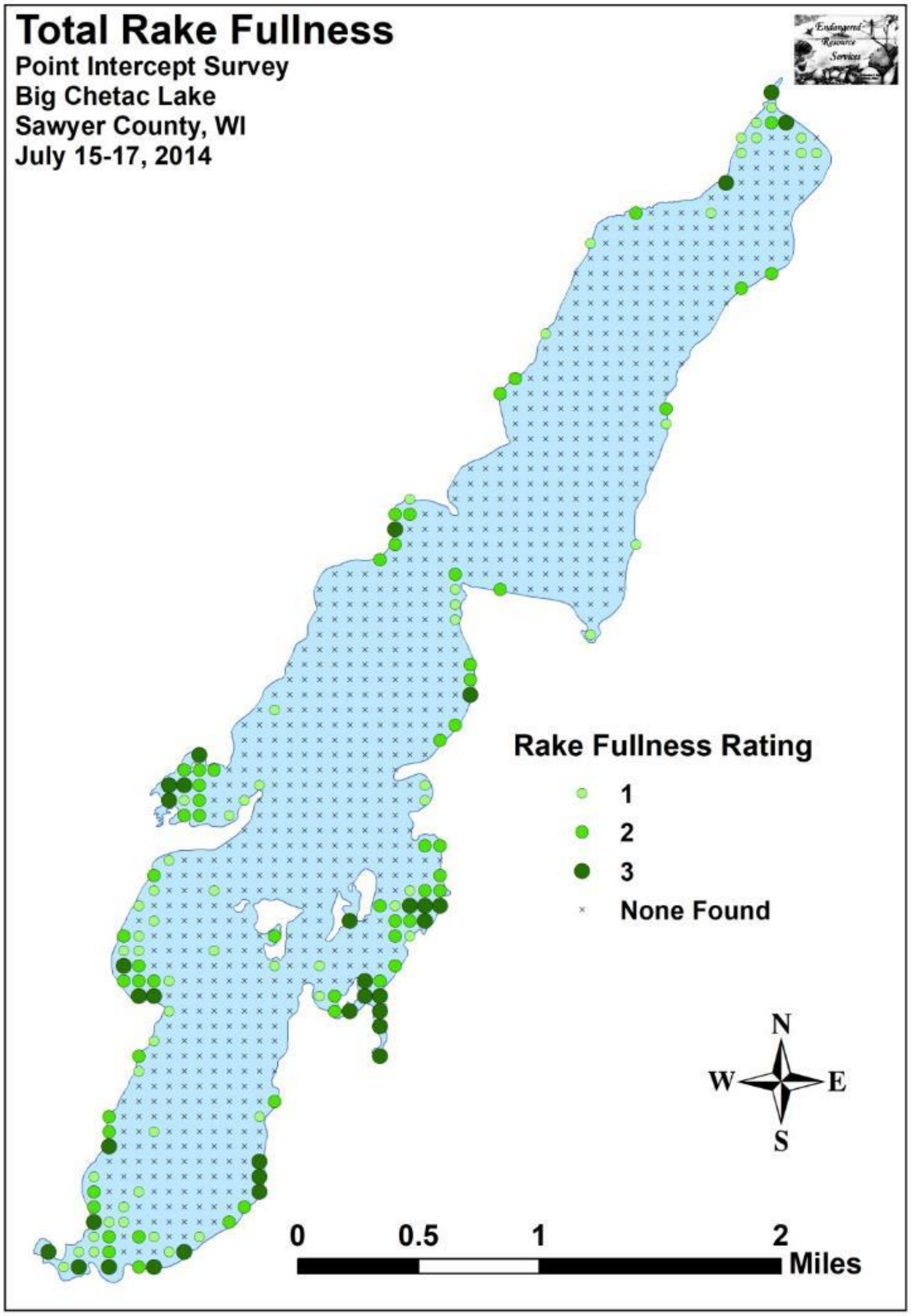

Native Species Richness
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 20-22, 2008
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 8
9 - 10
11 - 12
N
W
E
S
0
0.5
1
2
Miles

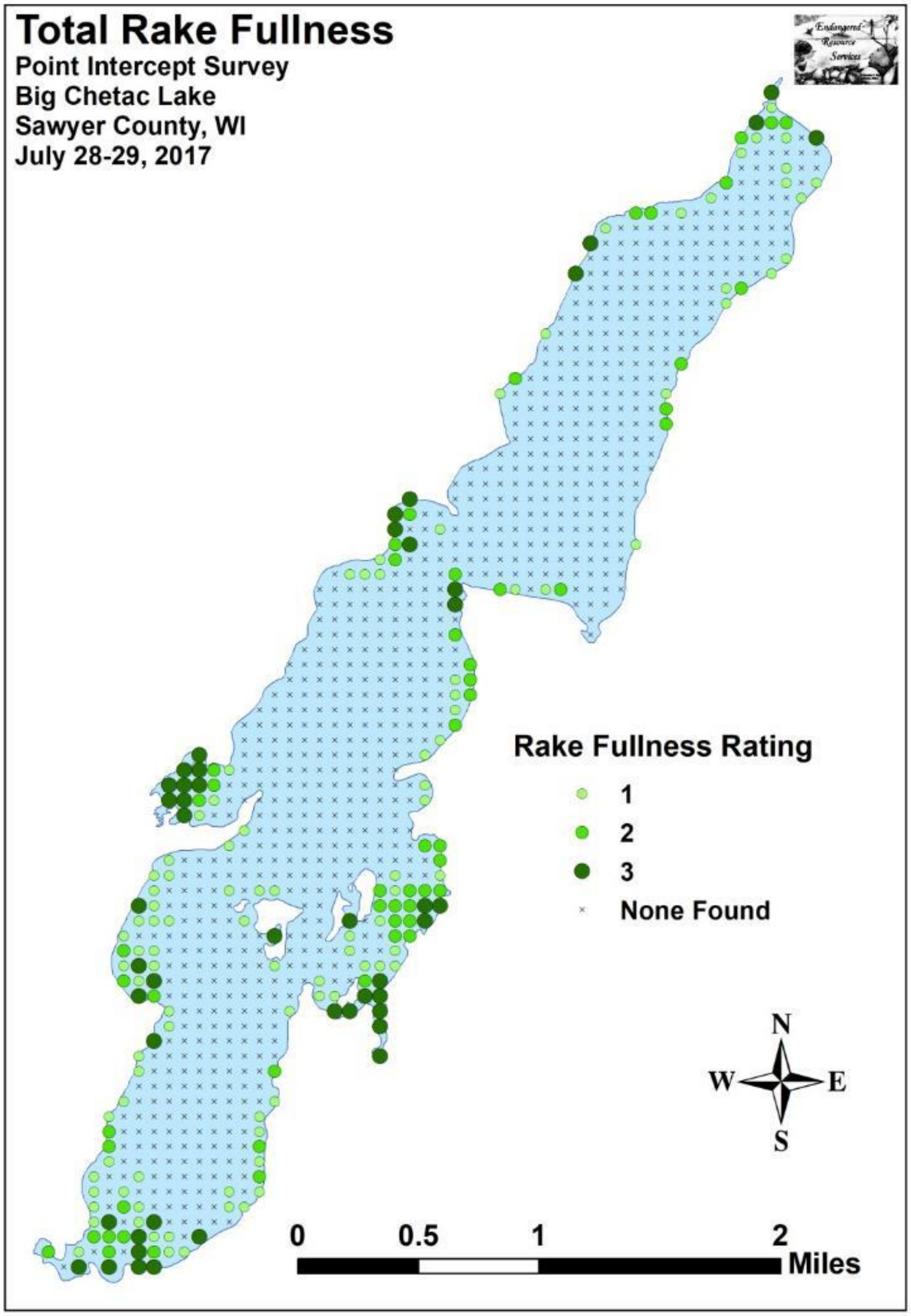

Native Species Richness
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 8
9 - 10
11 - 12
N
W
E
S
0
0.5
1
2
Miles



Native Species Richness
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 8
9 - 10
11 - 12
N
W
E
S
0
0.5
1
2
Miles

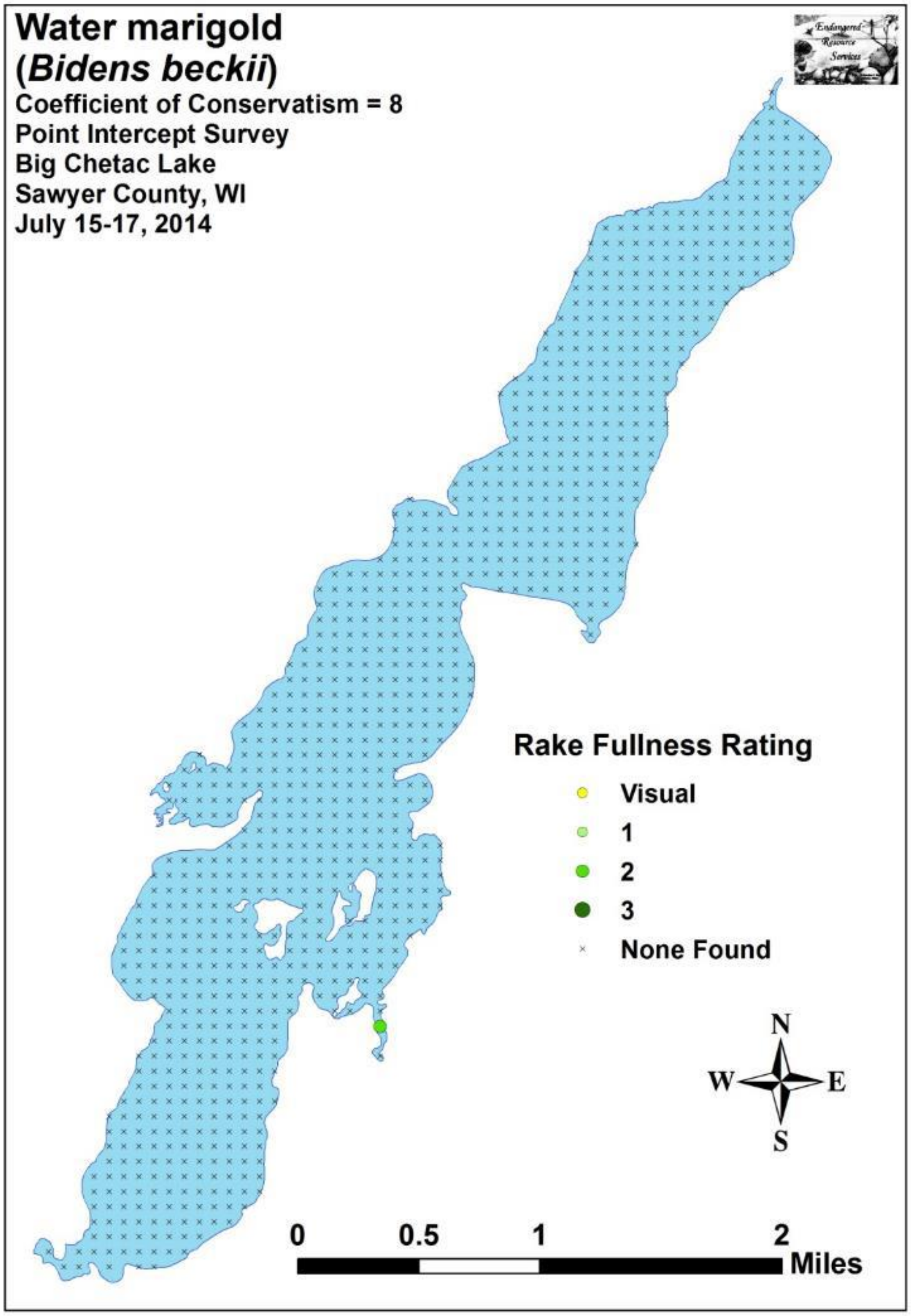

Total Rake Fullness (est.)
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 20-22, 2008
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

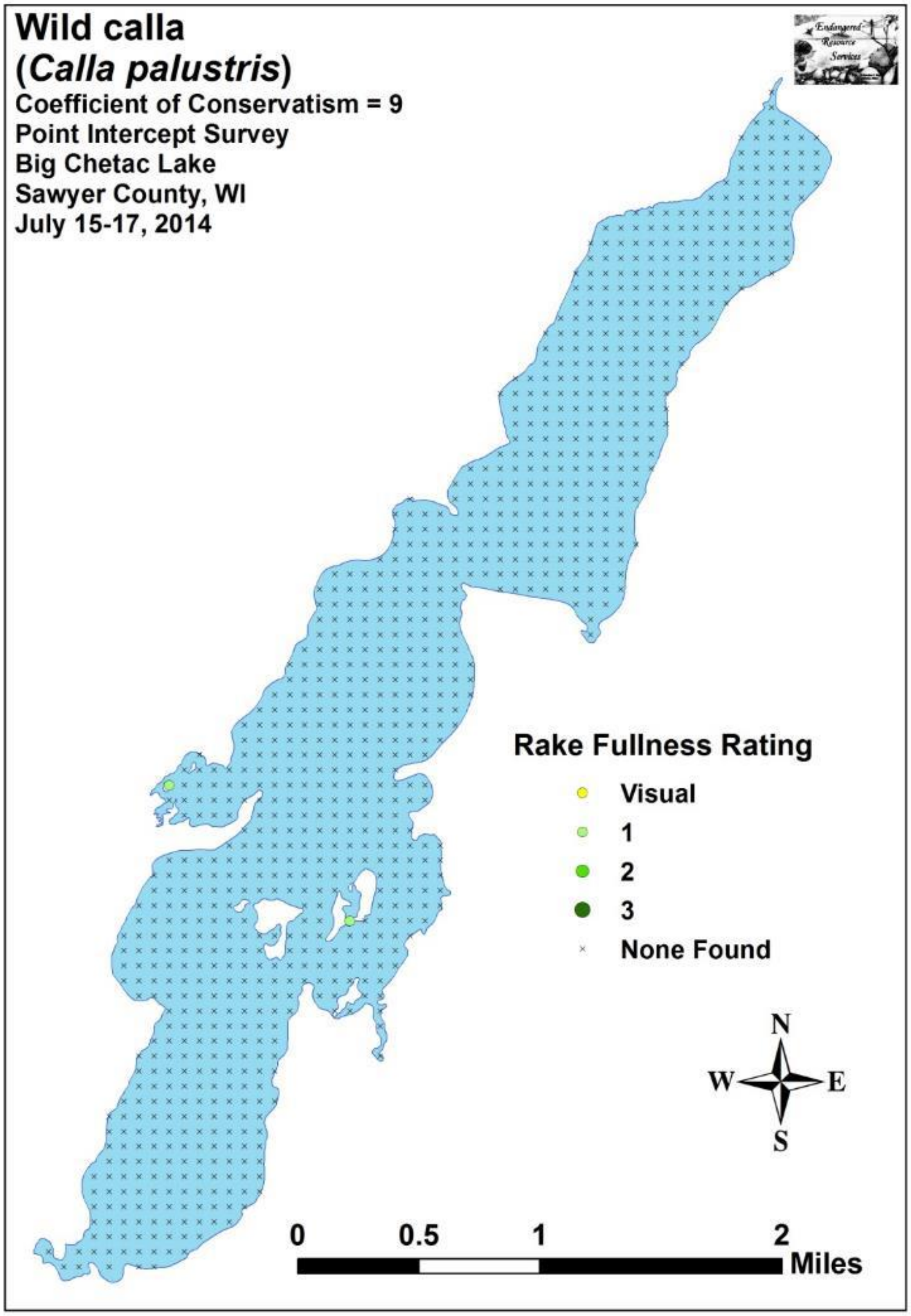

Total Rake Fullness
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

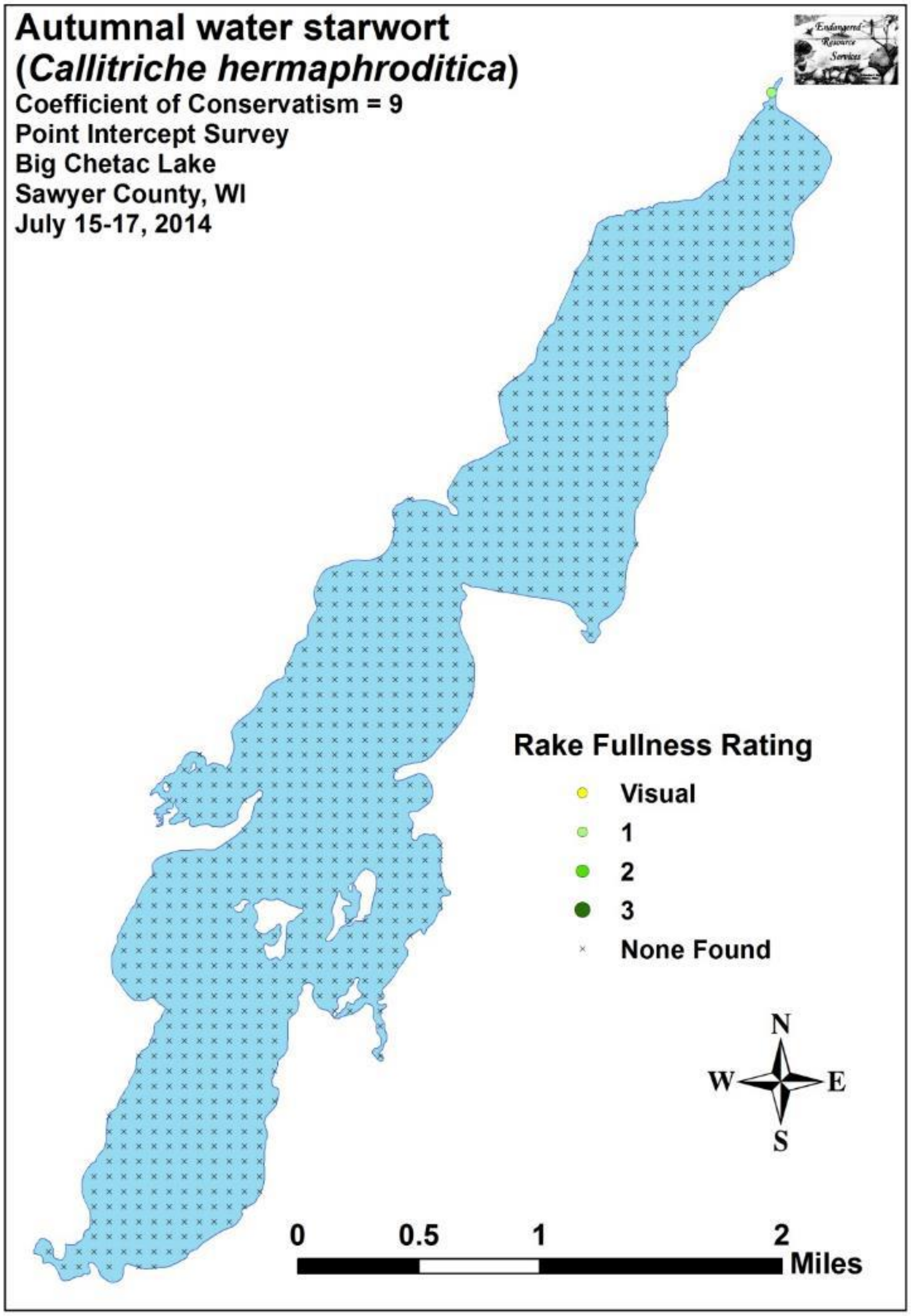


Total Rake Fullness
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

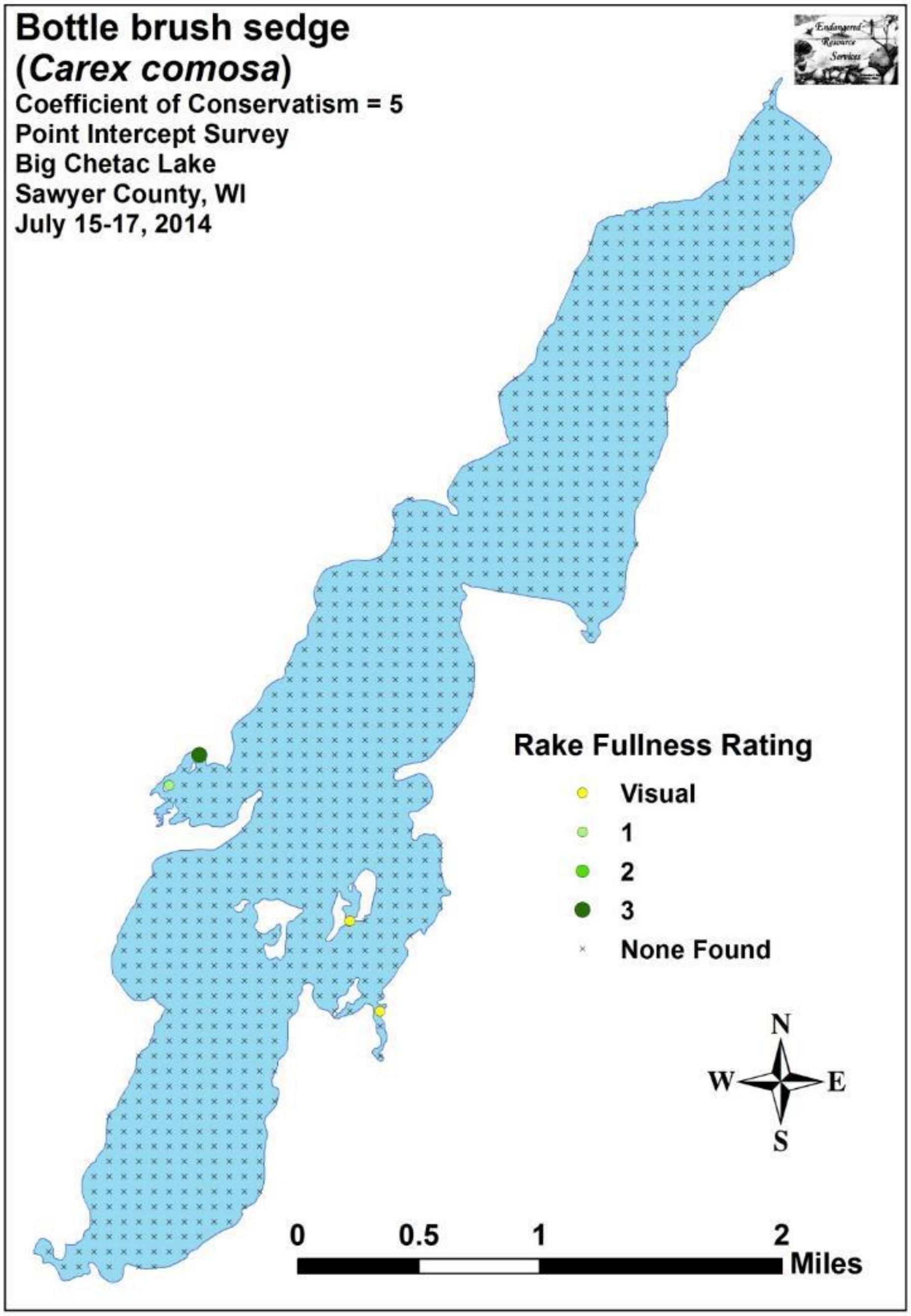
Appendix V: 2014 Plant Species Density and Distribution Maps

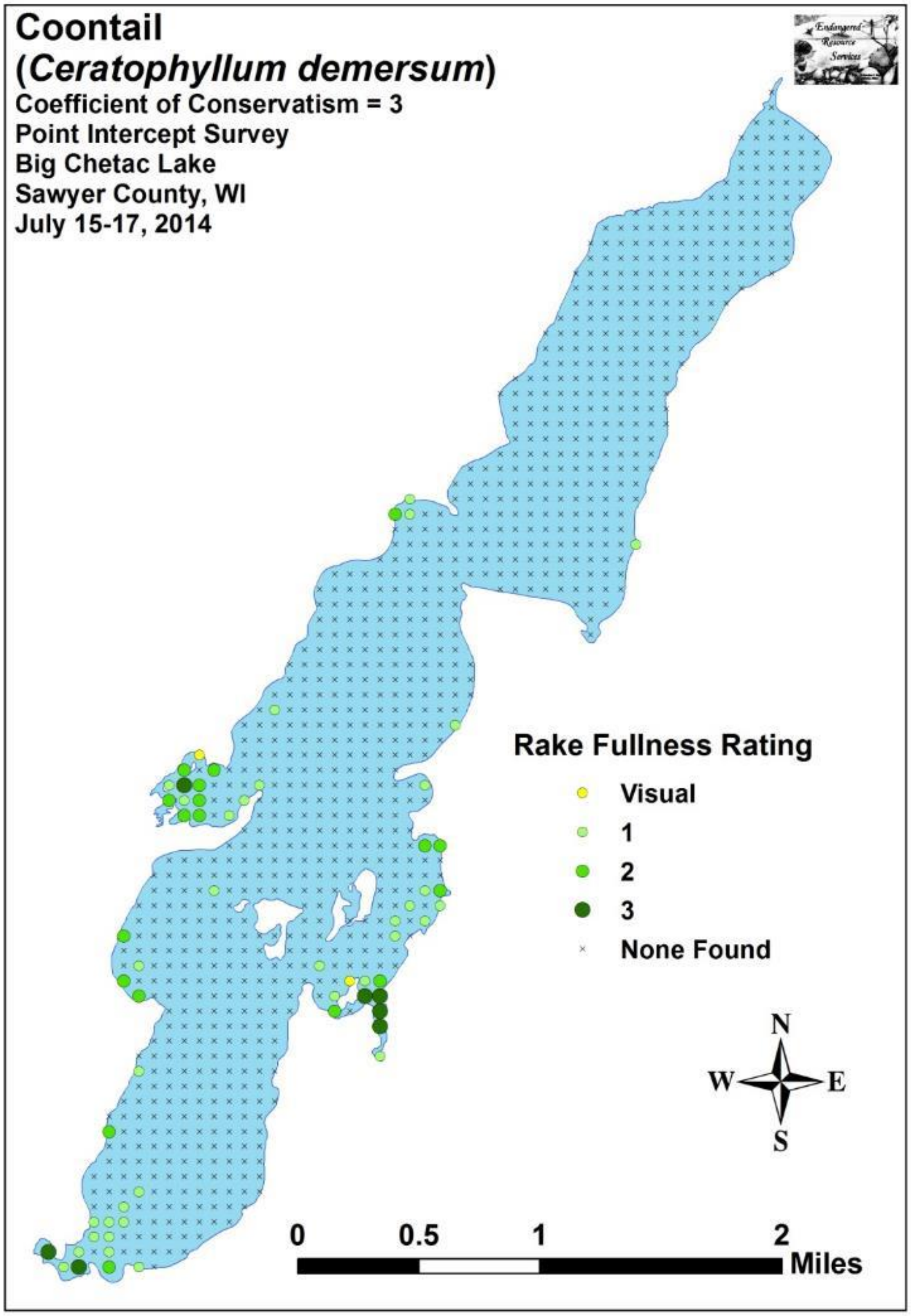

Water marigold
(*Bidens beckii*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

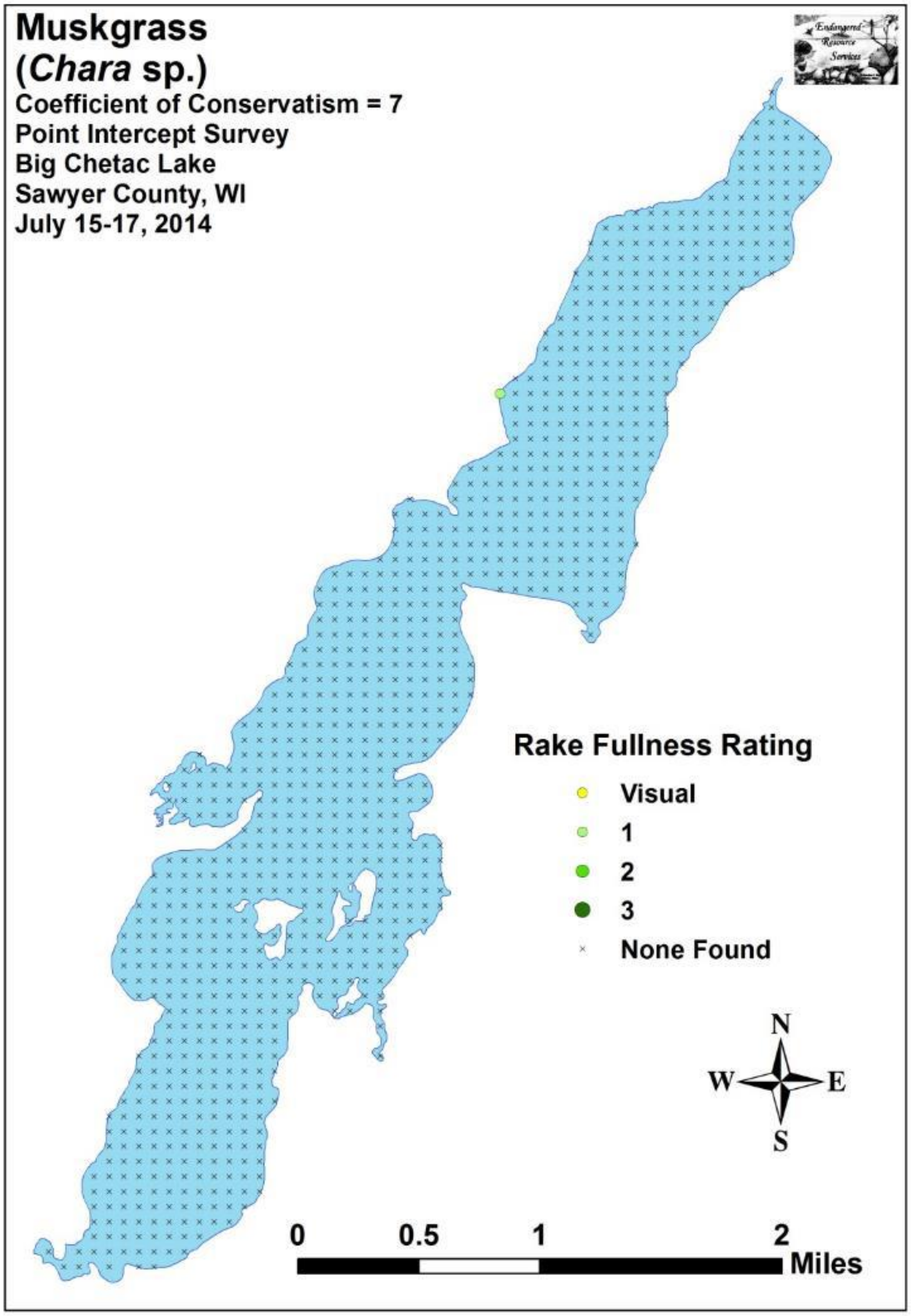

Wild calla
(*Calla palustris*)
Coefficient of Conservatism = 9
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

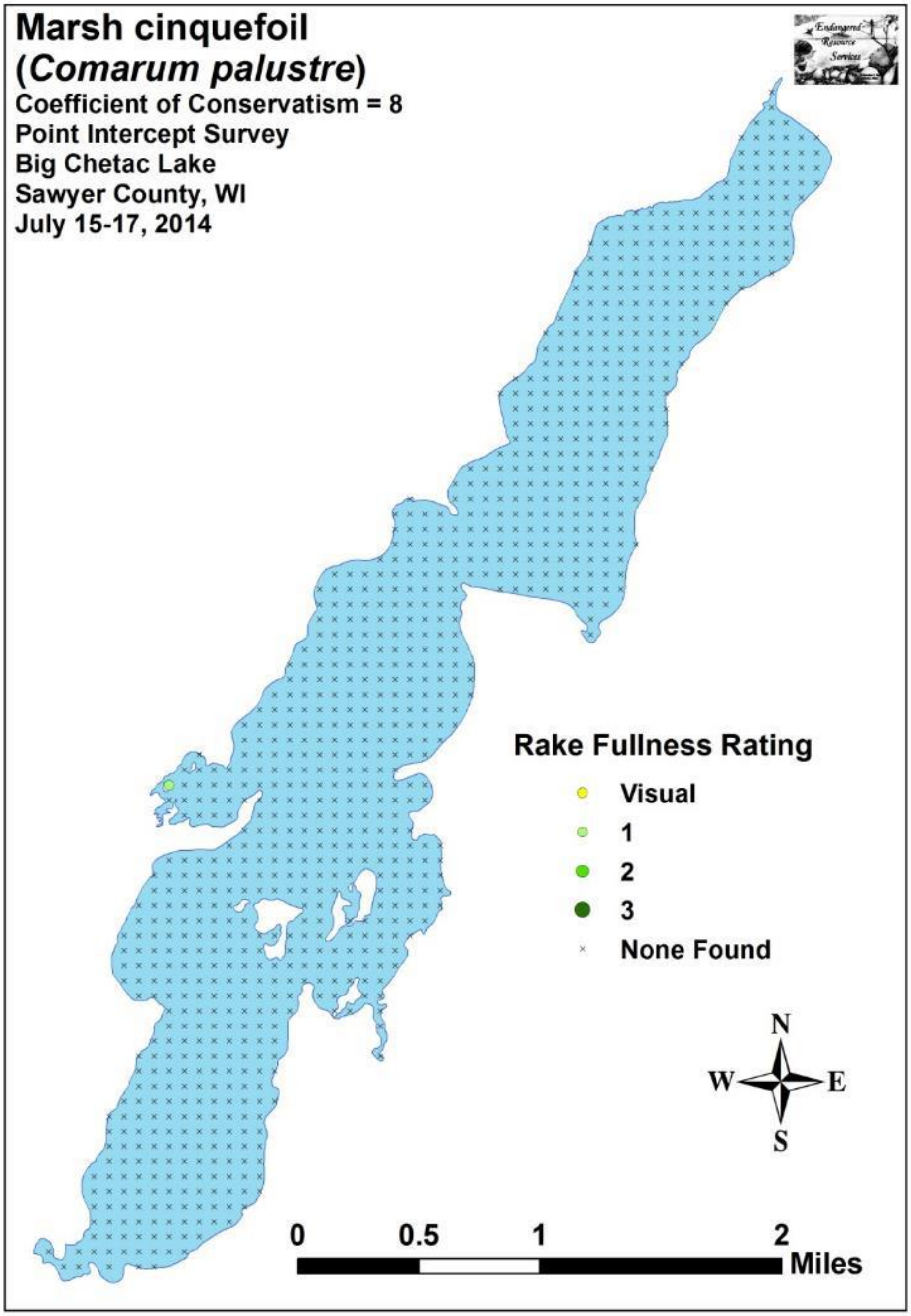


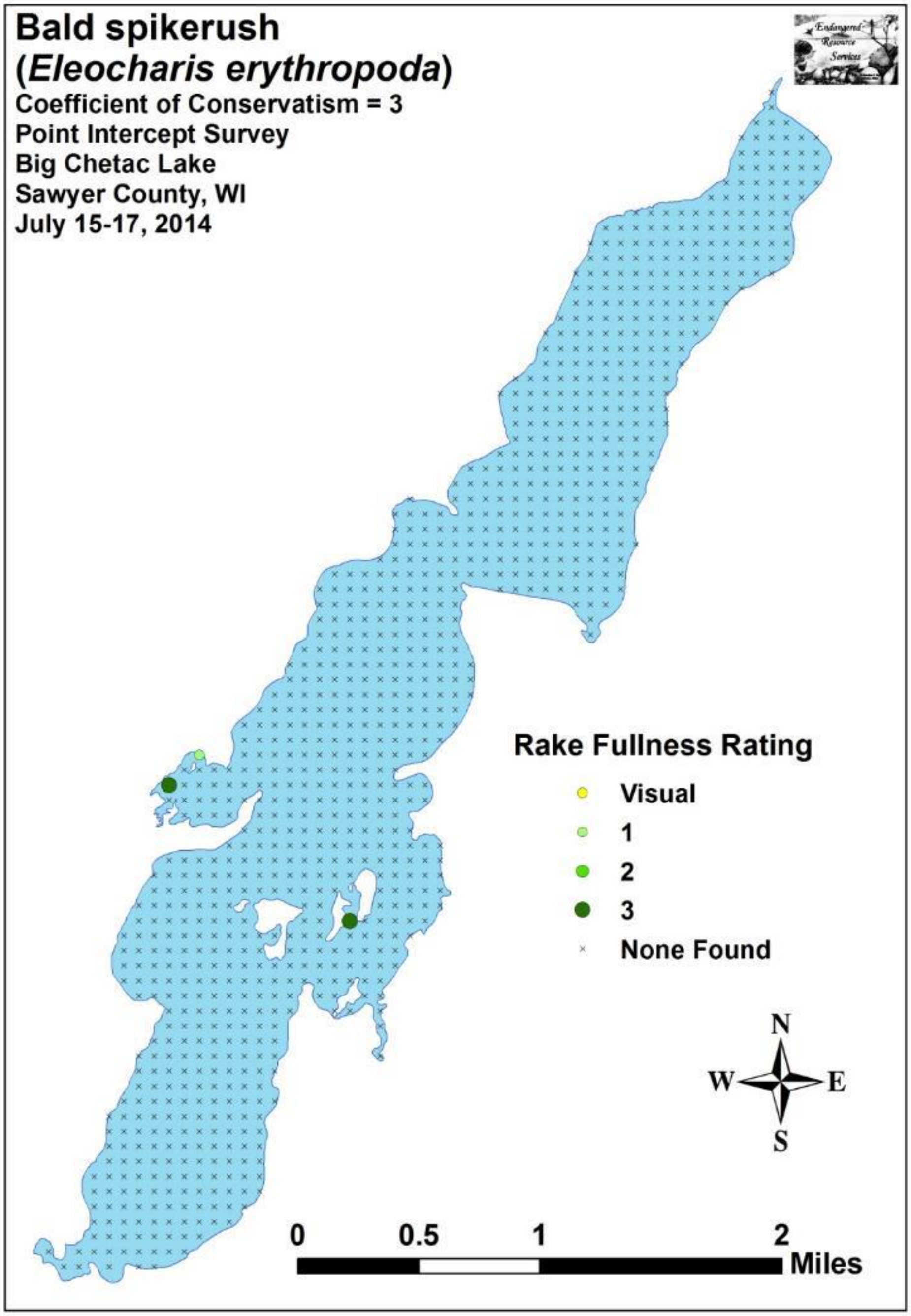
Autumnal water starwort
(*Callitriche hermaphroditica*)
Coefficient of Conservatism = 9
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

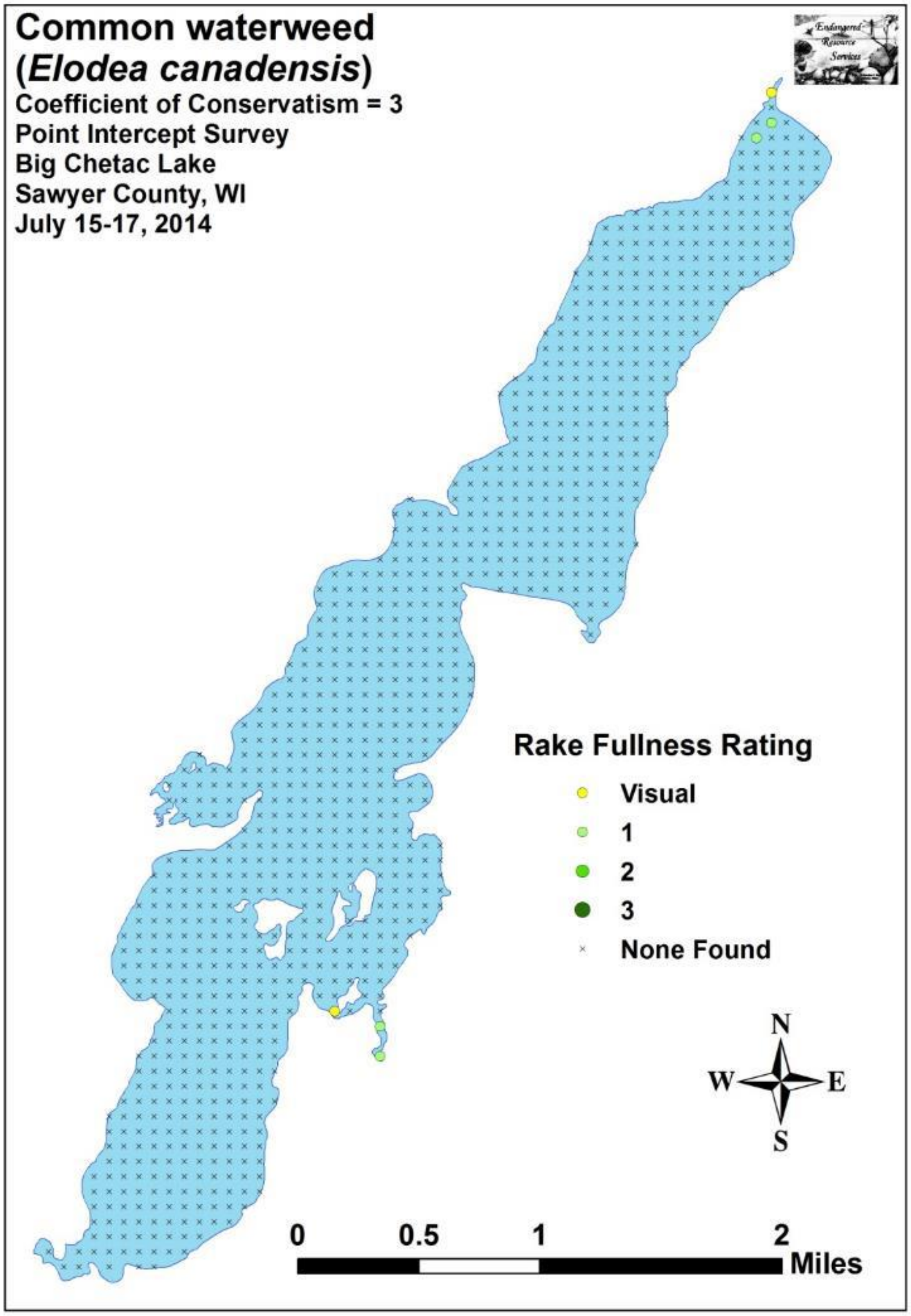

Bottle brush sedge
(Carex comosa)
Coefficient of Conservatism = 5
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

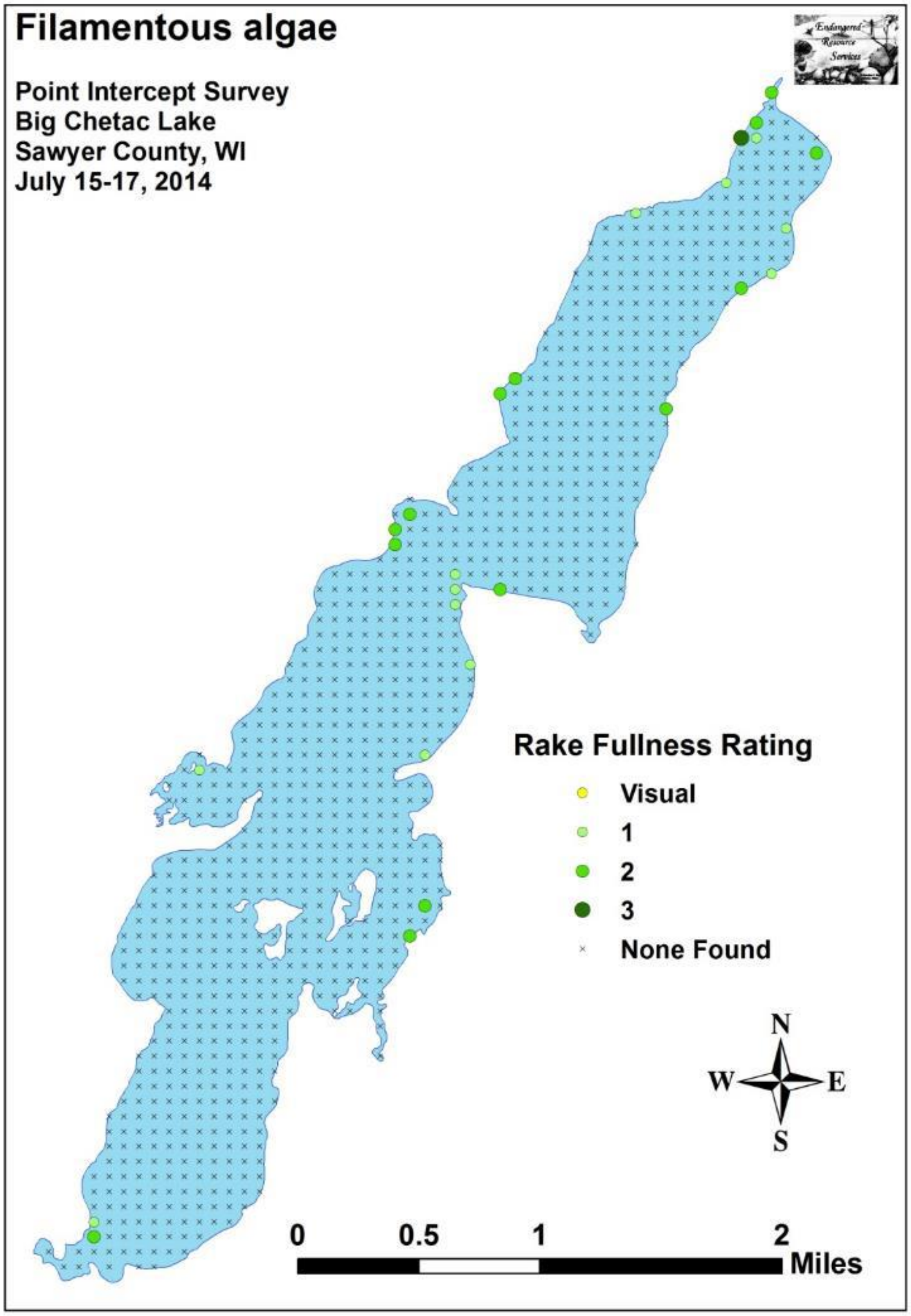

Coontail
(*Ceratophyllum demersum*)
Coefficient of Conservatism = 3
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

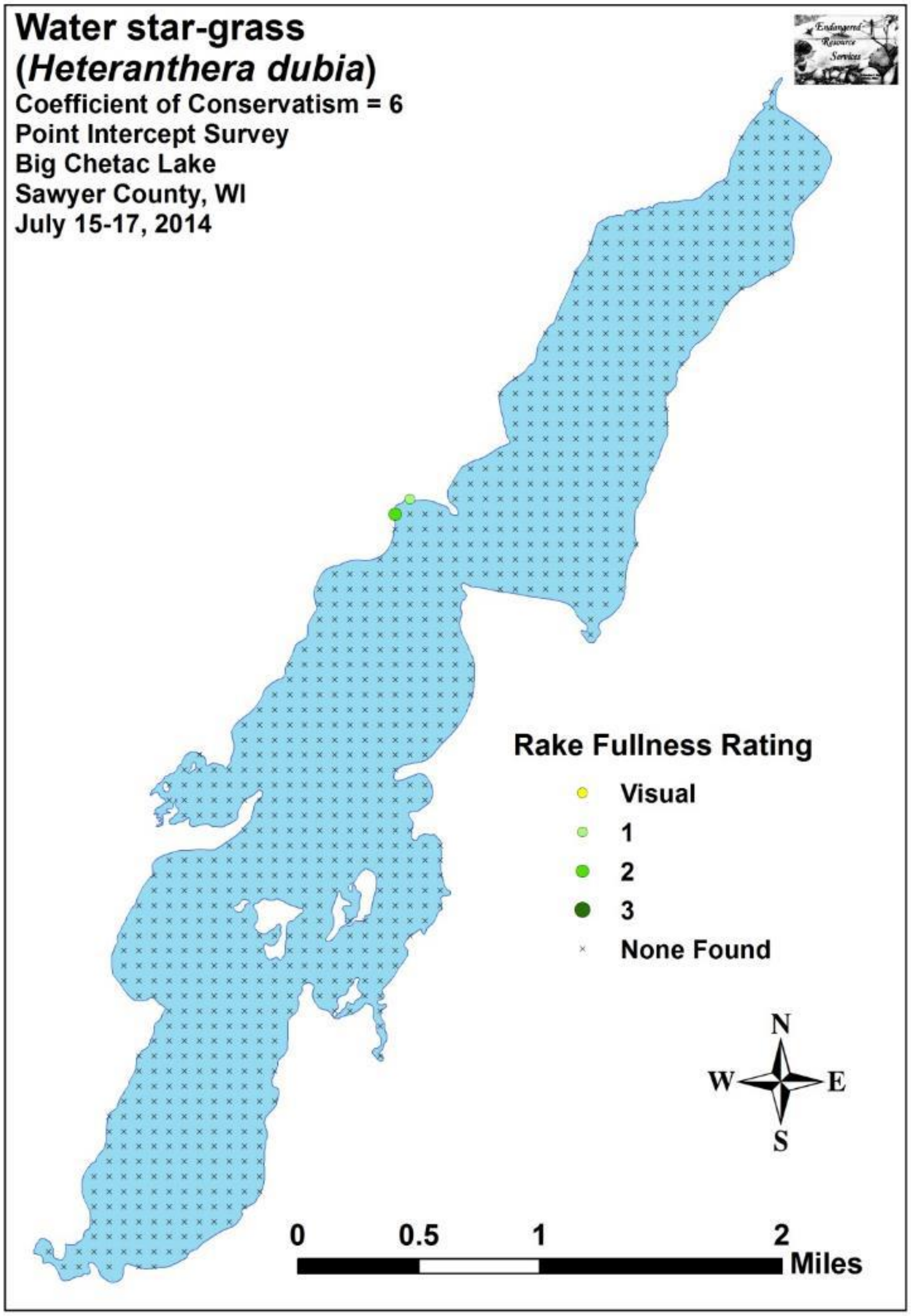

Muskgrass
(*Chara* sp.)
Coefficient of Conservatism = 7
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

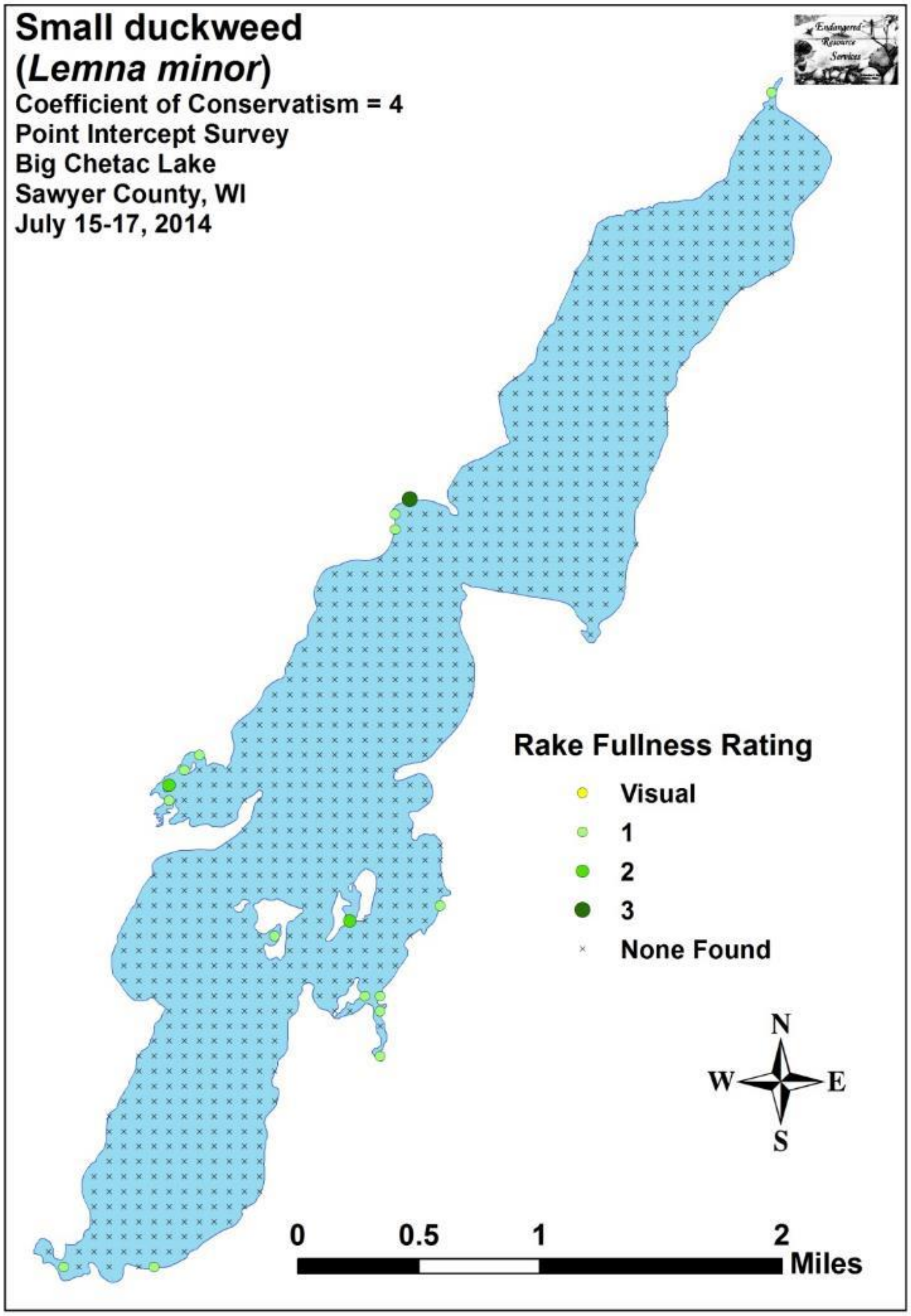

Marsh cinquefoil
(*Comarum palustre*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


Bald spikerush
(Eleocharis erythropoda)
Coefficient of Conservatism = 3
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

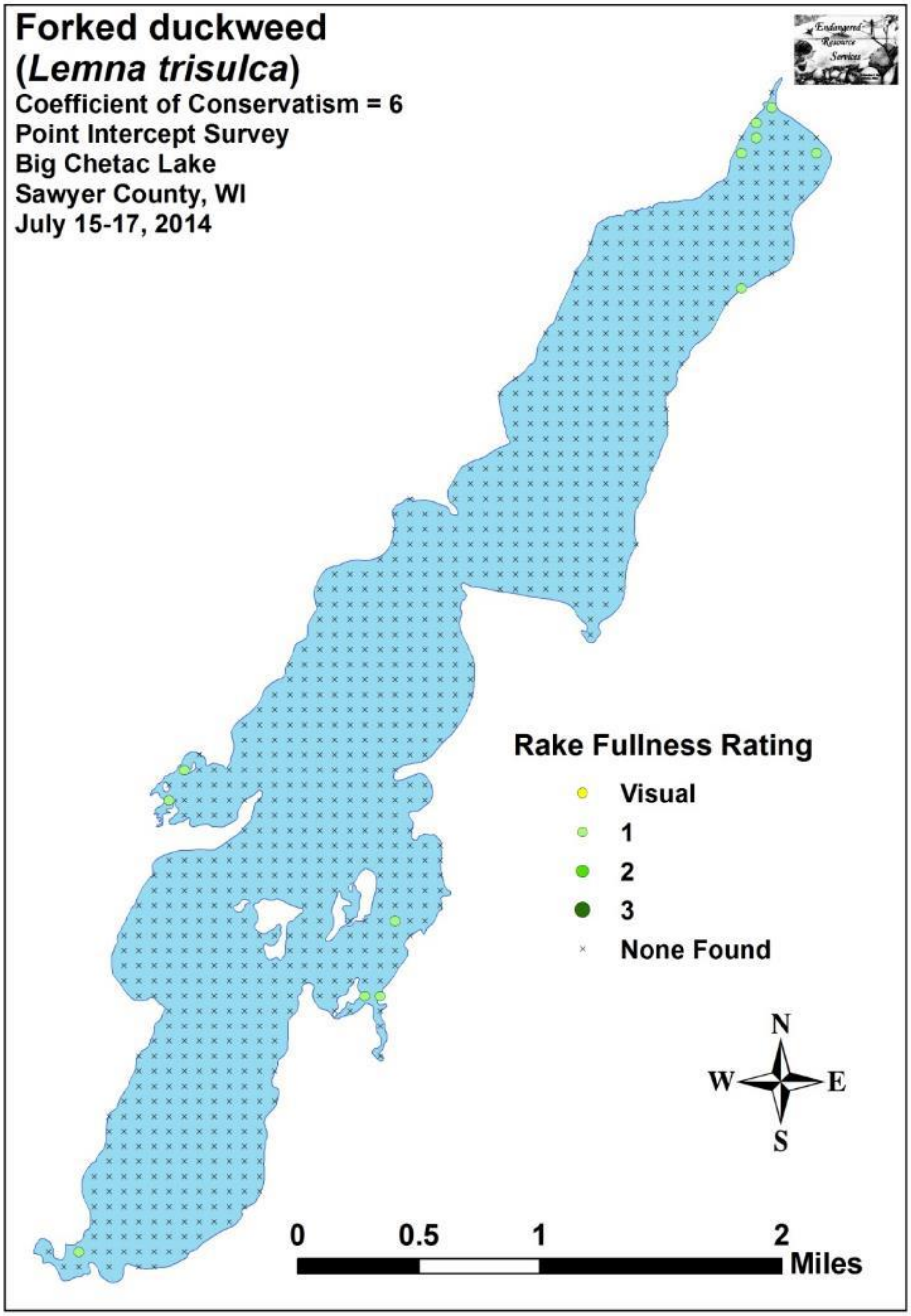

Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

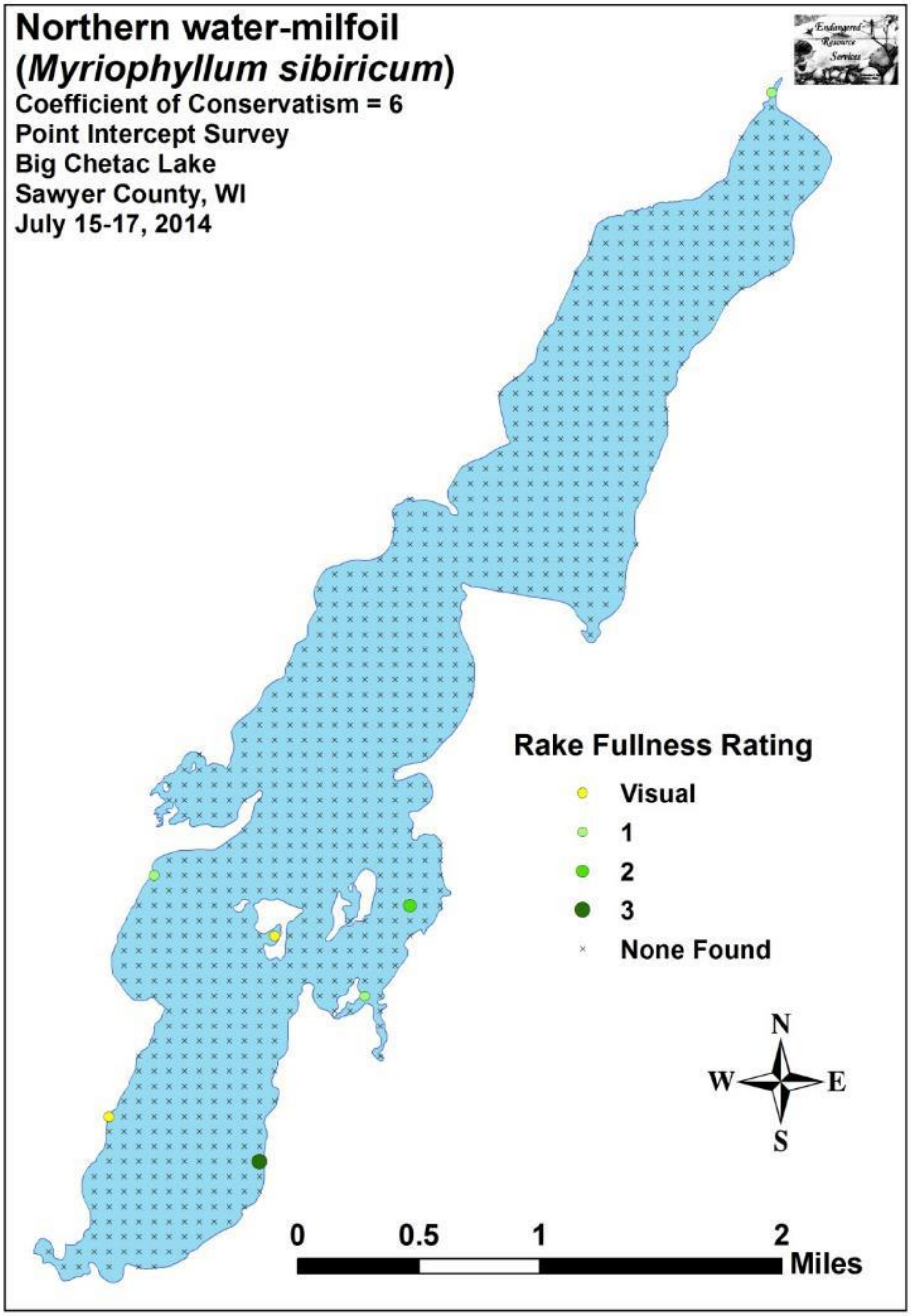

Filamentous algae
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

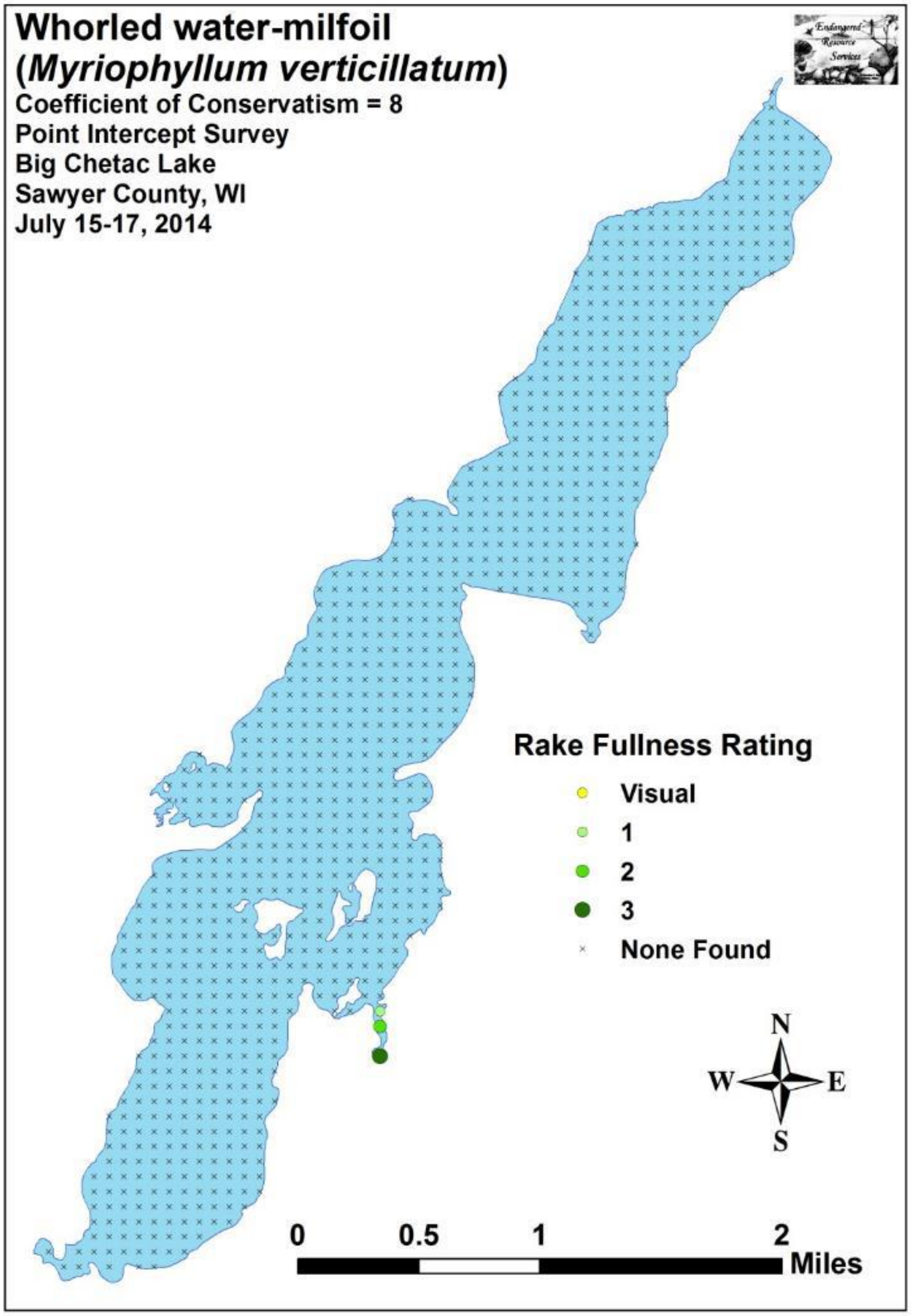

Water star-grass
(*Heteranthera dubia*)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

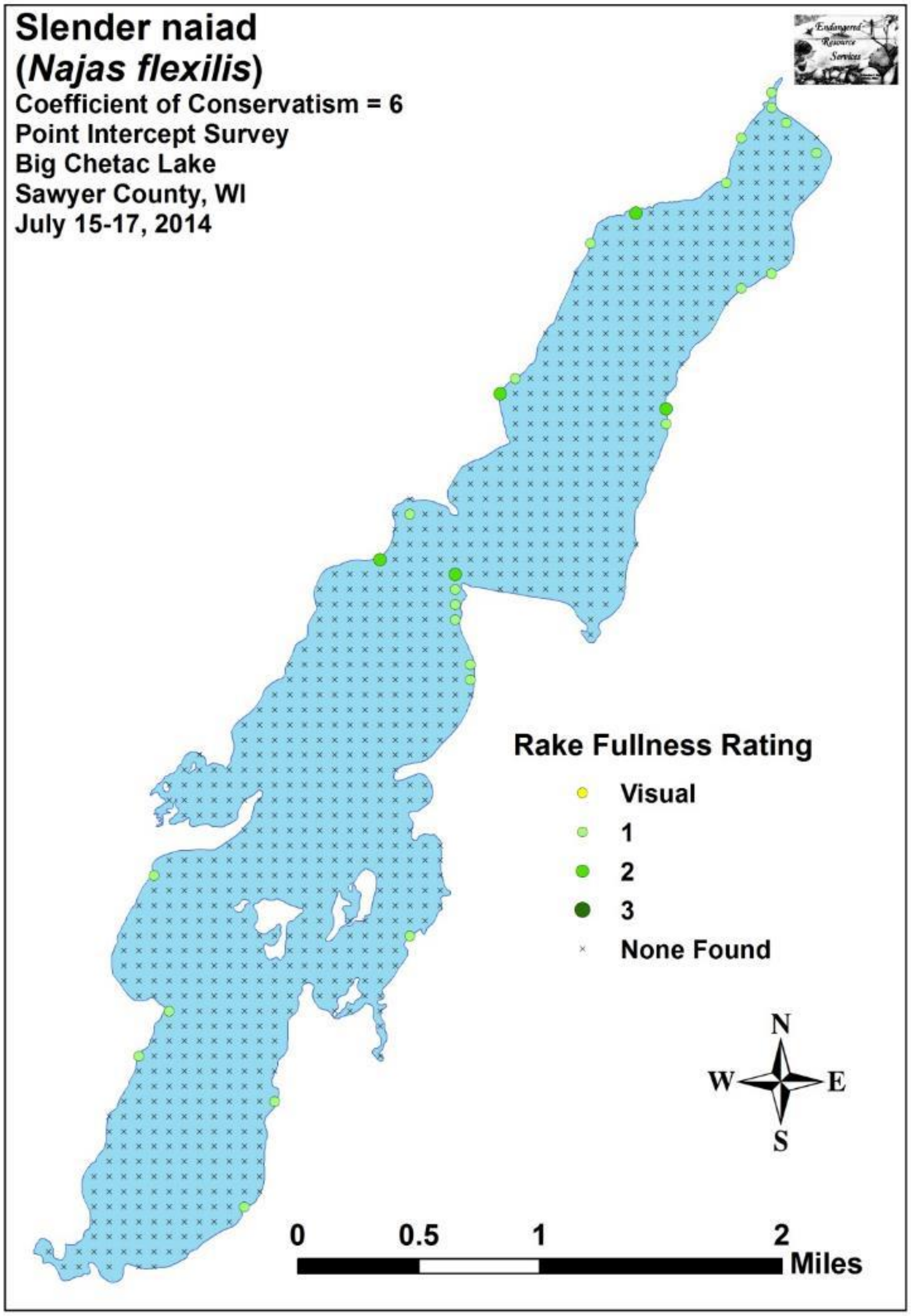


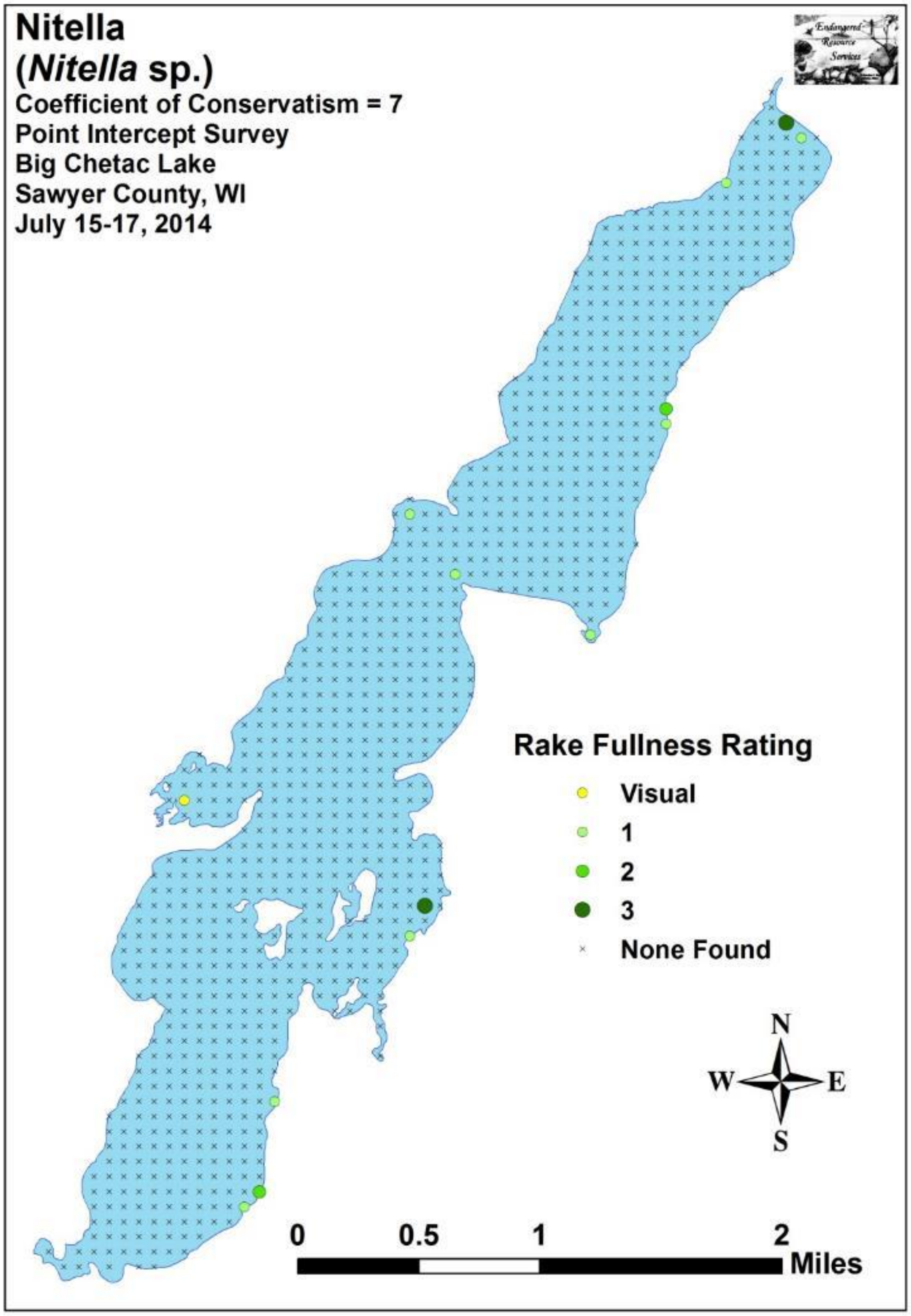
Small duckweed
(*Lemna minor*)
Coefficient of Conservatism = 4
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

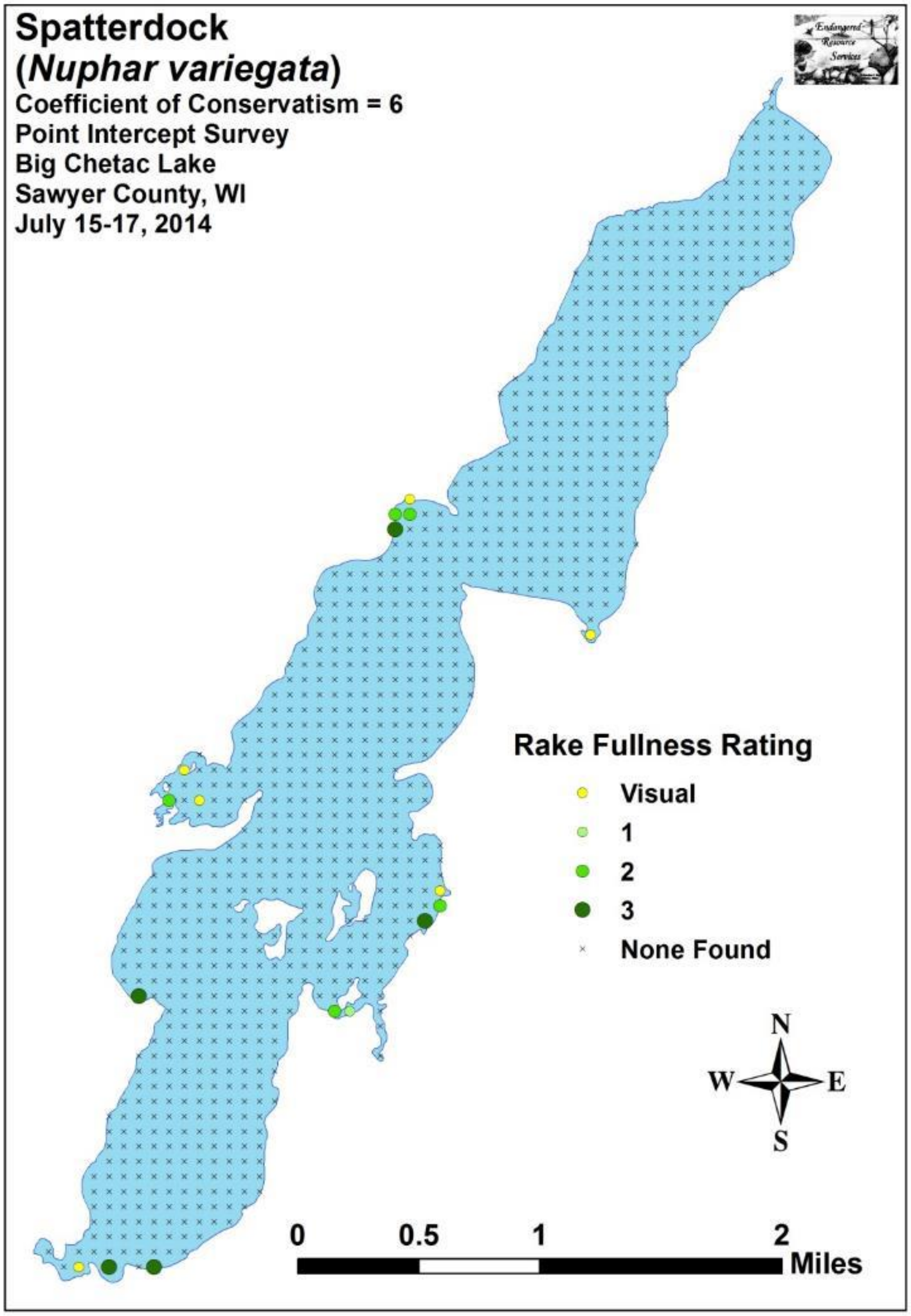

Forked duckweed
(Lemna trisulca)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

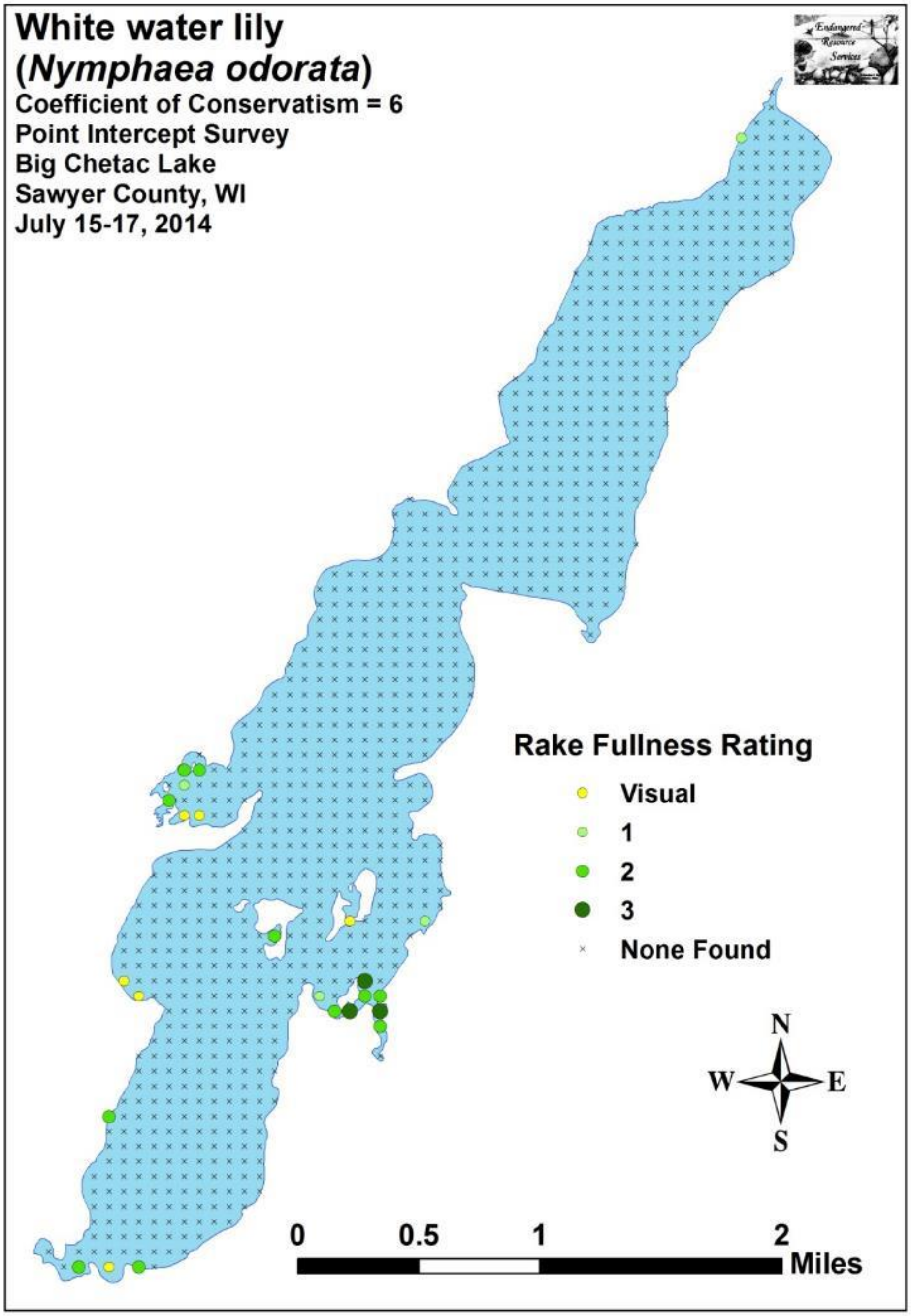

Northern water-milfoil
(*Myriophyllum sibiricum*)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


Whorled water-milfoil
(*Myriophyllum verticillatum*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

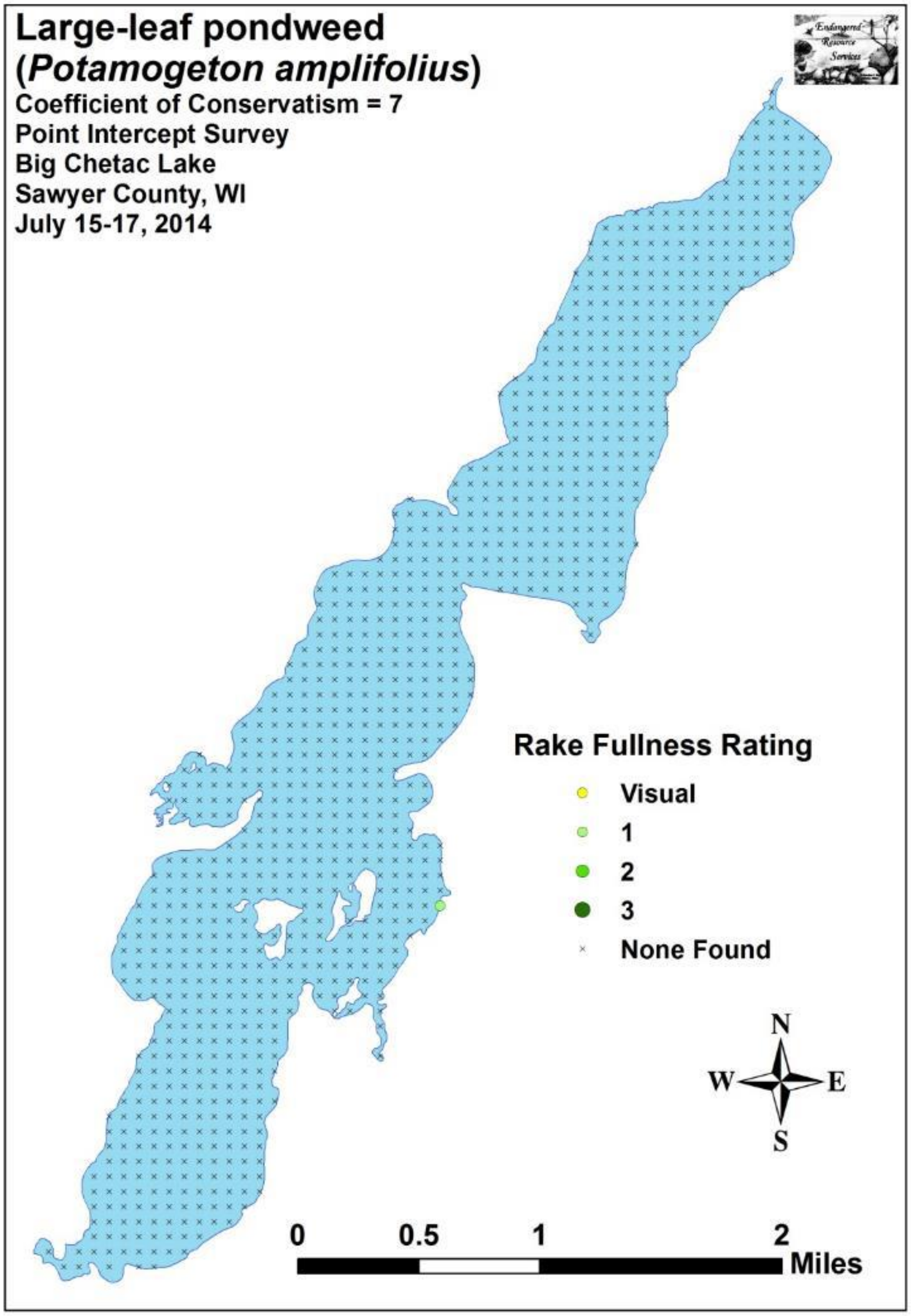

Slender naiad
(Najas flexilis)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


Nitella
(Nitella sp.)
Coefficient of Conservatism = 7
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

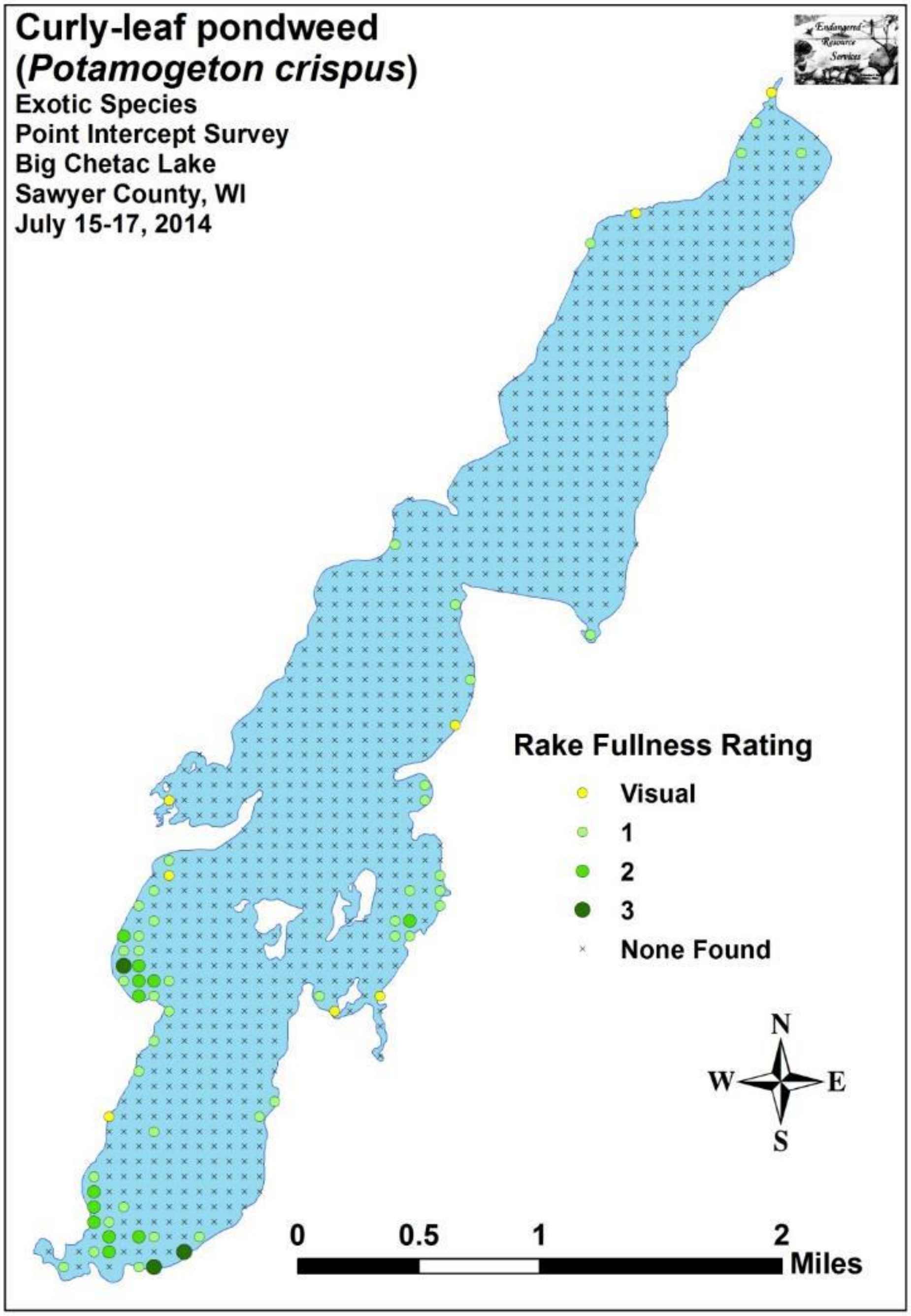

Spatterdock
(Nuphar variegata)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

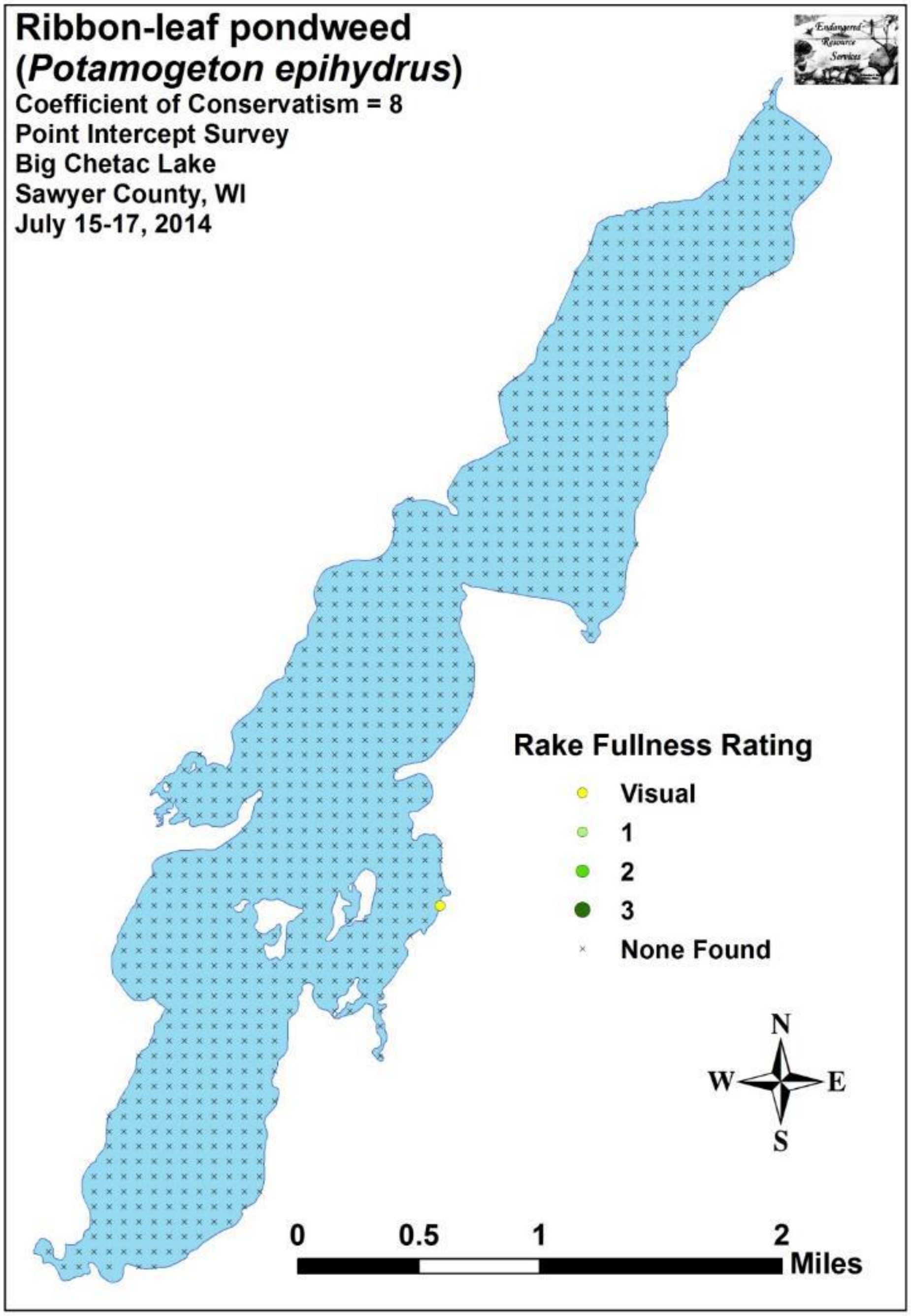


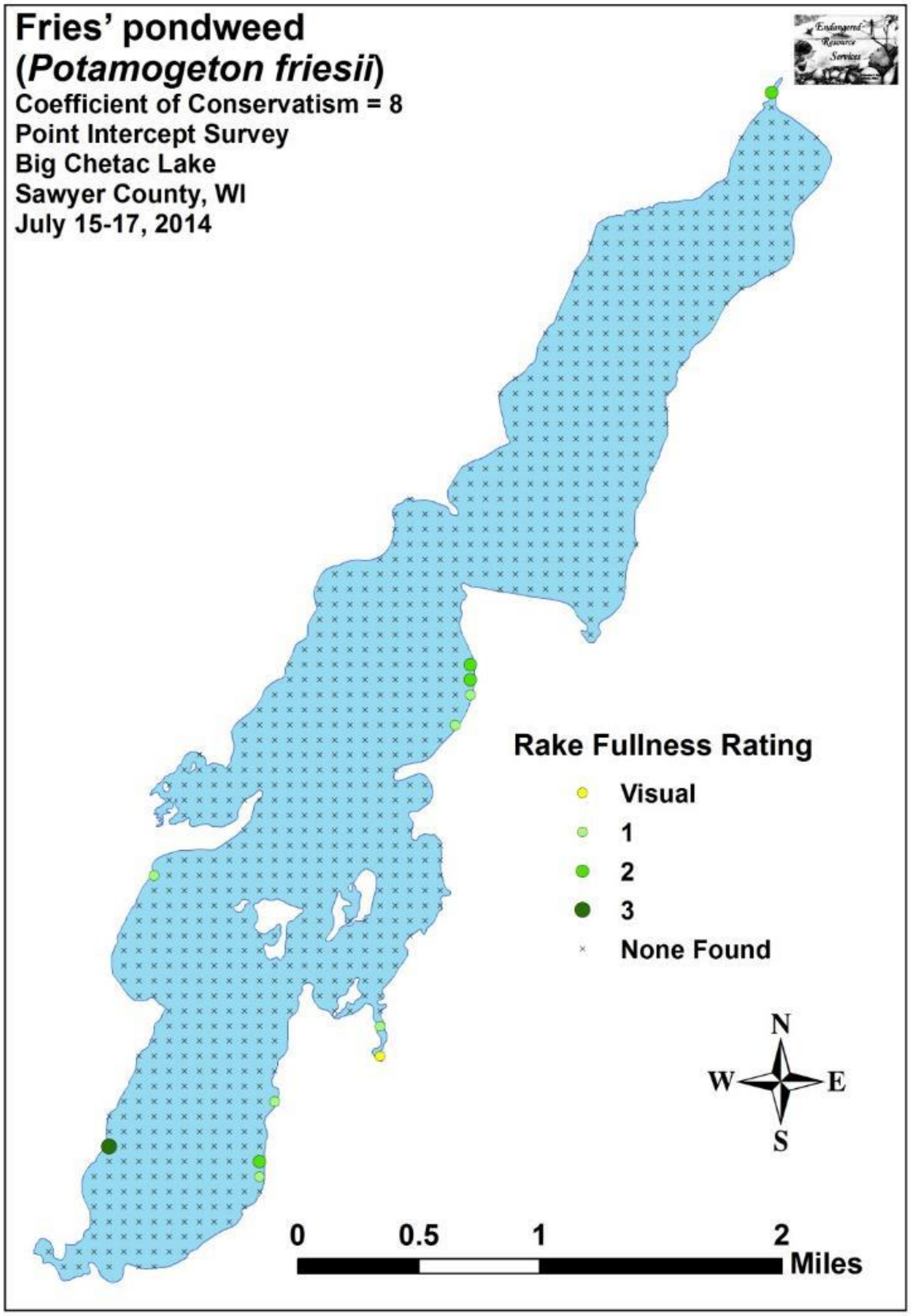
White water lily
(*Nymphaea odorata*)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

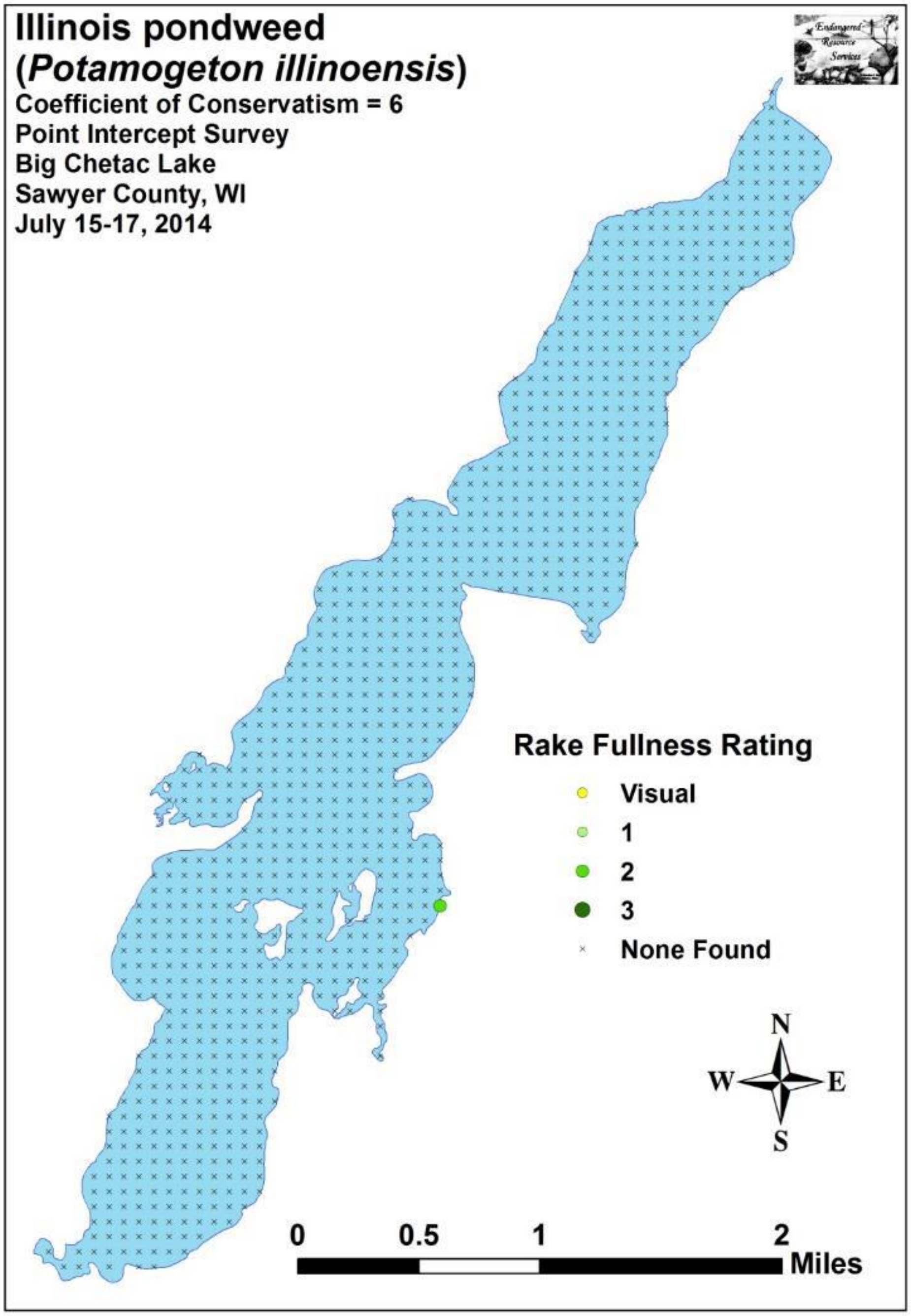


Large-leaf pondweed
(*Potamogeton amplifolius*)
Coefficient of Conservatism = 7
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

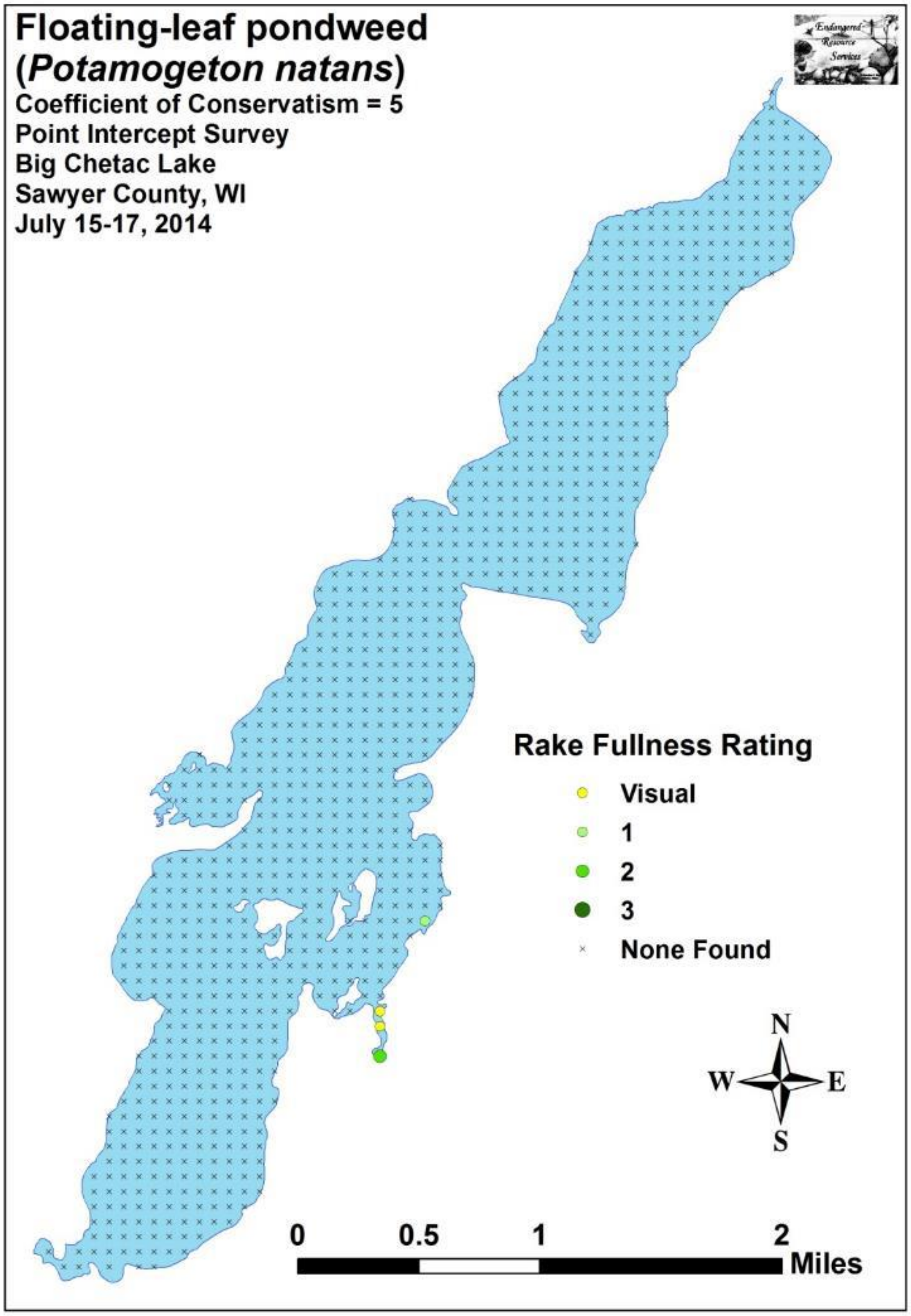

Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

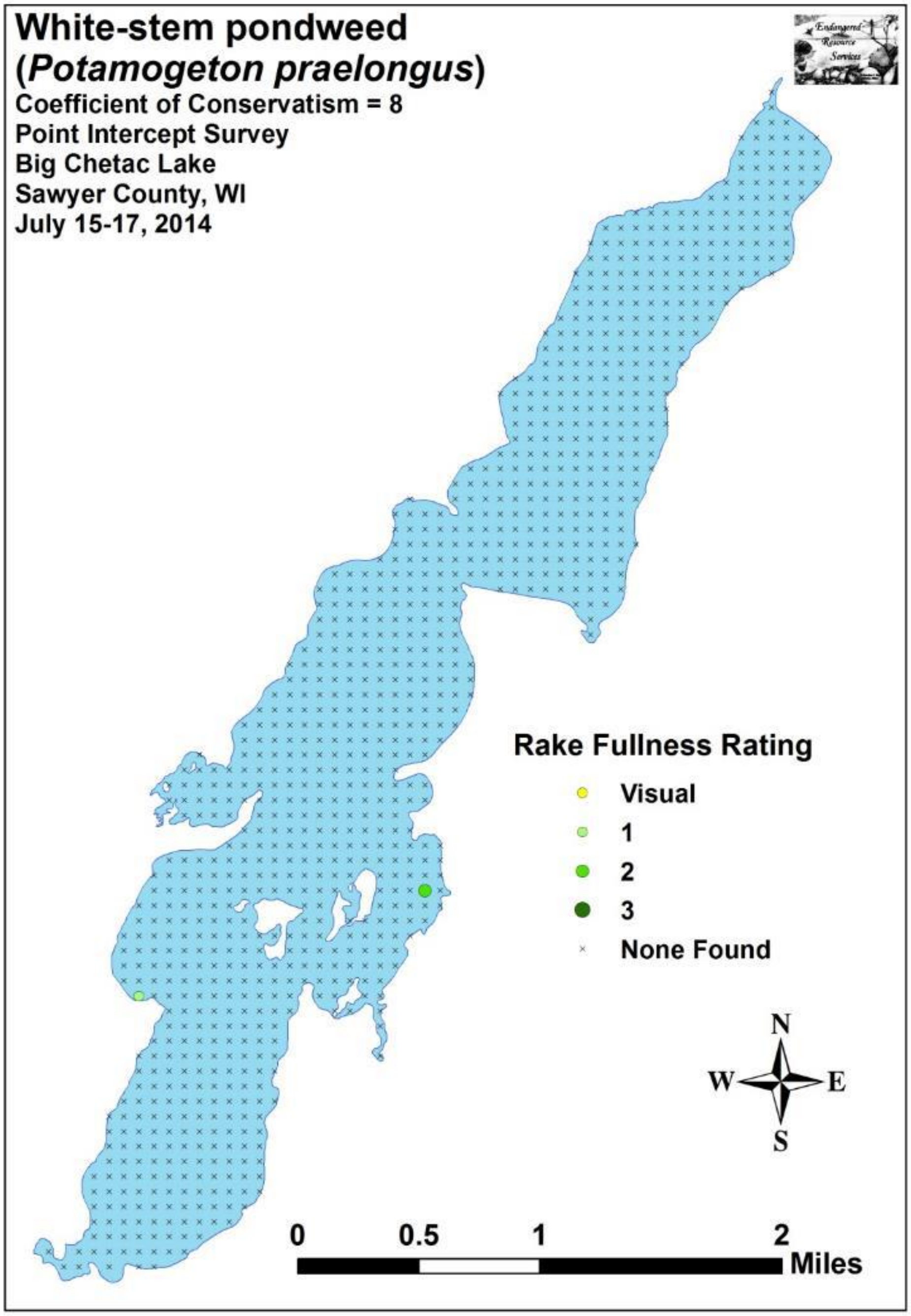

Ribbon-leaf pondweed
(*Potamogeton epihydrus*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

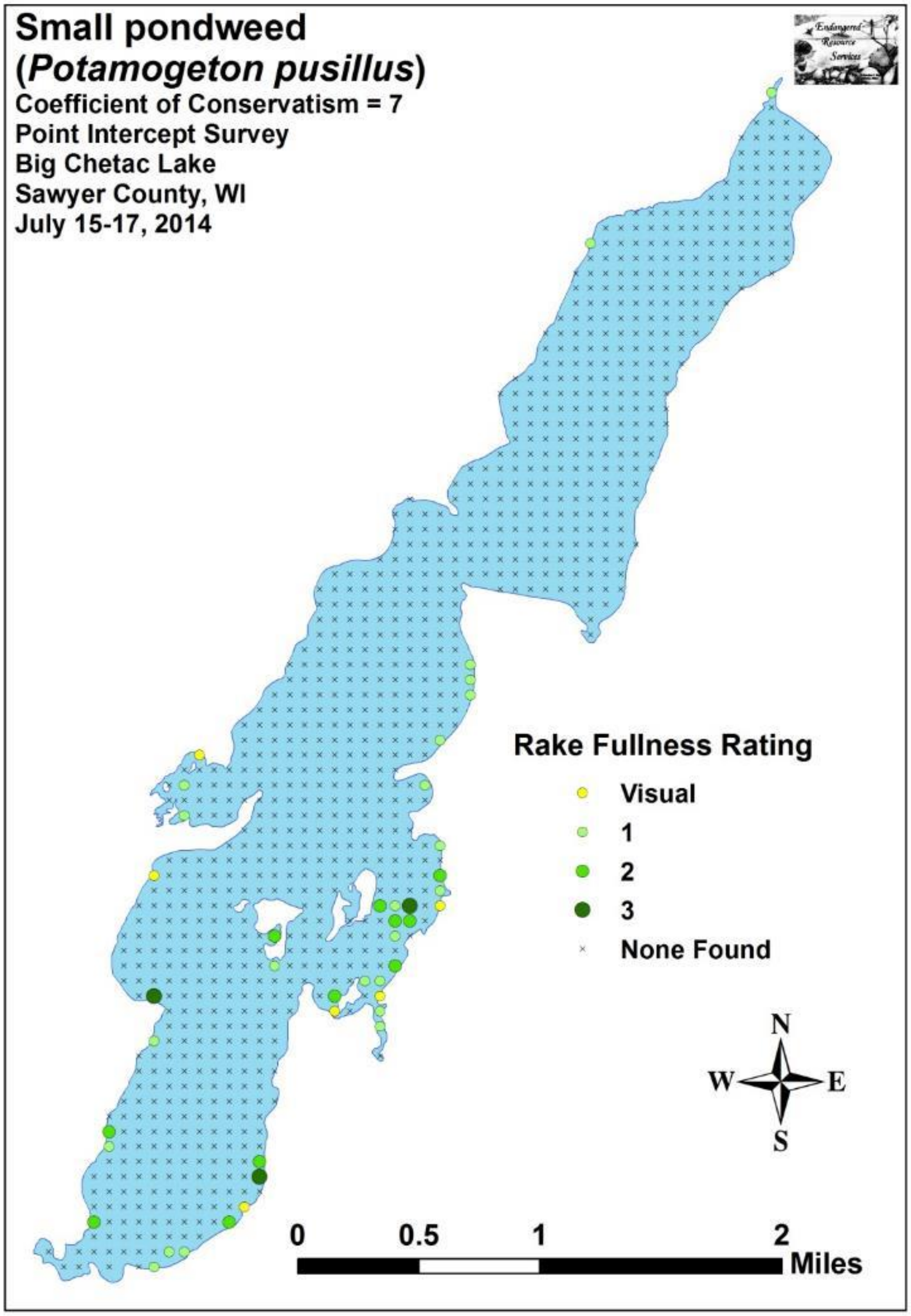

Fries' pondweed
(Potamogeton friesii)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

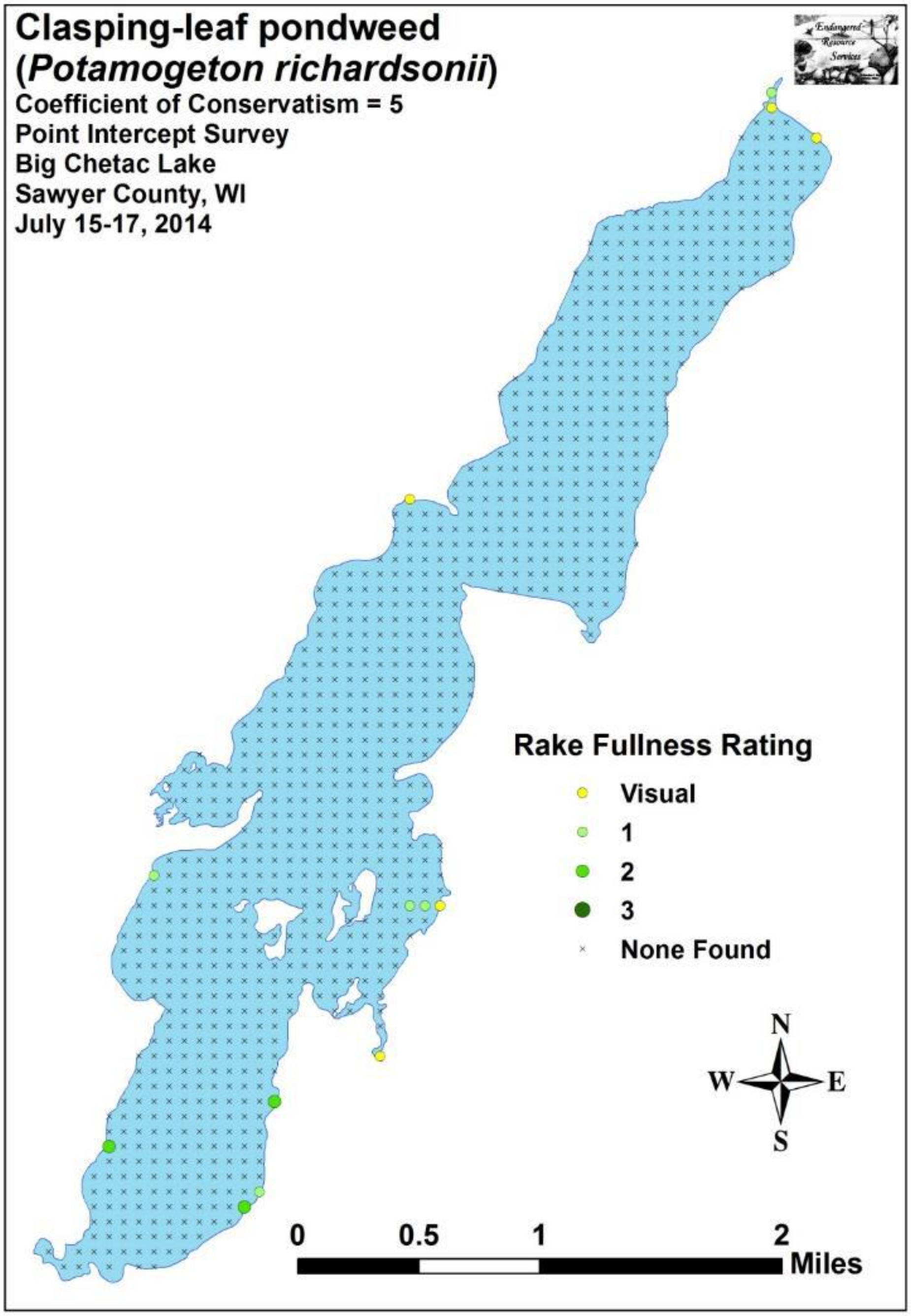


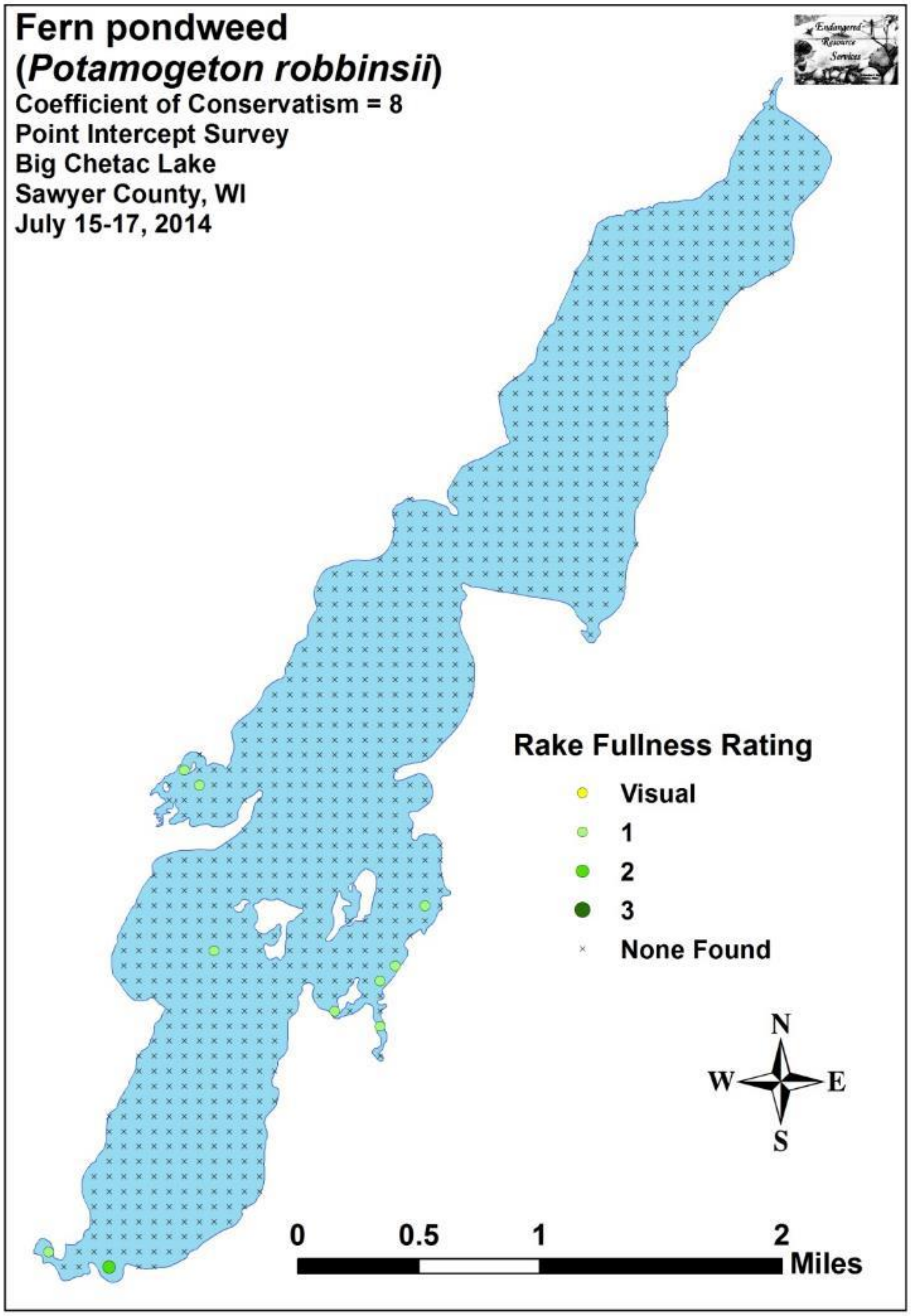
Illinois pondweed
(Potamogeton illinoensis)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

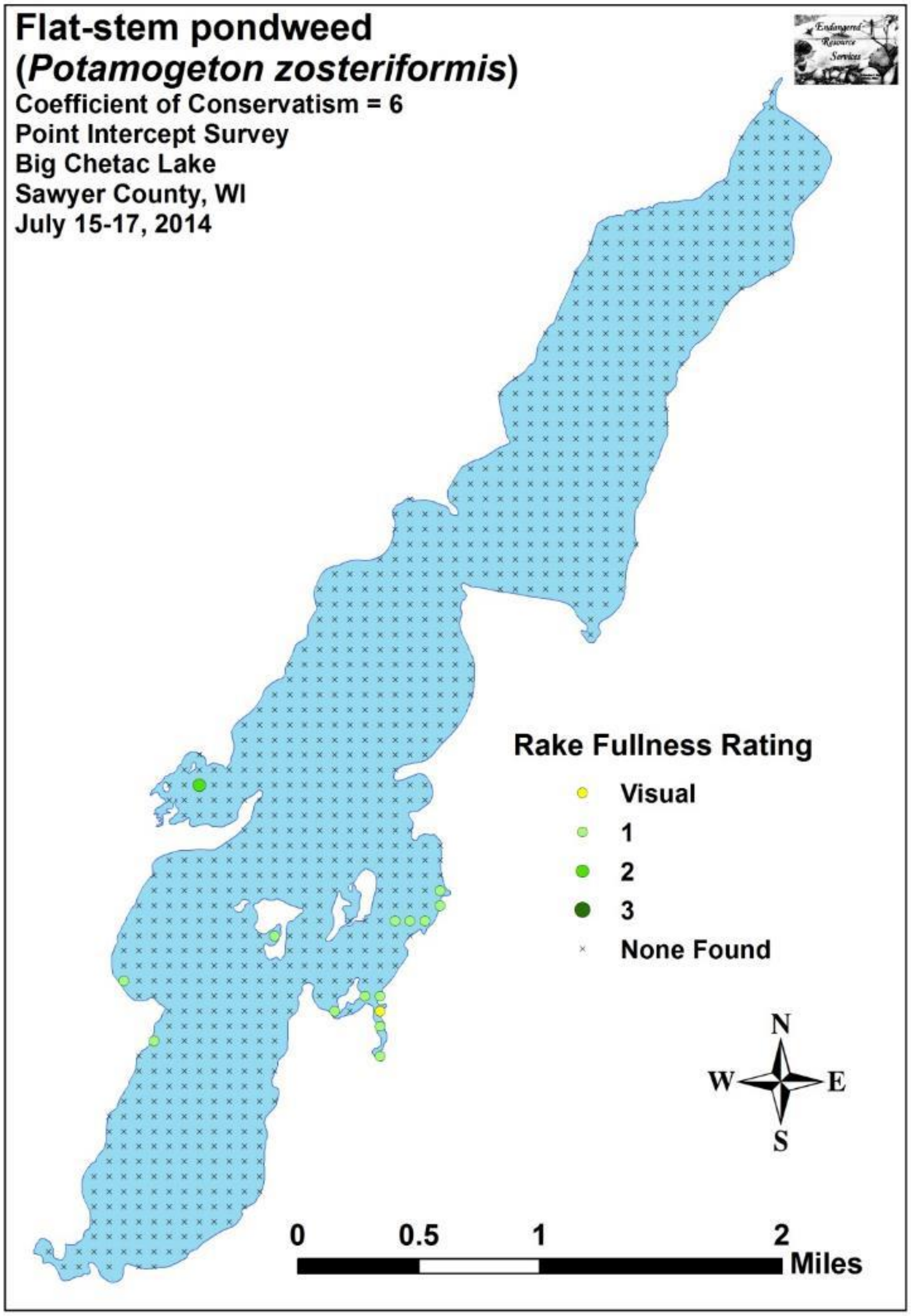

Floating-leaf pondweed
(Potamogeton natans)
Coefficient of Conservatism = 5
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

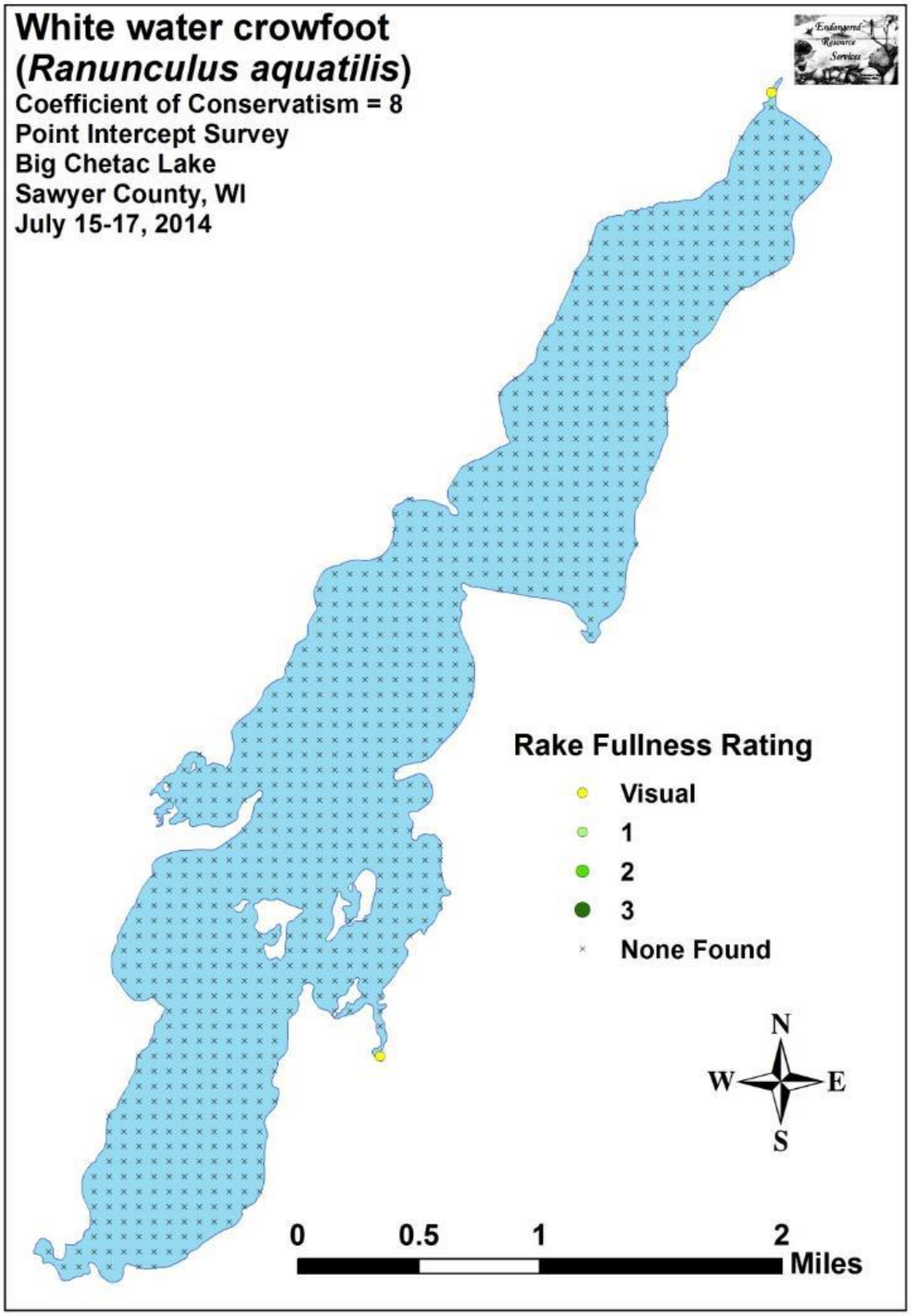

White-stem pondweed
(*Potamogeton praelongus*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

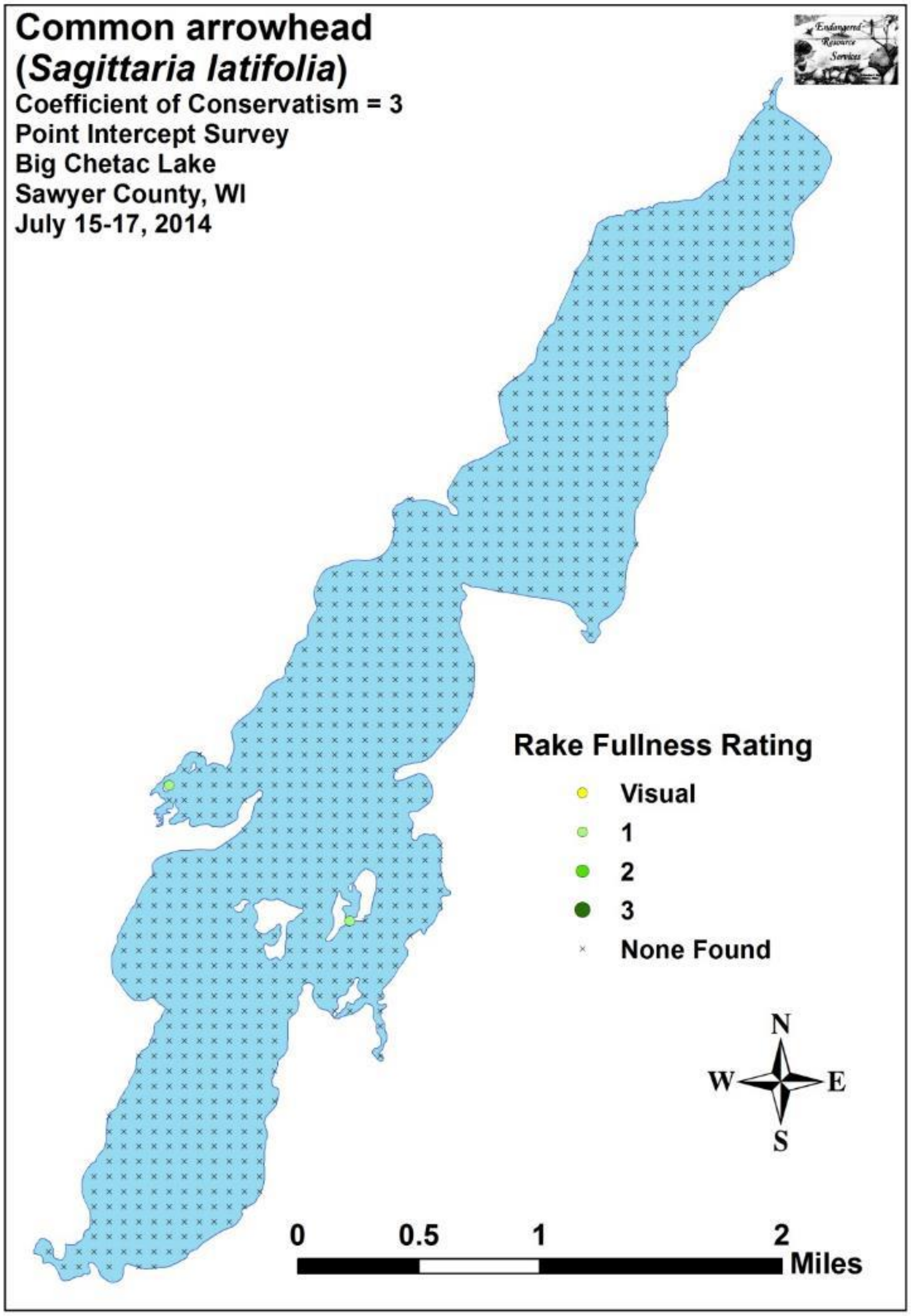

Small pondweed
(*Potamogeton pusillus*)
Coefficient of Conservatism = 7
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles

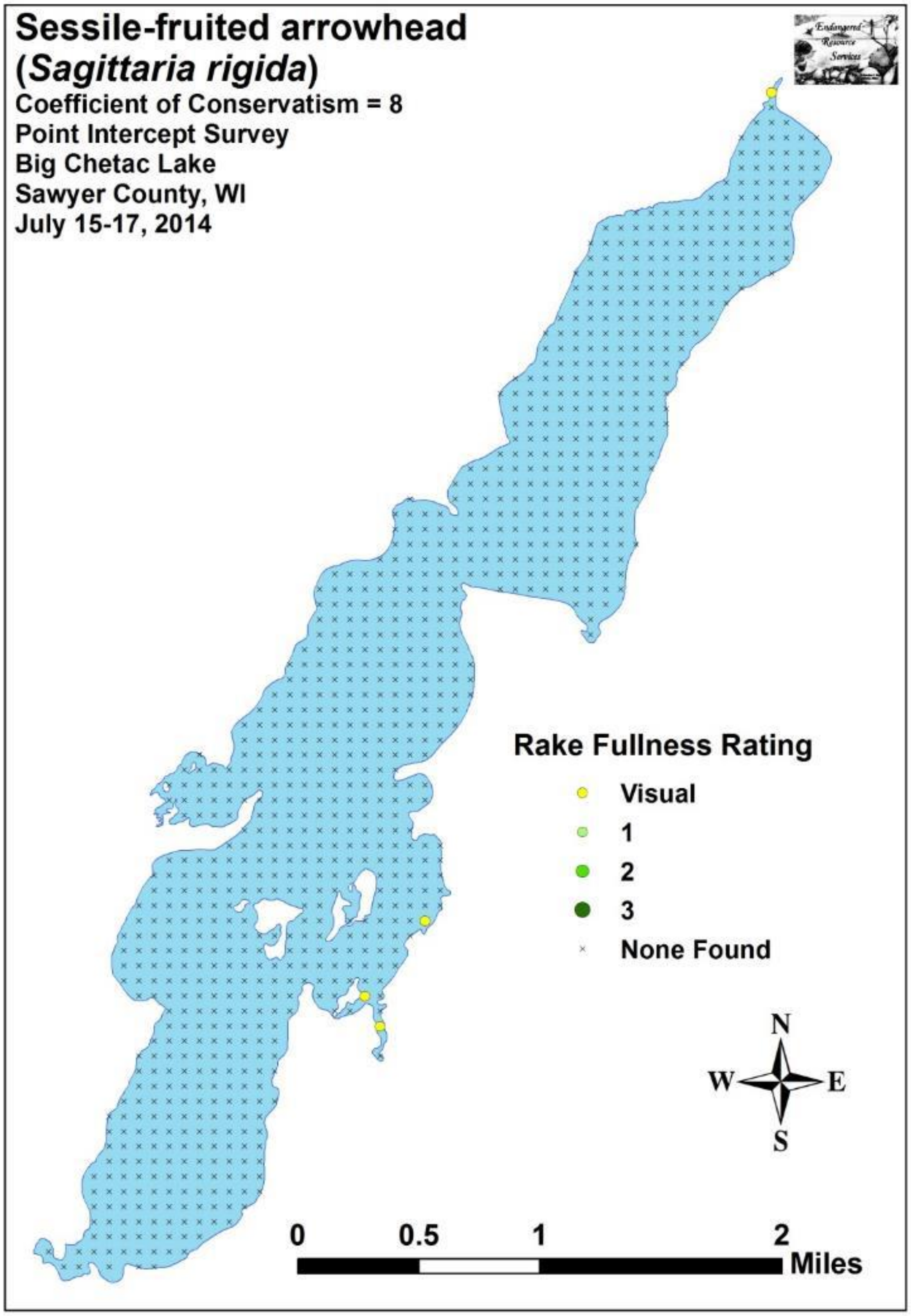

Clasping-leaf pondweed
(Potamogeton richardsonii)
Coefficient of Conservatism = 5
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


Fern pondweed
(*Potamogeton robbinsii*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


Flat-stem pondweed
(Potamogeton zosteriformis)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


White water crowfoot
(*Ranunculus aquatilis*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


Common arrowhead
(Sagittaria latifolia)
Coefficient of Conservatism = 3
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


Sessile-fruited arrowhead
(*Sagittaria rigida*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
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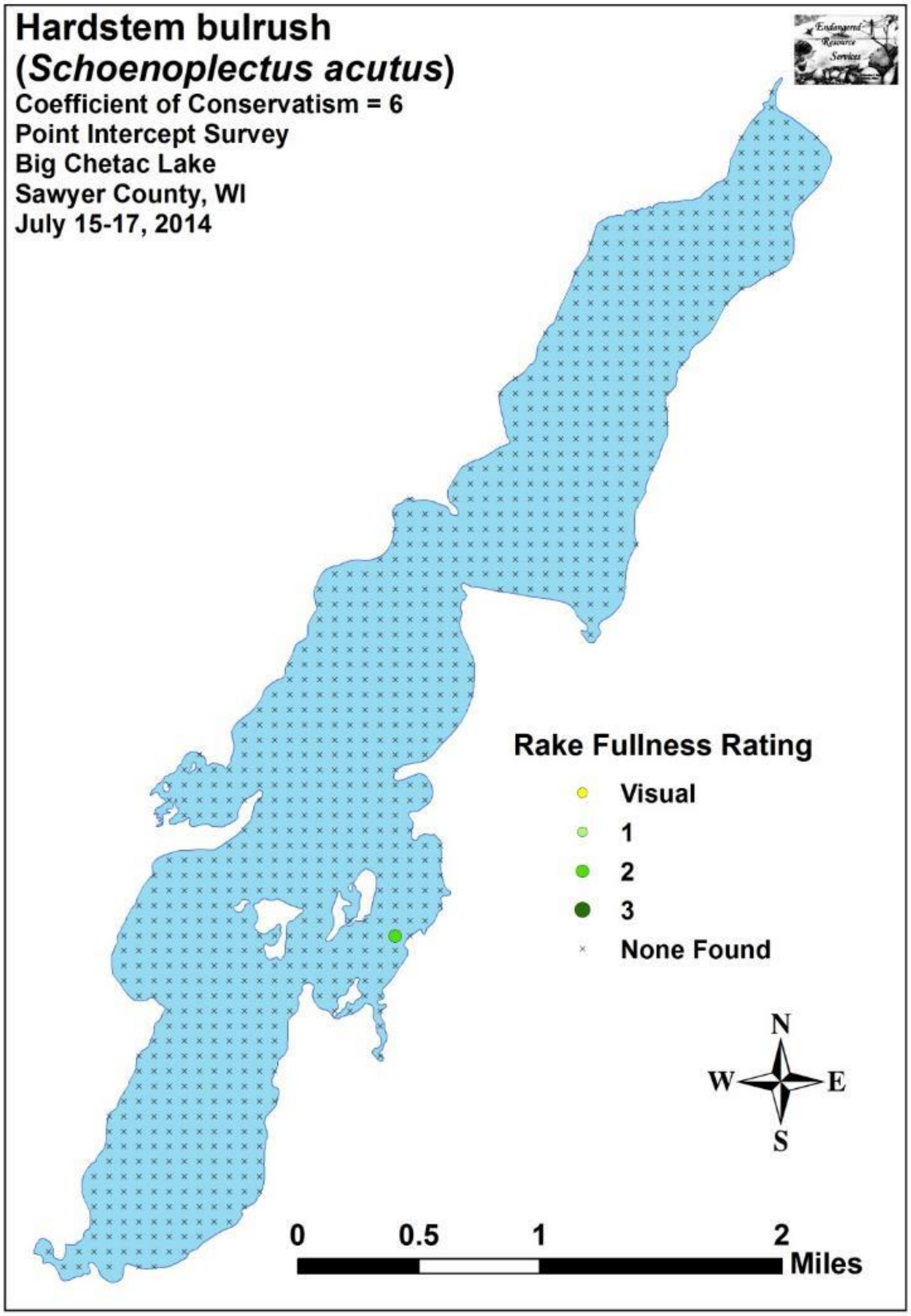
Miles


Hardstem bulrush
(*Schoenoplectus acutus*)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Endangered Resource Services
Rake Fullness Rating
Visual
1
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3
None Found
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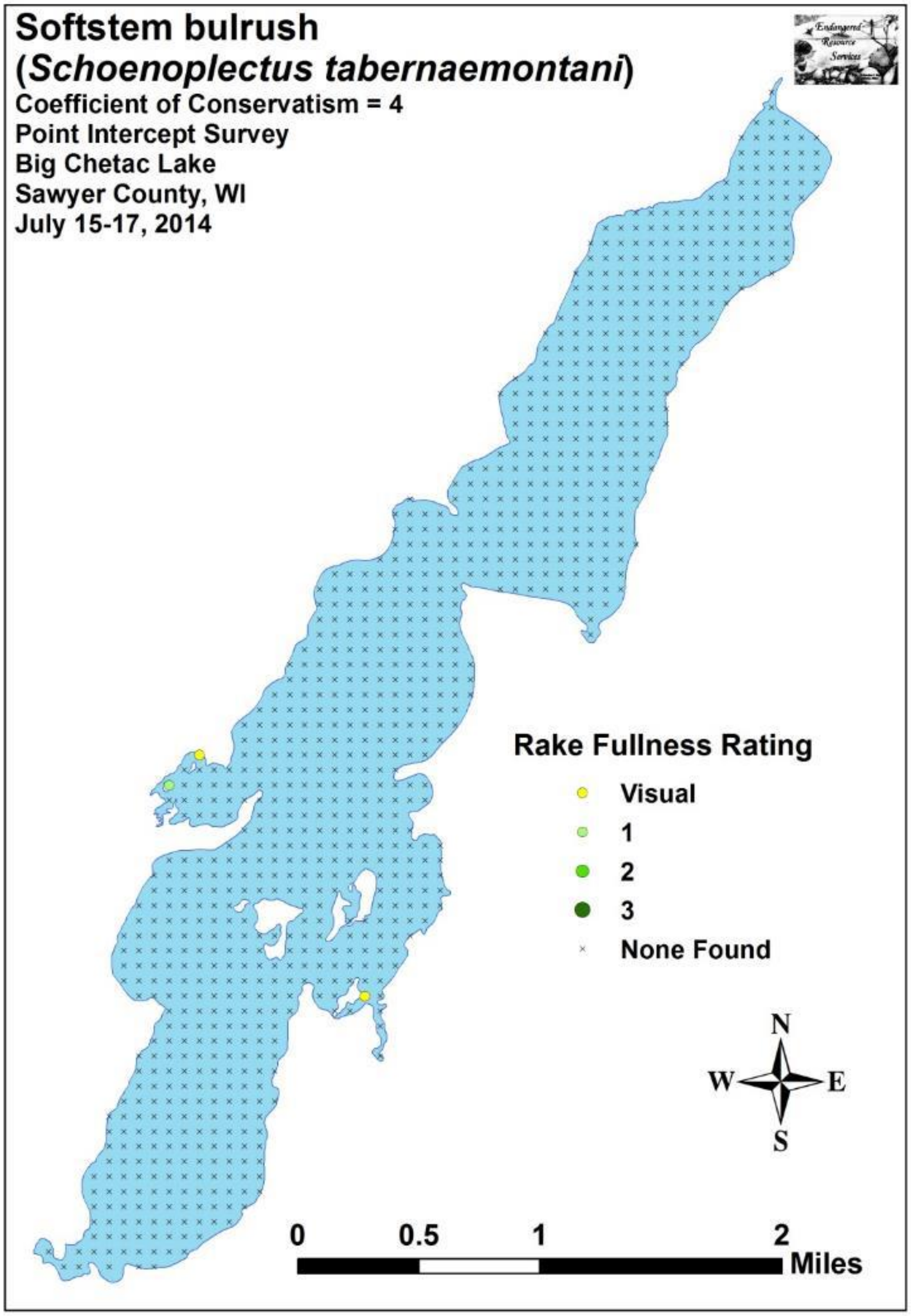
Miles


Softstem bulrush
(Schoenoplectus tabernaemontani)
Coefficient of Conservatism = 4
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
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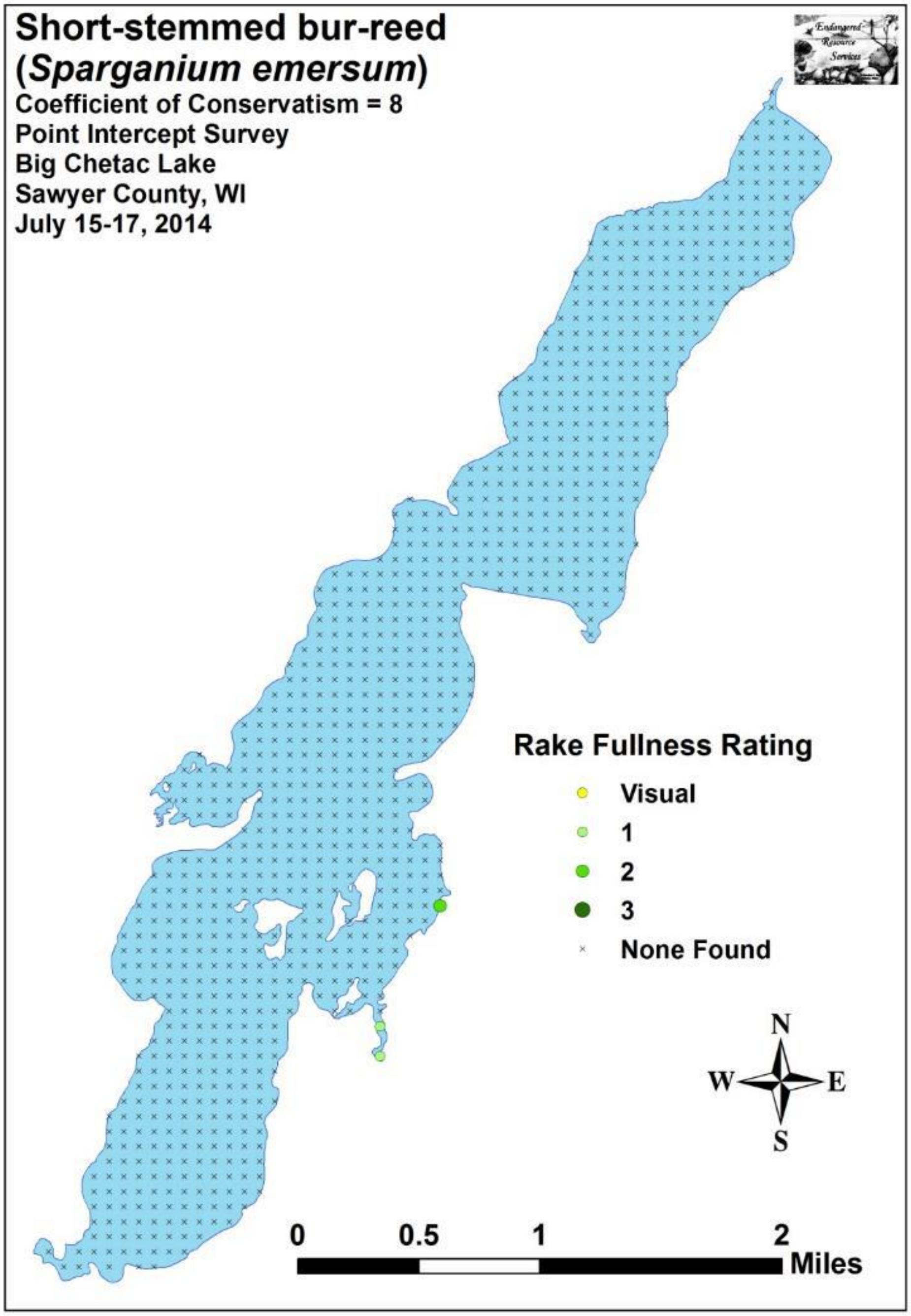
Miles


Short-stemmed bur-reed
(*Sparganium emersum*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
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None Found
N
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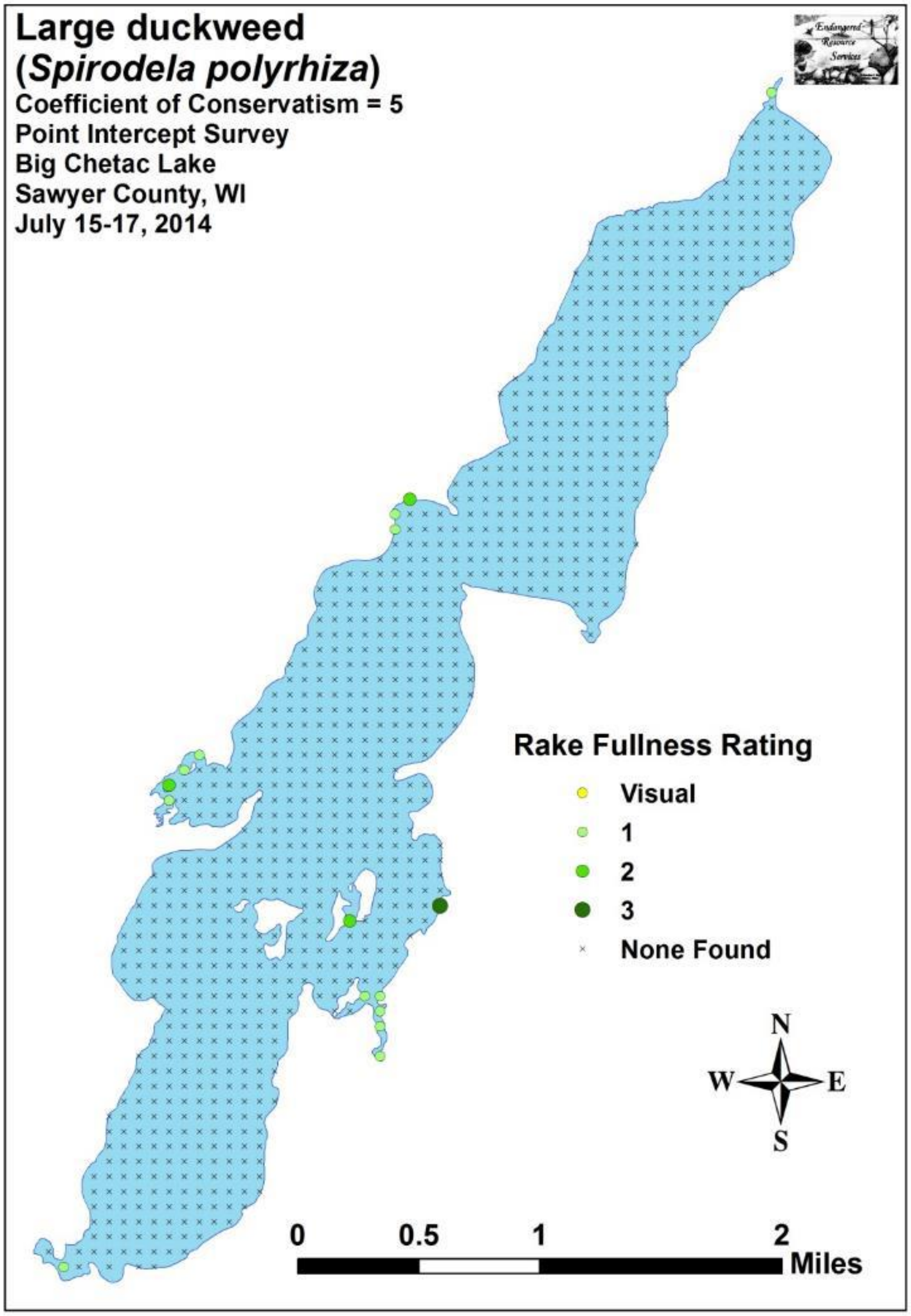
Miles



Large duckweed
(*Spirodela polyrhiza*)
Coefficient of Conservatism = 5
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
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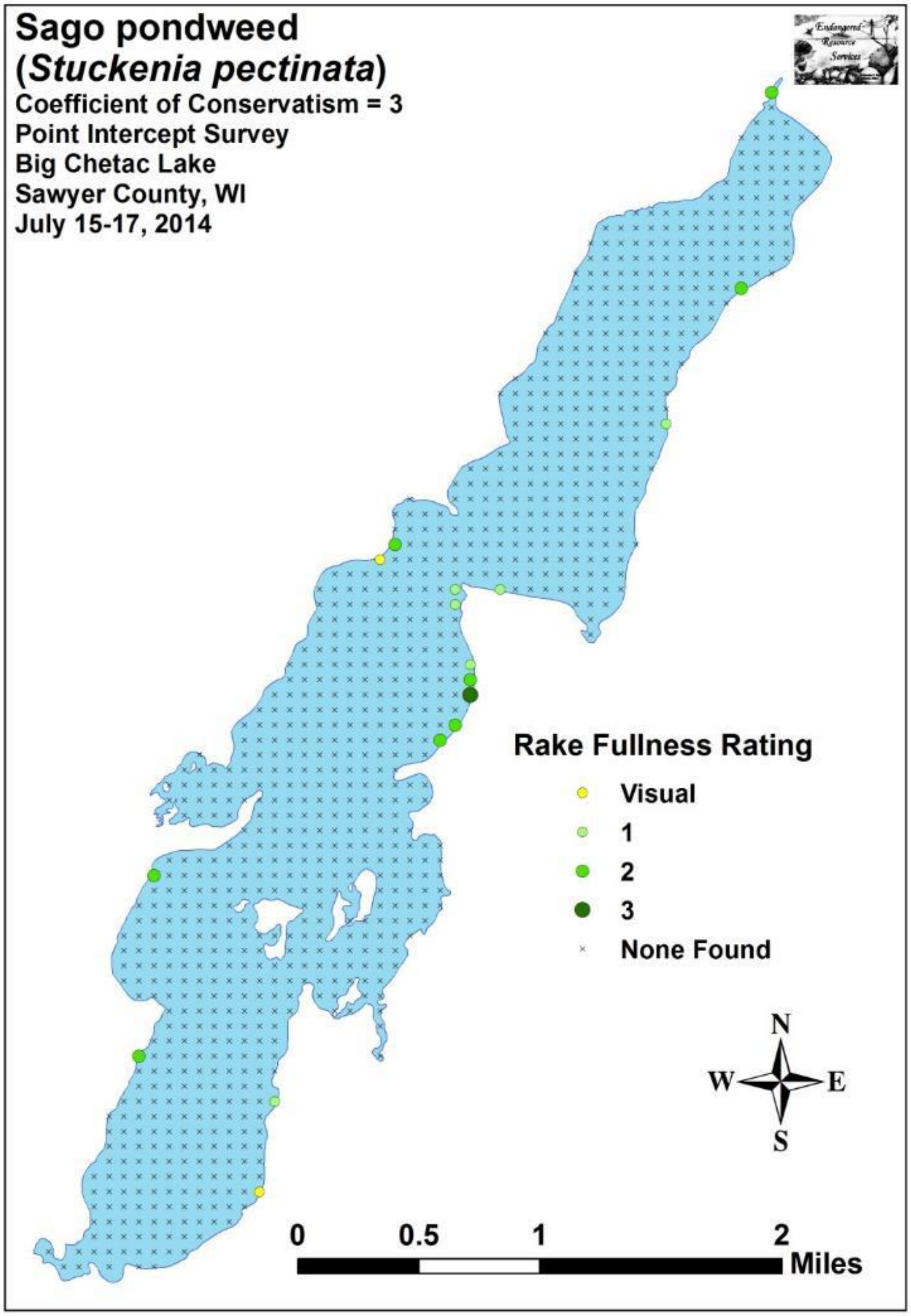
Miles


Sago pondweed
(Stuckenia pectinata)
Coefficient of Conservatism = 3
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
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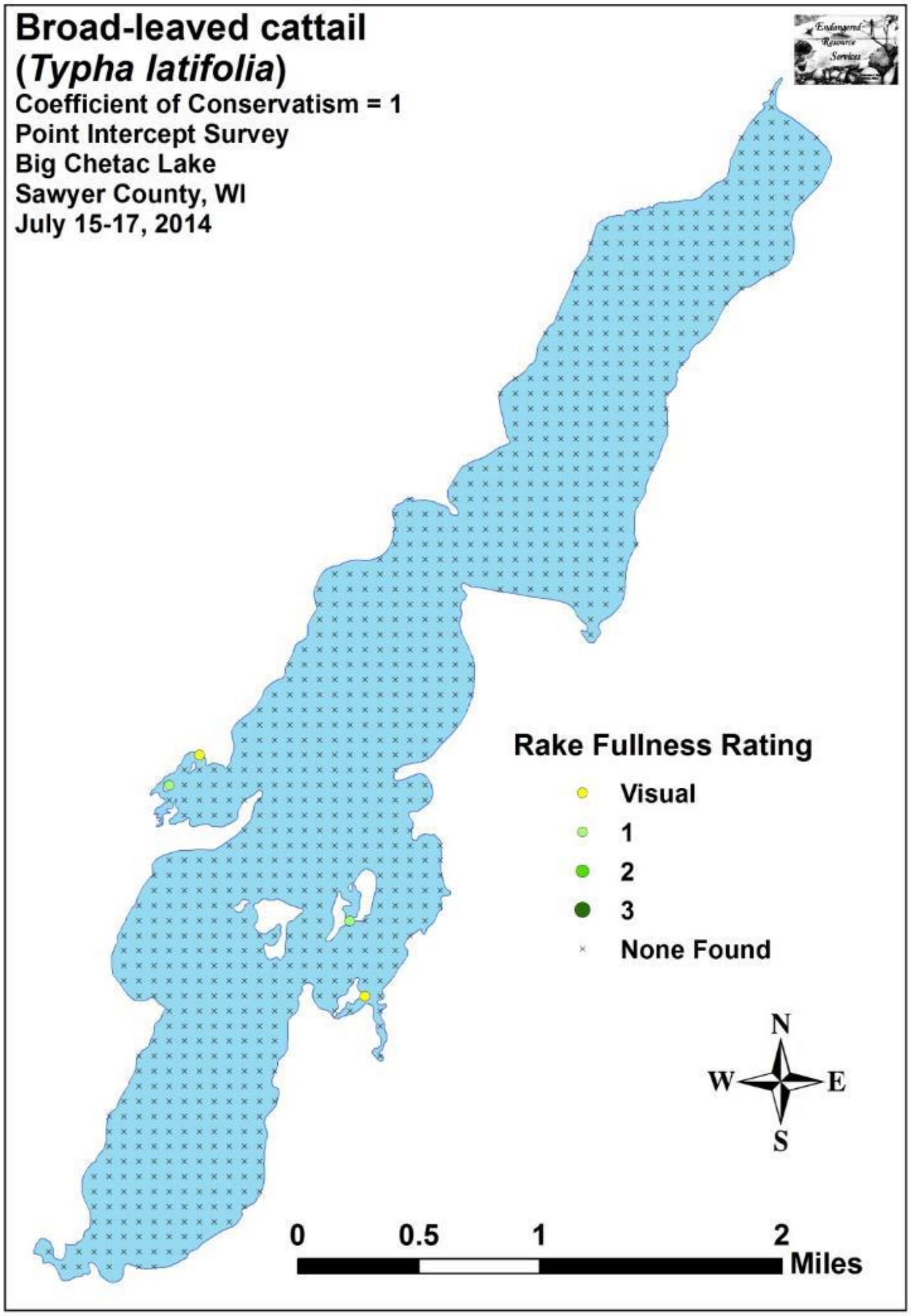
Miles


Broad-leaved cattail
(*Typha latifolia*)
Coefficient of Conservatism = 1
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
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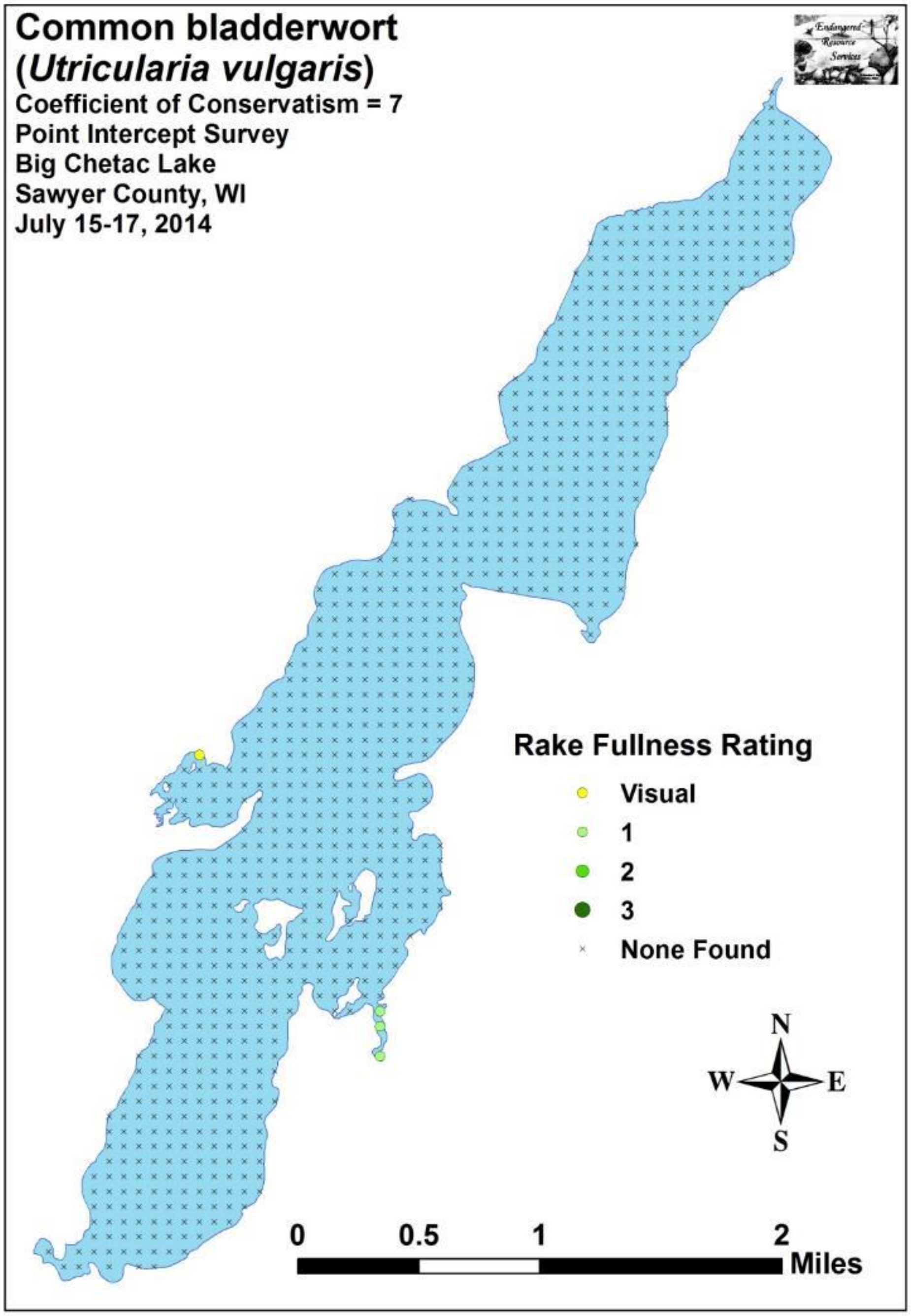
Miles


Common bladderwort
(*Utricularia vulgaris*)
Coefficient of Conservatism = 7
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Endangered Resource Services
Rake Fullness Rating
Visual
1
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3
None Found
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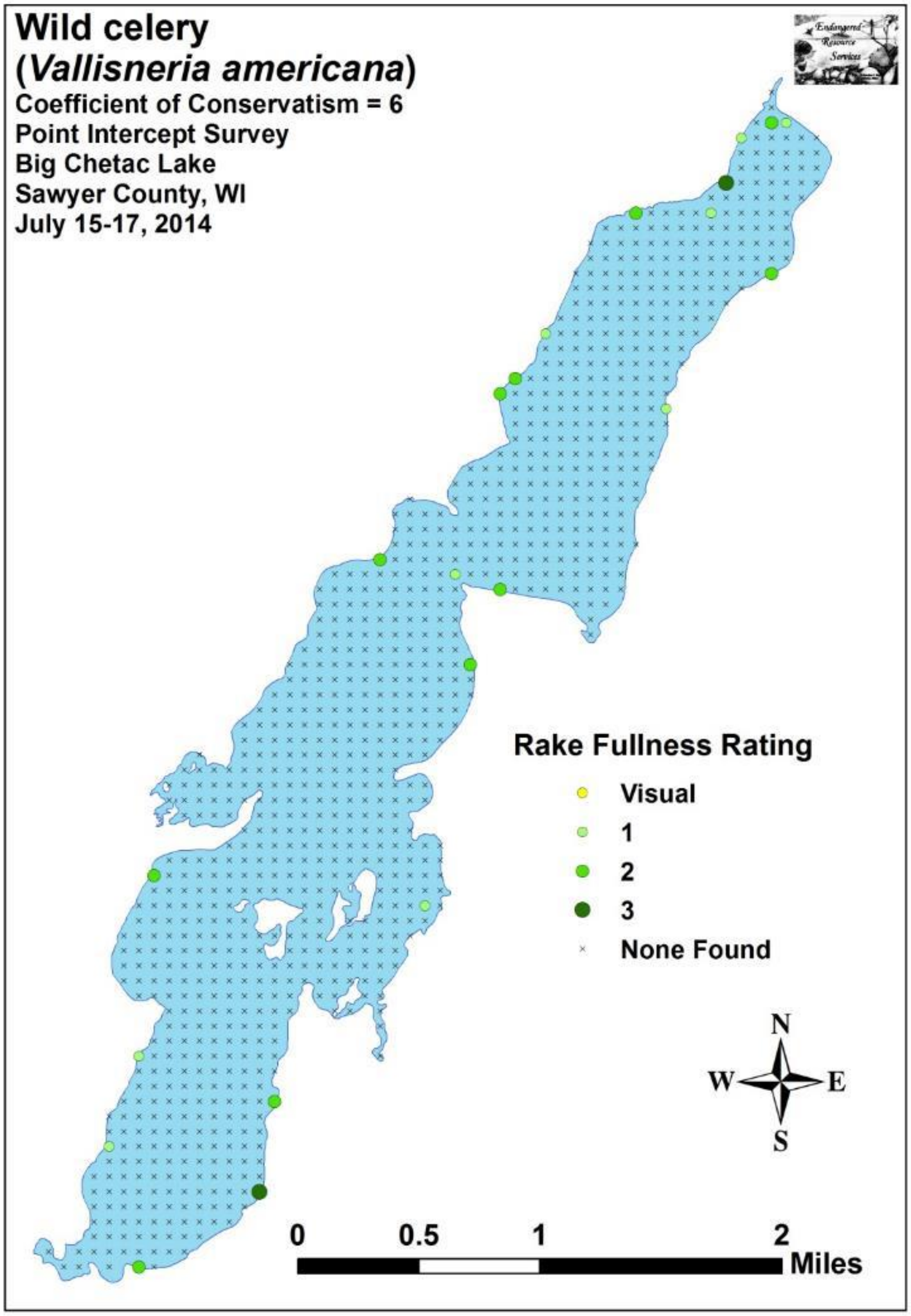
Miles


Wild celery
(Vallisneria americana)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
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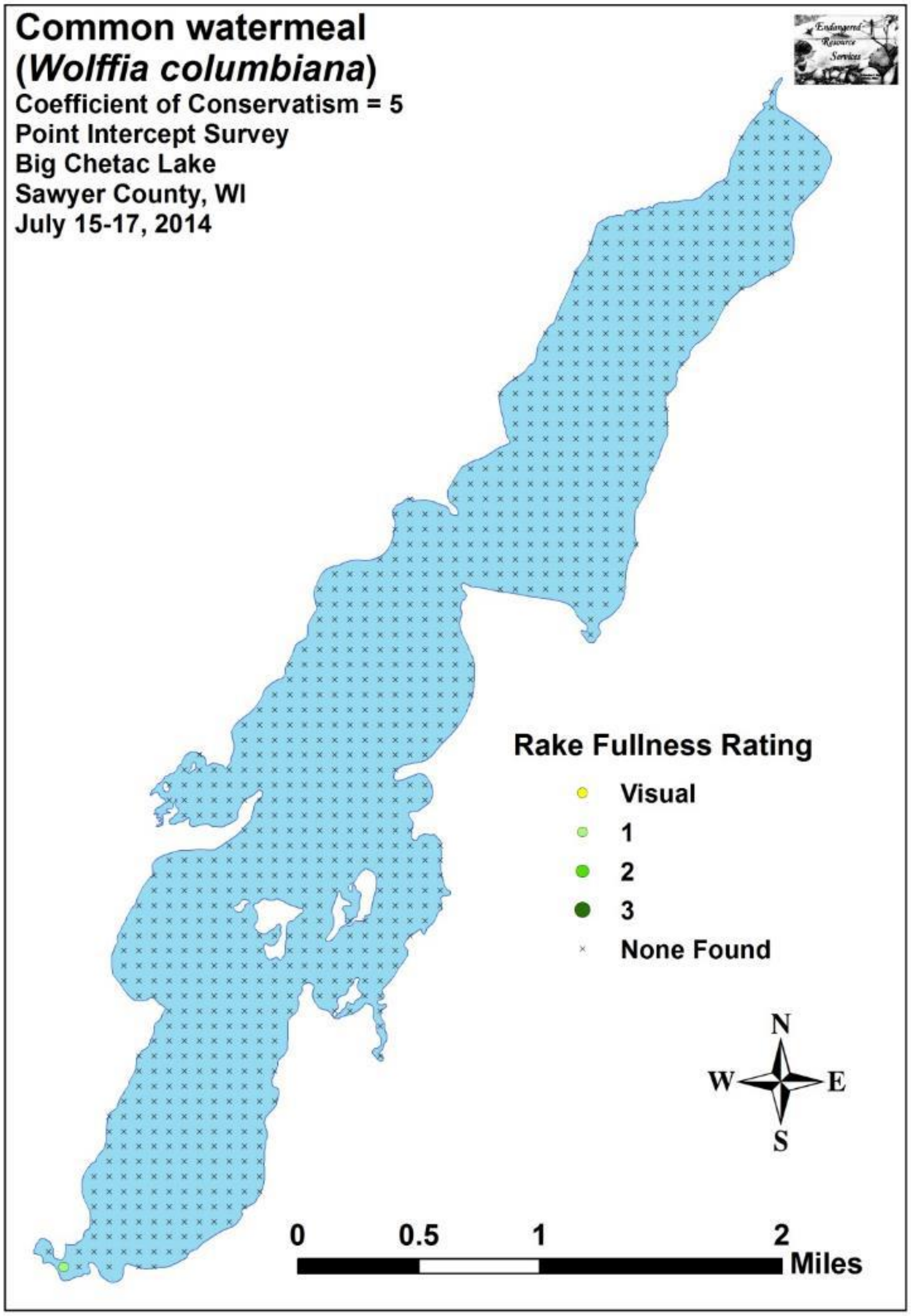
Miles


Common watermeal
(*Wolffia columbiana*)
Coefficient of Conservatism = 5
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
2
3
None Found
N
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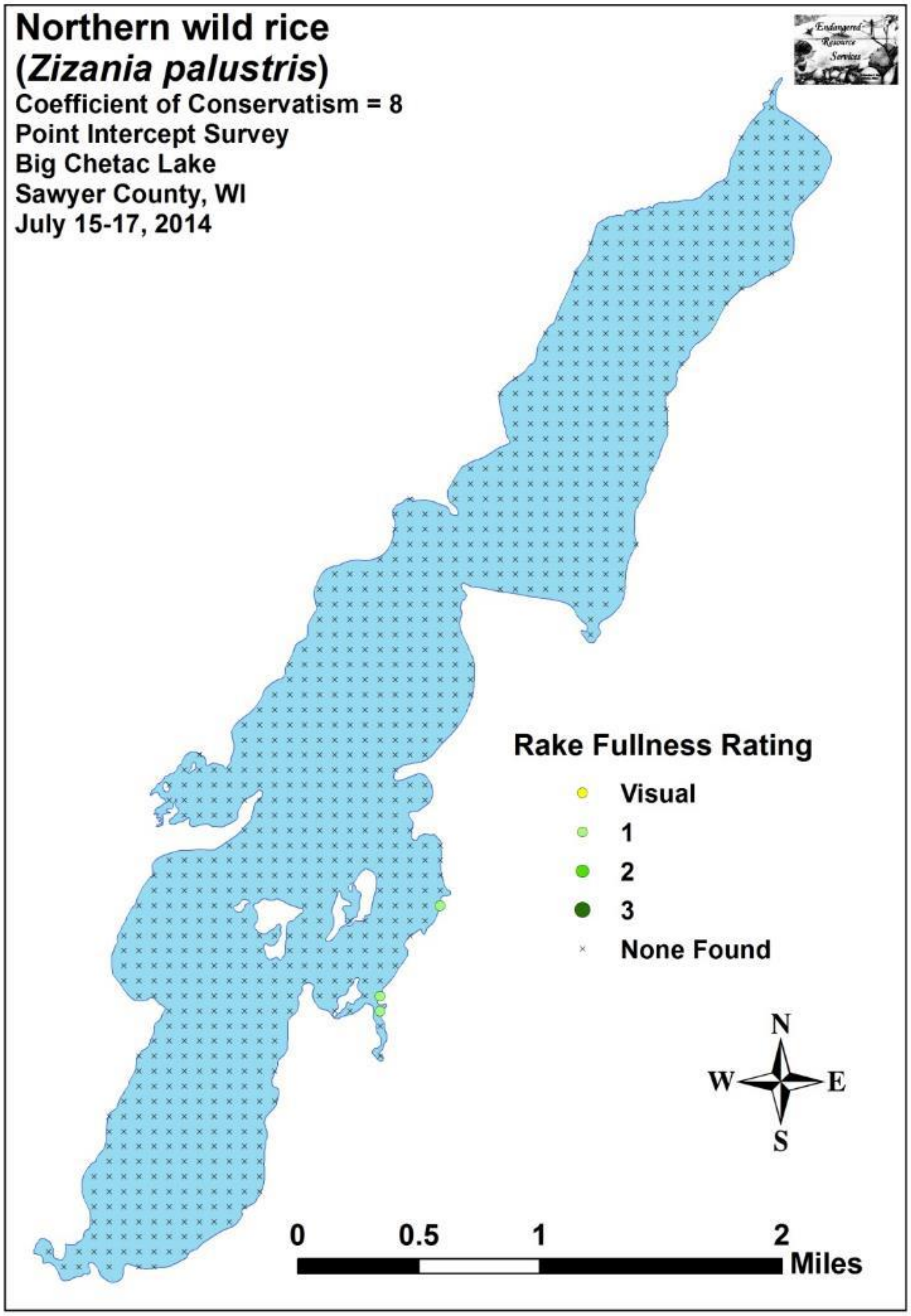
Miles


Northern wild rice
(Zizania palustris)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 15-17, 2014
Rake Fullness Rating
Visual
1
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None Found
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Miles

Appendix VI: Big Chetac Lake Plant Species Accounts

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: Aquatic moss
Specimen Location: Chetac Lake; N45.68089°, W91.51016°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-101
Habitat/Distribution: Mucky bottoms in 0-1.5 meters. Rare with a few scattered patches near shore in the bays east of the islands, and at a single survey point in the southeast end of the lake.
Common Associates: (*Potamogeton friesii*) Fries' pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Lemna trisulca*) Forked duckweed, (*Ceratophyllum demersum*) Coontail

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Bidens beckii*) **Water marigold**
Specimen Location: Chetac Lake; N45.70783°, W91.51474°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-115
Habitat/Distribution: A single cluster of plants was found in the west bay in 0.5 m over muck.
Common Associates: (*Nymphaea odorata*) White water lily**,** (*Potamogeton robbinsii*) Fern pondweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton pusillus*) Small pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Calla palustris*) **Water calla**
Specimen Location: Chetac Lake; N45.69811°, W91.50163°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-102
Habitat/Distribution: Muck bottom at the shoreline in 0 – 0.25 meters of water. Rare; only a few scattered individuals were located along shore near the Benson Creek inlet and in the sheltered bays of the islands.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Spirodela polyrhiza*) Large duckweed, (*Carex comosa*) Bottle-brush sedge, (*Comarum palustris*) Marsh cinquefoil

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Callitriche hermaphroditica*) **Autumnal water starwort**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-103
Habitat/Distribution: Muck bottom in shallow water <1m. Rare; found only at the Benson Creek inlet on the north end of the lake. In places, it completely covered the bottom.
Common Associates: (*Callitriche palustris*) Common water starwort, (*Ranunculus aquatilis*) White water crowfoot, (*Chara* sp.) Muskgrass, (*Stuckenia pectinata*) Sago pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Callitriche palustris*) **Common water starwort**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-104
Habitat/Distribution: Muck bottom in shallow water <1m. Rare; found only at the Benson Creek inlet growing among the much more numerous Autumnal water starwort.
Common Associates: (*Callitriche hermaphroditica*) Autumnal water starwort, (*Ranunculus aquatilis*) White water crowfoot, (*Chara* sp.) Muskgrass, (*Stuckenia pectinata*) Sago pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Carex comosa*) **Bottle-brush sedge**
Specimen Location: Chetac Lake; N45.69811°, W91.50163°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-105
Habitat/Distribution: Muck bottom at the shoreline in 0 – 0.25 meters of water. Rare; only a few scattered individuals were located in the sheltered bays of the islands.
Common Associates: (*Calla palustris*) Water calla, (*Typha latifolia*) Broad-leaved cattail, (*Spirodela polyrhiza*) Large duckweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Ceratophyllum demersum*) **Coontail**
Specimen Location: Chetac Lake; N45.74628°, W91.46564°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-106
Habitat/Distribution: Muck bottom in 0-4 meters. Abundant throughout; especially common in the muck bays in the lower third of the lake. Along with Small and Curly-leaf pondweed, it was the deepest growing macrophyte.
Common Associates: (*Potamogeton crispus*) Curly-leaf pondweed, (*Potamogeton pusillus*) Small pondweed, (*Potamogeton robbinsii*) Fern pondweed, (*Lemna trisulca*) Forked duckweed, (*Potamogeton zosteriformis*) Flat-stem pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Chara* sp.) **Muskgrass**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-107
Habitat/Distribution: Uncommon in sand/silt bottom areas in water from 0 – 1 meter deep. Species at Benson Creek inlet was different from elsewhere in the lake.
Common Associates: (*Callitriche palustris*) Common water starwort, (*Ranunculus aquatilis*) White water crowfoot, (*Callitriche hermaphroditica*) Autumnal water starwort, (*Stuckenia pectinata*) Sago pondweed, (*Najas flexilis*) Slender naiad

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Comarum palustre*) **Marsh cinquefoil**
Specimen Location: Chetac Lake; N45.748244°, W91.46701°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-135
Habitat/Distribution: Muck bottom at the shoreline in 0 – 0.25 meters of water. Rare with only a few scattered individuals located along the Benson Creek inlet.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water calla

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Dulichium arundinaceum*) **Three-way sedge**
Specimen Location: Chetac Lake; N45.69338°, W91.50003°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-108
Habitat/Distribution: Located at the edge of the water in mucky soil. Uncommon in scattered locations in the muck bays east of the islands.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water calla, (*Eleocharis erythropoda*) Bald spikerush, (*Schoenoplectus tabernaemontani*) Softstem bulrush

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Eleocharis erythropoda*) **Bald spikerush**
Specimen Location: Chetac Lake; N45.69363°, W91.50023°
Collected/Identified by: **Matthew S. Berg Col. #:** MSB-2008-109
Habitat/Distribution: Located at the edge of the water in mucky soil. Uncommon in scattered locations in the muck bays east of the islands.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water calla, (*Dulichium arundinaceum*) Three-way sedge, (*Schoenoplectus tabernaemontani*) Softstem bulrush

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Eleocharis palustris*) **Creeping spikerush**
Specimen Location: Chetac Lake; N45.69726°, W91.49776°
Collected/Identified by: **Matthew S. Berg Col. #:** MSB-2008-110
Habitat/Distribution: Mucky to firm bottoms in 0-0.5 meters of water. Found in the bay east of the islands where it formed dense reed beds with Hardstem bulrush.
Common Associates: (*Schoenoplectus acutus*) Hardstem bulrush, (*Potamogeton crispus*) Curly-leaf pondweed, (*Lemna trisulca*) Forked duckweed

County/State: Sawyer County, Wisconsin **Date:** 7/28/17
Species: (*Eleocharis robbinsii*) **Robbins' spikerush**
Specimen Location: Chetac Lake; N45.69004°, W91.49885°
Collected/Identified by: **Matthew S. Berg Col. #:** MSB-2017-019
Habitat/Distribution: Mucky to firm bottoms in 0-0.25 meters of water. Only plants seen were in the Malviney Creek inlet at the point. Population numbered in the 100's with many specimens in fruit confirming identification.
Common Associates: (*Myriophyllum verticillatum*) Whorled water-milfoil, (*Sparganium emersum*) Short-stemmed bur-reed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Elodea canadensis*) **Common waterweed**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: **Matthew S. Berg Col. #:** MSB-2008-111
Habitat/Distribution: Muck bottom in 0-1.5 meters of water.
Uncommon in stagnant areas of bays in the south end of the lake and near the Benson Creek inlet.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Potamogeton pusillus*) Small pondweed, (*Spirodela polyrhiza*) Large duckweed, (*Lemna minor*) Small duckweed, (*Myriophyllum sibiricum*) Northern water-milfoil, (*Nuphar variegata)* Spatterdock

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Heteranthera dubia*) **Water star-grass**
Specimen Location: Chetac Lake; N45.71810°, W91.48675°
Collected/Identified by: **Matthew S. Berg Col. #:** MSB-2008-112
Habitat/Distribution: Firm muck bottoms usually in water 0.5-2.5 meters deep. Rare with only scattered individuals throughout and never abundant.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Lemna trisulca*) Forked duckweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Lemna minor*) **Small duckweed**
Specimen Location: Chetac Lake; N45.72249°, W91.49586°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-113
Habitat/Distribution: Located floating at or just under the surface in sheltered areas. Scattered individuals found interspersed between the lilypads. Wind and current scattered them throughout the lake.
Common Associates: (*Nymphaea odorata*) White water lily, (*Nuphar variegata)* Spatterdock, (*Spirodela polyrhiza*) Large duckweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton pusillus*) Small pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Lemna trisulca*) **Forked duckweed**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-114
Habitat/Distribution: Located entangled in other plants and along the bottom. Common throughout in almost any bottom type in water up to 2.5 meters deep.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Ceratophyllum demersum*) Coontail

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Myriophyllum sibiricum*) **Northern water-milfoil**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-116
Habitat/Distribution: Muck to sand bottom in water up to 2 meters. Widespread and relatively common throughout the lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Ceratophyllum demersum*) Coontail, (*Ranunculus aquatilis*) White water crowfoot, (*Potamogeton crispus*) Curly-leaf pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Myriophyllum verticillatum*) **Whorled water-milfoil**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-117
Habitat/Distribution: Muck bottom in < 1.5 meters of water. Only plants found were in the unnamed creek inlet east of the islands.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Pontederia cordata*) Pickerelweed, (*Potamogeton vaseyi*) Vasey's pondweed, (*Myriophyllum sibiricum*) Northern water-milfoil, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sparganium emersum*) Short-stemmed bur-reed, (*Potamogeton natans*) Floating-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Najas flexilis*) **Slender naiad**
Specimen Location: Chetac Lake; N45.72905°, W91.47547°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-118
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-1.5 meters of water. Relatively common, and widely distributed throughout.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton friesii*) Fries' pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Vallisneria americana*) Wild celery, (*Stuckenia pectinata*) Sago pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Nitella* sp.) **Nitella**
Specimen Location: Chetac Lake; N45.72249°, W91.49586°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-119
Habitat/Distribution: Primarily muck and sand bottom area in water 2-4 meters deep. Relatively common and widely scattered throughout.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton crispus*) Curly-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Nuphar variegata)* **Spatterdock**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-120
Habitat/Distribution: Muck bottom in 0-1.5 meters of water where it often forms dense canopies. Relatively common in muck bays and sheltered shoreline areas. It prefers a firmer bottom than (*Nymphaea odorata*).
Common Associates: (*Nymphaea odorata*) White water lily, (*Potamogeton natans*) Floating-leaf pondweed, (*Pontederia cordata*) Pickerelweed, (*Ceratophyllum demersum*) Coontail

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Nymphaea odorata*) **White water lily**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-121
Habitat/Distribution: Muck bottom in 0-2 meters where it forms dense canopies with other floating leaf species. Common in calm water bays throughout the lake.
Common Associates: (*Nuphar variegata)* Spatterdock, (*Elodea canadensis*) Common waterweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Spirodela polyrhiza*) Large duckweed, (*Lemna minor*) Small duckweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Phalaris arundinacea*) **Reed canary grass**
Specimen Location: Chetac Lake; N45.69460°, W91.521844°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-122
Habitat/Distribution: Prefers thick muck soil in and out of water <0.5 meters. Primarily found on shore in undeveloped low areas.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water calla, (*Schoenoplectus tabernaemontani*) Softstem bulrush

County/State: Sawyer County, Wisconsin **Date:** 7/17/14
Species: (*Phragmites australis*) **Common reed**
Specimen Location: Chetac Lake; N45.681140°, W91.519783°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2014-116
Habitat/Distribution: Plants were interspersed among bulrushes on the gravel bar near the lake outlet. Most individuals had been cropped by geese.
Common Associates: (*Schoenoplectus acutus*) Hardstem bulrush

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Pontederia cordata*) **Pickerelweed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-123
Habitat/Distribution: Muck bottom in < 1.0 meter of water. Scattered beds in calm southern bays.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Potamogeton vaseyi*) Vasey's pondweed, (*Myriophyllum sibiricum*) Northern water-milfoil, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sparganium emersum*) Short-stemmed bur-reed, (*Potamogeton natans*) Floating-leaf pondweed, (*Myriophyllum verticillatum*) Whorled water-milfoil

County/State: Sawyer County, Wisconsin **Date:** 7/17/14
Species: (*Potamogeton amplifolius*) **Large-leaf pondweed**
Specimen Location: Chetac Lake; N45.69911°, W91.49395°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2014-117
Habitat/Distribution: Found in mucky bottom conditions in shallow water 0.5-1.5 meter deep. A few clusters of plants was located at the Knuteson Creek inlet.
Common Associates: (*Potamogeton illinoensis*) Illinois pondweed, (*Elodea canadensis*) Common waterweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Ceratophyllum demersum*) Coontail, (*Ranunculus aquatilis*) White water crowfoot, (*Zizania palustris*) Northern wild rice, (*Potamogeton epihydrus*) Ribbon-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Potamogeton crispus*) **Curly-leaf pondweed**
Specimen Location: Chetac Lake; N45.74443°, W91.46945°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-124
Habitat/Distribution: Found in most mucky bottom areas in water from 1-4.5m deep. Abundant to the point of restricting boat traffic early in the season.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Lemna trisulca*) Forked duckweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Potamogeton epihydrus*) **Ribbon-leaf pondweed**
Specimen Location: Chetac Lake; N45.69911°, W91.49395°
Collected/Identified by: **Matthew S. Berg** **Col. #:** MSB-2008-125
Habitat/Distribution: Found in mucky bottom conditions in shallow water 0.5-1.5 meter deep. A single bed of plants was located at the Knuteson Creek inlet.
Common Associates: (*Potamogeton illinoensis*) Illinois pondweed, (*Elodea canadensis*) Common waterweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Ceratophyllum demersum*) Coontail, (*Ranunculus aquatilis*) White water crowfoot, (*Zizania palustris*) Northern wild rice

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Potamogeton friesii*) **Fries' pondweed**
Specimen Location: Chetac Lake; N45.74443°, W91.46945°
Collected/Identified by: **Matthew S. Berg Col. #:** MSB-2008-126
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-2.5 meters of water. Relatively common, and widely distributed in sandy and rocky areas throughout the lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Vallisneria americana*) Wild celery, (*Stuckenia pectinata*) Sago pondweed, (*Najas flexilis*) Slender naiad

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Potamogeton illinoensis*) **Illinois pondweed**
Specimen Location: Chetac Lake; N45.69911°, W91.49395°
Collected/Identified by: **Matthew S. Berg Col. #:** MSB-2008-127
Habitat/Distribution: Found in mucky bottom conditions in shallow water 0.5-1.5 meter deep. A single bed of plants was located at the Knuteson Creek inlet.
Common Associates: (*Elodea canadensis*) Common waterweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Ranunculus aquatilis*) White water crowfoot, (*Zizania palustris*) Northern wild rice, (*Potamogeton epihydrus*) Ribbon-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Potamogeton natans*) **Floating-leaf pondweed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg Col. #:** MSB-2008-128
Habitat/Distribution: Muck bottom in < 1.0 meters of water. Only plants found were in the bay/unnamed creek inlet east of the islands.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Pontederia cordata*) Pickerelweed, (*Potamogeton vaseyi*) Vasey's pondweed, (*Myriophyllum sibiricum*) Northern water-milfoil, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sparganium emersum*) Short-stemmed bur-reed, (*Myriophyllum verticillatum*) Whorled water-milfoil

County/State: Sawyer County, Wisconsin **Date:** 7/28/17
Species: (*Potamogeton obtusifolius*) **Blunt-leaf pondweed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: **Matthew S. Berg Col. #:** MSB-2017-020
Habitat/Distribution: Muck bottom in < 1.0 meters of water. Only plants found were in the Malviney Creek inlet east of the islands.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Pontederia cordata*) Pickerelweed, (*Potamogeton vaseyi*) Vasey's pondweed, (*Myriophyllum sibiricum*) Northern water-milfoil, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sparganium emersum*) Short-stemmed bur-reed, (*Myriophyllum verticillatum*) Whorled water-milfoil

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Potamogeton praelongus*) **White-stem pondweed**
Specimen Location: Chetac Lake; N45.67813°, W91.51522°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-129
Habitat/Distribution: Variable substrate in 1-2 meters of water. It seems to be most common in areas that had some, but not thick muck over gravel of sand. Rare, found at a handful of scattered locations on the south end of the lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Ceratophyllum demersum*) Coontail, (*Myriophyllum sibiricum*) Northern water-milfoil, (*Potamogeton crispus*) Curly-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Potamogeton pusillus berchtoldii*) **Small pondweed**
Specimen Location: Chetac Lake; N45.74353°, W91.46943°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-130
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0-4 meters of water. Normally it and Coontail, and Curly-leaf pondweed are the deepest growing vascular plant. It is abundant throughout the lake.
Common Associates: (*Potamogeton crispus*) Curly-leaf pondweed, (*Vallisneria americana*) Wild celery, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Potamogeton friesii*) Fries' pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/17/14
Species: (*Potamogeton pusillus pusillus*) **Small pondweed**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2014-118
Habitat/Distribution: Muck bottom in shallow water <1m. Rare; found only at the Benson Creek inlet growing among the much more numerous Autumnal water starwort. Plants were bright red and blunt tipped as in *P. obtusifolius*, but fruits were not keeled/wrinkled as in this species. Based on the small leaf width, and the fruit characteristics, we believe it is *pusillus pusillus*.
Common Associates: (*Callitriche hermaphroditica*) Autumnal water starwort, (*Ranunculus aquatilis*) White water crowfoot, (*Chara* sp.) Muskgrass, (*Stuckenia pectinata*) Sago pondweed, (*Potamogeton crispus*) Curly-leaf pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Potamogeton richardsonii*) **Clasping-leaf pondweed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-131
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-1.5 meters of water. Relatively common, and widely distributed in sandy and rocky areas throughout the lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton friesii*) Fries' pondweed, (*Vallisneria americana*) Wild celery, (*Stuckenia pectinata*) Sago pondweed, (*Najas flexilis*) Slender naiad

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Potamogeton robbinsii*) **Fern pondweed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-132
Habitat/Distribution: Organic muck in 0.5-3 meters of water. Widespread and relatively common in the southern half of the lake, but absent in the northern half.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton crispus*) Curly-leaf pondweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton zosteriformis*) Flat-stem pondweed, (*Lemna trisulca*) Forked duckweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Potamogeton vaseyi*) **Vasey's pondweed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-133
Habitat/Distribution: Muck bottom in < 1.0 meters of water. Only plants found were in the unnamed creek inlet east of the islands. Not seen anywhere in 2014.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Pontederia cordata*) Pickerelweed, (*Myriophyllum sibiricum*) Northern water-milfoil, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sparganium emersum*) Short-stemmed bur-reed, (*Potamogeton natans*) Floating-leaf pondweed, (*Myriophyllum verticillatum*) Whorled water-milfoil

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Potamogeton zosteriformis*) **Flat-stem pondweed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-134
Habitat/Distribution: It prefers substrate of thick organic muck. Widely distributed and common in all four lakes where it grows in 0-3 meters of water.
Common Associates: (*Ceratophyllum demersum*) Coontail, (*Potamogeton pusillus*) Small pondweed, (*Potamogeton crispus*) Curly-leaf pondweed**,** (*Lemna trisulca*) Forked duckweed, (*Potamogeton friesii*) Fries' pondweed

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Ranunculus aquatilis*) **White water crowfoot**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-136
Habitat/Distribution: Uncommon at a few widely scattered locations. Found primarily over muck and sandy muck in shallow water <1m deep.
Common Associates: (*Callitriche hermaphroditica*) Autumnal water starwort, (*Callitriche palustris*) Common water starwort, (*Chara* sp.) Muskgrass

County/State: Sawyer County, Wisconsin **Date:** 7/17/14
Species: (*Sagittaria latifolia*) **Common arrowhead**
Specimen Location: Chetac Lake; N45.69338°, W91.50003°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2014-119
Habitat/Distribution: Located at the edge of the water in mucky soil. Uncommon in scattered locations in the muck bays east of the islands.
Common Associates: (*Typha latifolia*) Broad-leaved cattail, (*Calla palustris*) Water calla, (*Eleocharis erythropoda*) Bald spikerush, (*Schoenoplectus tabernaemontani*) Softstem bulrush

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Sagittaria rigida*) **Sessile-fruited arrowhead**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-137
Habitat/Distribution: Firm muck bottom in < 0.5 meters of water. Scattered locations; especially in areas that had some water flow.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Pontederia cordata*) Pickerelweed, (*Potamogeton vaseyi*) Vasey's pondweed, (*Myriophyllum sibiricum*) Northern water-milfoil, (*Sparganium emersum*) Short-stemmed bur-reed, (*Potamogeton natans*) Floating-leaf pondweed, (*Myriophyllum verticillatum*) Whorled water-milfoil

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Schoenoplectus acutus*) **Hardstem bulrush**
Specimen Location: Chetac Lake; N45.69725898°, W91.4977581°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-138
Habitat/Distribution: Mucky to firm bottoms in 0-0.5 meters of water. Found in the bay east of the islands where it formed dense reed beds with Creeping spikerush.
Common Associates: (*Eleocharis palustris*) Creeping spikerush, (*Potamogeton crispus*) Curly-leaf pondweed**,** (*Lemna trisulca*) Forked duckweed

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Schoenoplectus tabernaemontani*) **Softstem bulrush**
Specimen Location: Chetac Lake; N45.69363°, W91.50023°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-139
Habitat/Distribution: Firm muck bottoms in 0-0.5 meter of water. Uncommon; scattered clusters occurred in at the shoreline in bays throughout the south end of the lake.
Common Associates: (*Potamogeton natans*) Floating-leaf pondweed, (*Spirodela polyrhiza*) Large duckweed, (*Eleocharis erythropoda*) Bald spikerush, (*Lemna minor*) Small duckweed, (*Typha latifolia*) Broad-leaved cattail, (*Nymphaea odorata*) White water lily

County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Sparganium emersum*) **Short-stemmed bur-reed**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-140
Habitat/Distribution: Muck bottom in < 1.0 meters of water. Only plants found were in the unnamed creek inlet east of the islands.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Utricularia intermedia*) Flat-leaf bladderwort, (*Pontederia cordata*) Pickerelweed, (*Potamogeton vaseyi*) Vasey's pondweed, (*Myriophyllum sibiricum*) Northern water-milfoil, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Potamogeton natans*) Floating-leaf pondweed, (*Myriophyllum verticillatum*) Whorled water-milfoil

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Spirodela polyrhiza*) **Large duckweed**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-141
Habitat/Distribution: Located floating at or just under the surface in stagnant bays. Common, but less so than Small duckweed. Scattered individuals occur interspersed between the lilypads and wild rice beds.
Common Associates: (*Nymphaea odorata*) White water lily, (*Nuphar variegata)* Spatterdock, (*Lemna minor*) Small duckweed, (*Ceratophyllum demersum*) Coontail, (*Potamogeton pusillus*) Small pondweed, (*Zizania palustris*) Northern wild rice

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Stuckenia pectinata*) **Sago pondweed**
Specimen Location: Chetac Lake; N45.74806°, W91.46698°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-142
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-1.5 meters of water. Fairly common, especially in the narrows, and along sandy shoreline areas.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton friesii*) Fries' pondweed, (*Vallisneria americana*) Wild celery, (*Najas flexilis*) Slender naiad

County/State: Sawyer County, Wisconsin **Date:** 7/28/17
Species: (*Typha* X *glauca*) **Hybrid cattail**
Specimen Location: Chetac Lake; N45.69317°, W91.50002°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2017-021
Habitat/Distribution: Muck bottom at the shoreline in 0 – 0.25 meters of water. Only plants seen were near the point in the bay south of the Malviney Creek inlet.
Common Associates: (*Calla palustris*) Water calla, (*Spirodela polyrhiza*) Large duckweed, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Zizania palustris*) Northern wild rice

County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Typha latifolia*) **Broad-leaved cattail**
Specimen Location: Chetac Lake; N45.69811°, W91.50163°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-143
Habitat/Distribution: Muck bottom at the shoreline in 0 – 0.25 meters of water. Relatively common throughout; especially in undeveloped low areas and in sheltered bays.
Common Associates: (*Calla palustris*) Water calla, (*Spirodela polyrhiza*) Large duckweed, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Zizania palustris*) Northern wild rice

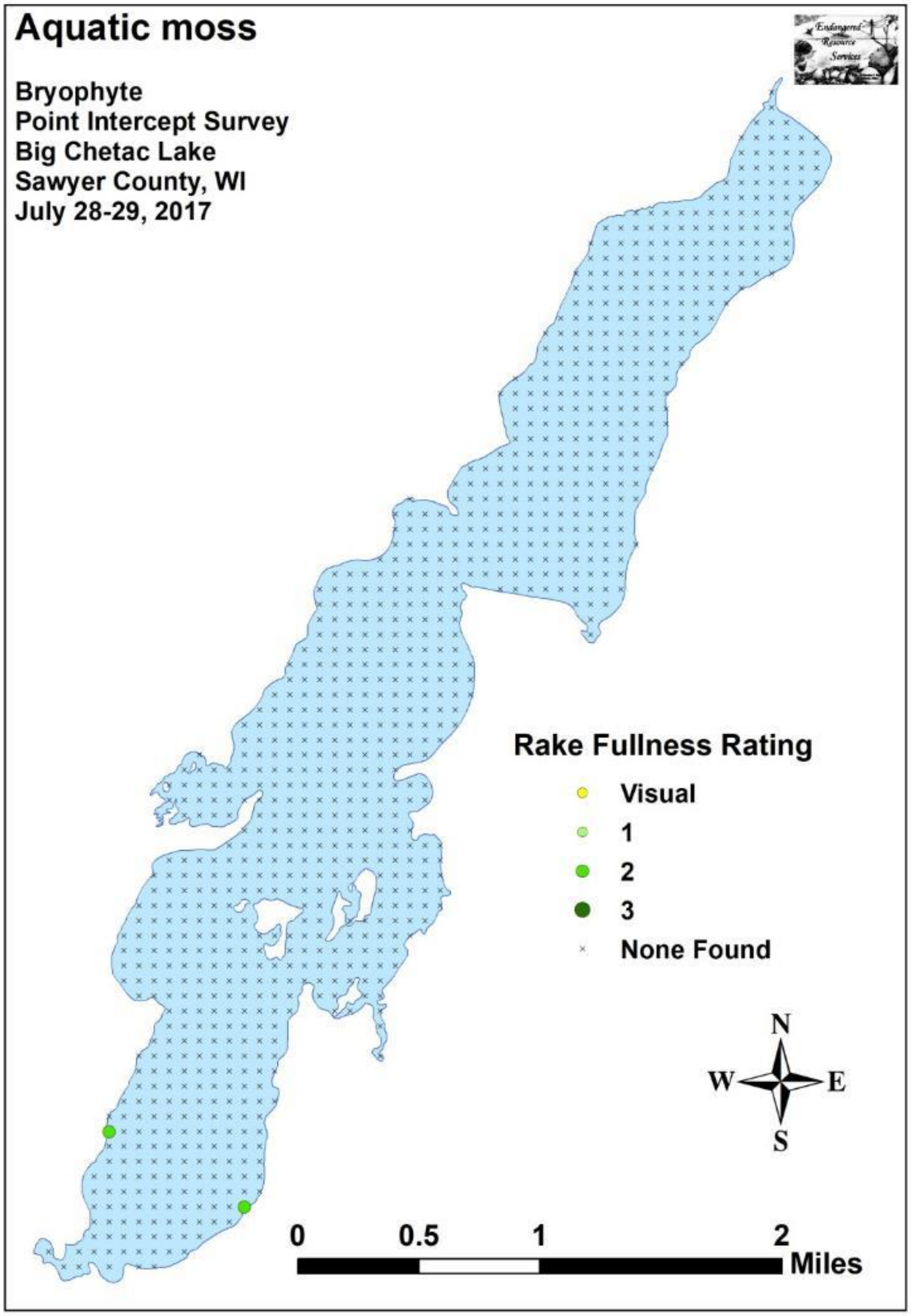
County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Utricularia intermedia*) **Flat-leaf bladderwort**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-144
Habitat/Distribution: Muck bottom in < 1.0 meters of water. Only plants found were in the unnamed creek inlet east of the islands.
Common Associates: (*Utricularia vulgaris*) Common bladderwort, (*Pontederia cordata*) Pickerelweed, (*Potamogeton vaseyi*) Vasey's pondweed, (*Myriophyllum sibiricum*) Northern water-milfoil, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sparganium emersum*) Short-stemmed bur-reed, (*Potamogeton natans*) Floating-leaf pondweed, (*Myriophyllum verticillatum*) Whorled water-milfoil

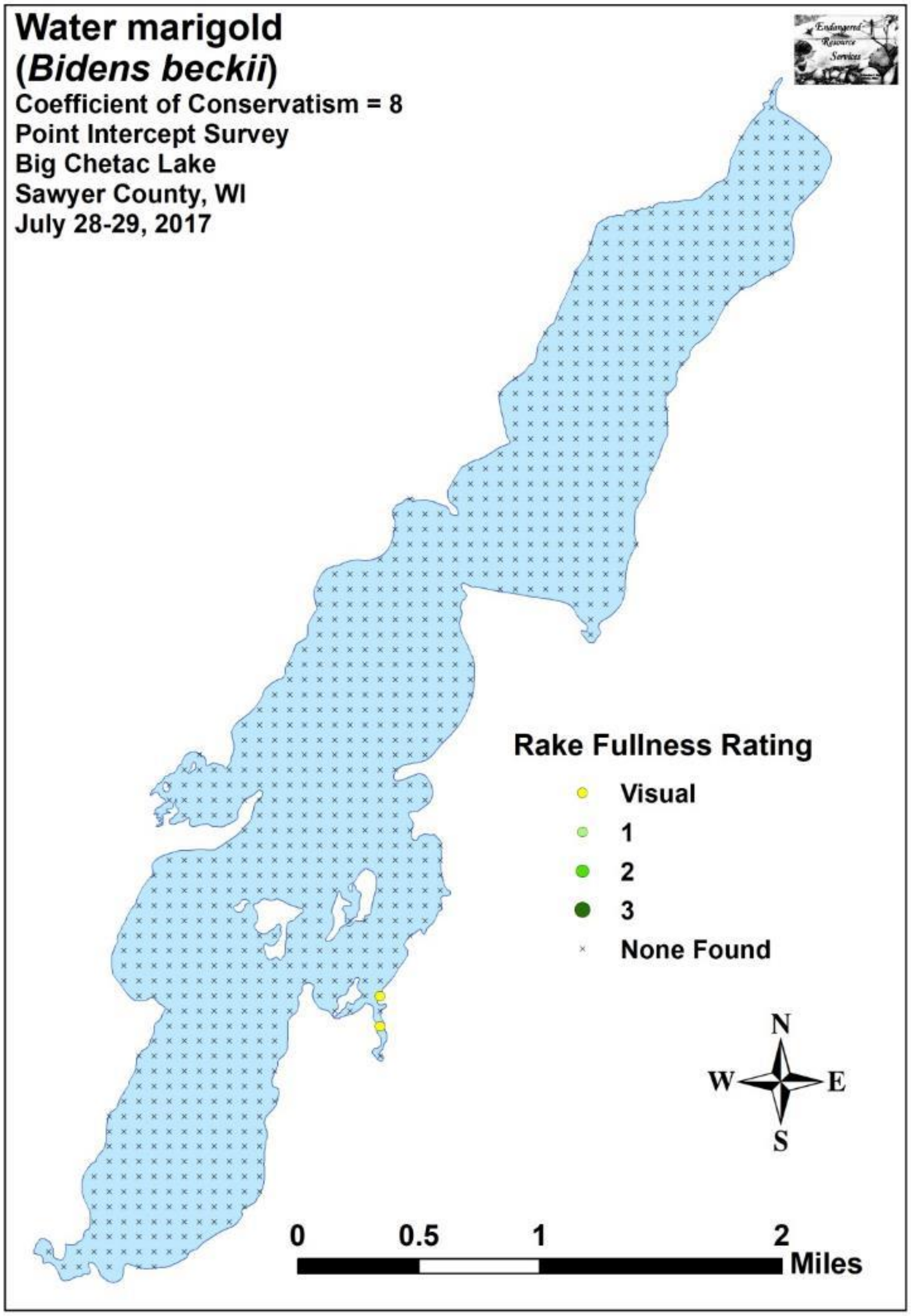
County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Utricularia vulgaris*) **Common bladderwort**
Specimen Location: Chetac Lake; N45.69184°, W91.49890°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-145
Habitat/Distribution: Floating over muck bottoms in < 1.5 meters of water. Only plants found were in the unnamed creek inlet east of the islands and in the bog areas near pt. 114.
Common Associates: (*Utricularia intermedia*) Flat-leaf bladderwort, (*Potamogeton vaseyi*) Vasey's pondweed, (*Sagittaria rigida*) Sessile-fruited arrowhead, (*Sparganium emersum*) Short-stemmed bur-reed, (*Potamogeton natans*) Floating-leaf pondweed, (*Myriophyllum verticillatum*) Whorled water-milfoil

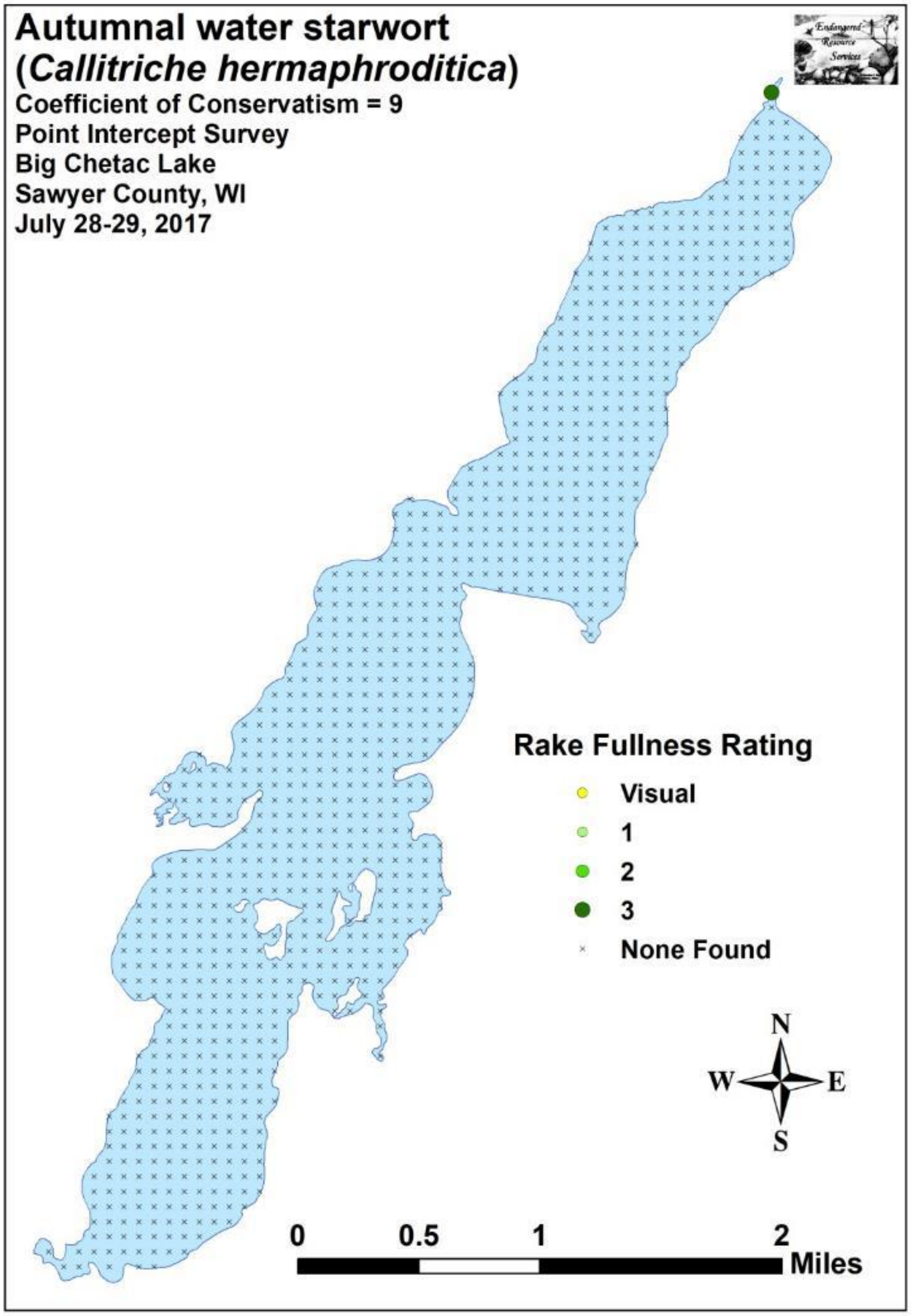
County/State: Sawyer County, Wisconsin **Date:** 7/20/08
Species: (*Vallisneria americana*) **Wild celery**
Specimen Location: Chetac Lake; N45.72905°, W91.47547°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-146
Habitat/Distribution: Found in almost any bottom conditions, but grows best in rock/ sand bottoms in 0.5-1.5 meters of water. Relatively common, and widely distributed in sandy and rocky areas throughout the lake.
Common Associates: (*Potamogeton pusillus*) Small pondweed, (*Potamogeton friesii*) Fries' pondweed, (*Potamogeton richardsonii*) Clasping-leaf pondweed, (*Stuckenia pectinata*) Sago pondweed, (*Najas flexilis*) Slender naiad

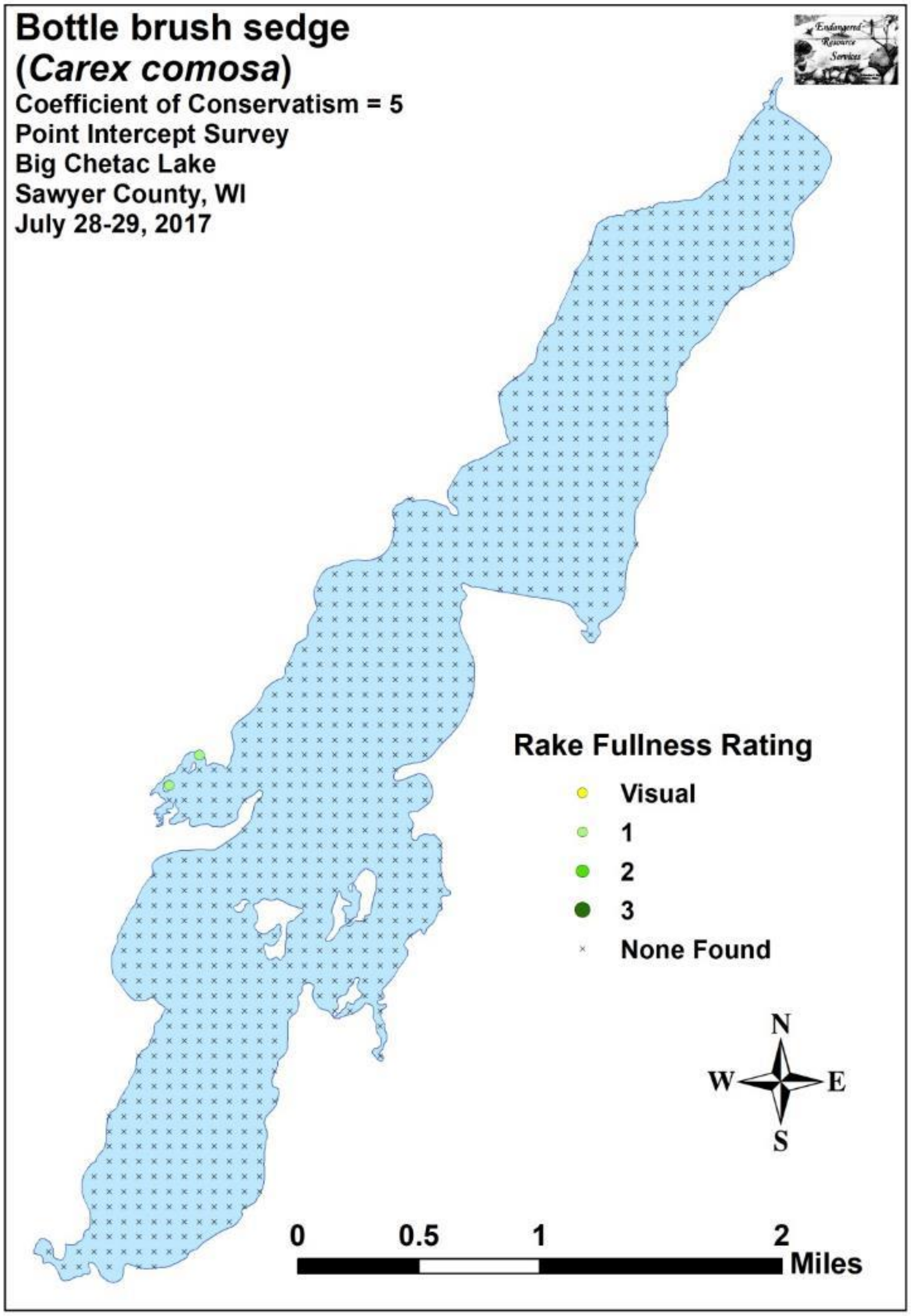
County/State: Sawyer County, Wisconsin **Date:** 7/21/08
Species: (*Zizania palustris*) **Northern wild rice**
Specimen Location: Chetac Lake; N45.69911°, W91.49395°
Collected/Identified by: Matthew S. Berg Col. #: MSB-2008-147
Habitat/Distribution: Thick muck bottom in shallow water 0-1.0 meter deep. Common to abundant in the bay east of the islands.
Common Associates: (*Potamogeton natans*) Floating-leaf pondweed, (*Spirodela polyrhiza*) Large duckweed, (*Schoenoplectus tabernaemontani*) Softstem bulrush, (*Lemna minor*) Small duckweed, (*Typha latifolia*) Broad-leaved cattail

Appendix VII: 2017 Species Density and Distribution Maps


Aquatic moss
Bryophyte
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


Water marigold
(Bidens beckii)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


Autumnal water starwort
(Callitriche hermaphroditica)
Coefficient of Conservatism = 9
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles



Bottle brush sedge
(*Carex comosa*)
Coefficient of Conservatism = 5
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
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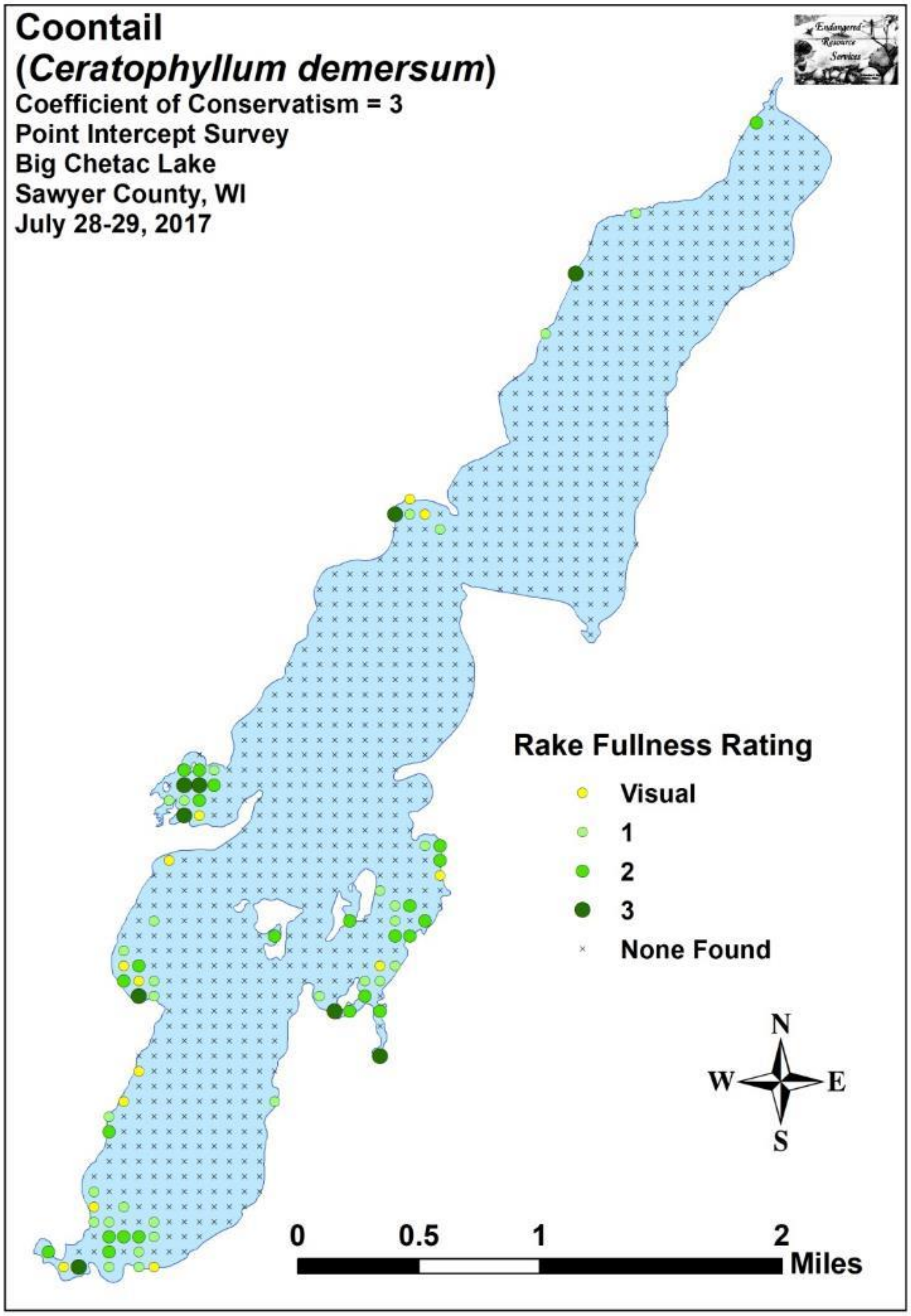
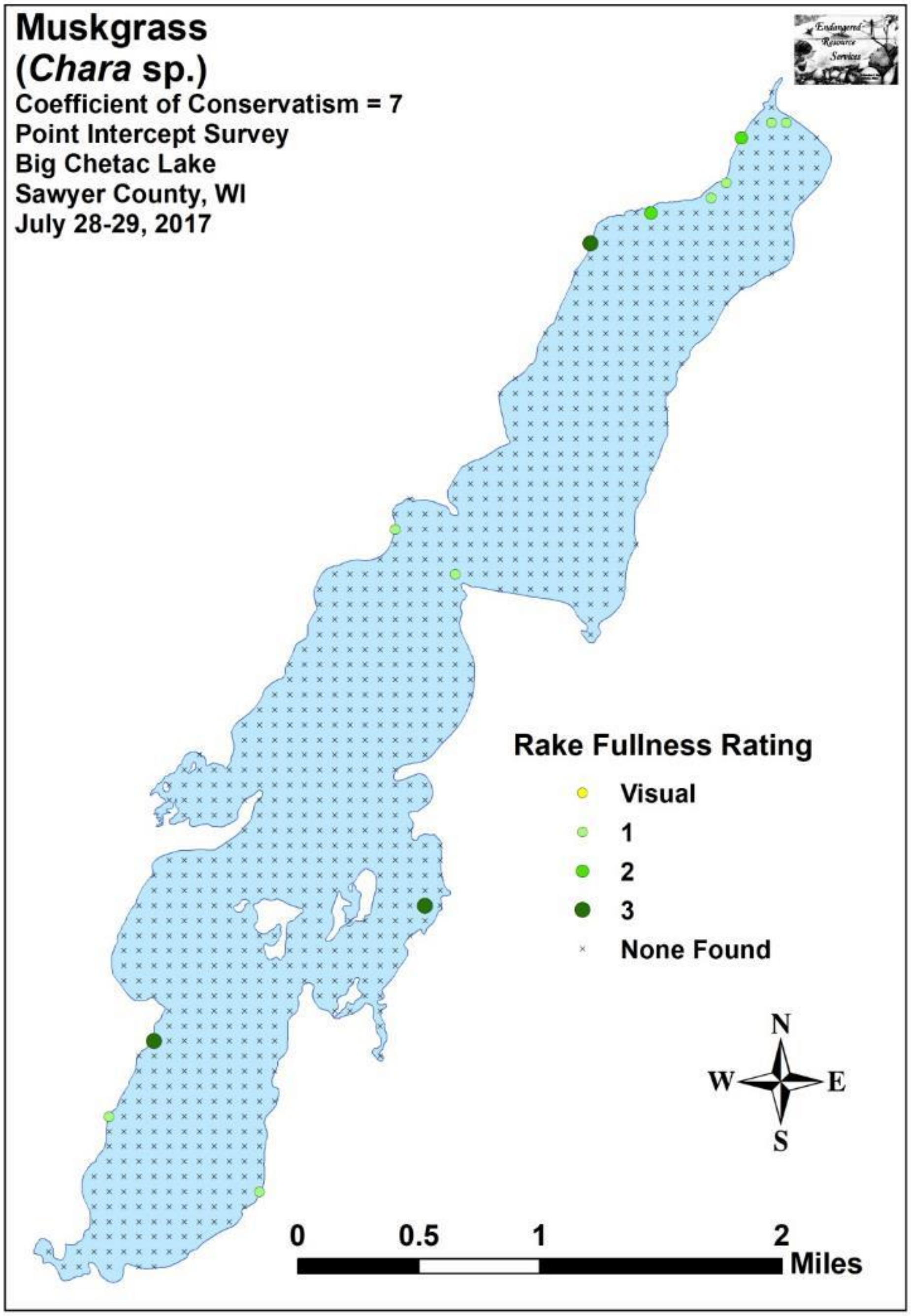
S
0
0.5
1
2
Miles


Coontail
(*Ceratophyllum demersum*)
Coefficient of Conservatism = 3
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


Muskgrass
(Chara sp.)
Coefficient of Conservatism = 7
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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2
3
None Found
N
W
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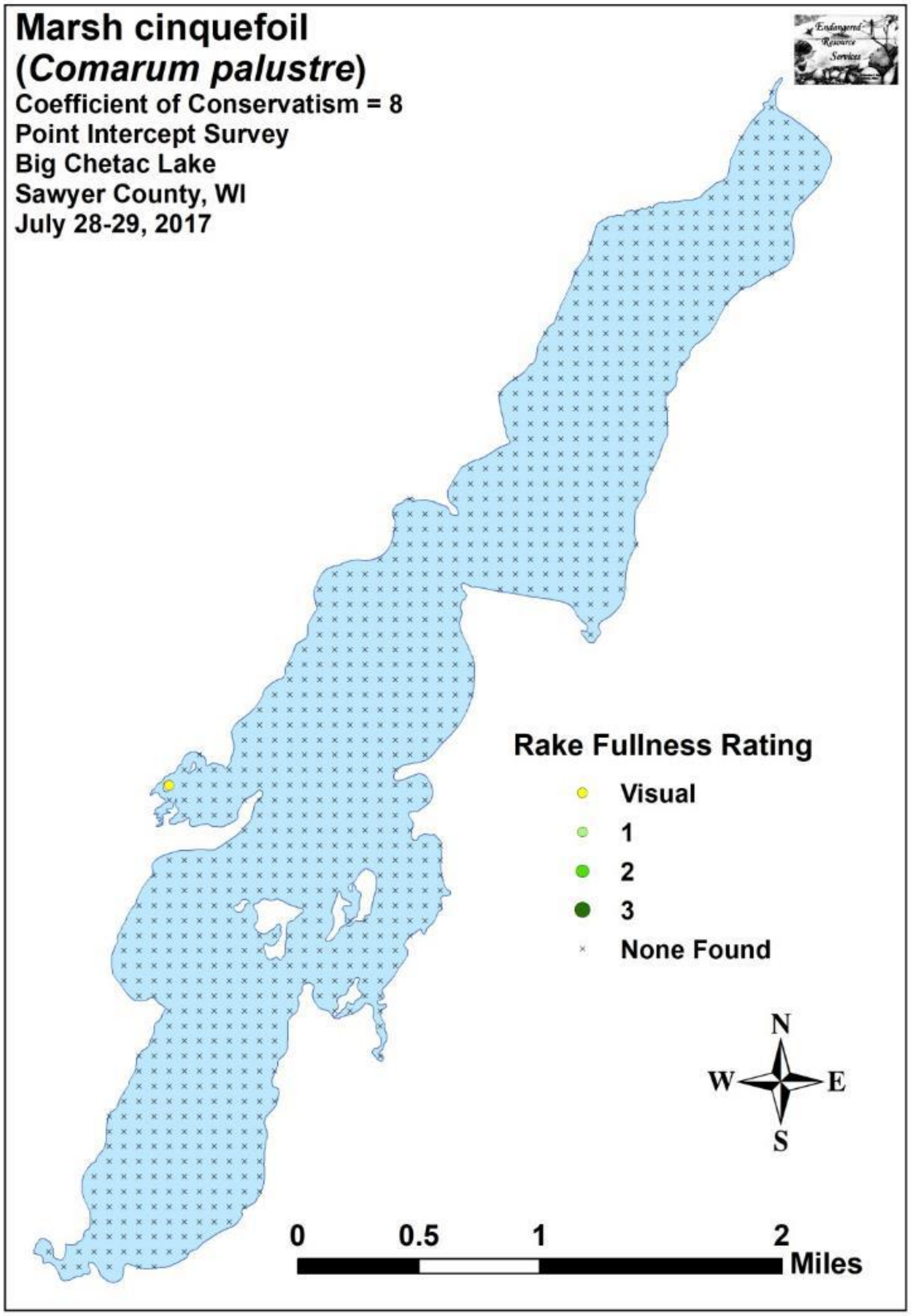
S
0
0.5
1
2
Miles


Marsh cinquefoil
(*Comarum palustre*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
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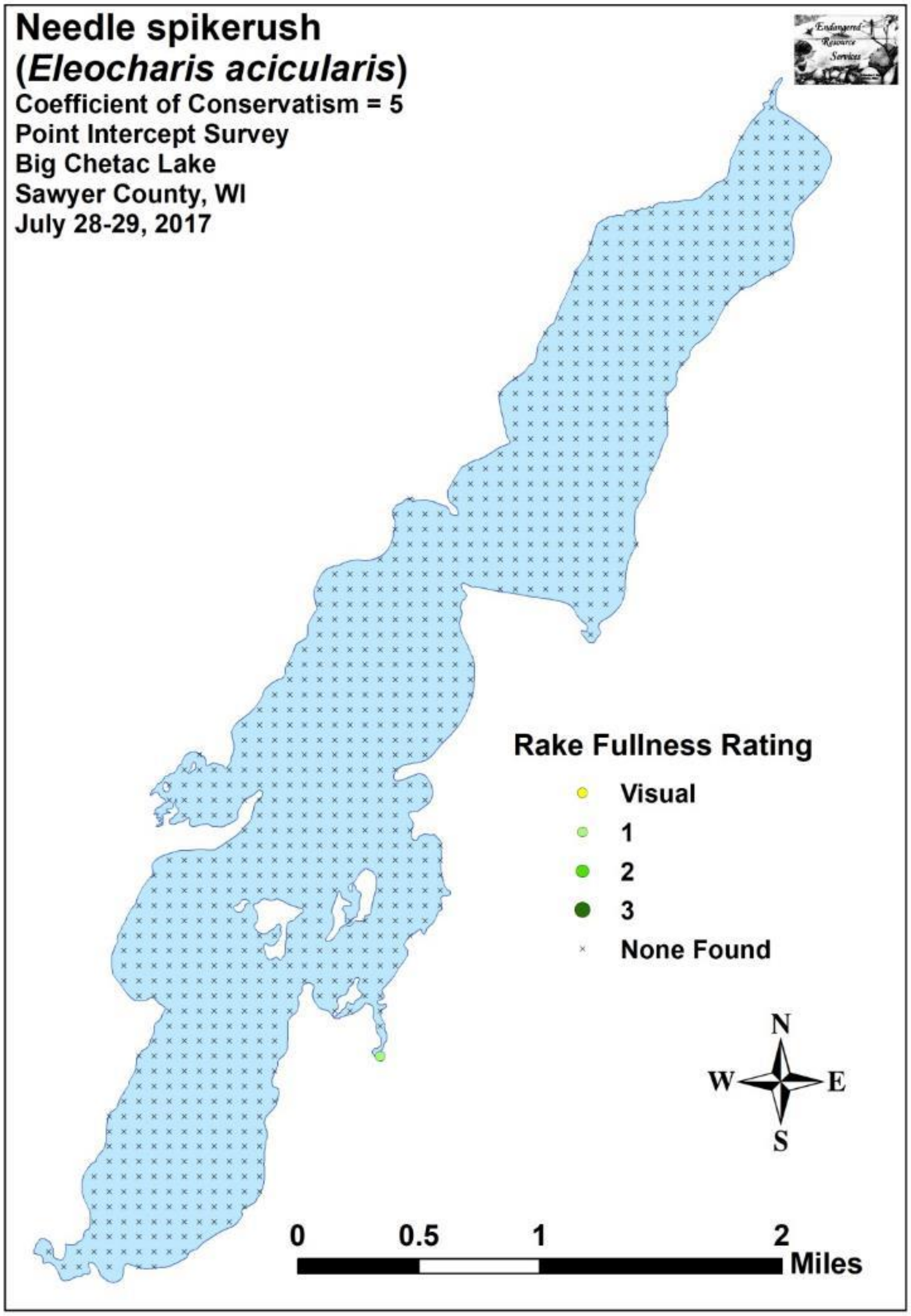
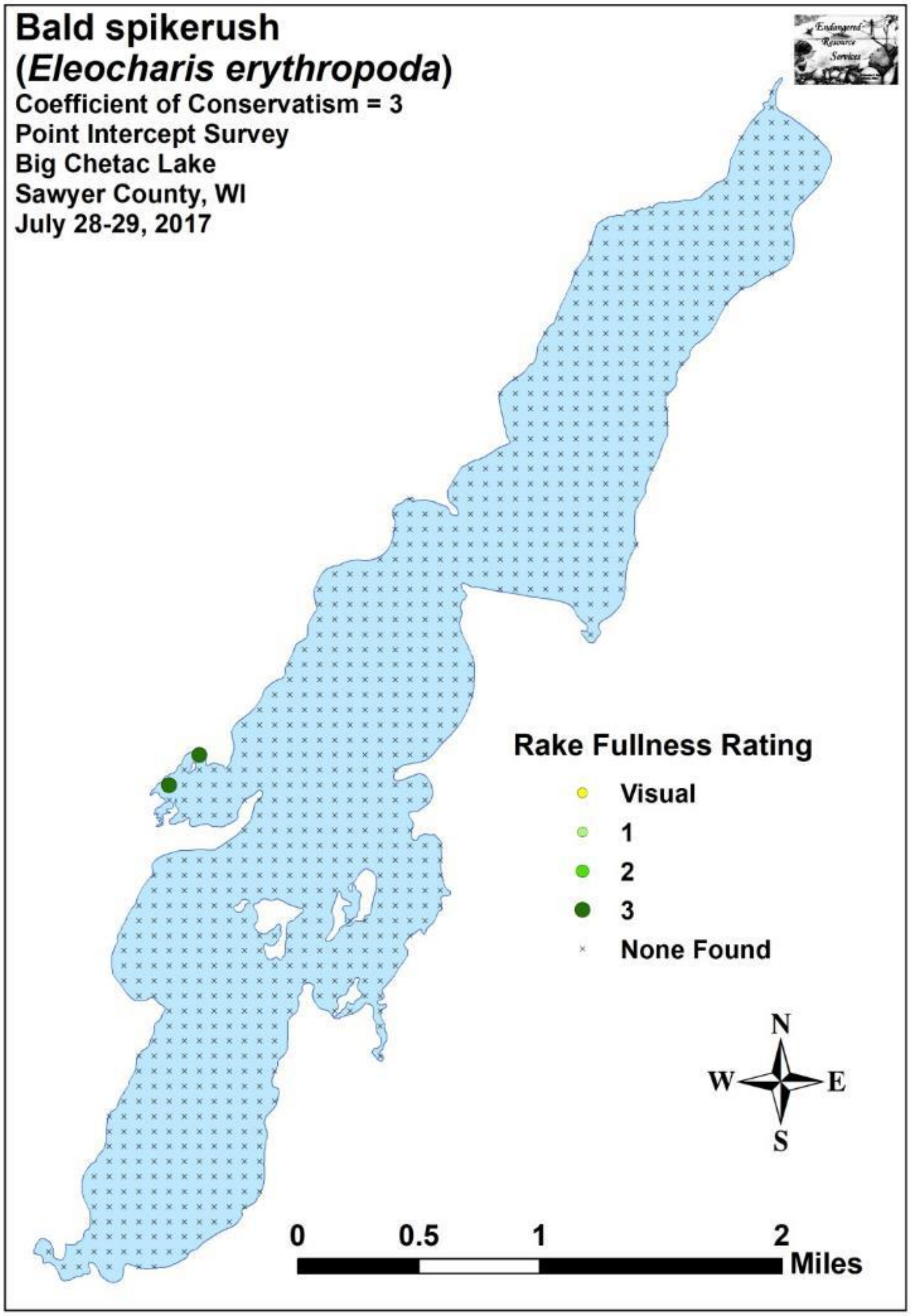
S
0
0.5
1
2
Miles


Needle spikerush
(*Eleocharis acicularis*)
Coefficient of Conservatism = 5
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


Bald spikerush
(*Eleocharis erythropoda*)
Coefficient of Conservatism = 3
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
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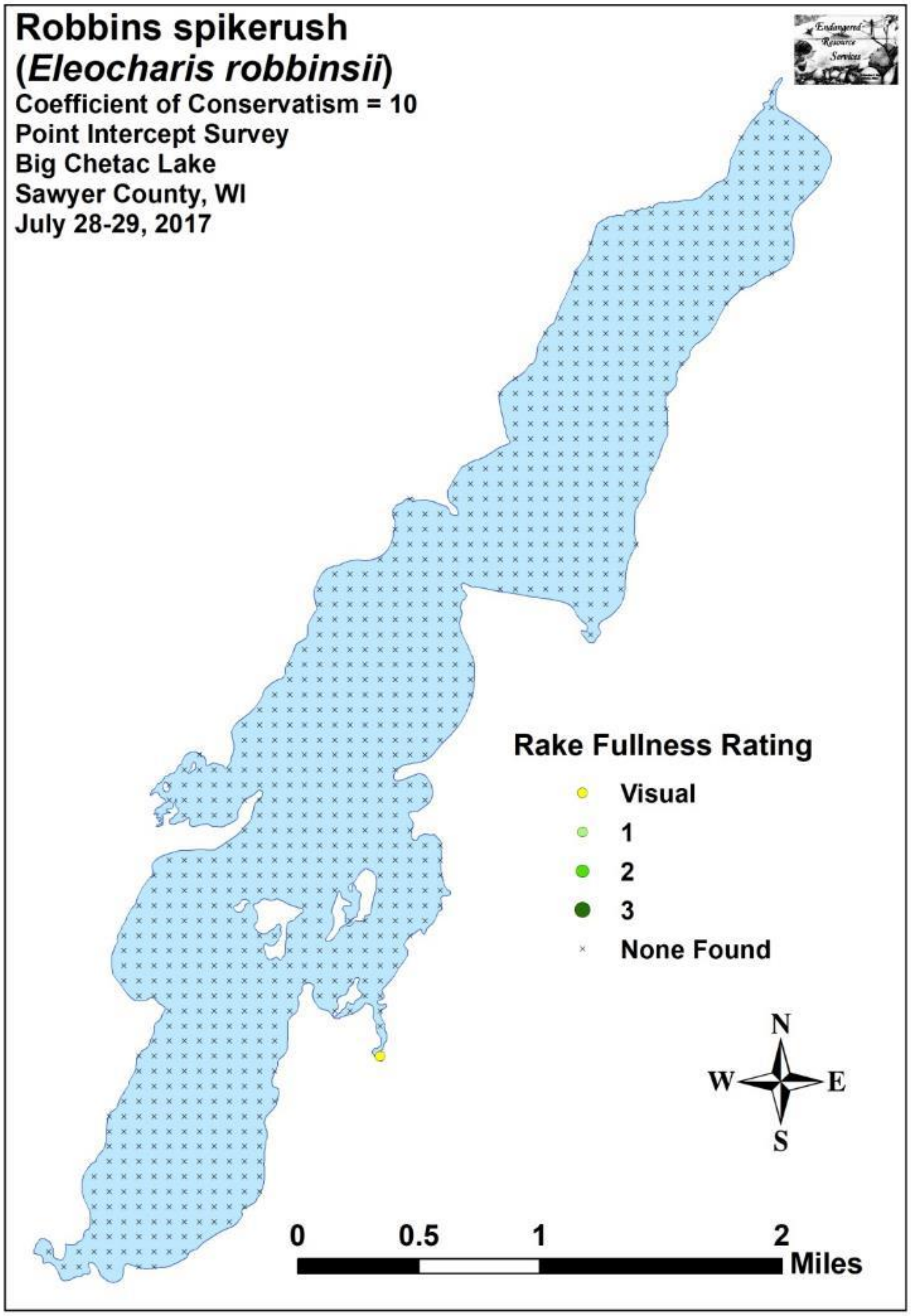
S
0
0.5
1
2
Miles


Robbins spikerush
(*Eleocharis robbinsii*)
Coefficient of Conservatism = 10
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
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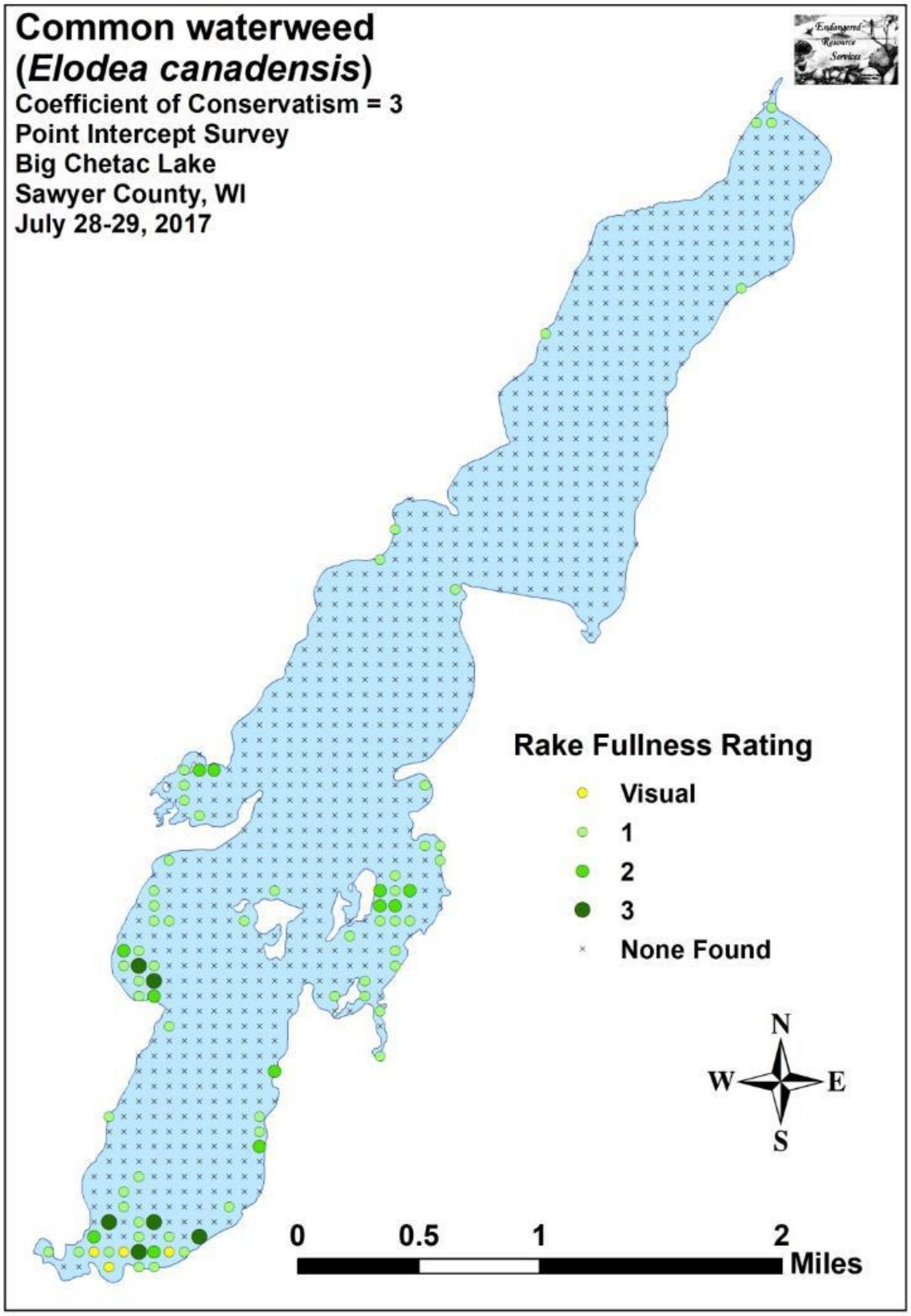
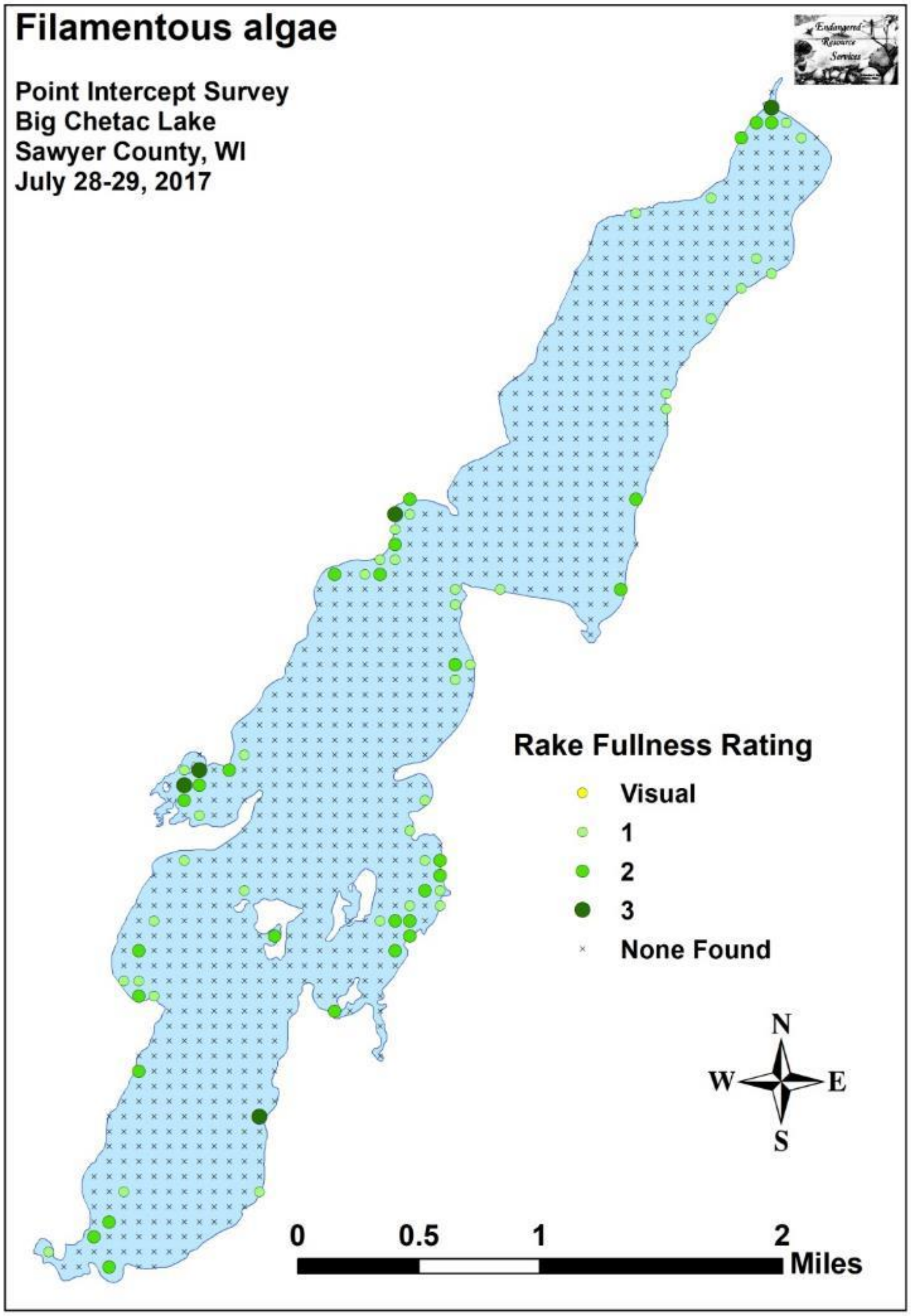
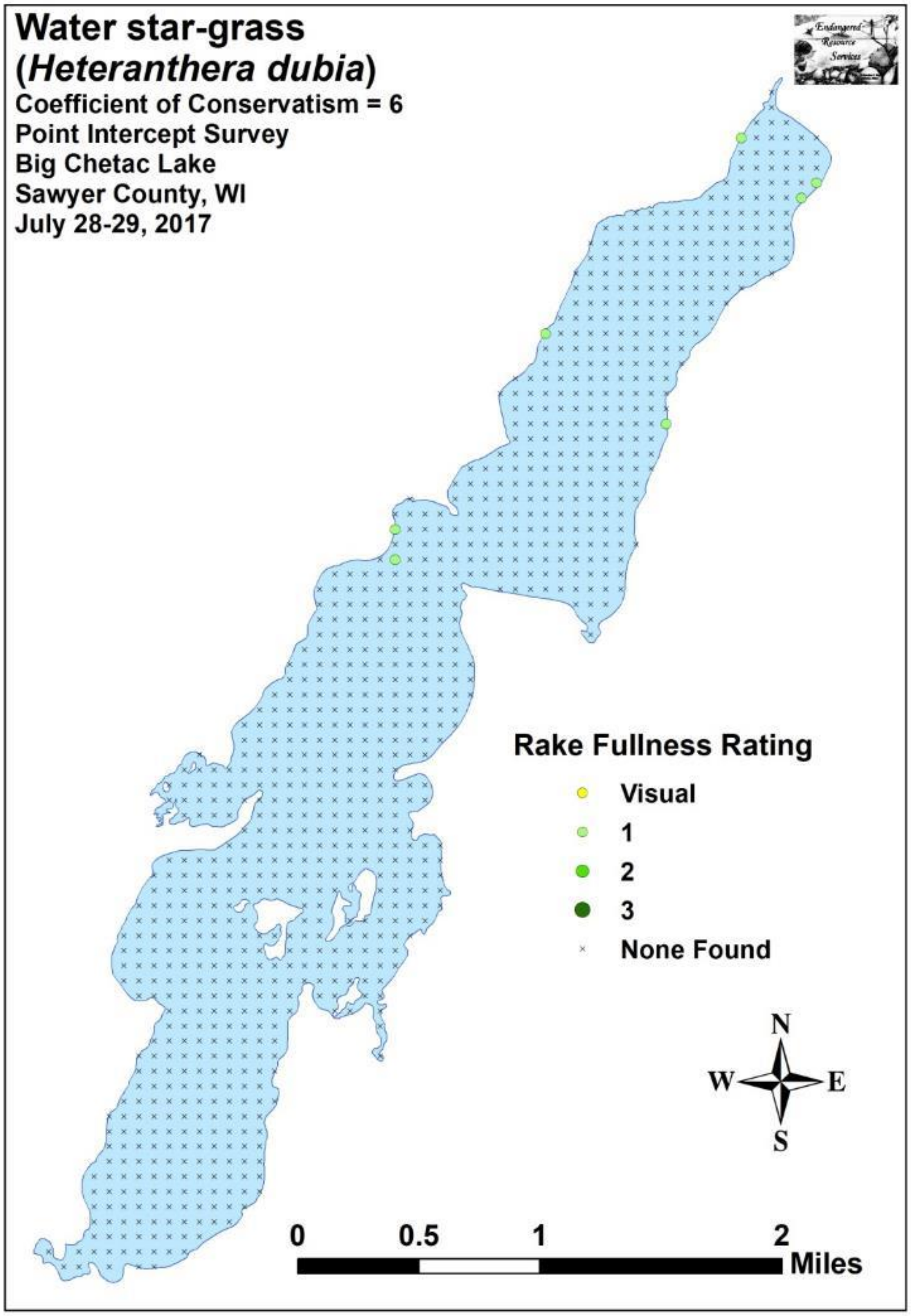
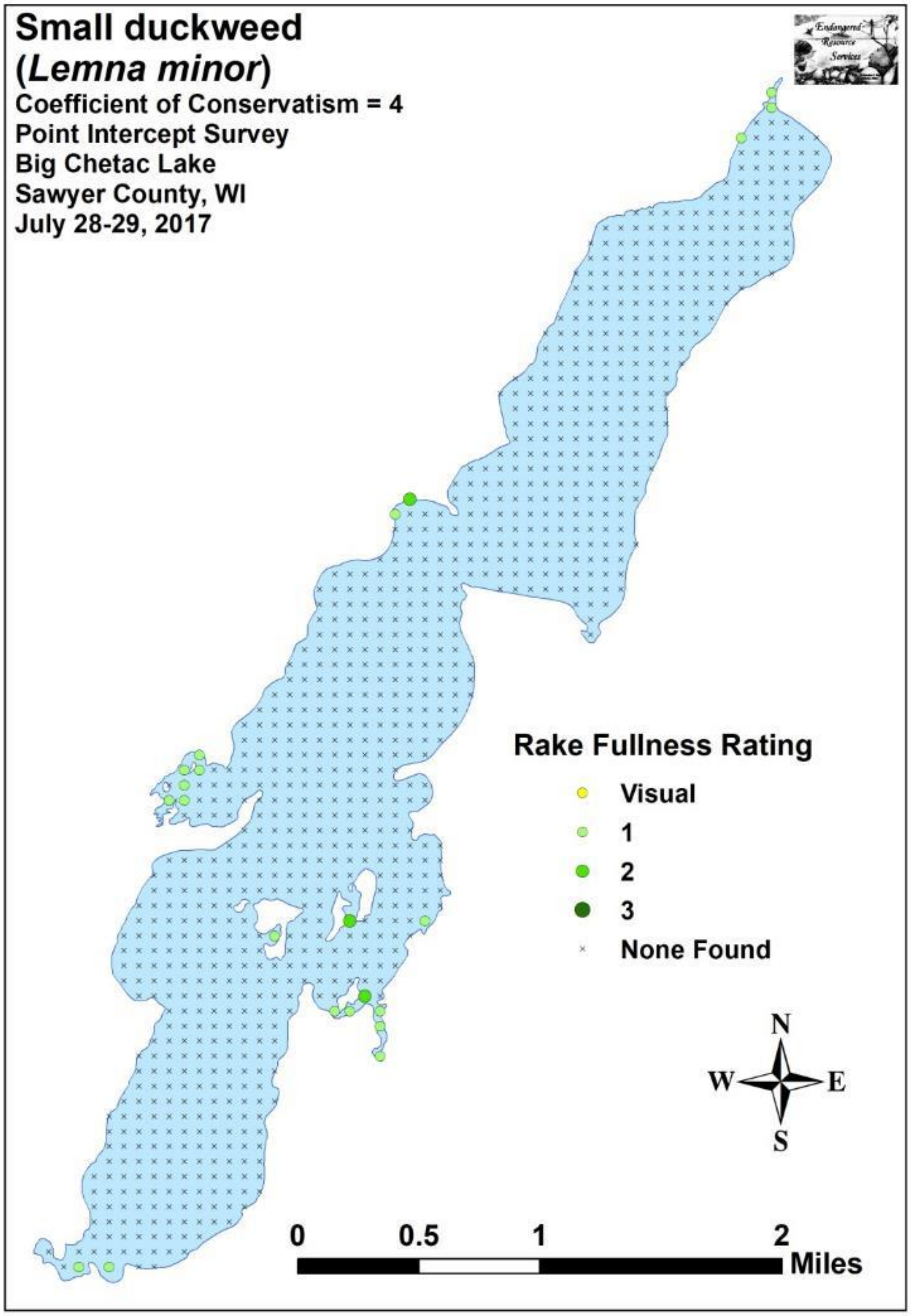
S
0
0.5
1
2
Miles


Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


Filamentous algae
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles



Water star-grass
(*Heteranthera dubia*)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.5
1
2
Miles


Small duckweed
(Lemna minor)
Coefficient of Conservatism = 4
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
1
2
3
None Found
N
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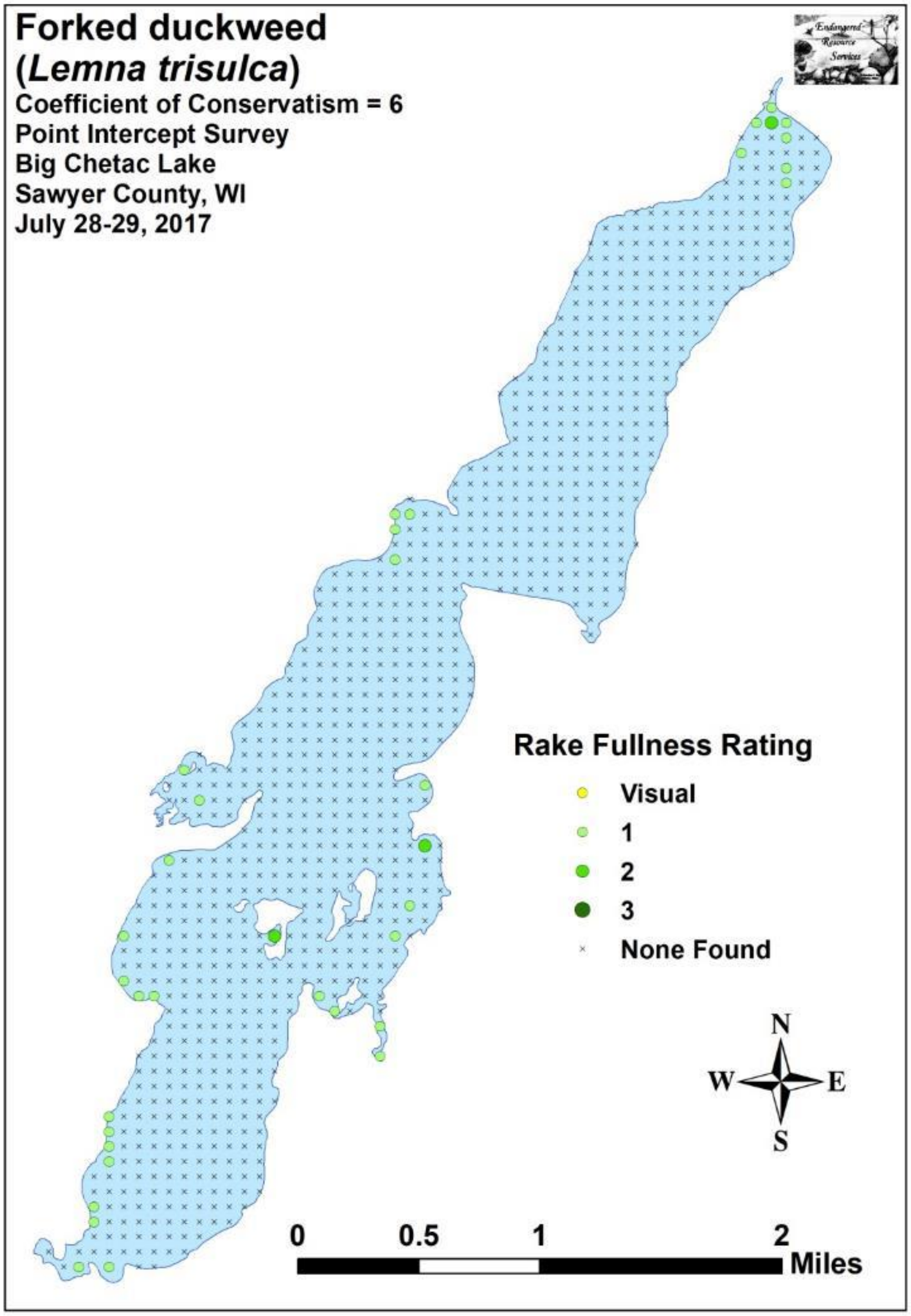
S
0
0.5
1
2
Miles


Forked duckweed
(*Lemna trisulca*)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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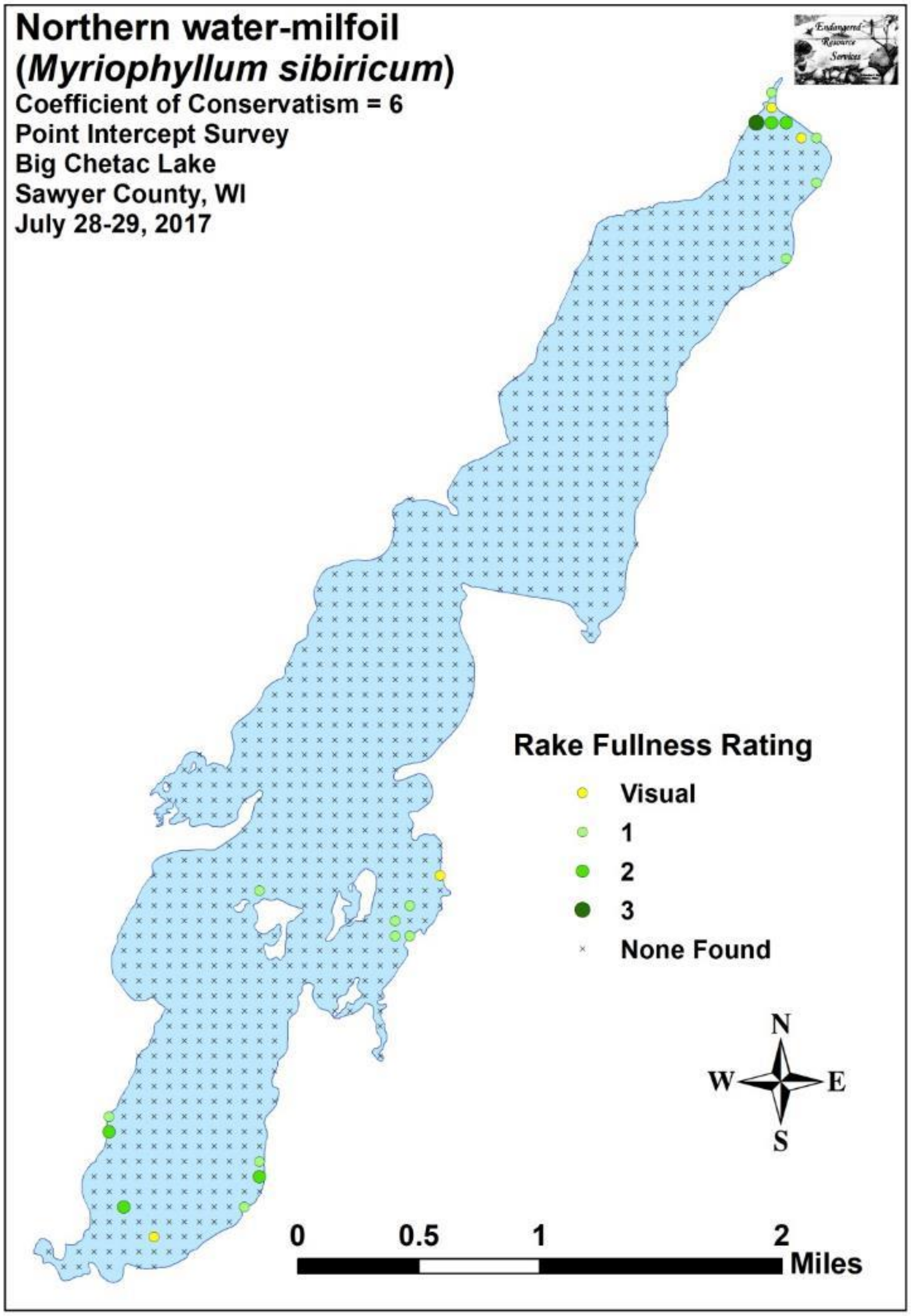
Northern water-milfoil
(*Myriophyllum sibiricum*)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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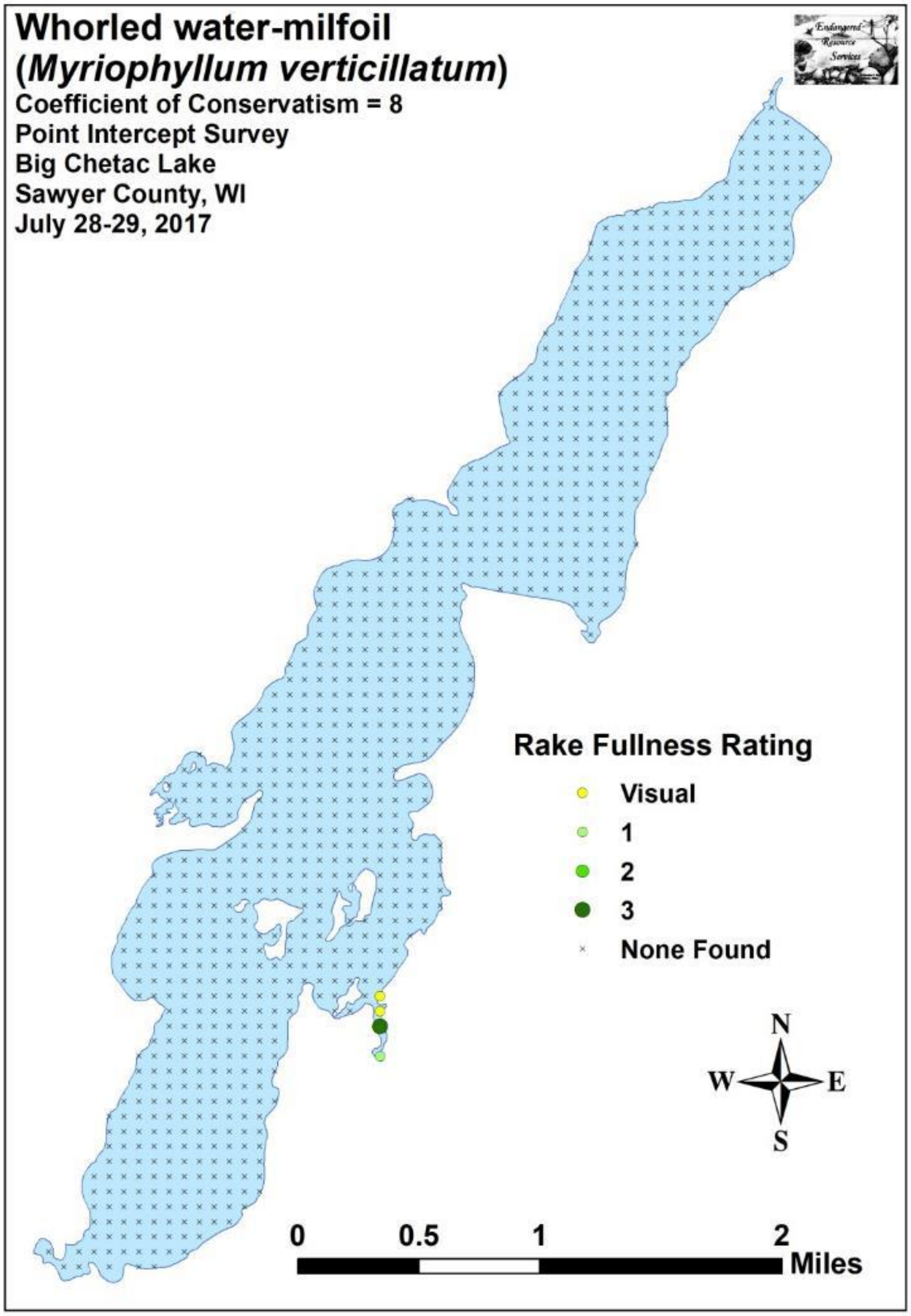
Whorled water-milfoil
(*Myriophyllum verticillatum*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
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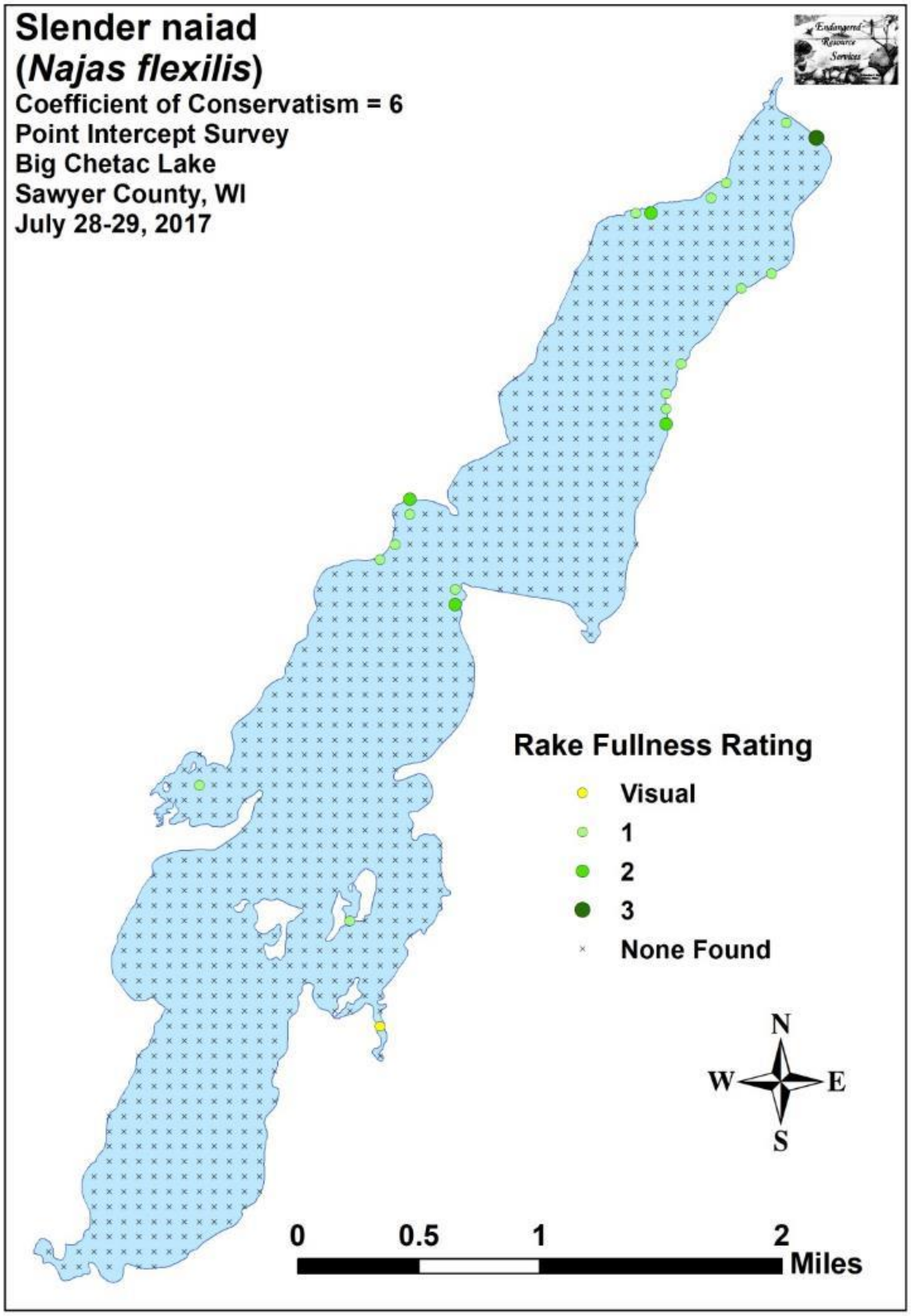
Slender naiad
(*Najas flexilis*)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
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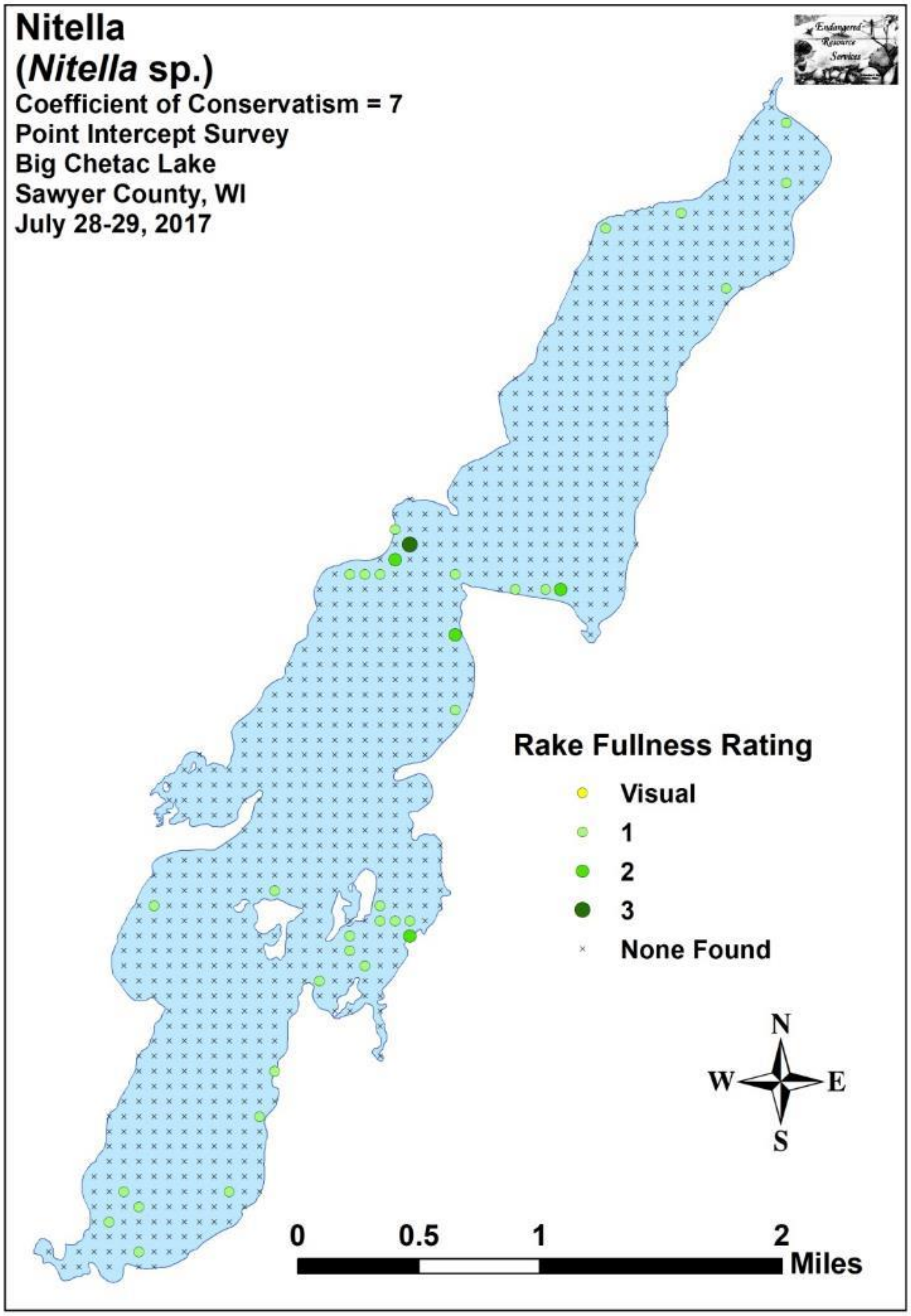
Nitella
(*Nitella* sp.)
Coefficient of Conservatism = 7
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
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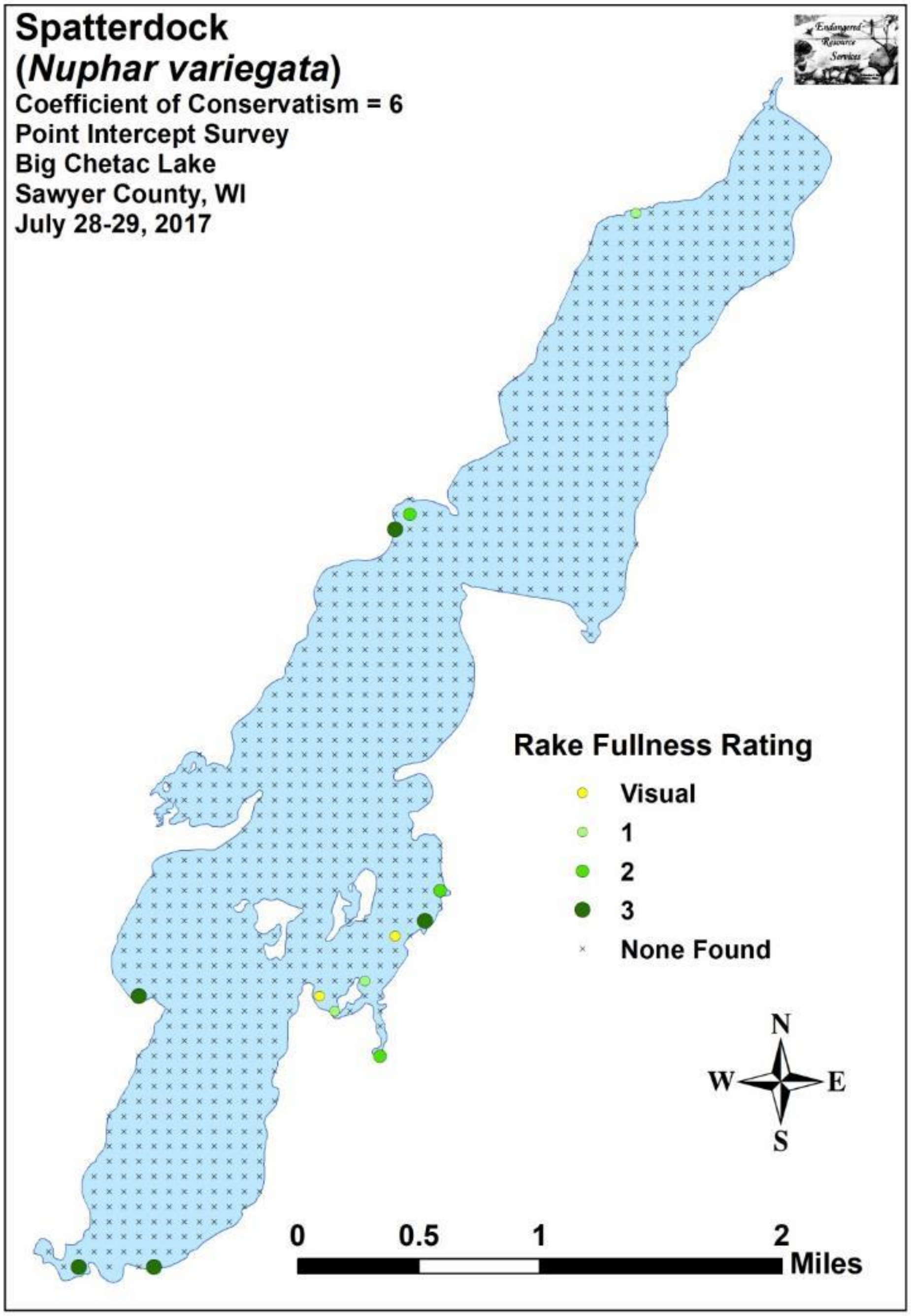
Spatterdock
(*Nuphar variegata*)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
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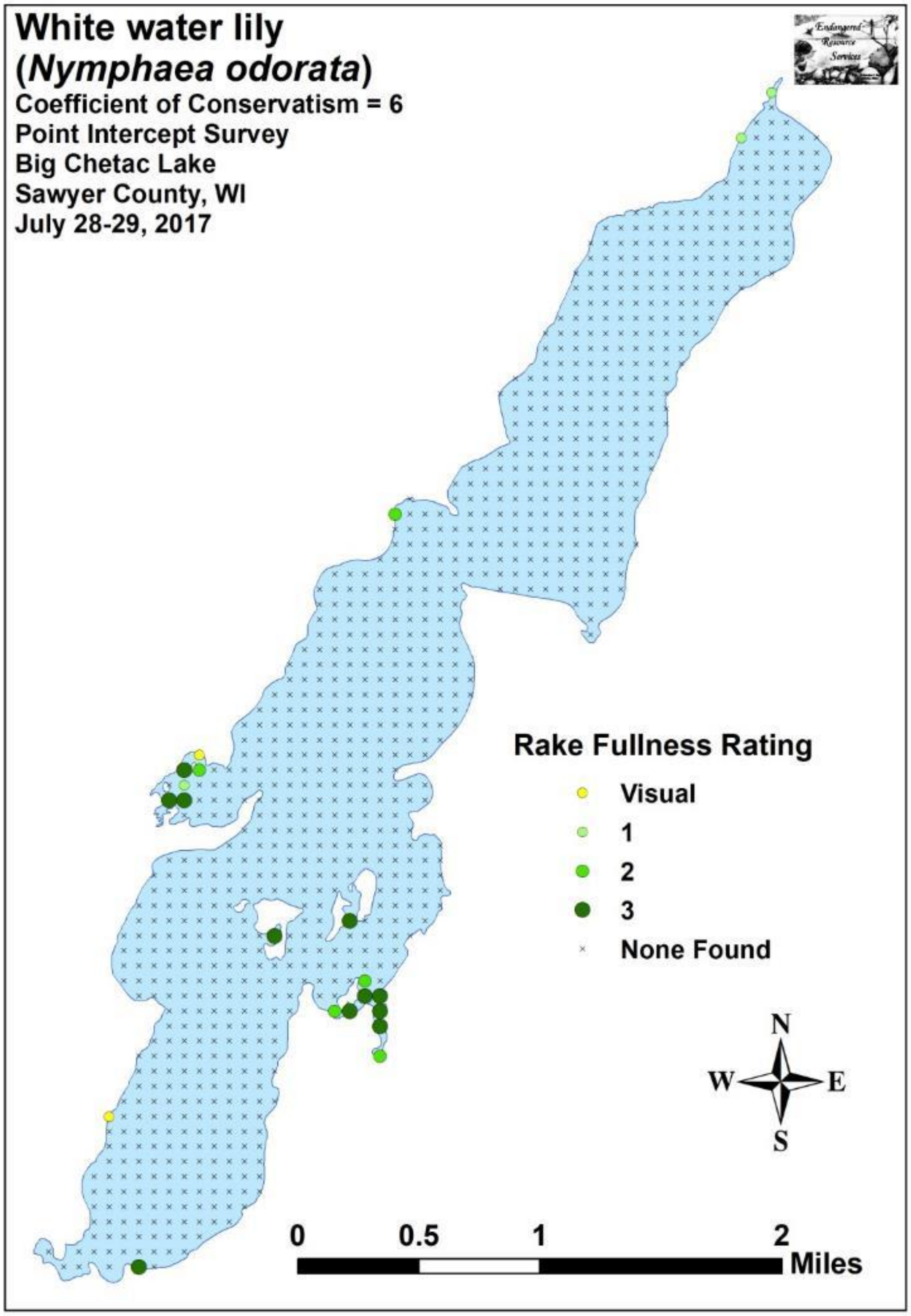

White water lily
(*Nymphaea odorata*)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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None Found
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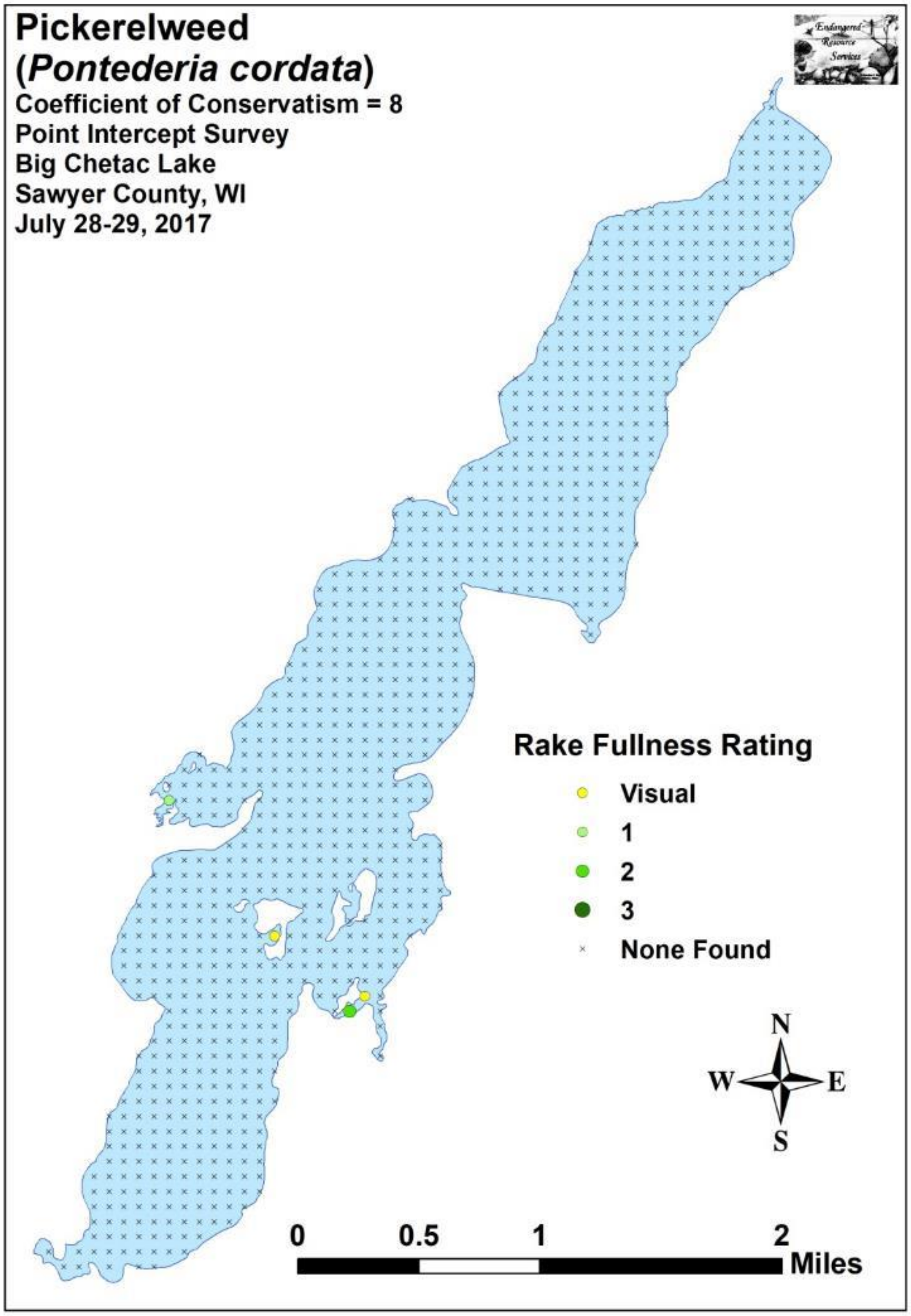
Pickerelweed
(*Pontederia cordata*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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None Found
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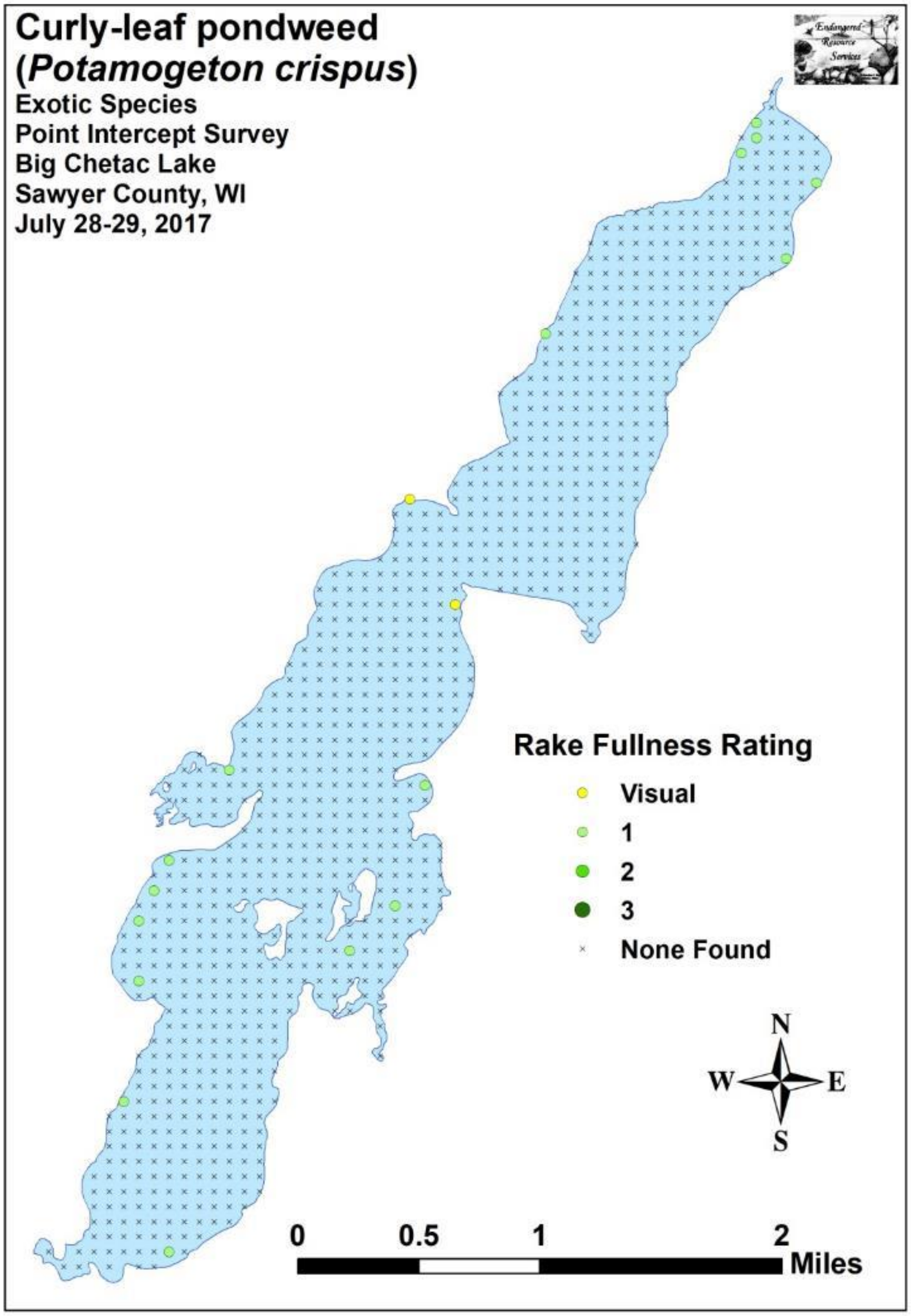
Curly-leaf pondweed
(*Potamogeton crispus*)
Exotic Species
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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None Found
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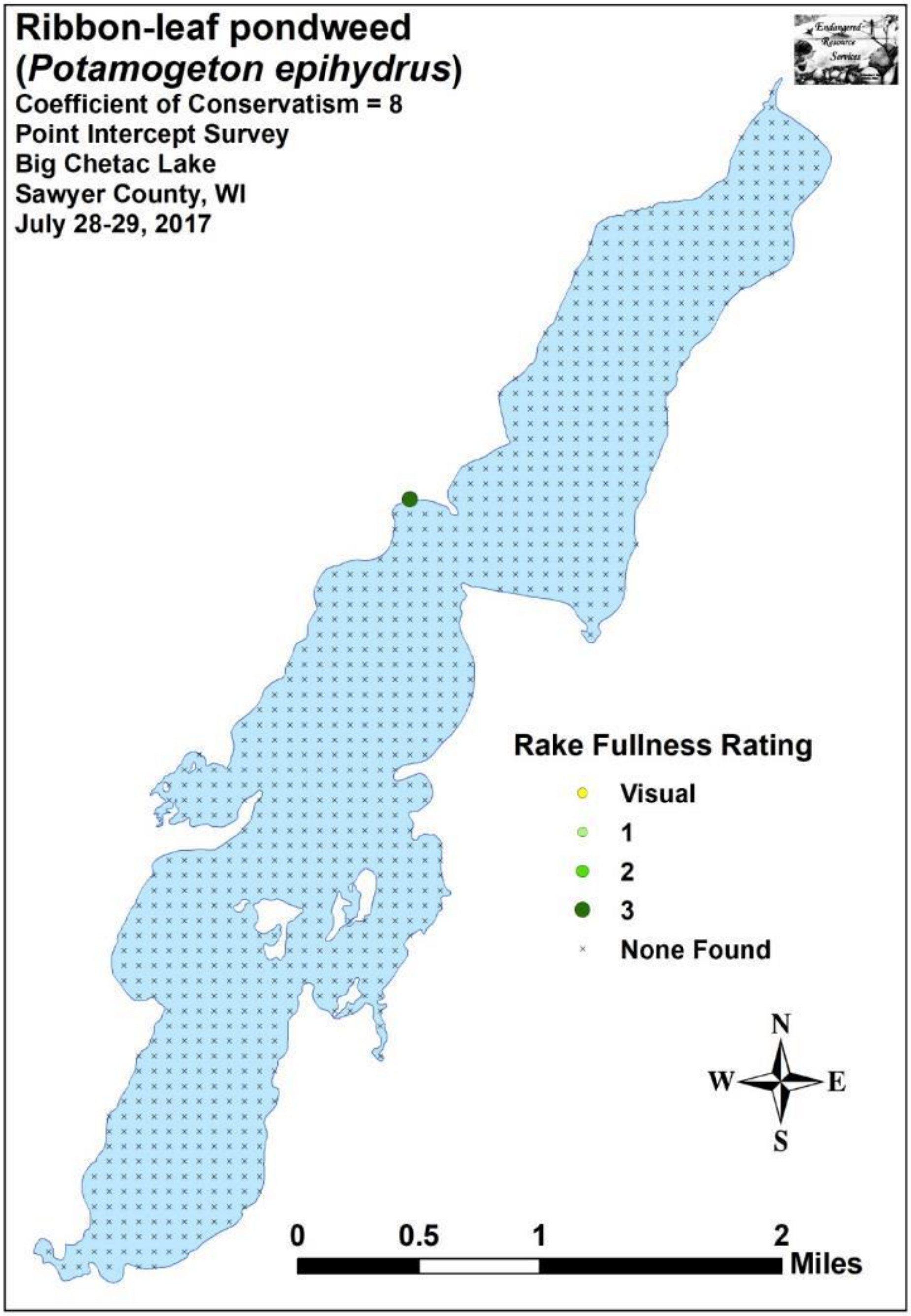
Miles



Ribbon-leaf pondweed
(*Potamogeton epihydrus*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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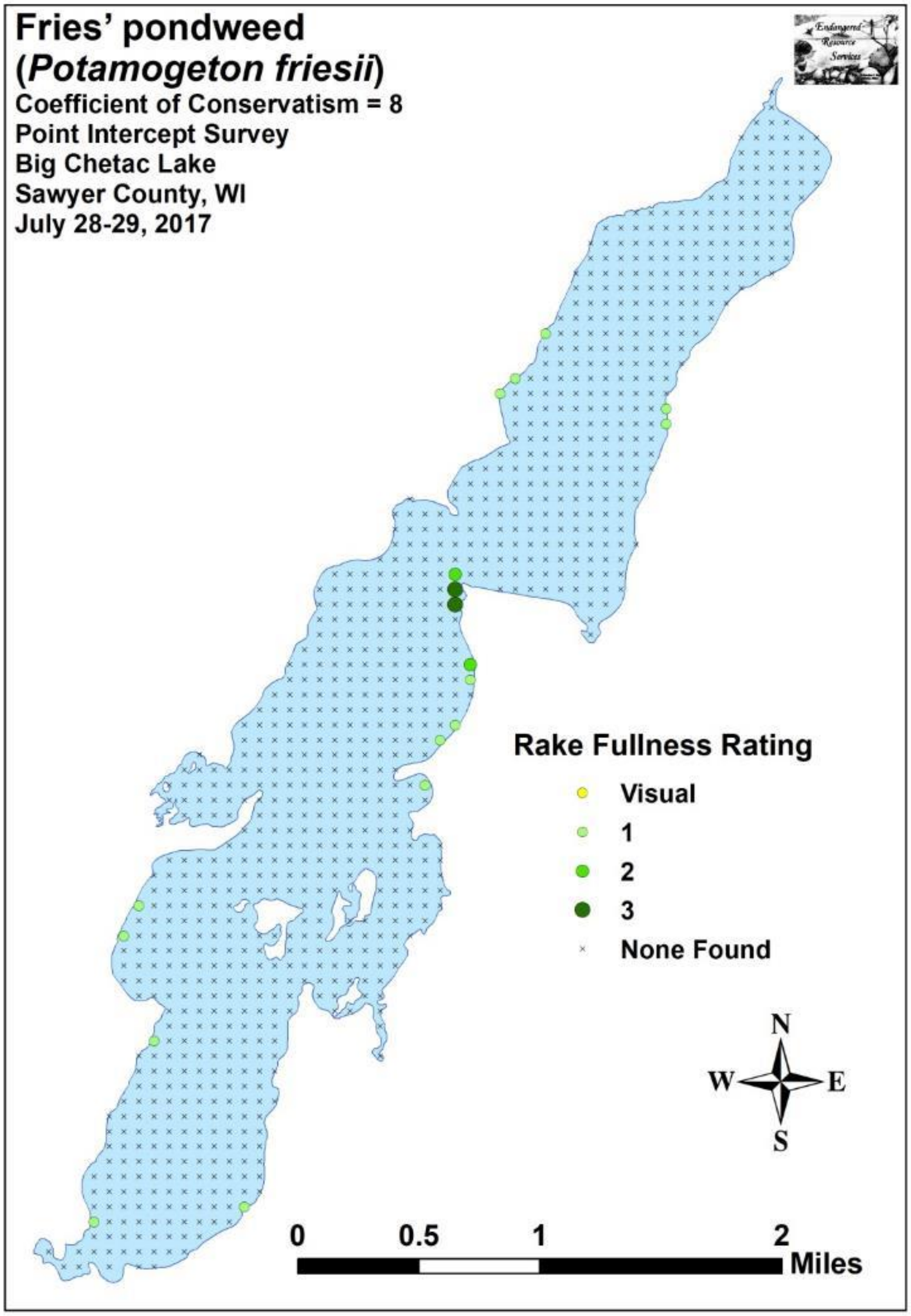
Fries' pondweed
(*Potamogeton friesii*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
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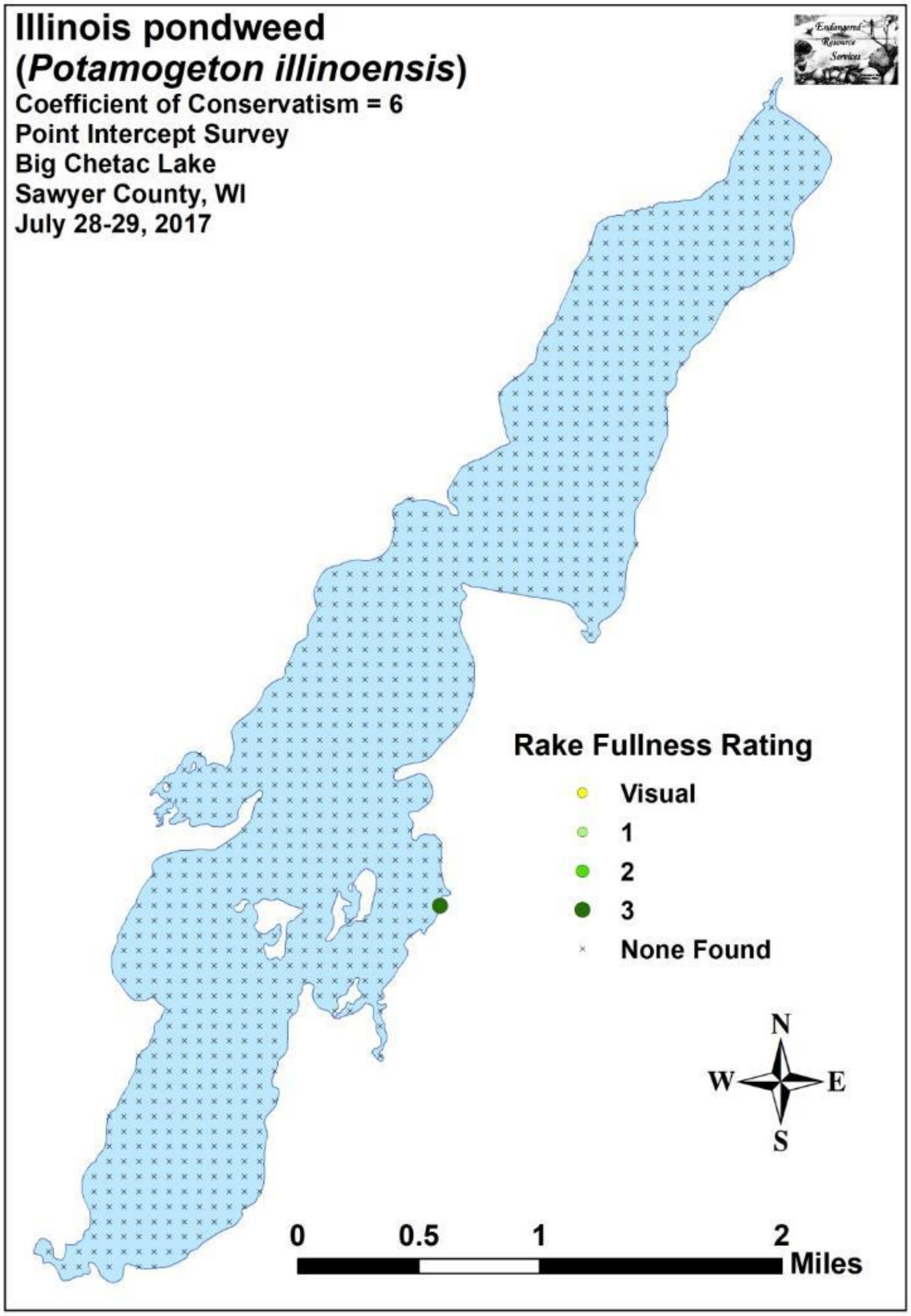
Illinois pondweed
(Potamogeton illinoensis)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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None Found
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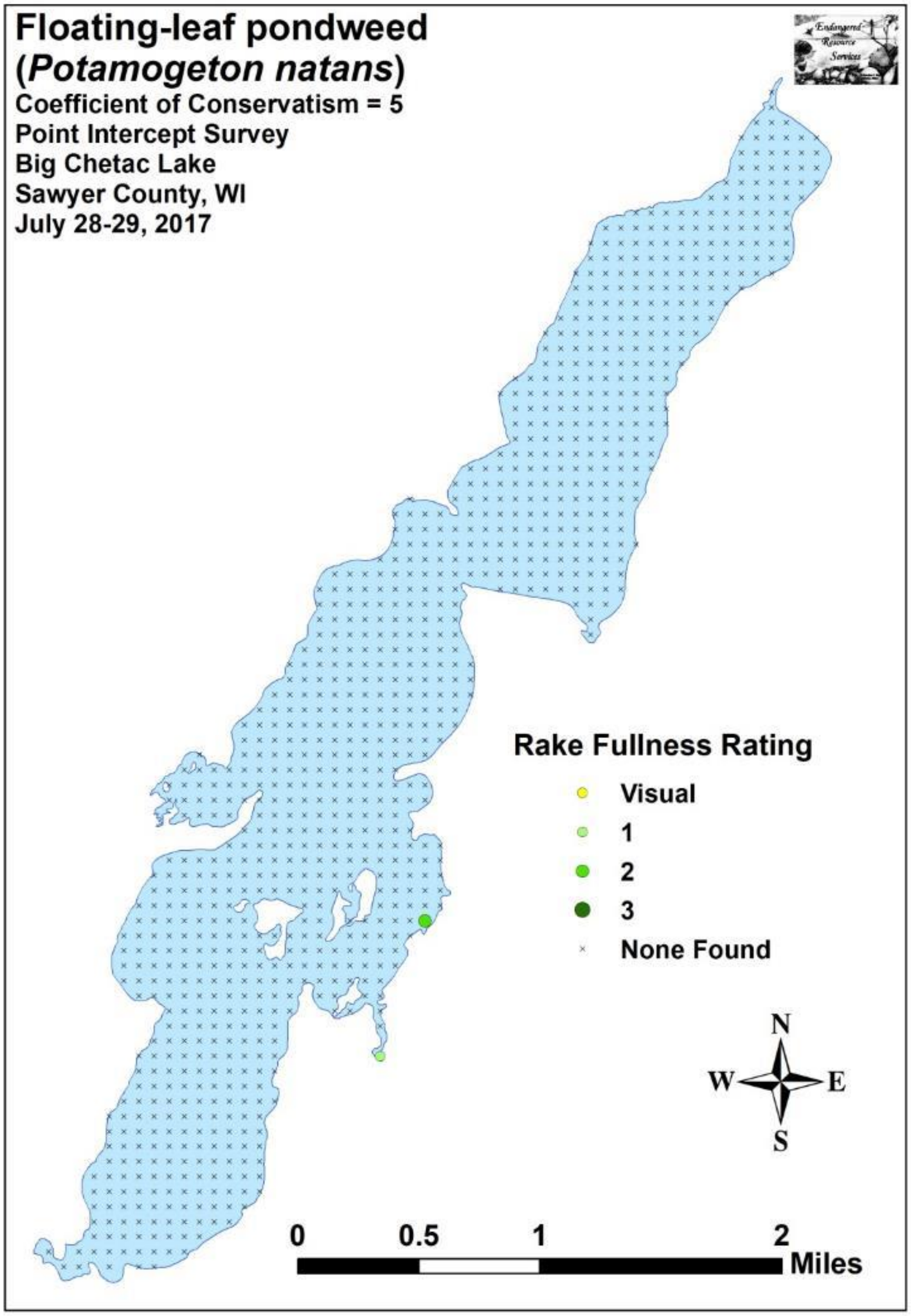

Floating-leaf pondweed
(*Potamogeton natans*)
Coefficient of Conservatism = 5
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
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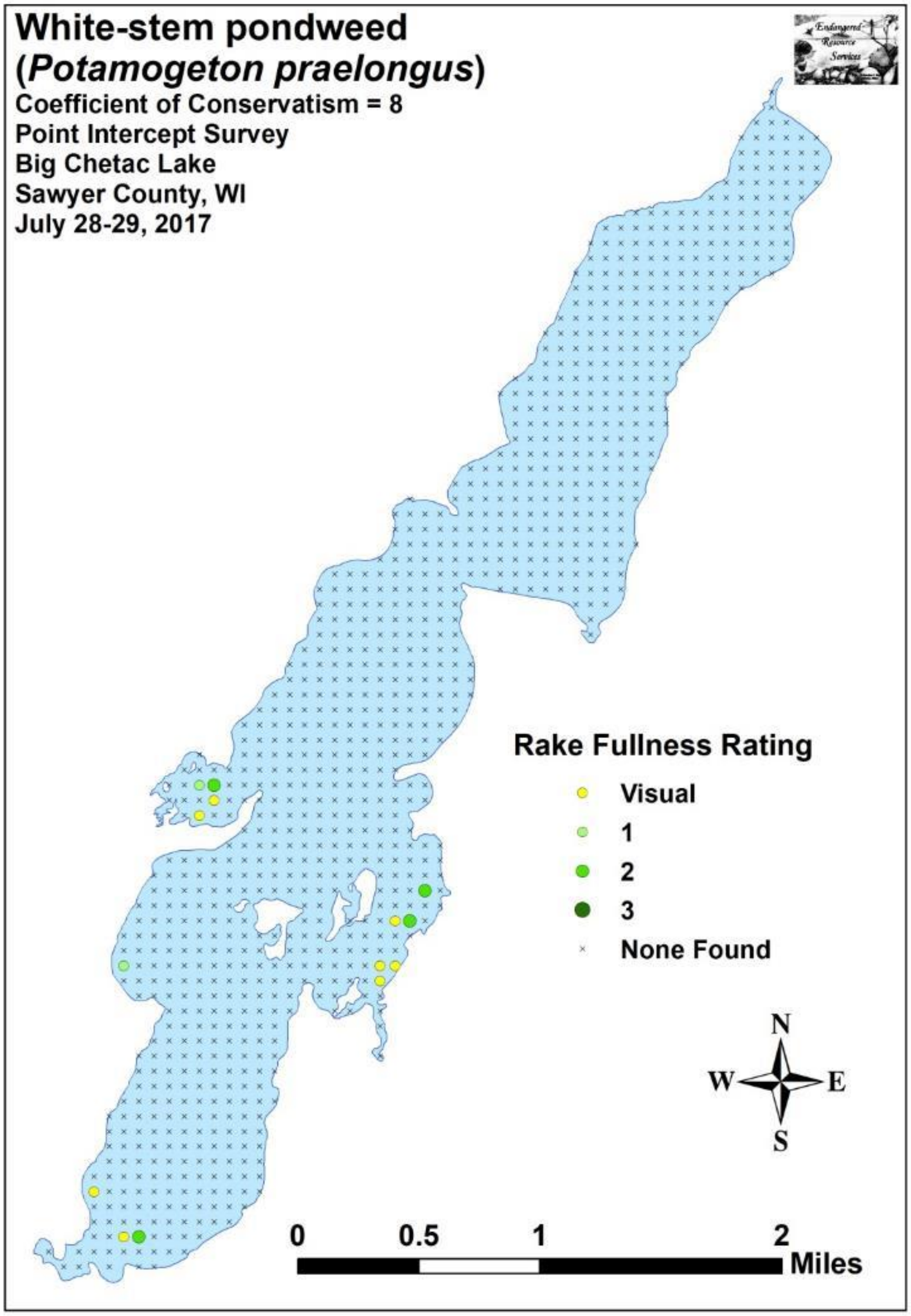
Miles


White-stem pondweed
(Potamogeton praelongus)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
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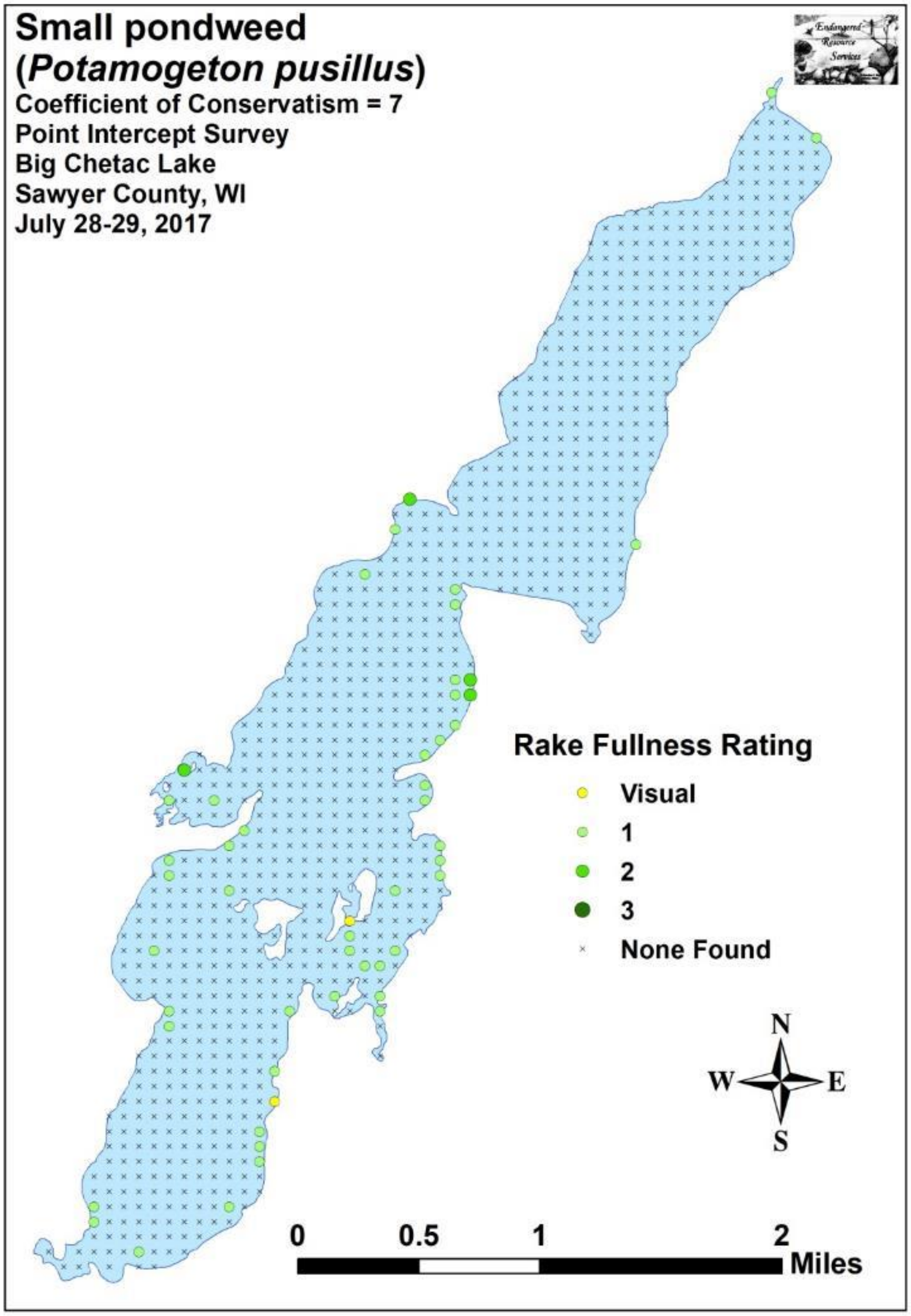
Small pondweed
(*Potamogeton pusillus*)
Coefficient of Conservatism = 7
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
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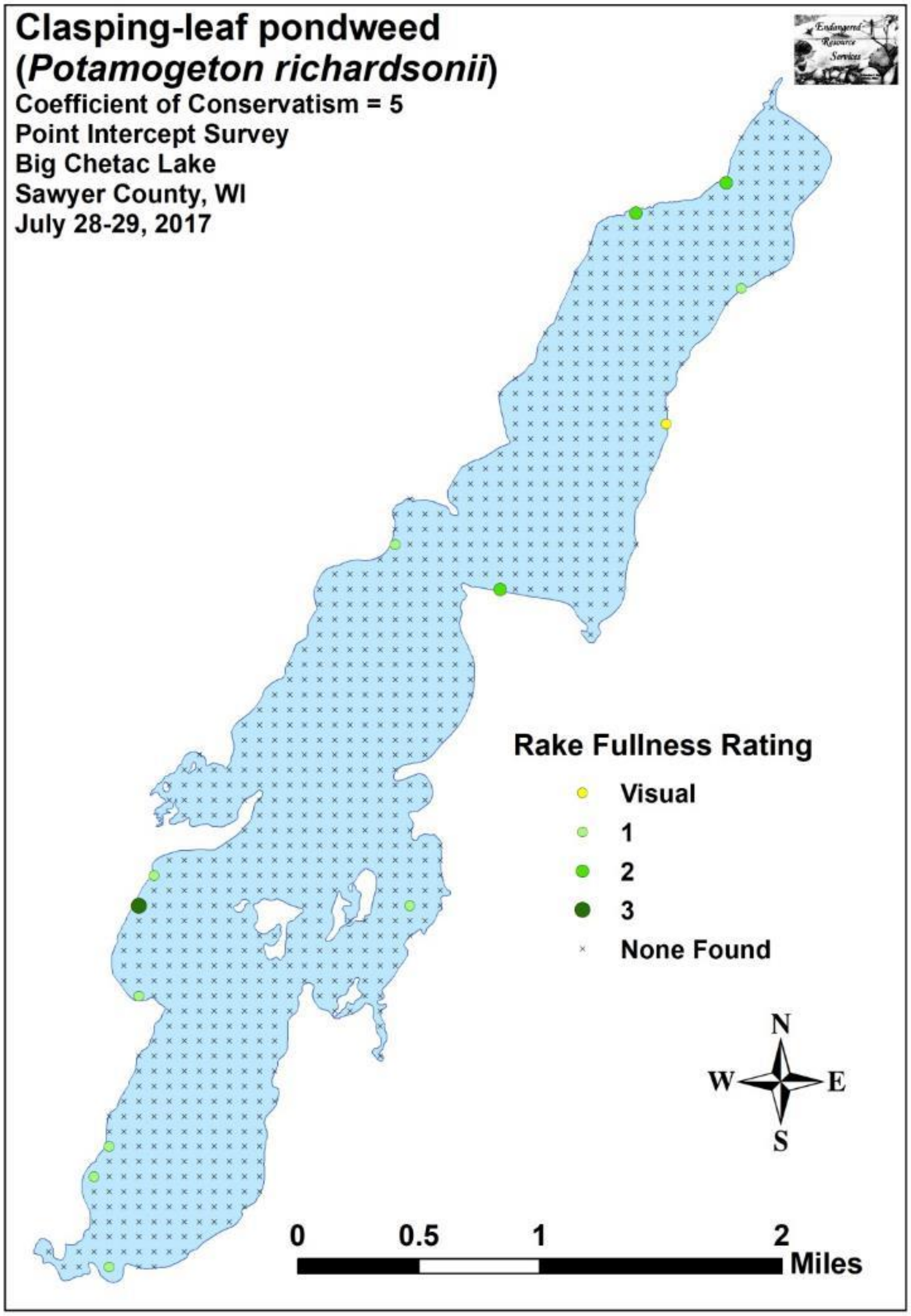
Clasping-leaf pondweed
(*Potamogeton richardsonii*)
Coefficient of Conservatism = 5
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
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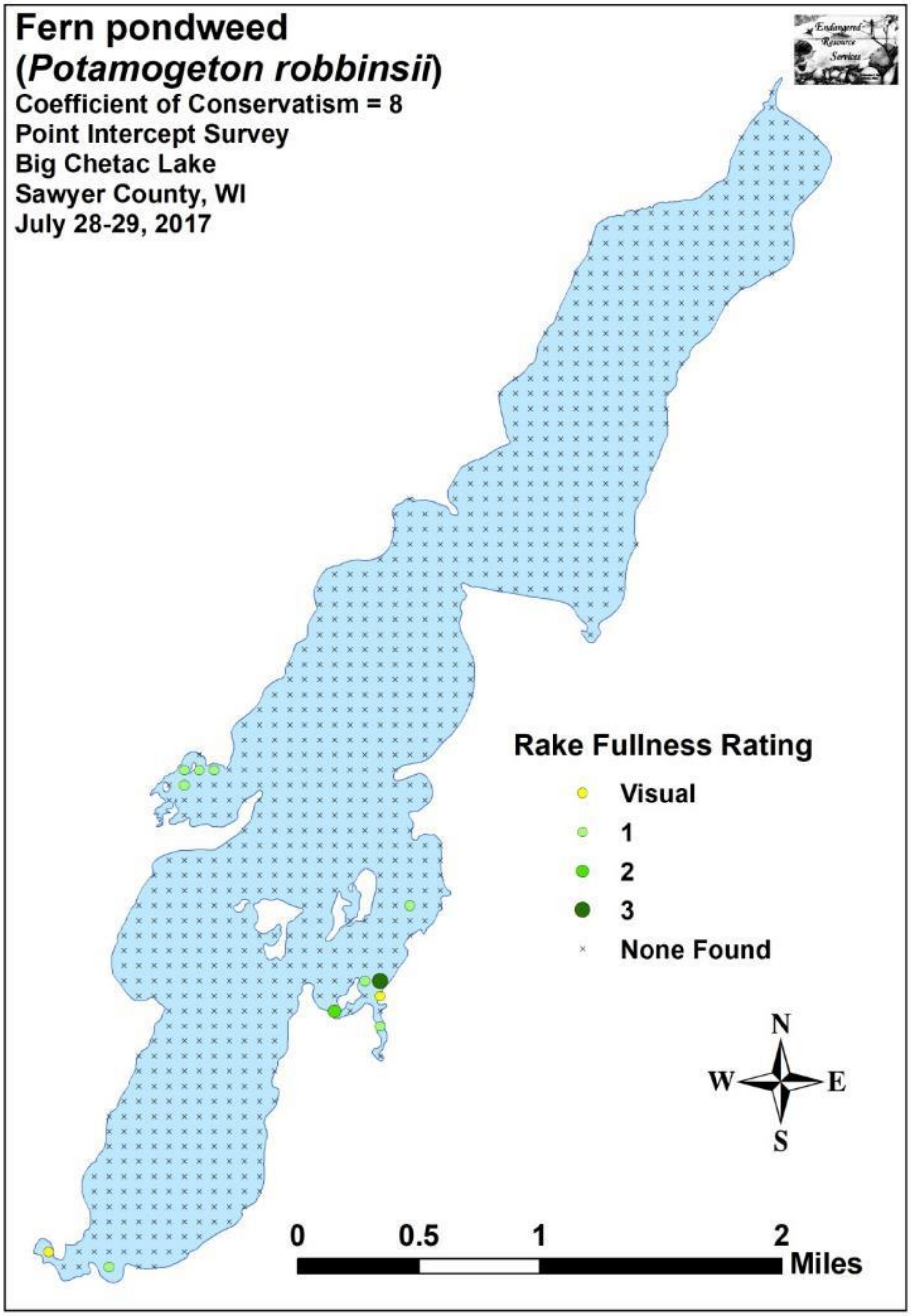
Fern pondweed
(*Potamogeton robbinsii*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
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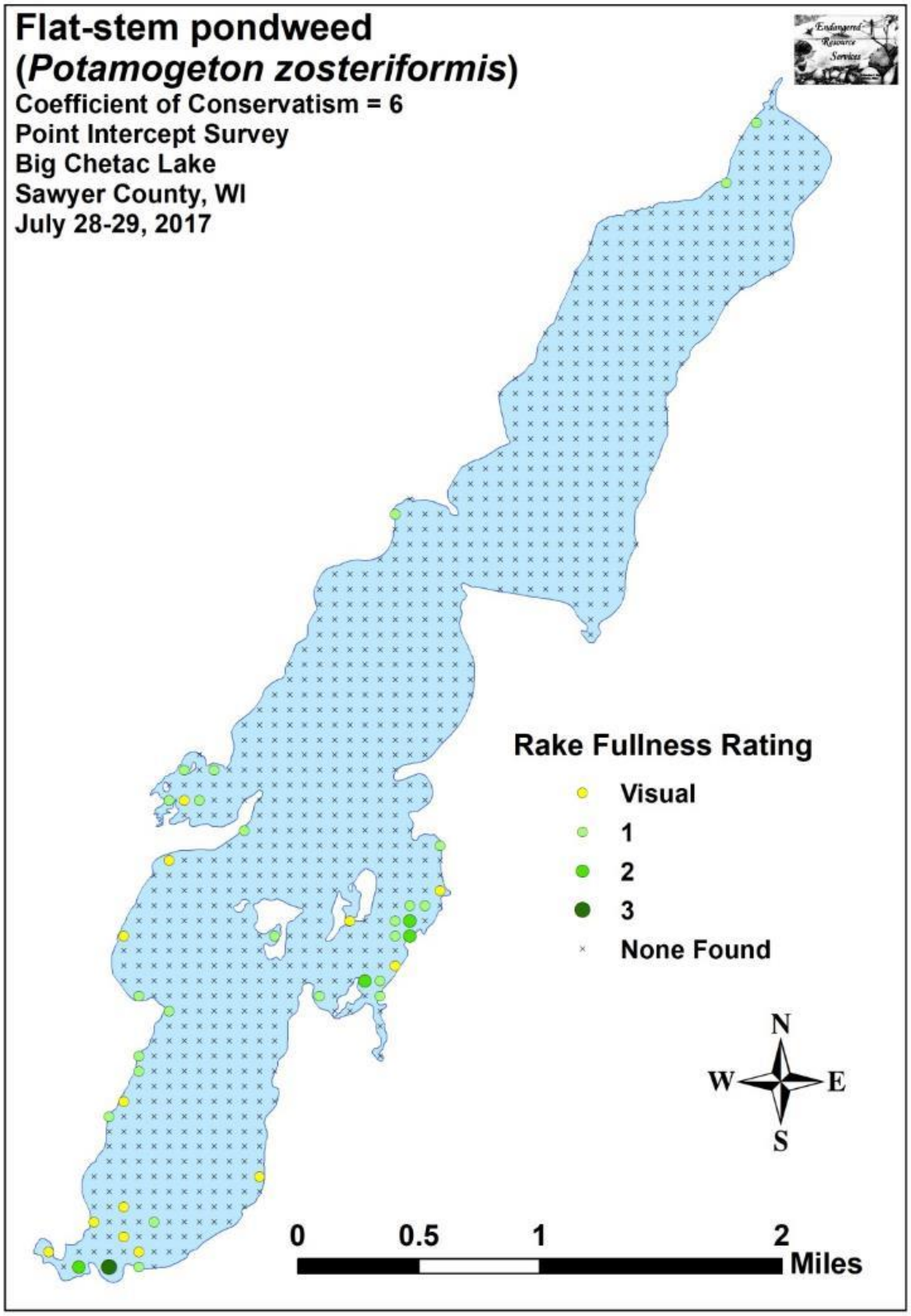
Flat-stem pondweed
(*Potamogeton zosteriformis*)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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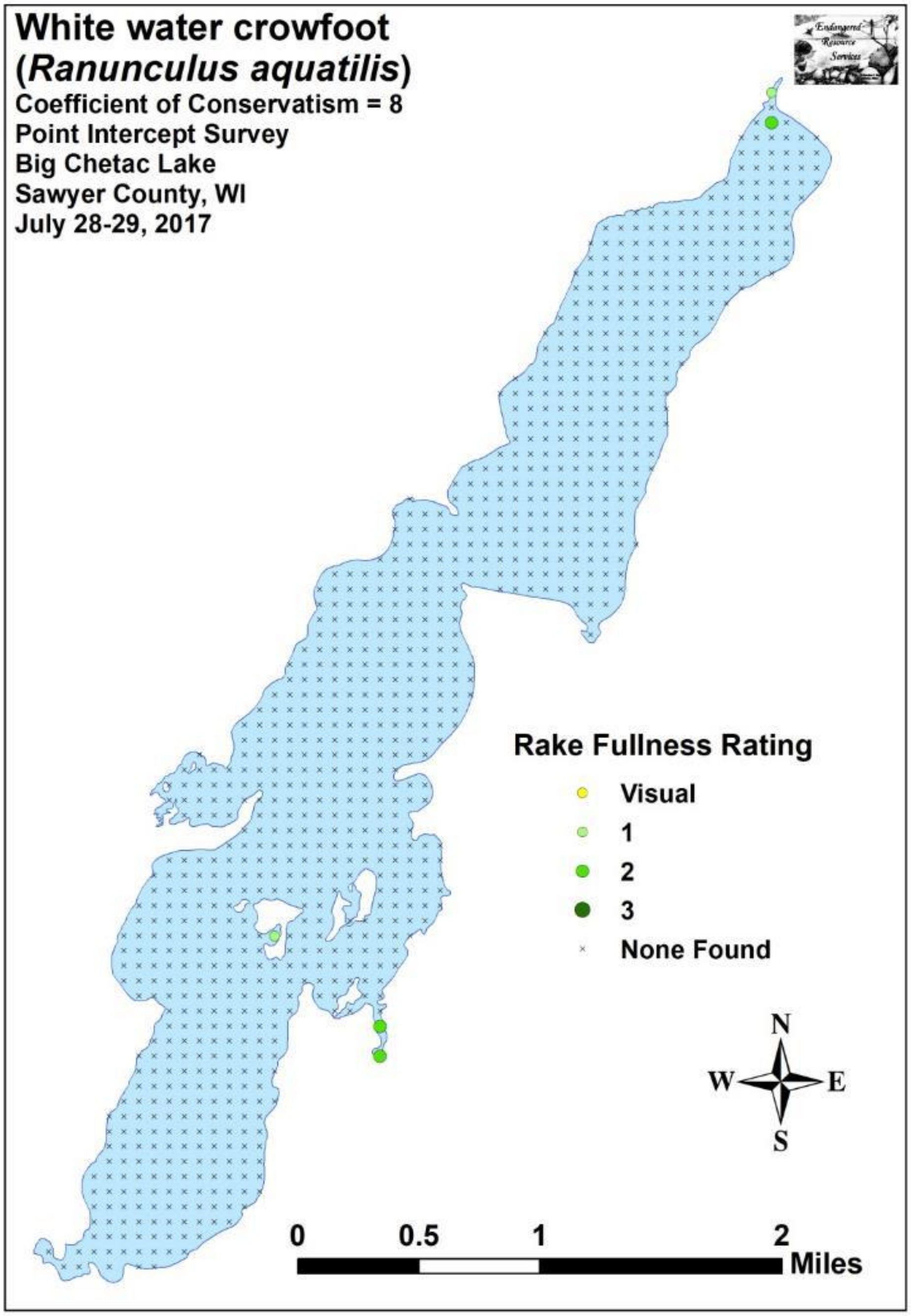
White water crowfoot
(*Ranunculus aquatilis*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
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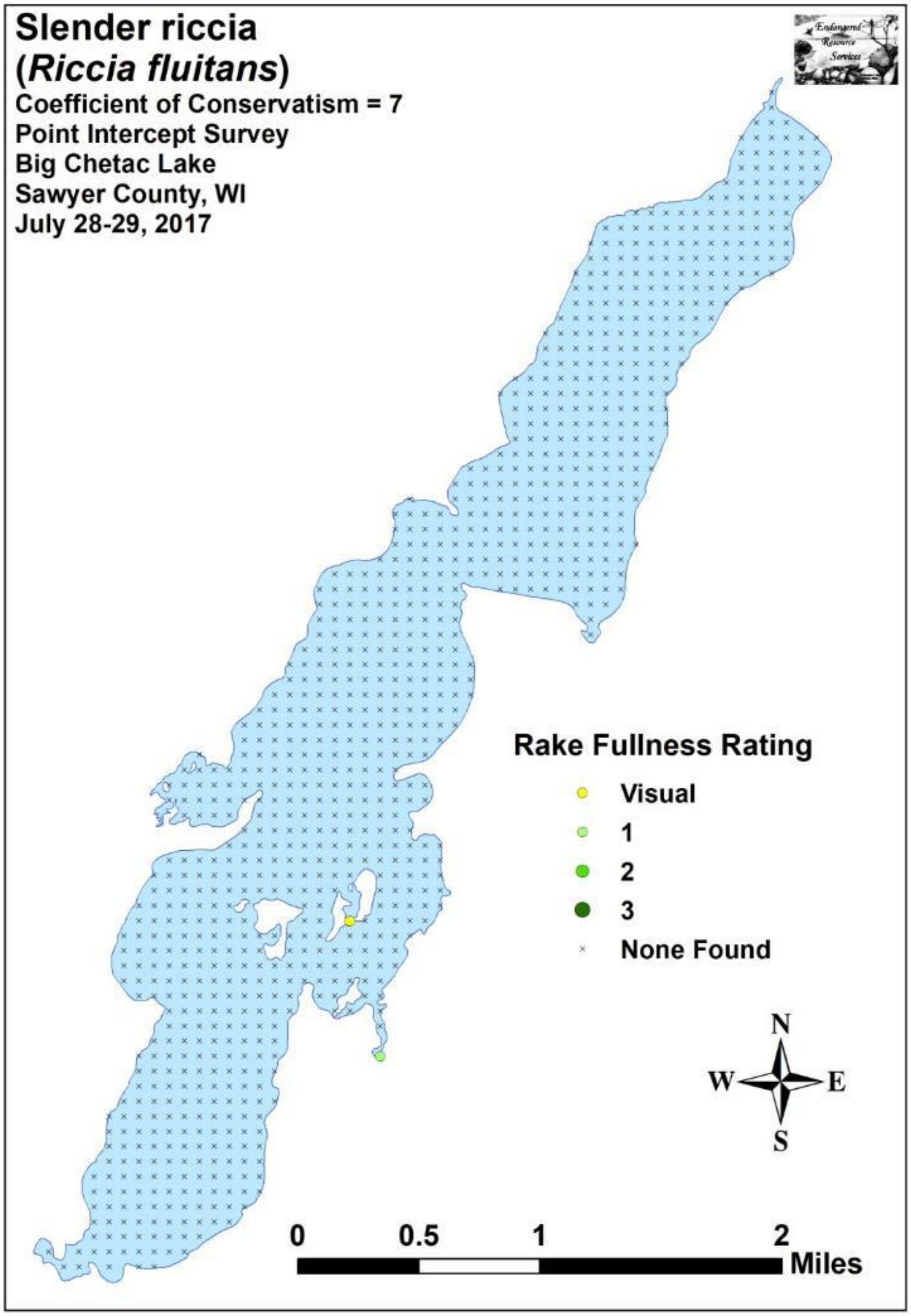
Slender riccia
(Riccia fluitans)
Coefficient of Conservatism = 7
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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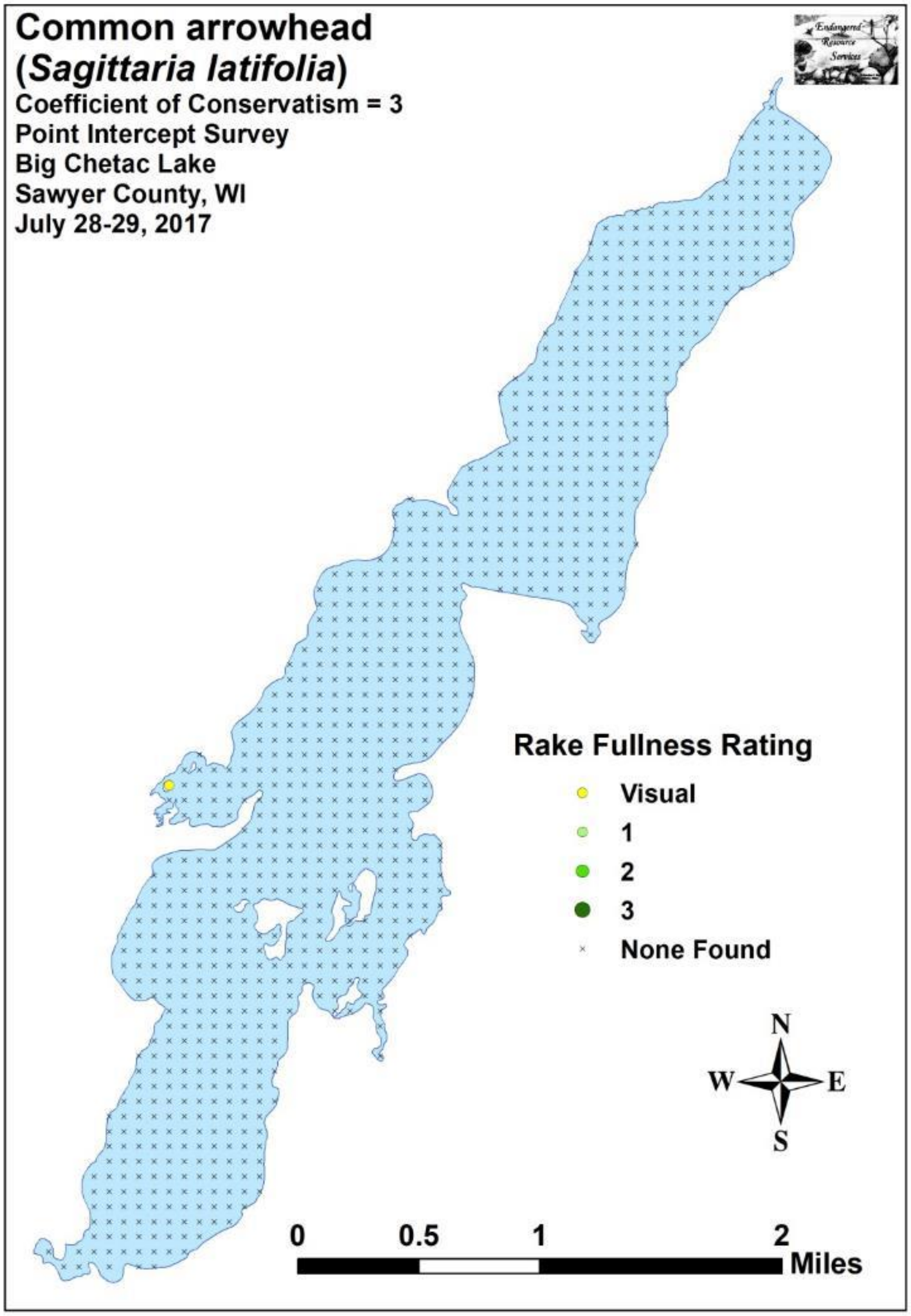
Common arrowhead
(Sagittaria latifolia)
Coefficient of Conservatism = 3
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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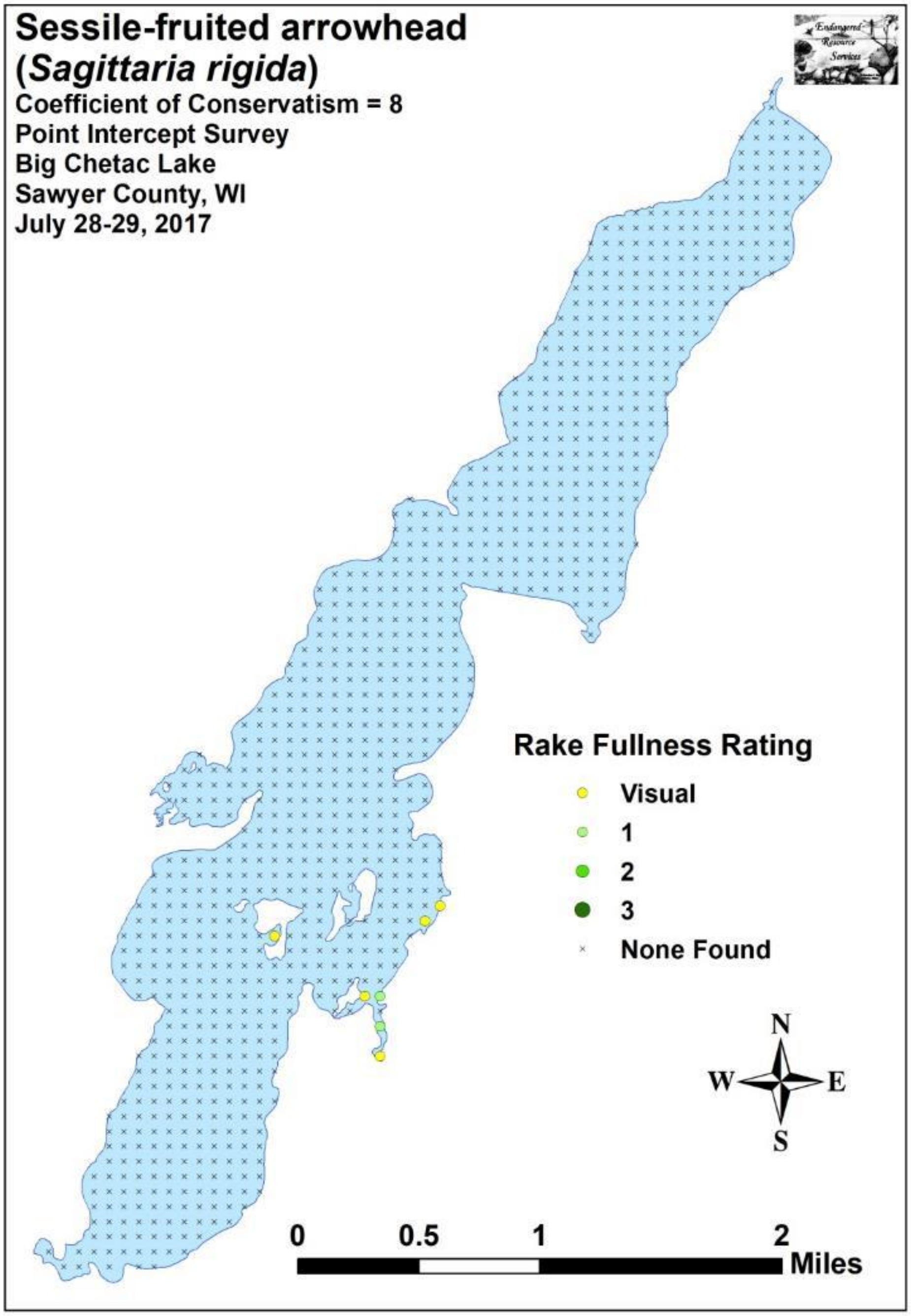
Sessile-fruited arrowhead
(Sagittaria rigida)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
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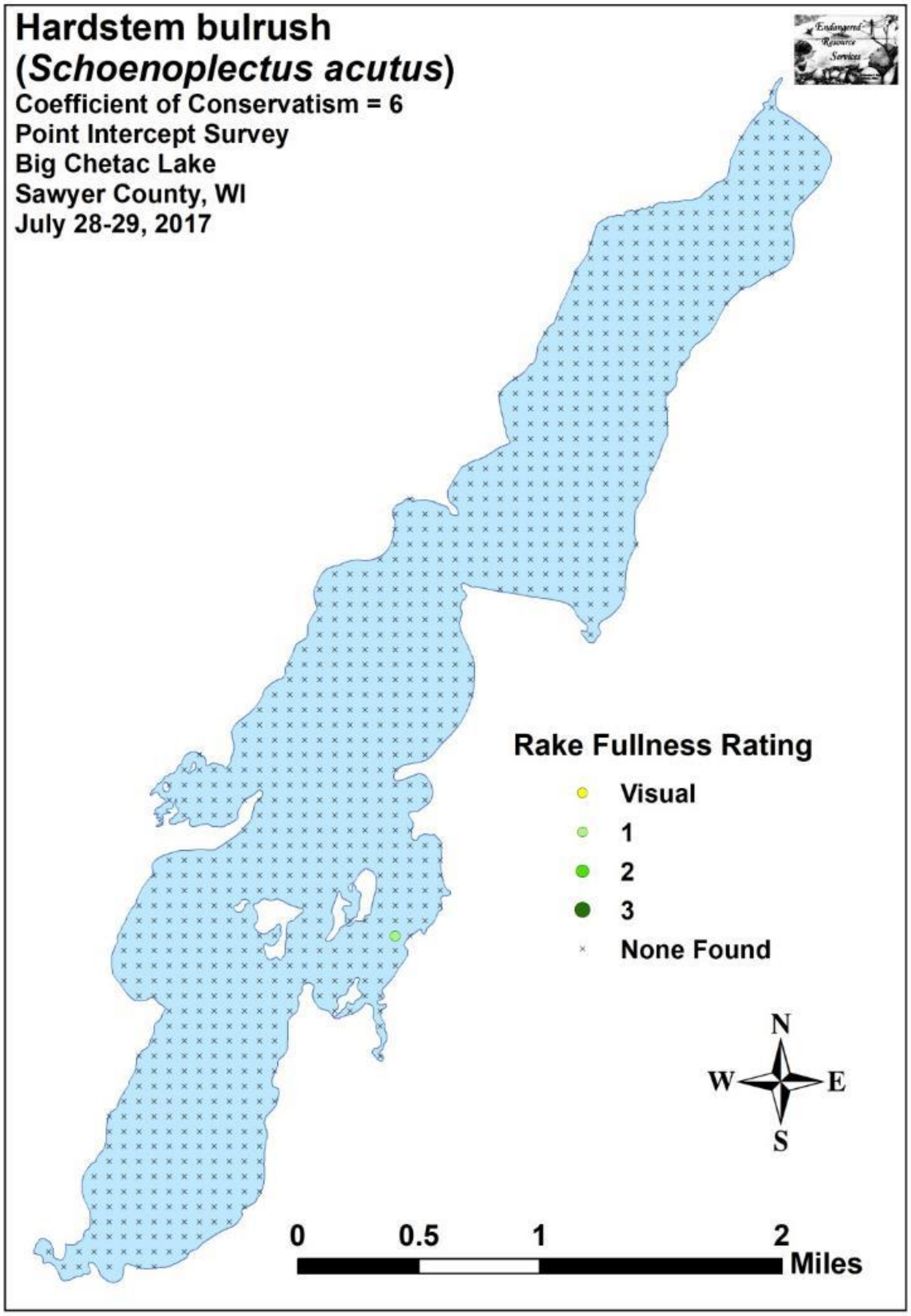
Hardstem bulrush
(Schoenoplectus acutus)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
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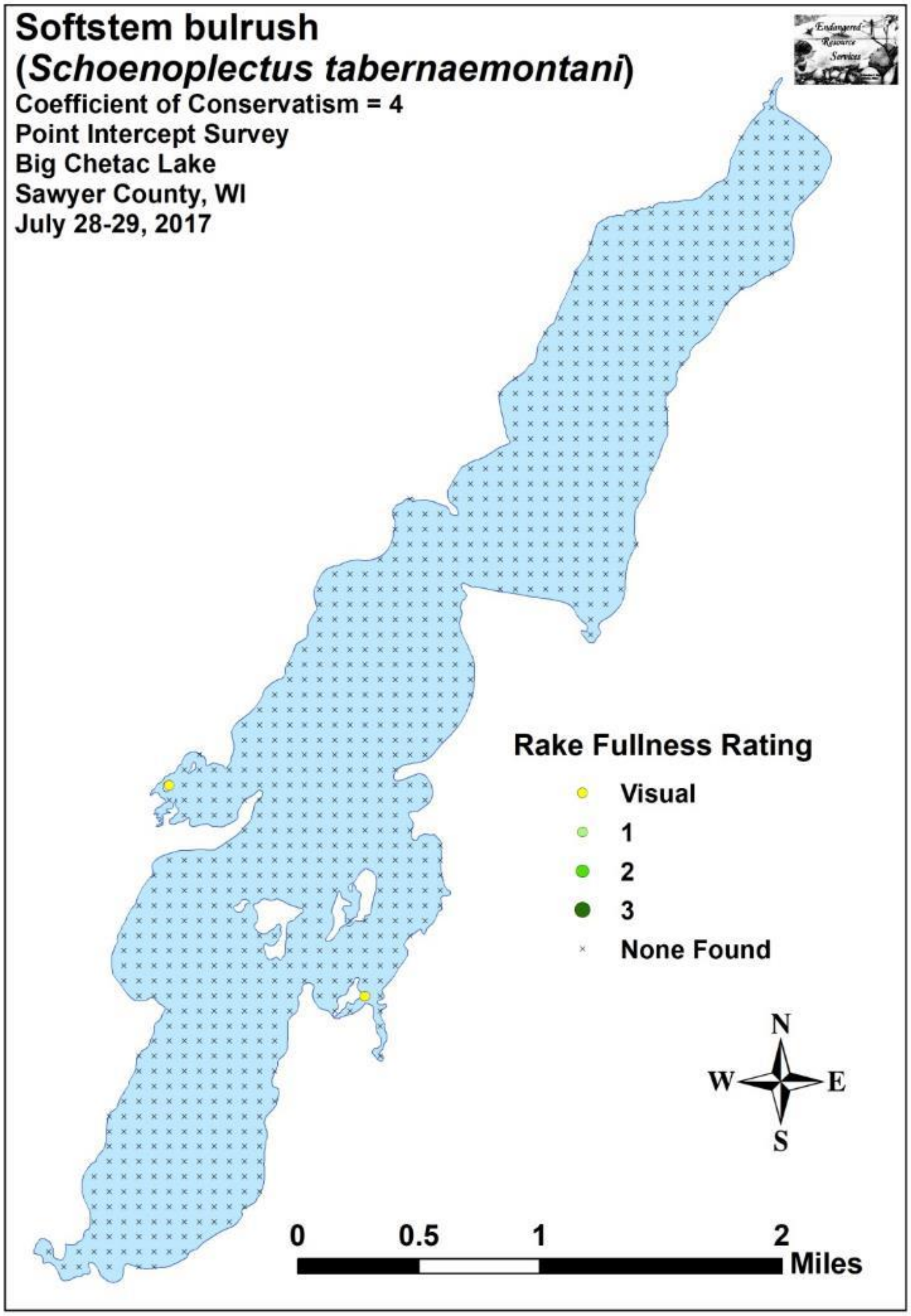
Softstem bulrush
(Schoenoplectus tabernaemontani)
Coefficient of Conservatism = 4
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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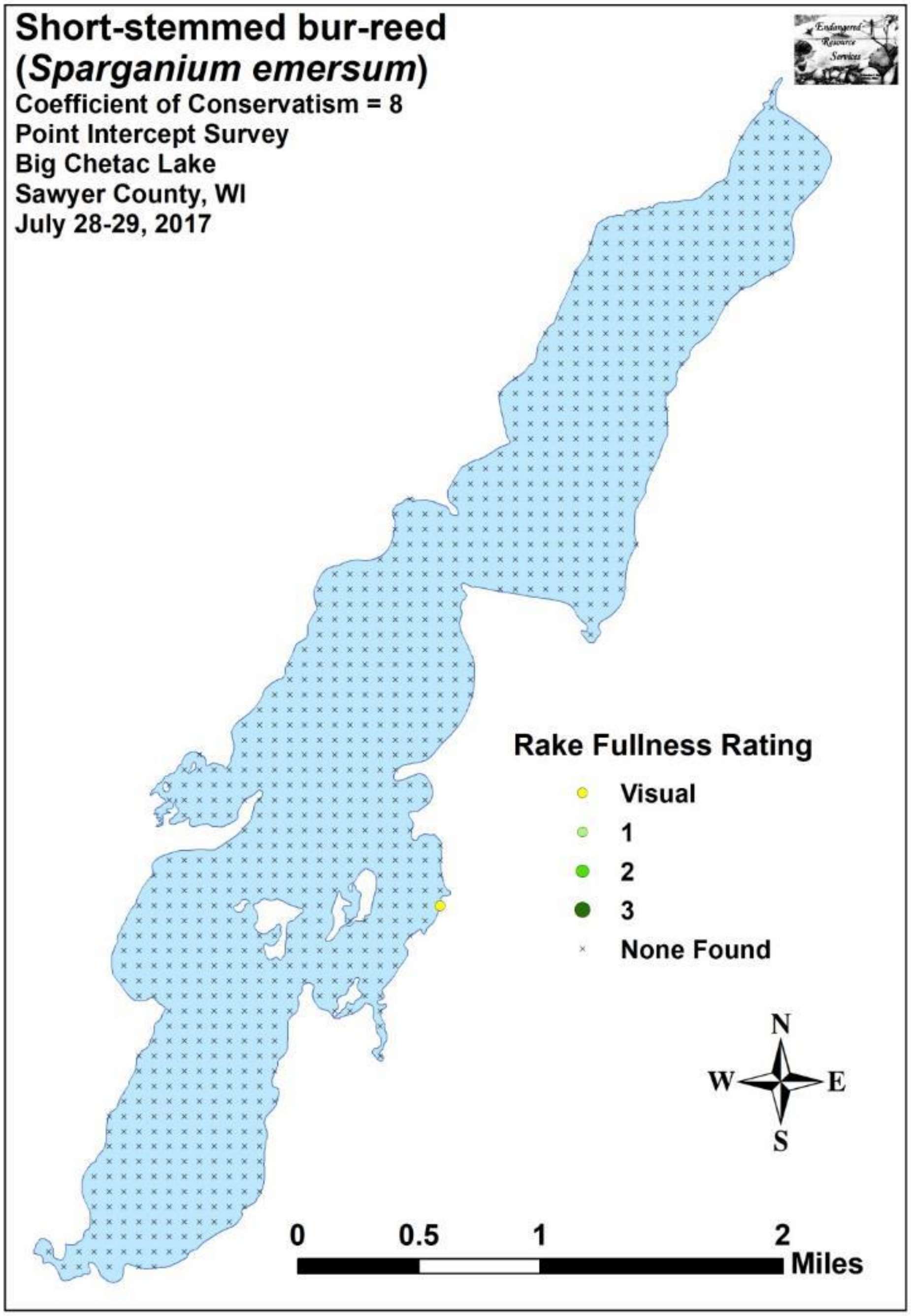
Short-stemmed bur-reed
(*Sparganium emersum*)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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None Found
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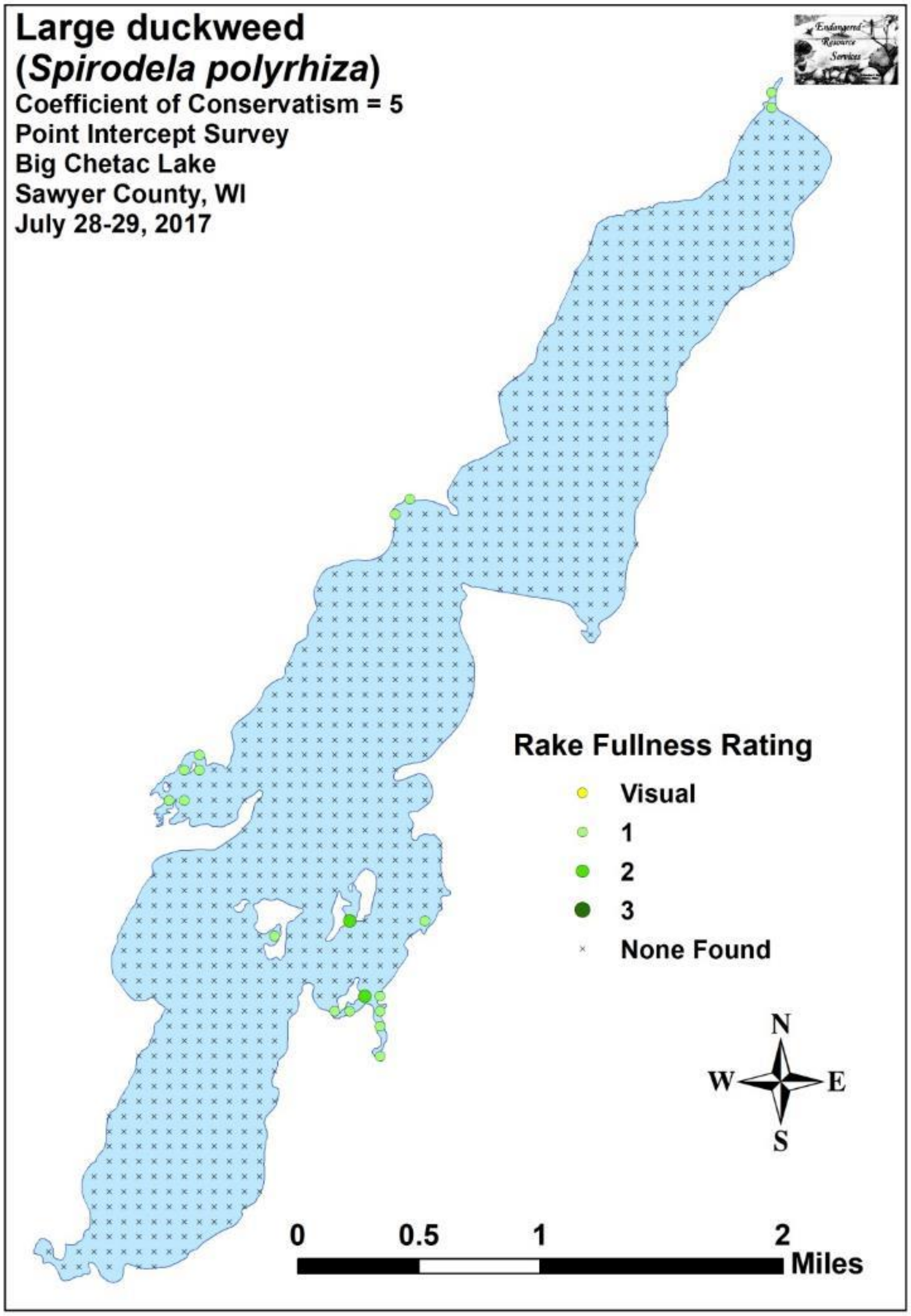
Large duckweed
(*Spirodela polyrhiza*)
Coefficient of Conservatism = 5
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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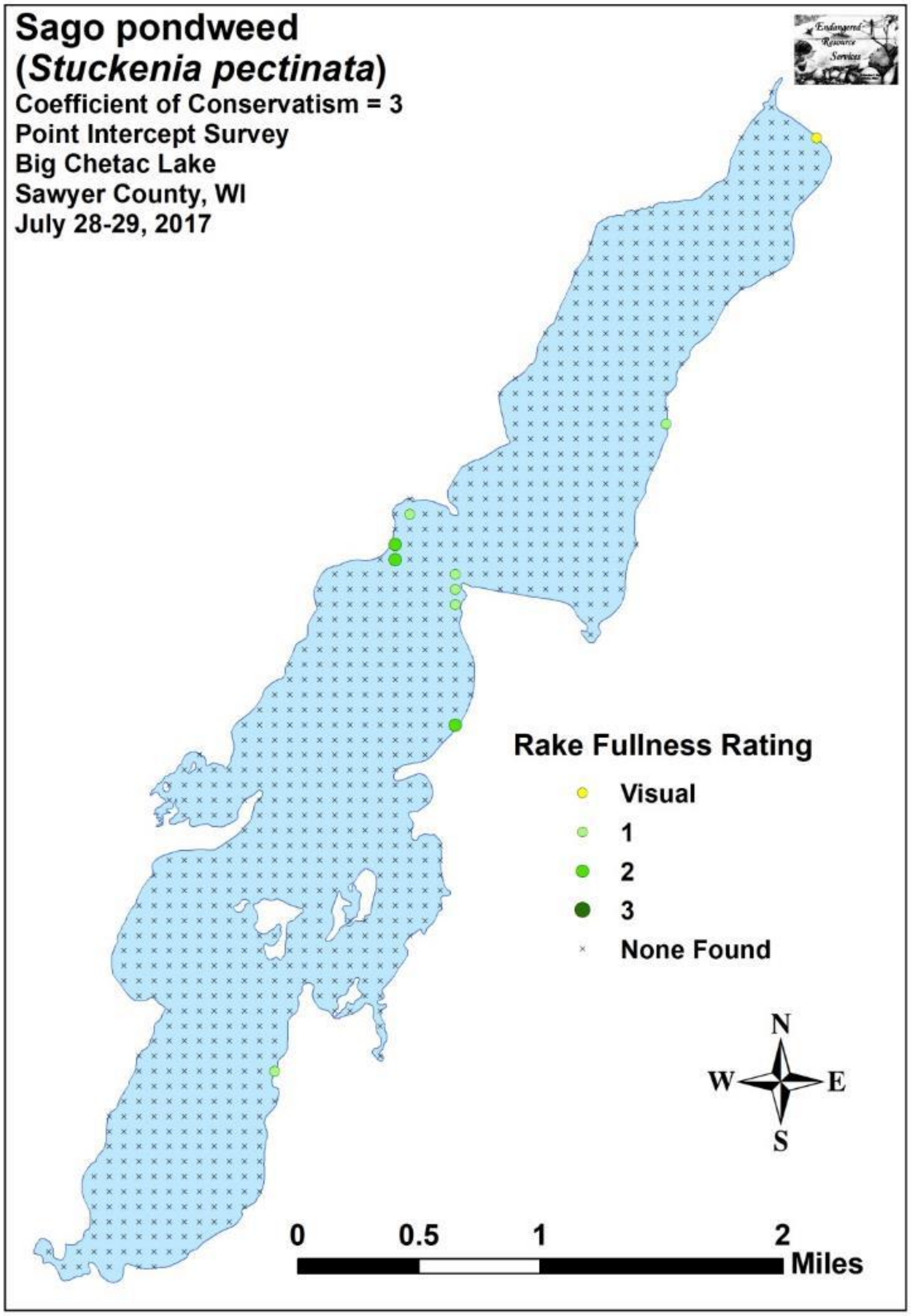
Sago pondweed
(Stuckenia pectinata)
Coefficient of Conservatism = 3
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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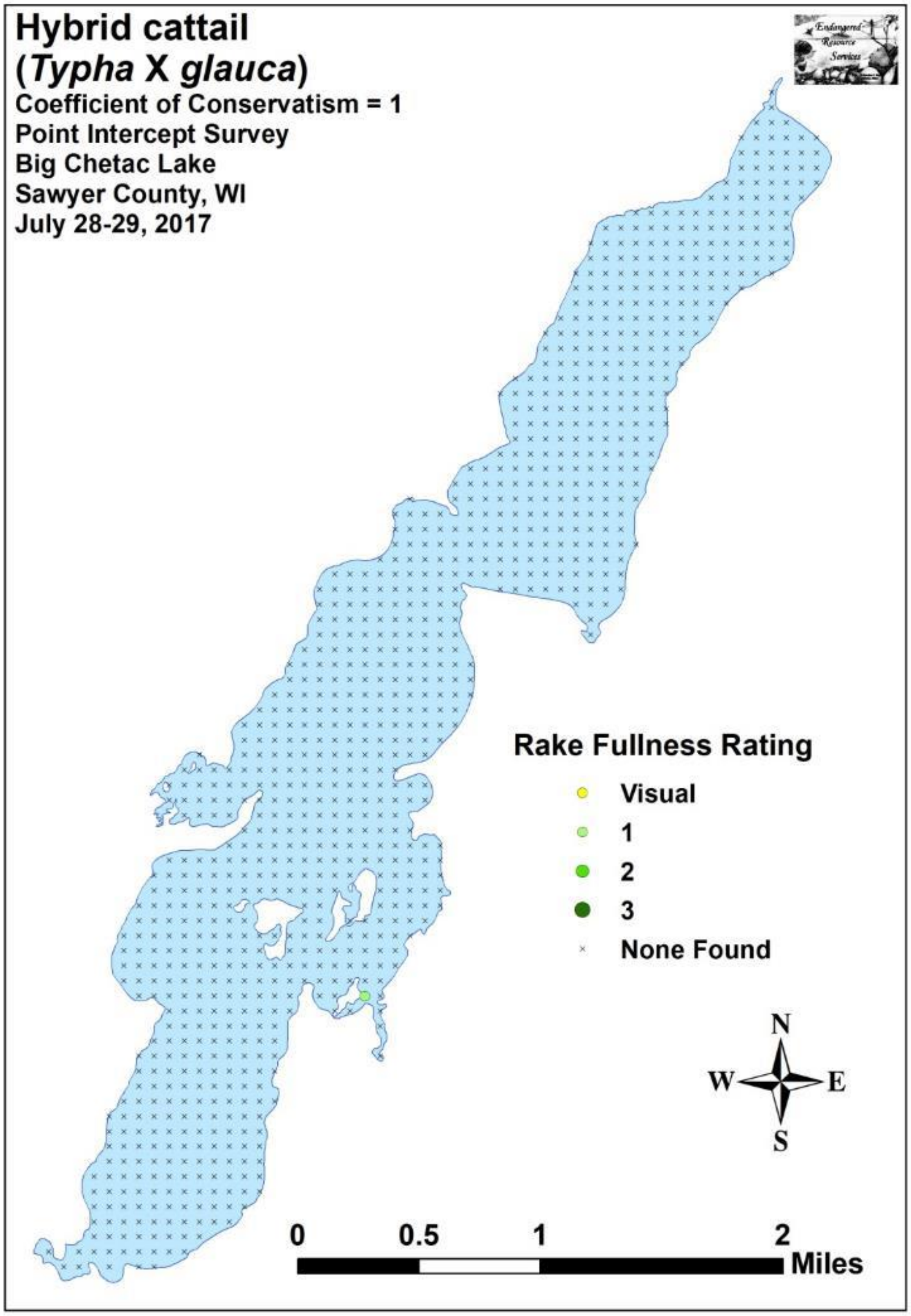
Hybrid cattail
(*Typha* X *glauca*)
Coefficient of Conservatism = 1
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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None Found
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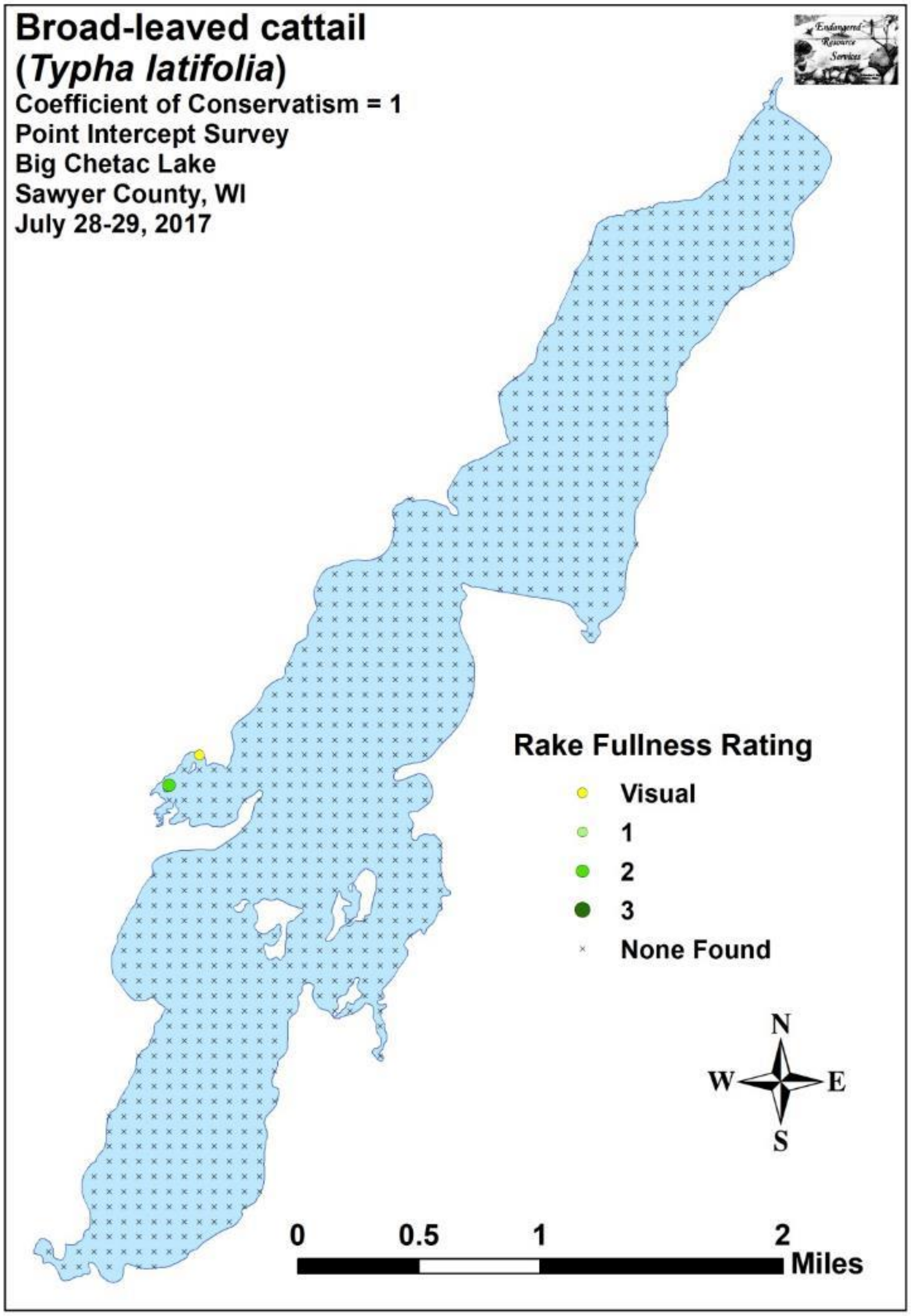
Broad-leaved cattail
(*Typha latifolia*)
Coefficient of Conservatism = 1
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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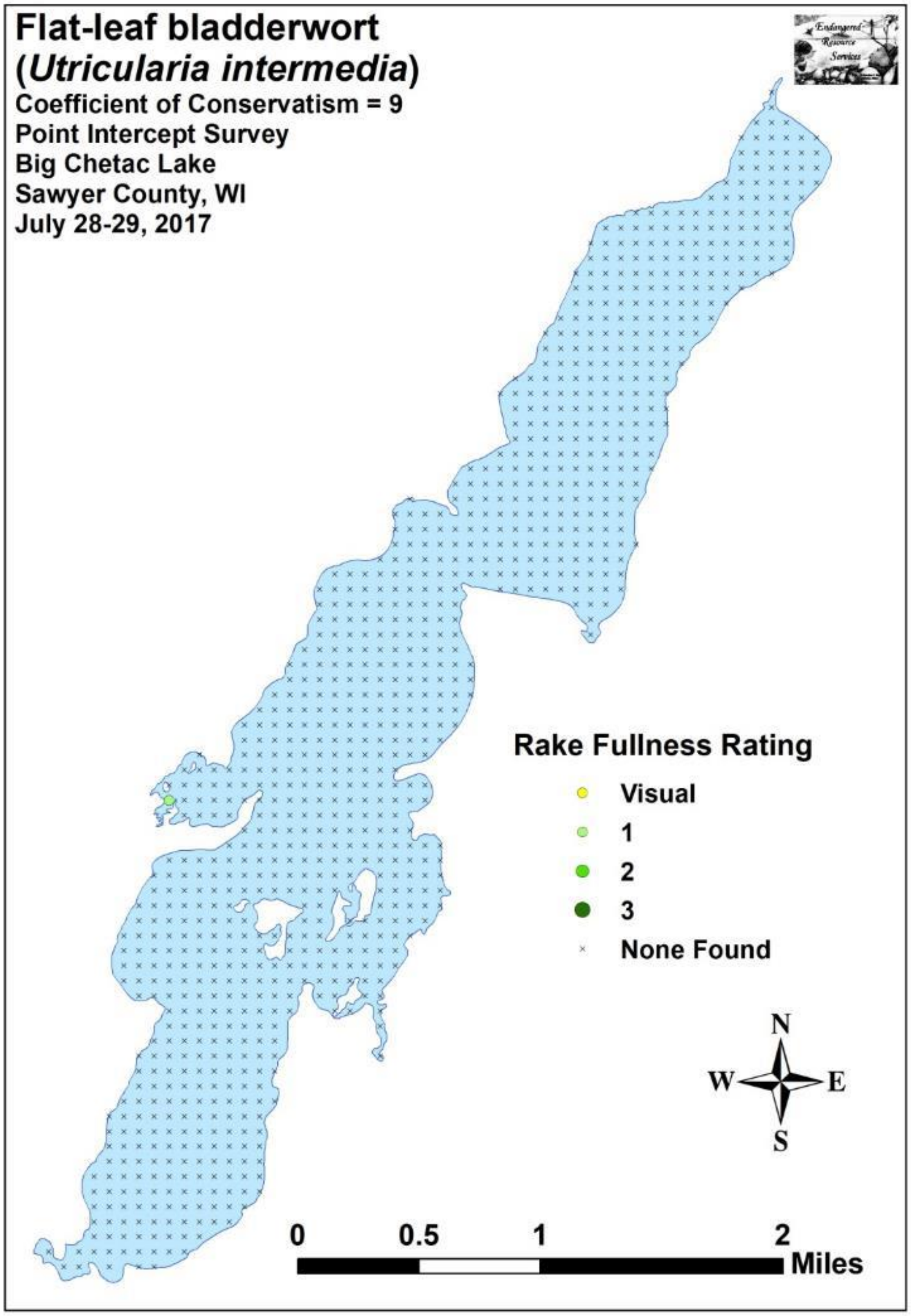
Flat-leaf bladderwort
(Utricularia intermedia)
Coefficient of Conservatism = 9
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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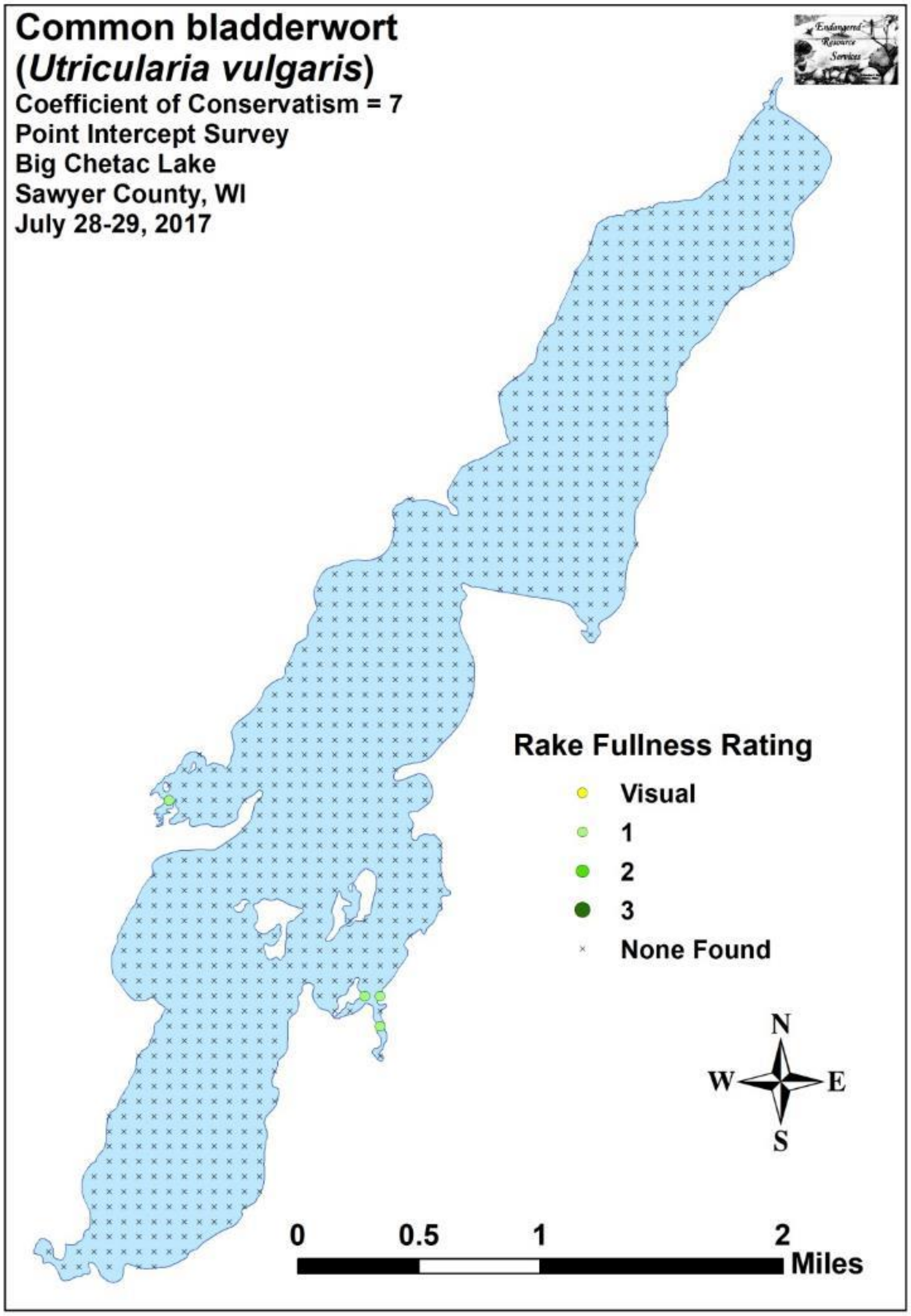
Common bladderwort
(*Utricularia vulgaris*)
Coefficient of Conservatism = 7
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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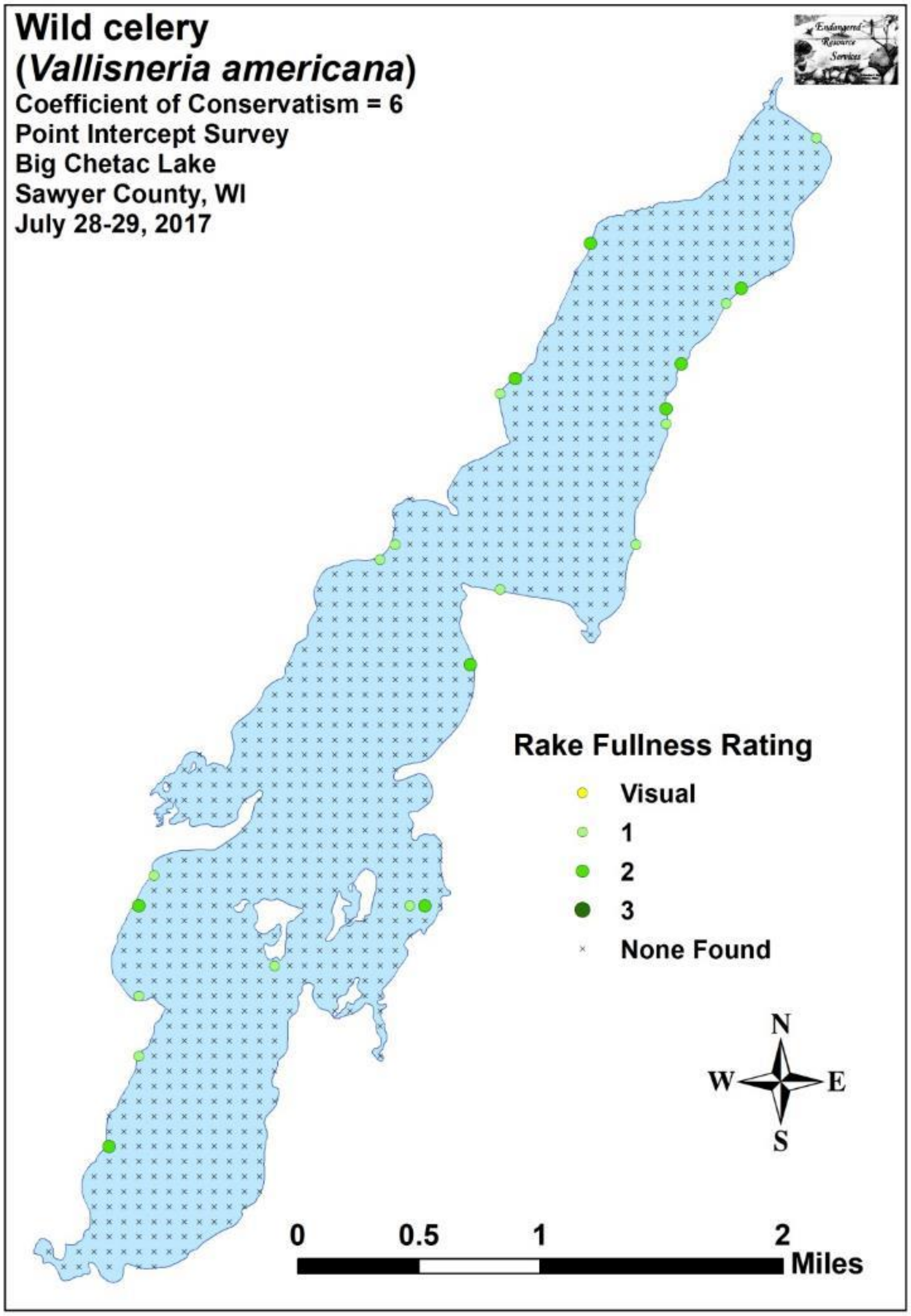
Wild celery
(*Vallisneria americana*)
Coefficient of Conservatism = 6
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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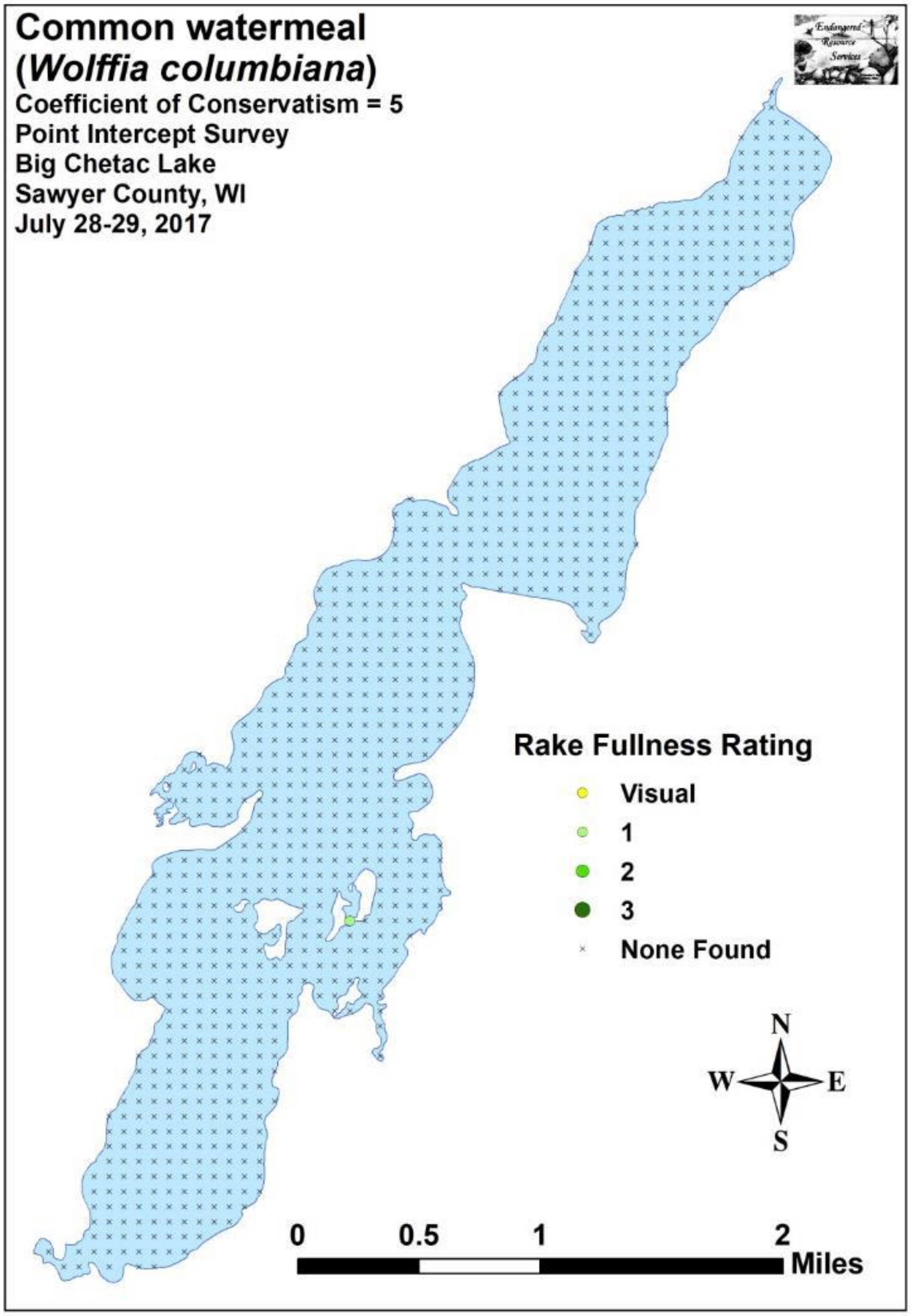
Common watermeal
(Wolffia columbiana)
Coefficient of Conservatism = 5
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Endangered Resource Services
Rake Fullness Rating
Visual
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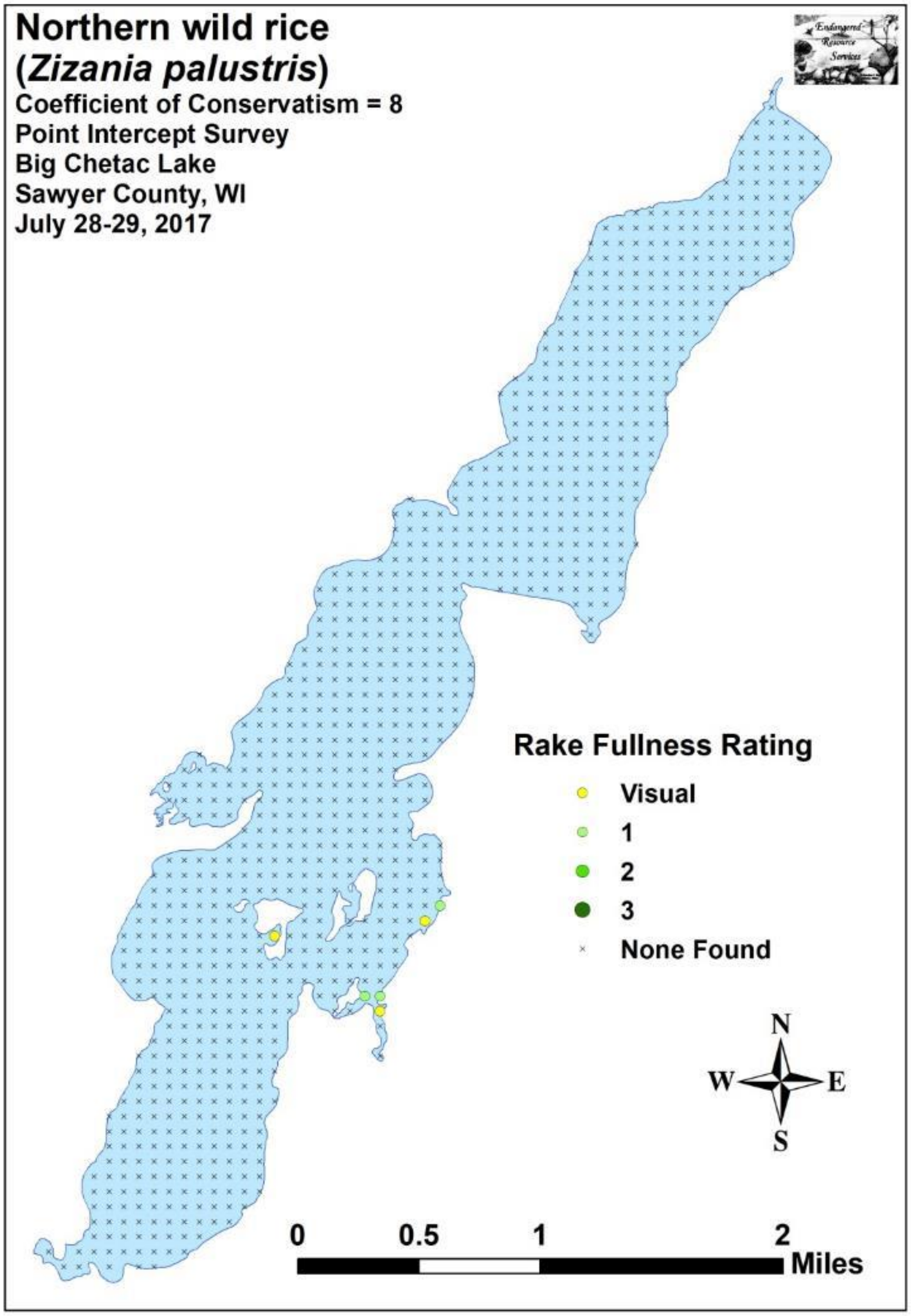
Northern wild rice
(Zizania palustris)
Coefficient of Conservatism = 8
Point Intercept Survey
Big Chetac Lake
Sawyer County, WI
July 28-29, 2017
Rake Fullness Rating
Visual
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Appendix VIII: Aquatic Exotic Invasive Plant Species Information

Eurasian water-milfoil

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

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

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

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

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

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

Curly-leaf pondweed

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

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

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

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

Reed canary grass

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

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

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

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

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

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

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

Purple loosestrife
(Photo Courtesy Brian M. Collins)

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

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

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

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

Purple loosestrife was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties. Low densities in most areas of the state suggest that the plant is still in the pioneering stage of establishment. Areas of heaviest infestation are sections of the Wisconsin River, the extreme southeastern part of the state, and the Wolf and Fox River drainage systems.

This plant's optimal habitat includes marshes, stream margins, alluvial flood plains, sedge meadows, and wet prairies. It is tolerant of moist soil and shallow water sites such as pastures and meadows, although established plants can tolerate drier conditions. Purple loosestrife has also been planted in lawns and gardens, which is often how it has been introduced to many of our wetlands, lakes, and rivers.

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

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

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

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

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

Aquatic:
organisms that live in or frequent water.

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

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

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

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

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

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

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

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

Limnology:
the study of inland lakes and waters.

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

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

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

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

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

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

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

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

Richness:

number of species in a particular community or habitat.

Rooted Aquatic Plants:

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

Runoff:

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

Secchi Disc:

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

Seepage lakes:

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

Turbidity:

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

Watershed:

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

Zooplankton:

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

Appendix X: 2017 Raw Data Spreadsheets