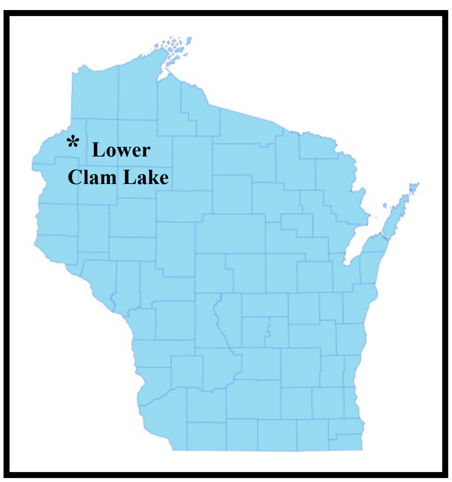
Warm-water Point-intercept Macrophyte Survey
Lower Clam Lake (WBIC: 2655300)
Burnett County, Wisconsin

Aerial Photo Lower Clam Lake (2008)

Germinating CLP Turion – (Berg 2016)

Project Initiated by: The St. Croix Tribal Environmental Department and the Clam Lake Protection and Rehabilitation District



Dense Wild Rice on the South End of the East Bay (Berg 2016)

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September 8-9, 2016

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ABSTRACT

Lower Clam Lake (WBIC 2655300) is a 366 acre flowage in central Burnett County, Wisconsin. The lake's average depth is 7ft, and the bottom substrate is predominantly muck and sandy/muck with a pure sand shoreline. The lake is eutrophic, and water clarity is very poor with Secchi values ranging from 2-4ft from 2009-2016. Following the netting and removal of 1,000's of Carp (*Cyprinus carpio*) from the Clam Lakes in the winters of 2011-2012 and 2013-14, the St. Croix Tribal Environmental Department and the Clam Lakes Protection and Rehabilitation District requested follow-up warm-water full point-intercept surveys in 2012 and 2014. Neither of these surveys found a significant increase in vegetation, but, because there was evidence of a Carp die-off over the winter of 2014-15, and because plants appeared to be recovering, additional full-lake warm-water point-intercept surveys were requested in September 2015 and 2016. During the 2016 survey, we found macrophytes at 49 points which extrapolated to 14.0% of the total bottom, and 44.6% of the 5.5ft littoral zone. This was a non-significant decline from the 57 points we found plants at in September 2015 (16.3% of the total bottom and 40.1% of the littoral zone). Overall diversity was high with a Simpson Index of 0.92 (up from 0.90 in 2015 and 0.86 in 2014). Mean native species/site with native vegetation was 2.96; a significant increase (p=0.02) from 2.38 in 2015, and a further increase from 2.14 in 2014. Mean rake fullness at sites with vegetation was a moderate 2.06 – a non-significant increase from 2.00 in 2015 and 2014. Of the 23 species found in the rake (identical to 2015), Common waterweed (*Elodea canadensis*), Coontail (*Ceratophyllum demersum*), White water lily (*Nymphaea odorata*), and Slender naiad (*Najas flexilis*) were the most common. They were present at 51.02%, 36.73%, 32.65%, and 7.64% of survey points with vegetation, and accounted for 48.61% of the total relative frequency. Floating-leaf pondweed (*Potamogeton natans*) was the only species that experienced a significant change (+p=0.03) in distribution. Thirteen other species had non-significant increases, nine had non-significant declines, and four showed no change in distribution. The 22 native index species found in the rake during the 2016 survey produced a mean Coefficient of Conservatism of 5.0 (similar to 5.2 in 2015/4.8 in 2014) and a Floristic Quality Index of 23.7 (24.5 in 2015/19.3 in 2014). Compared to other lakes in this part of the state, the mean C continues to be well below average, while the FQI is just below the median. Northern wild rice (*Zizania palustris*) occurred on the south side of the east bay where we found it in the rake at eight points (one additional visual point) with a mean rake fullness of 2.50. Although this was a non-significant increase from the five points with a mean rake fullness of 2.00 in 2015, it represented a further expansion from the two points (mean rake fullness of 2.00) we found rice at in 2014. The west side of the bay continued to support only patchy rice, but the east side was now dense enough to offer significant human harvest potential albeit over a relatively small area. Other than CLP, Purple loosestrife (*Lythrum salicaria*) around the shoreline of the east bay and scattered patches of Reed canary grass (*Phalaris arundinacea*) were the only other exotic species found. Most PL showed at least some Loosestrife beetle (*Galerucella* spp.) damage. Future management considerations include resuming Secchi disc monitoring of water clarity to document improvements that should accompany an increase in rooted plants; and potentially seeding additional rice grain to further/hasten recovery in the east bay.

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INTRODUCTION:

Lower Clam Lake (WBIC 2655300) is a 366 acre flowage in central Burnett County, Wisconsin in the Town of Meenon (T39N R16W S26 SW SE). The lake reaches a maximum depth of 14ft on the west side just north of the HWY 70 Narrows and has an average depth of approximately 7ft (Figure 1). The lake is eutrophic with Secchi readings averaging 2-3ft at the time of the 2016 survey and never higher than the 4ft we recorded in 2009. Tribal data also suggests there has been little change over time (Havranek, pers. comm.). This very poor water clarity produced a littoral zone that extended to 5.5ft during the September 2016 survey. The lake's bottom substrate is predominately muck and sandy muck with a ring of pure sand around the majority of the shoreline (Sather et al, 1964).

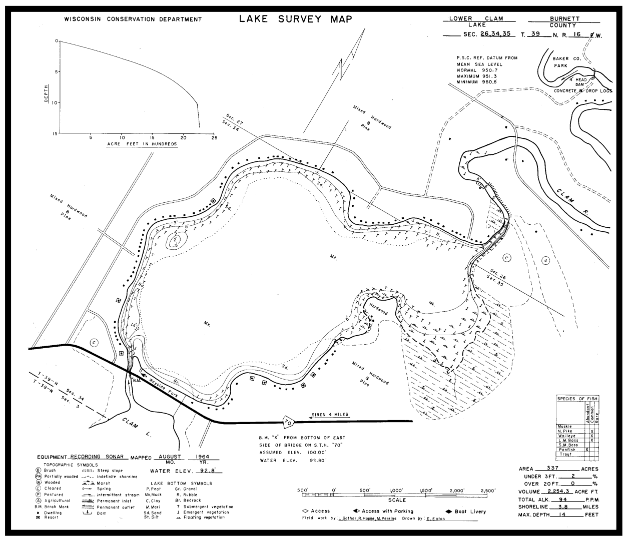


Figure 1: Lower Clam Lake Bathymetric Map

The Clam Lakes Protection and Rehabilitation District (CLPRD) originally authorized lakewide systematic point-intercept macrophyte surveys in May and July/August 2009 as part of developing a Wisconsin Department of Natural Resources approved Aquatic Plant Management Plan. At that time, the lakes were mechanically harvesting beds of Curly-leaf pondweed (*Potamogeton crispus*) that dominated the spring littoral zone. However, since then, the lakes have experienced an explosion in their Carp (*Cyprinus carpio*) population, and the fish have devastated the lakes' plants including nearly eliminating CLP on Upper Clam and significantly reducing it on Lower Clam. The Carp had also largely destroyed the expansive Northern wild rice (*Zizania palustris*) beds that formerly occupied large areas in the south bays of Upper Clam Lake. Following the netting and removal of 1,000's of Carp from the lakes in the winters of 2011-2012 and 2013-2014, the St. Croix Tribal Environmental Department (SCTED) and the CLPRD requested follow up warm-water point-intercept surveys in summer 2012 and 2014. Neither of these surveys showed a significant rebound in vegetation (except inside the carp exclosure), but, because there was evidence the carp population had experienced a die-off over the winter in 2014-15 and plants anecdotally appeared to be recovering on the lakes in 2015 and 2016, additional full point-intercept surveys were requested late in the summers of 2015 and 2016. This report is the summary analysis of the September 8-9, 2016 survey.

METHODS:
Warm-water Full Point-intercept Macrophyte Survey:
Using a standard formula that takes into account the shoreline shape and distance, water clarity, depth, and total acreage, Jennifer Hauxwell (WDNR) generated the 350 point sampling grid used for Lower Clam Lake in 2009, 2012, 2014, 2015, and again in 2016 (Appendix I). Prior to beginning the point-intercept survey, we conducted a general boat survey of the lake to regain familiarity with the species present. All plants found were identified (Voss 1996, Boreman et al. 1997; Chadde 2002; Crow and Hellquist 2009; Skawinski 2011), and a data sheet was built from the species present (Appendix II).

During the point-intercept survey, we located each point using a handheld mapping GPS unit (Garmin 76CSx), recorded a depth reading with a metered pole rake or hand held sonar (Vexilar LPS-1), and used a rake to sample an approximately 2.5ft section of the bottom. All plants on the rake, as well as any that were dislodged by the rake, were identified and assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 2). We also recorded visual sightings of all plants within six feet of the sample point not found in the rake. In addition to a rake rating for each species, a total rake fullness rating was also noted. Substrate (bottom) type was assigned at each site where the bottom was visible or it could be reliably determined using the rake.

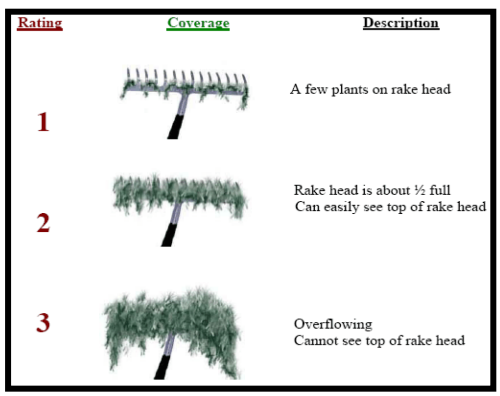


Figure 2: Rake Fullness Ratings (UWEX 2010)

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.

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

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

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

<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).

<u>Relative frequency:</u> This value shows a species' frequency relative to all other species. It is expressed as a percentage, and the total of all species' relative 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 2-3).

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. Lower Clam Lake is in the Northern Lakes and Forests Ecoregion (Tables 4-5).

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

Comparison to Past Surveys: We compared data from our 2015 and 2016 warm-water point-intercept surveys (Figures 7) to see if there were any significant changes in the lake's vegetation. For individual plant species as well as count data, we used the Chi-square analysis on the WDNR Pre/Post Survey Worksheet. For comparing averages (mean species/point and mean rake fullness/point), we used t-tests. Differences were considered significant at $p < .05$, moderately significant at $p < .01$ and highly significant at $p < .001$ (UWEX 2010). It should be noted that we used the initial number of littoral points from 2009 (338) as the basis for "sample points" as the lake's clarity appeared to be nearly constant over this time, and we felt this gave us the best way to estimate changes that were, presumably, largely caused by carp herbivory or the lack there of.

RESULTS:

Warm-water Full Point-intercept Macrophyte Survey:

Depth soundings taken at Lower Clam Lake's 350 survey points revealed the deepest areas in the lake occur on the west side where the channel from Upper Clam cuts a 9-13ft furrow along the shoreline before turning to the northeast approximately 400 yards north of the bridge. The central basin is a generally uniform 6-9ft bowl that gets gradually shallower moving west to east. The far south end of the eastern bay is a shallow 2-5ft flat that slopes towards the 6ft river channel that exits the lake in the northeast corner (Figure 3) (Appendix III).

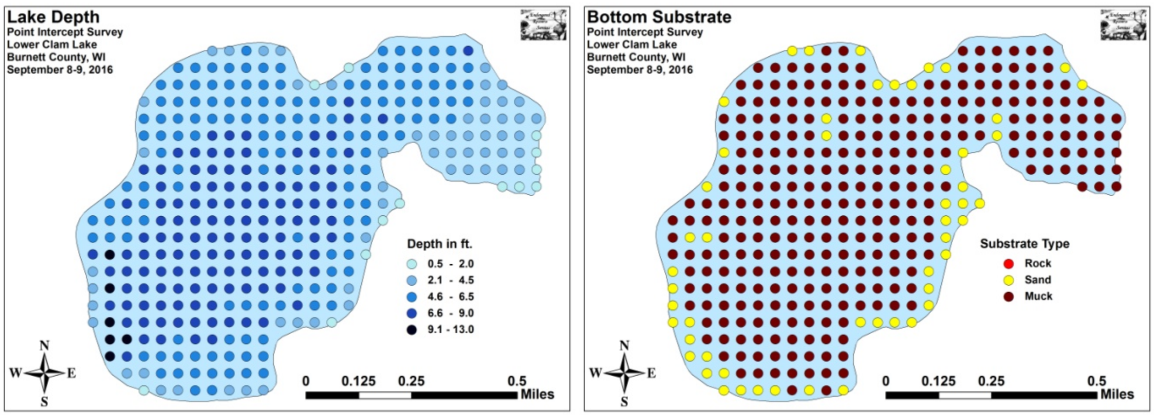


Figure 3: Lake Depth and Bottom Substrate

Sand dominated the majority of the nearshore lake bottom on Lower Clam on the north, west and south sides. This quickly transitioned to nutrient poor sandy muck at most depths beyond 4ft. Further to the east, this muck gradually thickened and became more nutrient rich; especially in the south end of the east bay. Of the lake's 350 points, we categorized 298 (85.1%) as being muck or sandy muck and the remaining 52 (14.9%) as being pure sand (Figure 3) (Appendix III).

At the time of the survey, Secchi disc readings were in the 2-3ft range. This very poor water clarity produced a littoral zone that extended to 5.5ft and included 110 survey points. This was a significant decline (p=0.01) from 2015's 142 littoral survey points (Figure 4) (Appendix IV). In 2016, plants were present at 49 points (14.0% of the bottom and 44.6% of the littoral zone) – a non- significant decline (p=0.40) from the 57 points (16.3% of the bottom and 40.1% of the littoral zone) they were found at in 2015. In 2016, the mean and median depths plants were 3.2ft/3.5ft – nearly identical to the 3.1ft/3.5ft we found in 2015 (Table 1).

As in 2015, the quantitative survey failed to capture much of the plant growth around the western basin as few points occurred in <5ft. These nearshore sandy flats were again dominated by Muskgrass (*Chara* sp.), Slender naiad (*Najas flexilis*), Water star-grass (*Heteranthera dubia*), Sago pondweed (*Stuckenia pectinata*), and Wild celery (*Vallisneria americana*) – species that normally disappeared at depths beyond approximately 3ft.

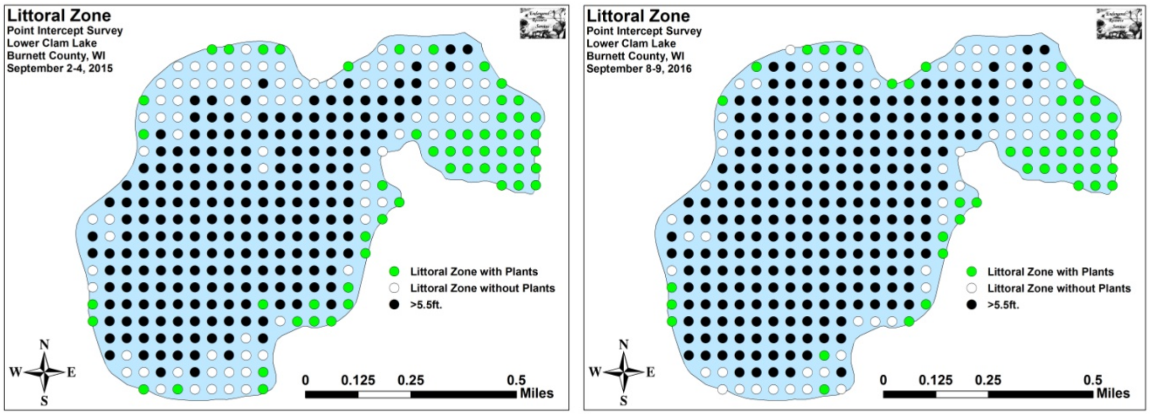


Figure 4: 2015 and 2016 Summer Littoral Zone

Table 1: Aquatic Macrophyte P/I Survey Summary Statistics Lower Clam Lake, Burnett Co. July 24-25, 2009, July 31-August 1, 2012, August 2, 2014, September 2-4, 2015, and September 8-9, 2016

Summary Statistics:	2009	2012	2014	2015	2016	*p*
Total number of points sampled	350	350	350	350	350	n.s.
Total number of sites with vegetation	69	42	30	57	49	n.s.
Total number of sites shallower than the max. depth of plants	338	122	71	142	109	-*
Freq. of occurrence at sites shallower than max. depth of plants	20.41	34.43	42.25	40.14	44.95	n.s.
Simpson Diversity Index	0.91	0.91	0.86	0.90	0.92	n.s.
Maximum depth of plants (ft)	8.0	5.5	4.5	5.5	5.5	n.s.
Mean depth of plants (ft)	3.9	2.9	2.6	3.1	3.2	n.s.
Median depth of plants (ft)	3.5	3.0	3.0	3.5	3.5	n.s.
Average # of all species per site (shallower than max depth)	0.45	0.88	0.89	0.94	1.31	+*
Average # of all species per site (veg. sites only)	2.22	2.55	2.10	2.33	2.94	+*
Average # of native species per site (shallower than max depth)	0.41	0.88	0.87	0.92	1.29	+*
Average # of native species per site (sites with native veg. only)	2.34	2.55	2.14	2.38	2.96	+*
Species richness	25	19	17	23	23	n.s.
Species richness (including visuals)	27	22	21	27	27	n.s.
Species richness (including visuals and boat survey)	29	33	28	32	32	n.s.
Mean total rake fullness (veg. sites only)	1.71	1.86	2.00	2.00	2.06	n.s.

n.s. = Not Significant - Significant differences = * $p < .05$, ** $p < .01$, *** $p < .001$

Overall diversity improved to an exceptionally high Simpson Index value of 0.92 (up from 0.90 in 2015 and 0.86 in 2014). Richness was, however, low with 23 species found in the rake. This total jumped to 32 when including visuals and the boat survey, and these values were all identical to 2015. Lakewide, the mean native species richness at points with native vegetation was 2.96; a significant increase (p=0.02) from 2.38 in 2015, and a further increase from 2.14 in 2014. Analyzing the maps revealed that many points in the southern end of the eastern bay experienced an increase in species present (Figure 5) (Appendix IV).

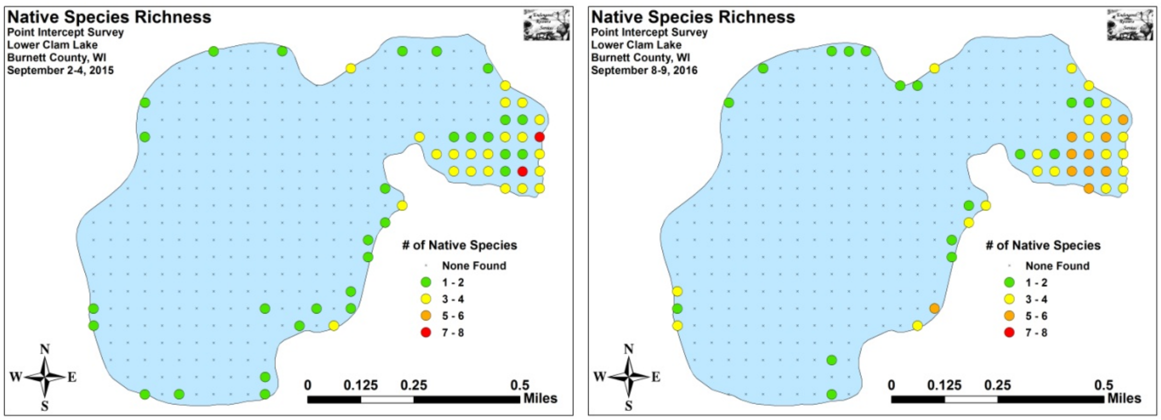


Figure 5: 2015 and 2016 Summer Native Species Richness

The mean rake fullness at sites with vegetation was a moderate 2.06 in 2016. This represented a non-significant increase over both 2014 and 2015 when growth was exactly 2.00. Points in the east bay continued to have moderate to high density while points around the western basin continued to have very low density (Figure 6) (Appendix IV).

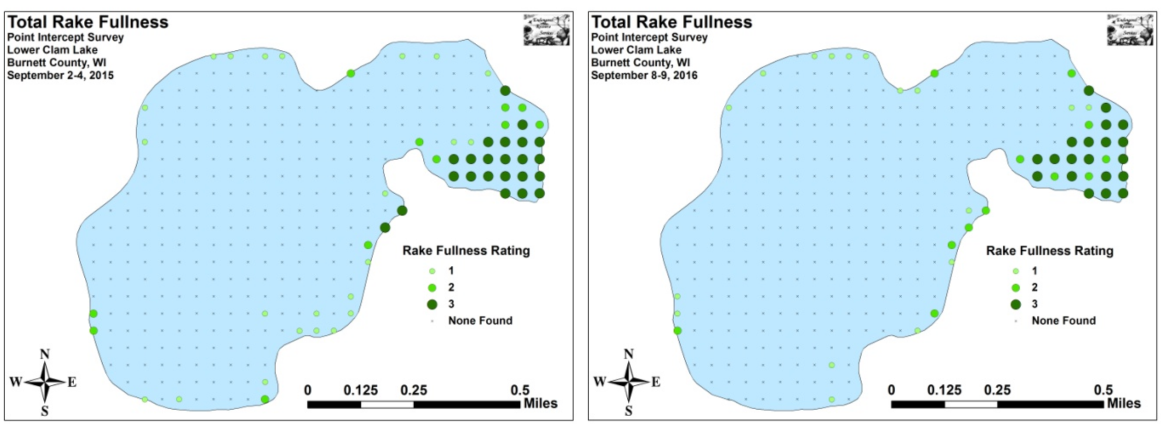


Figure 6: 2015 and 2016 Summer Total Rake Fullness Rating

Comparison of the 2015 and 2016 Surveys:

During our September 2015 survey, we found Coontail (*Ceratophyllum demersum*), Common waterweed (*Elodea canadensis*), White water lily (*Nymphaea odorata*), and Slender naiad were the most common species (Table 2). They were located at 45.61%, 33.33%, 33.33%, and 15.79% of survey points with vegetation, and, collectively, they accounted for 54.89% of the total relative frequency. Small pondweed (*Potamogeton pusillus*) (4.51) and Wild celery (4.51) were the only other species that had relative frequencies over 4.0% (Species accounts and distribution maps for all plants found in 2009, 2012, 2014, and 2015 can be found on the attached CD).

The 2016 survey again found Common waterweed, Coontail, White water lily, and Slender naiad to be the most common species (Table 3). They were located at 51.02%, 36.73%, 32.65%, and 7.64% of survey points with vegetation, and, collectively, they accounted for 48.61% of the total relative frequency. Wild celery (6.94), Floating-leaf pondweed (*Potamogeton natans*) (6.25), Northern wild rice (5.56), and Water star-grass (4.86) were the only other species that had relative frequencies over 4.0% (Density and distribution maps for all native plant species found in 2016 can be found in Appendix V).

Comparing the two surveys found a single significant change in distribution - Floating-leaf pondweed experienced a significant increase (p=0.03) (Figure 7). Thirteen other species had non-significant increases, nine had non-significant declines, and four showed no change in distribution.

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Lower Clam Lake, Burnett County
September 2-4, 2015

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sightings
Ceratophyllum demersum	Coontail	26	19.55	45.61	18.31	1.81	1
Elodea canadensis	Common waterweed	19	14.29	33.33	13.38	1.79	1
Nymphaea odorata	White water lily	19	14.29	33.33	13.38	2.00	10
Najas flexilis	Slender naiad	9	6.77	15.79	6.34	1.56	1
Potamogeton pusillus	Small pondweed	6	4.51	10.53	4.23	1.00	4
Vallisneria americana	Wild celery	6	4.51	10.53	4.23	1.50	4
Chara sp.	Muskgrass	5	3.76	8.77	3.52	1.00	0
Zizania palustris	Northern wild rice	5	3.76	8.77	3.52	2.00	5
Sagittaria latifolia	Common arrowhead	4	3.01	7.02	2.82	2.00	0
Spirodela polyrhiza	Large duckweed	4	3.01	7.02	2.82	1.00	0
Stuckenia pectinata	Sago pondweed	4	3.01	7.02	2.82	1.00	0
Eleocharis erythropoda	Bald spikerush	3	2.26	5.26	2.11	2.33	0
Heteranthera dubia	Water star-grass	3	2.26	5.26	2.11	1.33	3
Lemna minor	Small duckweed	3	2.26	5.26	2.11	1.00	1
Nitella sp.	Nitella	3	2.26	5.26	2.11	1.00	0
Potamogeton zosteriformis	Flat-stem pondweed	3	2.26	5.26	2.11	1.00	1
Typha latifolia	Broad-leaved cattail	3	2.26	5.26	2.11	2.00	0
Potamogeton crispus	Curly-leaf pondweed	2	1.50	3.51	1.41	1.00	0
Potamogeton natans	Floating-leaf pondweed	2	1.50	3.51	1.41	1.00	8

Table 2 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Lower Clam Lake, Burnett County
September 2-4, 2015

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sightings
Myriophyllum sibiricum	Northern water-milfoil	1	0.75	1.75	0.70	2.00	2
Nuphar variegata	Spatterdock	1	0.75	1.75	0.70	2.00	2
Potamogeton vaseyi	Vasey's pondweed	1	0.75	1.75	0.70	1.00	0
Schoenoplectus tabernaemontani	Softstem bulrush	1	0.75	1.75	0.70	2.00	1
	Aquatic moss	1	*	1.75	0.70	1.00	0
	Filamentous algae	1	*	1.75	0.70	1.00	0
Carex comosa	Bottle brush sedge	**	**	**	**	**	1
Dulichium arundinaceum	Three-way sedge	**	**	**	**	**	1
Lythrum salicaria	Purple loosestrife	**	**	**	**	**	1
Phalaris arundinacea	Reed canary grass	**	**	**	**	**	1
Bolboschoenus fluviatilis	River bulrush	***	***	***	***	***	***
Myriophyllum verticillatum	Whorled water milfoil	***	***	***	***	***	***
Phragmites australis americanus	Common reed (native)	***	***	***	***	***	***
Potamogeton epihydrus	Ribbon-leaf pondweed	***	***	***	***	***	***
Schoenoplectus acutus	Hardstem bulrush	***	***	***	***	***	***

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

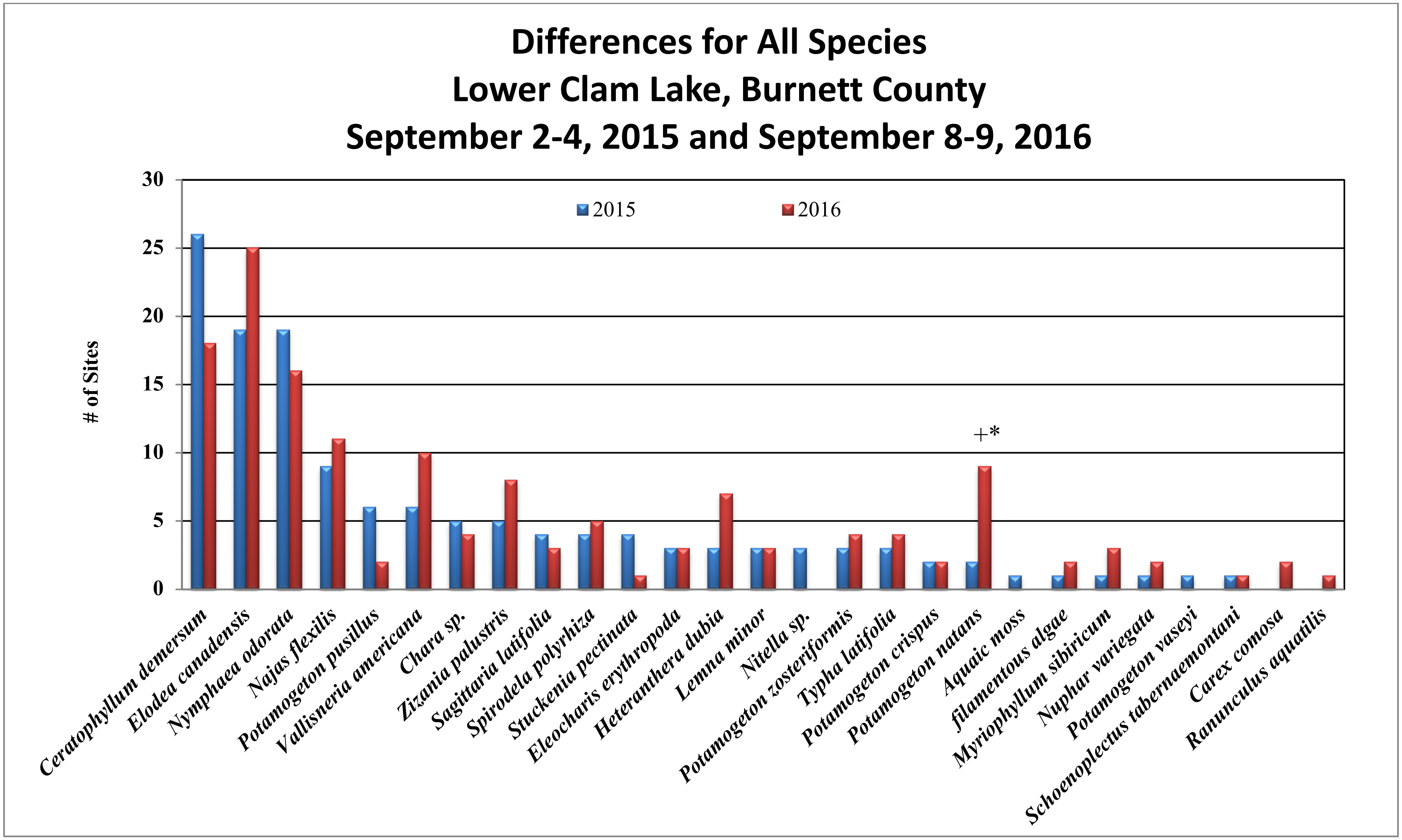
Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Lower Clam Lake, Burnett County
September 8-9, 2016

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sightings
Elodea canadensis	Common waterweed	25	17.36	51.02	22.73	1.44	0
Ceratophyllum demersum	Coontail	18	12.50	36.73	16.36	1.89	2
Nymphaea odorata	White water lily	16	11.11	32.65	14.55	1.50	6
Najas flexilis	Slender naiad	11	7.64	22.45	10.00	1.09	0
Vallisneria americana	Wild celery	10	6.94	20.41	9.09	1.50	2
Potamogeton natans	Floating-leaf pondweed	9	6.25	18.37	8.18	1.56	4
Zizania palustris	Northern wild rice	8	5.56	16.33	7.27	2.50	1
Heteranthera dubia	Water star-grass	7	4.86	14.29	6.36	1.00	0
Spirodela polyrhiza	Large duckweed	5	3.47	10.20	4.55	1.00	0
Chara sp.	Muskgrass	4	2.78	8.16	3.64	1.00	0
Potamogeton zosteriformis	Flat-stem pondweed	4	2.78	8.16	3.64	1.50	2
Typha latifolia	Broad-leaved cattail	4	2.78	8.16	3.64	1.75	0
Eleocharis erythropoda	Bald spikerush	3	2.08	6.12	2.73	1.67	1
Lemna minor	Small duckweed	3	2.08	6.12	2.73	1.00	1
Myriophyllum sibiricum	Northern water-milfoil	3	2.08	6.12	2.73	1.33	1
Sagittaria latifolia	Common arrowhead	3	2.08	6.12	2.73	1.33	2
Carex comosa	Bottle brush sedge	2	1.39	4.08	1.82	2.00	0
Nuphar variegata	Spatterdock	2	1.39	4.08	1.82	1.50	2
Potamogeton crispus	Curly-leaf pondweed	2	1.39	4.08	1.82	1.00	0

Table 3 (cont'): Frequencies and Mean Rake Sample of Aquatic Macrophytes
Lower Clam Lake, Burnett County
September 8-9, 2016

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sightings
Potamogeton pusillus	Small pondweed	2	1.39	4.08	1.82	1.00	1
	Filamentous algae	2	*	4.08	1.82	1.00	0
Ranunculus aquatilis	White water crowfoot	1	0.69	2.04	0.91	1.00	0
Schoenoplectus tabernaemontani	Softstem bulrush	1	0.69	2.04	0.91	1.00	0
Stuckenia pectinata	Sago pondweed	1	0.69	2.04	0.91	1.00	0
Bolboschoenus fluviatilis	River bulrush	**	**	**	**	**	2
Lythrum salicaria	Purple loosestrife	**	**	**	**	**	3
Phalaris arundinacea	Reed canary grass	**	**	**	**	**	1
Riccia fluitans	Slender riccia	**	**	**	**	**	1
Utricularia vulgaris	Common bladderwort	**	**	**	**	**	1
Myriophyllum verticillatum	Whorled water-milfoil	***	***	***	***	***	***
Phragmites australis	Common reed (native)	***	***	***	***	***	***
Potamogeton epihydrus	Ribbon-leaf pondweed	***	***	***	***	***	***
Schoenoplectus acutus	Hardstem bulrush	***	***	***	***	***	***
Sparganium eurycarpum	Common bur-reed	***	***	***	***	***	***

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



Significant differences = * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 7: 2015 – 2016 Macrophyte Changes

We found Coontail was the most common species in 2015 and the second most common in 2016. In 2015, it was present at 26 points before experiencing a non-significant decline (p=0.21) to 18 sites in 2016 (Figure 8). Despite this loss in distribution, density ticked up from a mean rake fullness of 1.81 in 2015 to 1.89 although this was also non-significant (p = 0.38). Analysis of the maps suggested a thickening on the outer edge of the rice bed that was offset by a decline in density within the expanding rice bed.

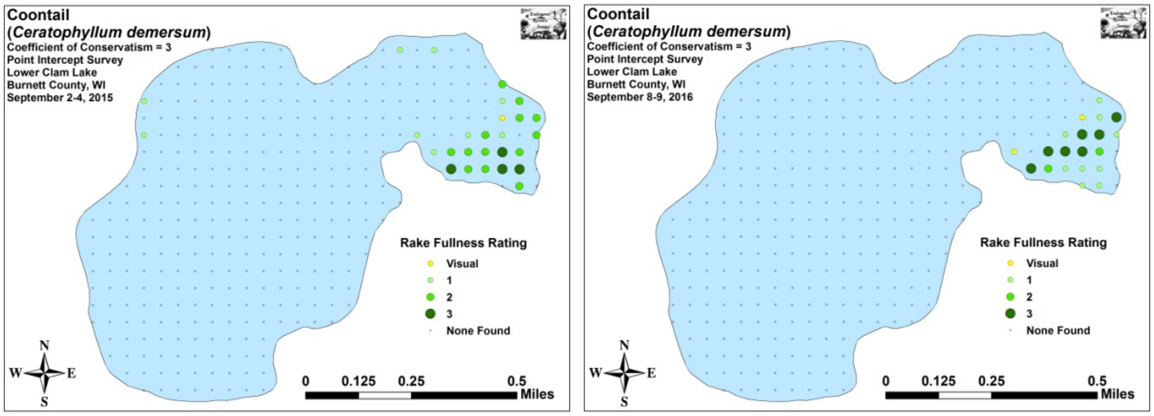


Figure 8: 2015 and 2016 Coontail Density and Distribution

Common waterweed, the second most common species in 2015 (19 sites) and the most common in 2016 (25 sites), experienced a non-significant increase in distribution (p=0.35). It also experienced a nearly-significant decline in density (p=0.07) from a mean rake fullness of 1.79 in 2015 to 1.44 in 2016 (Figure 9).

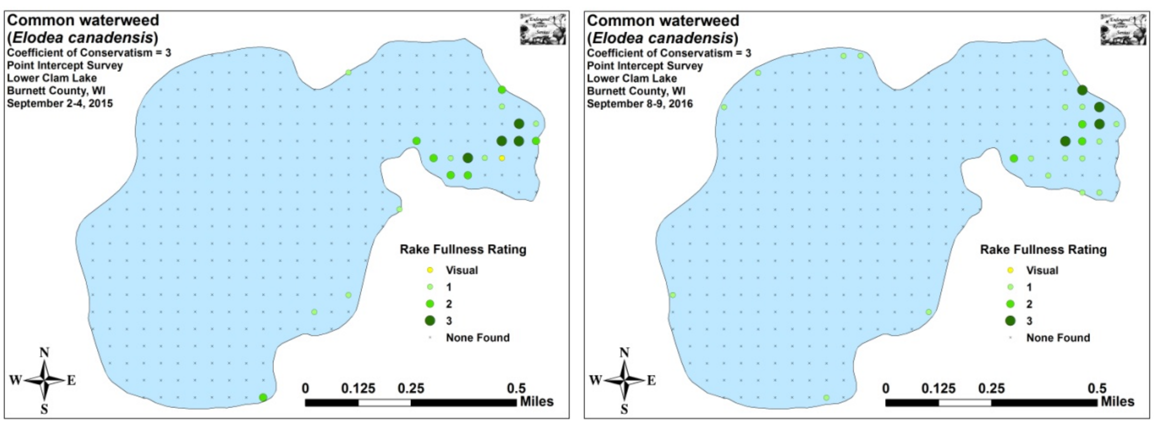


Figure 9: 2015 and 2016 Common Waterweed Density and Distribution

White water lily, the third most common species in both 2015 (19 sites) and 2016 (16 sites), experienced a significant decline in density (p=0.02) from a mean rake of 2.00 in 2015 to a mean of 1.50 in 2016 (Figure 10). As with other species, lily density within the bed appeared to decline as the rice both expanded and thickened.

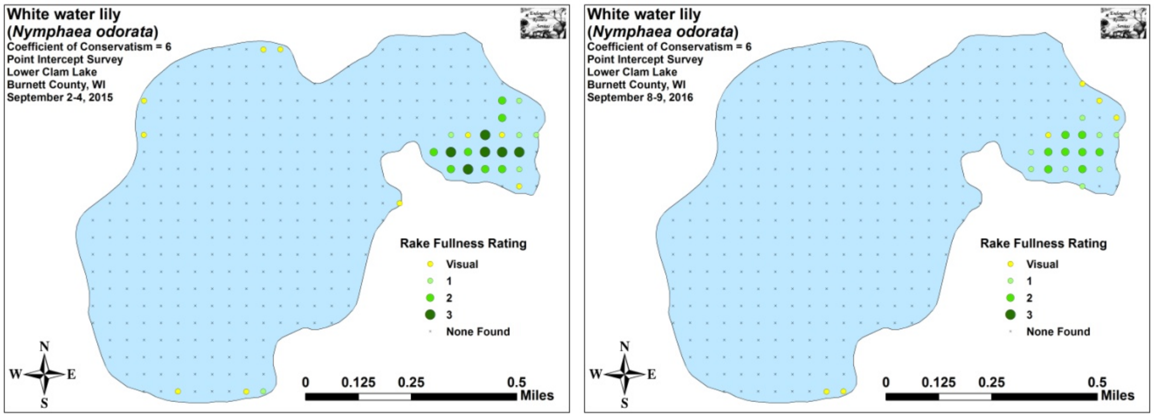


Figure 10: 2015 and 2016 White Water Lily Density and Distribution

In 2015, we found 22 **native index species** in the rake during the point-intercept survey. They produced a mean Coefficient of Conservatism of 5.2 and a Floristic Quality Index of 24.5 (Table 4).

**Table 4: Floristic Quality Index of Aquatic Macrophytes
Lower Clam Lake, Burnett County
September 2-4, 2015**

Species	Common Name	C
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
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 natans	Floating-leaf pondweed	5
Potamogeton pusillus	Small pondweed	7
Potamogeton vaseyi	Vasey's pondweed	10
Potamogeton zosteriformis	Flat-stem pondweed	6
Sagittaria latifolia	Common arrowhead	3
Schoenoplectus tabernaemontani	Softstem bulrush	4
Spirodela polyrhiza	Large duckweed	5
Stuckenia pectinata	Sago pondweed	3
Typha latifolia	Broad-leaved cattail	1
Vallisneria americana	Wild celery	6
Zizania palustris	Northern wild rice	8
N		**22**
Mean C		**5.2**
FQI		**24.5**

During the 2016 survey, we again found 22 **native index species** in the rake. They produced a mean Coefficient of Conservatism of 5.0 and a Floristic Quality Index of 23.7. Both of these values represented a slight decline compared to 2015 totals. Nichols (1999) reported an average mean C for the Northern Lakes and Forest Ecoregion of 6.7 and a median FQI of 24.3 meaning Lower Clam Lake's mean C continues to be well below average, but the FQI was just slightly below the median FQI for this part of the state (Table 5).

Table 5: Floristic Quality Index of Aquatic Macrophytes Lower Clam Lake, Burnett County September 8-9, 2016

Species	Common Name	C
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
Myriophyllum sibiricum	Northern water-milfoil	6
Najas flexilis	Slender naiad	6
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton pusillus	Small pondweed	7
Potamogeton zosteriformis	Flat-stem pondweed	6
Ranunculus aquatilis	White water crowfoot	8
Sagittaria latifolia	Common arrowhead	3
Schoenoplectus tabernaemontani	Softstem bulrush	4
Spirodela polyrhiza	Large duckweed	5
Stuckenia pectinata	Sago pondweed	3
Typha latifolia	Broad-leaved cattail	1
Vallisneria americana	Wild celery	6
Zizania palustris	Northern wild rice	8
N		**22**
Mean C		**5.0**
FQI		**23.7**

Northern Wild Rice:

The 2009 and 2012 surveys found a very limited number of wild rice plants growing along the margins of the east bay (Figure 11). By 2014, the number and density of plants appeared to be much increased albeit not covering a wide enough area to be quantified by the survey as it was only found in the rake at two points (mean rake fullness of 2.00) with two additional visual sightings. In 2015, we found rice in the rake at five points (mean rake fullness of 2.00) with five additional visuals sightings. The 2016 survey documented further expansion and thickening as rice was in the rake at eight points (mean rake fullness of 2.50) with an additional visual sighting (Appendix VI). The west side of the bay (Figure 12) still had only a few clusters, but the eastern side was now so dense that the beds offered significant human harvest potential, albeit over a relatively small area (Figure 13).

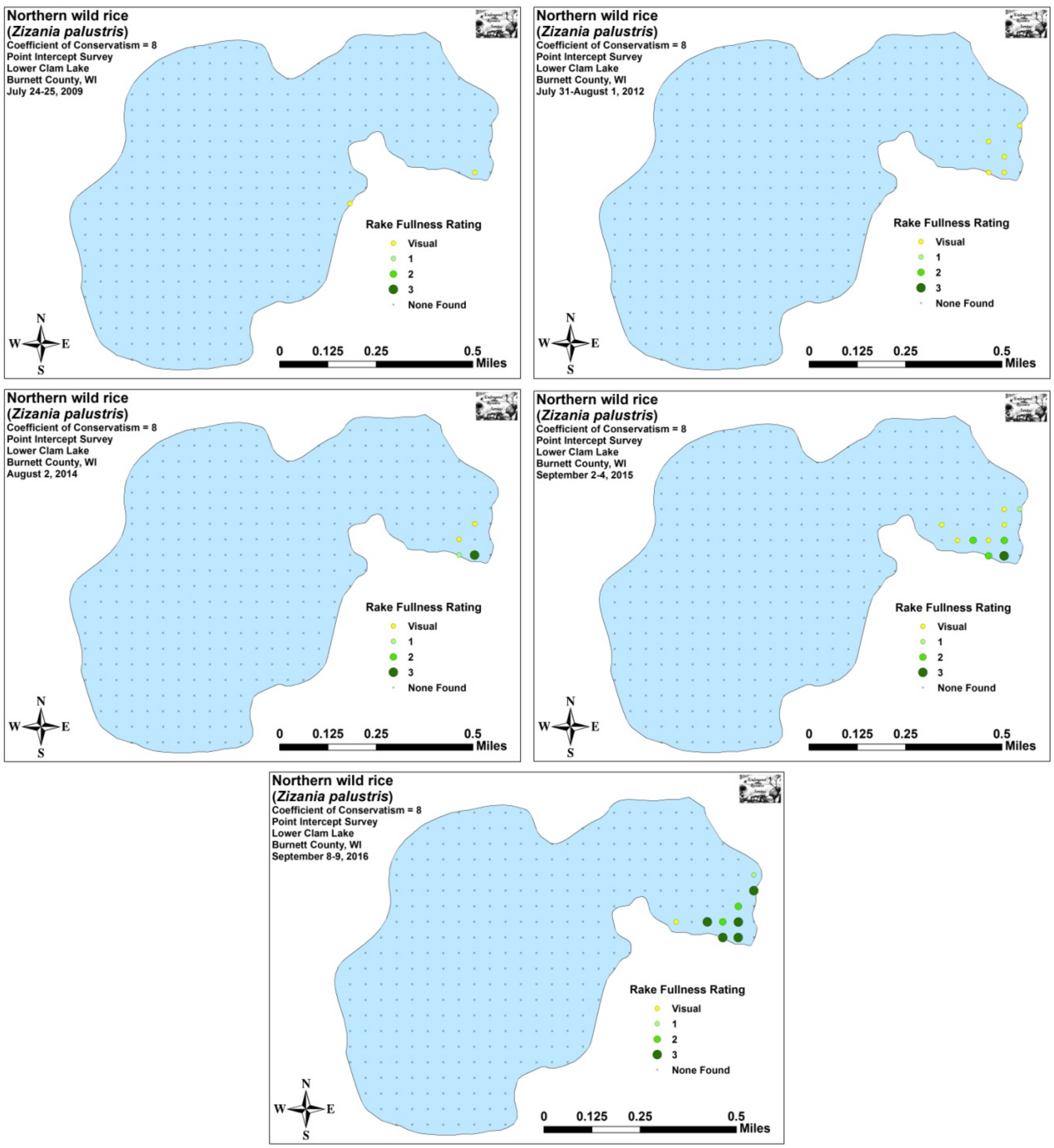


Figure 11: 2009, 2012, 2014, 2015, and 2016
Northern Wild Rice Density and Distribution

Figure 12: Panorama of Northern Wild Rice in Southeast Corner of East Bay Facing Southeast - 9/8/16

Figure 13: Panorama of Northern Wild Rice from Southeast Corner of East Bay Facing Northwest - 9/8/16

Exotic Species:

By the time of the September survey, most Curly-leaf pondweed appeared to have senesced. With the exception of a couple of plants in the rake that had recently sprouted from turions, we found no evidence of CLP anywhere in the lake (Figure 14) (Appendix VII).

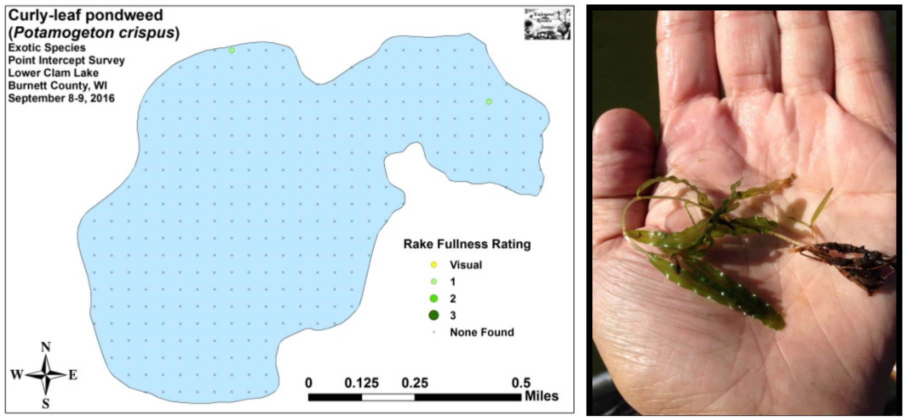


Figure 14: 2016 CLP Summer Density and Distribution

Other than CLP, Purple loosestrife (*Lythrum salicaria*) and Reed Canary Grass (*Phalaris arundinacea*) were the only other exotic species found. PL continues to be scattered primarily around the southeast shoreline of the east bay (Figure 15). As in the past, RCG occurred in scattered shoreline locations (Appendix VII).

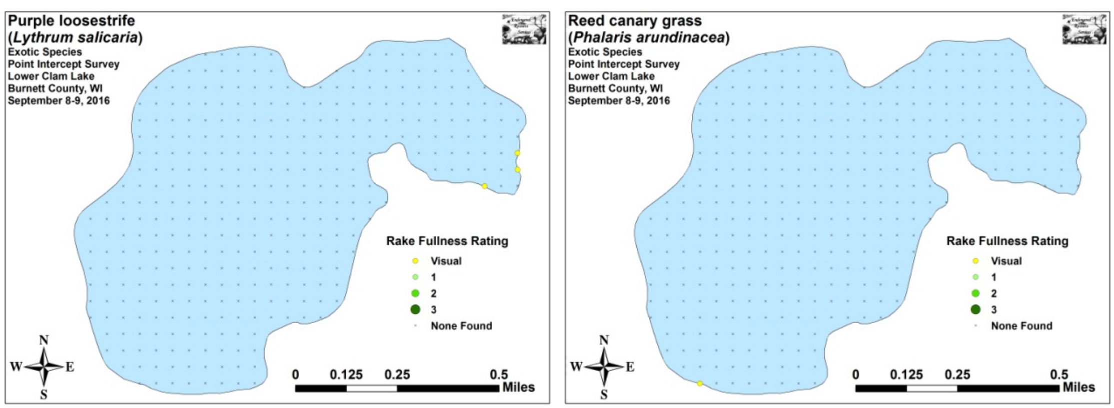


Figure 15: Purple Loosestrife and Reed Canary Grass Density and Distribution

Common reed (*Phragmites australis*), a potentially highly invasive species in its exotic form, is also found on Lower Clam Lake. Fortunately, careful analysis of the plants present showed their leaf sheaths are detached, and the culms (stems) are red in color. These characteristics suggest it is the native subspecies *americanus* which is NOT generally invasive. The bed also has native plants mixed in with it, has occurred at the same location on the lake since our first survey in 2009, and, anecdotally at least, doesn't seem to be expanding. Although the bed deserves to be looked at again in the future, based on all these considerations, we aren't overly concerned about its presence at this time.

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:

Native Plant Community:

Although the richness and mean rake fullness of native plants leveled out in 2016, diversity and localized richness continued to improve. Because these rooted plants absorb nutrients out of the water column, an increase in their numbers should also result in an increase in water clarity. Unfortunately, we again noticed that no Secchi Disc data has been taken on the lake since 2011. It would be helpful to monitor this as it is a quick and inexpensive way to track changes in water clarity, and would be useful to compare with plant data assuming the lake's macrophytes continue to rebound.

Carp and Wild Rice Management:

We again anecdotally noted there seemed to be fewer Carp than in years past; although we still saw several Carp jump/bubble trails from schools both in the east bay and along the north shore of the lake. On the positive side, the wild rice bed in the eastern bay continues to expand in both density and distribution. We also noted there were few uprooted rice plants or lily pad roots/stems in the east bay. Seeding additional rice grain in this area may still be worth considering as there appears to be significant room for rice to expand along the southwest corner of the east bay.

Purple Loosestrife:

Purple Loosestrife was again scattered in shallow muck bottom areas around the shoreline of the eastern bay. Fortunately, the Loosestrife beetles (*Galerucella* spp.) released on Lower Clam Lake in June/July 2015 by Grantsburg High School students and the Burnett County Land and Water Conservation office appear to have taken hold as we noted beetle herbivory on almost every plant we checked. We again encourage all residents to watch for and remove any PL plants in August and September when the bright fuchsia candle-shaped flower spikes are easily seen. Plants should be bagged and disposed of well away from any wetland. Also, because the plants have an extensive root system, care should be taken to remove the entire plant as even small root fragments can survive and produce new plants the following year.

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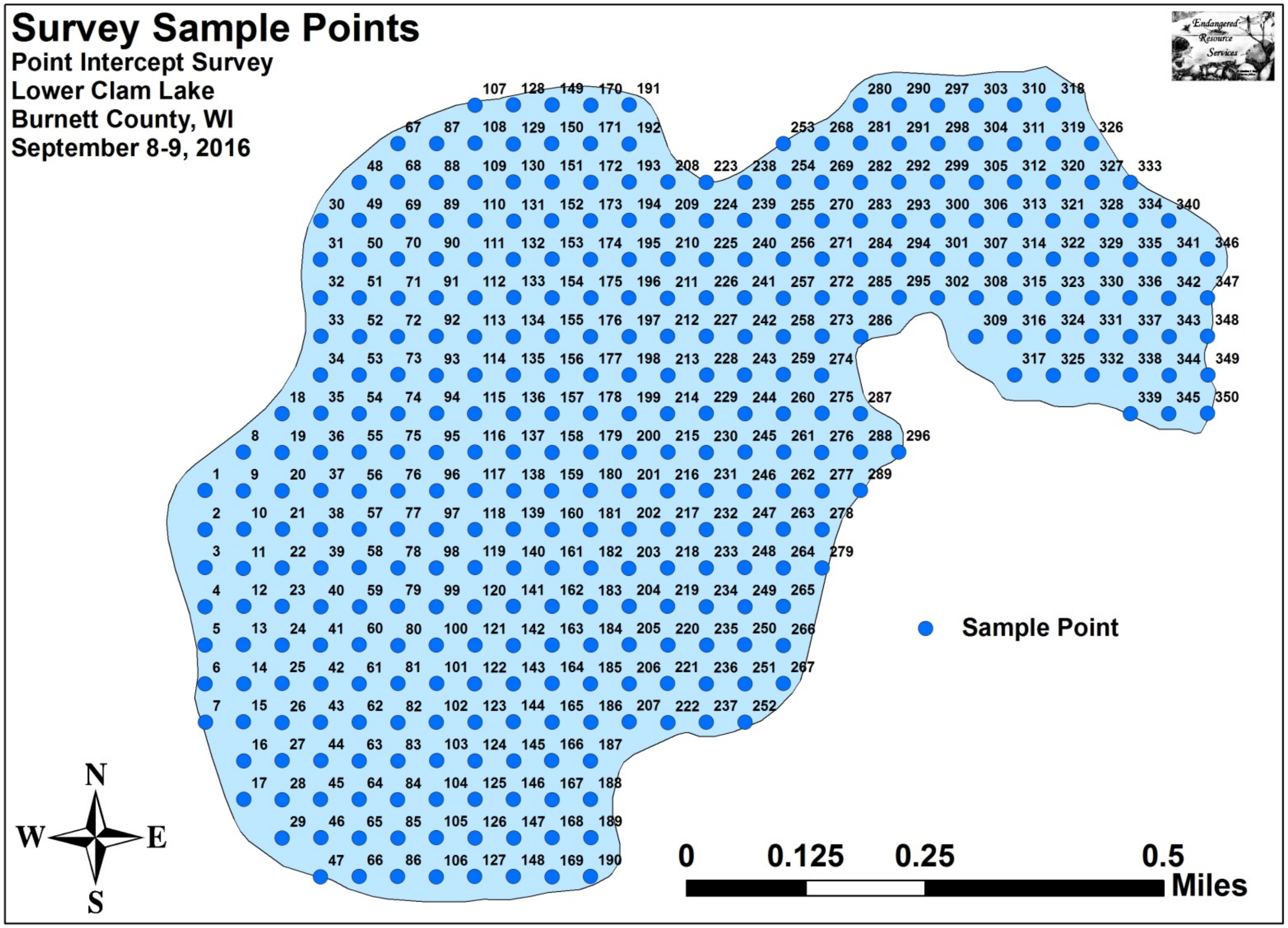
Appendix I: Lower Clam Lake Survey Sample Points

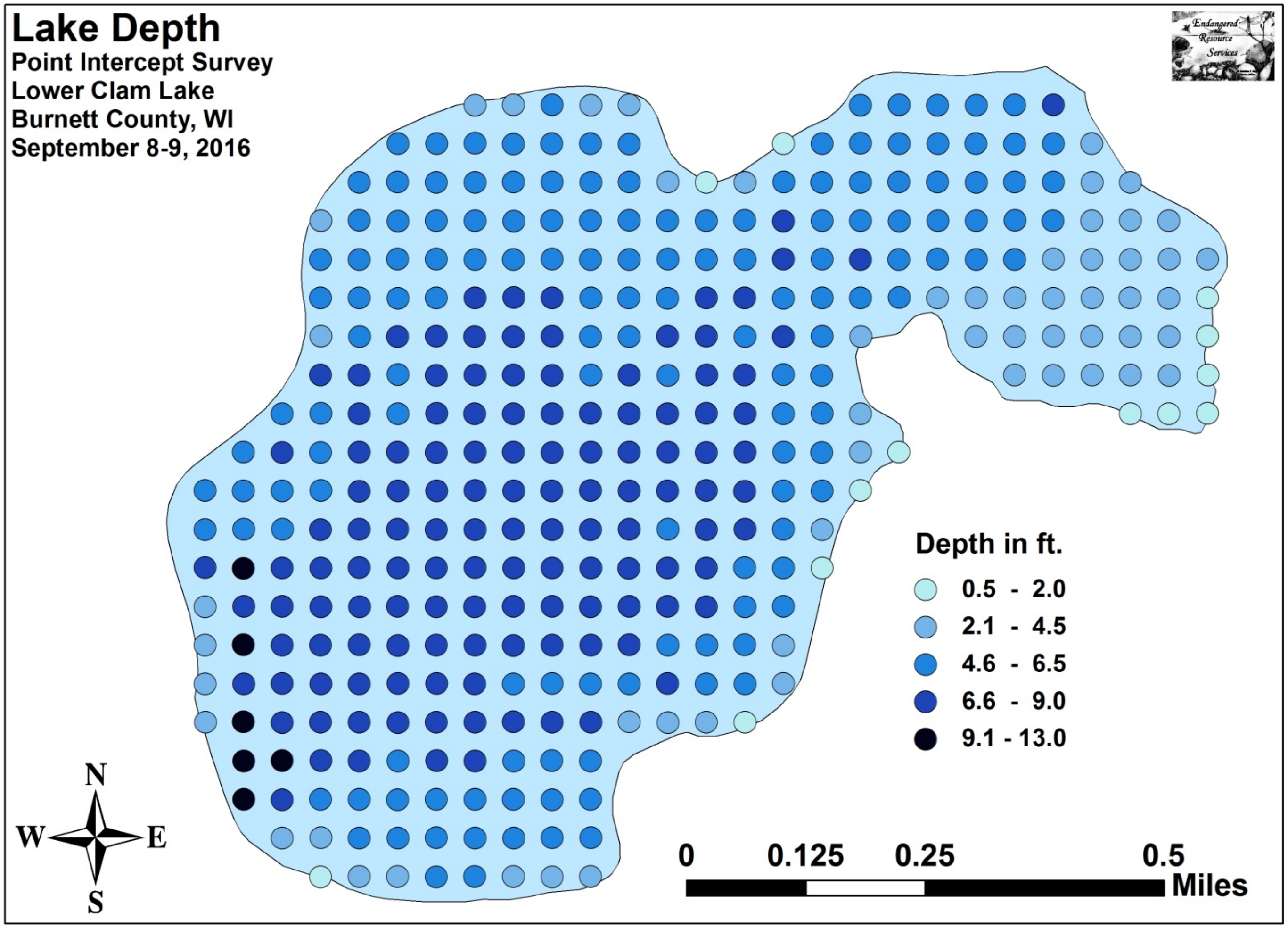

Survey Sample Points
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Sample Point
0
0.125
0.25
0.5
Miles
N
W
E
S

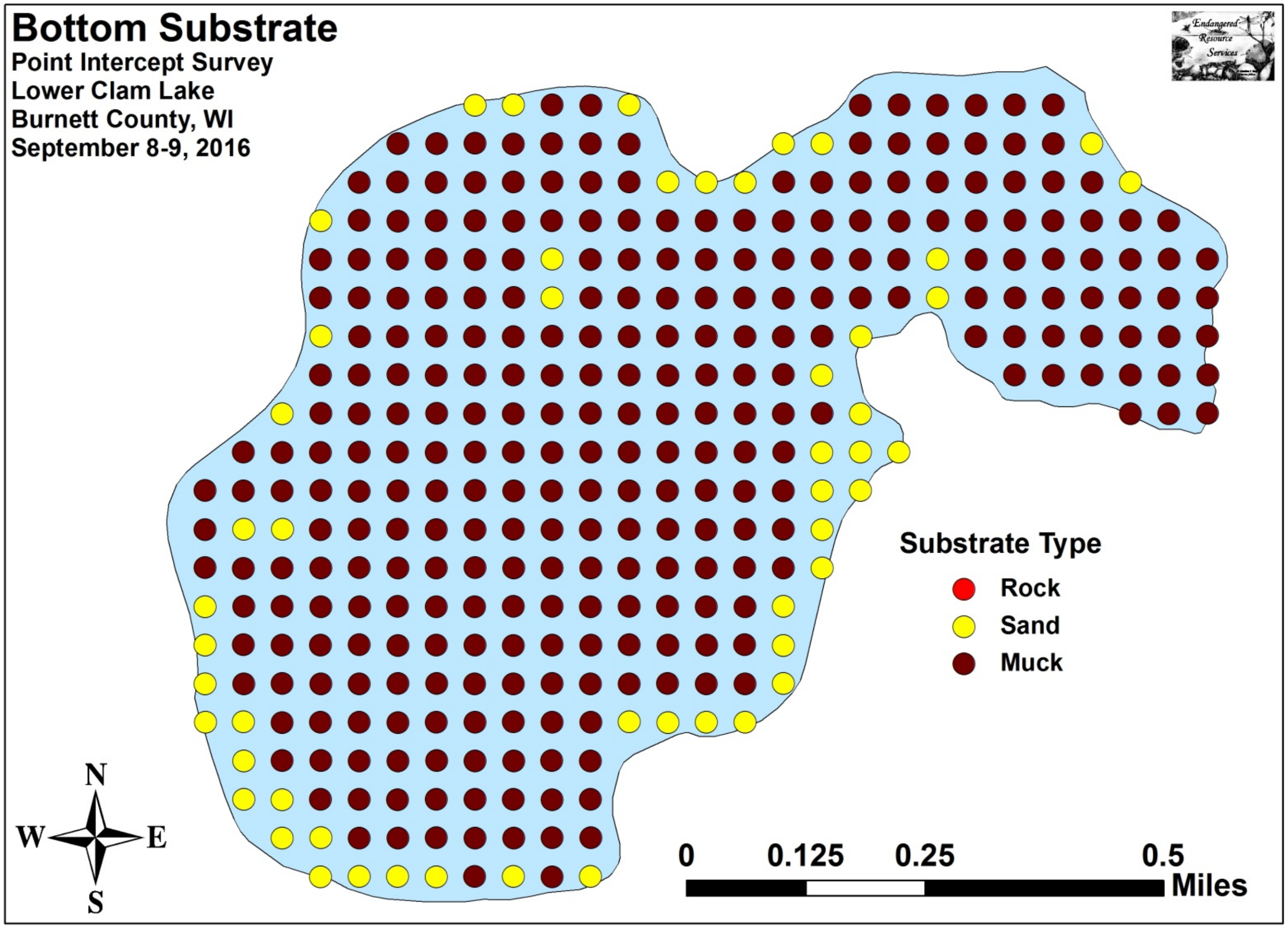
Appendix II: Boat and Vegetative Survey Data Sheets

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

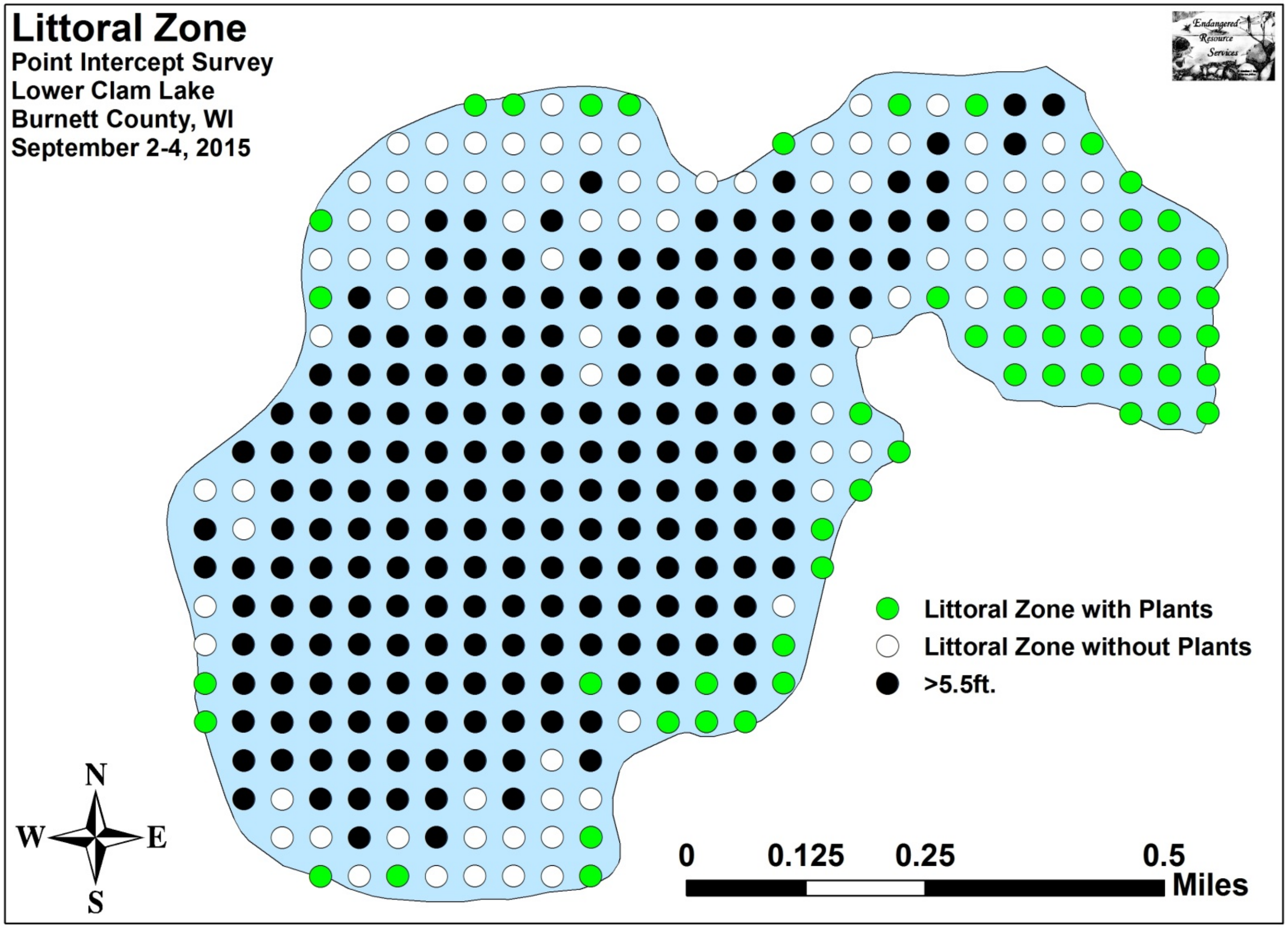
Observers for this lake: names and hours worked by each:																									
Lake:									**WBIC**									**County**						**Date:**	
Site #	**Depth (ft)**	**Muck (M), Sand (S), Rock (R)**	**Rake pole (P) or rake rope (R)**	**Total Rake Fullness**	**EWM**	**CLP**	**1**	**2**	**3**	**4**	**5**	**6**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

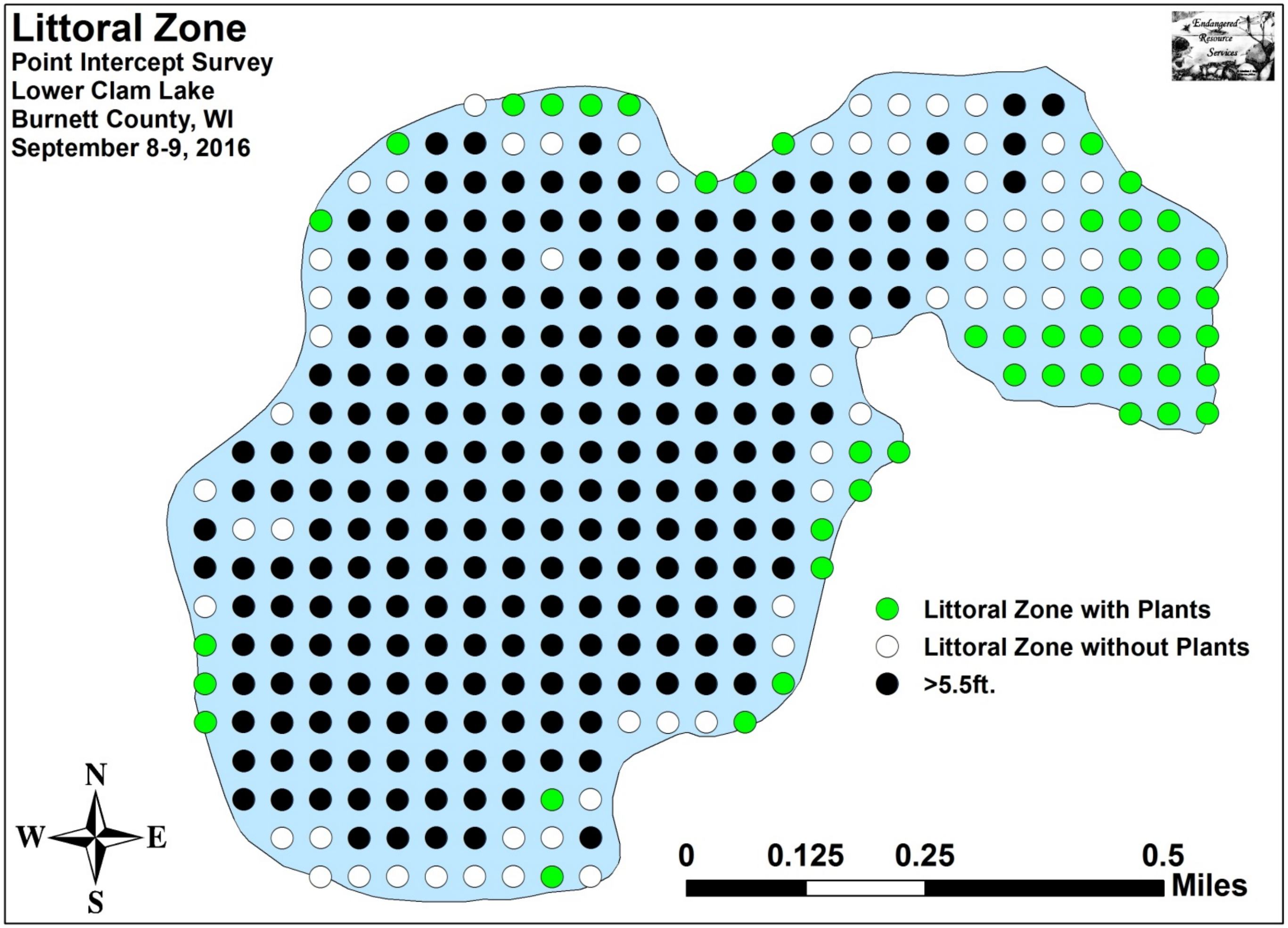
Appendix III: Habitat Variable Maps

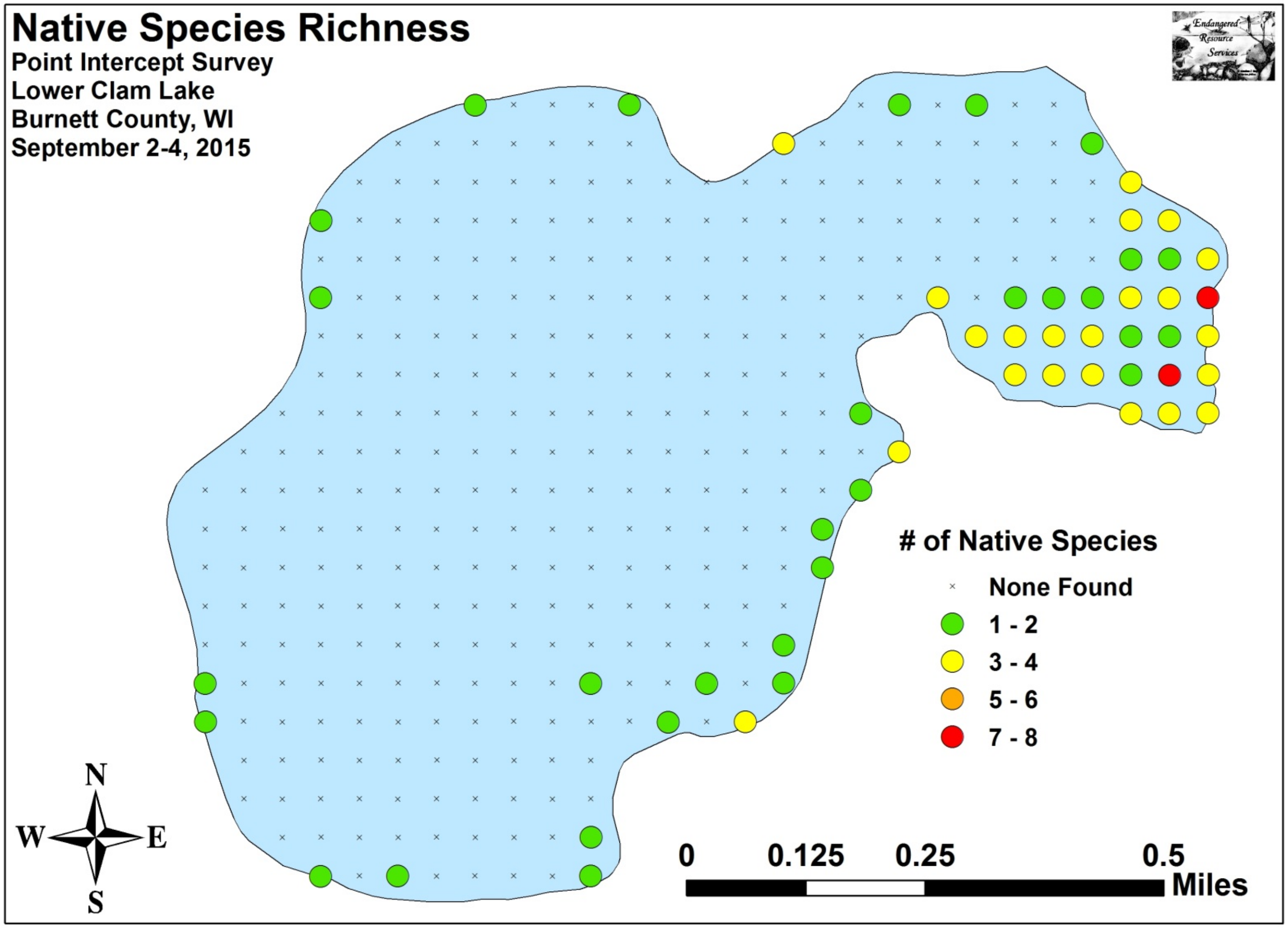

Lake Depth
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Depth in ft.
0.5 - 2.0
2.1 - 4.5
4.6 - 6.5
6.6 - 9.0
9.1 - 13.0
N
W
E
S
0
0.125
0.25
0.5
Miles
Endangered Resource Services

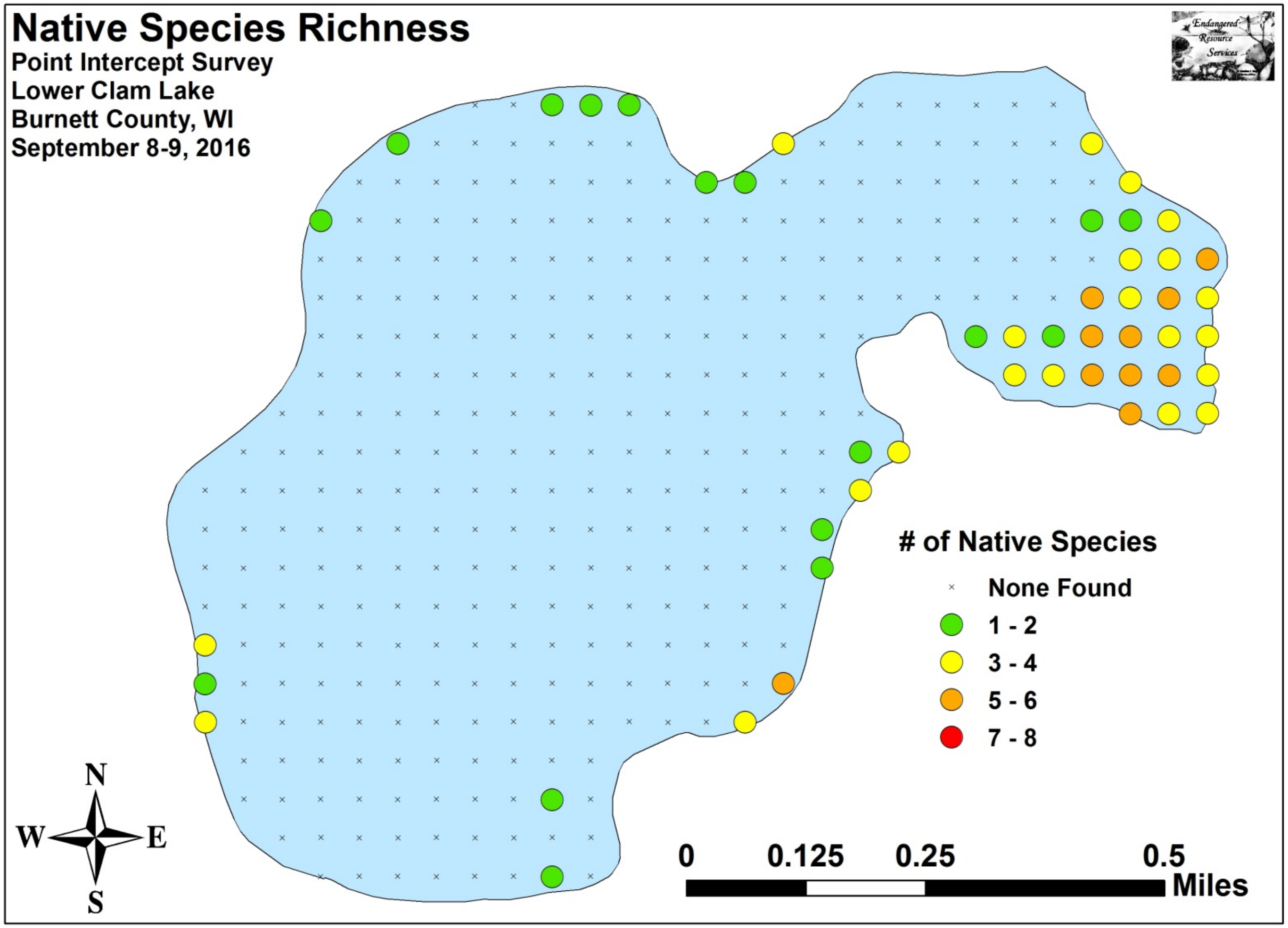

Bottom Substrate
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Substrate Type
Rock
Sand
Muck
N
W
E
S
0
0.125
0.25
0.5
Miles
Endangered Resource Services

Appendix IV: 2015 and 2016 Littoral Zone, Native Species Richness, and Total Rake Fullness Maps

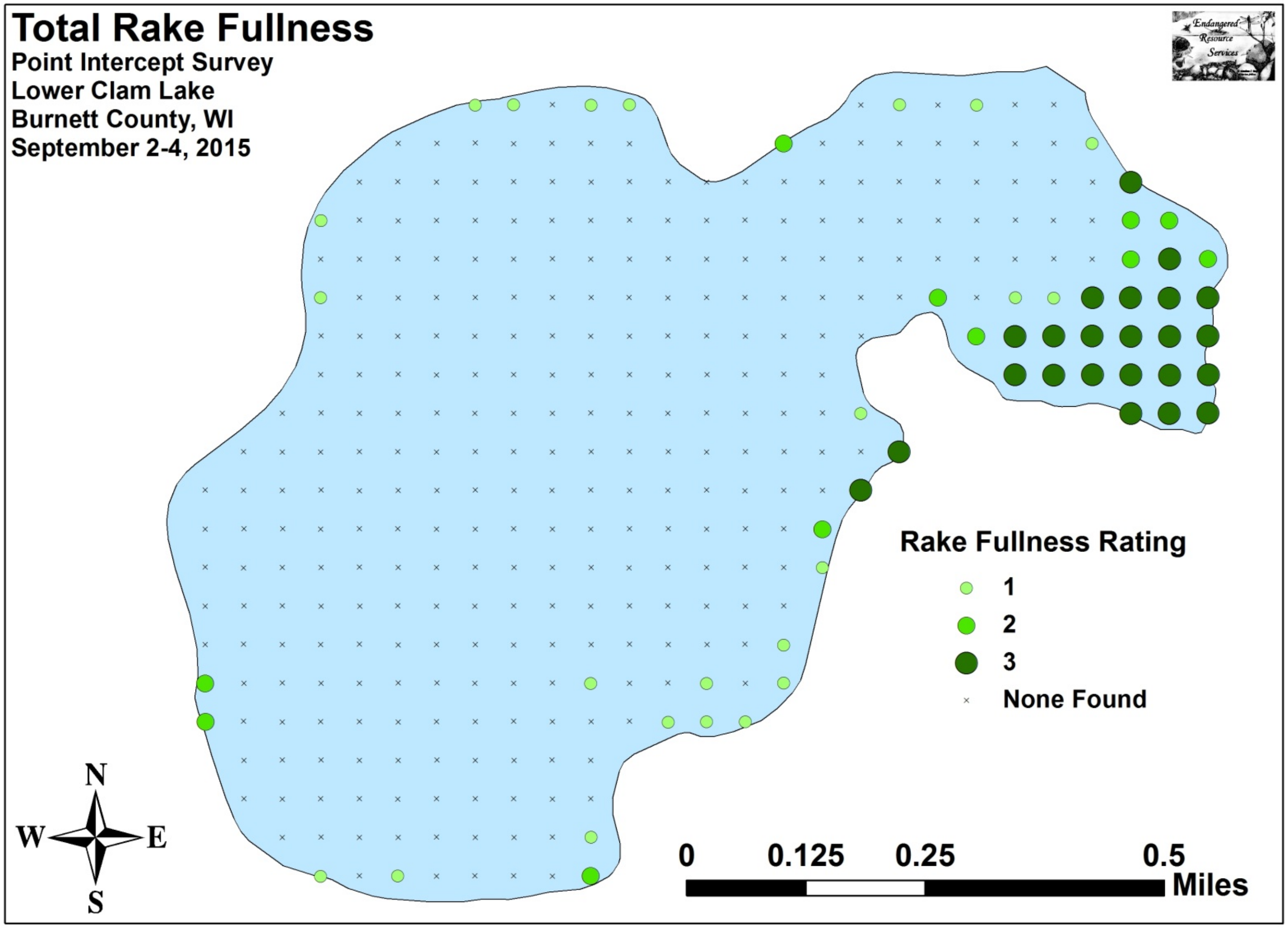

Littoral Zone
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 2-4, 2015
Endangered Resource Services
Littoral Zone with Plants
Littoral Zone without Plants
>5.5ft.
N
W
E
S
0
0.125
0.25
0.5
Miles

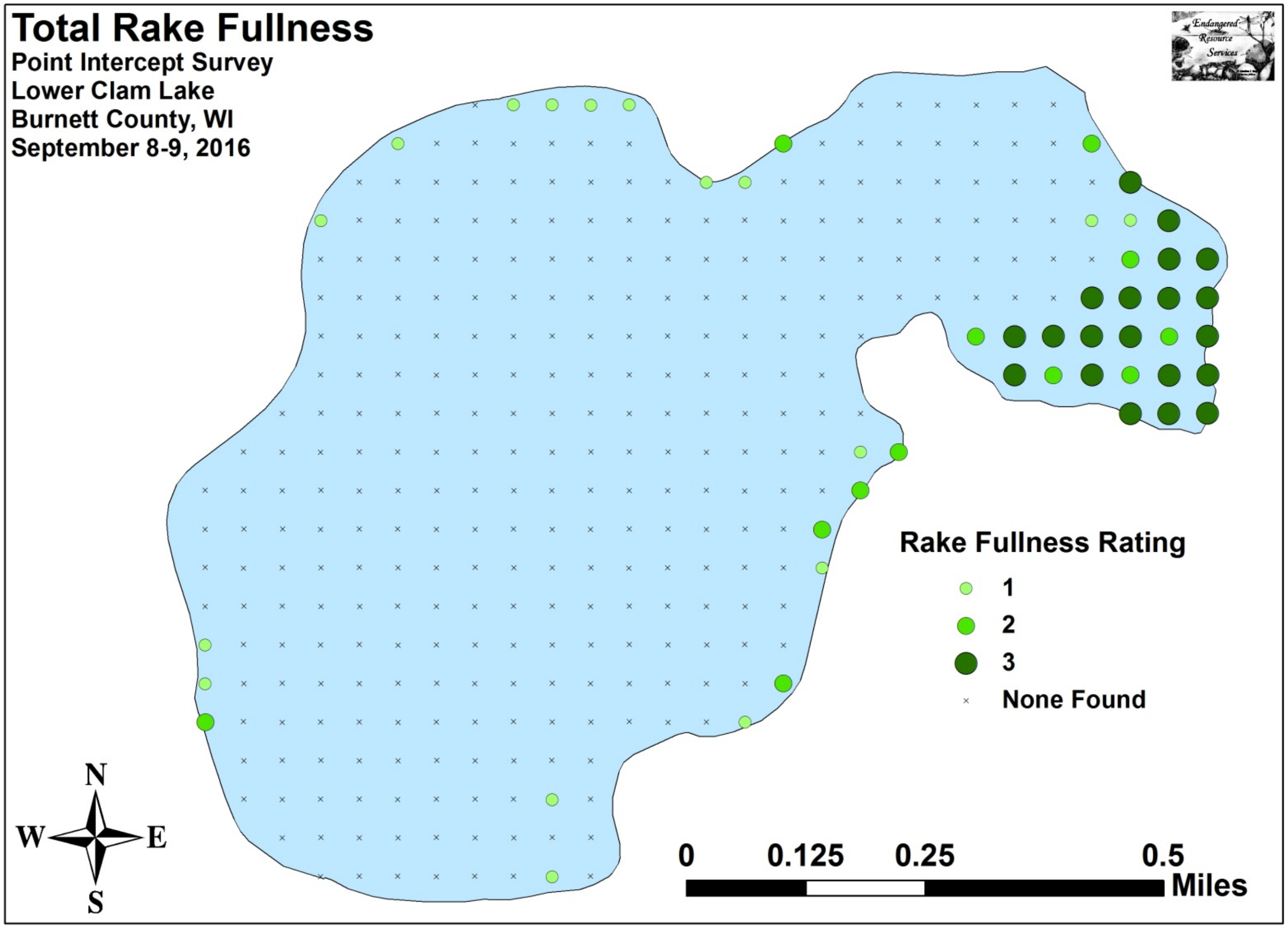

Littoral Zone
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Littoral Zone with Plants
Littoral Zone without Plants
>5.5ft.
N
W
E
S
0
0.125
0.25
0.5
Miles


Native Species Richness
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 2-4, 2015
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 8
N
W
E
S
0
0.125
0.25
0.5
Miles



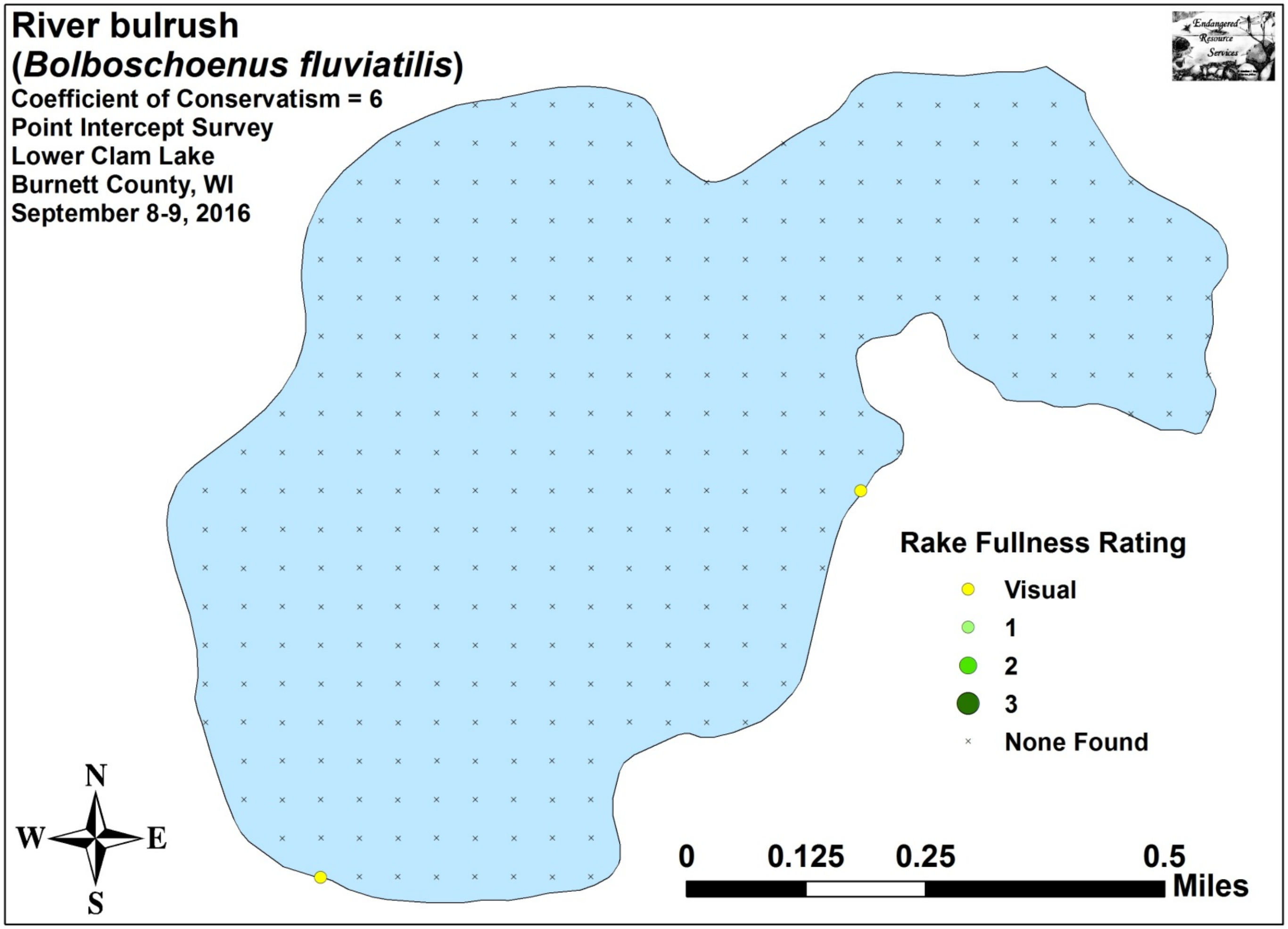
Native Species Richness
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 8
N
W
E
S
0
0.125
0.25
0.5
Miles

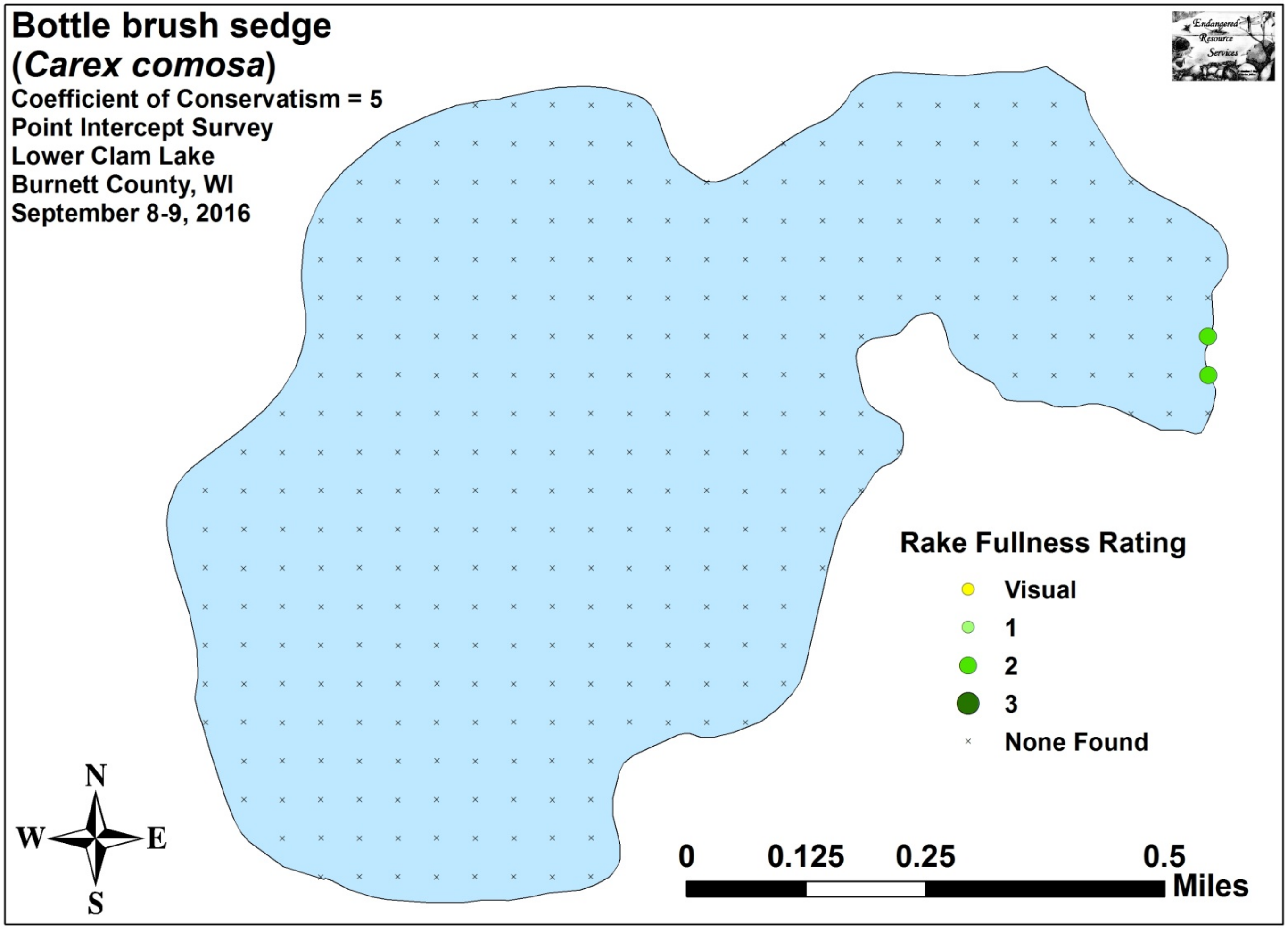

Total Rake Fullness
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 2-4, 2015
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

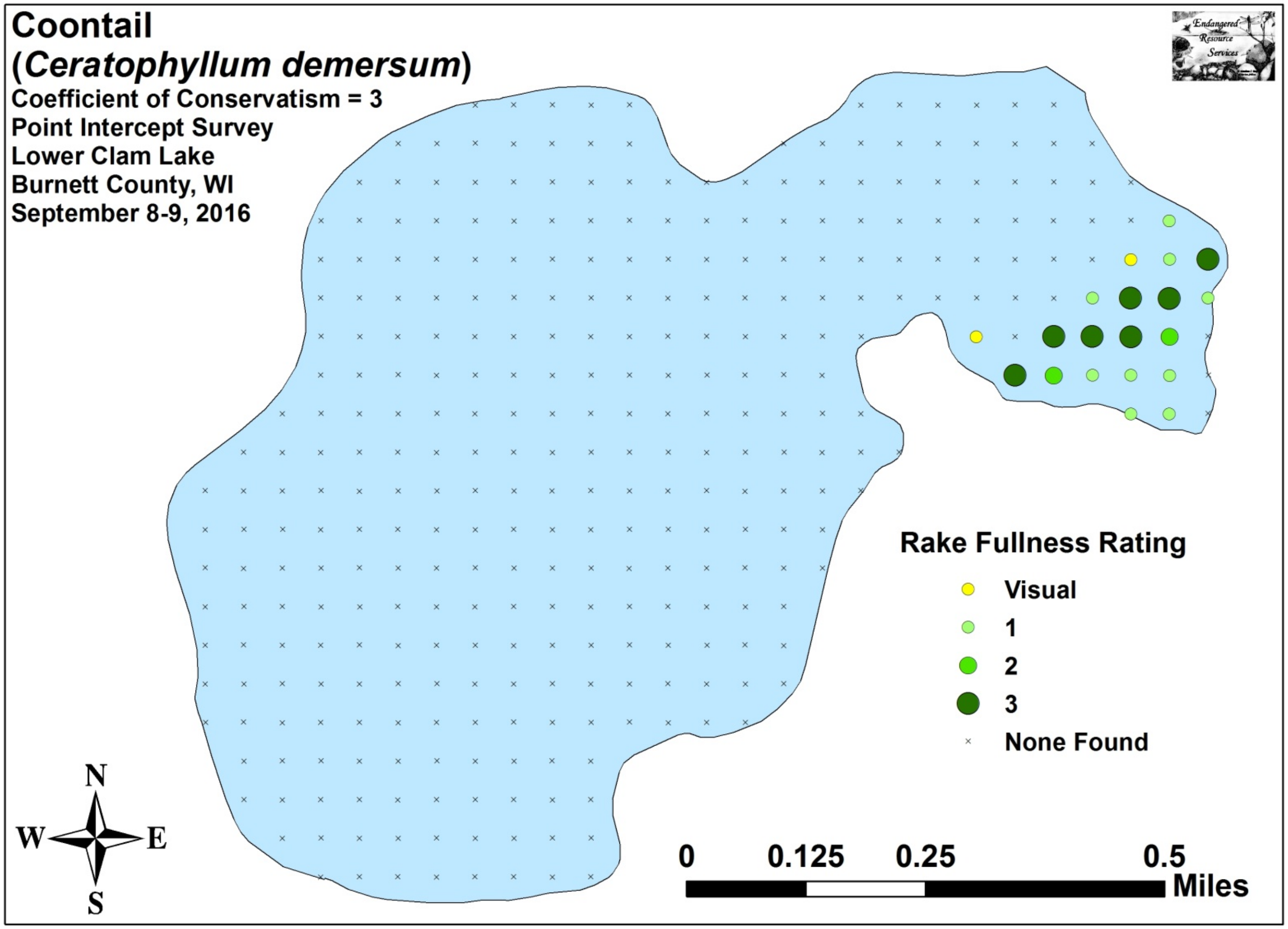


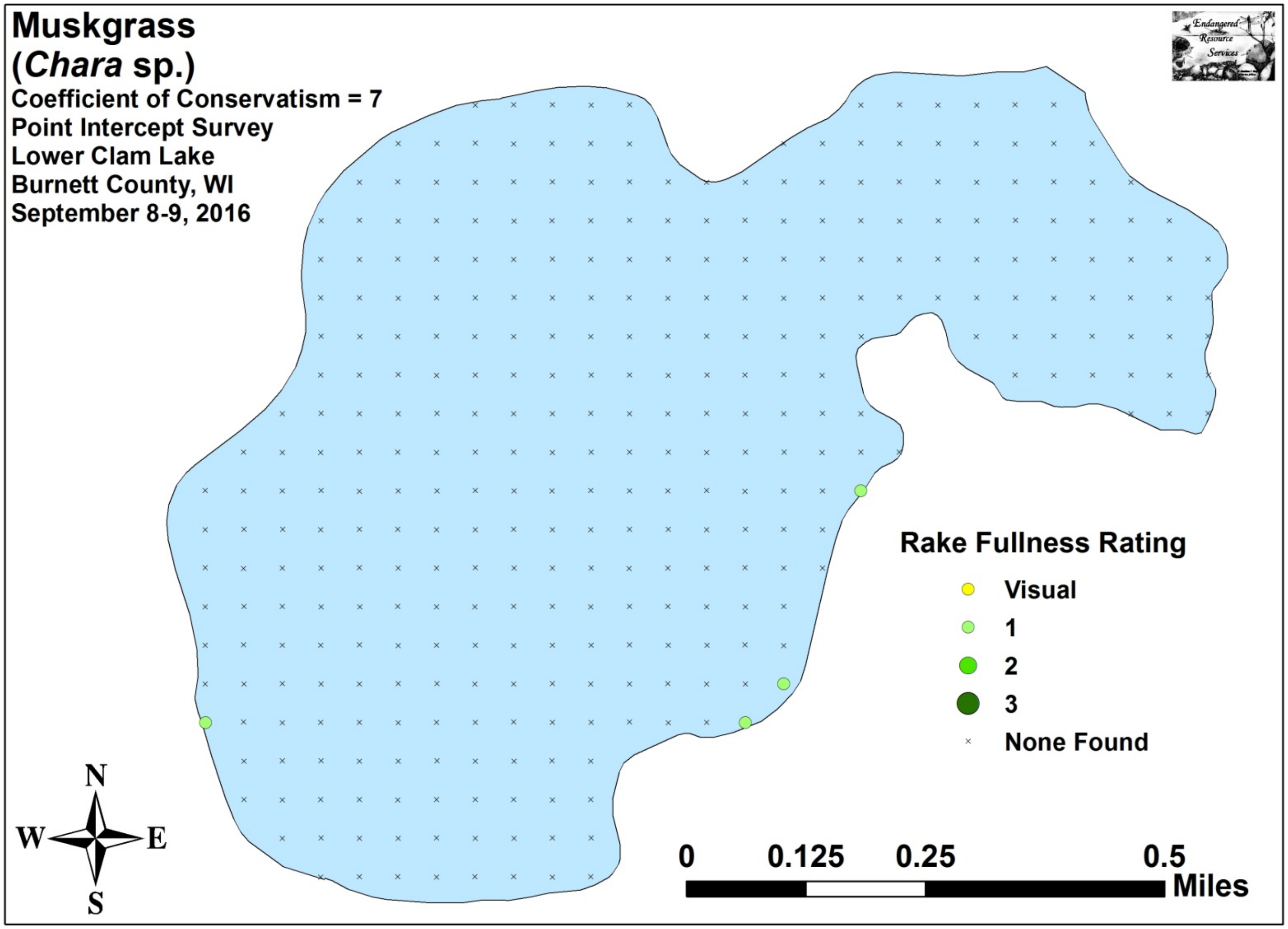
Total Rake Fullness
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

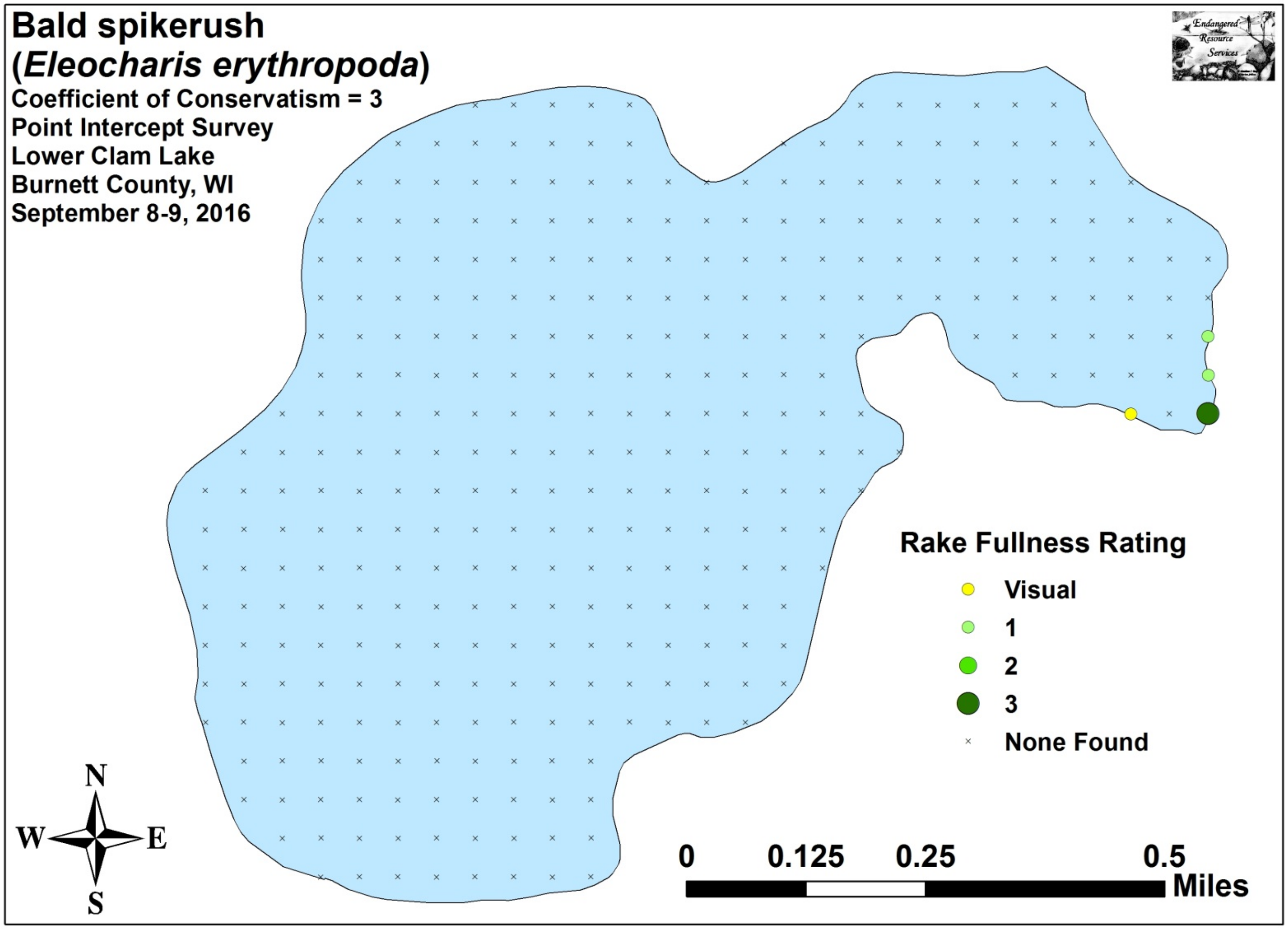
Appendix V: 2016 Native Plant Species Density and Distribution Maps


River bulrush
(Bolboschoenus fluviatilis)
Coefficient of Conservatism = 6
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

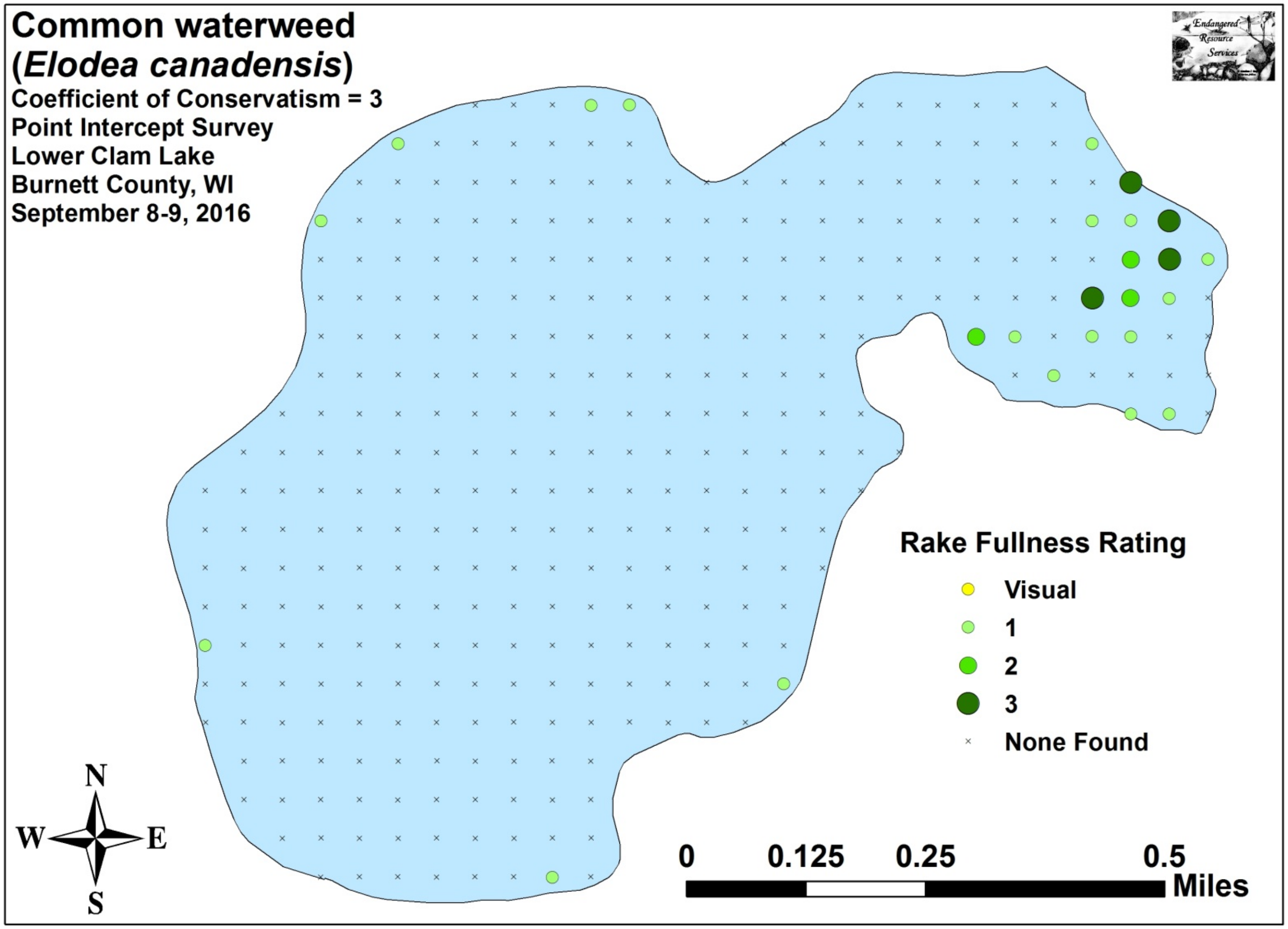

Bottle brush sedge
(*Carex comosa*)
Coefficient of Conservatism = 5
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

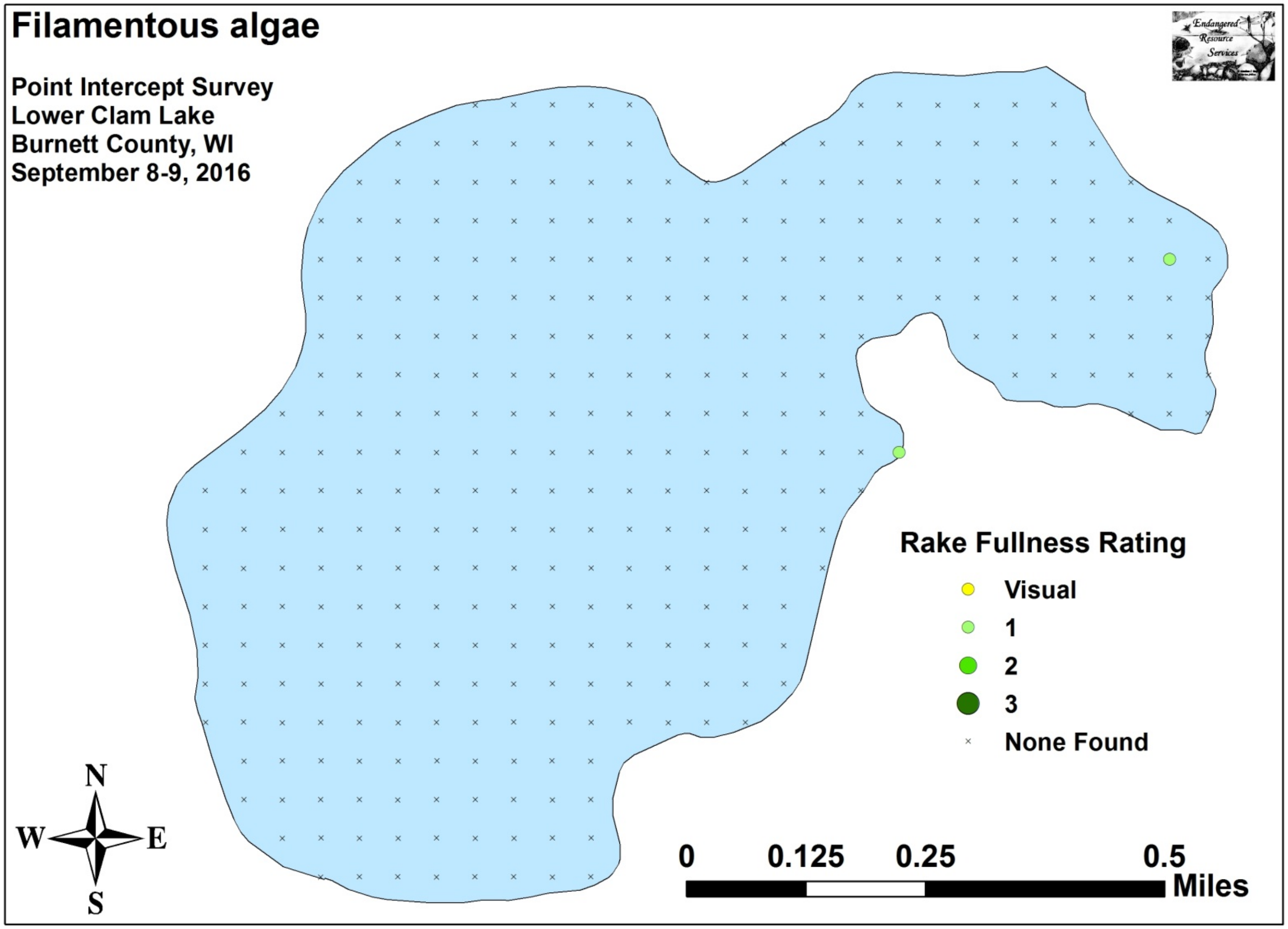

Coontail
(*Ceratophyllum demersum*)
Coefficient of Conservatism = 3
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Muskgrass
(*Chara* sp.)
Coefficient of Conservatism = 7
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles



Bald spikerush
(*Eleocharis erythropoda*)
Coefficient of Conservatism = 3
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Common waterweed
(*Elodea canadensis*)
Coefficient of Conservatism = 3
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Filamentous algae
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
N
W
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S
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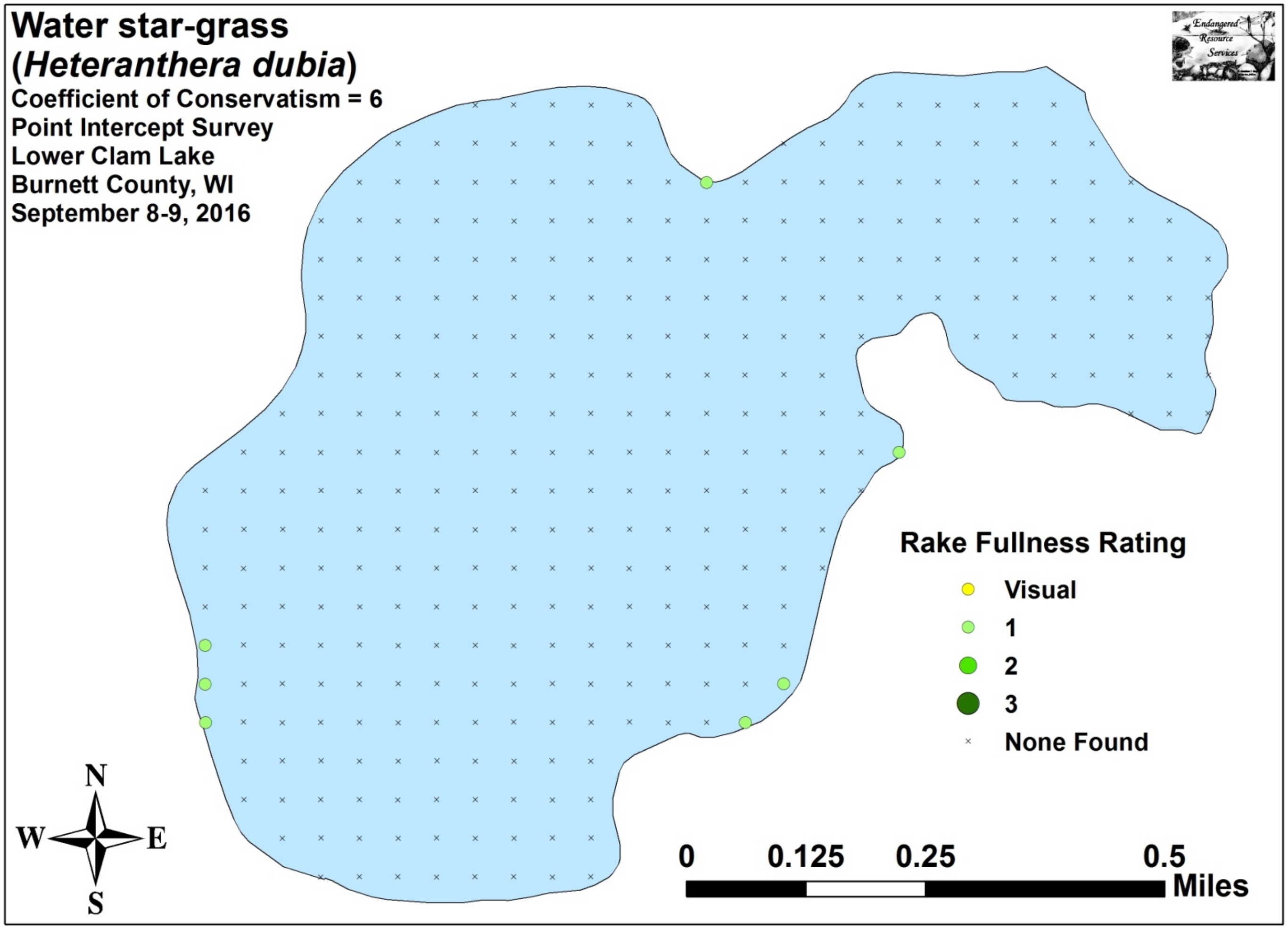
0.125
0.25
0.5
Miles


Water star-grass
(*Heteranthera dubia*)
Coefficient of Conservatism = 6
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
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3
None Found
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0.125
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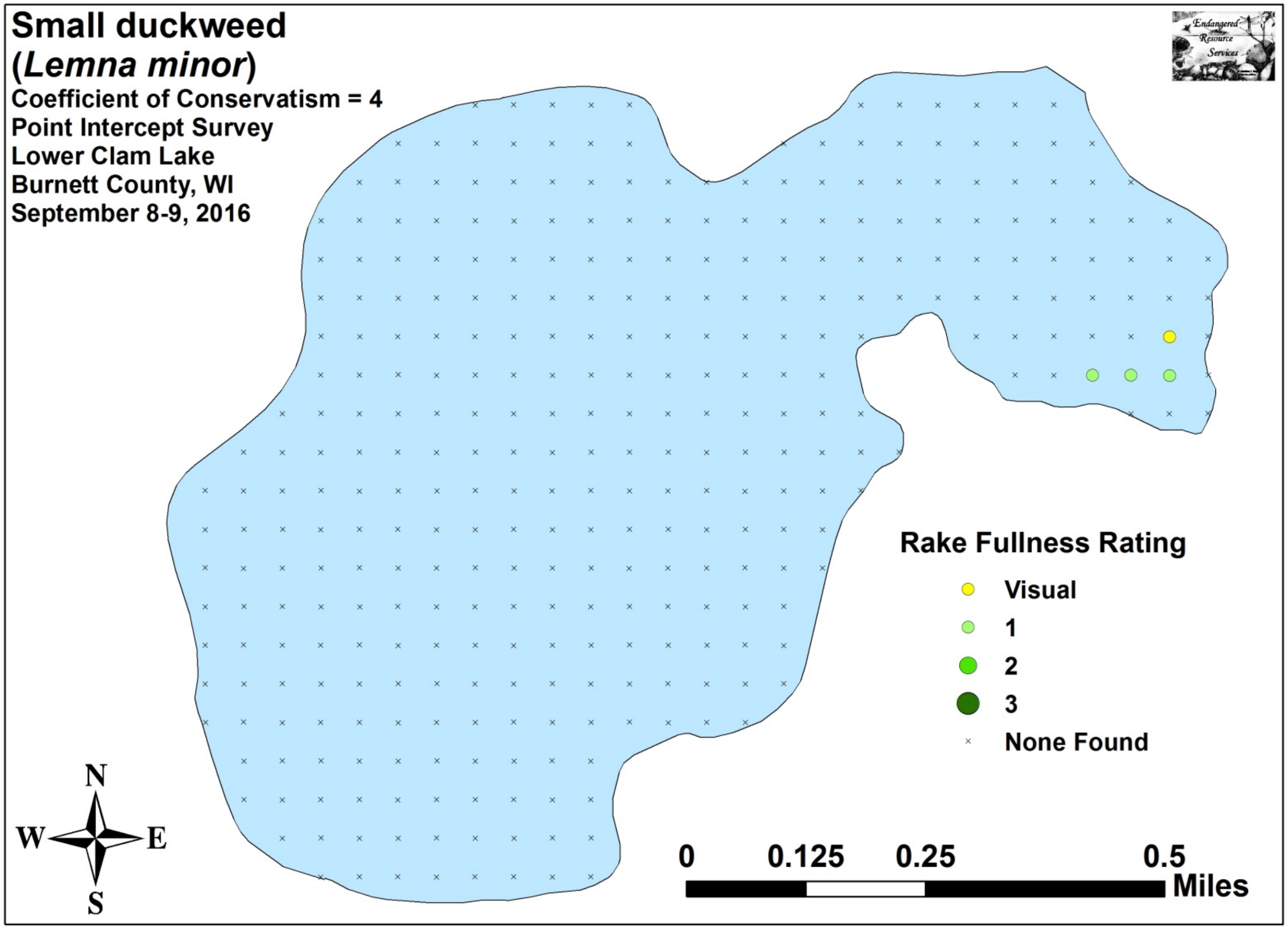
Miles


Small duckweed
(Lemna minor)
Coefficient of Conservatism = 4
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
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0.125
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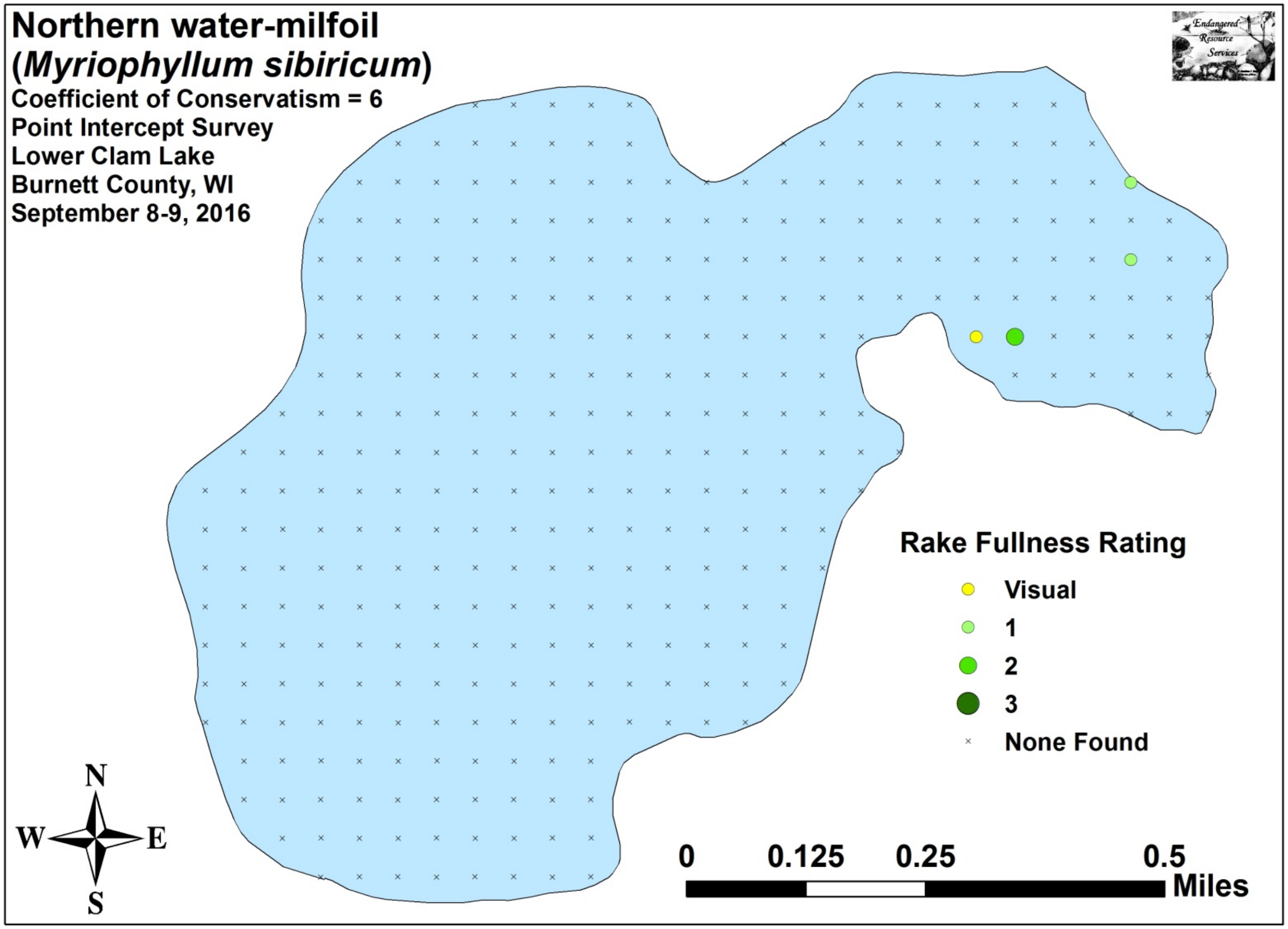
Miles


Northern water-milfoil
(*Myriophyllum sibiricum*)
Coefficient of Conservatism = 6
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Rake Fullness Rating
Visual
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3
None Found
0
0.125
0.25
0.5
Miles
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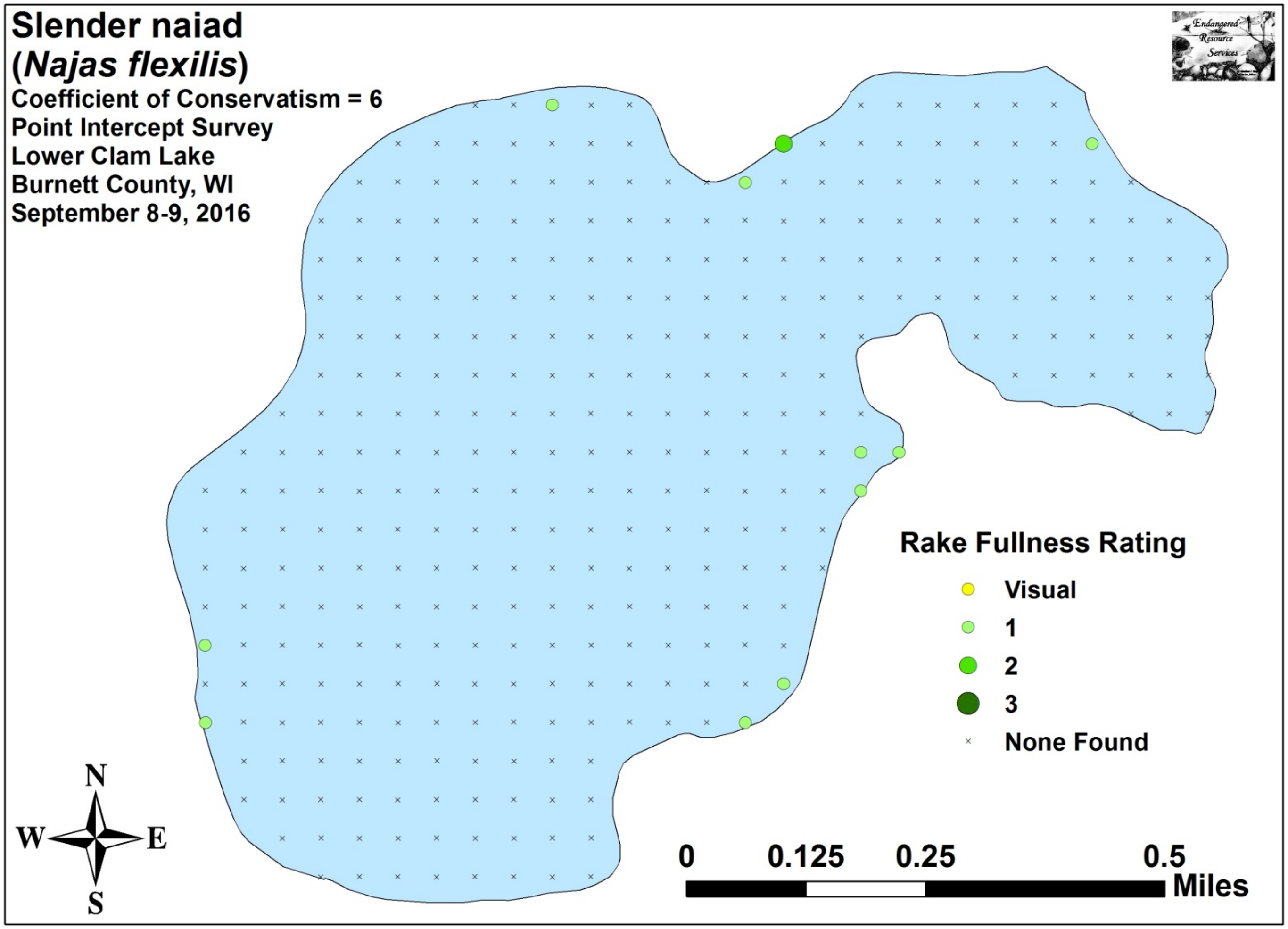
Slender naiad
(*Najas flexilis*)
Coefficient of Conservatism = 6
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Rake Fullness Rating
Visual
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None Found
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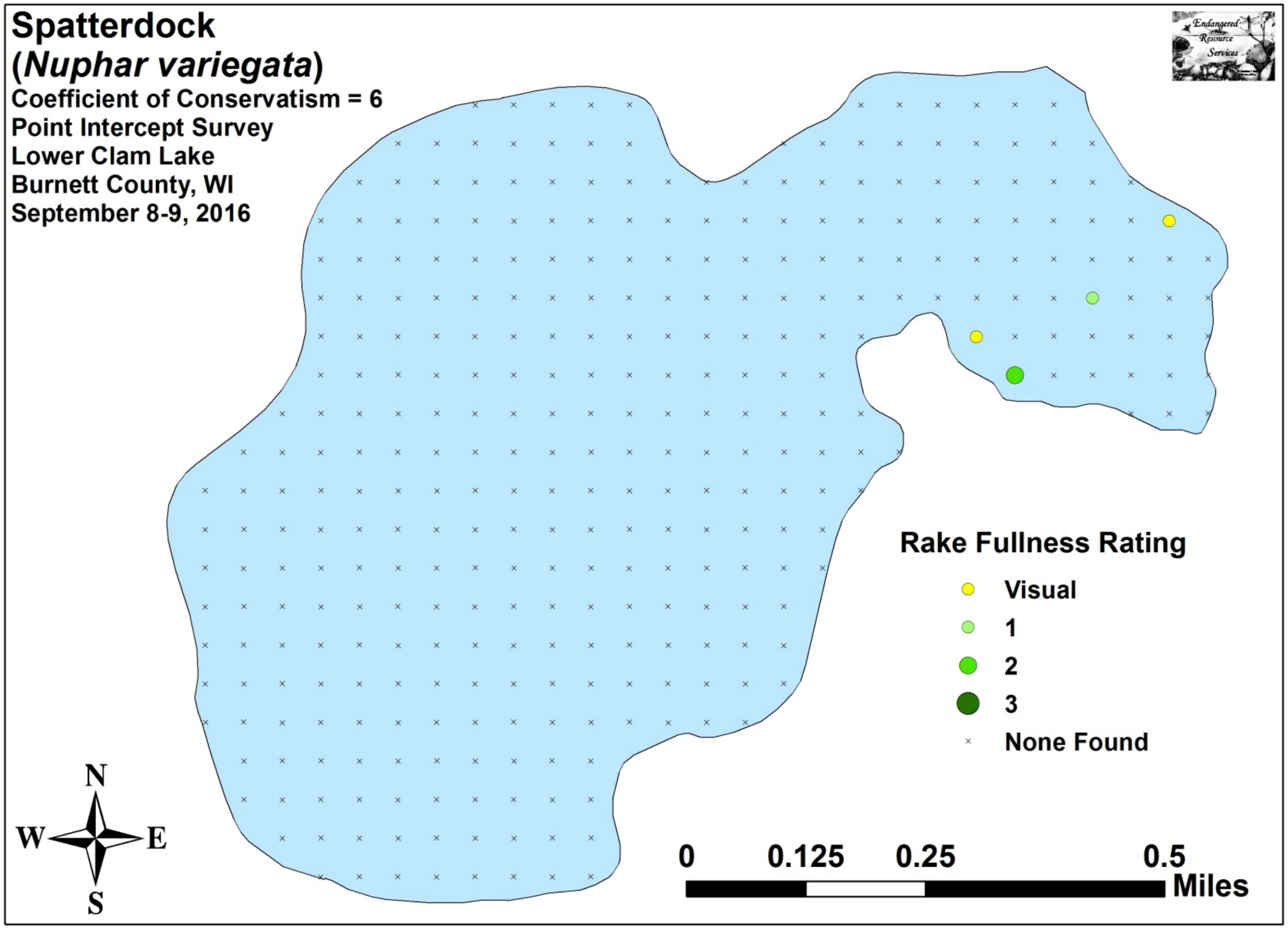
Miles


Spatterdock
(Nuphar variegata)
Coefficient of Conservatism = 6
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
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3
None Found
N
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0.125
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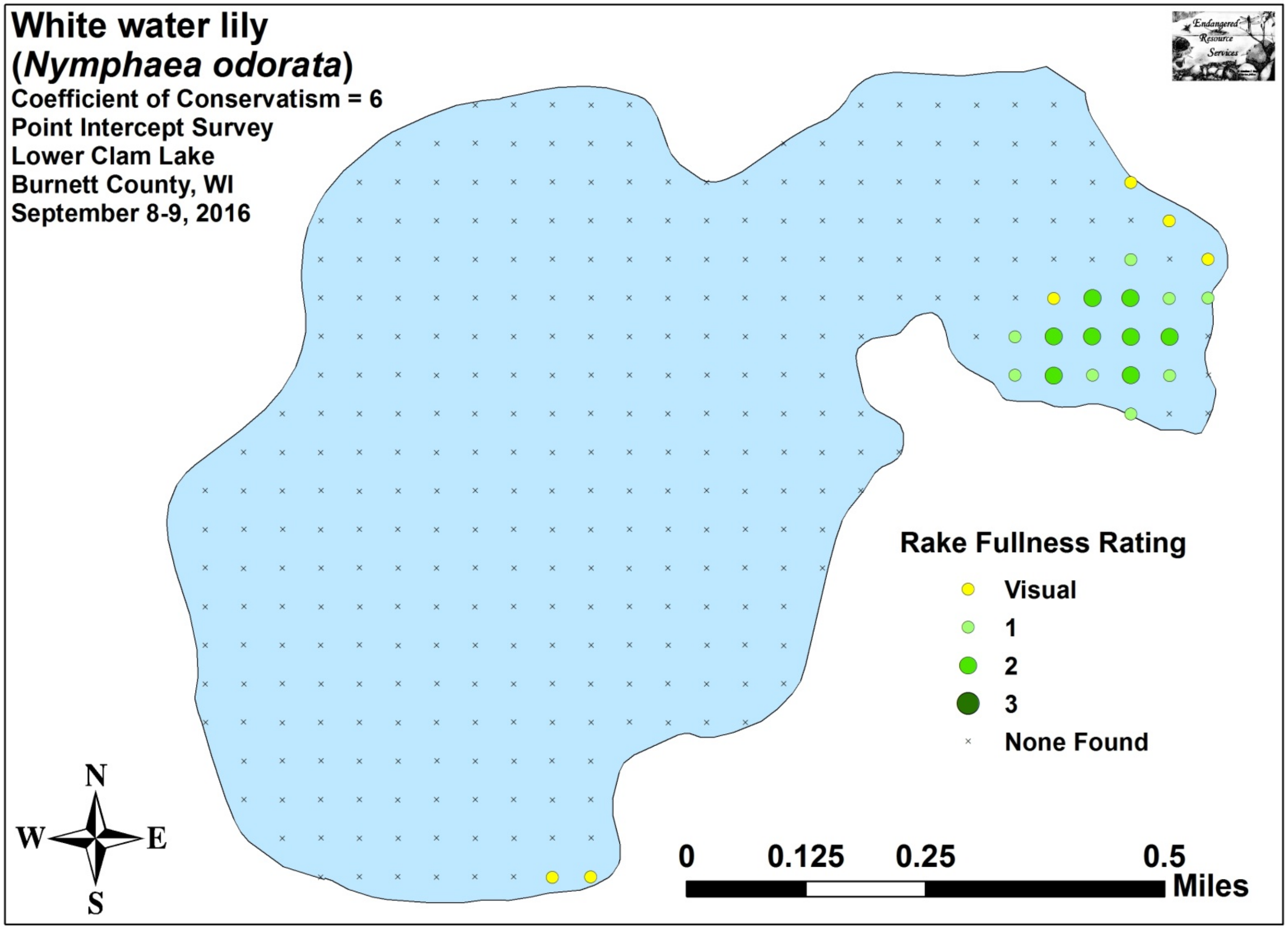
Miles


White water lily
(*Nymphaea odorata*)
Coefficient of Conservatism = 6
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
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S
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0.125
0.25
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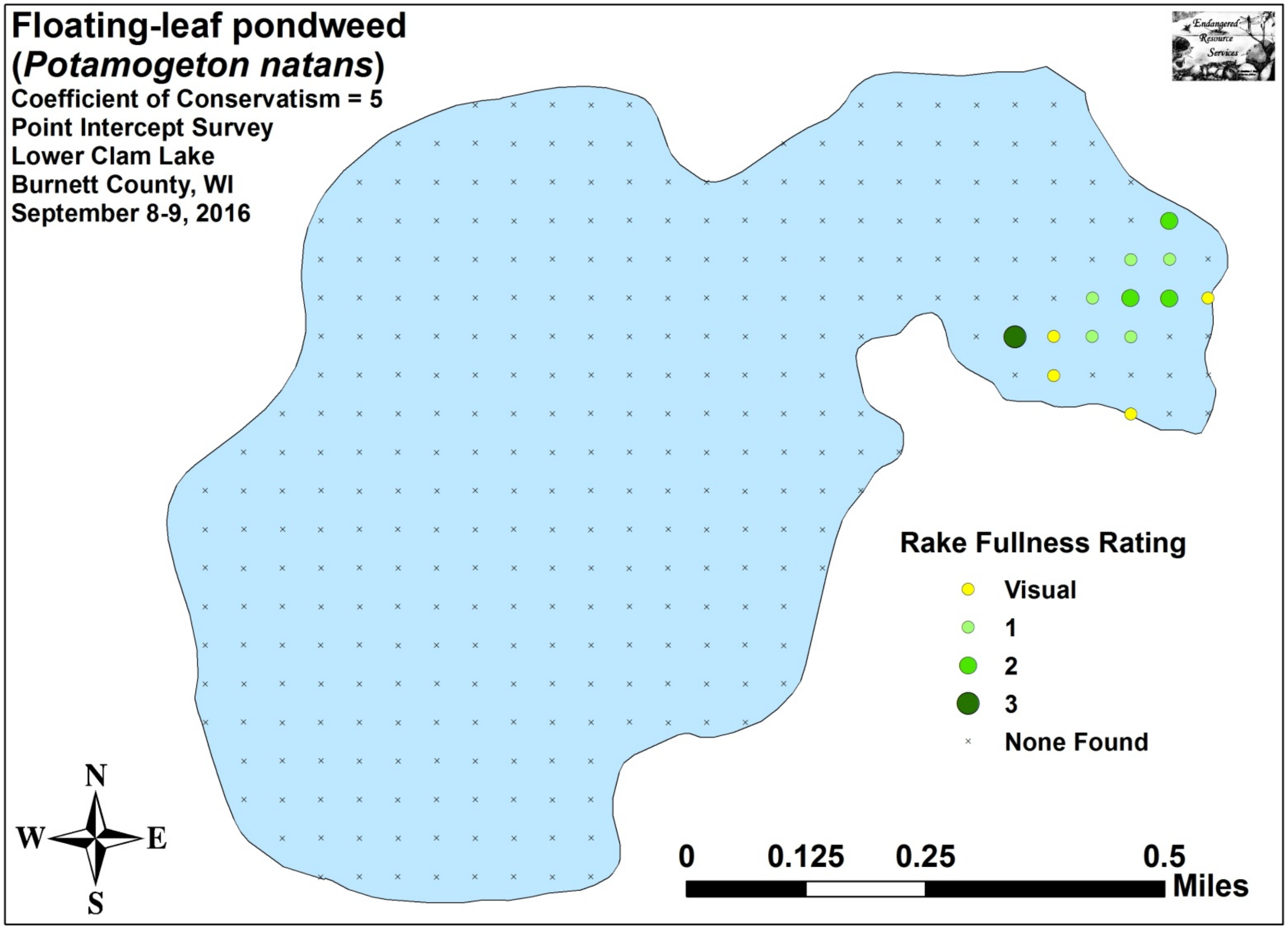
Miles


Floating-leaf pondweed
(*Potamogeton natans*)
Coefficient of Conservatism = 5
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
N
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0.125
0.25
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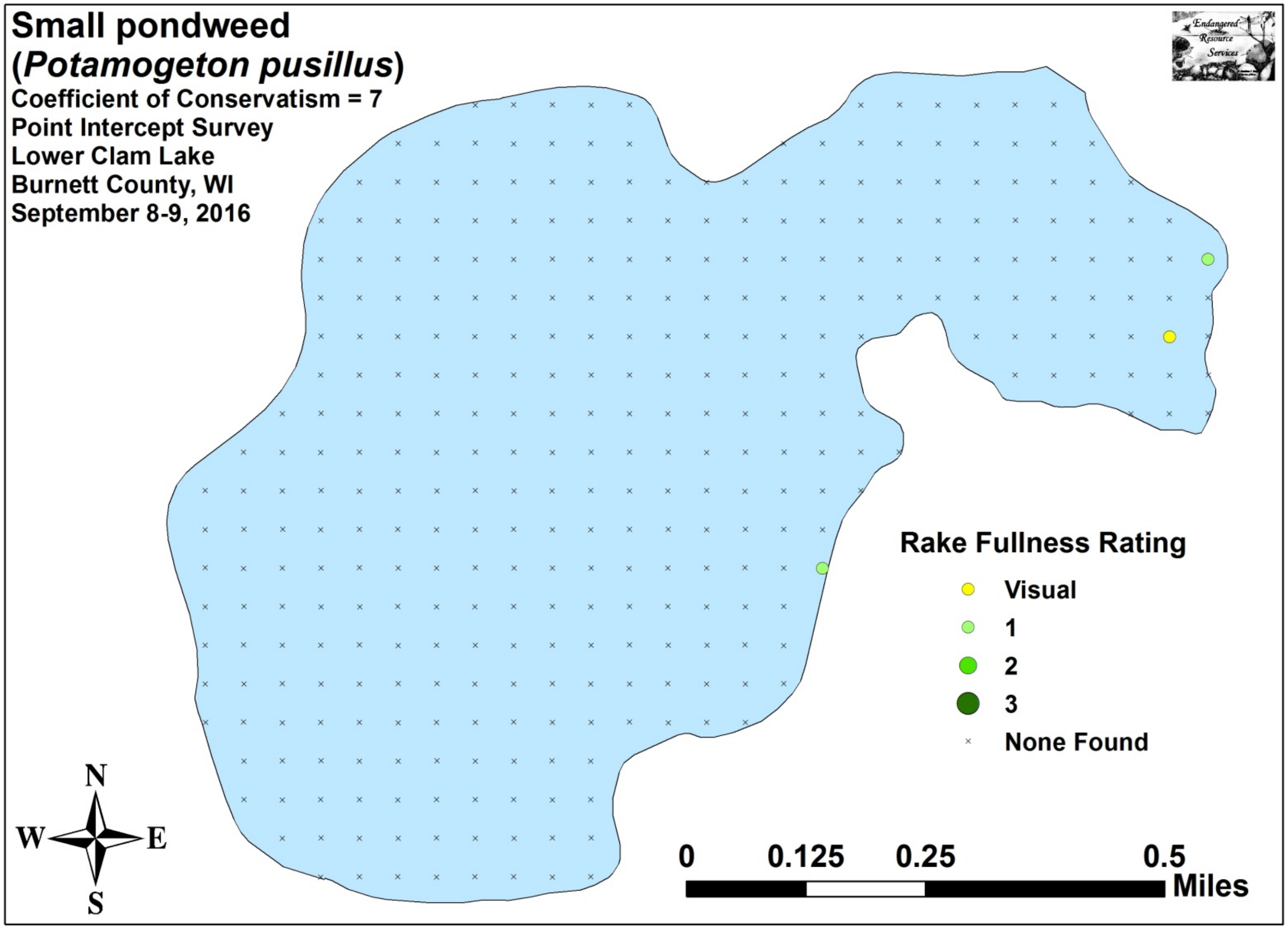
Miles


Small pondweed
(*Potamogeton pusillus*)
Coefficient of Conservatism = 7
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
N
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0.125
0.25
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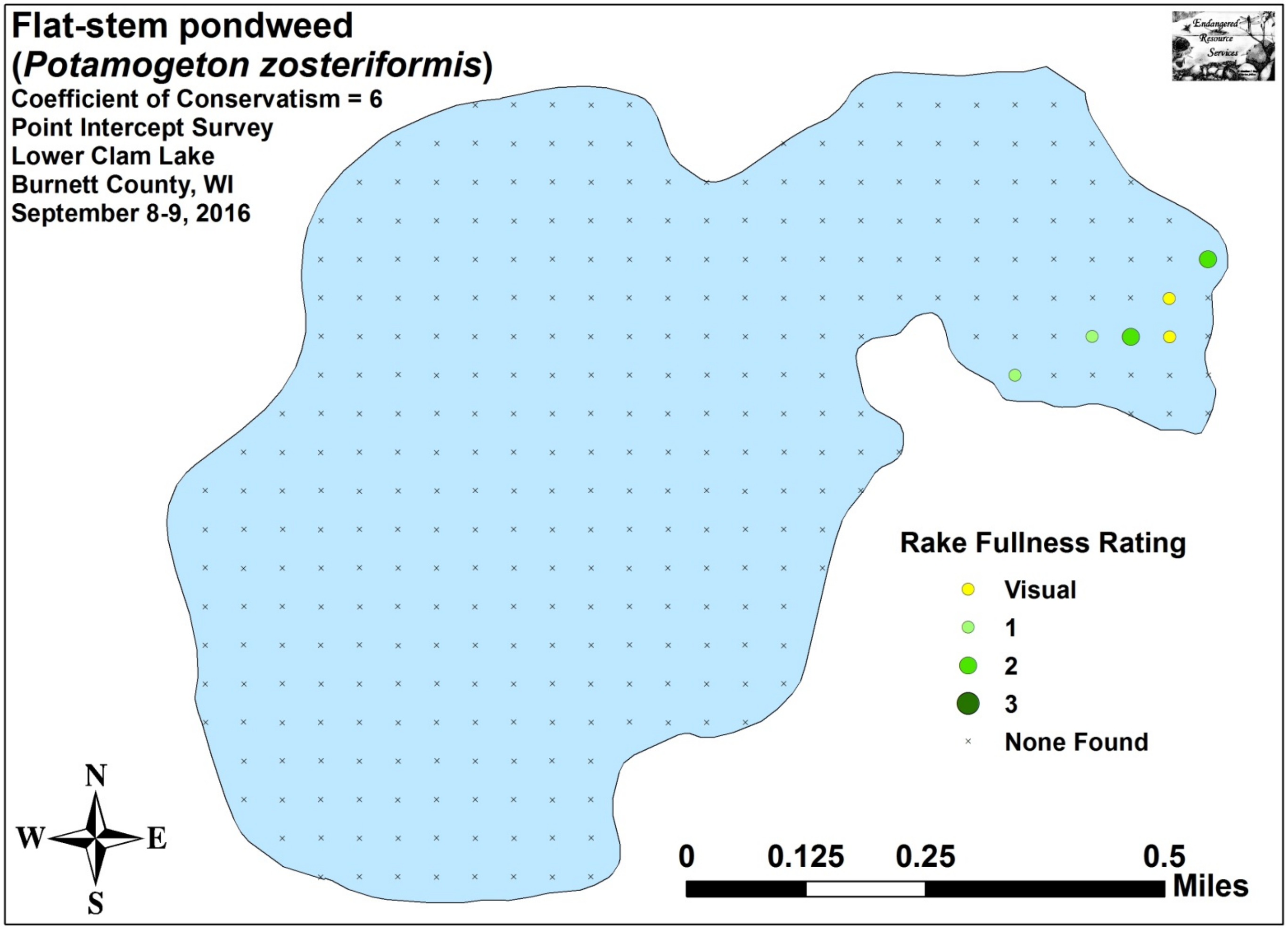
Miles


Flat-stem pondweed
(*Potamogeton zosteriformis*)
Coefficient of Conservatism = 6
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Rake Fullness Rating
Visual
1
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3
None Found
N
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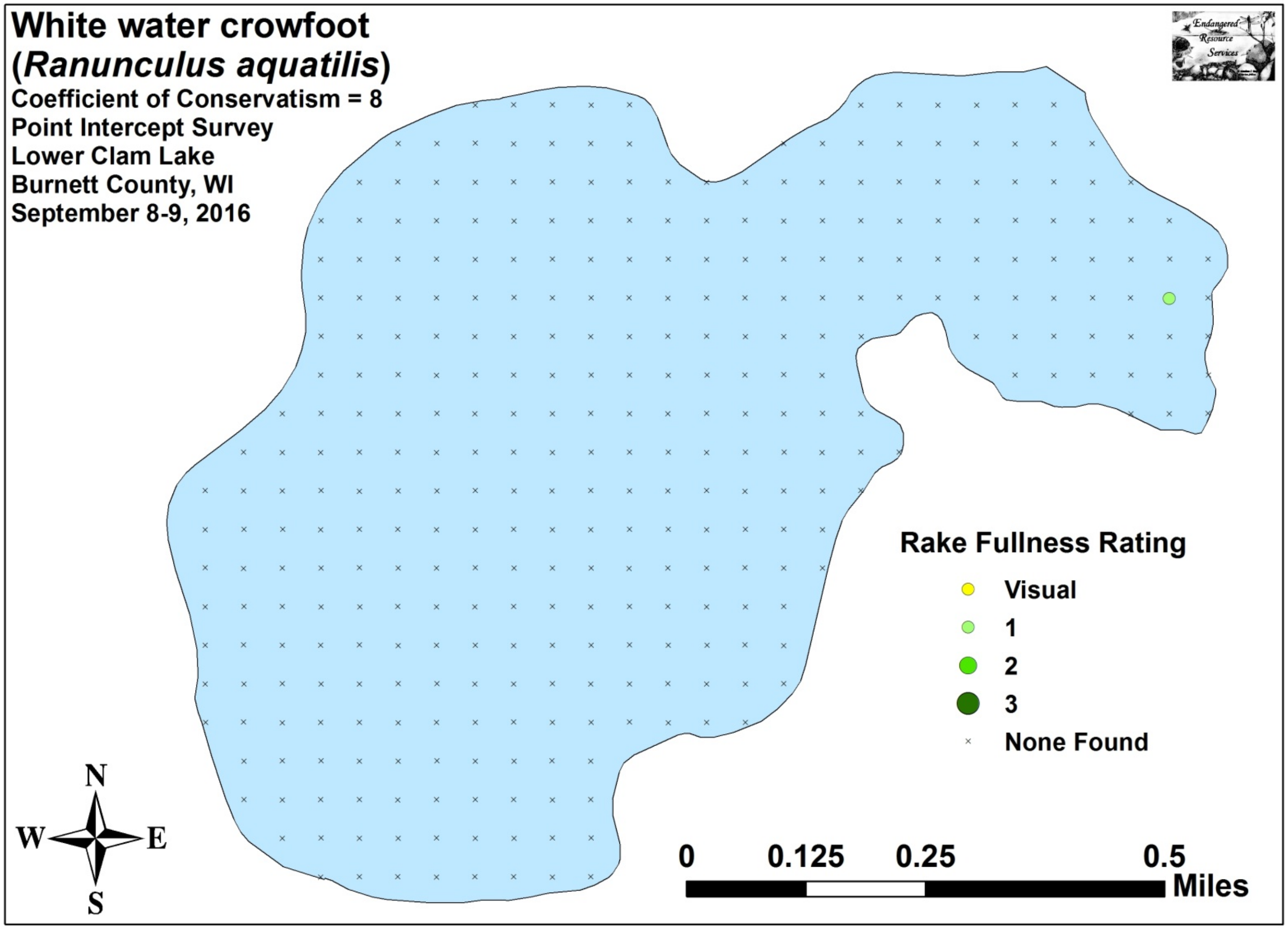
0.125
0.25
0.5
Miles


White water crowfoot
(Ranunculus aquatilis)
Coefficient of Conservatism = 8
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
N
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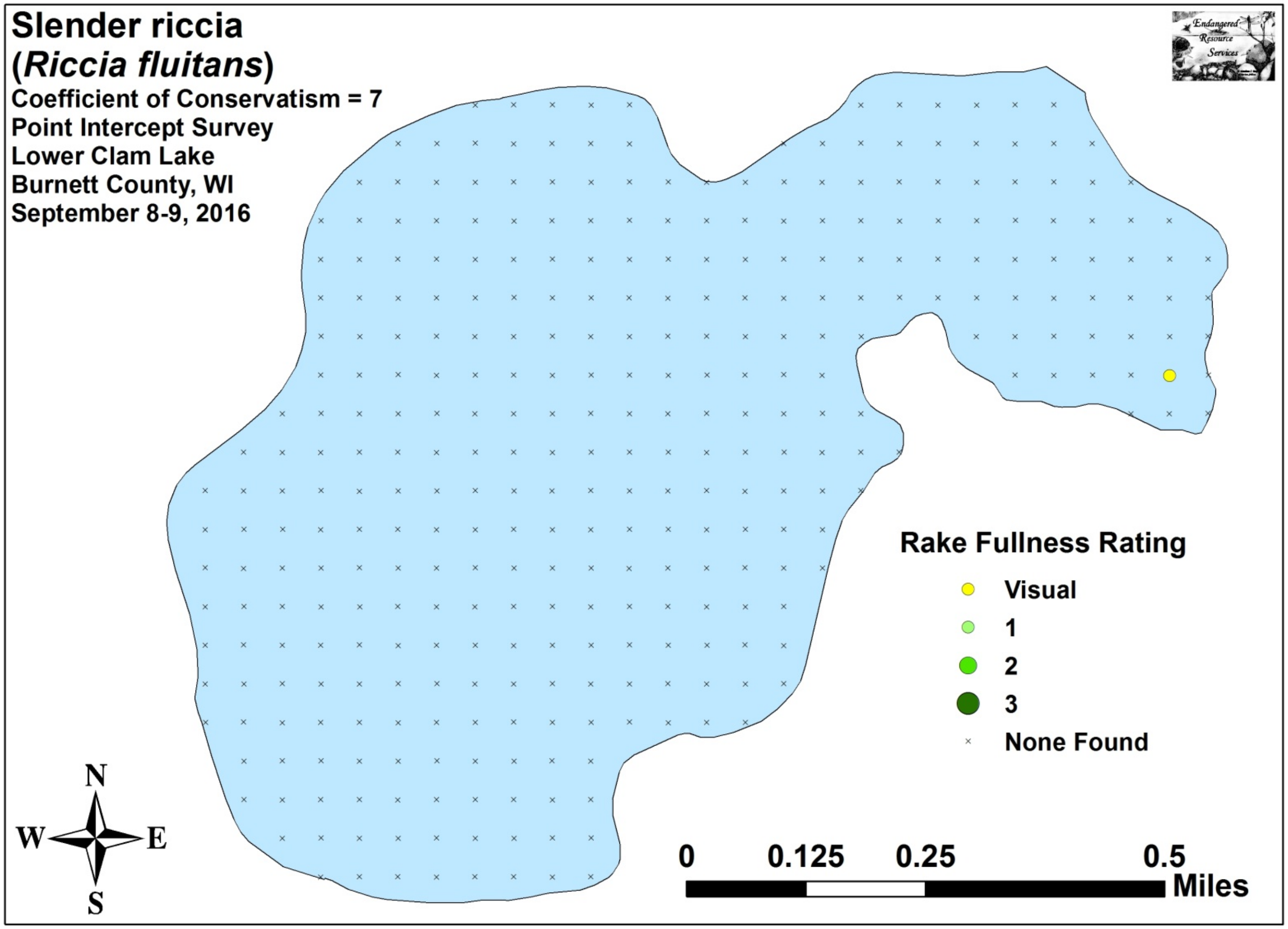
0.125
0.25
0.5
Miles



Slender riccia
(Riccia fluitans)
Coefficient of Conservatism = 7
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
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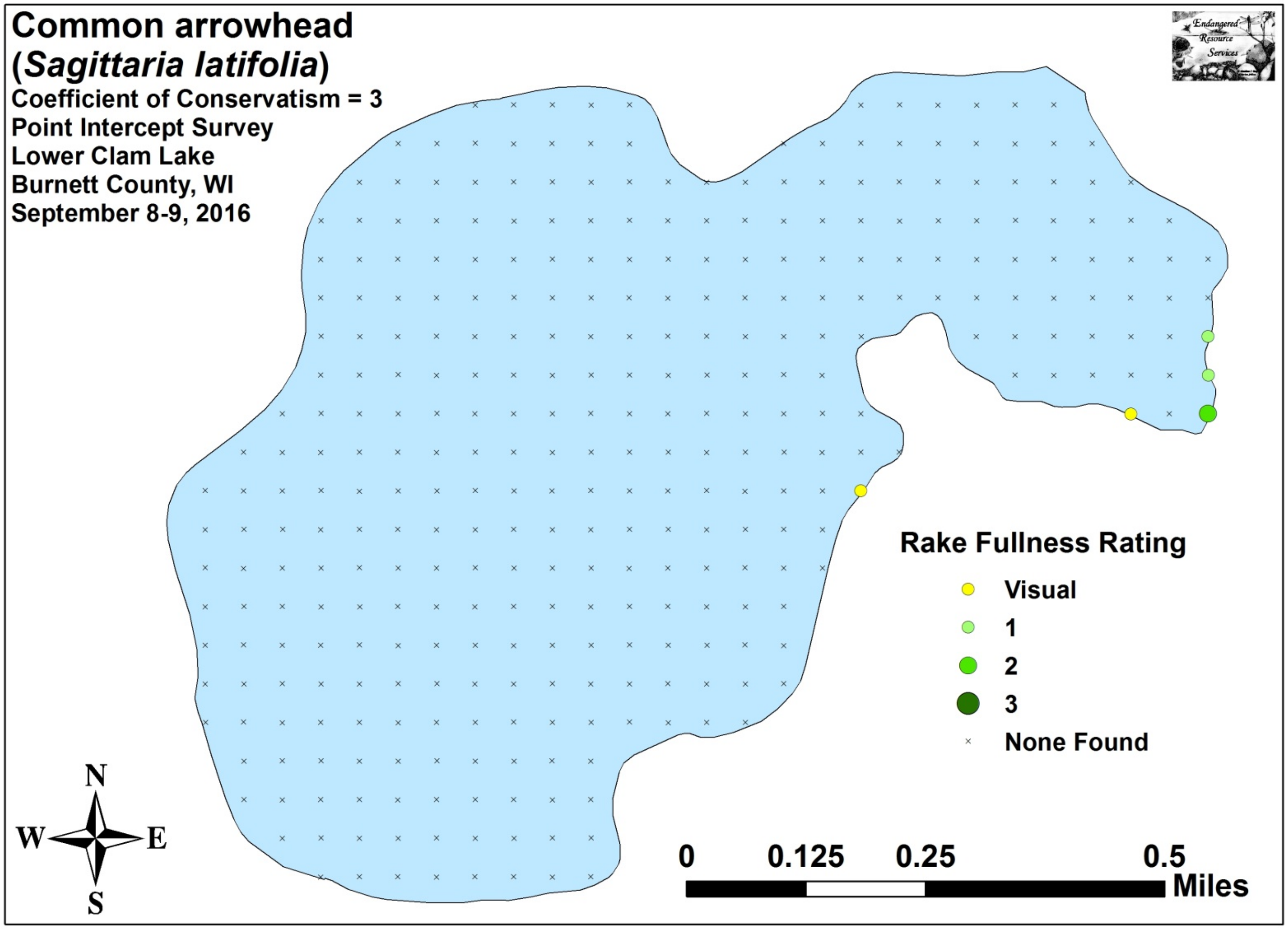
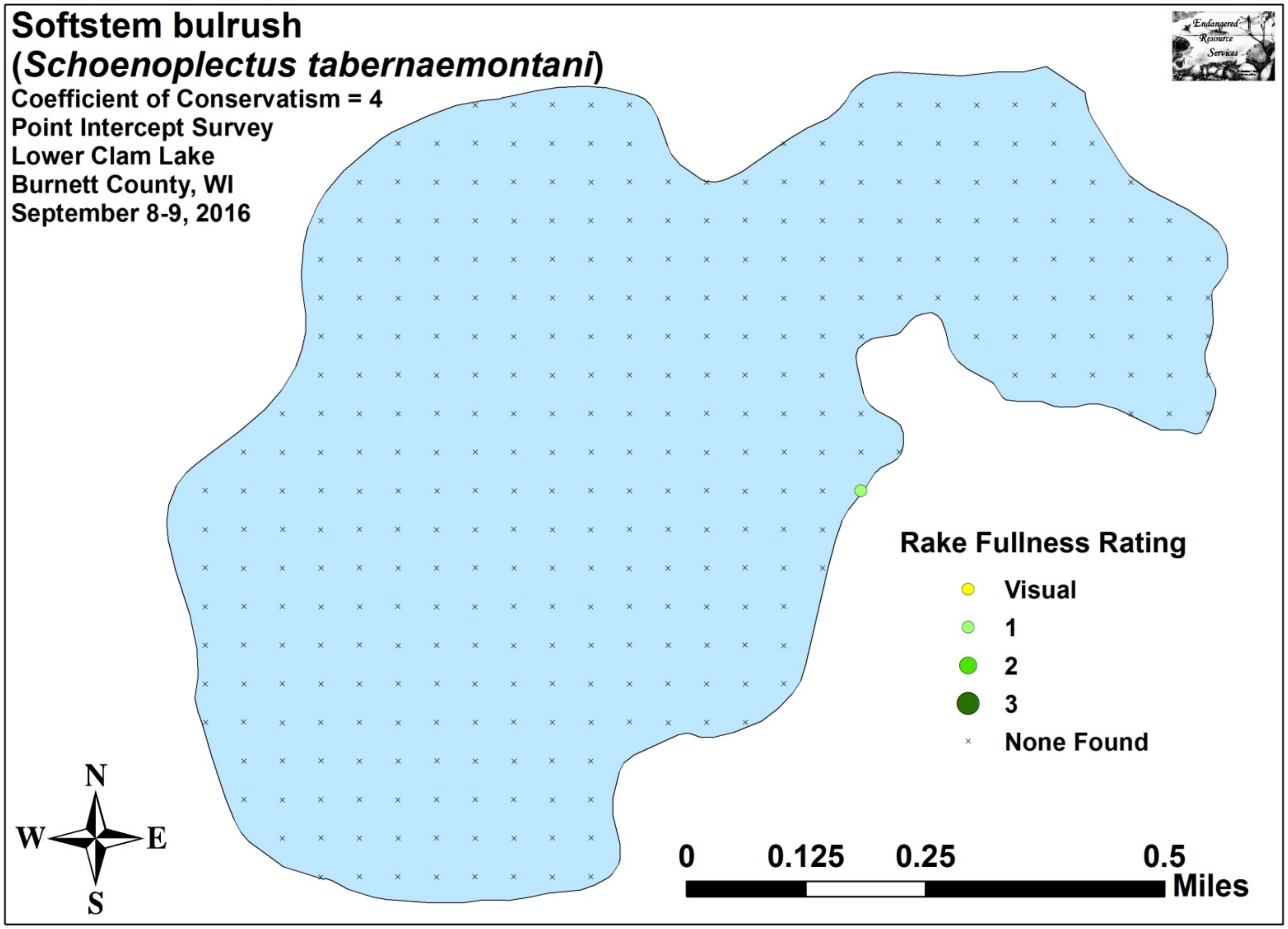
S
0
0.125
0.25
0.5
Miles


Common arrowhead
(Sagittaria latifolia)
Coefficient of Conservatism = 3
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles



Softstem bulrush
(Schoenoplectus tabernaemontani)
Coefficient of Conservatism = 4
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
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0
0.125
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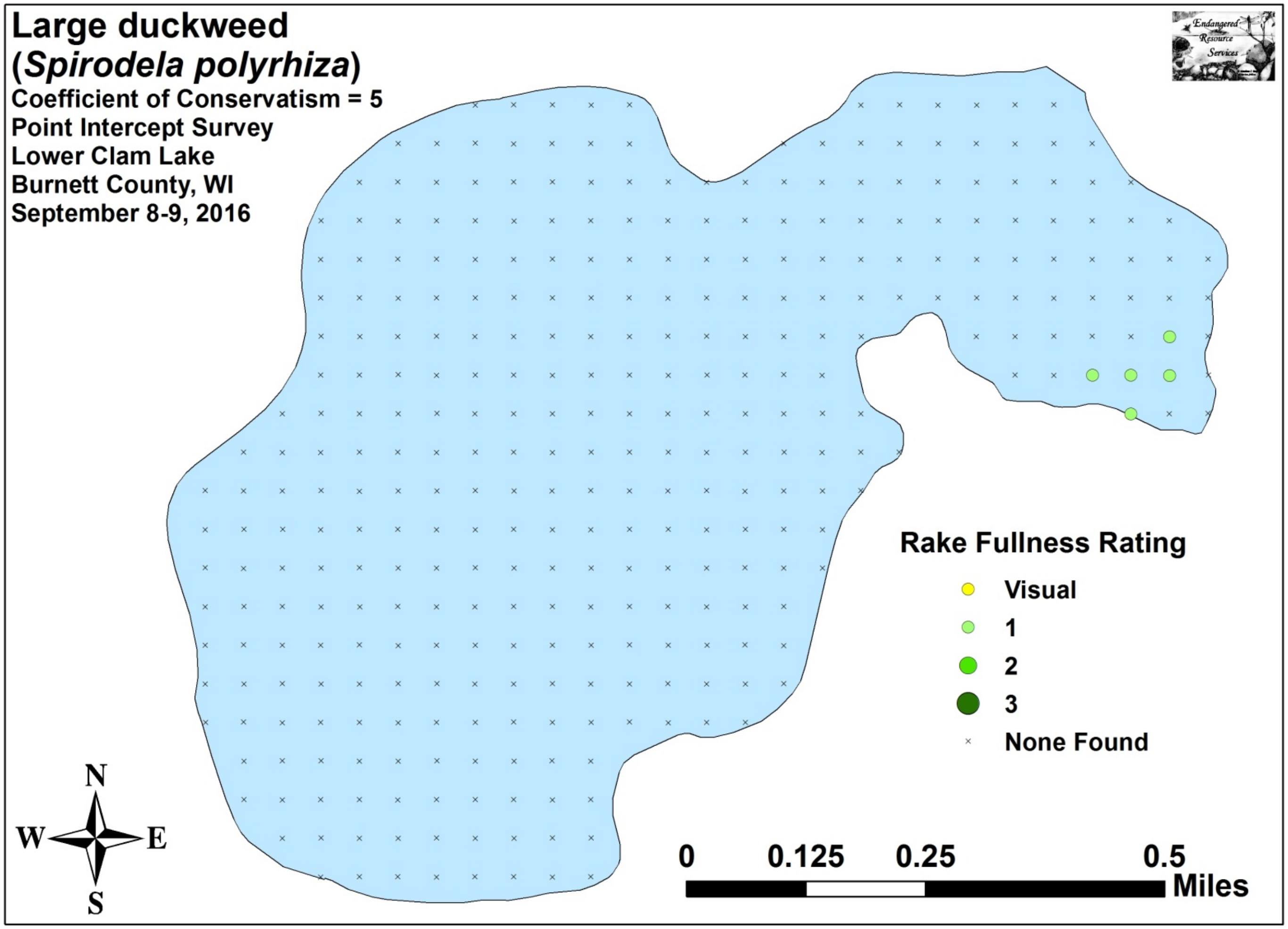
0.5
Miles


Large duckweed
(*Spirodela polyrhiza*)
Coefficient of Conservatism = 5
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
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S
0
0.125
0.25
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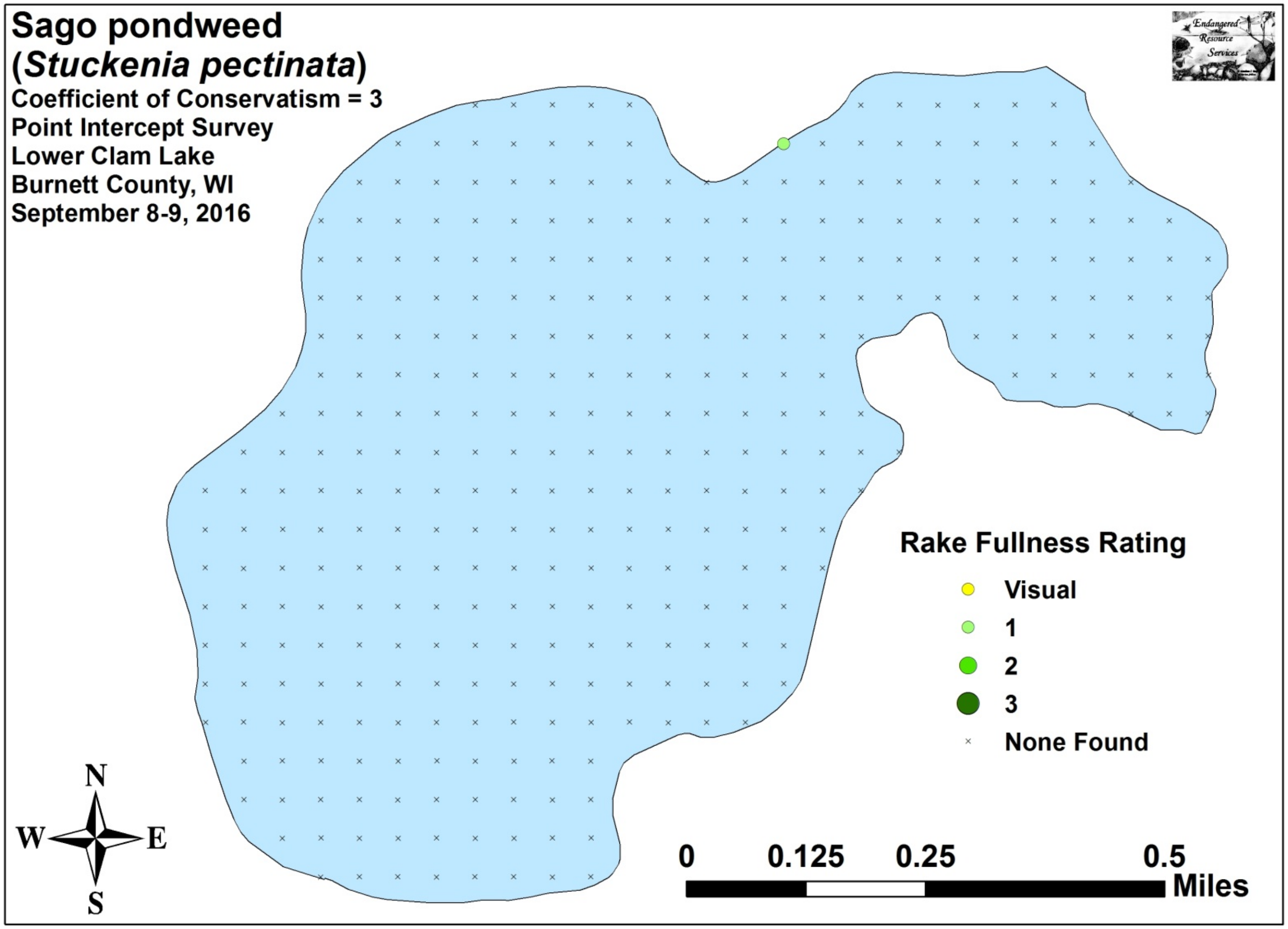
Miles



Sago pondweed
(*Stuckenia pectinata*)
Coefficient of Conservatism = 3
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
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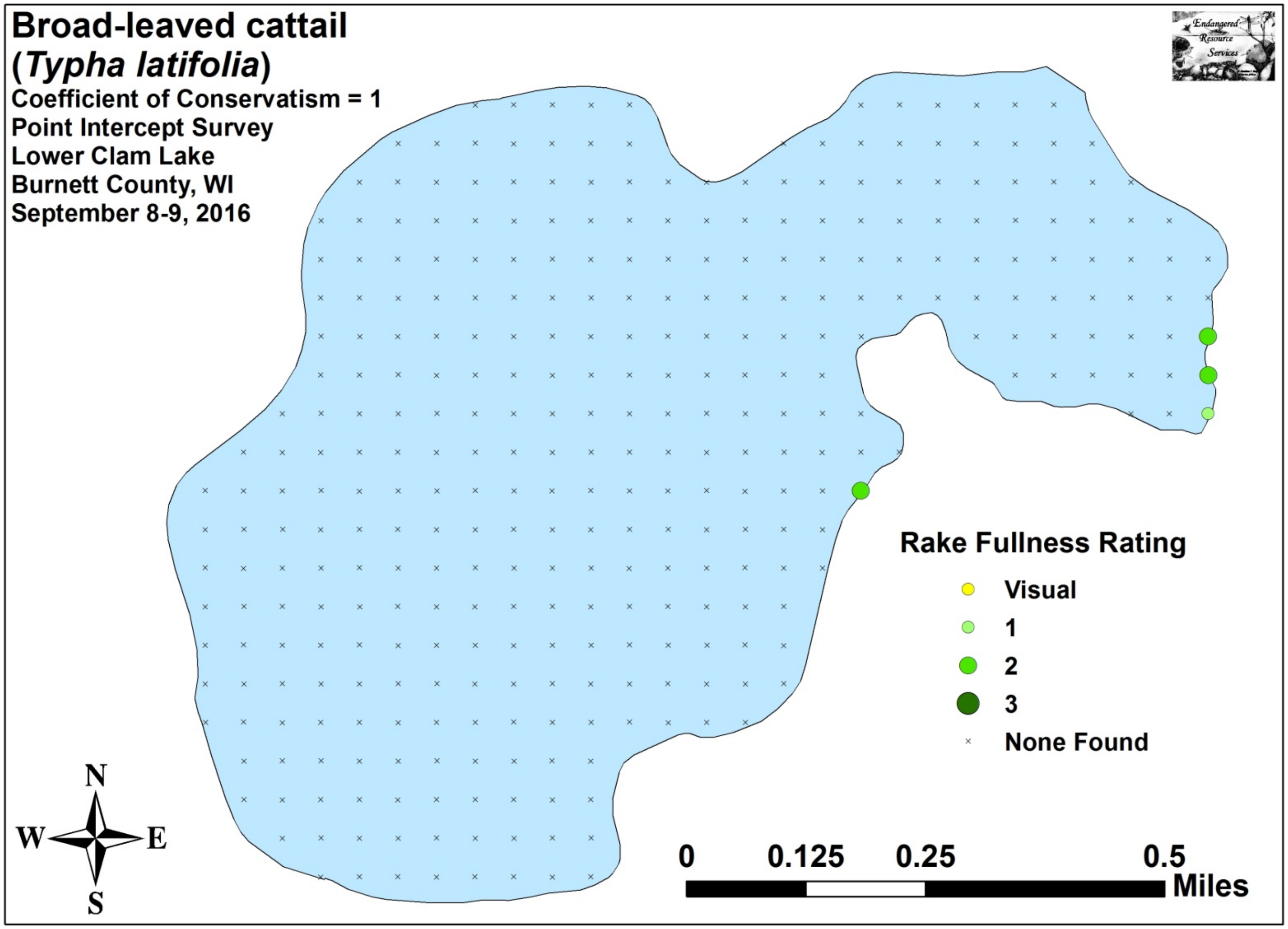
0.125
0.25
0.5
Miles



Broad-leaved cattail
(Typha latifolia)
Coefficient of Conservatism = 1
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
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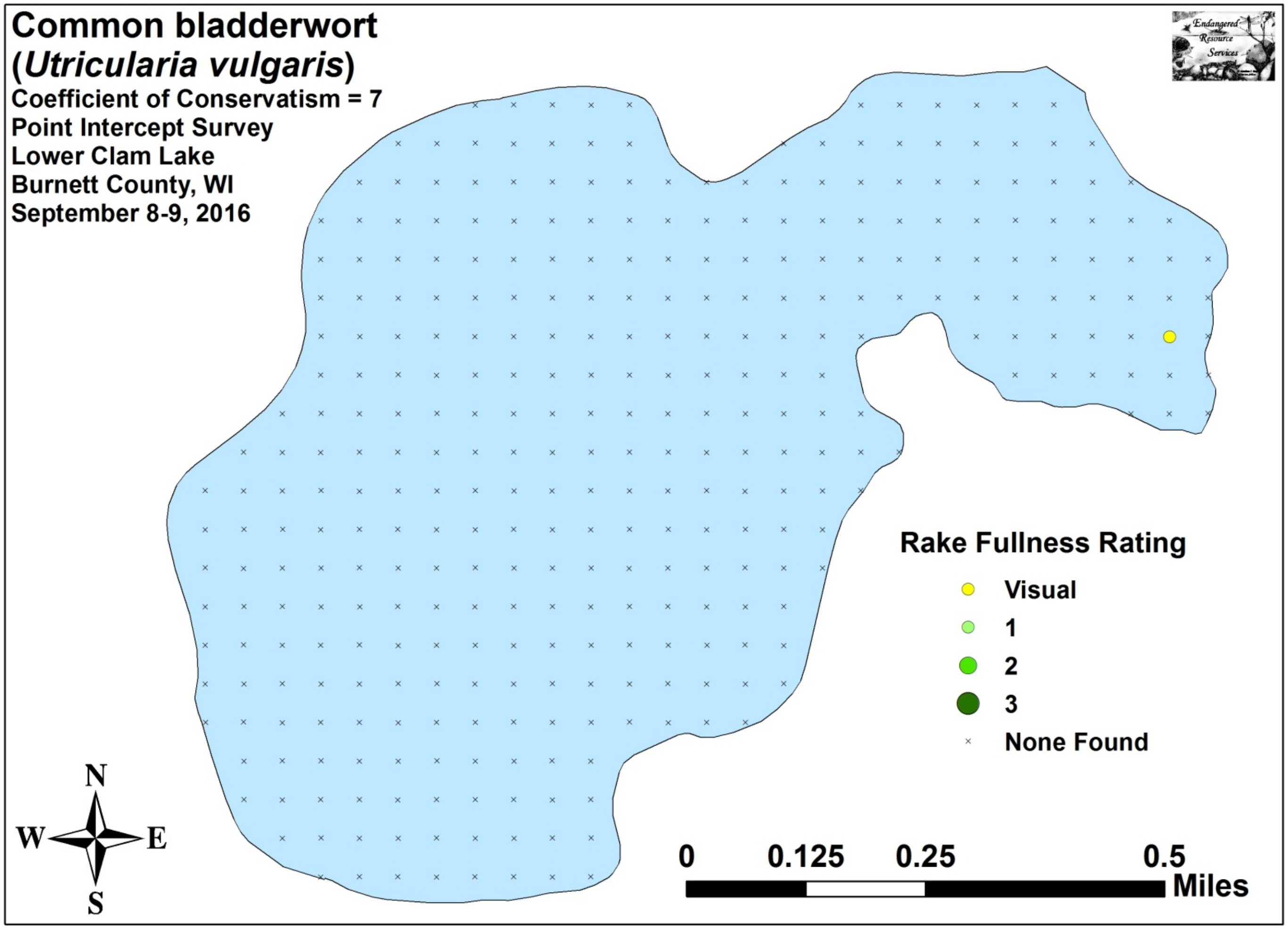
S
0
0.125
0.25
0.5
Miles


Common bladderwort
(Utricularia vulgaris)
Coefficient of Conservatism = 7
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
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S
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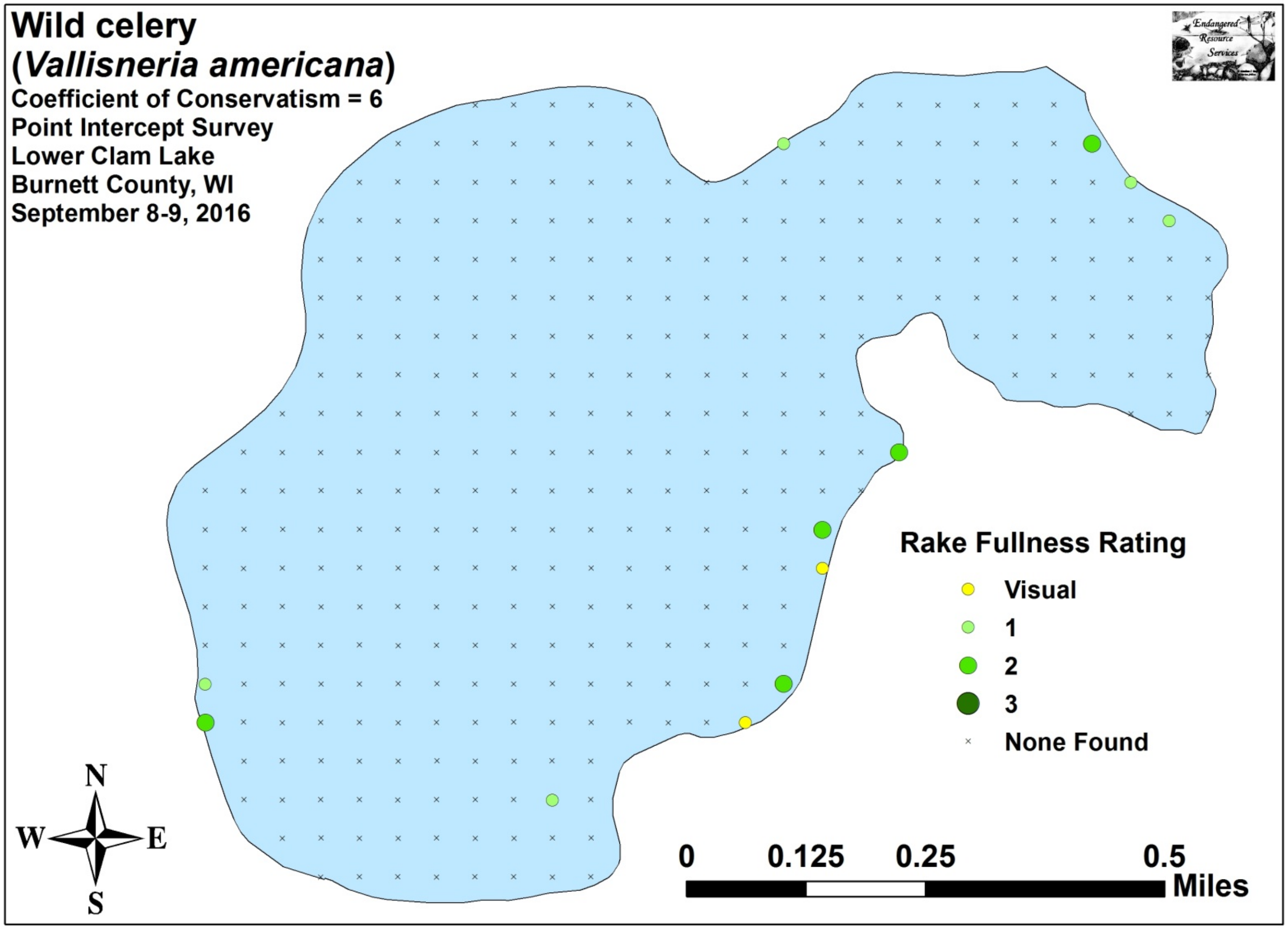
0.125
0.25
0.5
Miles


Wild celery
(*Vallisneria americana*)
Coefficient of Conservatism = 6
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
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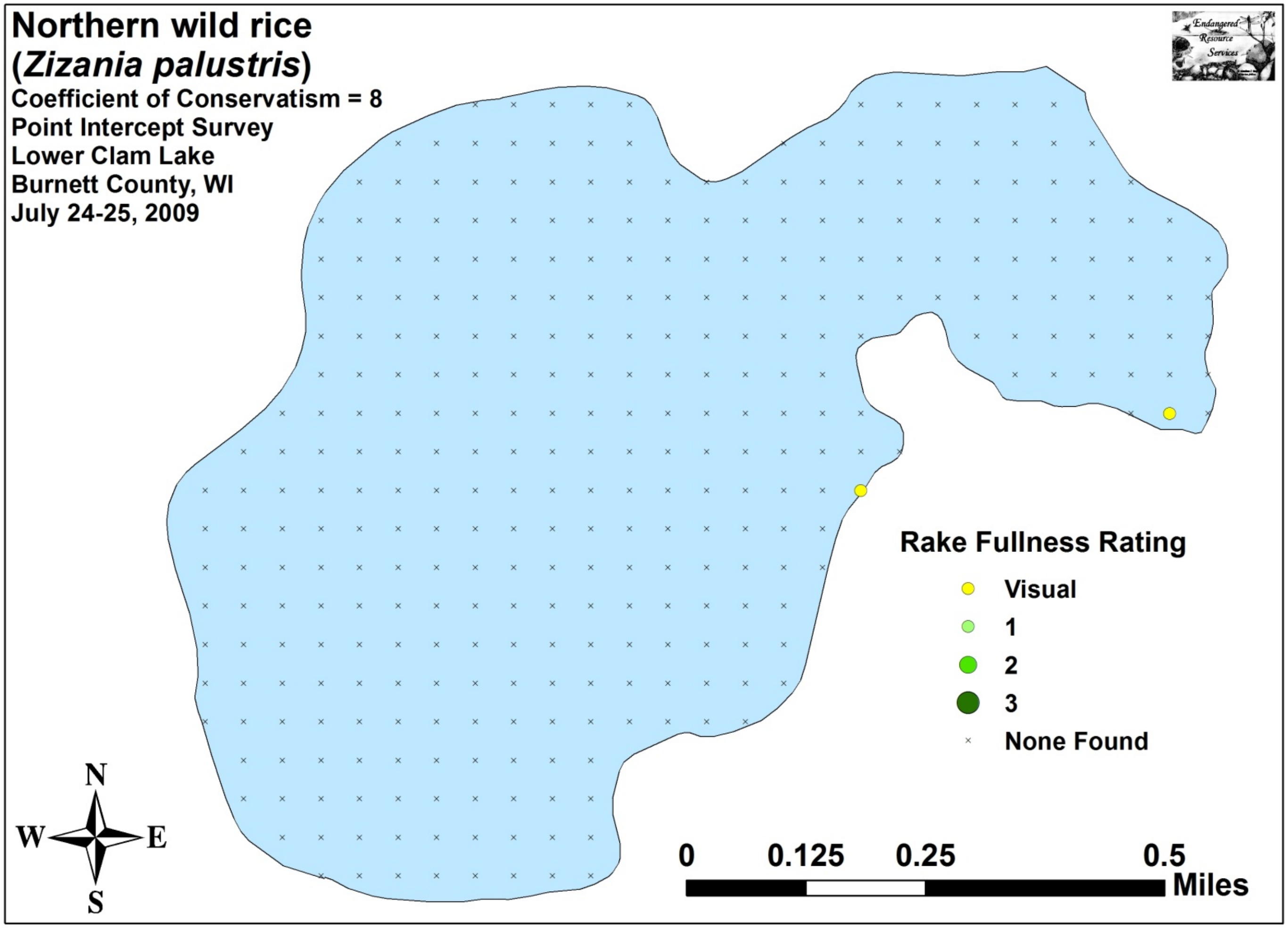
0
0.125
0.25
0.5
Miles

Appendix VI: 2009, 2012, 2014, 2015, and 2016 Northern Wild Rice Density and Distribution Maps


Northern wild rice
(*Zizania palustris*)
Coefficient of Conservatism = 8
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
July 24-25, 2009
Rake Fullness Rating
Visual
1
2
3
None Found
0
0.125
0.25
0.5
Miles
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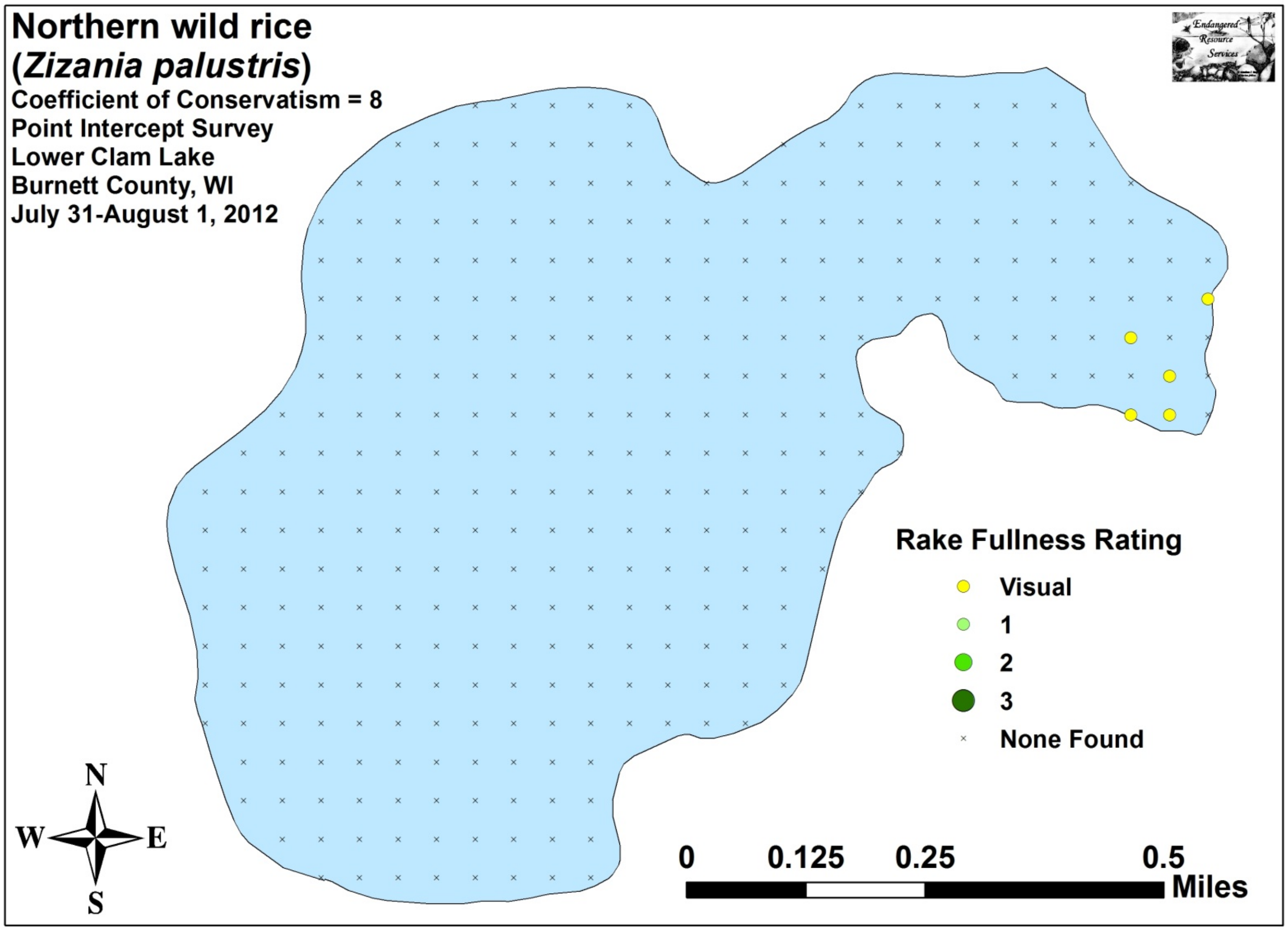
Northern wild rice
(*Zizania palustris*)
Coefficient of Conservatism = 8
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
July 31-August 1, 2012
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
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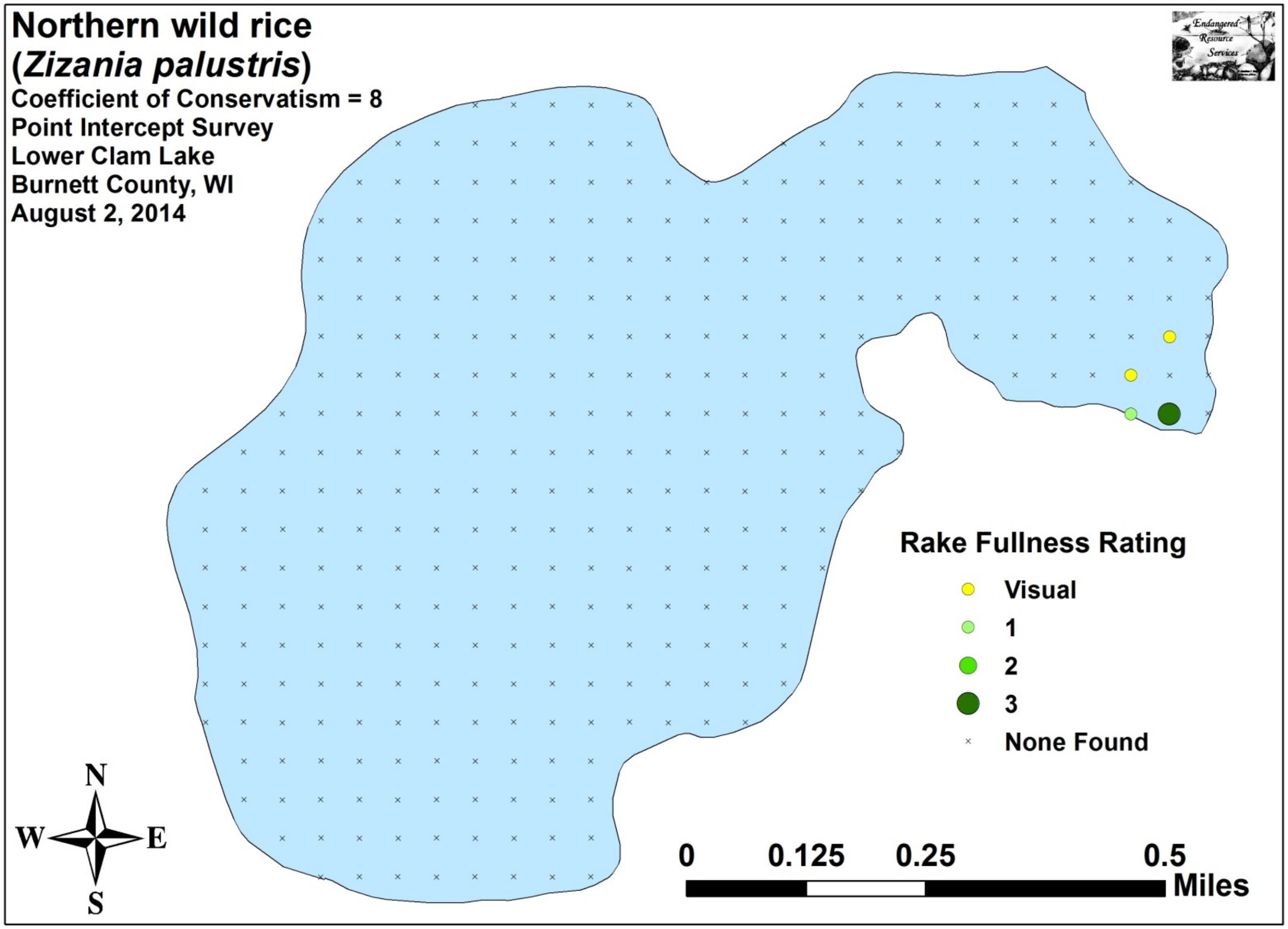
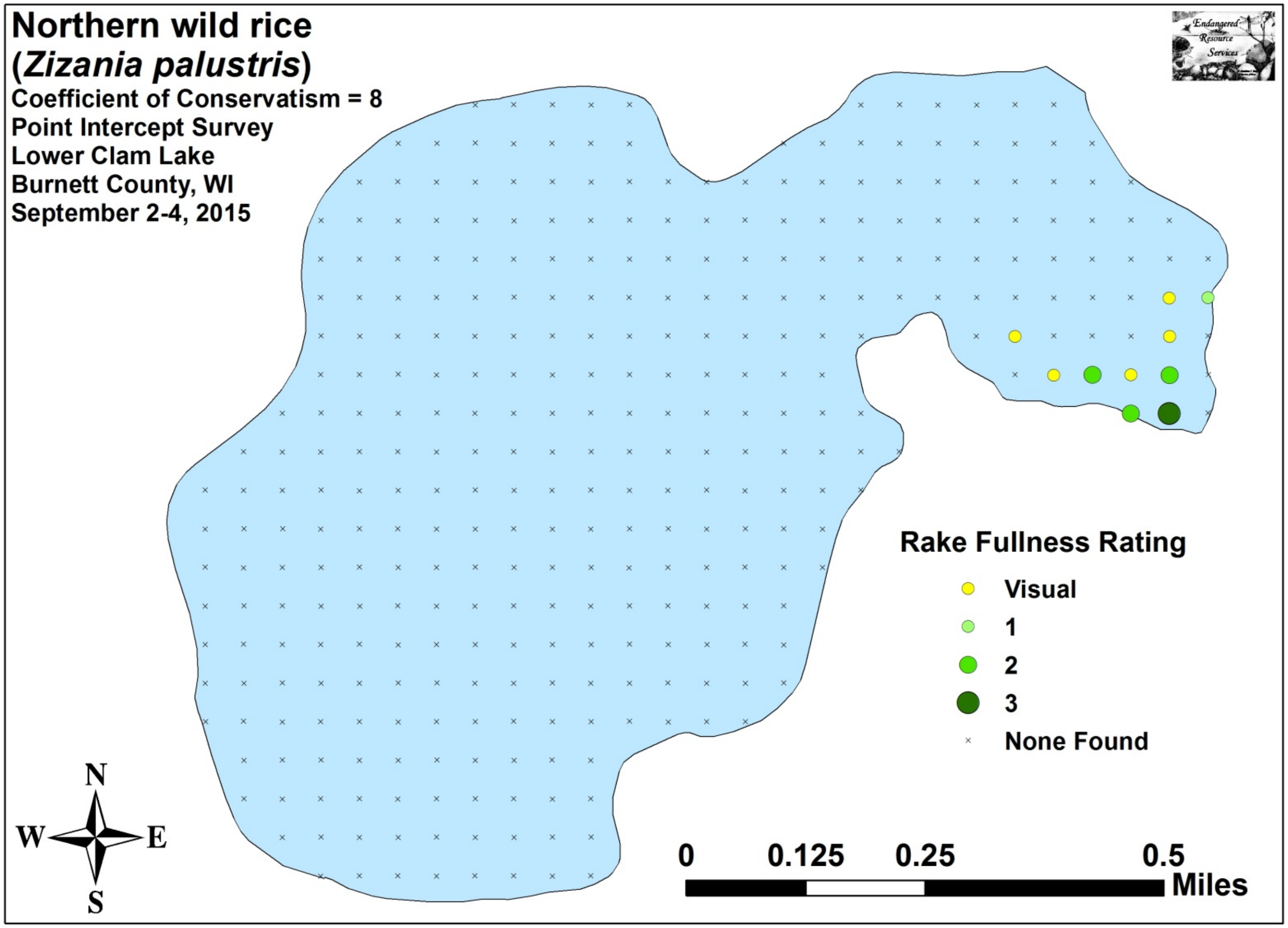
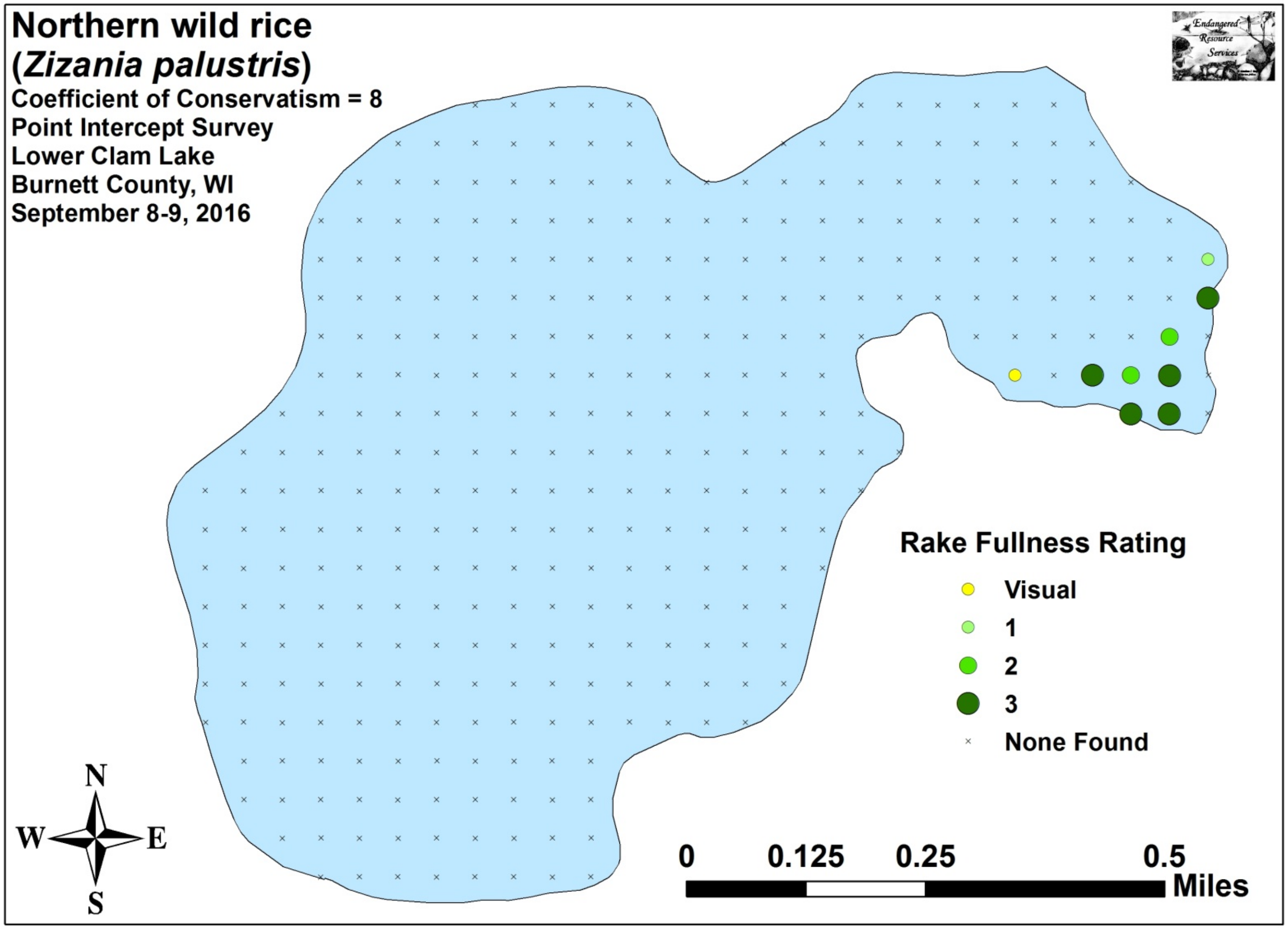
0
0.125
0.25
0.5
Miles

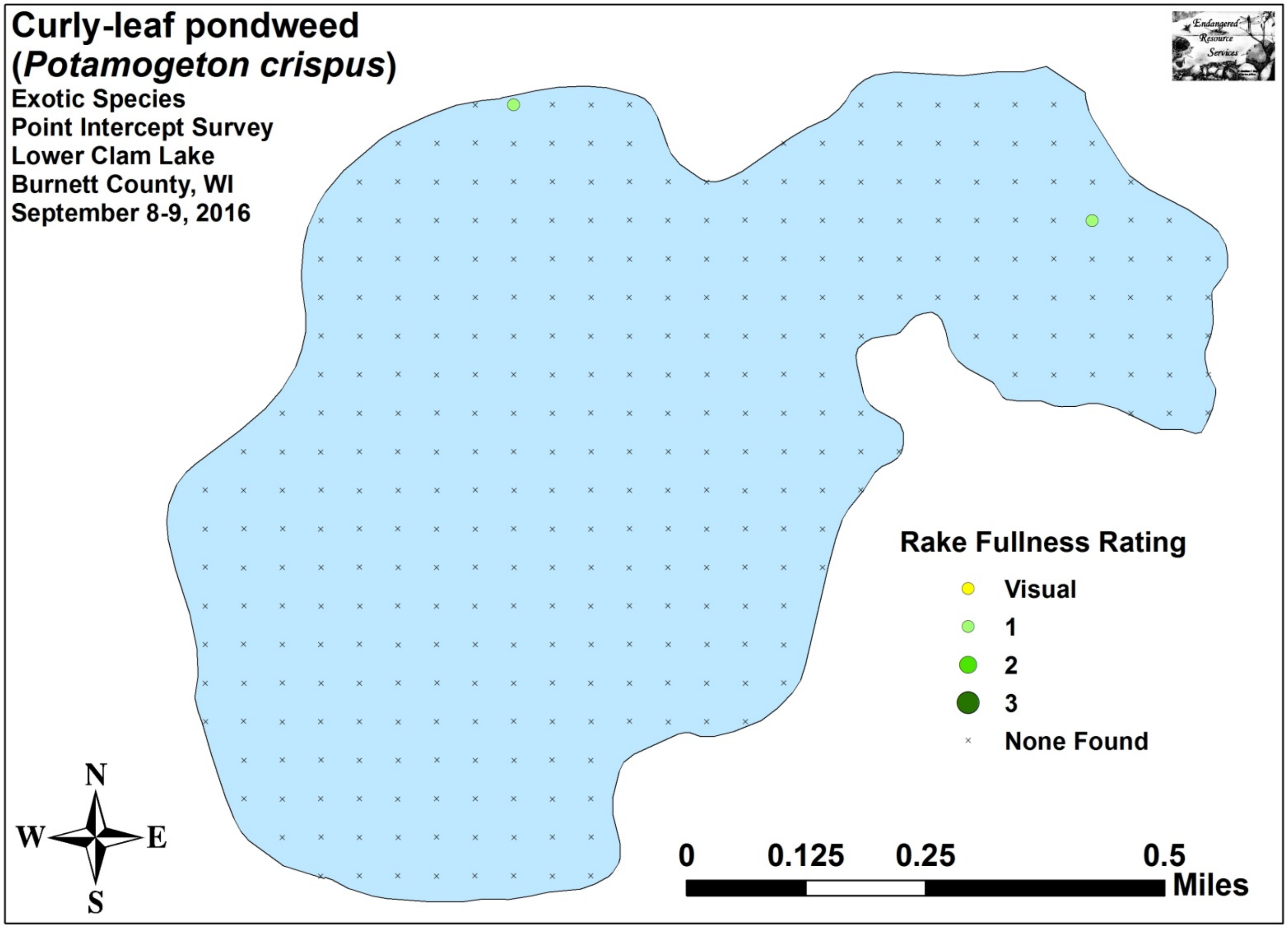


Northern wild rice
(*Zizania palustris*)
Coefficient of Conservatism = 8
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
August 2, 2014
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

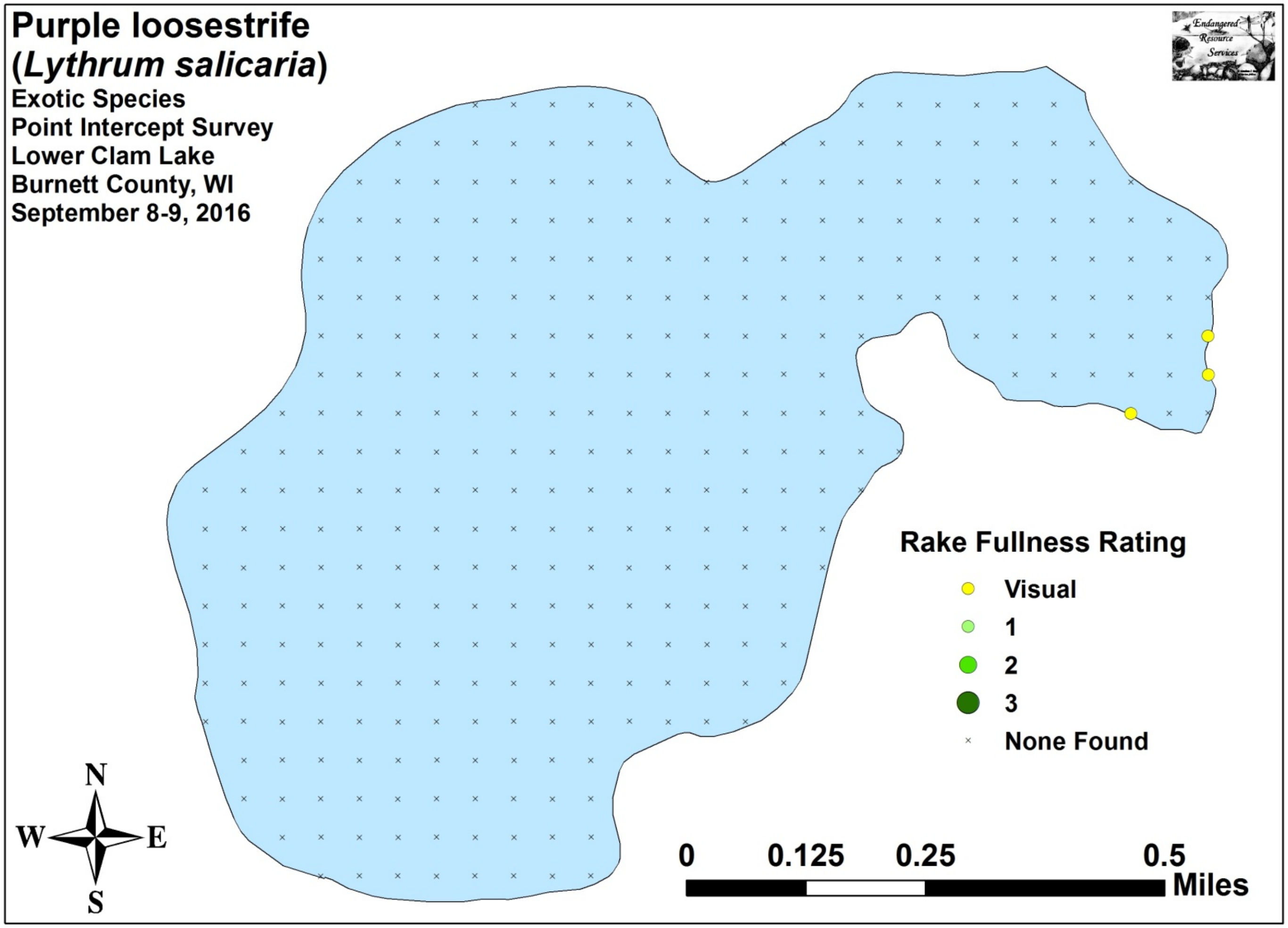

Northern wild rice
(*Zizania palustris*)
Coefficient of Conservatism = 8
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 2-4, 2015
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

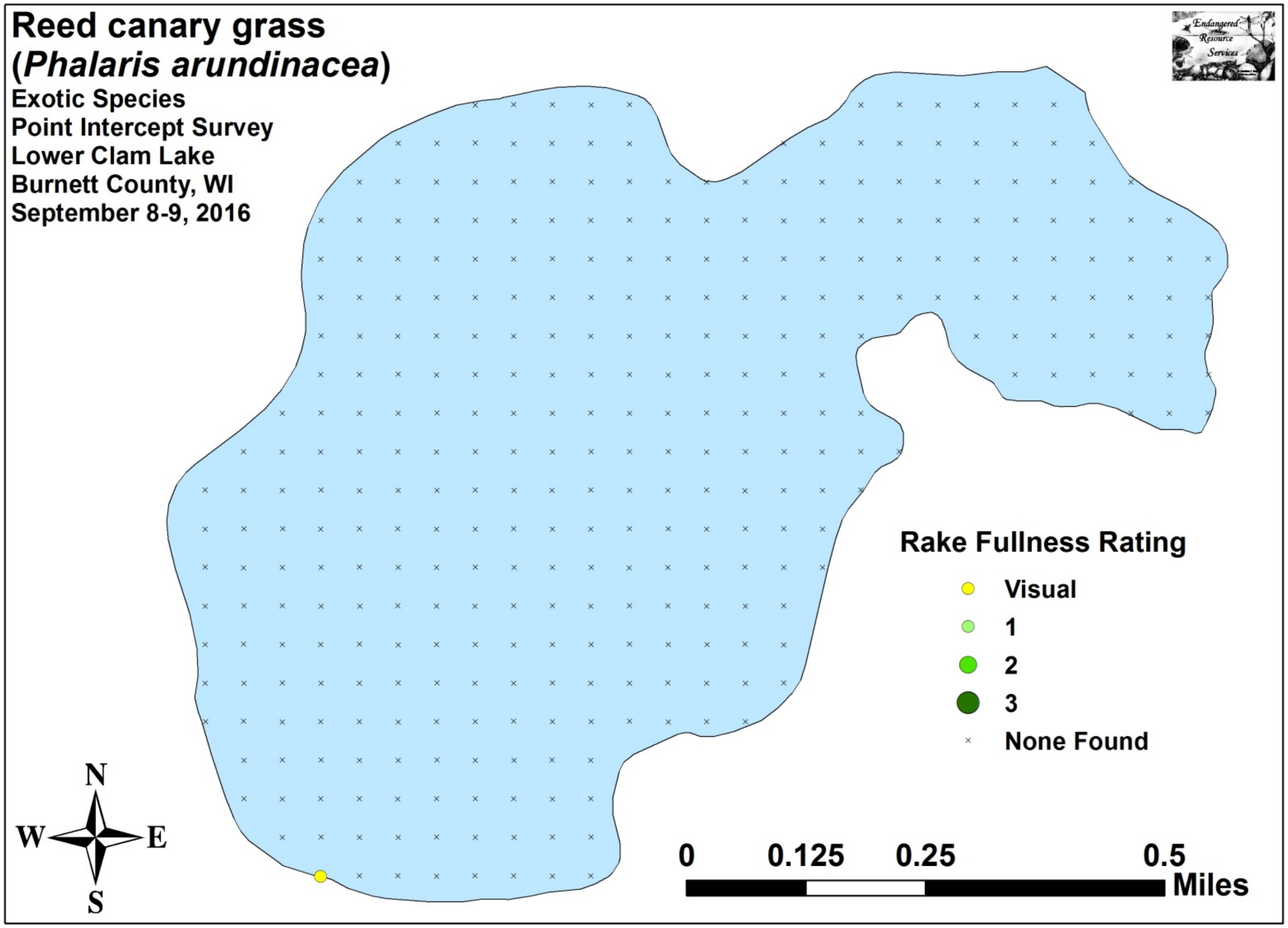

Northern wild rice
(*Zizania palustris*)
Coefficient of Conservatism = 8
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

Appendix VII: 2016 CLP and Other Exotic Species Density and Distribution Maps



Curly-leaf pondweed
(*Potamogeton crispus*)
Exotic Species
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Purple loosestrife
(*Lythrum salicaria*)
Exotic Species
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles


Reed canary grass
(*Phalaris arundinacea*)
Exotic Species
Point Intercept Survey
Lower Clam Lake
Burnett County, WI
September 8-9, 2016
Rake Fullness Rating
Visual
1
2
3
None Found
N
W
E
S
0
0.125
0.25
0.5
Miles

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

Aquatic:
: organisms that live in or frequent water.

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

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

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

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

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

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

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

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

Limnology:
: the study of inland lakes and waters.

Littoral:

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

Macrophytes:

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

Nutrients:

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

Organic Matter:

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

Photosynthesis:

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

Phytoplankton:

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

Plankton:

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

ppm:

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

Richness:
number of species in a particular community or habitat.

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

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

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

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

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

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

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

Appendix IX: 2016 Raw Data Spreadsheets