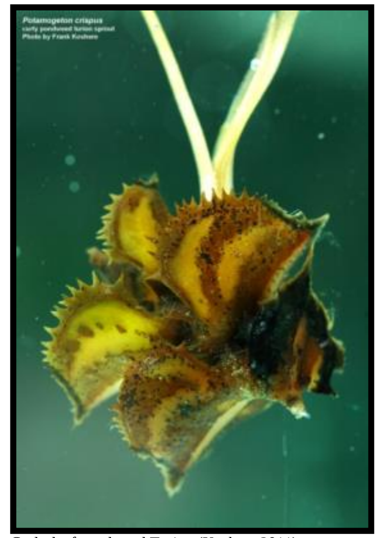
Curly-leaf pondweed (*Potamogeton crispus*)
Pre/Post Herbicide, Bed Mapping, and Turion Surveys
Long Lake - WBIC: 2478200
Polk County, Wisconsin

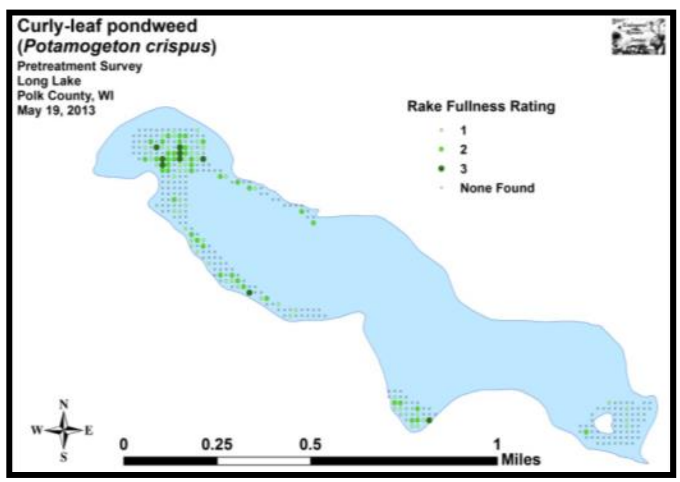
Aerial Photo Long Lake with Final 2013 Treatment Areas



Curly-leaf pondweed Turion (Koshere 2011)

Project Initiated by:

Long Lake Protection and Rehabilitation District, Harmony Environmental, and the Wisconsin Department of Natural Resources



Survey Conducted by and Report Prepared by:

Endangered Resource Services, LLC

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St. Croix Falls, Wisconsin

May 19, June 15-16, and November 10, 2013

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INTRODUCTION:

Long Lake (WBIC 2478200) is a 272 acre seepage lake in central Polk County, Wisconsin in the Town of Balsam Lake (T34N R17W S07 NE NE). It reaches a maximum depth of just over 17ft in the central basin and has an average depth of approximately 11ft (Busch et al. 1969). Long Lake is eutrophic trending toward hypereutrophic, and visibility is generally poor with summer Secchi readings averaged just over 4.9ft since 1992 (WDNR 2013). The bottom substrate in the lake's bays and central basin is predominately thick organic muck, while exposed points and most north/south shorelines are dominated by gravel and sand substrates.

Figure 1: Long Lake with 2013 CLP Treatment Areas

In 2013, the Long Lake Protection and Rehabilitation District (LLPRD) and the Wisconsin Department of Natural Resources (WDNR) authorized a series of four Curly-leaf pondweed (*Potamogeton crispus*) (CLP) surveys to assit in the lake's ongoing efforts to control this exotic invasive species. In accordance with the district's WDNR approved Aquatic Management Plan (APMP), it was decided that herbicide would be used to treat the lake's CLP infestation in 2013. A pretreatment survey of the lake on May 18-19th was used to determine initial CLP levels and finalize treatment areas (Figure 1). Following the May 29th Aquathol K ® application on 26.60 acres of CLP, a post herbicide treatment survey on June 15th was conducted to determine the treatment's effectiveness. As the acreage treated was significantly reduced from 2012, an exploratory point intercept and bed mapping survey of CLP in former beds that were not treated in 2013 was also conducted to determine if beds had reformed in these areas and/or if they should again be considered for control in 2014. A November 10th ponar dredge turion survey was also requested to help with planning for 2014. This report is the summary analysis of these four surveys.

METHODS:

Pre/Post Herbicide Survey:

Following a discussion with the lake's president Mike Kreig and APMP director Cheryl Clemens (Harmony Environmental) about where treatment would occur in 2013, we used Hawth's Analysis Tools Extension to ArcGIS 9.3.1 to generate pre/post survey points at 25m resolution within the nearly 50 acres of proposed treatment areas. The resulting sampling grid contained 323 points which approximated to 6.5 points/acre. This total was based on the WDNR protocol's expected 4-10 pts/acre for pre/post herbicide surveys (Appendix I).

Following the establishment of the survey points, we uploaded them to a handheld mapping GPS unit (Garmin 76CSx) and located the points on the lake. At each point, we used a rake to sample an approximately 2.5ft section of the bottom and recorded the depth and bottom substrate. CLP was assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 2). We also recorded visual sightings of CLP within six feet of the sample point. Because visual sightings are not calculated into the pre/post statistical formulas, we only assigned a rake fullness value for non-CLP plants. A cumulative rake fullness value was also recorded.

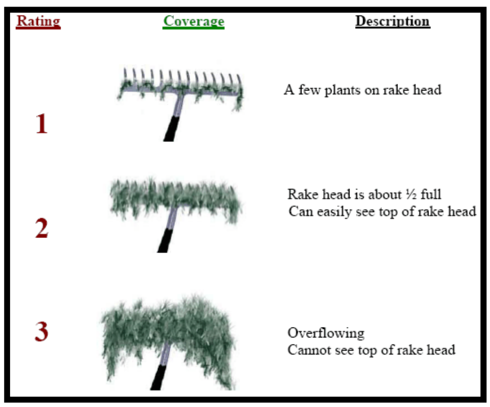


Figure 2: Rake Fullness Ratings (UWEX 2010)

We entered all data collected into the standard APM spreadsheet (Appendix II) (UWEX 2010). Data was analyzed using the linked statistical summary sheet and the WDNR pre/post analysis worksheet (UWEX 2010). Pre/post differences were determined to be significant at p <.05, moderately significant at p <.01 and highly significant at p<.005.

Exploritory CLP Point Intercept and Bed Mapping Surveys:

Following the posttreatment survey, we conducted a point intercept survey where the level of CLP was recorded at 200 additonal points – also at 25m resolution. These sites were located outside the proposed treatment areas, but within areas that had been treated at some time during the past three years.

We also searched the lake's entire visible littoral zone looking for CLP beds where a "bed" was defined as any area that we visually estimated CLP made up >50% of the area's plants, was generally continuous with clearly defined borders, and was canopied or close enough to being canopied that it would likely interfere with boat traffic. Areas that did not meet the 50% threshold or were not canopied, but had significant amounts of CLP were also mapped as "High Density Areas".

After we located a bed, we motored around the perimeter of the area, took GPS coordinates at regular intervals, and estimated the average rake fullness rating of CLP within the bed (Figure 2). These data were then mapped using ArcMap 9.3.1., and the acreage of each bed was calculated to the nearest hundredth of an acre.

Fall Ponar Dredge Turion Survey:

Within the initial 2013 proposed treatment area shapefile, we used Hawth's Analysis Tools Extension to ArcGIS 9.3.1 to generate offset regular points at the rate of 2/acre. We added 10 additional points in thin areas of the polygons where there were no points, or in areas that fell outside the polygons we thought had the potential for CLP growth.

At each point, we used a Petite Ponar Grab with a $6in^2$ sample area to take two sediment samples. These samples were then rinsed in a fine sieve. All live turions were tallied, and the total turions in each sieve were multiplied by 18 to give a value in turions/yd^2. This value gives an idea of how many CLP plants will germinate in an area in 2014. The resulting data, coupled with the CLP exploritory point intercept survey will be used to help determine if, where, and how to treat CLP in 2014.

RESULTS AND DISCUSSION:

Finalization of Treatment Areas:

Initial expectations were to treat six beds totaling 49.88 (Table 1). Following the pretreatment survey, it was decided to trim all beds inward and completely eliminate treatment in Bed 7 as these areas had little or no CLP present. This reduction of 23.28 acres represented a nearly 53% decline from initial expectations (Figure 3) (Appendix I).

Table 1: 2013 Spring CLP Treatment Summary
Long Lake, Polk Co.

Polygon Number	Proposed Bed Area (acres)	Final Bed Area (acres)	Difference (+/-)
1	13.34	9.70	-3.64
2	8.46	5.00	-3.46
3	3.84	3.31	-0.53
4	9.51	6.07	-3.44
6	4.88	2.52	-2.36
7	9.85	0.00	-9.85
	49.88	**26.60**	**-23.28**

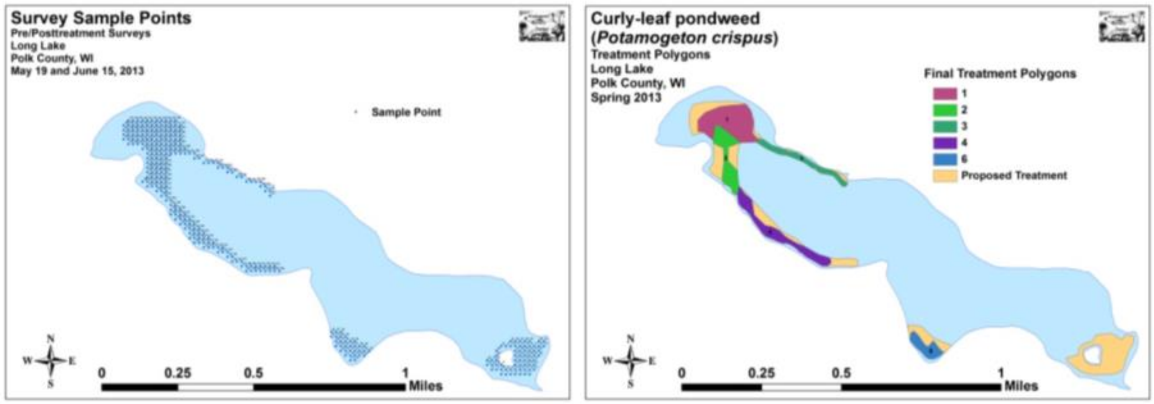


Figure 3: 2013 Pre/Post Survey Points and Final CLP Treatment Areas

Pre/Post Treatment Surveys:

Treatment occurred on May 28th, 2013 with Northern Aquatics (Dresser, WI) applying Aquathol K (Endothall) at a rate of 2.0-2.5 ppm (252.4 total gallons). The reported water temperatures at the time of treatment were 58.0°F which was within the recommended treatment temperature range of 50 - 60°F. Wind speeds were reported to be 0-4mph.

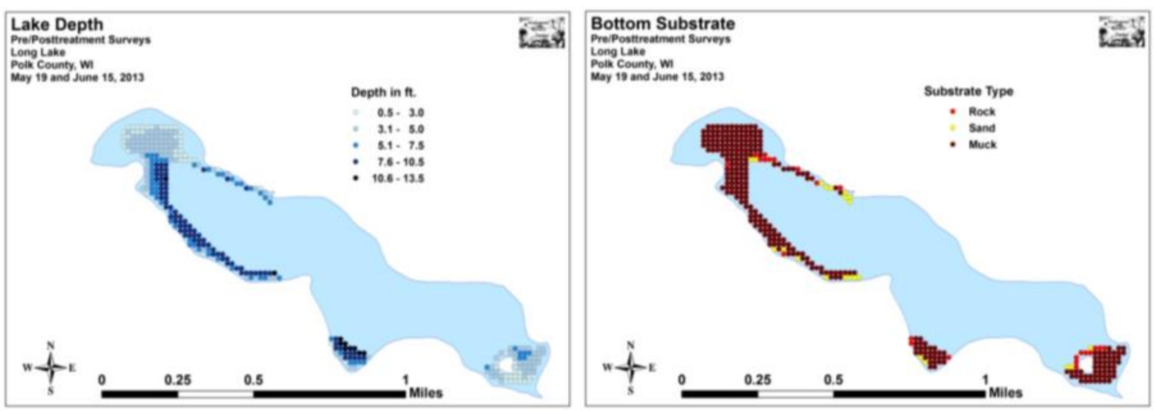


Figure 4: Treatment Area Depths and Bottom Substrate

All CLP treatment areas occurred in water between 0.5ft and 13.5ft. During the pretreatment survey, we found the mean and median depth of plant growth to be 5.0ft and 4.0ft respectively (Table 2). Posttreatment, the mean shrunk slightly to 4.5ft while the median was unchanged. Most CLP beds occurred over organic muck, but Bed 3 on the north shoreline was established over sandy/rocky substrates (Figure 4) (Appendix III).

Table 2: Pre/Post Survey Summary Statistics
Long Lake, Polk County
May 19 and June 15, 2013

Summary Statistics:	Pre	Post
Total number of points sampled	323	323
Total number of sites with vegetation	241	196
Total number of sites shallower than the maximum depth of plants	315	292
Frequency of occurrence at sites shallower than maximum depth of plants	76.51	67.12
Simpson Diversity Index	0.73	0.78
Mean Coefficient of Conservatism	4.4	4.8
Floristic Quality Index	12.4	16.7
Maximum depth of plants (ft)	11.0	9.5
Average number of all species per site (shallower than max depth)	1.38	1.05
Average number of all species per site (veg. sites only)	1.80	1.56
Average number of native species per site (shallower than max depth)	1.05	1.03
Average number of native species per site (veg. sites only)	1.55	1.55
Species Richness	9	13
Mean depth of plants (ft)	5.0	4.5
Median depth of plants (ft)	4.0	4.0
Mean Rake Fullness	1.80	1.35

The pretreatment littoral zone extended to 11.0ft. However, likely because CLP dominated the outer littoral edge, the posttreatment zone receded to 9.5ft (Figure 5) (Appendix IV). Even in this narrower posttreatment littoral area, the frequency of plants encountered declined from 76.51% to 67.12%. Species richness increased from 9 pretreatment to 13 posttreatment. This helped the Simpson's Diversity Index increase slightly from a pretreatment value of 0.73 to a posttreatment value of 0.78. The pretreatment Floristic Quality Index (another measure of the native plant community health) of 12.4 also increased slightly to 16.7 posttreatment.

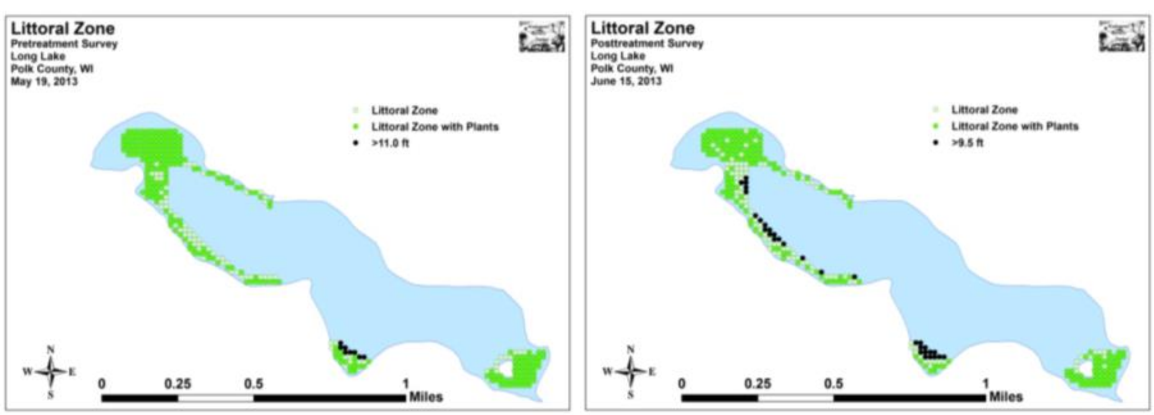


Figure 5: Pre/Post Littoral Zone

Native species richness was unchanged at 1.55 species/vegetative site during both the pre and posttreatment surveys (Figures 6). Total mean rake fullness declined sharply from a low/moderate 1.80 pretreatment to a low 1.35 posttreatment (Figures 7) (Appendix IV).

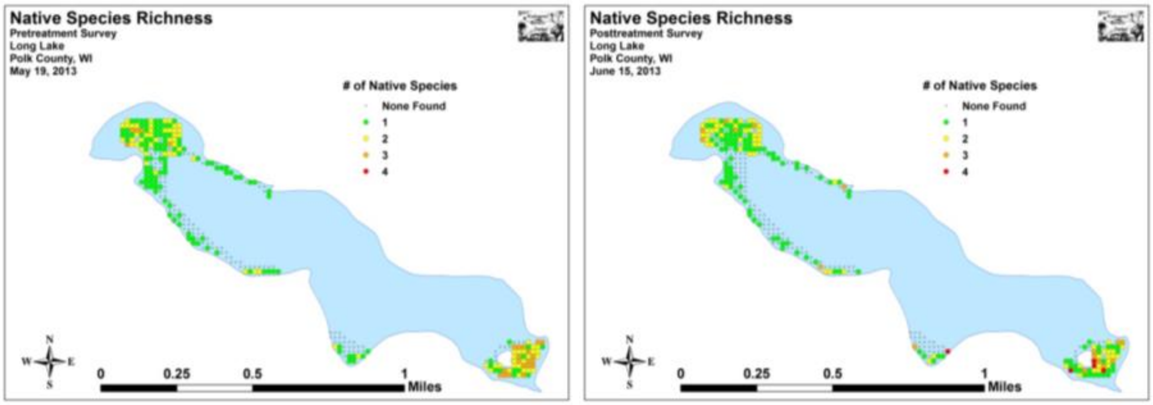


Figure 6: Pre/Post Native Species Richness

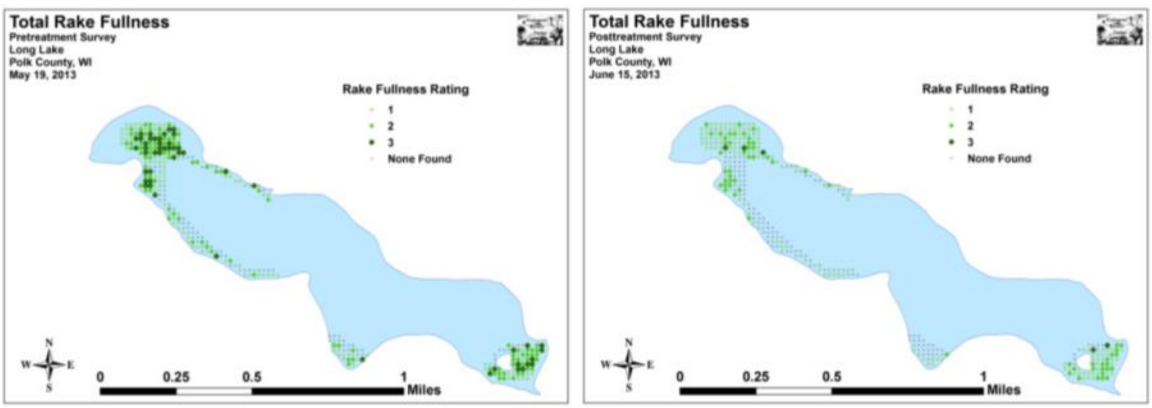


Figure 7: Pre/Post Total Rake Fullness

We found CLP at 103 of 323 sites (31.9%) during the pretreatment survey (Figures 8) (Appendix V). Of these, nine had a rake fullness rating of 3, 41 rated a 2, and 53 a 1. During the posttreatment survey, we found six individual CLP plants at six different locations. Our findings demonstrated a highly significant reduction of total CLP, rake fullness 2, and 1, and a moderately significant reduction of rake fullness 3 (Figure 9).

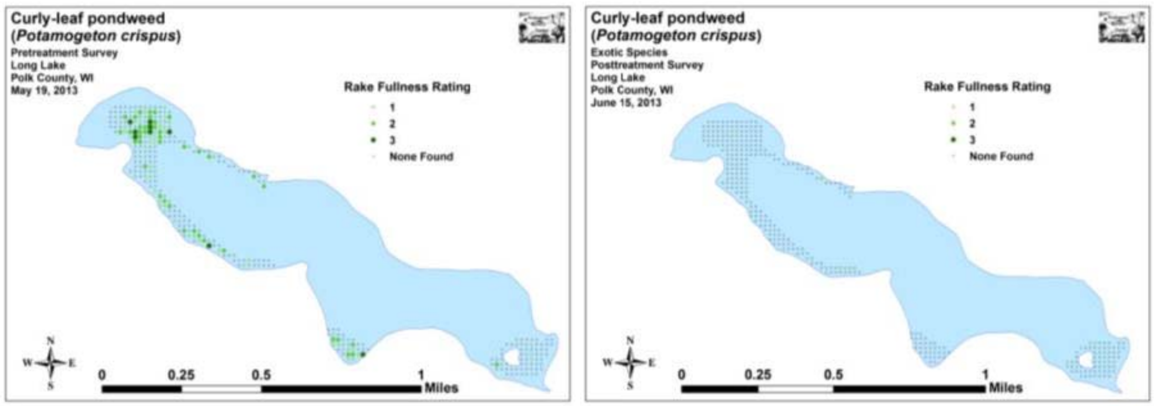
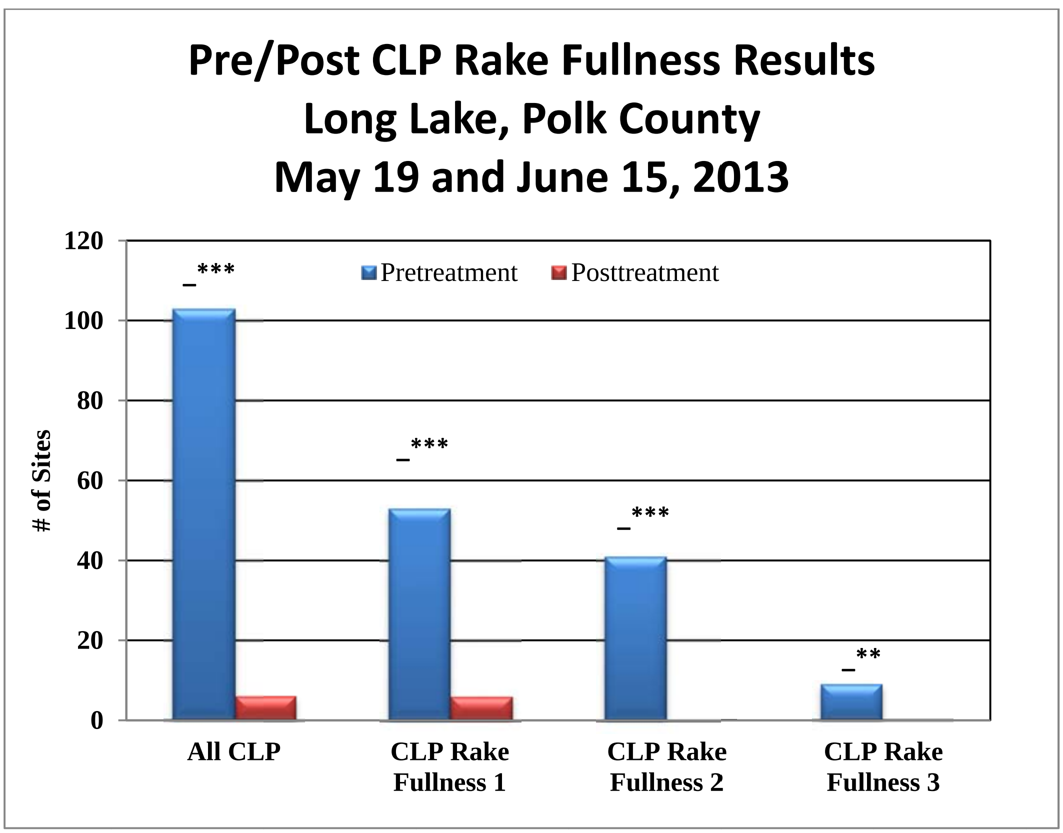


Figure 8: Pre/Post CLP Density and Distribution



Significant differences = * p <. 05, ** p <. 01, *** p <. 005

Figure 9: Changes in CLP Rake Fullness Ratings

Common waterweed (*Elodea canadensis*) , the most common native species in both the pre and posttreatment surveys, showed a highly significant decline posttreatment (Figure 10) (Tables 3 and 4). Coontail (*Ceratophyllum demersum*), the second most common native species, also showed a significant decline (Figure 11). Forked duckweed was the only other native species that demonstrated a decline and it was moderately significant (Figure 12). White water lily (*Nymphaea odorata*) and Slender naiad (*Najas flexilis*), two later growing species, produced highly and moderately significant increases respectively (Maps of all species from the pre and posttreatment surveys can be found in Appendixes VI and VII).

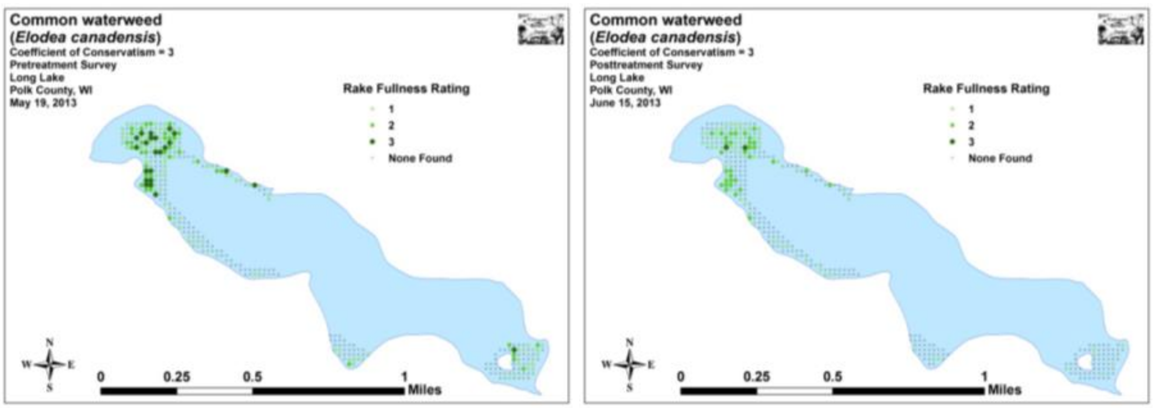


Figure 10: Pre/Post Common Waterweed Density and Distribution

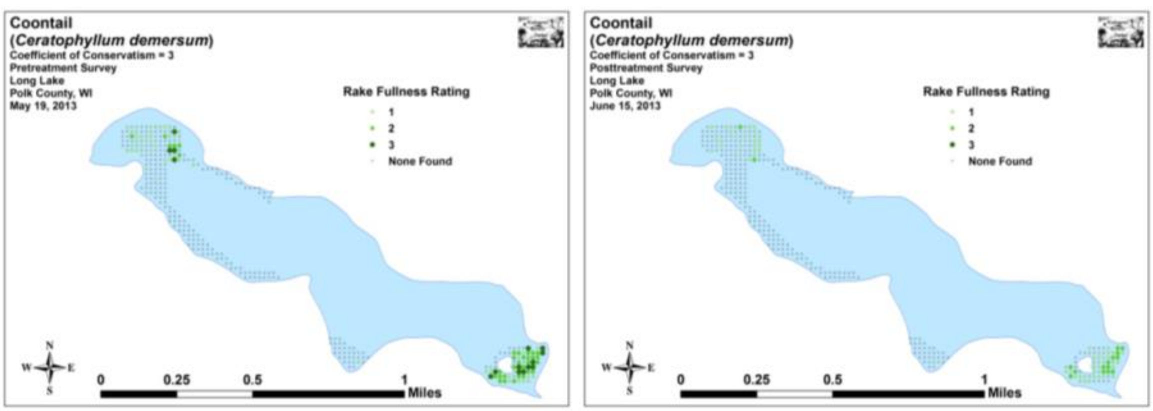


Figure 11: Pre/Post Coontail Density and Distribution

Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Pretreatment Survey - Long Lake, Polk County
May 19, 2013

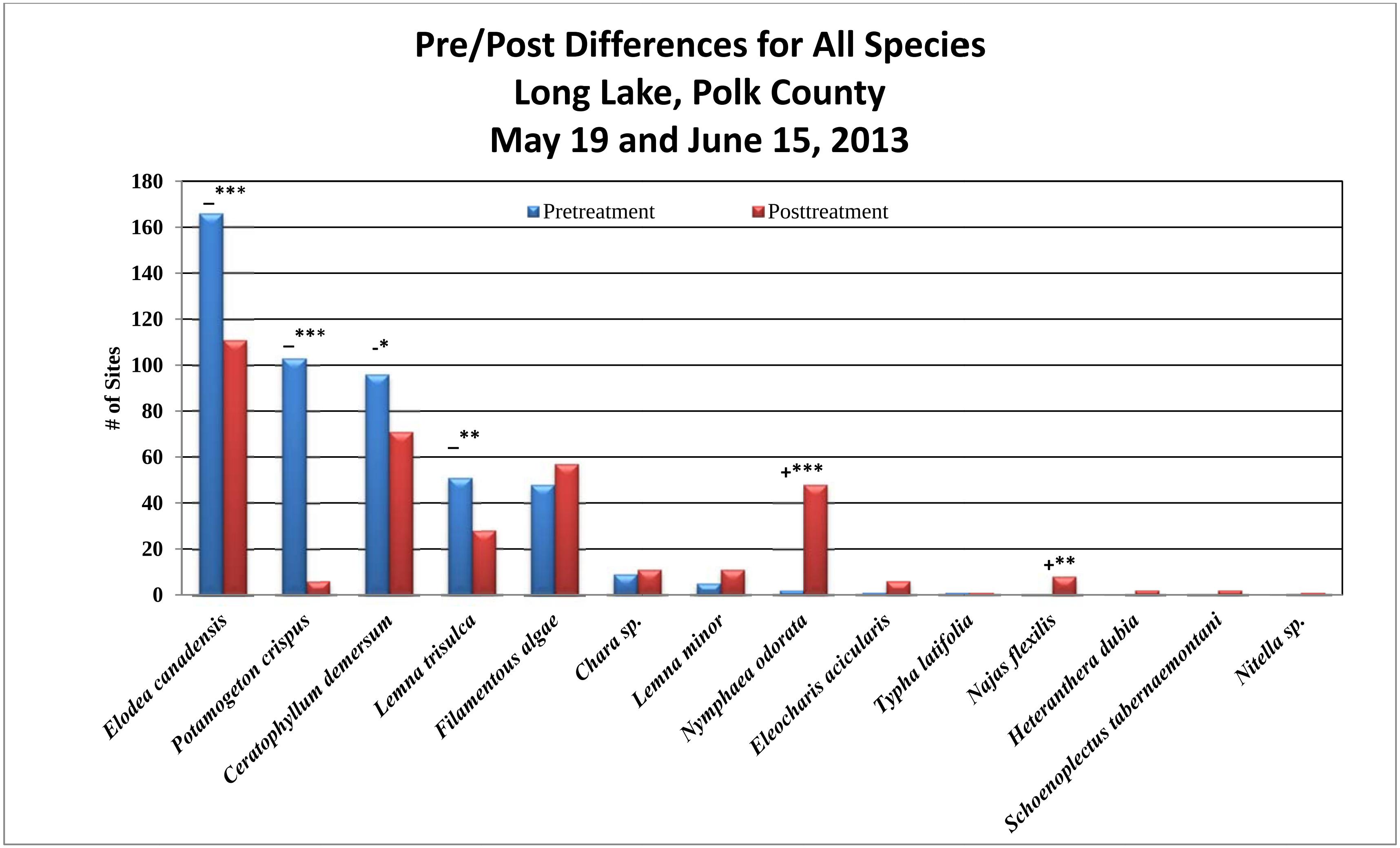
Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Elodea canadensis	Common waterweed	166	38.25	68.88	52.70	1.50
Potamogeton crispus	Curly-leaf pondweed	103	23.73	42.74	32.70	1.57
Ceratophyllum demersum	Coontail	96	22.12	39.83	30.48	1.65
Lemna trisulca	Forked duckweed	51	11.75	21.16	16.19	1.04
	Filamentous algae	48	*	19.92	15.24	1.52
Chara sp.	Muskgrass	9	2.07	3.73	2.86	1.11
Lemna minor	Small duckweed	5	1.15	2.07	1.59	1.00
Nymphaea odorata	White water lily	2	0.46	0.83	0.63	1.00
Eleocharis acicularis	Needle spikerush	1	0.23	0.41	0.32	1.00
Typha latifolia	Broad-leaved cattail	1	0.23	0.41	0.32	3.00

* Excluded from relative frequency analysis

Table 4: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Posttreatment Survey - Long Lake, Polk County
June 15, 2013

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Elodea canadensis	Common waterweed	111	36.27	56.63	38.01	1.33
Ceratophyllum demersum	Coontail	71	23.20	36.22	24.32	1.23
	Filamentous algae	57	*	29.08	19.52	1.40
Nymphaea odorata	White water lily	48	15.69	24.49	16.44	1.17
Lemna trisulca	Forked duckweed	28	9.15	14.29	9.59	1.04
Chara sp.	Muskgrass	11	3.59	5.61	3.77	1.45
Lemna minor	Small duckweed	11	3.59	5.61	3.77	1.00
Najas flexilis	Slender naiad	8	2.61	4.08	2.74	1.00
Eleocharis acicularis	Needle spikerush	6	1.96	3.06	2.05	1.00
Potamogeton crispus	Curly-leaf pondweed	6	1.96	3.06	2.05	1.00
Heteranthera dubia	Water star-grass	2	0.65	1.02	0.68	1.00
Schoenoplectus tabernaemontani	Softstem bulrush	2	0.65	1.02	0.68	1.50
Nitella sp.	Nitella	1	0.33	0.51	0.34	1.00
Typha latifolia	Broad-leaved cattail	1	0.33	0.51	0.34	3.00

* Excluded from relative frequency analysis



Significant differences = * p <. 05, ** p <. 01, *** p <. 005

Figure 12: Pre/Post Macrophyte Changes

June CLP Exploritory PI Survey and Bed Mapping Survey:

During the June 16th exploratory survey, Curly-leaf pondweed proved to be rare and generally scattered within the former beds along the north and south shorelines of the lake. We found CLP at only 14 of 200 rake samples (7.0%), and, of these, three had a rake fullness rating of 2 and the other 11 rated a 1 for a mean rake fullness of 1.21 (Figure 13). None of these plants were canopied, and, despite doing additional rake sampling in areas were CLP plants were present, we found **no evidence of any surviving beds or high density areas** anywhere in the lake. This should not be taken to mean that CLP will not return in 2014 as there likely continues to be some latent turions surviving in the bottom substrate of these areas. However, it does suggest, along with the results from the pre/post treatment surveys, that the 2013 treatment was highly successful in controlling CLP in the lake.

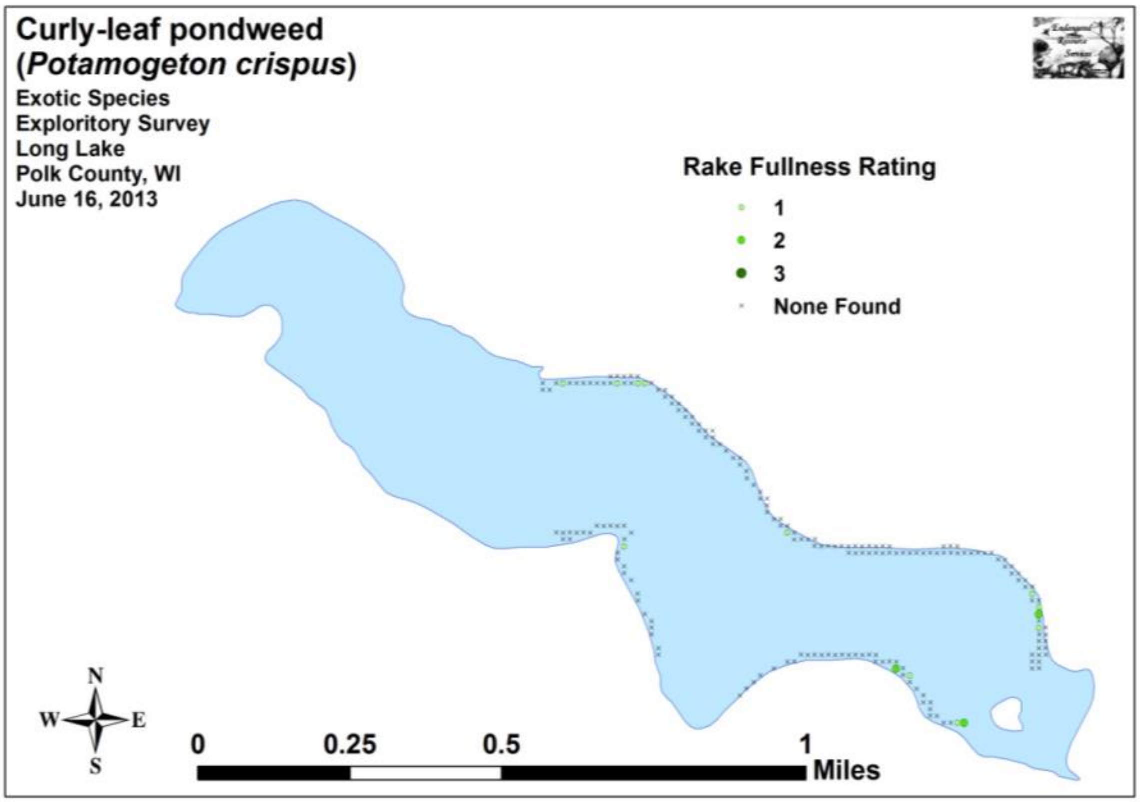


Figure 13: 2013 Long Lake June Exploritory CLP PI Survey

November Ponar Dredge Turion Survey:

During the November 10th ponar dredge survey, we found CLP at 28 of 75 survey points (37.3%). Of these, none exceeded the expected "nuiscance level" of 200/sqr. yd., and only five topped 50/sqr. yard (Figure 14) (Appendix IX). Using a t-test to comparing these results to the 2012 turion survey, we found that the decline in lakewide turion levels was nearly significant (p=.09).

Broken down by area, these findings suggest treatment in Area 7 will again likely not be necessary in 2014; the latent turion bank in Areas 3 and 4 may be nearly exhausted; and that the deeper edges of Areas 1, 2, and 6 appear to be nearly turion free. Adjusting the size of the treatment areas to match sites with turions suggests that a treatment to maintain CLP at these very low levels is not likely to cover more than 20 acres in 2014.

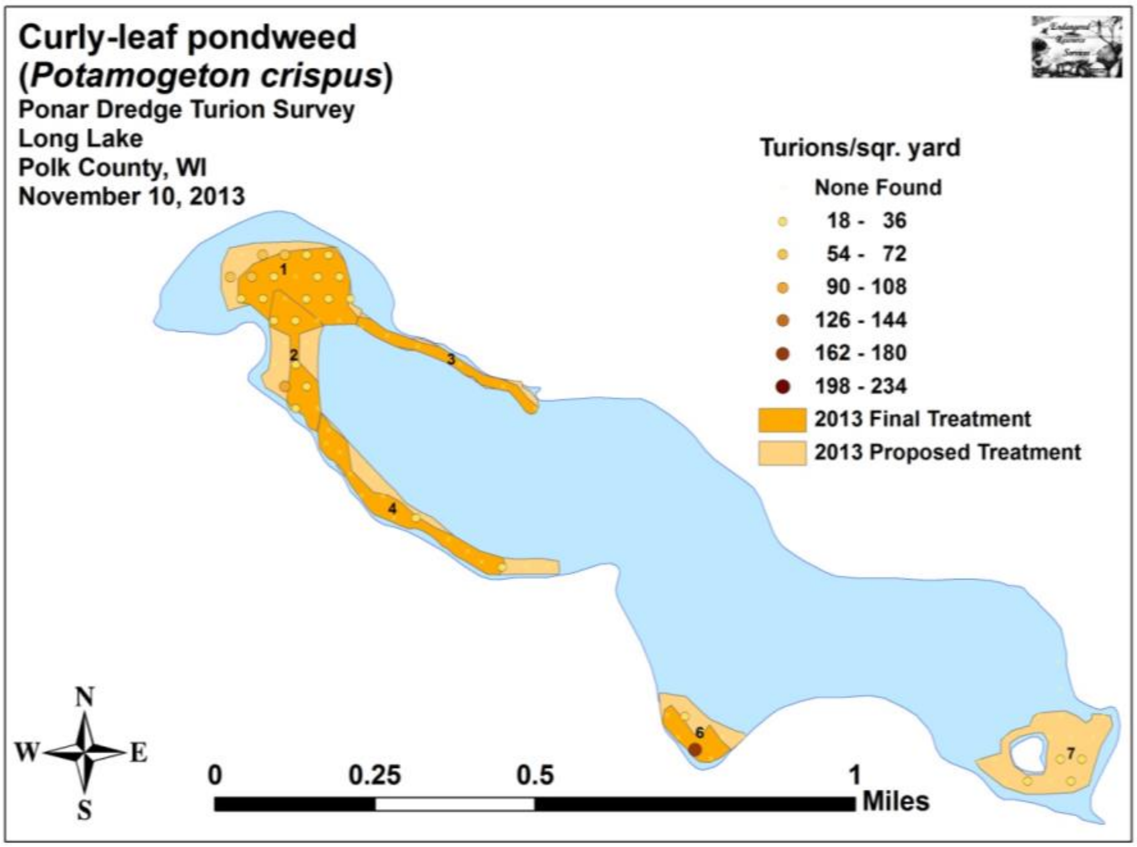


Figure 14: 2013 Ponar Dredge Turion Survey

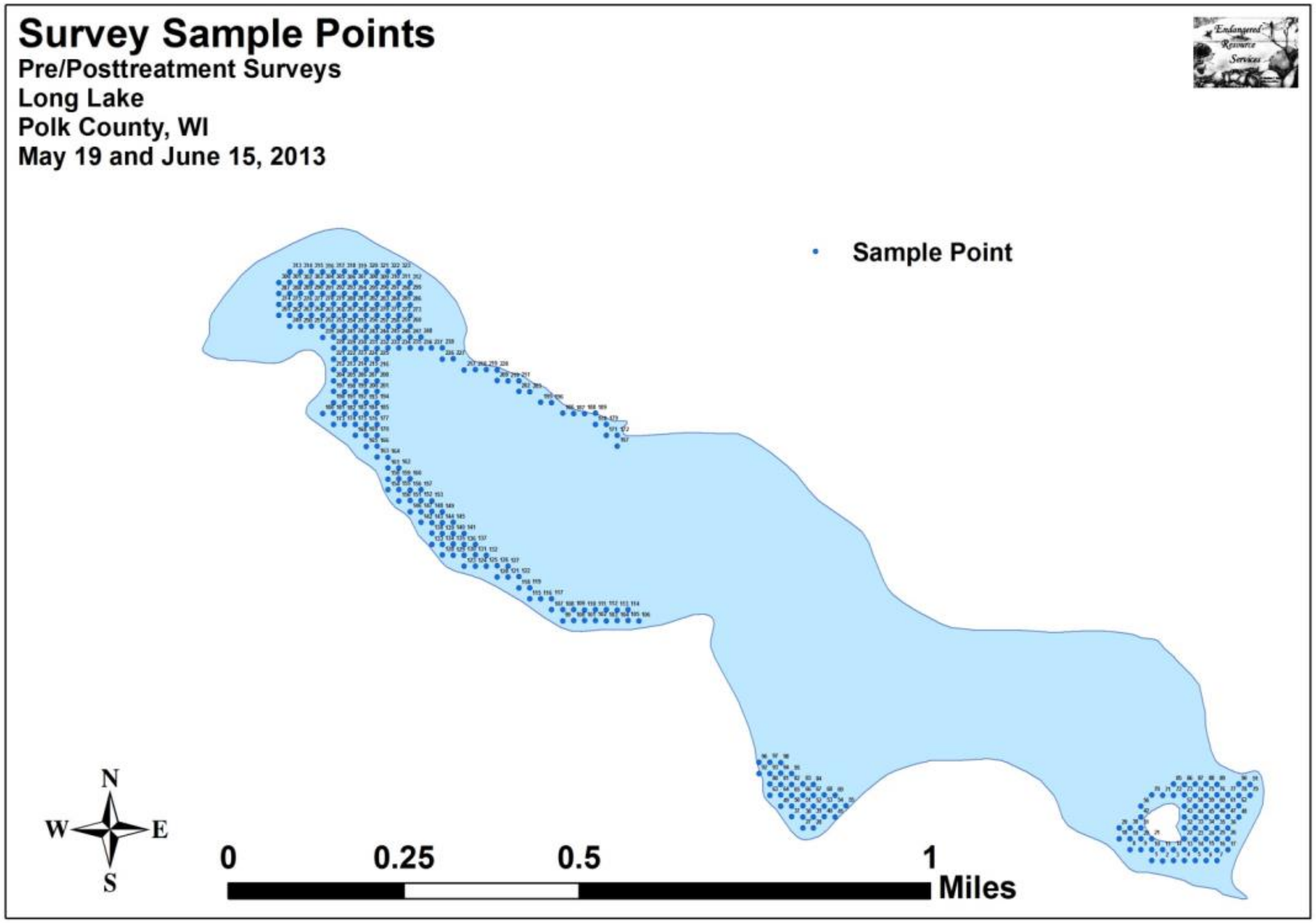
LITERATURE CITED

Busch, C., G. Lund, L. Sather, and C. Holt. 1969. Long Lake Map. Available from http://dnr.wi.gov/lakes/maps/DNR/2478200a.pdf (2010, October).

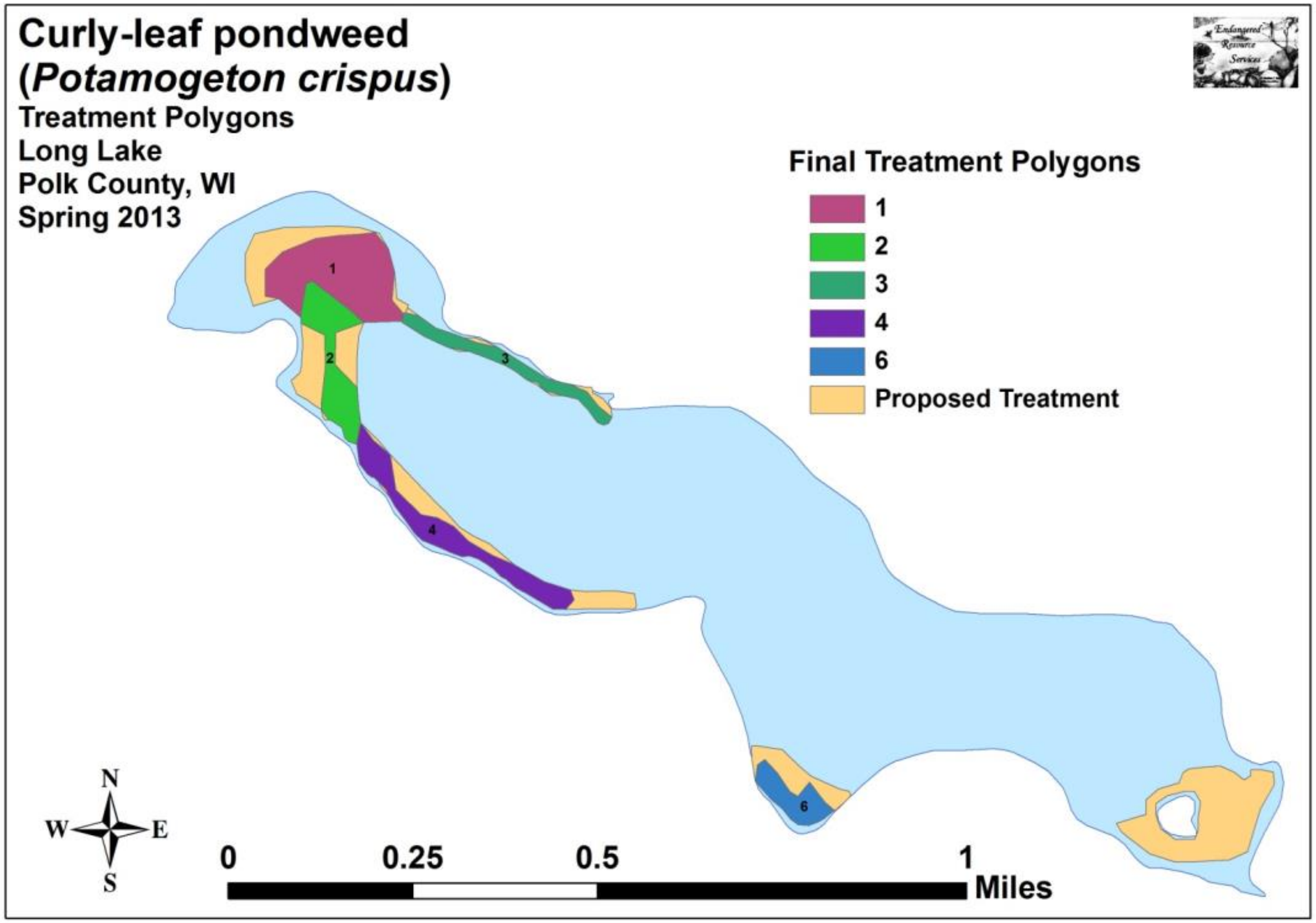
UWEX Lakes Program. [online]. 2010. Aquatic Plant Management in Wisconsin. Available from http://www.uwsp.edu/cnr/uwexlakes/ecology/APMguide.asp (2012, November).

WDNR. [online]. 2013. Citizen Lake Monitoring Water Quality Data Report for Long Lake. http://dnr.wi.gov/lakes/waterquality/Station.aspx?id=493102 (2013, July)

Appendix I: CLP Pre/Post Survey Sample Points and Proposed/Final Treatment Areas



Survey Sample Points
Pre/Posttreatment Surveys
Long Lake
Polk County, WI
May 19 and June 15, 2013
Sample Point
N
W
E
S
0
0.25
0.5
1
Miles


Curly-leaf pondweed
(*Potamogeton crispus*)
Treatment Polygons
Long Lake
Polk County, WI
Spring 2013
Final Treatment Polygons
1
2
3
4
6
Proposed Treatment
N
W
E
S
0
0.25
0.5
1
Miles

Appendix II: Vegetative Survey Data Sheet

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	CLP	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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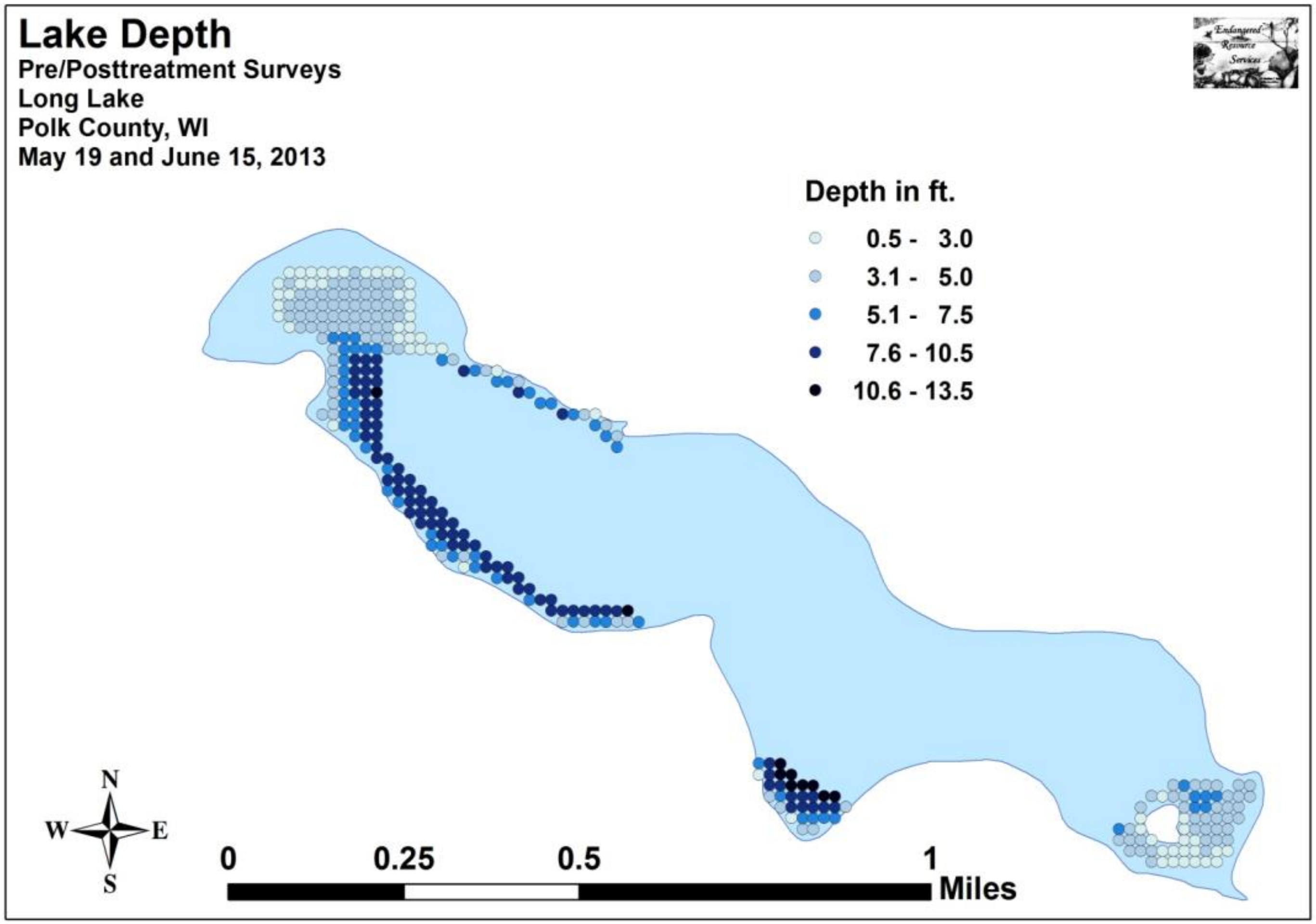
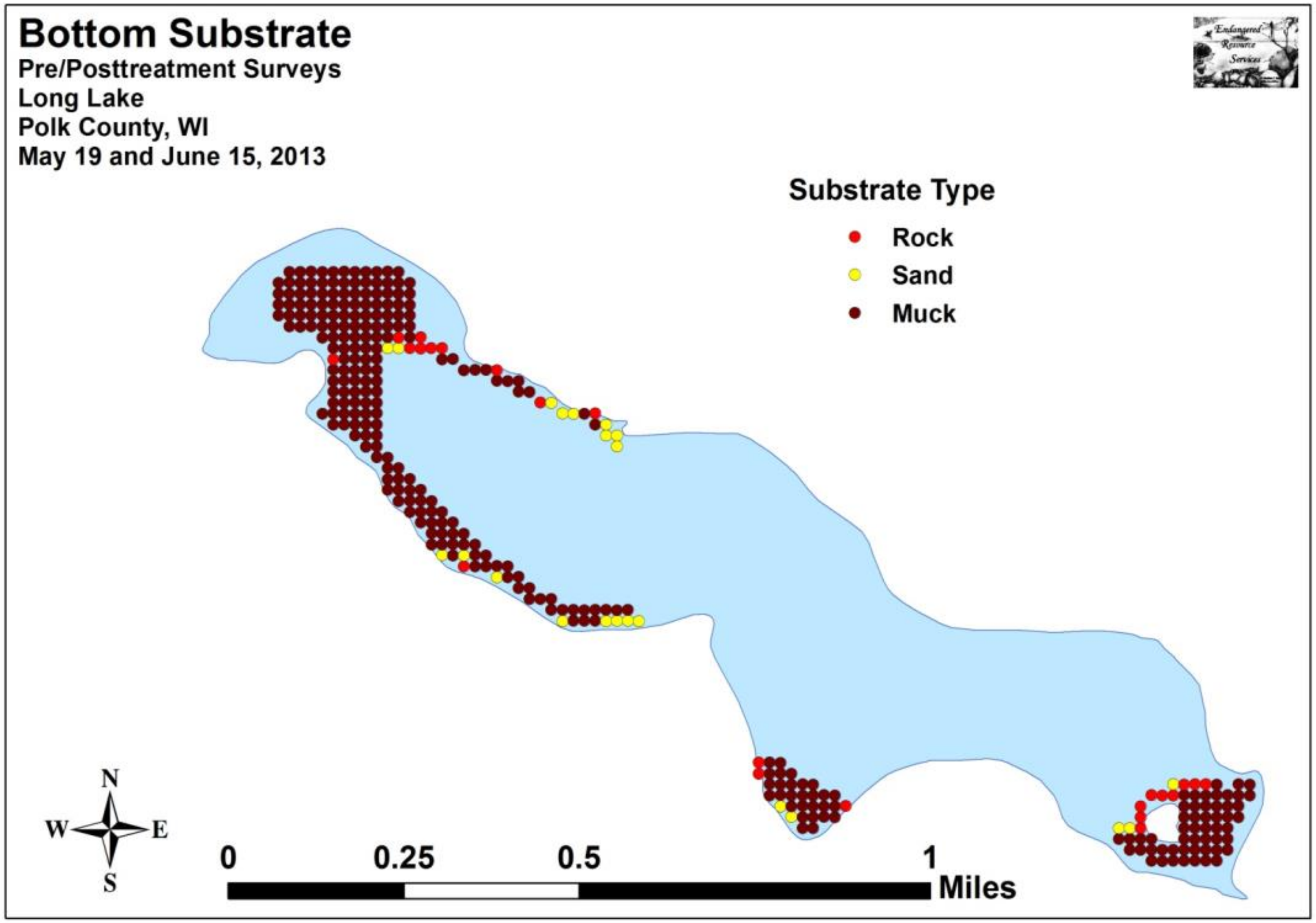
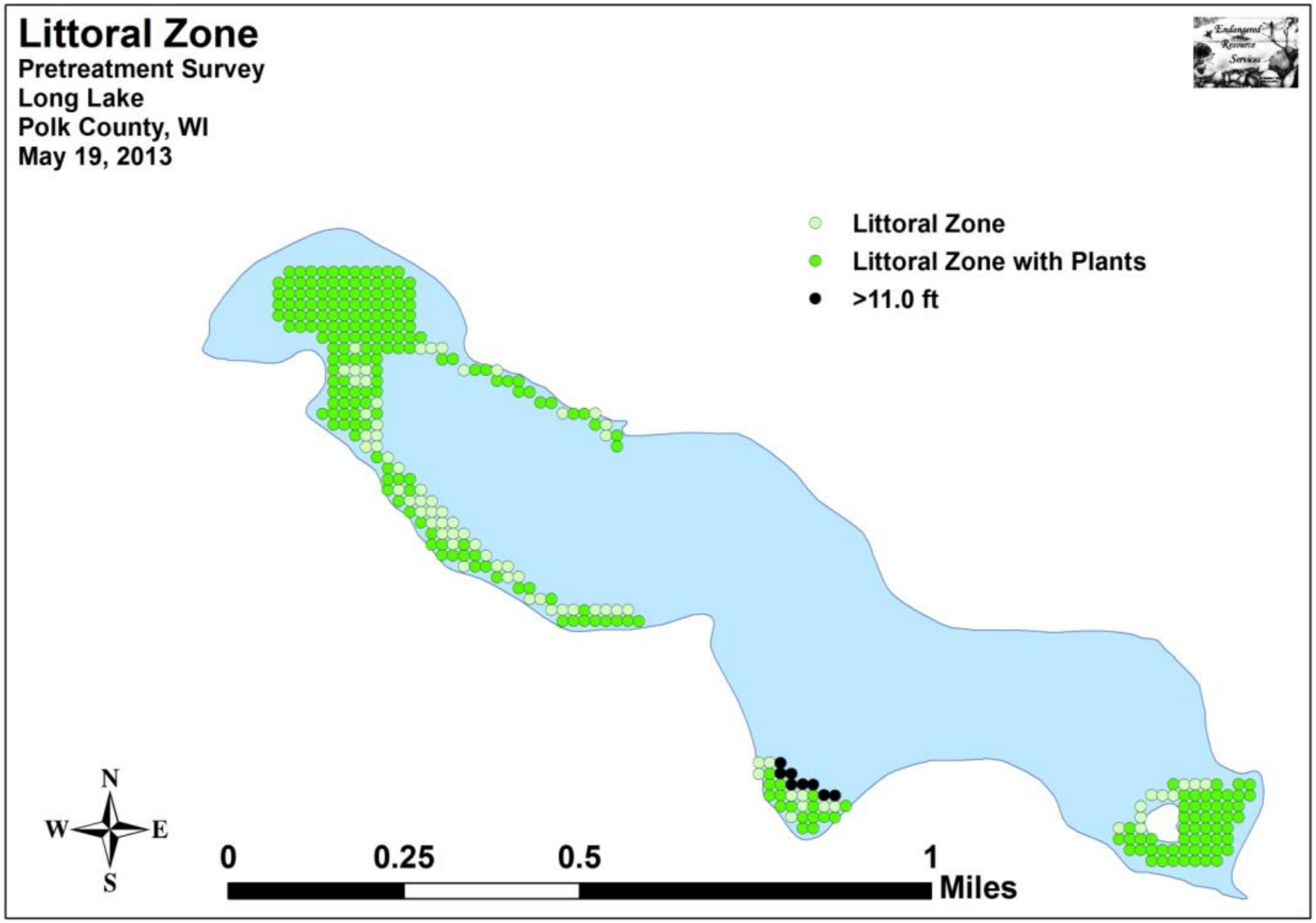
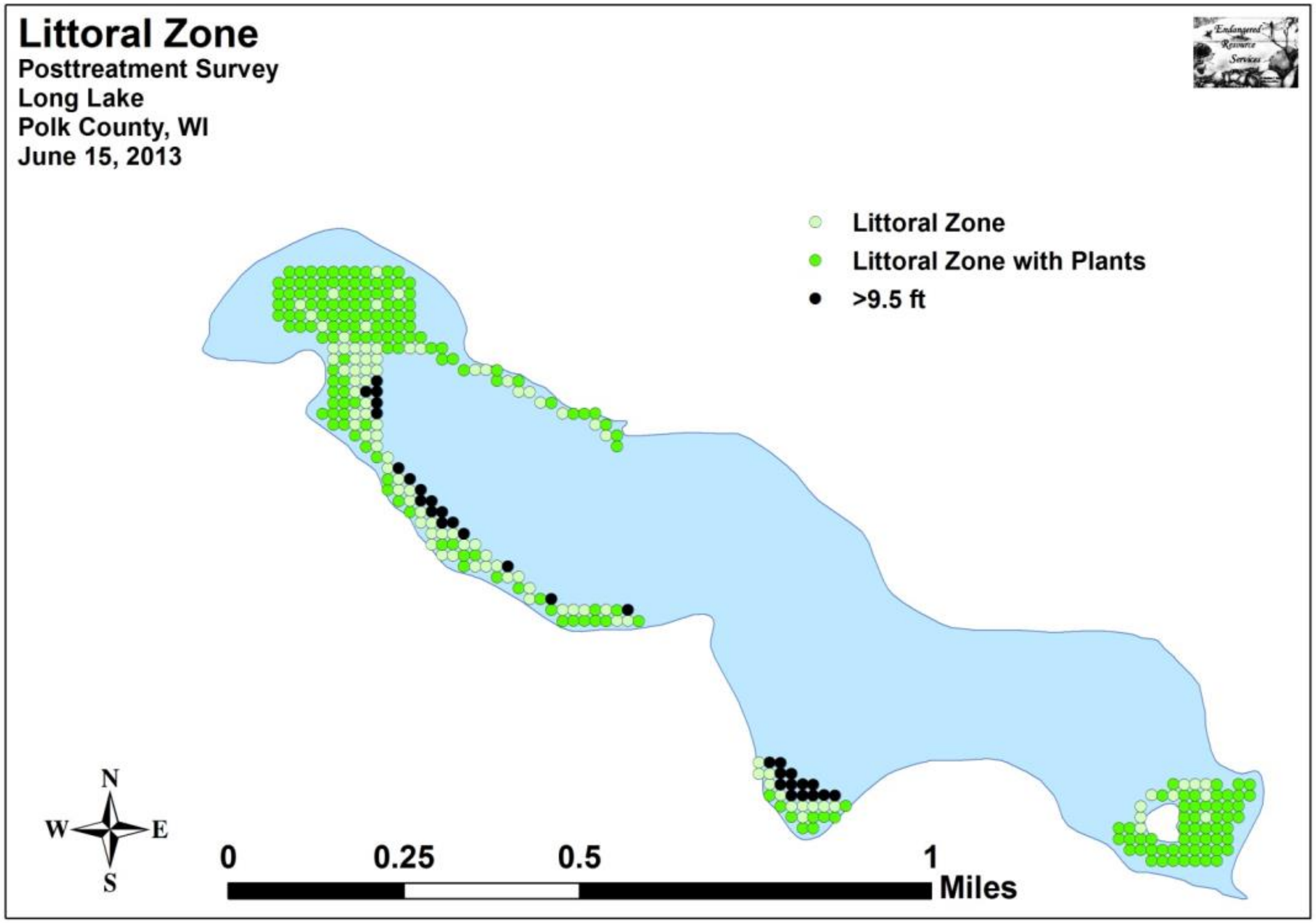
Appendix III: Pre/Post Habitat Variables


Lake Depth
Pre/Posttreatment Surveys
Long Lake
Polk County, WI
May 19 and June 15, 2013
Depth in ft.
0.5 - 3.0
3.1 - 5.0
5.1 - 7.5
7.6 - 10.5
10.6 - 13.5
N
W
E
S
0
0.25
0.5
1
Miles

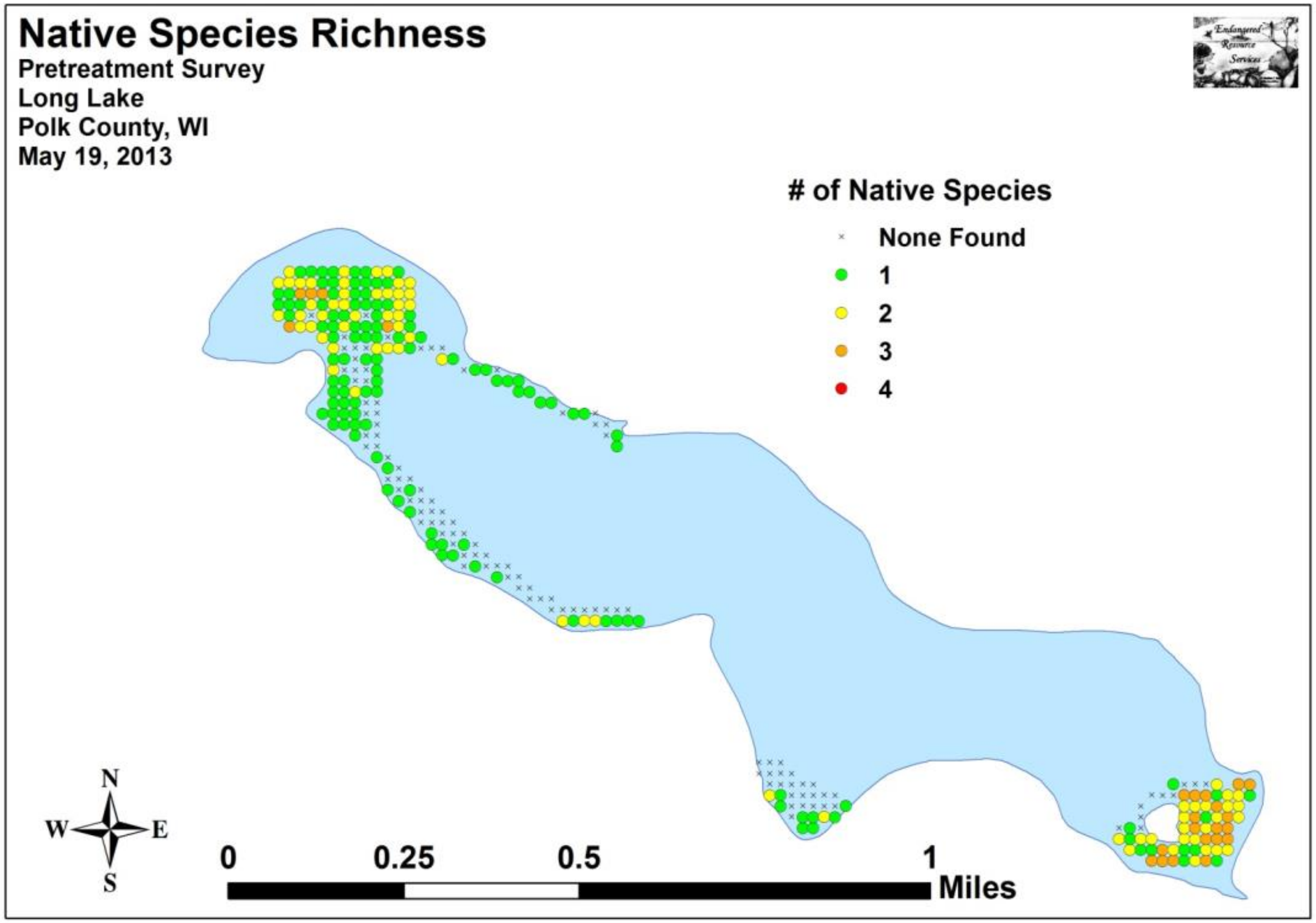

Bottom Substrate
Pre/Posttreatment Surveys
Long Lake
Polk County, WI
May 19 and June 15, 2013
Substrate Type
Rock
Sand
Muck
N
W
E
S
0
0.25
0.5
1
Miles
Endangered Resource Services

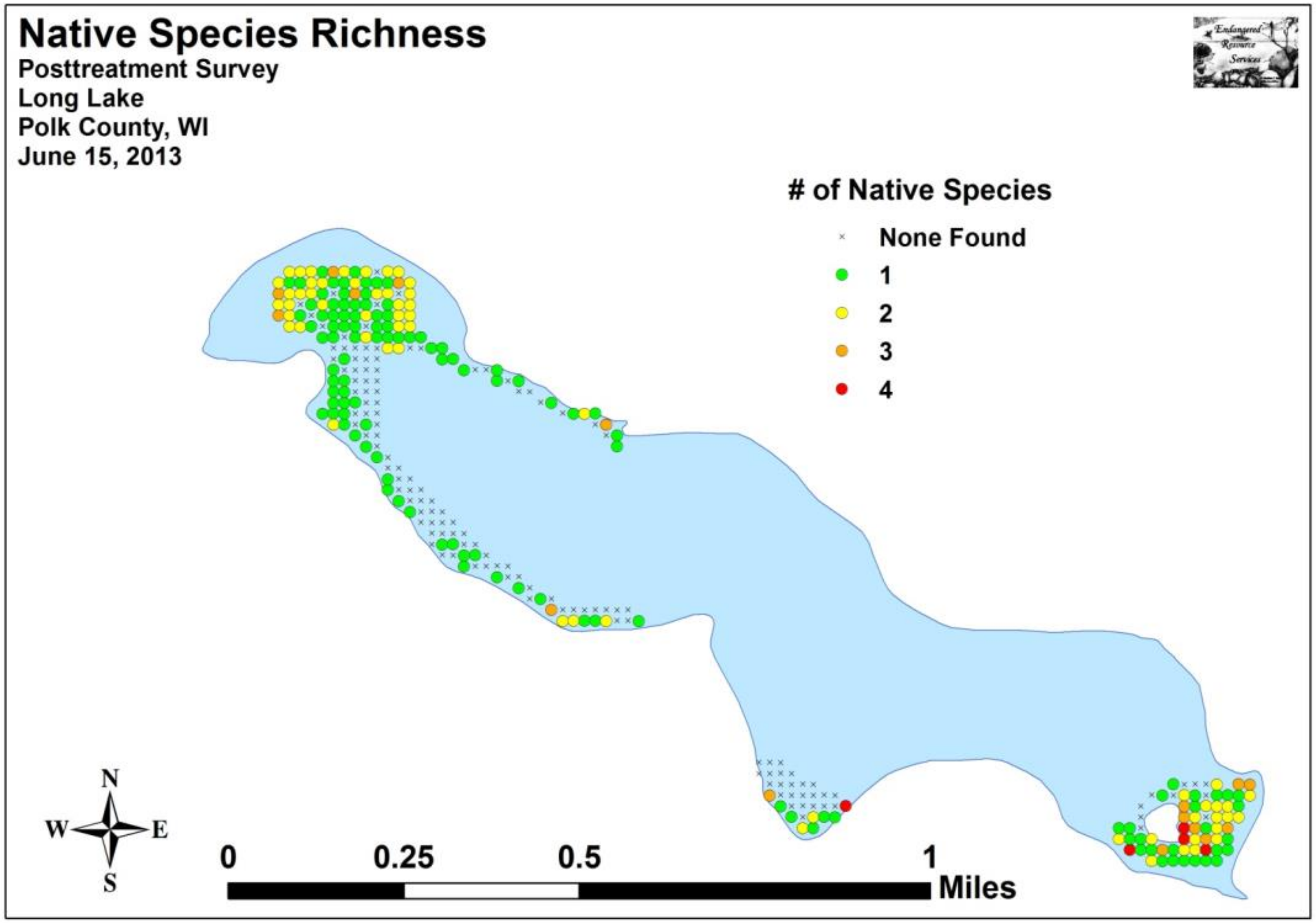
Appendix IV: Pre/Post Littoral Zone, Native Species Richness, and Total Rake Fullness

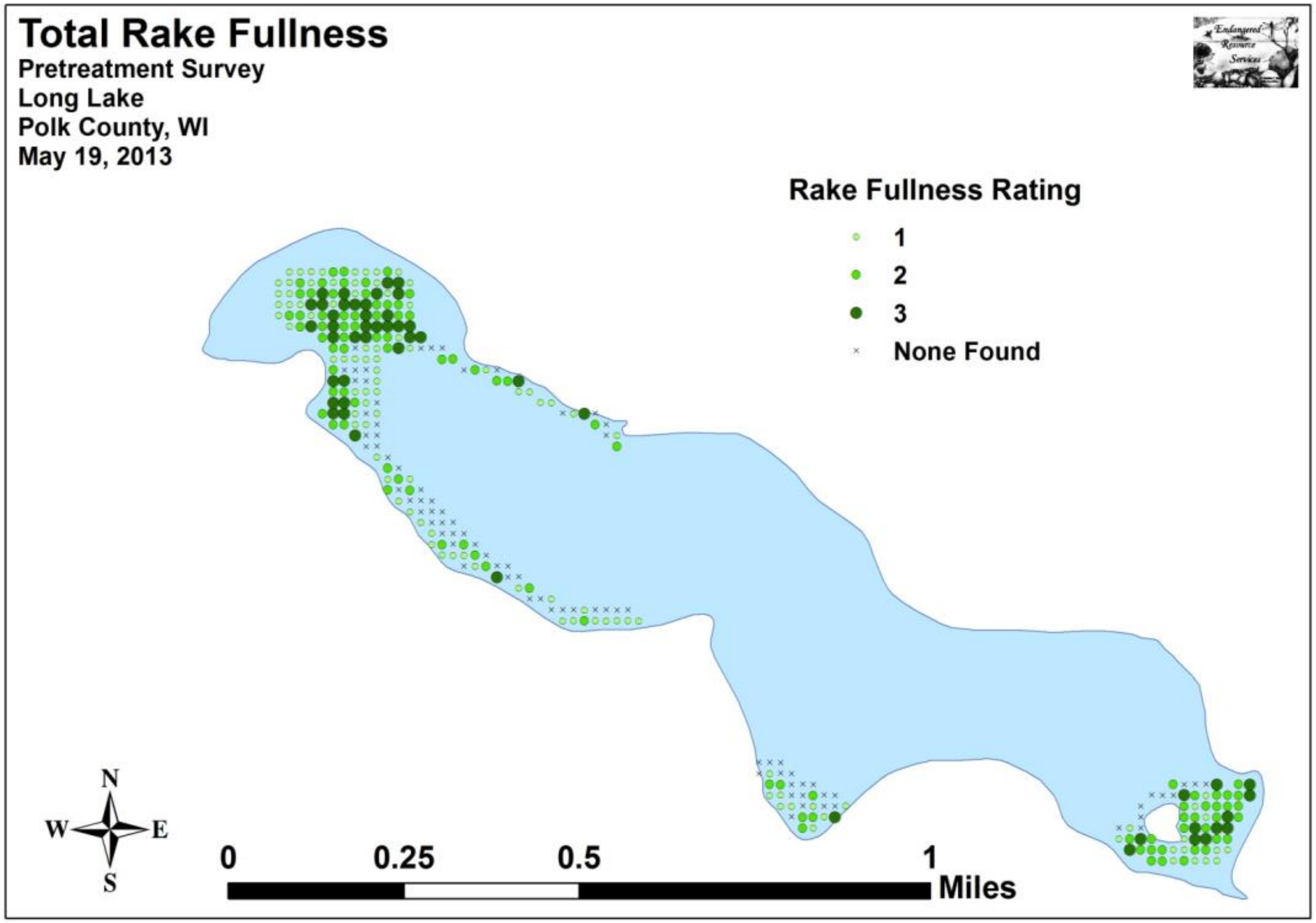

Littoral Zone
Pretreatment Survey
Long Lake
Polk County, WI
May 19, 2013
Littoral Zone
Littoral Zone with Plants
>11.0 ft
N
W
E
S
0
0.25
0.5
1
Miles



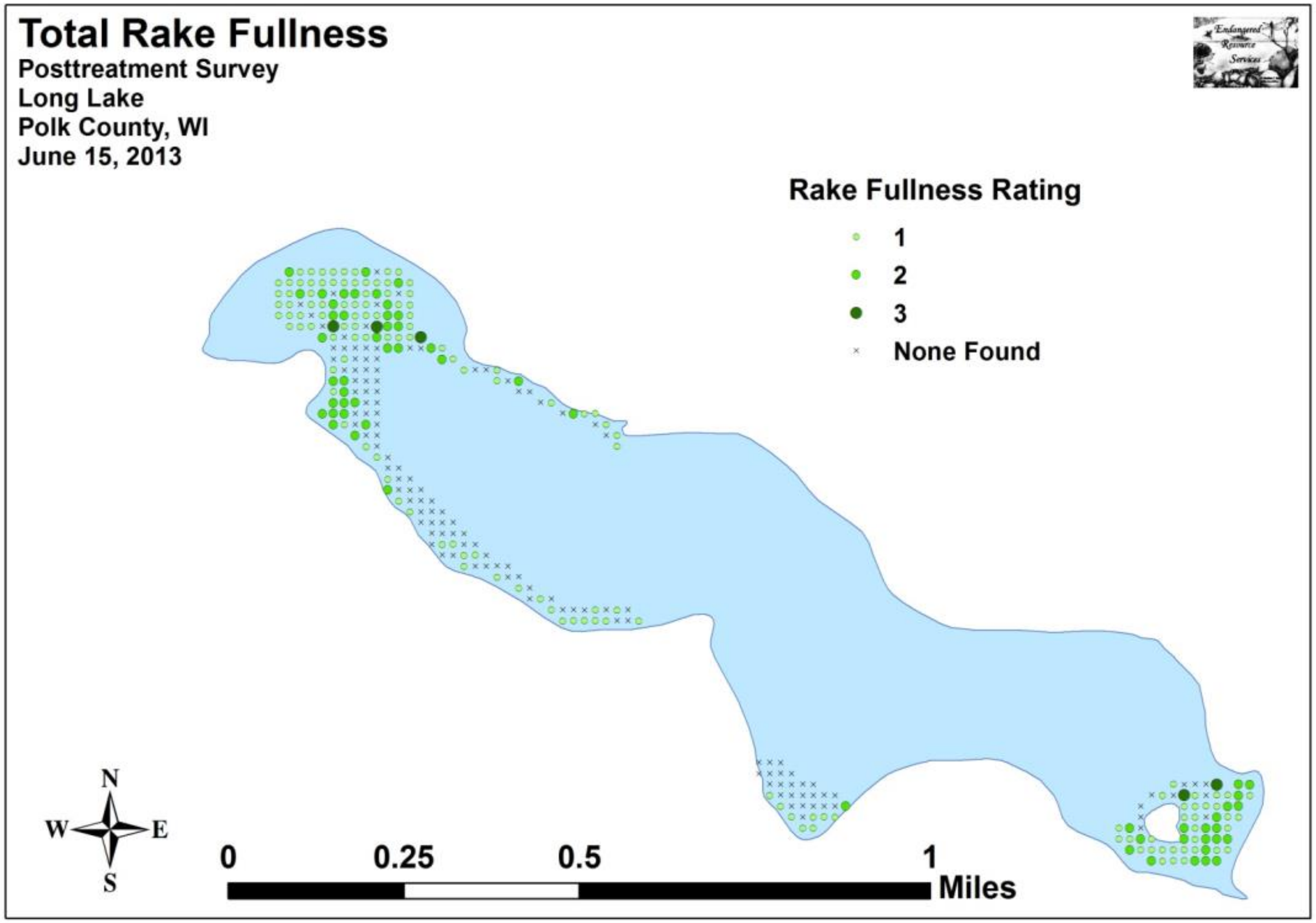
Littoral Zone
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Littoral Zone
Littoral Zone with Plants
>9.5 ft
N
W
E
S
0
0.25
0.5
1
Miles


Native Species Richness
Pretreatment Survey
Long Lake
Polk County, WI
May 19, 2013
# of Native Species
None Found
1
2
3
4
N
W
E
S
0
0.25
0.5
1
Miles

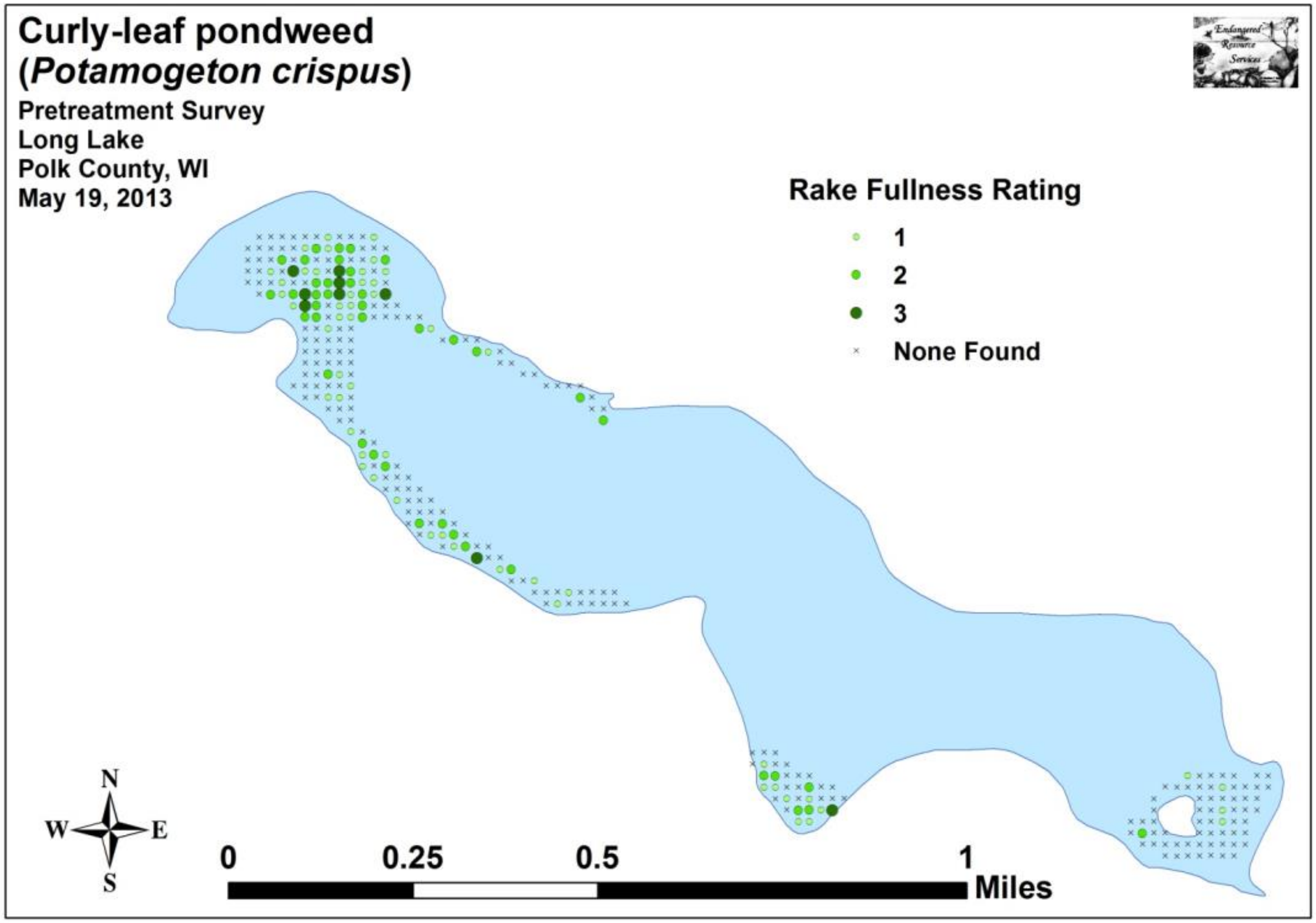

Native Species Richness
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
# of Native Species
None Found
1
2
3
4
N
W
E
S
0
0.25
0.5
1
Miles



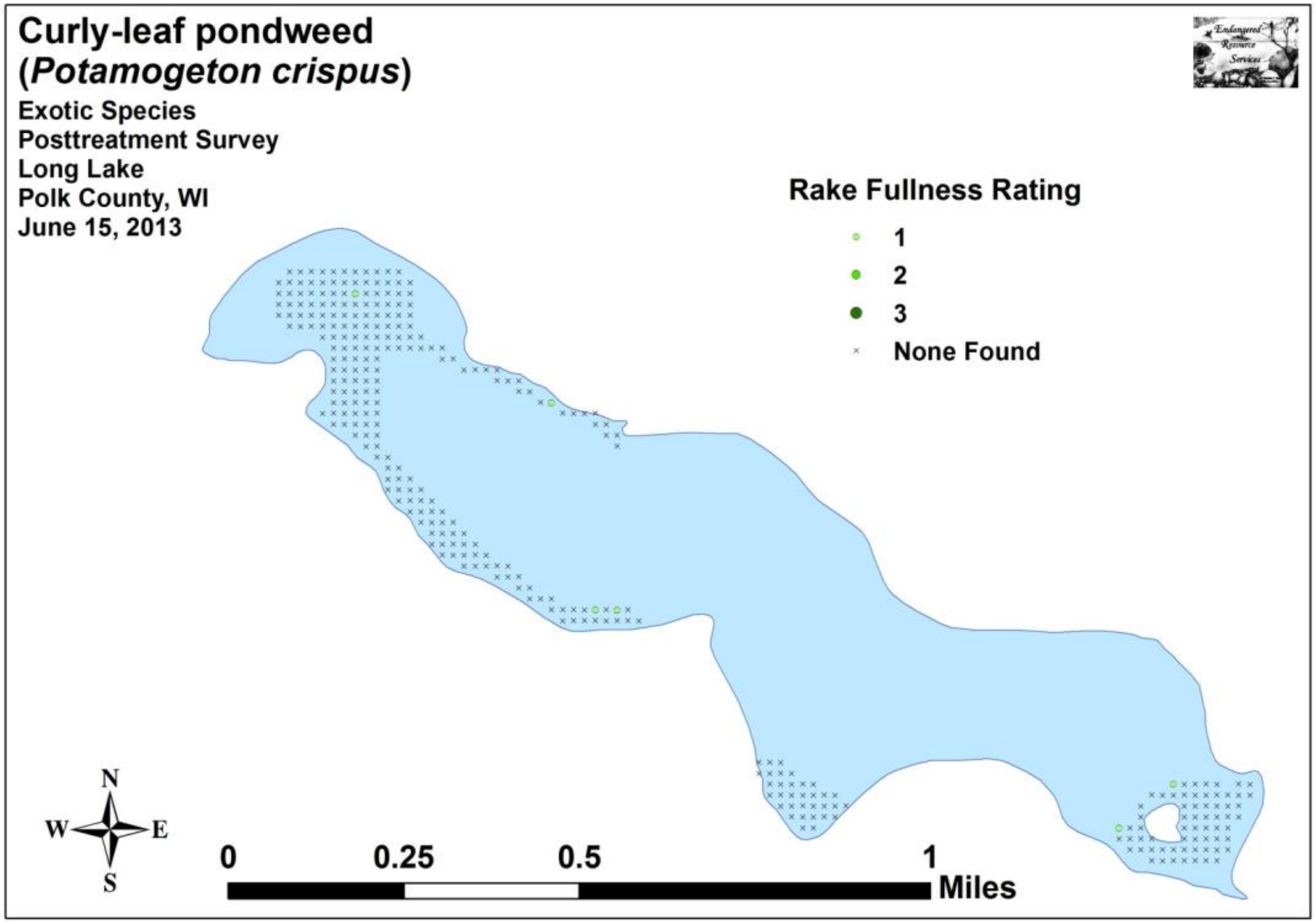
Total Rake Fullness
Pretreatment Survey
Long Lake
Polk County, WI
May 19, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Total Rake Fullness
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

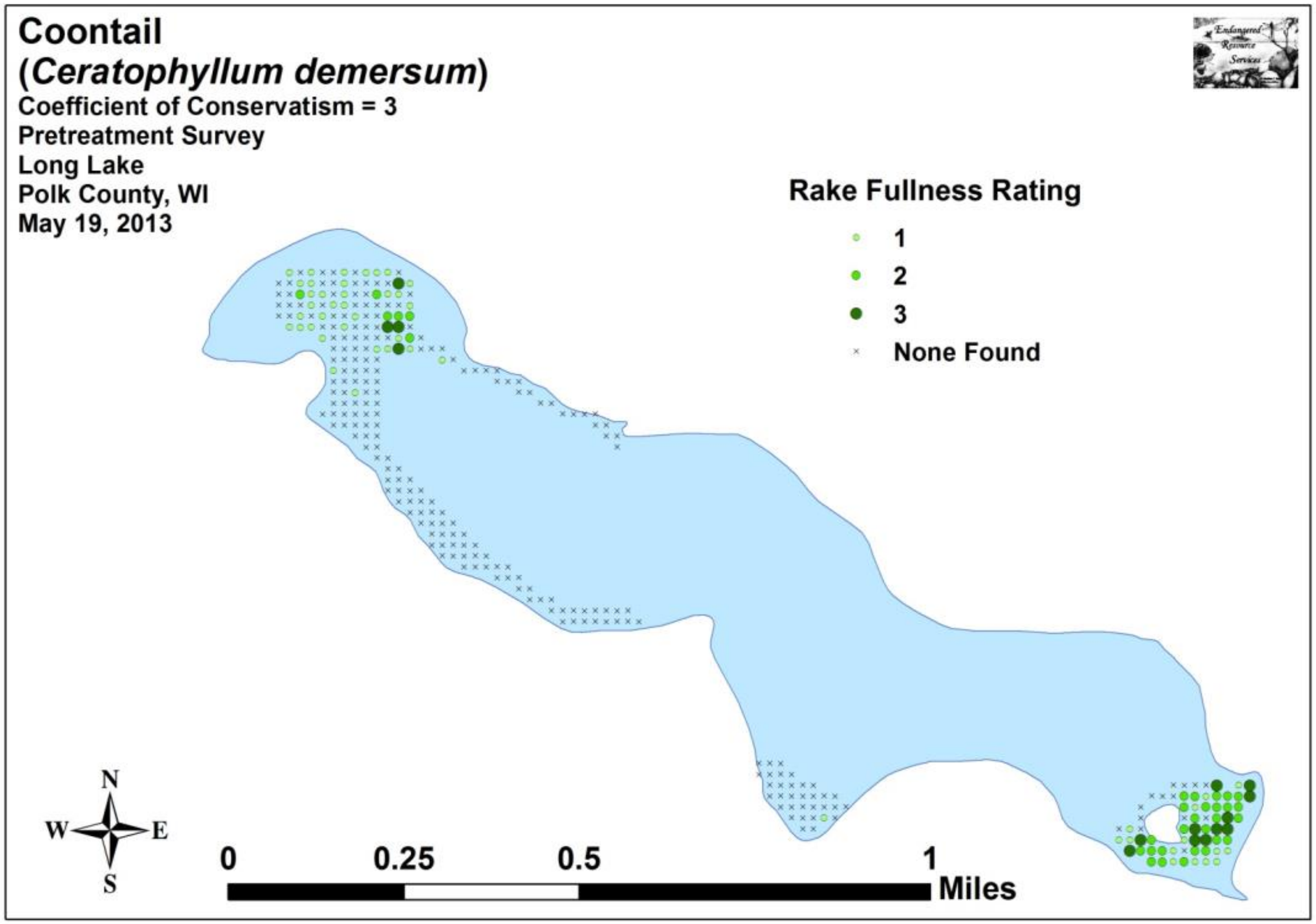
Appendix V: CLP Pre/Posttreatment Distribution

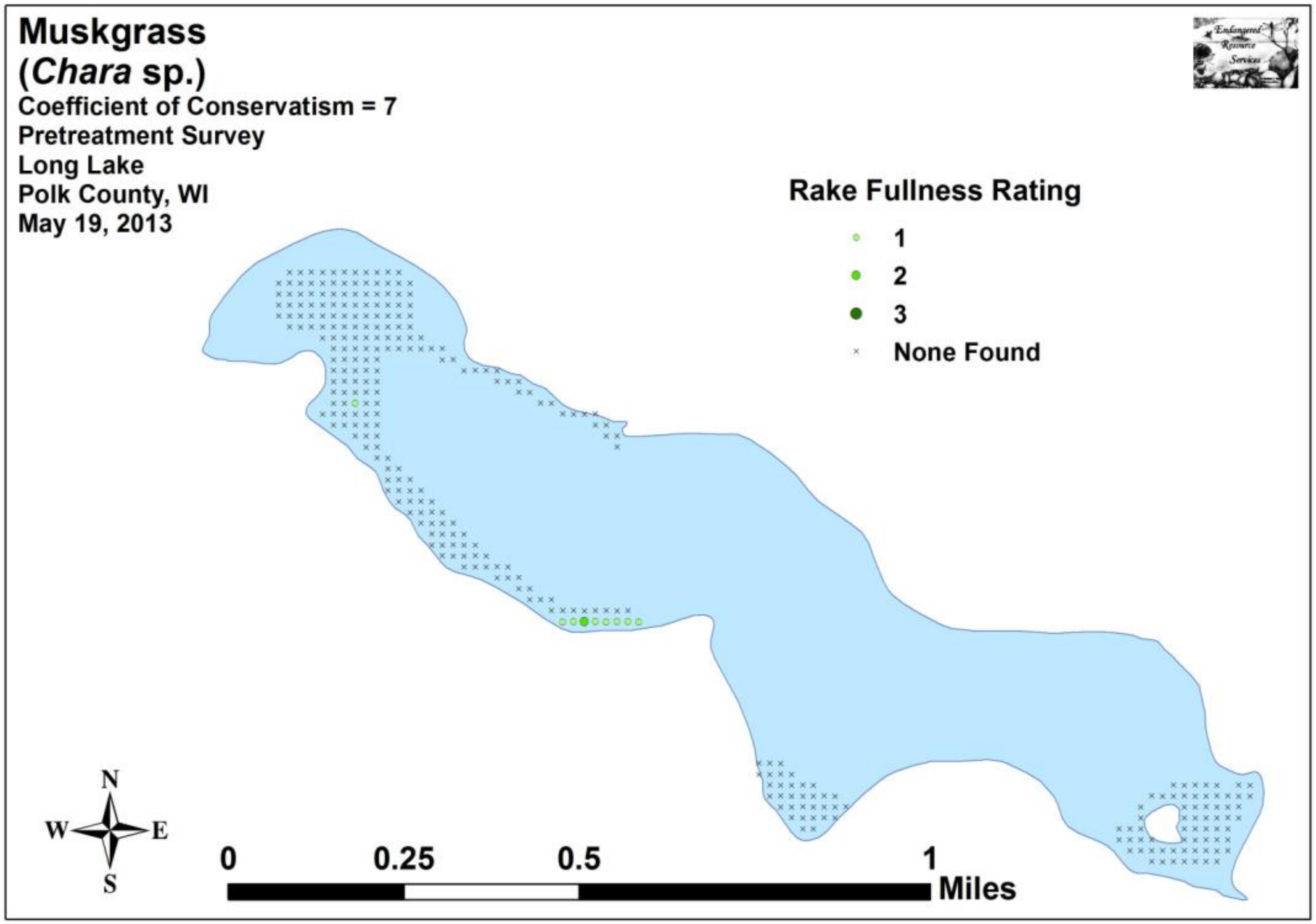


Curly-leaf pondweed
(Potamogeton crispus)
Pretreatment Survey
Long Lake
Polk County, WI
May 19, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

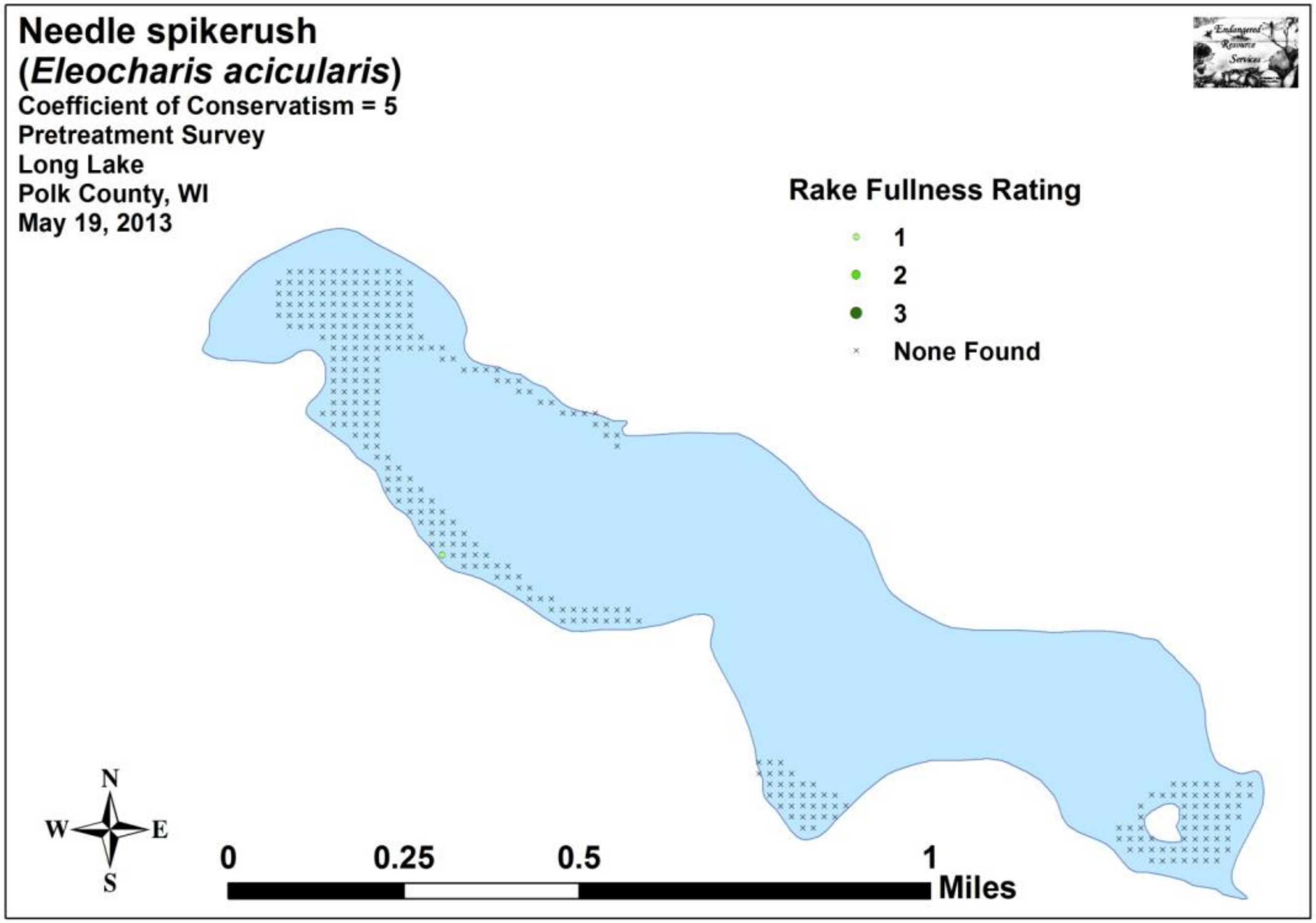

Curly-leaf pondweed
(*Potamogeton crispus*)
Exotic Species
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

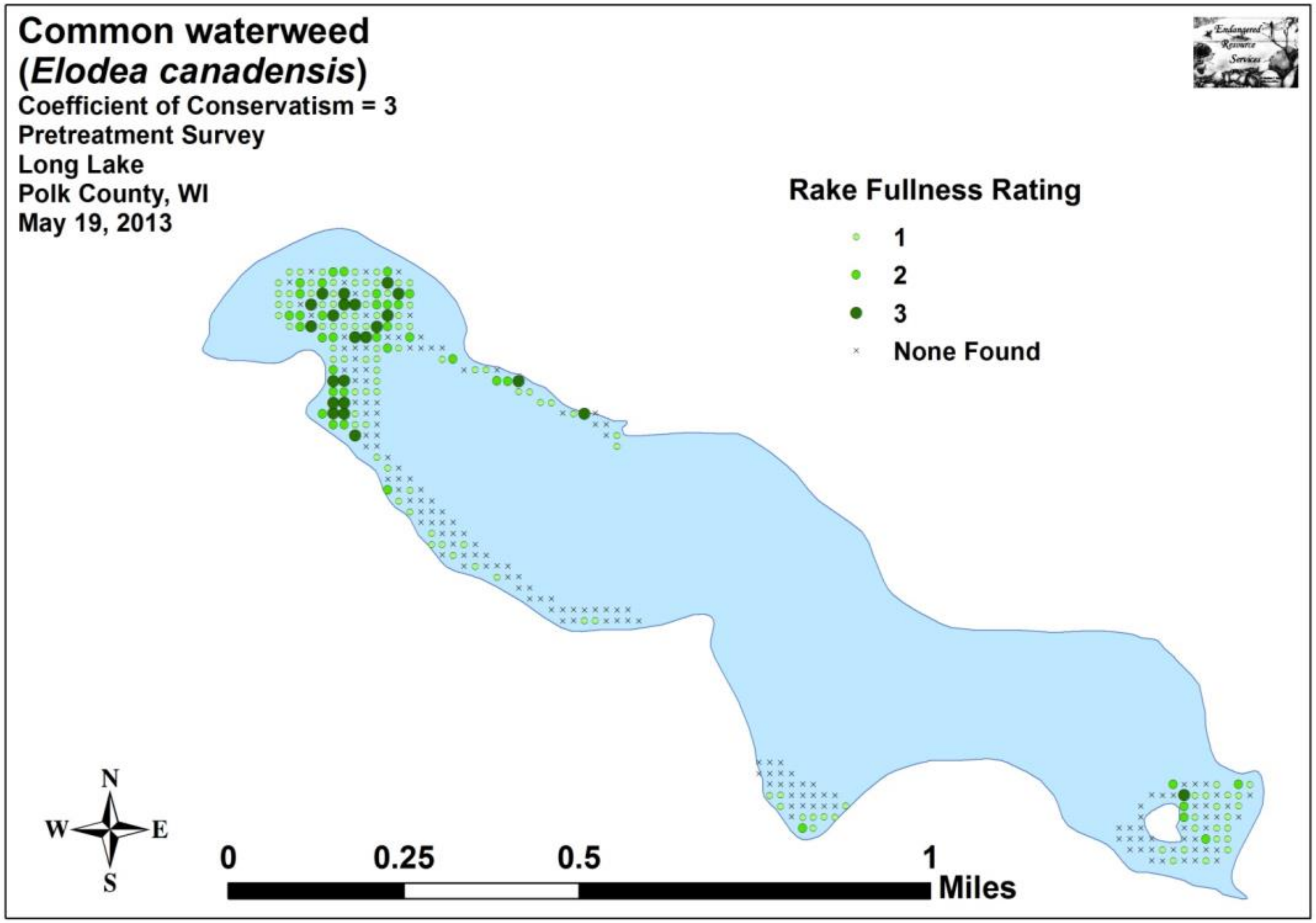
Appendix VI: Pretreatment Native Species Distribution

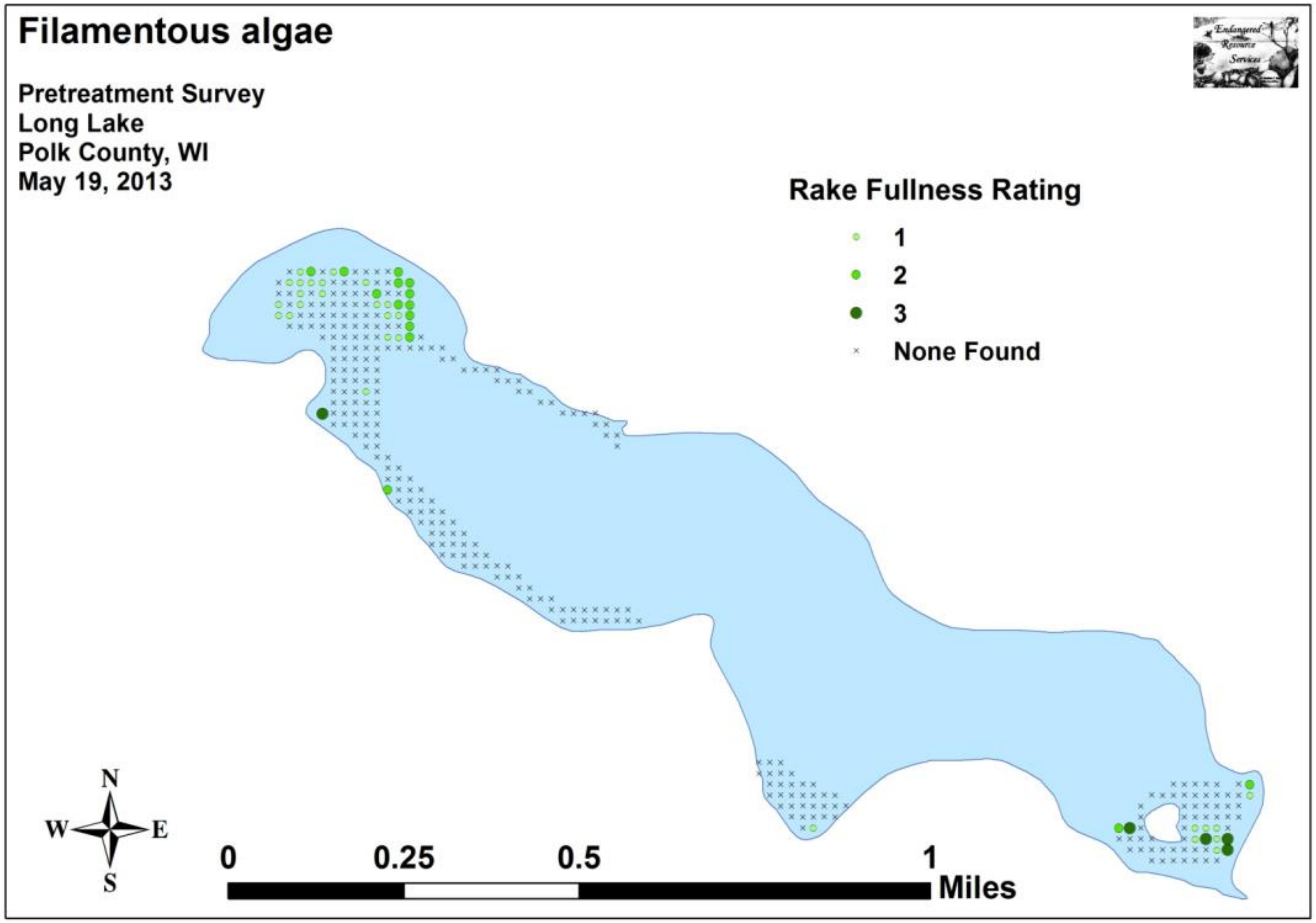

Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Pretreatment Survey
Long Lake
Polk County, WI
May 19, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

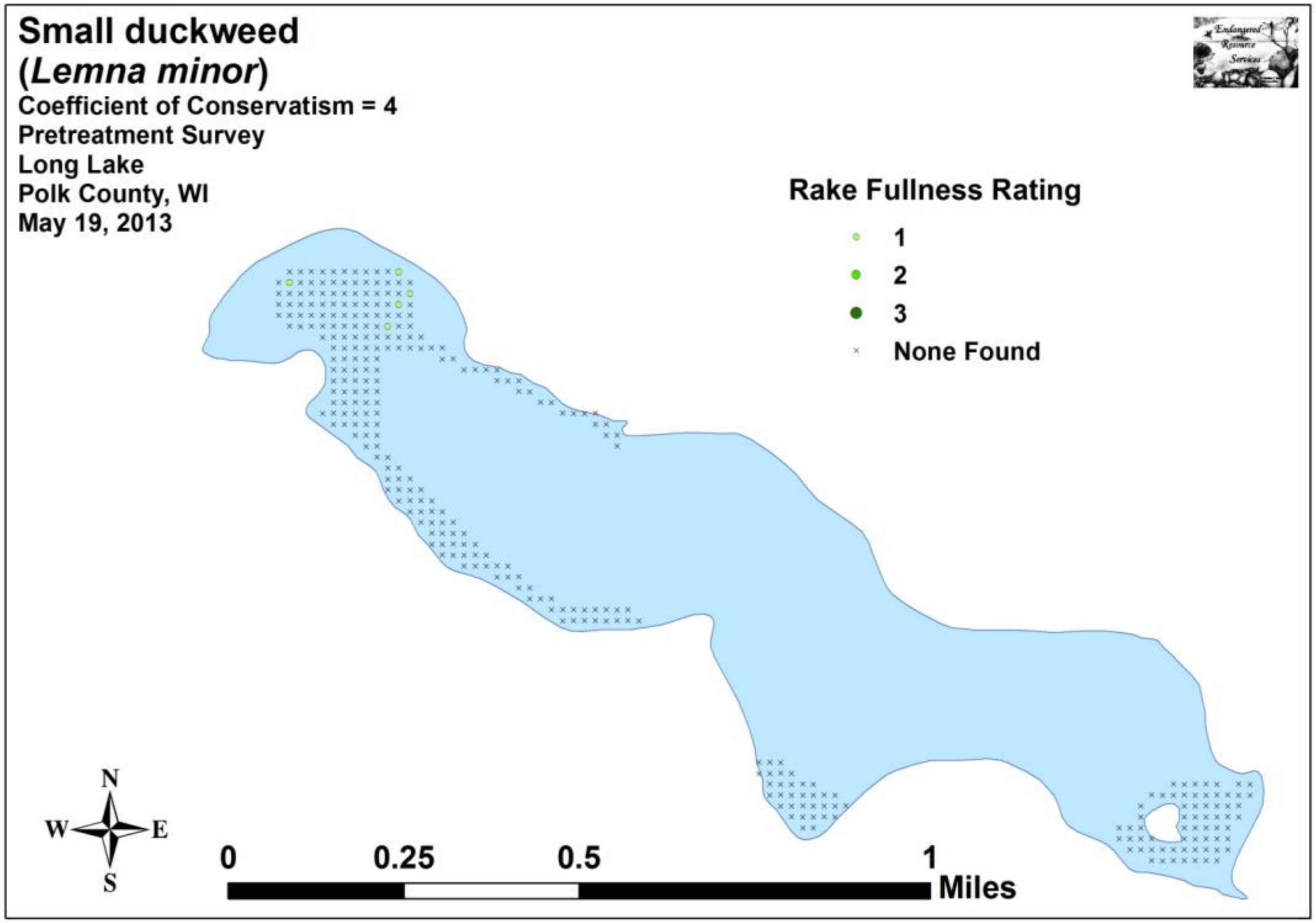


Muskgrass
(*Chara* sp.)
Coefficient of Conservatism = 7
Pretreatment Survey
Long Lake
Polk County, WI
May 19, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

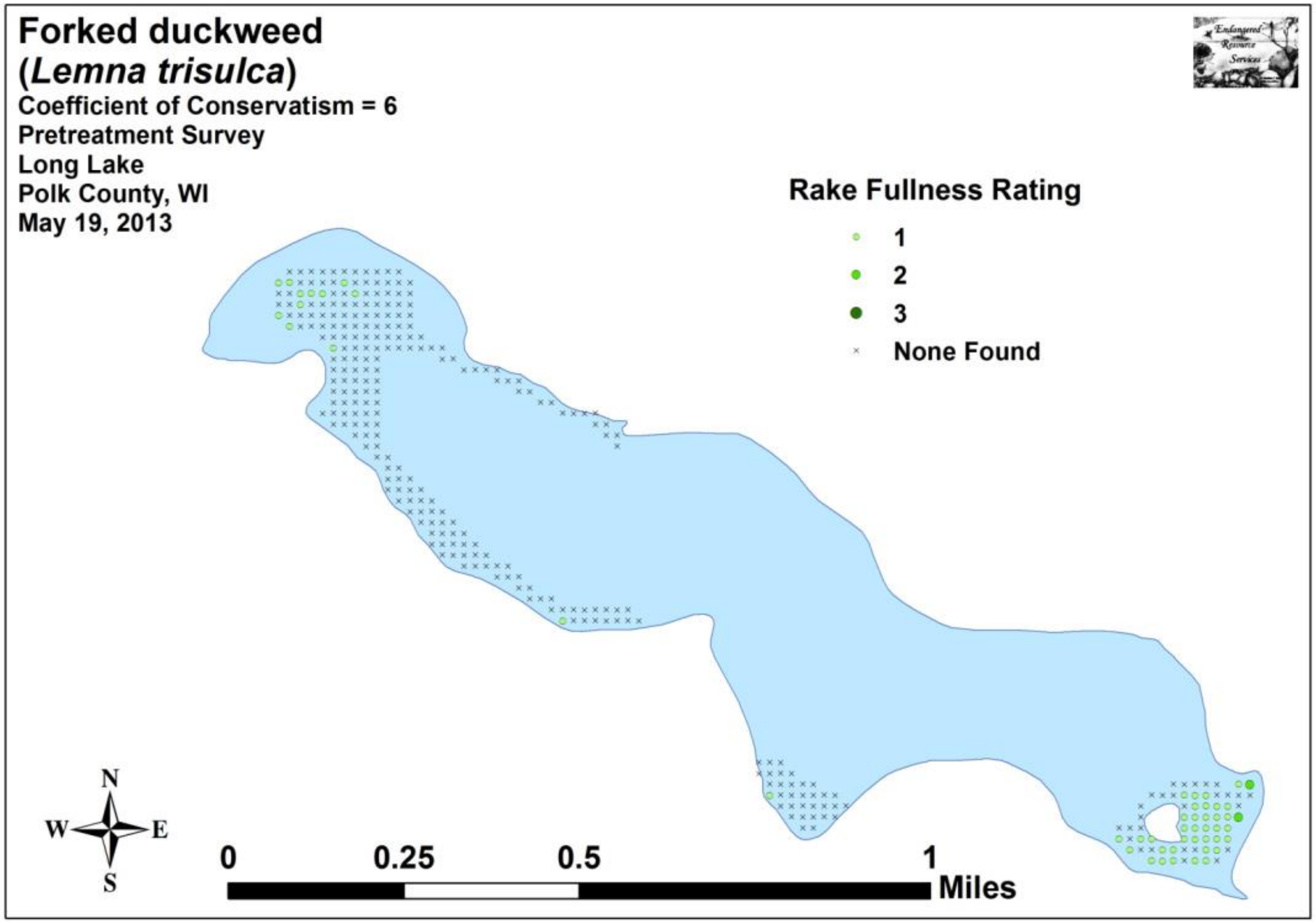

Needle spikerush
(*Eleocharis acicularis*)
Coefficient of Conservatism = 5
Pretreatment Survey
Long Lake
Polk County, WI
May 19, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

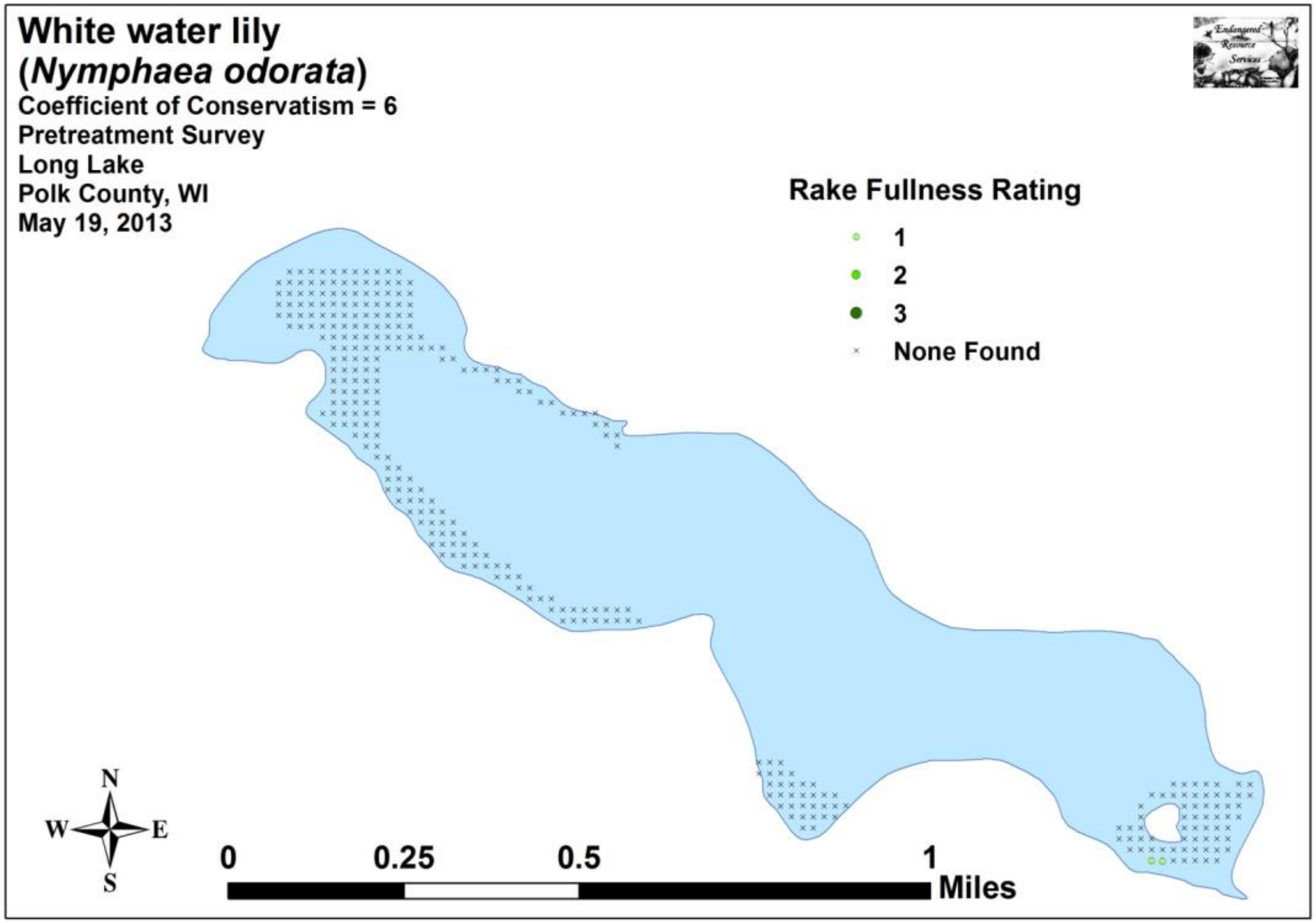

Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Pretreatment Survey
Long Lake
Polk County, WI
May 19, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

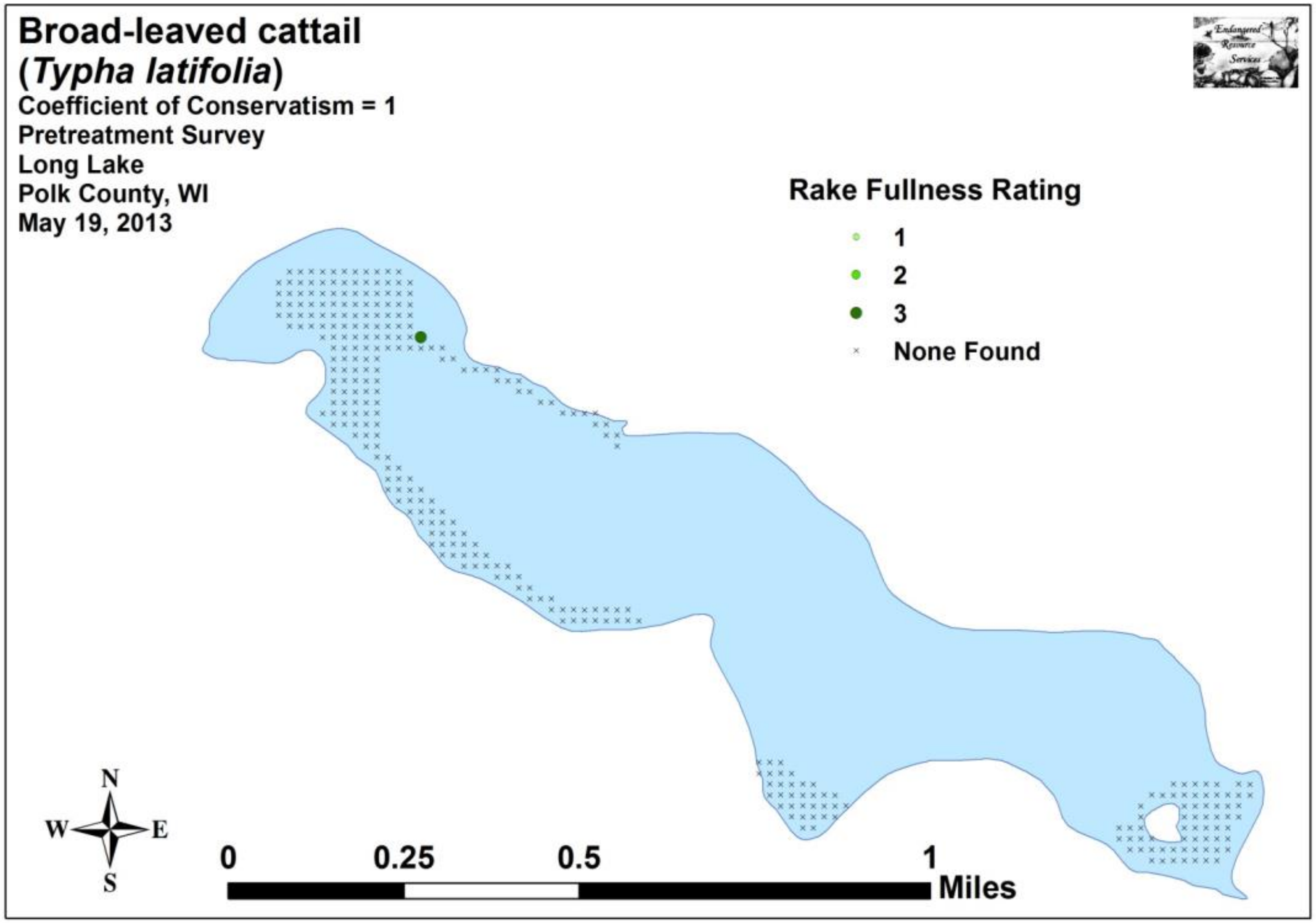

Filamentous algae
Pretreatment Survey
Long Lake
Polk County, WI
May 19, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles



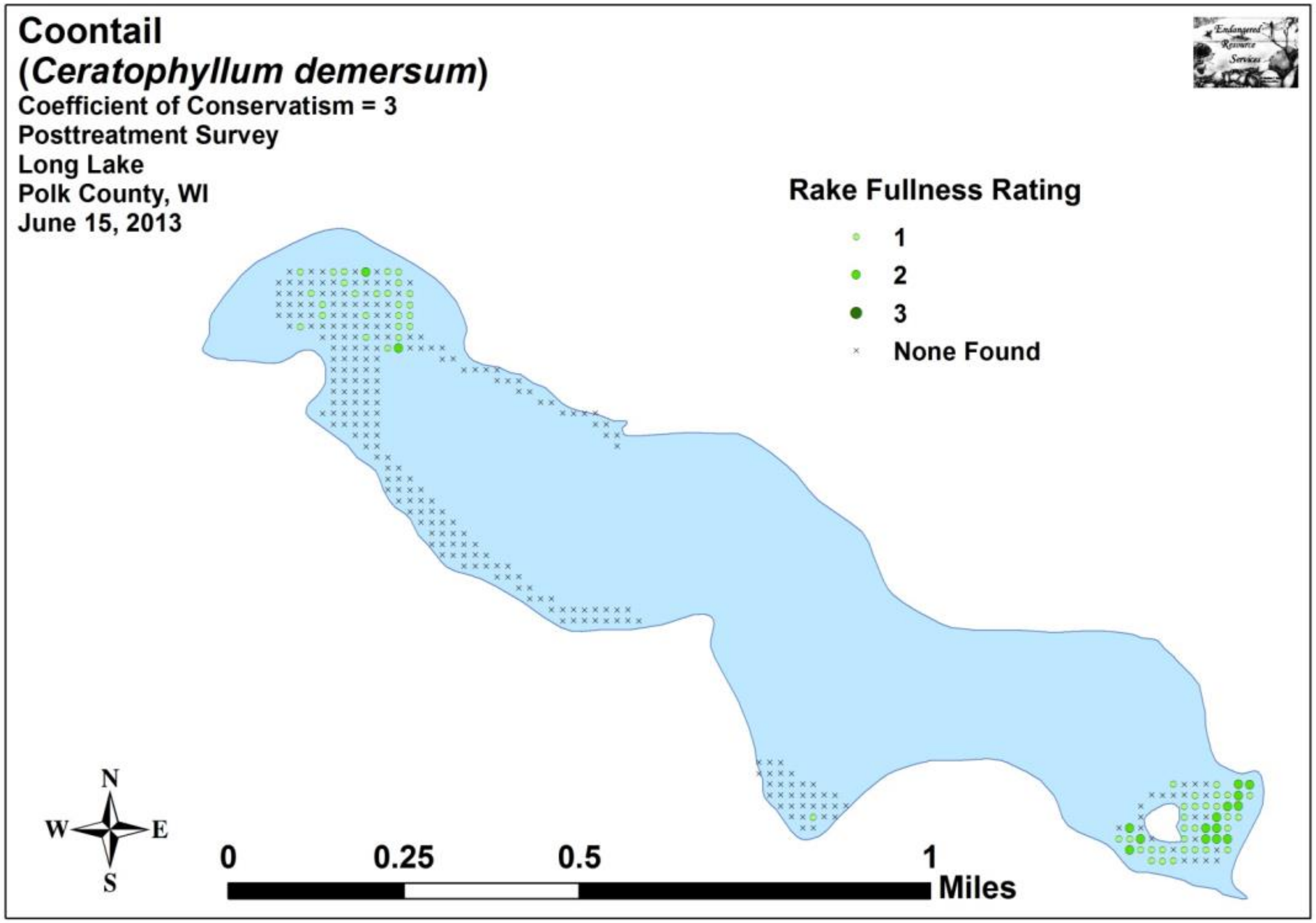
Small duckweed
(*Lemna minor*)
Coefficient of Conservatism = 4
Pretreatment Survey
Long Lake
Polk County, WI
May 19, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

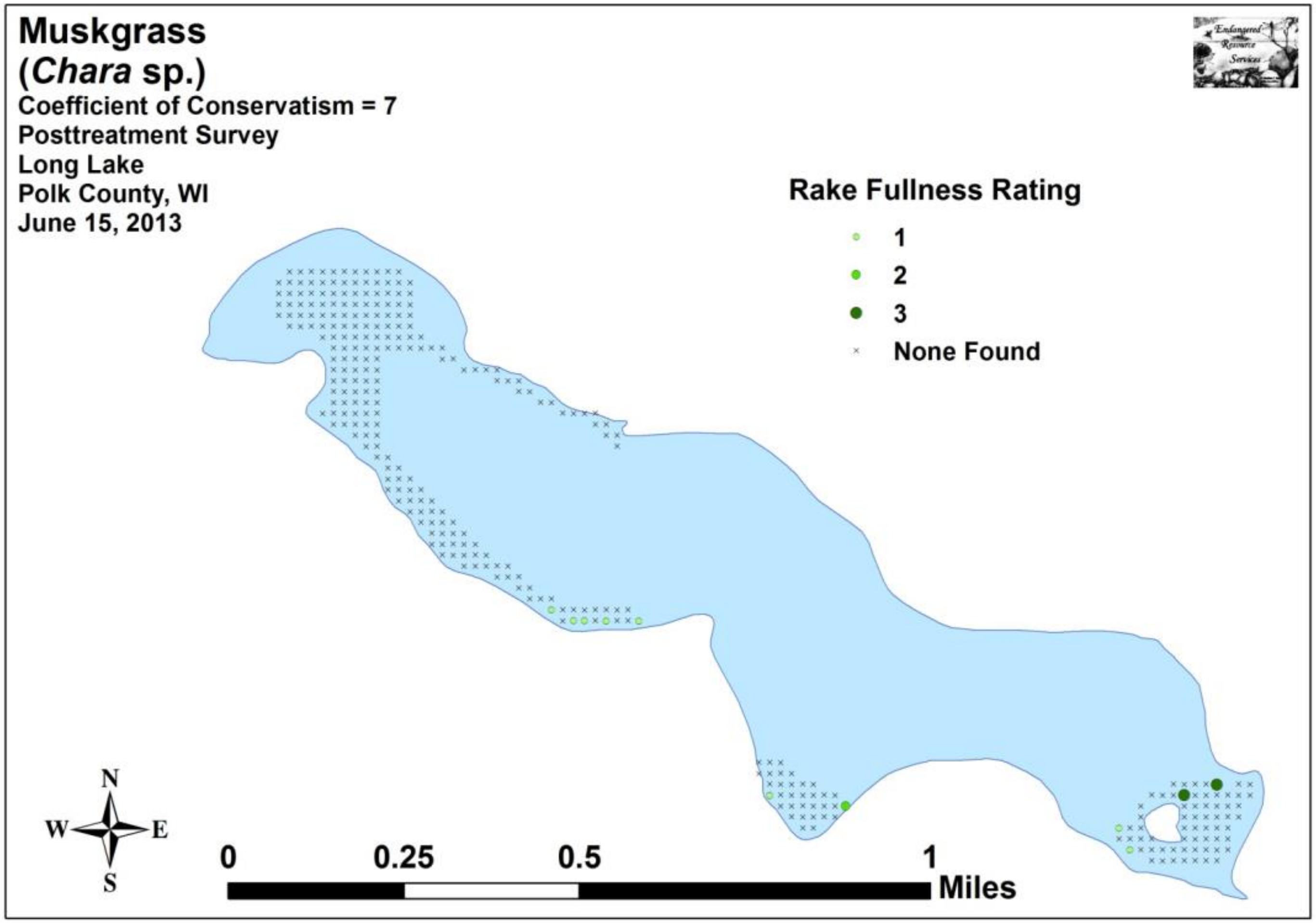

Forked duckweed
(Lemna trisulca)
Coefficient of Conservatism = 6
Pretreatment Survey
Long Lake
Polk County, WI
May 19, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Pretreatment Survey
Long Lake
Polk County, WI
May 19, 2013
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

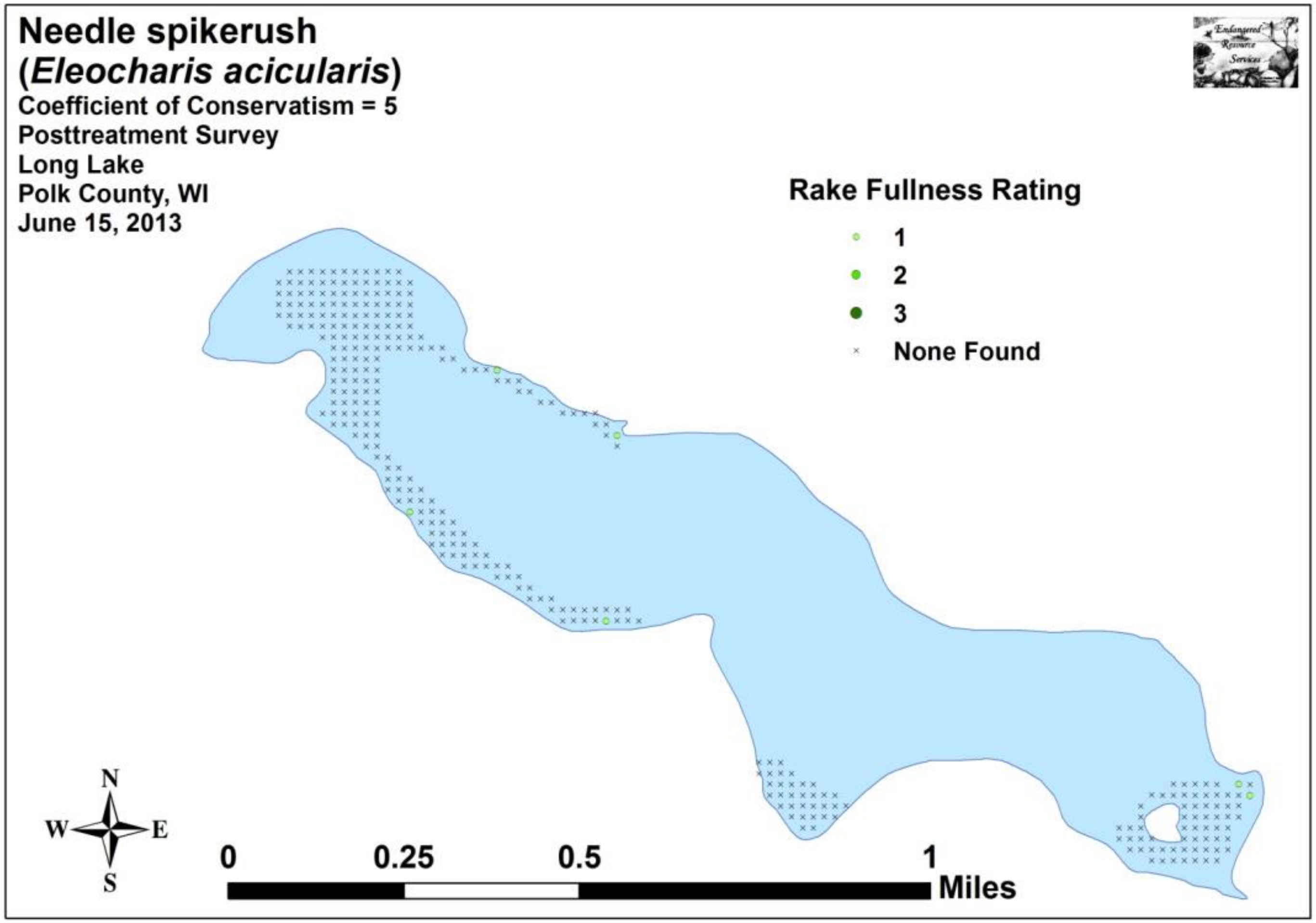

Broad-leaved cattail
(*Typha latifolia*)
Coefficient of Conservatism = 1
Pretreatment Survey
Long Lake
Polk County, WI
May 19, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

Appendix VII: Posttreatment Native Species Distribution

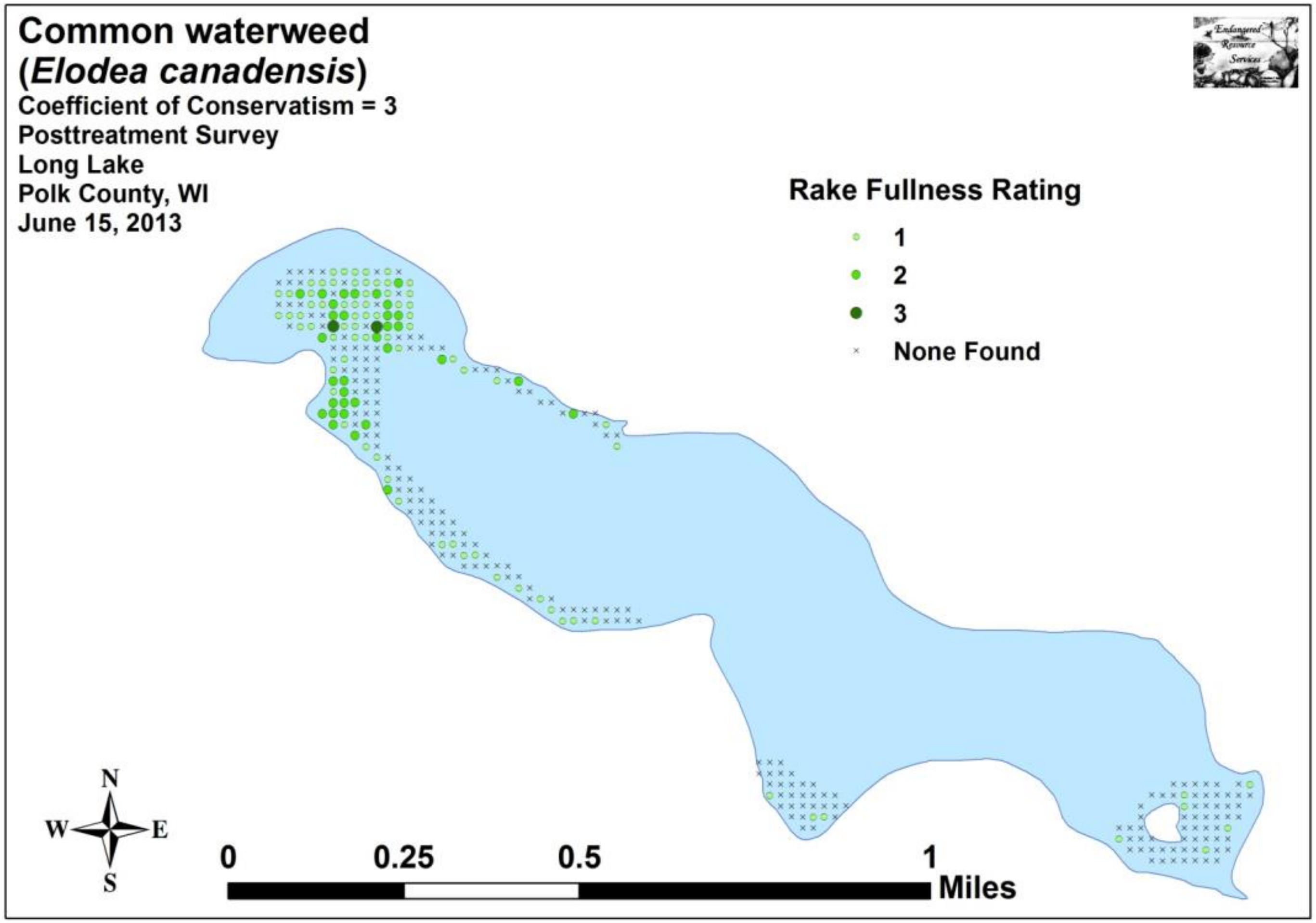

Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

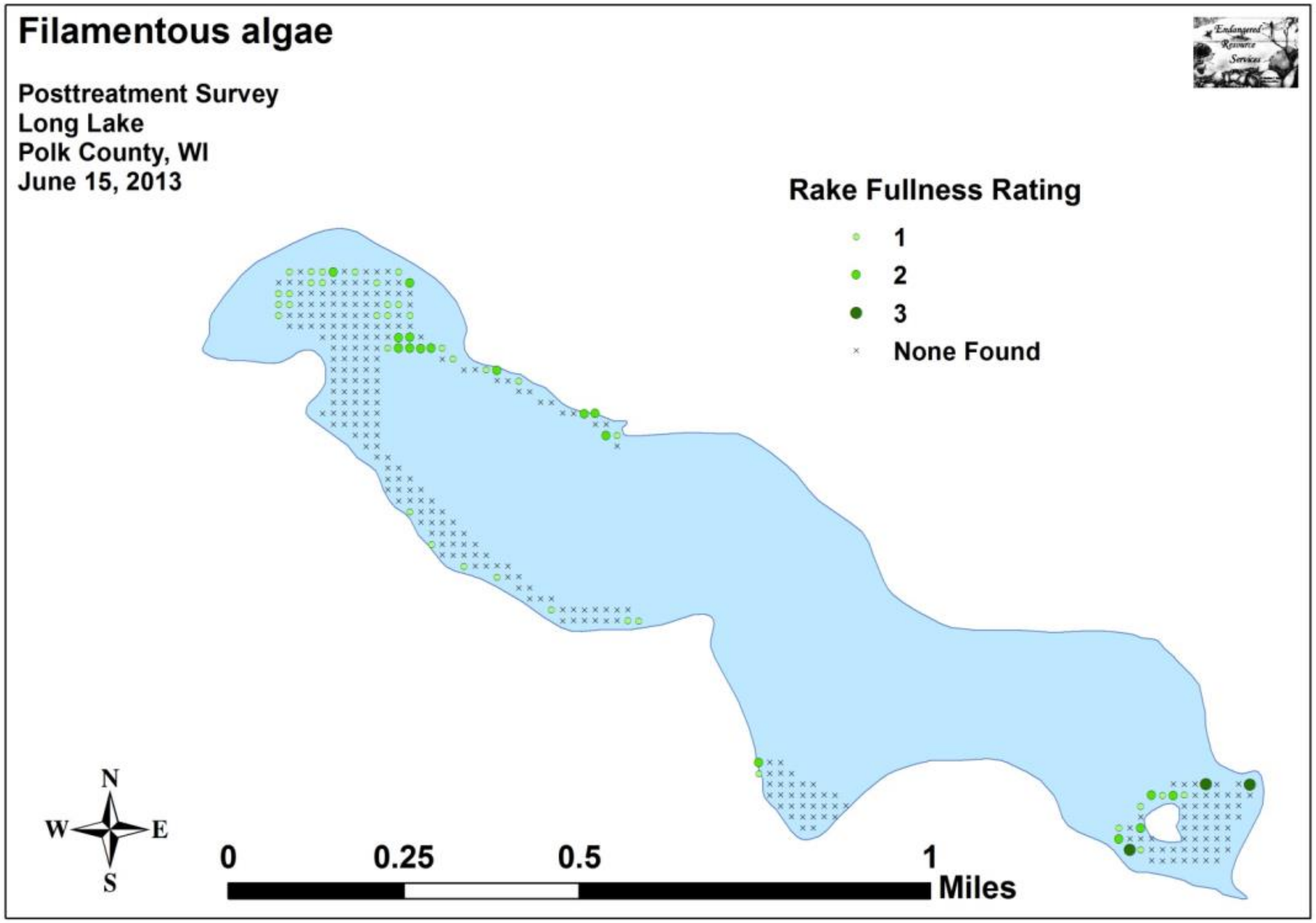


Muskgrass
(*Chara* sp.)
Coefficient of Conservatism = 7
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

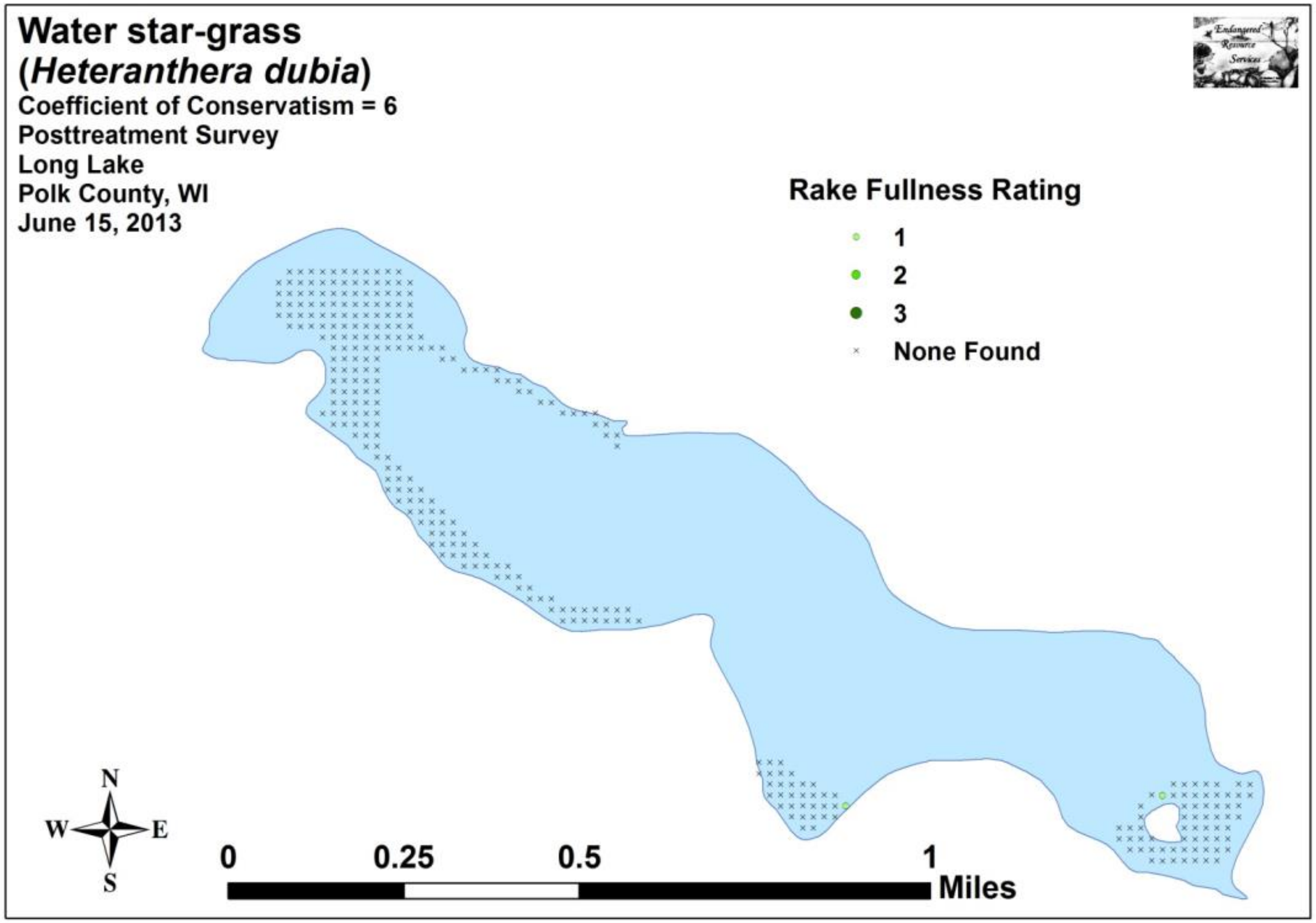


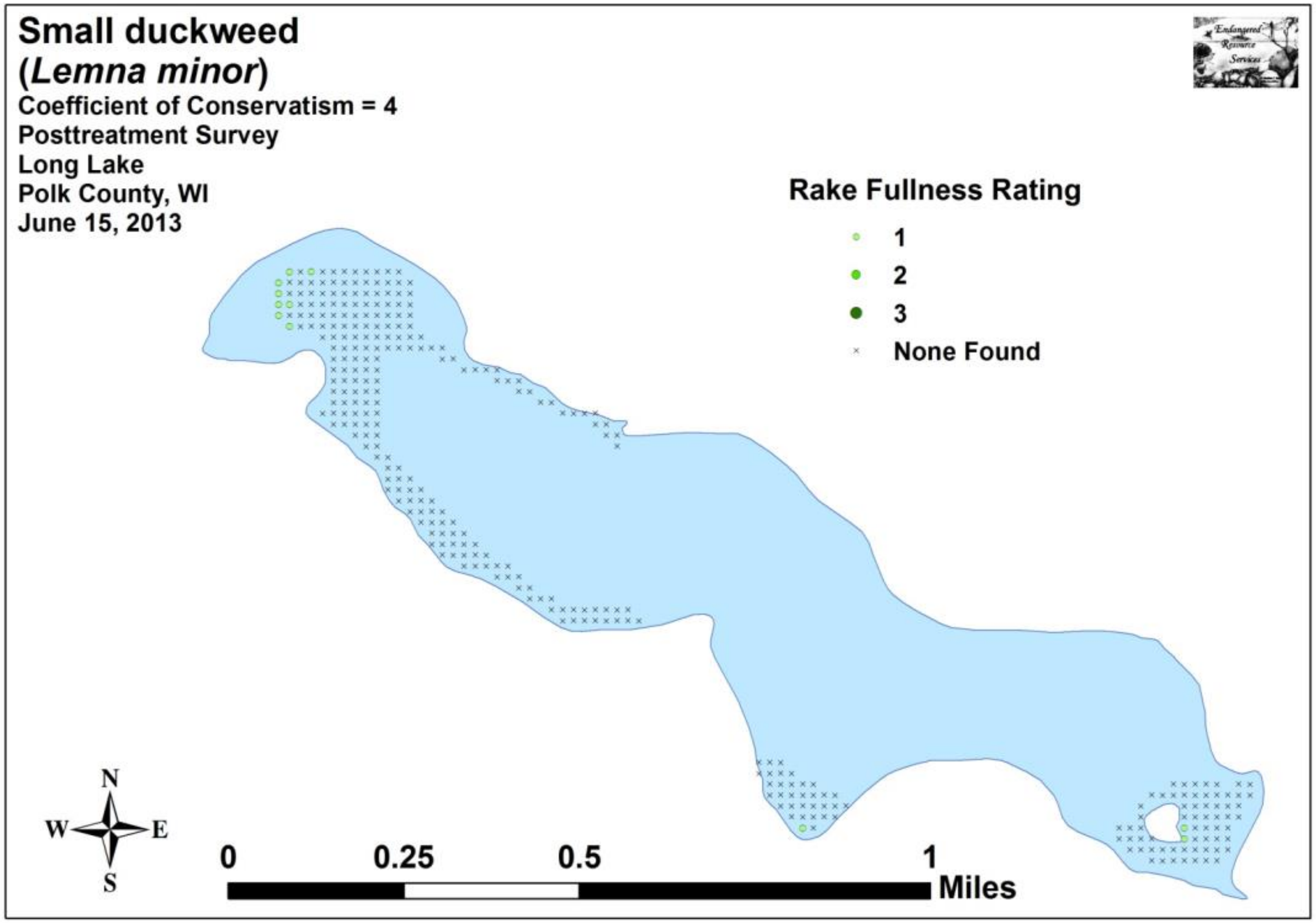
Needle spikerush
(Eleocharis acicularis)
Coefficient of Conservatism = 5
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

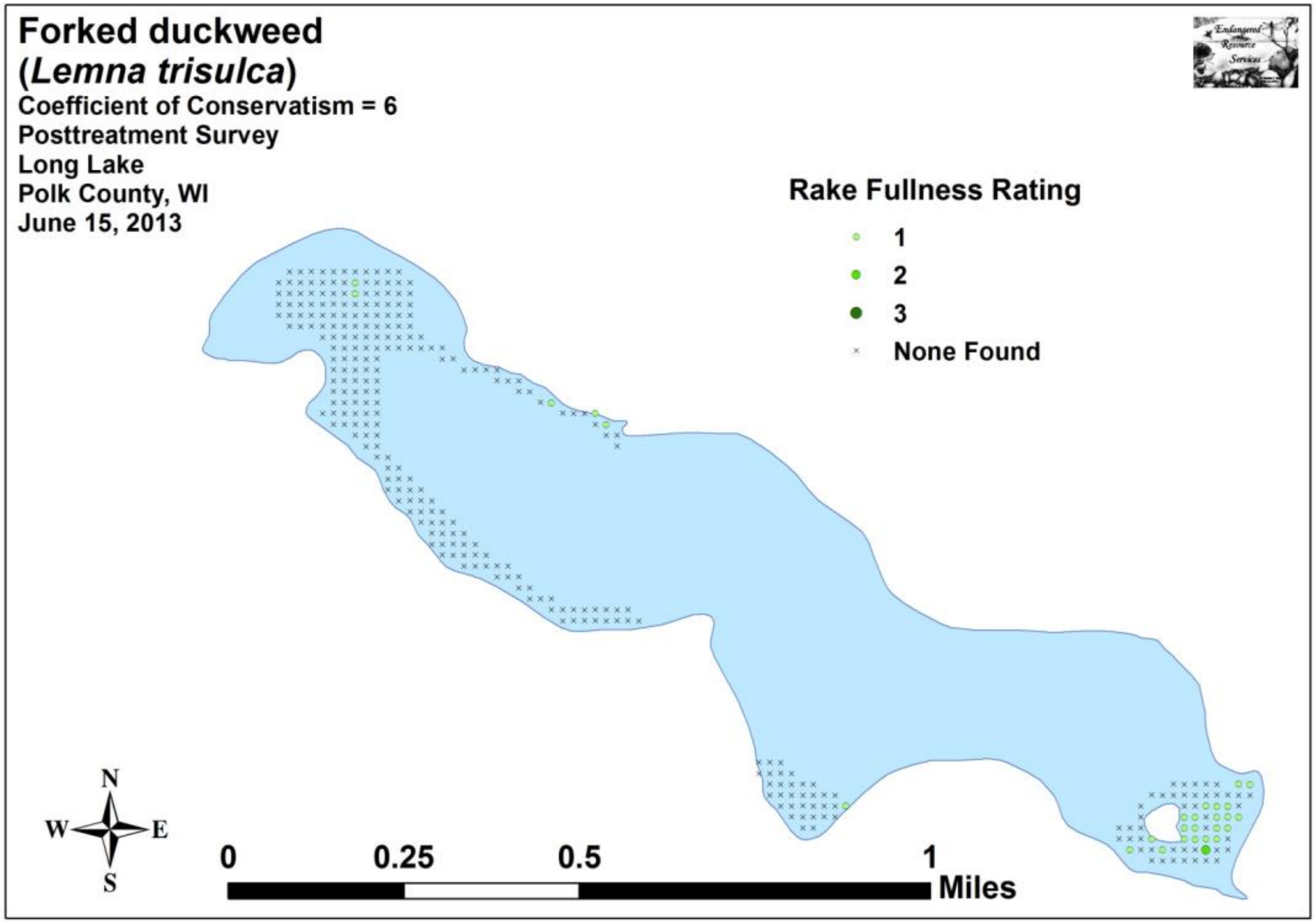

Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

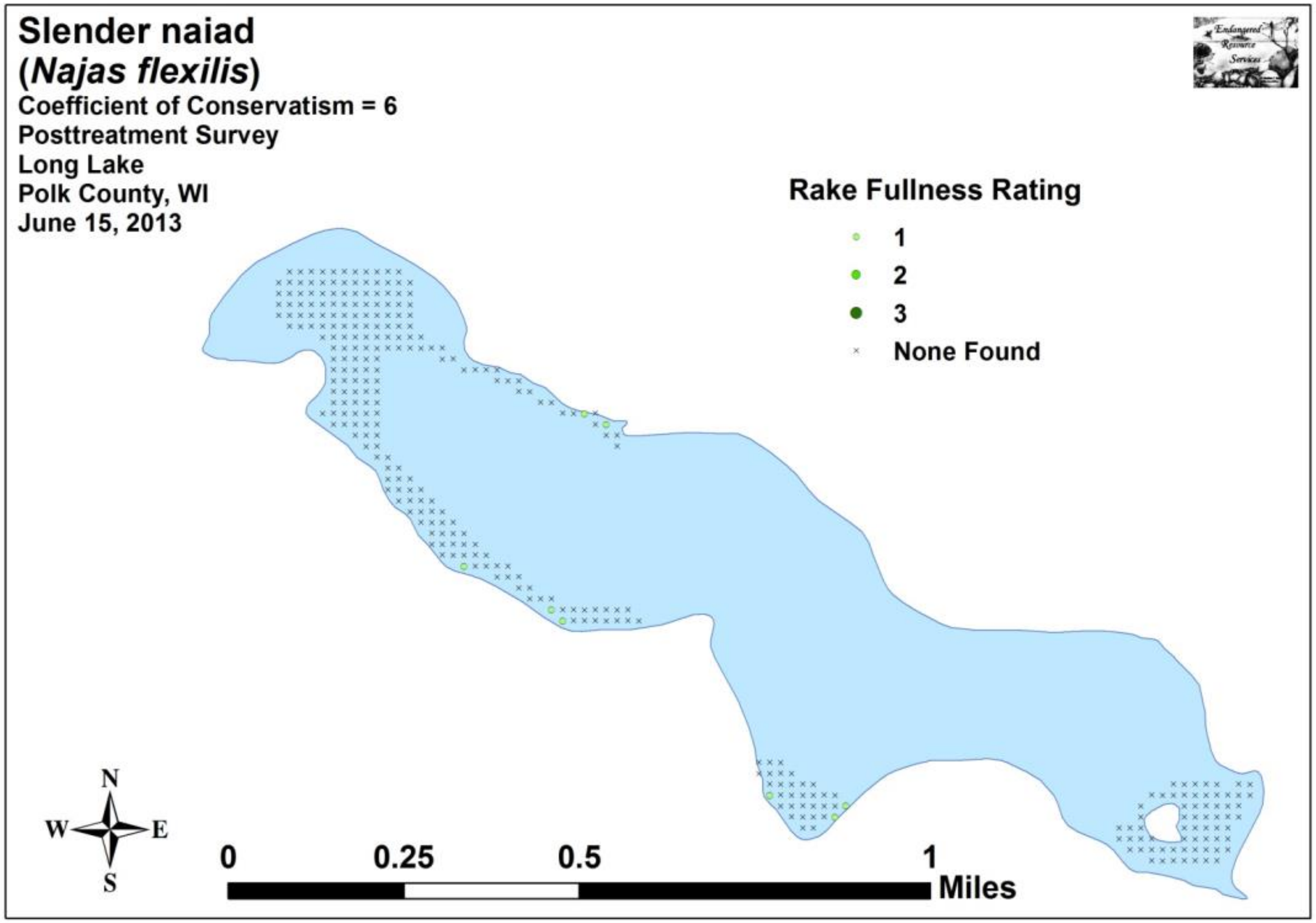


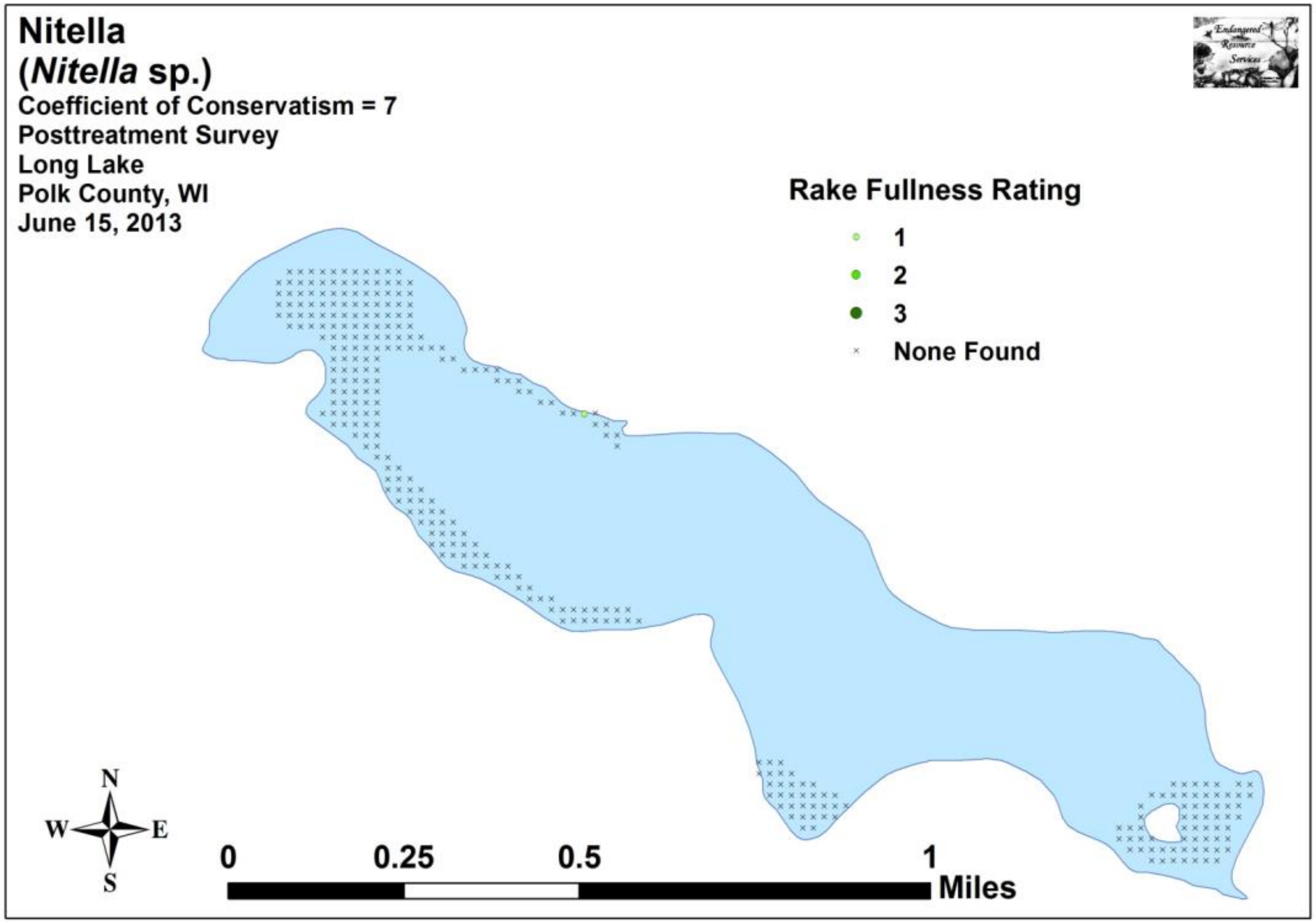
Filamentous algae
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

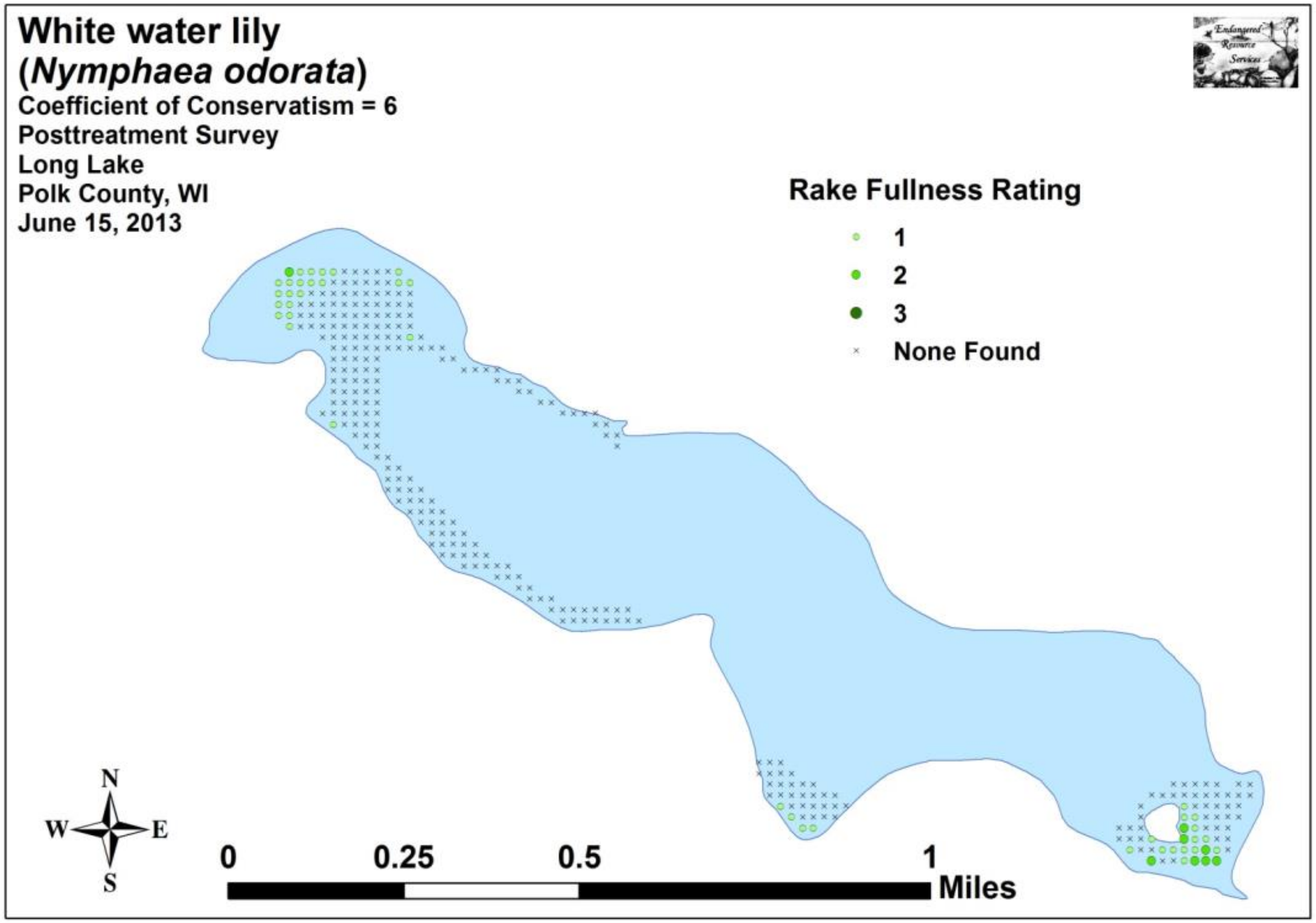

Water star-grass
(*Heteranthera dubia*)
Coefficient of Conservatism = 6
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

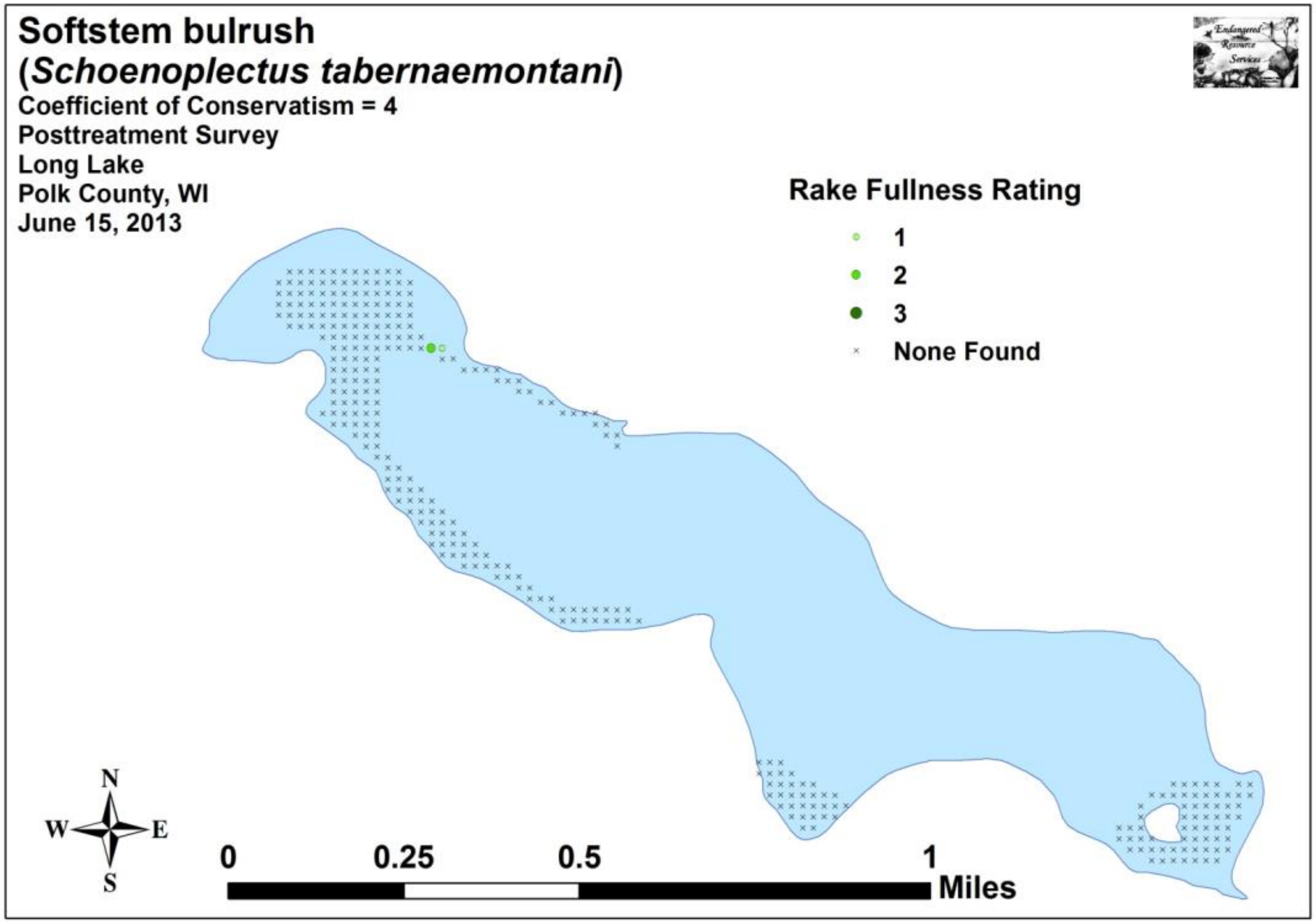

Small duckweed
(*Lemna minor*)
Coefficient of Conservatism = 4
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

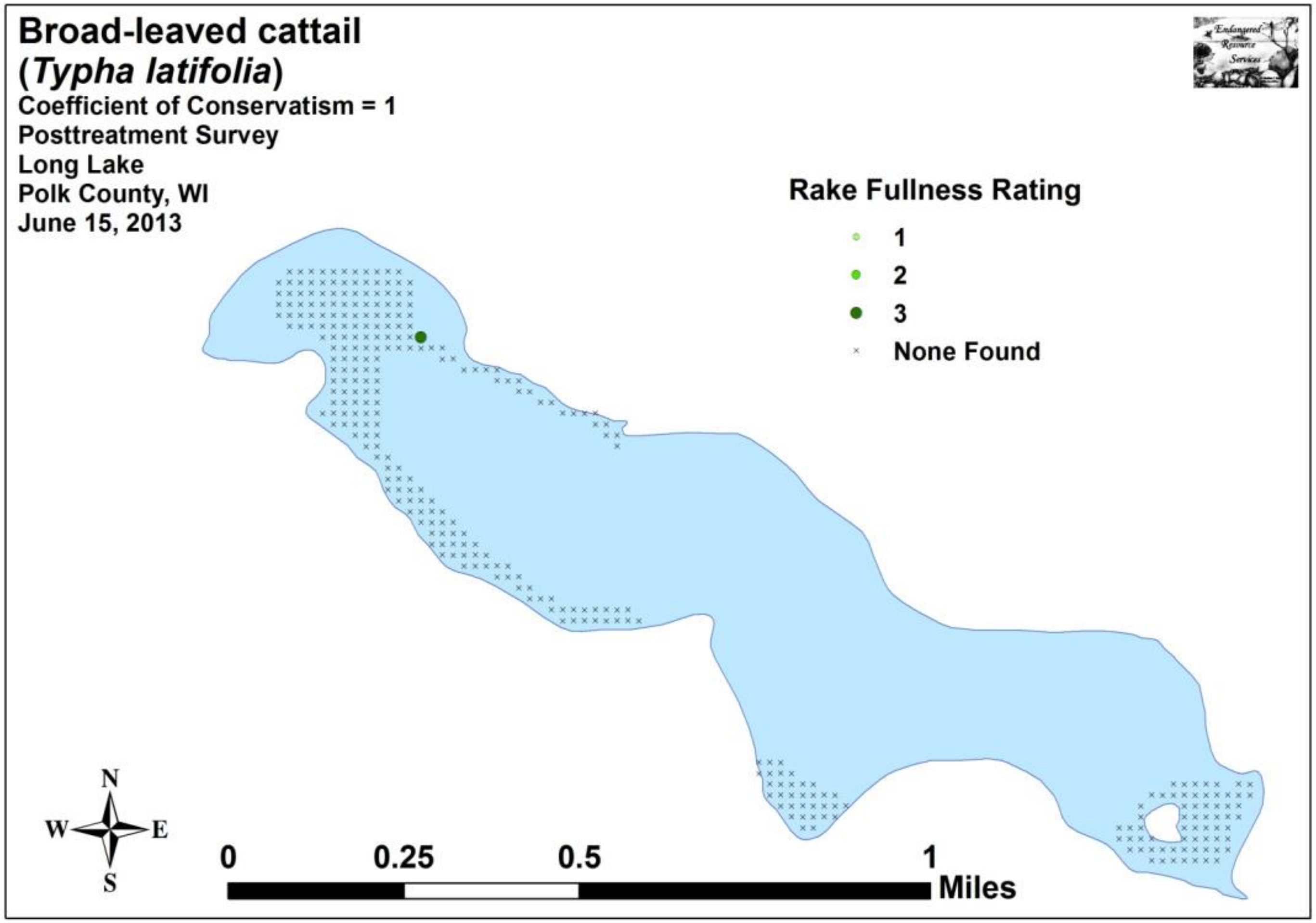

Forked duckweed
(Lemna trisulca)
Coefficient of Conservatism = 6
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Slender naiad
(*Najas flexilis*)
Coefficient of Conservatism = 6
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

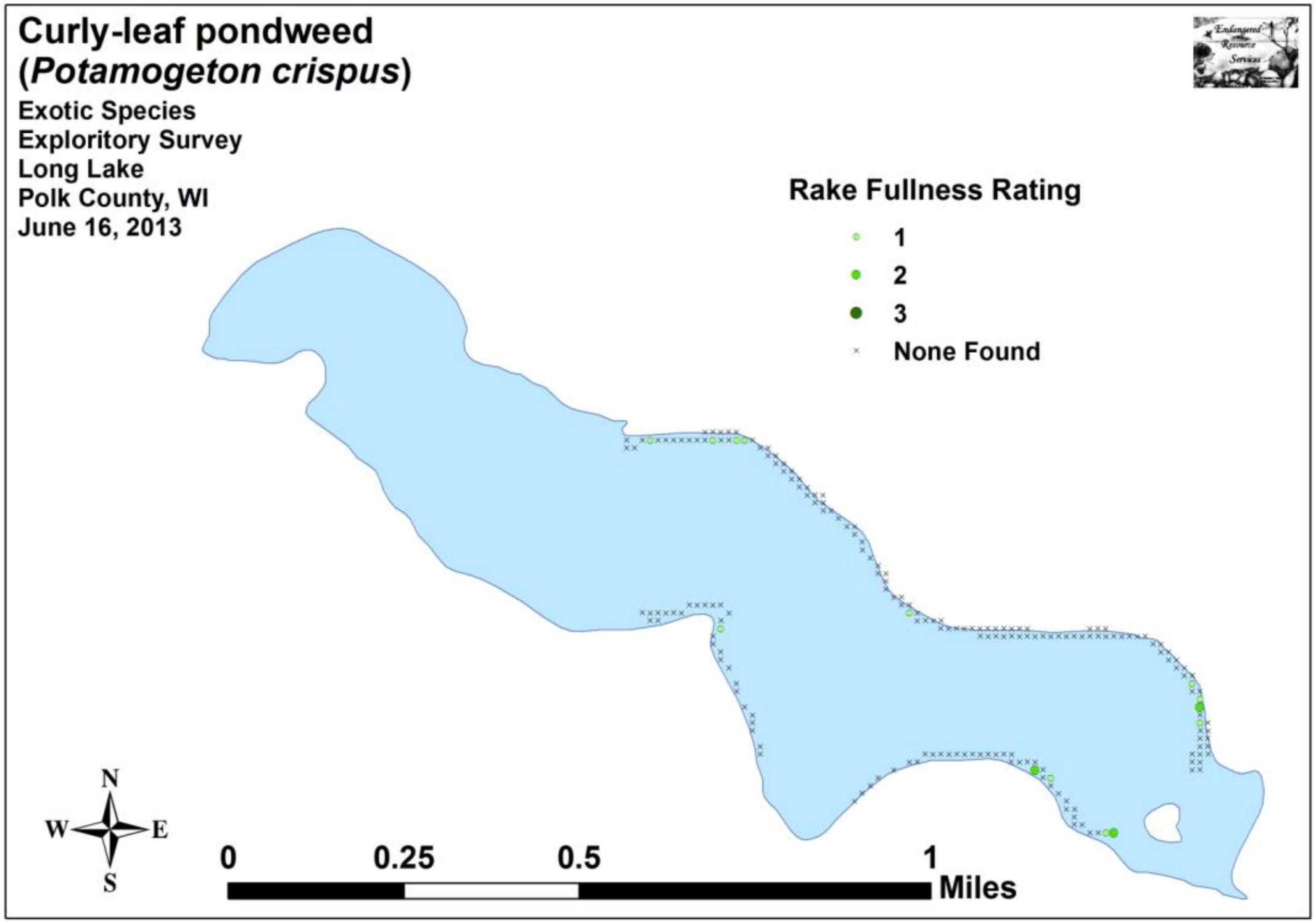

Nitella
(Nitella sp.)
Coefficient of Conservatism = 7
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

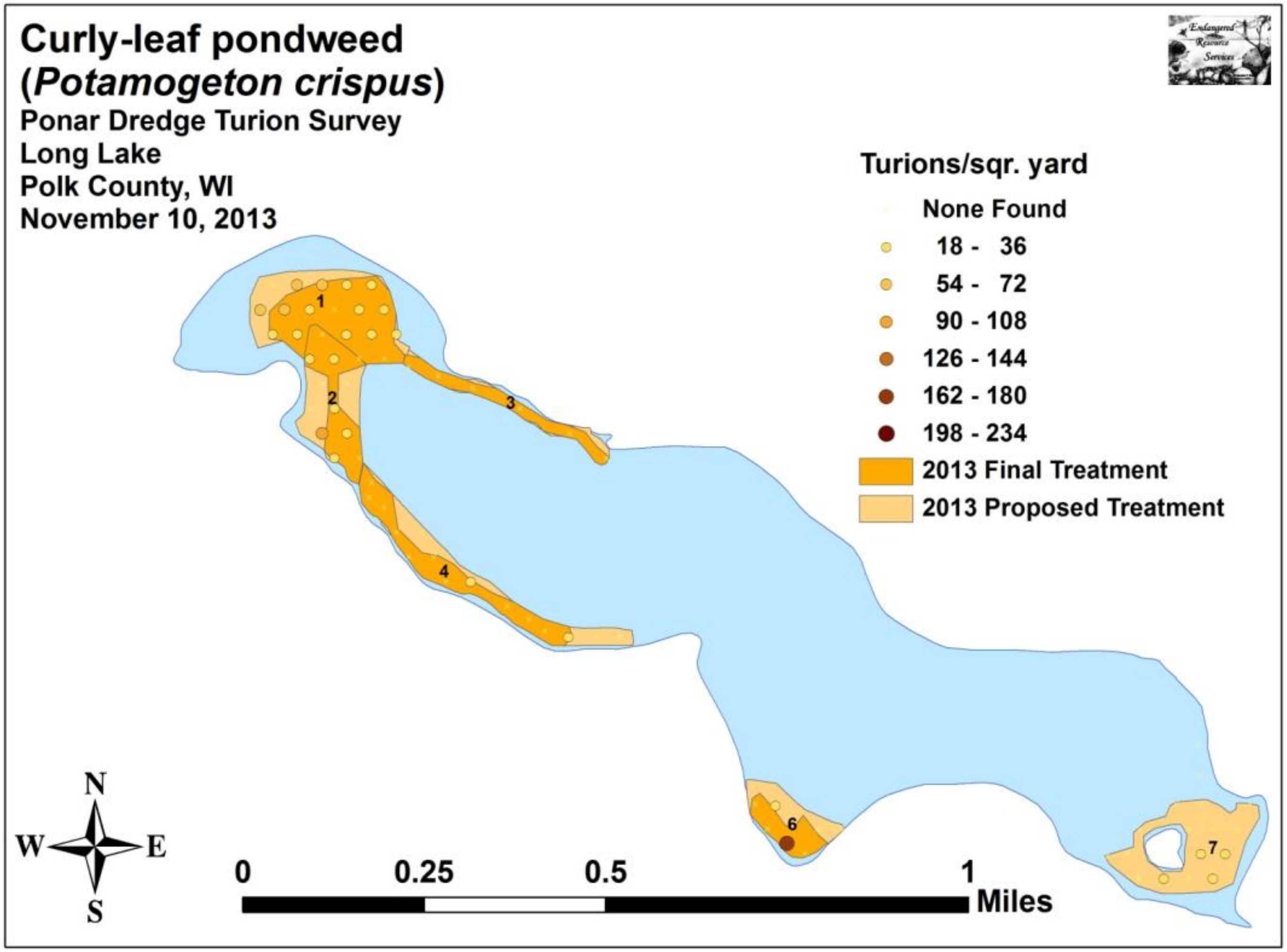

Softstem bulrush
(Schoenoplectus tabernaemontani)
Coefficient of Conservatism = 4
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles


Broad-leaved cattail
(Typha latifolia)
Coefficient of Conservatism = 1
Posttreatment Survey
Long Lake
Polk County, WI
June 15, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

Appendix VIII: 2013 June CLP Exploritory PI Survey


Curly-leaf pondweed
(*Potamogeton crispus*)
Exotic Species
Exploritory Survey
Long Lake
Polk County, WI
June 16, 2013
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles

Appendix IX: 2013 November Ponar Dredge Turion Survey


Curly-leaf pondweed
(*Potamogeton crispus*)
Ponar Dredge Turion Survey
Long Lake
Polk County, WI
November 10, 2013
Turions/sqr. yard
None Found
18 - 36
54 - 72
90 - 108
126 - 144
162 - 180
198 - 234
2013 Final Treatment
2013 Proposed Treatment
1
2
3
4
6
7
N
W
E
S
0
0.25
0.5
1
Miles