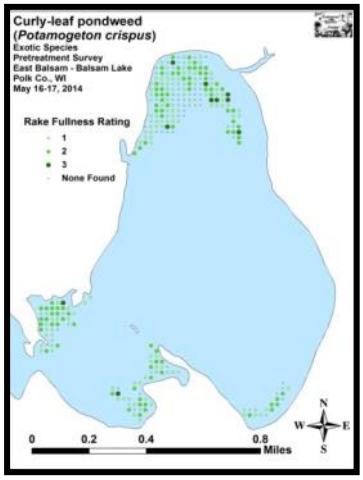
Curly-leaf Pondweed (*Potamogeton crispus*) Pre/Post Herbicide and Bed Mapping Surveys Balsam Lake - WBIC: 2620600 Polk County, Wisconsin

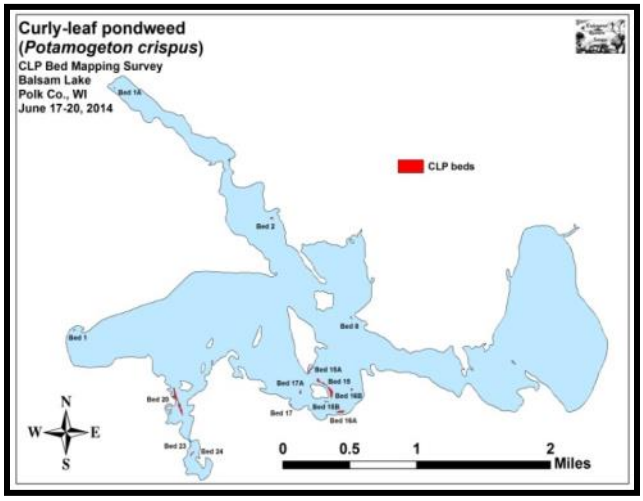
Spring 2014 CLP Treatment Beds



2014 CLP Pretreatment in East Balsam

Project Initiated by:

Balsam Lake Protection and Rehabilitation District and the
Wisconsin Department of Natural Resources – Grant AEPP - 430-14



Posttreatment 2014 CLP Beds

Survey Conducted by and Report Prepared by:

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May 16-17, June 15, 17-20, 2014

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INTRODUCTION:

Balsam Lake (WBIC 2620600) is a 2,054 acre stratified drainage lake in central Polk County, Wisconsin in the Towns of Balsam Lake, Milltown, Georgetown, and Apple River (T34N R17W S10 NE NE). The lake reaches a maximum depth of 37ft north of Cedar Island in the western basin and has an average depth of 20ft (Hopke et al. 1964). Balsam Lake is mesotrophic bordering on eutrophic in nature and water clarity is fair with historical summer Secchi readings averaging 6ft in East Balsam, 7ft in Little Balsam, and 8ft in the deep hole north of Cedar Island (WDNR 2014). Bottom substrate is variable with muck bottoms in most bays, and rock/sand bars in the Big and Little narrows and around the lake's many islands.

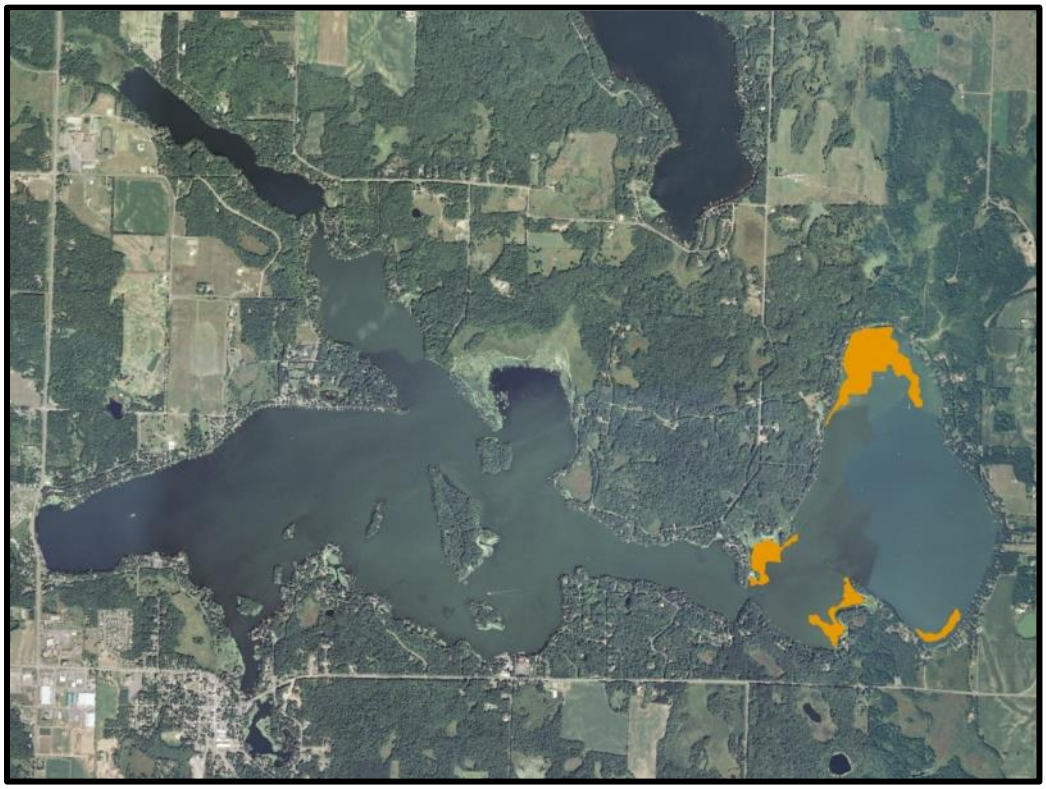


Figure 1: Balsam Lake with 2014 CLP Treatment Areas

In the spring of 2014, the Balsam Lake Protection and Rehabilitation District (BLPRD) and the Wisconsin Department of Natural Resources (WDNR) authorized the herbicide treatment of five Curly-leaf pondweed (*Potamogeton crispus*) (CLP) beds totaling 65.49 acres or approximately 3.19% of the lake's total surface area (Figure 1). These beds were selected based on the 2013 spring CLP bed mapping survey that found CLP in these areas was interfering with boat traffic and/or restricting resident access to the lake from their docks. On May 16th and 17th, we conducted a pretreatment survey to document spring CLP densities and to finalize treatment plans. Following the herbicide application on May 28th, we completed a June 15th posttreatment survey to evaluate the effectiveness of this control effort. From June 17-20th, we also searched the lake's visible littoral zone and mapped all CLP beds found. These maps will be used to guide any potential CLP management in 2015. This report is the summary analysis of these three field surveys.

METHODS:

Pre/Post Herbicide Survey:

Following a meeting with the BLPRD's Aquatic Plant Management Committee Chair Loren Johnson and Aquatic Plant Management Plan author Cheryl Clemens (Harmony Environmental) where these beds were selected for treatment, we used Hawth's Analysis Tools Extension to ArcGIS 9.3.1 to generate regular pre/post survey points at 31m resolution. The resulting sampling grid contained 276 points which approximated to just over four points/acre. This total was based on the WDNR protocol's expected 4-10 survey pts/acre for pre/post herbicide surveys (Appendix I).

Once points were established, they were uploaded to a handheld mapping GPS (Garmin 76CSx) and located 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 noted.

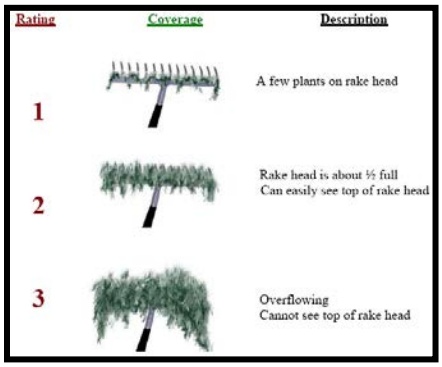


Figure 2: Rake Fullness Ratings

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 $p < .005$.

CLP Bed Mapping Survey:

By definition, a "bed" was determined to be any area where we visually estimated that 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.

During the bed mapping survey, we searched the lake's entire visible littoral zone. 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. We also used the WDNR's Forestry Tools Extension to determine the acreage of each bed to the nearest hundredth of an acre. The resulting data will be used to determine if, where, and how to manage CLP in 2015.

RESULTS AND DISCUSSION:

CLP Pre/Post Herbicide Survey:

The proposed treatment areas covered 65.49 acres or approximately 3.19% of the lake's 2,054 total acres. However, the May 16-17th pretreatment survey found few CLP plants on the southern edge of Bed 13 so this area was trimmed inward. The final treatment area covered 63.32 acres or 3.08% of the lake's surface area – a 3.3% reduction over initial expectations (Table 1) (Figure 3) (Appendix I).

Table 1: 2014 Spring CLP Treatment Summary
May 28, 2014
Balsam Lake, Polk Co.

Bed Number	Proposed Bed Area (acres)	Final Bed Area (acres)	Change in Acreage (+/-)
12	10.37	10.37	0.00
13	40.83	38.66	-2.17
14	4.37	4.37	0.00
14B	9.91	9.91	0.00
14C	0.01	0.01	0.00
	65.49	**63.32**	**-2.17**

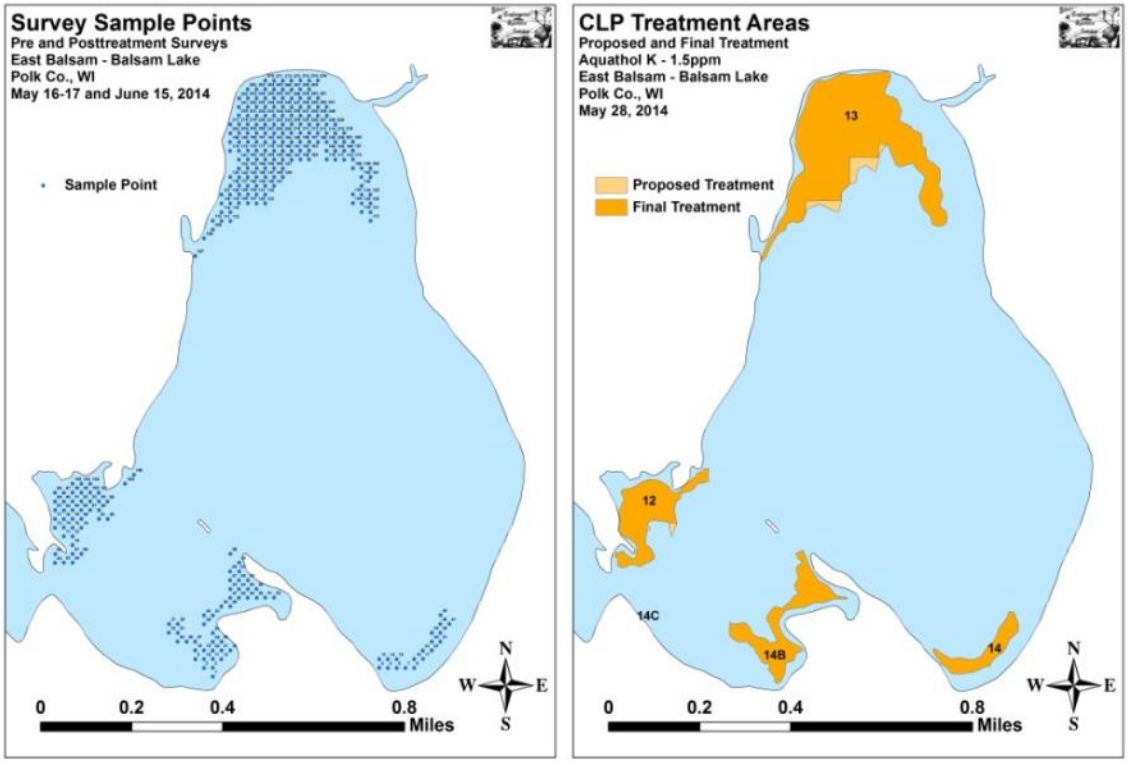


Figure 3: 2014 Pre/Post Survey Points and CLP Treatment Areas

Treatment occurred on May 28th, 2014 with Clean Lakes, Inc. (Oakwood Hills, IL) applying Aquathol K (Endothall) at a rate of 1.5 ppm (440.10 total gallons). The reported water temperature at the time of treatment was 71.34°F. This temperature was higher than the recommended treatment range of 50 - 60°F. Wind speeds were reported to be 1-2.5mph.

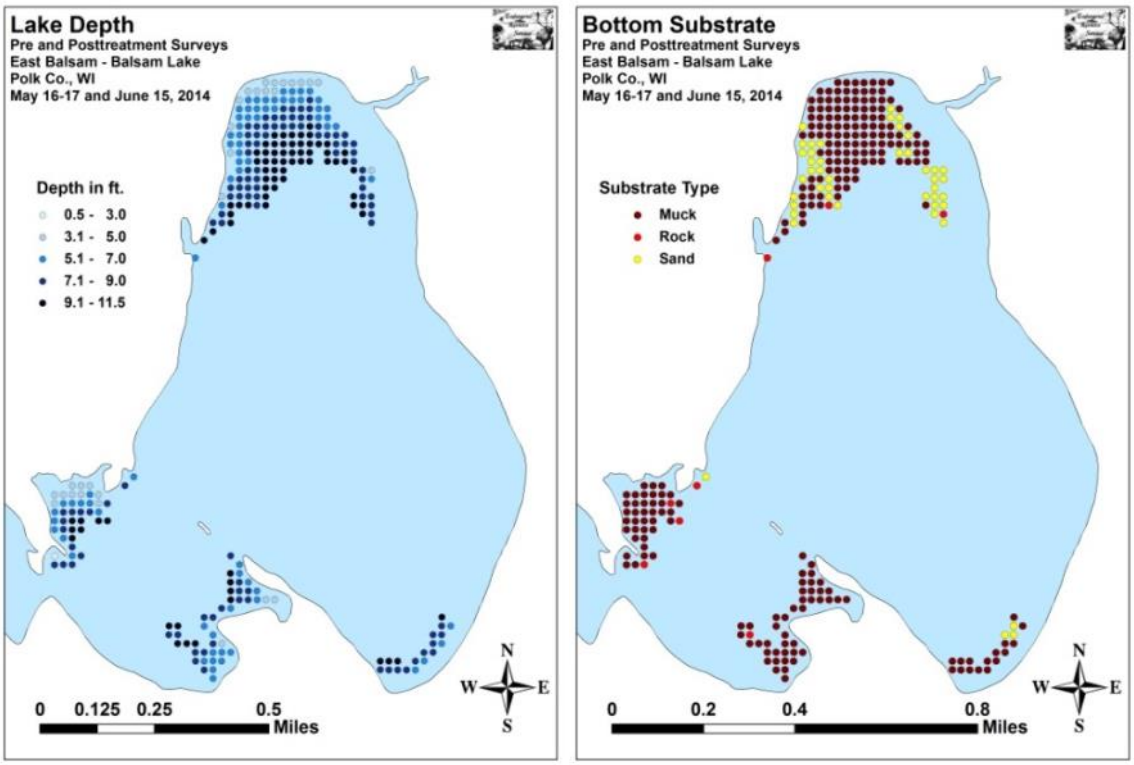


Figure 4: Treatment Area Depths and Bottom Substrate

All beds occurred in areas between 0.5 and 11.5ft of water. Within those beds, plants grew at a mean depth of 7.7ft and a median depth of 8.0ft during the pretreatment survey before declining to 7.2ft and 7.0ft respectively during the posttreatment survey (Table 2). The densest areas of CLP were established over organic muck, but we also found low to moderate CLP density in the sandy/rocky areas of Bed 13 in the north bay (Figure 4) (Appendix III).

The littoral zone extended to 11.0-11.5ft during both surveys, but the frequency of occurrence dropped sharply from 90.15% pretreatment to 56.16% posttreatment (Figure 5) (Appendix IV). Species richness dropped only slightly from 11 pretreatment to 10 posttreatment; however, the Simpson's Index dropped sharply from a moderate pretreatment value of 0.65 to a posttreatment value of only 0.49. The Floristic Quality Index (another measure of native plant community health) also declined from 19.3 pretreatment to 16.0 posttreatment.

Table 2: Pre/Post Survey Summary Statistics
Balsam Lake, Polk County
May 16-17 and June 15, 2014

Summary Statistics:	Pre	Post
Total number of points sampled	276	276
Total number of sites with vegetation	247	155
Total number of sites shallower than the maximum depth of plants	274	276
Frequency of occurrence at sites shallower than maximum depth of plants	90.15	56.16
Simpson Diversity Index	0.65	0.49
Floristic Quality Index	19.3	16.0
Mean Coefficient of Conservatism	6.1	5.3
Maximum depth of plants (ft)	11.0	11.5
Mean depth of plants (ft)	7.7	7.2
Median depth of plants (ft)	8.0	7.0
Average number of all species per site (shallower than max depth)	1.60	0.75
Average number of all species per site (veg. sites only)	1.77	1.34
Average number of native species per site (shallower than max depth)	0.82	0.75
Average number of native species per site (sites with native veg. only)	1.43	1.34
Species Richness	11	10
Mean Rake Fullness	1.61	1.11

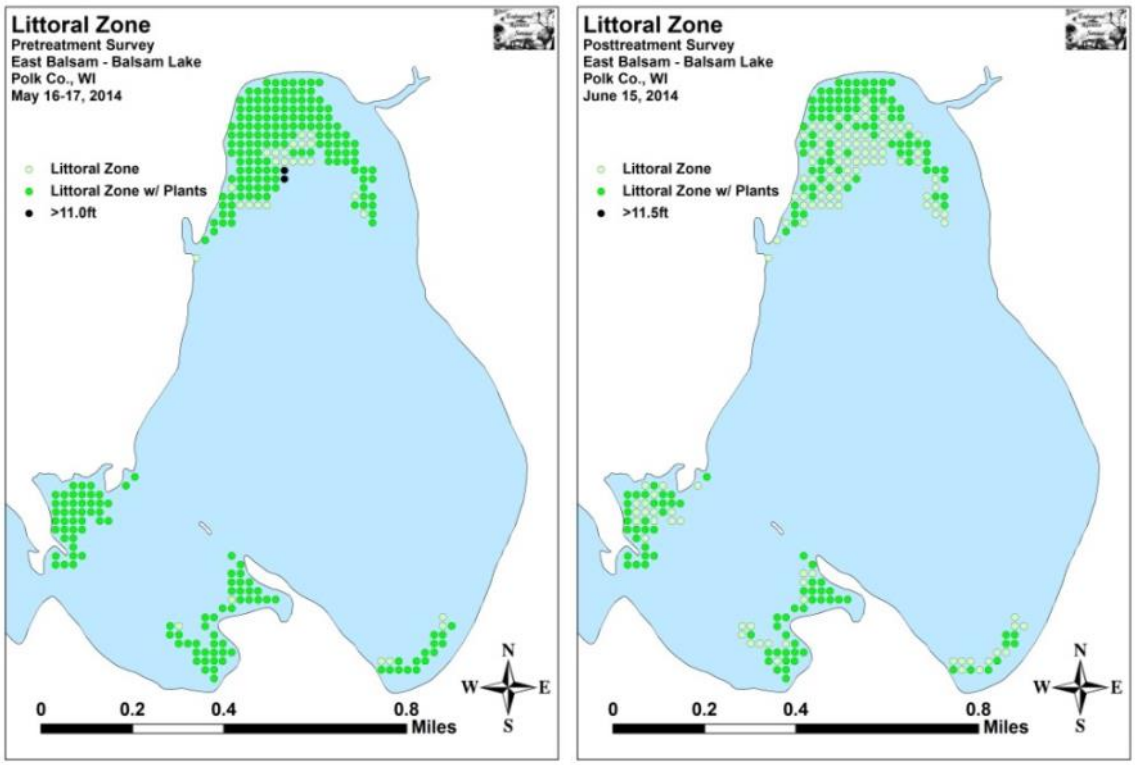


Figure 5: Pre/Post Littoral Zone

In a similar fashion to overall richness, mean native species richness at points with native vegetation declined slightly from 1.43 species/point pretreatment to 1.34 species/point posttreatment (Figures 6). Total mean rake fullness also decreased from a low/moderate 1.61 pretreatment to an exceptionally low 1.11 posttreatment (Figures 7) (Appendix IV).

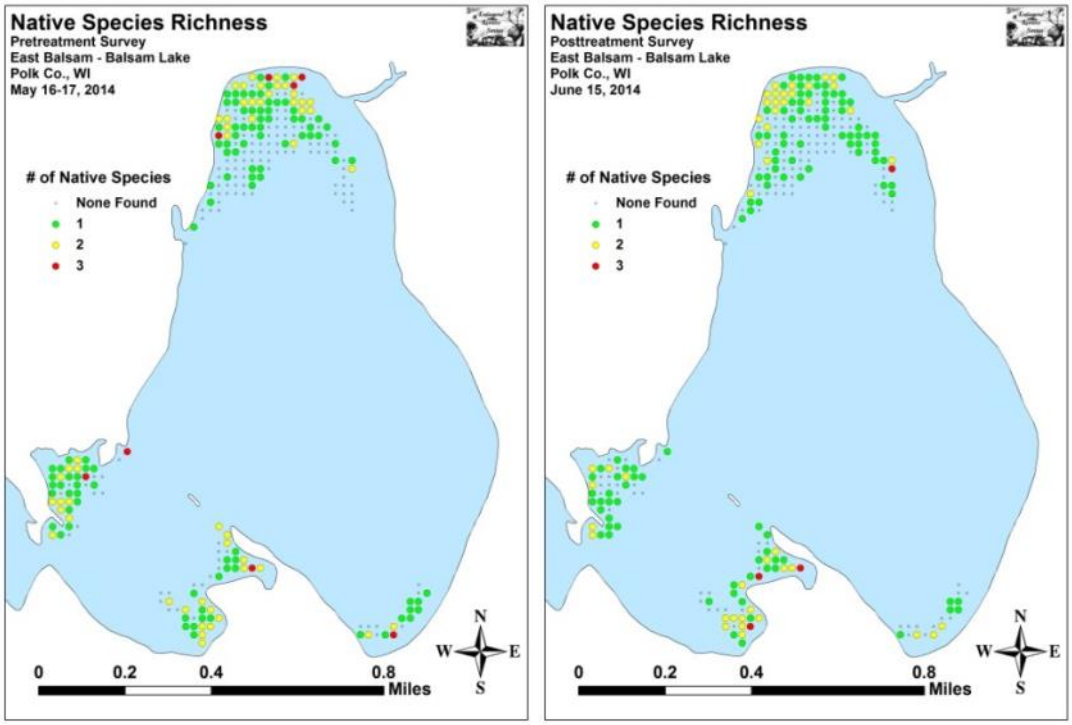


Figure 6: Pre/Post Native Species Richness

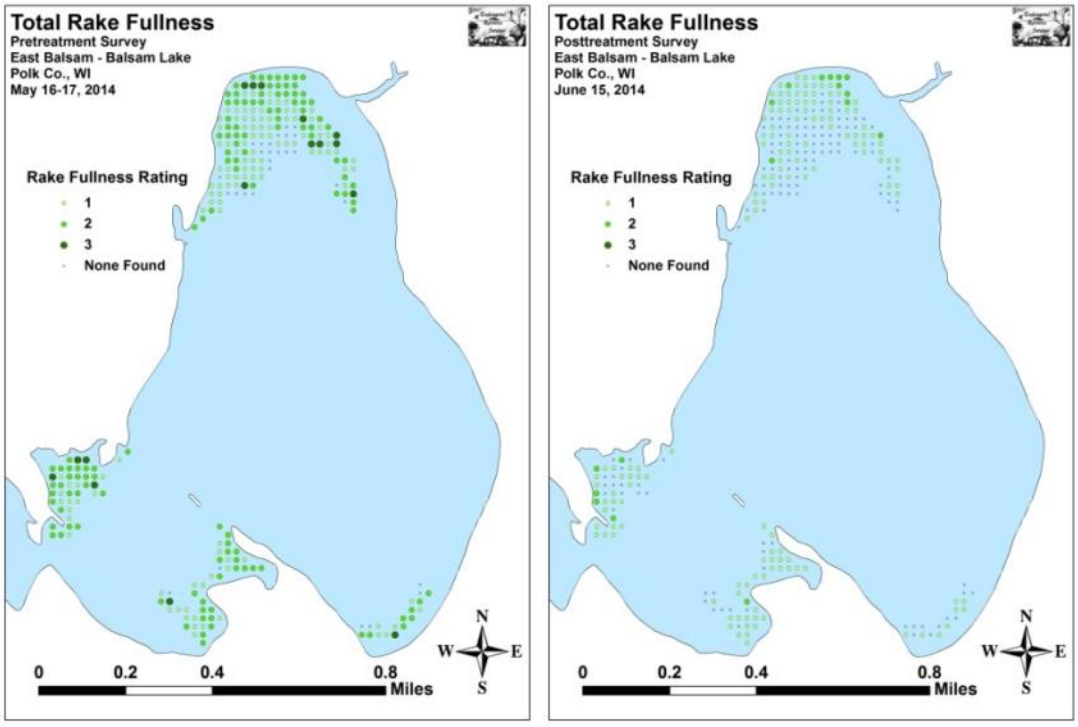


Figure 7: Pre/Post Total Rake Fullness

We found Curly-leaf pondweed at 213 of 276 sites (77.2%) during the pretreatment survey (Figures 8) (Appendix V). Of these, ten had a rake fullness rating of 3, 88 rated a 2, and 115 a 1. This produced a mean fullness for CLP of 1.51. During the follow up survey, we found a single burned CLP plant at a single point (0.4%). **Our results suggest that the treatment almost completely eliminated CLP throughout East Balsam both in and beyond the treatment areas.** Statistically speaking, overall CLP as well as rake fullness 3, 2, and 1 all showed moderately to highly significant declines (Figure 9).

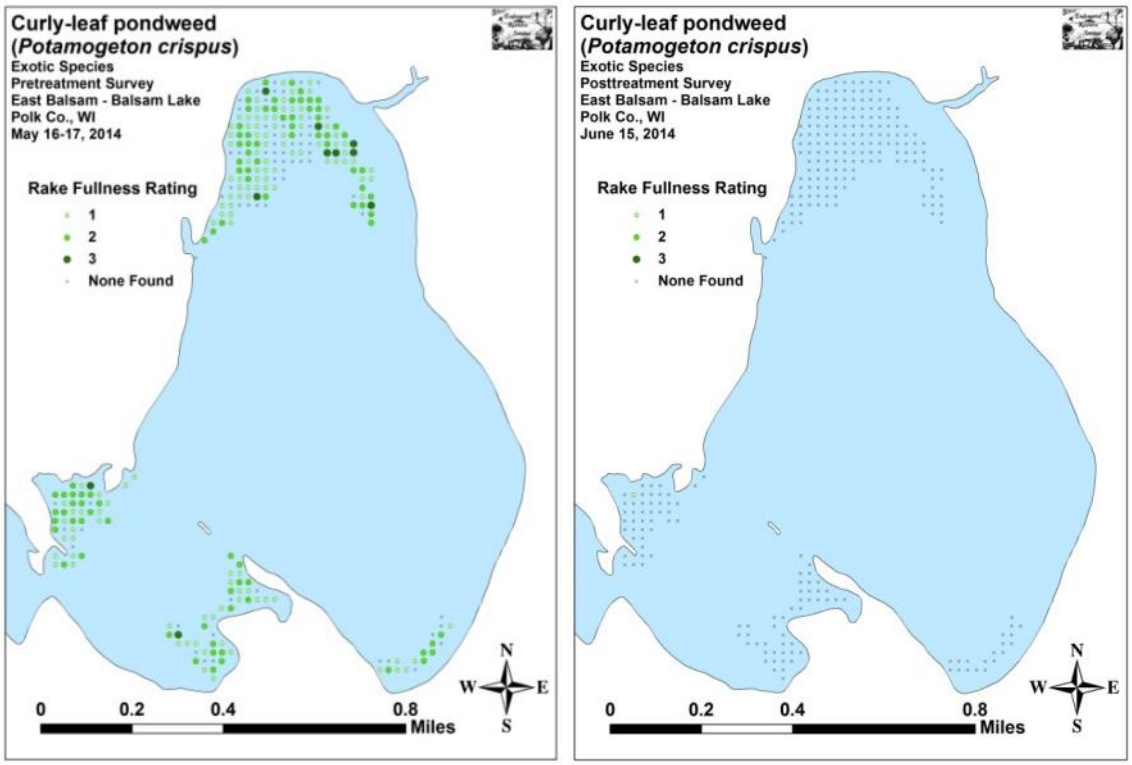
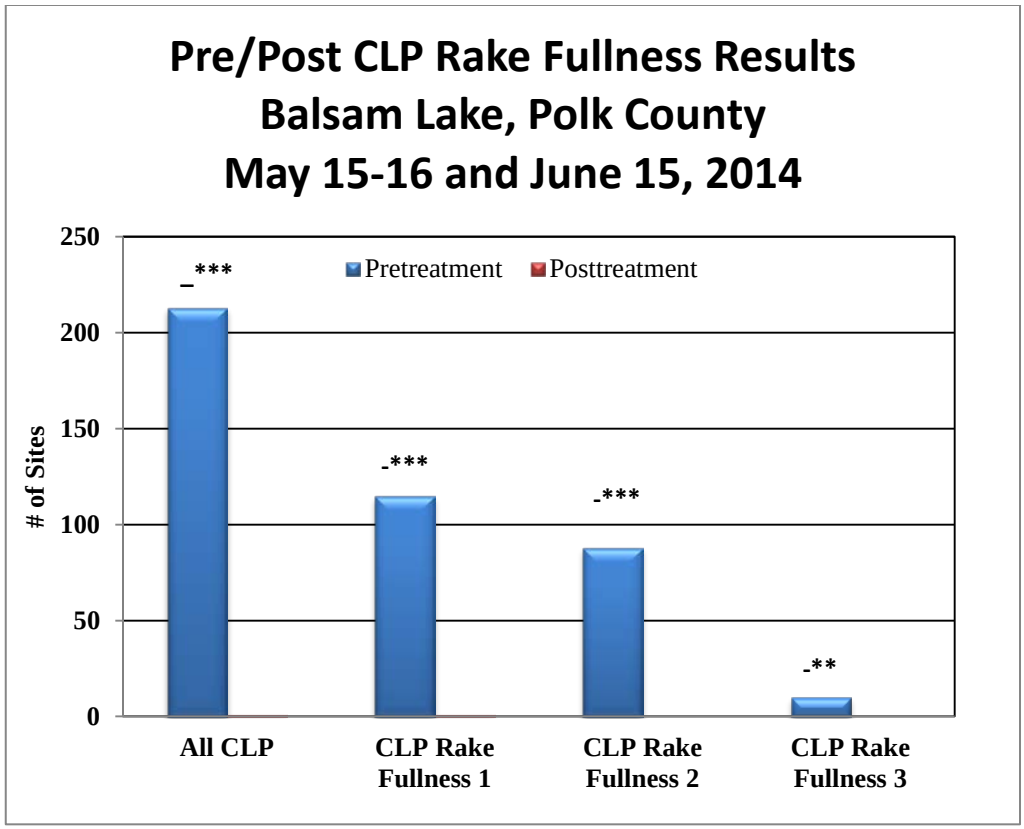


Figure 8: Pre/Post CLP Density and Distribution



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

Figure 9: Changes in CLP Rake Fullness

Forked duckweed (*Lemna trisulca*) and Coontail (*Ceratophyllum demersum*) were the most common native species in both the pre and posttreatment surveys (Figures 10 and 11) (Tables 3 and 4). Forked duckweed showed a significant increase posttreatment, while Coontail, like CLP, demonstrated a highly significant decline (Figure 12). No other species declined significantly, but Wild celery (*Vallisneria americana*) and Aquatic moss both demonstrated significant increases (Maps of all native species from the pre and posttreatment surveys can be found in Appendixes VI and VII).

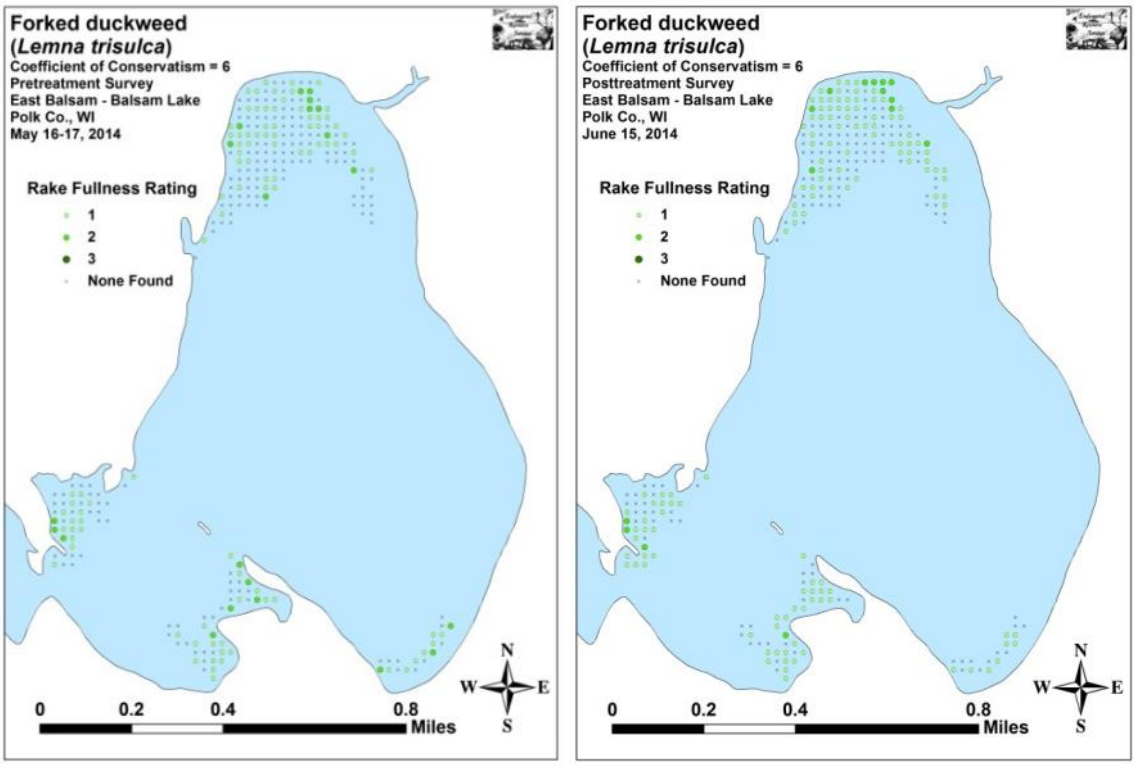


Figure 10: Pre/Post Forked Duckweed Density and Distribution

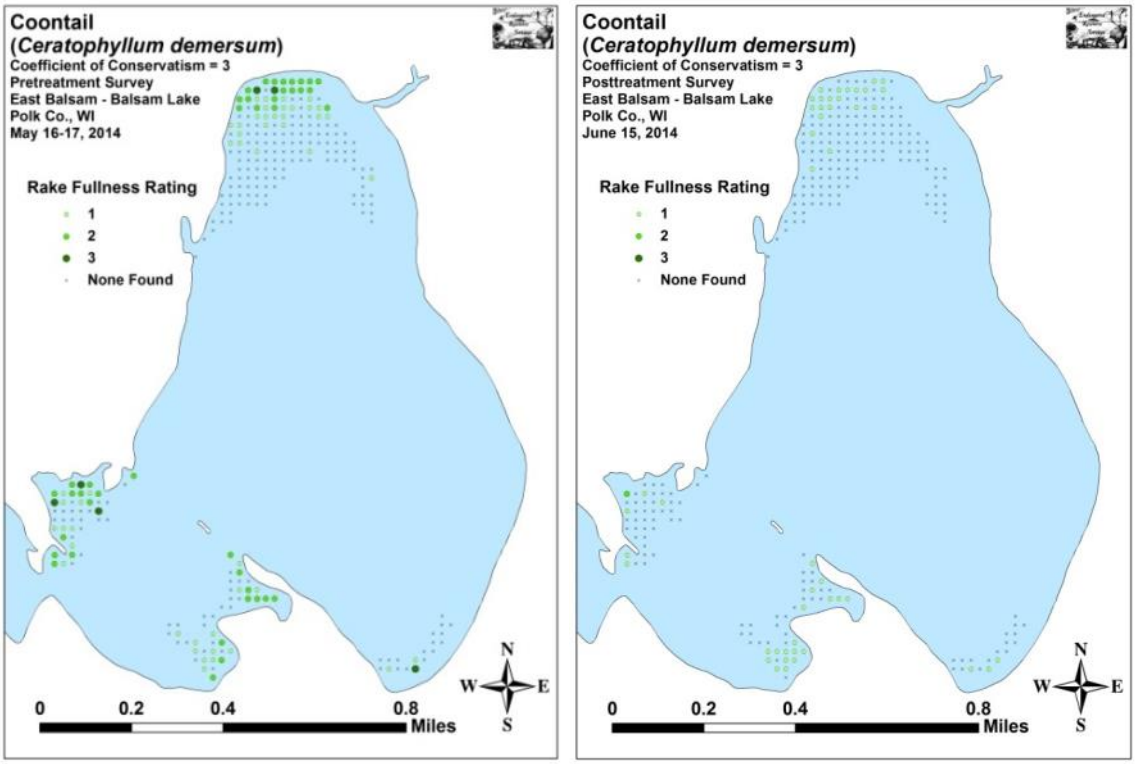


Figure 11: Pre/Post Coontail Density and Distribution

Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Pretreatment Survey - Balsam Lake, Polk County
May 16-17, 2014

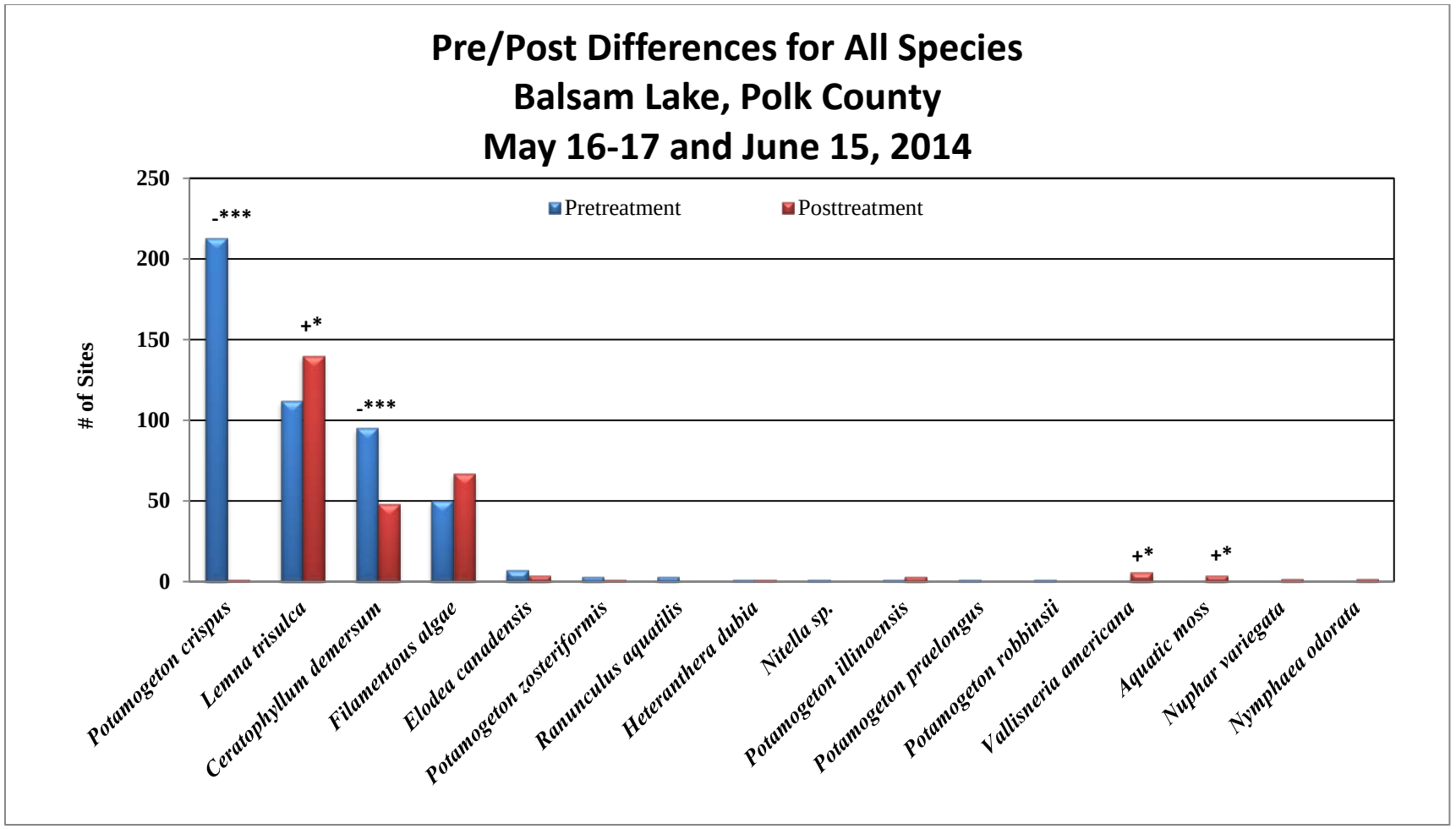
Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Potamogeton crispus	Curly-leaf pondweed	213	48.63	86.23	77.74	1.51
Lemna trisulca	Forked duckweed	112	25.57	45.34	40.88	1.19
Ceratophyllum demersum	Coontail	95	21.69	38.46	34.67	1.56
	Filamentous algae	50	*	20.24	18.25	1.64
Elodea canadensis	Common waterweed	7	1.60	2.83	2.55	1.00
Potamogeton zosteriformis	Flat-stem pondweed	3	0.68	1.21	1.09	1.00
Ranunculus aquatilis	White water crowfoot	3	0.68	1.21	1.09	1.33
Heteranthera dubia	Water star-grass	1	0.23	0.40	0.36	1.00
Nitella sp.	Nitella	1	0.23	0.40	0.36	1.00
Potamogeton illinoensis	Illinois pondweed	1	0.23	0.40	0.36	1.00
Potamogeton praelongus	White-stem pondweed	1	0.23	0.40	0.36	1.00
Potamogeton robbinsii	Fern pondweed	1	0.23	0.40	0.36	1.00

* Excluded from Relative Frequency Analysis

Table 5: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Posttreatment Survey - Balsam Lake, Polk County
June 15, 2014

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Lemna trisulca	Forked duckweed	140	67.31	90.32	50.72	1.11
	Filamentous algae	67	*	43.23	24.28	1.28
Ceratophyllum demersum	Coontail	48	23.08	30.97	17.39	1.02
Vallisneria americana	Wild celery	6	2.88	3.87	2.17	1.00
Elodea canadensis	Common waterweed	4	1.92	2.58	1.45	1.25
	Aquatic moss	4	*	2.58	1.45	1.00
Potamogeton illinoensis	Illinois pondweed	3	1.44	1.94	1.09	1.00
Nuphar variegata	Spatterdock	2	0.96	1.29	0.72	1.00
Nymphaea odorata	White water lily	2	0.96	1.29	0.72	1.00
Heteranthera dubia	Water star-grass	1	0.48	0.65	0.36	1.00
Potamogeton crispus	Curly-leaf pondweed	1	0.48	0.65	0.36	1.00
Potamogeton zosteriformis	Flat-stem pondweed	1	0.48	0.65	0.36	1.00

* Excluded from Relative Frequency Analysis



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

Figure 12: Pre/Post Macrophyte Changes

Spring CLP Bed Mapping Survey:

We located and mapped a total of 14 beds in 2014 (up from 13 in 2013, but down from 20 in 2012) that ranging in size from 0.04 acre (Bed 1A in Little Balsam) to 1.58 acres (Bed 20 east of Idlewild Bay/South and West of First Island) (Figure 13) (Appendix VIII). All combined, these beds covered a total of 4.45 acres or 0.2% of the lake's 2,054 total acres (Table 5). This represented a 76.13 acre (-94.5%) reduction from the 80.58 acres mapped in 2013, and a 23.76 acre (-84.2%) decrease from the 2012 total of 28.21 acres.

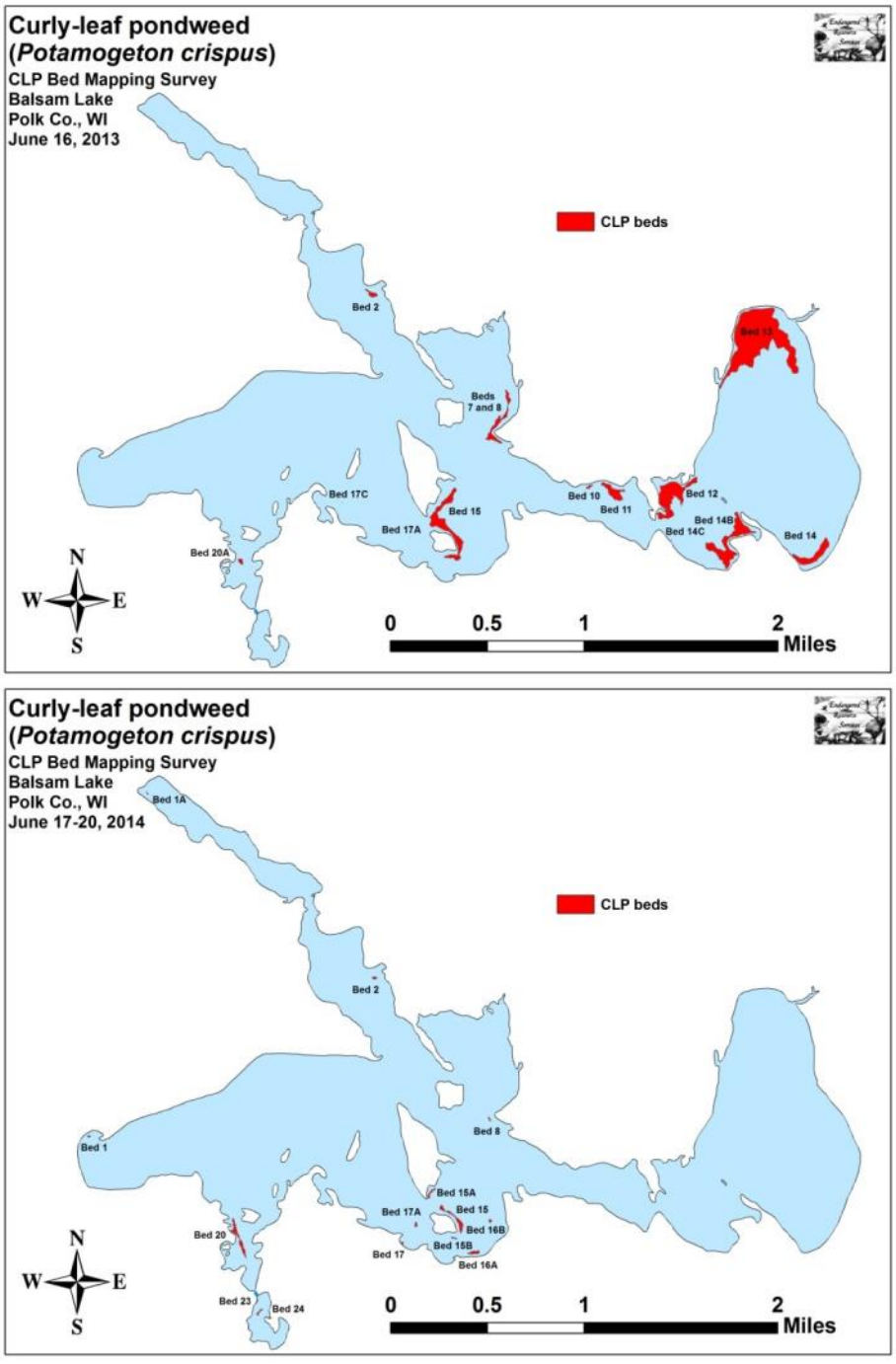


Figure 13: 2013 and 2014 Balsam Lake June CLP Beds

Table 5: CLP Bed Summary - Balsam Lake, Polk Co. June 17-20, 2014

Bed #	Location	2014 Area (Acres)	2013 Area	2012 Area	2011 Area	Change in Area	Est. Range and Mean Rake-full	Years Treated	Acreage Treated
1	HWY 46 Landing	0.07	0.00	0.58	0.00	0.07	<1-2; 1	2011	1.81
1A	Balsam Branch Inlet	0.04	0.00	0.00	0.00	0.04	<<1-2; <1	-	-
2	Boston Bay	0.15	0.64	1.23	0.08	-0.49	<1-2; 1	-	-
3-6	Stump Bay	0.00	0.00	0.67	0.00	0.00	<<<1	-	-
7+8	East Shore Stump Bay/Outlet	0.08	3.08	4.91	0.00	-3.00	<1-3; 2	-	-
9	NW of Big Narrows	0.00	0.00	0.19	0.00	0.00	<<<1	2011	0.11
10	NW of Big Narrows	0.00	0.18	0.00	0.00	-0.18	<<<1	2011	0.22
11	Bay NW of Big Narrows	0.00	2.70	4.72	1.04	-2.7	<<1-1; <<1	2013, 11, '10	4.71, 2.80, 2.85
12	Bay NE of Big Narrows	0.00	10.34	0.00	5.91	-10.34	0	**2014**, 2012	10.37, 5.91
13	N. Bay of East Balsam	0.00	40.83	0.00	43.14	-40.83	0	**2014**, 2012	38.66, 43.14
14	SE Bay of East Balsam	0.00	4.37	0.00	6.95	-4.37	0	**2014**, 2012	4.37, 6.95
14B, 14C	Bay SE of Big Narrows	0.00	9.92	0.00	0.00	-9.92	0	**2014**, '11, '09	9.92, 3.07, 11.38
15, A, B	SE of Big Island	1.59	8.22	8.78	3.80	-6.63	<<1-3; 2	2013	8.70
16	Bay S. of Paradise Island	0.00	0.00	0.65	0.00	0.00	<<<1	2011	1.26
16A	N. of Paradise Landing	0.42	.000	.000	.000	0.42	1-3; 3	-	-
16B	NE of Paradise Landing	0.11	.000	.000	.000	0.11	1-3; 2	-	-
17	Bay SW of Paradise Island	0.08	.000	.000	.000	0.08	1-2; 2	-	-
17A	West of Paradise Island	0.13	<0.01	1.86	0.00	0.12	<1-2; 2	-	-
17B	Raskin Bay	0.00	0.00	0.00	0.26	0.00	<<<1	-	-
17C	Raskin Bay Outlet	0.00	<0.01	1.04	0.00	-<0.01	<1-1; <1	-	-
18	Channel E. of Pine Island	0.00	0.00	0.00	0.00	0.00	<<<1	2011, '10	0.59, 0.57
19A , B	Channel E. of First Island	0.00	0.00	0.98	0.00	0.00	<<<1	2011, '10	4.87, 4.55
20, 20A	East of Idlewild Bay	1.58	0.30	0.10	0.00	1.28	<1-3; 3	2011	4.26
21	N. of Village Beach	0.00	0.00	0.00	0.00	0.00	<<<1	-	-
22	Northwest Mill Pond	0.00	0.00	0.40	0.00	0.00	<<<1	-	-
23	Northeast Mill Pond	0.05	0.00	0.43	0.00	0.05	1-2; 1	-	-
24	Mill Pond Point	0.15	0.00	1.37	0.00	0.15	1-2; 1	-	-
25	Southeast Mill Pond	0.00	0.00	0.30	0.00	0.00	<<<1	-	-
	Total	**4.45**	**80.58**	**28.21**	**61.18**	**-76.13**			

Description of Past and Present CLP Beds:

Bed 1 – This bed near the western boat landing was characterized by low density, but continuously canopied Curly-leaf pondweed and Coontail.

Bed 1A – Located at the Balsam Branch Inlet adjacent the lake's largest Northern wild rice (*Zizania palustris*) bed, this area was more a collection of clusters than a true bed. We felt it deserved mapping, however, as it was the first time we have found CLP in Little Balsam.

Bed 2 – Scattered canopied CLP was present throughout the area. Plants were dense at the core before becoming fragmented along the edges.

Beds 3-6 – We found only very widely scattered CLP in Stump Bay.

Beds 7 and 8 – Located along the east shoreline of Stump Bay, this area was dominated by native vegetation in 2014. Although very low levels of CLP was scattered throughout the former large bed, it was never dominant and only canopied in the small mapped area on the south side at the drop off.

Beds 9, 10 and 11 – Located just northwest of the Big Narrows/East Balsam, these beds have been treated several times in the past with minimal success. Despite not being directly treated in 2014, we could find almost no CLP growing in the area. We feel it is possible and perhaps likely that "downstream residual control" from the major treatment in East Balsam may have knocked these beds down as well.

Beds 12, 13, 14, 14B, and 14C – None of East Balsam's CLP beds survived the 2014 treatment. Despite this, there likely continues to be a large CLP turion bank in the sediment, and we expect these beds will reestablish in 2015 without control. We feel this is especially likely as many of the former native plant beds in East Balsam have been eliminated by the 2012 and 2014 treatments that were, in effect, basin-wide.

Bed 15 and 15A – Although these beds were not treated in 2014, they acted as though they were with limited numbers of CLP plants reaching canopy. In the center and along the northern edge of Bed 15 where CLP has historically been dense, canopied, and nearly monotypic, we found almost no plants of any kind. As currents runs through these areas, we wondered if this bed had also been impacted by residual herbicide from East Balsam.

Bed 16 – We saw only a handful of CLP plants in this area in 2014, and none of them were canopied or bed forming.

Beds 16A, 16B, and 16C – Each of these beds was new in 2014, and, although dense and canopied at their cores, they were all <0.5 acre making them relatively easy to avoid. They were also surrounded by important native plant beds. This was especially true of 16B as this area has some of the best stands of Northern water milfoil (*Myriophyllum sibiricum*) in the lake. Because of this, and because the beds are located adjacent to deep water where treatment is often difficult, we hope efforts in 2015 will focus elsewhere.

Beds 17 and 17A – Neither of these beds were particularly dense, and, although canopied or near canopy, they did not appear likely to interfere with boat traffic. As in the past, 17A is situated next to a Hardstem bulrush (*Schoenoplectus acutus*) bed that provides important spawning habitat for the lake panfish (personal observation).

Beds 17B, and 17C – There were almost no CLP plants in Raskin Bay in 2014, and the bed at the bay entrance had only a handful of plants. Raskin Bay was again dominated by Coontail and water lilies while 17C had large numbers of Clasping-leaf pondweed (*Potamogeton richardsonii*).

Beds 18 and 19 – The areas around Pine Island and east of First Island continued to be almost completely CLP free.

Bed 20 – This bed stretched farther north (past Idlewild Bay and beyond the No Wake Zone) along the western shoreline than we have ever seen before. This area could be considered for control as most parts of the bed were canopied, and many plants were prop clipped or had been ripped out of the sediment by boat traffic.

Bed 21 – In 2014, CLP was rare and not bed forming north of the village beach.

Beds 23-24 – CLP was dense and canopied in the Mill Pond in 2012, nearly absent in 2013, and only moderately dense in 2014. Most areas around the beds were dominated by Coontail and Northern water milfoil.

Beds 22 and 25 – These Mill Pond beds had almost no CLP in them in 2014.

LITERATURE CITED

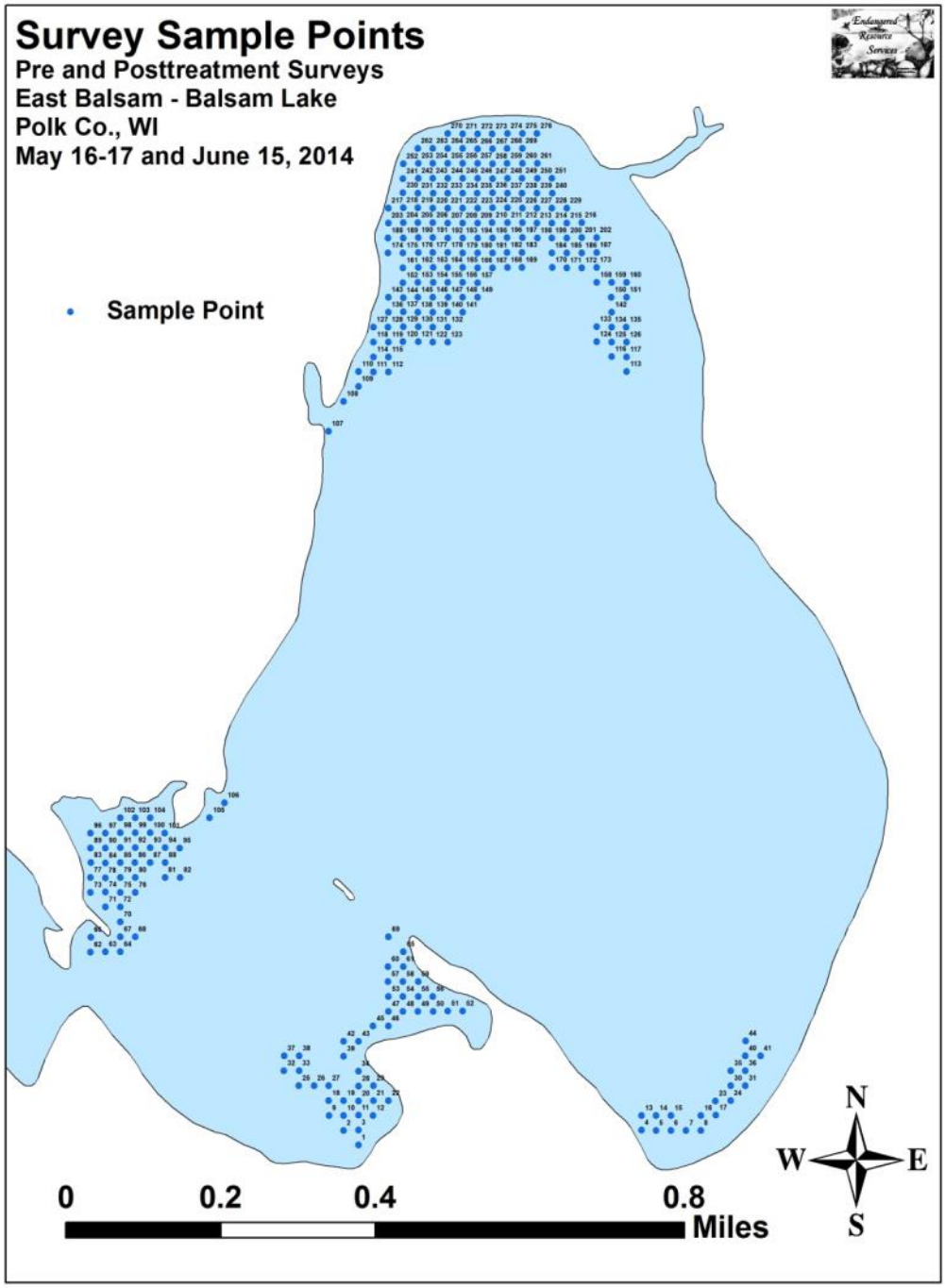
Hopke, R., E. Nelson, and E. Eaton [online]. 1964. Balsam Lake Maps. Available from http://www.dnr.state.wi.us/org/water/fhp/lakes/lakemap/2620600a.pdf (2010, June).

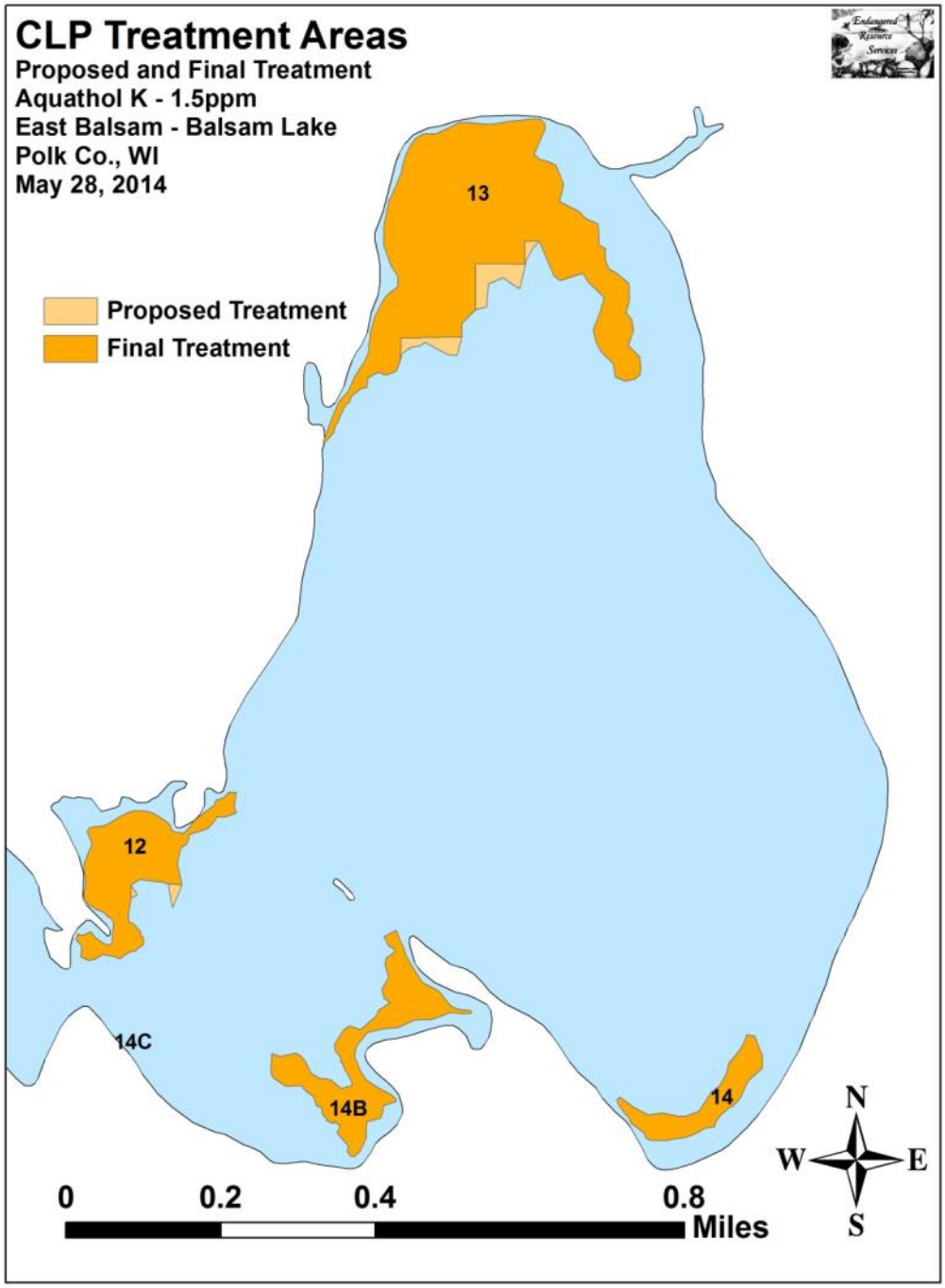
UWEX Lakes Program. [online]. 2010. Aquatic Plant Management in Wisconsin. Available from http://www.uwsp.edu/cnr/uwexlakes/ecology/APMguide.asp (2010, June).

UWEX Lakes Program. [online]. 2010. Pre/Post Herbicide Comparison. Available from http://dnr.wi.gov/org/water/fhp/lakes/PrePostEvaluation.pdf (2010, June).

WDNR. [online]. 2014. Balsam Lake Citizen Monitoring Water Quality Database. Available from http://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=2620600&page=waterquality (2014, November).

Appendix I: CLP Survey Sample Points and Treatment Areas

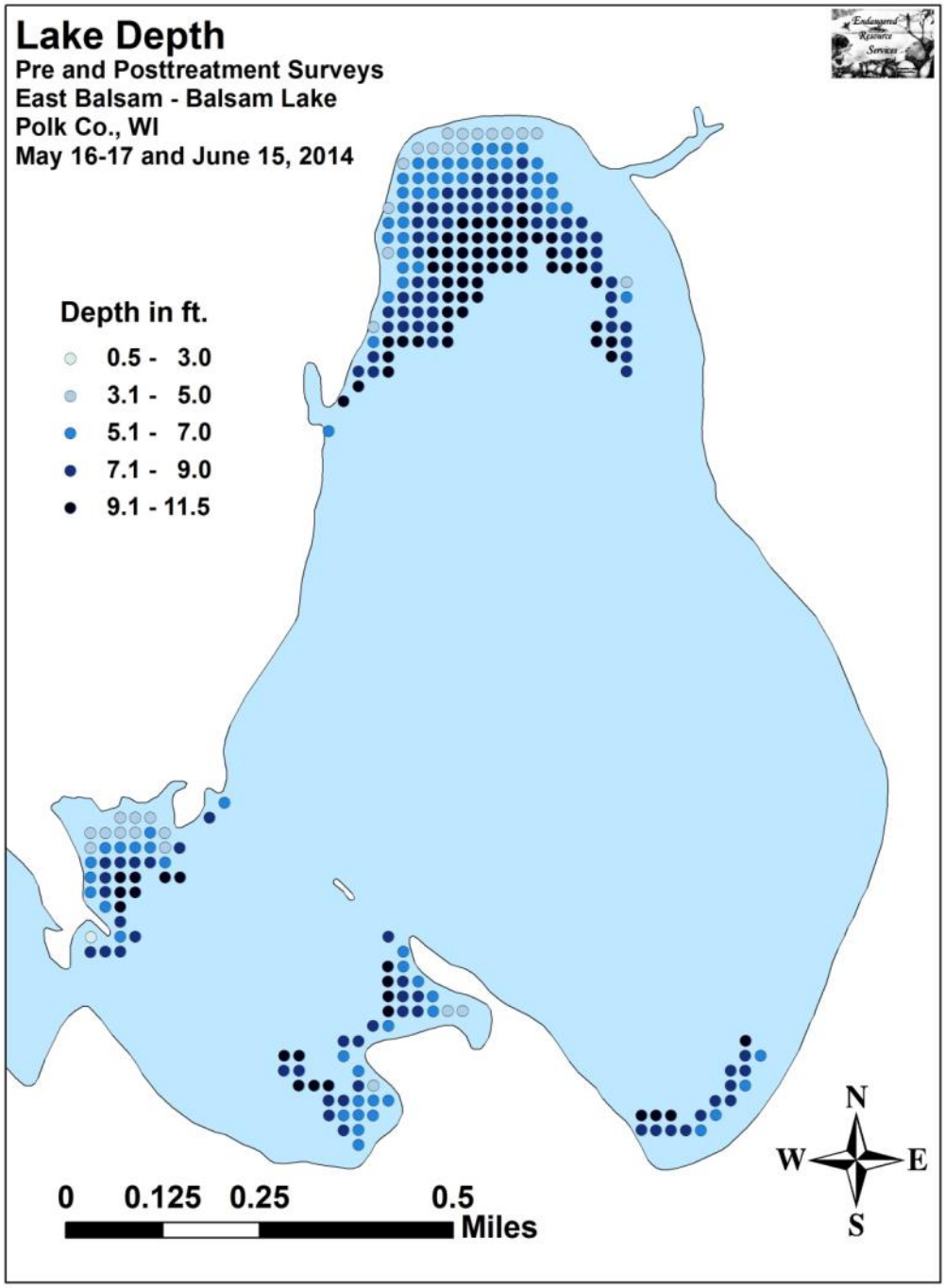

Survey Sample Points
Pre and Posttreatment Surveys
East Balsam - Balsam Lake
Polk Co., WI
May 16-17 and June 15, 2014
Sample Point
0
0.2
0.4
0.8
Miles
N
W
E
S

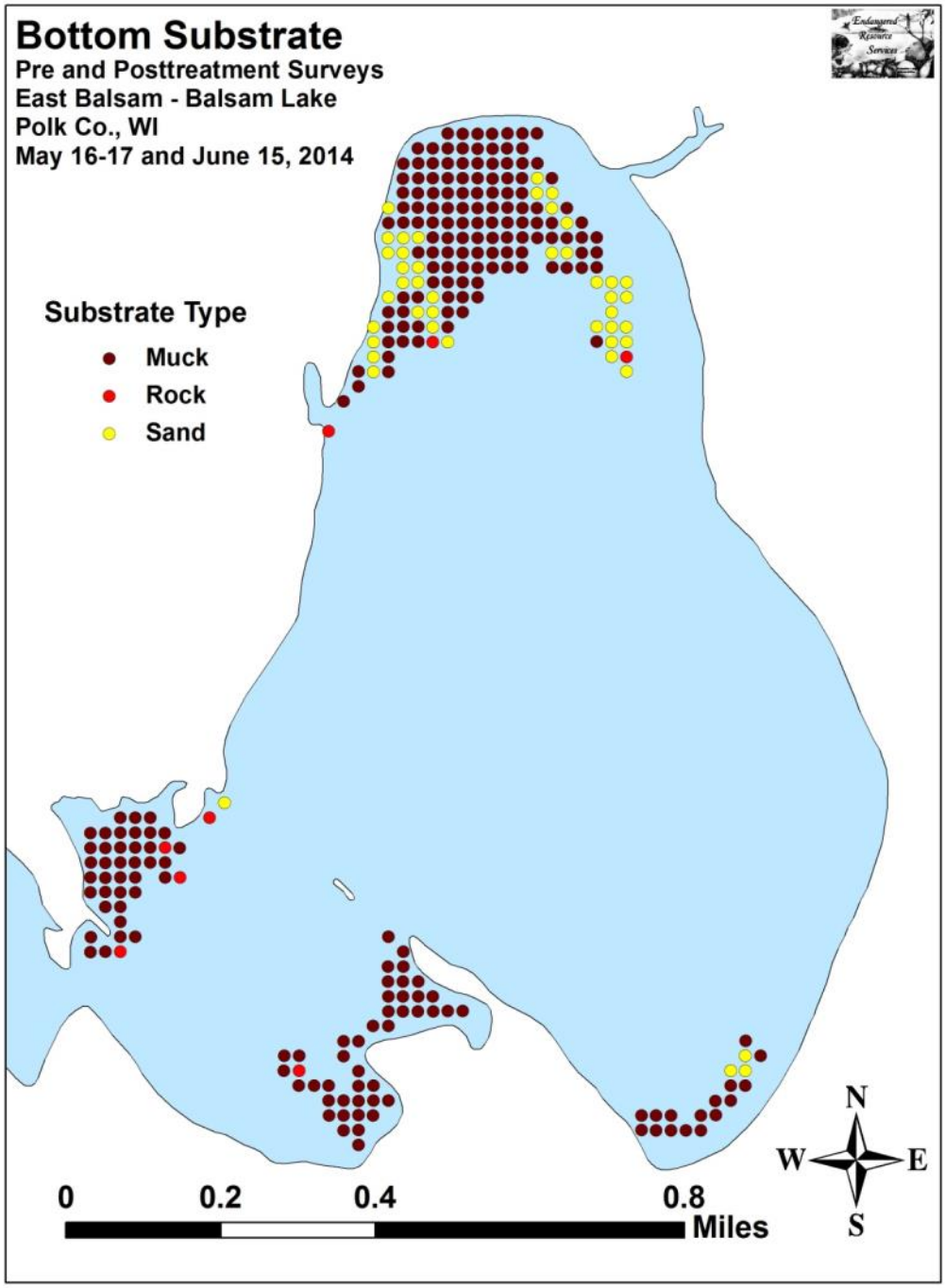

CLP Treatment Areas
Proposed and Final Treatment
Aquathol K - 1.5ppm
East Balsam - Balsam Lake
Polk Co., WI
May 28, 2014
Proposed Treatment
Final Treatment
13
12
14C
14B
14
0
0.2
0.4
0.8
Miles
N
W
E
S

Appendix II: Vegetative Survey Data Sheet

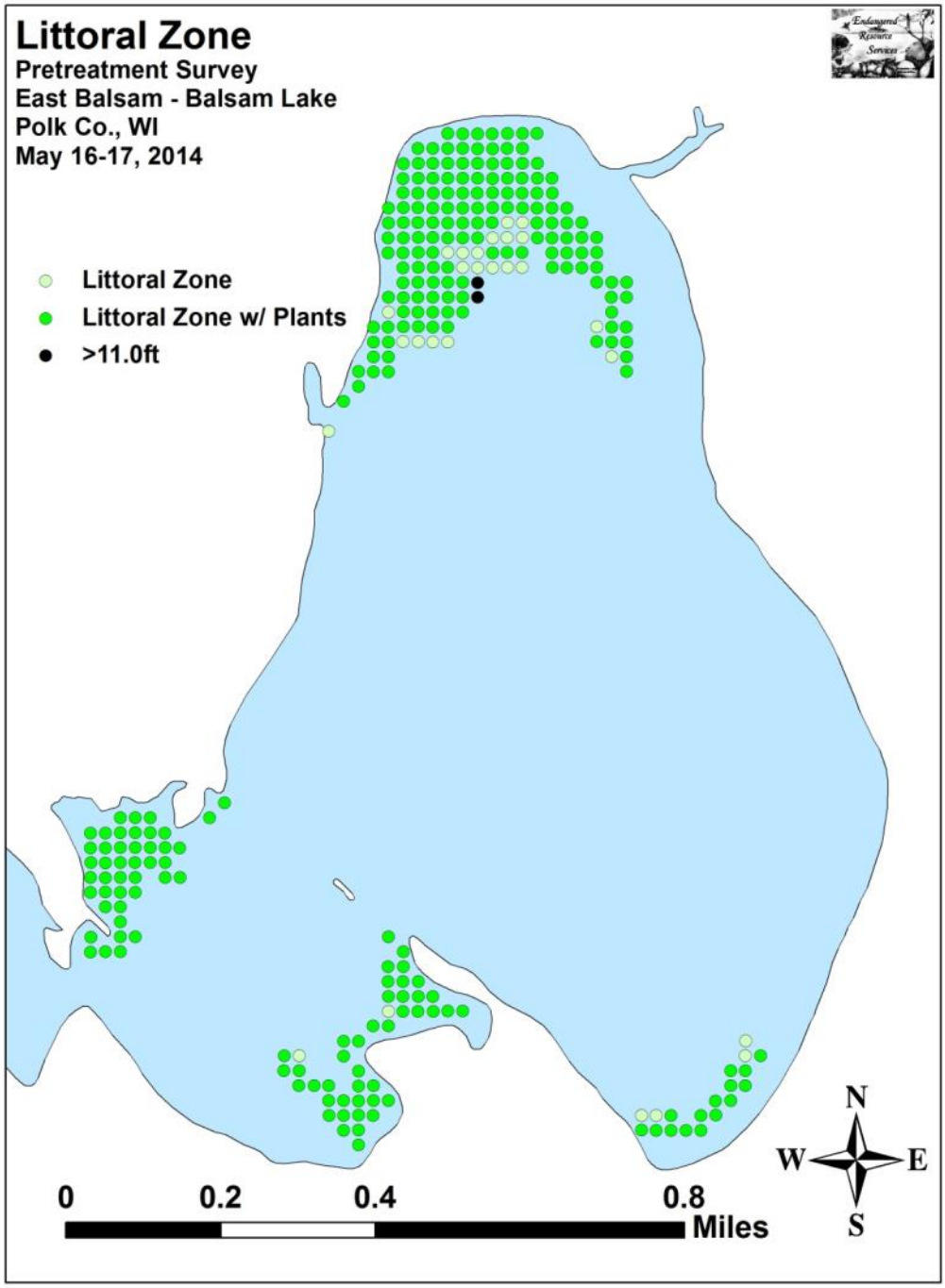
Observers for this lake: names and hours worked by each:																										
Lake:									WBIC									County						Date:	
Site #	Depth (ft)	Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	Total Rake Fullness	CLP	CLP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1																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

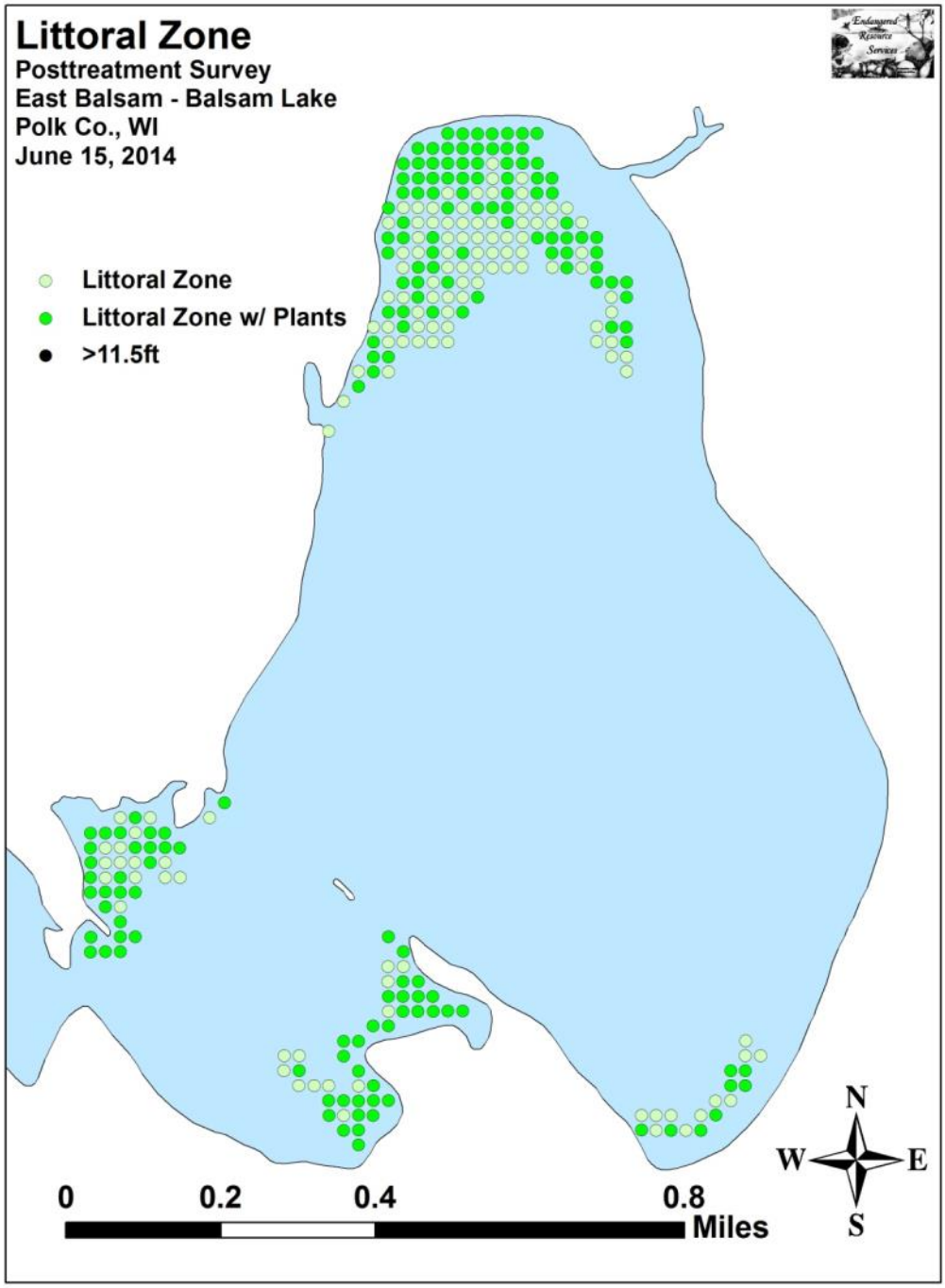
Appendix III: Pre/Post Habitat Variables

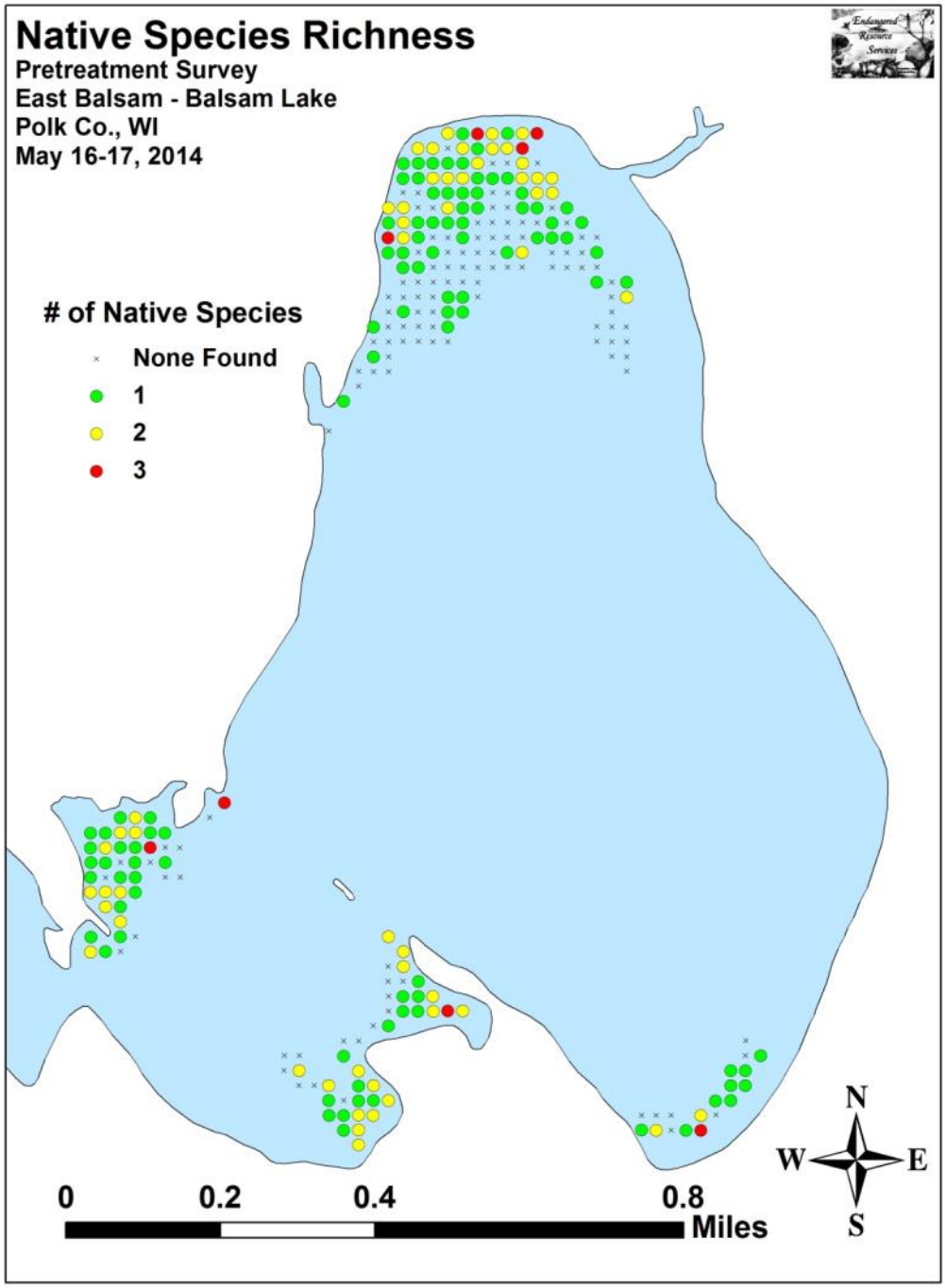

Lake Depth
Pre and Posttreatment Surveys
East Balsam - Balsam Lake
Polk Co., WI
May 16-17 and June 15, 2014
Depth in ft.
0.5 - 3.0
3.1 - 5.0
5.1 - 7.0
7.1 - 9.0
9.1 - 11.5
0 0.125 0.25 0.5
Miles
N
W
E
S

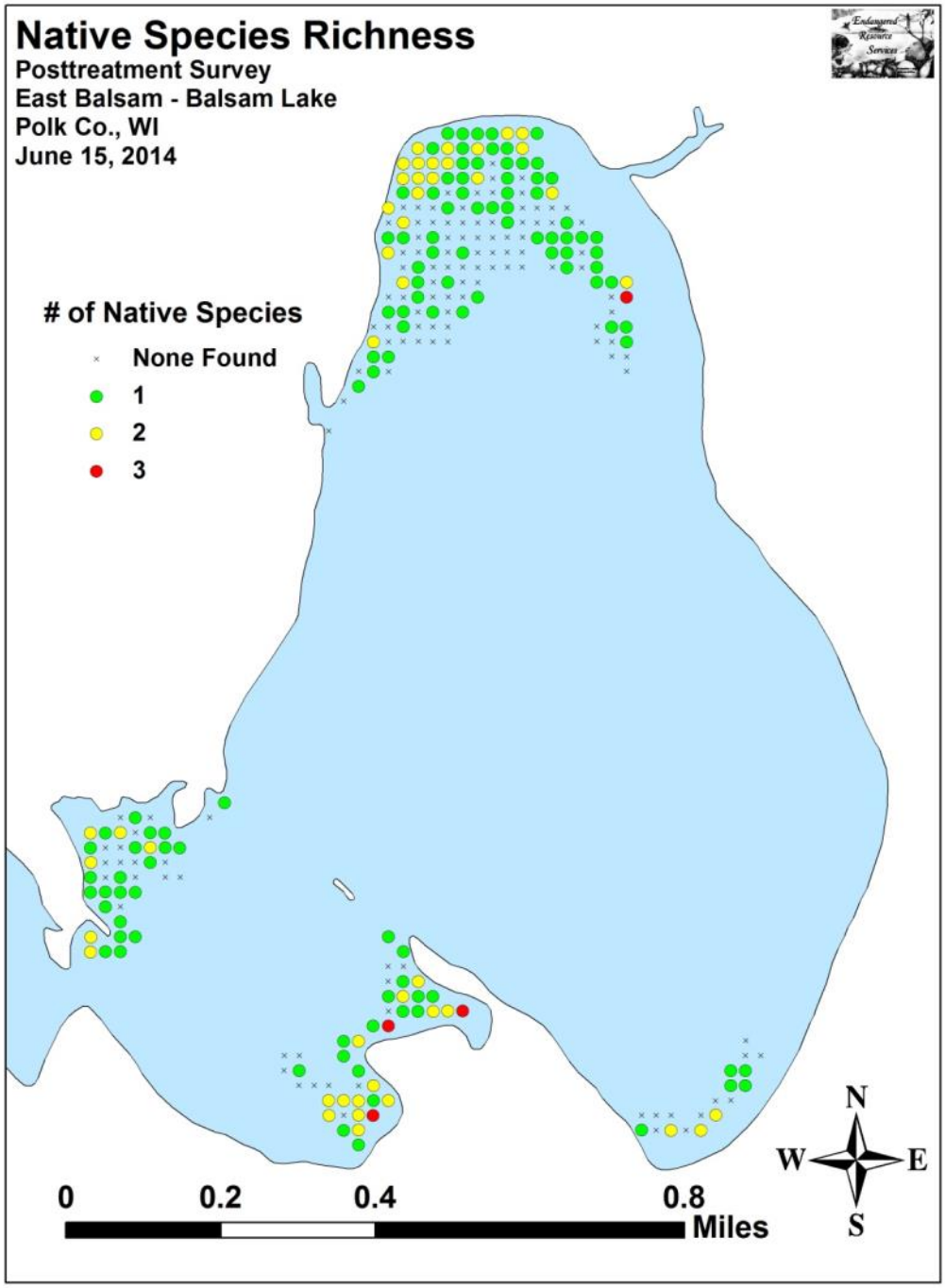

Bottom Substrate
Pre and Posttreatment Surveys
East Balsam - Balsam Lake
Polk Co., WI
May 16-17 and June 15, 2014
Substrate Type
Muck
Rock
Sand
0
0.2
0.4
0.8
Miles
N
W
E
S

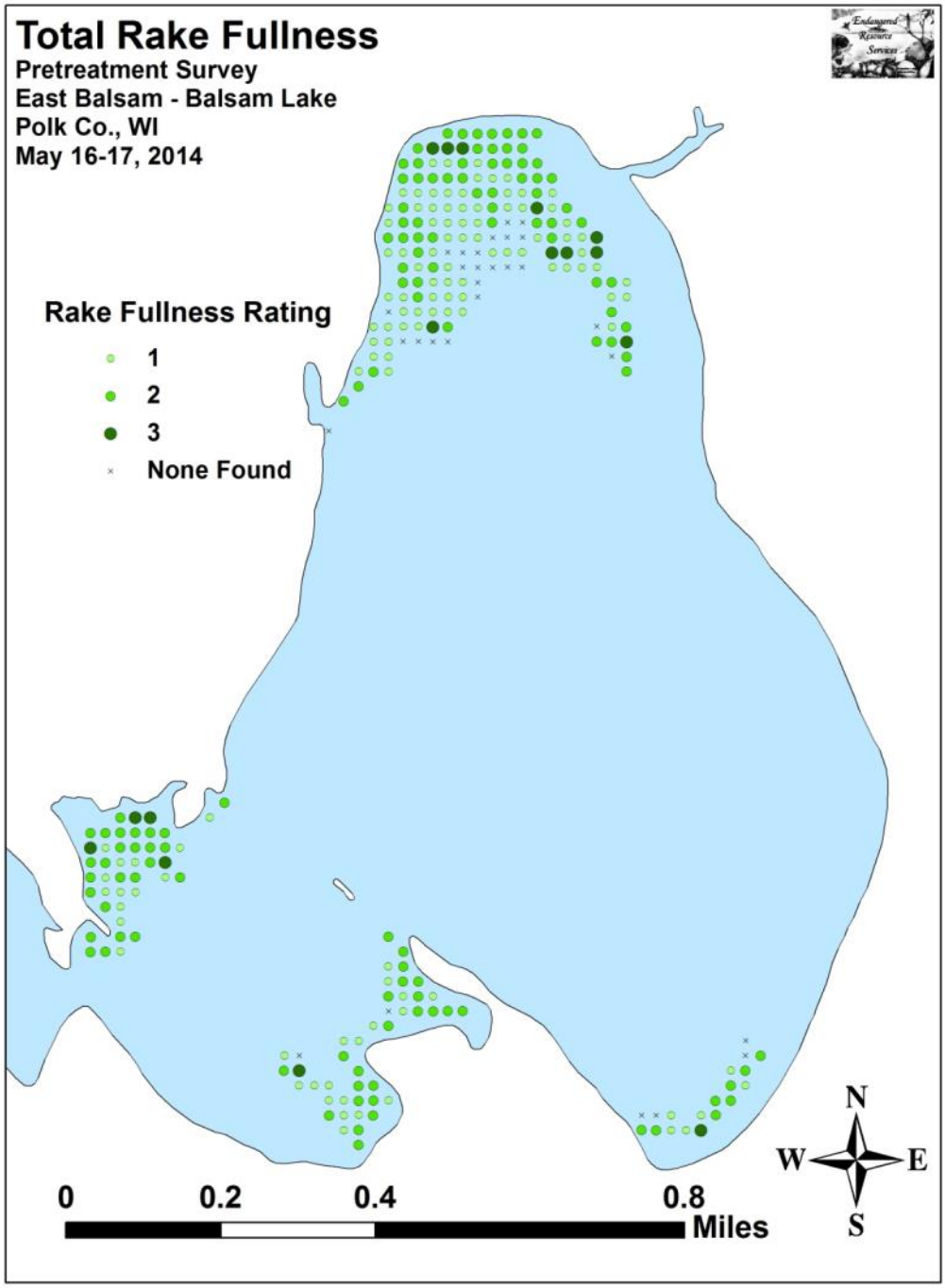
Appendix IV: Pre/Post Littoral Zone, Native Species Richness and Total Rake Fullness

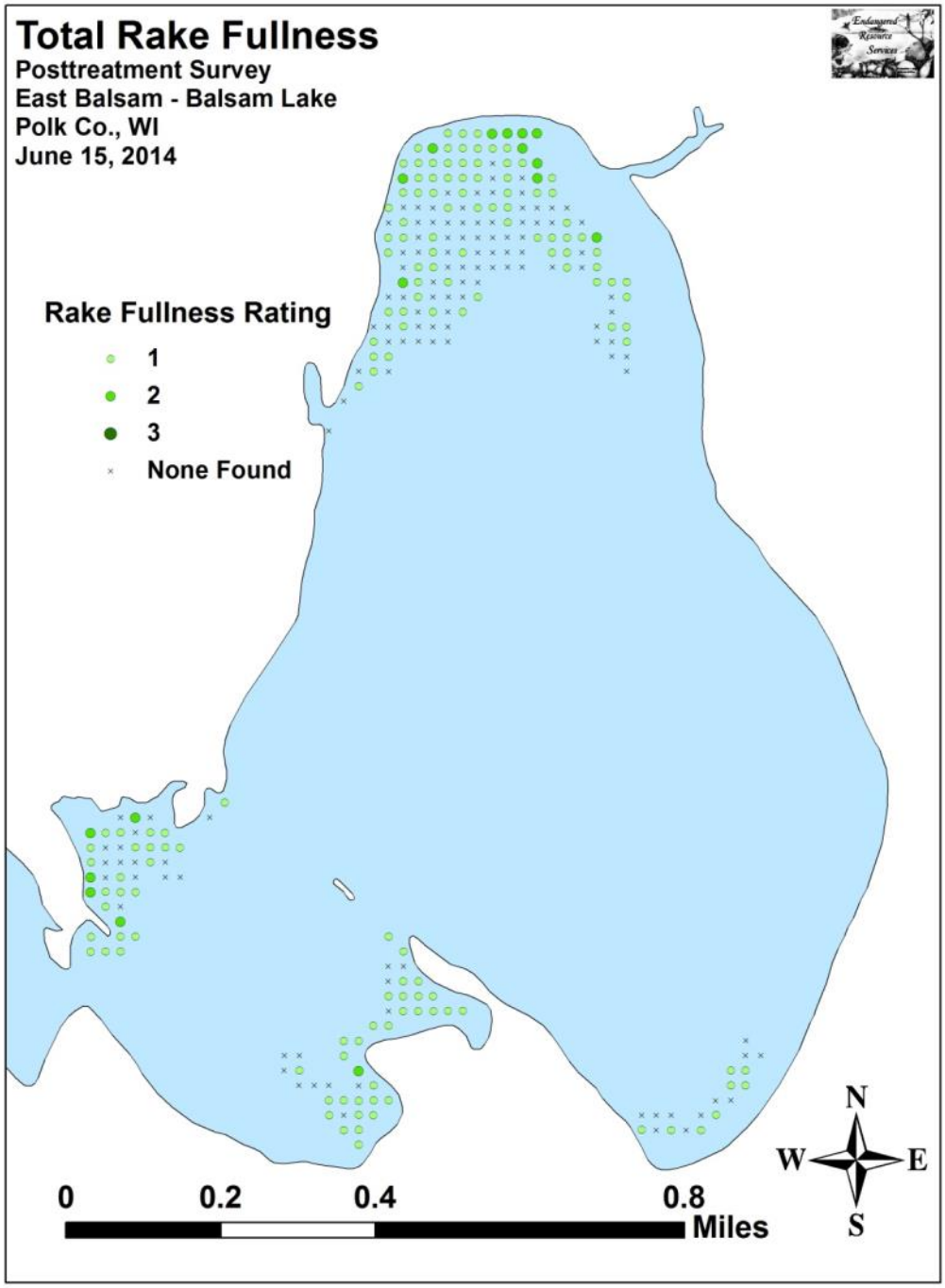

Littoral Zone
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Littoral Zone
Littoral Zone w/ Plants
>11.0ft
0
0.2
0.4
0.8
Miles
N
W
E
S


Littoral Zone
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Littoral Zone
Littoral Zone w/ Plants
>11.5ft
0
0.2
0.4
0.8
Miles
N
W
E
S

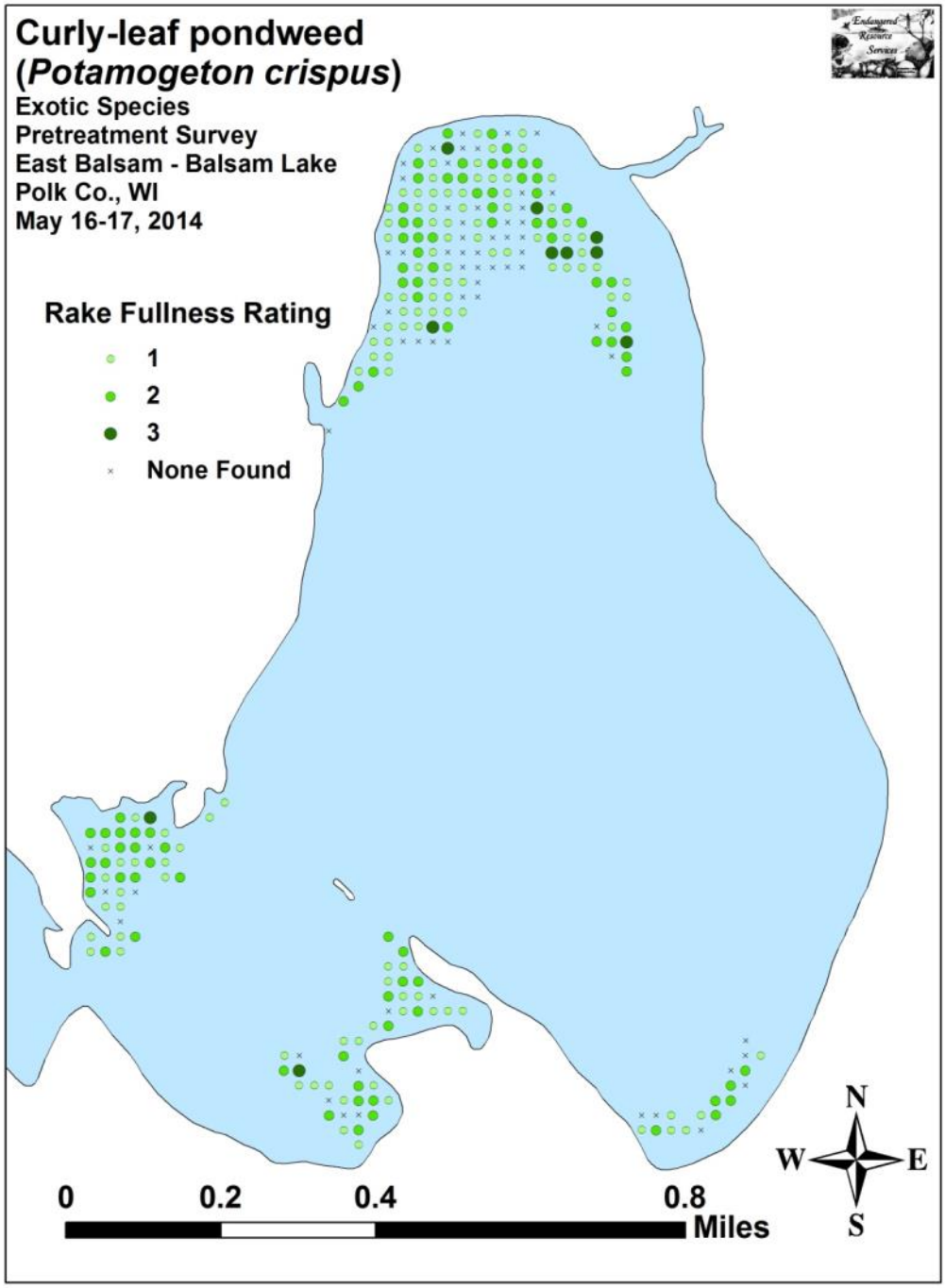

Native Species Richness
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
# of Native Species
None Found
1
2
3
0
0.2
0.4
0.8
Miles
N
W
E
S

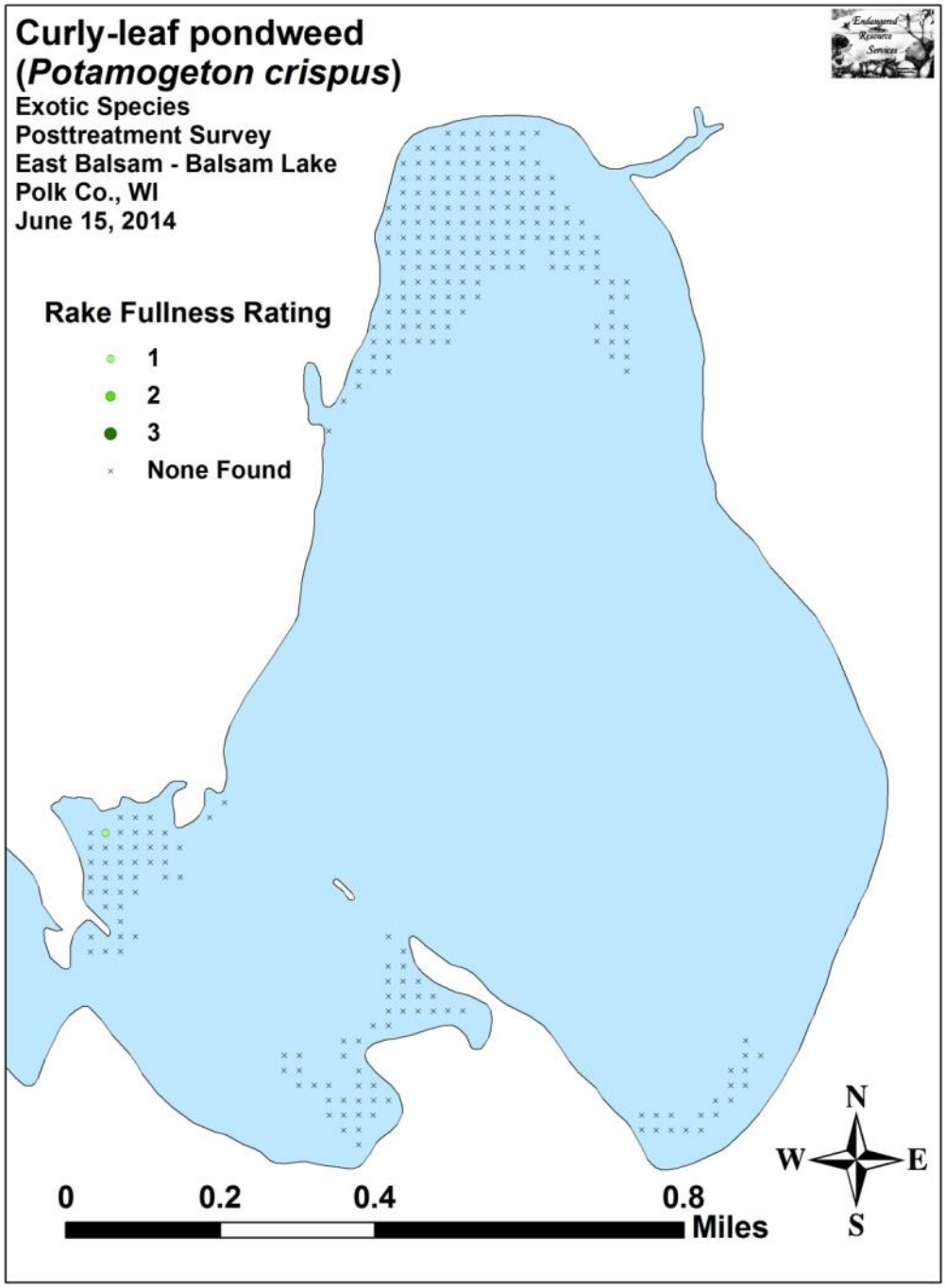

Native Species Richness
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
# of Native Species
None Found
1
2
3
0
0.2
0.4
0.8
Miles
N
W
E
S


Total Rake Fullness
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

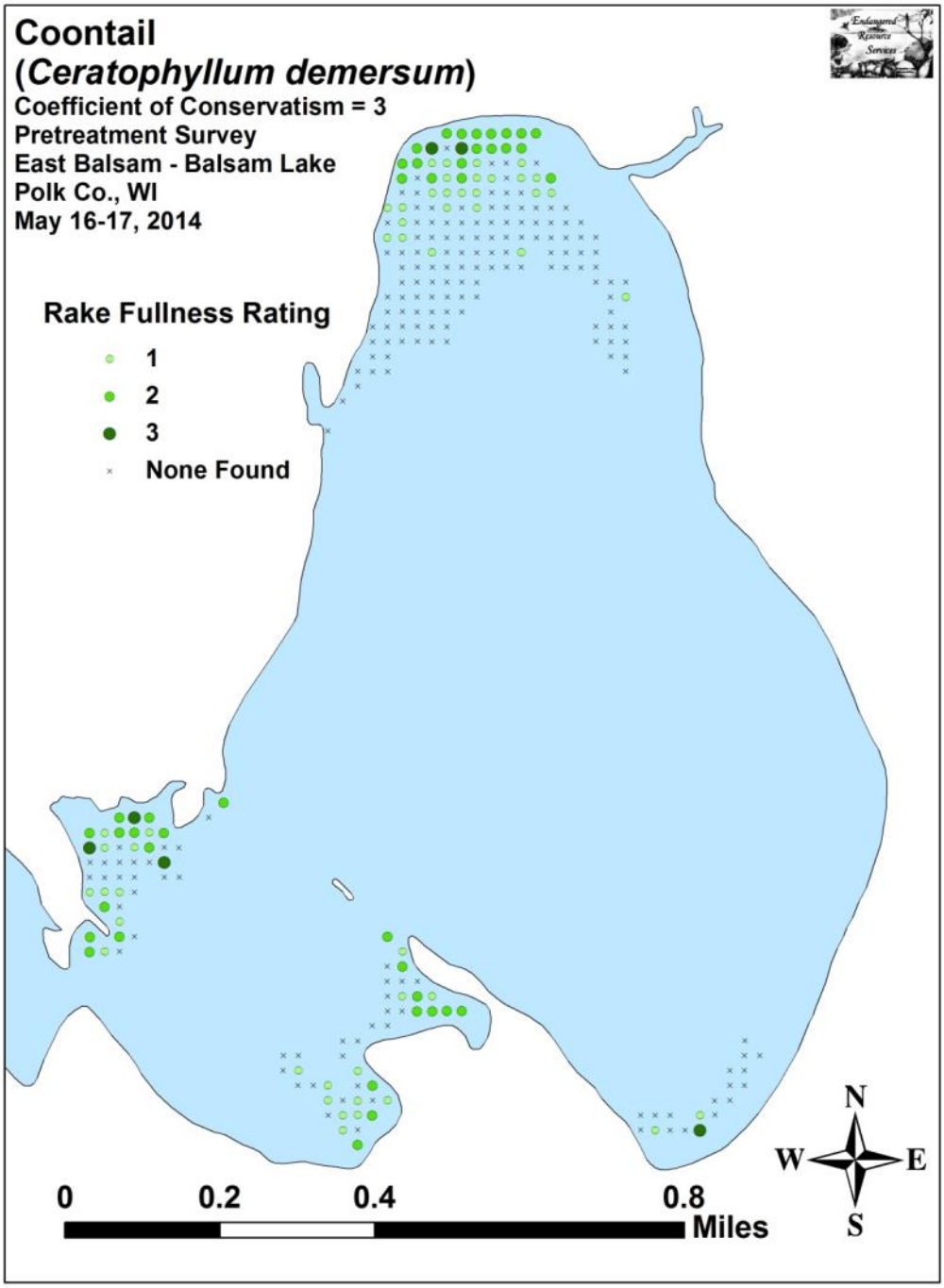

Total Rake Fullness
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

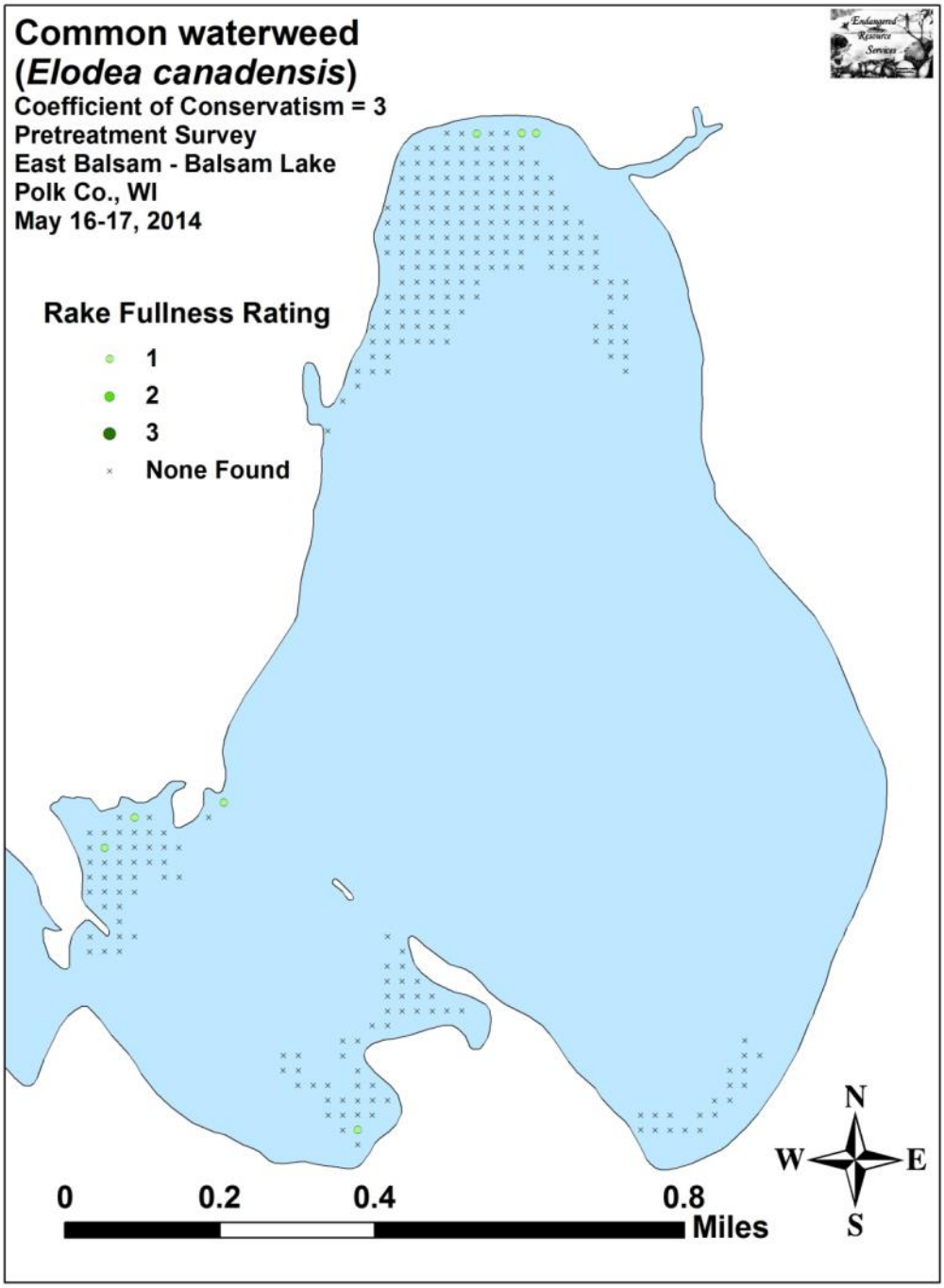
Appendix V: CLP Pre/Posttreatment Distribution

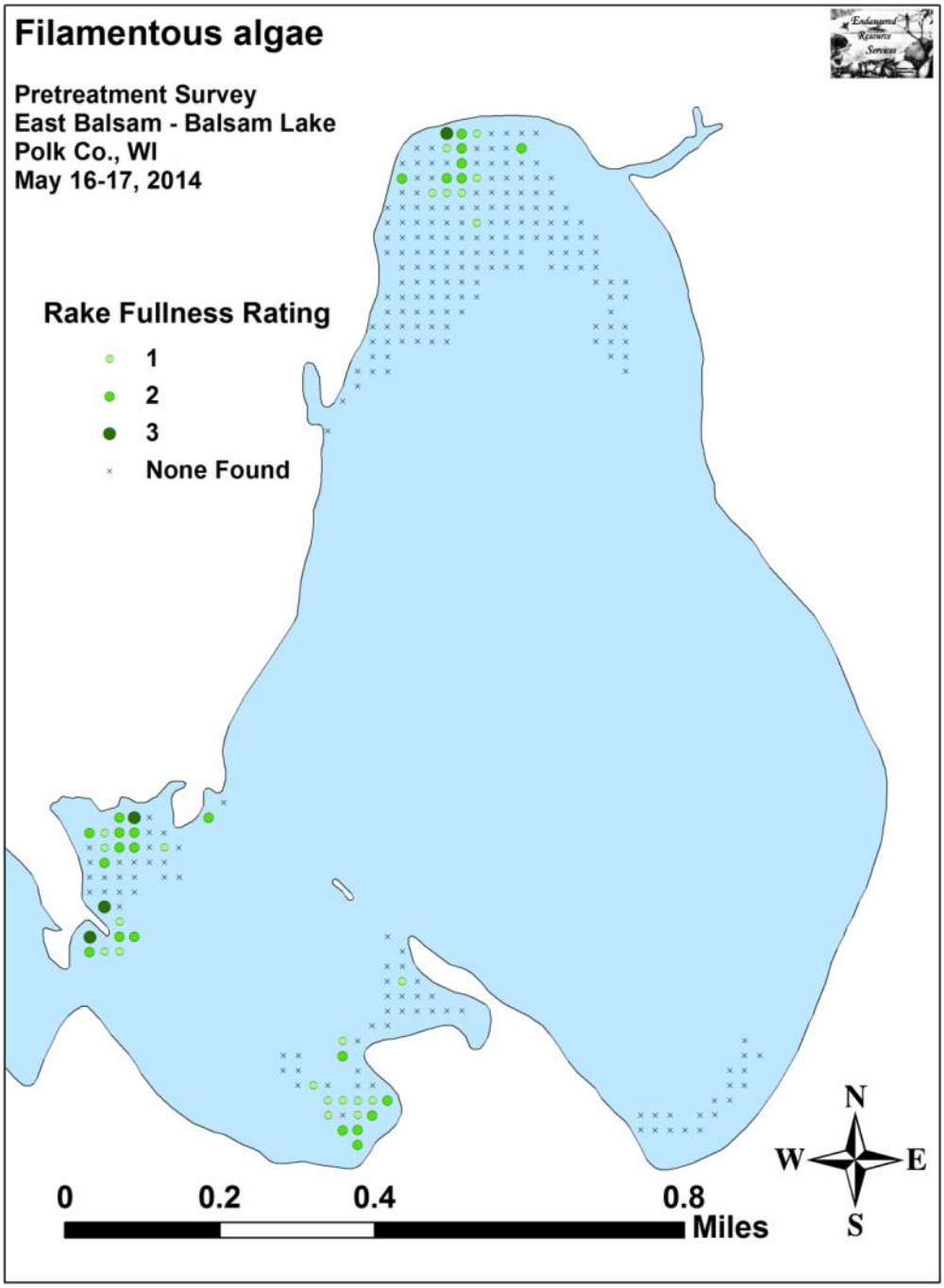

Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

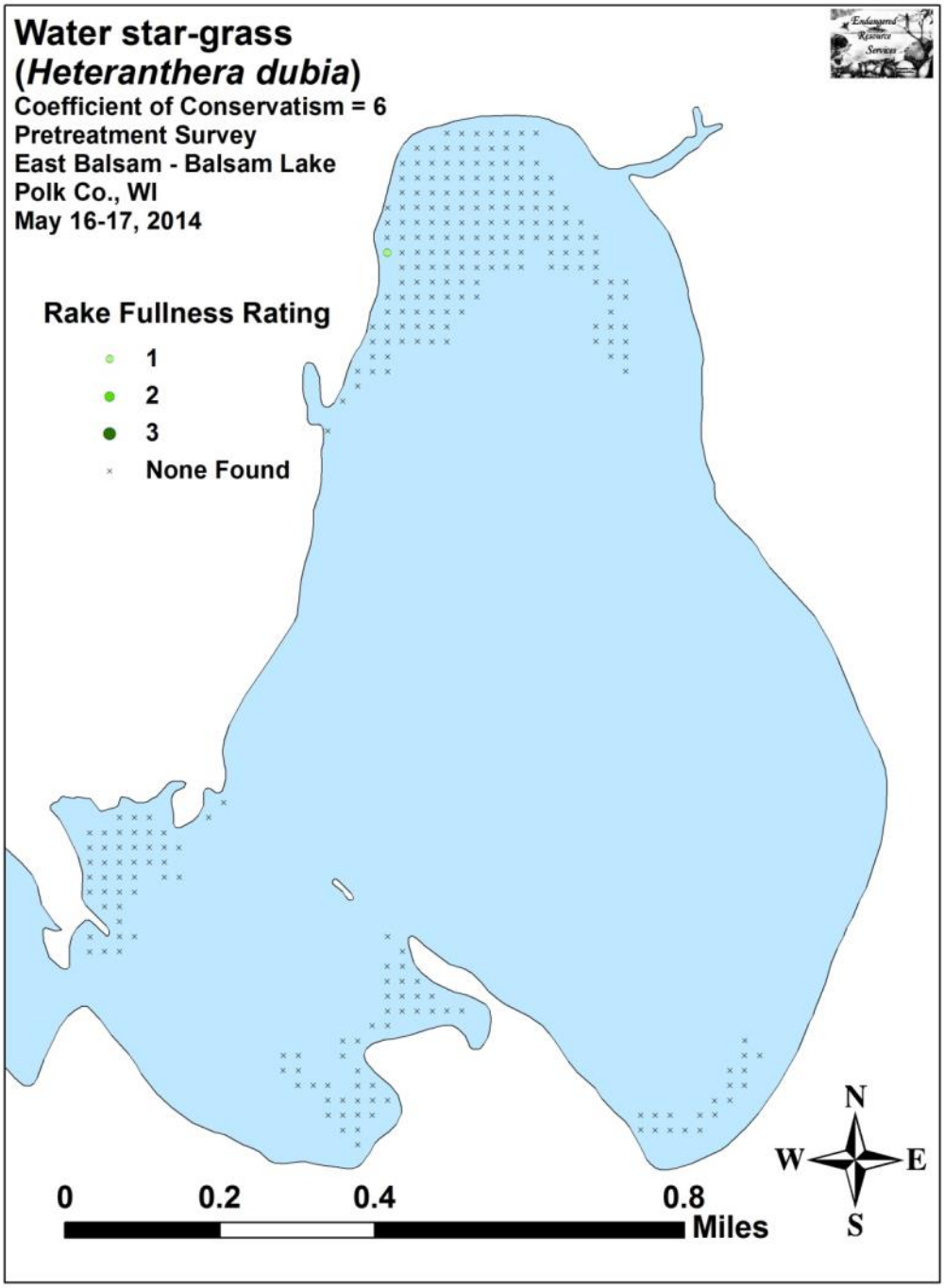

Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

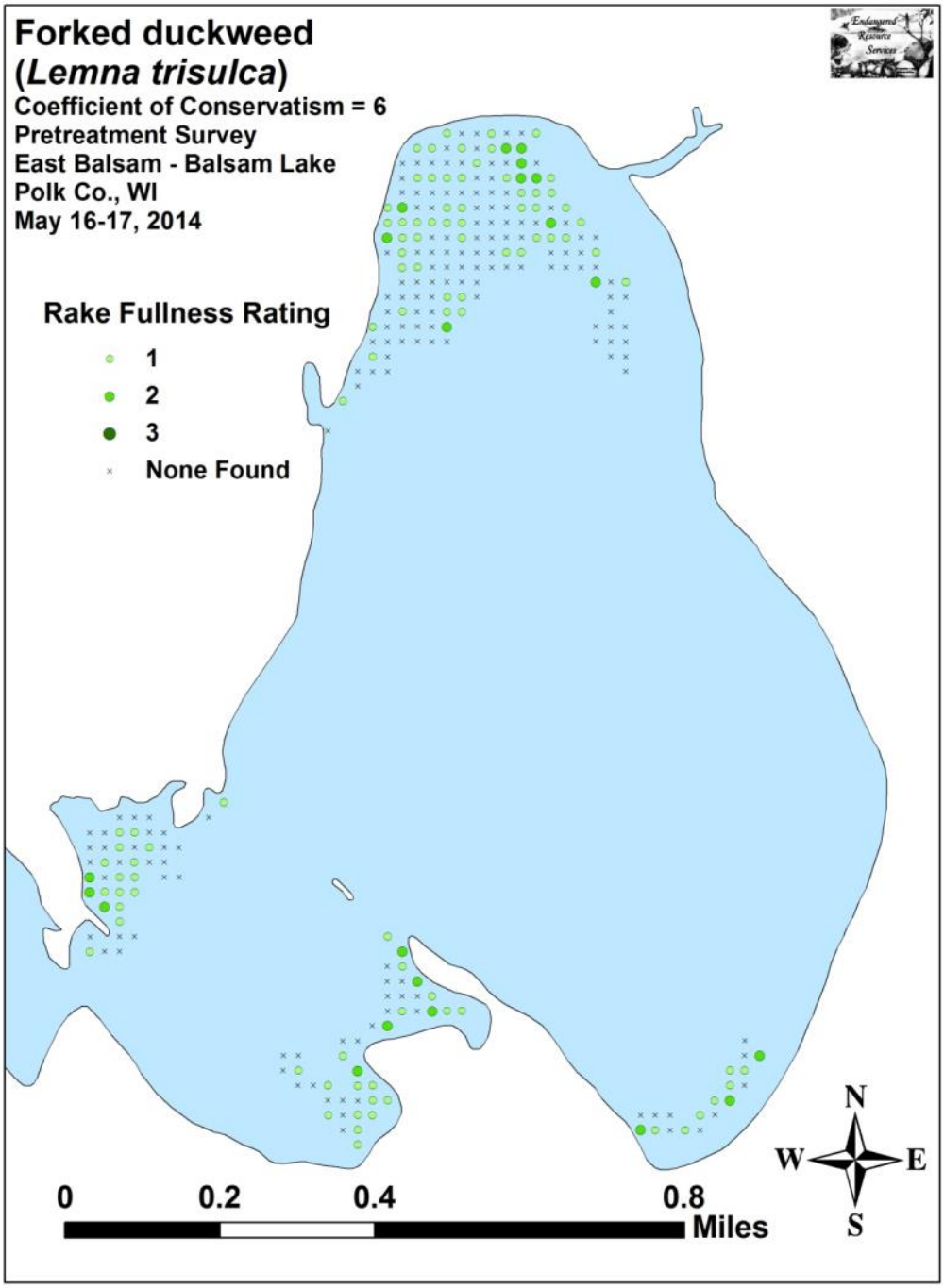
Appendix VI: Pretreatment Native Species Distribution

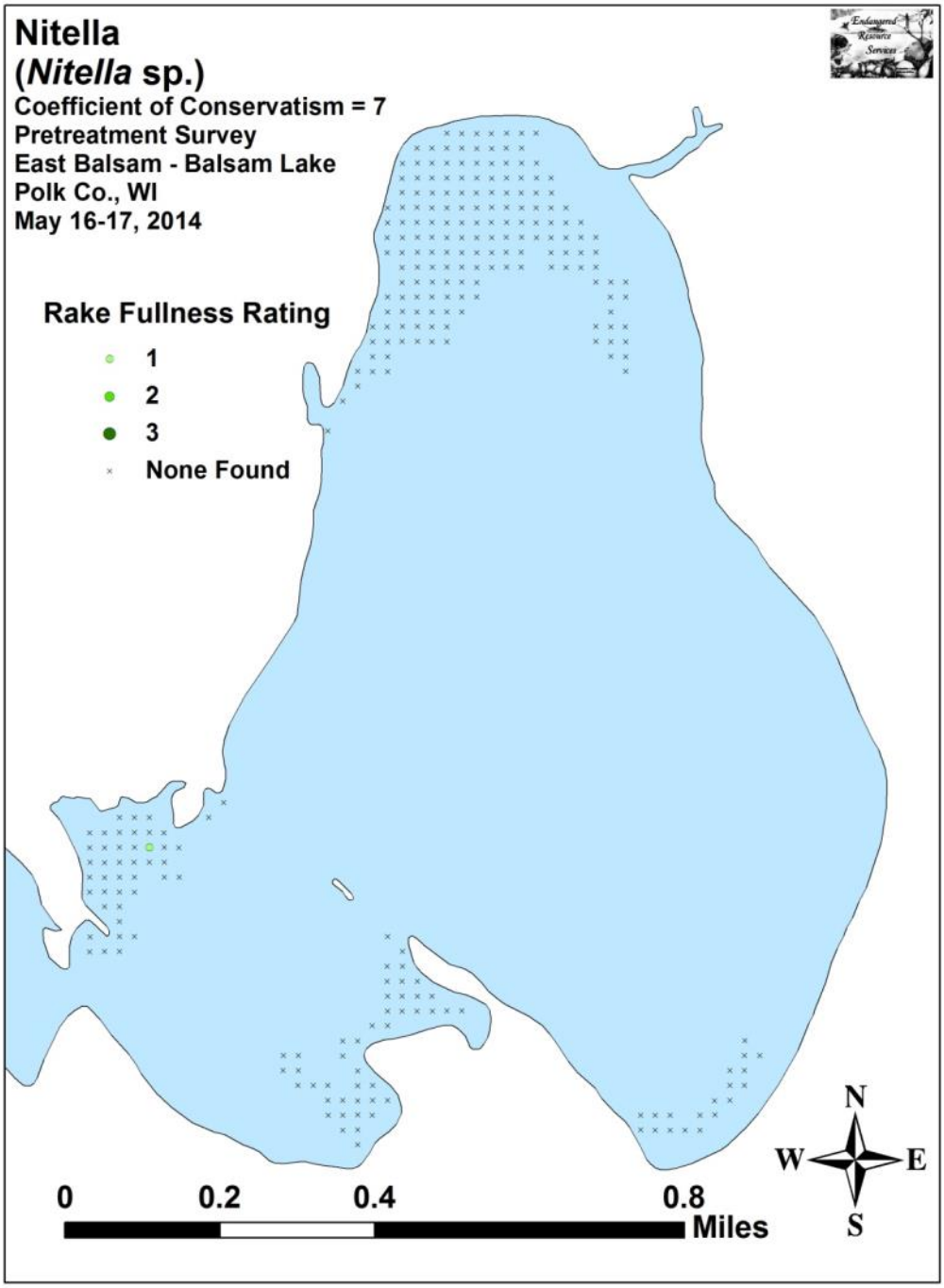

Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

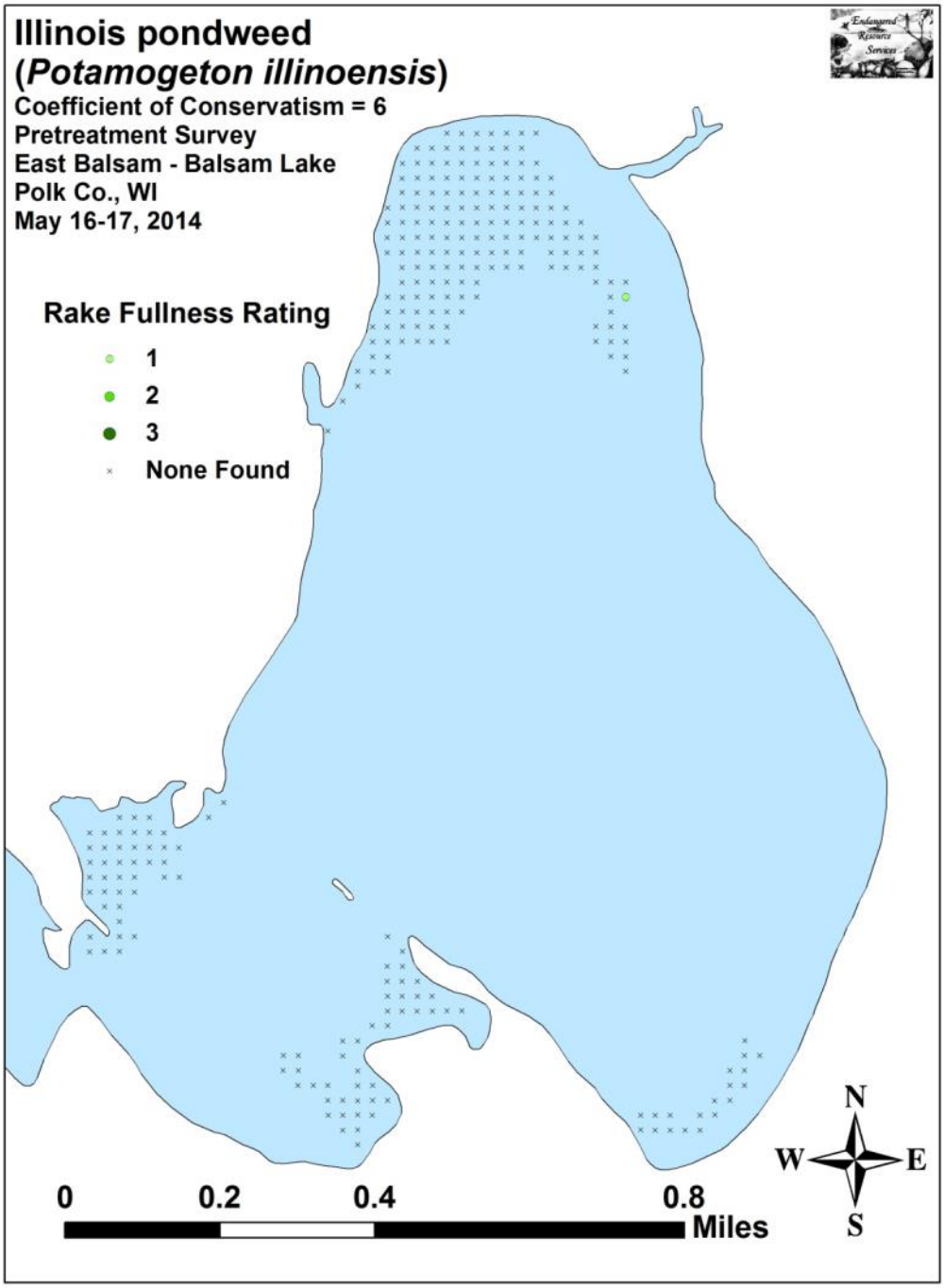

Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

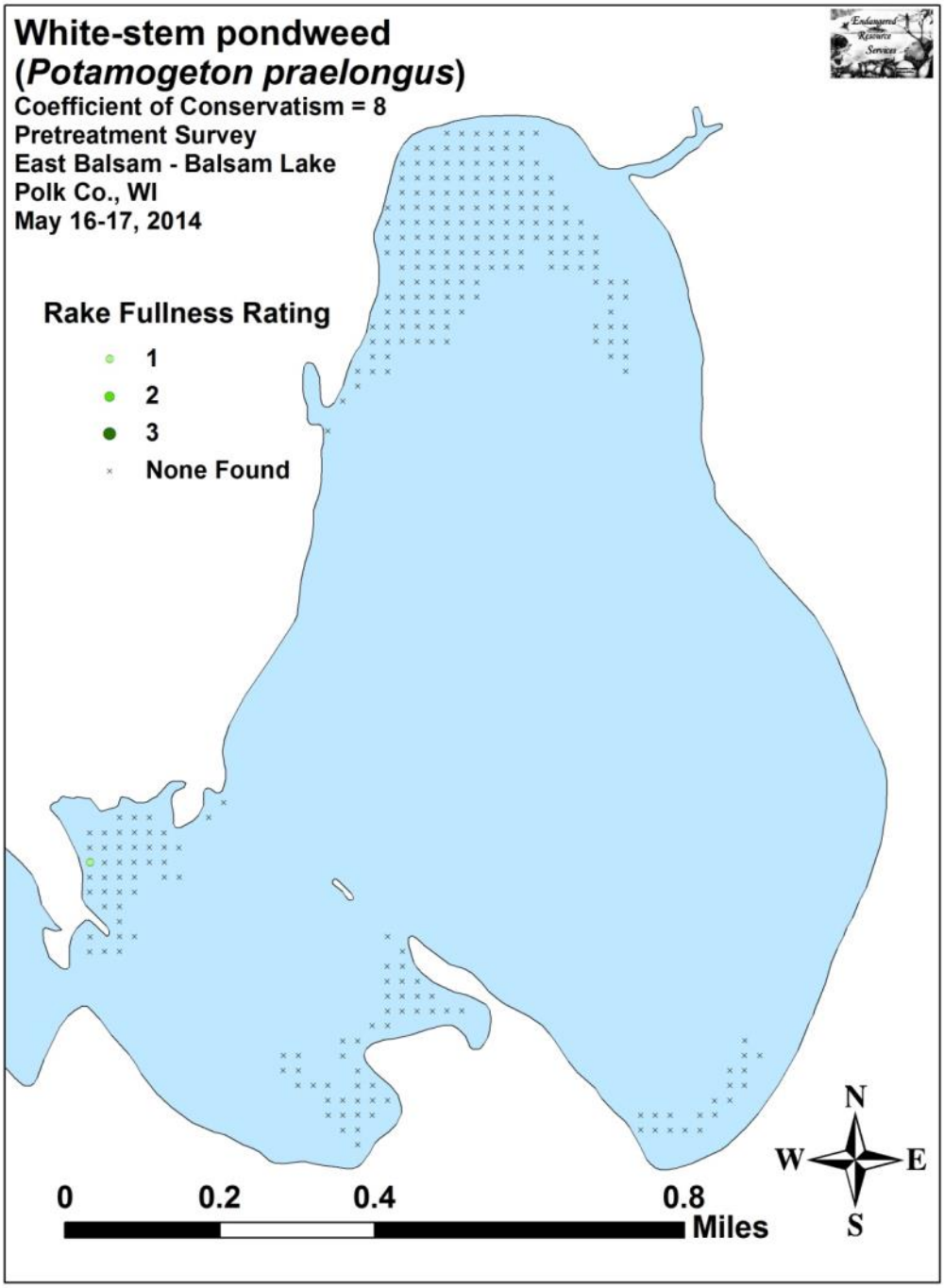

Filamentous algae
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

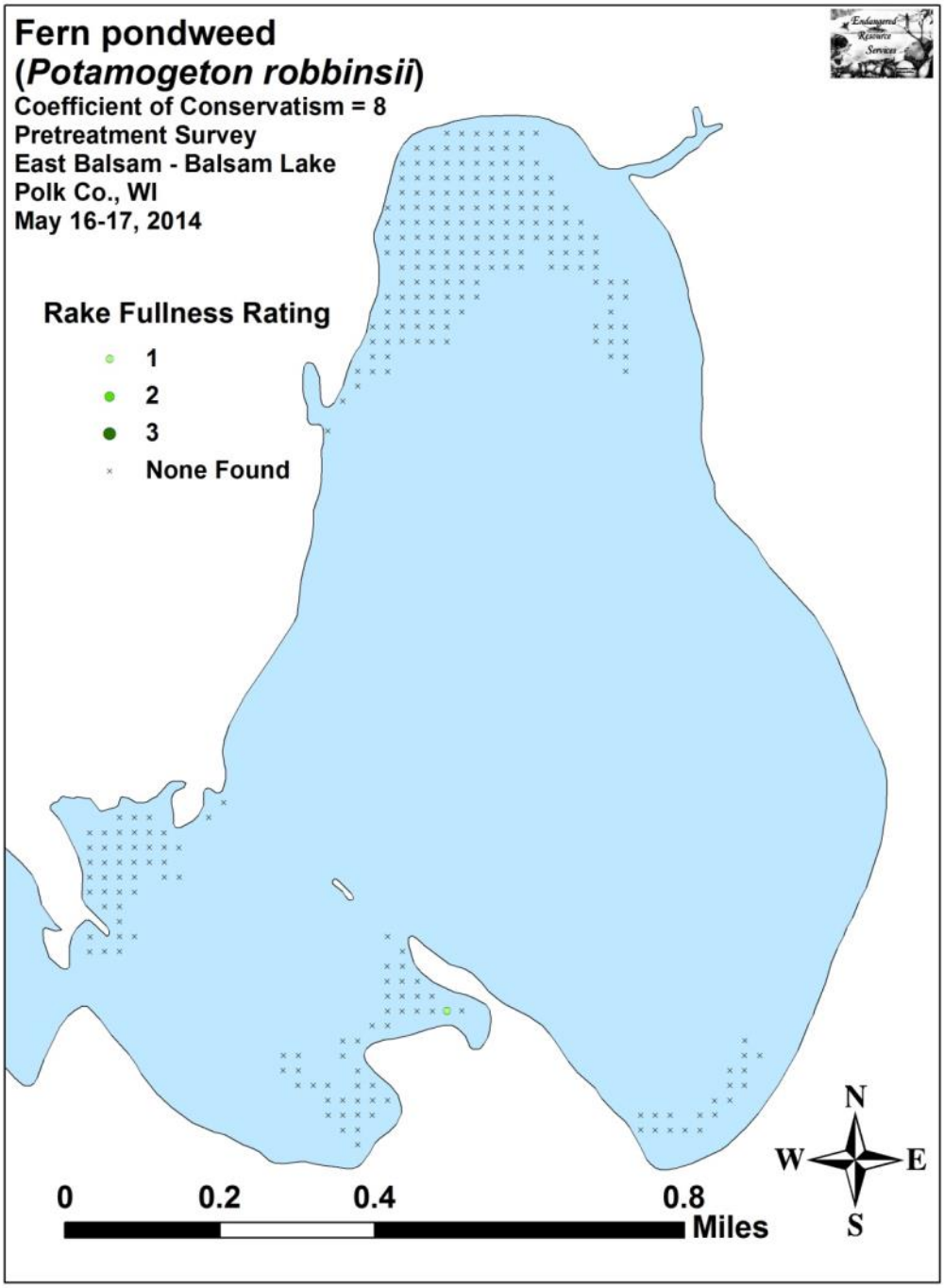

Water star-grass
(Heteranthera dubia)
Coefficient of Conservatism = 6
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

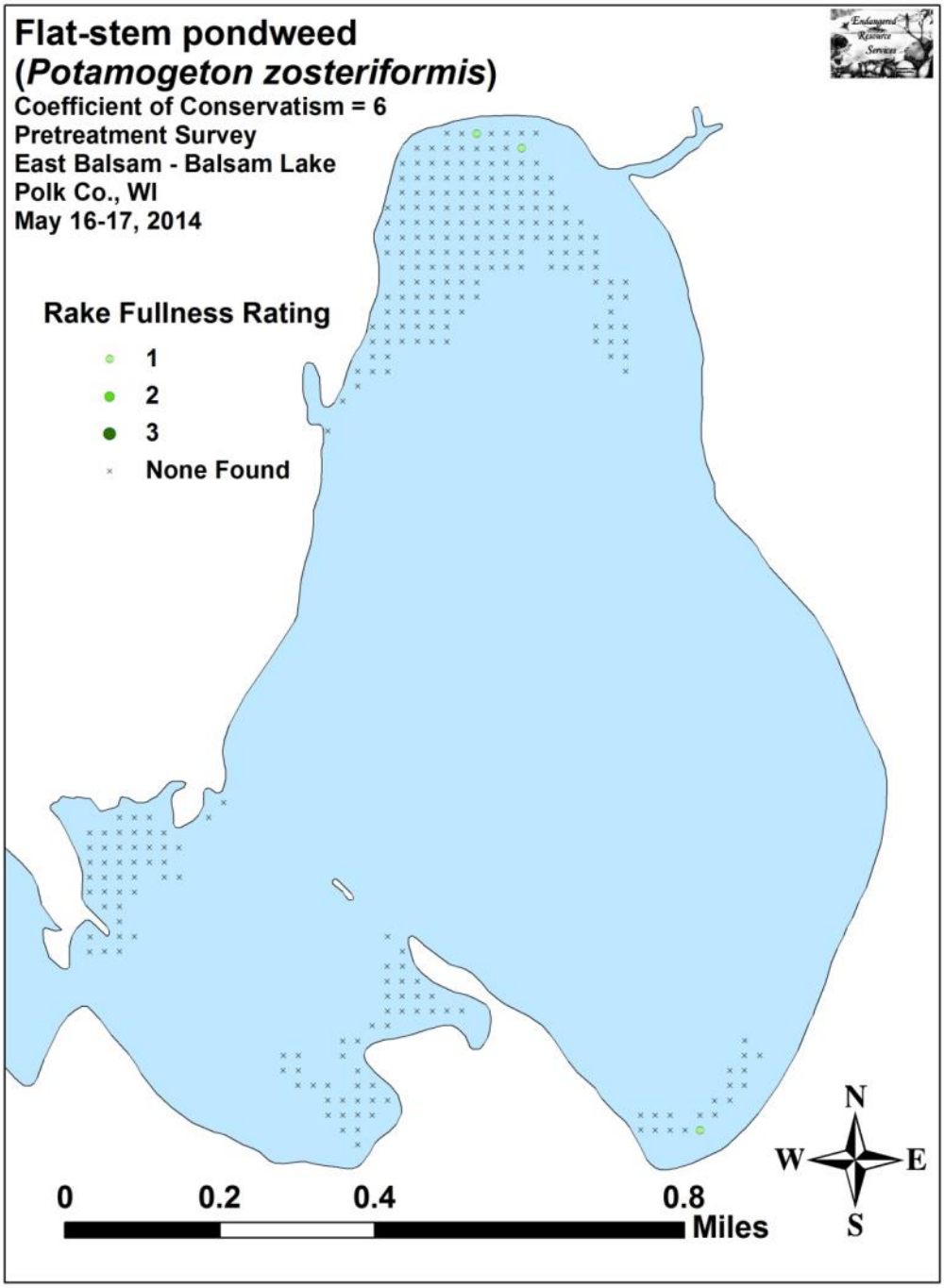

Forked duckweed
(Lemna trisulca)
Coefficient of Conservatism = 6
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

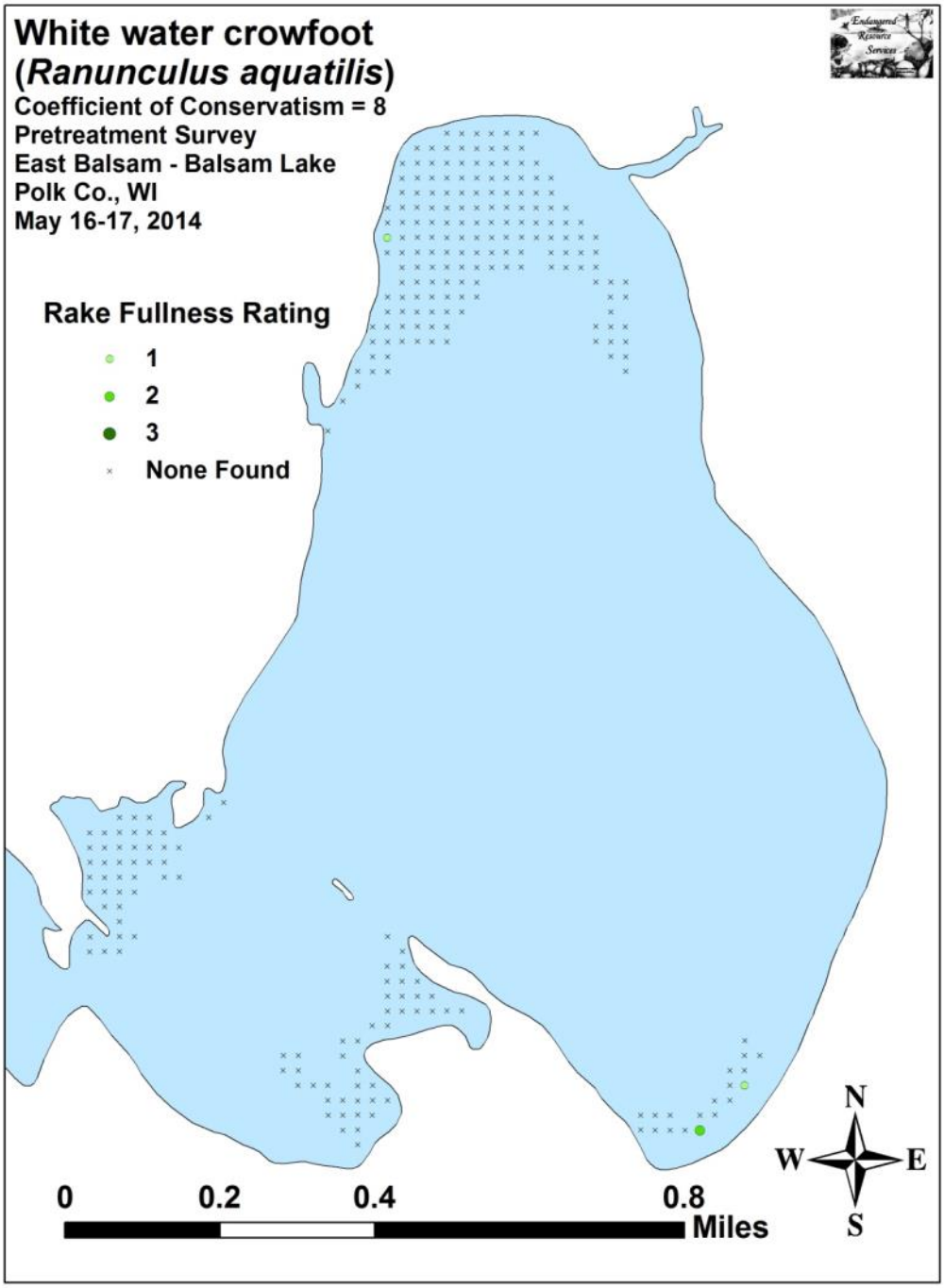

Nitella
(*Nitella* sp.)
Coefficient of Conservatism = 7
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S


Illinois pondweed
(Potamogeton illinoensis)
Coefficient of Conservatism = 6
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

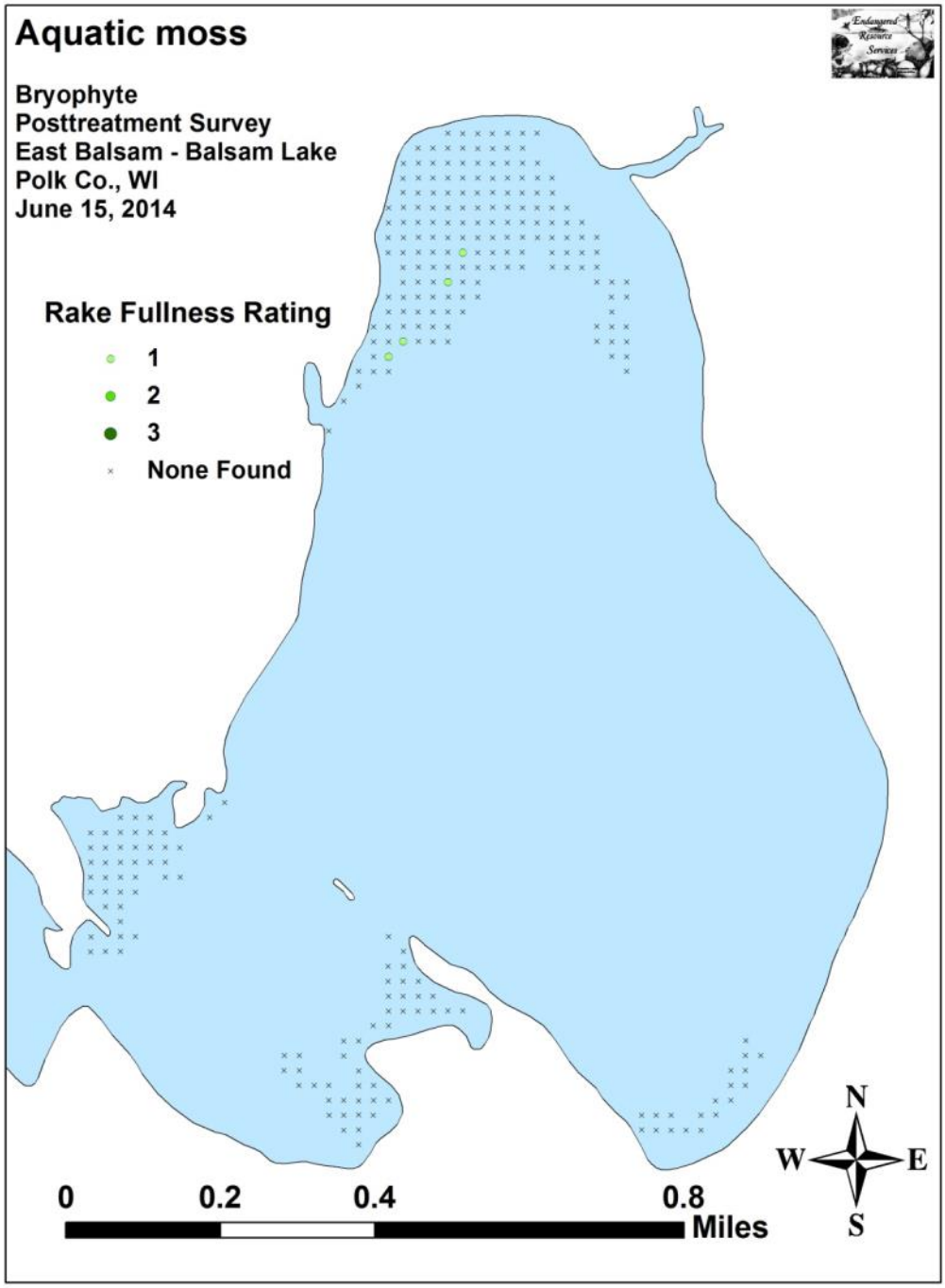

White-stem pondweed
(Potamogeton praelongus)
Coefficient of Conservatism = 8
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

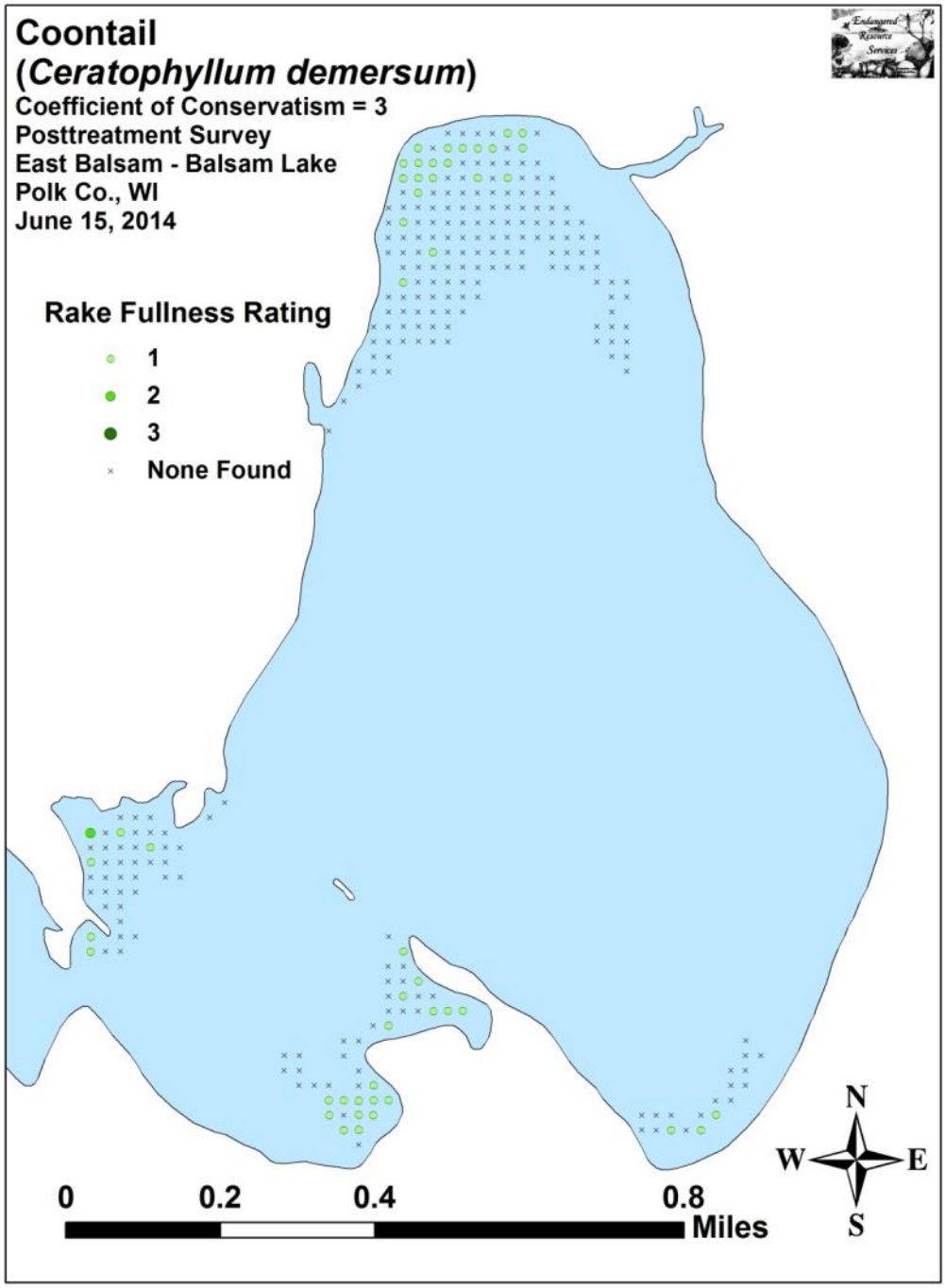

Fern pondweed
(Potamogeton robbinsii)
Coefficient of Conservatism = 8
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

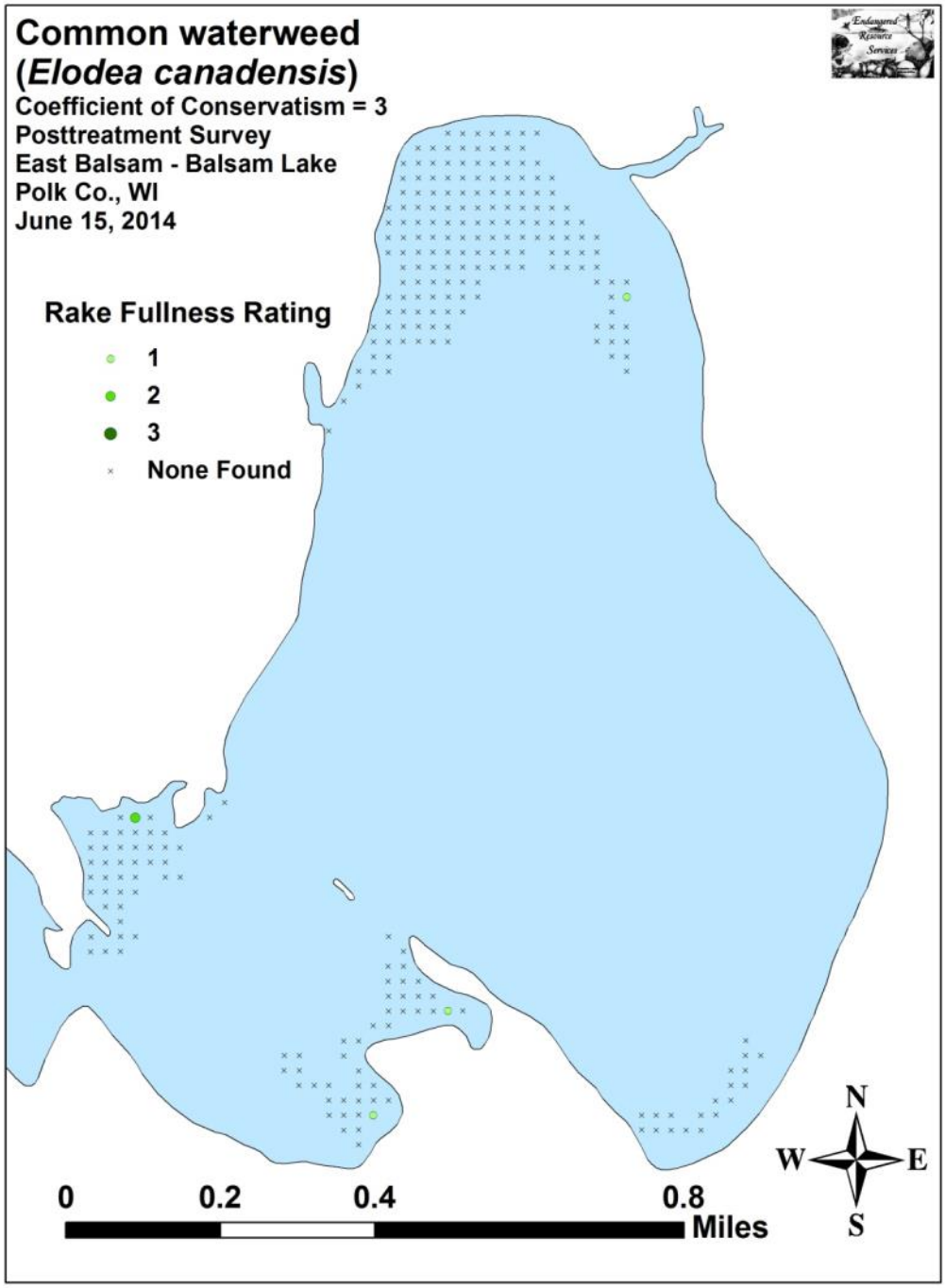

Flat-stem pondweed
(Potamogeton zosteriformis)
Coefficient of Conservatism = 6
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

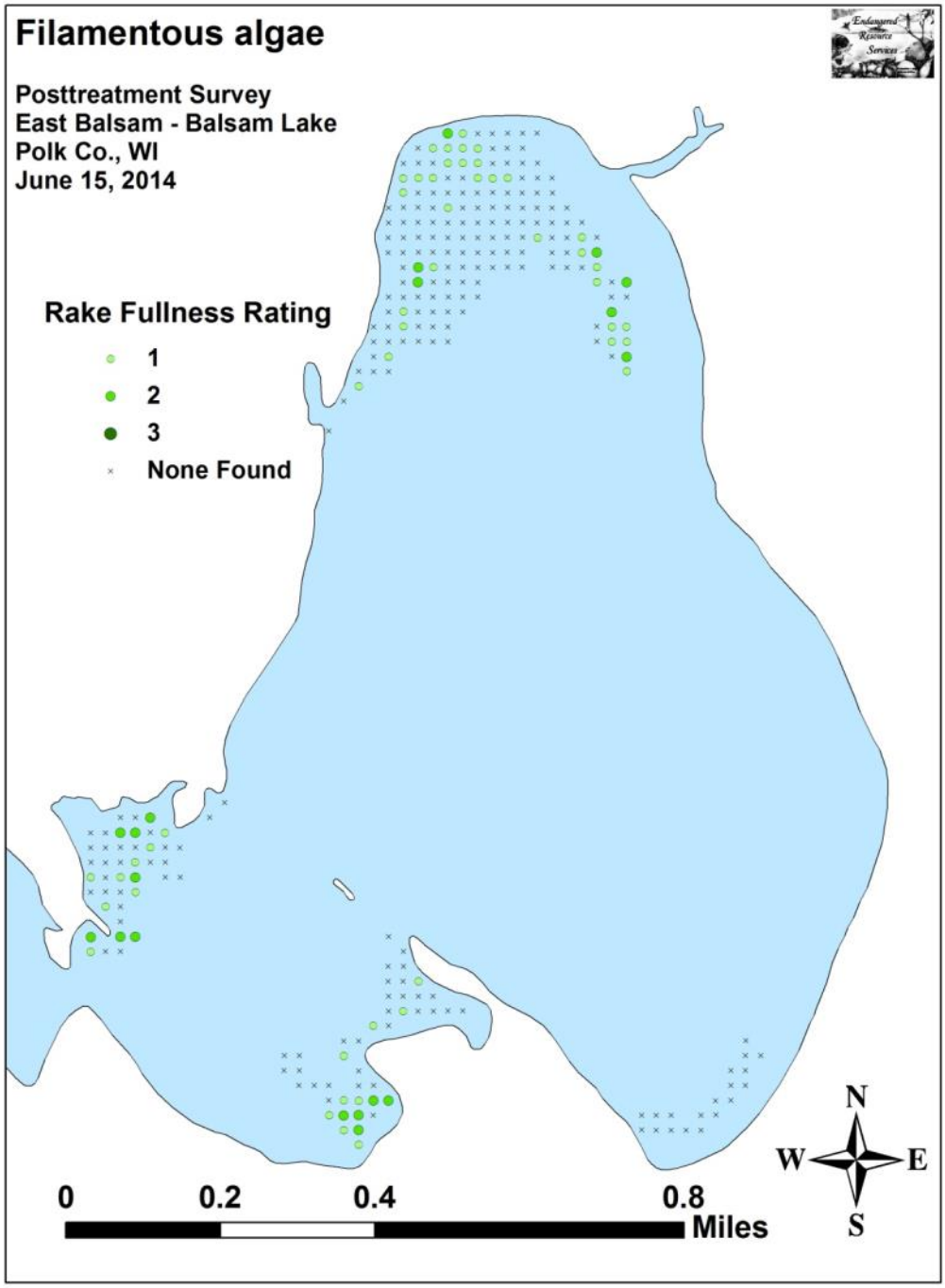

White water crowfoot
(Ranunculus aquatilis)
Coefficient of Conservatism = 8
Pretreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
May 16-17, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

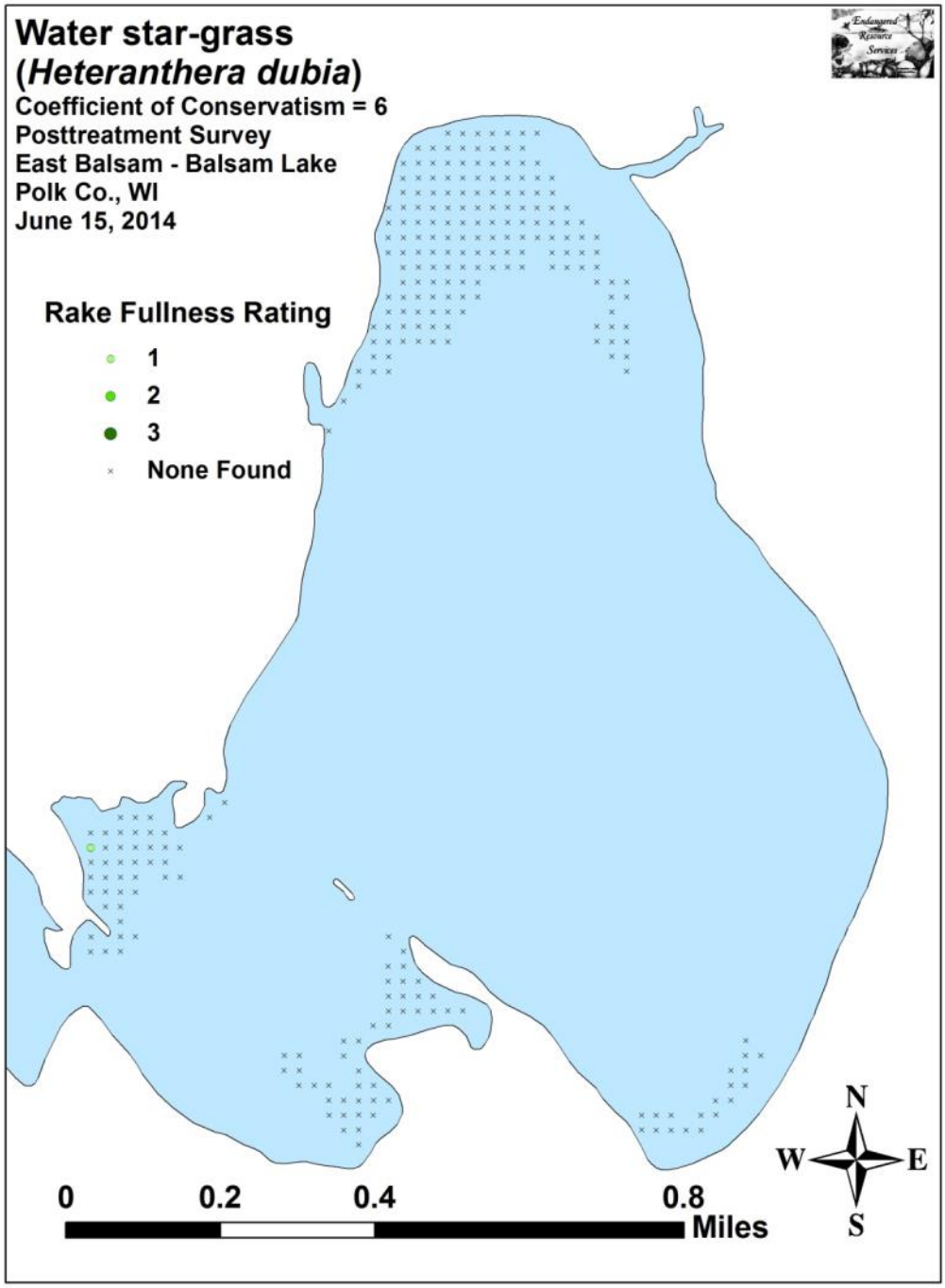
Appendix VII: Posttreatment Native Species Distribution

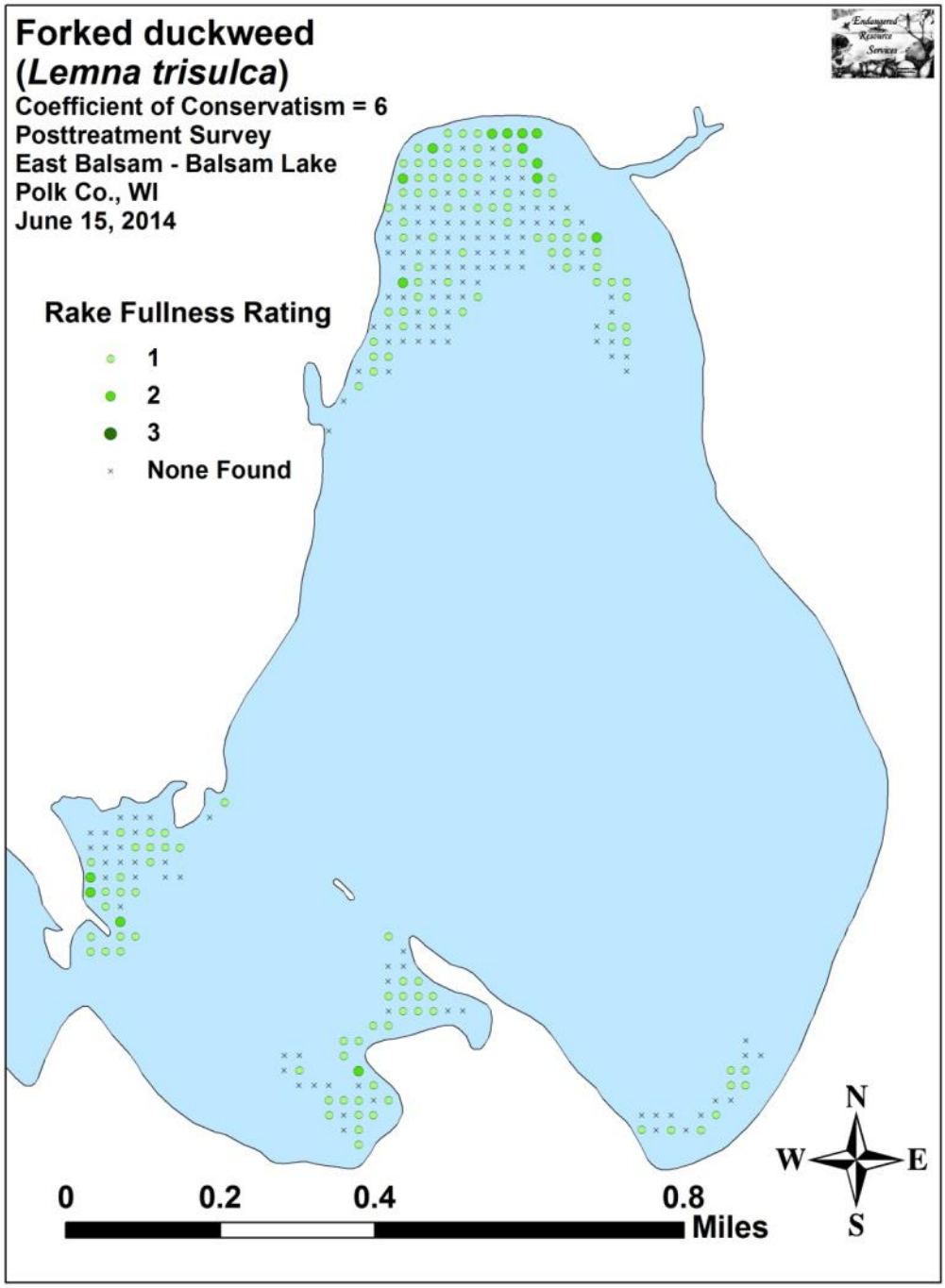

Aquatic moss
Bryophyte
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

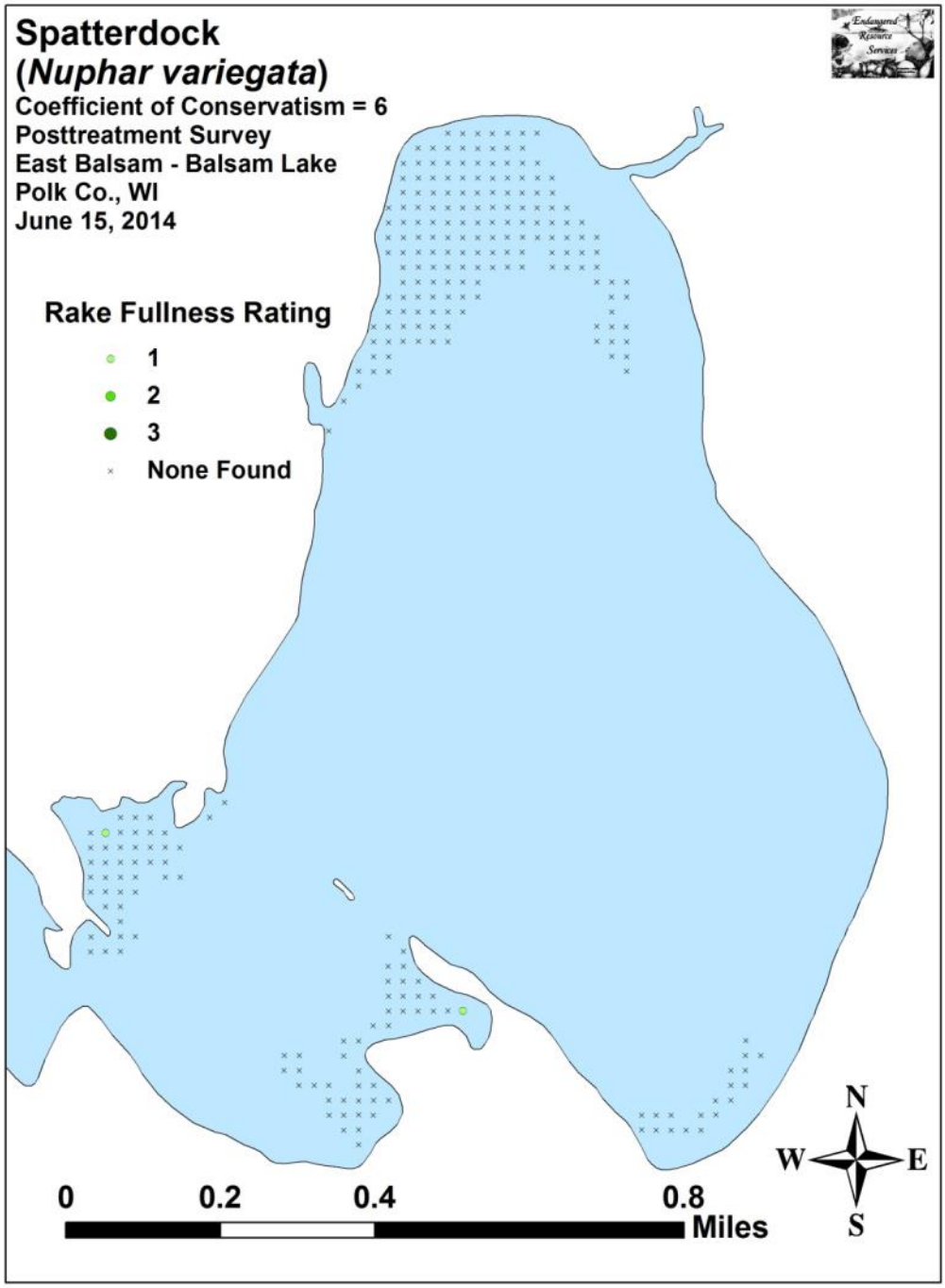

Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

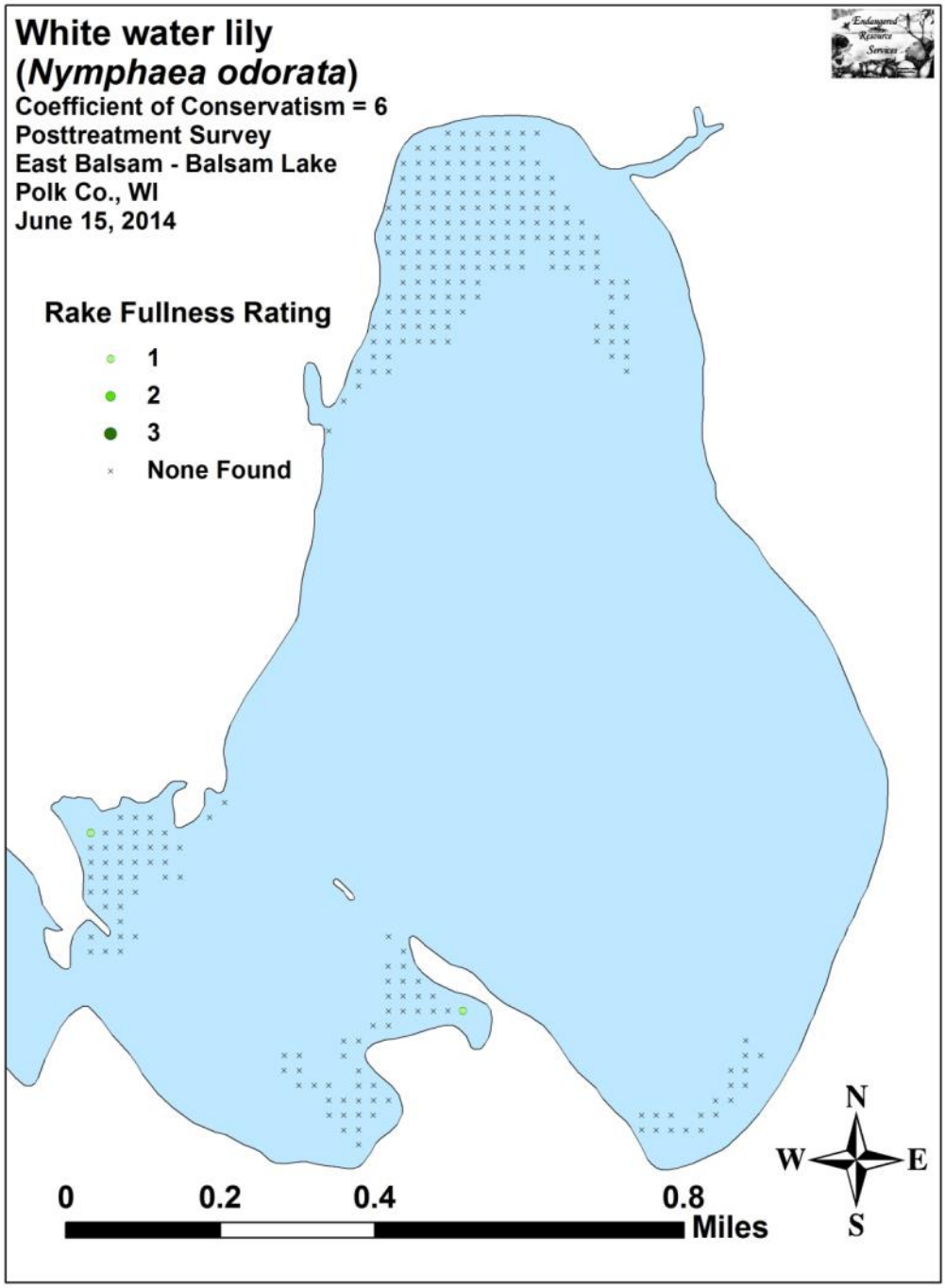

Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

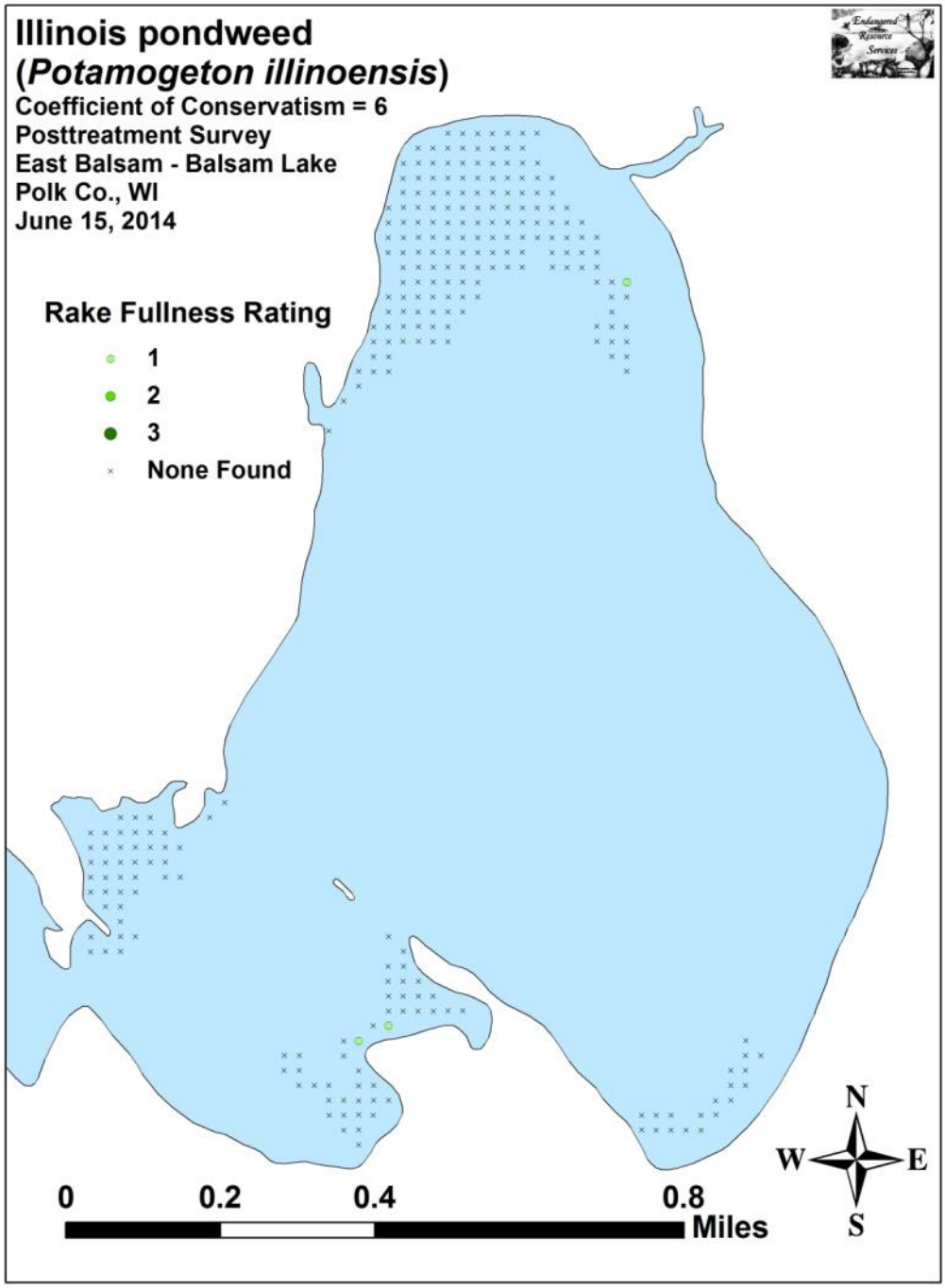

Filamentous algae
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

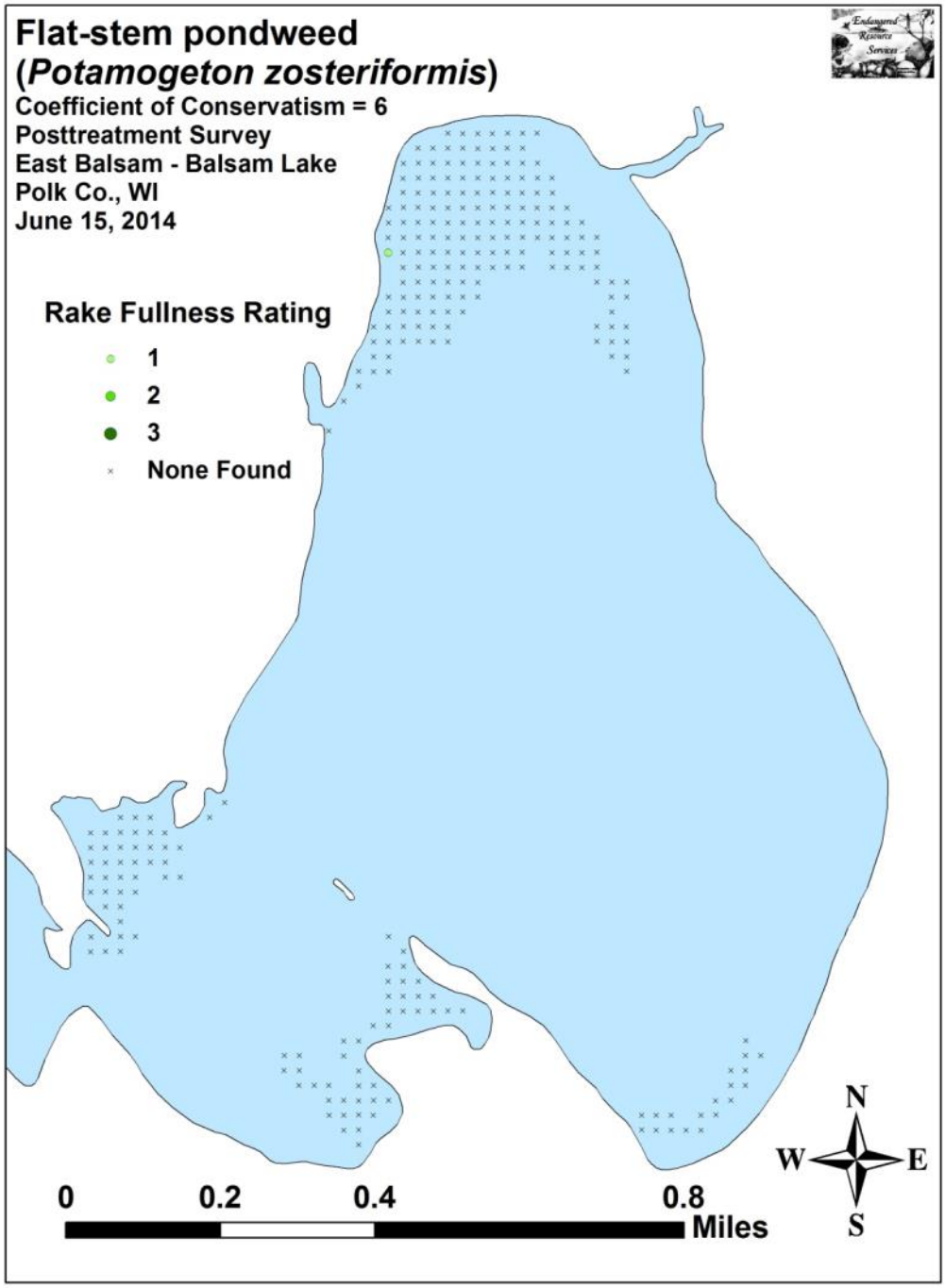

Water star-grass
(Heteranthera dubia)
Coefficient of Conservatism = 6
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

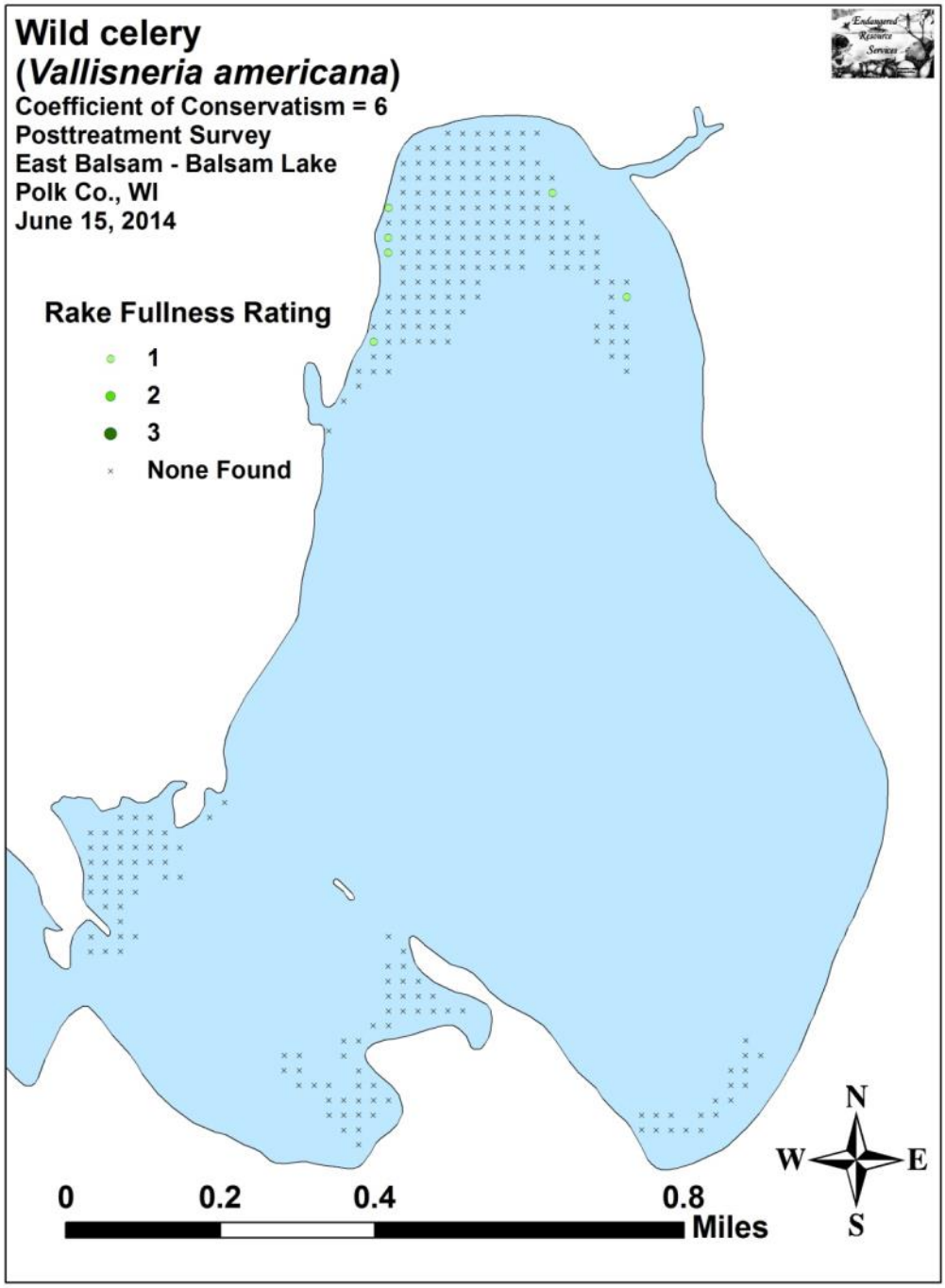

Forked duckweed
(Lemna trisulca)
Coefficient of Conservatism = 6
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S


Spatterdock
(Nuphar variegata)
Coefficient of Conservatism = 6
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

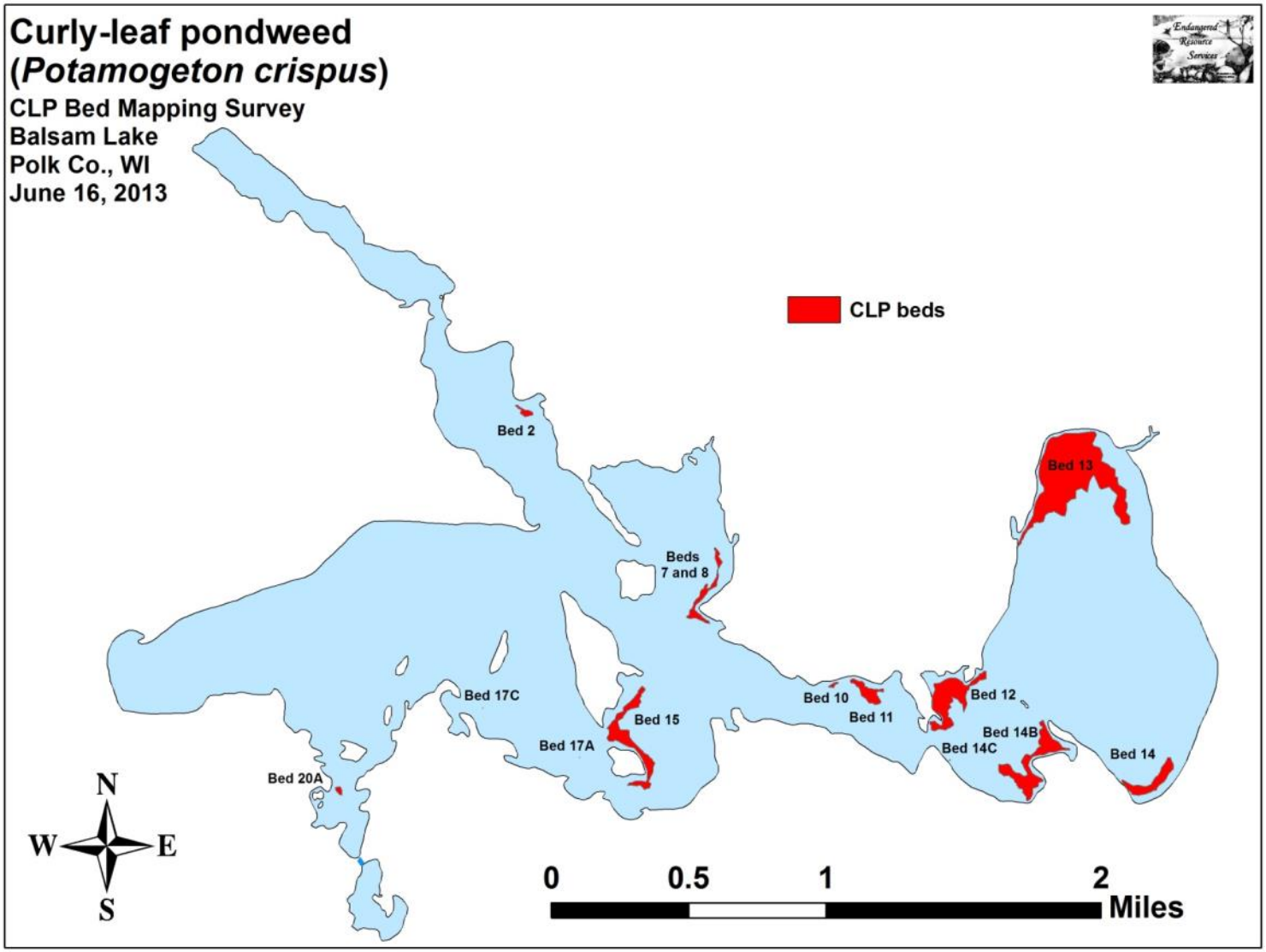

White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

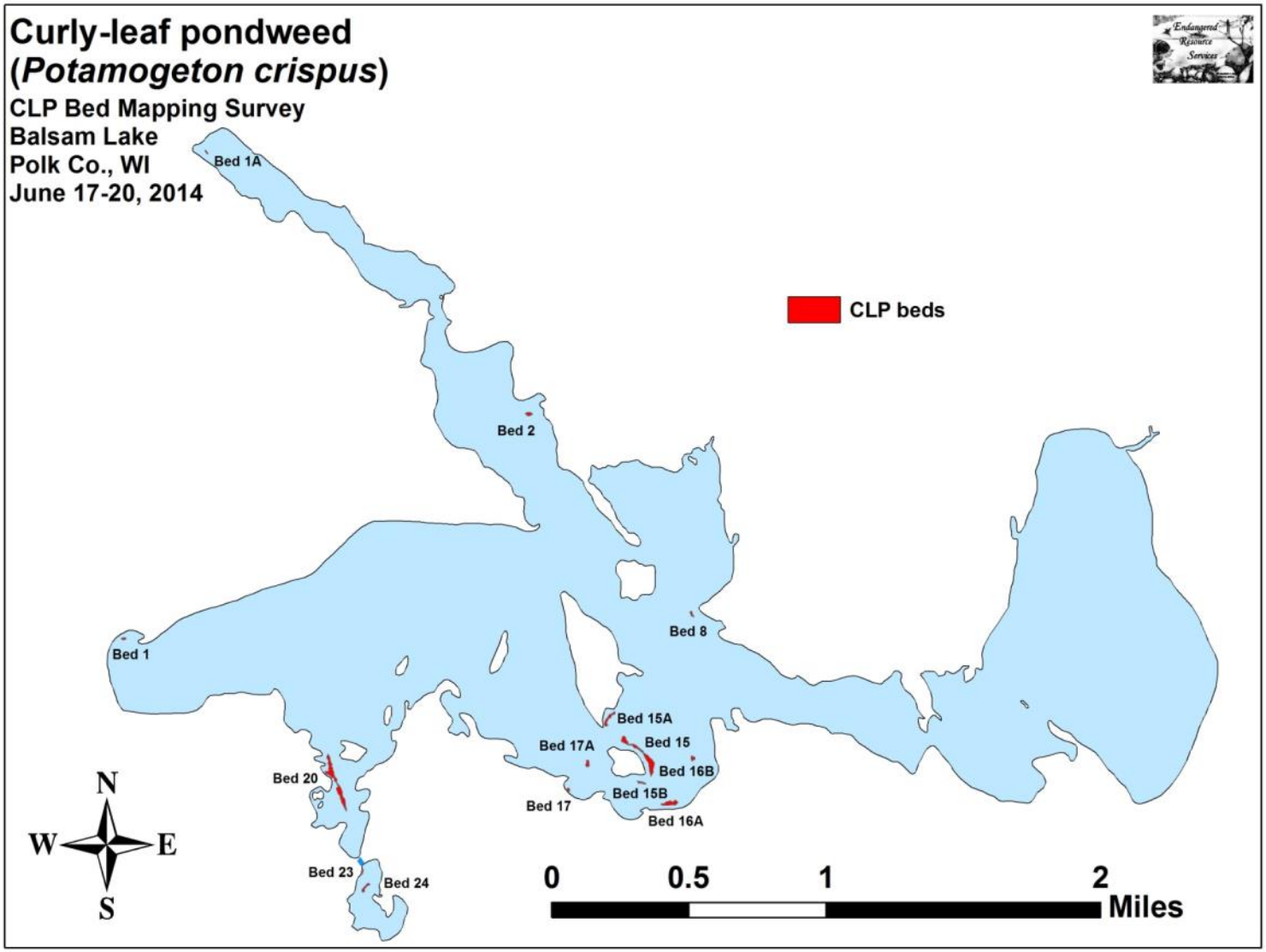

Illinois pondweed
(Potamogeton illinoensis)
Coefficient of Conservatism = 6
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S


Flat-stem pondweed
(Potamogeton zosteriformis)
Coefficient of Conservatism = 6
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S


Wild celery
(Vallisneria americana)
Coefficient of Conservatism = 6
Posttreatment Survey
East Balsam - Balsam Lake
Polk Co., WI
June 15, 2014
Rake Fullness Rating
1
2
3
None Found
0
0.2
0.4
0.8
Miles
N
W
E
S

Appendix VIII: 2013 and 2014 June CLP Bed Maps


Curly-leaf pondweed
(Potamogeton crispus)
CLP Bed Mapping Survey
Balsam Lake
Polk Co., WI
June 16, 2013
Endangered Resource Services
CLP beds
Bed 2
Beds 7 and 8
Bed 13
Bed 17C
Bed 15
Bed 17A
Bed 20A
Bed 10
Bed 11
Bed 12
Bed 14B
Bed 14C
Bed 14
N
W
E
S
0
0.5
1
2
Miles


Curly-leaf pondweed
(Potamogeton crispus)
CLP Bed Mapping Survey
Balsam Lake
Polk Co., WI
June 17-20, 2014
CLP beds
Bed 1A
Bed 2
Bed 8
Bed 1
Bed 15A
Bed 17A
Bed 15
Bed 16B
Bed 20
Bed 15B
Bed 17
Bed 16A
Bed 23
Bed 24
N
W
E
S
0
0.5
1
2
Miles