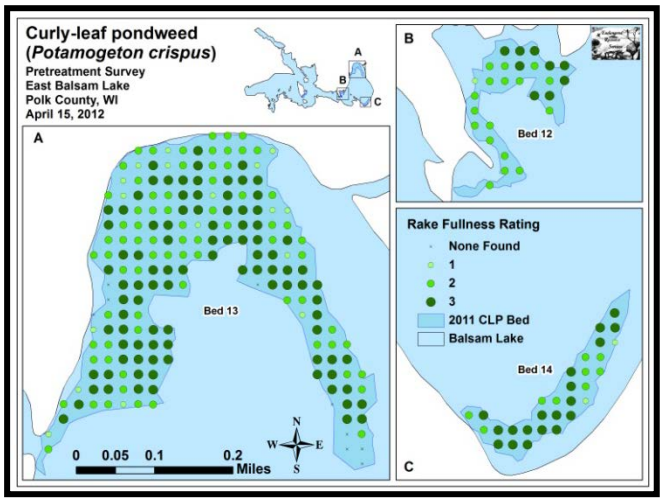
Curly-leaf Pondweed (*Potamogeton crispus*) Pre/Post Herbicide and Bed Mapping Surveys Balsam Lake - WBIC: 2620600 Polk County, Wisconsin

Spring 2012CLP Treatment Beds

Dead CLP – Posttreatment Survey in East Balsam

Project Initiated by:
Balsam Lake Protection and Rehabilitation District and the
Wisconsin Department of Natural Resources



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April 15, May 30, June 4-5, 9, 2012

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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, 2012). 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 2012 CLP Treatment Areas

In the spring of 2012, the Balsam Lake Protection and Rehabilitation District (BLPRD) and the Wisconsin Department of Natural Resources (WDNR) authorized the herbicide treatment of three Curly-leaf pondweed (*Potamogeton crispus*) (CLP) beds on East Balsam Lake totaling approximately 56 acres. These areas were selected based on the 2011 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 April 15th, we conducted a pretreatment survey and found that CLP was present throughout all three beds at levels justifying treatment. Following the herbicide applications on April 30th and May 2nd, we completed a May 30th posttreatment survey to evaluate the effectiveness of this control strategy. On June 4-5, and 9th, we returned to the lake, searched the visible littoral zone, and mapped all CLP beds found. These maps will guide any potential CLP management in 2013. This report is the summary analysis of these three field surveys.

METHODS:

Pre/Post Herbicide Survey:

Following a meeting with the lake's Aquatic Plant Management Committee Chair Milt Stanze (BLPRD), Chair apparent Loren Johnson and APMP author Cheryl Clemens (Harmony Environmental) where these three beds were selected for treatment, we used Hawth's Analysis Tools Extension to ArcGIS 9.3.1 to generate pre/post survey points at 30m resolution. The resulting sampling grid contained 253 points which approximated to 4.5 points/acre. This total was based on the WDNR protocol's expected 4-10 survey pts/acre for pre/post herbicide surveys (Figure 3) (Appendix I).

Following the establishment of the survey points, we uploaded them to a handheld mapping GPS unit (Garmin 76CSx), 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.

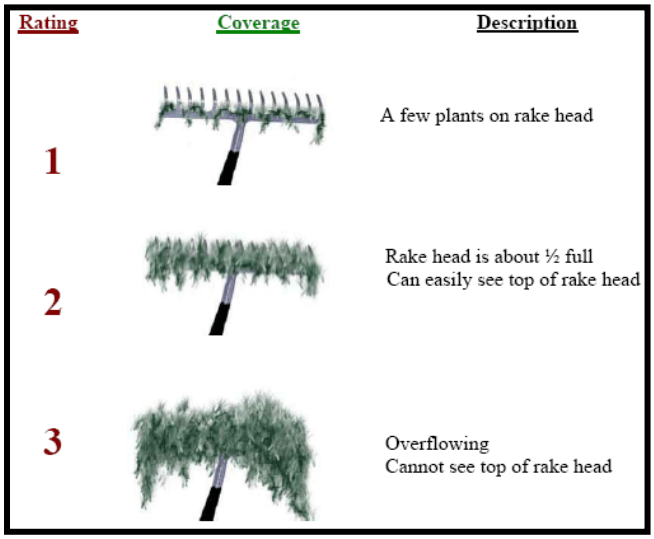


Figure 2: Rake Fullness Ratings (UWEX, 2010)

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.

Spring 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 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 used the WDNR's Forestry Tools Extension to determine the acreage of each bed to the nearest hundredth of an acre and the perimeter to the nearest meter. The resulting data will be used to determine if, where, and how to treat CLP in 2013.

RESULTS AND DISCUSSION:

CLP Pre/Post Herbicide Survey:

After touring the proposed treatment areas on April 15th, we found CLP was present throughout and opted to maintain all beds as originally proposed (Table 1) (Figure 3). All combined, these treatment areas covered 55.99 acres or approximately 2.73% of the lake's 2,054 total acres.

Table 1: 2012 Spring CLP Treatment Summary
Balsam Lake, Polk Co.

Bed Number	Proposed Bed Area (acres)	Final Bed Area (acres)	Final Bed Perimeter (meters)
12	5.91	5.91	1,479
13	43.14	43.14	3,306
14	6.94	6.94	1,163
	55.99	**55.99**	

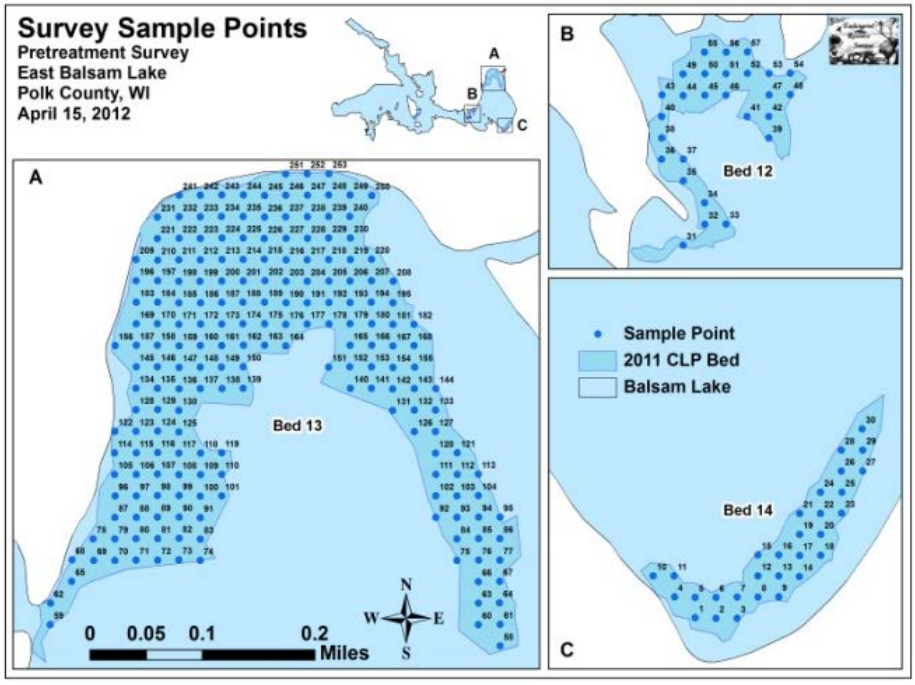


Figure 3: 2012 Pre/Post Survey Points and CLP Treatment Areas

Treatment occurred on April 30th and May 2nd, 2012 with Lake Restoration, Inc. (Rogers, MN) applying Aquathol K (Endothall) at a rate of 1.5 ppm (416.2 total gallons). The reported water temperatures at the time of treatment were 52.0°F on the 30th and 55.6°F on the 2nd. Both of these values were well within the recommended treatment temperature range of 50 - 60°F. Wind speeds were reported to be 0-5mph and 0-6mph respectively.

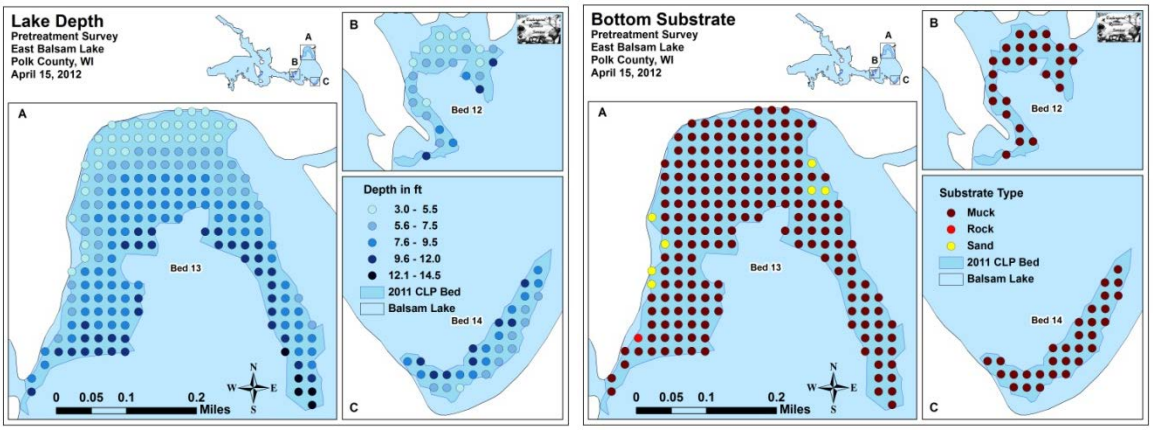


Figure 4: Treatment Area Depths and Bottom Substrate

All beds occurred in areas between 3.0 and 14.5ft of water. Within those beds, plants grew at a mean depth of 7.9ft and a median depth of 8.0ft during the pretreatment survey (Table 2). The thickest areas of CLP were established over organic muck, but we also found plants along the sandy/rocky areas on the east/west borders of Bed 13 (Figure 4) (Appendix III).

Table 2: Pre/Post Survey Summary Statistics
Balsam Lake, Polk County
April 15 and May 30, 2012

Summary Statistics:	Pre	Post
Total number of points sampled	253	253
Total number of sites with vegetation	249	167
Total number of sites shallower than the maximum depth of plants	253	244
Frequency of occurrence at sites shallower than maximum depth of plants	98.42	68.44
Simpson Diversity Index	0.79	0.58
Floristic Quality Index	21.7	11.6
Maximum depth of plants (ft)	14.5	11.5
Average number of all species per site (shallower than max depth)	2.83	0.95
Average number of all species per site (veg. sites only)	2.88	1.38
Average number of native species per site (shallower than max depth)	1.87	0.94
Average number of native species per site (veg. sites only)	2.12	1.38
Species Richness	13	6
Mean depth of plants (ft)	7.9	7.4
Median depth of plants (ft)	8.0	7.5
Mean Rake Fullness	2.76	1.34

The pretreatment littoral zone in the three beds extended to over 14.5ft. However, posttreatment, it had receded to only 11.5ft (Figure 5) (Appendix III). Even in this narrower posttreatment littoral zone, the frequency of plants encountered declined from over 98.42% to 68.44%. Species richness also declined from 13 pretreatment to 6 posttreatment. These losses in richness and distribution resulted in a decline in the Simpson's Diversity Index from a moderate pretreatment value of 0.79 to a low posttreatment value of 0.58. The pretreatment Floristic Quality Index (another measure of plant community health) of 21.7 was nearly cut in half to 11.6 posttreatment.

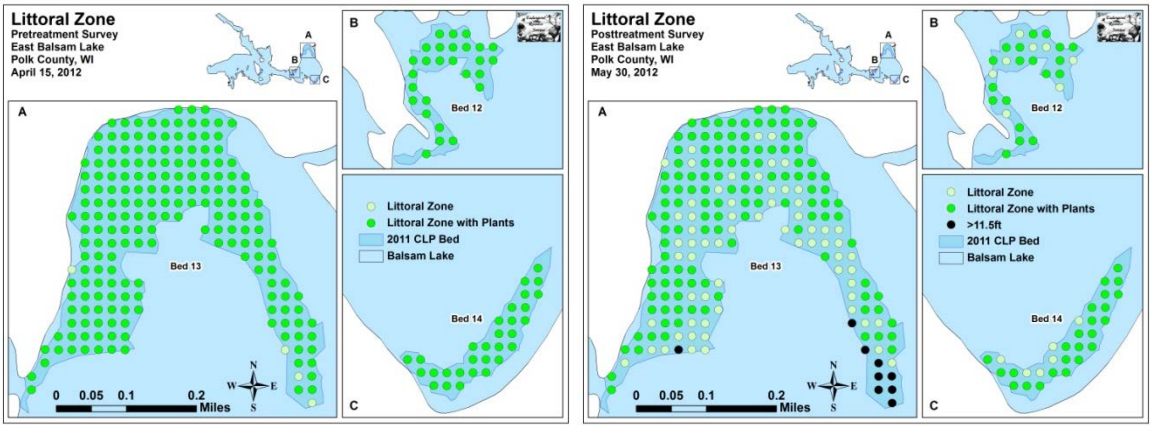


Figure 5: Pre/Post Littoral Zone

In a similar fashion, pretreatment mean native species richness declined from 2.12/vegetative site to 1.38 native species/vegetative site posttreatment (Figures 6). Total mean rake fullness also declined from a very dense 2.76 pretreatment to a sparse 1.34 posttreatment (Figures 7) (Appendix IV).

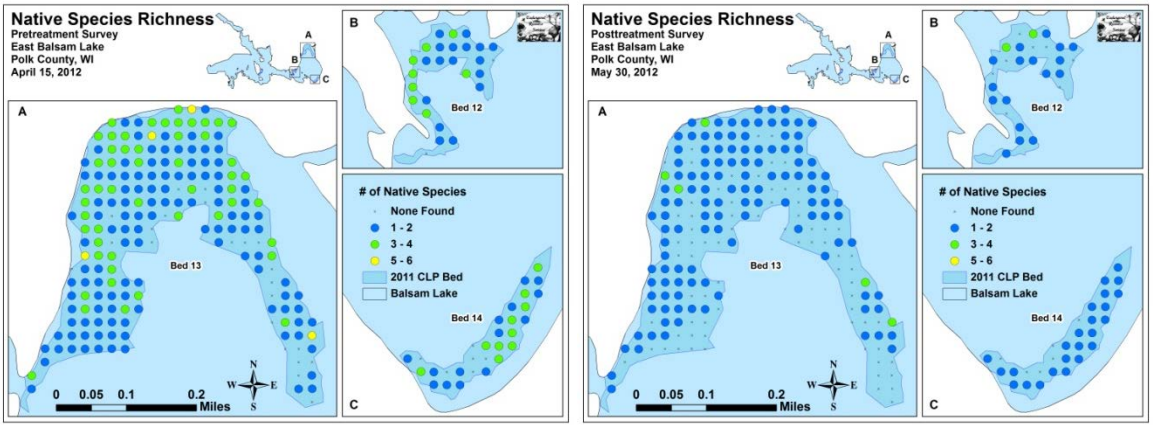


Figure 6: Pre/Post Native Species Richness

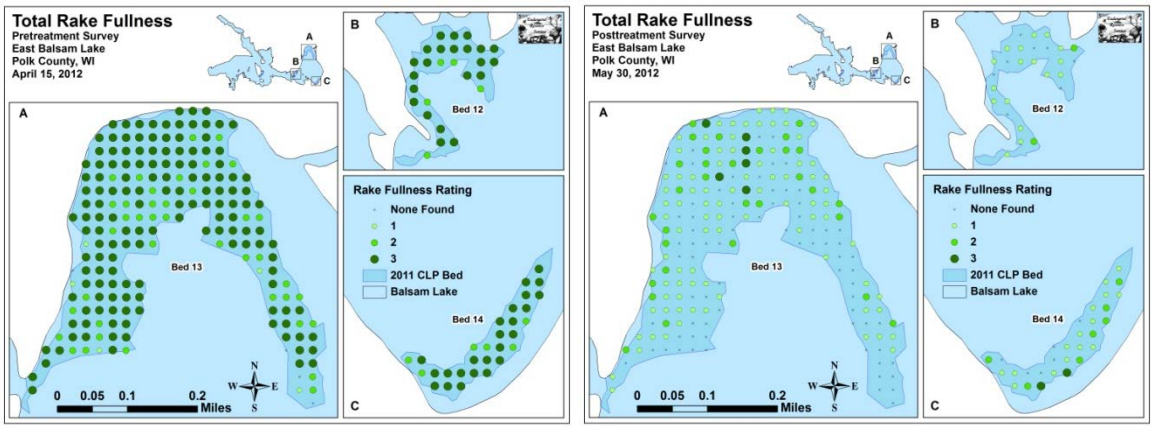


Figure 7: Pre/Post Total Rake Fullness

We found CLP at 244 of 253 sites (96.4%) during the pretreatment survey (Figures 8) (Appendix V). Of these, 124 had a rake fullness rating of 3, 100 rated a 2, and 20 a 1. During the posttreatment survey, we found a single surviving CLP plant. It was only two inches long and appeared to be recently sprouted from a turion. Our findings demonstrated a highly significant reduction of total CLP, as well as rake fullness 3, 2, and 1 (Figure 9) (Table 3). CLP detritus was present at almost every site, but we did not find any evidence of fresh green turions that would indicate any CLP plants survived long enough to develop these overwintering buds (Figure 10).

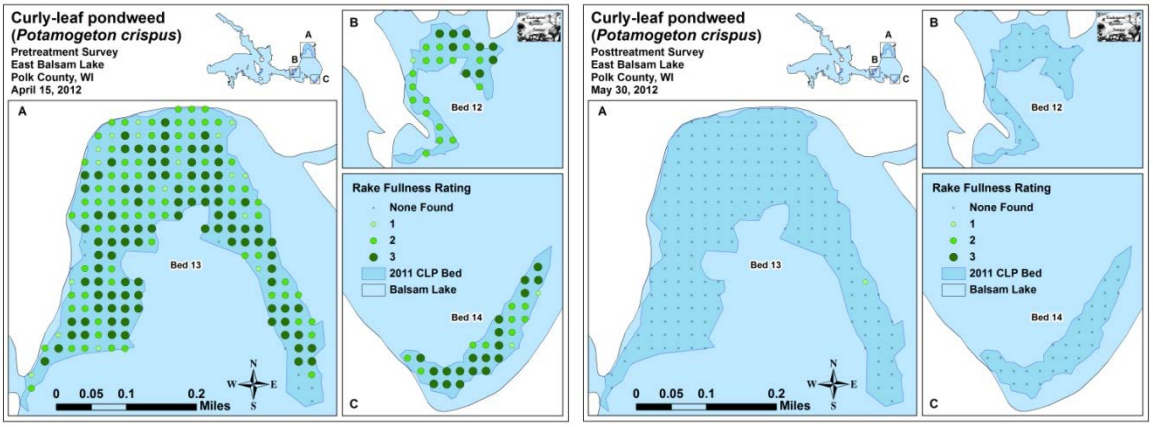
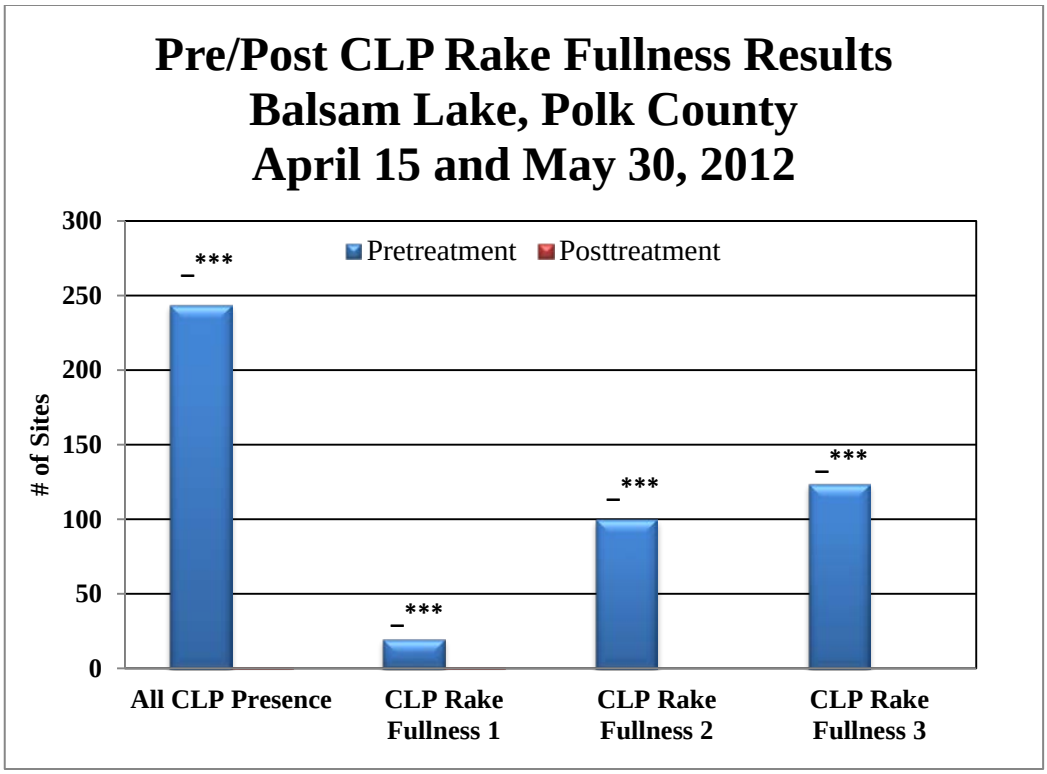


Figure 8: Pre/Post CLP Density and Distribution



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

Figure 9: Changes in CLP Rake Fullness Ratings

Figure 10: CLP Detritus in Bed 13 – May 30, 2012

Table 3: 2012 Individual Bed Pre/Post
CLP Frequency and Mean Rake Summary Comparison
Balsam Lake, Polk Co.

		Pretreatment			Posttreatment				
Bed Number	**# of Survey Points**	**Points with CLP**	**CLP Freq.**	**Mean Rake**	**Points with CLP**	**CLP Freq.**	**Mean Rake**	**Change in CLP Freq.**	**Change in Mean Rake**
12	27	27	100.0	2.30	0	0.00	0.00	**-100.00**	**-2.30**
13	196	187	97.40	2.42	1	0.53	1.00	**-96.87**	**-1.42**
14	30	30	100.0	2.57	0	0.00	0.00	**-100.00**	**-2.57**

Coontail (*Ceratophyllum demersum*), the second most common native species in both the pre and posttreatment surveys was significantly impacted by the herbicide although some sizable patches did survive on the north-central end of Bed 13 (Tables 4 and 5) (Figure 11). Common waterweed (*Elodea canadensis*) was the only species that was present pretreatment that showed an increase posttreatment and it was not significant (Figure 12). The only other species we documented an increase in was Wild celery (*Vallisneria americana*). This change was not significant and was likely due to normal growing season expansion as celery sprouts from turions and is a later growing species.

All other species present in the pretreatment survey, with the exception of White-stem pondweed (*Potamogeton praelongus*), were either significantly reduced or, as was the case with the high value native species Northern water milfoil (*Myriophyllum sibiricum*), Small pondweed (*Potamogeton pusillus*), Fern pondweed (*Potamogeton robbinsii*), Illinois pondweed (*Potamogeton robbinsii*), Flat-stem pondweed (*Potamogeton zosteriformis*), Large-leaf pondweed (*Potamogeton amplifolius*), and White water crowfoot (*Ranunculus aquatilis*), **completely eliminated** (Figures 13). Maps of all species from the pre and posttreatment surveys can be found in Appendixes VI and VII.

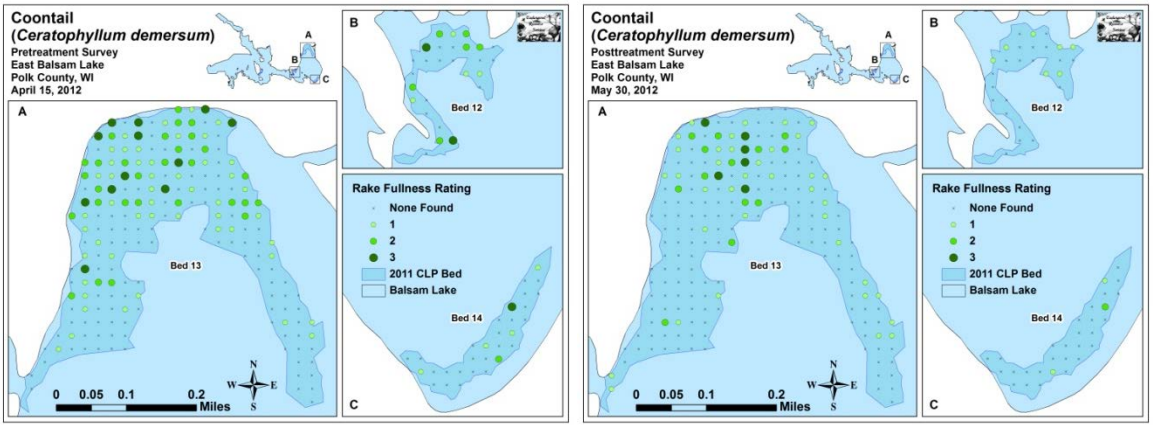


Figure 11: Pre/Post Coontail Density and Distribution

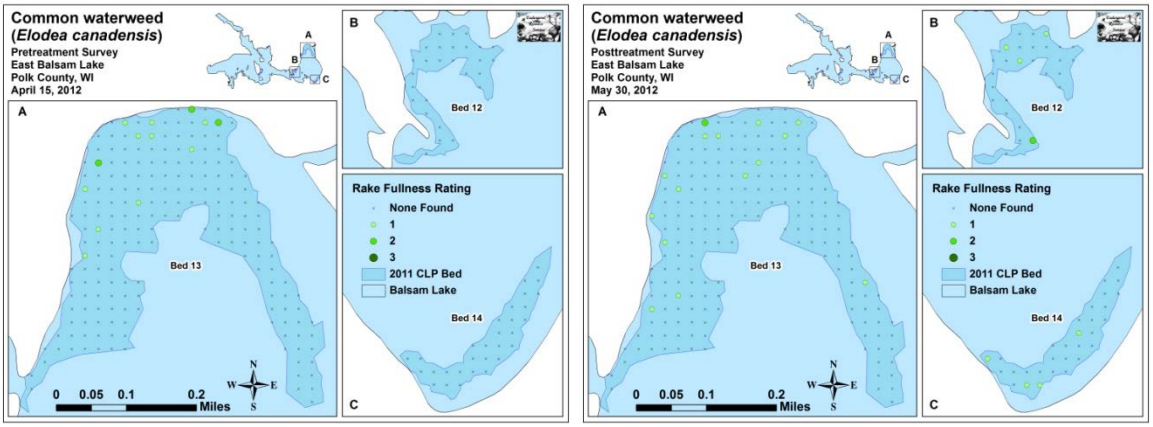


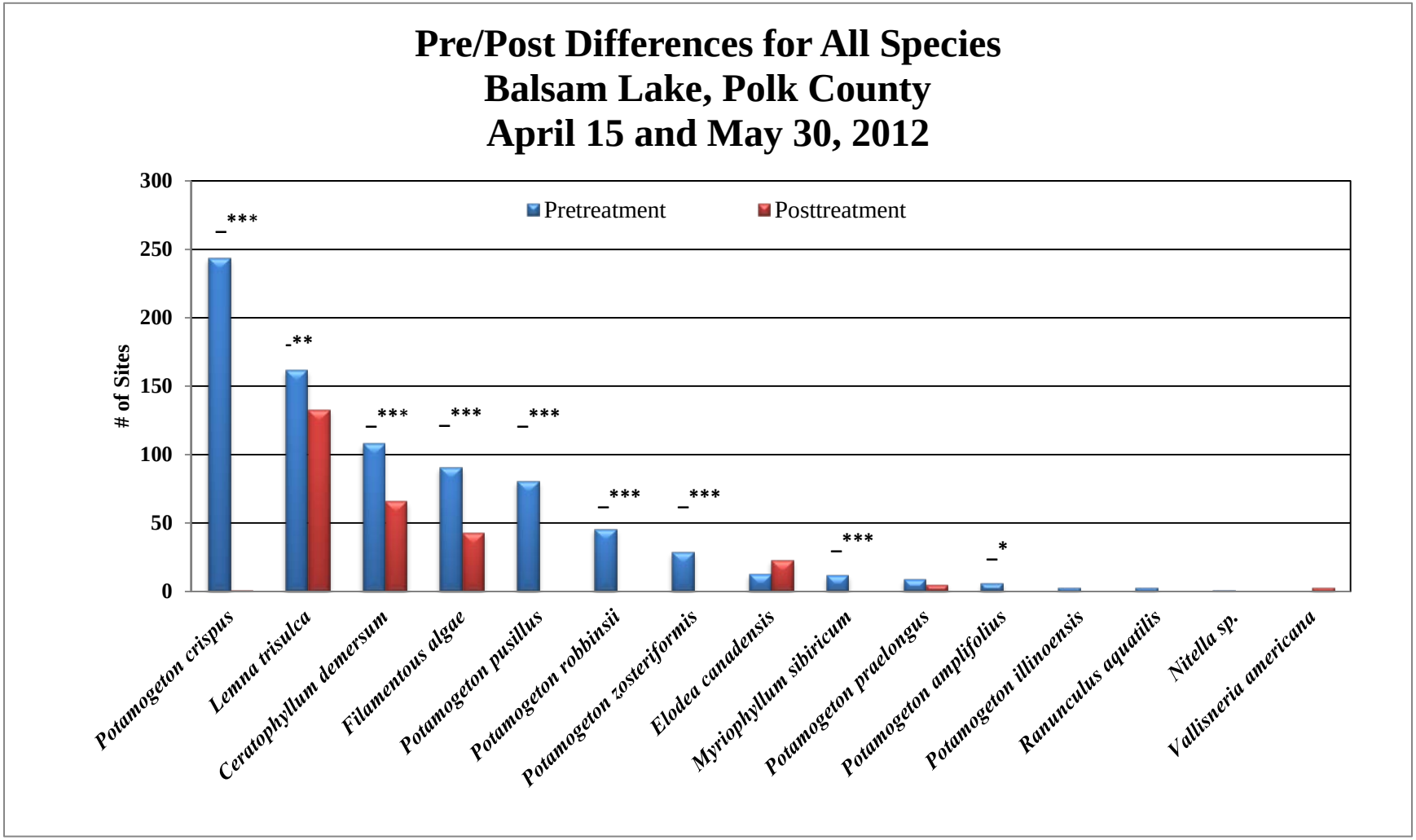
Figure 12: Pre/Post Common waterweed Density and Distribution

Table 4: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Pretreatment Survey - Balsam Lake, Polk County
April 15, 2012

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Potamogeton crispus	Curly-leaf pondweed	244	34.03	97.99	96.44	2.43
Lemna trisulca	Forked duckweed	162	22.59	65.06	64.03	1.73
Ceratophyllum demersum	Coontail	108	15.06	43.37	42.69	1.61
	Filamentous algae	91		36.55	35.97	1.88
Potamogeton pusillus	Small pondweed	81	11.30	32.53	32.02	1.25
Potamogeton robbinsii	Fern pondweed	46	6.42	18.47	18.18	1.70
Potamogeton zosteriformis	Flat-stem pondweed	29	4.04	11.65	11.46	1.21
Elodea canadensis	Common waterweed	13	1.81	5.22	5.14	1.23
Myriophyllum sibiricum	Northern water-milfoil	12	1.67	4.82	4.74	1.33
Potamogeton praelongus	White-stem pondweed	9	1.26	3.61	3.56	1.00
Potamogeton amplifolius	Large-leaf pondweed	6	0.84	2.41	2.37	1.00
Potamogeton illinoensis	Illinois pondweed	3	0.42	1.20	1.19	1.00
Ranunculus aquatilis	White water crowfoot	3	0.42	1.20	1.19	1.33
Nitella sp.	Nitella	1	0.14	0.40	0.40	1.00

Table 5: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Posttreatment Survey - Balsam Lake, Polk County
May 30, 2012

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Lemna trisulca	Forked duckweed	133	57.58	79.64	54.51	1.22
Ceratophyllum demersum	Coontail	66	28.57	39.52	27.05	1.39
	Filamentous algae	43		25.75	17.62	1.79
Elodea canadensis	Common waterweed	23	9.96	13.77	9.43	1.09
Potamogeton praelongus	White-stem pondweed	5	2.16	2.99	2.05	1.00
Vallisneria americana	Wild celery	3	1.30	1.80	1.23	1.00
Potamogeton crispus	Curly-leaf pondweed	1	0.43	0.60	0.41	1.00
Lemna trisulca	Forked duckweed	133	57.58	79.64	54.51	1.22



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

Figure 13: Pre/Post Macrophyte Changes

Spring CLP Bed Mapping Survey:

Curly-leaf pondweed appeared to have excellent growing conditions as it was common throughout Balsam Lake in 2012. We located and mapped a total of 20 beds ranging in size from 0.08 acre (Bed 15A southeast of Big Island) to 8.70 acres (Bed 15 east of Big Island/north of Paradise Island) (Appendix VIII). All combined, these beds covered a total of 28.21 acres or 1.4% of the lake's 2,054 total acres (Table 6) (Figure 14). Several historic beds that had little to no CLP in 2011 returned to canopied beds in 2012.

Table 6: CLP Bed Summary
Balsam Lake, Polk Co. June 4-5, 9, 2012

Bed #	Location	2012 Area (Acres)	2011 Area	Change in Area	Est. Mean Rake-full	Years Treated	Acreage Treated
1	HWY 46 Landing	0.58	0.00	0.58	<1-2	2011	1.81
2	Boston Bay	1.23	0.08	1.15	1-3	-	-
3	Stump Bay	0.00	0.00	0.00	<1-1	-	-
4	Stump Bay	0.37	0.00	0.37	<1-3	-	-
5	Stump Bay	0.30	0.00	0.30	<1-3	-	-
6	Stump Bay	0.00	0.00	0.00	<1-1	-	-
7	East Shore Stump Bay	2.58	0.00	2.58	2-3	-	-
8	Stump Bay Outlet	2.33	0.00	2.33	2-3	-	-
9	NW of Big Narrows	0.19	0.00	0.19	<1-3	2011	0.11
10	NW of Big Narrows	0.00	0.00	0.00	0	2011	0.22
11	Bay NW of Big Narrows	4.72	1.04	3.68	<1-3	2011, '10	2.80, 2.85
12	Bay NE of Big Narrows	0.00	5.91	**-5.91**	0	2012	5.91
13	N. Bay of East Balsam	0.00	43.14	**-43.14**	0	2012	43.14
14	SE Bay of East Balsam	0.00	6.95	**-6.95**	0	2012	6.95
14B	Bay SE of Big Narrows	0.00	0.00	0.00	0	2011, '09	3.07, 11.38
15	SE of Big Island	8.70	3.80	4.90	<1-3	-	-
15A	SE of Big Island	0.08	0.00	0.08	<1-3	-	-
16	Bay S. of Paradise Island	0.65	0.00	0.65	2-3	2011	1.26
17	Bay SW of Paradise Island	0.00	0.00	0.00	<1	-	-
17A	West of Paradise Island	1.86	0.00	1.86	1-3	-	-
17B	Raskin Bay	0.00	0.26	**-0.26**	<1-2	-	-
17C	Raskin Bay Outlet	1.04	0.00	1.04	1-3	-	-
18	Channel E. of Pine Island	0.00	0.00	0.00	<1	2011, '10	0.59, 0.57
19A , B	Channel E. of First Island	0.98	0.00	0.98	<1-3	2011, '10	4.87, 4.55
20, 20A	East of Idlewild Bay	0.10	0.00	0.10	<1-2	2011	4.26
21	N. of Village Beach	0.00	0.00	0.00	<1	-	-
22	Northwest Mill Pond	0.40	0.00	0.40	1-3	-	-
23	Northeast Mill Pond	0.43	0.00	0.43	1-3	-	-
24	Mill Pond Point	1.37	0.00	1.37	1-3	-	-
25	Southeast Mill Pond	0.30	0.00	0.30	1-3	-	-
	Total	**28.21**	**61.18**	**-32.97**			

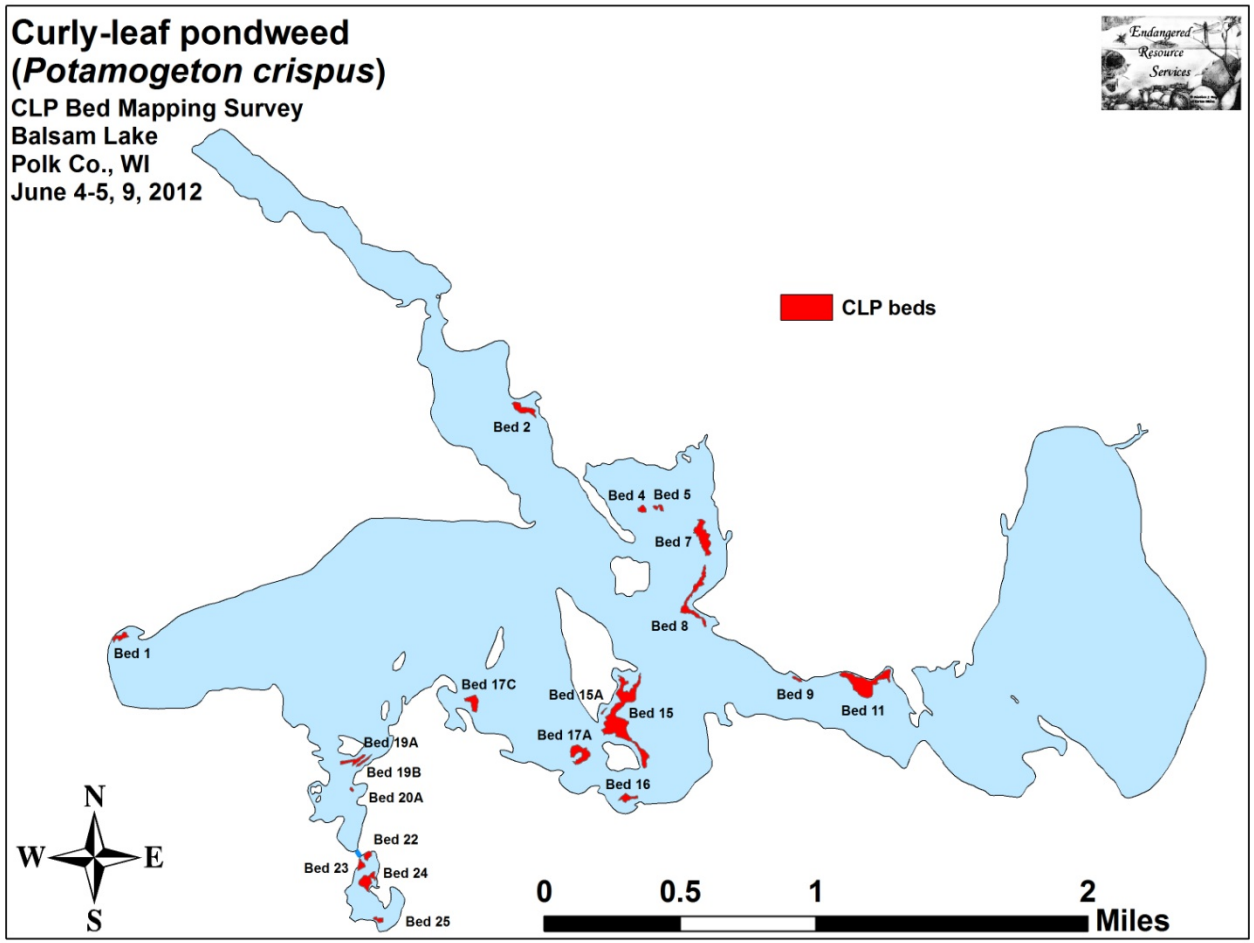


Figure 14: 2012 Balsam Lake June CLP Beds

Description of Past and Present CLP Beds:

Bed 1 – This area was somewhat patchy – perhaps because plants were prop clipped/pulled out throughout the area. CLP made up about 50% of plants with canopied Coontail composing the bulk of the rest.

Bed 2 – Dense monotypic canopied CLP was present in the heart of bed. This became somewhat fragmented on the outer edge and mixed with Coontail. The inner edge was almost entirely prop clipped from residents accessing the lake.

Beds 3, 6 – Widely scattered CLP was the only thing of note in these former beds. The areas were neither canopied nor monotypic.

Beds 4, 5 – These small beds were somewhat fragmented, but were easily >50% CLP. They were both out of the way, easily avoided, and showed no prop clipping.

Beds 7 and 8 – Located along the east shoreline of Stump Bay, this area was heavily utilized by people fishing. There were some prop trails throughout as plants were canopied in up to 9ft of water, but residents along the east shoreline had a natural channel to access the main lake along the shore as these sandy/sandy muck areas did not support dense CLP growth. Plants ended abruptly on the south side at the drop off.

Beds 9, 10, and 11 – Beds 9 and 11 were both canopied and an impediment to navigation while Bed 10 had little CLP in it. Areas in Bed 11 that were treated successfully in 2011 were mixed with natives while areas on the outer edge that were unsuccessfully treated were again dense, canopied and monotypic. This bed appeared to have expanded further into deep water.

Beds 12, 13, 14, and 14B – All of East Balsam's CLP beds showed complete control – including Bed 14B which wasn't treated. Despite raking outside of the treatment areas during the post treatment survey, we failed to locate any viable CLP that was more than a few inches tall anywhere in East Balsam - a dramatic change from 2011 (Figure 15).

Figure 15: 2011/2012 Representative East Balsam Lake CLP Growth

Bed 15 and 15A - Located on the east and southeast shore of Big Island, this bed was dense, canopied, mostly monotypic, and had well defined borders where the lake dropped off into deep water. It was loaded with panfish and was difficult to survey because there were always boats fishing in the area. Since last year, the bed had expanded and wrapped around the east corner of Paradise Island. There were prop trails throughout as plants were canopied in 8ft of water. Nearer shore in water <4ft, CLP became mixed with natives. A narrow channel separated 15 and 15A, and may have been created by boats. This area was one of the densest this spring and may be a consideration for treatment in 2013.

Bed 16 – CLP plants were canopied throughout, but were somewhat scattered in distribution. Most were prop clipped so we believe the bed was likely denser earlier in the year.

Bed 17 – This bed never formed in 2011 or 2012, and we didn't see many CLP plants anywhere in the area.

Bed 17A – This area has always had CLP, but it was never canopied and filled in like this year. A large, high value Hardstem bulrush (*Schoenoplectus acutus*) bed is located inside the "horseshoe" and should be protected. In other words, if treatment is desired here, it should be as early in the year as possible to avoid damaging this fish spawning habitat.

Bed 17B – In 2009, there were almost no CLP plants in Raskin Bay, but, in 2011, a small patch grew up in the bay's entrance. In 2012, the whole bay was again choked with plants, but CLP was only scattered/patchy. If herbicide treatment is used to create navigation channels in 2013, it would likely also eliminate the majority of the CLP bed in the bay as these plants are primarily found in the disturbed areas created by boats entering/leaving the bay.

Beds 18, 19 and 20 – Bed 18 continued to be almost entirely free of CLP while Beds 19 and 20 have started to fill back in. A boat made navigation path separated 19A and 19B, and most plants were clipped. On the south side of First Island, CLP was canopied in over 9ft of water.

Bed 21 – There were again very few CLP plants north of the village beach.

Beds 22-25 – CLP was very dense in the Mill Pond this year for the first time since we started surveying in 2009. These four beds were all dense, canopied, and nearly monotypic. Beds 23 and 24 by the Thirsty Otter were especially difficult to navigate throughout/around.

LITERATURE CITED

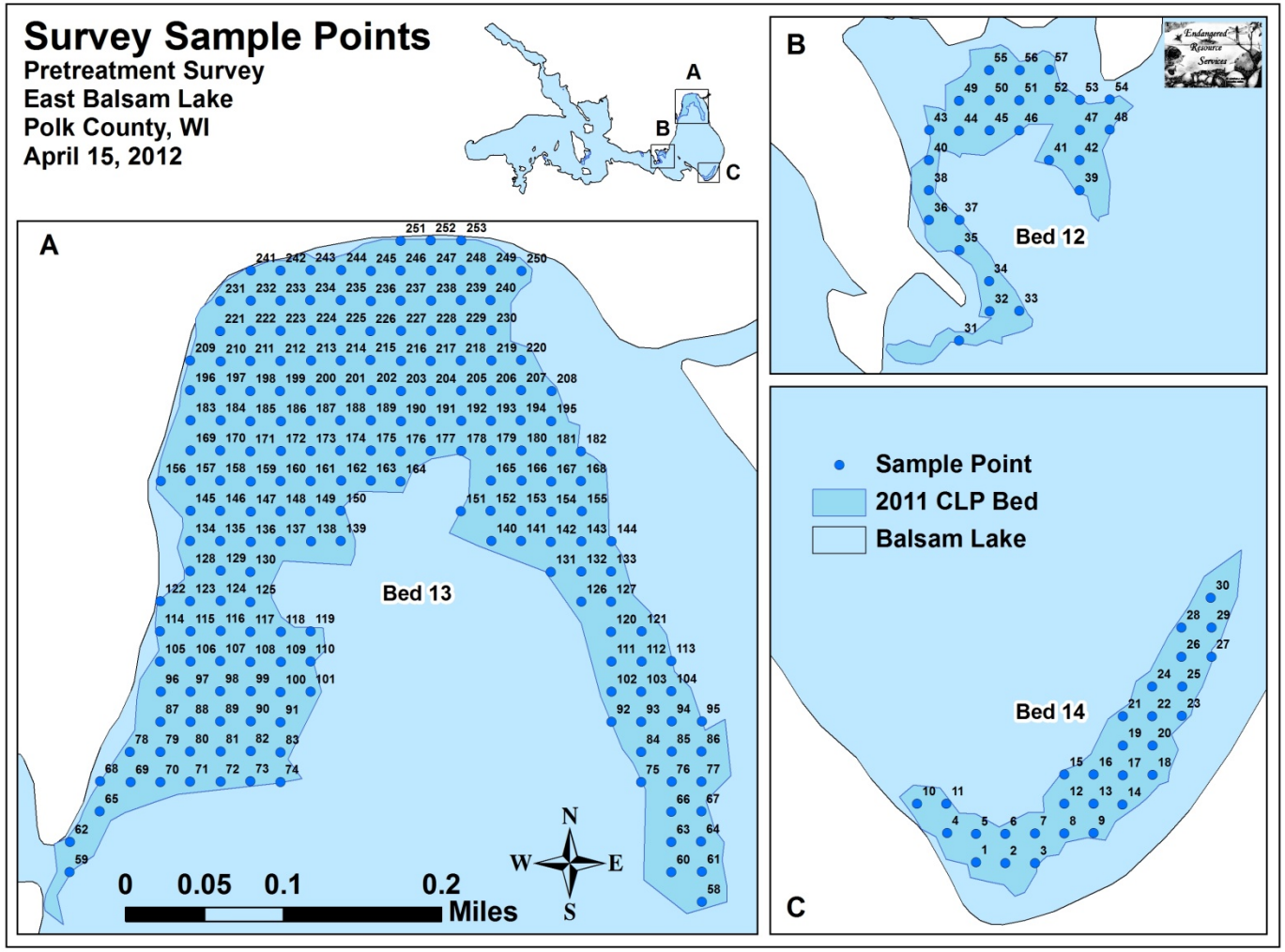
Hopke, R., E. Nelson, and E. Eaton [online]. 1964. Balsam Lake Maps. Available from http://www.dnr.state.wi.us/org/water/fhp/lakes/lakemap/2620600a.pdf (2010, June).

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]. 2012. Citizen Monitoring Lake Water Quality Database. Available from http://dnr.wi.gov/lakes/CLMN/Station.aspx?id=493056 (2012, November).

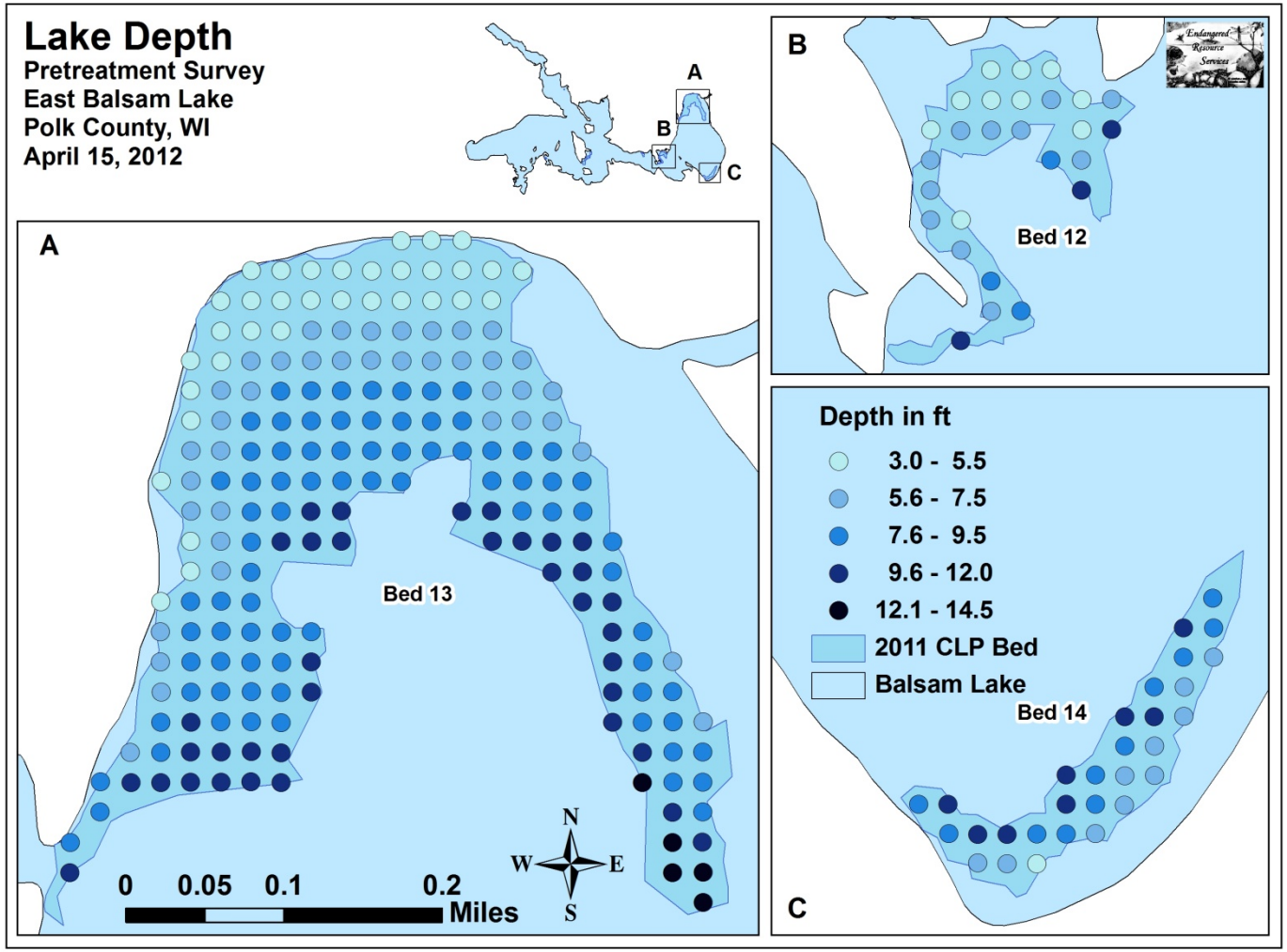
Appendix I: CLP Pre/Post Survey Areas with Survey Sample Points

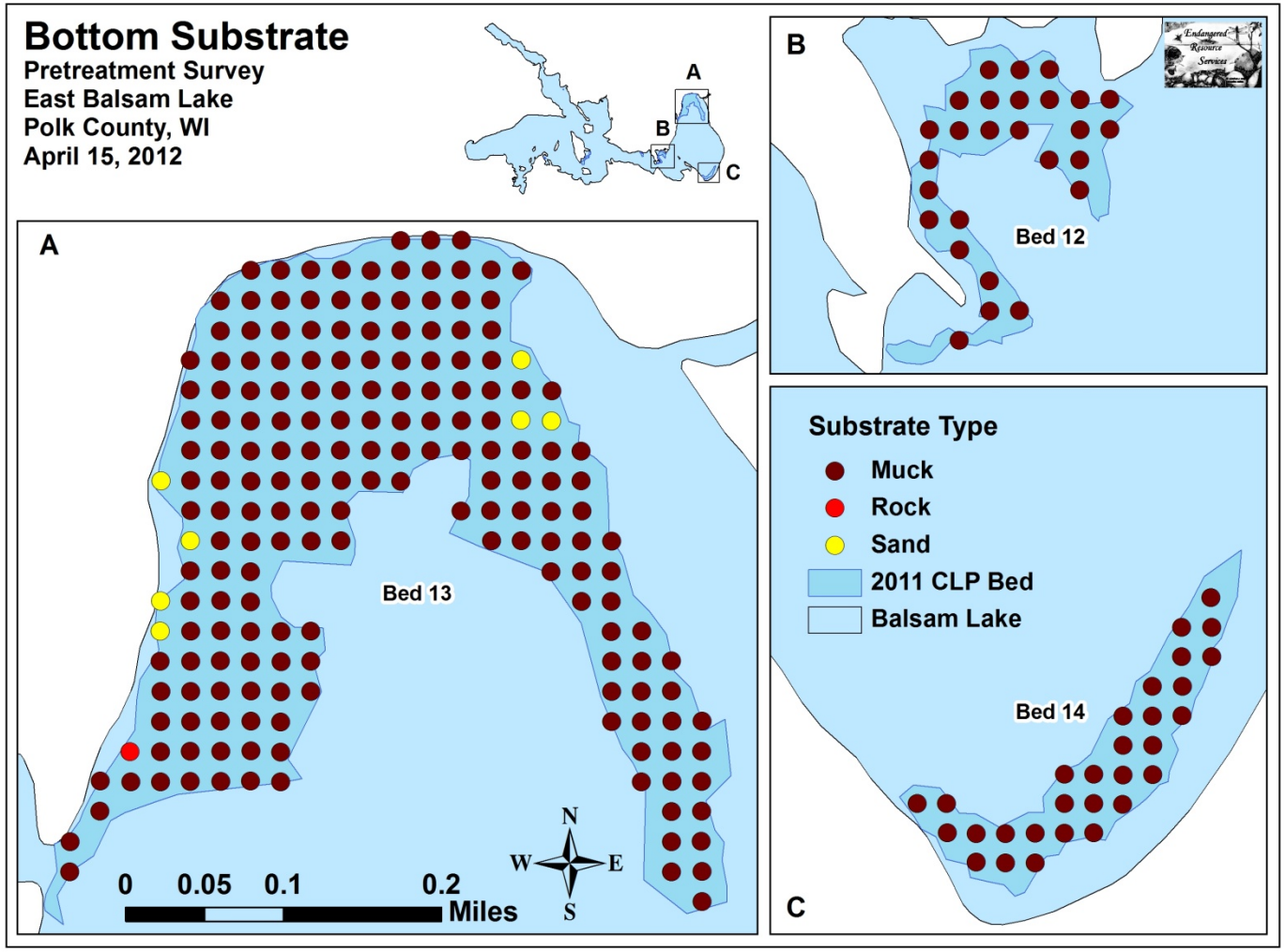

Survey Sample Points
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
Bed 13
Bed 12
Bed 14
Sample Point
2011 CLP Bed
Balsam Lake
N
S
E
W
0 0.05 0.1 0.2
Miles

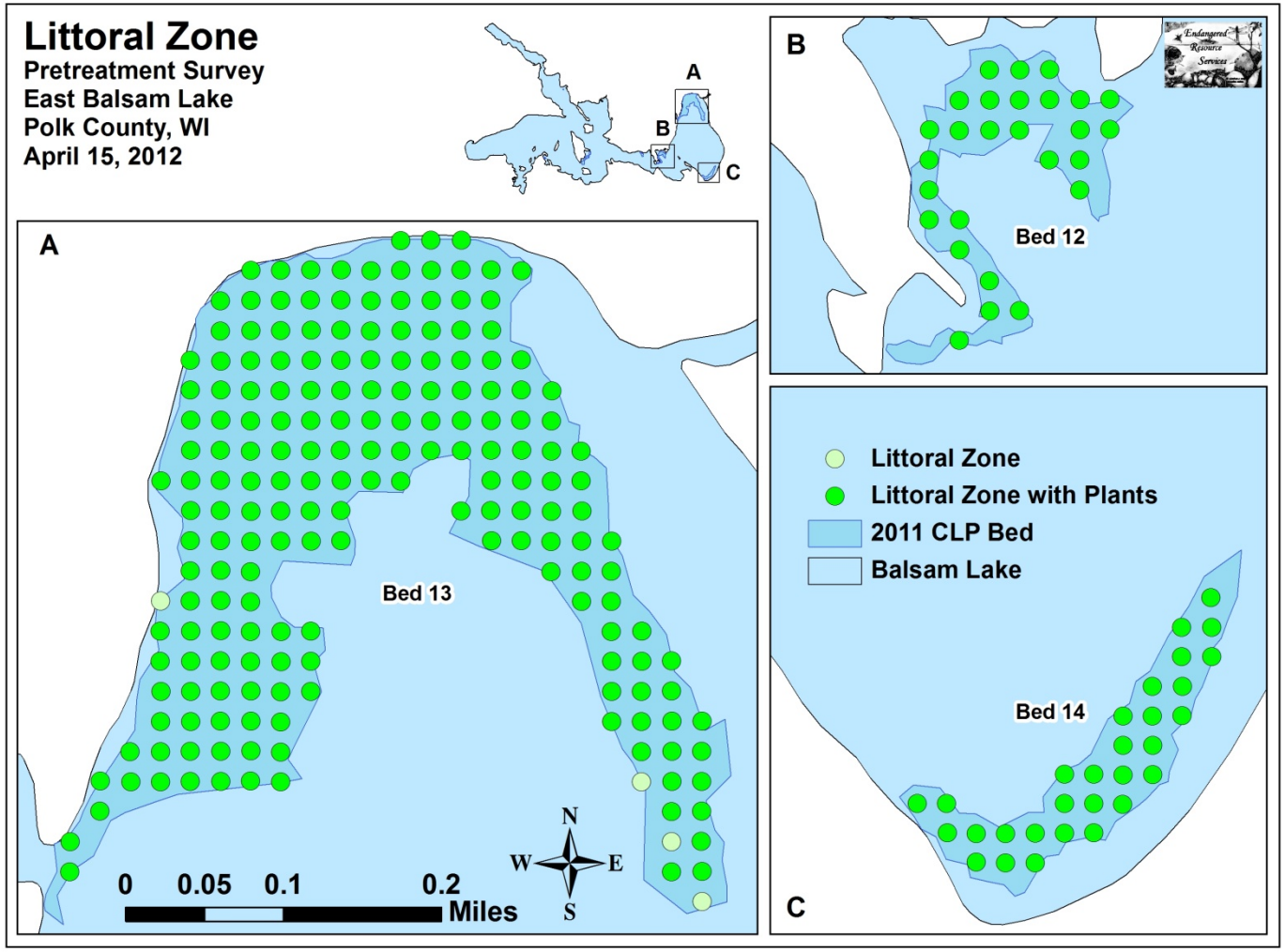
Appendix II: Vegetative Survey Data Sheet

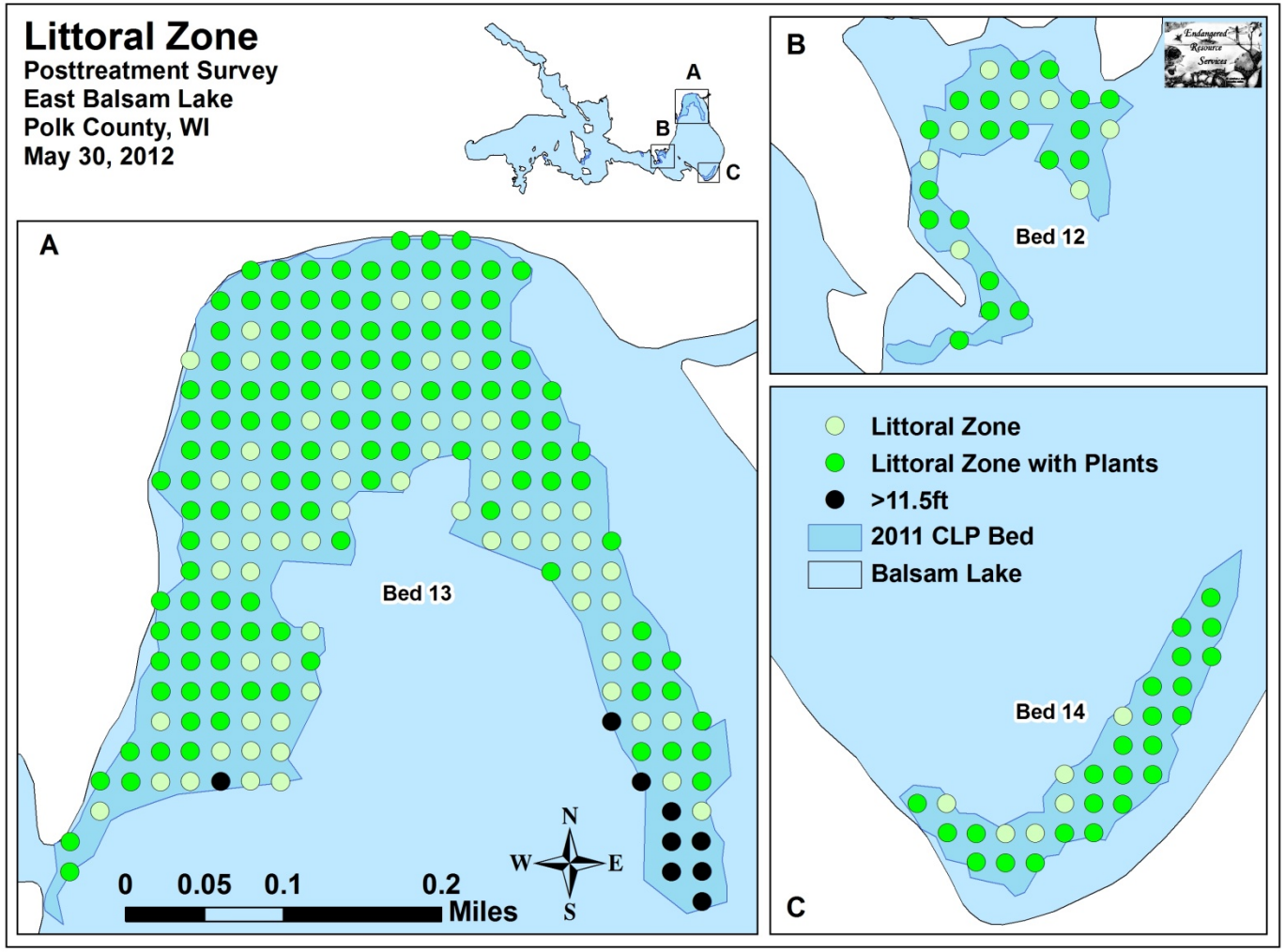
Observers for this lake: names and hours worked by each:																										
Lake:									WBIC									County						Date:	
Site #	Depth (ft)	Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	Total Rake Fullness	CLP	CLP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1																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

Appendix III: Pre/Post Habitat Variables

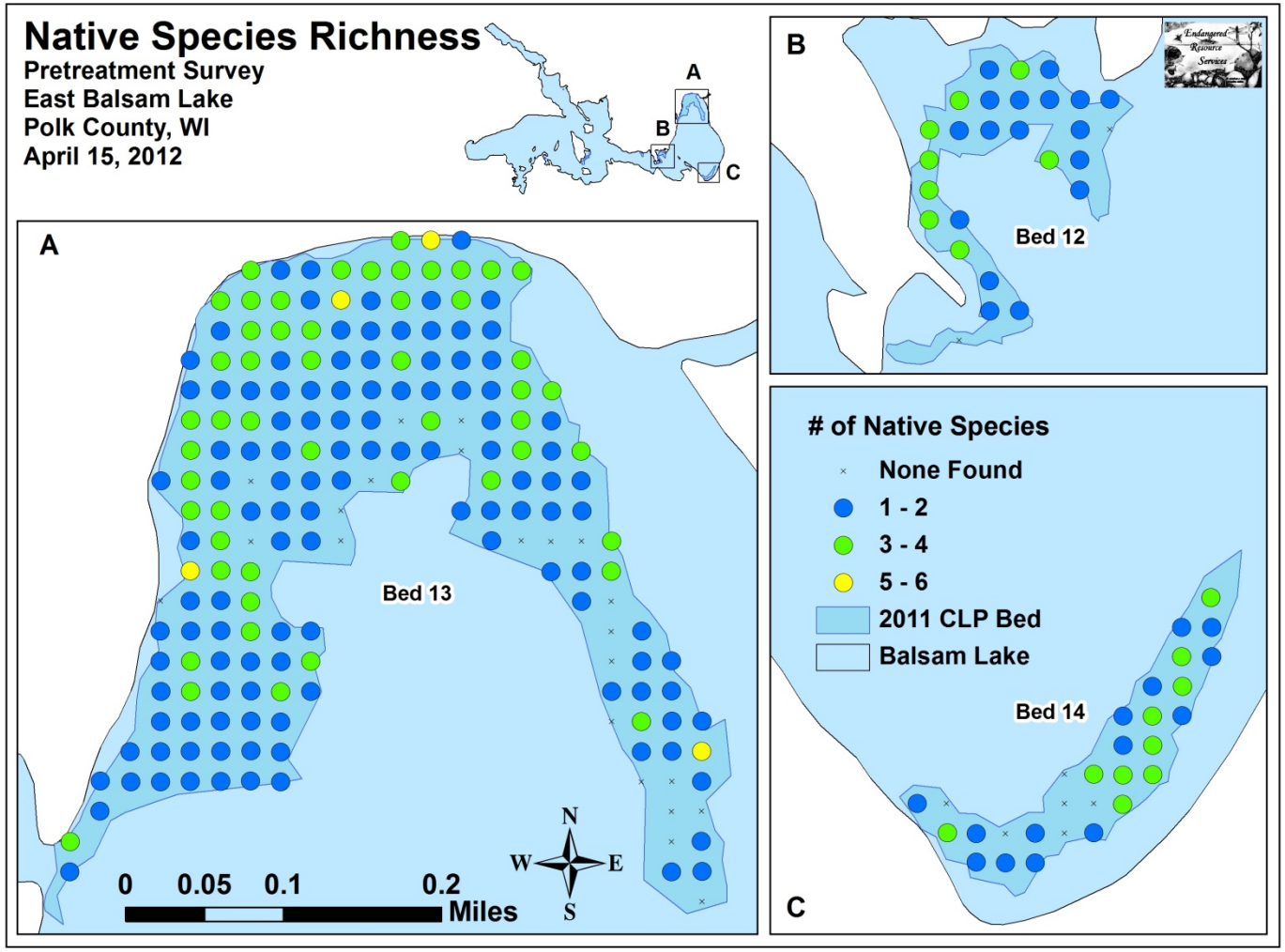

Lake Depth
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
B
Bed 12
C
Bed 14
Depth in ft
3.0 - 5.5
5.6 - 7.5
7.6 - 9.5
9.6 - 12.0
12.1 - 14.5
2011 CLP Bed
Balsam Lake
N
W
E
S
0
0.05
0.1
0.2
Miles

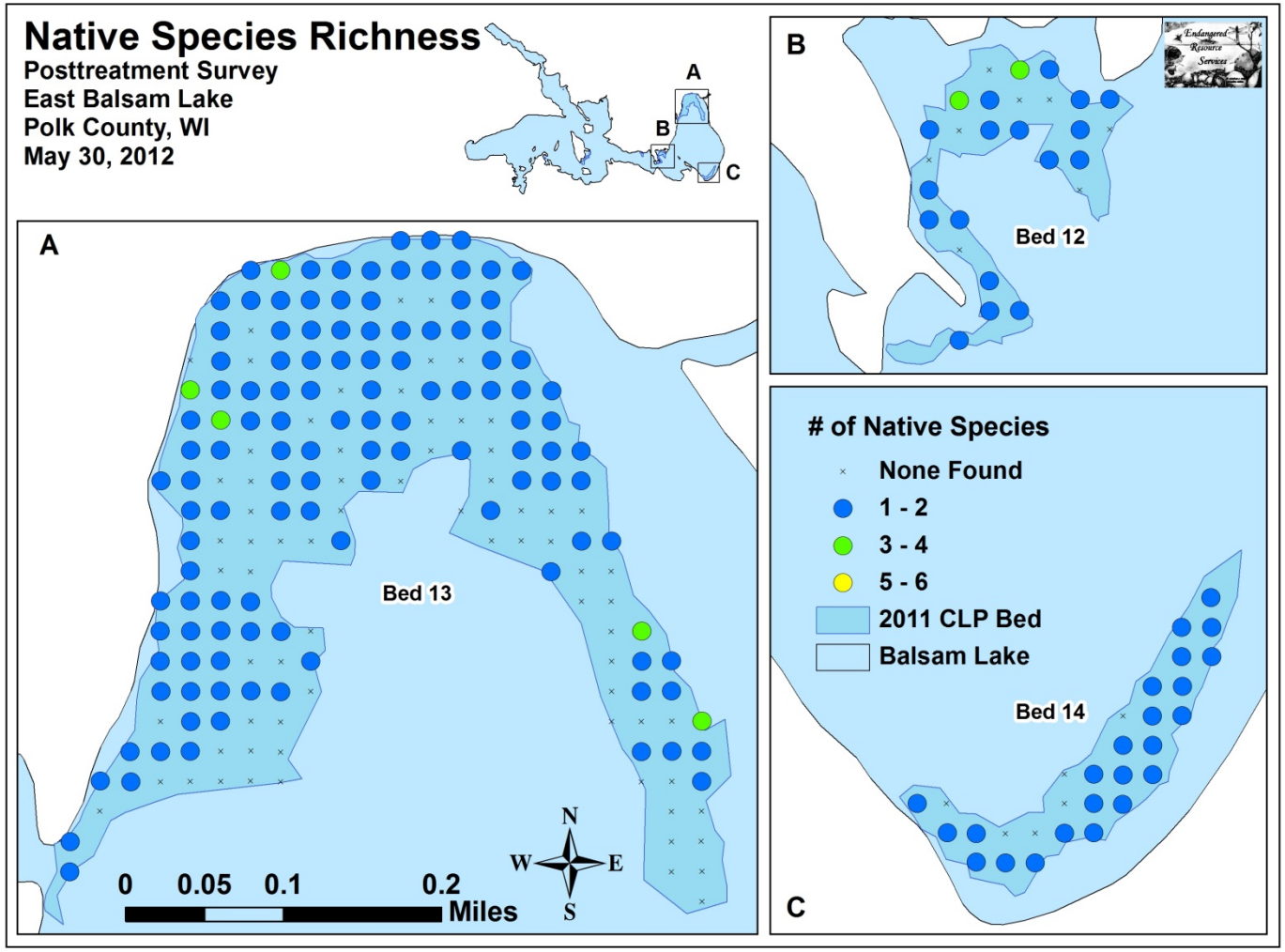

Bottom Substrate
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Substrate Type
Muck
Rock
Sand
2011 CLP Bed
Balsam Lake
Bed 14
C

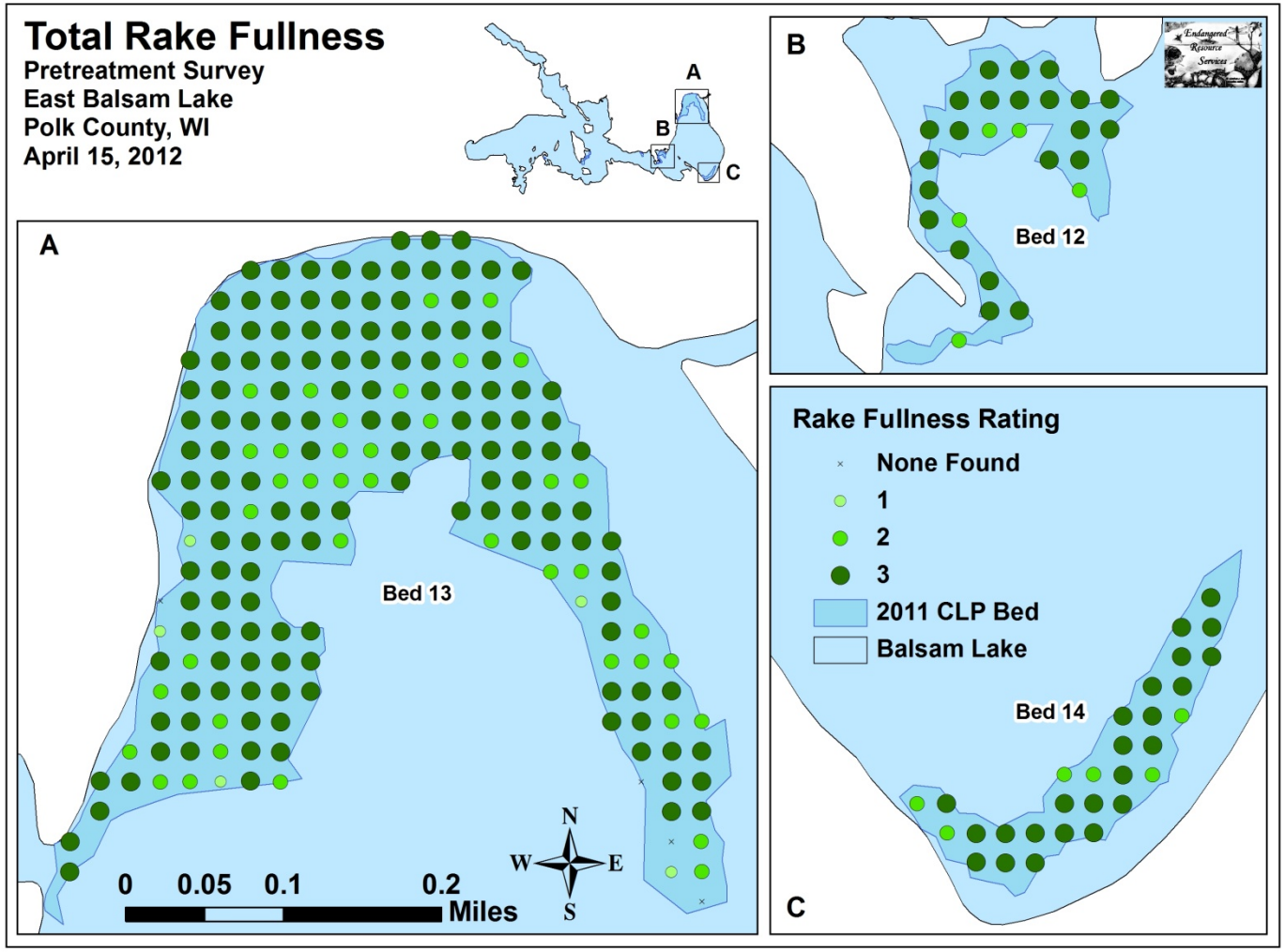

Littoral Zone
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
C
Bed 14
Littoral Zone
Littoral Zone with Plants
2011 CLP Bed
Balsam Lake

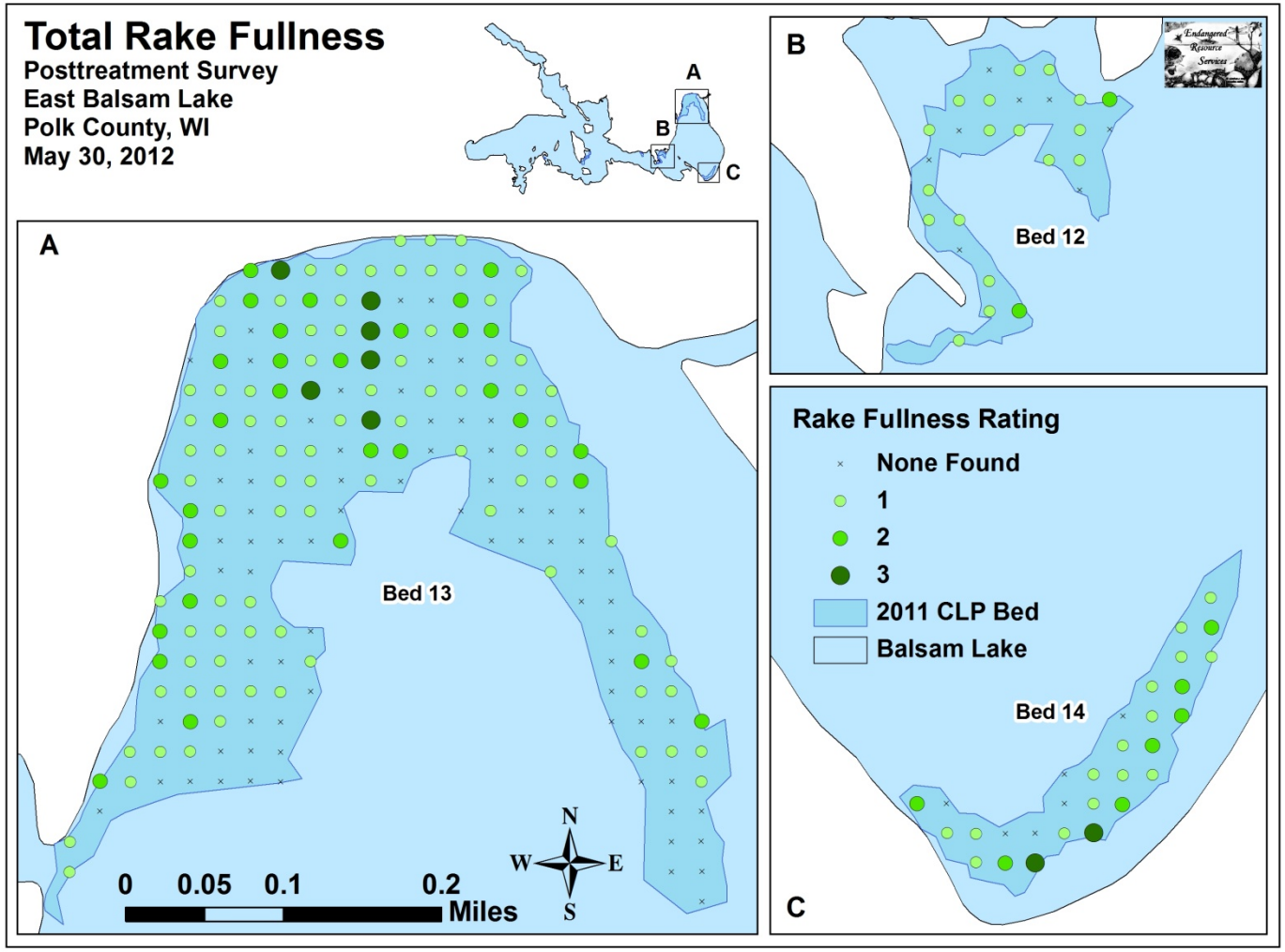

Littoral Zone
Posttreatment Survey
East Balsam Lake
Polk County, WI
May 30, 2012
A
B
C
A
Bed 13
B
Bed 12
C
Bed 14
Littoral Zone
Littoral Zone with Plants
>11.5ft
2011 CLP Bed
Balsam Lake
N
W
E
S
0
0.05
0.1
0.2
Miles

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

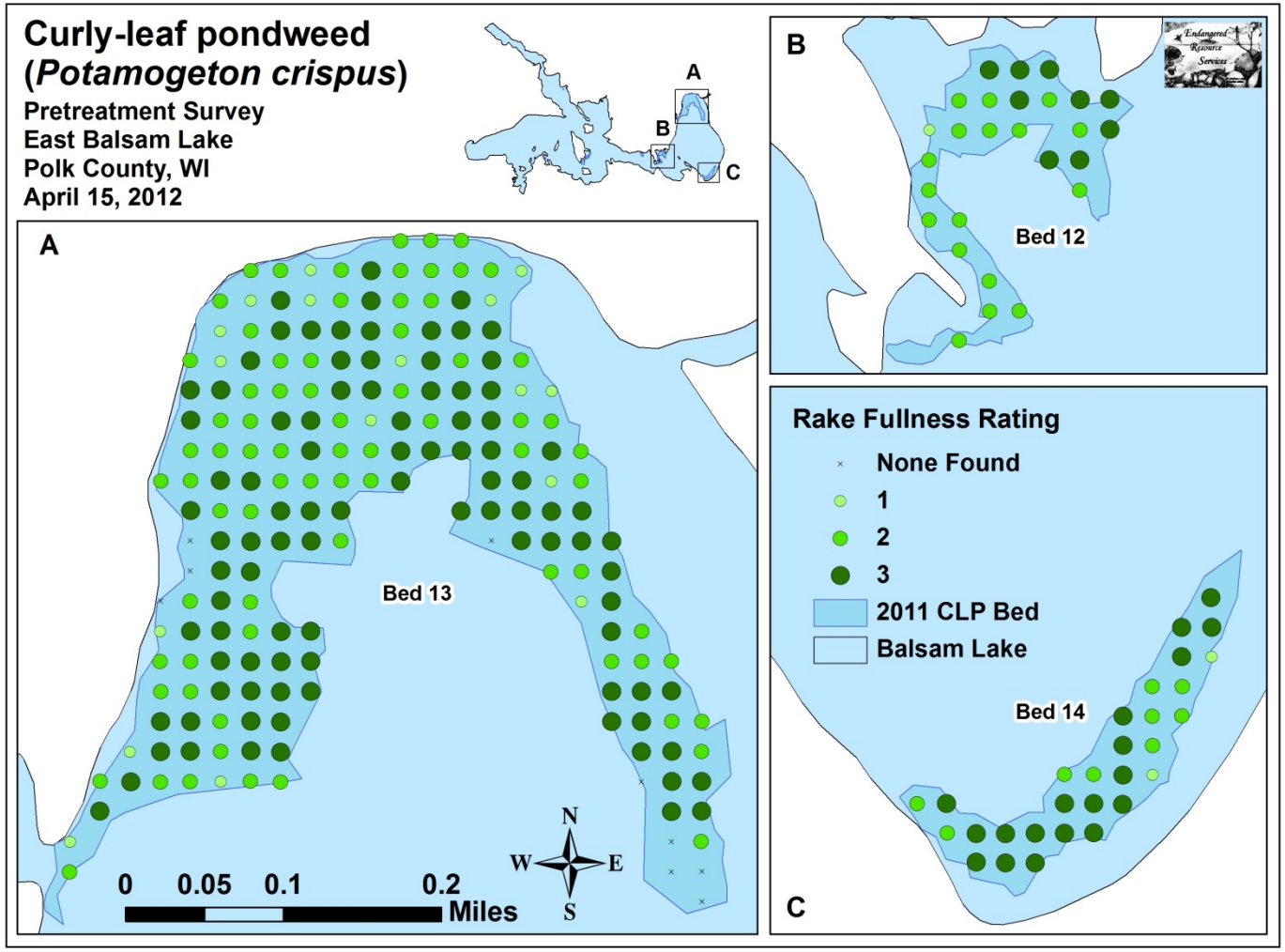

Native Species Richness
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
2011 CLP Bed
Balsam Lake
Bed 14
C

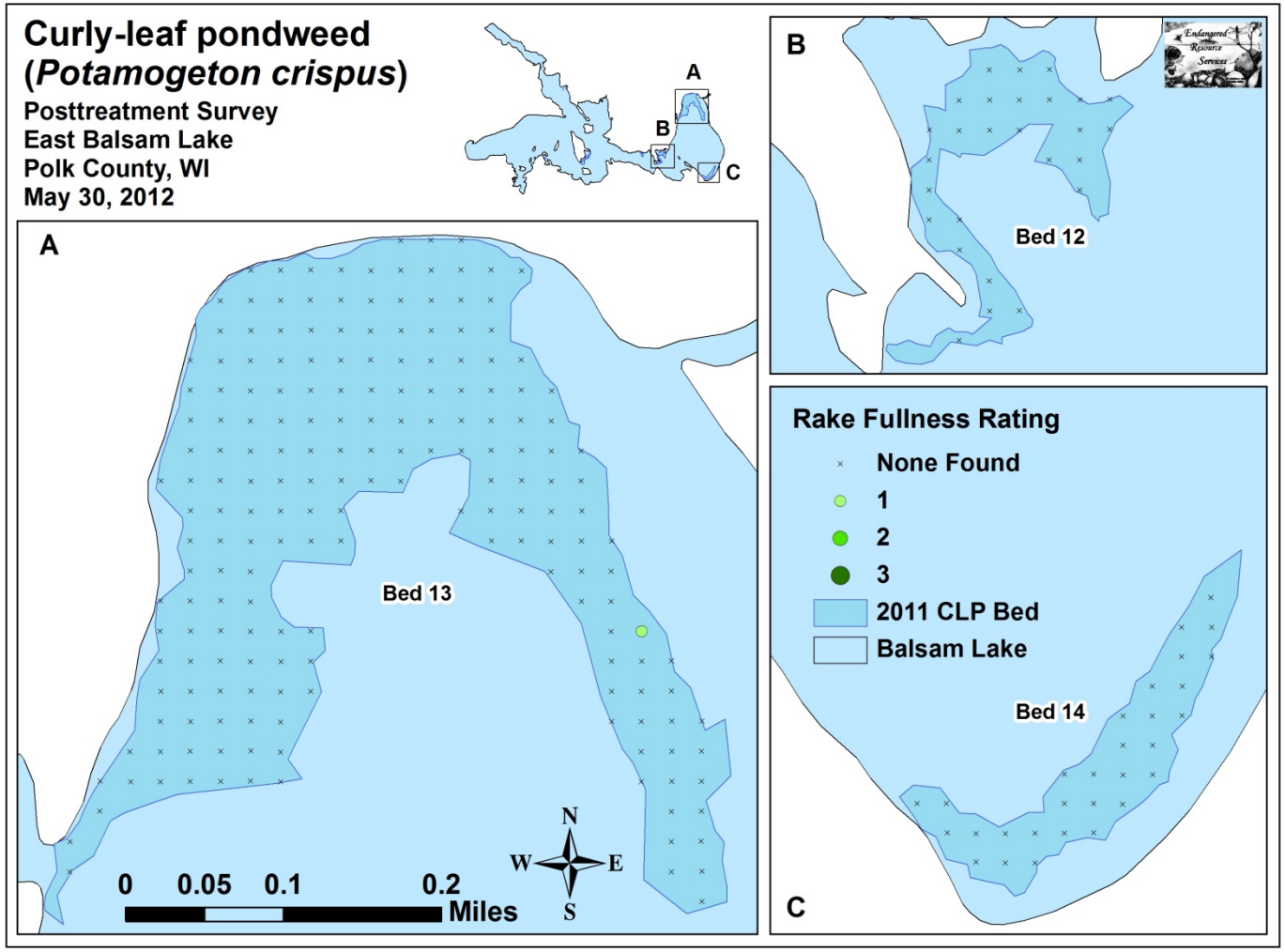

Native Species Richness
Posttreatment Survey
East Balsam Lake
Polk County, WI
May 30, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
C
Bed 14
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
2011 CLP Bed
Balsam Lake


Total Rake Fullness
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
Bed 14
C

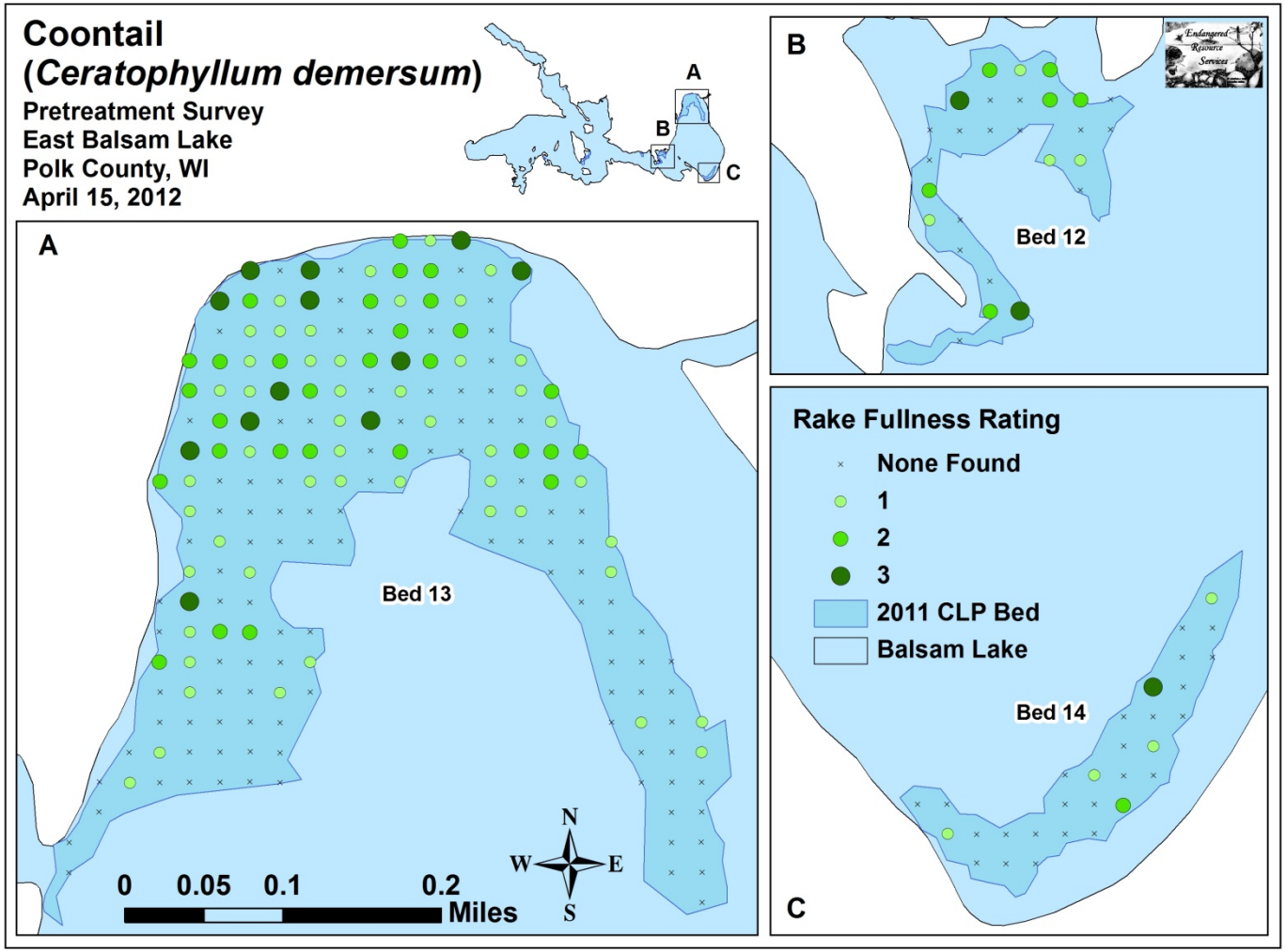

Total Rake Fullness
Posttreatment Survey
East Balsam Lake
Polk County, WI
May 30, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
Bed 14
C

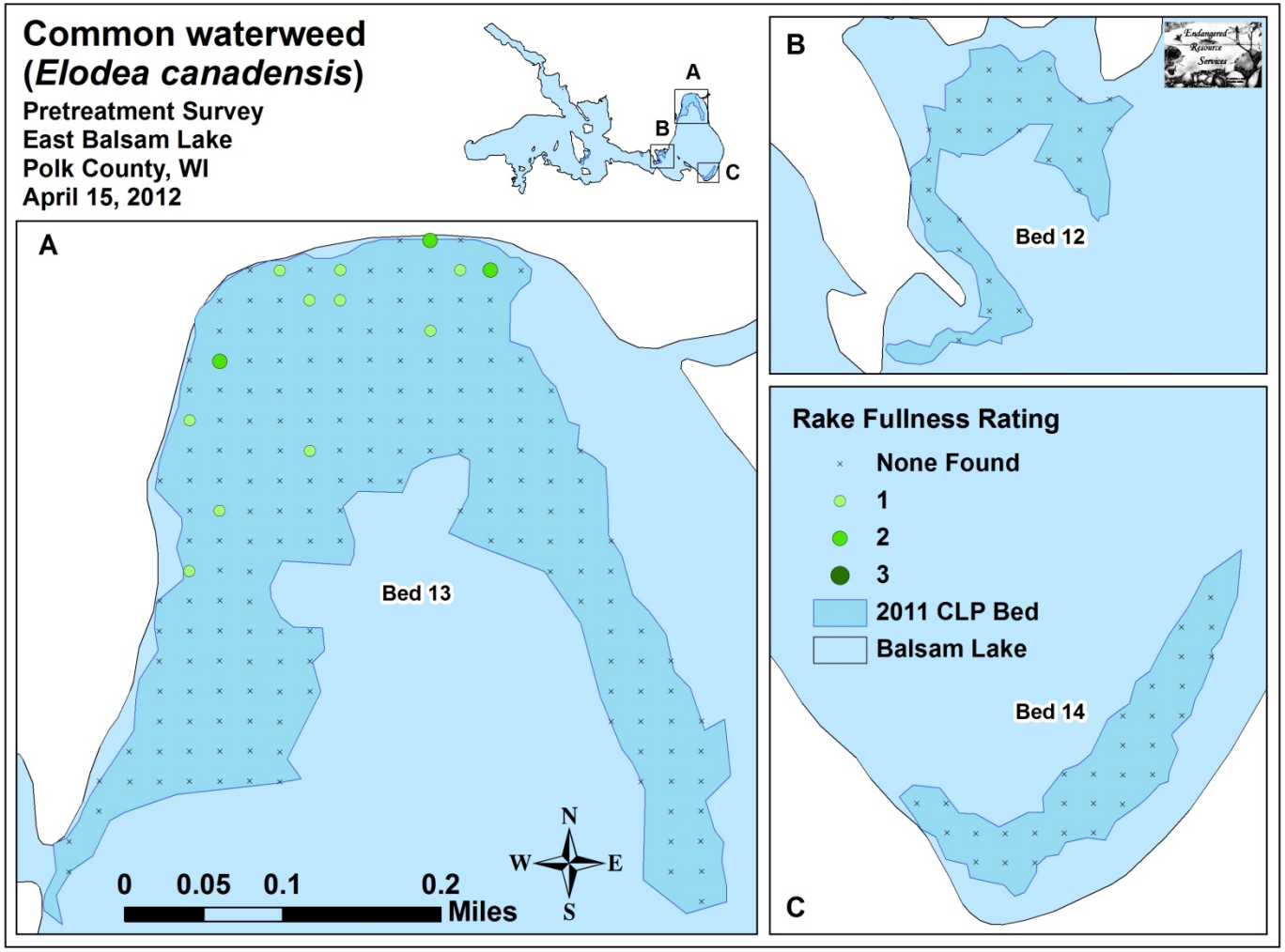
Appendix V: CLP Pre/Posttreatment Distribution

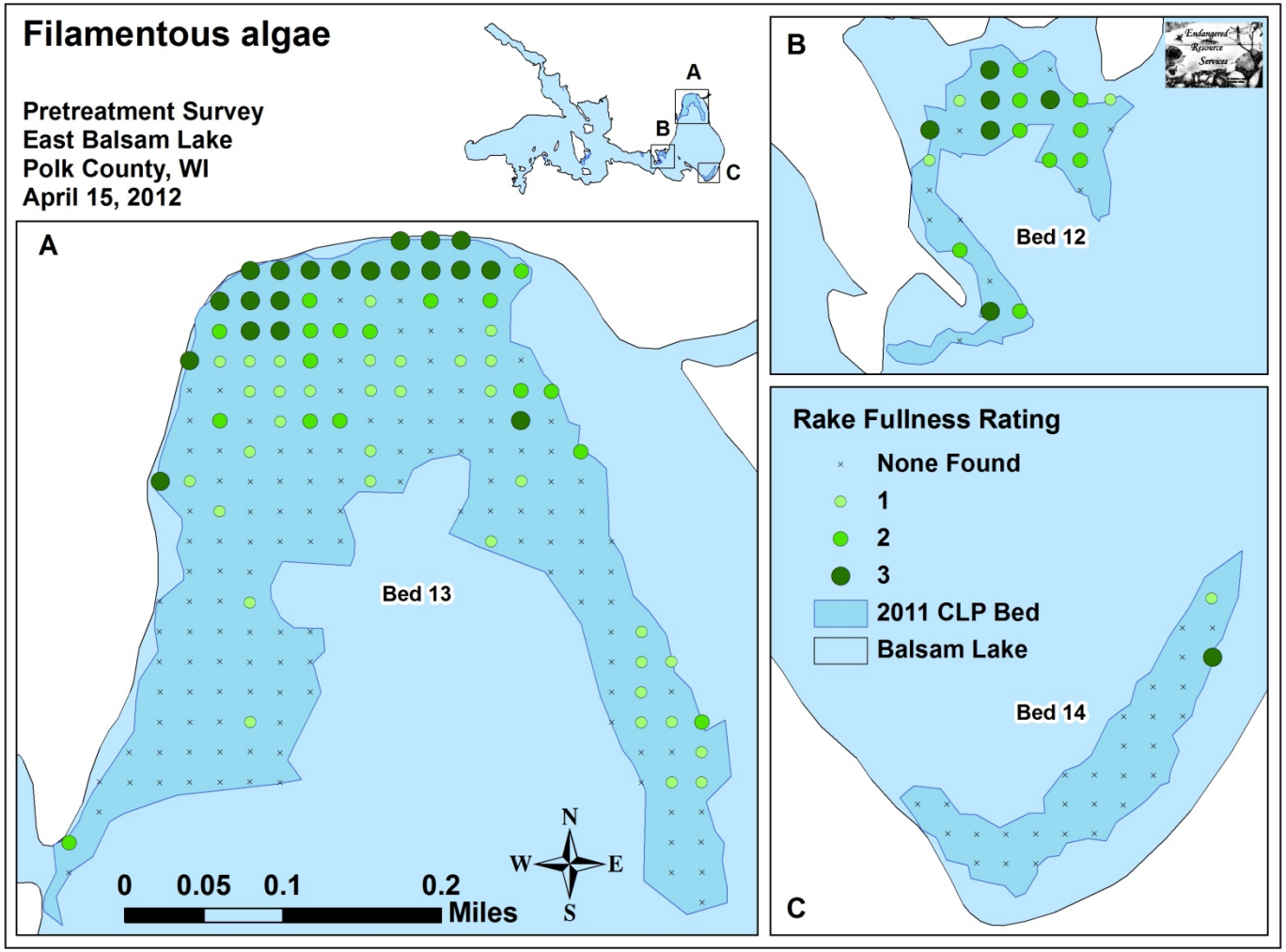

Curly-leaf pondweed
(Potamogeton crispus)
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
Bed 14
C

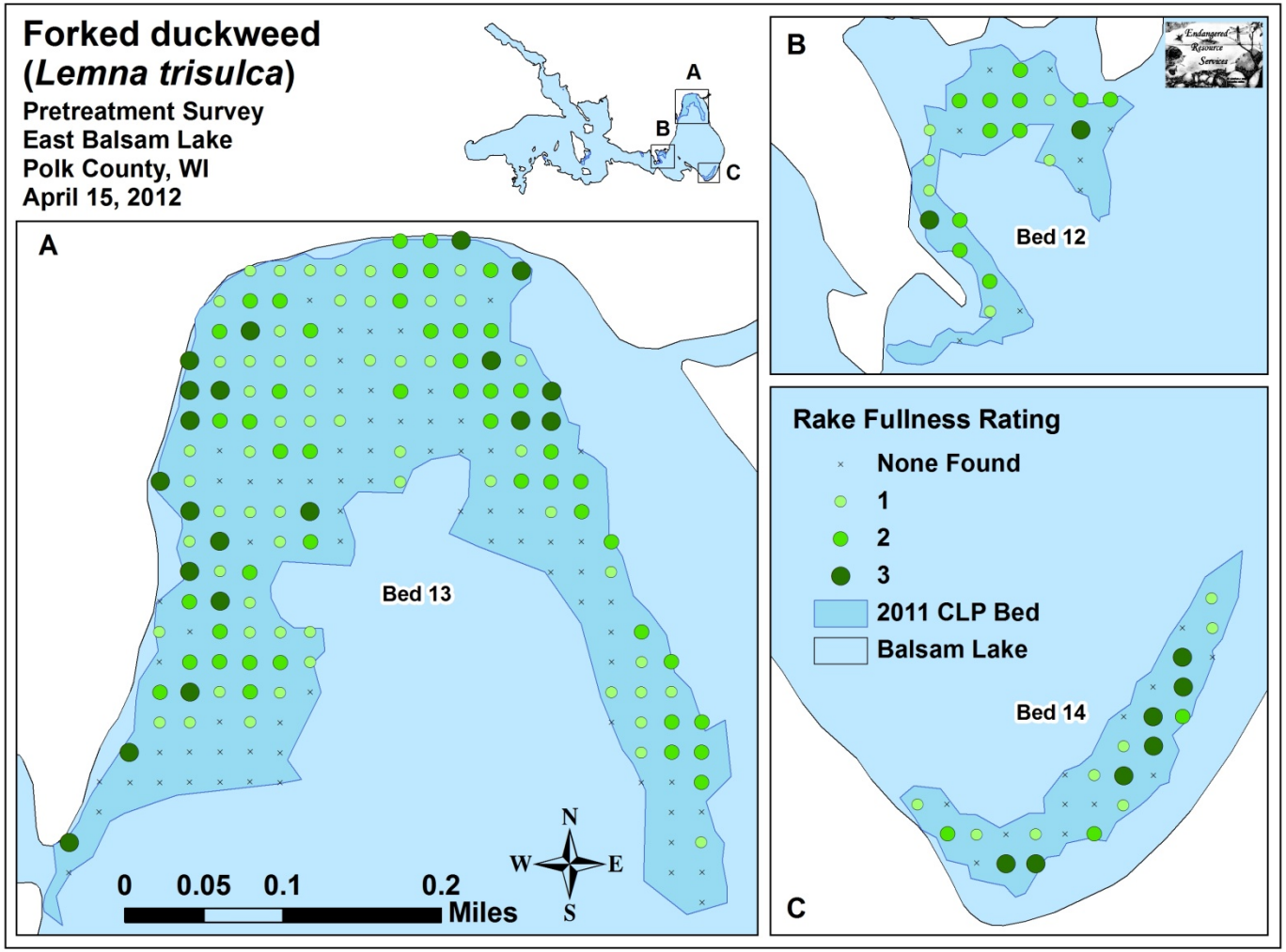

Curly-leaf pondweed
(Potamogeton crispus)
Posttreatment Survey
East Balsam Lake
Polk County, WI
May 30, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
Bed 14
C

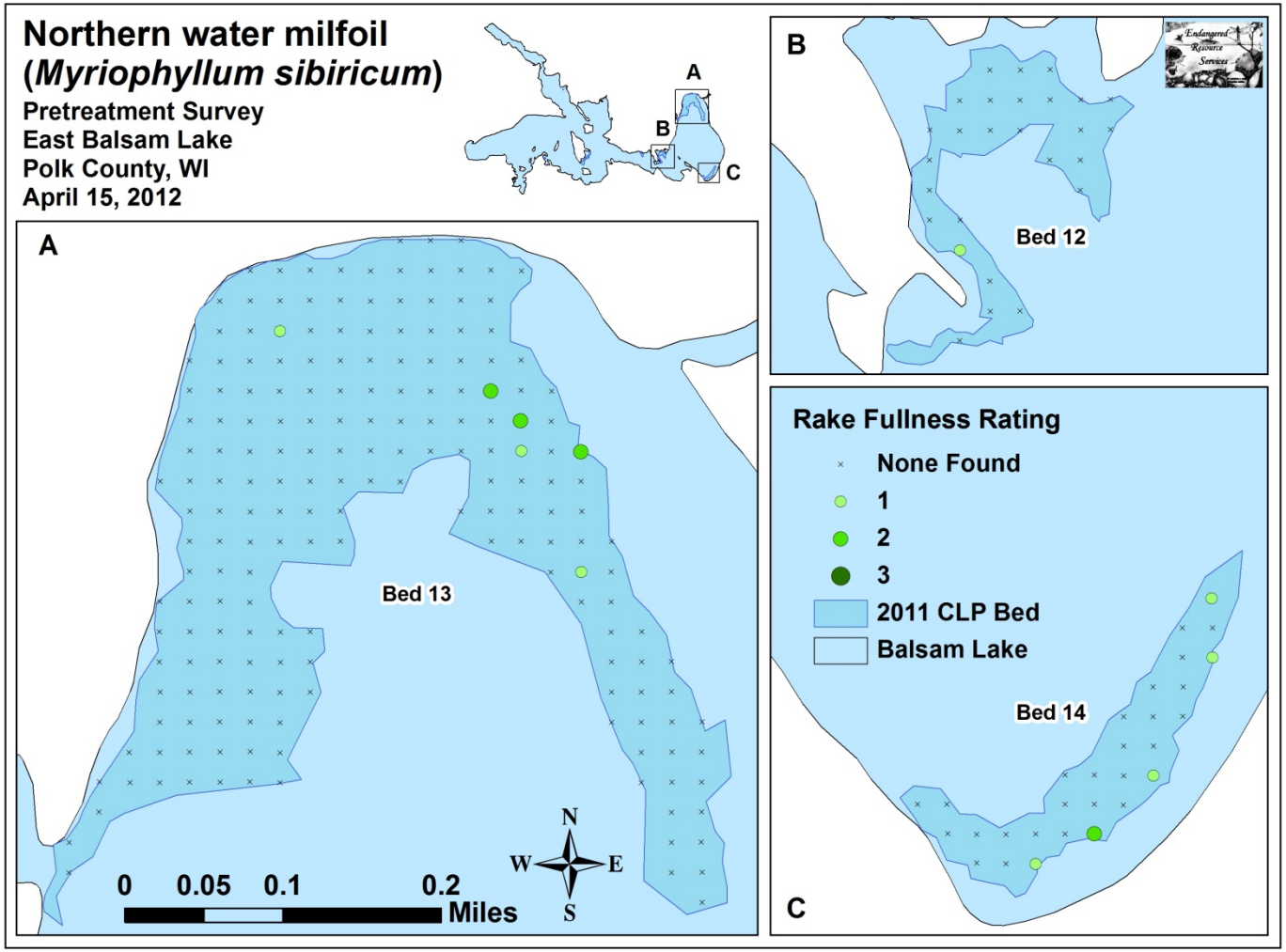
Appendix VI: Pretreatment Native Species Distribution

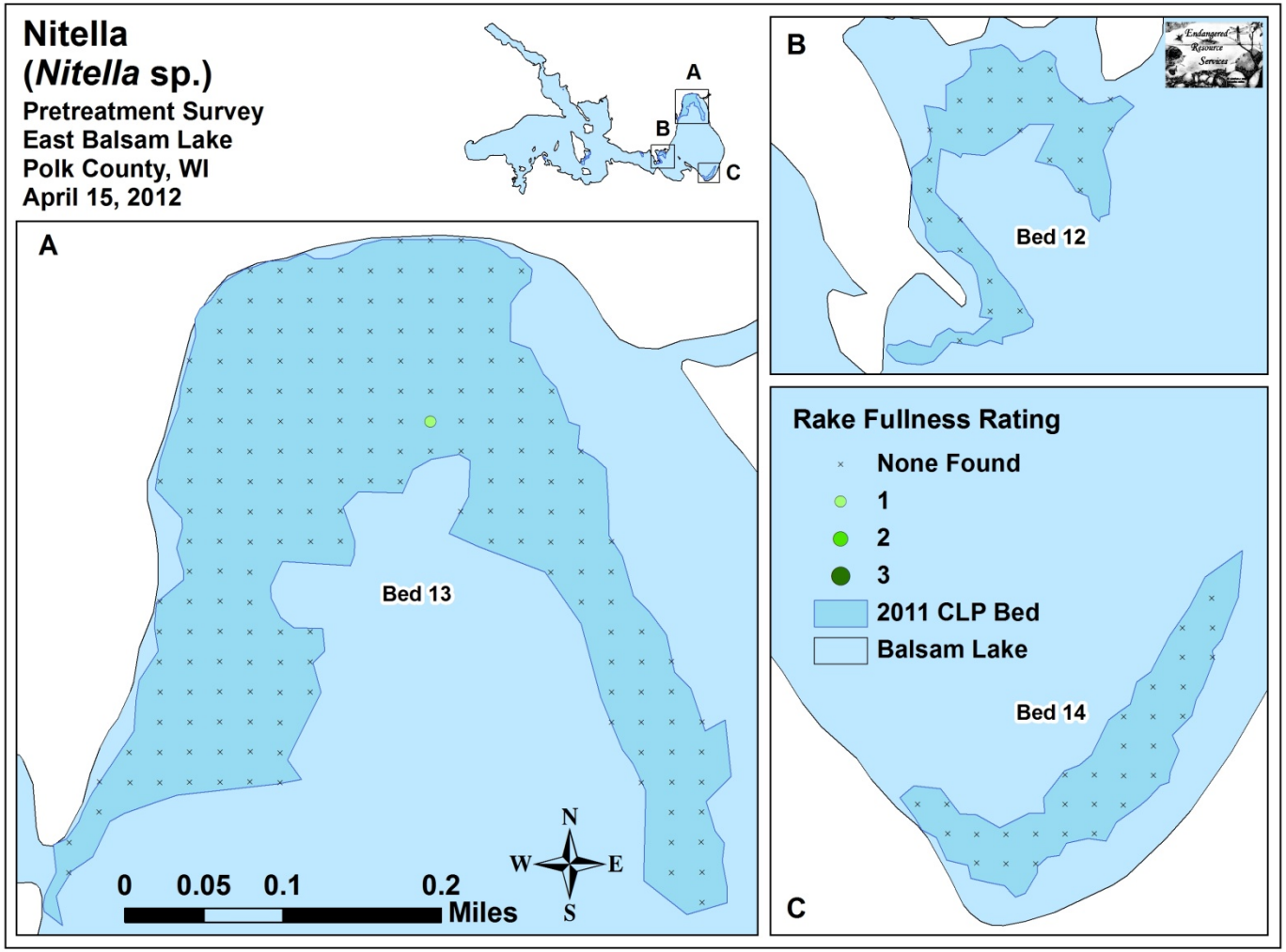

Coontail
(Ceratophyllum demersum)
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
Bed 13
Bed 12
Bed 14
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
0 0.05 0.1 0.2
Miles
N
W
E
S

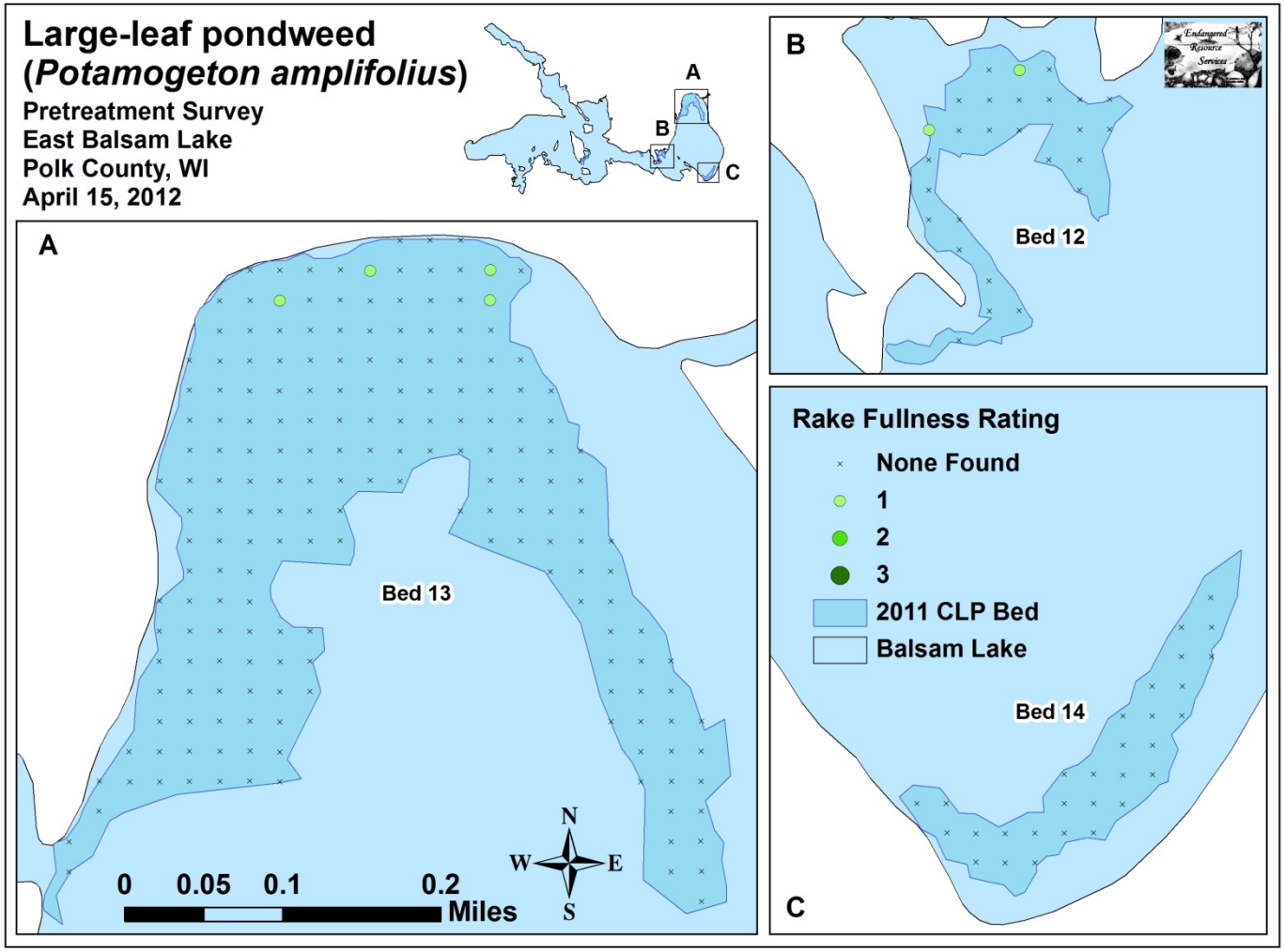

Common waterweed
(Elodea canadensis)
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
Bed 14
C

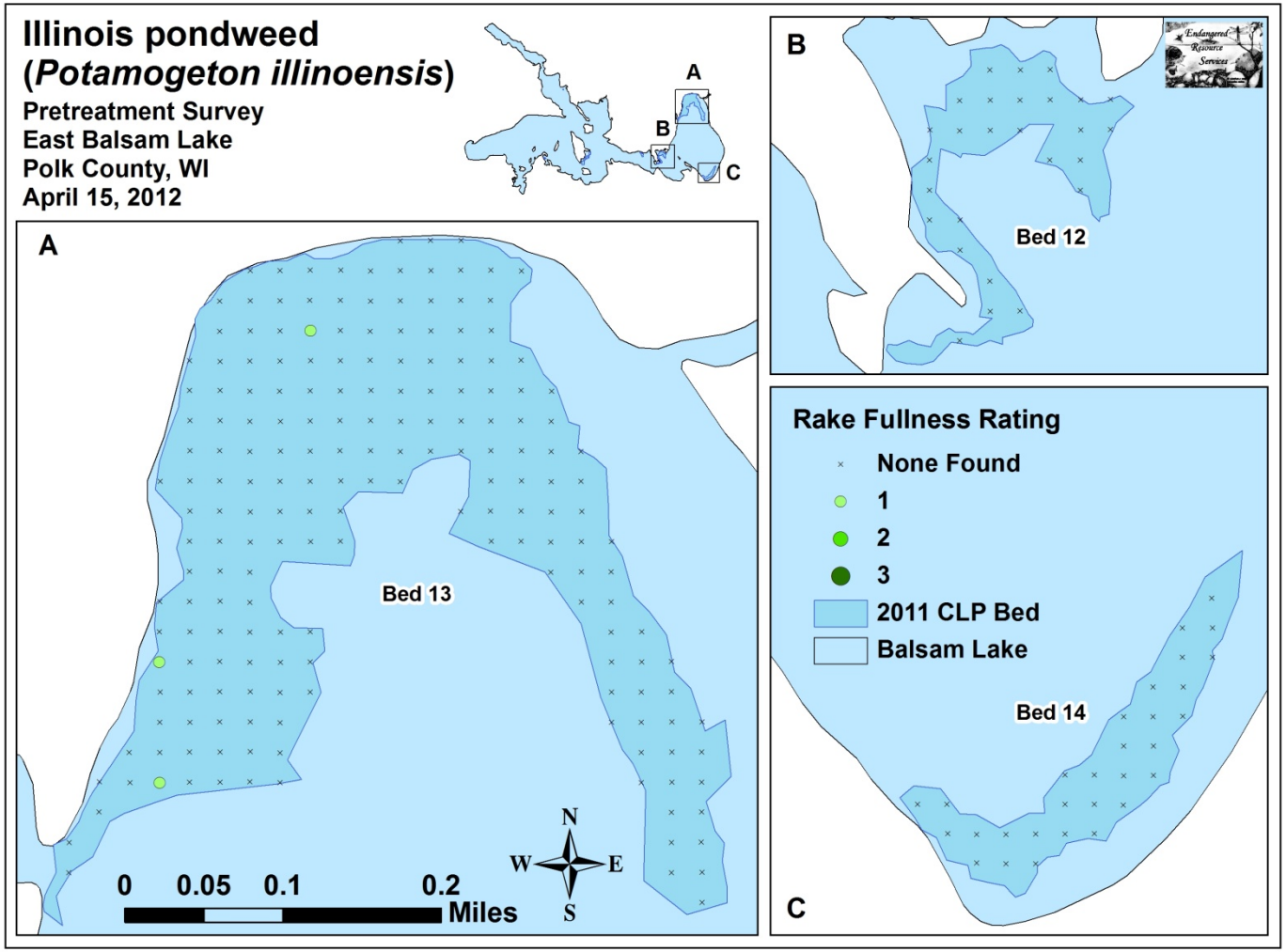

Filamentous algae
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
Bed 14
C

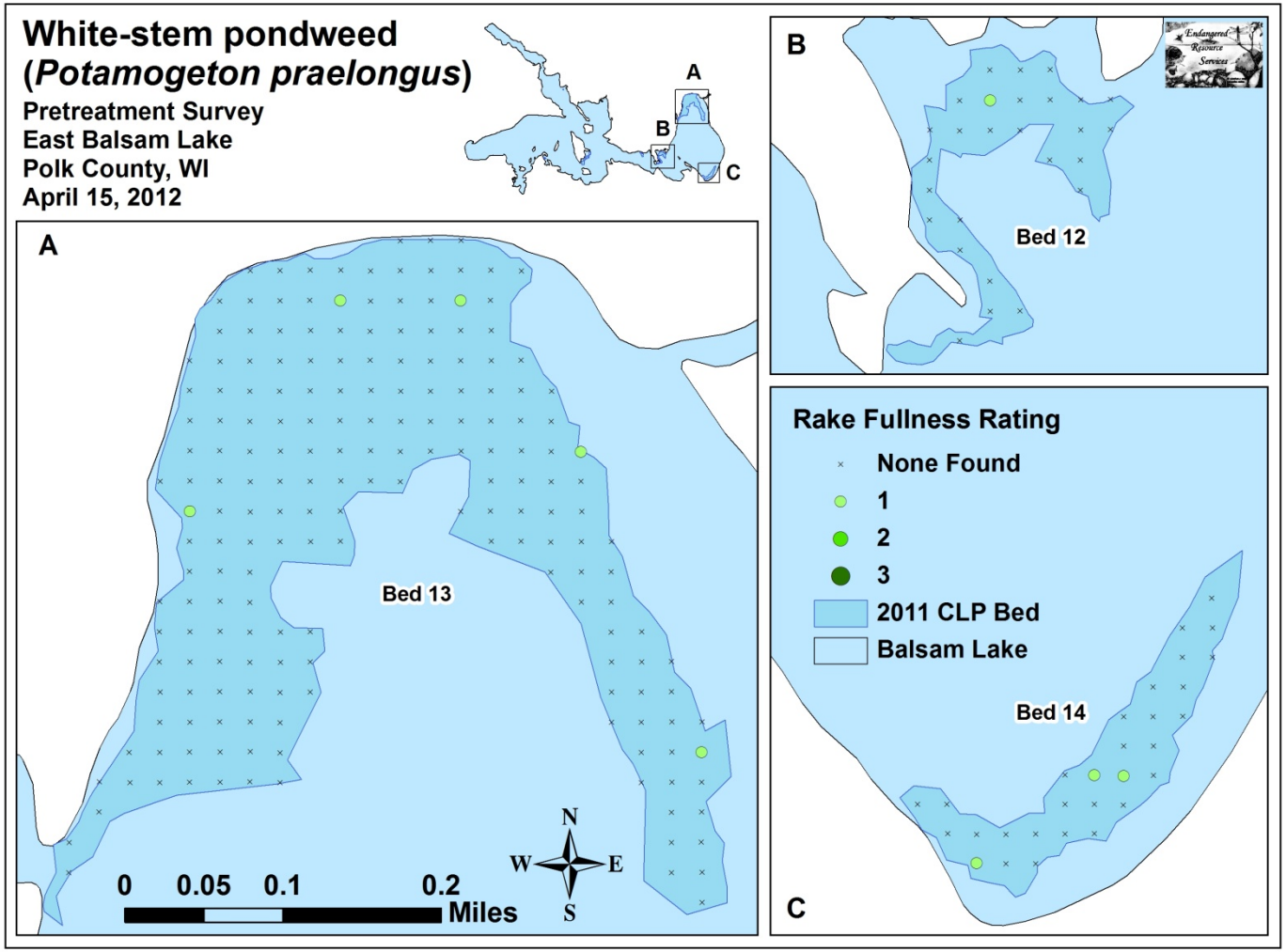

Forked duckweed
(Lemna trisulca)
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
Bed 14
C

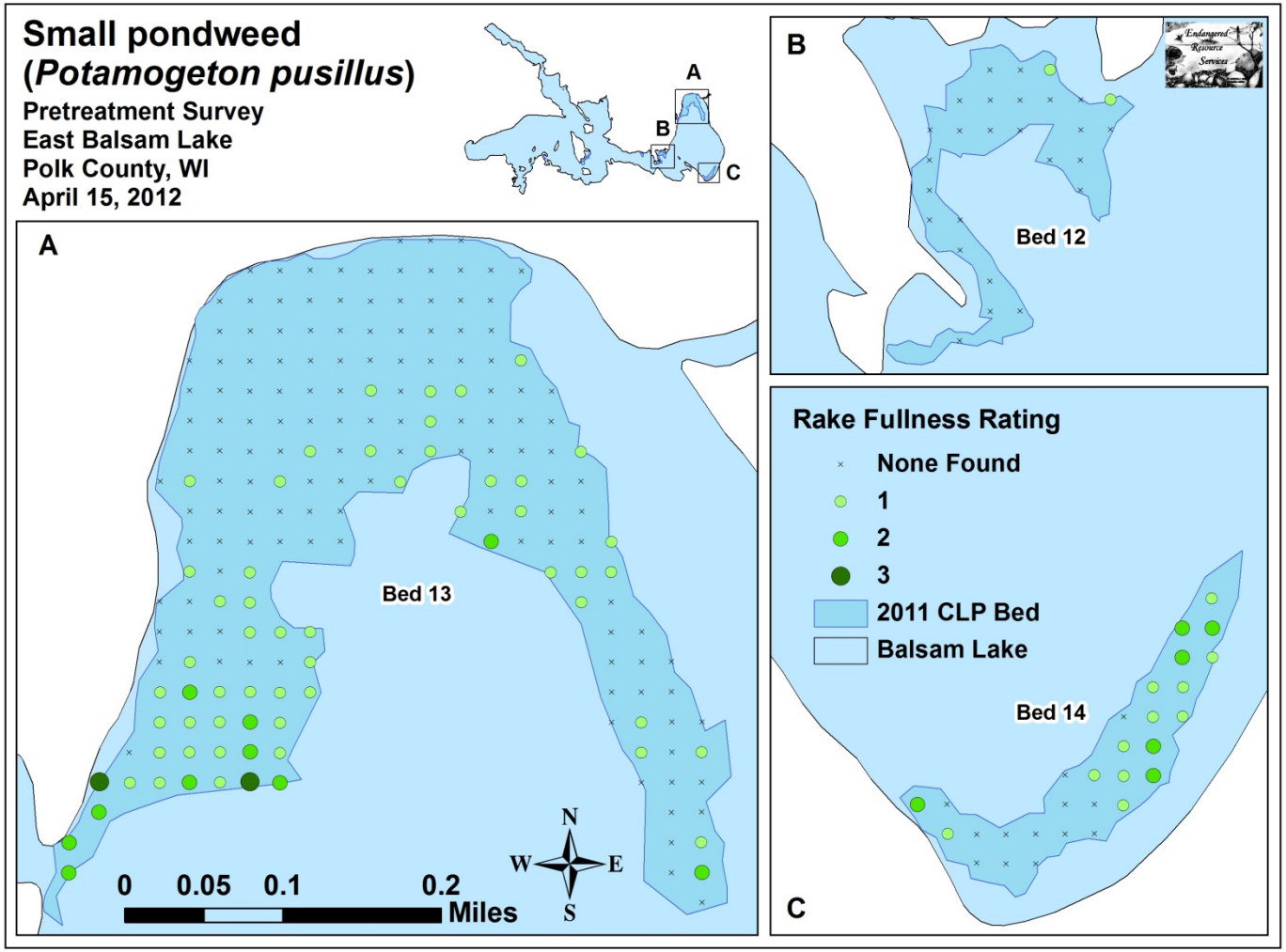

Northern water milfoil
(Myriophyllum sibiricum)
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
C
Bed 14
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake

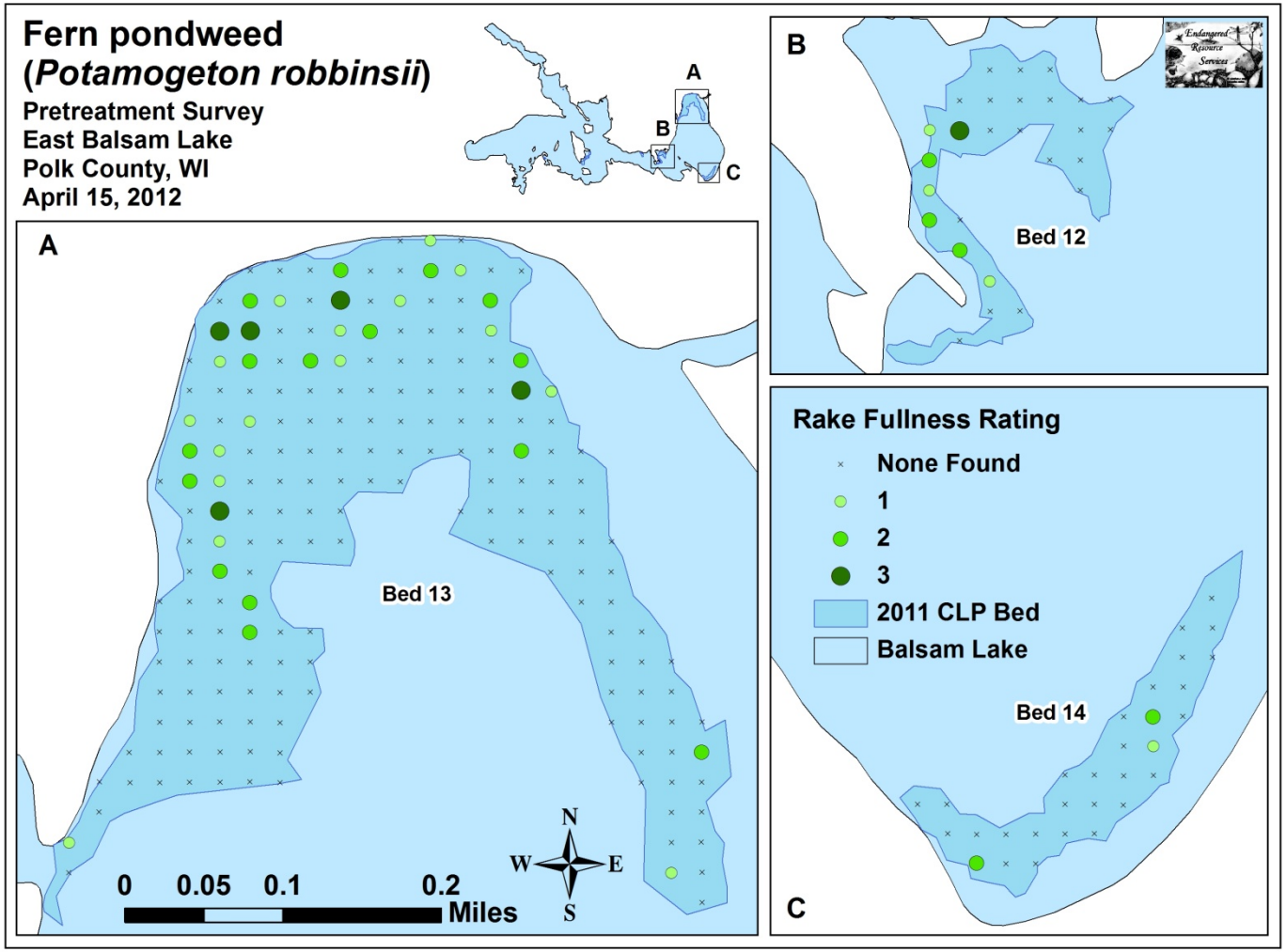

Nitella
(*Nitella* sp.)
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
Bed 13
Bed 12
Bed 14
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
0 0.05 0.1 0.2
Miles
N
W
E
S

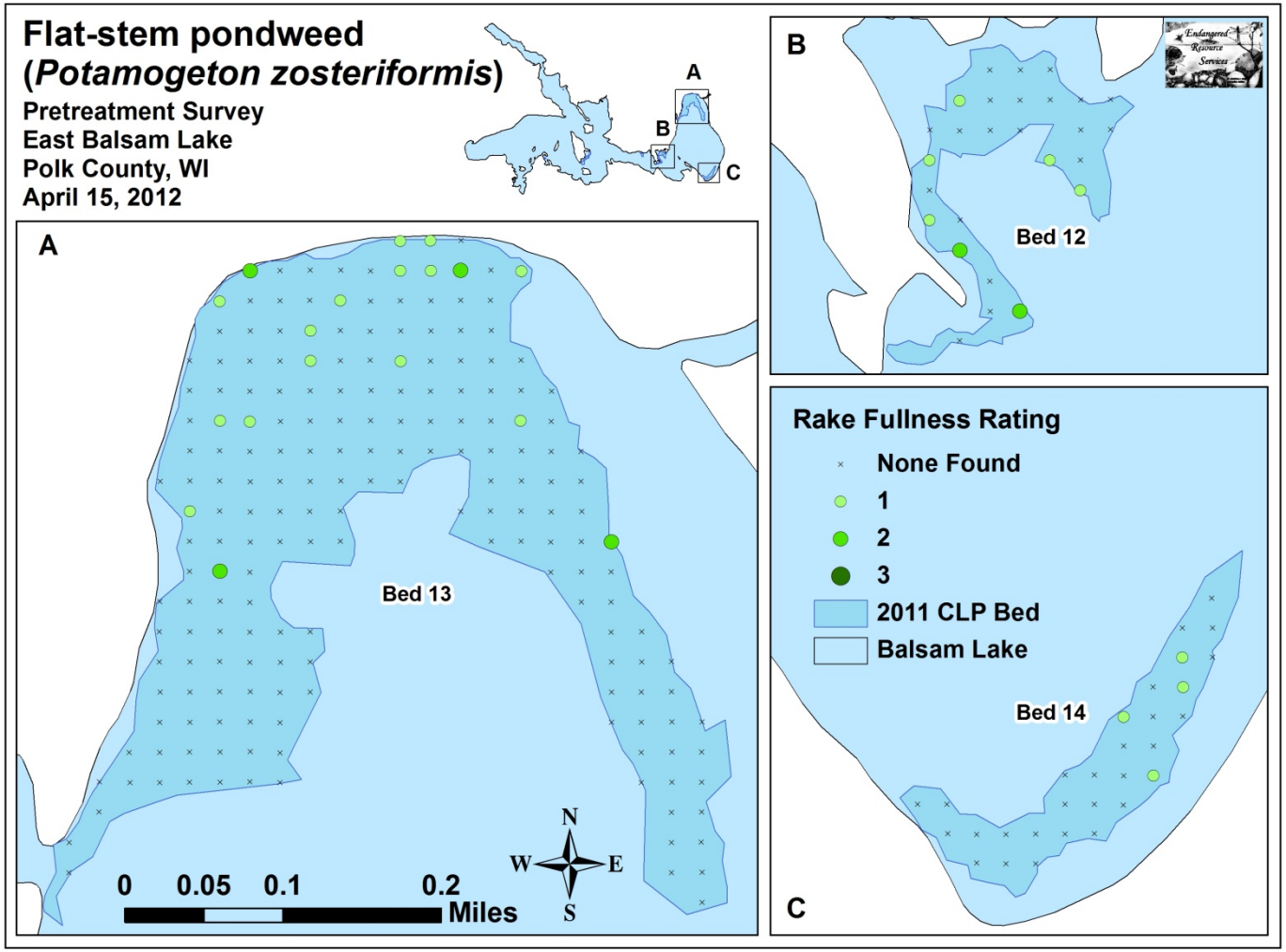

Large-leaf pondweed
(Potamogeton amplifolius)
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
Bed 14
C

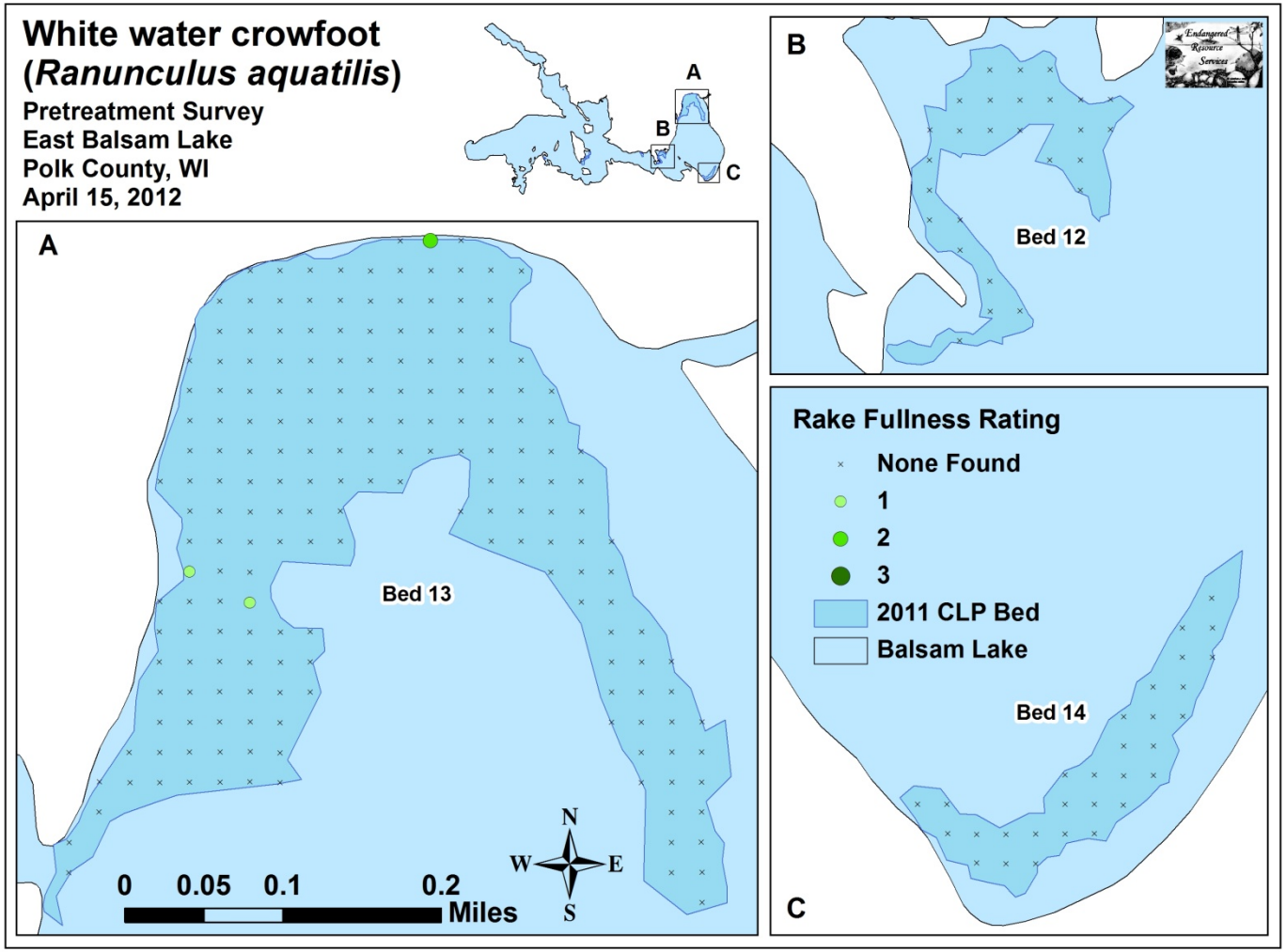

Illinois pondweed
(Potamogeton illinoensis)
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
Bed 13
Bed 12
Bed 14
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
N
W
E
S
0 0.05 0.1 0.2
Miles


White-stem pondweed
(Potamogeton praelongus)
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
Bed 13
Bed 12
Bed 14
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
N
W
E
S
0
0.05
0.1
0.2
Miles

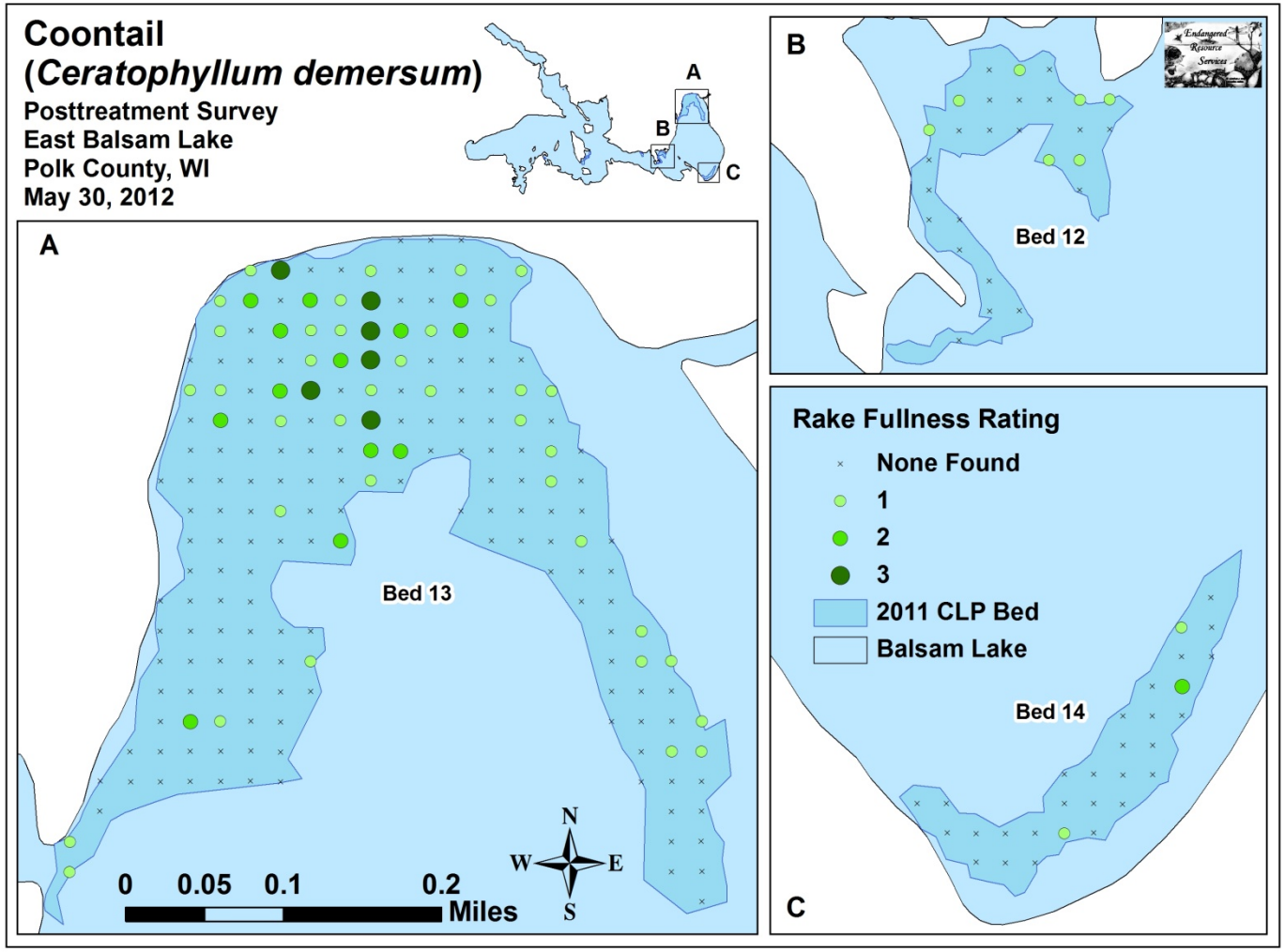

Small pondweed
(Potamogeton pusillus)
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
Bed 14
C

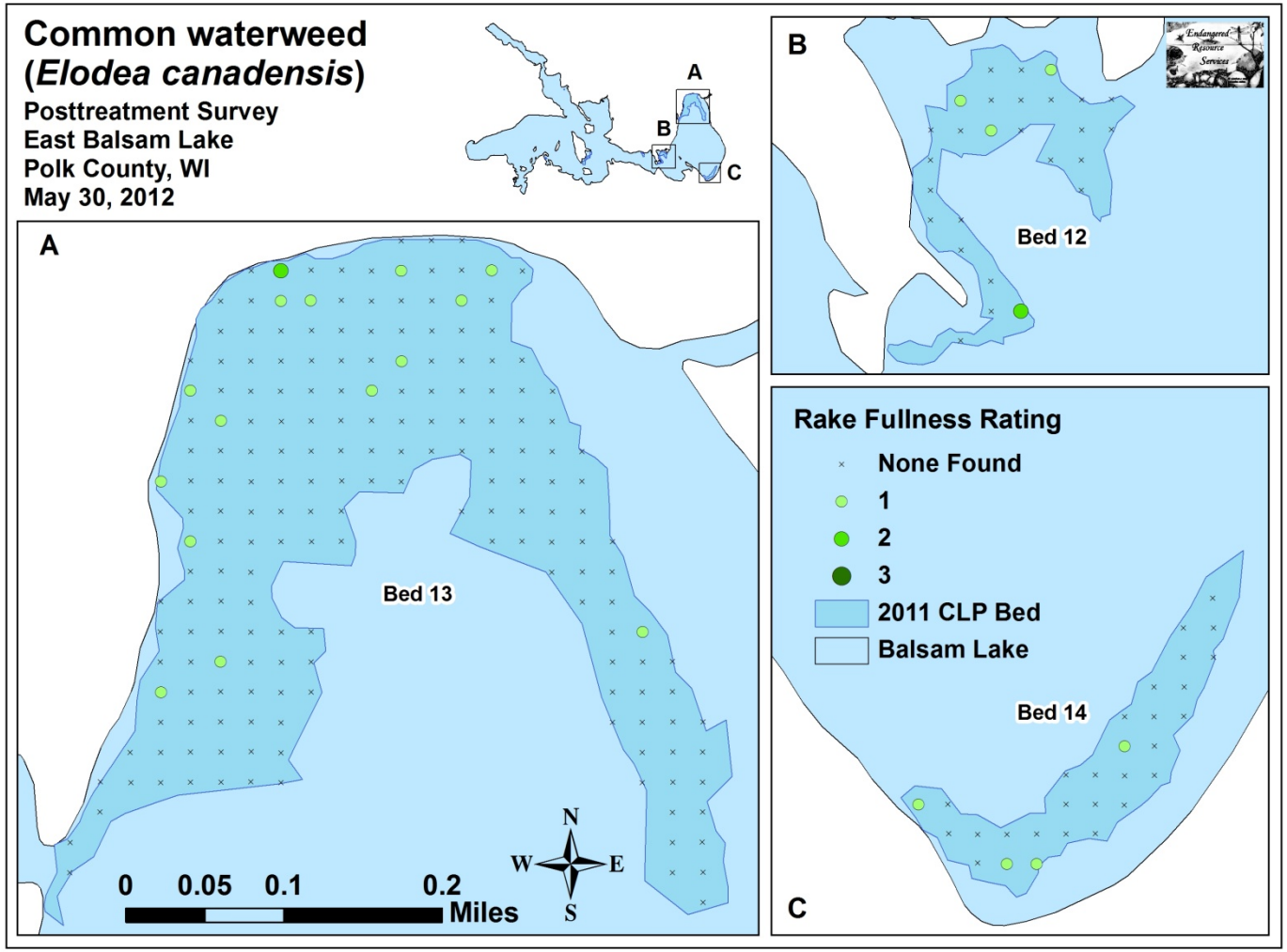

Fern pondweed
(Potamogeton robbinsii)
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
Bed 14
C

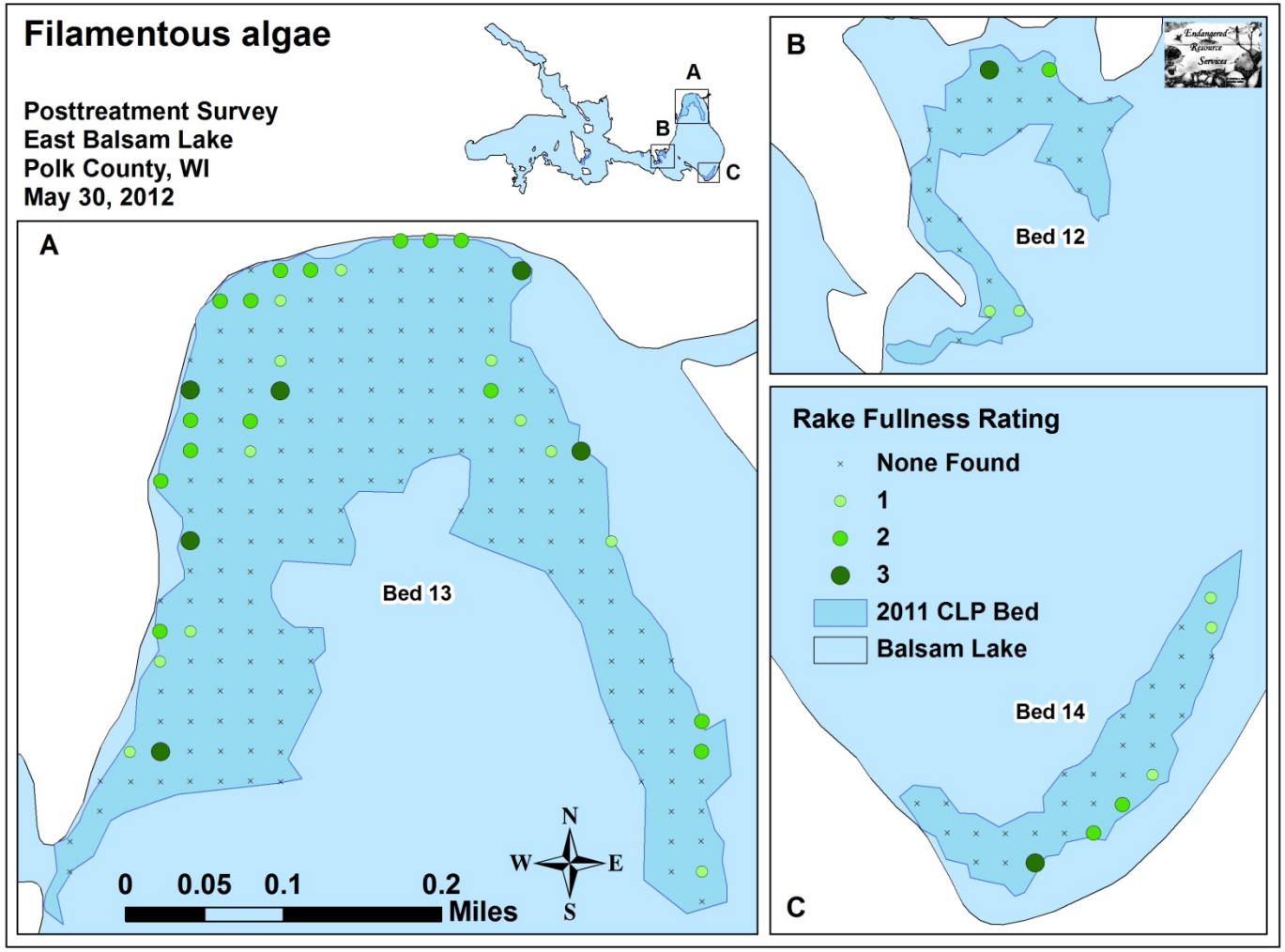

Flat-stem pondweed
(Potamogeton zosteriformis)
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
Bed 14
C

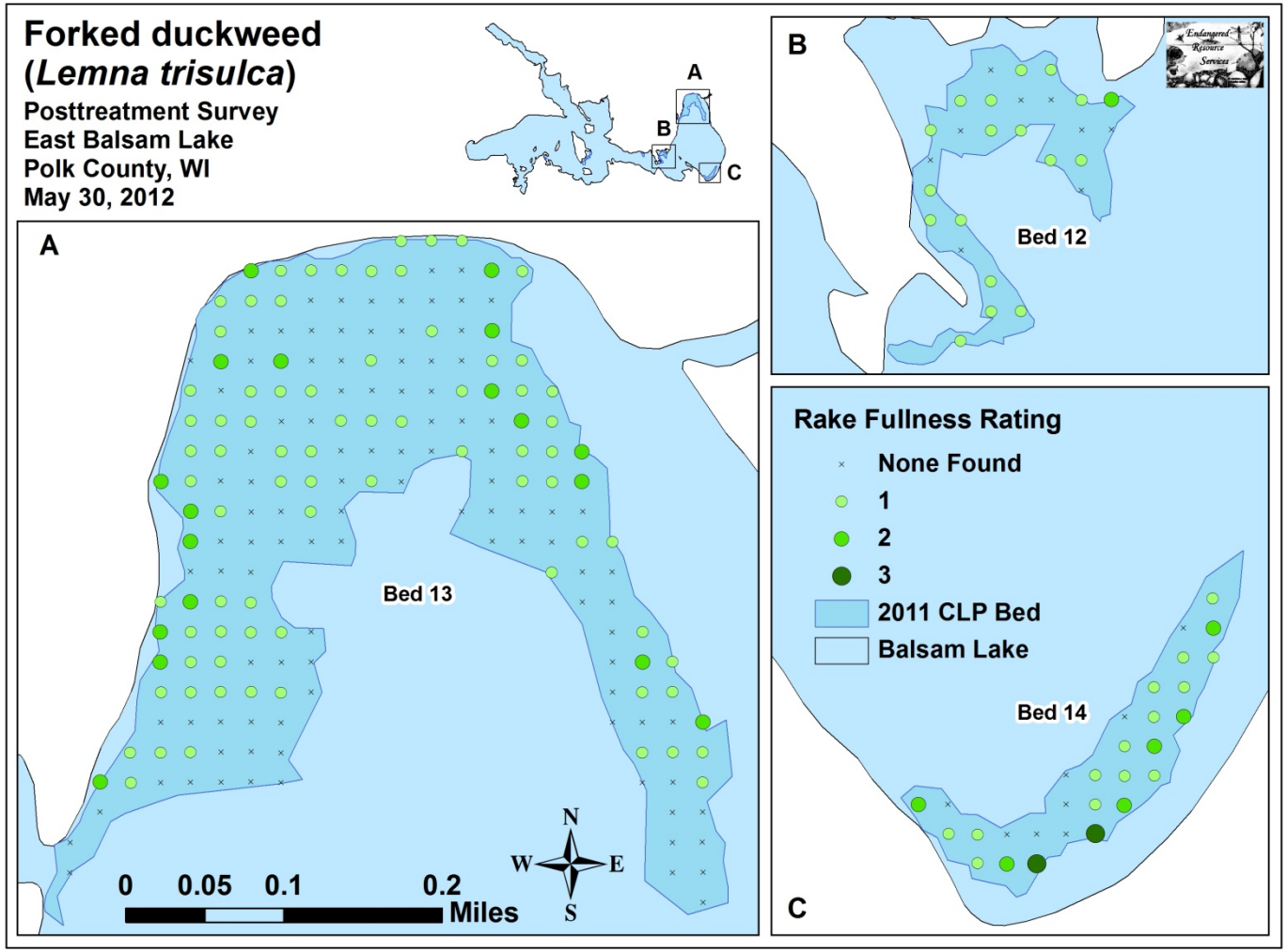

White water crowfoot
(Ranunculus aquatilis)
Pretreatment Survey
East Balsam Lake
Polk County, WI
April 15, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
Bed 14
C

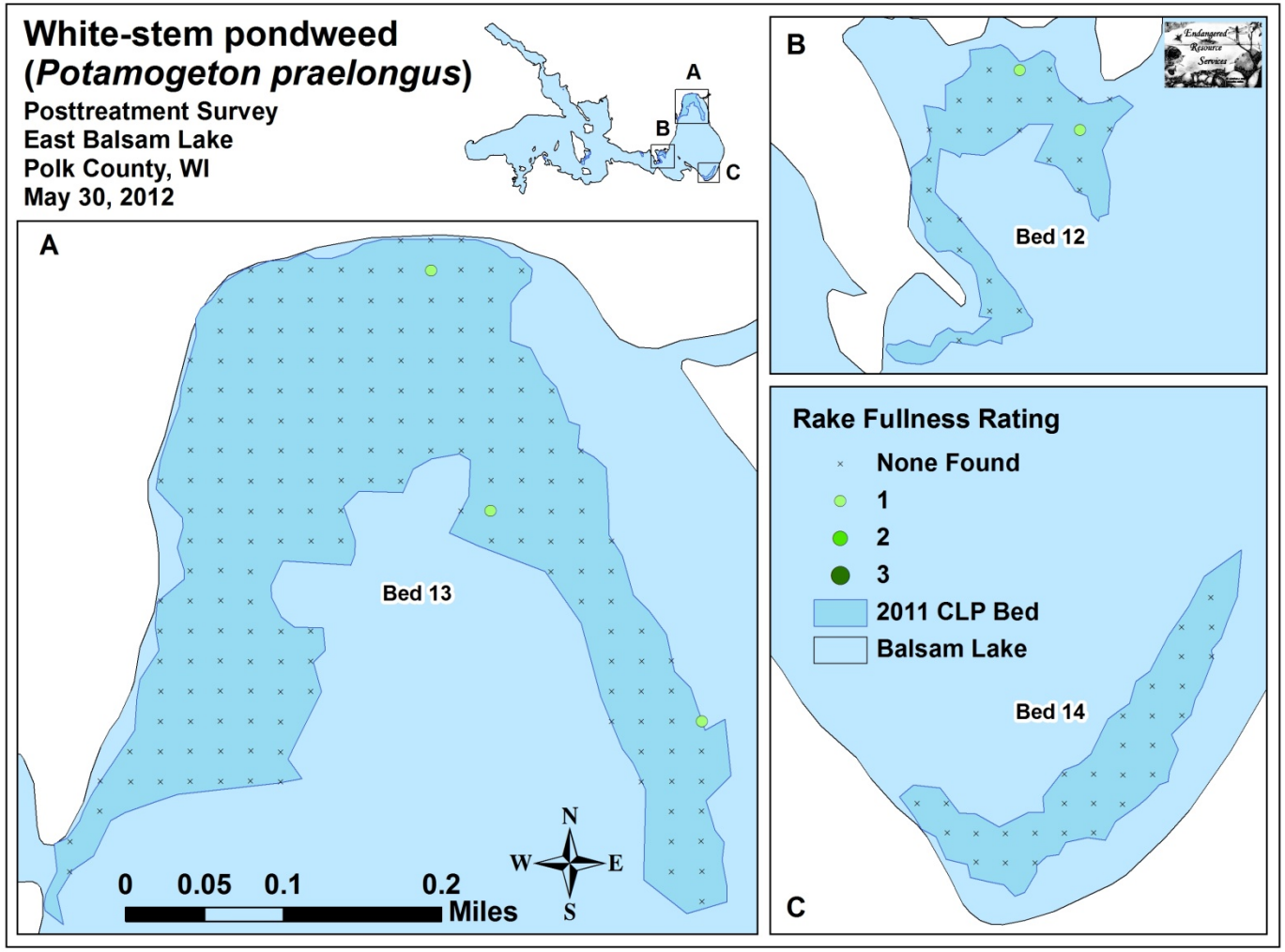
Appendix VII: Posttreatment Native Species Distribution

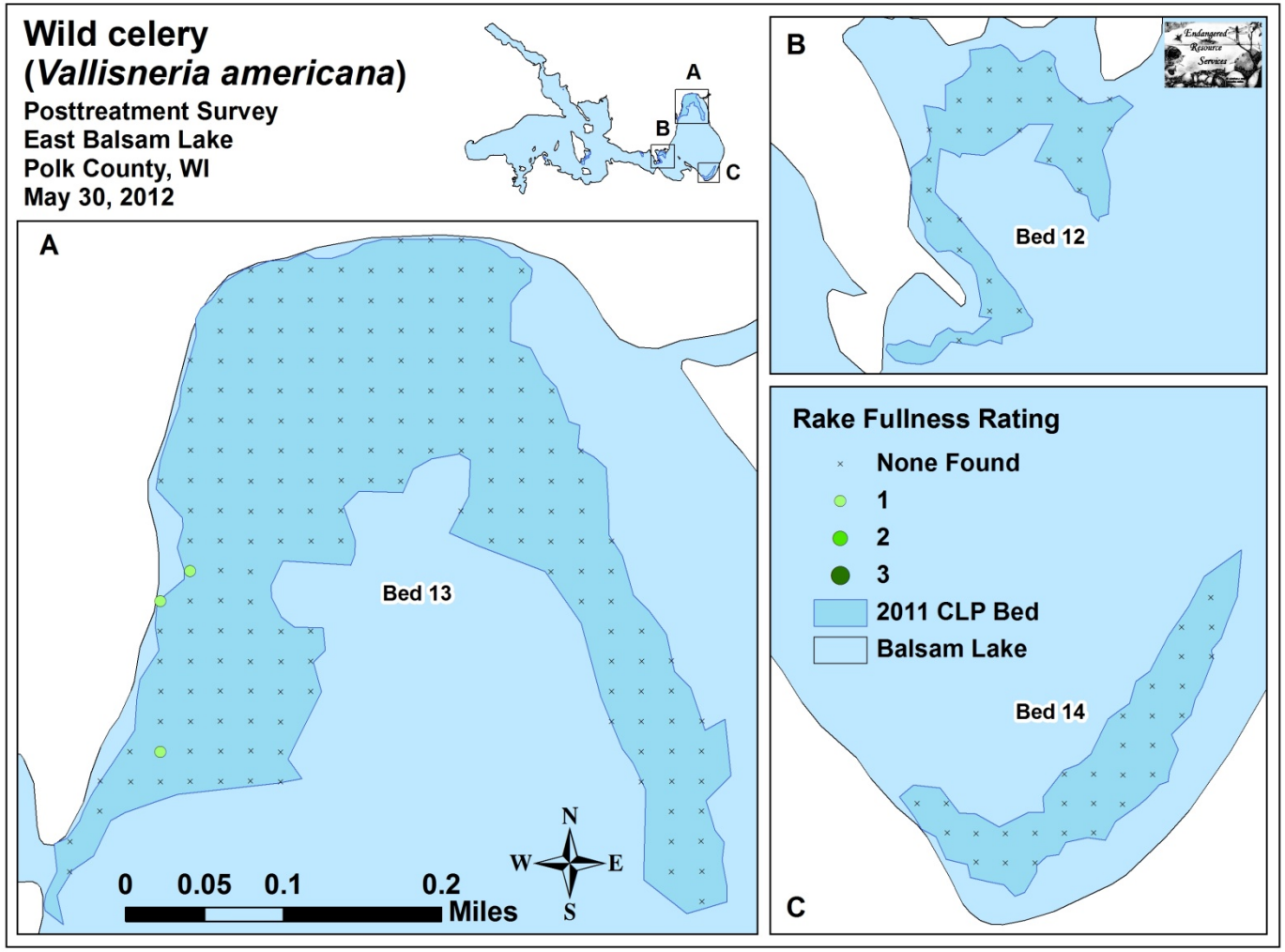

Coontail
(Ceratophyllum demersum)
Posttreatment Survey
East Balsam Lake
Polk County, WI
May 30, 2012
A
B
C
A
Bed 13
0 0.05 0.1 0.2
Miles
N
W
E
S
B
Bed 12
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
Bed 14
C


Common waterweed
(Elodea canadensis)
Posttreatment Survey
East Balsam Lake
Polk County, WI
May 30, 2012
A
B
C
Bed 13
Bed 12
Bed 14
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
N
W
E
S
0
0.05
0.1
0.2
Miles

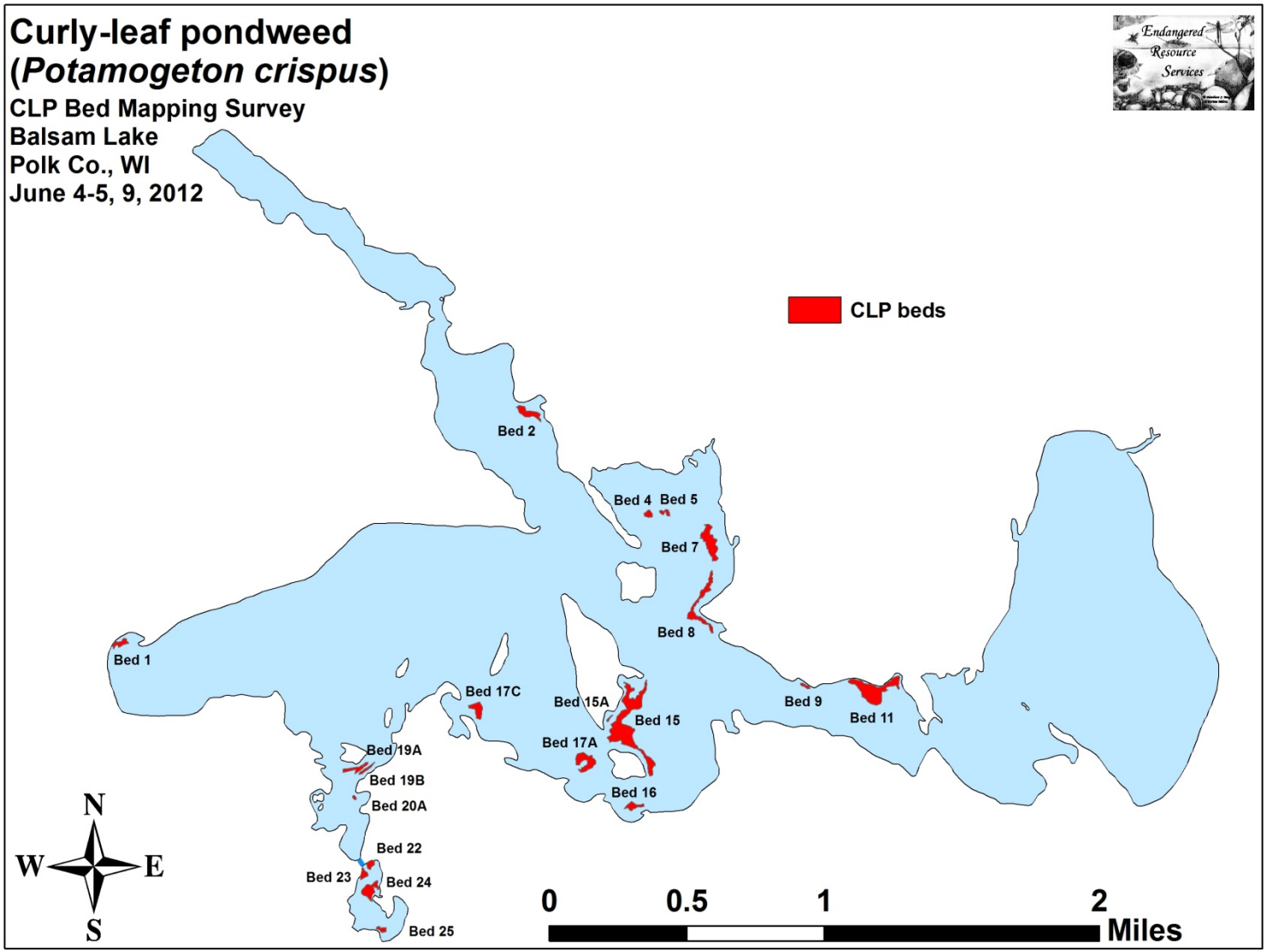

Filamentous algae
Posttreatment Survey
East Balsam Lake
Polk County, WI
May 30, 2012
A
B
C
A
Bed 13
B
Bed 12
C
Bed 14
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
N
W
E
S
0
0.05
0.1
0.2
Miles


Forked duckweed
(Lemna trisulca)
Posttreatment Survey
East Balsam Lake
Polk County, WI
May 30, 2012
A
B
C
Bed 13
Bed 12
Bed 14
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
N
W
E
S
0
0.05
0.1
0.2
Miles


White-stem pondweed
(Potamogeton praelongus)
Posttreatment Survey
East Balsam Lake
Polk County, WI
May 30, 2012
A
B
C
A
Bed 13
B
Bed 12
C
Bed 14
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
0
0.05
0.1
0.2
Miles
N
W
E
S


Wild celery
(Vallisneria americana)
Posttreatment Survey
East Balsam Lake
Polk County, WI
May 30, 2012
A
B
C
A
Bed 13
B
Bed 12
C
Bed 14
Rake Fullness Rating
None Found
1
2
3
2011 CLP Bed
Balsam Lake
N
W
E
S
0
0.05
0.1
0.2
Miles

Appendix VIII: 2012 June CLP Bed Maps


Curly-leaf pondweed
(Potamogeton crispus)
CLP Bed Mapping Survey
Balsam Lake
Polk Co., WI
June 4-5, 9, 2012
Endangered Resource Services
CLP beds
Bed 1
Bed 2
Bed 4
Bed 5
Bed 7
Bed 8
Bed 9
Bed 11
Bed 15
Bed 15A
Bed 16
Bed 17A
Bed 17C
Bed 19A
Bed 19B
Bed 20A
Bed 22
Bed 23
Bed 24
Bed 25
N
W
E
S
0
0.5
1
2
Miles