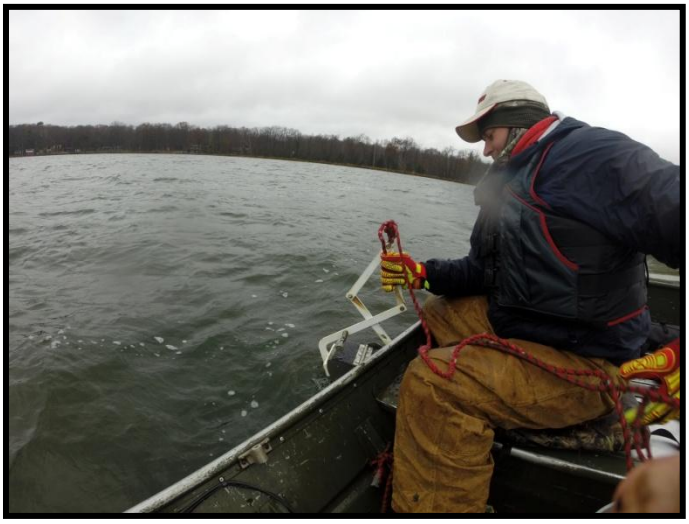
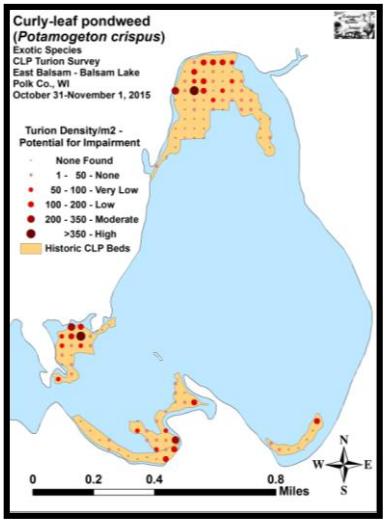
Curly-leaf pondweed (*Potamogeton crispus*) Post Herbicide Turion Survey Balsam Lake – WBIC: 2620600 Polk County, Wisconsin



B. Collins Lowering the Ponar Dredge – East Balsam (10/31/15)



2015 Posttreatment Turion Density

Project Funded by:
Balsam Lake Protection and Rehabilitation District and the
Wisconsin Department of Natural Resources - Grant AEPP-430-14

CLP Turions and Blood Worm Larvae in the Sieve

Survey Conducted by and Report Prepared by:
Endangered Resource Services, LLC
Matthew S. Berg, Research Biologist
St. Croix Falls, Wisconsin
October 31 - November 1, 2015

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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 2015). 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 2015 CLP Treatment Areas

Curly-leaf pondweed (*Potamogeton crispus*) (CLP) is an invasive exotic plant that is common to abundant in parts of Balsam Lake. In their 2010 Wisconsin Department of Natural Resources (WDNR) approved Aquatic Plant Management Plan (APMP), the Balsam Lake Protection and Rehabilitation District's (BLPRD) identified a) reducing overall lake coverage of CLP to <20 acres and b) relieving navigation impairment caused by canopied CLP beds as management goals (Clemens 2010). As part of their continuing efforts to meet these goals, in the spring of 2014, the BLPRD and the WDNR authorized the herbicide treatment of five CLP beds in East Balsam Lake. These beds, which totaled 65.49 acres, were selected based on the 2013 spring CLP bed mapping survey that found they were the largest areas of CLP on the lake, and because they were interfering with boat traffic and/or restricting resident access to the lake from their docks. Although no CLP beds were found in East Balsam following the treatment, the fall 2014 turion survey suggested there would again be significant amounts of CLP in East Balsam. Because of this, in spring 2015, 65.45 acres or approximately 3.19% of the lake's total surface area were again treated (Figure 1).

Following the herbicide application on May 5th, we completed a May 31st posttreatment survey to evaluate the effectiveness of this control effort. On June 13th, we also searched the lake's visible littoral zone and mapped all CLP beds found. As in 2014, these surveys showed that CLP plants were all but eliminated from East Balsam by the treatment. Knowing there was still the potential for the beds to return in 2016, the BLPRD, under the direction of Harmony Environmental, requested a late fall CLP turion survey to determine the level of any latent turions remaining in the lake substrate.

CLP LIFE HISTORY AND STUDY OBJECTIVES:

Although Curly-leaf pondweed occasionally reproduces by seed, the vast majority of plants resprout from stiff overwintering buds called turions that are normally produced in number by the plants prior to their late June/early July senescence (Figure 2). After the pinecone-like turions germinate in late fall or early winter, plants continue to grow slowly under the ice. Following ice out, growth accelerates, and plants rapidly canopy allowing them a competitive advantage over slower growing native species (Capers 2005).

Figure 2: Germinating CLP Turion

Research suggests approximately 50% of turions germinate in a growing season while the rest remain dormant until the following growing season when another 50% will germinate (Johnson 2012). Depending on the level of turions at a given location, and knowing that latent turions may be able to survive for over 5 years in the sediment, it may take several years of control to exhaust the "turion bank" (R. Newman – U of M unpublished data).

Following the May 5th herbicide application and the summer growing season, we conducted a posttreatment turion survey on October 31st and November 1st. The goals of the survey were to determine if there were still CLP turions in any of the East Balsam treatment areas, and, if there were, whether their numbers suggested there would likely be enough to cause navigation issues in 2016. This report is the summary analysis of that field survey.

METHODS:

Ponar Dredge Turion Survey:

After merging the 2014 treatment areas and the 2009 treatment of Bed 14C into a single shapefile, we used Hawth's Analysis Tools Extension to ArcGIS 9.3.1 to generate regular points at the rate of approximately 1.7 points/acre. This produced a 120 point sampling grid of which 18 were in Bed 12, 65 were in Bed 13, 7 were in Bed 14, and the remaining 30 were in the combined area of Beds 14B and 14C. This same sampling grid was used in 2015 to allow for the most accurate comparison possible (Figure 3) (Appendix I). For ease of comparison, we also left the 2014 narrative in the results section of the report.

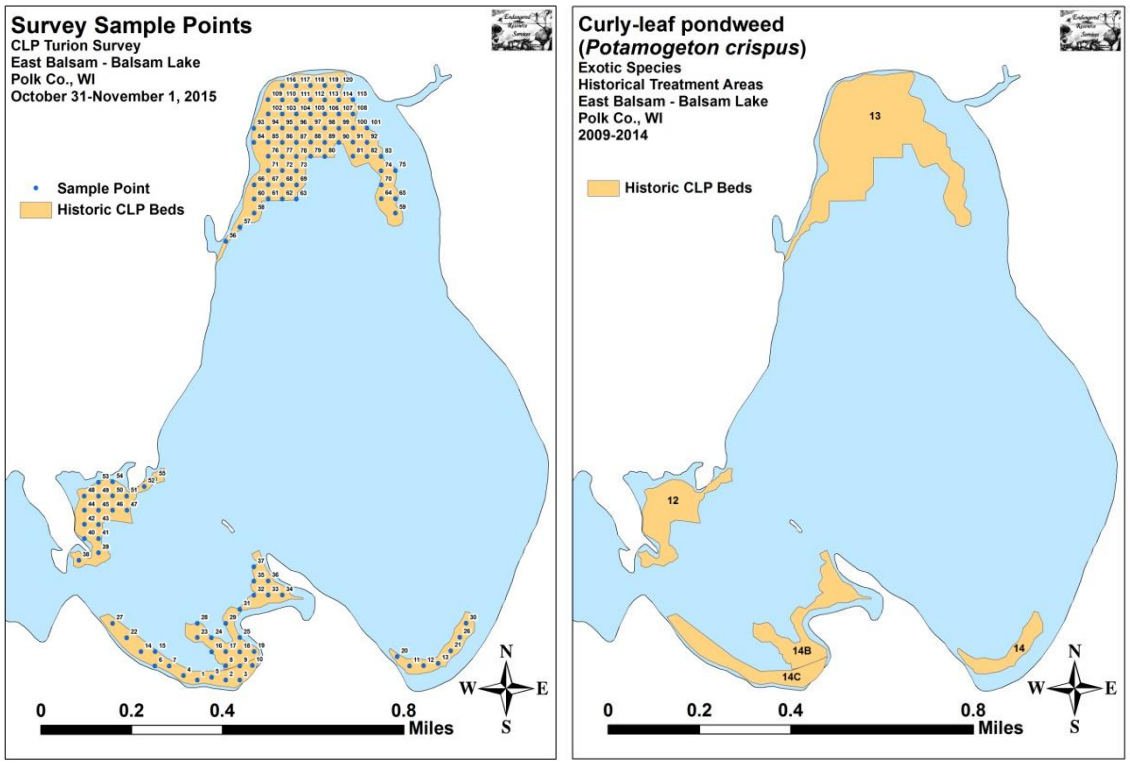


Figure 3: Turion Survey Sample Points in Historical Treatment Areas

During the surveys, we located each point with a handheld mapping GPS unit (Garmin 76CSx) and used a Petite Ponar dredge with a 0.0232m^2 (36in^2) sample area to take a bottom sediment grab from each side of the boat at each location. These samples were then rinsed in a fine sieve to separate out the sediment (Figure 4). Samples with high numbers of turions/levels of detritus were bagged for later analysis at which time we discarded all rotten turions, tallied all live turions, and multiplied the combined total live turions from the two samples by 21.53 to estimate turions/m^2 at each location. This value gives an idea of how many CLP plants will germinate in an area in 2016.

Figure 4: East Balsam Ponar Grab and Turion Sieving

DATA ANALYSIS:

We entered all data collected into an Excel spreadsheet and used standard formulas in the data analysis tool pack to calculate the following:

Total number of points sampled: This value is the total number of points on the lake within each study area. We took two Ponar samples at each sample point.

Total number of live turions: This value includes all live turions found at all sites within a study area.

Total number of points with live turions: This number includes all survey sites that had at least one turion in **either** of the Ponar samples taken at the site.

Frequency of occurrence: The frequency of turions is generally reported as a percentage of occurrences at all sample points. The value is used to extrapolate coverage within the study area. For example, if 20% of all sample sites have turions, it suggests that 20% of the study area will have at least some Curly-leaf pondweed coverage the following year.

Points at or above nuisance level: This value gives the number of survey sites within the study area that were above the predicted nuisance threshold (Figure 5). Research suggests that when the turion density is at or above 200/m^2, the following year's CLP growth has the potential to at least moderately impair navigation (Johnson 2012).

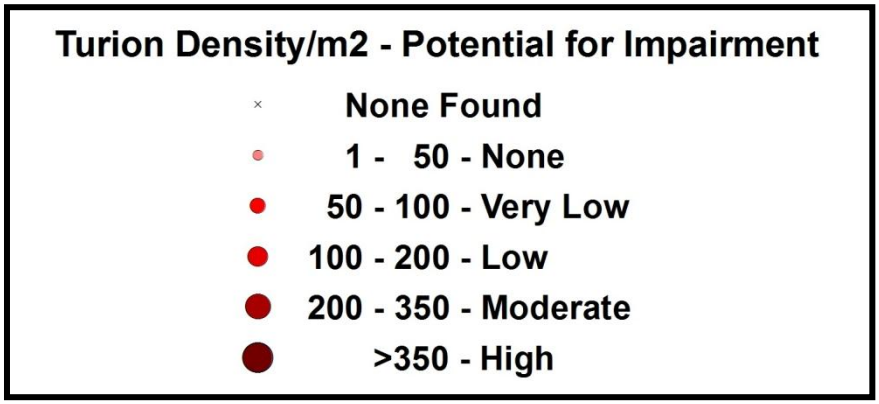


Figure 5: Predicted Navigation Impairment Based on Turion Density

Percent nuisance level: The percentage of nuisance points divided by the total number of survey points can be extrapolated to determine what percent of the study area has the potential to have at least moderate navigation impairment during the next growing season.

Mean turions/m^2: This value is the average number of turions/m^2 when pooling the data from all survey sites regardless of whether or not they had turions present.

Standard deviation of turions/m^2: This value tells us how far apart the data is from the mean. A low standard deviation suggests most points have a turion density that was similar to the mean, while a high value suggests there was greater variability in turion density within the sample area.

2014-2015 Significant Differences:

Data from the 2014 and 2015 surveys was compared using paired t-tests as we returned to the same sites during each survey. Year-over-year differences were determined to be significant at $p < .05$, moderately significant at $p < .01$, and highly significant at $p < .005$ (Table 1).

RESULTS AND DISCUSSION:

2014 Fall Ponar Dredge Turion Survey:

The November 8-9th, 2014 survey revealed CLP turions were present throughout much of the 2014 treatment areas with 92 of 120 points having live turions (76.67%) (Figure 6) (Appendix II). Despite this, only 6 points (5%) suggested CLP growth in 2015 had the potential to exceed the nuisance threshold with densities >200 turions/m^2 (Table 1). When broken down by area, Bed 12 had the highest rate with over 22% of the bed projected to exceed this level. Bed 13 was the only other area with any nuisance points, and both of them were located at the very northern edge of the bed. All of the nuisance points were in areas with shallow water (<5ft) that historically have also had dense canopied CLP.

The overall mean turion density was 61.53 turions/m^2. This value suggested that the average potential for impairment would be very low. Turion densities were somewhat variable with all standard deviations values being greater than the mean. However, only Bed 12 was more than 25% higher than the mean, and none were double the mean.

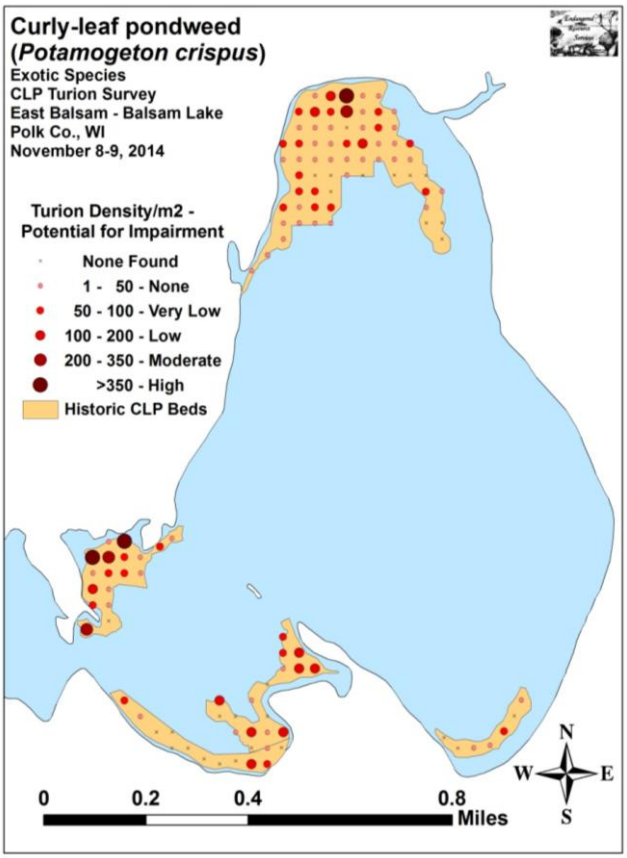


Figure 6: 2014 Fall CLP Turion Survey Density and Distribution

2015 Fall Ponar Dredge Turion Survey:

During the October 31st - November 1st, 2015 survey, we found live CLP turions at 68 of 120 points (56.67%) (Figure 7) (Appendix II). This was a decline in distribution of 26.1% from the 92 points with turions in 2014. When broken down by area, all beds showed a decline in distribution except for Bed 14B/C which increased from 56.67% coverage in 2014 to 63.33% coverage in 2015 (Table 1).

The number of high density "predictive nuisance" locations also declined fractionally from 6 points (5.00%) in 2014 to 5 points (4.17%) in 2015. As in 2014, Bed 12 had the highest percentage of high density points (11.11%). Outside this area, no other bed had more that 3.33% (Bed 14B/C). The majority of the highest density turion points again occurred in areas with shallow water (<5ft) that historically have had dense canopied CLP growth in the spring as well as moderate levels later in the summer. These areas may be producing a "second crop" of plants that sprout from latent turions after the treatment and, consequently, are able to produce turions/maintain the bank at these locations.

We calculated the overall mean density within the study areas at 44.20 turions/m^2 with a standard deviation of 75.00 turions/m^2. This was a nearly significant decline from 2014 (***p* = 0.057**) when we found a mean of 61.53turions/m^2 with a standard deviation of 114.47 turions/m^2. Visual analysis of the 2014 and 2015 maps suggested the turion bank has been nearly exhausted in most deep water areas over 8ft while shallow areas continue to have regular turions present. Densities continue to be variable with all standard deviations values being greater than the mean. With the exception of Bed 14 (southeast bay) which showed a slight increase, all other areas declined, although none of these changes were significant.

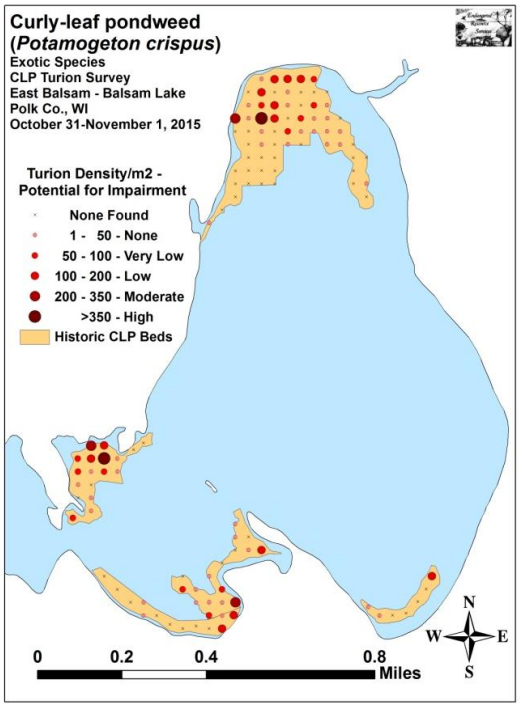


Figure 7: 2015 Fall CLP Turion Survey Density and Distribution

Table 1: CLP Turion Surveys - Summary Statistics
East Balsam Lake, Polk County
November 8-9, 2014 and October 31-November 1, 2015

	2014					2015				
Summary Statistics:	Total	Bed 12	Bed 13	Bed 14	Bed 14B/C	Total	Bed 12	Bed 13	Bed 14	Bed 14B/C
Total number of points sampled	120	18	65	7	30	120	18	65	7	30
Total live turions	343	127	142	7	67	246	69	111	10	56
Total number of points with live turions	92	17	54	4	17	68	14	32	3	19
Frequency of occurrence (in percent)	76.67	94.44	83.08	57.14	56.67	56.67	77.78	49.23	42.86	63.33
Points at or above nuisance level (+200/m^2)	6	4	2	0	0	5	2	2	0	1
% nuisance level	5.00	22.22	3.08	0.00	0.00	4.17	11.11	3.08	0.00	3.33
Maximum turions/m^2	1,012	1,012	388	65	194	431	409	431	172	258
Mean turions/m^2	61.53	151.89	47.03	21.53	48.08	44.20	82.52	36.76	30.75	40.21
Standard deviation/m^2	114.47	249.58	58.70	24.86	58.39	75.00	107.58	71.07	63.20	57.00
Standard error of the paired difference						0.51	2.70	0.47	1.23	0.58
Degrees of freedom						119	17	64	6	29
t-statistic						-1.59	-1.19	-1.01	0.34	-0.63
p - value						**0.057**	0.12	0.15	0.37	0.27

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

CONSIDERATIONS FOR FUTURE MANAGMENT:

The turion survey suggests there will again be CLP throughout much of East Balsam Lake in 2016. Despite this, the overall mean suggests that the potential for navigation impairment from CLP will be very low in East Balsam with higher levels of impairment being localized to a few nearshore spots including parts of Bed 12 (northwest of the Big Narrows outlet to the main lake), Bed 13 (north bay), and Bed 14B/C (the southeast corner of the southwest bay). If the BLPRD determines its goal is to further reduce CLP with an eye on future native plant restoration, it may be looking at another large scale treatment with the hope of getting basin-wide residual control. If they decide they would rather solely focus on minimizing navigation impairment, it appears they could be much more limited in scope.

LITERATURE CITED

Clemens, C. 2010. Aquatic Plant Management Plan - Balsam Lake Polk County, WI. Sponsored by Balsam Lake Protection and Rehabilitation District - Prepared by Harmony Environmental – October 2010. Available from http://www.blprd.com/docs/BalsamLakeAPMfinal101810.pdf (2014, November).

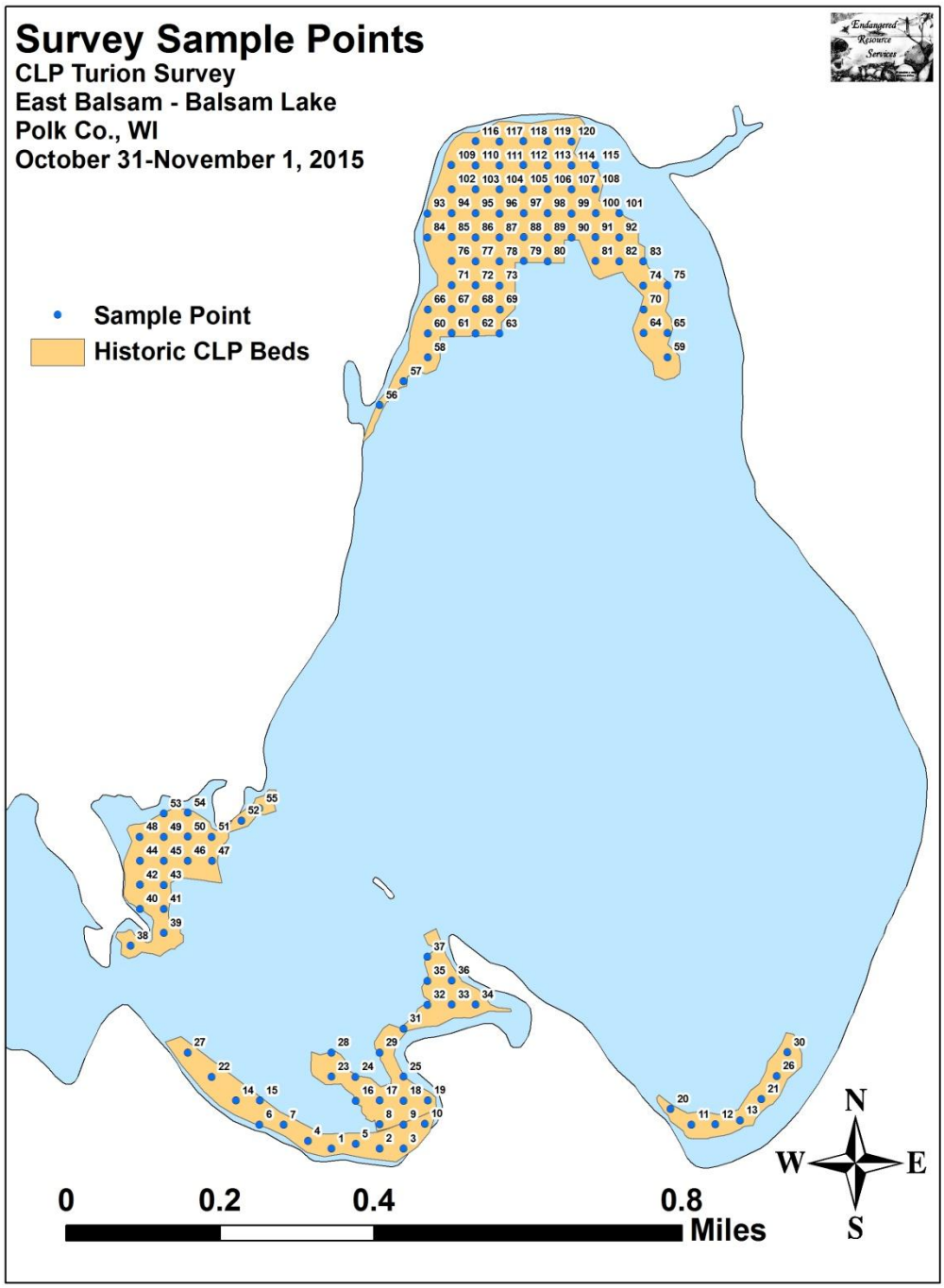
Hopke, R., E. Nelson, and E. Eaton [online]. 1964. Balsam Lake Maps. Available from http://dnr.wi.gov/lakes/maps/DNR/2620600a.pdf (2014, November).

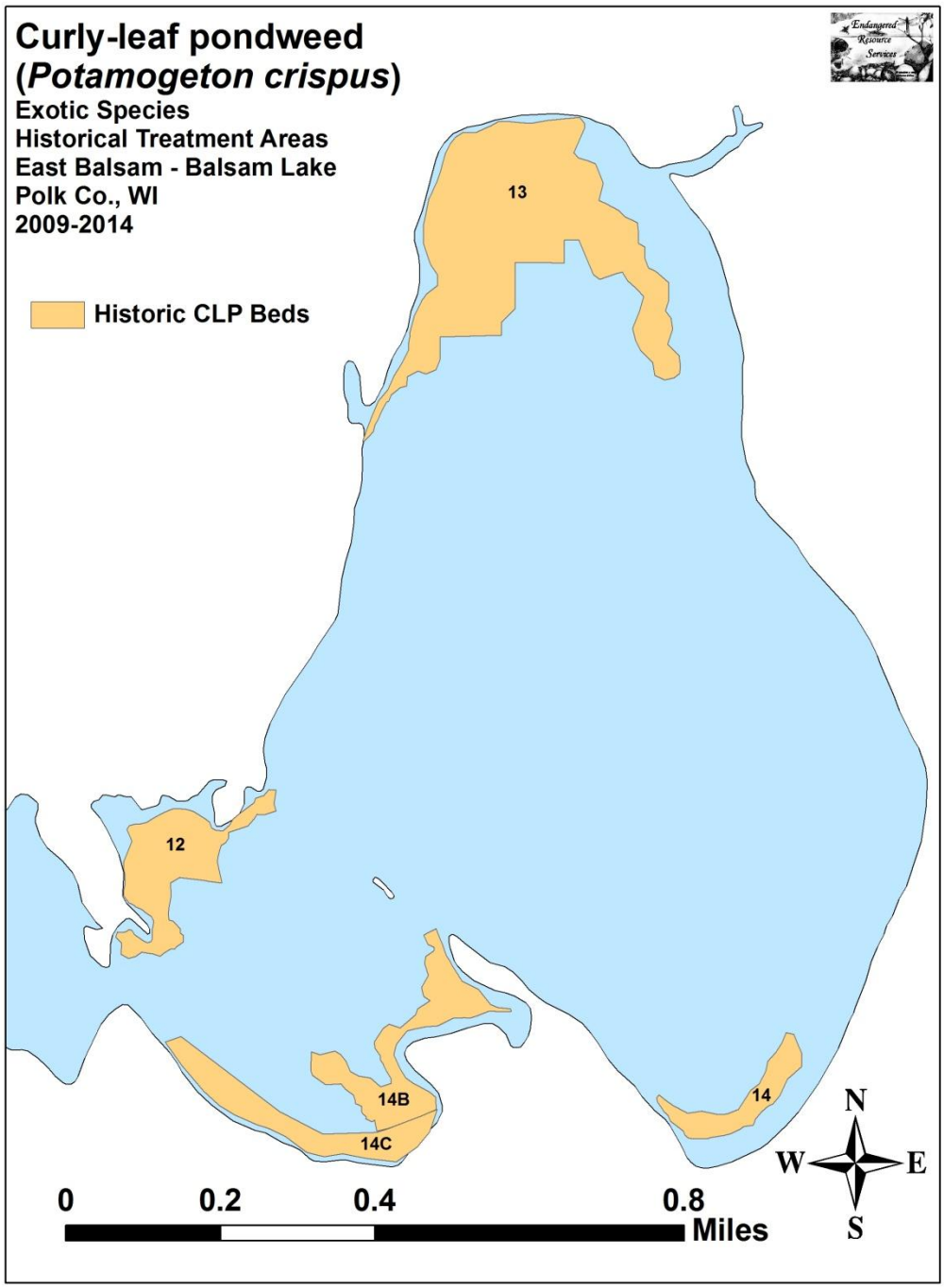
UWEX Lakes Program. [online]. 2010. Aquatic Plant Management in Wisconsin. Available from http://www.uwsp.edu/cnr/uwexlakes/ecology/APMguide.asp (2010, June).

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

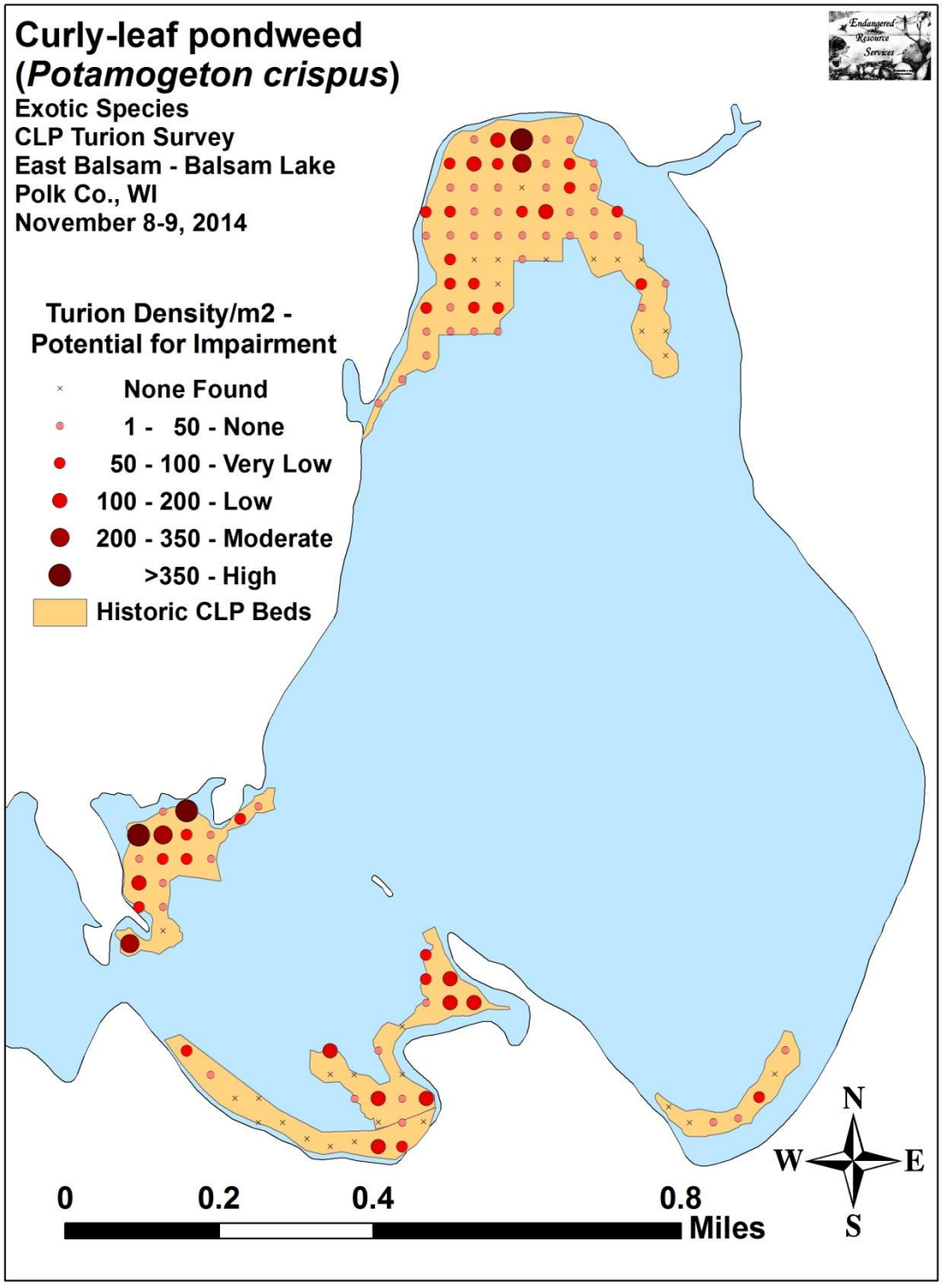
WDNR. [online]. 2015. Balsam Lake Citizen Monitoring Water Quality Database. Available from http://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=2620600&page=waterquality (2015, November).

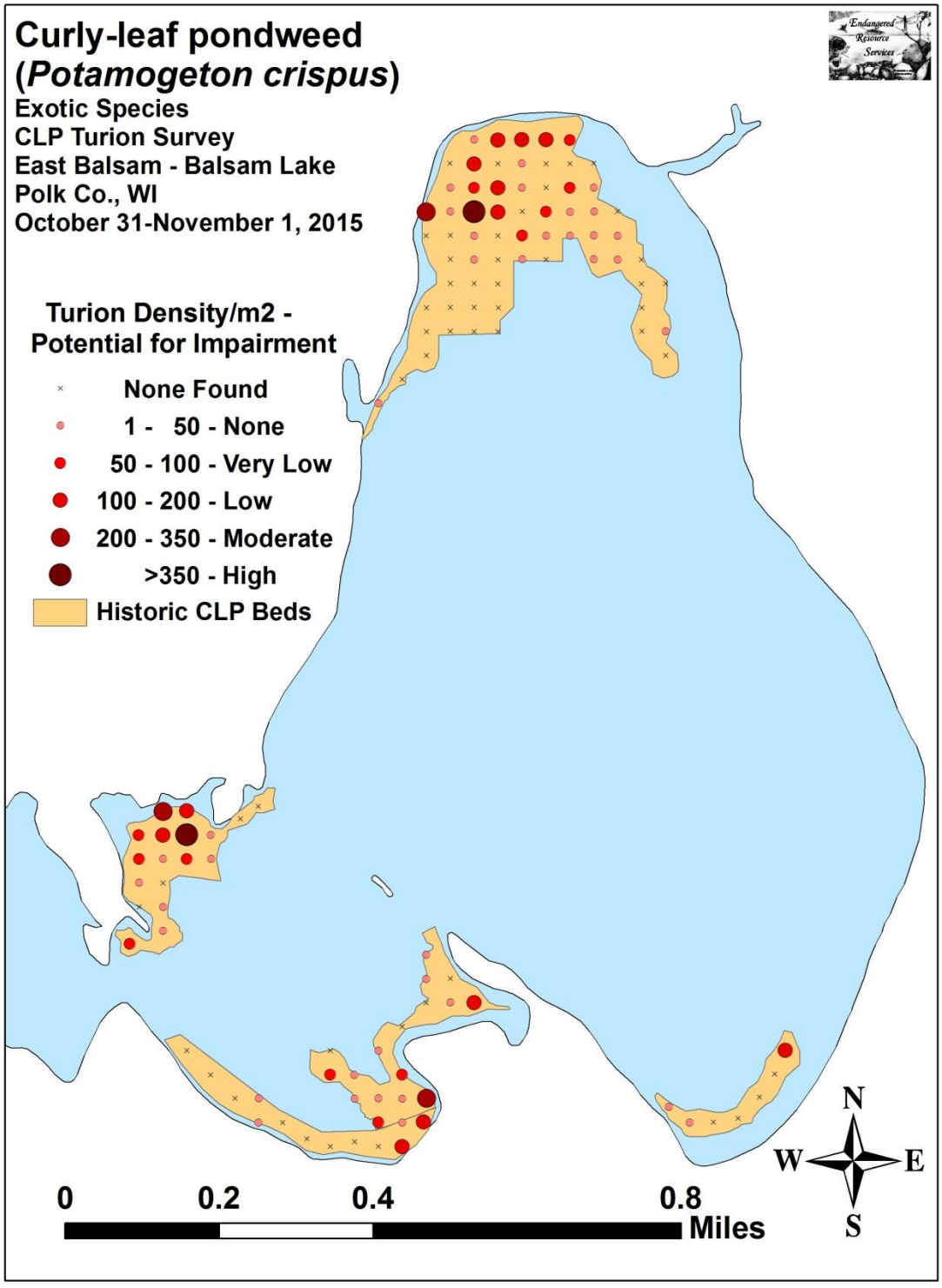
Appendix I: Survey Sample Points and Historic CLP Treatment Areas


Survey Sample Points
CLP Turion Survey
East Balsam - Balsam Lake
Polk Co., WI
October 31-November 1, 2015
Sample Point
Historic CLP Beds
Endangered Resource Services
N
W
E
S
0
0.2
0.4
0.8
Miles


Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
Historical Treatment Areas
East Balsam - Balsam Lake
Polk Co., WI
2009-2014
Historic CLP Beds
13
12
14B
14C
14
N
W
E
S
0
0.2
0.4
0.8
Miles

Appendix II: 2014 and 2015 Fall CLP Turion Density and Distribution Maps


Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
CLP Turion Survey
East Balsam - Balsam Lake
Polk Co., WI
November 8-9, 2014
Endangered Resource Services
Turion Density/m2 -
Potential for Impairment
None Found
1 - 50 - None
50 - 100 - Very Low
100 - 200 - Low
200 - 350 - Moderate
>350 - High
Historic CLP Beds
N
W
E
S
0
0.2
0.4
0.8
Miles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Turion Density/m2 -
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50 - 100 - Very Low
100 - 200 - Low
200 - 350 - Moderate
>350 - High
Historic CLP Beds
N
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0.4
0.8
Miles