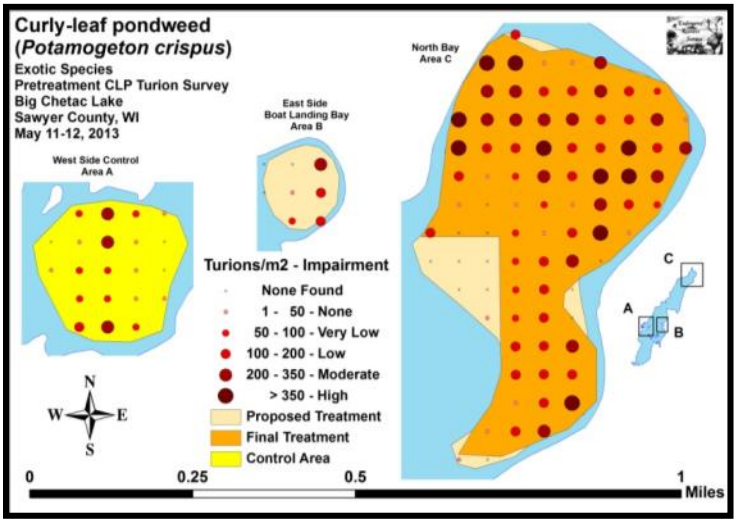
Curly-leaf pondweed (*Potamogeton crispus*) Pre/Post Herbicide Turion Surveys Big Chetac Lake – WBIC: 2113300 Sawyer County, Wisconsin



2013 - Pretreatment Turion Density

2013 Final CLP Treatment Area

Project Funded by:

Grant ACEI-133-13 - Big Chetac Chain Lake Association, and the Wisconsin Department of Natural Resources

CLP Turions and Blood Worm Larvae – Posttreatment North Bay – 9/28/13

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May 11-12 and September 28-29, 2013

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ABSTRACT

Big Chetac Lake (WBIC 2113300) is a 1,920-acre stratified drainage lake in southwestern Sawyer Co., WI. The lake is eutrophic with a littoral zone that reached 13ft. in the spring of 2013. Following the acceptance of a three year exotic species control grant to actively manage Curly-leaf pondweed (*Potamogeton crispus*), the Big Chetac Chain Lake Association and the WDNR initiated plans to chemically treat 105 acres in the lake's north bay (97.5acres) and in the main east side boat landing bay (7.5 acres) where CLP nearly completely dominates the plant community. However, out of concern for the Northern wild rice (*Zizania palustris*) located in the "Bull Pen" bay immediately south of the boat landing area, it was decided to cancel treatment in the boat landing area. Because of this, data from the bay was pooled with the western control bay for statistical analysis. On May 11-12th, prior to the May 28th herbicide application, we conducted baseline Petite Ponar dredge turions surveys in both the treatment and control areas. In the north bay treatment area, we found CLP turions at 73 of 85 survey points (85.88%) with a mean density of 158.59 turions/m^2 and a standard deviation of 151.88. In the control bays, turions were present at 23 of 29 points (79.31%) with a mean density of 68.21 turions/m2 and a standard deviation of 71.32. In the treatment area, 26 points had densities of 200 turions/m^2 or higher suggesting that over 30% of the north bay would have experienced moderate to severe navigation impairment without management, while the control bays had only four points or approximately 14% of the area reaching the nuisance level. Following the herbicide application and summer growing season, the September 28-29th survey found CLP turions at 65 of 85 survey points (65.88%) in the north bay treatment area with a mean density of 71.33 turions/m^2 and a standard deviation of 142.93. In the control bays, turions were present at 21 of 29 points (72.41%) with a mean density of 63.02 turions/m*2* and a standard deviation of 88.07. Although a majority of points in the treatment area still have viable turions, the nuisance level was reduced almost 75% with only 7 points still having densities >200 turions/m^2. **These results demonstrated a highly significant reduction in mean turion density in the treatment area (t = -5.65, *p*<.001)**, but no significant change in the control bays (t=-0.51, *p*=.30). Although the September turion survey suggests there will again be large numbers of CLP plants in the north bay in 2014, the highly significant reduction in both density and coverage demonstrates that large steps were taken towards the initial goal of CLP reduction in 2013. As the project moves into its second year, all data from 2013 along with the 2014 pretreatment survey will be used to finalize 2014 treatment areas as we continue to work towards the Aquatic Plant Management Plan's restoration goals.

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INTRODUCTION:

Big Chetac Lake (WBIC 2113300) is a 1,920-acre stratified drainage lake in southwestern Sawyer County, Wisconsin in the Town of Edgewater (T37N R09W S19 NE NE). It reaches a maximum depth of 28ft in the narrows between the islands in the south basin and has an average depth of approximately 14ft (Busch et al. 1967). The lake is eutrophic (nutrient rich) in nature with summer Secchi readings averaging 3.3ft over the past 16 years (WDNR 2013). This poor to very poor water clarity produced a littoral zone that extended to approximately 13ft in the spring of 2013. The bottom substrate is predominately muck in the lake's side bays and throughout the north and south ends, and a mixture of sand and rock along exposed shorelines, the mid-lake narrows, and around the islands (Busch et al. 1967).

Figure 1: Proposed 2013 Spring CLP Treatment Areas

Curly-leaf pondweed (*Potamogeton crispus*) (CLP), an exotic invasive species, is abundant in Big Chetac Lake. The 2008 spring point-intercept survey found CLP dominated approximately 30% of the lake's surface area, and, especially in the lake's muck bottom bays, almost always formed a solid canopy in up to 10ft of water, excluded most native plants, and often made boating difficult. Additionally, CLP's natural annual senescence in late June/early July contributes significantly to phosphorus loading (James et al. 2002) making it a factor in the lake's summer algae blooms that negatively impact water clarity and quality.

In 2013, after years of study and discussion among board members, residents, local businesses, and the WDNR, the Big Chetac Chain Lake Association applied for and received a 3 year WDNR exotic species control grant to begin actively managing CLP chemically and manually. After evaluating the 2008 maps, it was determined the expansive beds in the north bay and the boat landing bay would be chemically treated. Combined, these areas totaled 105 surface acres (Figure 1).

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 – North Bay of Big Chetac 9/29/13

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).

On May 11-12th, we conducted a baseline Ponar dredge turion survey in the scheduled treatment and control areas. Following the May 28th herbicide application and the summer growing season, we conducted a posttreatment survey on September 28-29th to determine if the herbicide had had a significant impact on the number of turions in the lake's sediment in the treatment area. These results were then compared to areas that were left untreated. This report is the summary analysis of these two field surveys.

METHODS:

Ponar Dredge Turion Survey:

Within the initial 2013 proposed treatment and control area shapefiles, we used Hawth's Analysis Tools Extension to ArcGIS 9.3.1 to generate regular points at the rate of approximately 1 point for every 1.25 acres. This resulted in a sampling grid totaling 114 points of which 85 were in the 97.5 acre north bay treatment area, 21 were in the 25 acre western control bay, and 8 were in the 7.5 acre boat landing bay (Figure 3) (Appendix I).

Out of concern for the Northern wild rice (*Zizania palustris*) located in the "Bull Pen" bay immediately south of the boat landing area, treatment of the entire 7.5 acres in this area was also cancelled. Because of this, the data from these points were pooled with the control data set for statistical analysis.

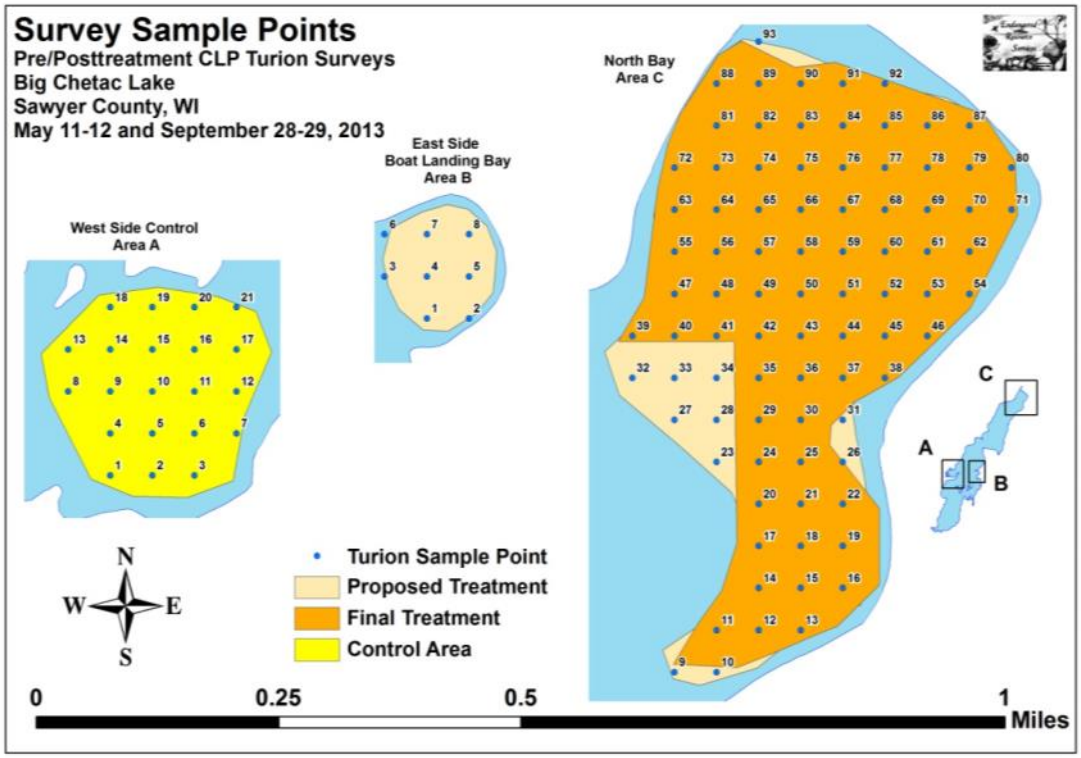

Figure 3: 2013 Turion Survey Sample Points and Final Treatment Area

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 and detritus (Figure 4). We discarded all rotten turions, tallied all live turions, and multiplied the combined total live turions from the two samples by 21.5 to get an estimate in turions/m^2 at each location. This value gives an idea of how many CLP plants will germinate in an area in 2014.

Figure 4: 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.

Points at or above nuisance level: This value gives the number of survey sites within the study area that were above the moderate nuisance threshold (Figure 5). Research suggests that when the turion density is at or above 200/m^2, the resulting CLP growth is likely 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 survey points can be extrapolated to determine what percent of the study area is likely to have at least moderate navigation impairment during the coming 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.

Pre/Post Treatment and May/September Significance:
Data from the two surveys was compared using a paired t-test as surveyors returned to the same sites during each survey. Pre/posttreatment and May/September differences in the untreated areas were determined to be significant at $p < .05$, moderately significant at $p < .01$, and highly significant at $p < .005$ (Table 1).

RESULTS AND DISCUSSION:

May Ponar Dredge Turion Survey:

During the May 11-12th survey, we found Curly-leaf pondweed turions at 73 of 85 survey points (85.88%) in the north bay treatment area, and in 23 of 29 points (79.31%) in the control bays (Table 1). In the north bay treatment area, 26 points had densities of 200 turions/m^2 or higher suggesting that over 30% of the north bay would have experienced moderate to severe navigation impairment without management (Figure 6) (Appendix II). Results from the control bays suggested lower overall CLP densities with only four points or approximately 14% of the area reaching the nuisance level.

We found that turion densities were highly variable as the standard deviation in the north bay was +/- 151.88 around a mean density of 158.59 turions/m^2. In general, densities in the deeper water areas in the south-central parts of the bed and over sandy shoreline areas on the north and east sides of the bed had lower densities while areas over organic muck in the 4-8ft range had the highest densities (Figure 6). Mean densities in the control bays were 43% lower than in the north bay with an average of 68.21 turions/m^2; however, as in the north bay, turions densities varied widely as the standard deviation was 71.32. In the boat landing bay, density appeared to be primarily a function of depth, while in the western bay, both the eastern and western sides of the bed had reduced densities. This is likely related to increasing depth on the east, and, potentially, competition from a diverse native plant community on the western edge.

September Ponar Dredge Turion Survey:

The September 28-29th survey revealed an approximately 23% reduction in overall turion coverage in the north treatment area with 56 of 85 points having live turions present (65.88%) (Figure 7) (Appendix II). Coverage in the control bays was also down 8% with 21 of 29 sites having turions. Although a majority of points in the treatment area still had viable turions, the nuisance level was reduced almost 75% with only 7 points still having densities >200 turions/m^2. Interestingly, the control bays also experienced a 75% reduction in predicted nuisance coverage with a single point exceeding this threshold.

Overall mean turion density in the treatment area decreased 55% to 71.33 turions/m^2. Although a decline in density was not surprising, this was greater than the expected reduction of 50% based on predicted germination rates. Furthermore, this value suggests there was minimal survival or regrowth of CLP plants following treatment. In the control area, mean density declined nearly 7% indicating that CLP plants produced turions at a rate slightly below replacement level. Densities continued to be highly variable in the treatment area as the standard deviation of +/- 142.93 was twice as high as the mean. The control areas standard deviation of +/- 88.07 was also above the mean density of 63.02 turions/m^2.

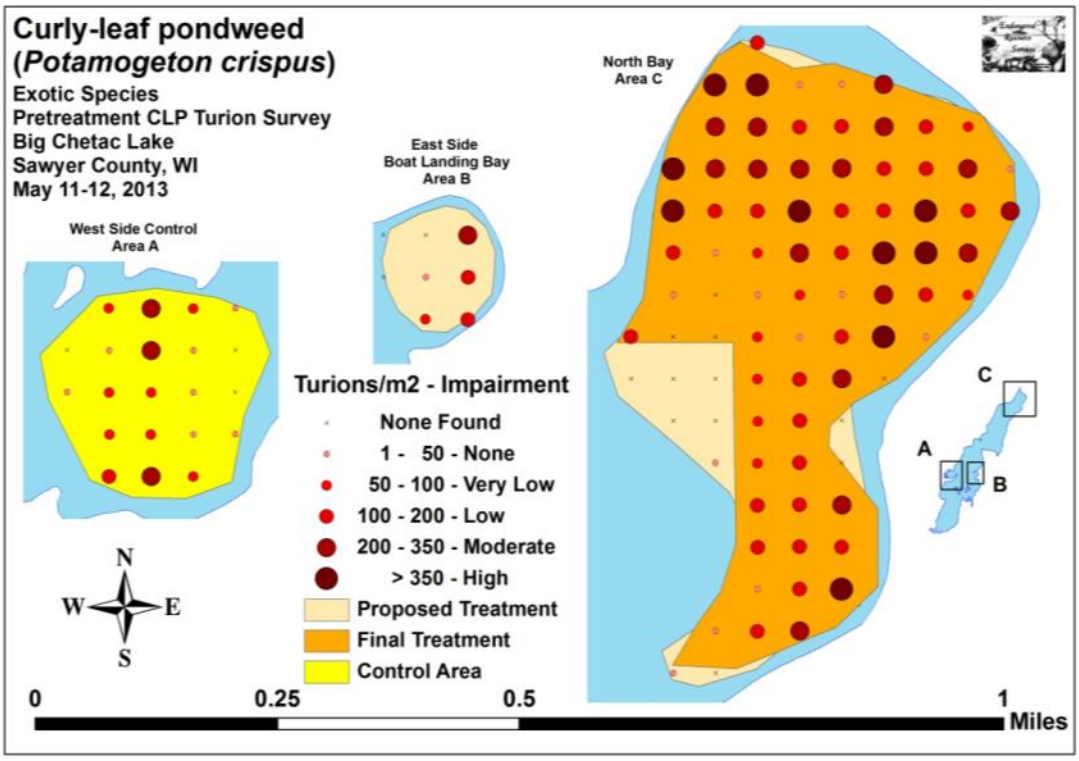

Figure 6: Pretreatment CLP Turion Survey Density and Distribution

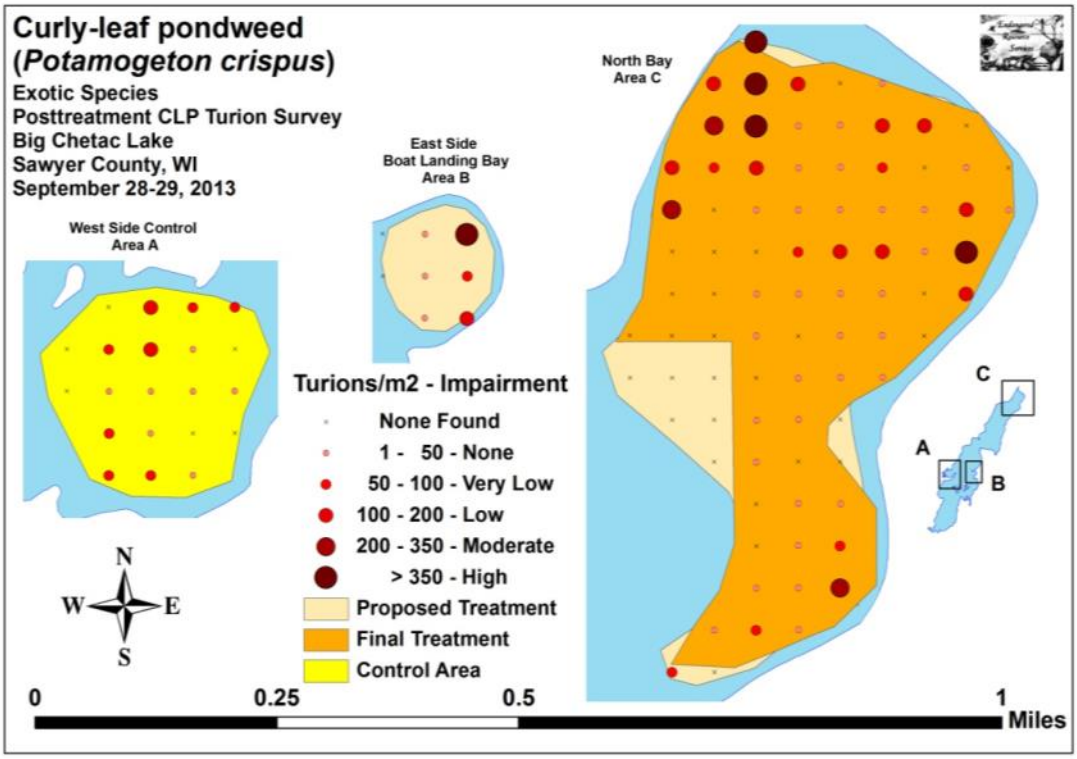

Figure 7: Posttreatment CLP Turion Survey Density and Distribution

Table 1: CLP Turion Surveys - Summary Statistics
Big Chetac Lake, Sawyer County
May 11-12 and September 28-29, 2013

	North Bay Treatment Area		Boat Landing and Western Control Bays	
Summary Statistics:	Pre	Post	May	Sept.
Total number of points sampled	85	85	29	29
Total live turions	627	282	92	85
Total number of points with live turions	73	56	23	21
Frequency of occurrence	85.88%	65.88%	79.31%	72.41%
Points at or above nuisance level (+200/m^2)	26	7	4	1
% nuisance level	30.59%	8.24%	13.79%	3.45%
Maximum turions/m^2	731	1,011	237	430
Mean turions/m^2	158.59	71.33	68.21	63.02
Standard deviation/m^2	151.88	142.93	71.32	88.07
Standard error of the paired difference		0.72		0.46
Degrees of freedom		84		28
t-statistic		-5.65		-0.51
p-value		***<.001		0.30

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

Statistical Analysis of Surveys:

Using a paired t-test to compare the results of the May and September turion surveys, we found that the decline in the north bay densities was highly significant ($p<<.001$). This suggests that the reduction was a direct result of the herbicide treatment (Table 1). Although the control areas also demonstrated a reduction in both coverage and densities, these changes were not significant and are likely due to normal year over year growing season fluctuation.

CONSIDERATIONS FOR FUTURE MANAGMENT:

With a project goal being to significantly reduce CLP prior to beginning the restoration of native plants (BCABLA 2010), the 2013 herbicide application has to be considered a success. Although the September turion survey suggests there will again be large numbers of CLP plants in the north bay in 2014, the highly significant reduction in both density and coverage demonstrates that large steps were taken towards the initial goal of CLP reduction in 2013. As the project moves into its second year, all data from 2013 along with the 2014 pretreatment survey will be used to finalize 2014 treatment areas as we continue to work towards these restoration goals.

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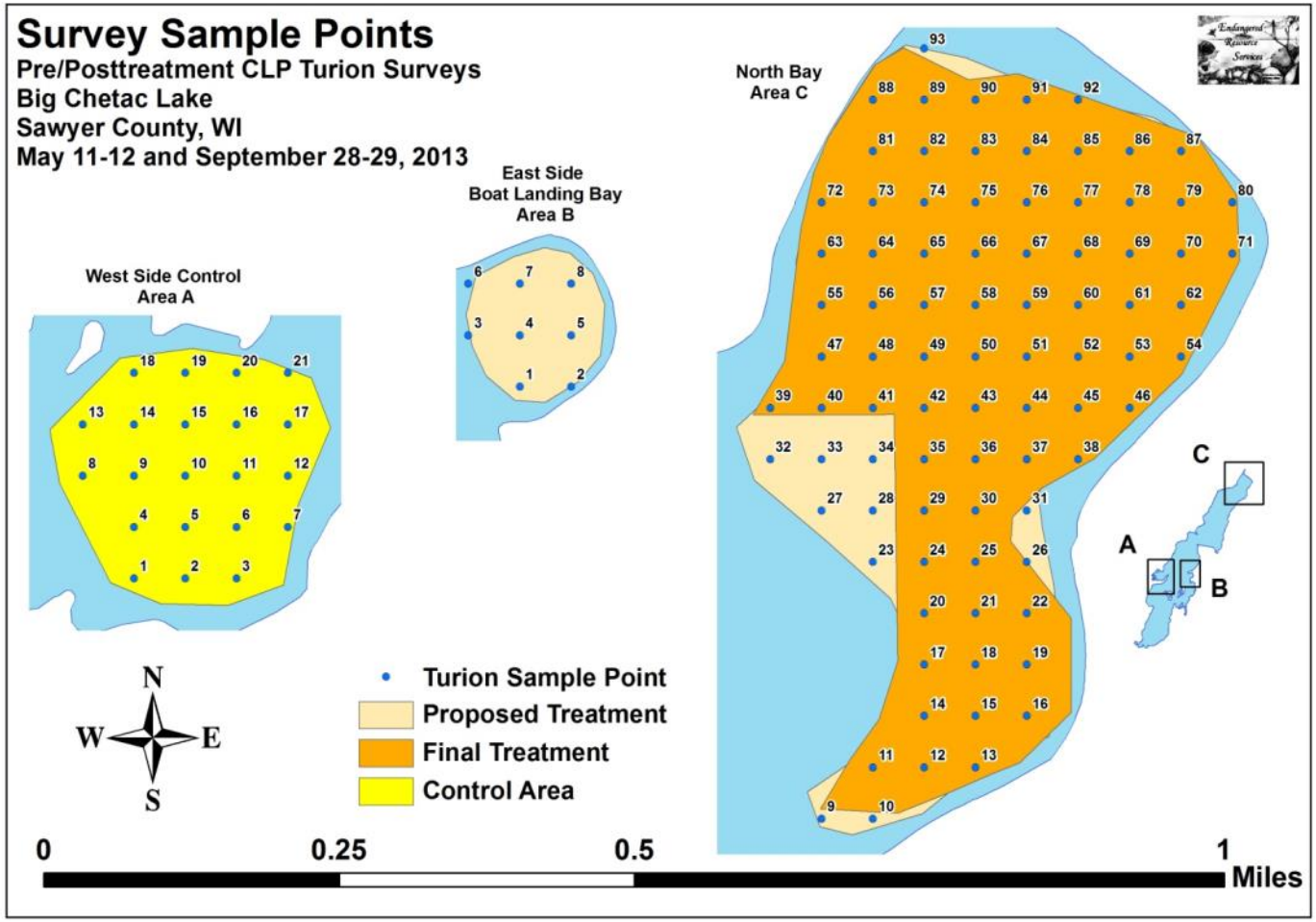
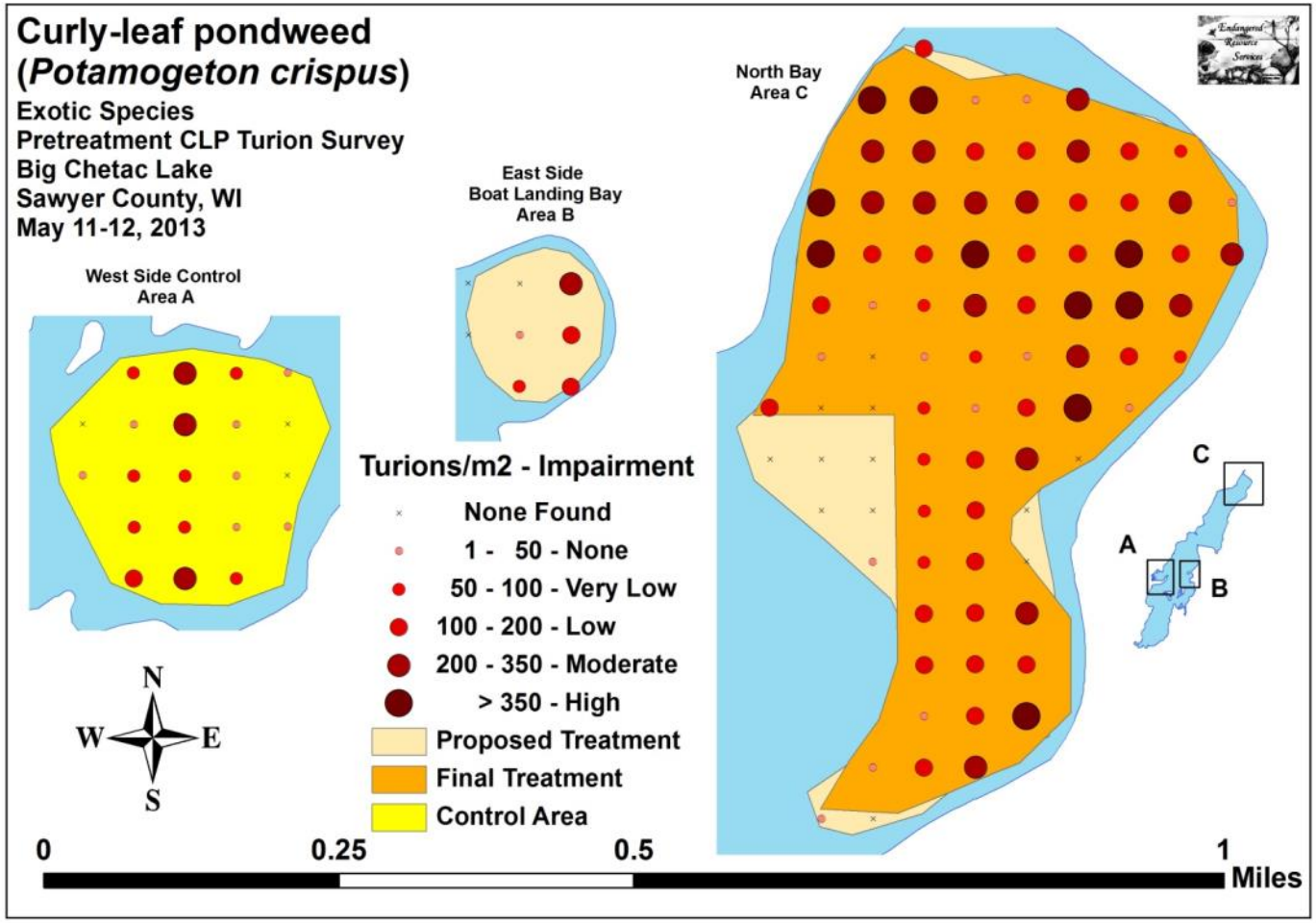
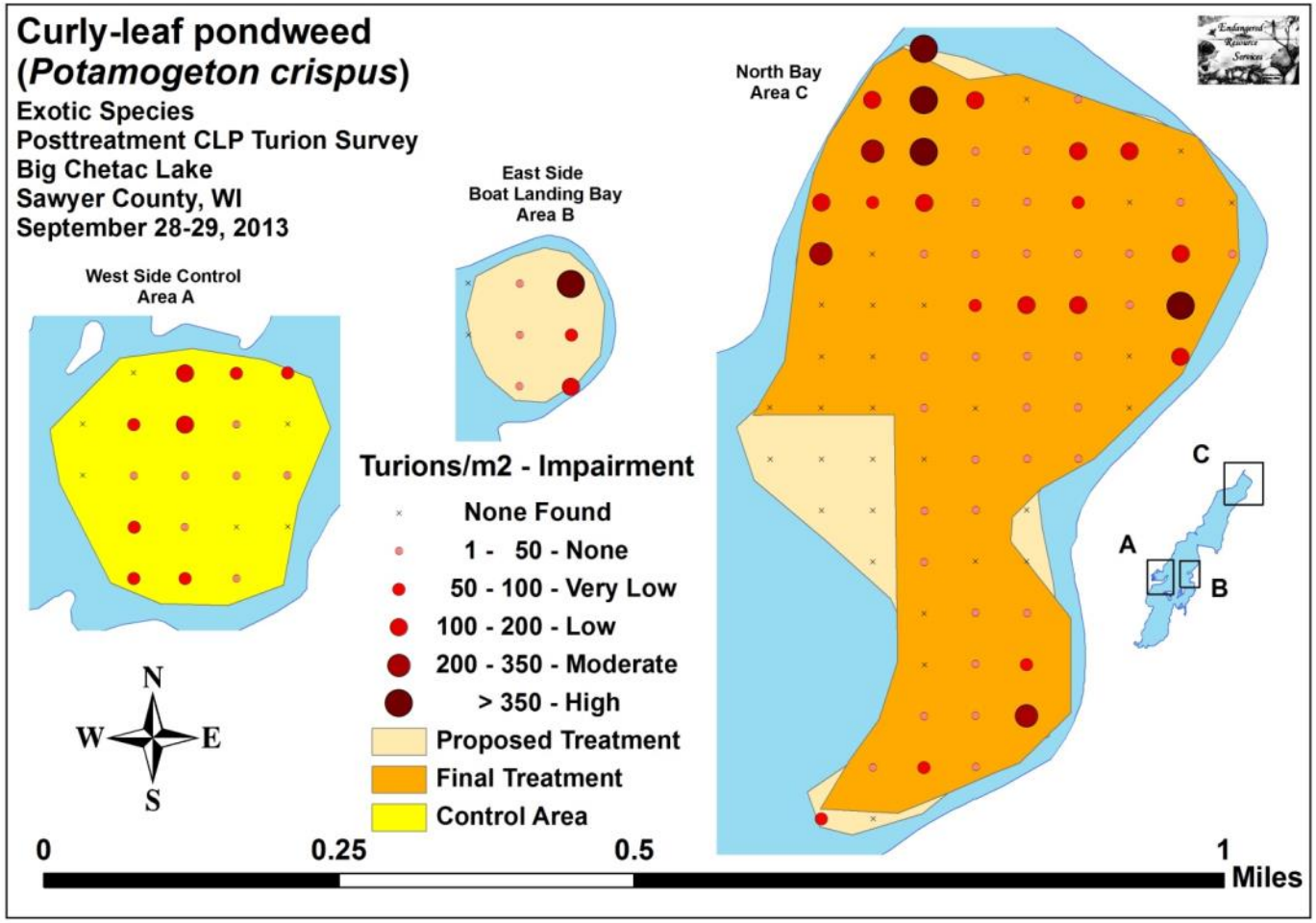
Appendix I: Survey Sample Points and CLP Treatment Area


Survey Sample Points
Pre/Posttreatment CLP Turion Surveys
Big Chetac Lake
Sawyer County, WI
May 11-12 and September 28-29, 2013
West Side Control
Area A
East Side
Boat Landing Bay
Area B
North Bay
Area C
N
W
E
S
Turion Sample Point
Proposed Treatment
Final Treatment
Control Area
0
0.25
0.5
1
Miles

Appendix II: 2013 Pre/Posttreatment CLP Turion Density and Distribution Maps


Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
Pretreatment CLP Turion Survey
Big Chetac Lake
Sawyer County, WI
May 11-12, 2013
West Side Control
Area A
East Side
Boat Landing Bay
Area B
North Bay
Area C
Turions/m2 - Impairment
None Found
1 - 50 - None
50 - 100 - Very Low
100 - 200 - Low
200 - 350 - Moderate
> 350 - High
Proposed Treatment
Final Treatment
Control Area
N
W
E
S
A
B
C
0
0.25
0.5
1
Miles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N
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E
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A
B
C
0
0.25
0.5
1
Miles