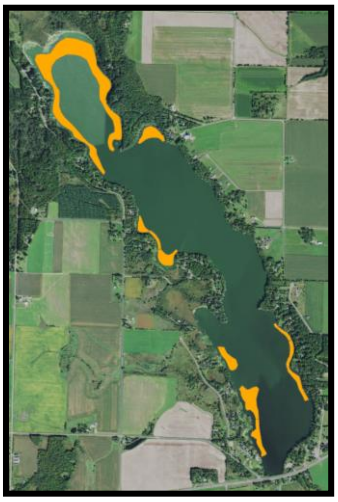
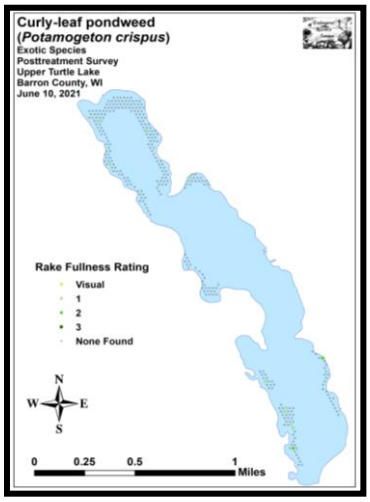
# Curly-leaf pondweed (*Potamogeton crispus*)
# Fall Turion Survey
# Upper Turtle Lake - WBIC: 2079800
# Barron County, Wisconsin



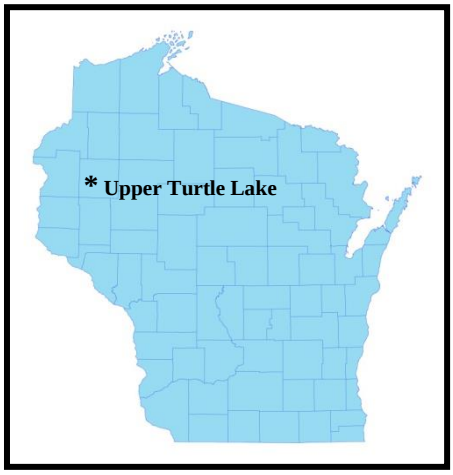



Upper Turtle Lake 2021 treatment areas and posttreatment CLP density and distribution

Sieve with single turion in north bay 10/17/21

## Project Initiated by:

The Upper Turtle Lake Management District, the Wisconsin Department of Natural Resources, and Lake Education and Planning Services, LLC




Upper Turtle Common Loon in 1st year winter plumage 10/28/18 (B. Collins)

## Survey Conducted by and Report Prepared by:

Endangered Resource Services, LLC
Matthew S. Berg, Research Biologist
St. Croix Falls, Wisconsin
October 17, 2021

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## INTRODUCTION:

Upper Turtle Lake (WBIC 2079800) is a 427-acre, stratified, drainage lake located in the Town of Almena in west-central Barron County (T34N R14W S27 NE NW). It reaches a maximum depth of 25ft in the central basin and has an average depth of 14ft (Figure 1) WDNR 2021). The lake is eutrophic in nature with Secchi readings from 1994-2020 averaging 5.5ft (WDNR 2021). This poor water clarity produced a littoral zone that reached approximately 13.0ft in the spring of 2021. The lake's bottom substrate is predominantly organic muck in the north, south, and western bays as well as the majority of the main basin with a narrow ring of sand/rock occurring along most of the eastern shore and on scattered exposed points (Bush et al. 1966).

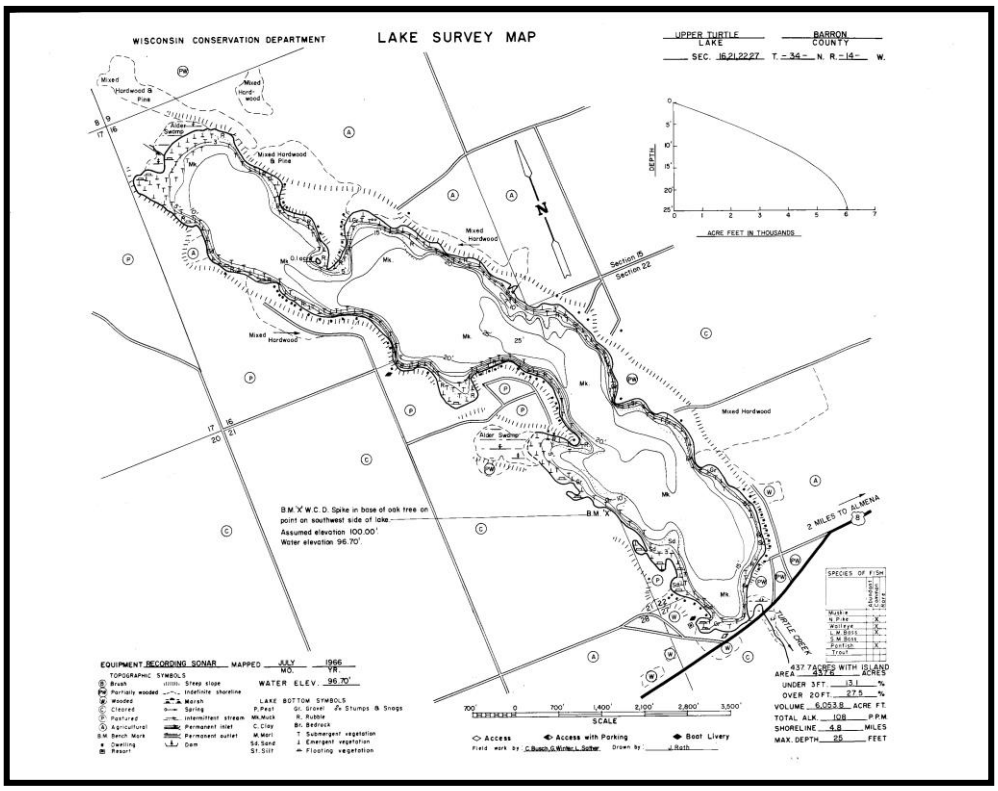



**Figure 1: Upper Turtle Lake Bathymetric Map**

## BACKGROUND AND STUDY RATIONALE:

In 2010, the Upper Turtle Lake Management District (UTLMD) and the Wisconsin Department of Natural Resources (WDNR) authorized a series of full-lake plant surveys as a prerequisite to developing the lake's initial Aquatic Plant Management Plan (APMP). Although those surveys found that the exotic invasive species Curly-leaf pondweed (*Potamogeton crispus*) (CLP) occurred throughout the lake, it was decided that the generally low growth levels did not justify active management at that time. However, following several years of high CLP density on the lake that resulted in severe navigation impairment for many residents, mats of rotting vegetation, and poor summer water quality (UTLMD board, pers. comm.), the UTLMD decided to authorize follow-up plant surveys in 2017 so they could update their APMP in 2018 and revisit active management.

Using the information gained from the 2017 bed-mapping survey that quantified CLP's dramatic increase on the lake, in 2018 the UTLMD, under the direction of Dave Blumer - Lake Education and Planning Services, LLC (LEAPS), decided to conduct a small-scale trial herbicide treatment in the thumb bay in the northwest corner of the lake's southern basin (9.88 acres or approximately 2.31% of the lake's total surface area) (Figure 2). Because this treatment was so successful at reducing CLP in the bay, the UTLMD decided to expand their herbicide program in future years. Prior to beginning these treatments, the UTLA requested a late fall survey in 2018 to establish a baseline on the level of latent CLP turions in the lake's substrate.

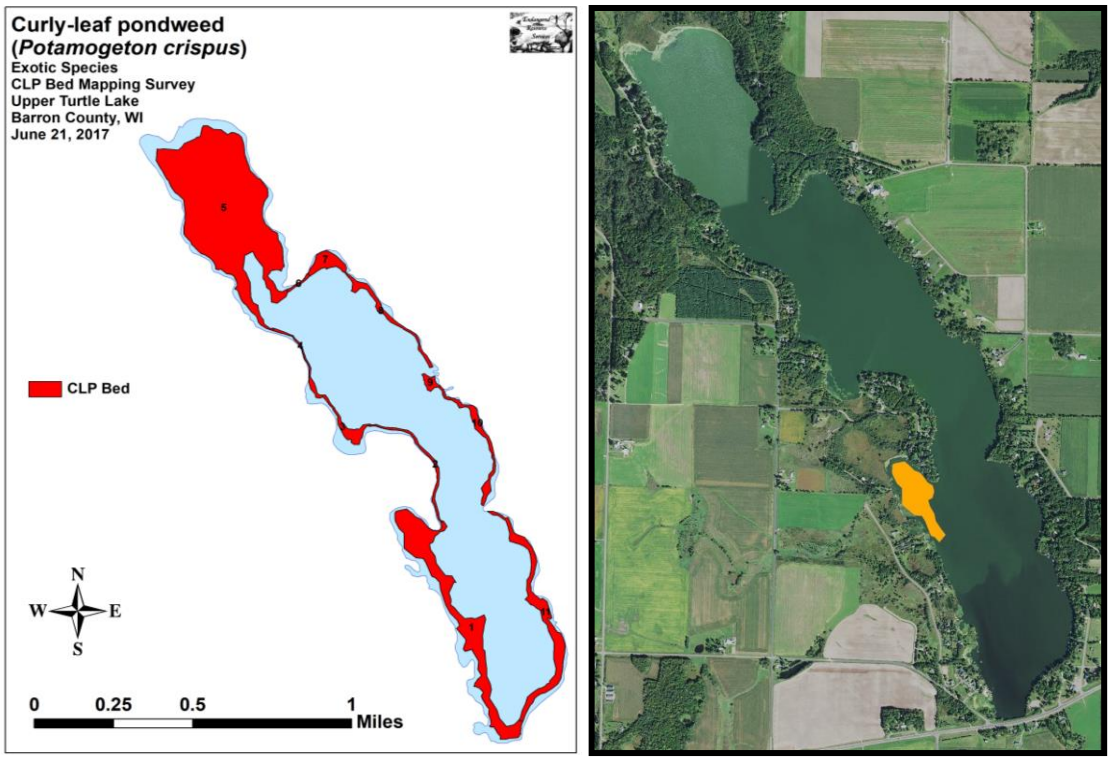



**Figure 2: 2017 June CLP Bed Map and 2018 CLP Treatment Area**

In 2019, seven areas totaling 74.07 acres (17.35% of the lake's surface area) were treated for Curly-leaf pondweed. This was followed by the treatment of six areas covering 65.30 acres (15.23% of the surface area) in 2020, and ten areas total 57.08 acres (13.37% of the surface area) in 2021. All of these treatments produced highly significant declines in overall CLP density and distribution, and we found little evidence that the few surviving plants were healthy enough to produce turions. Because of this, in the fall of 2021, the UTLA requested a follow-up turion survey to determine how many residual CLP turions remained in the lake's substrate following three years of nearly lakewide active management.

## 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 3). 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 3: 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 2021 summer growing season, we conducted a fall turion survey. The goals of the survey were to determine the remaining level of CLP turions within the lake's historic high density CLP areas; compare these levels to the original turion survey data from 2018; and predict whether the levels of remaining turions suggested there would likely be navigation issues in 2022. This report is the summary analysis of that survey conducted on October 17, 2021.

## METHODS:

## Fall Ponar Dredge Turion Survey:

Within the 2017 mapped Curly-leaf pondweed beds, we used Hawth's Analysis Tools Extension to ArcGIS 9.3.1 to create 80 survey points at the rate of approximately 1 point for every 1.65 acres. Although the points were auto-generated as offset regular, we moved points into thin areas of the polygons where there were no points and tried to spread points uniformly throughout these areas at regular intervals (Figure 4) (Appendix I). These same points were used in both the 2018 and 2021 surveys. For ease in determining the total impact of the current treatment program, we also left the 2018 narrative in the results section of this report.

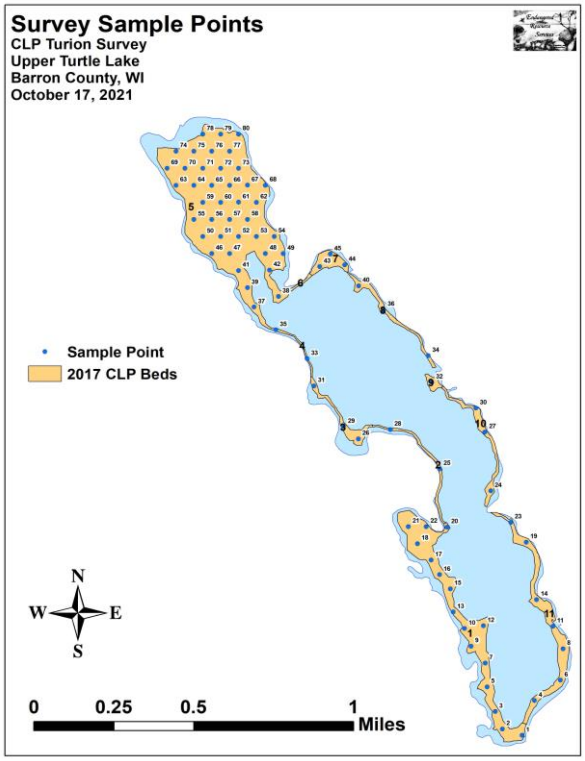



**Figure 4: Turion Survey Sample Points**

During the survey, we located each point with a handheld mapping GPS unit (Garmin 76CSx) and used a Petite Ponar dredge with a 0.0232$m^2$ (36$in^2$) 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 5). Samples with high numbers of turions or significant amounts 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 during the 2022 growing season.


**Figure 5: 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 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 6). 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).

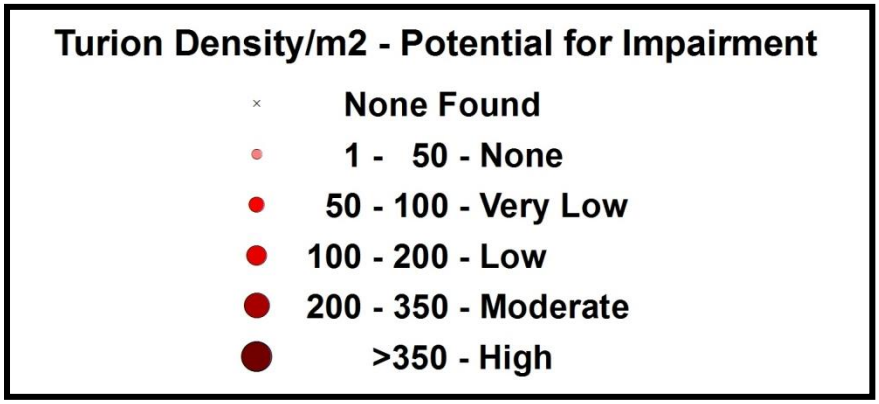



**Figure 6: Predicted Navigation Impairment Based on Turion Density**

**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 (Table 1).

**Year-over-Year Significant Differences:**
Data from the 2018 and 2021 surveys were 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 $p<0.05$, moderately significant at $p<0.01$, and highly significant at $p<0.001$ (Table 1).

# RESULTS AND DISCUSSION:

## 2018 Fall Ponar Dredge Turion Survey:

We counted a total of 296 Curly-leaf pondweed turions at 53 of 80 survey points (66.3% coverage) (Table 1). Of these, nine points (11.3% coverage/17.0% of points with turions) exceeded the expected "nuisance level" of 200/$m^2$, and 37 points (46.3% coverage/69.8% of points with turions) topped 50 turions/$m^2$ meaning it is likely there would be at least some potential for navigation impairment (Figure 7) (Appendix II). Despite this, the standard deviation of 112.95 turions/$m^2$ was higher than the mean density of 79.65 turions/$m^2$ suggesting there will be significant variability.

Visual analysis of the map showed that most of the 2018 treatment area will likely experience low impairment in 2019, while Beds 3, 7, and 9 around the central basin could experience moderate to high impairment. Somewhat surprisingly, the survey suggested most of Bed 5 in the north bay will likely have little to no impairment away from the immediate shoreline. The only other area on the lake that appeared likely to be an issue in 2019 was the north finger of Bed 11 on the southeastern shoreline.

## 2021 Fall Ponar Dredge Turion Survey:

Our 2021 survey showed a dramatic and highly significant reduction of CLP turions in the lake following three years of large-scale active management. Collectively, we counted a total of just 68 turions – a 77.0% reduction compared to the 2018 survey. Turions were present at 33 of 80 points (41.3% coverage) – a 37.7% reduction in total coverage (Table 1). Of these, **none exceeded the expected "nuisance level" of 200/$m^2$**, and only nine points (11.3% coverage/27.3% of points with turions) topped 50 turions/$m^2$ suggesting they would have any potential for navigation impairment (Figure 7) (Appendix II). The standard deviation of 31.60 turions/$m^2$ was nearly double the mean density of 18.30 turions/$m^2$ suggesting there will likely be significant variability during the 2022 growing season. Visual analysis of the map found no areas are likely to have widespread impairment with the possible exception of the northern half of Bed 1 on the southwest shoreline. Despite this area, **the lake-wide reduction in the mean density compared to 2018 was highly significant ($p<0.001$)**.

## Table 1: CLP Turion Survey - Summary Statistics
## Upper Turtle Lake, Barron County
## October 28, 2018 and October 17, 2021

| Summary Statistics: | 2018 Total | 2021 Total |
|---|---|---|
| Total number of points sampled | 80 | 80 |
| Total # of points with live turions | 53 | 33 |
| Frequency of occurrence (in percent) | 66.3 | 41.3 |
| Total live turions | 296 | 68 |
| Number of points at or above potential impairment (+50/$m^2$) | 37 | 9 |
| % potential impairment | 46.3 | 11.3 |
| Number of points at or above predicted nuisance level (+200/$m^2$) | 9 | 0 |
| % nuisance level | 11.3 | 0.0 |
| Maximum turions/$m^2$ | 689 | 194 |
| Mean turions/$m^2$ | 79.65 | 18.30 |
| Standard deviation/$m^2$ | 112.95 | 31.60 |
| Standard error of the paired difference | | 0.57 |
| Degrees of freedom | | 79 |
| t-statistic | | -5.02 |
| *p* - value | | **<0.001** |

**Significant differences = * $p<0.05$, ** $p<0.01$, *** $p<0.001$**

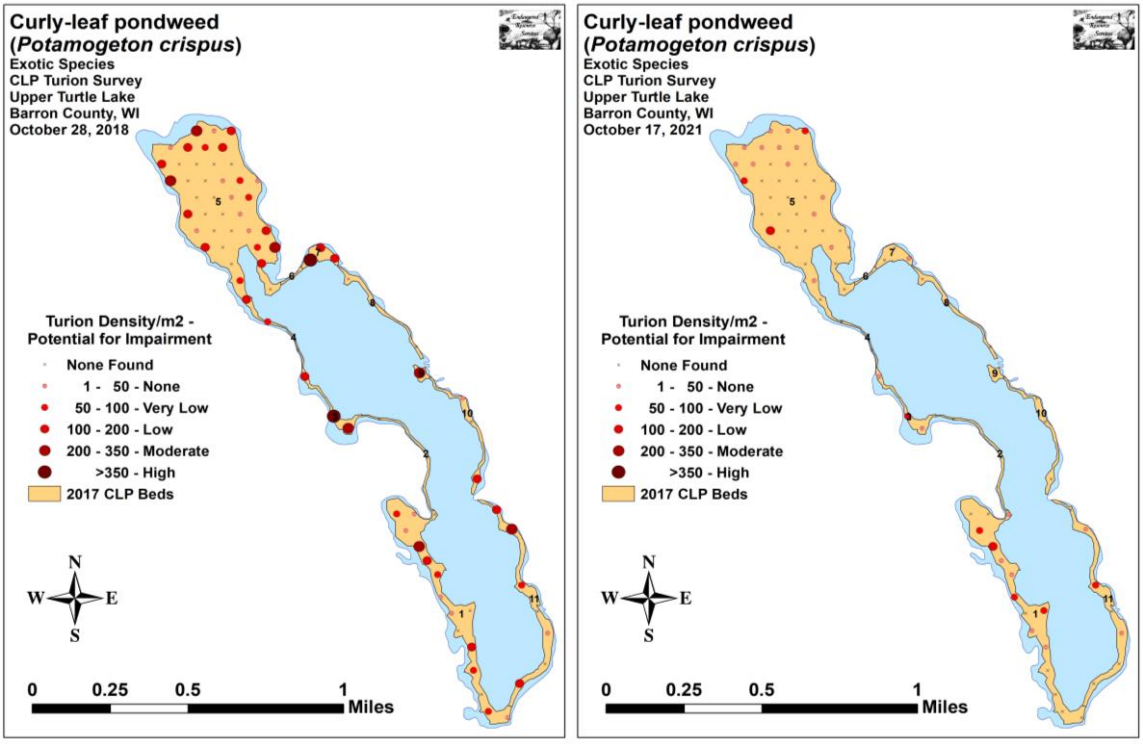



**Figure 7: 2018 and 2021 Fall CLP Turion Survey**
**Density and Distribution**

## CONSIDERATIONS FOR FUTURE MANAGMENT:

The 2021 turion survey suggested there will again be Curly-leaf pondweed throughout much of Upper Turtle Lake in 2022 – albeit at low levels. Ultimately, the level of CLP growth the board is comfortable with will determine how much, if any, of the lake is actively managed in the coming years.

## LITERATURE CITED

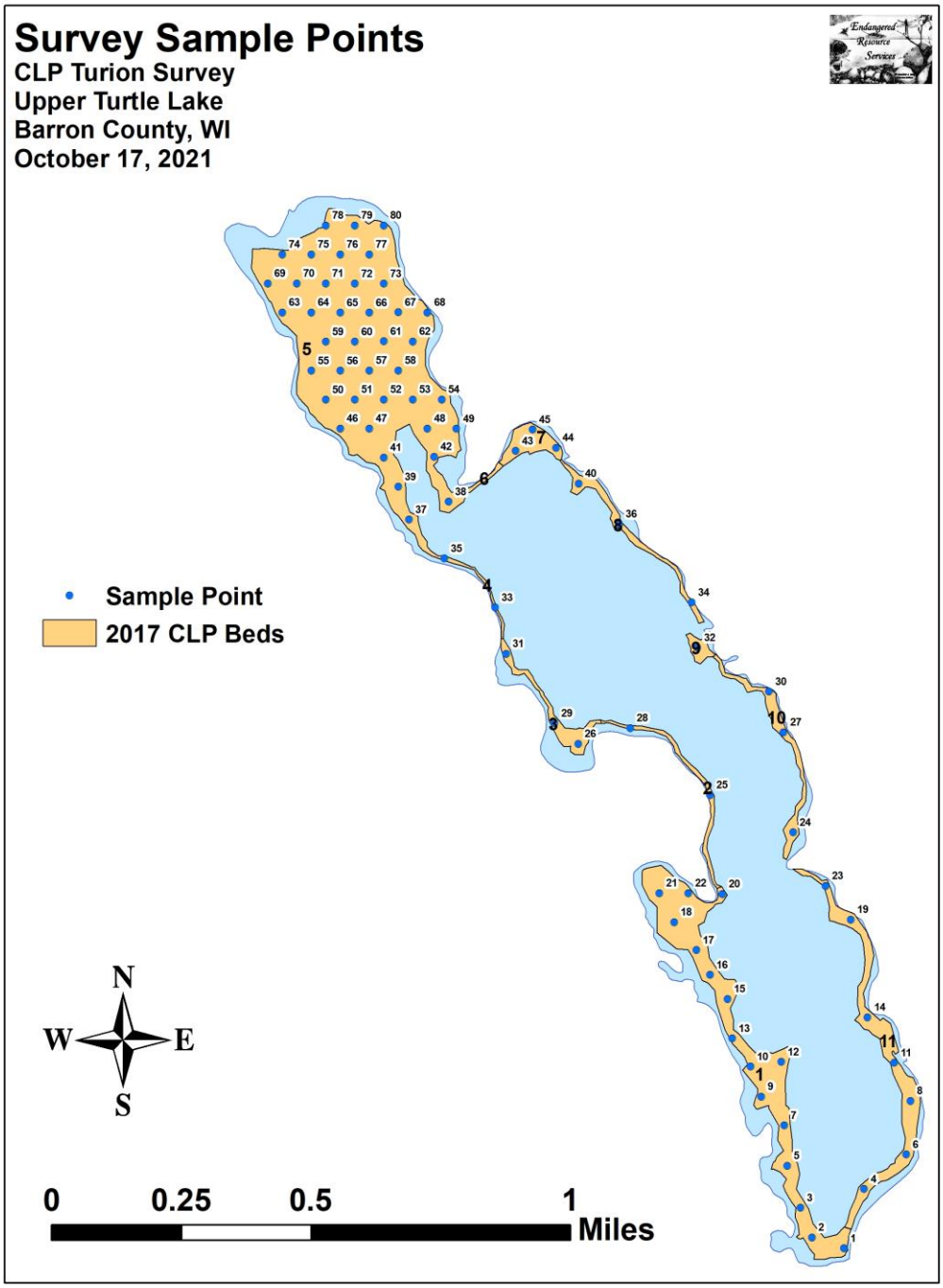

Busch, C., G. Winter, L. Sather, and J. Roth. 1966. Upper Turtle Lake Map. Available from http://dnr.wi.gov/lakes/maps/DNR/2079800a.pdf (2021, June).

UWEX Lakes Program. [online]. 2010. Aquatic Plant Management in Wisconsin. Available from http://www.uwsp.edu/cnr-ap/UWEXLakes/Pages/ecology/aquaticplants/default.aspx (2021, June).

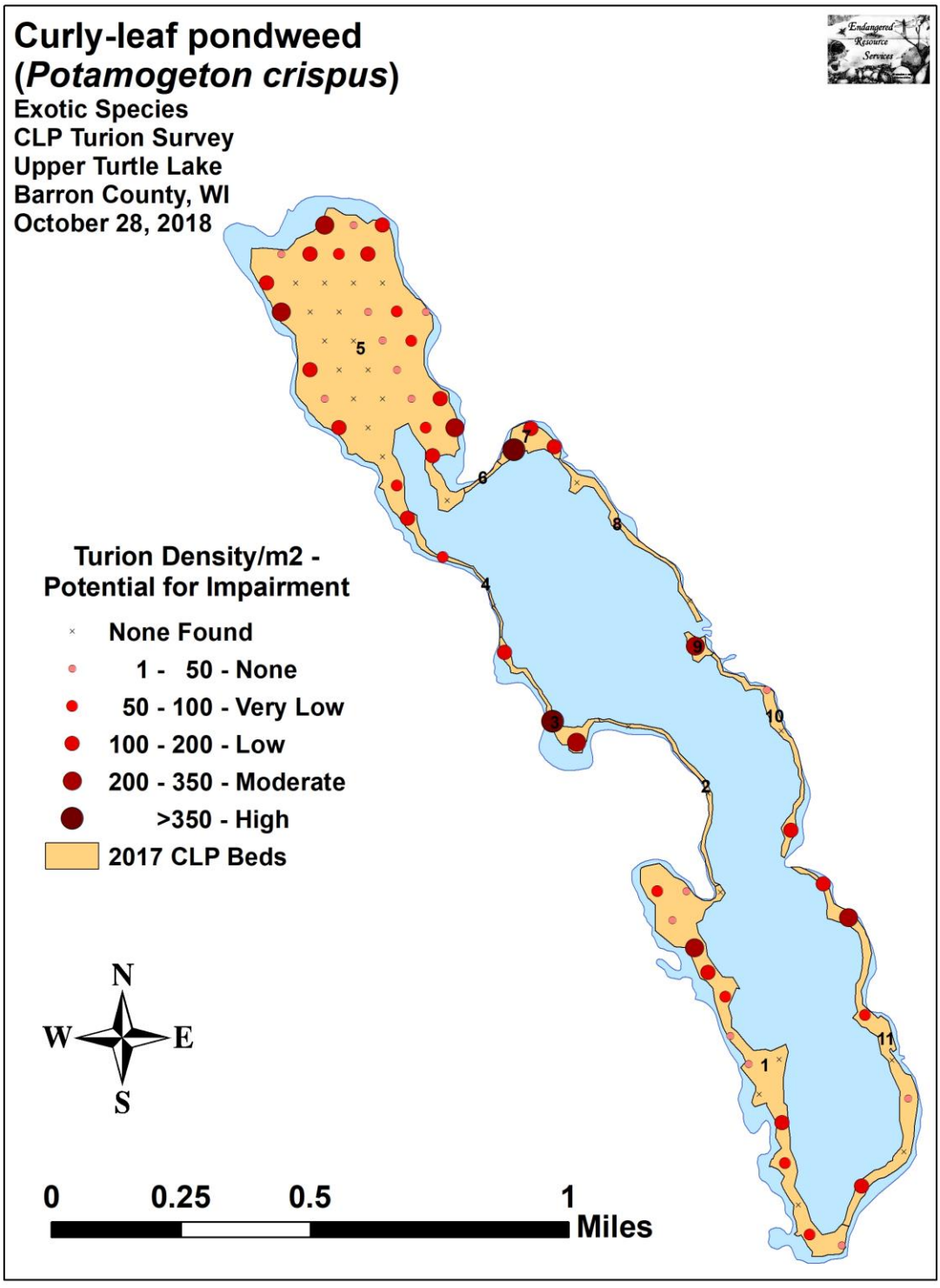
UWEX Lakes Program. [online]. 2010. Pre/Post Herbicide Comparison. Available from http://www.uwsp.edu/cnr-ap/UWEXLakes/Documents/ecology/Aquatic%20Plants/Appendix-D.pdf (2021, June).

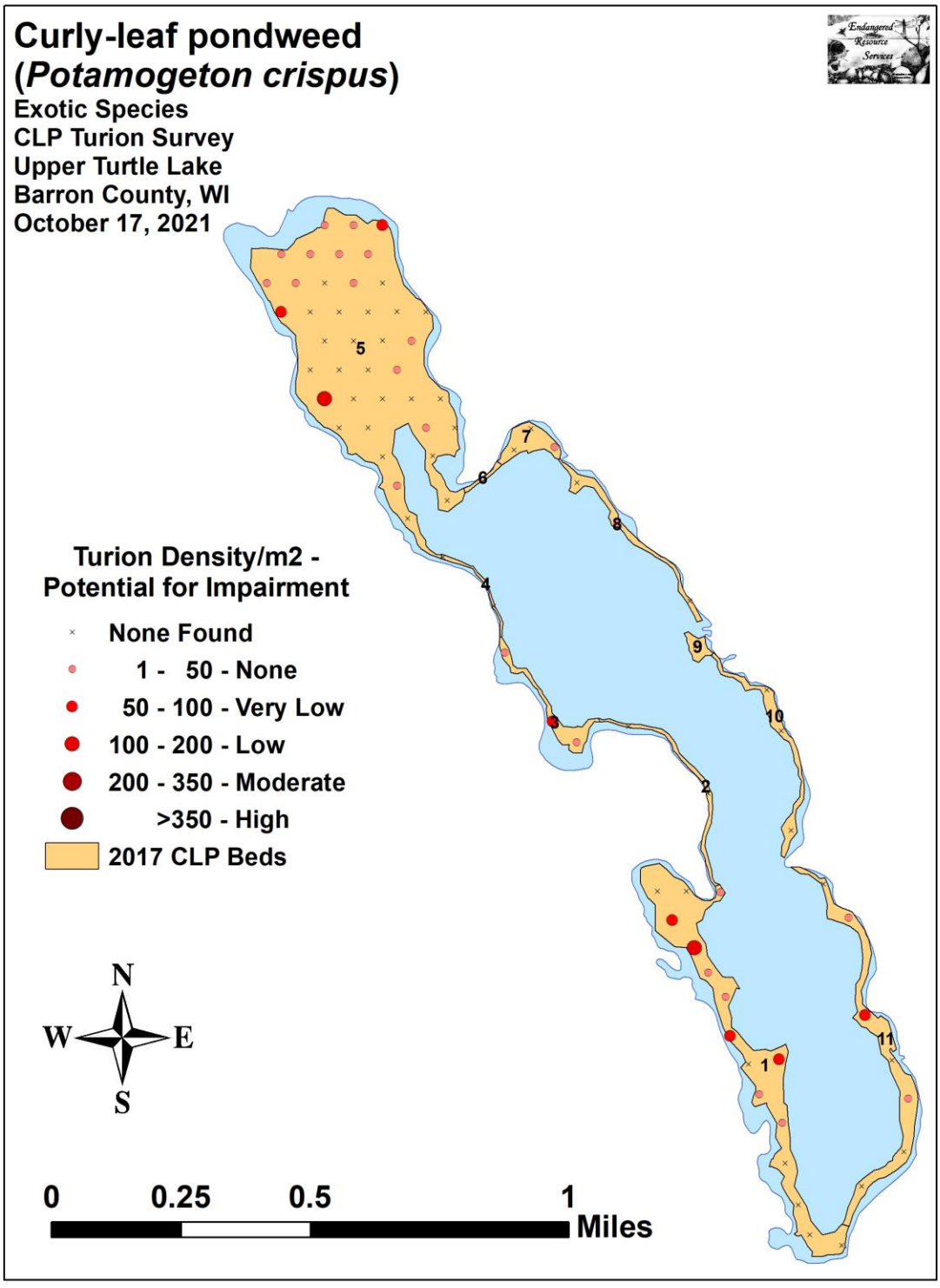
WDNR. [online]. 2021. Citizen Lake Monitoring Water Quality Data Report for Upper Turtle Lake. http://dnr.wi.gov/lakes/waterquality/Station.aspx?id=033175 (2021, June).

## Appendix I:  Turion Survey Sample Points


Survey Sample Points
CLP Turion Survey
Upper Turtle Lake
Barron County, WI
October 17, 2021
Endangered Resource Services
Sample Point
2017 CLP Beds
N
W
E
S
0
0.25
0.5
1
Miles

## Appendix II:  2018 and 2021 Fall CLP Turion Density and Distribution


Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
CLP Turion Survey
Upper Turtle Lake
Barron County, WI
October 28, 2018
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
2017 CLP Beds
N
W
E
S
0
0.25
0.5
1
Miles
1
2
3
4
5
6
7
8
9
10
11


Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
CLP Turion Survey
Upper Turtle Lake
Barron County, WI
October 17, 2021
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
2017 CLP Beds
N
W
E
S
0
0.25
0.5
1
Miles
5
7
6
8
4
9
10
3
2
11
1