Herbicide Treatment Analysis- *Potamogeton crispus*

Spooner Lake
Washburn County WI
2013

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Abstract

On June 11, 2013 the aquatic invasive species Potamogeton crispus (curly leaf pondweed or CLP) was treated with the herbicide Aquathol-K at a bed concentration of 1.5ppm. The pretreatment and post treatment analysis reveal that there was a statistically significant reduction in CLP frequency achieved. The native plants were not adversely affected, with no significant reduction in native plant frequency occurring after treatment. A turion analysis shows that all beds have turions still present with two beds showing a high density of turions in the sediment within the bed boundaries. The mapping of CLP beds showed a total of 1.15 acres of dense beds, and 0.97 acres of low density beds. This compares to 1.1 acres in 2012.

Introduction

This report will analyze the effectiveness of herbicide treatment for *Potamogeton crispus*-curly leaf pondweed (CLP). This treatment occurred on June 11, 2013. The analysis will review and compare a treatment survey of all plots treated in 2012, to a post treatment survey, which was conducted approximately four weeks after herbicide was applied. It will also analyze the effectiveness comparing a pretreatment survey to the post treatment survey in 2013.

There were six beds of CLP treated with herbicide in 2013. They will be referred to as Beds 2,3,5,6 and 7. Due to the success of past treatments in Bed 1, it was eliminated for treatment in 2013.

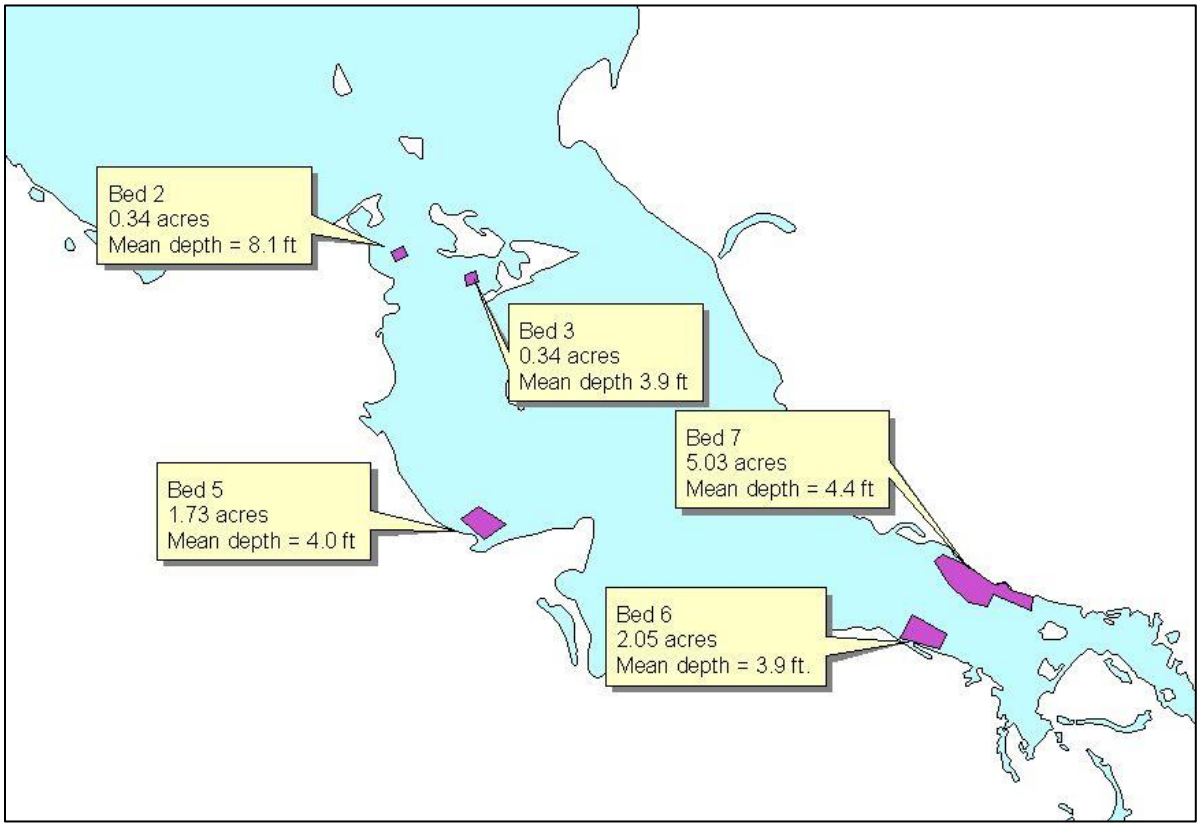


Figure 1: Map of 2013 CLP treatment beds-Spooner Lake, 2013.

Bed	*Acres*	*Depth*	*Acre-ft*	*Herbicide*	*Concentration*	*Winds*
2	0.34	8.1	2.754	Aquathol-K	1.5 ppm target 2.21 gal applied	0-4
3	0.34	3.9	1.326	Aquathol-K	1.5 ppm target 2.84 gal applied	0-4
5	1.73	4	6.92	Aquathol-K	1.5 ppm target 6.7 gal applied	0-4
6	2.05	3.9	7.995	Aquathol-K	1.5 ppm target 10.6 gal applied	0-4
7	5.03	4.4	22.132	Aquathol-K	1.5 ppm target 28.7 gal applied	0-4
Total	**9.49**		**41.127**			

Table 1: Summary of treatment bed statistics.

Methods

To conduct and analyze the treatment, two surveys are conducted following the Wisconsin DNR treatment protocol outlined in 2009 by the Wisconsin DNR. The first survey is referred to a pretreatment survey. This involves going to predetermined GPS coordinates within the proposed treatment area. A high definition underwater camera as well as a rake is used to determine the presence of CLP at that sample point. Density is not measured as the plants are typically very small and density is very subjective. The presence of CLP is simply determined. There are many points checked outside of the bed delineation to assure the boundary is correct.

The second survey is referred to as the post treatment survey. This survey involves going to the same GPS coordinates as the pre-treatment survey and doing a rake sample at the point. If any CLP is on the rake, the density of the CLP is recorded (see Figure 2 for reference). All other species are also recorded from the rake sample in order to verify no damage to the native plants.

Figure 2: Density rating system and example CLP rake sample.

When the surveys are complete, the frequency of occurrence is determined as well as the mean density for each bed as well as all beds combined. The frequency of occurrence for each native plant species sampled is also calculated. A chi-square analysis is then used to determine if the change in frequency is statistically significant ($p<0.05$). The goal is to find the chi-square analysis show that the frequency of CLP is significantly reduced and the native plants are not significantly reduced.

The comparison for reduction is two-fold. First, the result from the previous year's post treatment survey is compared to the present year post treatment survey. This reflects a long-term effectiveness. As more treatments are done in annual succession, these frequency values can become very similar since the CLP growth is reduced so much. This can make it appear the treatment is not progressing successfully since the frequency appears to not be reduced. Each year, new turions can germinate in the fall/winter creating new growth. The result is a low frequency in the post treatment survey, but in the next spring the CLP has grown immensely, and results in a high frequency.

In order to reflect that new growth and the effect the treatment has on it, a second comparison is done. This compares the frequency of CLP in the spring, pre-treatment survey to the post treatment results in that same year. This shows what the CLP growth really was just before treating and the result after treatment.

In the end, we want to see a statistically significant reduction when comparing the pre-treatment frequency to the post treatment frequency. We would also like to see a consistent frequency reduction from year to year, depending on how low it is. If the frequency in any post treatment survey is very low (less than 10% as an example), then lowering it even more may not be realistic, but is the goal. Turions can remain viable for several years, which can affect reduction amounts achieved.

In order to further reflect potential future growth and the cumulative success of treatments, a turion analysis is conducted. This analysis involves going to sample points

near the middle of the CLP bed (assuming this will reflect the highest density). At each sample point a sediment sampler is lowered to the lake sediment and a sediment sample is obtained. Two samples are obtained from each side of the boat at each location. The samples are then separated with a screened bucket to isolate the turions. The turions are then counted and the density of turions is calculated in turions/square meter. Consistently successful treatments should show a trend of reduced turion density each year. This way we know the treatments are killing plants prior to turion production, resulting in overall reduction in CLP in those beds.

a.

b.

c.

Figure 3: Pictures showing turion density methods. a. shows sediment sample; b. shows separation; c. shows separated turions.

Results

The pretreatment survey resulted in an adjustment to bed 3. This bed was 0.54 acres in 2012 and resulted in no CLP present in the 2012 post treatment survey. Some portions of the bed were lacking CLP, so the bed was reduced to 0.34 acres. All other beds were left the same size. The pretreatment showed a frequency of 66% after a frequency of 0% in the 2012 post treatment survey. This shows the turions germinating returned CLP growth in all of the beds from 2012. Figure 4 shows the pretreatment survey maps of each bed. Table 2 shows the frequency data breakdown.

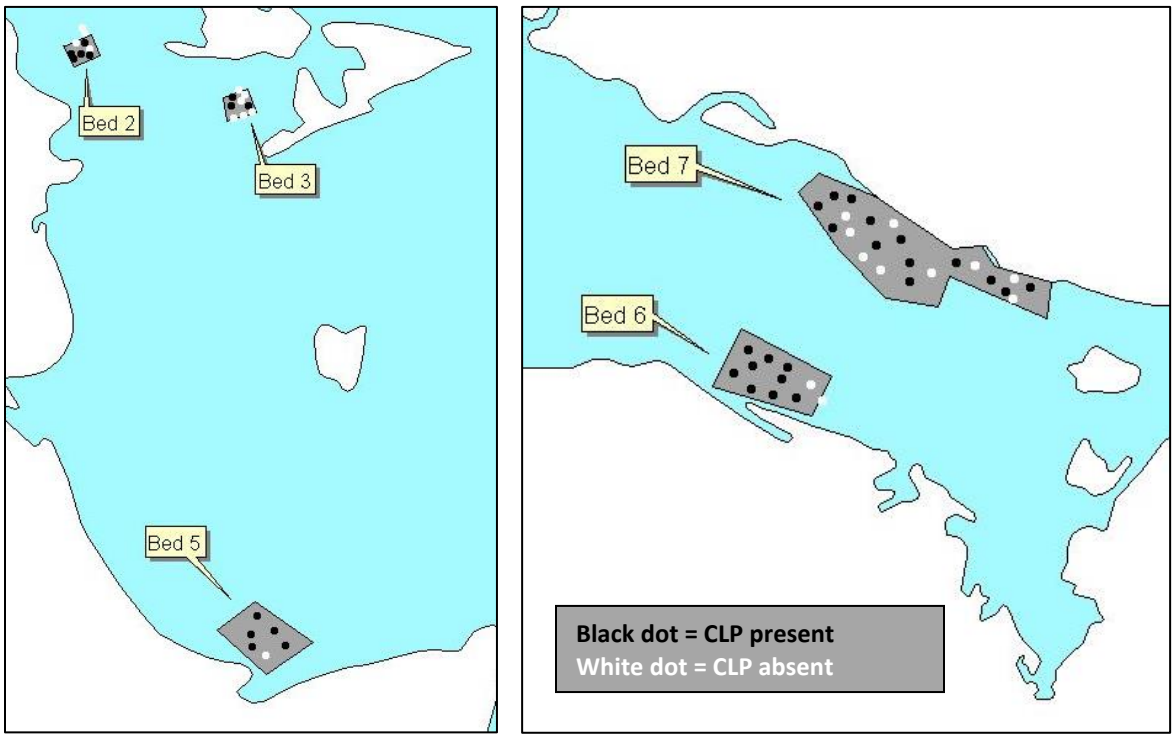


Figure 4: Pretreament maps showing presence of CLP in each bed (beds 2-6).

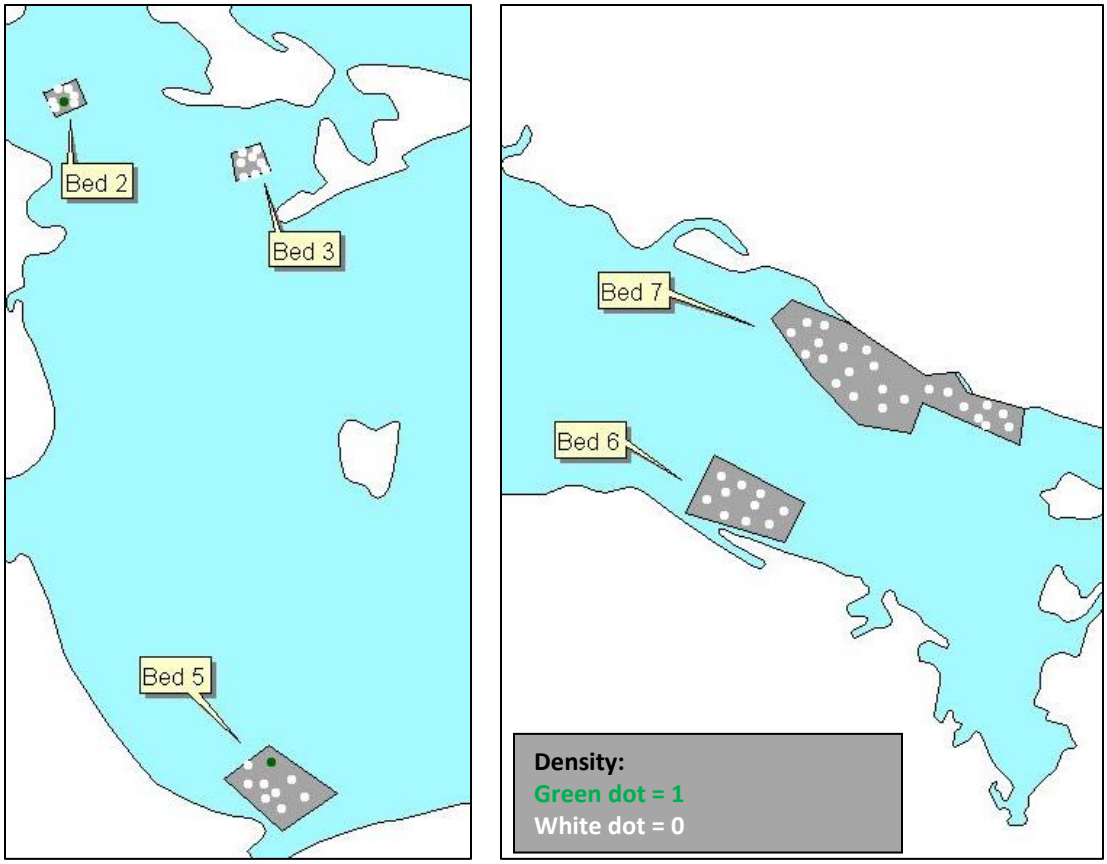


Figure 5: Post treatment density maps from post treatment survey-Spooner Lake 2013.

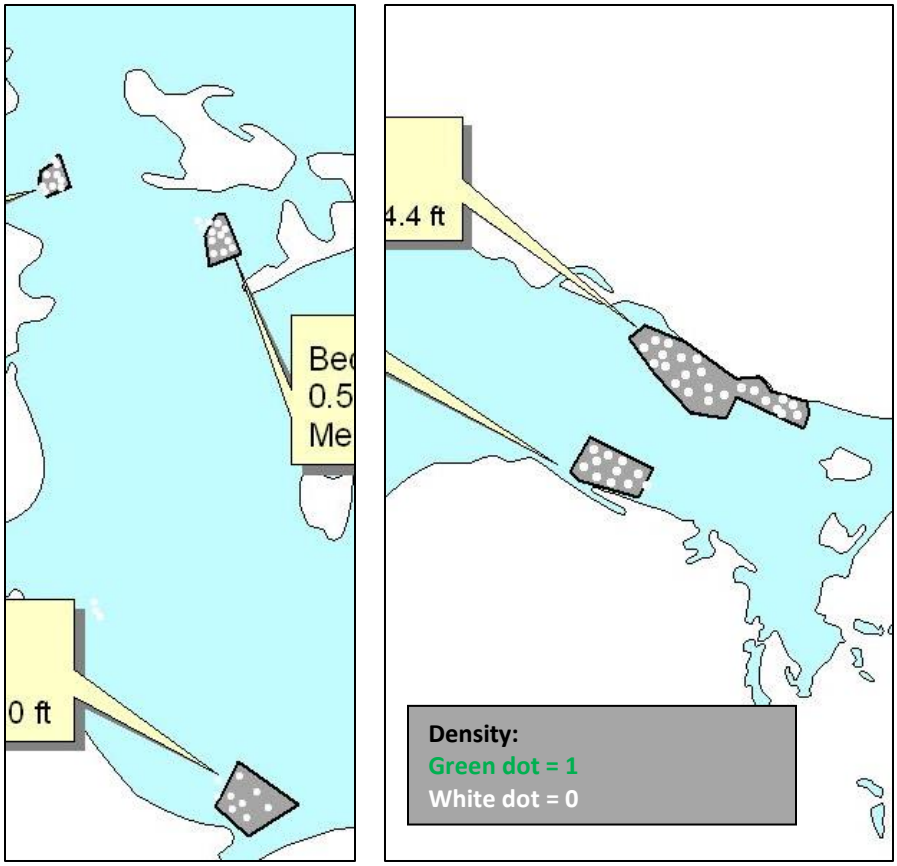


Figure 6: Post treatment density map from post treatment survey-Spooner Lake 2012.

Bed	2013 Pre Freq	2013 Post Freq	2012 Post Freq.	2013 Pre to Post change	2012 Post to 2013 Post change
2	71.4%	14.3%	0.0%	-57.1% *	+14.3%
3	37.5	0.0%	0.0%	-37.5%	n/c
5	83.3%	11.1%	0.0%	-72.2% *	+11.1%
6	90.0%	0.0%	0.0%	-90.0% ***	n/c
7	59.1%	0.0%	0.0%	-59.1% ***	n/c
All	66.0%	3.8%	0.0%	-62.2% ***	+3.8%

Significance: *p<0.05, **p<0.005, ***p<0.0005

Table 2: Summary of treatment results with frequency from various surveys.

The 2013 post treatment survey shows that the treatment applied in 2013 was effective. The pretreatment frequency was reduced a great deal in each bed and showed a 62.2% frequency reduction in all beds together when comparing the pretreatment frequency to the post treatment frequency, which was a statistically significant reduction (based upon a chi-square analysis). The comparison between the 2012 post treatment frequencies with the 2013 post treatment frequency actually shows a slight increase (see table 2 and figures 5 and 6). This is not a concern as the frequency in 2012 after treatment was 0.0%, so a

reduction was impossible. The frequency for 2013 after treatment was very small at 3.8%. See Figure 7 for a graphical comparison.

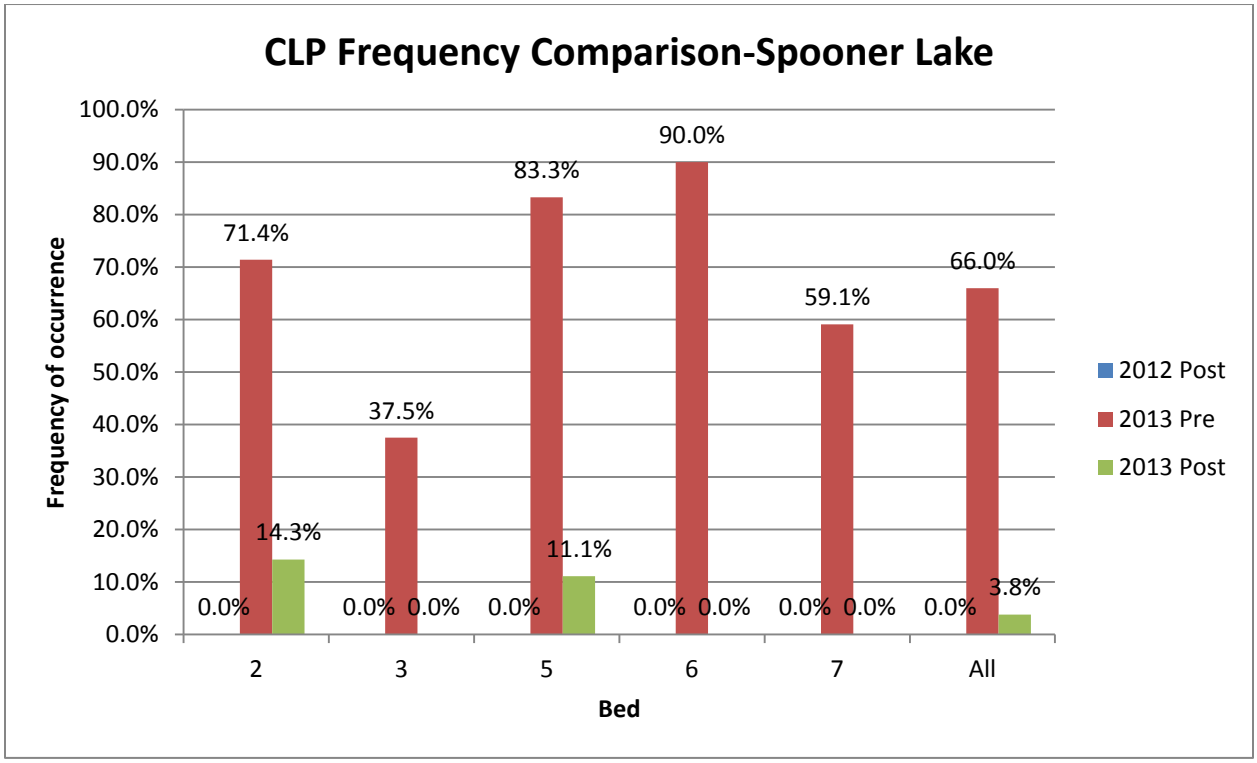


Figure 7: Graph showing frequencies from pretreatment and post treatment surveys.

The density is not analyzed as there was no growth in 2012 and only four points with CLP in 2013, all being 1's.

Native plant community

The frequency of native plants is also compared between the post treatment results to the previous year's post treatment results. This is to verify that the CLP was targeted with little or no adverse effects on the native plant community. Table 3 shows that the CLP was targeted with no adverse effect on the native plants. Two native plant species had a small decrease in frequency, but that decrease was not statistically significant. Most of the native plant changes from 2012 to 2013 were increases.

Species	2013 Freq.	2012 Freq.	Change
Waterweed *Elodea canadensis*	54.7%	61%	-6.3% n.s.
Coontail *Ceratophyllum demersum*	37.7%	30%	+7.7%
Northern water-milfoil *Myriophyllum sibiricum*	5.7%	7%	-1.3% n.s.
Sago pondweed *Stuckenia pectinatus*	5.7%	0%	+5.7%
Water stargrass *Heteranthera dubia*	5.7%	0%	+5.7%
Bushy pondweed *Najas flexilis*	3.8%	0%	+3.8%
White lily *Nymphaea odorata*	1.9%	0%	+1.9%
Filamentous algae	67.9%	34%	+33.9%

n.s.=not significant

Table 3: Summary of native plant frequencies 2012 and 2013.

Turion analysis

An important aspect of a CLP treatment analysis is the evaluation of the beds in terms of turion density. Turions are the reproductive structure of CLP and can remain viable for several years. Even if a treatment is successful in reducing CLP growth, turions remaining in the sediment can germinate the following year and give rise to more CLP growth. A turion analysis can reflect the potential growth for the upcoming year as well as show trends of successful treatments. The goal is to see a consistent reduction in turion density each year. This can happen as long as the CLP plants are killed prior to turion production.

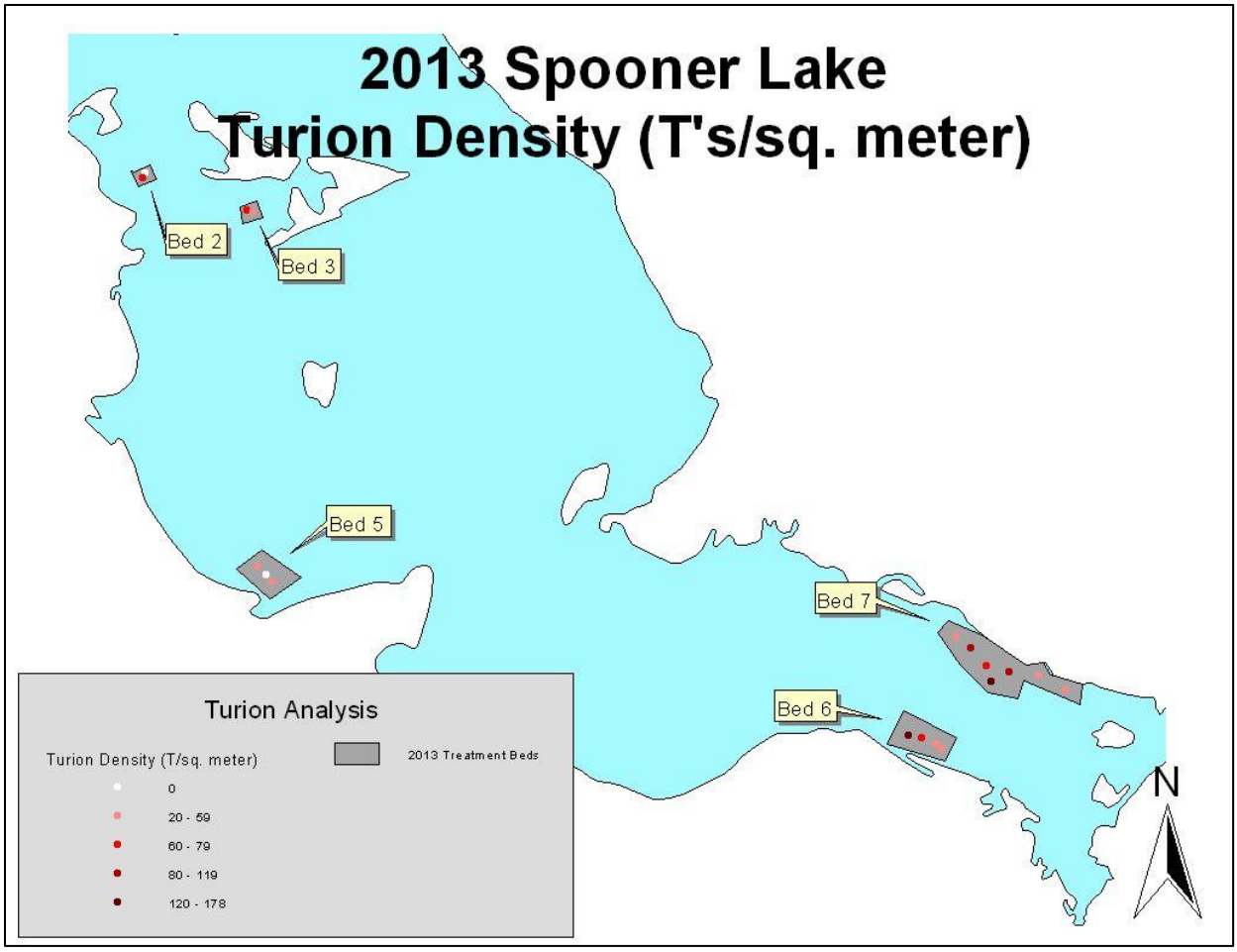


Figure 8: Map of turion density in each treatment bed-2013.

The turion density was conducted for the first time in 2013. As a result, a comparison is not available. This analysis can help predict which beds have the potential to have relatively dense CLP return next spring due to the germination of turions present in the beds. Beds 6 and 7 have the highest turion density and therefore indicate a potential for dense return of CLP in 2014. More successful treatments in these beds should result in decreasing turion densities if plants are killed prior to turion formation. All beds had turions present, and will likely result in CLP growth in 2014. Table 4 shows the turion density summary by bed.

Bed	Mean turion density (T/m^2)
2	39.6
3	49.5
5	13.2
6	84.2
7	82.0
All beds	62.7

Table 4: Turion density in each treatment bed.

CLP Mapping

Each year the CLP is remapped to determine the aerial coverage of dense CLP beds. Typically beds that have a mean density above 2 and have the CLP at or near the water surface have been delineated and mapped on Spooner Lake. The CLP has been declining annually. This is due to successful treatments and some apparent natural variation that has been a decline overall.

In 2013, the mapped beds were differentiated between "mapped beds" and "low density beds." "Mapped beds" are those beds with a mean density estimated to be above a 2 and the CLP growing at or near the surface of the water. The "low density beds" are beds that have a mean density below 2, are more sporadic in coverage and although may be seen from the surface may not be close to the surface.

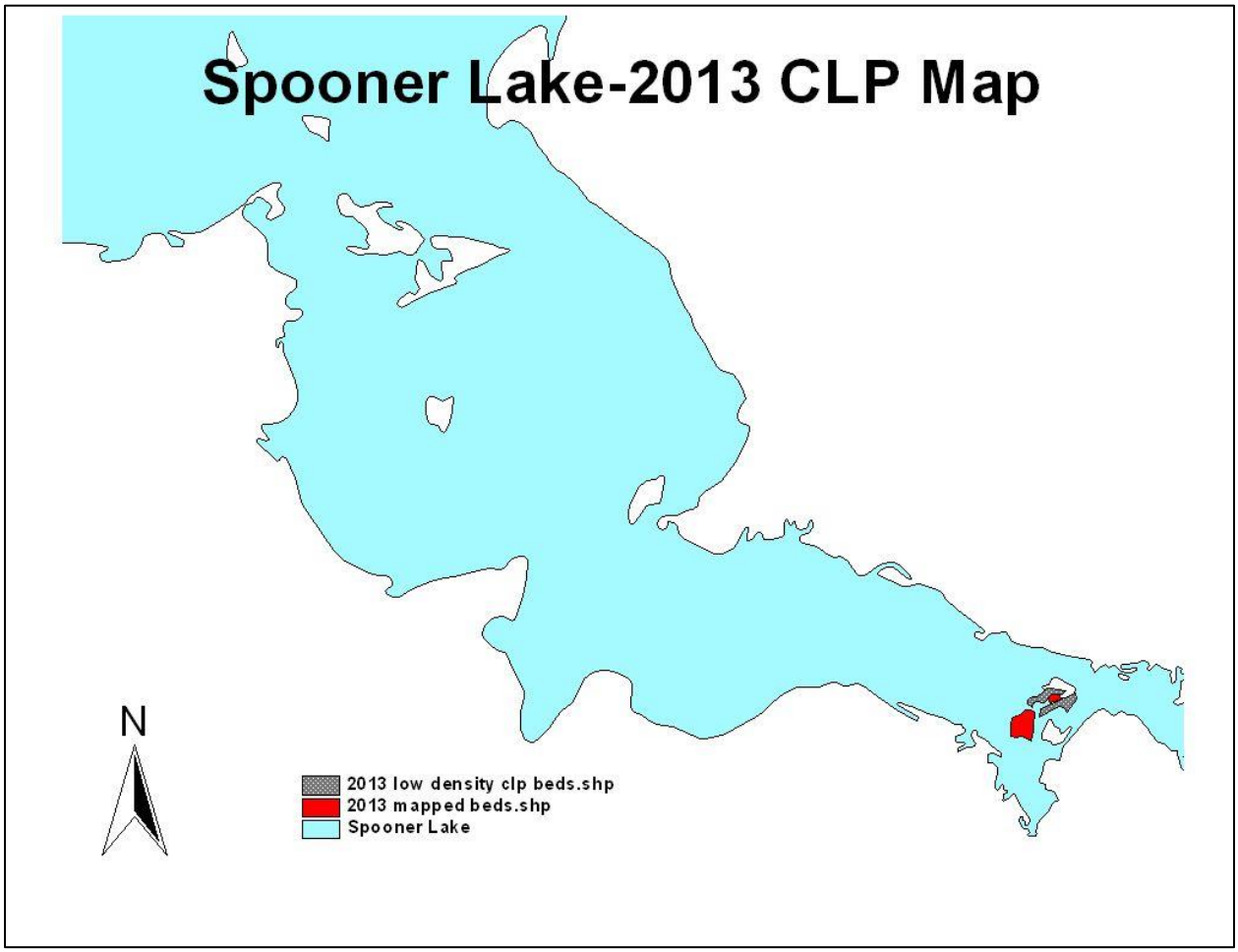


Figure 9: Map of CLP beds, Spooner Lake 2013.

The mapping of CLP resulted in 1.15 acres of dense beds and 0.97 acres of low density beds.

Discussion

The 2013 herbicide treatment for CLP on Spooner Lake was successful. There was a statistically significant reduction in CLP frequency when comparing the 2013 pretreatment survey frequency to the 2013 post treatment survey frequency. A comparison between the 2012 post treatment frequencies to the 2013 post treatment frequency couldn't result in a reduction since there was no CLP sampled after treatment in 2012. However, the pretreatment survey in 2013 showed a return of CLP growth due to turion germination. This is the reason the pretreatment comparison to the post treatment in 2013. Fortunately there was no reduction in native species from the treatment.

The turion analysis shows that CLP will likely return. All beds had turions sampled, with the densest turions in beds 6 and 7. The pretreatment in spring 2014 will reveal how much regrowth of CLP occurs. It is recommended treatment continue in the beds, contingent upon the growth in the spring 2014 pretreatment survey. The treatment beds may need adjustment at that time depending on the locations of regrowth of CLP.

References

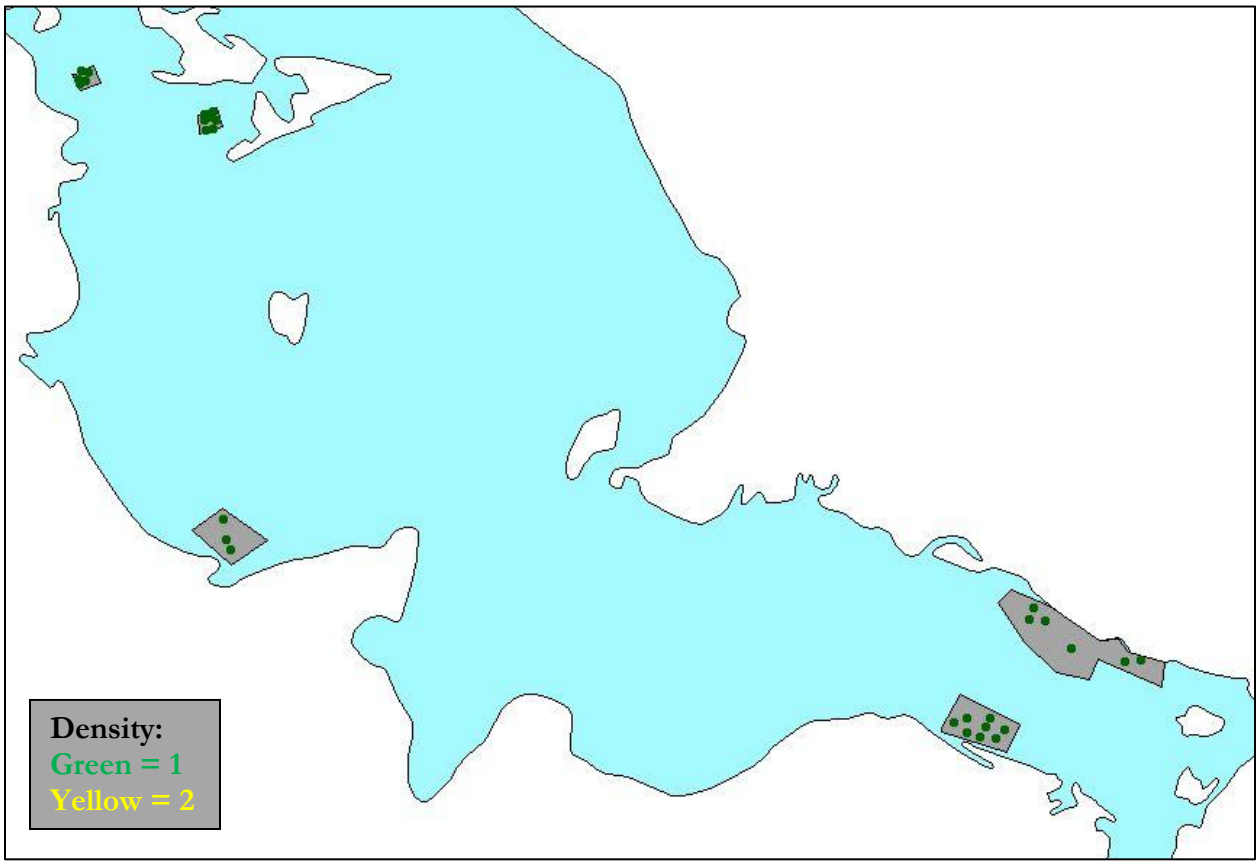
Borman, Susan, Robert Korth and Jo Tempte. *Through the Looking Glass.* University of Wisconsin-Extension. Stevens Point, Wisconsin. 1997. 248 p.

Crow, Garrett E. and C. Barre Hellquist. *Aquatic and Wetland Plants of Northeastern North America*. The University of Wisconsin Press. Madison, Wisconsin. Volumes 1 and 2. 2000. 880p.

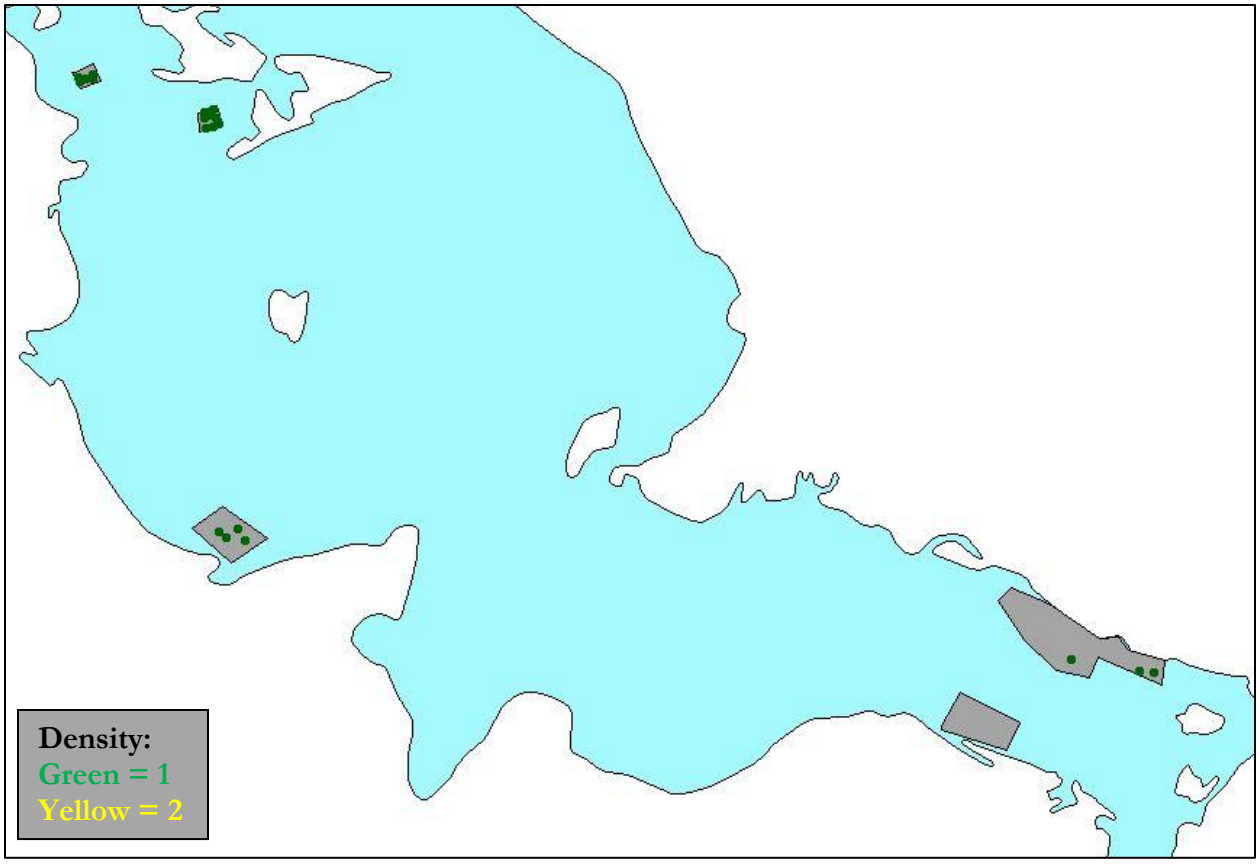
University of Wisconsin-Extension. *Aquatic Plant Management in Wisconsin*. April 2006 Draft. 46 p.

UW-Extension. Aquatic Plant Management website. http://www4.uwsp.edu/cnr/uwexlakes/ecology/apmguide.asp appendix d.

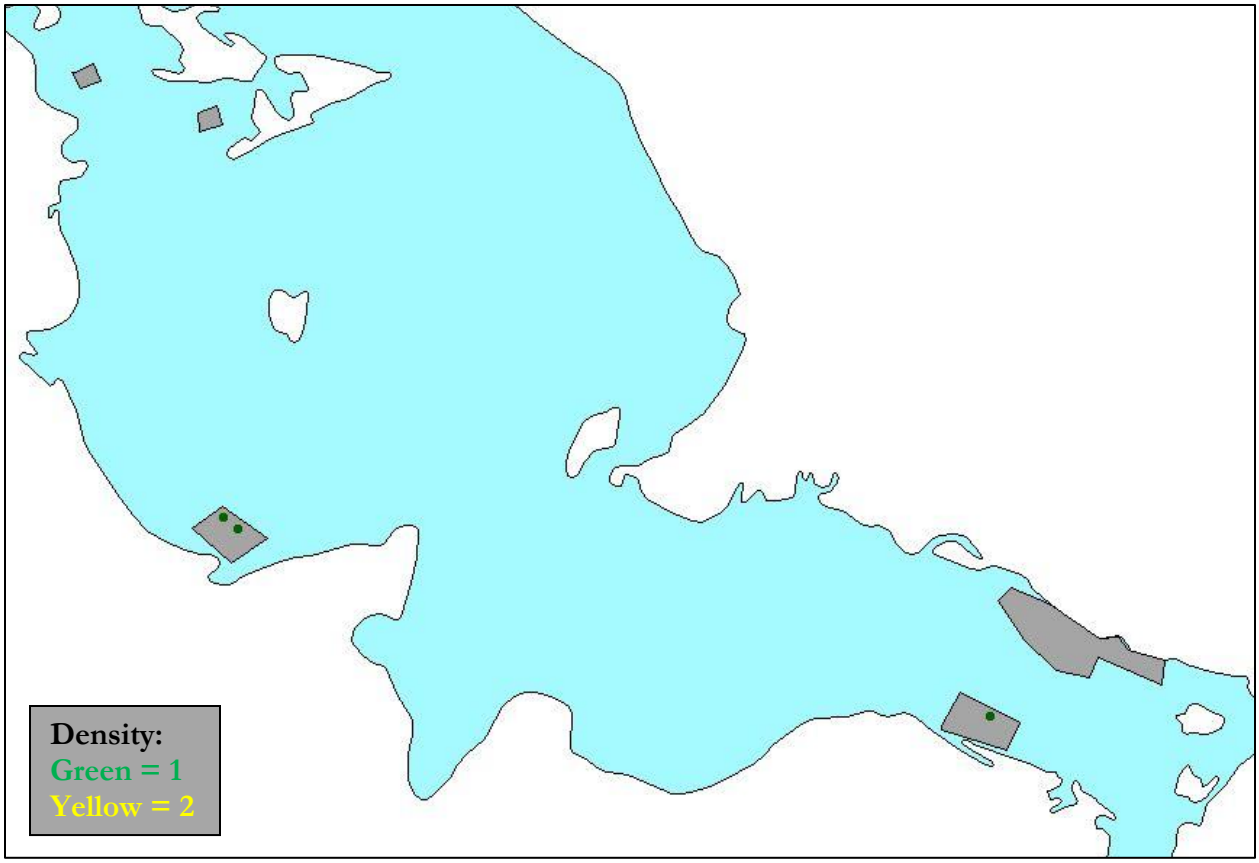
Appendix-Maps of native plants-June 2013



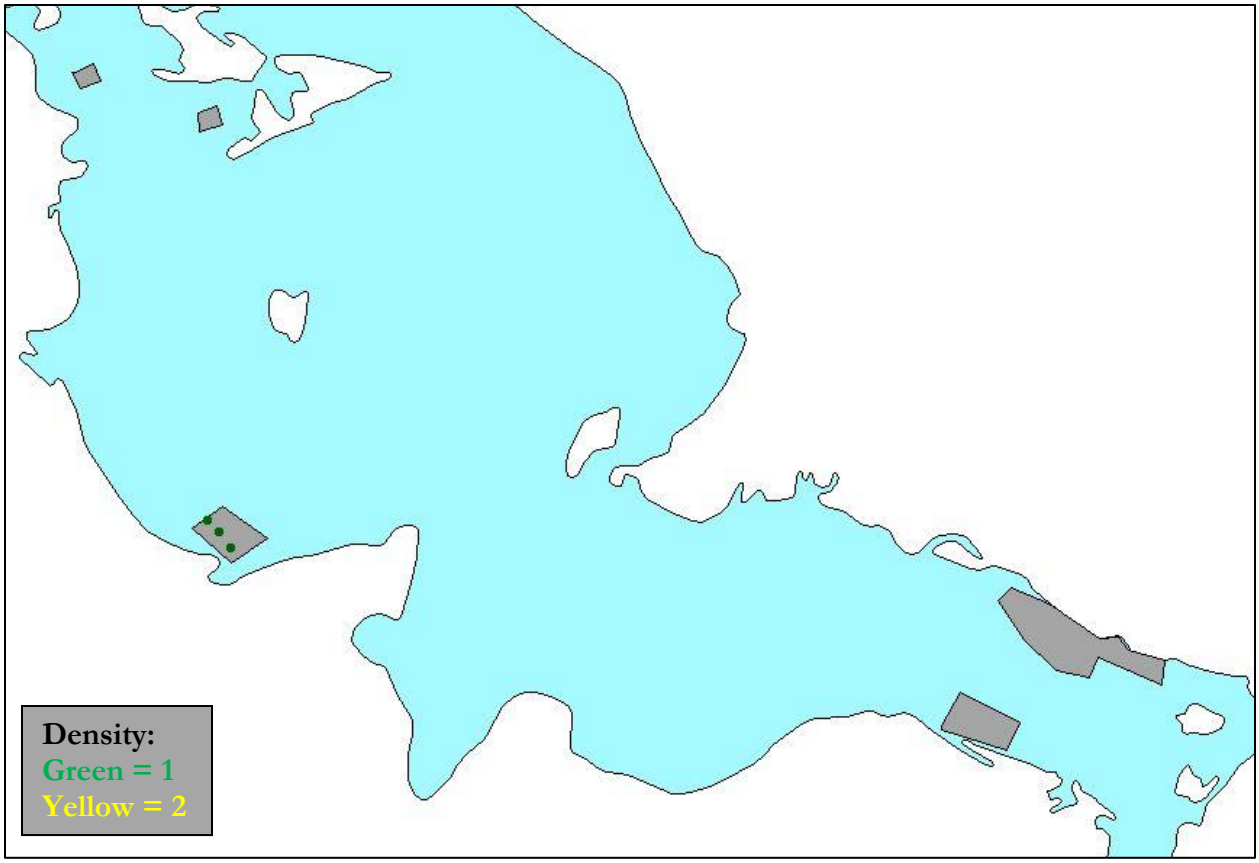
***Elodea Canadensis*-Common waterweed**



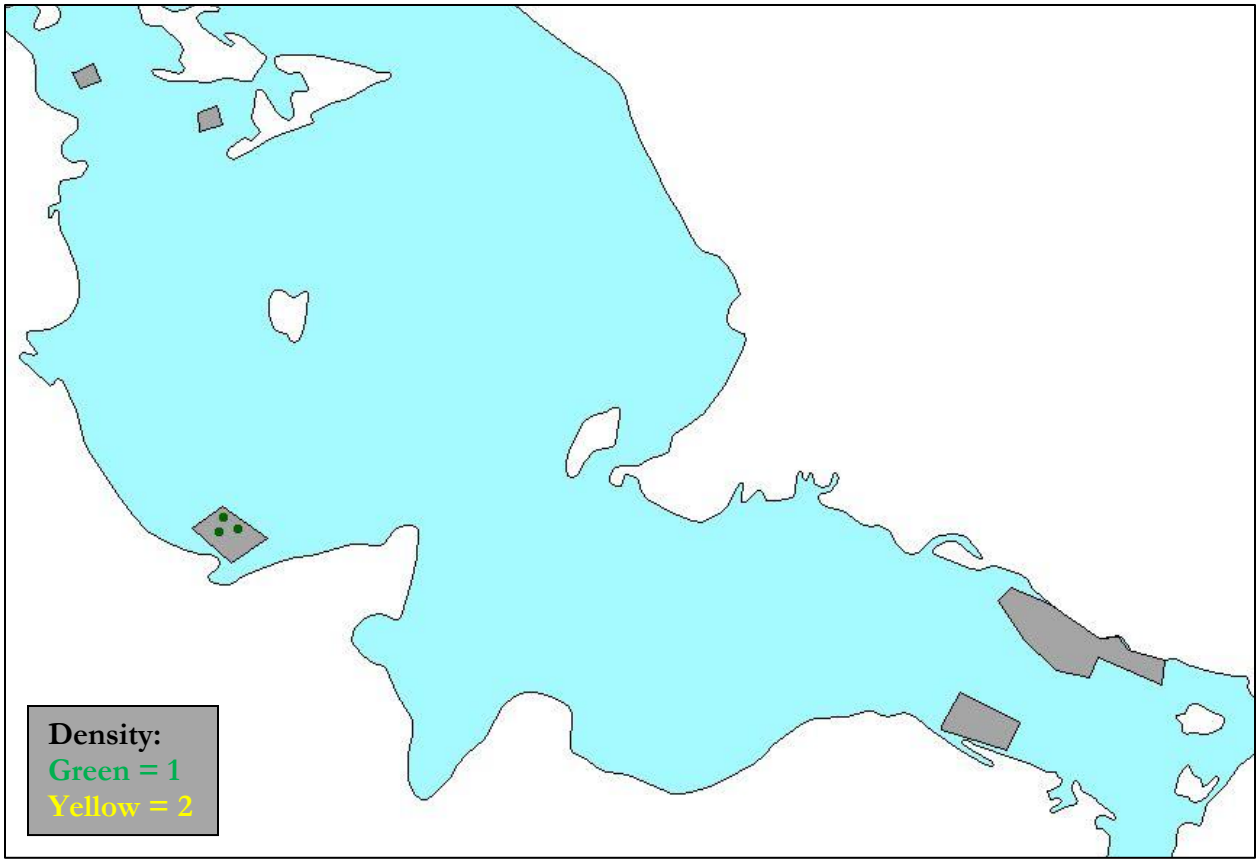
***Ceratophyllum demersum*-Coontail**



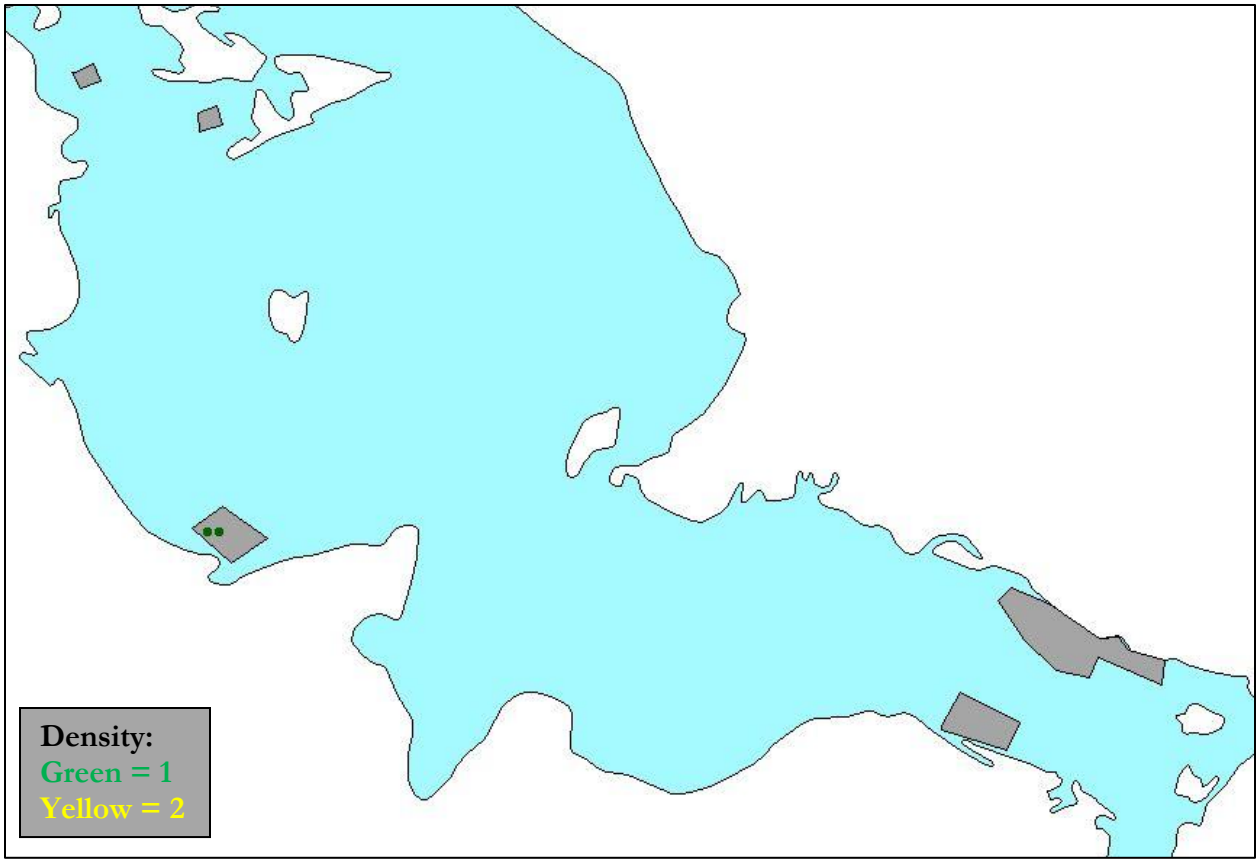
***Myriophyllum sibiricum*-Northern water-milfoil**



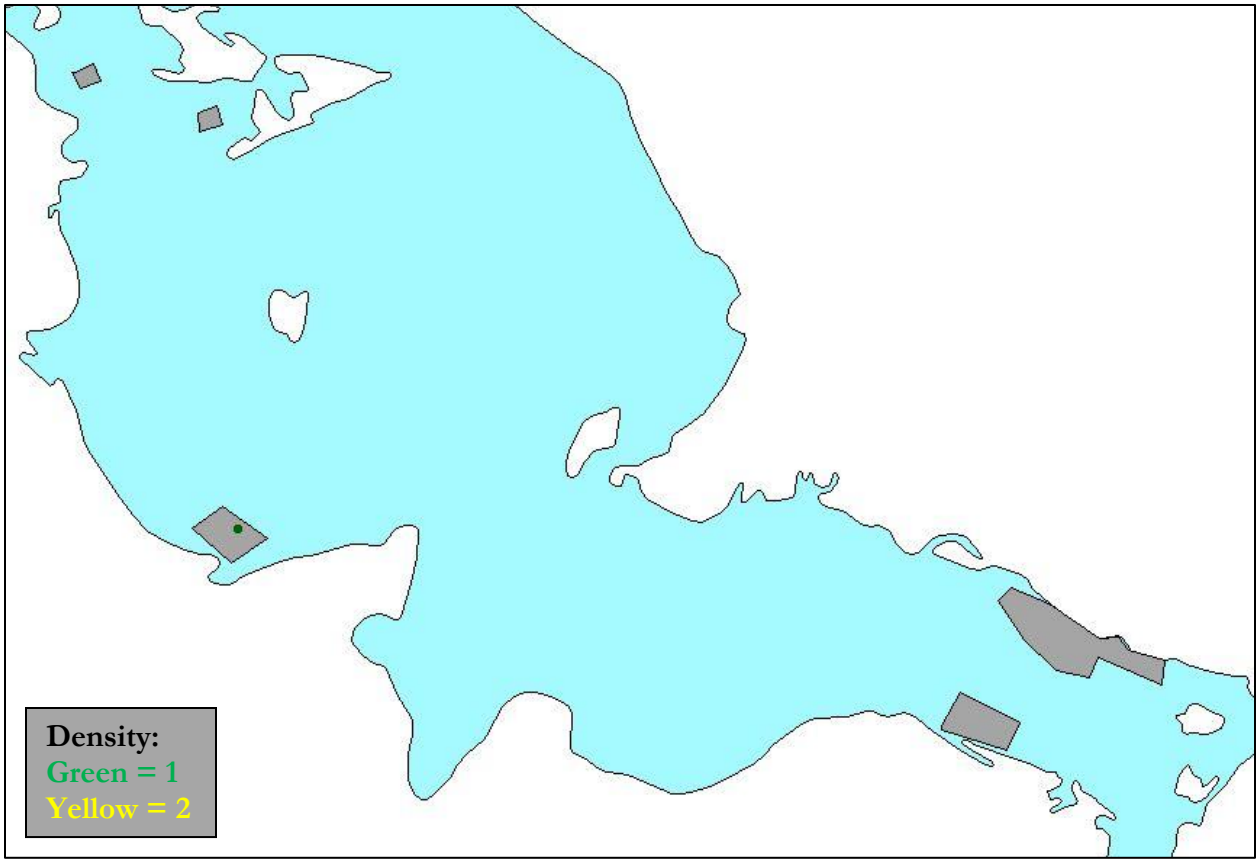
***Stuckenia pectinatus*-Sago pondweed**



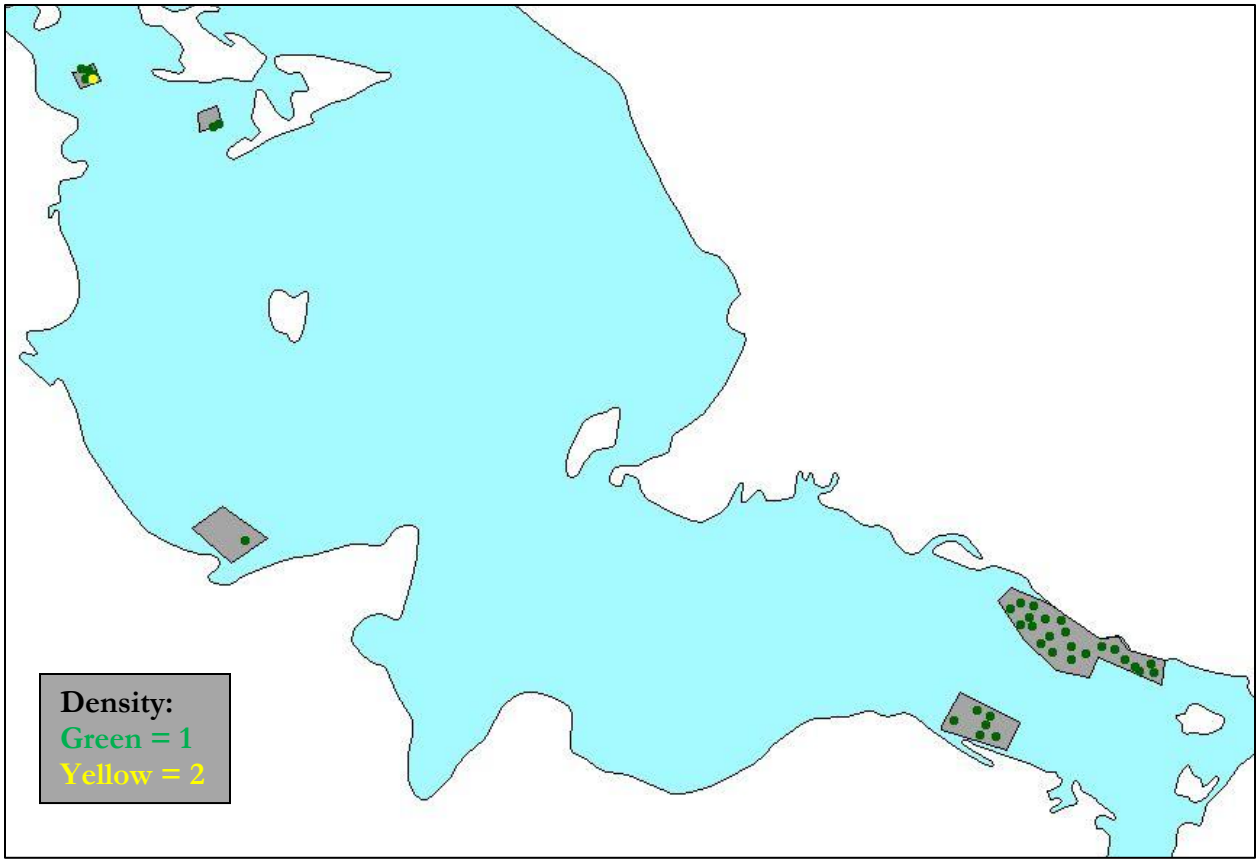
***Heteranthera dubia*- Water stargrass**



***Najas flexilis*-Bushy pondweed**



***Nymphaea odorata*-White water lily**



Filamentous algae