Herbicide Treatment Analysis for *Potamogeton crispus* (CLP)

Big Lake / Round Lake
Polk County, WI

July, 2012

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Abstract

On April 20, 2012 there were 16 beds(15 on Big Lake and 1 on Round Lake) totaling 20.66 acres of curly leaf pondweed (Potamogeton crispus)(CLP) treated with endothall K. The pre and post treatment survey data shows that the reduction in the frequency of was significant ($P<0.01$) if comparing the growth before treatment and after treatment. Only 17 of 161 sample points had CLP present in the post treatment survey. There were no beds found within treatment areas and no new beds observed elsewhere. A turion analysis conducted in August 2012 revealed a mean turion density of 12.8 turions/m^2, compared to 44 turions/m^2 in 2011, showing a substantial reduction. Some native plants had a significant reduction. This reduction could be due to the herbicide, however there were two native plants that had a significant increase in frequency.

Introduction

On April 20, 2012 a total of 20.66 acres of *Potamogeton crispus*-curly leaf pondweed (CLP) beds were treated with herbicide (endothall-K) for the second year. Figure 1 shows the location of the 16 beds.

The treatment comprised of concentrations ranging from 1.25 ppm to 2 ppm of endothall K. Table 1 shows the statistics for each treatment bed (Bed B-3 was not treated due to limited/no CLP growth at the time of treatment).

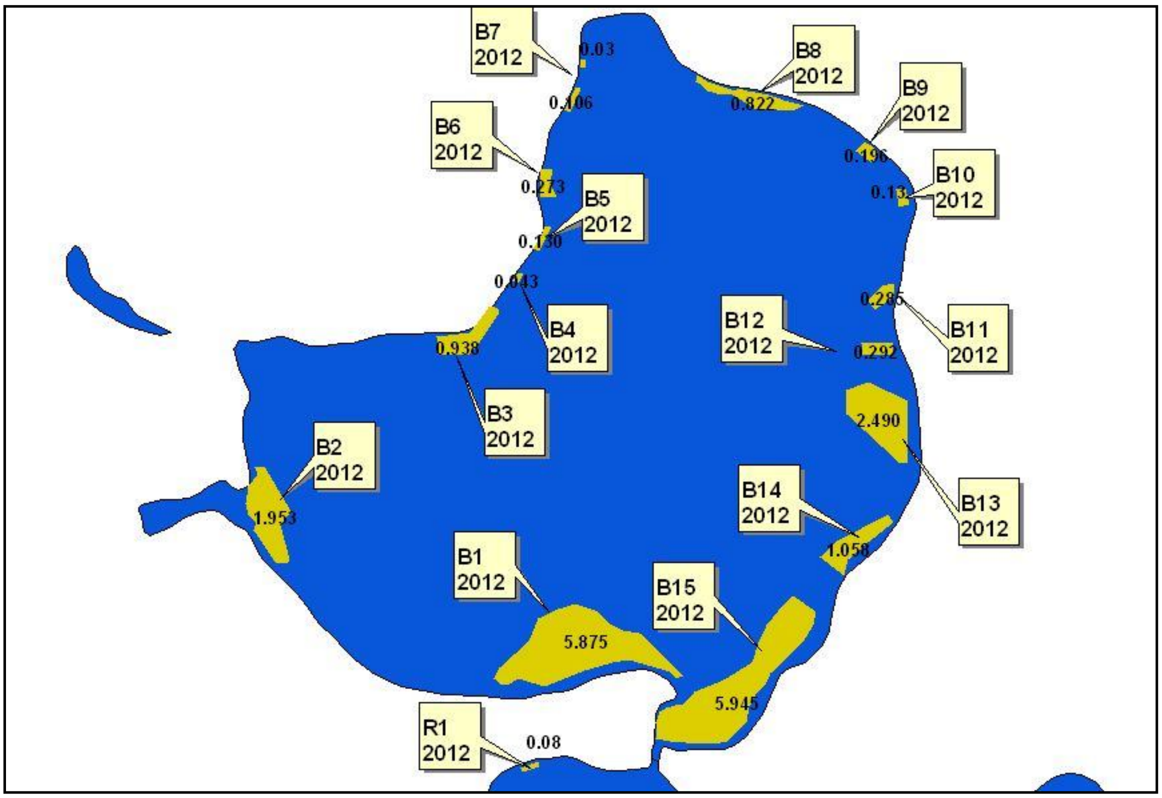

Figure 1: Treatment Beds on Big Lake (labeled "B_") and Round Lake (labeled "R1").

Big Lake 2012 CLP				
	Acres	**Mean Depth(ft)**	**Acre-feet**	**Herb. Conc. (ppm)**
B1	5.88	5.55	32.63	1.5
B2	1.95	5.3	10.34	1.5
B3	0.94	6.5	6.11	2.5
B4	0.04	6.5	0.26	2.5
B5	0.13	6	0.78	2.5
B6	0.27	5.1	1.38	2.5
B7	0.14	5.9	0.83	2.5
B8	0.82	6.56	5.38	2.5
B9	0.2	6.53	1.31	2.5
B10	0.13	7	0.91	2.5
B11	0.29	7.7	2.23	2.5
B12	0.29	6	1.74	2.5
B13	2.49	6.4	15.94	1.5
B14	1.06	5.7	6.04	1.5
B15	5.95	5.3	31.54	1.5
Total	**20.58**		**117.40**	
Round Lake 2012 CLP				
	Acres	**Mean Depth(ft)**	**Acre-feet**	
R1	0.08	4.2	0.34	2.5
Grand total (both lakes)	**20.66**		**117.74**	

Table 1: Treatment beds and data.

Methods

Prior to treatment, a pre-treatment survey was conducted at 161 predetermined sample points for Big Lake and 4 predetermined sample points for Round Lake. The presence of CLP was recorded at each sample point, along with depth and dominant sediment type. Treatment beds may be adjusted for depth and presence/absence of CLP from the previous years CLP mapping. A double tine rake was used and towed 1 meter for each sample.

Approximately 4 weeks after treatment took place, a post-treatment survey was conducted. Each of the sample points used in the pre-treatment survey was used. The CLP density was recorded as well as the density of each native plant species found on the rake after a 1-meter tow (density is not recorded in pre-treatment survey due to such limited plant size).

To examine the effectiveness of an herbicide treatment, data collected one year prior to the treatment is typically compared to the post–treatment survey of the treatment year. However, since the treatment was so effective in 2011, there really can't be much of a further reduction in CLP in 2012. Therefore, the growth of CLP just before treatment in April (pretreatment survey) will be compared to the post treatment survey results (this will be a better evaluation as the new April growth had to be killed to reduce the frequency in the June survey). Statistical analysis is then used to evaluate the effectiveness. A chi-square analysis is completed to evaluate the frequency of occurrence change of CLP in the treatment beds. The native plants present in the full lake PI survey conducted in 2009 were used to see how the native plants responded. Only points that coincide with the treatment beds were used. A chi-square analysis is used to evaluate any changes in the frequency of occurrence of each native plant species surveyed.

In addition, CLP mapping was conducted during peak growth. This was to determine the size of any nuisance level beds within the treatment areas as well as any new beds that may be present (no nuisance level CLP that was at or near surface was found and as a result, no new beds were delineated, and only individual plants were observed within the treatment beds).

In early August, a turion analysis was conducted. A sediment sampler was used to collect bottom sediment at several randomly selected sample points within the treatment beds. The sample was then filtered with a Wildco® filter bucket. The number of turions was counted from the sample and a density was calculated in square meters. Two sediment samples were taken at each sample point (one on each side of the boat). This analysis will allow for the future determination of turion density changes. This data can reflect long-term effectiveness of the CLP treatments. If several years of treatment are successful, resulting in limited CLP plants reaching turion production stages, new CLP growth from turion germination will also be reduced. This will be reflected in reduced turion counts, thus allowing for a more valid decision for continuing or ending treatment in any given bed.

Results

Frequency changes from pre to post treatment survey

Figure 2 shows the pretreatment frequency data on a map. The **black dots represent sample points where CLP was present, while the white dots represent where CLP was not present**. About 75% of the sample points had CLP present. Beds B3 and B6 as well as the areas of B11-B13 were reduced from 2011 due to lack of CLP growth.

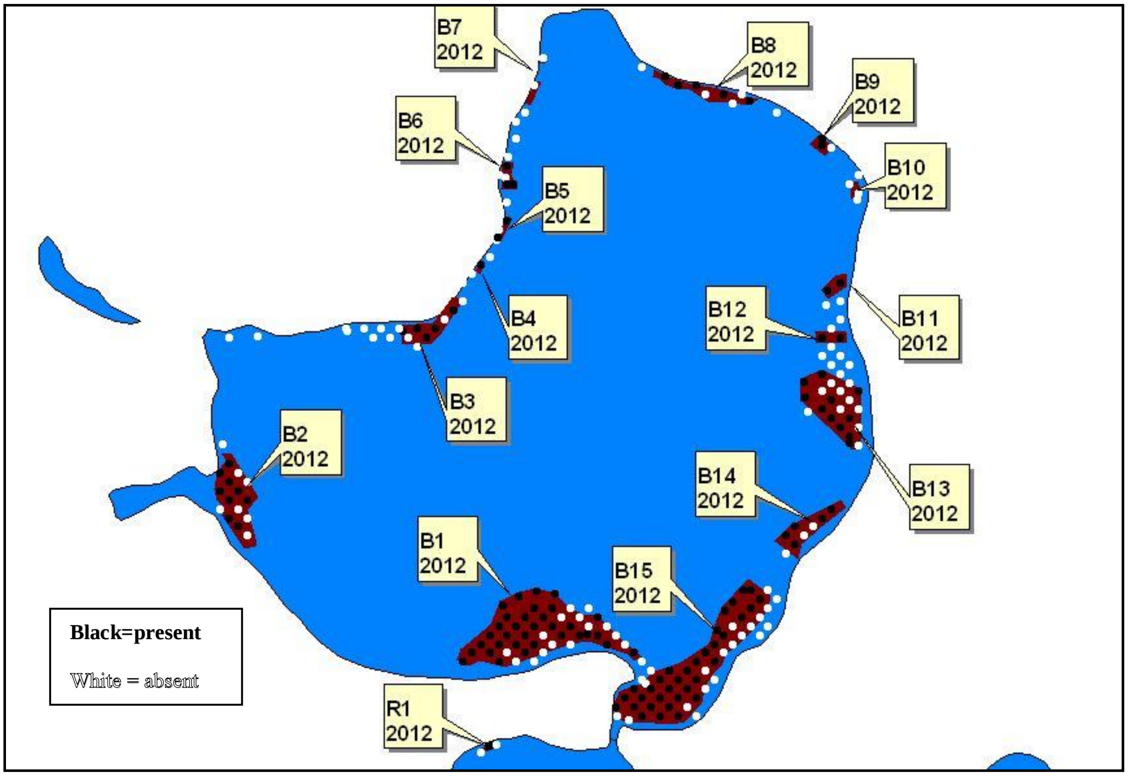

Figure 2: Map of beds with pre-treatment presence/absence of CLP.

Figure 3 shows the frequency map of the beds after treatment occurred. As can be seen, the number of points with CLP sampled was only 6 or 3.8% of the sample points. This demonstrates a dramatic reduction in CLP frequency.

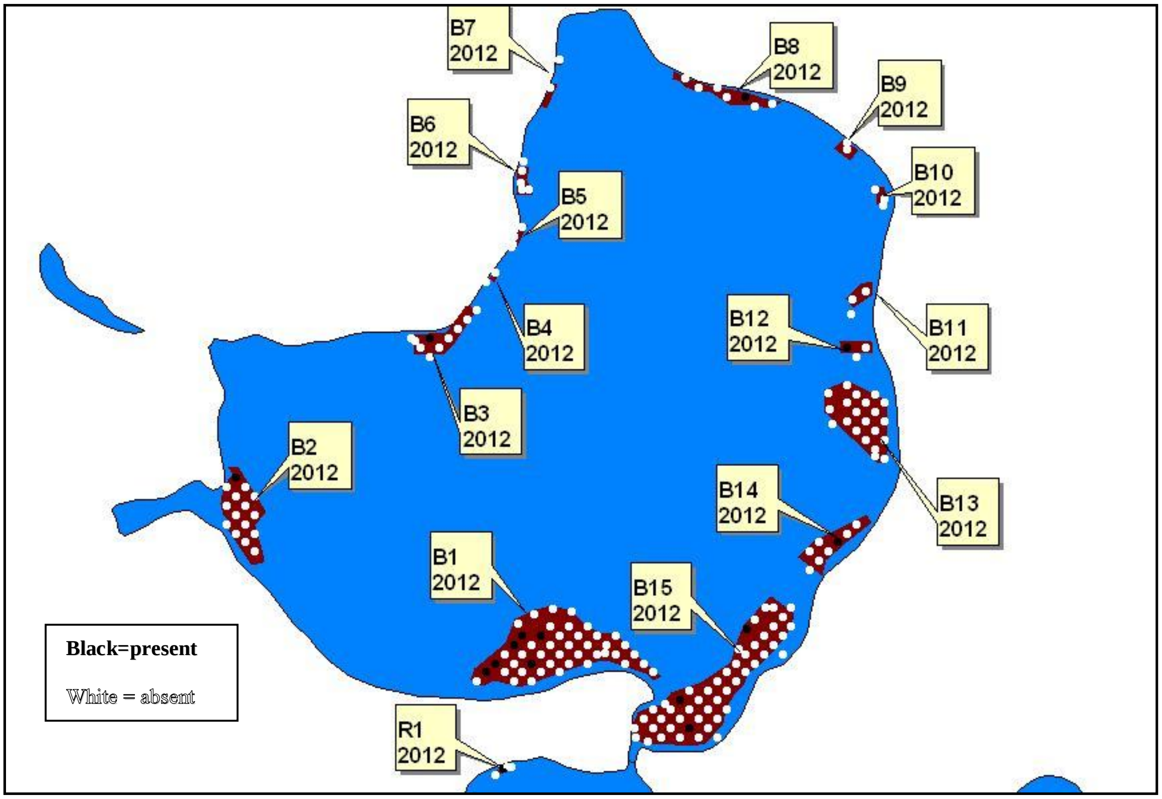

Figure 3: Map of beds with post-treatment presence/absence of CLP.

Table 2 summarizes the frequency reduction. The reduction was found to be very significant based upon the chi-square analysis (P<0.01).

CLP Data	*Measured*
Post-treatment 2011	0.04 or 4%
Pre-treatment	0.75 or 75%
Post-treatment	0.11 or 11%
Change	Reduced[1] (-0.64)
Significant	Yes ($P=3.7 \times 10^{-38}$)

Table 2: Frequency change data before and after treatment.

The post treatment survey following the 2011 treatment revealed a 4% frequency of CLP growth. The post treatment survey following the 2012 treatment revealed a 11% frequency of CLP growth. This is a slight increase, however since the treatment in 2011 was so successful, further reduction below the 4% frequency is difficult. As a result, the pretreatment survey of 2012 in early April reflects the growth that occurred since the post treatment survey in 2011 (largely due to turion germination). If the post treatment survey of 2012 is compared to this pretreatment survey, it is a better reflection of the actual effectiveness of the herbicide application.

[1] This is comparing the growth in April 2012 to the growth after treatment in June 2012.

In this comparison, there was a significant reduction in CLP frequency with P= 3.7×10^{-38}. This allows the conclusion that the 2012 herbicide treatment was a success at reducing CLP in Big and Round Lakes.

No CLP density was observed in any of the treatment areas that would constitute a bed. Furthermore, no new beds were observed to delineate for future treatments (in addition to the treatment areas in 2012) in any other locations.

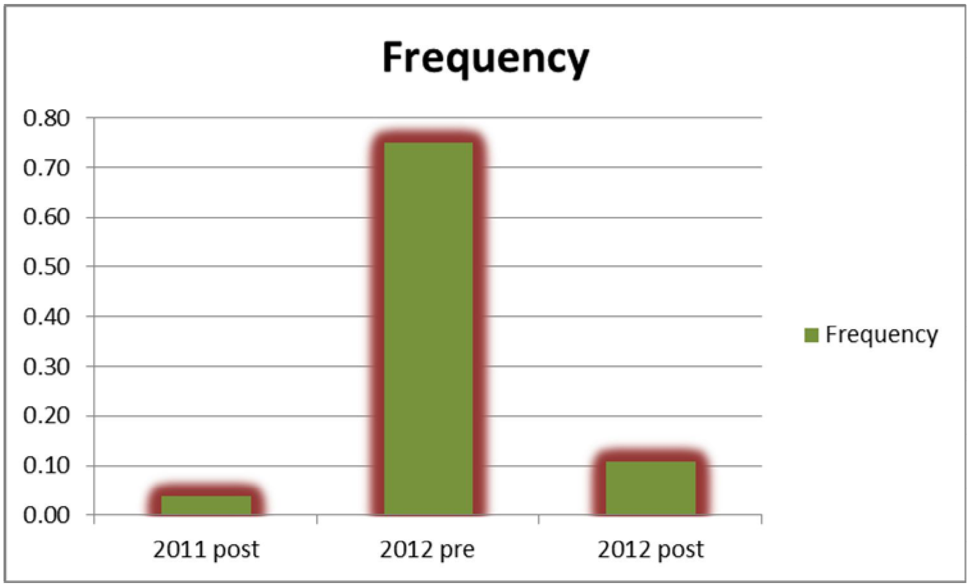

Figure 4: Graph showing frequency in various surveys.

Another important part of the treatment analysis is the evaluation of any negative response in the native plant community. The potential frequency changes are analyzed to assure that the target species (CLP) was the only plant affected by the herbicide treatment. The native frequency is compared from 2011 to 2012 since the treatment boundaries were largely the same.

Table 3 summarizes the native plant frequency data any potentially significant changes. There are some reductions that are statistically significant. These species include: *Potamogeton zosteriformis* (flat-stem pondweed), *Lemna triscula* (forked duckweed), *Potamogeton richardsonii* (clasping pondweed), *Potamogeton praelongis* (white-stem pondweed) and *Potamogeton robbinsii* (Robbin's pondweed). Two species had statistically significant increases. There species are: *Ceratophyllum demersum* (coontail) and *Vallisneria Americana* (wild celery).

The fact that five species had reduction from 2011 is of concern. This could indicate that the herbicide had an adverse effect on the native plants listed. However, there was also an increase in two species. One of these species is coontail, which is generally one of the few native species not dormant during early season herbicide application. Therefore it is puzzling that if the herbicide did adversely affect native species, that it didn't affect this species. The change could be due to annual variation in growth.

Species	Freq 2011	Freq 2012	Change	Significant
filamentous algae	0.15	0.20	+	NO
Chara sp.	0.01	0.01	nc	na
Elodea canadensis	0.29	0.25	-	NO
Heteranthera dubia	0.19	0.17	-	NO
Potamogeton zosteriformis	0.15	0.01	-	YES
Vallesnaria americana	0.01	0.10	+	YES
Ceratophyllum demersum	0.72	0.88	+	YES
Lemna triscula	0.21	0.04	-	YES
Potamogeton richardsonii	0.05	0.00	-	YES
Potamogeton robbinsii	0.06	0.01	-	YES
Potamogeton praelongus	0.10	0.01	-	YES
Myriophyllum sibiricum	0.13	0.09	-	NO
Potamogeton pusillus	0.01	0.01	nc	na
Stuckenia pectinatus	0.01	0.02	+	NO
Nymphae odorata	0.06	0.04	-	NO
Potamogeton pusillus	0.00	0.01	+	NO
Potamogeton illinoensis	0.03	0.06	+	NO
Potamogeton amplifolius	0.01	0.01	nc	na
Sagittaria cuneata	0.00	0.01	+	NO
Lemna minor	0.01	0.00	+	NO
****Expected Value Too Small-Use with caution.***				

Table 3: Native species frequency data. Shows comparison between 2011 post-treatment survey and the 2012 post-treatment survey.

Turion data was collected and is summarized in Table 4. This data will be used in future treatment years in order to help determine long-term effectiveness and then help determine when treatment should cease in various beds. The data shows that there

Turion data	Mean turion count	Density (per m^2)
Mean all beds 2011	2.05	44
Mean all beds 2012	0.8	12.8

Table 4: Turion survey data-2012

was a substantial reduction in turion density from 2011 to 2012 (12.8 vs 44 turions per square meter).

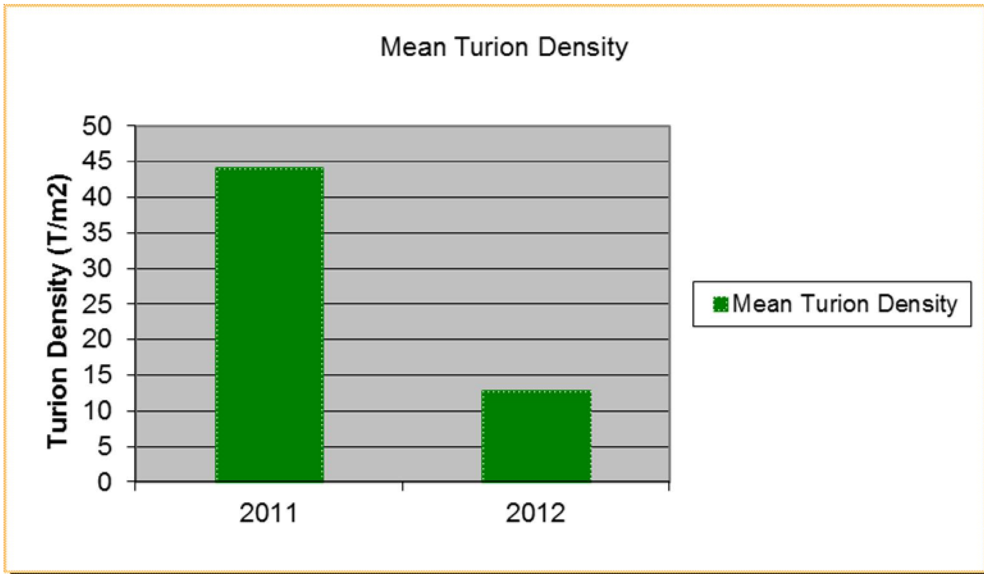

Figure 6: Graph showing turion density-mean all beds, highest bed and lowest bed.