Eurasian water milfoil (*Myriophyllum spicatum*) Pre/Post Herbicide and Bed Mapping Surveys Minong Flowage (WBIC: 2692900) Washburn County, Wisconsin

Project Initiated by:
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May 10, July 4-5 and September 26-27, 2009

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

INTRODUCTION:

The Minong Flowage (WBIC 2692900) is a 1,564-acre, eutrophic/mesotrophic stratified drainage lake located in north-central Washburn County and south-central Douglas County, Wisconsin in the Towns of Minong and Wascott (T42N R13W S13 SW NE) (Figure 1). The lake achieves a maximum depth of 21.5ft near the dam on the far south end of the flowage, and has an average depth of approximately 9ft. The lake bottom is predominately sand and sandy muck in the south basin, and organic muck in the northern bays. Water clarity is very poor to poor with average Secchi visibility of no more than 3-6ft under normal summer conditions (WDNR 2008).

Figure 1: Aerial Photo of Minong Flowage

With the discovery of Eurasian water milfoil (*Myriophyllum spicatum*) in the flowage in 2002, the WDNR authorized a systematic point intercept macrophyte sampling in the summer of 2003 to provide baseline data on the level and total area impacted by EWM. In the summer of 2008, a five year follow-up point intercept study and an EWM bed mapping survey were authorized to determine if EWM density and distribution had changed since 2003. These data were used by SEHI to develop an updated Aquatic Plant Management Plan (APMP) for the flowage. The new DNR approved plan determined that chemical treatment of EWM was potentially appropriate in five areas (Beds 7, 8, 12, 24 and 25). Navigation channels were also approved through Beds 14, 21 and 22 for a sum total of 68.89 acres authorized for potential treatment.

To evaluate the effectiveness of the chemical treatment, a pre-treatment survey was conducted on May 10, and a follow up post-treatment survey was conducted on July 4-5. We also conducted an annual fall EWM bed mapping survey to determine if and where EWM control should be considered in 2010. This report is the summary analysis of these three field surveys.

METHODS:

Pre/Post Herbicide Survey:

Frank Koshere (WDNR) authorized eight areas to be surveyed as potential EWM herbicide treatment areas (Figure 2) (Appendix I). For the five beds, we used Forestry Tools Extension to ArcMap 9.3.1 to generate pre/post survey points based on the size and shape of the bed: Bed 7's 8.9 acres produced a 34 point grid; Bed 8's 4.6 acres a 17 point grid; Bed 12's 3.5 acres a 16 point grid; Bed 24's 6.3 acres 23 point grid; and Bed 25's 1.8 acres an 8 point grid. In the three navigation channels through Beds 14 (28 points), 21(78 points), and 22 (82 points), we used the original 188 Point/Intercept points generated by Michelle Nault (WDNR) for the 2008 P/I survey. All total, 269 points were used for the PreTreatment surveys. Post treatment, 32 additional points were added including the original point/intercept points that fell within treatment areas and points in Bed 23 where there were concerns about EWM expanding into rice beds (Figure 2) (Appendix I).

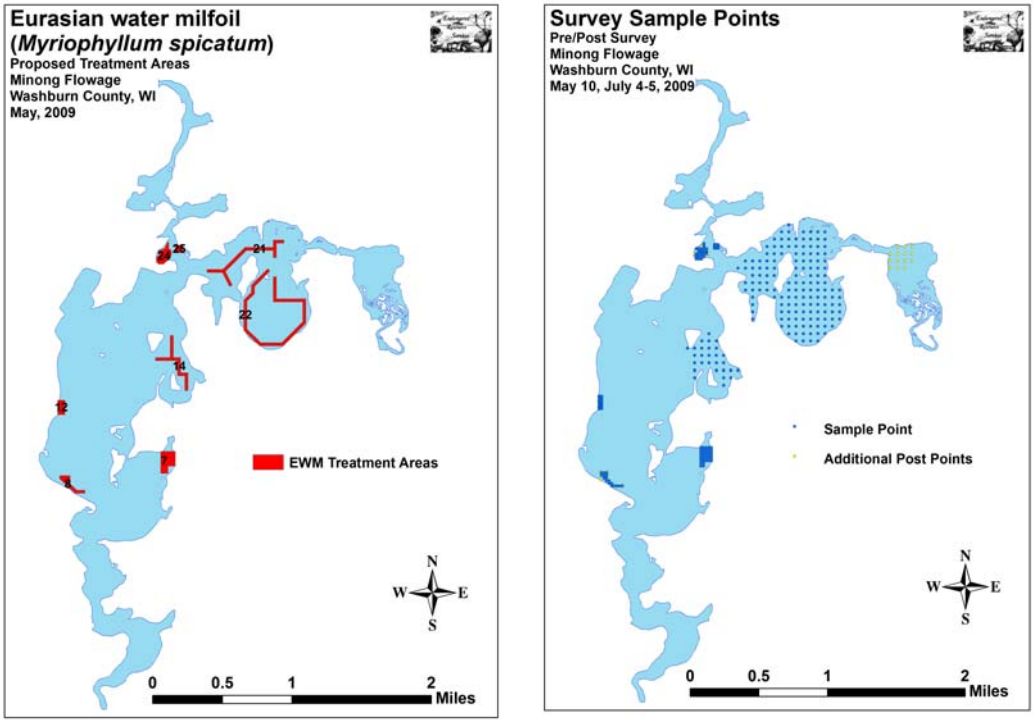


Figure 2: Proposed EWM Treatment Areas and Pre/Post Survey Points

We located each survey point using a handheld mapping GPS unit (Garmin 76CSx), and used a rake to sample an approximately 2.5ft section of the bottom. All plants on the rake were assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 3). We also recorded depth and bottom substrate at each point. All data collected was entered into the standard APM spreadsheet (Appendix II) (UWEX, 2009). Data was analyzed using the linked statistical summary sheet and the WDNR pre/post analysis worksheet (UWEX, 2009). Pre/post differences were determined to be significant at p <.05, moderately significant at p <.01 and highly significant at p<.005.

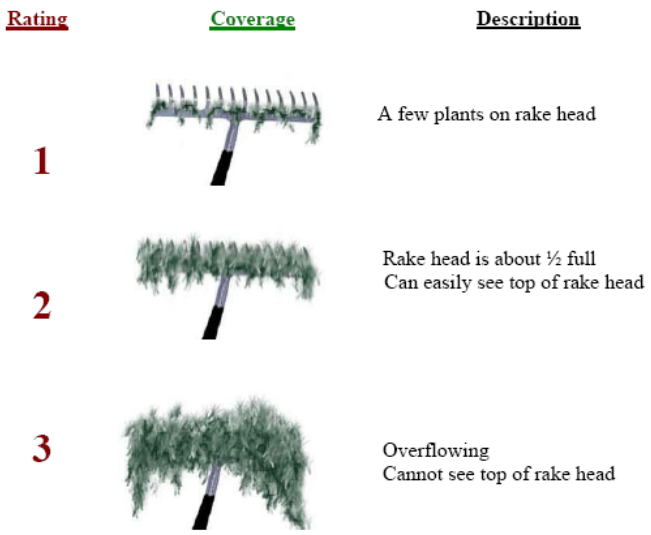


Figure 3: Rake Fullness Ratings (UWEX, 2009)

Fall Eurasian Water Milfoil Bed Mapping:

During the last weekend in September, we mapped all known beds of EWM on the flowage. A "bed" was determined to be any area where we visually estimated that EWM made up >50% of the area's plants and was continuous with clearly defined borders. After we located a bed, we motored around the perimeter of the area, took GPS coordinates at regular intervals, and estimated the average rakefull rating of EWM within the bed. We also mapped areas that had high numbers of "pioneer clusters". Although EWM in these areas were not continuous and thus did not meet the "bed" criteria, habitat conditions suggested they would likely continue to fill in and become significant beds in the near future thus deserving management consideration.

RESULTS AND DISCUSSION:

EWM Pre/Post Herbicide Survey:

EWM was found in water from 0.5-11ft, but the majority of plants were in the 4-6ft range (Figure 4). With the exception of Beds 8 and 12 which were predominantly sand, almost all points were located over organic muck (Figure 5) (Appendix III). During the PreTreatment survey, we found EWM in172 rake samples of which 46 were rake fullness 3, 58 were rake fullness 2, and 68 were rake fullness 1 (Figure 6 and 7) (Appendix IV). They produced a mean rake fullness of 1.87. During the PostTreatment survey, we found EWM at only 114 sites. There were still 44 sites with a rake fullness of 3, but only 29 sites with a rake fullness of 2, and 41 with a rake fullness of one. Mean rake fullness increased to 2.03 due to fewer small rake fullness samples. The results documented a highly significant total decline in EWM, and of rake fullness 2 and 1 sites. There was no significant difference in rake fullness 3 sites. This is likely due to the apparent ineffectiveness of the treatment in Beds 21 and 22 (Figure 8).

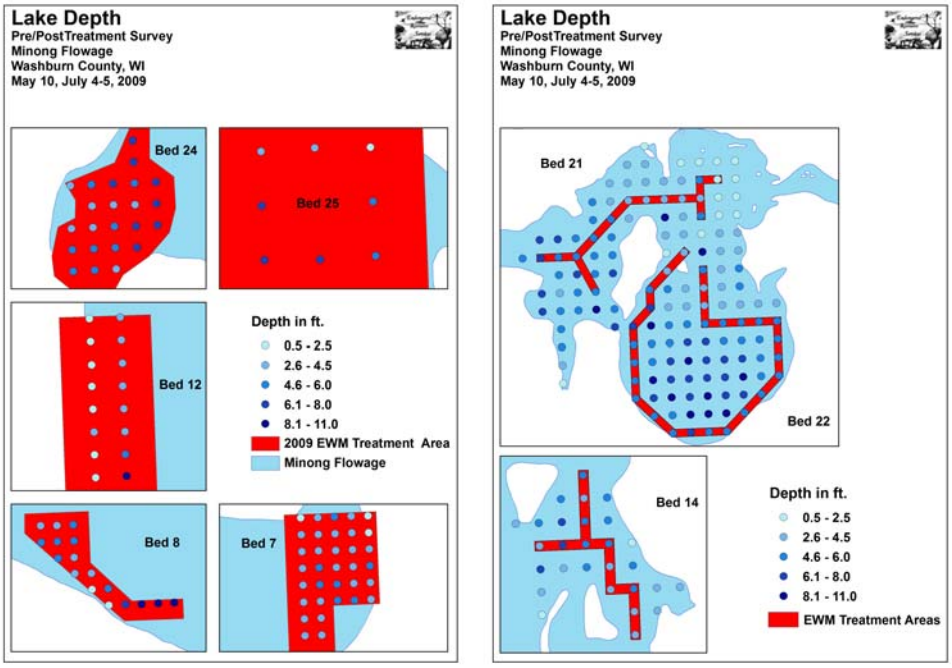


Figure 4: Minong Flowage Pre/Post Treatment Depths

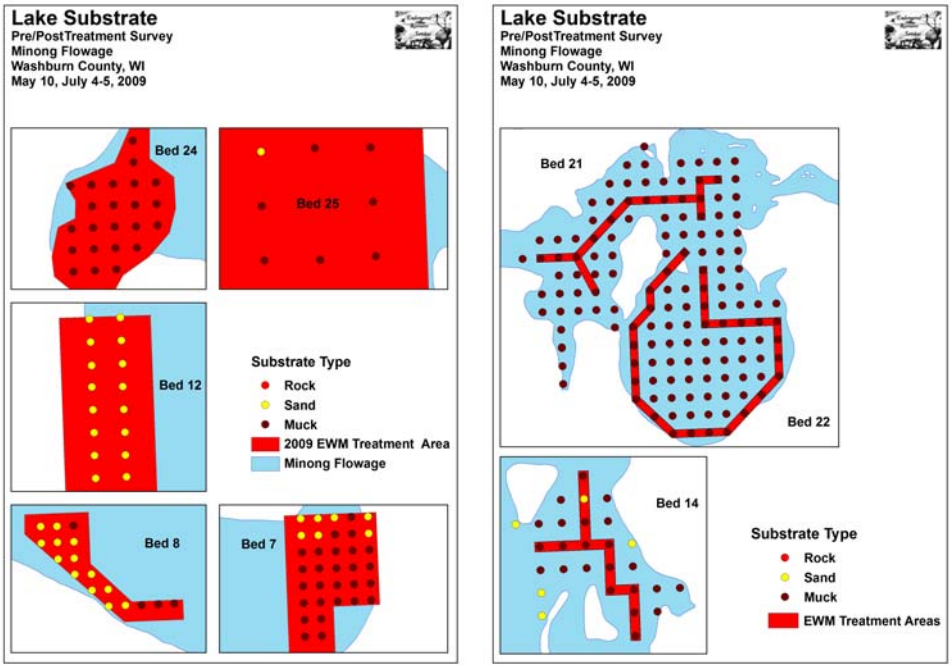


Figure 5: Minong Flowage Pre/Post Treatment Bottom Substrate

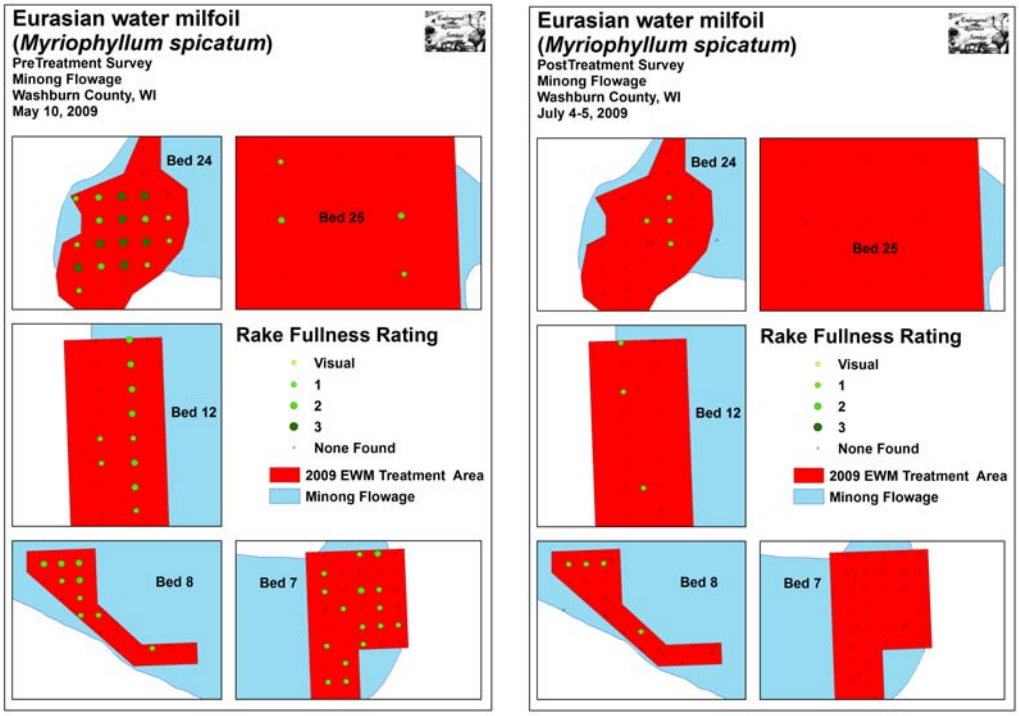


Figure 6: Beds 7, 8, 12, 24 and 25 Pre/Post EWM Distribution

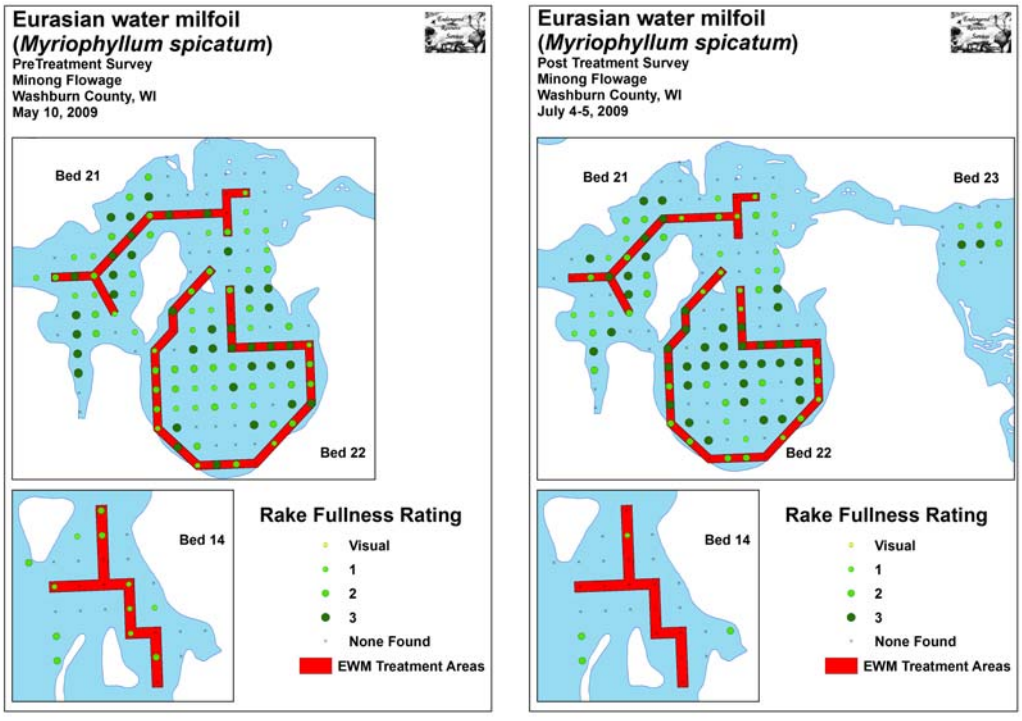
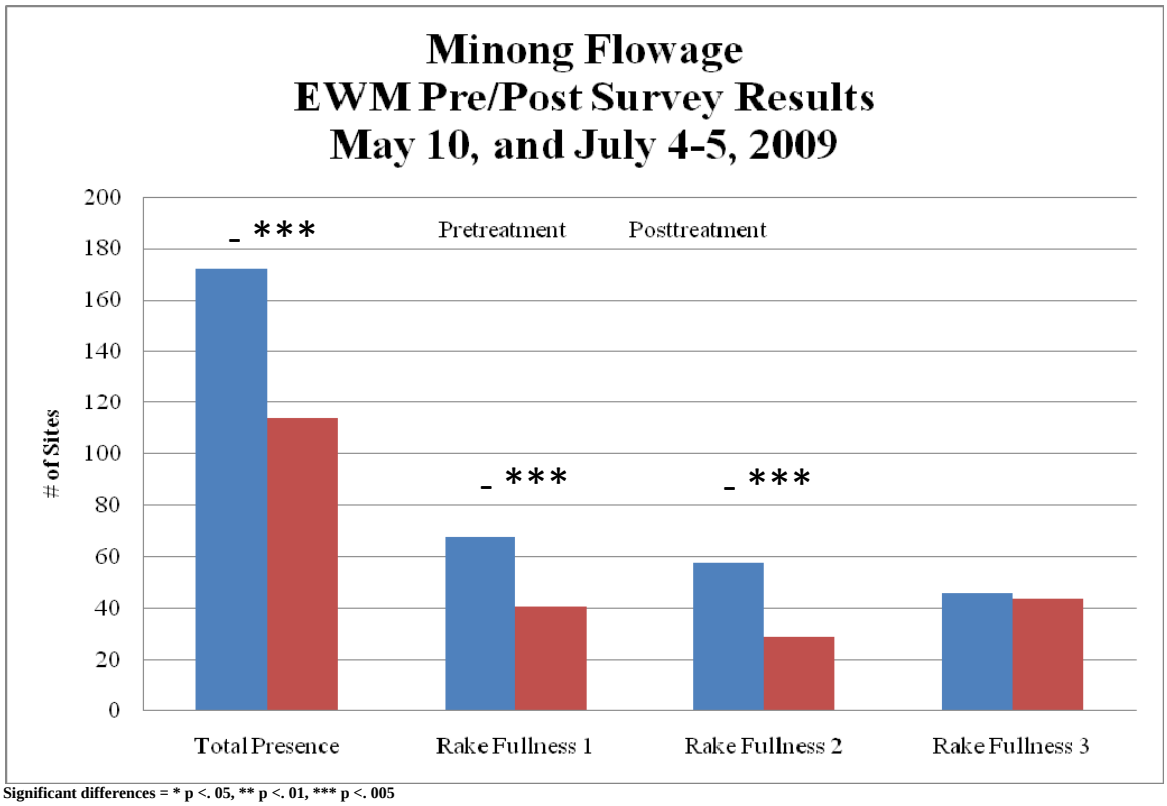


Figure 7: Beds 14, 21, 22 and 23 Pre/Post EWM Distribution



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

Figure 8: Significant Changes in Rake Fullness Ratings for EWM

Table 1: Pre/Post Survey Summary Statistics
Minong Flowage, Washburn and Douglas Counties
May 10, and July 4-5, 2009

Summary Statistics:	Pre	Post
Total number of points sampled	269	301
Total number of sites with vegetation	228	239
Total number of sites shallower than the maximum depth of plants	269	297
Frequency of occurrence at sites shallower than maximum depth of plants	84.76	80.47
Simpson Diversity Index	0.81	0.89
Maximum depth of plants (ft)	11.00	9.00
Number of sites sampled using rope rake (R)	0	0
Number of sites sampled using pole rake (P)	269	301
Average number of all species per site (shallower than max depth)	1.99	2.29
Average number of all species per site (veg. sites only)	2.34	2.85
Average number of native species per site (shallower than max depth)	1.30	1.87
Average number of native species per site (veg. sites only)	1.88	2.48
Species Richness	23	33
Mean depth of plants (ft)	4.90	5.12
Median depth of plants (ft)	5.00	5.50

Native species richness was relatively low in the PreTreatment survey averaging 1.88 species/site, but increased to 2.48/site in the PostTreatment survey (Table 1). No native species declined significantly including Coontail (*Ceratophyllum demersum*), the most common native macrophyte (Figure 9) (Table 2 and 3). Other species that increased significantly between surveys such as Wild Celery (*Vallisneria americana*) were likely due to normal increases in spring plant growth patterns (Figure 10).

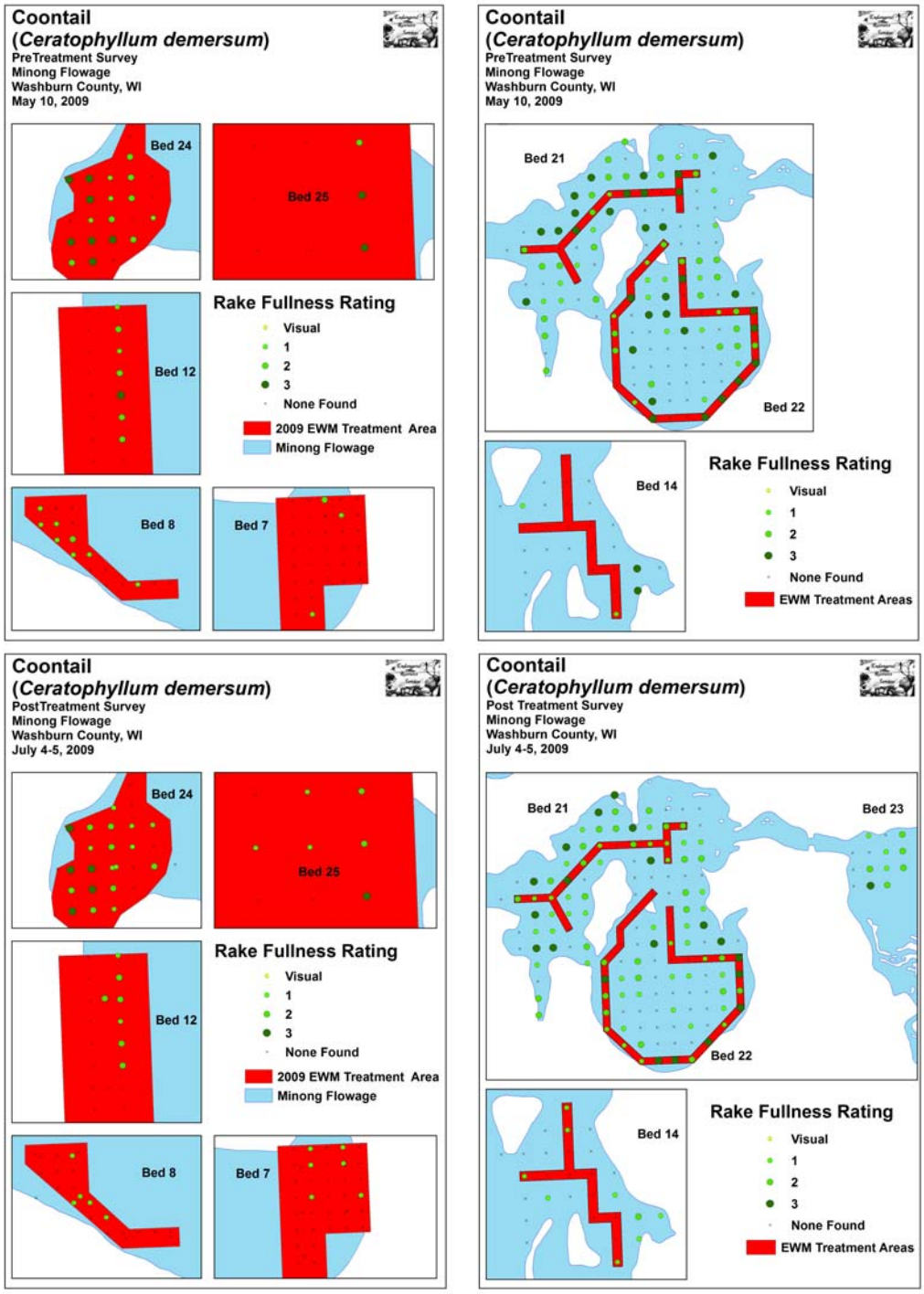
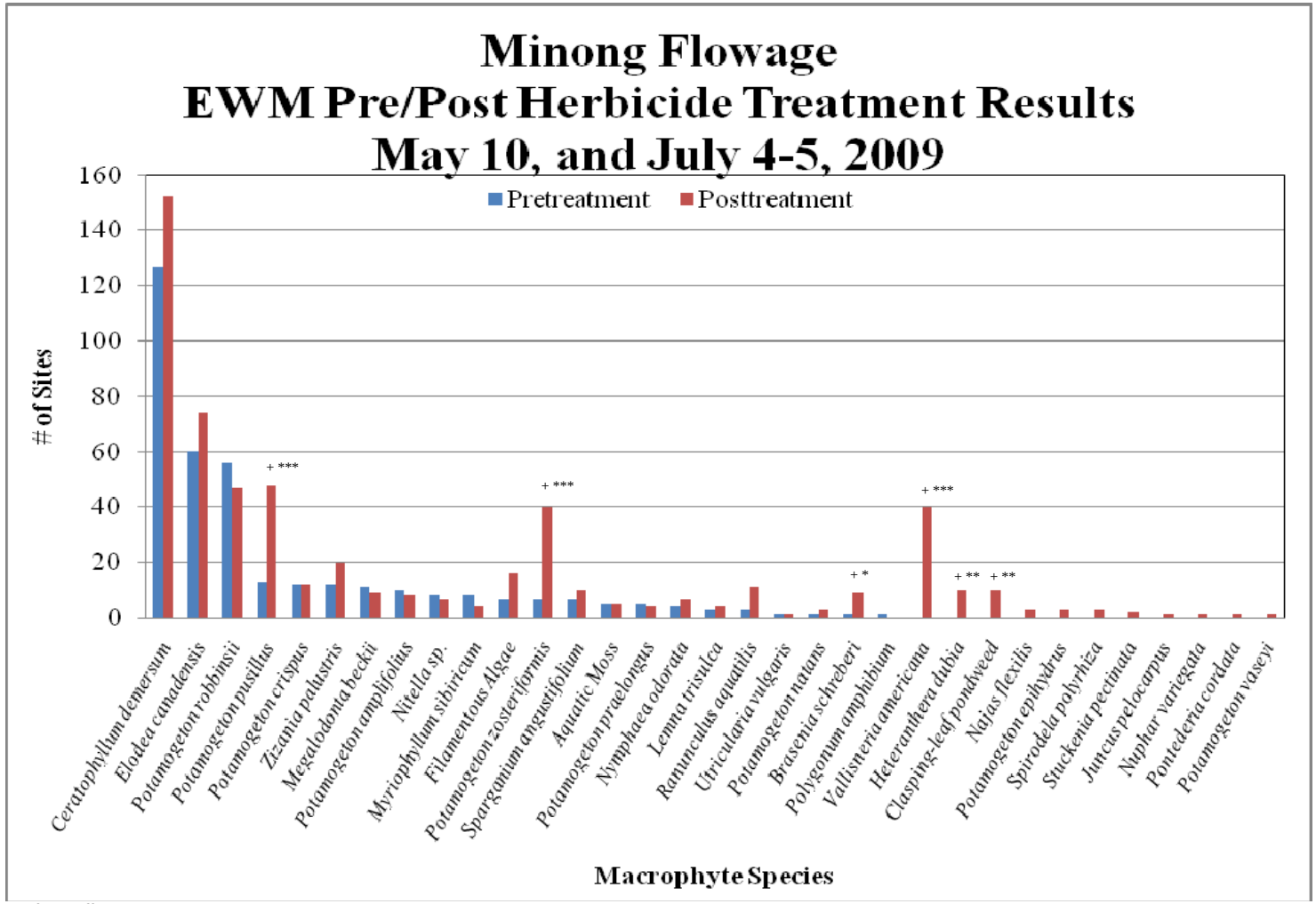


Figure 9: Minong Flowage Pre/Post Coontail Distribution



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

Figure 10: Significant Macrophyte Changes

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Pre-Treatment Survey Minong Flowage, Washburn and Douglas Counties
May 10, 2009

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Myriophyllum spicatum	Eurasian water milfoil	172	75.44	63.94	32.21	1.87
Ceratophyllum demersum	Coontail	127	55.70	47.21	23.78	2.04
Elodea canadensis	Common waterweed	60	26.32	22.30	11.24	1.63
Potamogeton robbinsii	Robbins (Fern) pondweed	56	24.56	20.82	10.49	1.71
Potamogeton pusillus	Small pondweed	13	5.70	4.83	2.43	1.00
Potamogeton crispus	Curly-leaf pondweed	12	5.26	4.46	2.25	1.50
Zizania palustris	Northern wild rice	12	5.26	4.46	2.25	1.67
Megalodonta beckii	Water marigold	11	4.82	4.09	2.06	1.00
Potamogeton amplifolius	Large-leaf pondweed	10	4.39	3.72	1.87	1.20
Myriophyllum sibiricum	Northern water milfoil	8	3.51	2.97	1.50	1.13
Nitella sp.	Nitella	8	3.51	2.97	1.50	1.13
	Filamentous algae	7	3.07	2.60	1.31	1.71
Potamogeton zosteriformis	Flat-stem pondweed	7	3.07	2.60	1.31	1.14
Sparganium angustifolium	Narrow-leaved bur-reed	7	3.07	2.60	1.31	1.29
	Aquatic moss	5	2.19	1.86	0.94	2.00
Potamogeton praelongus	White-stem pondweed	5	2.19	1.86	0.94	1.00
Nymphaea odorata	White water lily	4	1.75	1.49	0.75	1.00
Lemna trisulca	Forked duckweed	3	1.32	1.12	0.56	1.67
Ranunculus aquatilis	Stiff water crowfoot	3	1.32	1.12	0.56	1.33
Brasenia schreberi	Watershield	1	0.44	0.37	0.19	1.00
Polygonum amphibium	Water smartweed	1	0.44	0.37	0.19	2.00
Potamogeton natans	Floating-leaf pondweed	1	0.44	0.37	0.19	1.00
Utricularia vulgaris	Common bladderwort	1	0.44	0.37	0.19	1.00

Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Post-Treatment Survey Minong Flowage, Washburn and Douglas Counties
July 4-5, 2009

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Ceratophyllum demersum	Coontail	152	63.60	51.18	22.35	1.68
Myriophyllum spicatum	Eurasian water milfoil	114	47.70	38.38	16.76	2.03
Elodea canadensis	Common waterweed	74	30.96	24.92	10.88	1.53
Potamogeton pusillus	Small pondweed	48	20.08	16.16	7.06	1.23
Potamogeton robbinsii	Robbins (Fern) pondweed	47	19.67	15.82	6.91	1.96
Potamogeton zosteriformis	Flat-stem pondweed	40	16.74	13.47	5.88	1.40
Vallisneria americana	Wild celery	40	16.74	13.47	5.88	1.50
Zizania palustris	Northern wild rice	20	8.37	6.73	2.94	2.20
	Filamentous algae	16	6.69	5.39	2.35	2.00
Potamogeton crispus	Curly-leaf pondweed	12	5.02	4.04	1.76	1.17
Ranunculus aquatilis	Stiff water crowfoot	11	4.60	3.70	1.62	1.18
Heteranthera dubia	Water star-grass	10	4.18	3.37	1.47	1.60
Potamogeton richardsonii	Clasping-leaf pondweed	10	4.18	3.37	1.47	1.20
Sparganium angustifolium	Narrow-leaved bur-reed	10	4.18	3.37	1.47	2.50
Brasenia schreberi	Watershield	9	3.77	3.03	1.32	1.67
Megalodonta beckii	Water marigold	9	3.77	3.03	1.32	1.11
Potamogeton amplifolius	Large-leaf pondweed	8	3.35	2.69	1.18	1.50
Nitella sp.	Nitella	7	2.93	2.36	1.03	1.00
Nymphaea odorata	White water lily	7	2.93	2.36	1.03	1.57
	Aquatic moss	5	2.09	1.68	0.74	1.80
Lemna trisulca	Forked duckweed	4	1.67	1.35	0.59	1.00
Myriophyllum sibiricum	Northern water milfoil	4	1.67	1.35	0.59	1.50

Table 3 cont': Frequencies and Mean Rake Sample of Aquatic Macrophytes
Post-Treatment Survey Minong Flowage, Washburn and Douglas Counties
July 4-5, 2009

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Potamogeton praelongus	White-stem pondweed	4	1.67	1.35	0.59	1.00
Najas flexilis	Bushy pondweed	3	1.26	1.01	0.44	1.00
Potamogeton epihydrus	Ribbon-leaf pondweed	3	1.26	1.01	0.44	2.00
Potamogeton natans	Floating-leaf pondweed	3	1.26	1.01	0.44	1.00
Spirodela polyrhiza	Large duckweed	3	1.26	1.01	0.44	1.00
Stuckenia pectinata	Sago pondweed	2	0.84	0.67	0.29	1.00
Juncus pelocarpus f. submersus	Brown-fruited rush	1	0.42	0.34	0.15	2.00
Nuphar variegata	Spatterdock	1	0.42	0.34	0.15	1.00
Pontederia cordata	Pickerelweed	1	0.42	0.34	0.15	3.00
Potamogeton vaseyi	Vasey's pondweed	1	0.42	0.34	0.15	1.00
Utricularia vulgaris	Common bladderwort	1	0.42	0.34	0.15	1.00

EWM Bed Mapping Survey:

We located and mapped a total of 12 beds on the Minong Flowage on September 26-27 ranging in size from 0.17 acres (Beds 12) to a combined 211.49 acres (Beds 21 and 22) (Figure 11) (Appendix XI). All combined, these beds covered a total of 227.79 acres (Table 4). This represented a decrease in acreage of 97.96 acres over 2008 totals.

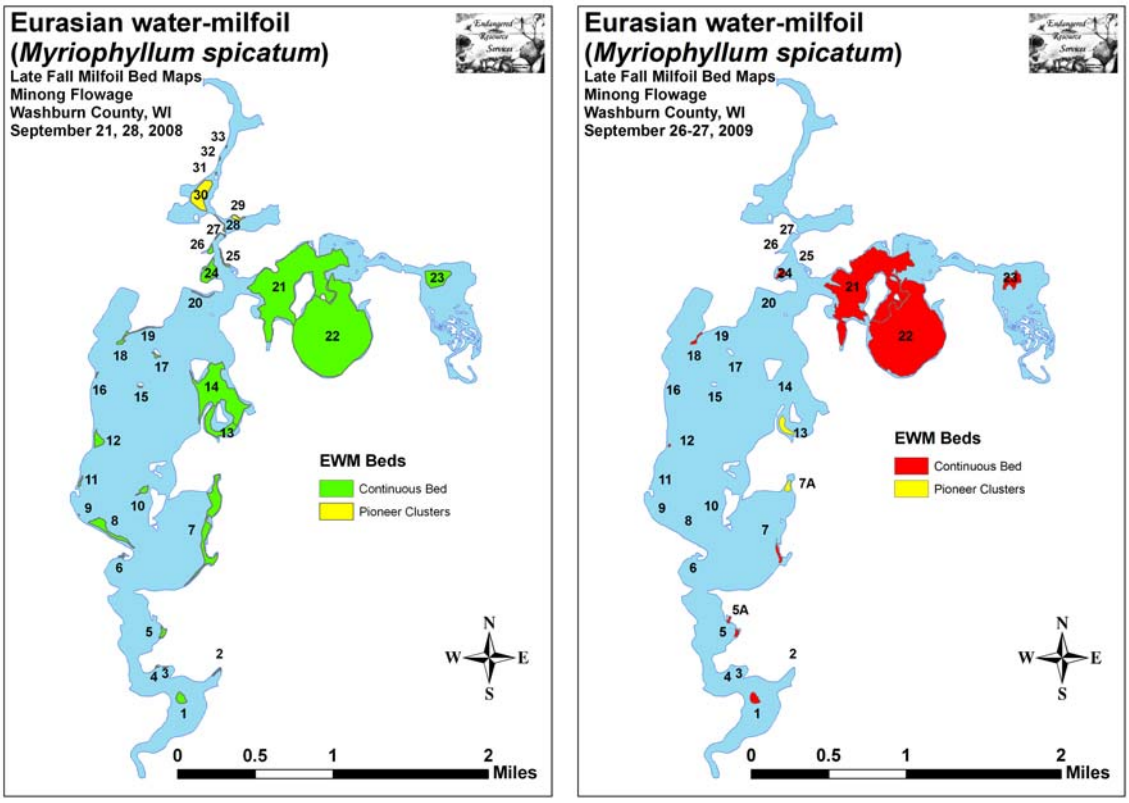


Figure 11: 2008 and 2009 Fall EWM Bed Maps

Table 4: Fall Eurasian water-milfoil Bed Mapping Data
Minong Flowage, Washburn and Douglas Counties
September 26-27, 2009

Bed Number	2009 Area in Acres	2008 Area in Acres	2009 Change in Acreage	Estimated 2009 Mean Rakefull	2009 Bed Characteristics
1	2.11	2.14	-0.03	3	Large # of NWM mixed in; EWM plants very healthy.
2	0	0.28	-0.28	<1	Almost no plants found.
3	0	0.13	-0.13	<1	Almost no plants found.
4	0	0.13	-0.13	<1	Almost no plants found.
5	0.67	1.07	-0.40	2	Scattered EWM mixed with NWM
5A	0.41	0	0.41	2	New bed in a formerly treated area. Also NWM and CLP.
6	0	0.23	-0.23	<1	Almost no plants found.
7	1.26	16.03	-14.77	2	Plants much reduced – none in treatment area.
7A	1.19	0	1.19	1	Not a bed, but pioneer clusters common. Also CLP
8	0	5.3	-5.30	<1	Almost no plants found.
9	0	0.02	-0.02	<1	Almost no plants found.
10	0	1.21	-1.21	<1	Almost no plants found.
11	0	0.38	-0.38	<1	Almost no plants found.
12	0.17	2.56	-2.39	2	EWM extending far out on sand flat; Plants in poor cond.
13	2.89	8.17	-5.28	<1	Scattered pioneer clusters in back channel; few by boat land..
14	0	38.24	-38.24	<1	Almost no plants found.
15	0	0.12	-0.12	<1	Almost no plants found.
16	0	0.1	-0.10	<1	Almost no plants found.
17	0	0.44	-0.44	<1	Almost no plants found.
18	0.94	1.1	-0.16	2	Solid EWM in center; other species mixed on edges
19	0	0.5	-0.50	<1	Almost no plants found.
20	0	0.42	-0.42	<1	Almost no plants found.
21+22	211.49	230.58	-19.09	3	Solid canopied EWM in center; regrowth in treated areas.
23	4.95	8.92	-3.97	3	Solid plants; density and coverage expanding

Table 4 cont': Fall Eurasian water-milfoil Bed Mapping Data
Minong Flowage, Washburn and Douglas Counties
September 26-27, 2009

Bed Number	2009 Area in Acres	2008 Area in Acres	2009 Change in Acreage	Estimated 2009 Mean Rakefull	2009 Bed Characteristics
24	1.71	5.89	-4.18	2	EWM in treatment area reestablishing.
25	0	0.72	-0.72	<1	Almost no plants found.
26	0	0.75	-0.75	<1	Almost no plants found.
27	0	0.32	-0.32	<1	Almost no plants found.
Total	227.79	336.87	-97.96		

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