Eurasian water milfoil (*Myriophyllum spicatum*) Pre/Post Herbicide and Fall Bed Mapping Surveys Sand Lake - WBIC: 2661100 Barron County, Wisconsin

EWM (Berg 2007)

2013 EWM Treatment Areas

Project Initiated by:

Sand Lake Management District, Short Elliott Hendrickson Inc, and the Wisconsin Department of Natural Resources

Bed Mapping Fall EWM

Survey Conducted by and Report Prepared by:

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June 14, August 11, and October 13, 2013

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INTRODUCTION:

Sand Lake (WBIC 2661100) is a 322 acre drainage lake in northwestern Barron County, Wisconsin in the Town of Maple Plain (T36N R14W S17 NW NE). It reaches a maximum depth of 57ft in the south basin and has an average depth of approximately 30ft. Sand Lake is mesotrophic bordering on oligotrophic in nature with good water clarity. From 1988 to 2013, summer Secchi readings have ranged from 10-18ft with an average of 13.6ft (WDNR 2013). The bottom substrate is predominately sand and sandy muck with scattered gravel primarily along the shoreline. Some areas of thick organic muck occur in bays on the west side of the lake and at the far north and south ends (Miller et al. 1965).

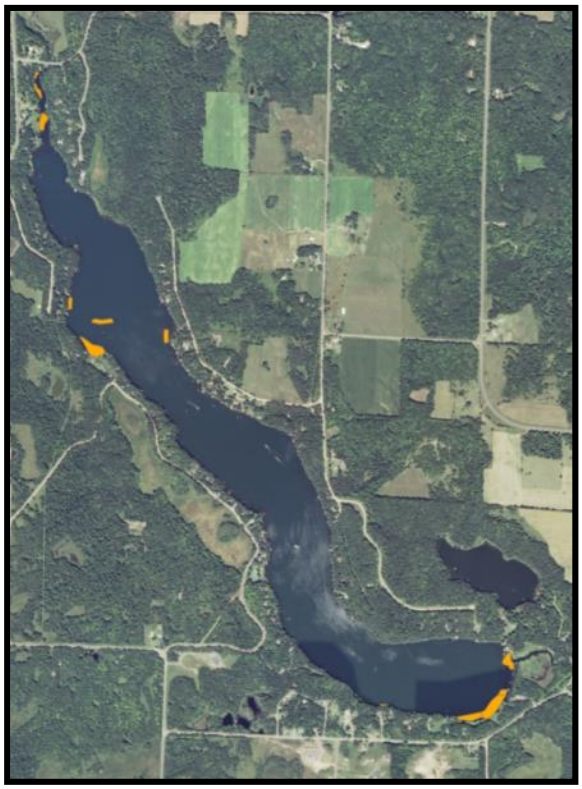


Figure 1: 2013 Spring EWM Treatment Areas

Eurasian water milfoil (*Myriophyllum spicatum*) (EWM) was discovered in the lake in 2002, and the Sand Lake Management District (SLMD) is engaged in active management to control this invasive exotic species. Following the 2012 fall EWM bed mapping survey that found EWM plants scattered throughout the lake, the SLMD, under the direction of Short Elliott Hendrickson Inc (SEH), decided to chemically treat 12 areas in 2013. Collectively, they totaled 7.02 acres or 2.2% of the lake's surface area (Figure 1).

On June 14th, we conducted a pretreatment survey to gather baseline data and to allow SEH biologists to finalize treatment plans. Following the July 8th herbicide application, we completed an August 11th posttreatment survey to evaluate the effectiveness of the treatment. We also conducted an October 13th EWM bed mapping survey to determine where EWM control might be considered in 2014. This report is the summary analysis of these three field surveys.

METHODS:

Pre/Post Herbicide Survey:

SEH biologists generated 200 pre/post survey points. Of these, 55 occurred within the treatment areas with the other "exploratory points" falling in areas that formerly supported EWM growth. These points equated to approximately 7.5pts/treatment acre which was well within the 4-10pts/acre required by WDNR protocol (Appendix I).

Following the establishment of these points, we located them 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, and a total rake fullness for all species was also recorded (Figure 2). Visual sightings of EWM were noted if they occurred within 6ft of the point. In addition to plant data, we recorded the lake depth using a hand held sonar (Vexilar LPS-1) and the bottom substrate (bottom type) when we could see it or reliably determine it with the rake.
We entered all data collected into the standard APM spreadsheet (Appendix II). These data were then analyzed using the linked statistical summary sheet and the WDNR pre/post analysis worksheet (UWEX 2010). Pre/post treatment differences were determined to be significant at p <.05, moderately significant at p <.01, and highly significant at p<.005.

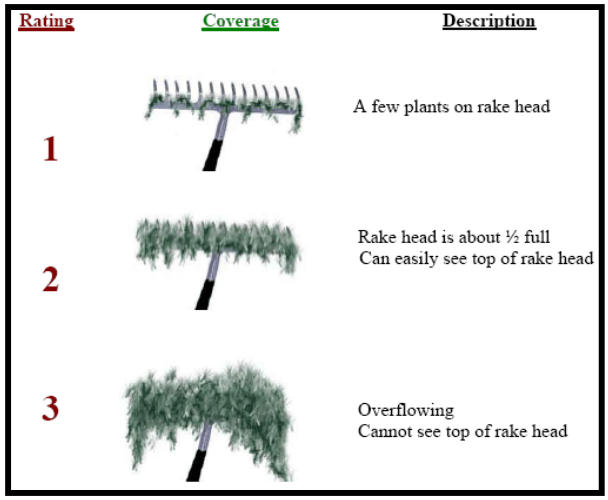


Figure 2: Rake Fullness Ratings

Fall Eurasian Water Milfoil Bed Mapping:

On October 13th, we searched the entire visible littoral zone of the lake and mapped all known beds of EWM. A "bed" was determined to be any area where we visually estimated that EWM made up >50% of the area's plants and was generally 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 rake fullness rating of EWM within the bed. Using the WDNR's Forestry Tool's Extension to ArcGIS 9.3.1, we used these coordinates to generate bed shapefiles and determine the acreage to the nearest hundredth of an acre.

RESULTS AND DISCUSSION:

Finalization of Treatment Areas:

Initial expectations were to treat 12 areas totaling 7.02 acres with liquid or granular 2, 4-D (Navigate) at a concentration of 1.5-3ppm (Figure 3) (Appendix I). The pretreatment survey revealed that, although EWM was patchy, it was found on point or inter-point in all areas. Because of this, it was decided to maintain all treatment areas as initially proposed (Table 1). This treatment was conducted by Northern Aquatics Services (Dale Dressel) on July 8th.

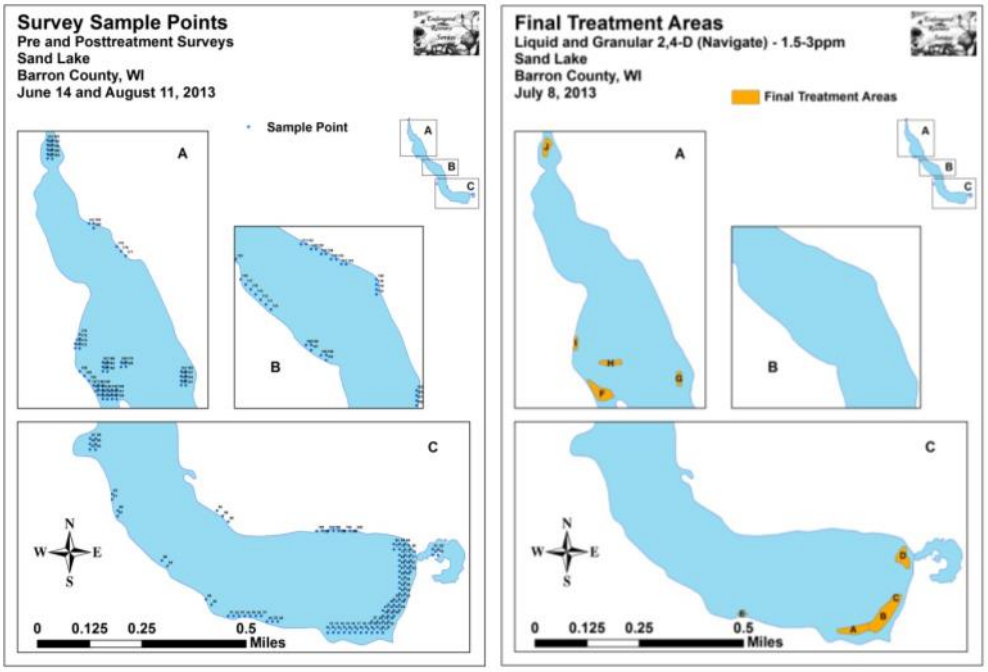


Figure 3: 2013 Survey Sample Points and Final Treatment Areas

Table 1: Spring EWM Treatment Summary
Sand Lake – July 8, 2013

Bed Number	Proposed Acreage	Final Acreage	Difference +/-
A	0.82	0.82	0
B	1.62	1.62	0
C	0.24	0.24	0
D	0.69	0.69	0
E	0.07	0.07	0
F	1.34	1.34	0
G	0.38	0.38	0
H	0.54	0.54	0
I	0.29	0.29	0
J	0.62	0.62	0
K	0.30	0.30	0
L	0.11	0.11	0
Total Acres	**7.02**	**7.02**	**0.00**

EWM Pre/Post Herbicide Survey:

The lake's littoral zone extended to a maximum of 12.5ft during the pretreatment survey and 10.0ft during the posttreatment survey. Mean and median depths for all plants were 6.2ft and 6.0ft respectively during the pretreatment survey before declining slightly to 5.7ft and 5.5ft in the posttreatment survey (Table 2). Most EWM was established over organic and sandy muck in 4-10ft of water (Figure 4) (Appendix III).

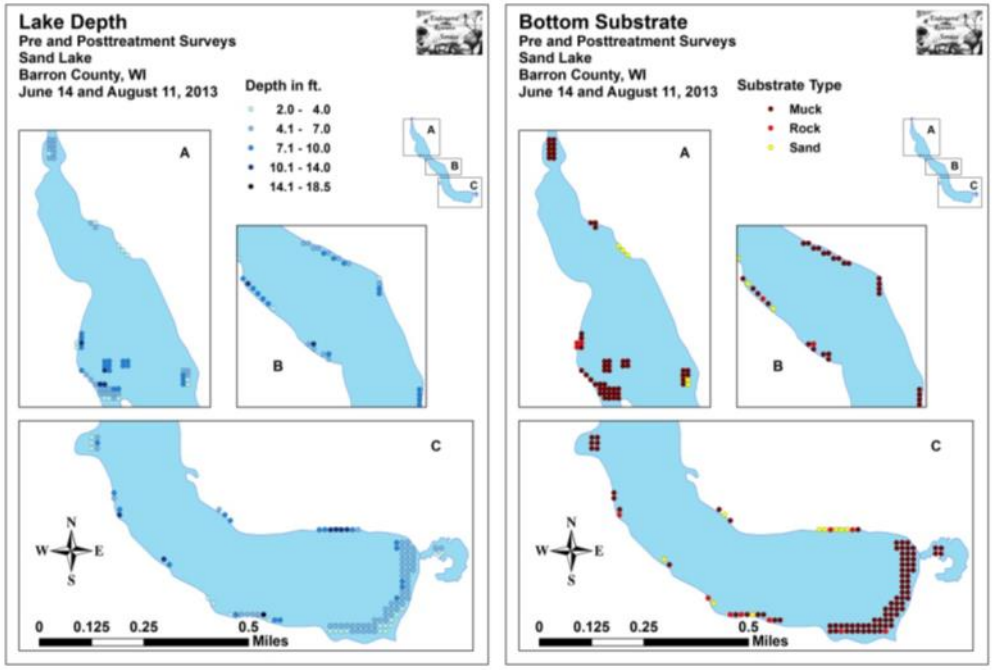


Figure 4: Depths and Bottom Substrate

Table 2: Pre/Post Survey Summary Statistics
Sand Lake, Barron County
June 14 and August 11, 2013

Summary Statistics:	Pre	Post
Total number of points sampled	200	200
Total number of sites with vegetation	187	190
Total number of sites shallower than the maximum depth of plants	198	196
Frequency of occurrence at sites shallower than maximum depth of plants	94.44	96.94
Simpson Diversity Index	0.84	0.88
Floristic Quality Index	25.9	29.4
Maximum depth of plants (ft)	12.5	10.0
Mean depth of plants (ft)	6.2	5.7
Median depth of plants (ft)	6.0	5.5
Average number of all species per site (shallower than max depth)	2.18	3.01
Average number of all species per site (veg. sites only)	2.31	3.11
Average number of native species per site (shallower than max depth)	2.13	2.96
Average number of native species per site (veg. sites only)	2.26	3.06
Species richness	19	24
Mean rake fullness (veg. sites only)	1.50	2.17

Initial diversity within the beds was moderately high with a Simpson Diversity Index of 0.84. This value increased slightly to 0.88 posttreatment. Mean native species richness at sites with vegetation was 2.26/site pretreatment, and this value also increased to 3.06/site posttreatment (Figure 5). Mean total rake fullness at sites with vegetation increased from a low/moderate 1.50 pretreatment to a moderate 2.17 posttreatment (Figure 6) (Appendix IV).

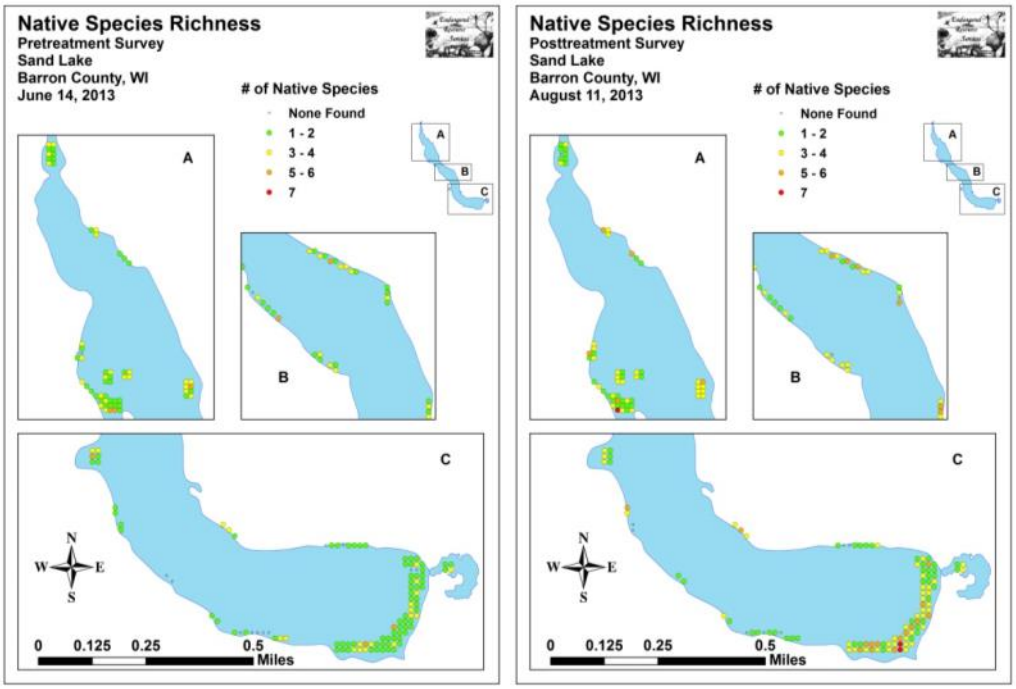


Figure 5: Pre/Post Native Species Richness

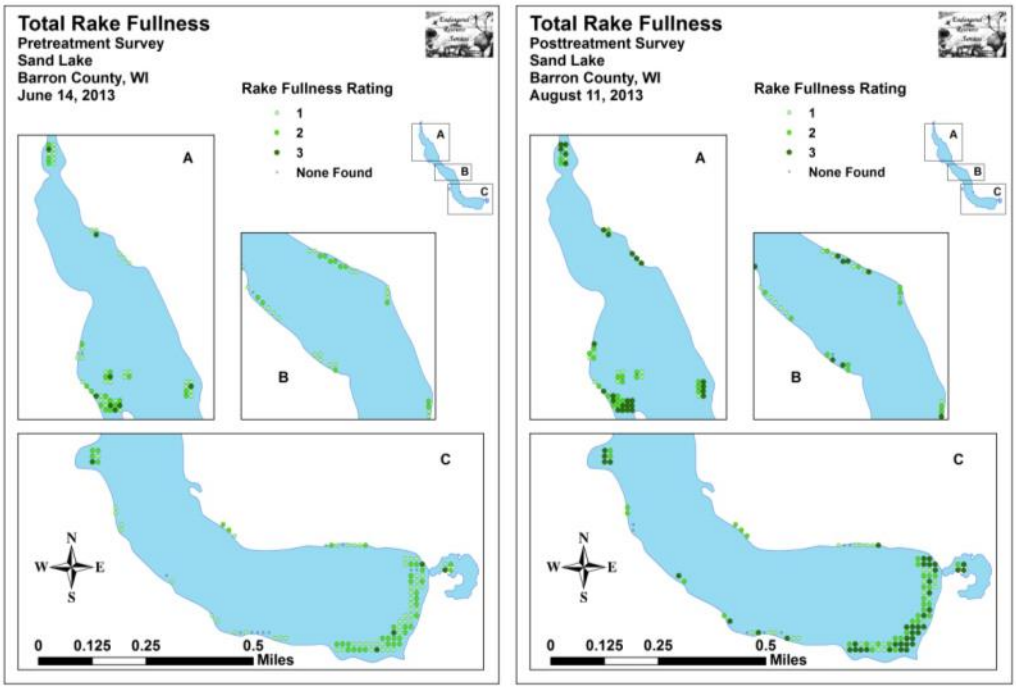


Figure 6: Pre/Post Total Rake Fullness

We found EWM at 11sites during the pretreatment survey. These sites had an average rake fullness of 1.27 as one rated a 3, one was a two, and the remaining nine had a rake fullness rating of 1. We also recorded EWM as a visual at 14 points. During the posttreatment survey, we found EWM at nine sites that averaged a rake fullness of 1.22. None rated a 3, two were a 2, and seven were a 1 with two additional visual records (Figure 7) (Appendix V). None of these changes suggested the herbicide treatment had a significant impact on the Eurasian water milfoil population (Figure 8).

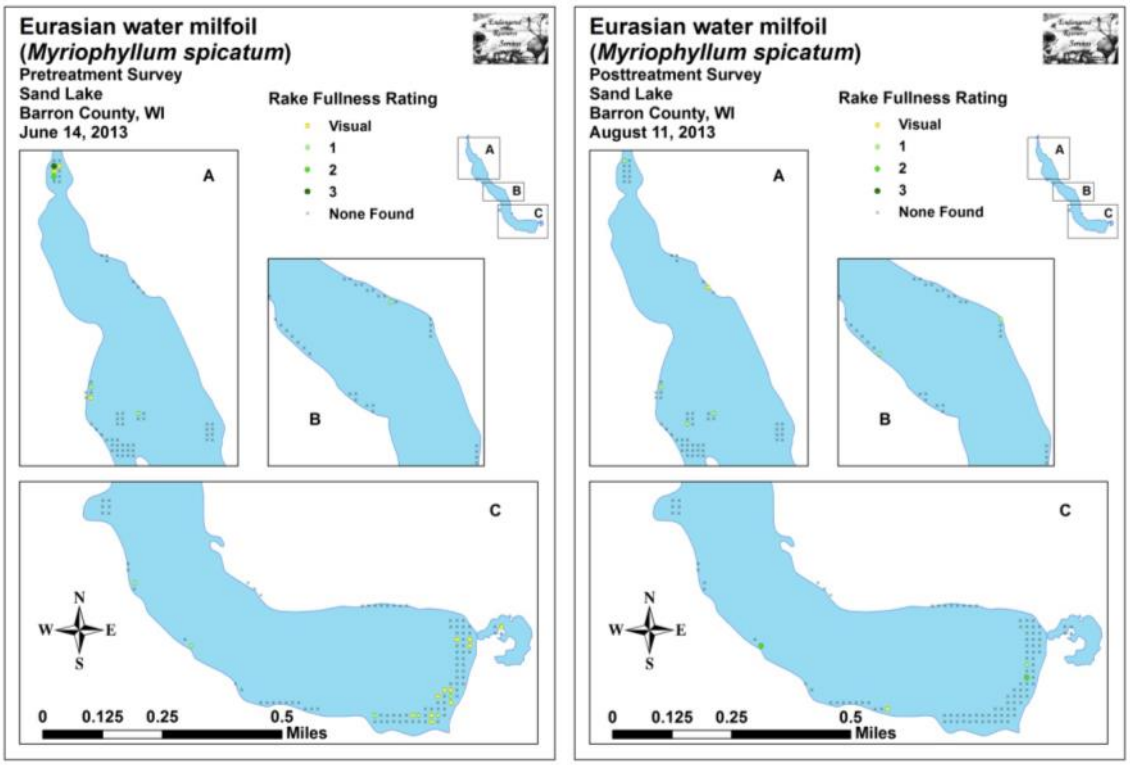
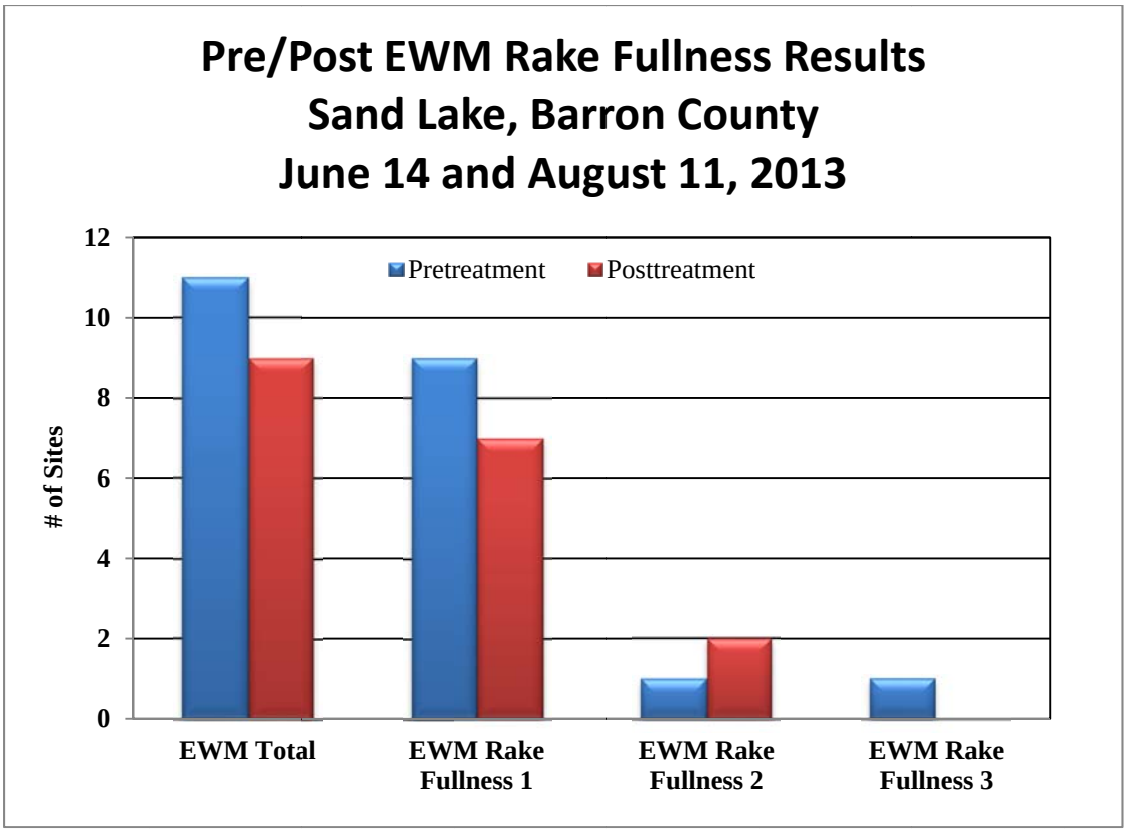


Figure 7: Pre/Post EWM Density and Distribution



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

Figure 8: Pre/Post Changes in EWM Rake Fullness

Coontail (*Ceratophyllum demersum*) and Flat-stem pondweed (*Potamogeton zosteriformis*) were the two most common native species in both the pre and posttreatment surveys, and, although Coontail showed no significant change, Flat-stem pondweed demonstrated a highly significant increase posttreatment (Tables 3 and 4) (Figures 9 and 10). Interestingly, only Fries' pondweed showed a significant decline posttreatment (Figure 11). This is likely due to this species' tendency to senesce in early August. In addition to Flat-stem pondweed, Northern water milfoil (*Myriophyllum sibiricum*), Filamentous algae, and Wild celery (*Vallisneria americana*) demonstrated highly significant increases posttreatment; Muskgrass (*Chara* sp.), Slender naiad (*Najas flexilis*), and White water lily (*Nymphaea odorata*) showed moderately significant increases; and Sago pondweed (*Stuckenia pectinata*), Clasping-leaf pondweed (*Potamogeton richardsonii*), and Floating-leaf pondweed (*Potamogeton natans*) showed significant increases. All of these changes are likely due to normal expansion over the growing season (Maps for all native species from the pre and posttreatment surveys are available in Appendixes VI and VII).

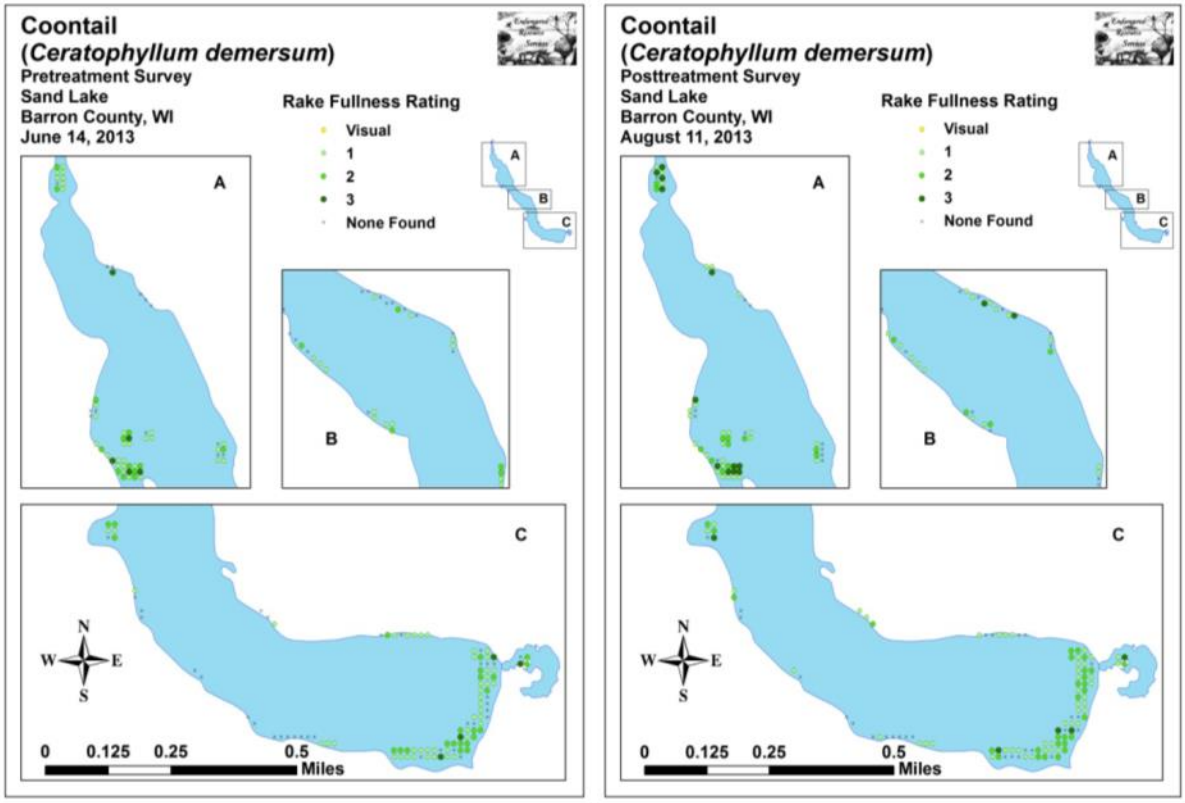


Figure 9: Pre/Post Coontail Density and Distribution

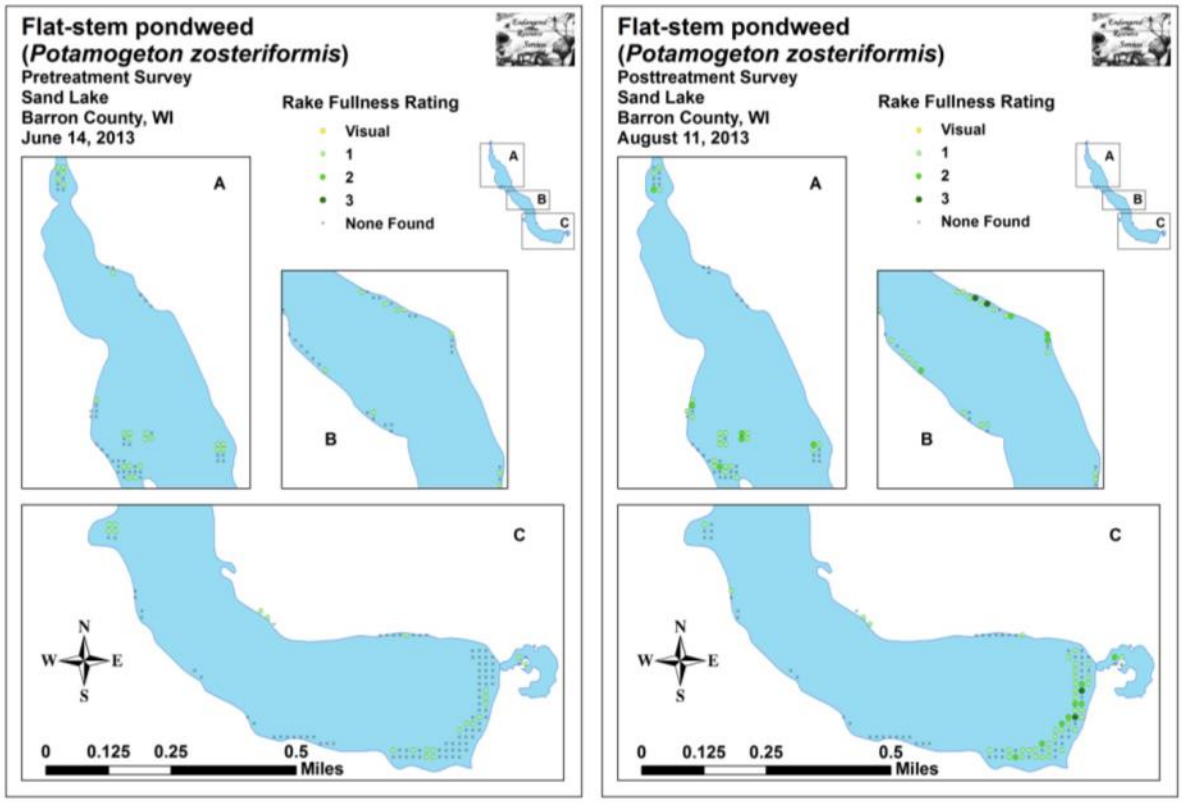
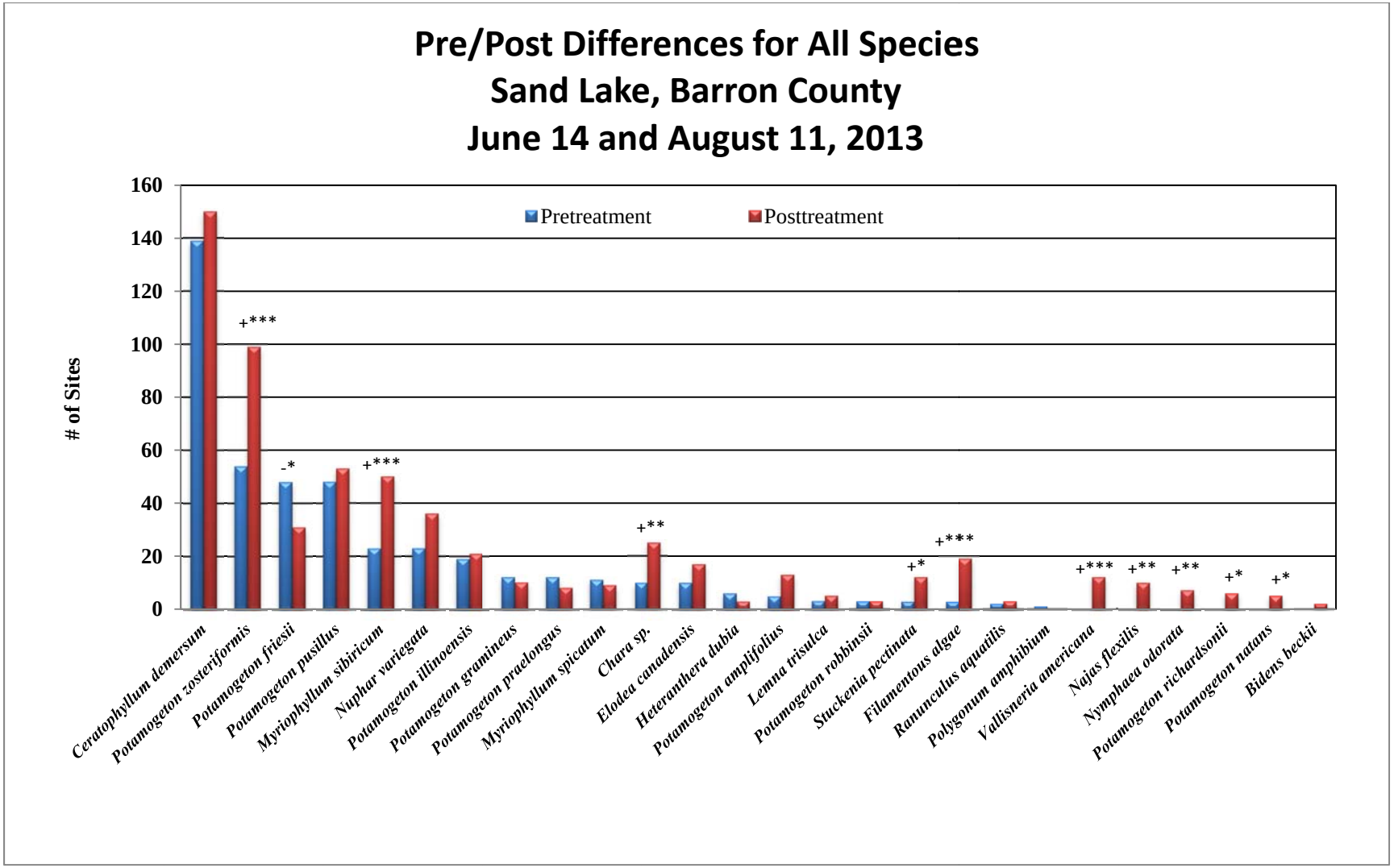


Figure 10: Pre/Post Flat-stem Pondweed Density and Distribution



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

Figure 11: Pre/Post Macrophyte Changes

Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Pretreatment Survey Sand Lake, Barron County
June 14, 2013

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sites
Ceratophyllum demersum	Coontail	139	32.18	74.33	70.20	1.43	0
Potamogeton zosteriformis	Flat-stem pondweed	54	12.50	28.88	27.27	1.00	0
Potamogeton friesii	Fries' pondweed	48	11.11	25.67	24.24	1.15	0
Potamogeton pusillus	Small pondweed	48	11.11	25.67	24.24	1.04	0
Myriophyllum sibiricum	Northern water-milfoil	23	5.32	12.30	11.62	1.22	0
Nuphar variegata	Spatterdock	23	5.32	12.30	11.62	1.48	0
Potamogeton illinoensis	Illinois pondweed	19	4.40	10.16	9.60	1.05	0
Potamogeton gramineus	Variable pondweed	12	2.78	6.42	6.06	1.00	0
Potamogeton praelongus	White-stem pondweed	12	2.78	6.42	6.06	1.42	0
Myriophyllum spicatum	Eurasian water milfoil	11	2.55	5.88	5.56	1.27	14
Chara sp.	Muskgrass	10	2.31	5.35	5.05	1.60	0
Elodea canadensis	Common waterweed	10	2.31	5.35	5.05	1.00	0
Heteranthera dubia	Water star-grass	6	1.39	3.21	3.03	1.00	0
Potamogeton amplifolius	Large-leaf pondweed	5	1.16	2.67	2.53	1.20	0
Lemna trisulca	Forked duckweed	3	0.69	1.60	1.52	1.00	0
Potamogeton robbinsii	Fern pondweed	3	0.69	1.60	1.52	1.00	0
Stuckenia pectinata	Sago pondweed	3	0.69	1.60	1.52	1.00	0
	Filamentous algae	3	*	1.60	1.52	2.00	0
Ranunculus aquatilis	White water crowfoot	2	0.46	1.07	1.01	1.00	0
Polygonum amphibium	Water smartweed	1	0.23	0.53	0.51	1.00	0

* Excluded from Relative Frequency Analysis

Table 4: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Posttreatment Survey Sand Lake, Barron County
August 11, 2013

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sites
Ceratophyllum demersum	Coontail	150	25.42	78.95	76.53	1.55	0
Potamogeton zosteriformis	Flat-stem pondweed	99	16.78	52.11	50.51	1.26	0
Potamogeton pusillus	Small pondweed	53	8.98	27.89	27.04	1.21	0
Myriophyllum sibiricum	Northern water-milfoil	50	8.47	26.32	25.51	1.30	0
Nuphar variegata	Spatterdock	36	6.10	18.95	18.37	2.81	0
Potamogeton friesii	Fries' pondweed	31	5.25	16.32	15.82	1.06	0
Chara sp.	Muskgrass	25	4.24	13.16	12.76	2.28	0
Potamogeton illinoensis	Illinois pondweed	21	3.56	11.05	10.71	1.00	0
	Filamentous algae	19	*	10.00	9.69	1.26	0
Elodea canadensis	Common waterweed	17	2.88	8.95	8.67	1.53	0
Potamogeton amplifolius	Large-leaf pondweed	13	2.20	6.84	6.63	1.15	0
Stuckenia pectinata	Sago pondweed	12	2.03	6.32	6.12	1.08	0
Vallisneria americana	Wild celery	12	2.03	6.32	6.12	1.17	0
Najas flexilis	Slender naiad	10	1.69	5.26	5.10	1.30	0
Potamogeton gramineus	Variable pondweed	10	1.69	5.26	5.10	1.00	0
Myriophyllum spicatum	Eurasian water milfoil	9	1.53	4.74	4.59	1.22	2
Potamogeton praelongus	White-stem pondweed	8	1.36	4.21	4.08	1.13	0
Nymphaea odorata	White water lily	7	1.19	3.68	3.57	2.14	0
Potamogeton richardsonii	Clasping-leaf pondweed	6	1.02	3.16	3.06	1.33	0
Lemna trisulca	Forked duckweed	5	0.85	2.63	2.55	1.00	0
Potamogeton natans	Floating-leaf pondweed	5	0.85	2.63	2.55	1.40	0
Heteranthera dubia	Water star-grass	3	0.51	1.58	1.53	1.00	0
Potamogeton robbinsii	Fern pondweed	3	0.51	1.58	1.53	1.00	0
Ranunculus aquatilis	White water crowfoot	3	0.51	1.58	1.53	1.00	0
Bidens beckii	Water marigold	2	0.34	1.05	1.02	1.00	0

* Excluded from Relative Frequency Analysis

Fall EWM Bed Mapping Survey:

On October 13th, 2013, we searched the lake's entire visible littoral zone for EWM. Although conditions were calm with bright overhead sun, we found that water clarity was relatively poor as we could only see down approximately 5ft. Because of this, we used a rake to randomly sample for EWM in former deep water beds. Using these techniques, we located 18 small beds that totaled 0.22 of an acre, and 99 additional individual EWM plants scattered around the lake (Figure 12) (Appendix VIII). This was well below the 2011 survey's 19 high EWM density areas totaling 15.25 acres (Table 5), but slightly above the 2012 survey where we found no beds or high density areas and a total of only 122 individual plants.

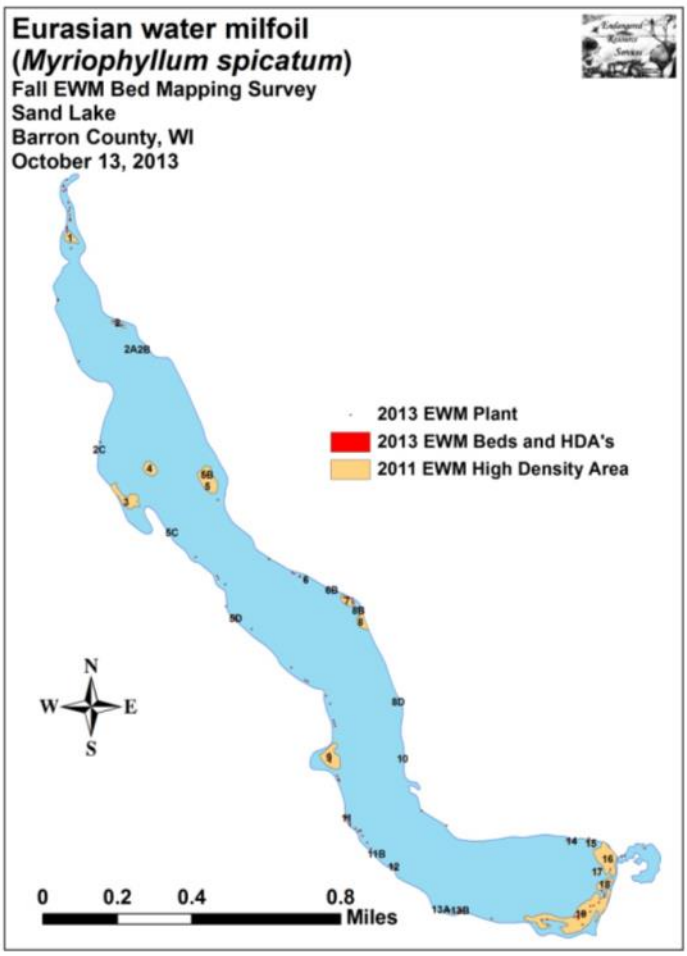


Figure 12: 2013 Fall EWM Bed Map

Table 5: Fall Eurasian Water Milfoil Bed Mapping Summary
Sand Lake, Barron County
October 13, 2013

HDA/Bed Number	2013 Fall Bed Acreage	2012 Fall Bed Acreage	2011 Fall Bed Acreage	2013 Change in Acreage	Estimated 2013 Mean Rake Fullness	2013 Bed Characteristics And Field Notes
1	0	0	0.48	0	<<<1	Scattered EWM plants
2	0.05	0	0.17	0.05	<1-3; mostly <1	Super cluster of 10's of plants
2A	<0.01	0	0	<0.01	3	$10ft^2$ canopied bed
2B	0.01	0	0	0.01	<1-2; mostly 1	Super cluster of 10's of plants
2C	<0.01	0	0	<0.01	3	$10ft^2$ canopied bed
3	0	0	1.27	0	0	No EWM found
4	0	0	0.66	0	0	No EWM found
5(A and B)	<0.01	0	1.61	<0.01	3	Two $10ft^2$ beds
5C	<0.01	0	0	<0.01	3	$10ft^2$ canopied bed
5D	0.4	0	0	0.4	<1-3; mostly 1	Highly variable/mixed with NWM
6	0	0	0.03	0	<<<1	Two plants found near former bed
6B	0.01	0	0	0.01	<1-1; mostly <1	Scattered plants in narrow bed
7	0	0	0.44	0	<<<1	Three plants found in former bed
8A, 8B, and 8C	0.01	0	0	0.01	3	Three $10ft^2$ canopied beds
8D	<0.01	0	0	<0.01	3	$10ft^2$ canopied bed
9	0	0	1.49	0	<1-1; mostly <1	Scattered plants at littoral edge
10	0	0	0.02	0	0	No EWM found
11	0	0	0.06	0	<1-1; mostly <1	Scattered plants in 6-10ft of water
11B	<0.01	0	0	<0.01	3	$10ft^2$ canopied bed
12	0.04	0	0.02	0.04	1-3; most 2	Dense bed in 8-12ft; canopy or near canopy
13(A and B)	<0.01	0	0.10	<0.01	<<1-1	Few 10's of plants each
14	0	0	0.08	0	0	No EWM found
15	0	0	0.16	0	0	No EWM found
16	0	0	2.12	0	<<<1	Single EWM plant found
17	0	0	0.09	0	0	No EWM found
18	0	0	0.56	0	<<1	Few widely scattered plants
19	0.03	0	5.29	0.03	<<<1-2; most <1	Single small bed with few additional plants
Total Acres	**0.22**	**0.00**	**15.25**	**0.22**		

Descriptions of Current and Former EWM Beds/High Density Areas:

HDA 1 and Lake Outlet – We found about 20 plants in this area. None were in the former bed, and most were single stems in water 4-6ft deep.

HDA 2 – This area continues to be a problem spot. We suspect there are more plants beyond the visible littoral zone as most of what we found was not visible/located during random rake samples in water 5-8ft deep.

HDA 2B – This new area was a super cluster of a few 10's of EWM mixed with NWM.

HDAs 3 and 4 – We found no EWM in either HDA 3 (Silo Bay) or in HDA 4 (bar).

HDA 5 (5A and 5B) – One of the worst areas in 2011, we again found two small dense deep-water beds in 10-12ft of water. Unfortunately, they were barely visible with plant tops more than 3ft underwater. This lead us to believe there may be more plants in the area, but we didn't find any despite doing 10's of additional random rake samples.

HDA 5D – This new area was highly variable with 10's of scattered individual plants and many canopied clusters in 6-8ft of water.

HDAs 6 and 7 – We found a few widely scattered plants in each area.

HDA 6B – This bed was a thin strip of nearly continuous plants between HDA 6 and 7.

HDA 8 (A, B, and C) – We found three small canopied beds within this area.

HDA 9– Random raking in this area again produced a handful of EWM plants growing out of sight at the edge of the littoral zone. Scattered additional plants extended south along the shoreline.

HDA 10 – We saw no plants in this area.

HDA 11 – EWM was widely scattered along the shoreline from HDA 11 to HDA 12.

HDA 12 – One of the highest density areas on the lake, most plants were in 8-12ft and near canopy.

HDA 13 and 13A – These two patches contained a few 10's of plants each.

HDAs 14 -17 – Collectively, we found a single EWM plant in these former HDA's.

HDAs 18-19 – The southeast bay near the boat landing continues to have scattered plants throughout. The only true bed was a small patch in 19.

Beds 2A, 5C, 8D, 11B – These small new beds were all approximately $10ft^2$ and should be treatment priorities as they were generally dense, monotypic, and canopied.

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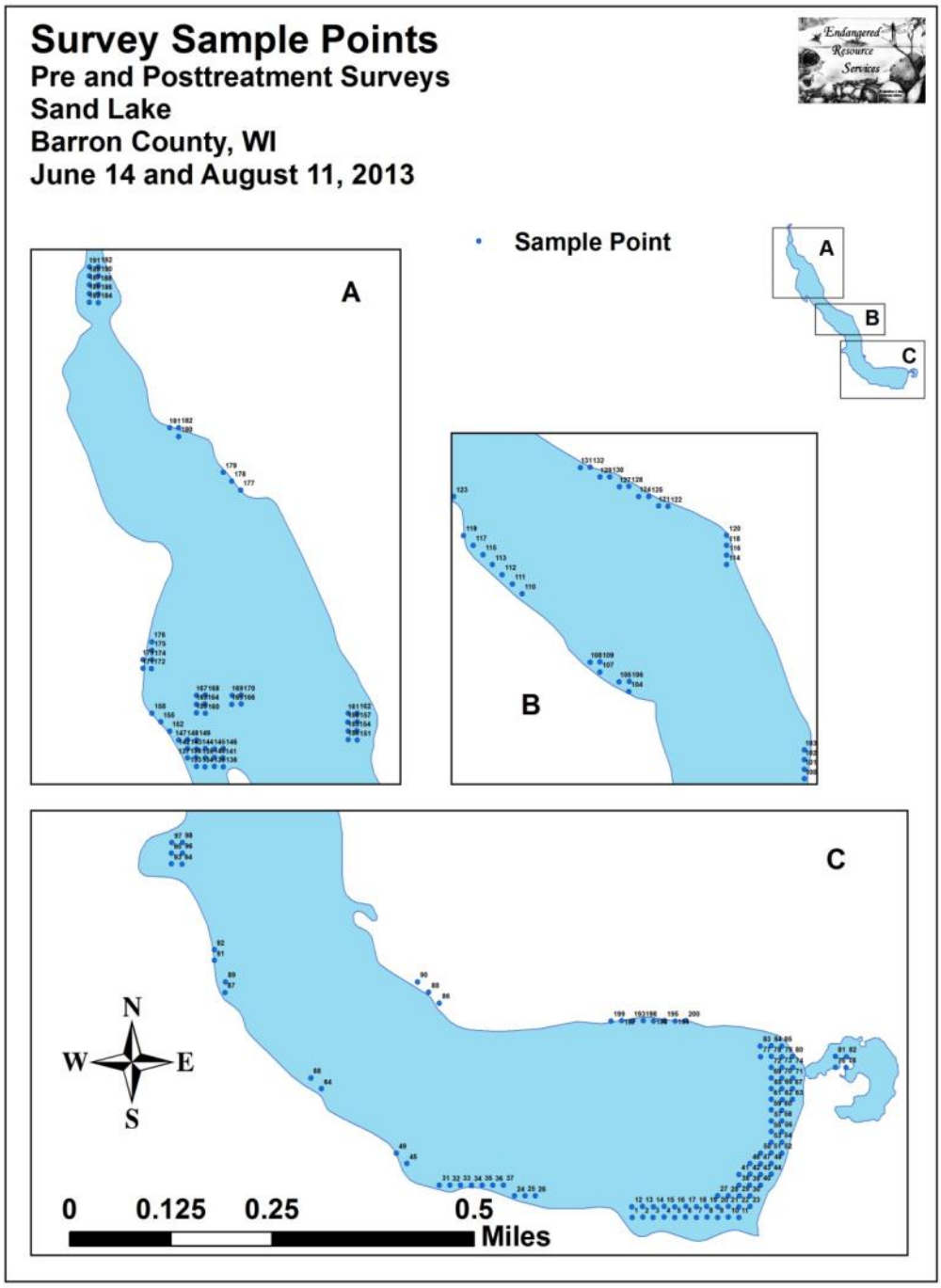
Appendix I: Survey Sample Points and EWM Treatment Areas


Survey Sample Points
Pre and Posttreatment Surveys
Sand Lake
Barron County, WI
June 14 and August 11, 2013
Endangered Resource Services
Sample Point
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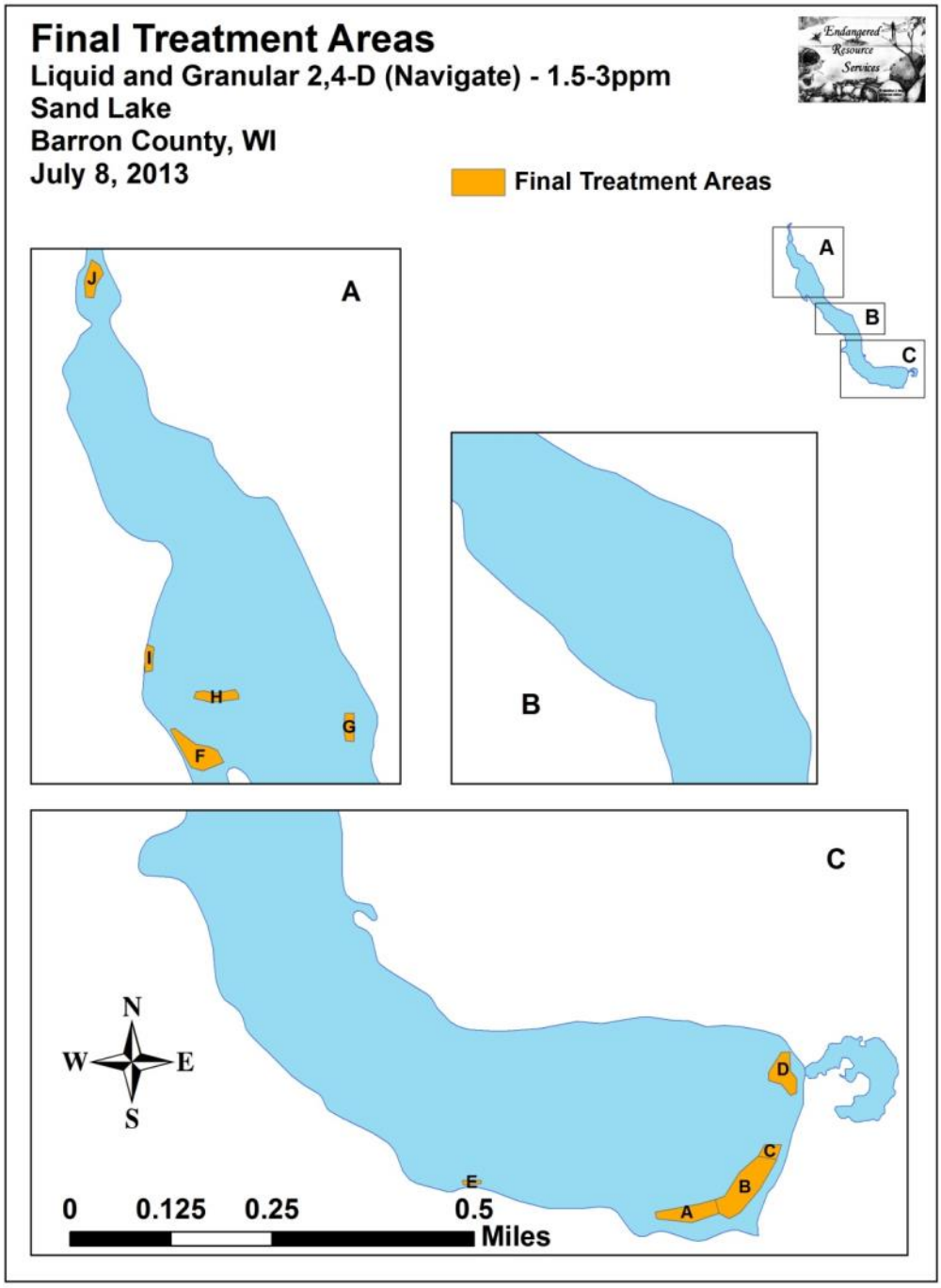
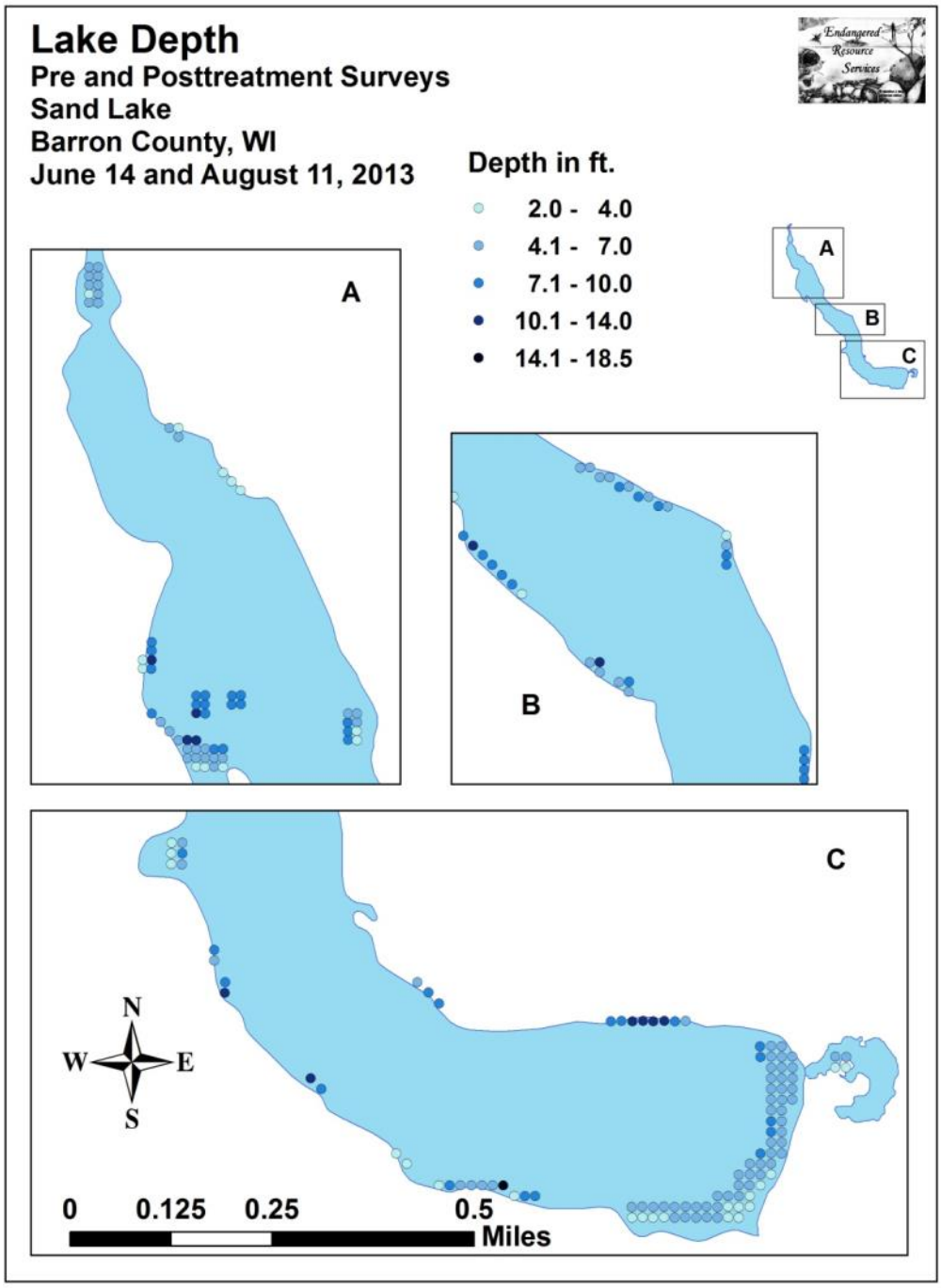
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

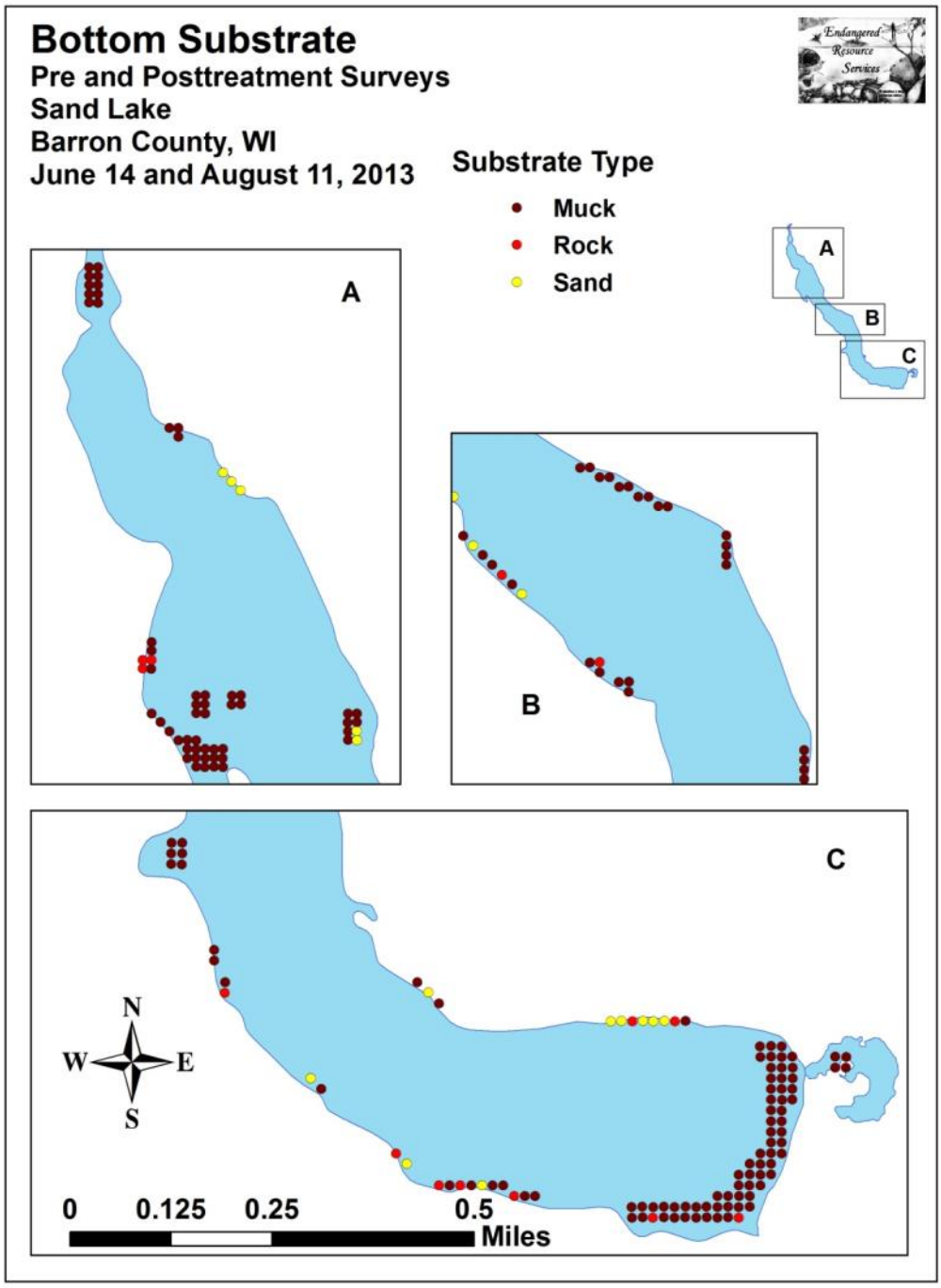

Final Treatment Areas
Liquid and Granular 2,4-D (Navigate) - 1.5-3ppm
Sand Lake
Barron County, WI
July 8, 2013
Endangered Resource Services
Final Treatment Areas
A
B
C
J
I
H
G
F
N
W
E
S
D
C
B
A
E
0
0.125
0.25
0.5
Miles

Appendix II: Vegetative Survey Data Sheet

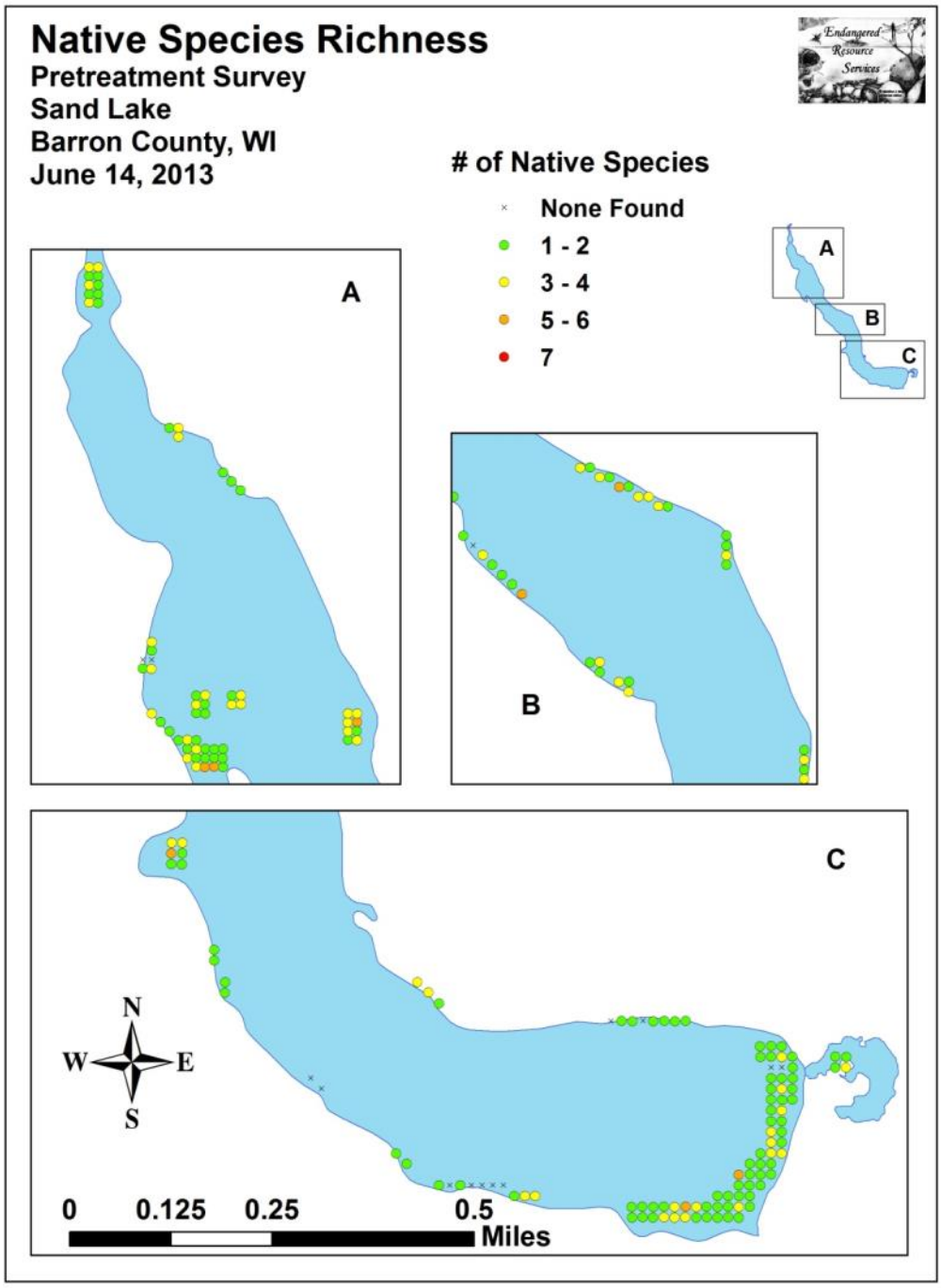
Observers for this lake: names and hours worked by each:																										
Lake:									**WBIC**									**County**						**Date:**		
Site #	**Depth (ft)**	**Muck (M), Sand (S), Rock (R)**	**Rake pole (P) or rake rope (R)**	**Total Rake Fullness**	**EWM**	**CLP**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
1																									
2																									
3																									
4																									
5																									
6																									
7																									
8																									
9																									
10																									
11																									
12																									
13																									
14																									
15																									
16																									
17																									
18																									
19																									
20																									

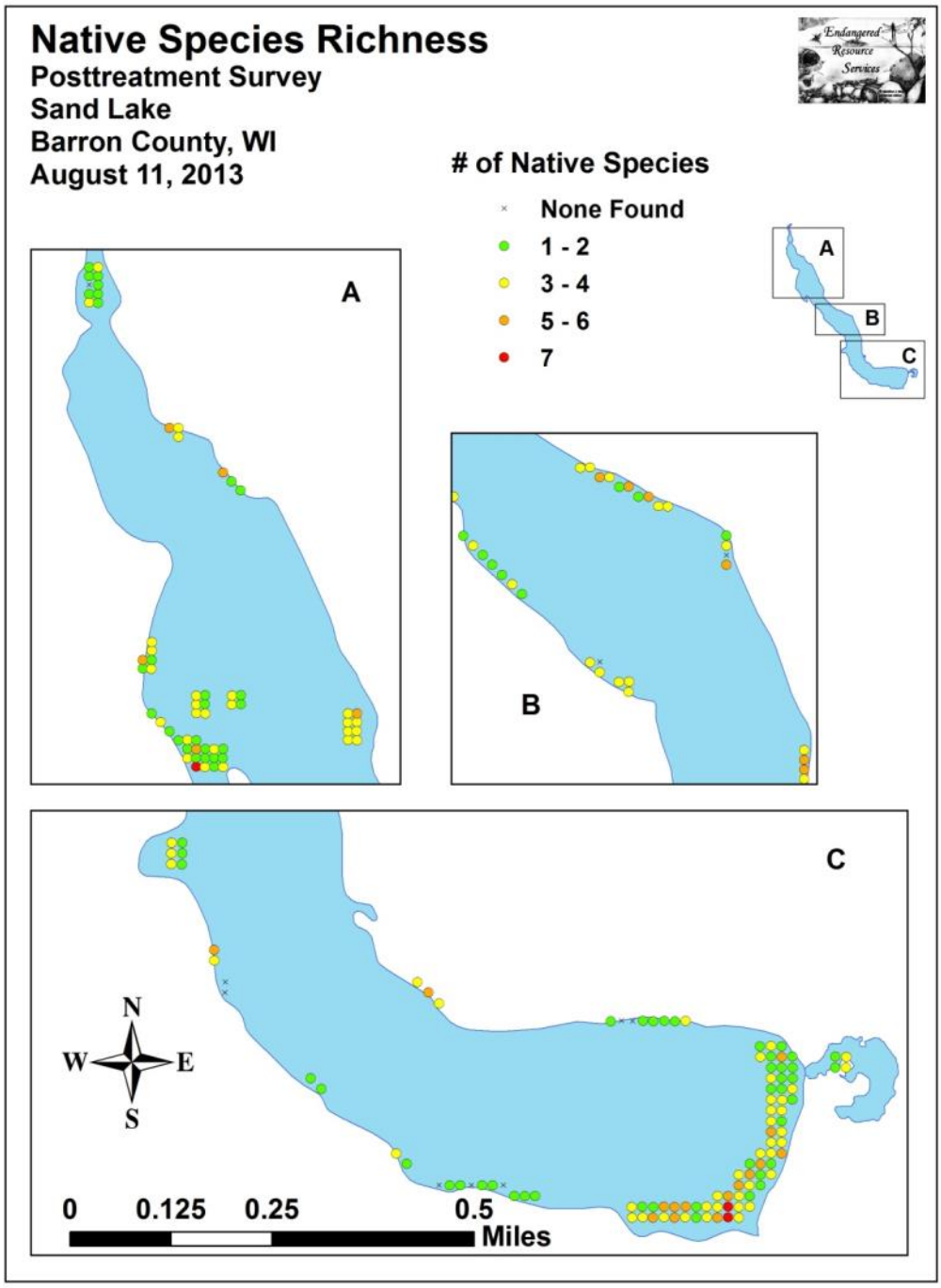
Appendix III: Pre/Post Habitat Variable Maps

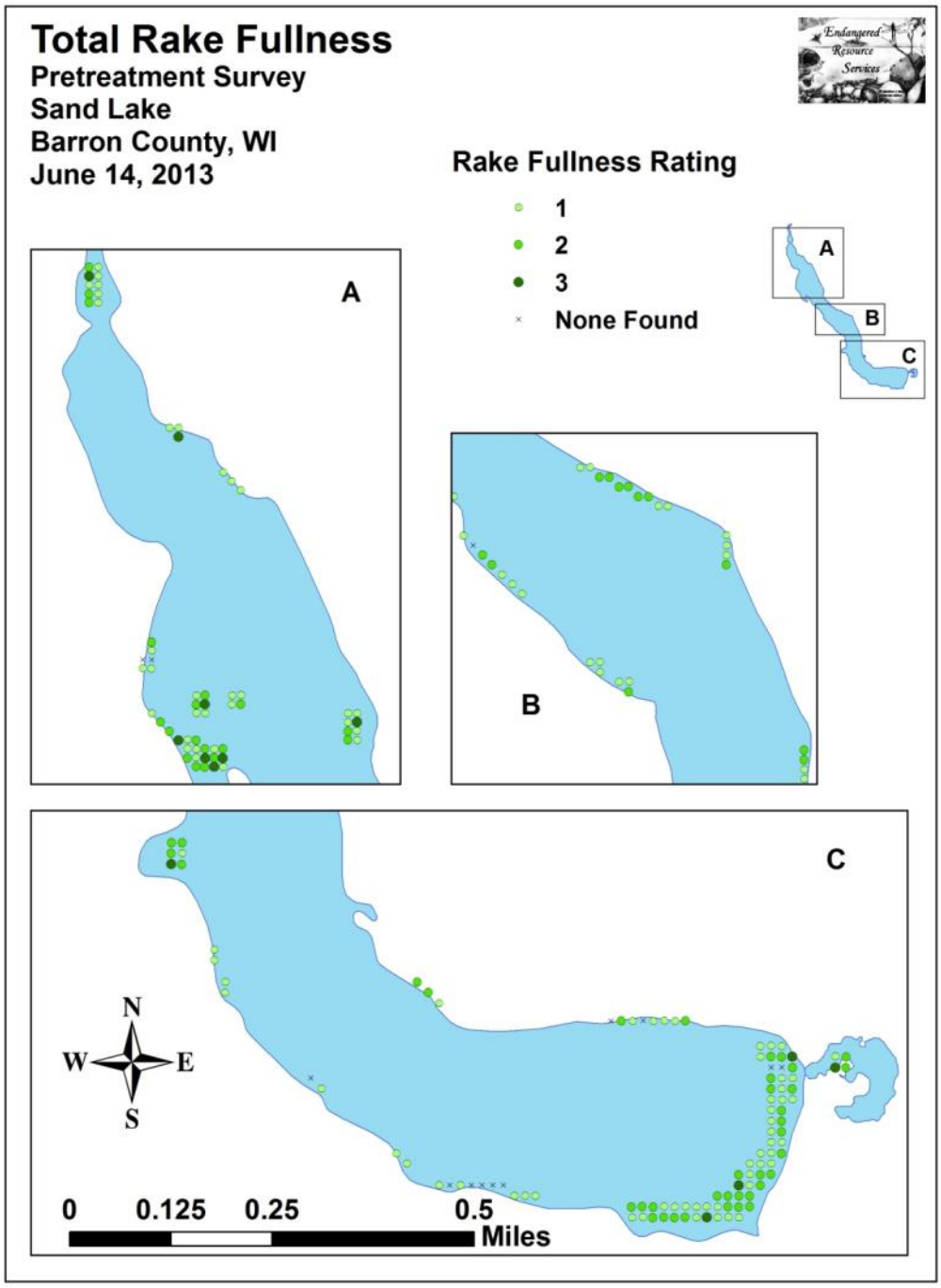

Lake Depth
Pre and Posttreatment Surveys
Sand Lake
Barron County, WI
June 14 and August 11, 2013
Endangered Resource Services
Depth in ft.
2.0 - 4.0
4.1 - 7.0
7.1 - 10.0
10.1 - 14.0
14.1 - 18.5
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

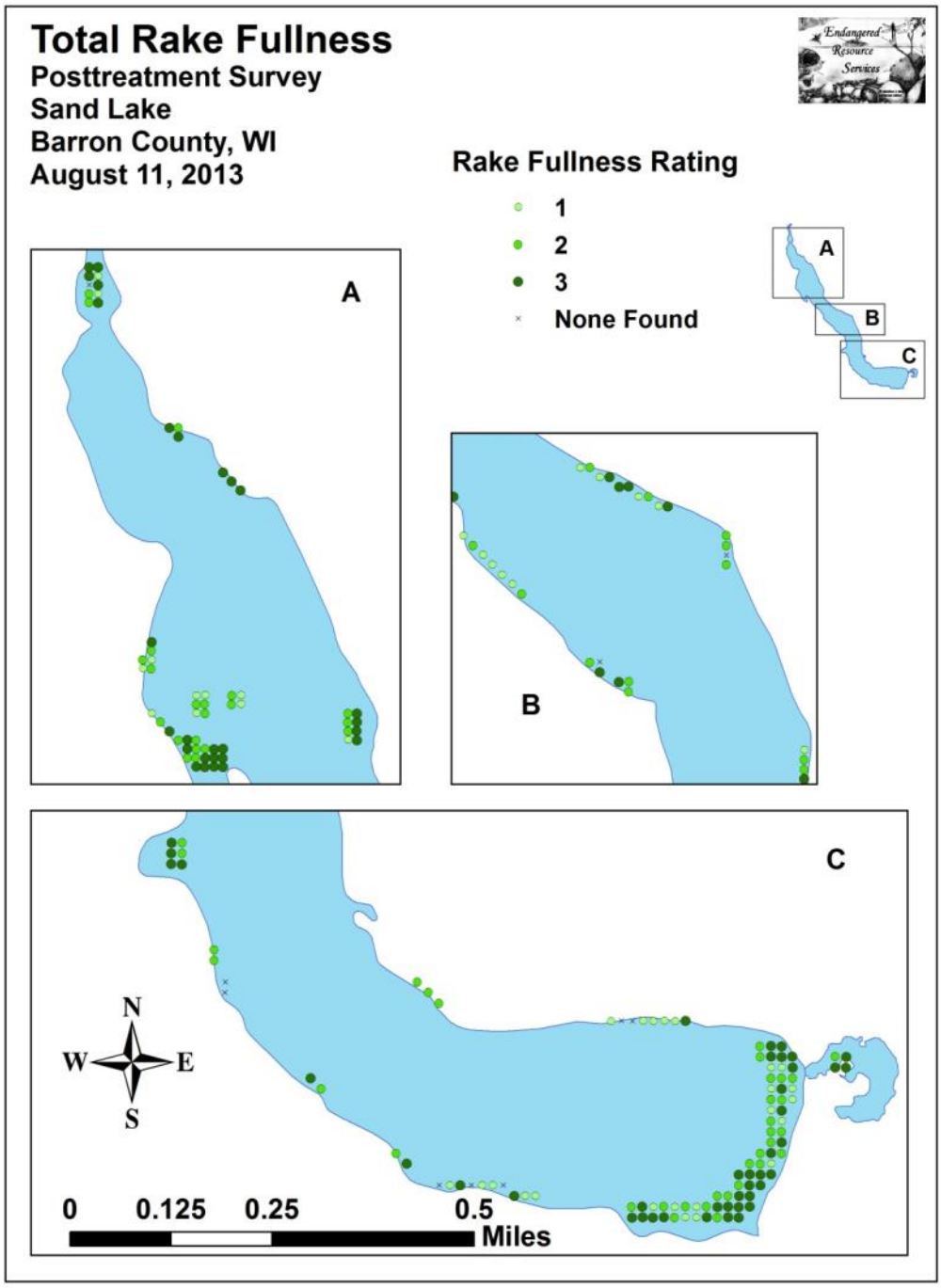

Bottom Substrate
Pre and Posttreatment Surveys
Sand Lake
Barron County, WI
June 14 and August 11, 2013
Endangered Resource Services
Substrate Type
Muck
Rock
Sand
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

Appendix IV: Pre/Post Native Species Richness and Total Rake Fullness

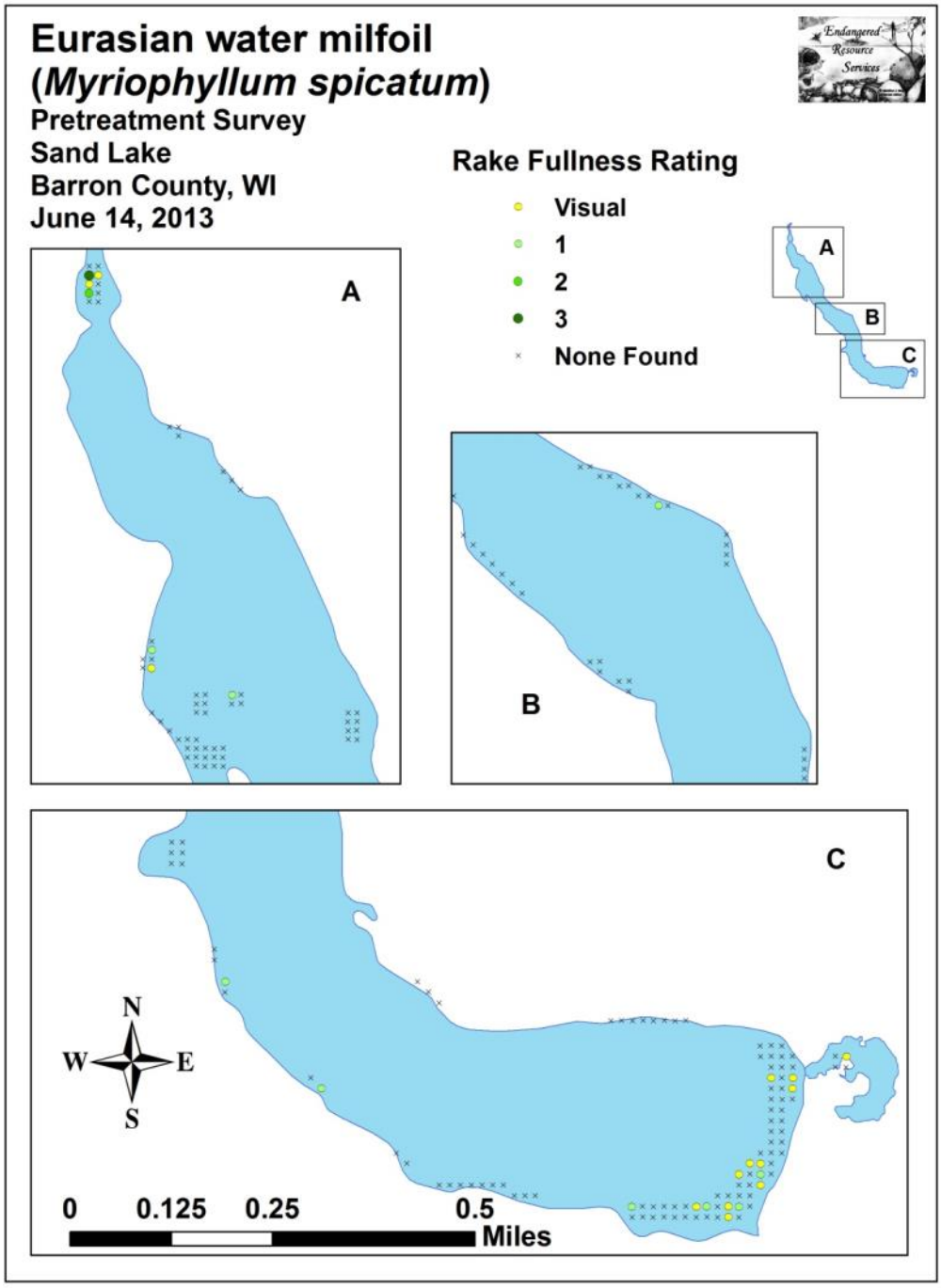

Native Species Richness
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

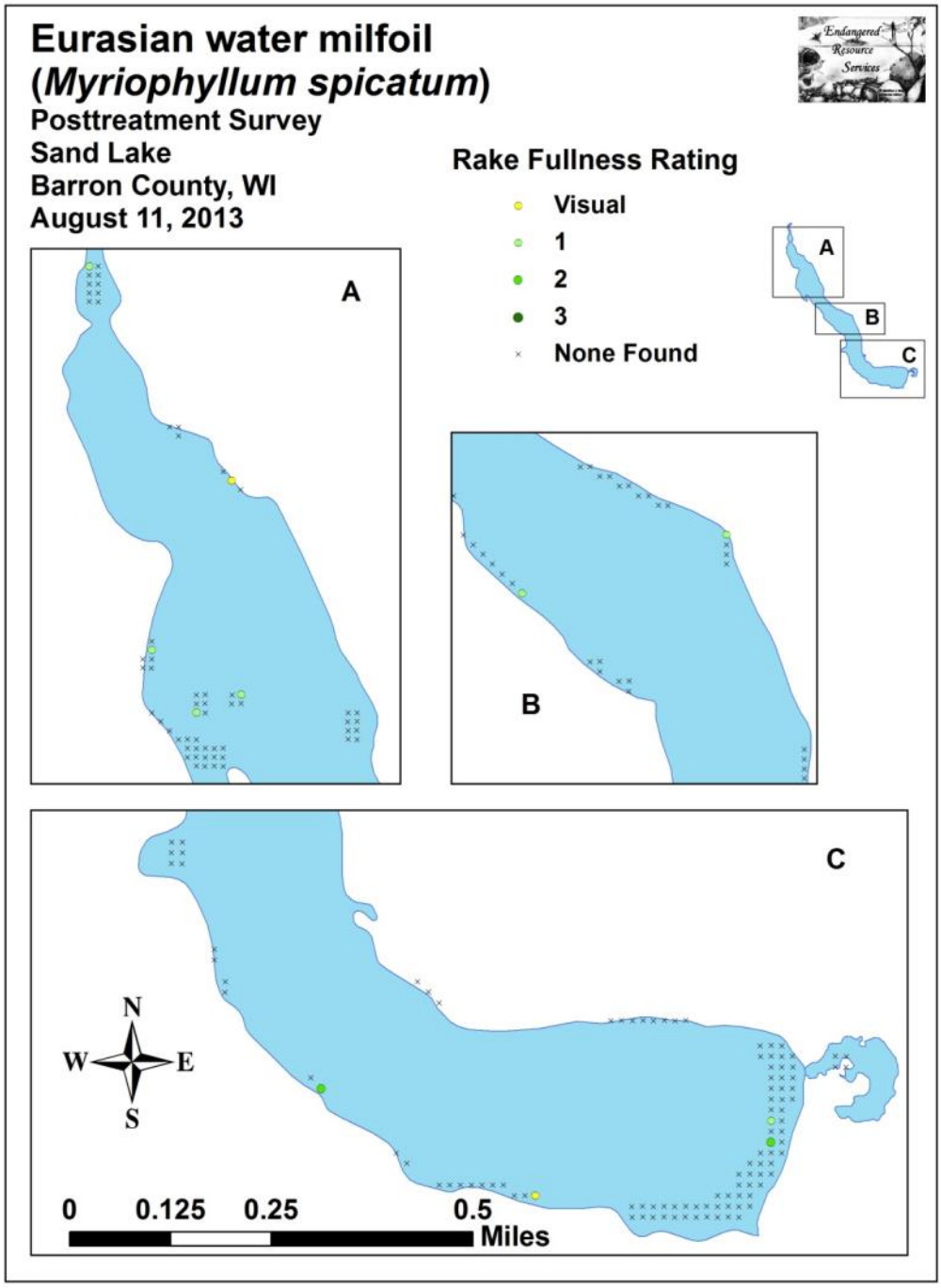

Native Species Richness
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles


Total Rake Fullness
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

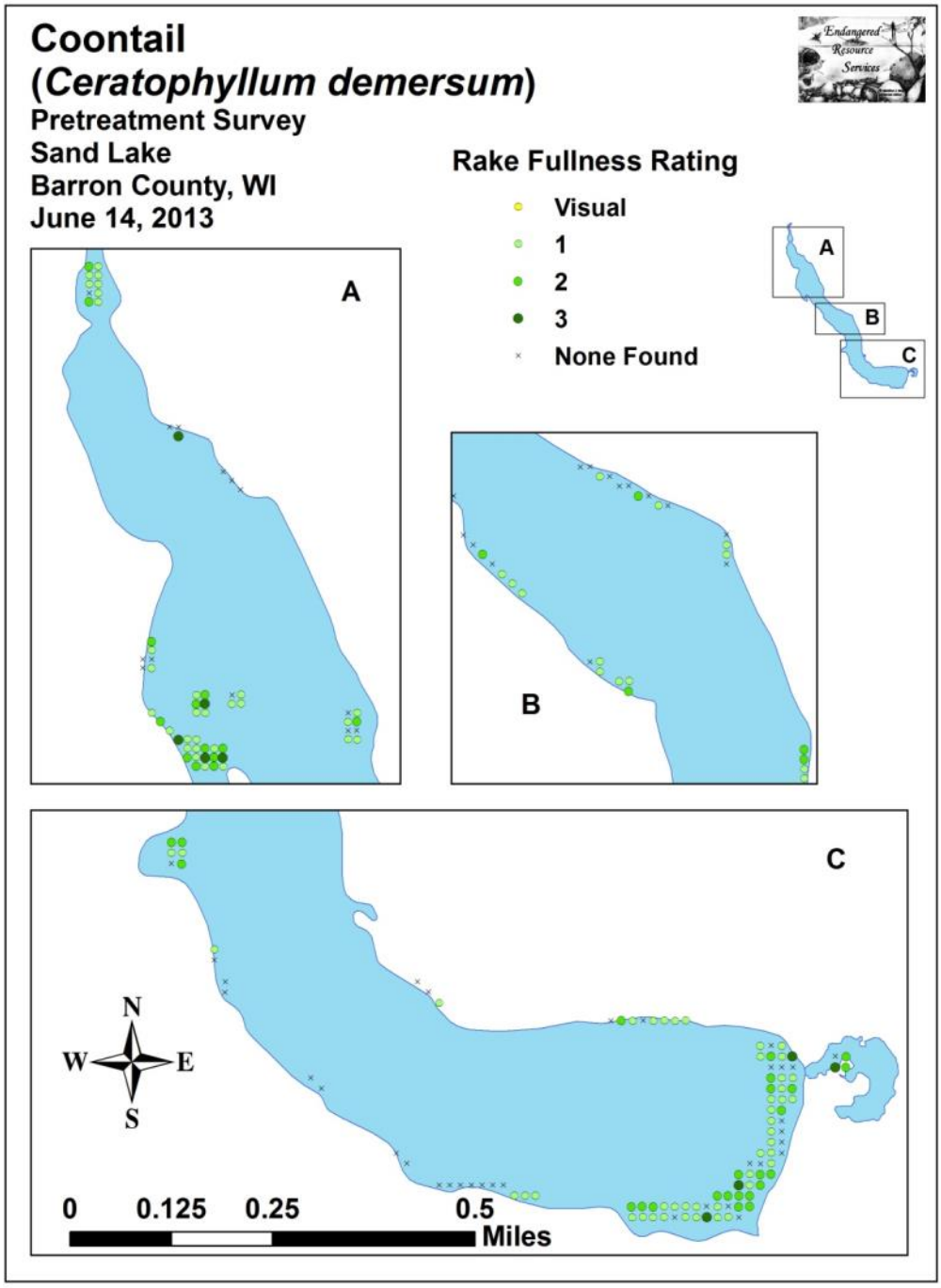

Total Rake Fullness
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

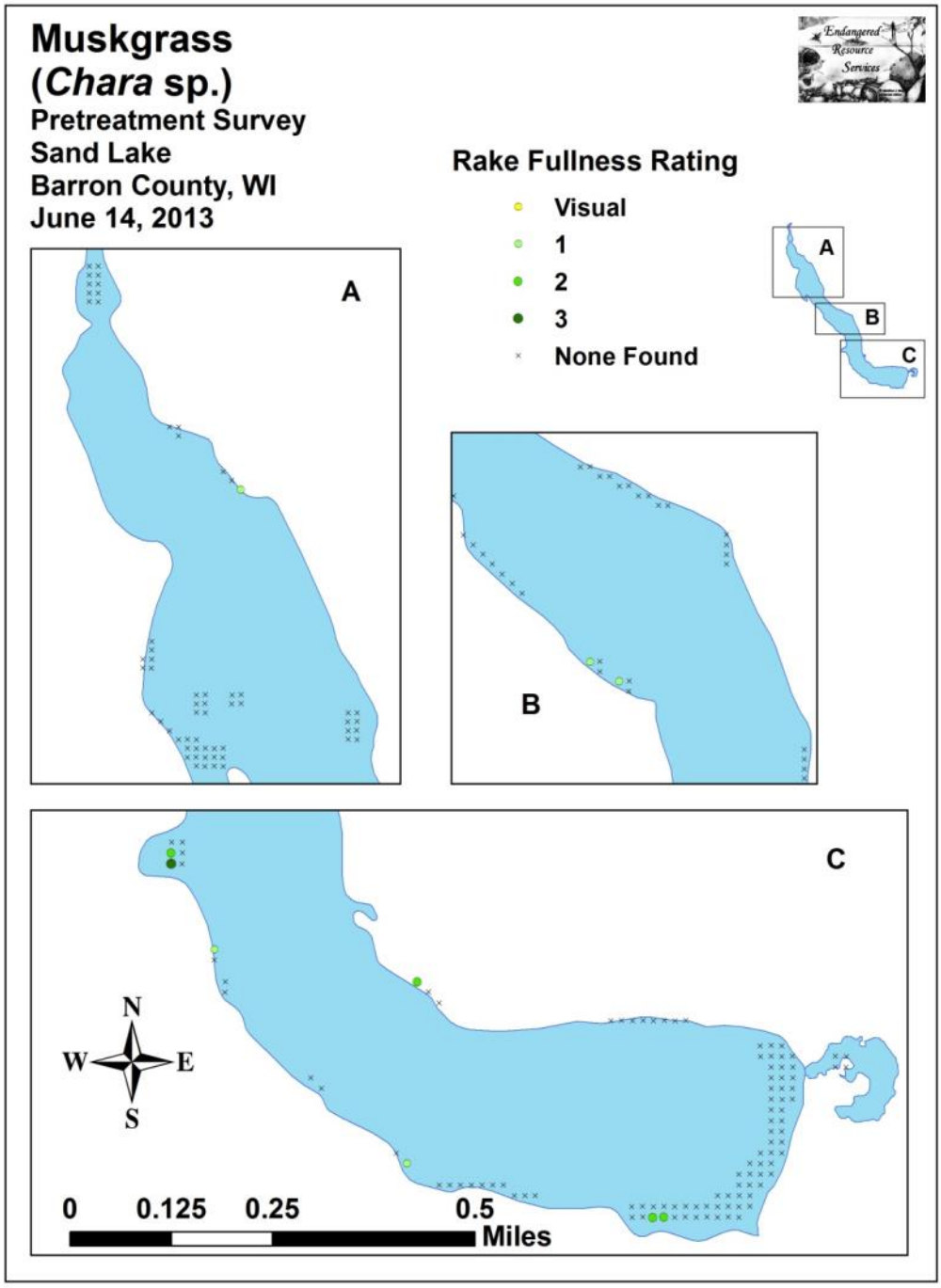
Appendix V: EWM Pre/Post Density and Distribution

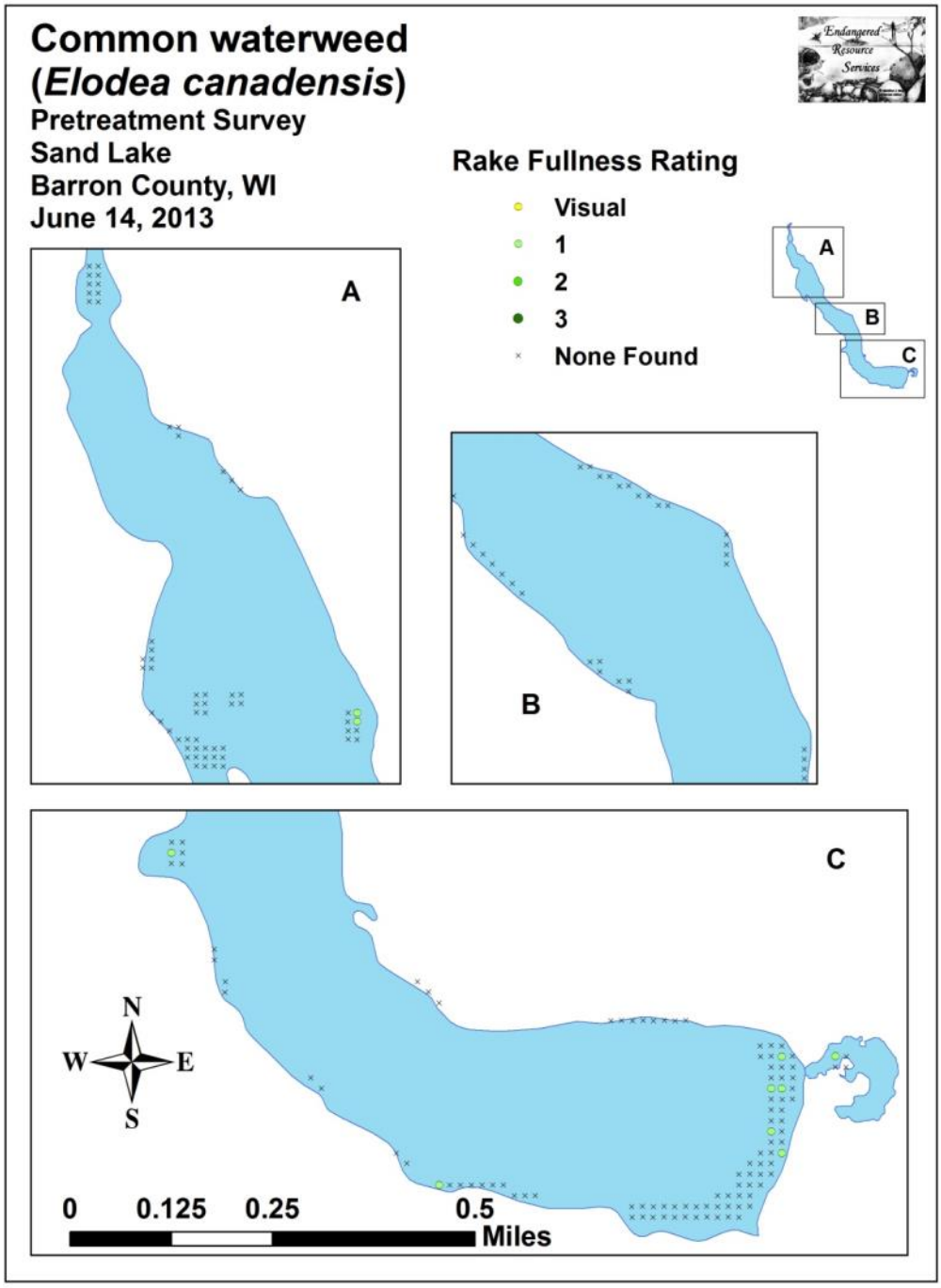

Eurasian water milfoil
(Myriophyllum spicatum)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

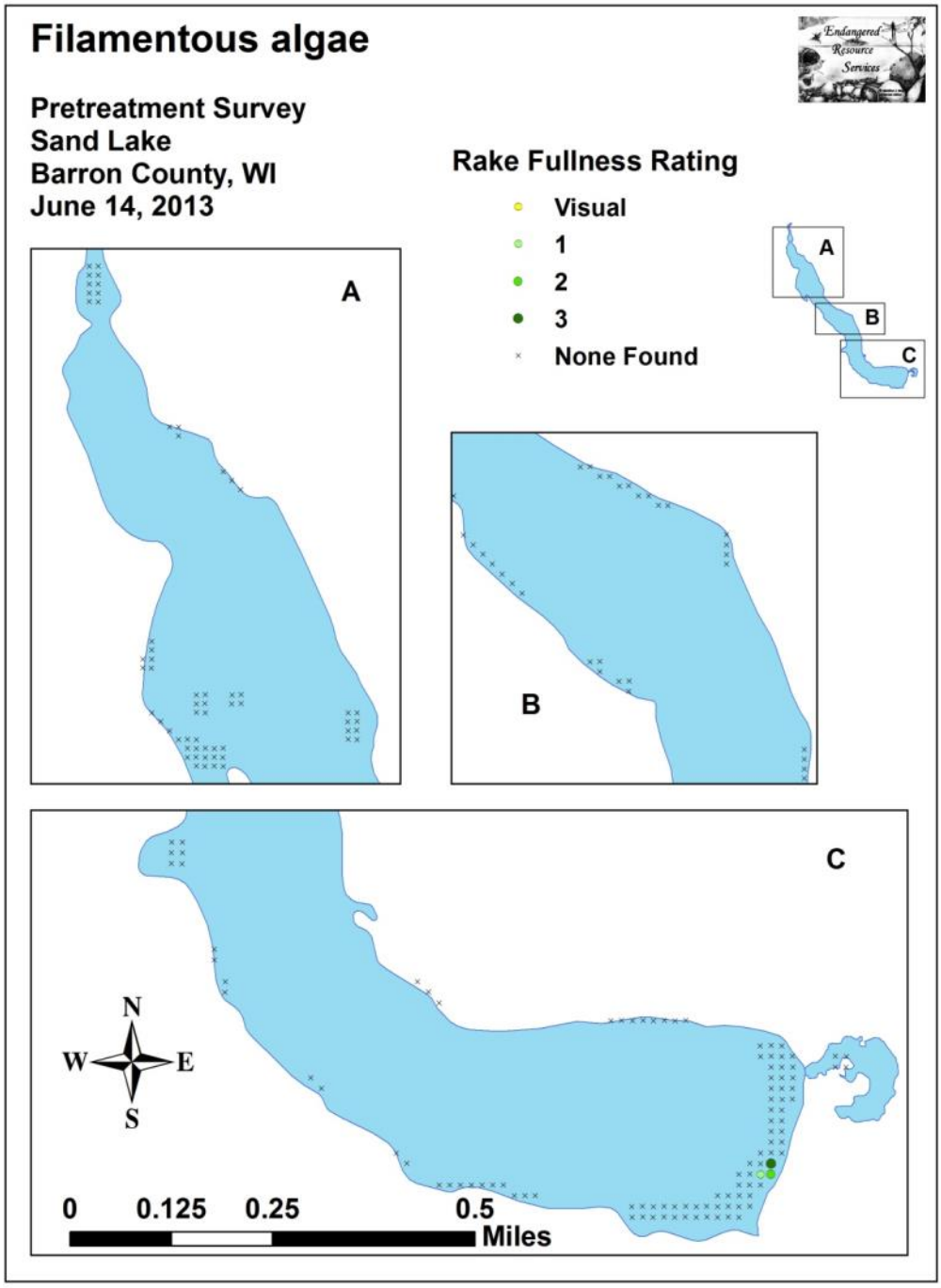

Eurasian water milfoil
(Myriophyllum spicatum)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

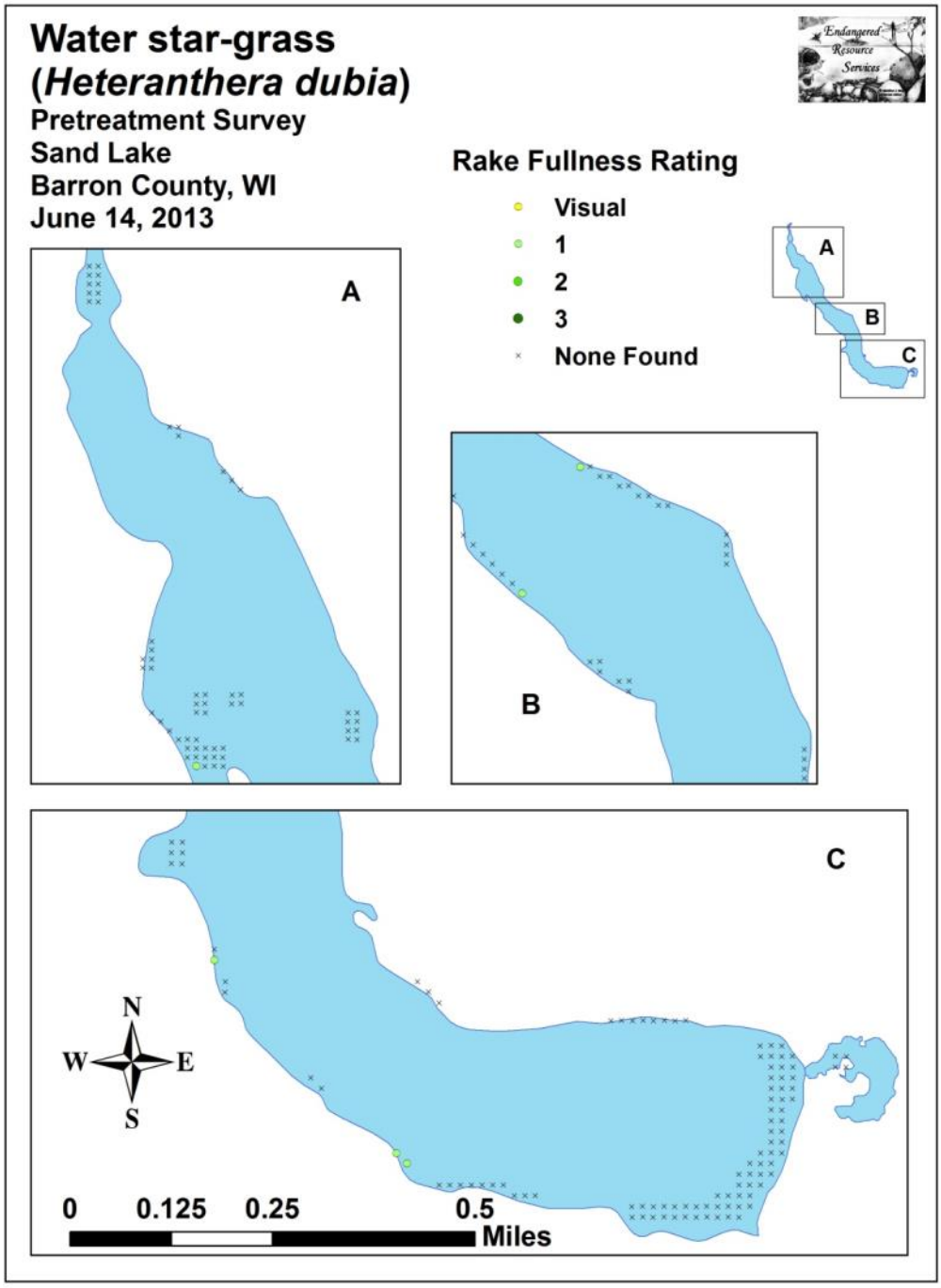
Appendix VI: Pretreatment Native Species Density and Distribution

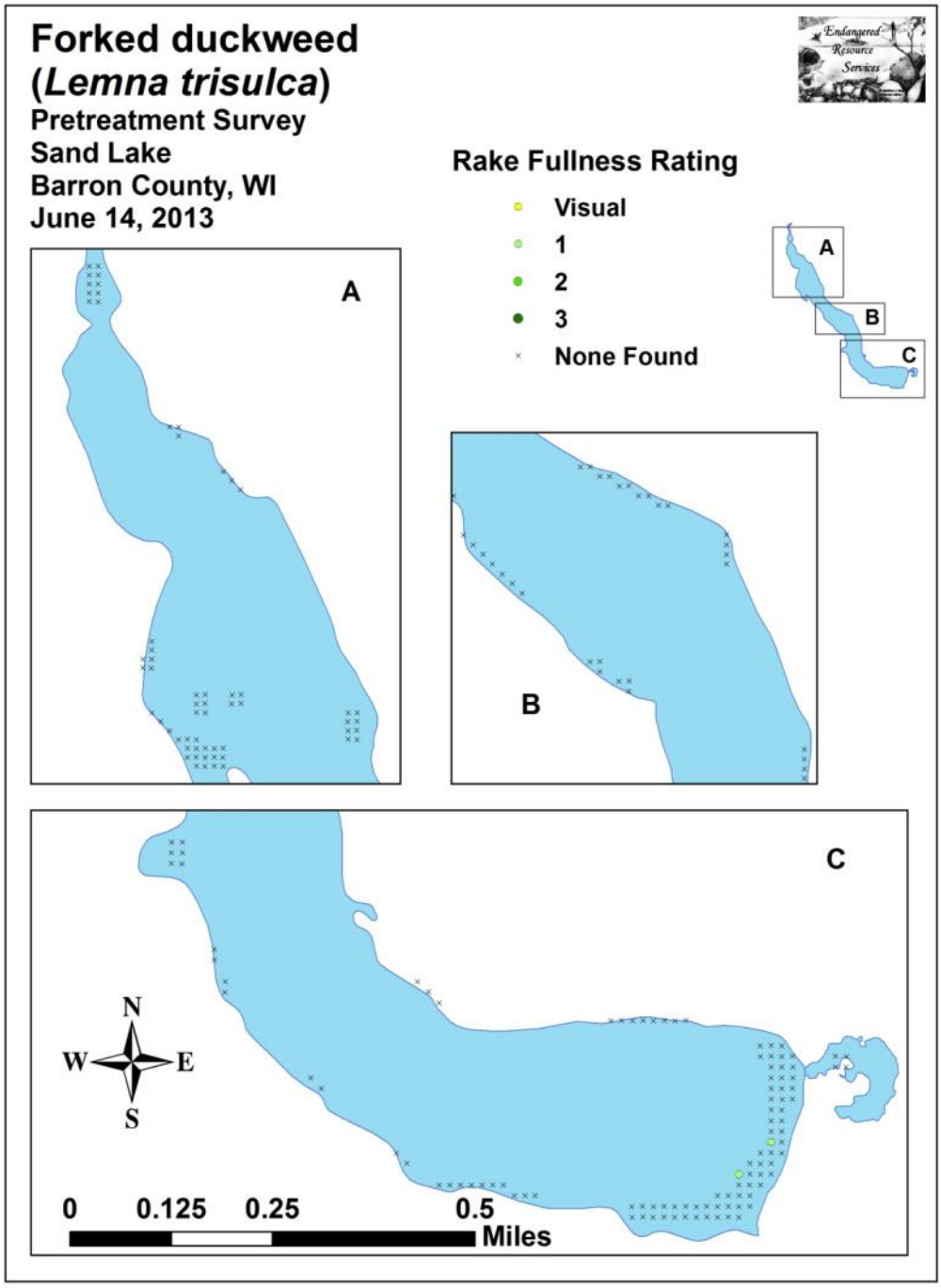

Coontail
(Ceratophyllum demersum)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

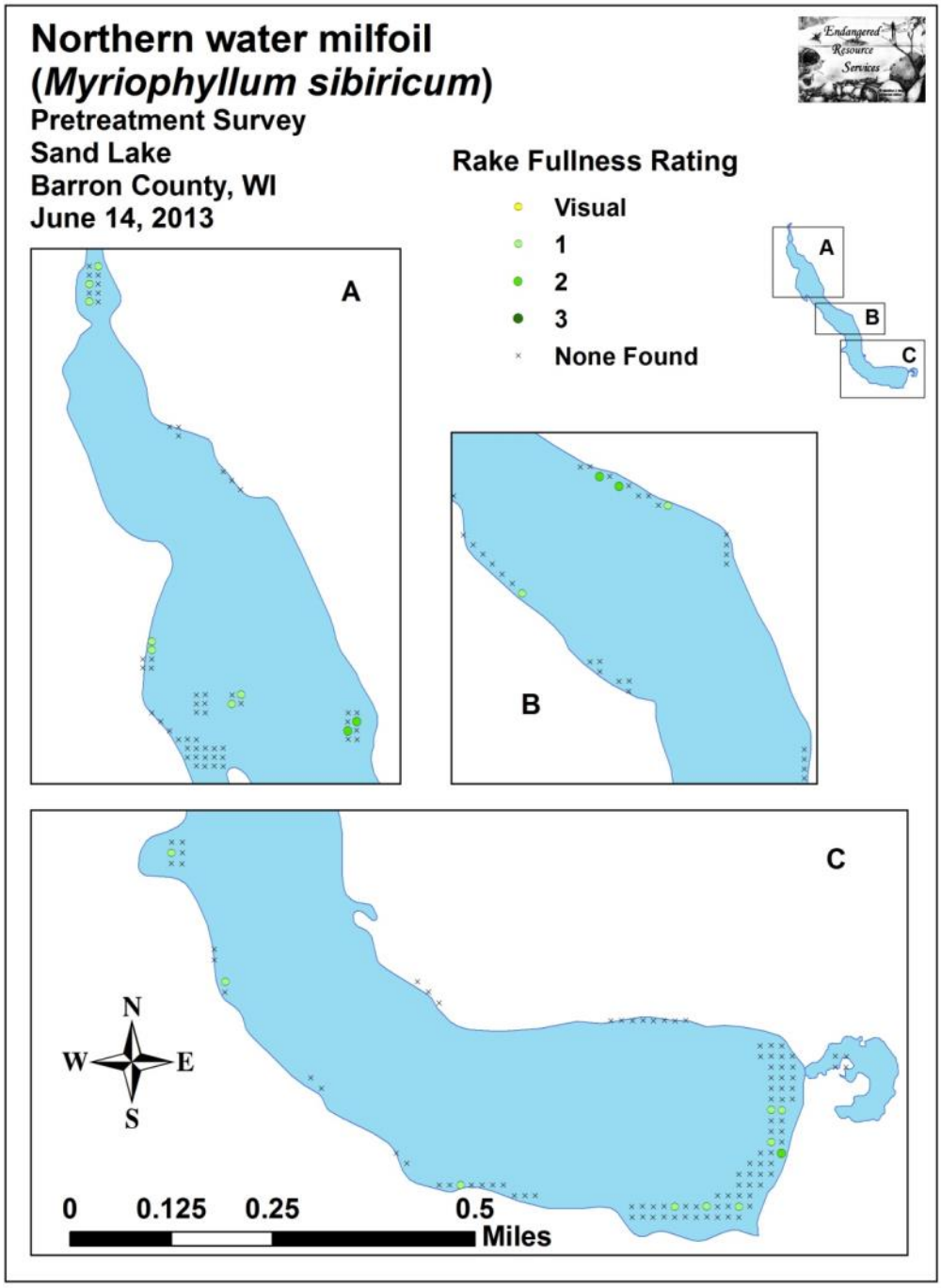

Muskgrass
(Chara sp.)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

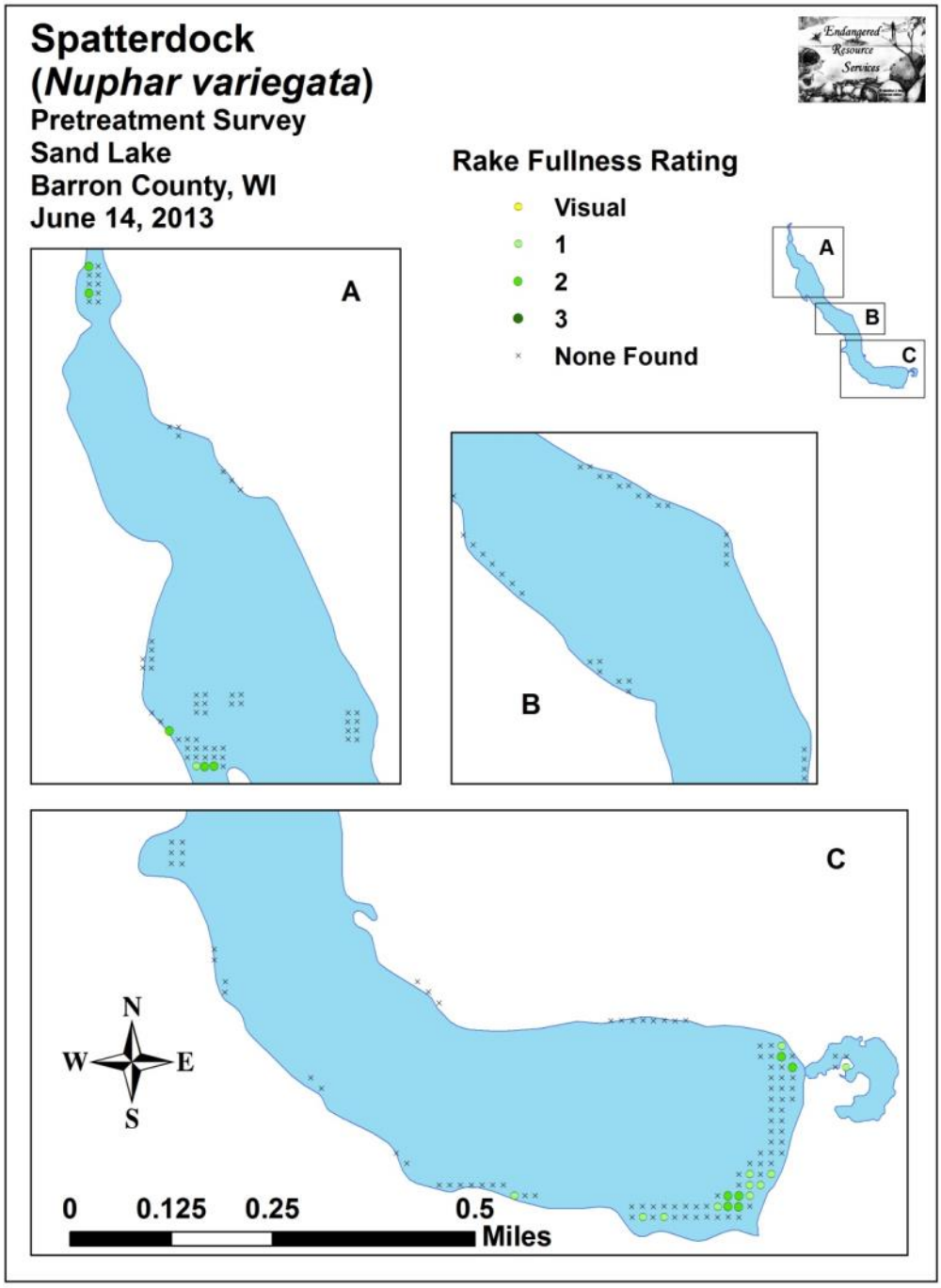

Common waterweed
(Elodea canadensis)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

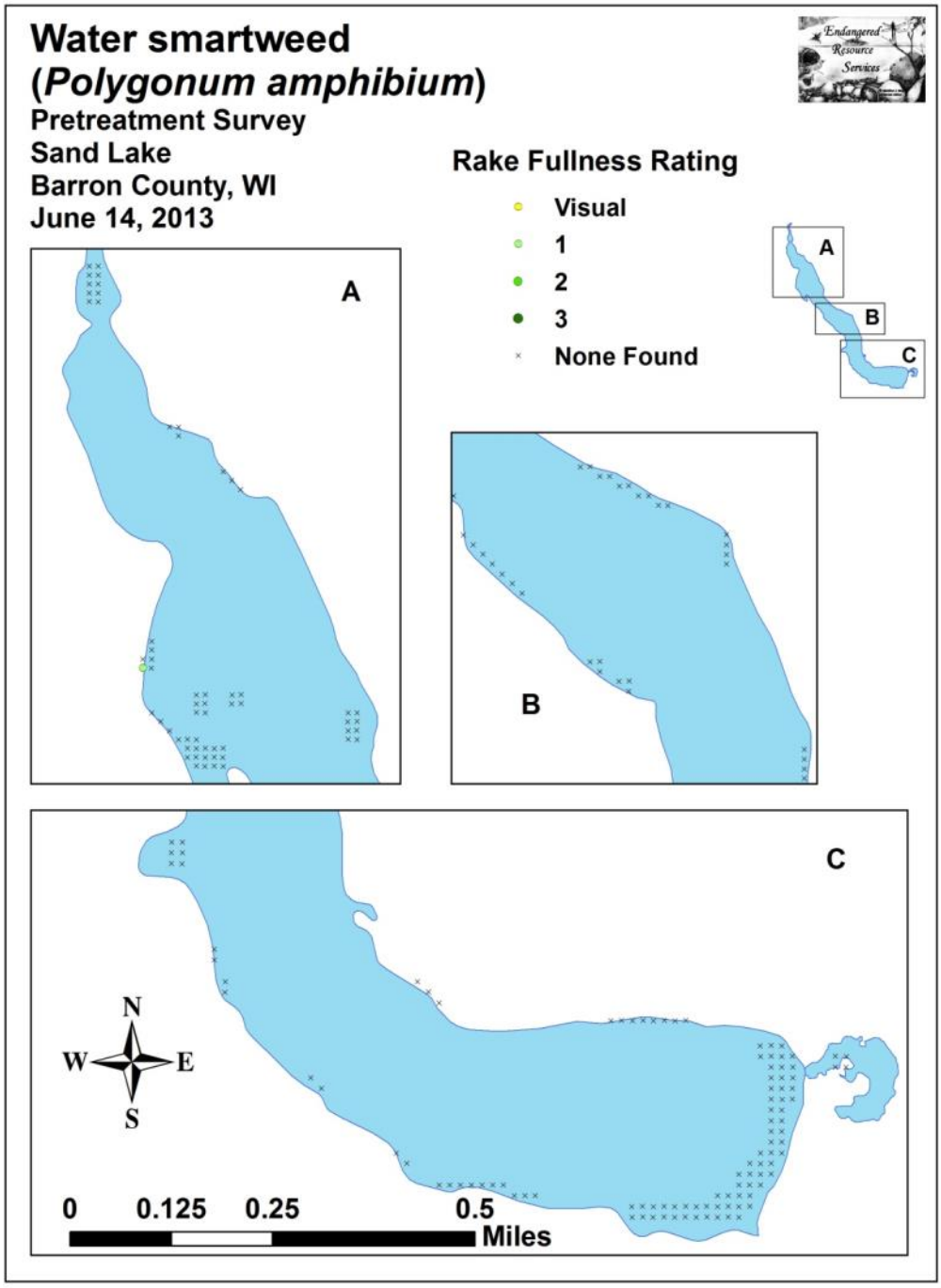

Filamentous algae
Endangered Resource Services
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

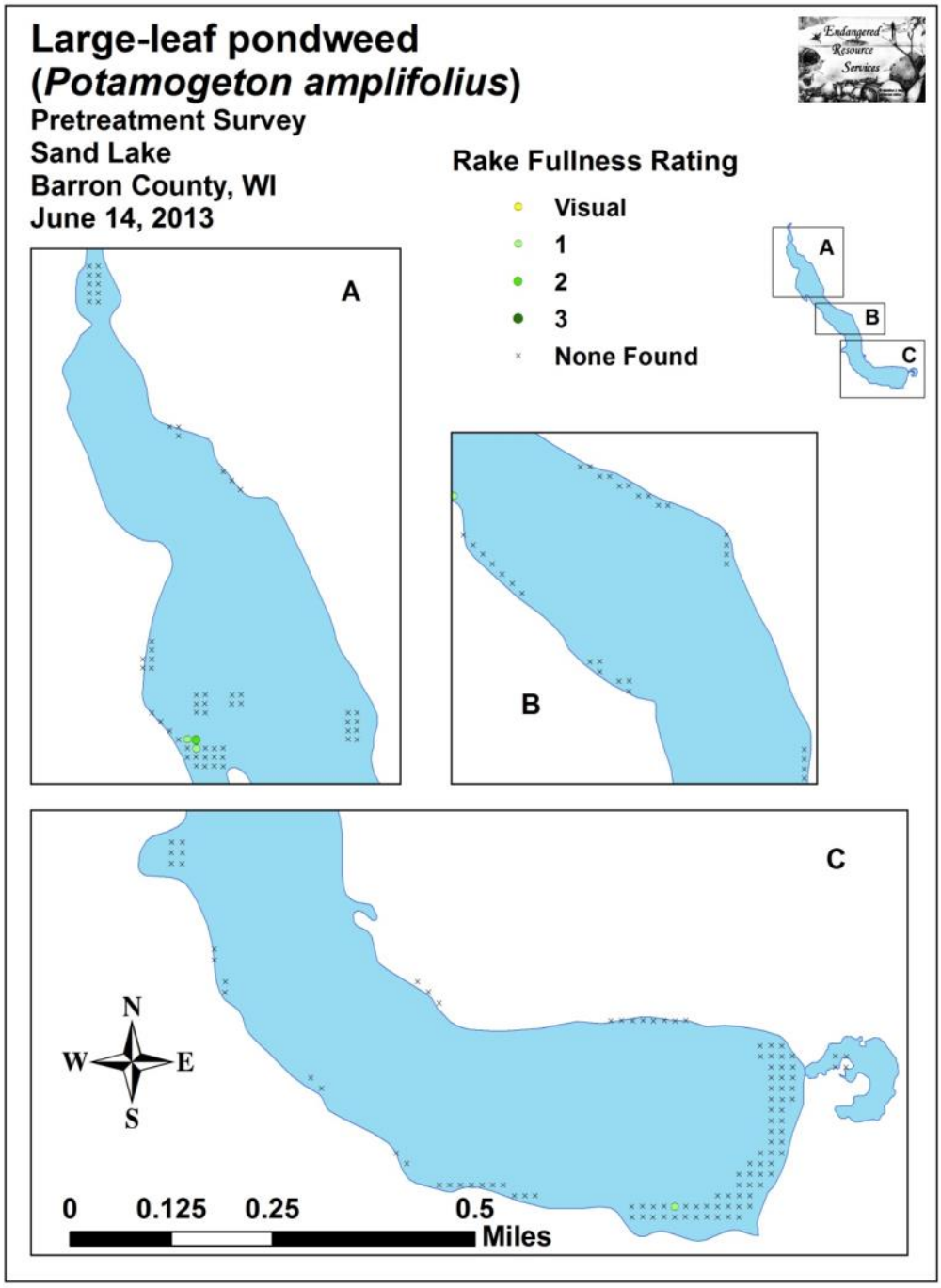

Water star-grass
(Heteranthera dubia)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

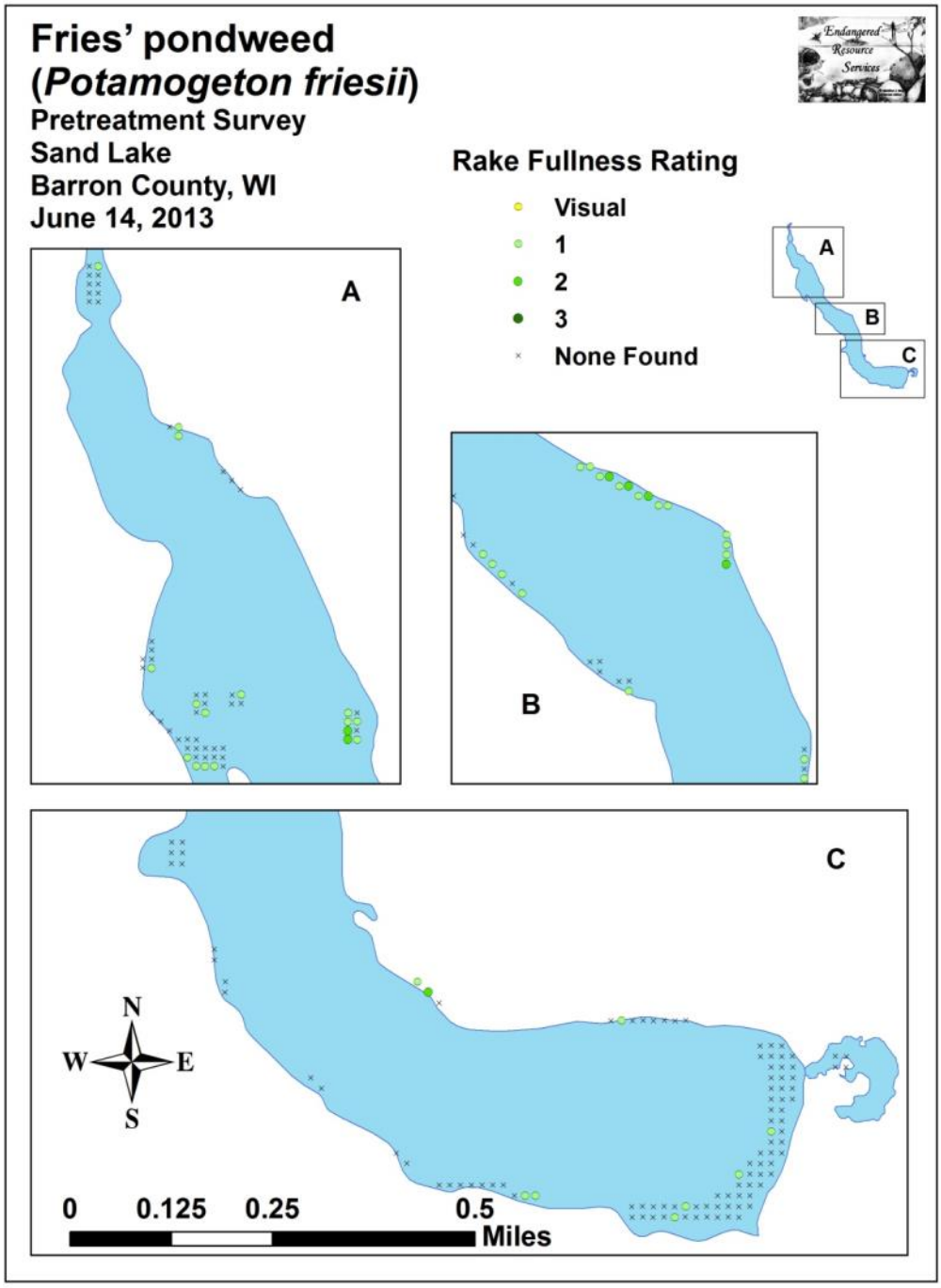

Forked duckweed
(Lemna trisulca)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

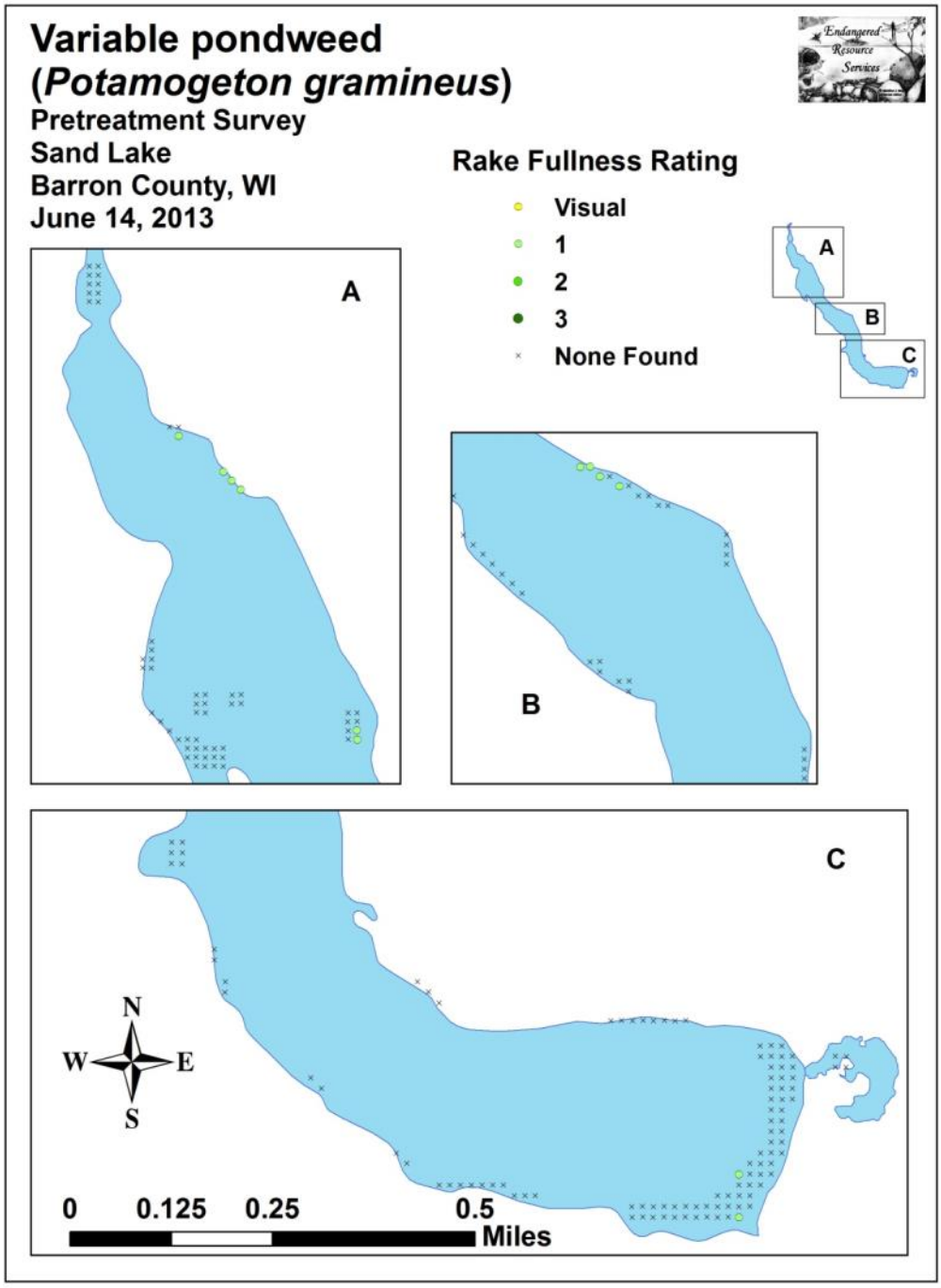

Northern water milfoil
(Myriophyllum sibiricum)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

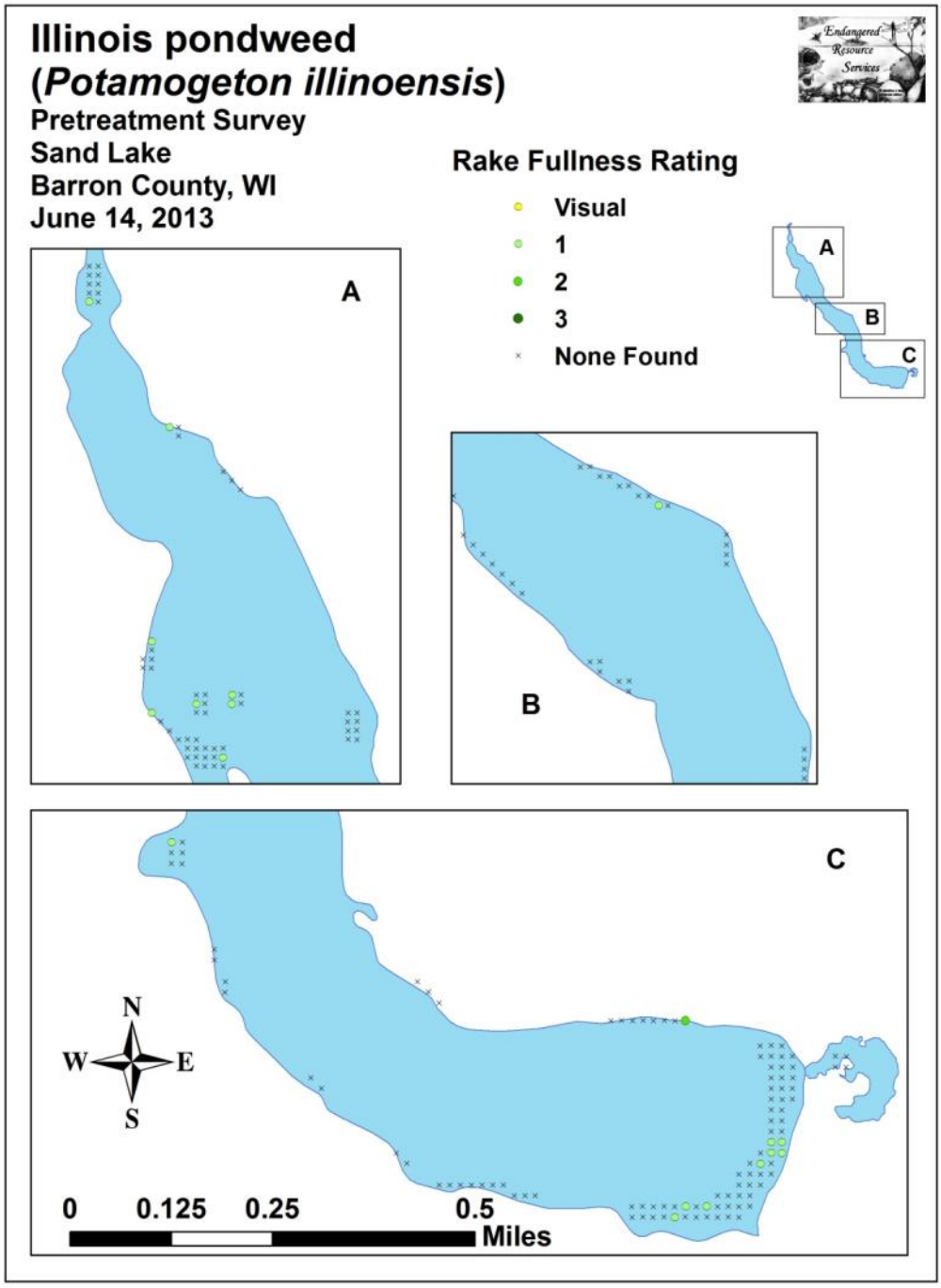

Spatterdock
(Nuphar variegata)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

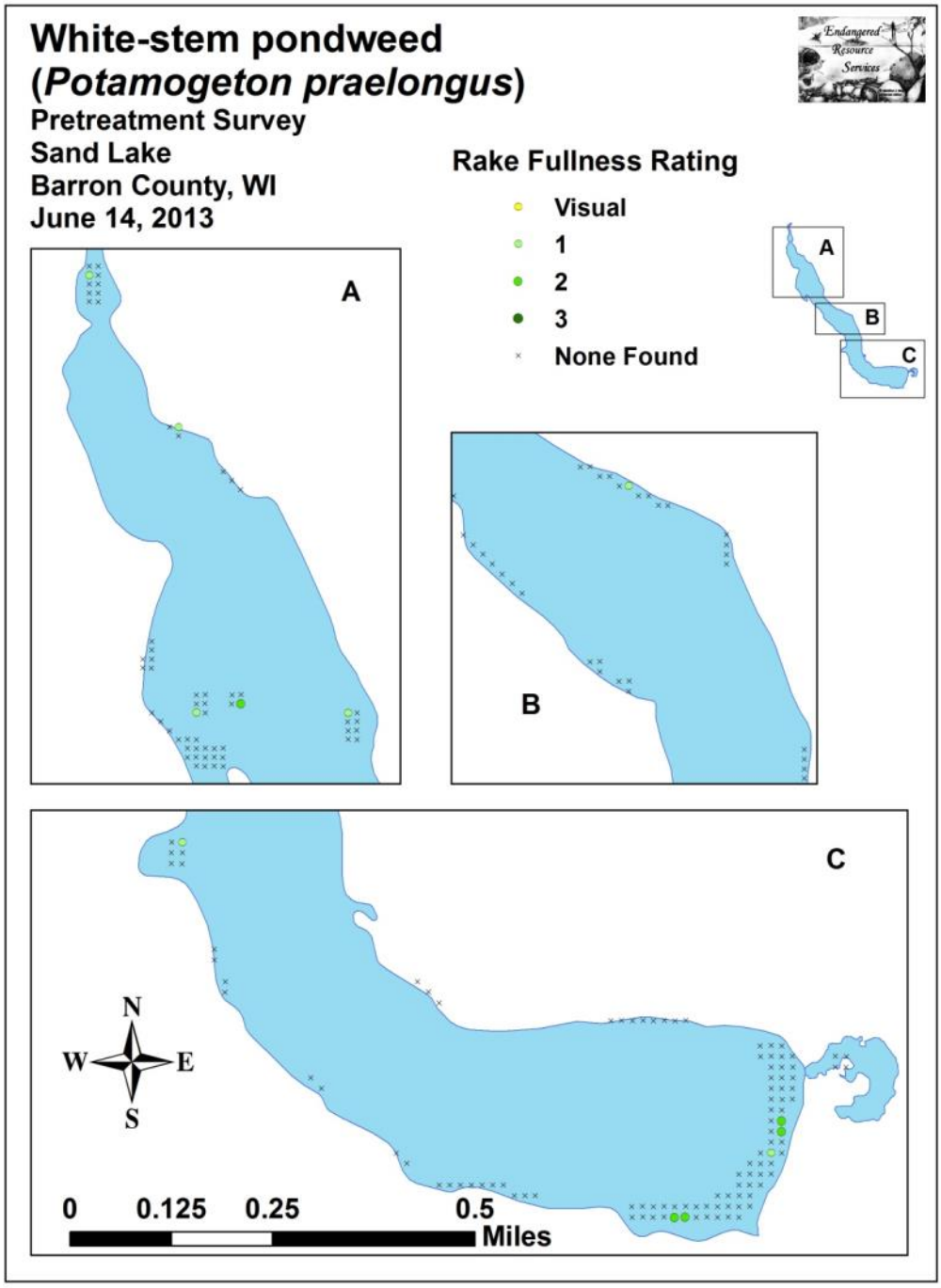

Water smartweed
(Polygonum amphibium)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

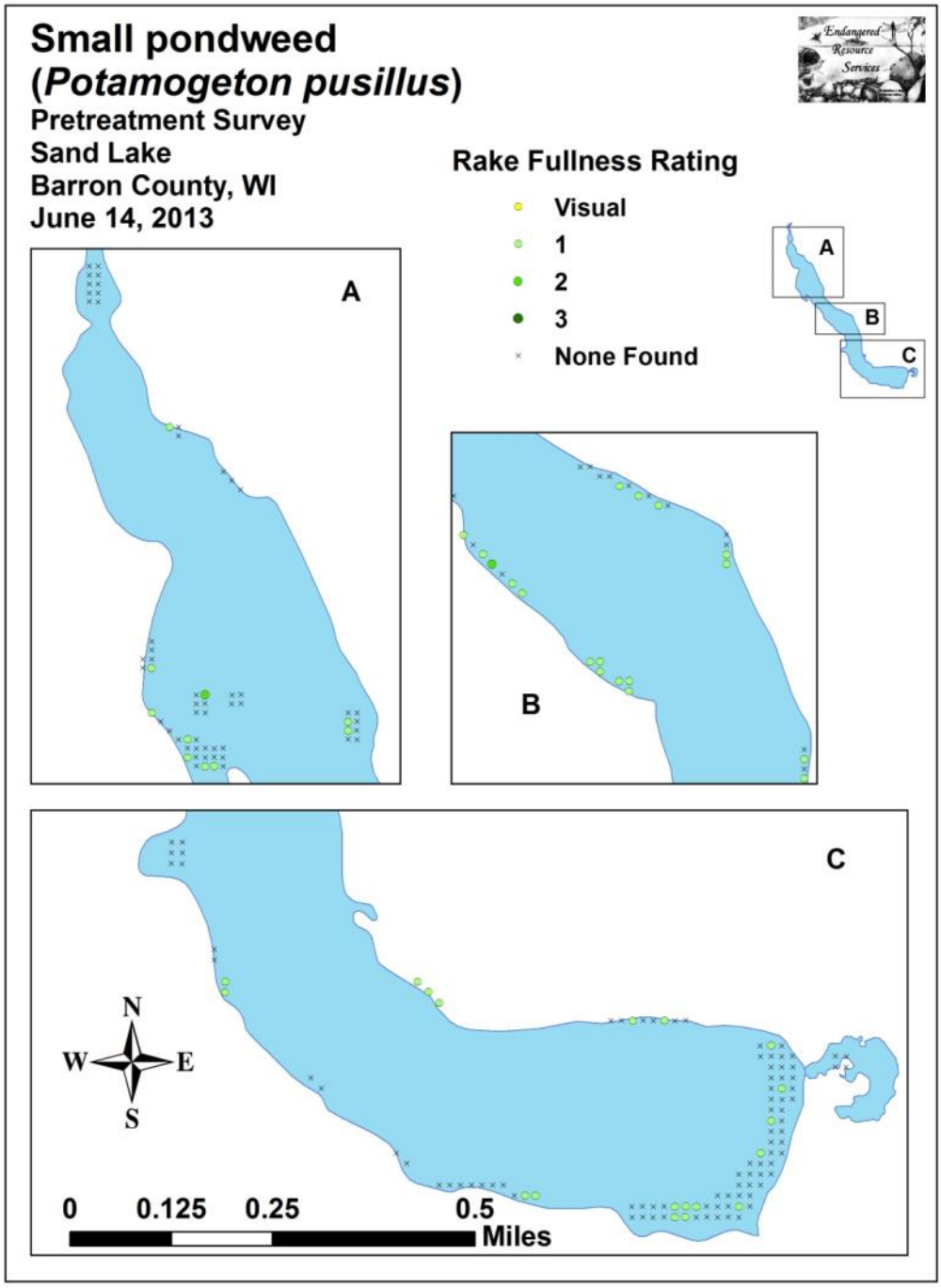

Large-leaf pondweed
(Potamogeton amplifolius)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

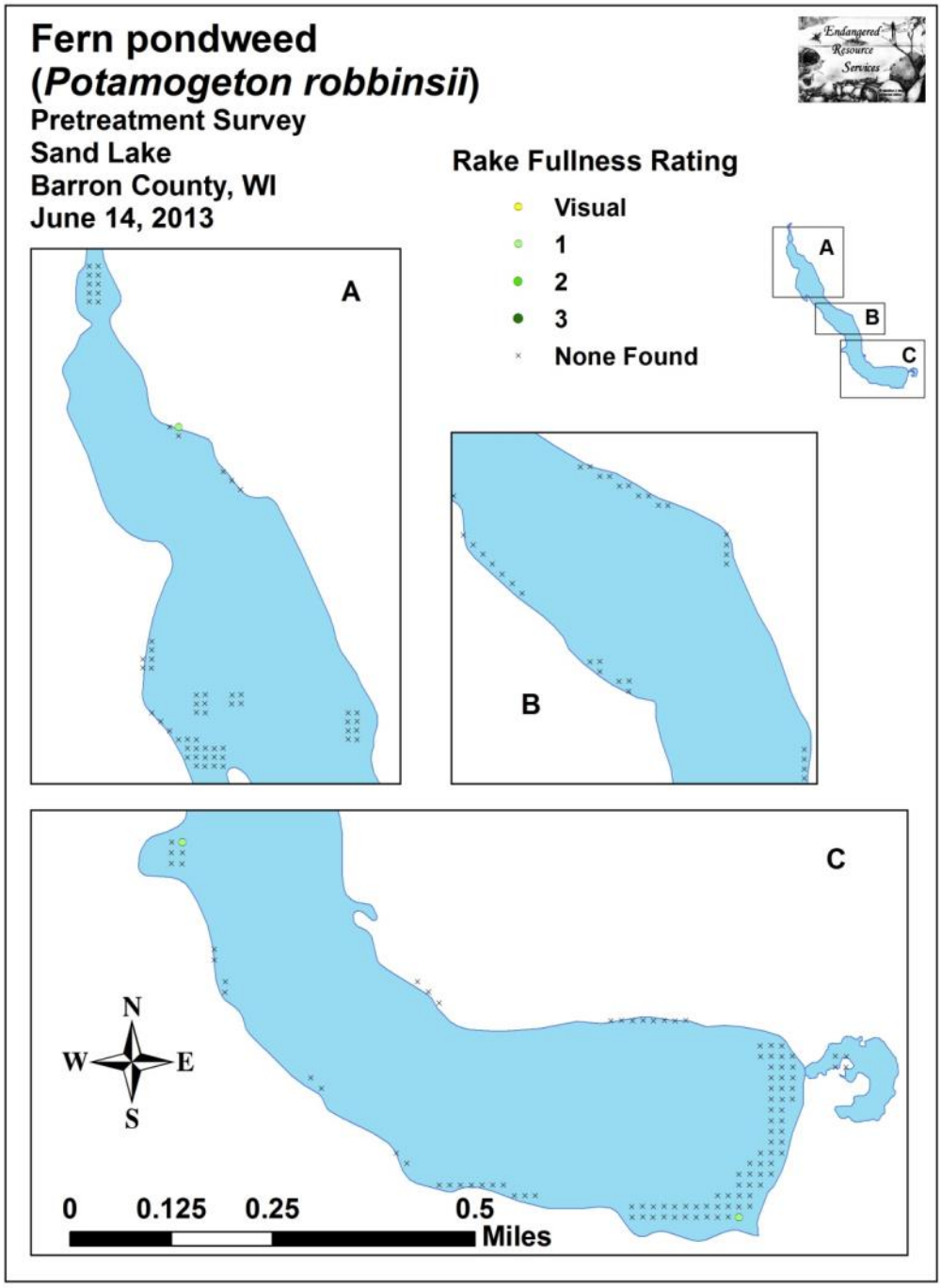

Fries' pondweed
(Potamogeton friesii)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

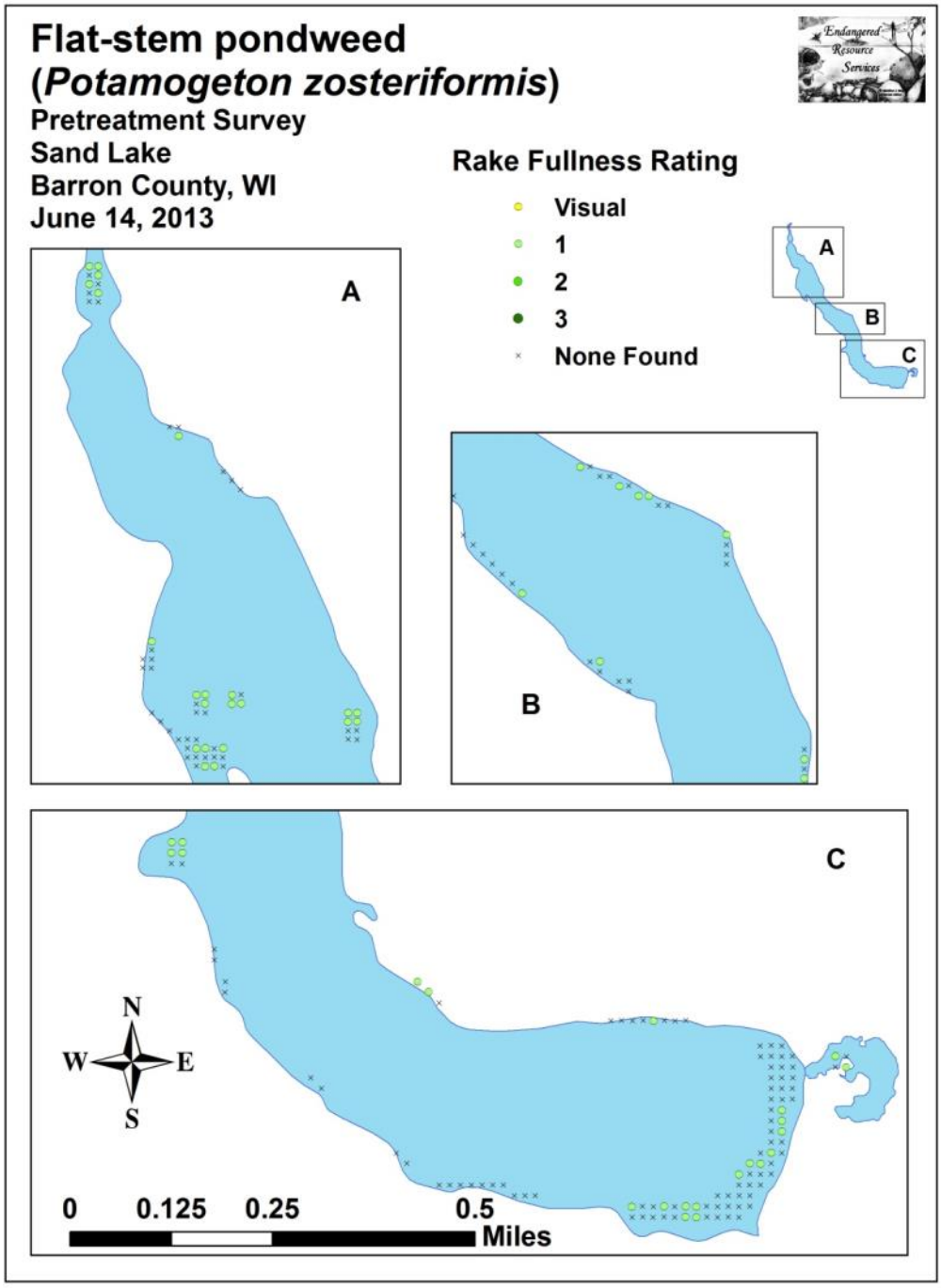

Variable pondweed
(Potamogeton gramineus)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

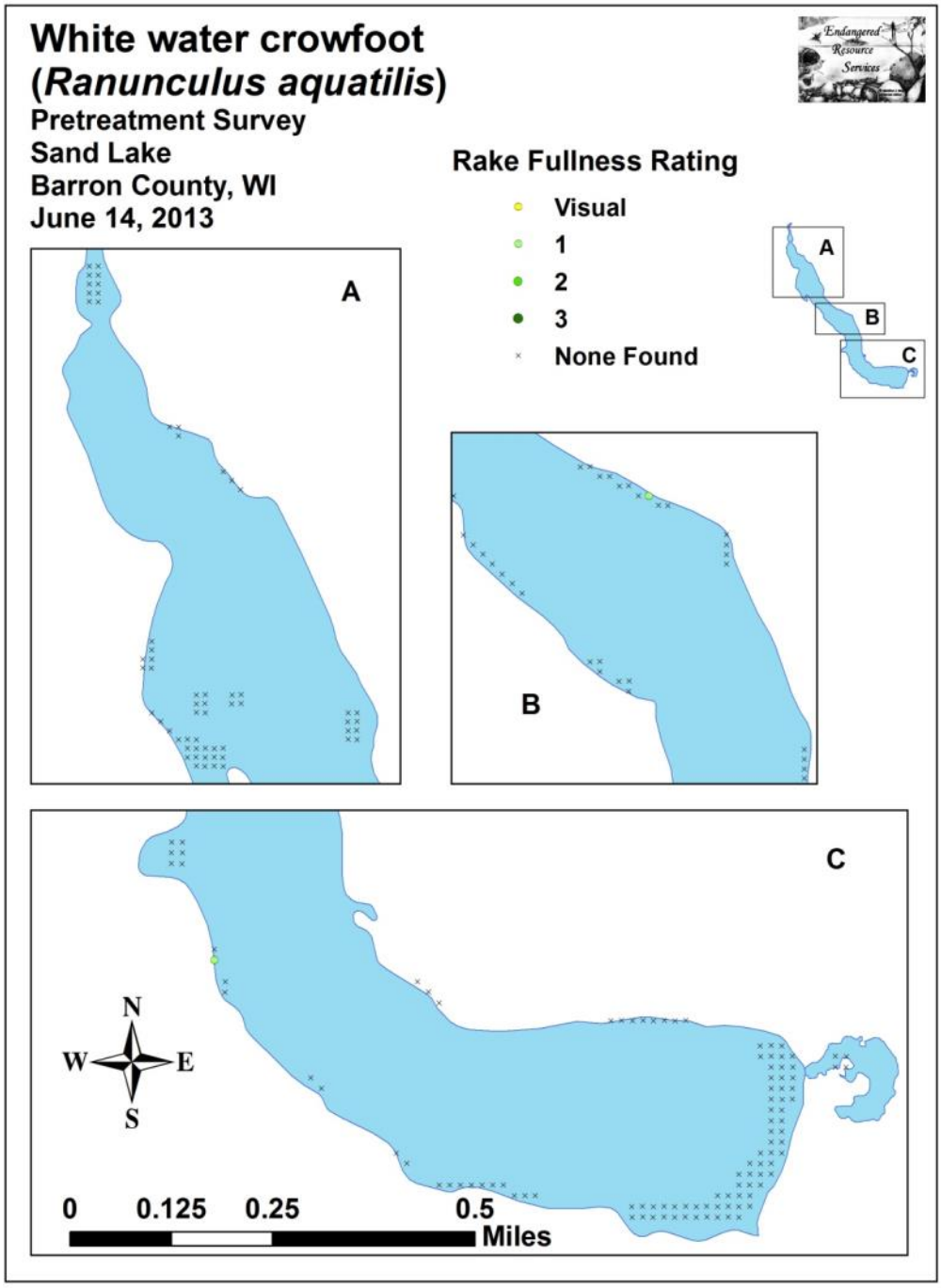

Illinois pondweed
(Potamogeton illinoensis)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

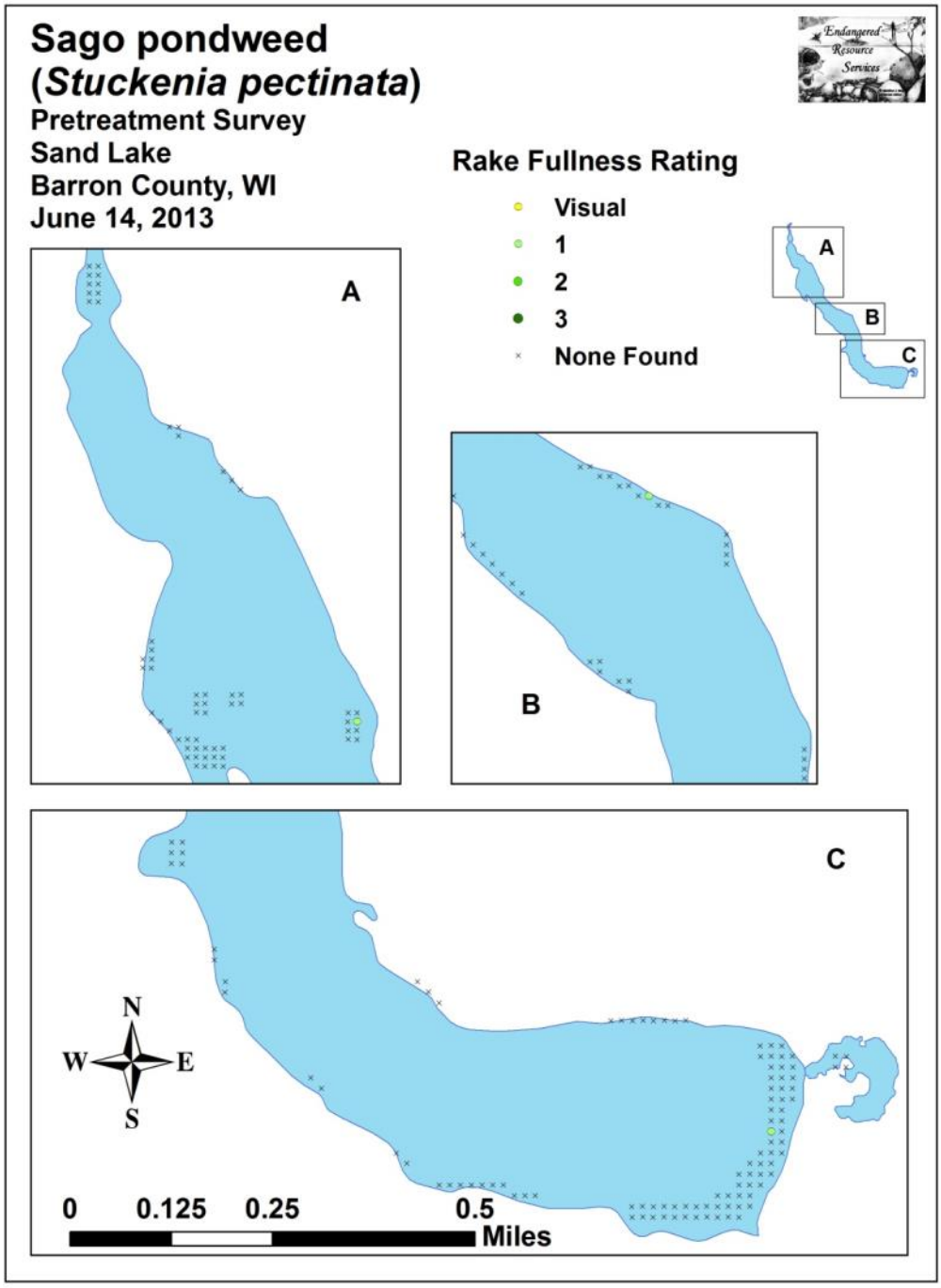

White-stem pondweed
(Potamogeton praelongus)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles


Small pondweed
(Potamogeton pusillus)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

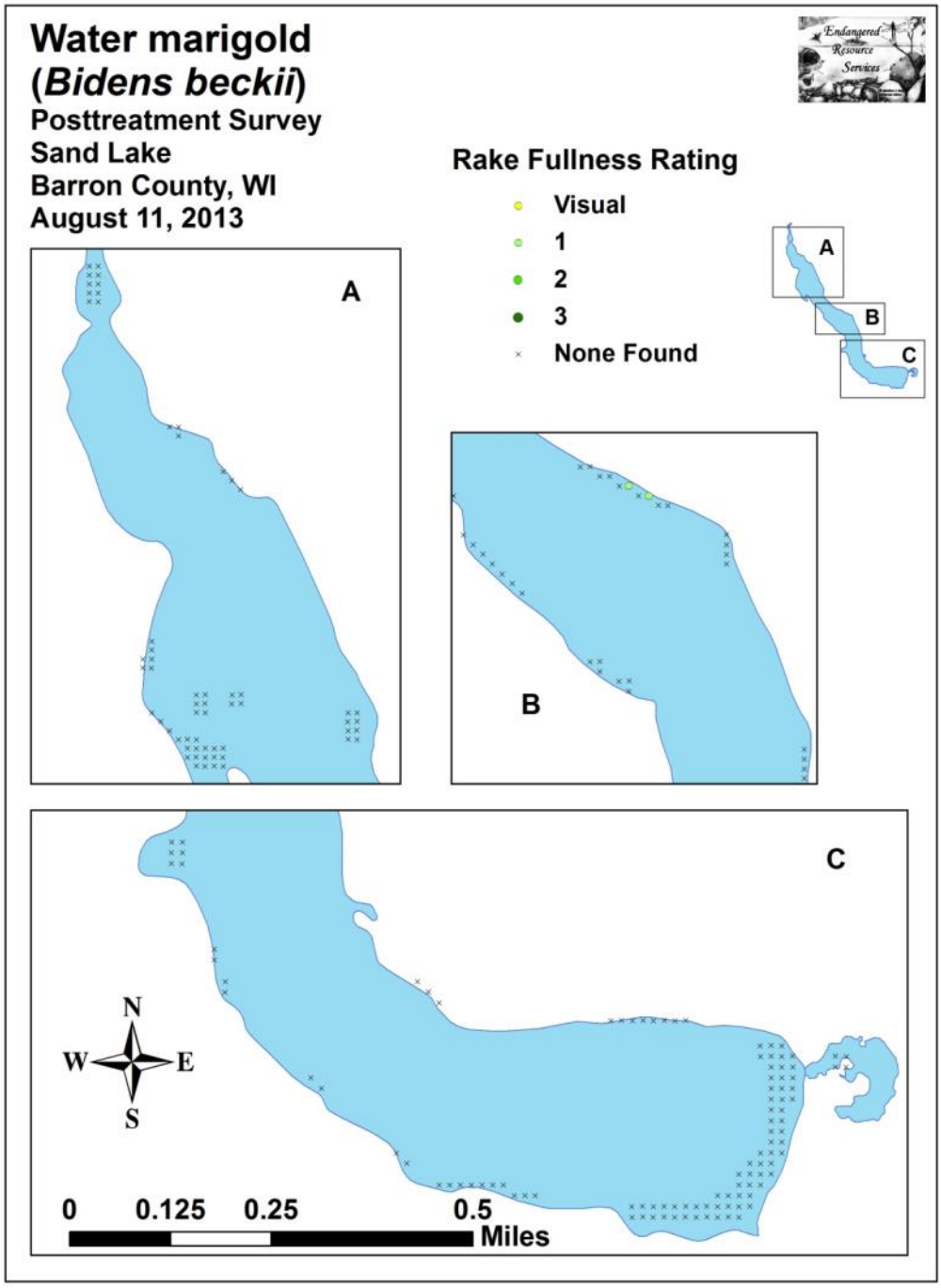

Fern pondweed
(Potamogeton robbinsii)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

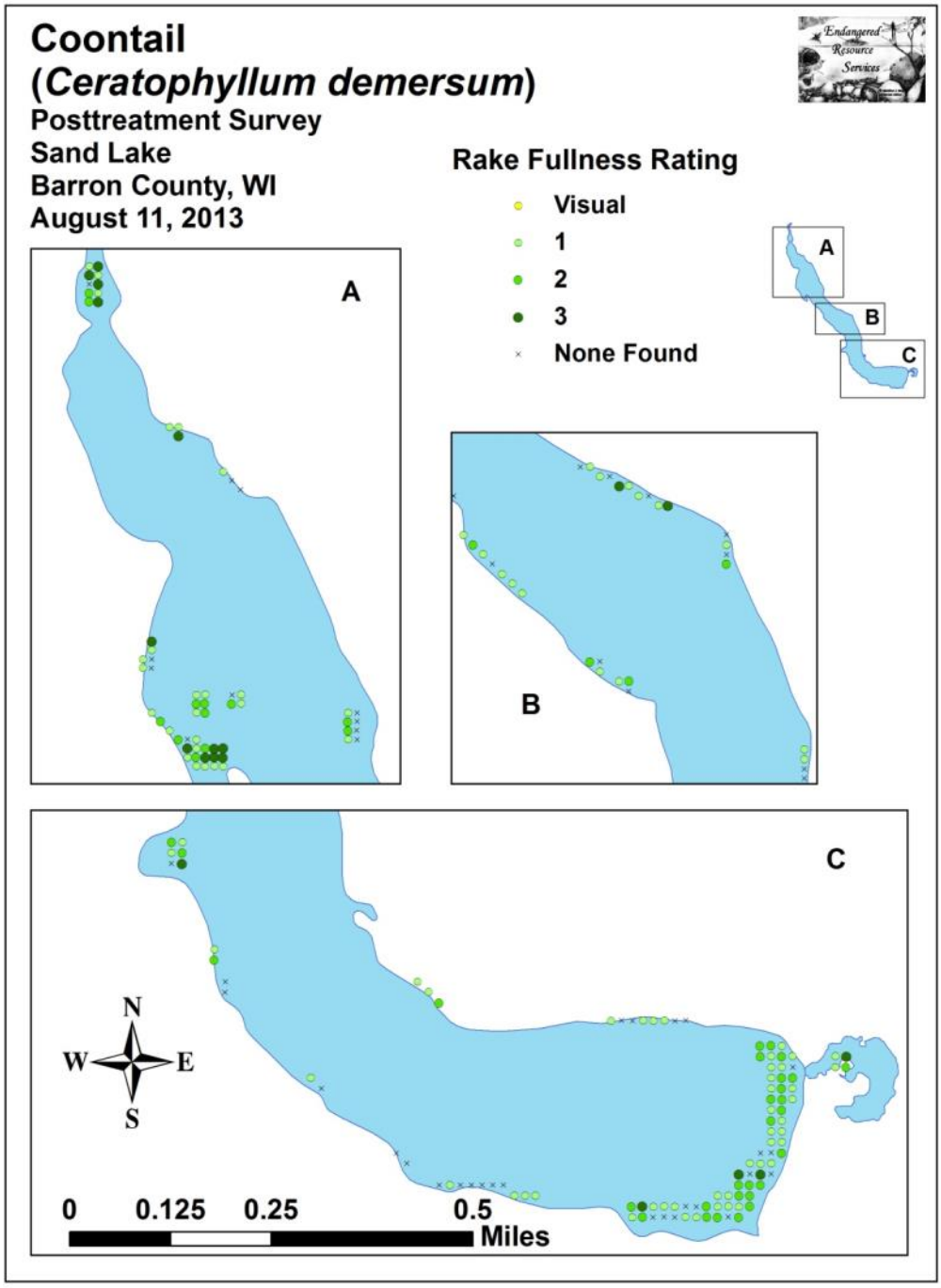

Flat-stem pondweed
(Potamogeton zosteriformis)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

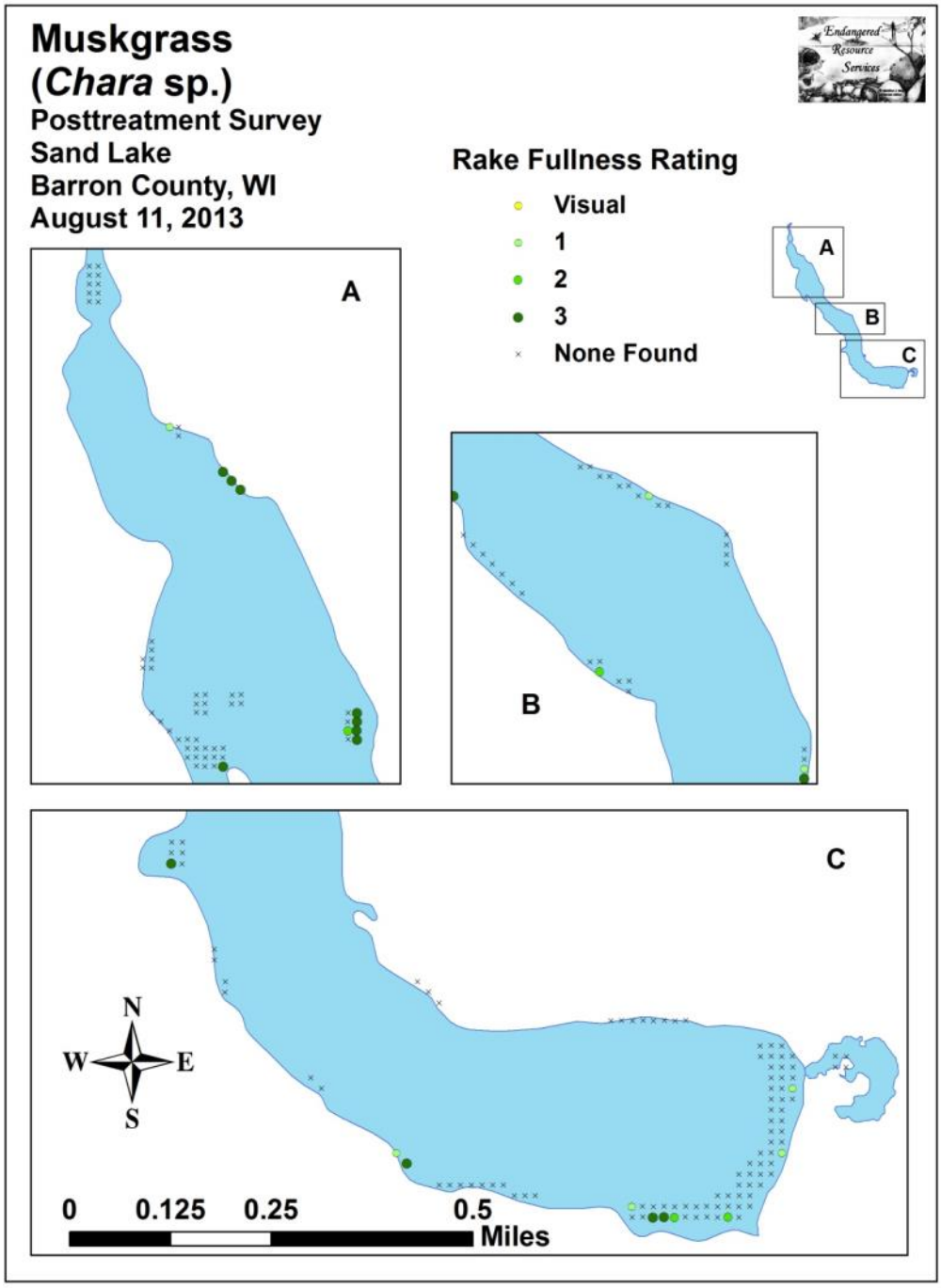

White water crowfoot
(Ranunculus aquatilis)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

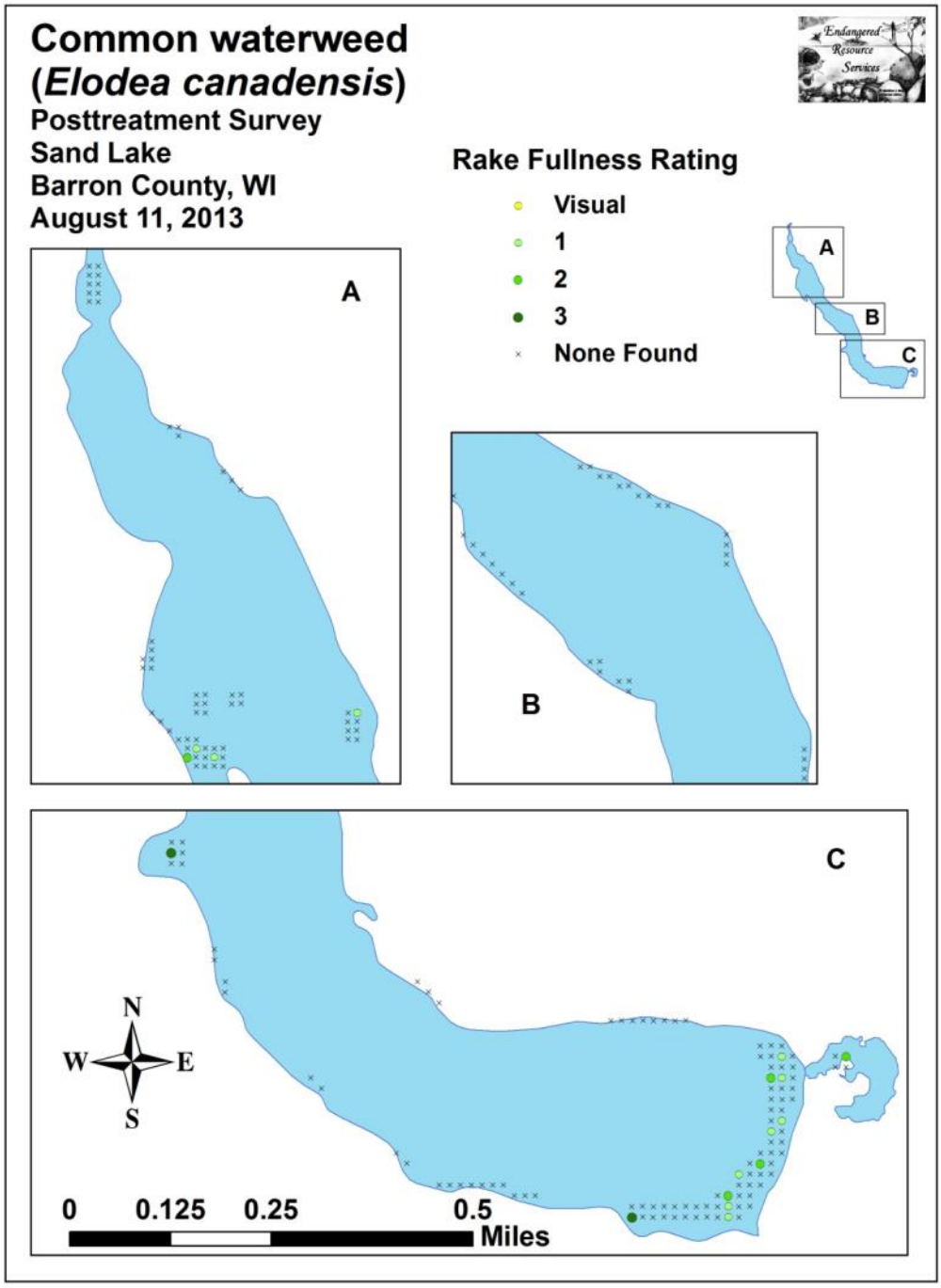

Sago pondweed
(Stuckenia pectinata)
Pretreatment Survey
Sand Lake
Barron County, WI
June 14, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles

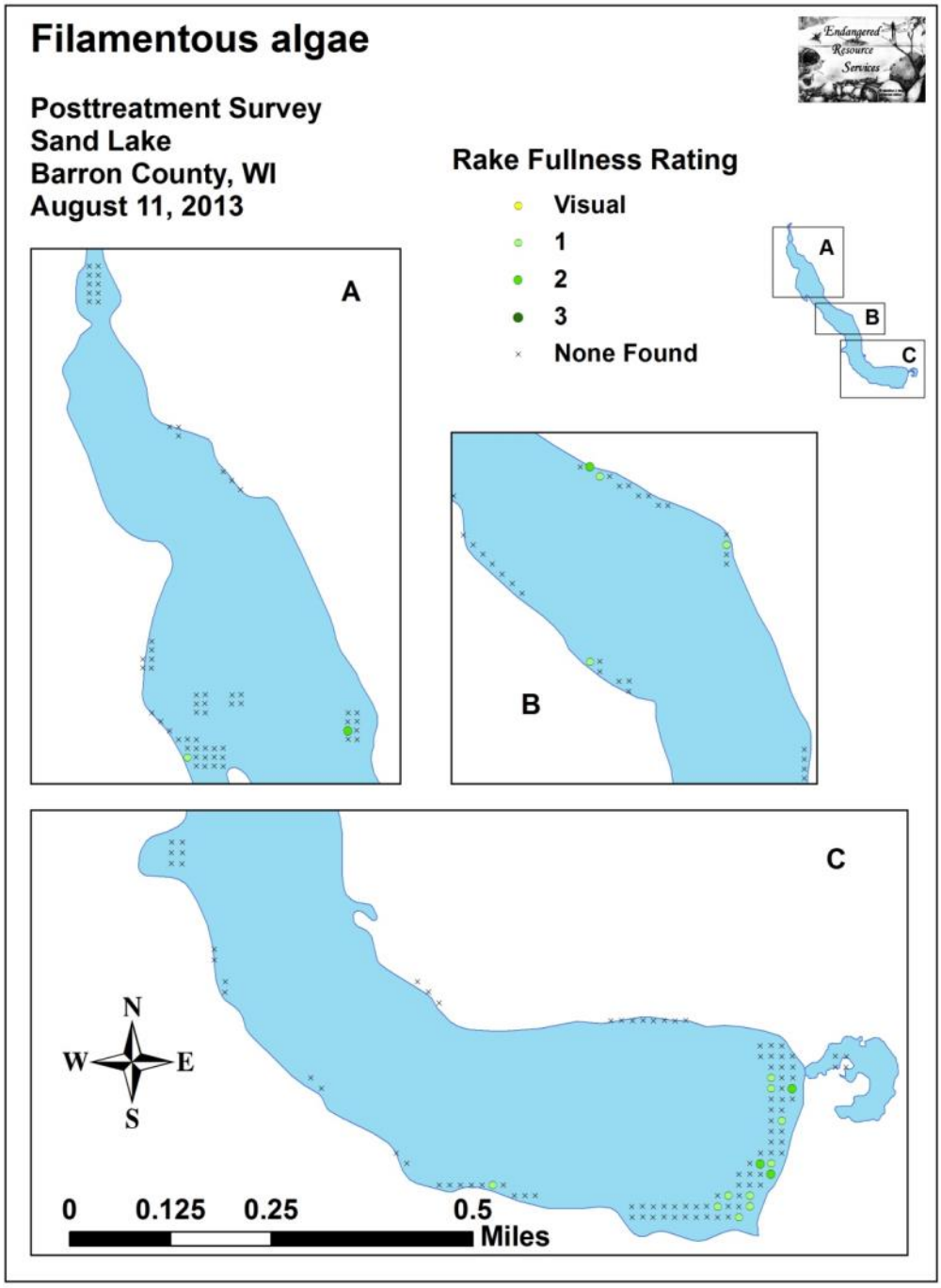
Appendix VII: Posttreatment Native Species Density and Distribution

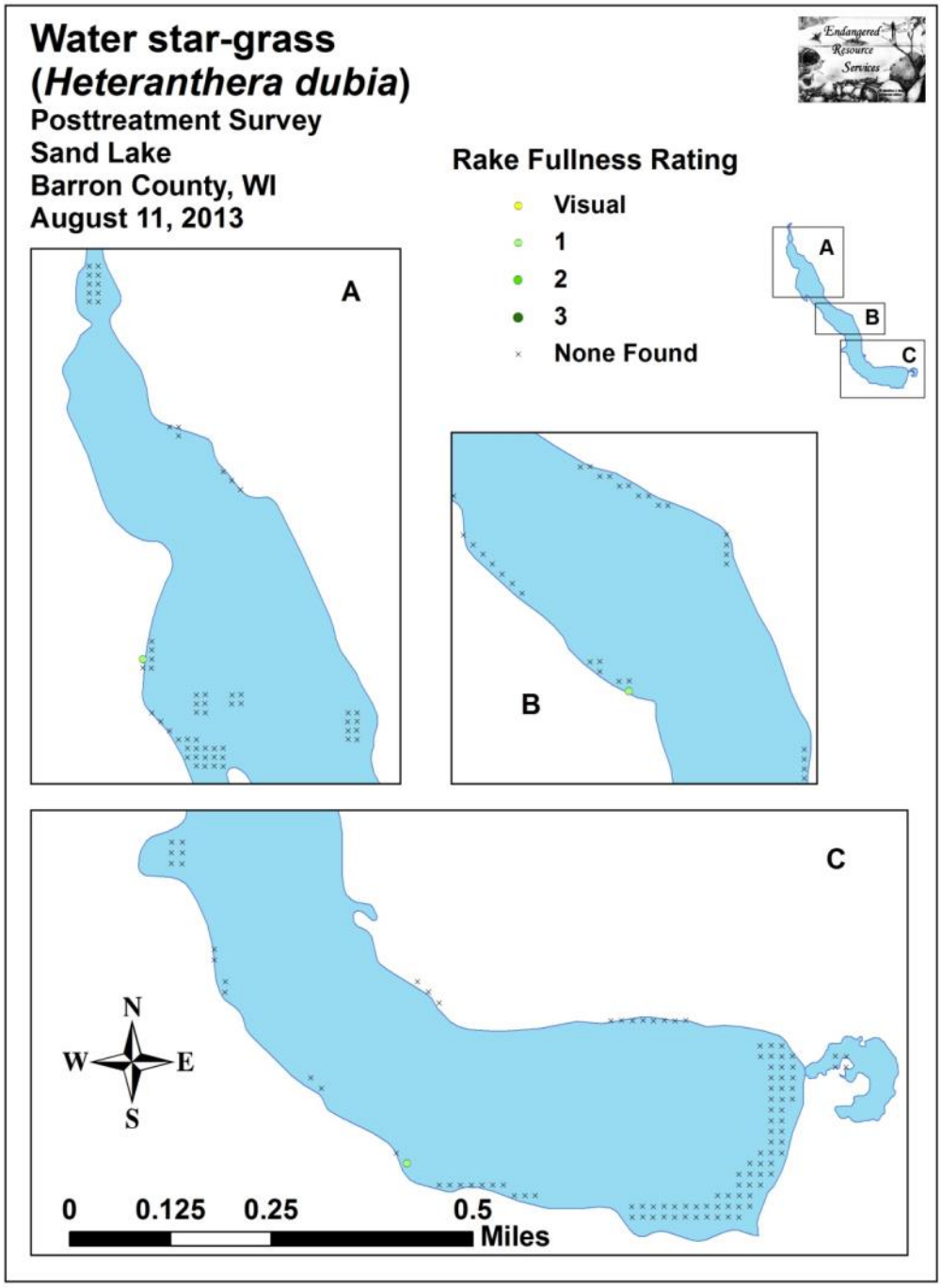

Water marigold
(Bidens beckii)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles


Coontail
(Ceratophyllum demersum)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles


Muskgrass
(Chara sp.)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles


Common waterweed
(Elodea canadensis)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles


Filamentous algae
Endangered Resource Services
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
W
E
S
0
0.125
0.25
0.5
Miles


Water star-grass
(Heteranthera dubia)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
B
C
N
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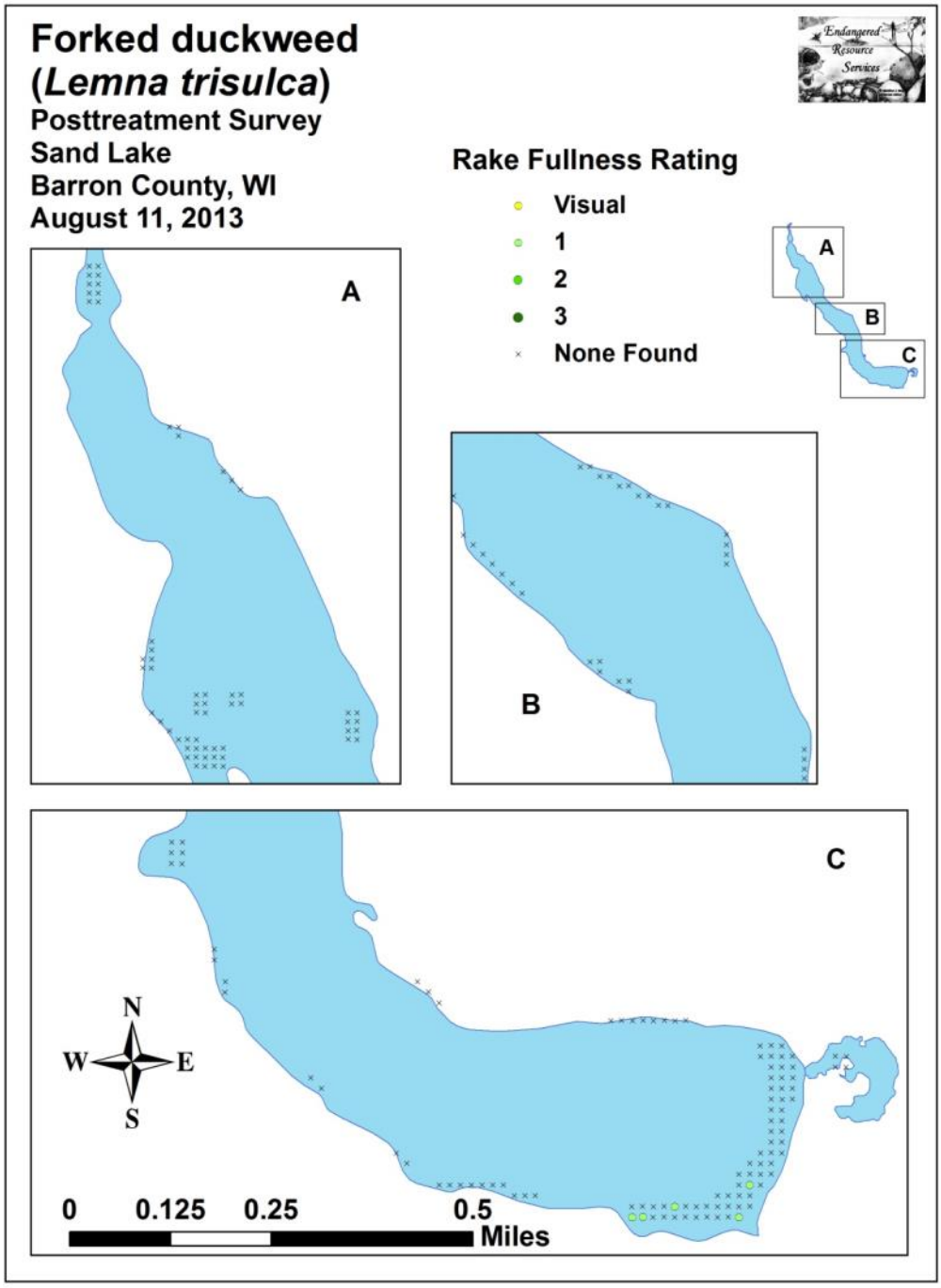
0.25
0.5
Miles


Forked duckweed
(Lemna trisulca)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
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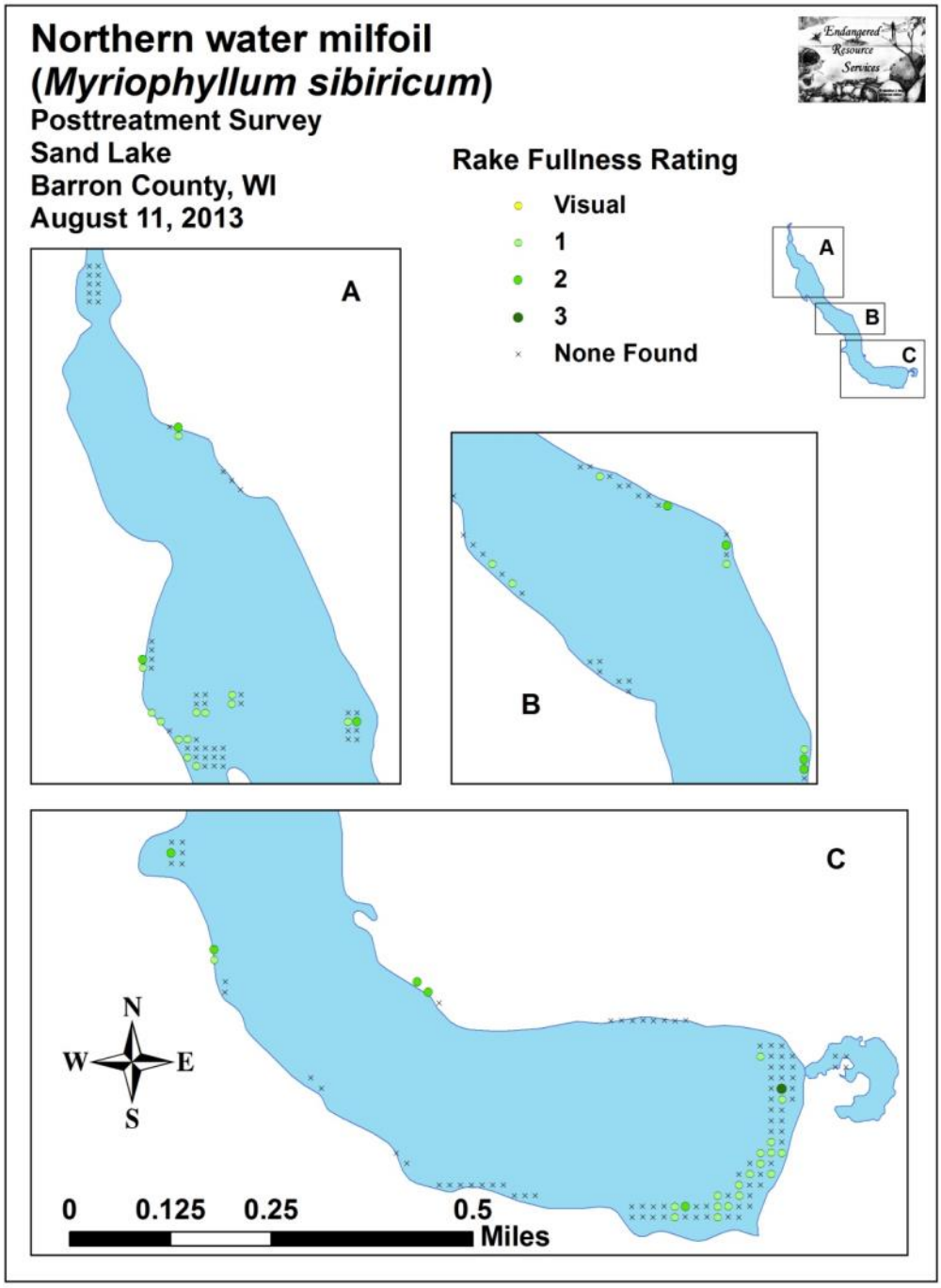
0.5
Miles


Northern water milfoil
(Myriophyllum sibiricum)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
A
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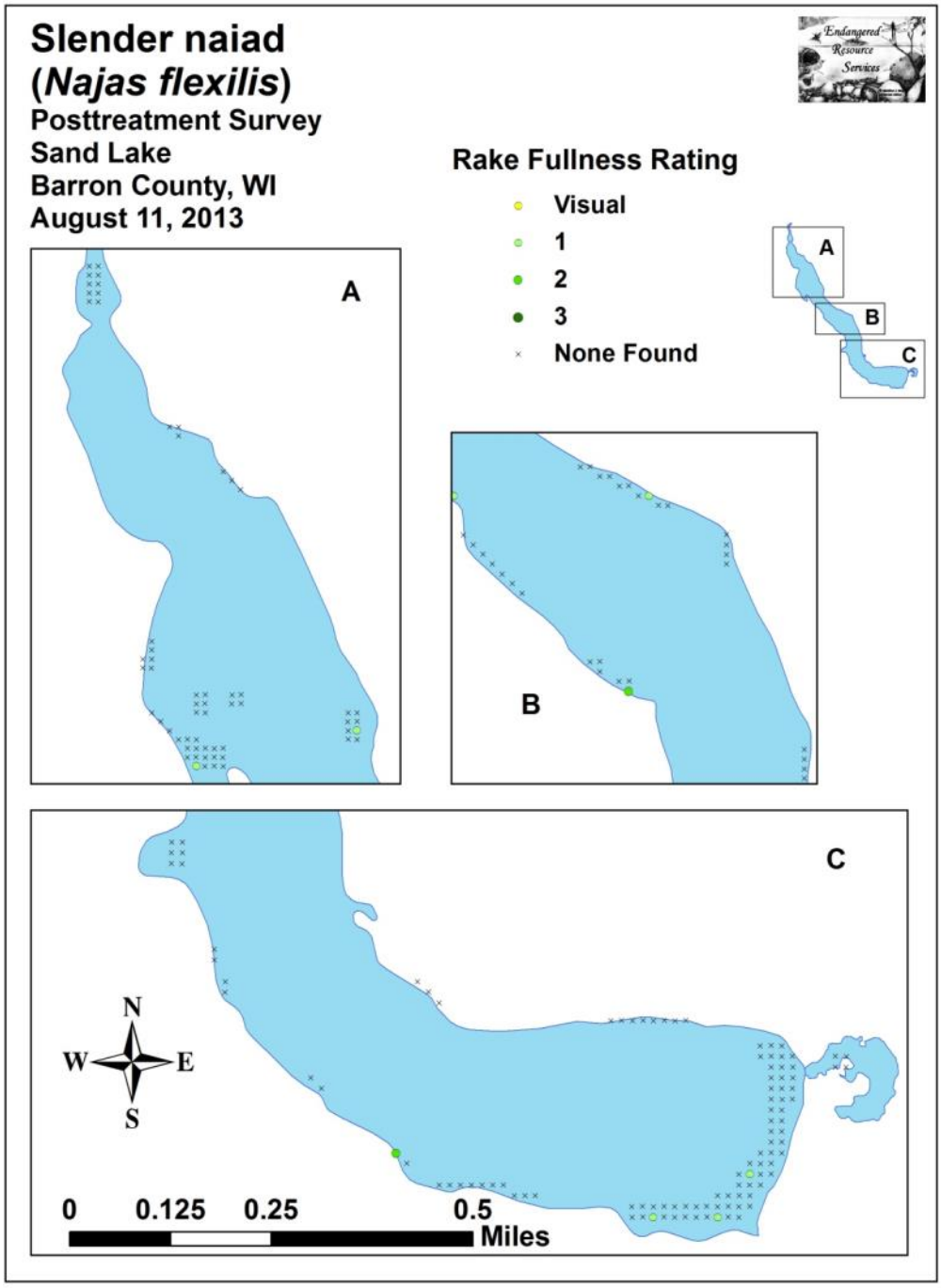
0.5
Miles


Slender naiad
(Najas flexilis)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
A
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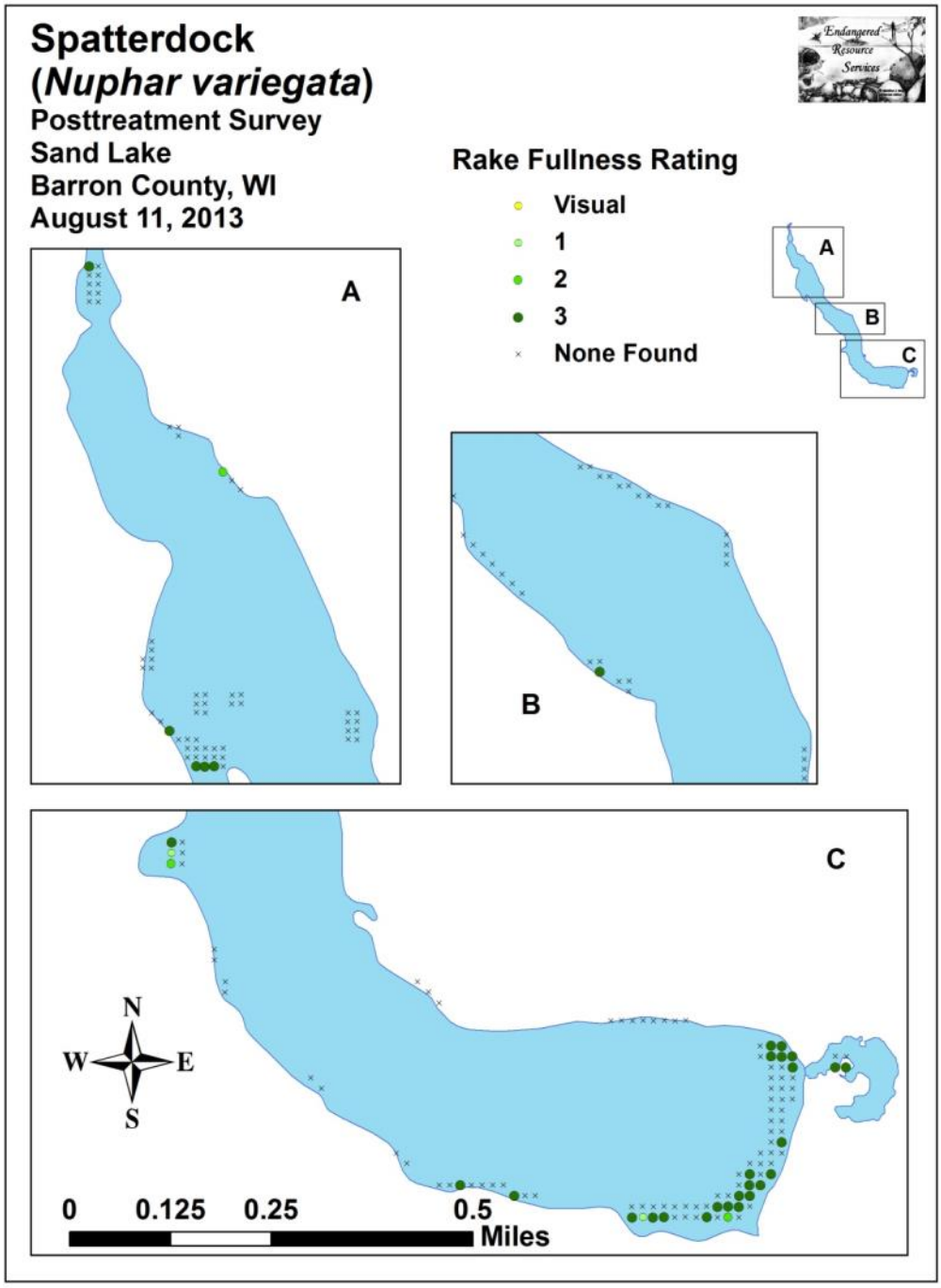
0.25
0.5
Miles


Spatterdock
(Nuphar variegata)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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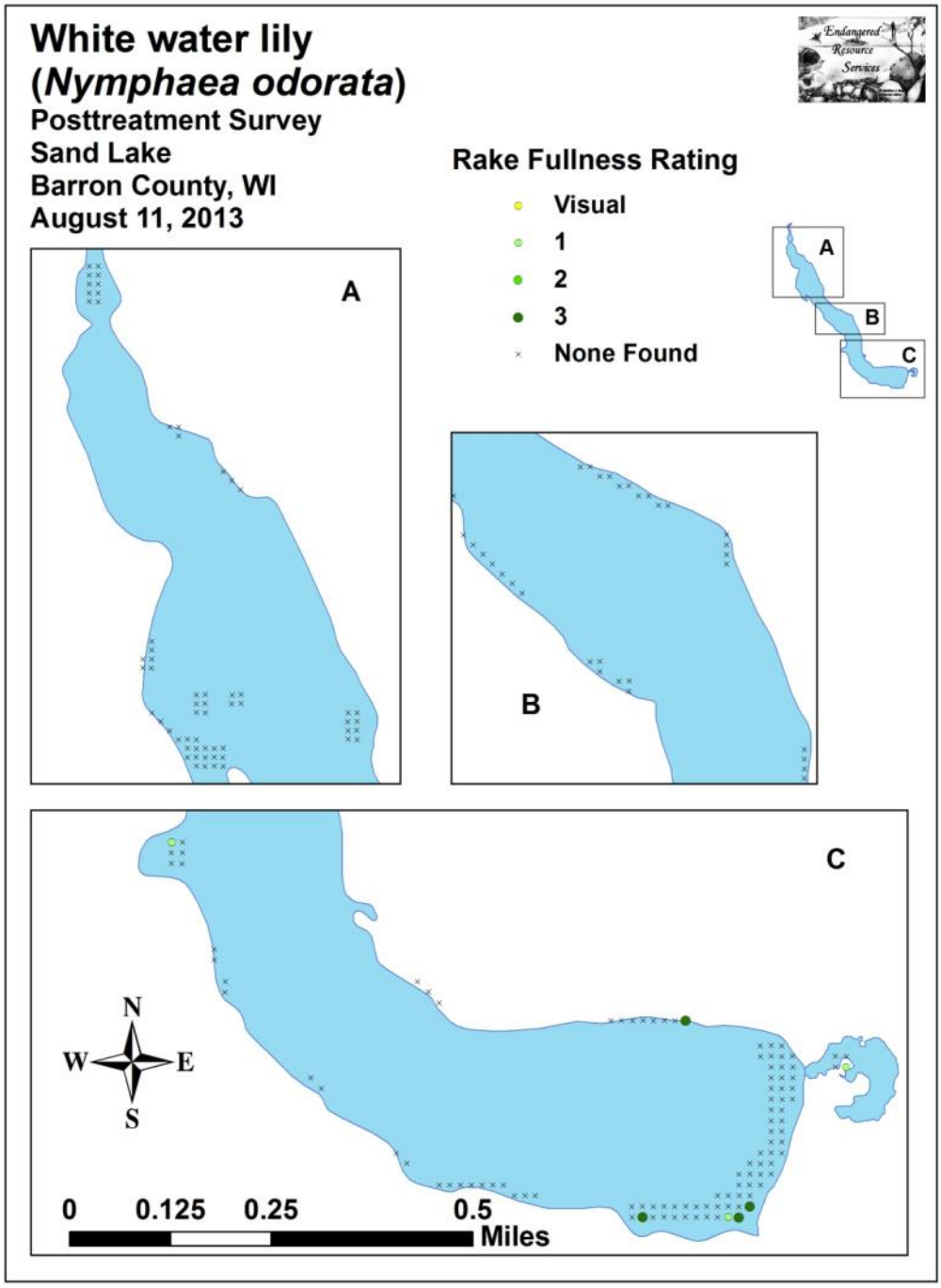
Miles


White water lily
(Nymphaea odorata)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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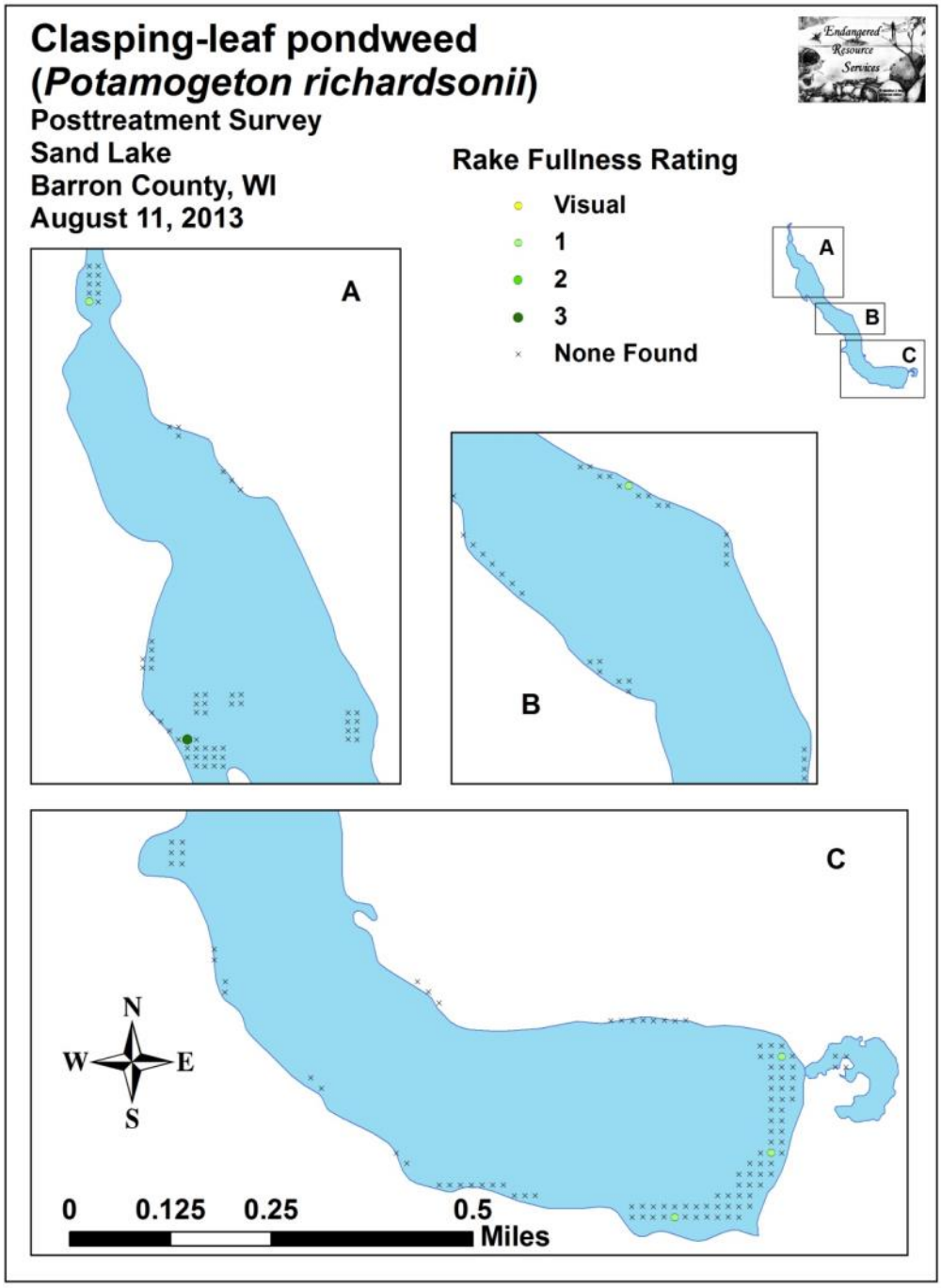
Miles


Clasping-leaf pondweed
(Potamogeton richardsonii)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
A
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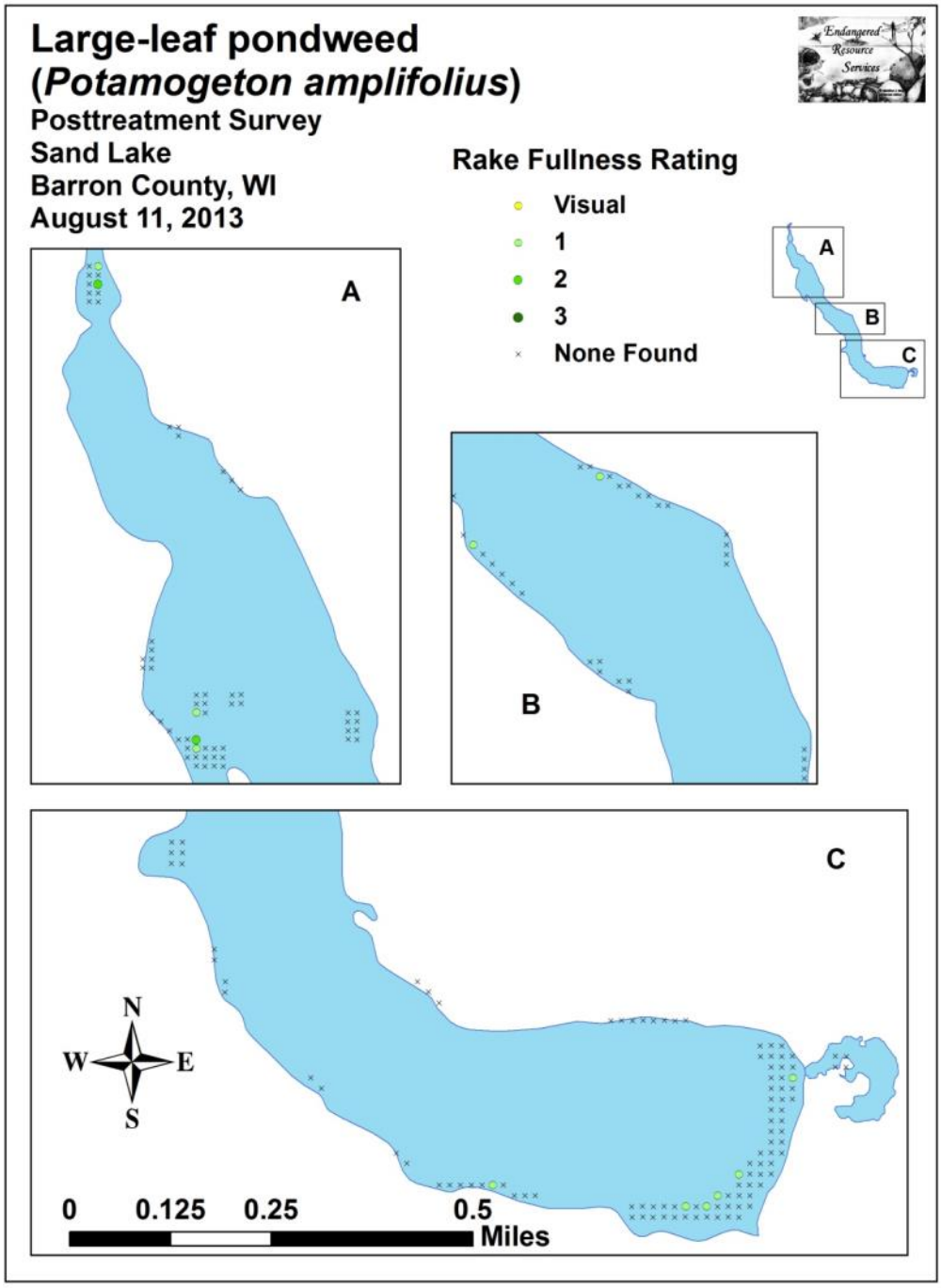
Miles


Large-leaf pondweed
(Potamogeton amplifolius)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
A
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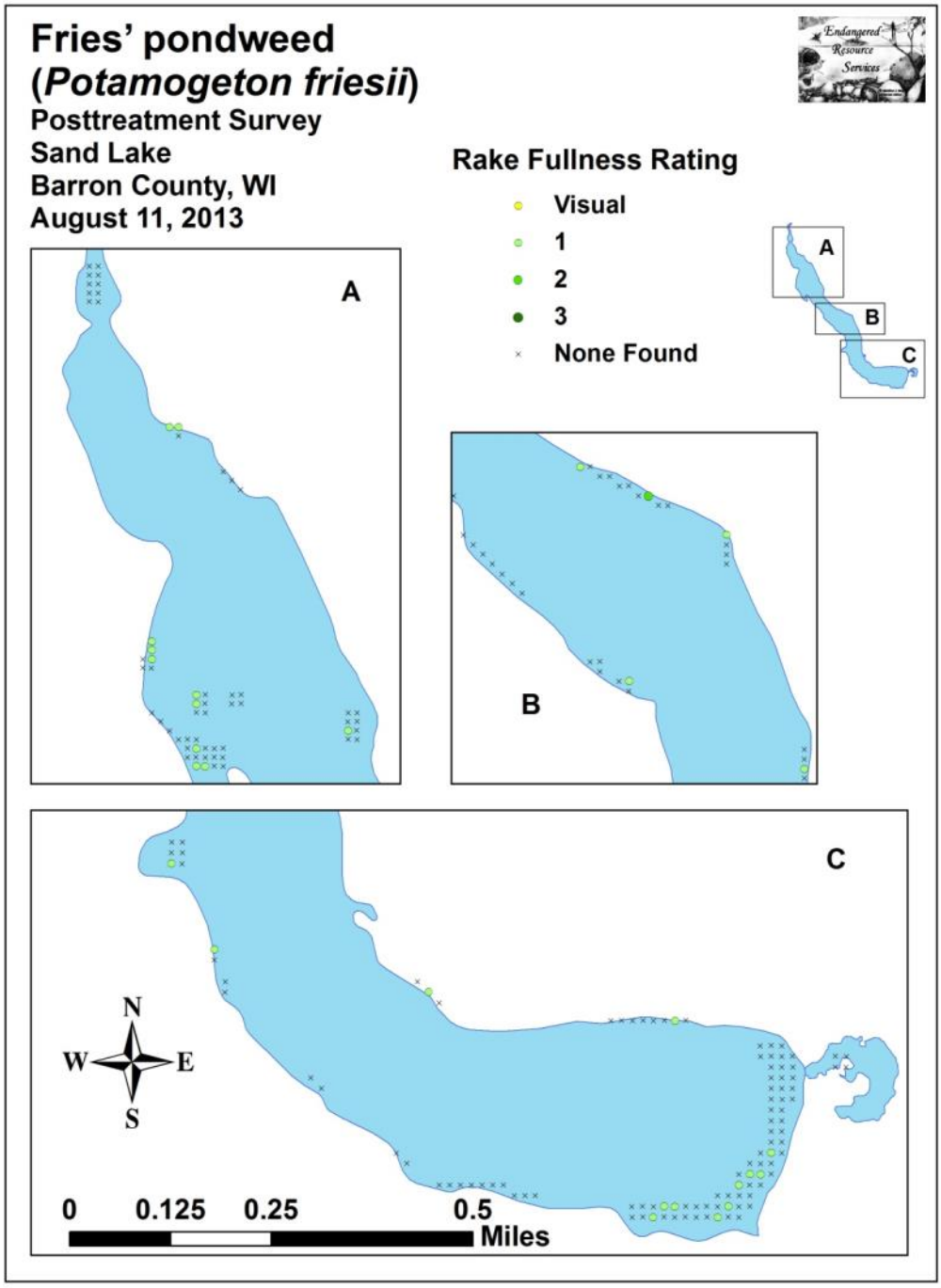
Miles


Fries' pondweed
(Potamogeton friesii)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
A
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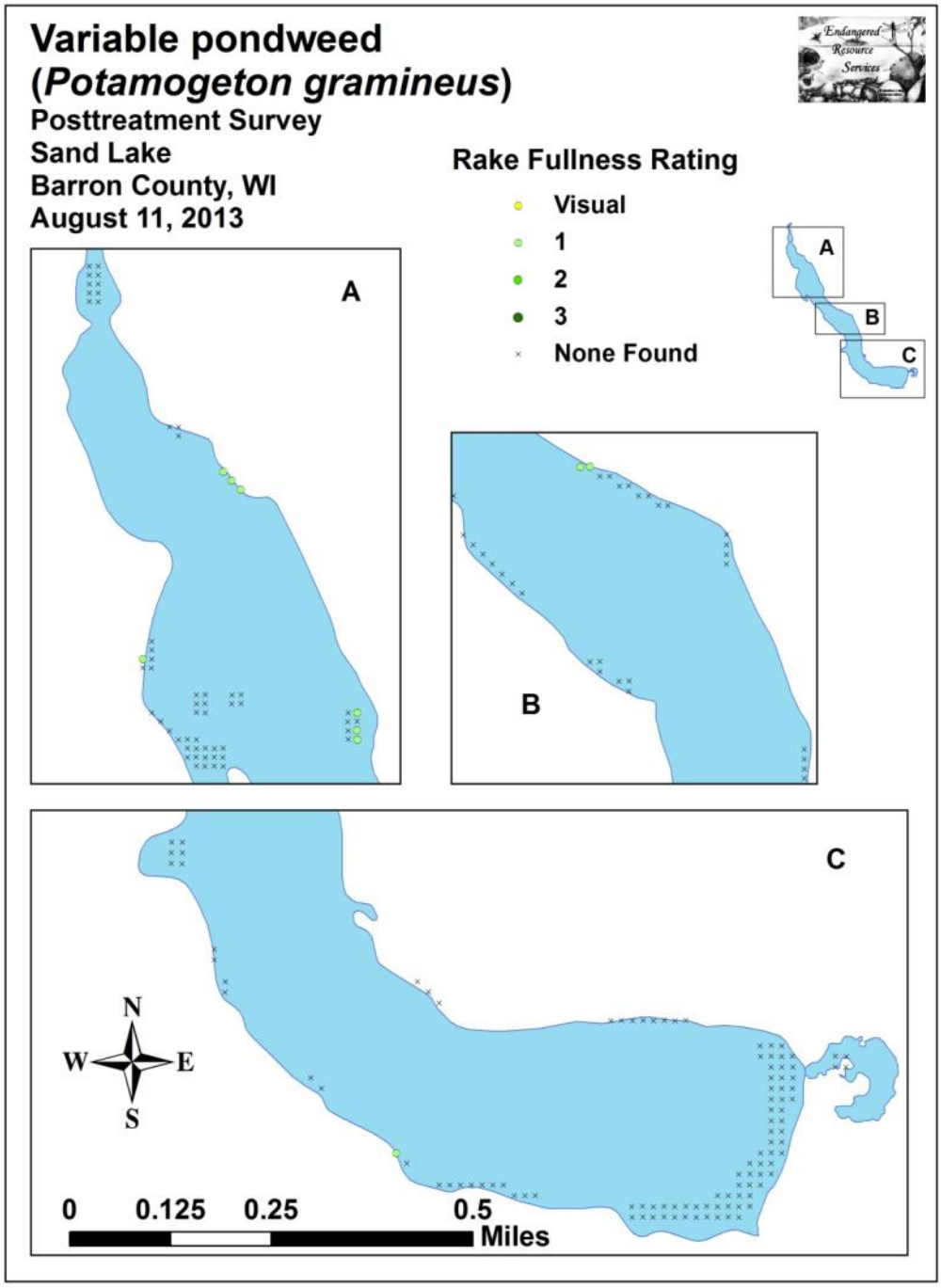
Miles


Variable pondweed
(Potamogeton gramineus)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
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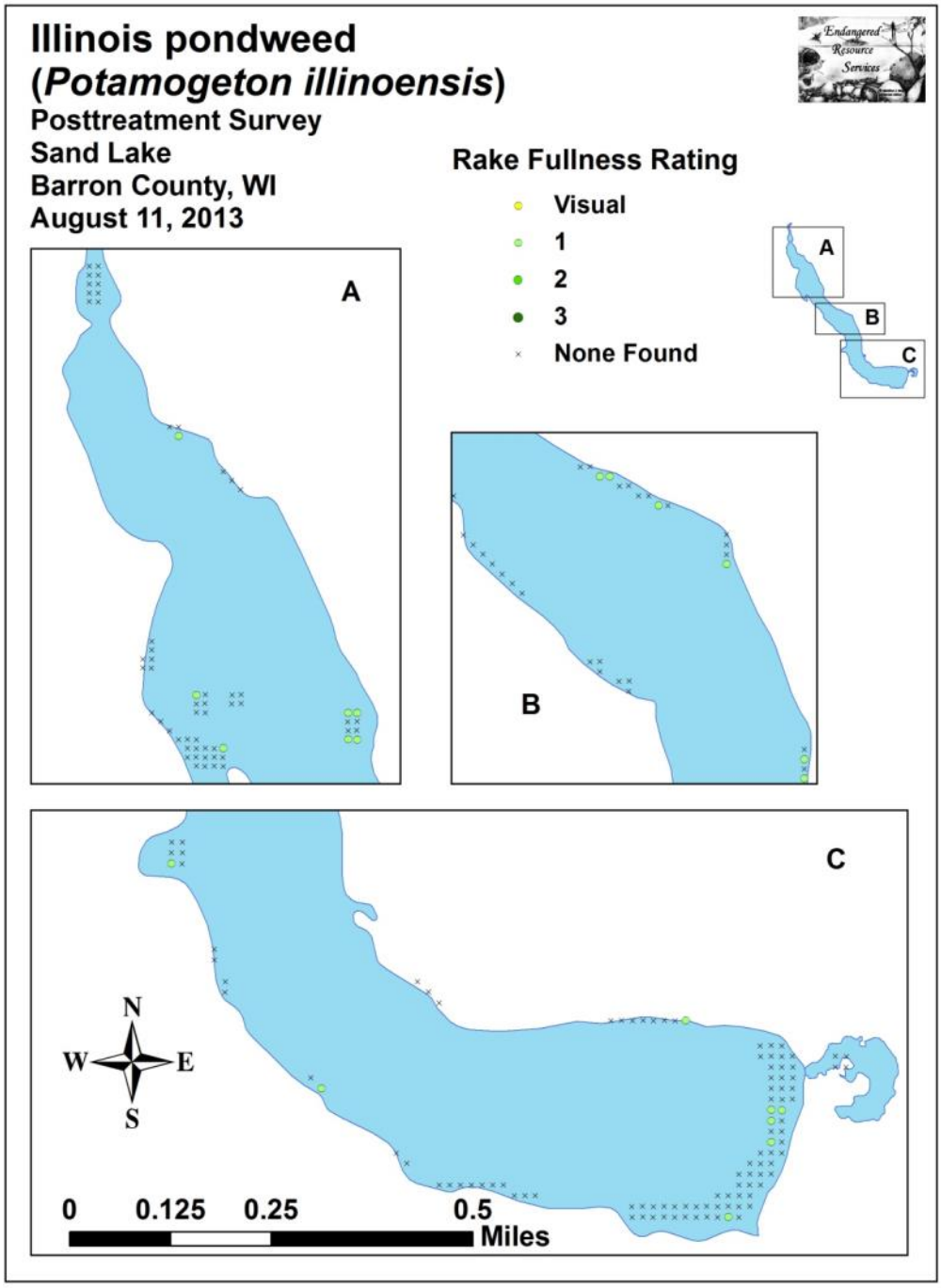
Miles


Illinois pondweed
(Potamogeton illinoensis)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
A
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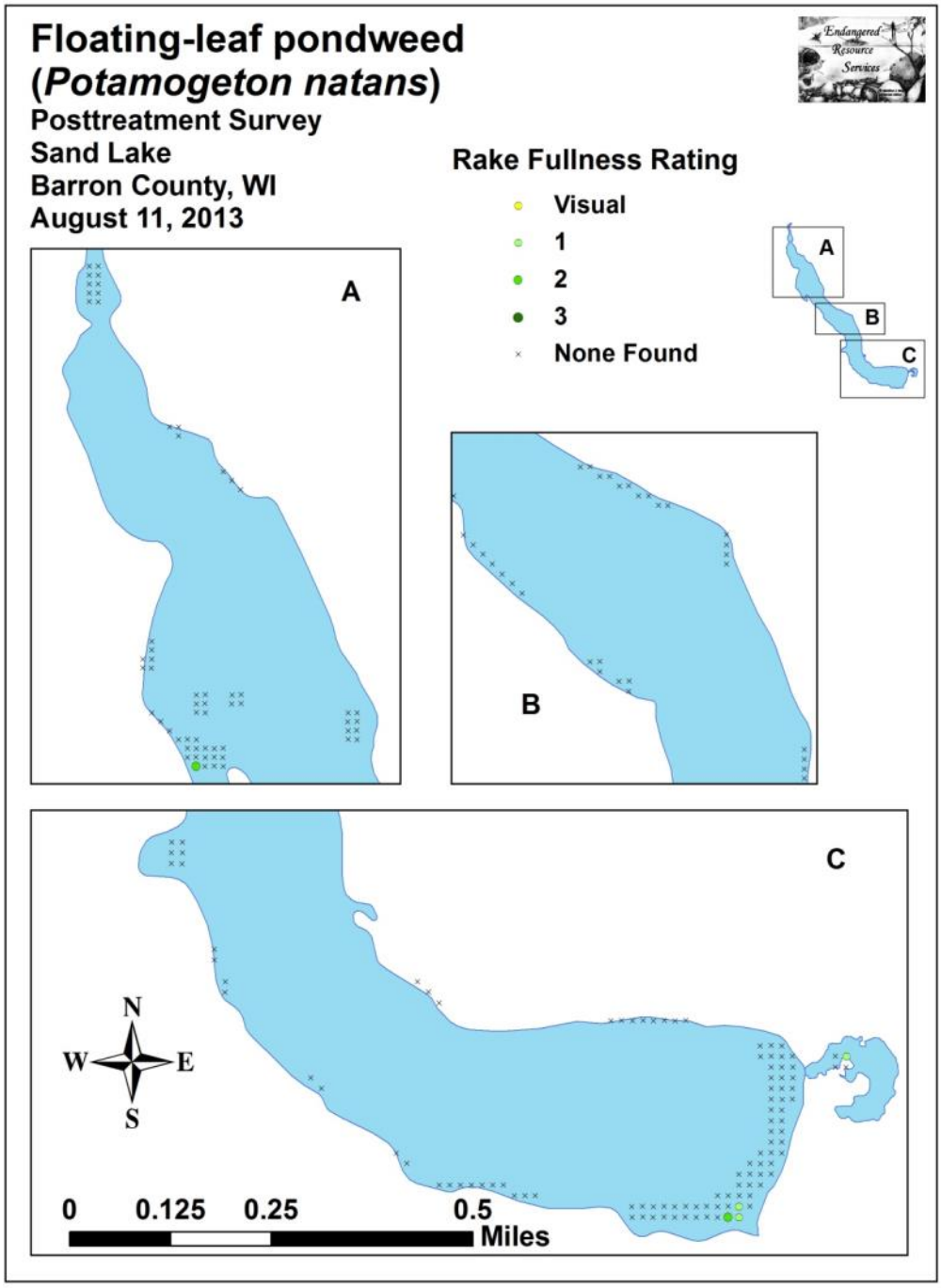
0.25
0.5
Miles


Floating-leaf pondweed
(Potamogeton natans)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
A
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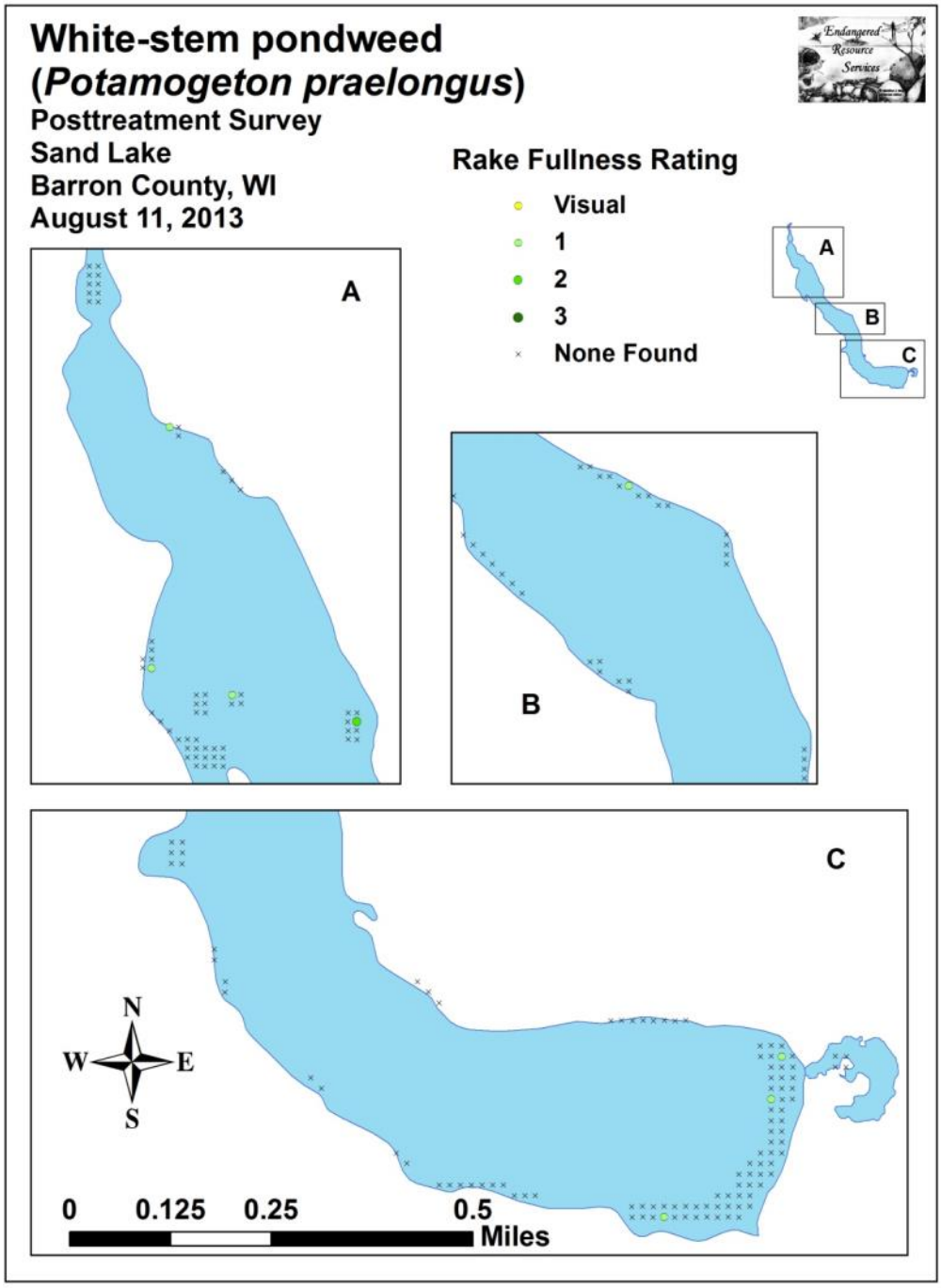
0.5
Miles


White-stem pondweed
(Potamogeton praelongus)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
A
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0.125
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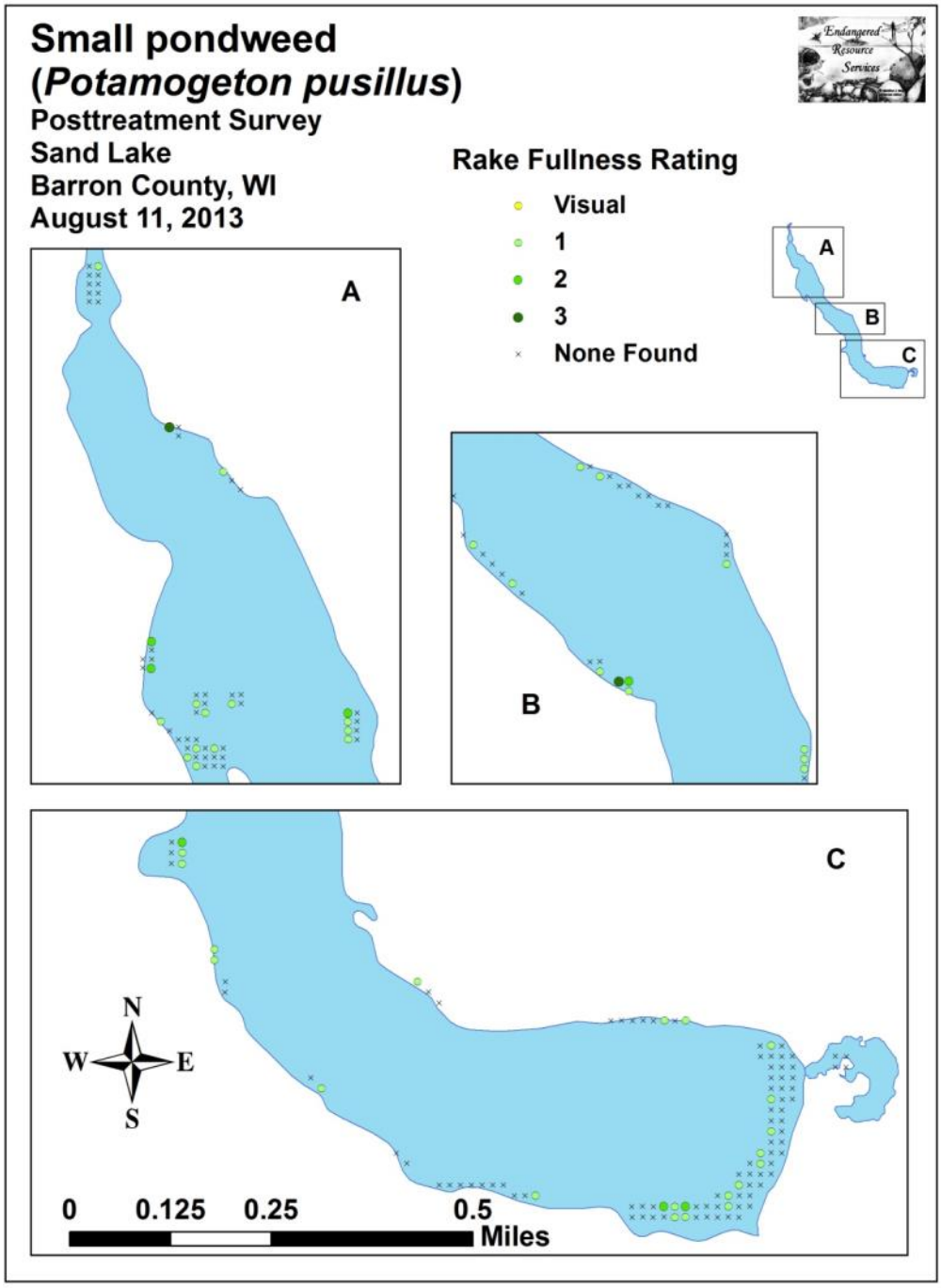
0.5
Miles


Small pondweed
(Potamogeton pusillus)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
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None Found
A
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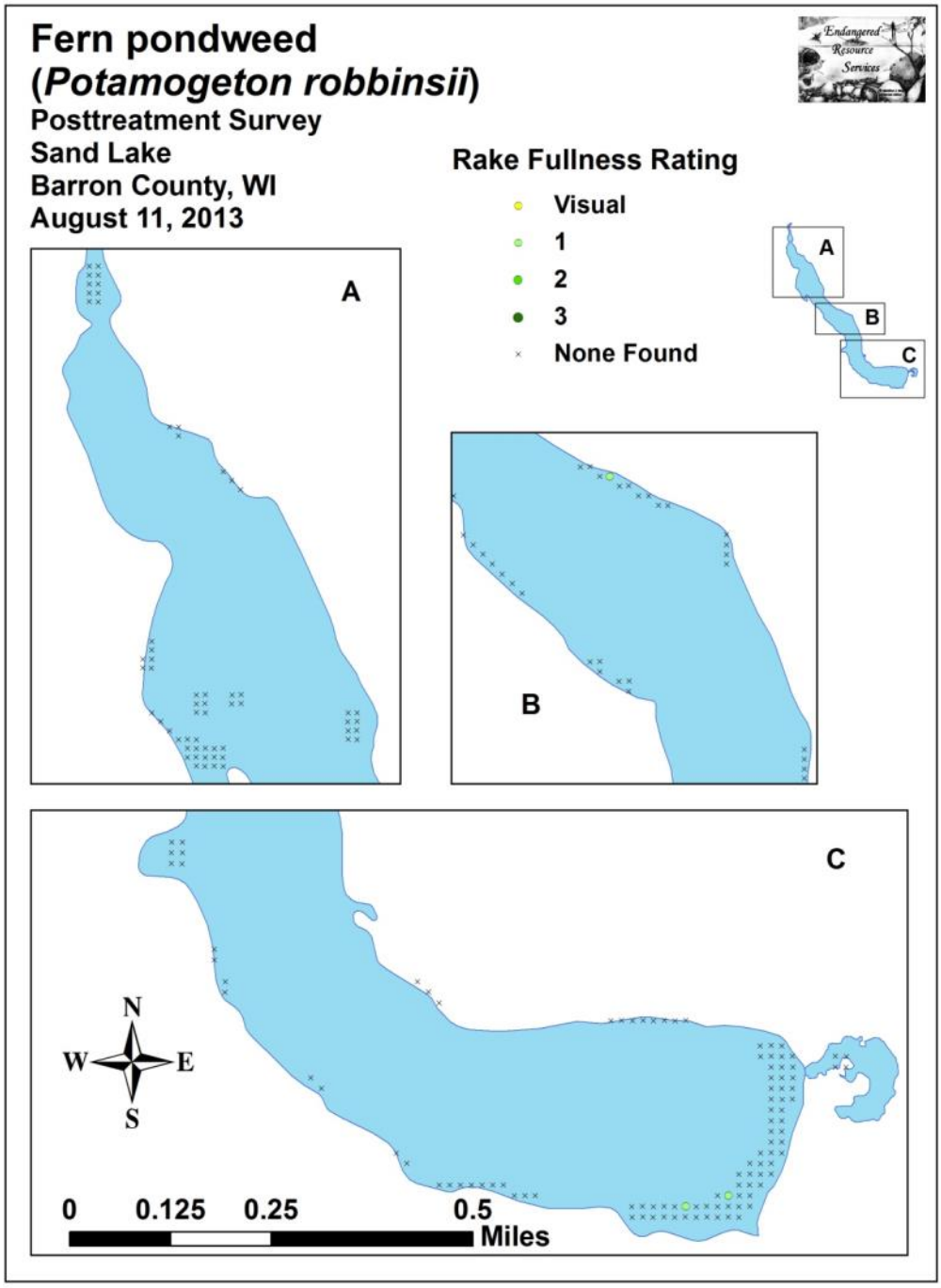
0.125
0.25
0.5
Miles


Fern pondweed
(Potamogeton robbinsii)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
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None Found
A
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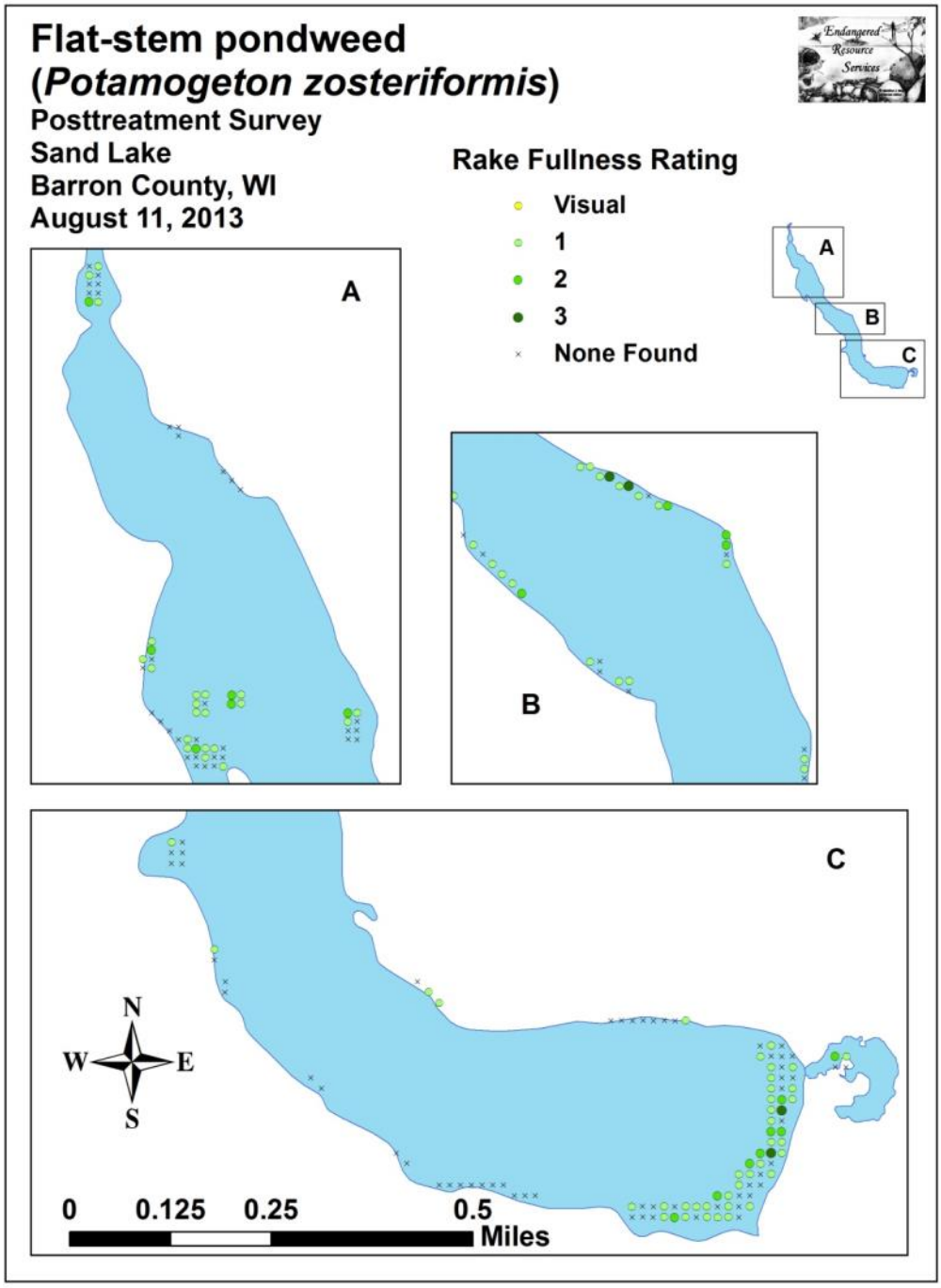
Miles


Flat-stem pondweed
(Potamogeton zosteriformis)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
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3
None Found
A
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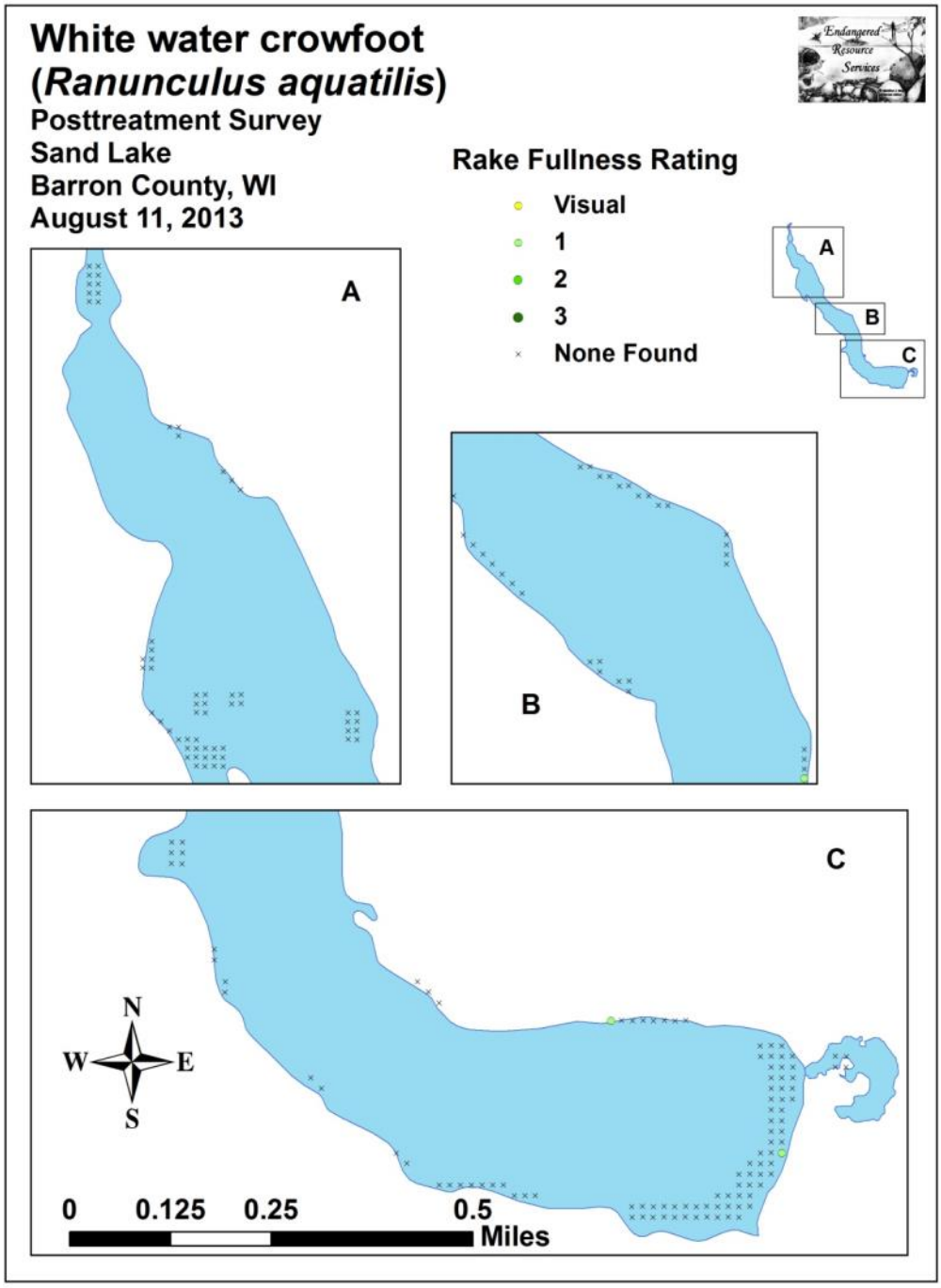
0.125
0.25
0.5
Miles


White water crowfoot
(Ranunculus aquatilis)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
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C
N
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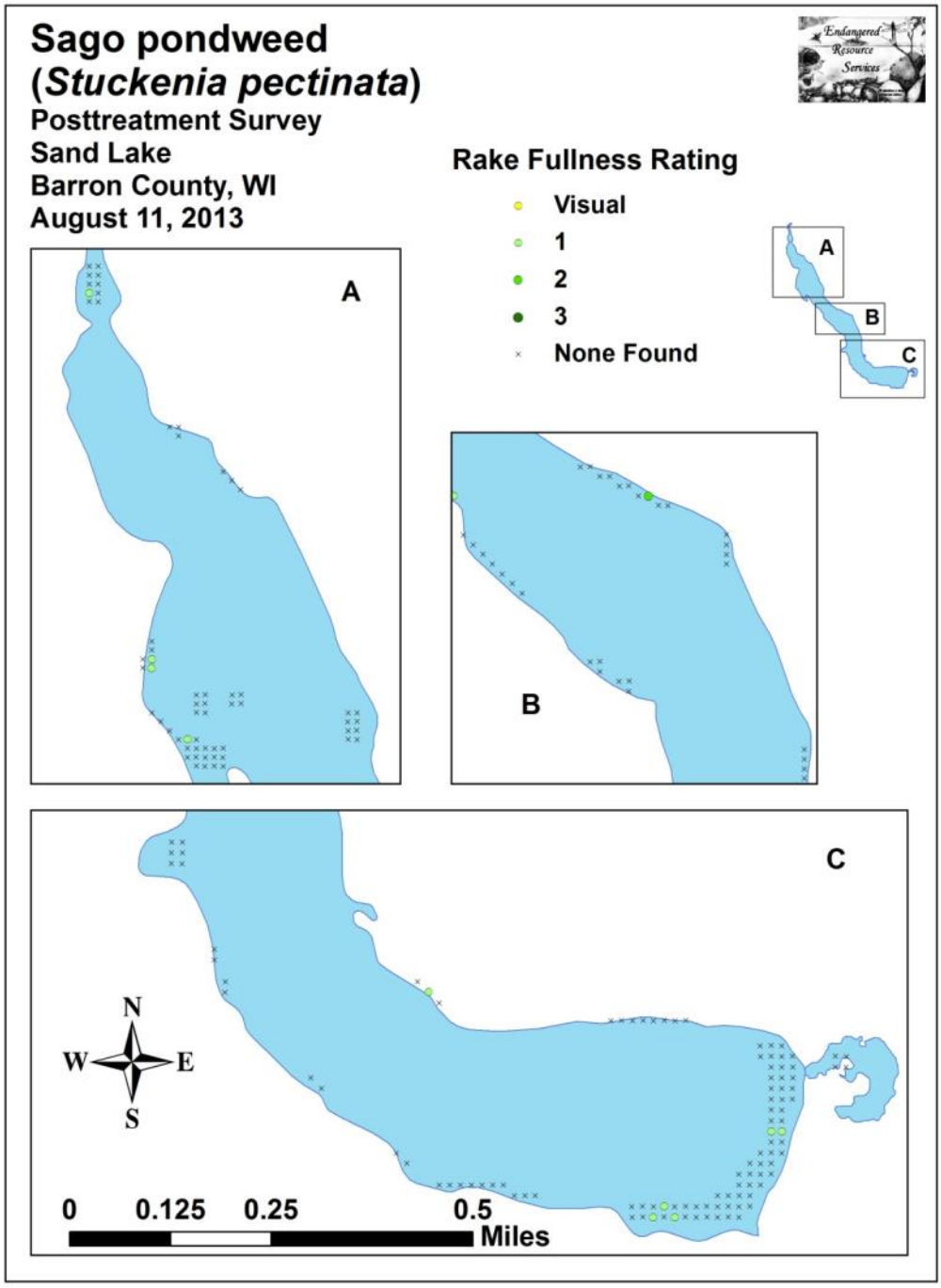
0.125
0.25
0.5
Miles


Sago pondweed
(Stuckenia pectinata)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
3
None Found
A
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N
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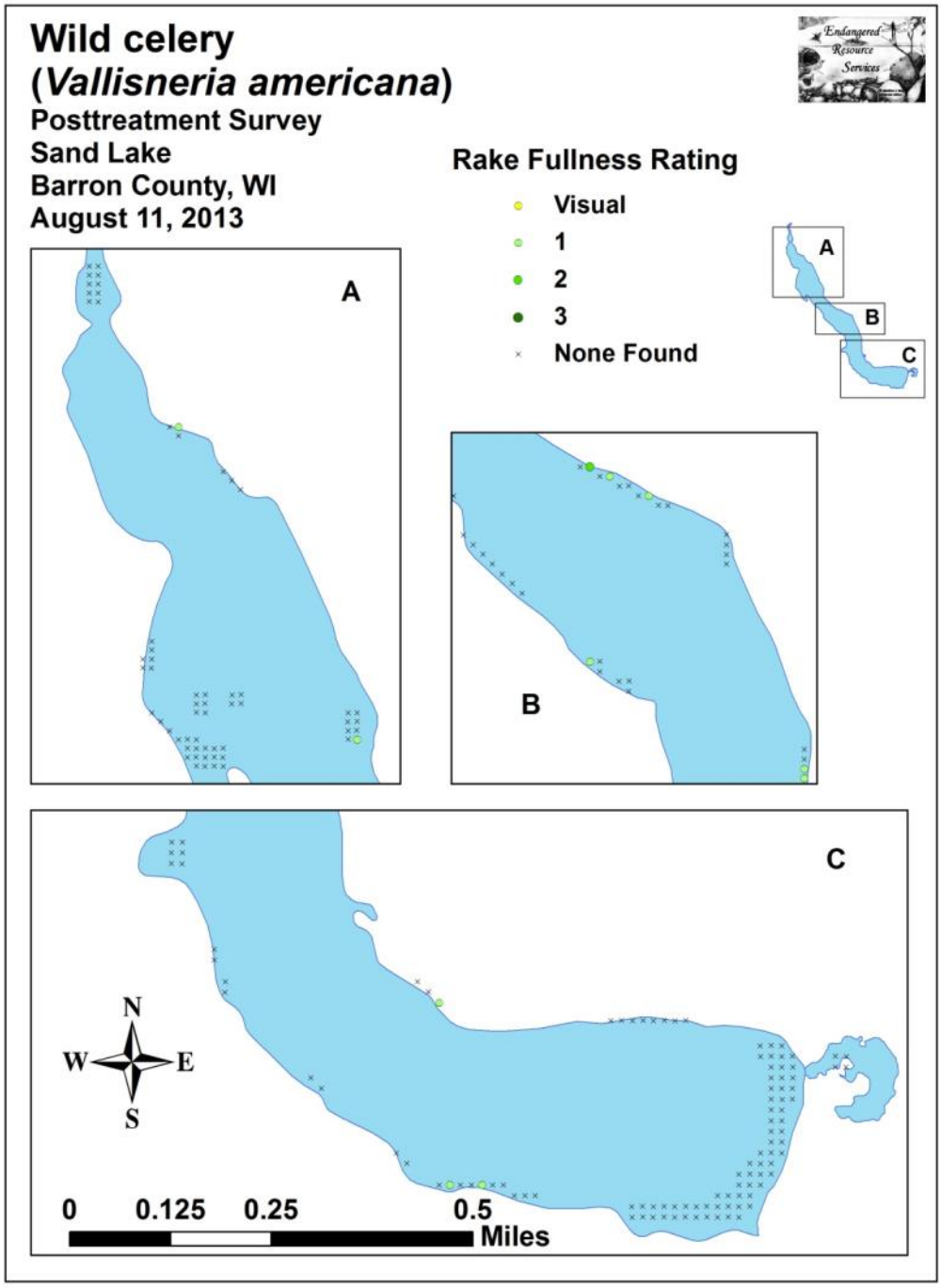
0.125
0.25
0.5
Miles


Wild celery
(Vallisneria americana)
Posttreatment Survey
Sand Lake
Barron County, WI
August 11, 2013
Endangered Resource Services
Rake Fullness Rating
Visual
1
2
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None Found
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0.125
0.25
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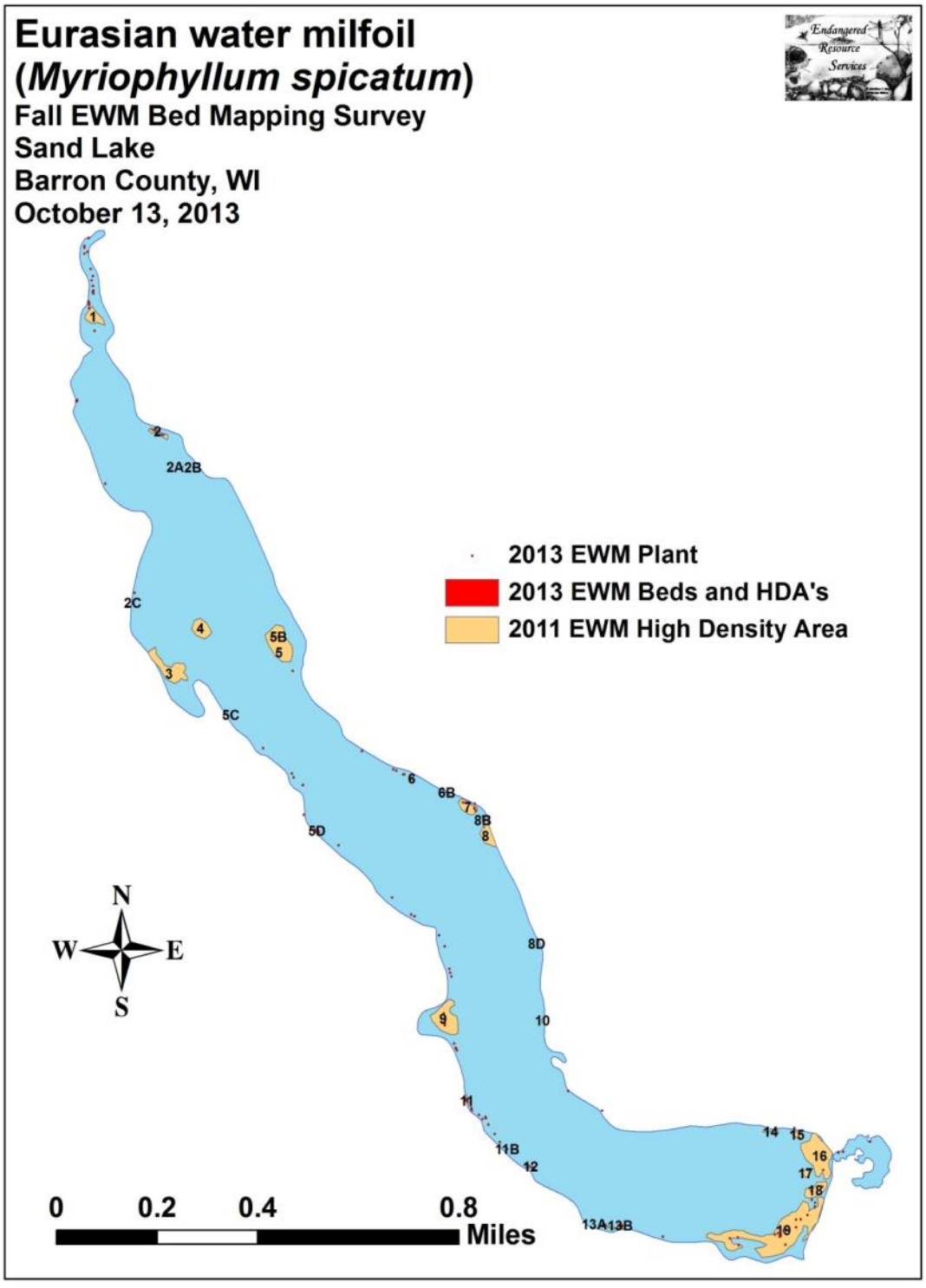
Miles

Appendix VIII: Sand Lake Fall 2013 EWM Survey Map


Eurasian water milfoil
(Myriophyllum spicatum)
Fall EWM Bed Mapping Survey
Sand Lake
Barron County, WI
October 13, 2013
Endangered Resource Services
2013 EWM Plant
2013 EWM Beds and HDA's
2011 EWM High Density Area
N
W
E
S
0
0.2
0.4
0.8
Miles
1
2
2A2B
2C
3
4
5
5B
5C
5D
6
6B
7
8
8B
8D
9
10
11
11B
12
13A13B
14
15
16
17
18
19