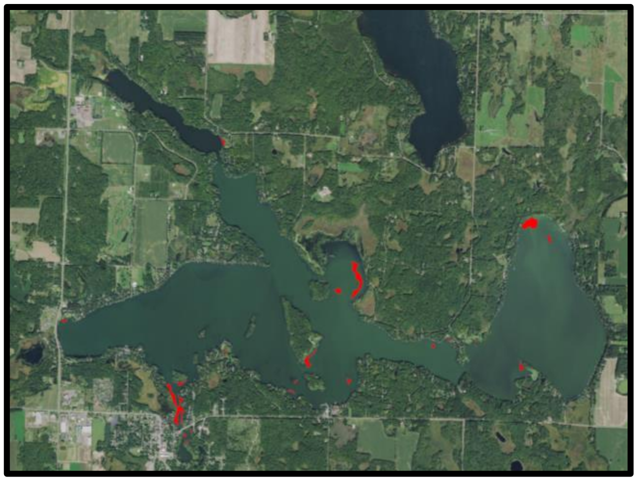
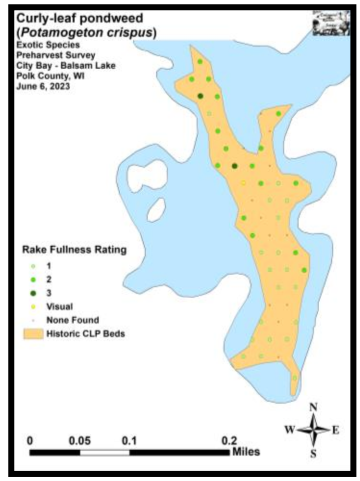
Curly-leaf Pondweed (*Potamogeton crispus*)
Preharvest Surveys
City Bay – Balsam Lake - WBIC: 2620600
Polk County, Wisconsin



Spring 2023 Curly-leaf Pondweed Beds



2023 CLP Preharvest in City Bay

Project Initiated by:
Balsam Lake Protection and Rehabilitation District and the
Wisconsin Department of Natural Resources – Grant ACEI21218

Rake of Curly-leaf pondweed

Surveys Conducted by and Report Prepared by:
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May 31, 2021, May 30, 2022, and June 6, 2023

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INTRODUCTION:

Balsam Lake (WBIC 2620600) is a 2,054-acre stratified drainage lake in central Polk County, Wisconsin in the Towns of Balsam Lake, Milltown, Georgetown, and Apple River (T34N R17W) (Figure 1). It reaches a maximum depth of 37ft north of Cedar Island in the western basin and has an average depth of 20ft (Hopke et al. 1964). The lake is mesotrophic bordering on eutrophic in nature, and water clarity is fair with summer Secchi readings over the last 10 years averaging 3.5ft in East Balsam, 6.1ft in Little Balsam, and 10.2ft in the deep hole north of Cedar Island (WDNR 2023). The lake's bottom substrate is variable with organic muck in most bays, and rock/sand in the Big and Little Narrows and around the lake's many islands.

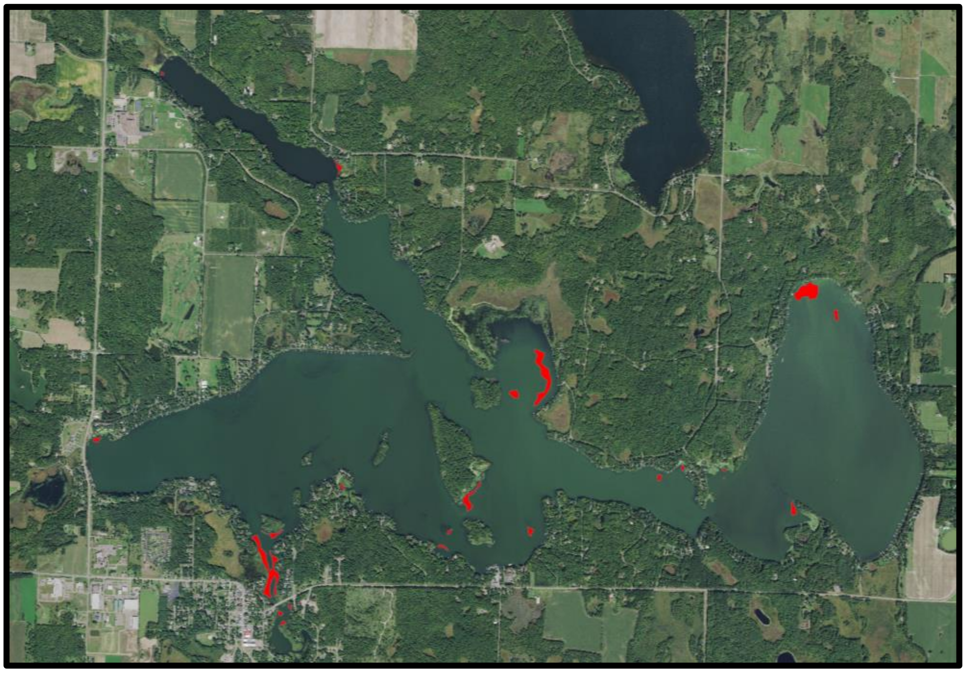


Figure 1: Balsam Lake with 2023 CLP Beds

BACKGROUND AND STUDY RATIONALE:

Curly-leaf pondweed (*Potamogeton crispus*) (CLP) is an invasive exotic plant that is common to abundant in parts of Balsam Lake. In their 2010 and 2015 Wisconsin Department of Natural Resources (WDNR) approved Aquatic Plant Management Plans (APMP), the Balsam Lake Protection and Rehabilitation District's (BLPRD) identified a) reducing overall lake coverage of CLP to <20 acres and b) relieving navigation impairment caused by canopied CLP beds as management goals (Clemens 2010, Clemens 2015). As part of their continuing efforts to meet these goals, the BLPRD is actively engaged in both herbicide treatments and mechanical harvesting. Although levels of CLP and native plants before and after herbicide use have been carefully studied, the long-term impacts of harvesting on the lake's vegetation have not been quantified. Because of this, the BLPRD and Harmoney Environmental (HE) requested we initiate annual preharvest sub point-intercept surveys of all plant species and fall CLP turion surveys in City Bay north of the CTH I bridge/south of First Island within areas historically dominated by CLP.

METHODS:

Preharvest Point-intercept Macrophyte Survey:

Starting with the spring 2020 survey that outlined a 9.81-acre Curly-leaf pondweed bed in City Bay, we used Hawth's Analysis Tools Extension to ArcGIS 9.3.1 to generate regular points at the rate of just over five points/acre within the historic bed. This produced a 50-point sampling grid which was used during each survey to allow for direct comparisons (Figure 2) (Appendix I).

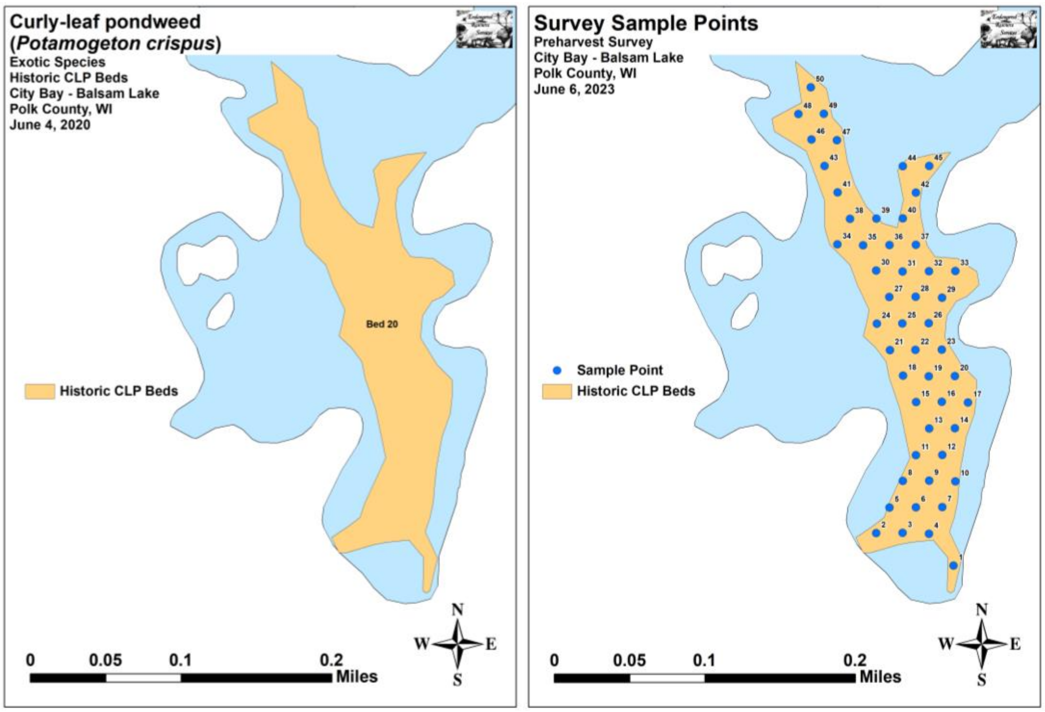


Figure 2: Survey Sample Points in Historic CLP Beds

These points were uploaded to a handheld mapping GPS (Garmin 76CSx) and located on the lake. At each point, we recorded the depth and bottom substrate and used a rake to sample an approximately 2.5ft section of the bottom. CLP was assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 3). We also recorded visual sightings of CLP within six feet of the sample point. Because visual sightings are not calculated into the statistical formulas, we only assigned a rake fullness value for non-CLP plants. A cumulative rake fullness value was also noted.

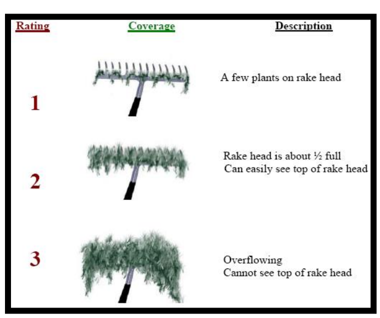


Figure 3: Rake Fullness Ratings

We entered all data collected into the standard APM spreadsheet (Appendix II), and data was analyzed using the linked statistical summary sheet. For pre/post differences of individual plant species and count data, we used the Chi-square analysis on the WDNR pre/post survey worksheet (UWEX 2010). For comparing averages (mean species/point and mean rake fullness/point), we used t-tests. Differences were determined to be significant at $p<0.05$, moderately significant at $p<0.01$ and highly significant at $p<0.001$.

RESULTS AND DISCUSSION:

Preharvest Surveys:

All points occurred in areas between 2.0ft and 10.0ft of water. During the pretreatment survey, we found the mean and median depths of plant growth were 7.4ft and 7.5ft respectively during each of the three surveys (Table 1). Most CLP was established over nutrient-rich organic muck, but we also found scattered plants in the few areas that had sandy muck substrates (Figure 4) (Appendix III).

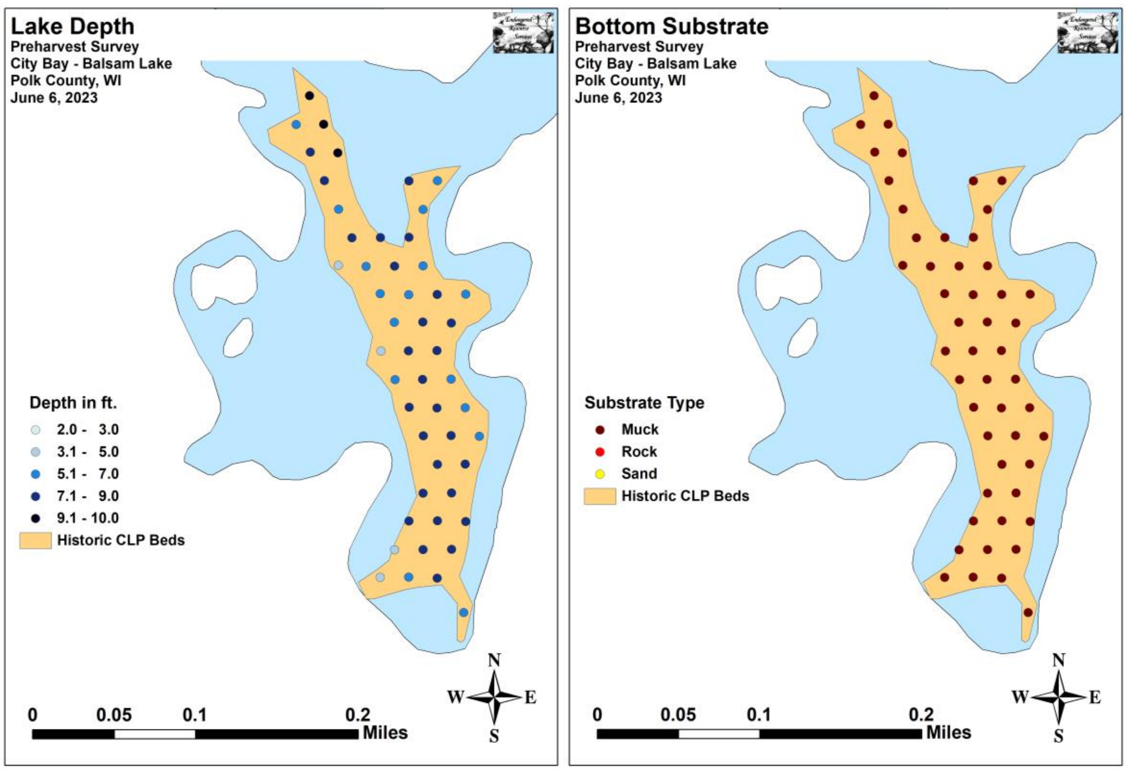


Figure 4: CLP Area Depths and Bottom Substrate

The entire study area fell within the littoral zone, and plants were found at all points during each survey. In 2021 and 2022, the maximum depth of vegetation was 10.5ft before falling slightly to 10.0ft in 2023 (Figure 5) (Appendix IV).

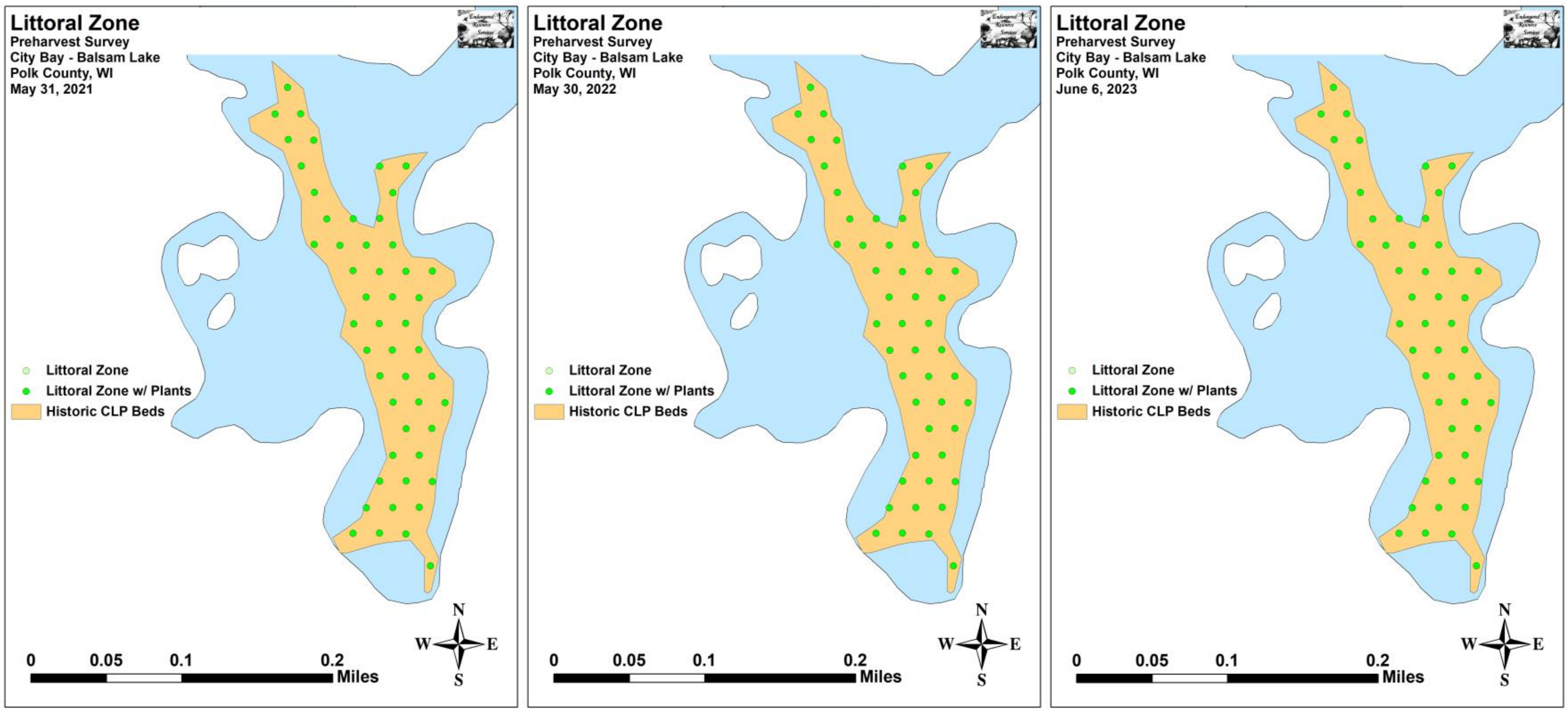


Figure 5: 2021, 2022, and 2023 Preharvest Littoral Zone

Table 1: Preharvest Surveys Summary Statistics
City Bay – Balsam Lake – Polk County, WI
May 31, 2021, May 30, 2022, and June 6, 2023

Summary Statistics:	5/31/21	5/30/22	6/6/23
Total number of points sampled	50	50	50
Total number of sites with vegetation	50	50	50
Total number of sites shallower than the maximum depth of plants	50	50	50
Frequency of occurrence at sites shallower than maximum depth of plants	100.00	100.00	100.00
Simpson Diversity Index	0.87	0.81	0.82
Mean Coefficient of Conservatism	6.4	6.3	6.1
Floristic Quality Index	25.8	21.7	20.2
Maximum depth of plants (ft)	10.5	10.5	10.0
Mean depth of plants (ft)	7.4	7.4	7.4
Median depth of plants (ft)	7.5	7.5	7.5
Average number of all species per site (shallower than max depth)	3.58	2.68	3.04
Average number of all species per site (veg. sites only)	3.58	2.68	3.04
Average number of native species per site (shallower than max depth)	2.98	2.00	2.30
Average number of native species per site (sites with native veg. only)	3.10	2.22	2.30
Species richness	17	13	12
Mean rake fullness (veg. sites only)	2.18	2.24	1.98

Total species richness declined from 17 in 2021 to 13 in 2022 to 12 in 2023. The Simpson's Diversity Index also declined from 0.87 in 2021 to 0.81 in 2022 before recovering slightly to 0.82 in 2023. The Floristic Quality Index, another measure of the native plant community health, declined from 25.8 in 2021 to 21.7 in 2022 with a further decline to 20.2 in 2023. Mean native species richness at points with native vegetation experienced a highly significant decline **(p<0.001)** from 3.58 species/point in 2021 to 2.22 species/point in 2022. However, it underwent a highly significant increase **(p<0.001)** to 3.04 species/point in 2023 (Figure 6). Although this initial decline could be related to the harvesting program, it should be noted that growth for many species in 2022 and 2023 appeared to be much behind normal due to the exceptionally late ice-out seen during each of these years. Although anecdotal, this could be a contributing factor to the observed declines in total richness since the original 2021 survey.

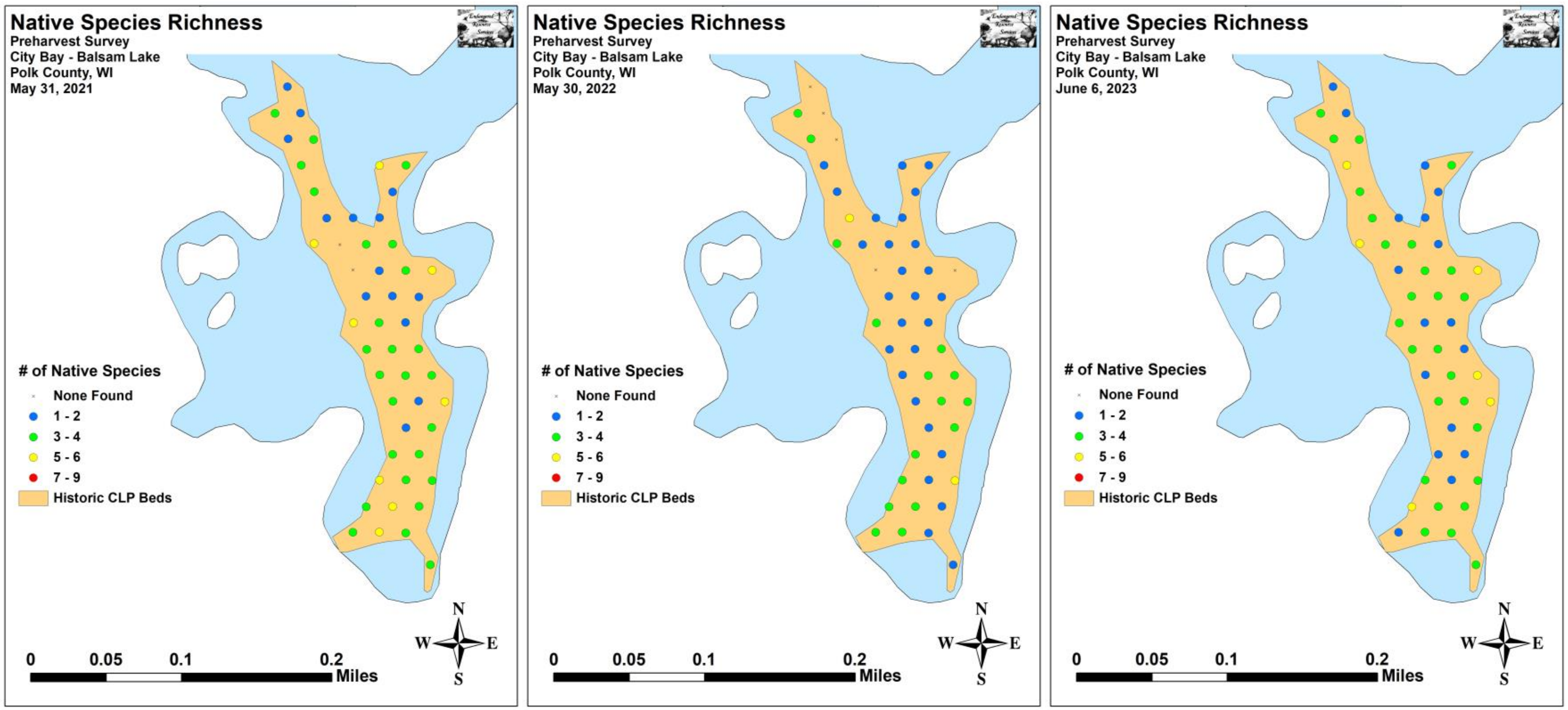


Figure 6: 2021, 2022, and 2023 Preharvest Native Species Richness

The total mean rake fullness during the 2021 survey was a moderate 2.18. The 2022 survey found these levels were almost unchanged at 2.24 – a non-significant increase (p=0.27). In 2023, we found mean rake fullness underwent a moderately significant decline **(p=0.004)** to a moderate 1.98 (Figure 7) (Appendix IV).

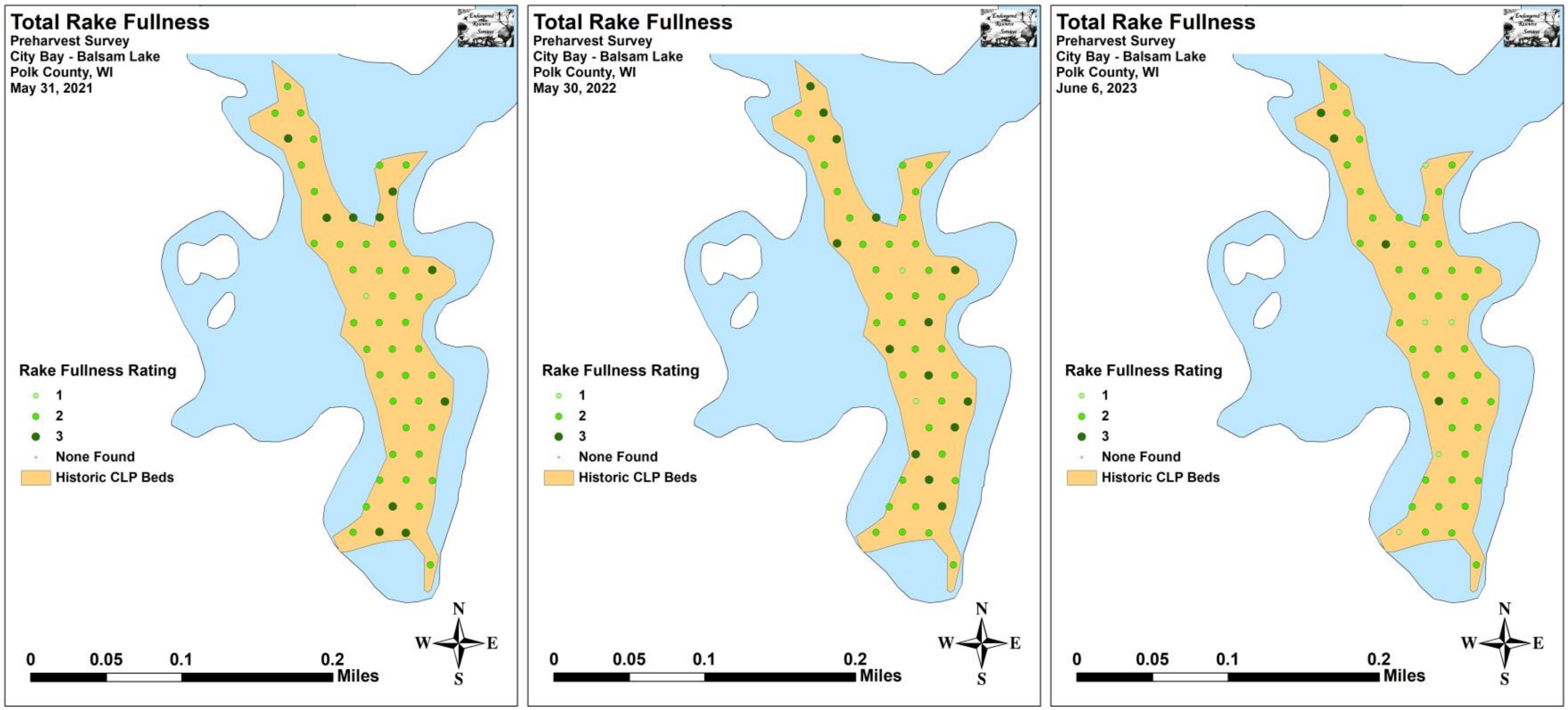


Figure 7: 2021, 2022, and 2023 Preharvest Total Rake Fullness

In 2021, we found Curly-leaf pondweed at 30 of 50 sites (60.0% coverage) during the preharvest survey (Figure 8). Of these, four points had a rake fullness rating of 3, 15 rated a 2, and 11 were a 1. This produced a mean rake fullness of 1.77 and suggested 38.0% of the beds had a significant infestation (rake fullness of 2 or 3). CLP was also recorded as a visual at eight points (Appendix V).

The 2022 survey documented CLP at 34 points (68.0% coverage) – a non-significant increase (p=0.40) in distribution when compared to 2021 (Figure 8). We rated seven of these points a 3, 12 points a 2 (38.0% significant infestation), and the remaining 15 points a 1. This produced a mean rake fullness of 1.76 – a non-significant decrease (p=0.50) compared to 2021 levels. Similarly, none of the changes in rake fullness rating were significantly different; however, the decline in visual sightings was **moderately significant (*p*=0.002)** (Figure 9).

Our 2023 survey found CLP at 37 sites (74.0% coverage) (Figure 8). Although this further increase in distribution was not significant (p=0.51), its decline in mean rake fullness to 1.54 was nearly significant (p=0.09). Broken out by density, two points rated a rake fullness of 3, 16 points rated a rake fullness of 2 (36.0% significant infestation), and the remaining 19 were a rake fullness of 1. We also recorded CLP as a visual at a single point. None of these changes were significantly different when compared to the 2022 survey (Figure 9).

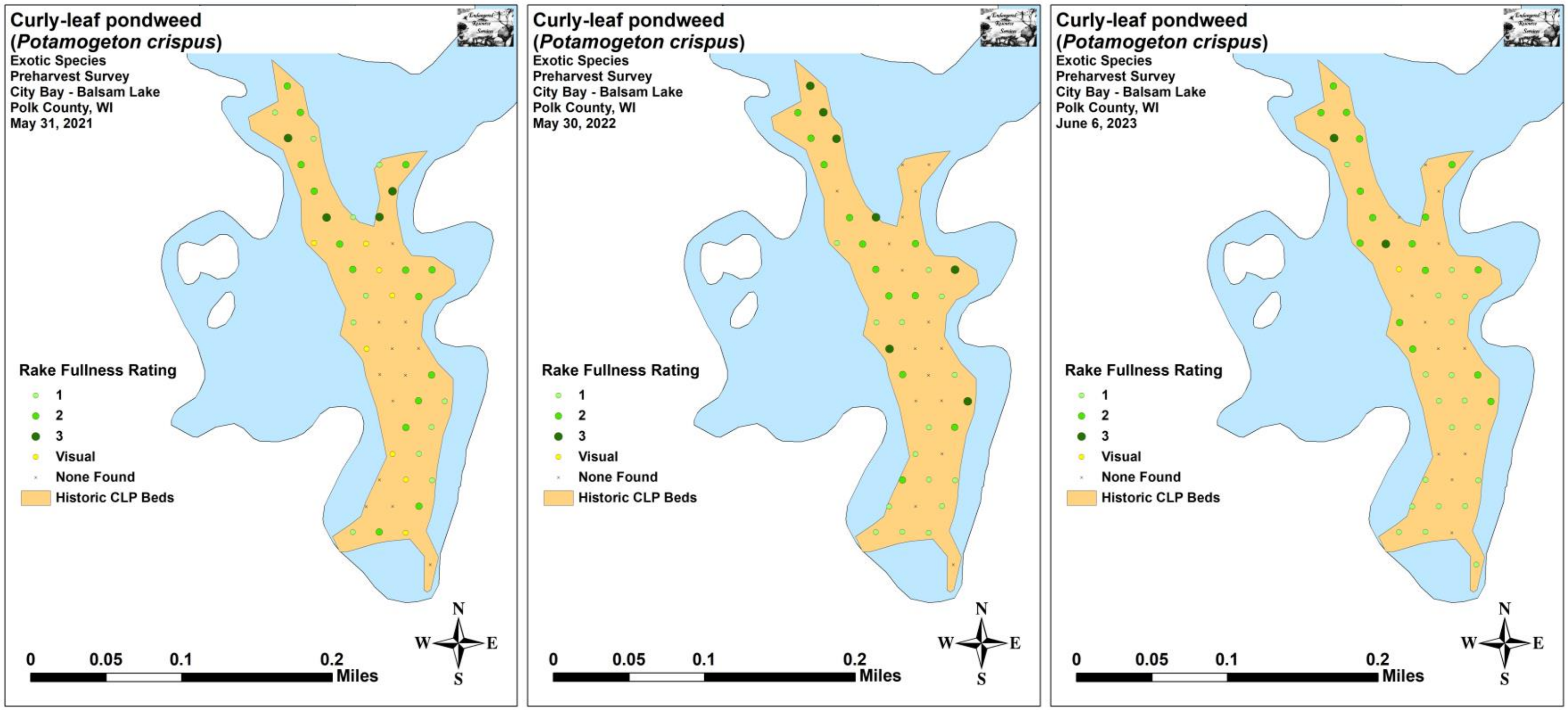
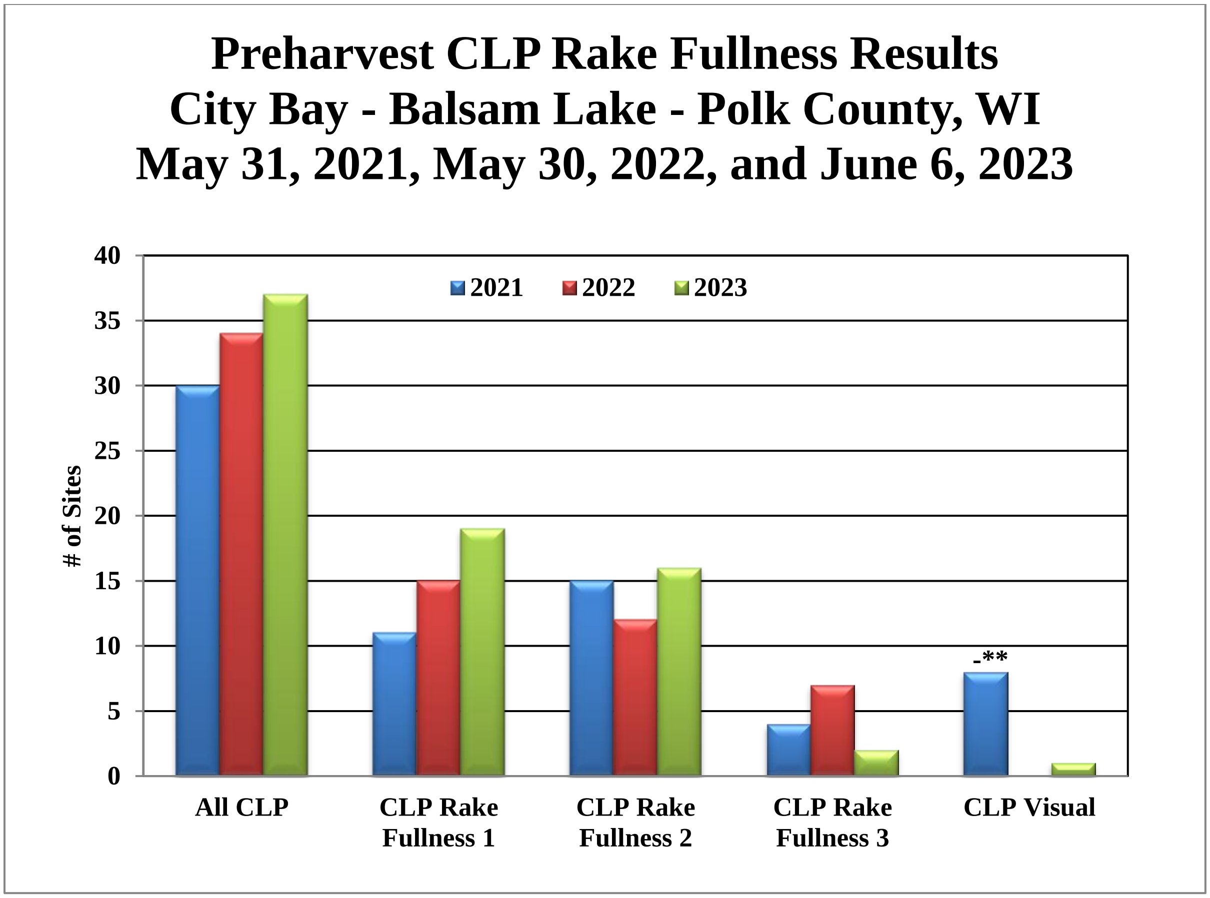


Figure 8: 2021, 2022, and 2023 Preharvest CLP Density and Distribution



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

Figure 9: 2021, 2022, and 2023 Preharvest Changes in CLP Rake Fullness

Coontail (*Ceratophyllum demersum*) was the most common native species during each of the three surveys (Figure 10) (Tables 2-4). From 2021 to 2022, it experienced non-significant increases (p=0.48/p=0.17) in both distribution (37 sites in 2021/40 sites in 2022) and density (mean rake 1.68 in 2021/1.83 in 2022). Our 2023 survey found its distribution was unchanged (40 sites), but it had undergone a moderately significant decline **(p=0.004)** in density (mean rake of 1.45).

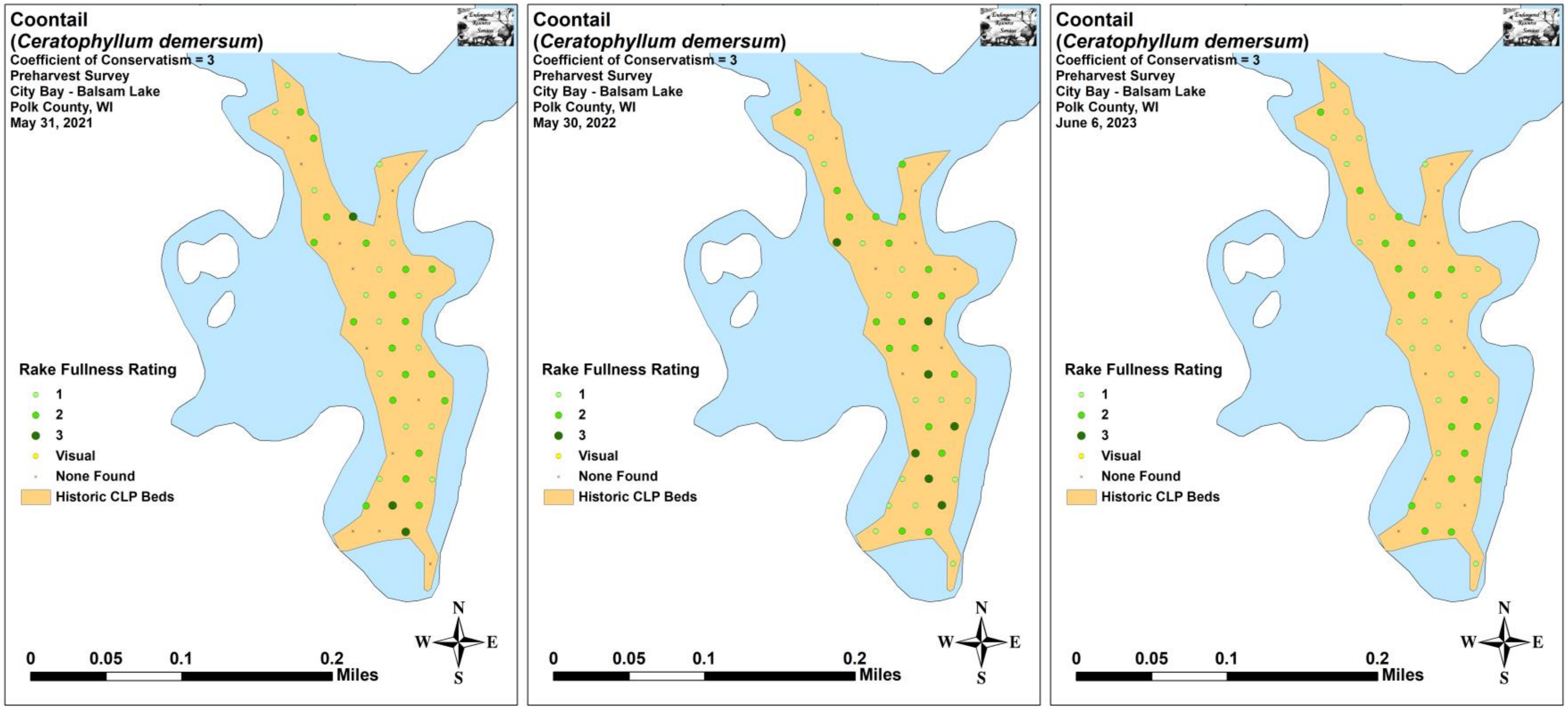


Figure 10: 2021, 2022, and 2023 Preharvest Coontail Density and Distribution

Common waterweed (*Elodea canadensis*), the second most common native species in 2021, underwent a highly significant decline **(*p*<0.001)** in distribution (32 sites in 2021/14 sites in 2022) and fell to the third most common species in 2022 (Figure 11). It also underwent a significant decline **(*p*=0.04)** in density from a mean rake of 1.47 in 2021 to 1.21 in 2022. This species was little changed in 2023 as neither its increase in distribution (16 sites) nor density (mean rake fullness of 1.44) were significant (*p*=0.66/*p*=0.10), and it remained the third-ranked native species in the overall plant community.

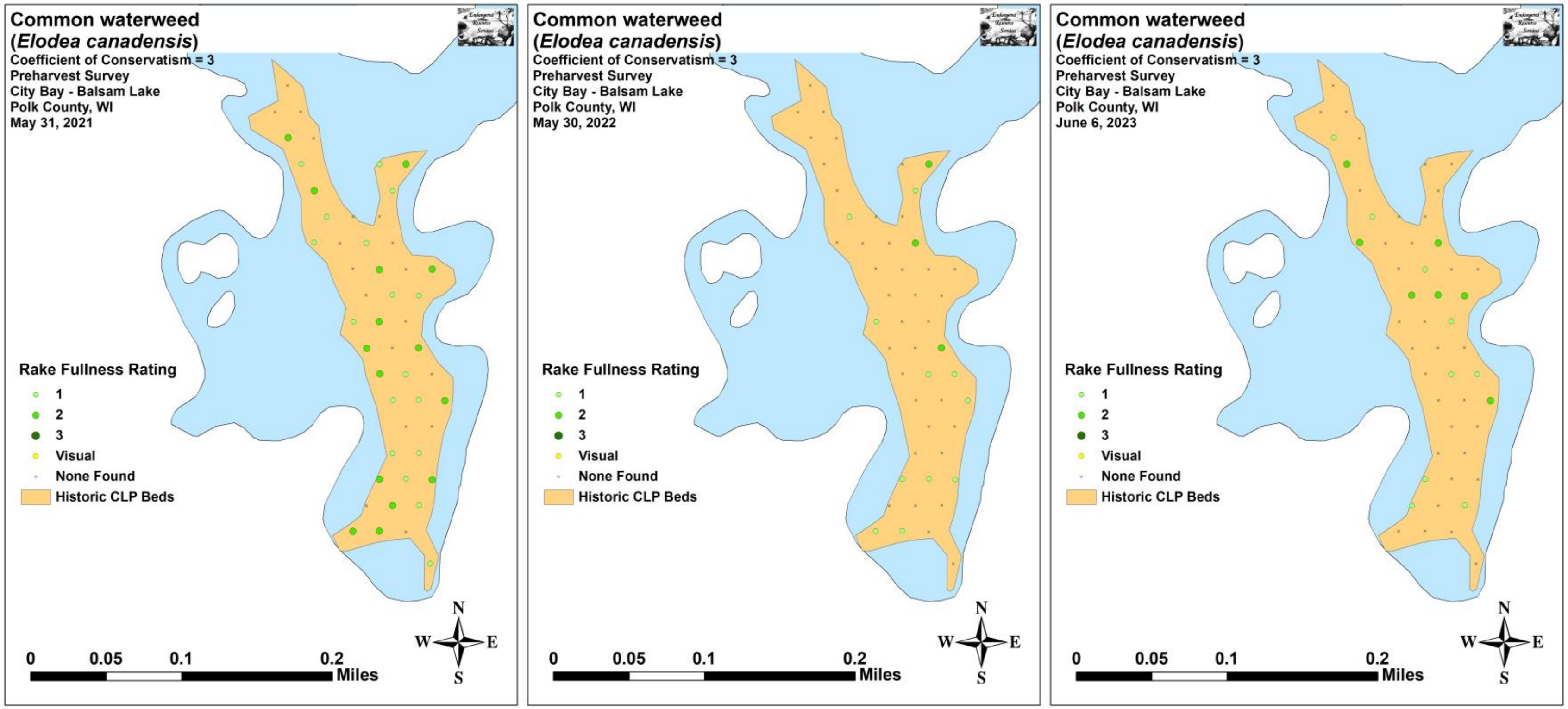


Figure 11: 2021, 2022, and 2023 Preharvest Common Waterweed Density and Distribution

Flat-stem pondweed (*Potamogeton zosteriformis*) was the third most common native species in 2021 and the fourth most common in both 2022 and 2023 (Figure 12). The 2021 survey found it at 20 sites with a mean rake fullness of 1.20. In 2022, we found it had undergone a significant decline **(*p*=0.02)** in distribution (nine sites) and a non-significant decline (*p*=0.27) in density (mean rake 1.11). The 2023 survey documented an increase in distribution to 14 sites, but a decline in density to a mean rake of 1.07. However, neither of these changes were significant (*p*=0.23/*p*=0.30).

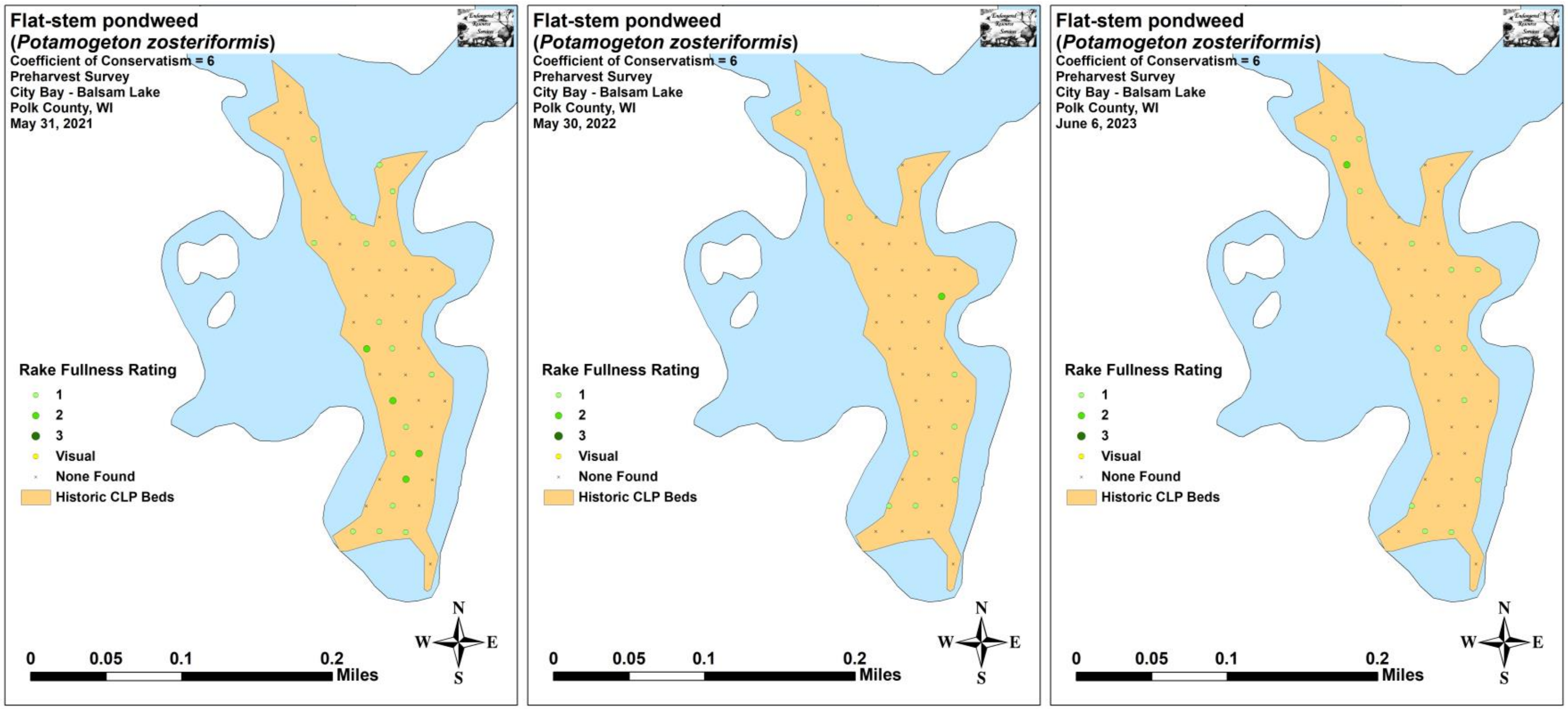


Figure 12: 2021, 2022, and 2023 Preharvest Flat-stem Pondweed Density and Distribution

From 2021 to 2022, Fern pondweed (*Potamogeton robbinsii*) increased its community rank from the fourth to the third most common native species (Figure 13). However, neither its increase in distribution (17 sites 2021/20 sites 2022), nor its increase in density (mean rake 1.41 2021/1.60 2022) were significant (p=0.53/p=0.13) over this time. In 2023, it became the second most common native species following a further non-significant increase (p=0.23) in distribution (26 sites). Although it declined slightly in density (mean rake fullness 1.58), this wasn't significant either (p=0.44).

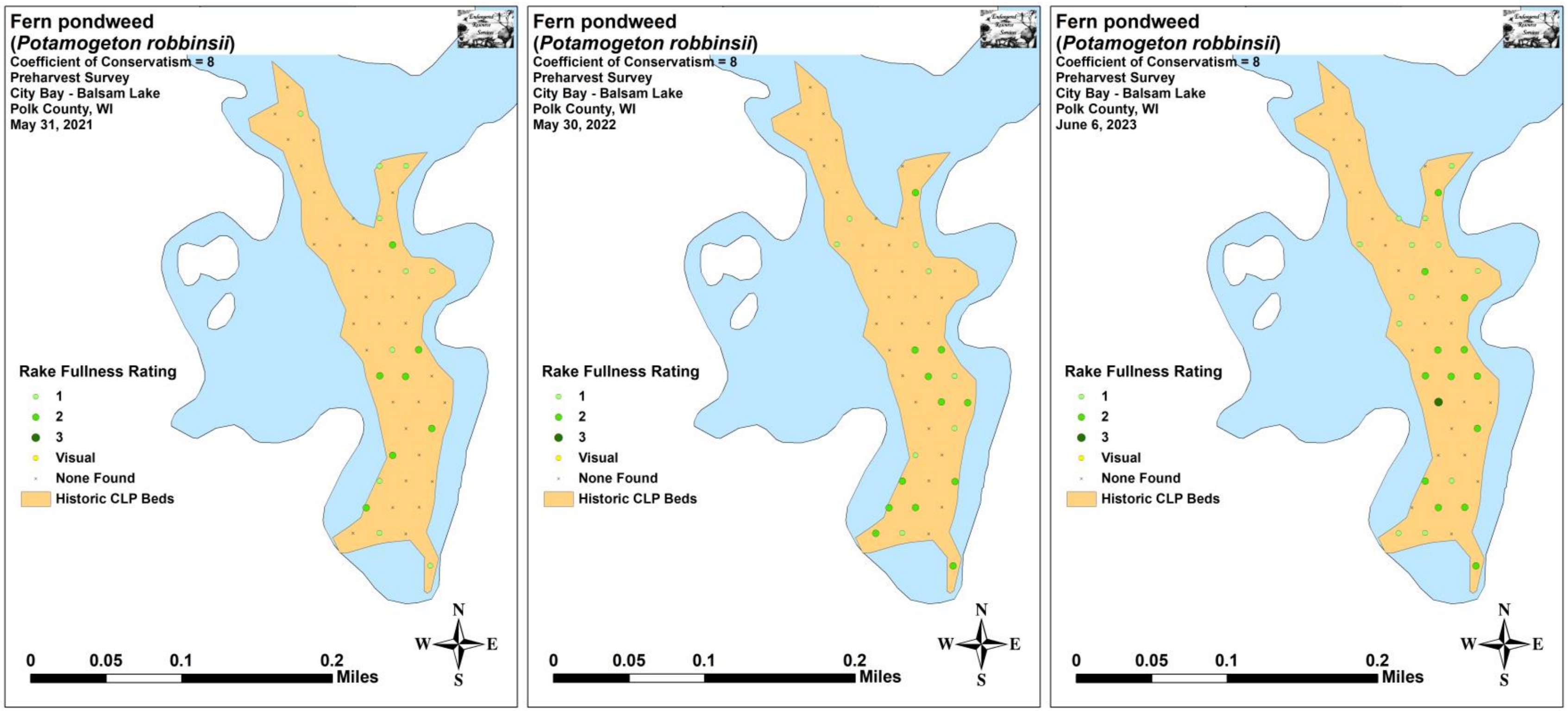


Figure 13: 2021, 2022, and 2023 Preharvest Fern pondweed Density and Distribution

Several other species experienced significant year-over-year changes from 2021 to 2022 (Figure 14). Filamentous algae underwent a significant increase **(p<0.05)** in distribution, but a non-significant increase in density (p=0.32) (10 sites/mean rake 1.30 in 2021 – 19 sites/mean rake 1.42 in 2022). In addition to Common waterweed and Flat-stem pondweed, Northern water-milfoil also suffered a significant decline in distribution **(p<0.05)**. The 2023 survey found comparatively few changes as Nitella (*Nitella* sp.) was the only species that demonstrated a significant change in distribution. Its moderately significant increase **(p=0.007)** from two sites in 2022 to 11 sites in 2023 saw it jump from the seventh to the fifth-ranked native species in the community (Maps for all native species from the 2021, 2022, and 2023 surveys can be found in Appendixes VI, VII, and VIII).

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Preharvest Survey – City Bay – Balsam Lake – Polk County, Wisconsin
May 31, 2021

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Ceratophyllum demersum	Coontail	37	20.67	74.00	74.00	1.68	0
Elodea canadensis	Common waterweed	32	17.88	64.00	64.00	1.47	0
Potamogeton crispus	**Curly-leaf pondweed**	**30**	**16.76**	**60.00**	**60.00**	**1.77**	**8**
Potamogeton zosteriformis	Flat-stem pondweed	20	11.17	40.00	40.00	1.20	0
Potamogeton robbinsii	Fern pondweed	17	9.50	34.00	34.00	1.41	0
	Filamentous algae	10	*	20.00	20.00	1.30	0
Myriophyllum sibiricum	Northern water-milfoil	8	4.47	16.00	16.00	1.38	0
Ranunculus aquatilis	White water crowfoot	8	4.47	16.00	16.00	1.25	0
Potamogeton praelongus	White-stem pondweed	7	3.91	14.00	14.00	1.14	0
Potamogeton amplifolius	Large-leaf pondweed	6	3.35	12.00	12.00	1.67	0
Heteranthera dubia	Water star-grass	3	1.68	6.00	6.00	1.00	0
Potamogeton illinoensis	Illinois pondweed	3	1.68	6.00	6.00	1.00	0
Nitella sp.	Nitella	2	1.12	4.00	4.00	1.50	0
Potamogeton richardsonii	Clasping-leaf pondweed	2	1.12	4.00	4.00	1.00	0
Bidens beckii	Water marigold	1	0.56	2.00	2.00	2.00	0
Chara sp.	Muskgrass	1	0.56	2.00	2.00	1.00	0
Nymphaea odorata	White water lily	1	0.56	2.00	2.00	1.00	0
Utricularia gibba	Creeping bladderwort	1	0.56	2.00	2.00	1.00	0

* Excluded from relative frequency analysis **Exotic species in bold**

Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Preharvest Survey – City Bay – Balsam Lake – Polk County, Wisconsin
May 30, 2022

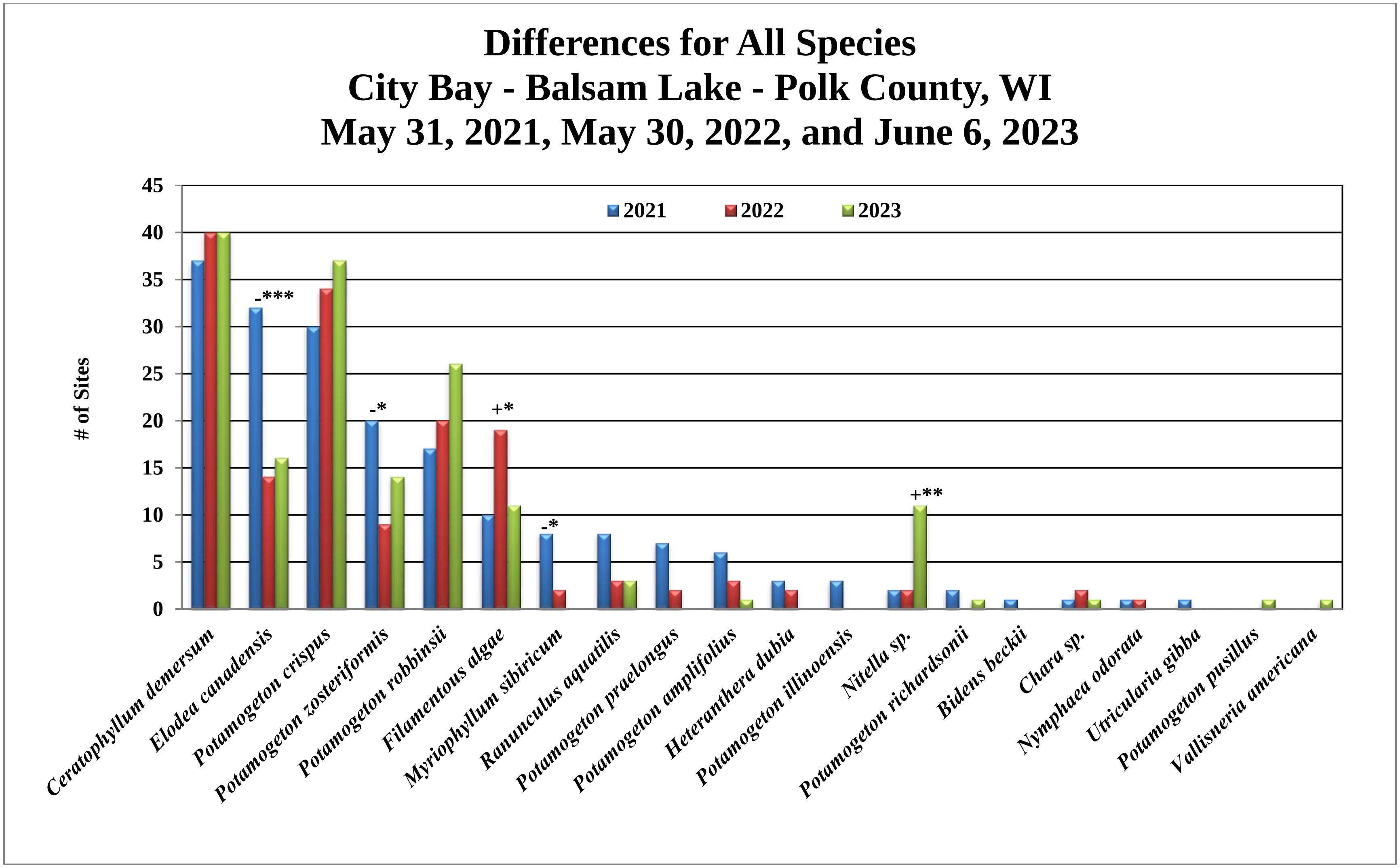
Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Ceratophyllum demersum	Coontail	40	29.85	80.00	80.00	1.83	0
Potamogeton crispus	**Curly-leaf pondweed**	**34**	**25.37**	**68.00**	**68.00**	**1.76**	**0**
Potamogeton robbinsii	Fern pondweed	20	14.93	40.00	40.00	1.60	0
	Filamentous algae	19	*	38.00	38.00	1.42	0
Elodea canadensis	Common waterweed	14	10.45	28.00	28.00	1.21	0
Potamogeton zosteriformis	Flat-stem pondweed	9	6.72	18.00	18.00	1.11	0
Potamogeton amplifolius	Large-leaf pondweed	3	2.24	6.00	6.00	1.33	0
Ranunculus aquatilis	White water crowfoot	3	2.24	6.00	6.00	1.00	0
Chara sp.	Muskgrass	2	1.49	4.00	4.00	2.00	0
Heteranthera dubia	Water star-grass	2	1.49	4.00	4.00	1.00	0
Myriophyllum sibiricum	Northern water-milfoil	2	1.49	4.00	4.00	1.50	0
Nitella sp.	Nitella	2	1.49	4.00	4.00	1.00	0
Potamogeton praelongus	White-stem pondweed	2	1.49	4.00	4.00	1.50	0
Nymphaea odorata	White water lily	1	0.75	2.00	2.00	1.00	0

* Excluded from relative frequency analysis **Exotic species in bold**

Table 4: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Preharvest Survey – City Bay – Balsam Lake – Polk County, Wisconsin
June 6, 2023

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Ceratophyllum demersum	Coontail	40	26.32	80.00	80.00	1.45	0
Potamogeton crispus	**Curly-leaf pondweed**	**37**	**24.34**	**74.00**	**74.00**	**1.54**	**1**
Potamogeton robbinsii	Fern pondweed	26	17.11	52.00	52.00	1.58	0
Elodea canadensis	Common waterweed	16	10.53	32.00	32.00	1.44	0
Potamogeton zosteriformis	Flat-stem pondweed	14	9.21	28.00	28.00	1.07	0
Nitella sp.	Nitella	11	7.24	22.00	22.00	1.27	0
	Filamentous algae	11	*	22.00	22.00	1.27	0
Ranunculus aquatilis	White water crowfoot	3	1.97	6.00	6.00	1.00	0
Chara sp.	Muskgrass	1	0.66	2.00	2.00	1.00	0
Potamogeton amplifolius	Large-leaf pondweed	1	0.66	2.00	2.00	1.00	0
Potamogeton pusillus	Small pondweed	1	0.66	2.00	2.00	1.00	0
Potamogeton richardsonii	Clasping-leaf pondweed	1	0.66	2.00	2.00	1.00	0
Vallisneria americana	Wild celery	1	0.66	2.00	2.00	1.00	0

* Excluded from relative frequency analysis **Exotic species in bold**



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

Figure 14: 2021, 2022, and 2023 Preharvest Macrophyte Changes

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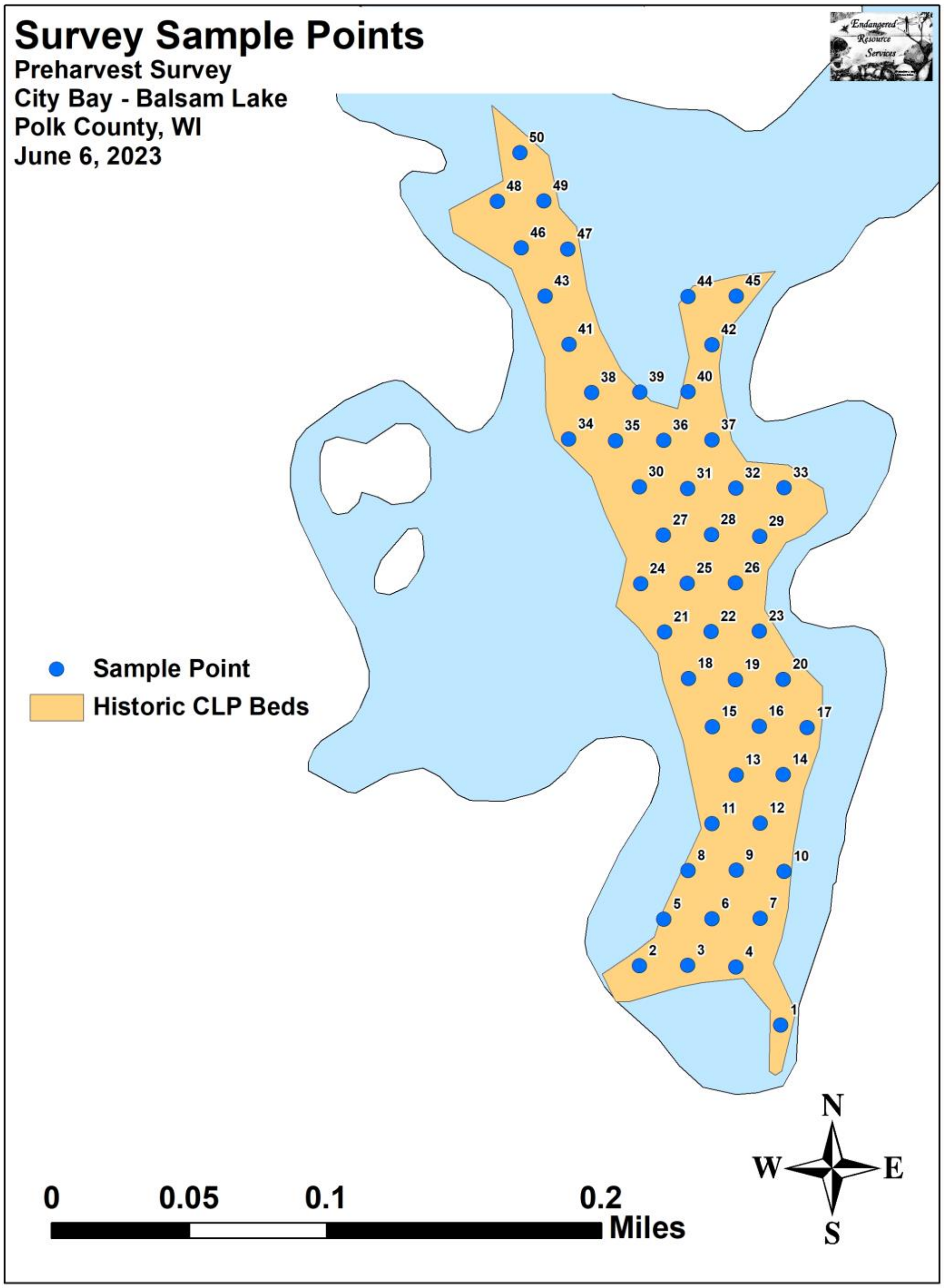
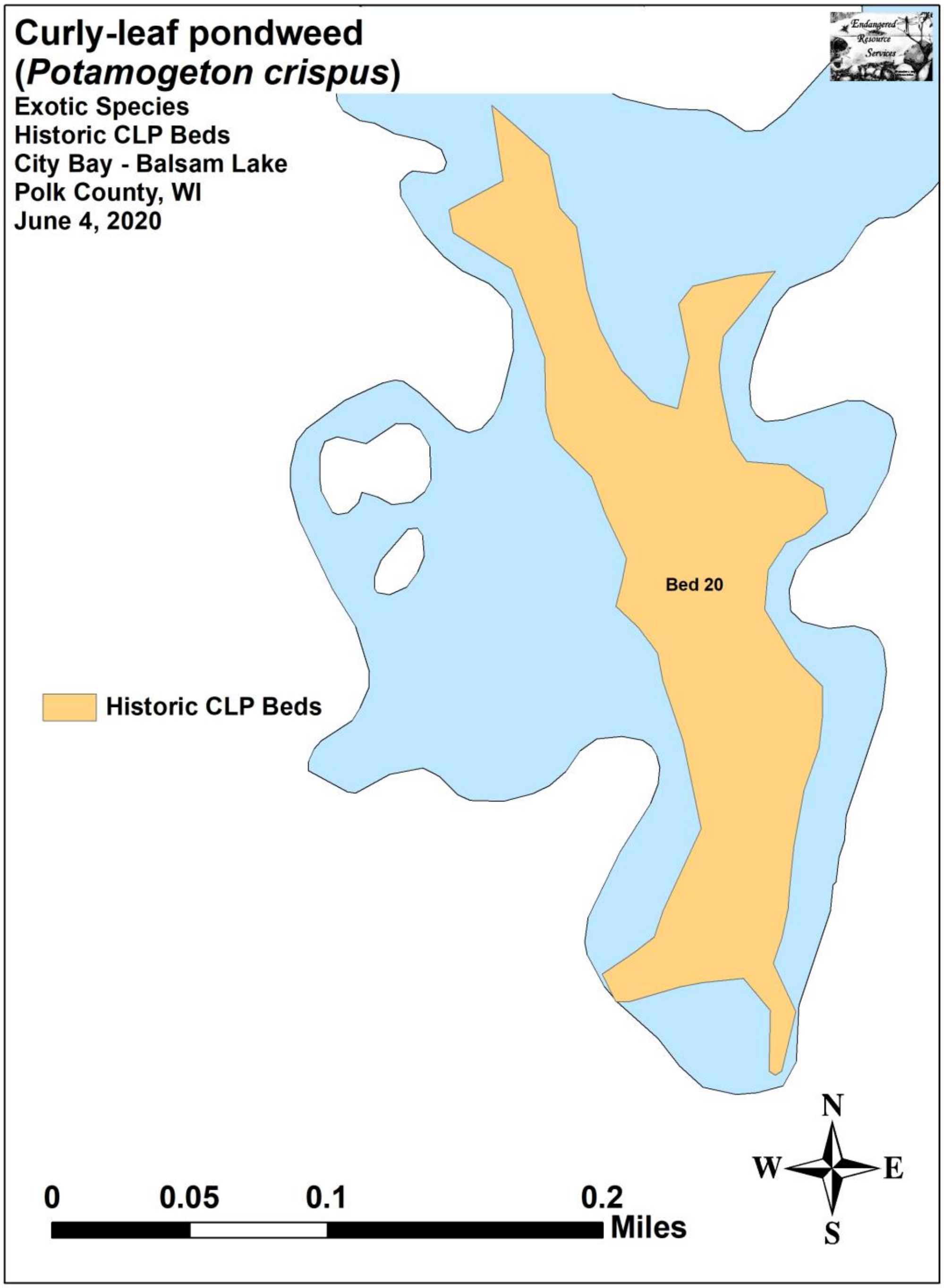
WDNR. [online]. 2023. Balsam Lake Citizen Monitoring Water Quality Database. Available from https://apps.dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=2620600&page=waterquality (2023, November).

WDNR. [online]. 2023. Wisconsin Lakes Information – Balsam Lake – Polk County. https://apps.dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=2620600 (2023 November).

Appendix I: Survey Sample Points and Historic CLP Bed Map

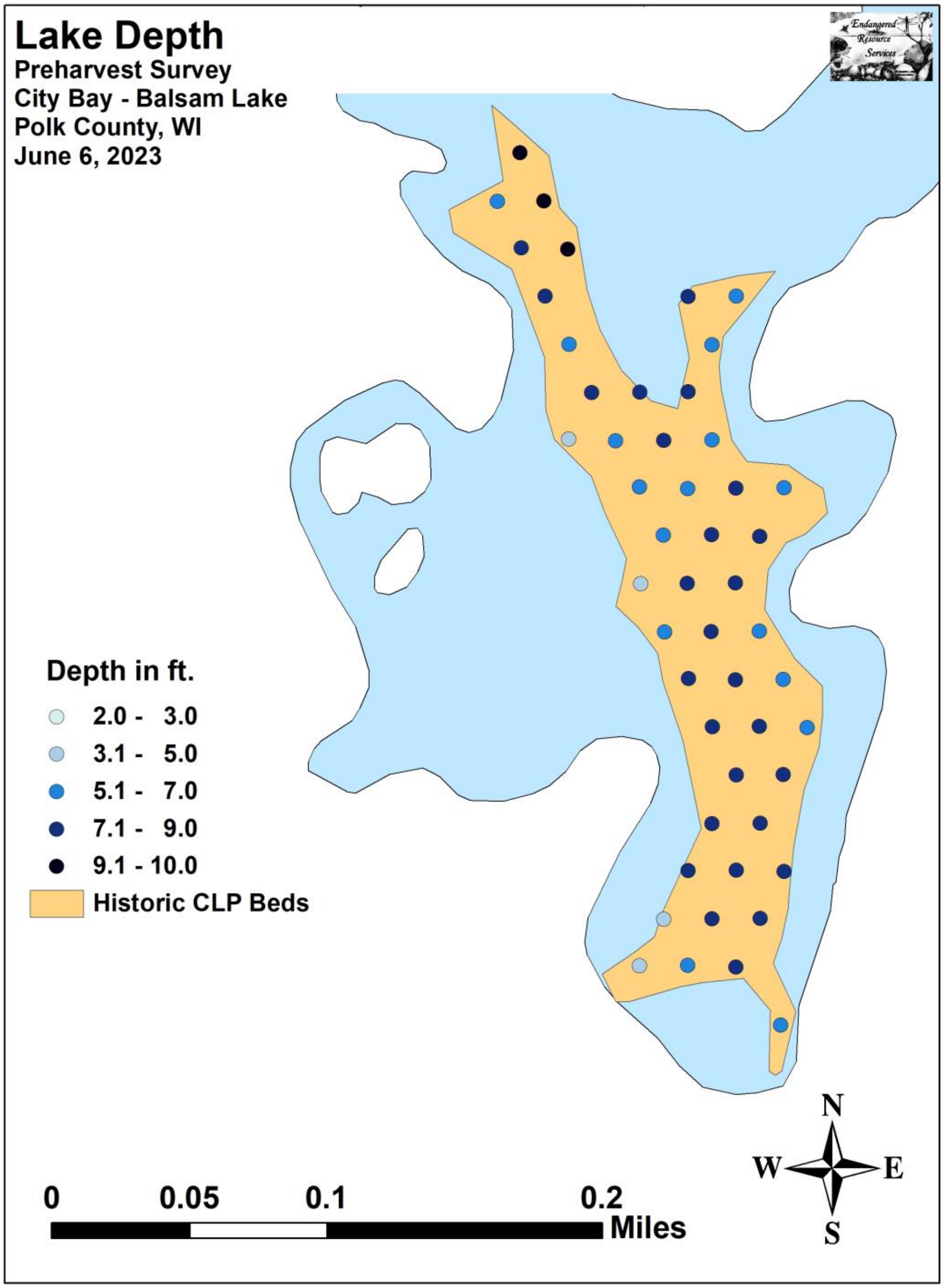

Survey Sample Points
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Endangered Resource Services
Sample Point
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

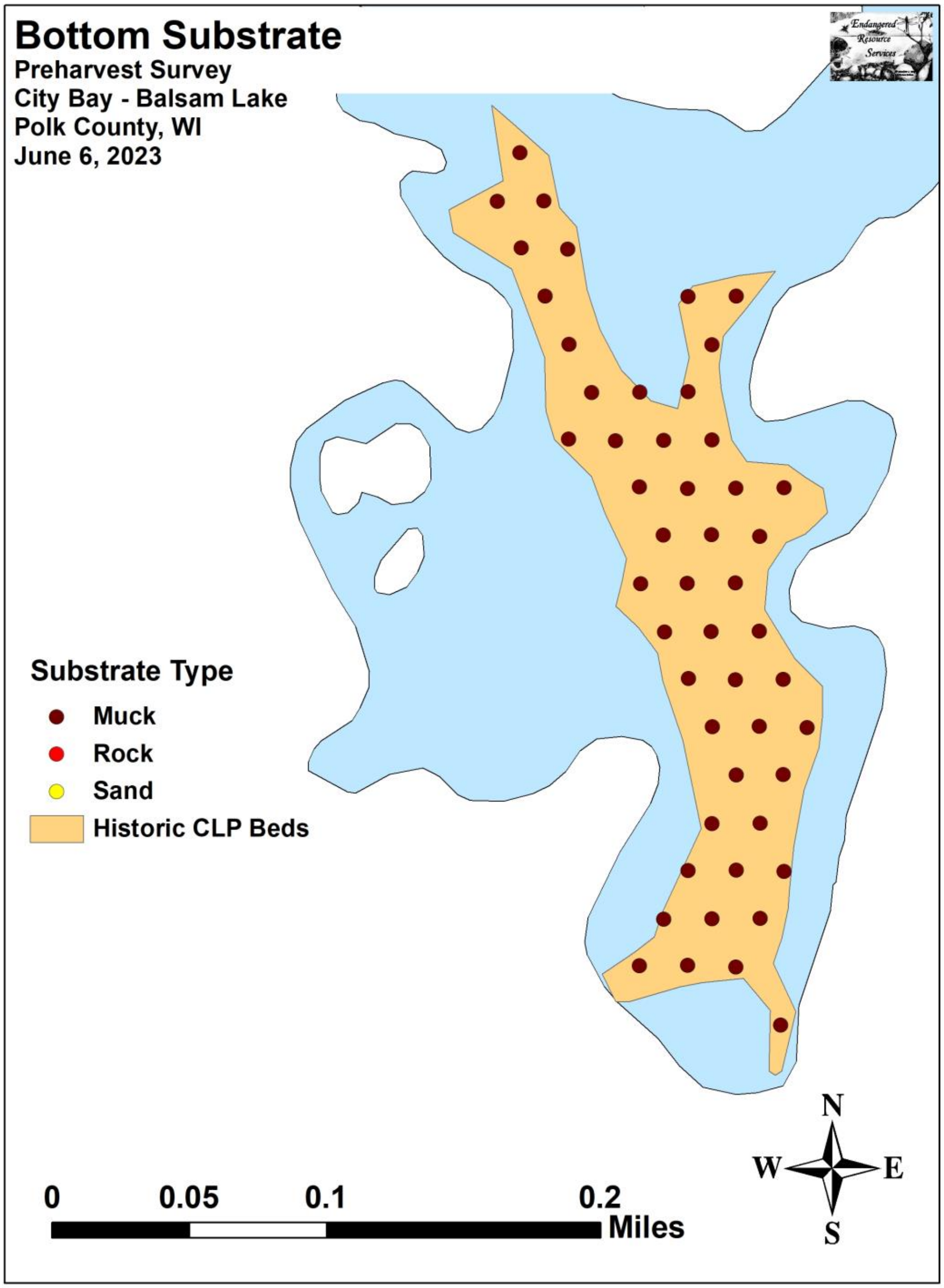

Curly-leaf pondweed
(*Potamogeton crispus*)
Exotic Species
Historic CLP Beds
City Bay - Balsam Lake
Polk County, WI
June 4, 2020
Bed 20
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

Appendix II: Vegetative Survey Datasheet

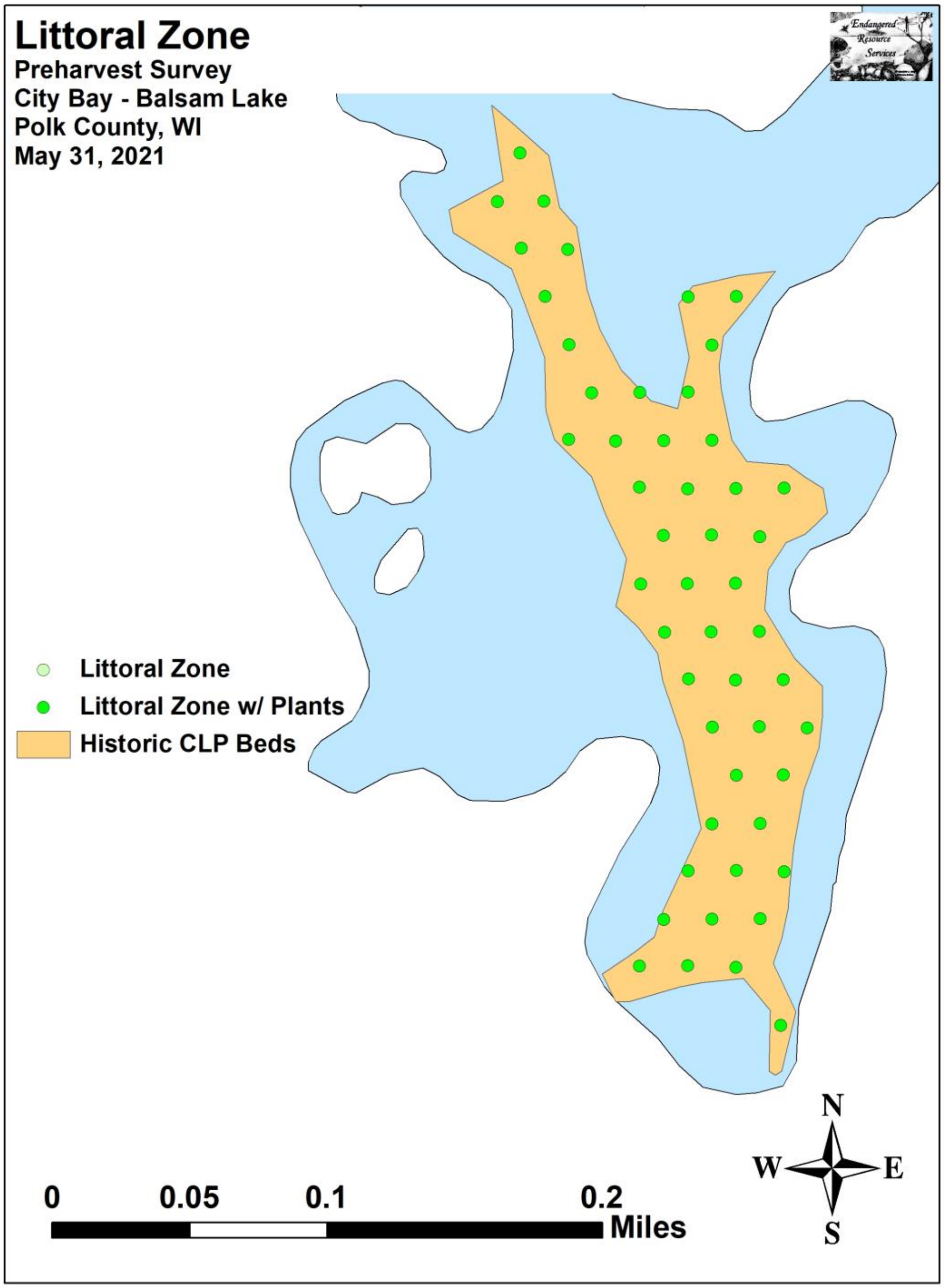
Observers for this lake: names and hours worked by each:																									
Lake:									**WBIC**									**County**						**Date:**	
Site #	**Depth (ft)**	**Muck (M), Sand (S), Rock (R)**	**Rake pole (P) or rake rope (R)**	**Total Rake Fullness**	**CLP**	**CLP**	**1**	**2**	**3**	**4**	**5**	**6**	**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: Preharvest Habitat Variables

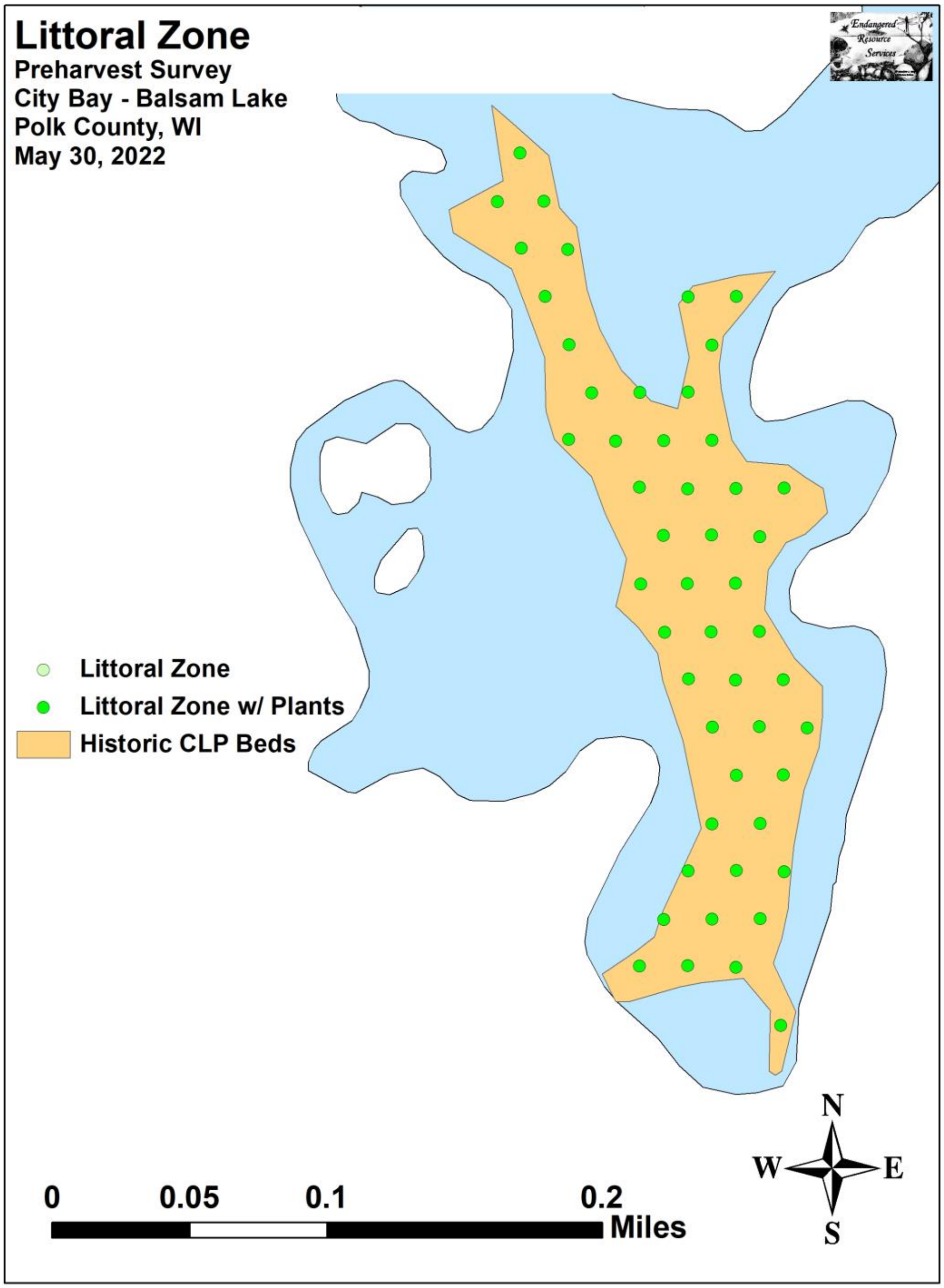

Lake Depth
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Depth in ft.
2.0 - 3.0
3.1 - 5.0
5.1 - 7.0
7.1 - 9.0
9.1 - 10.0
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

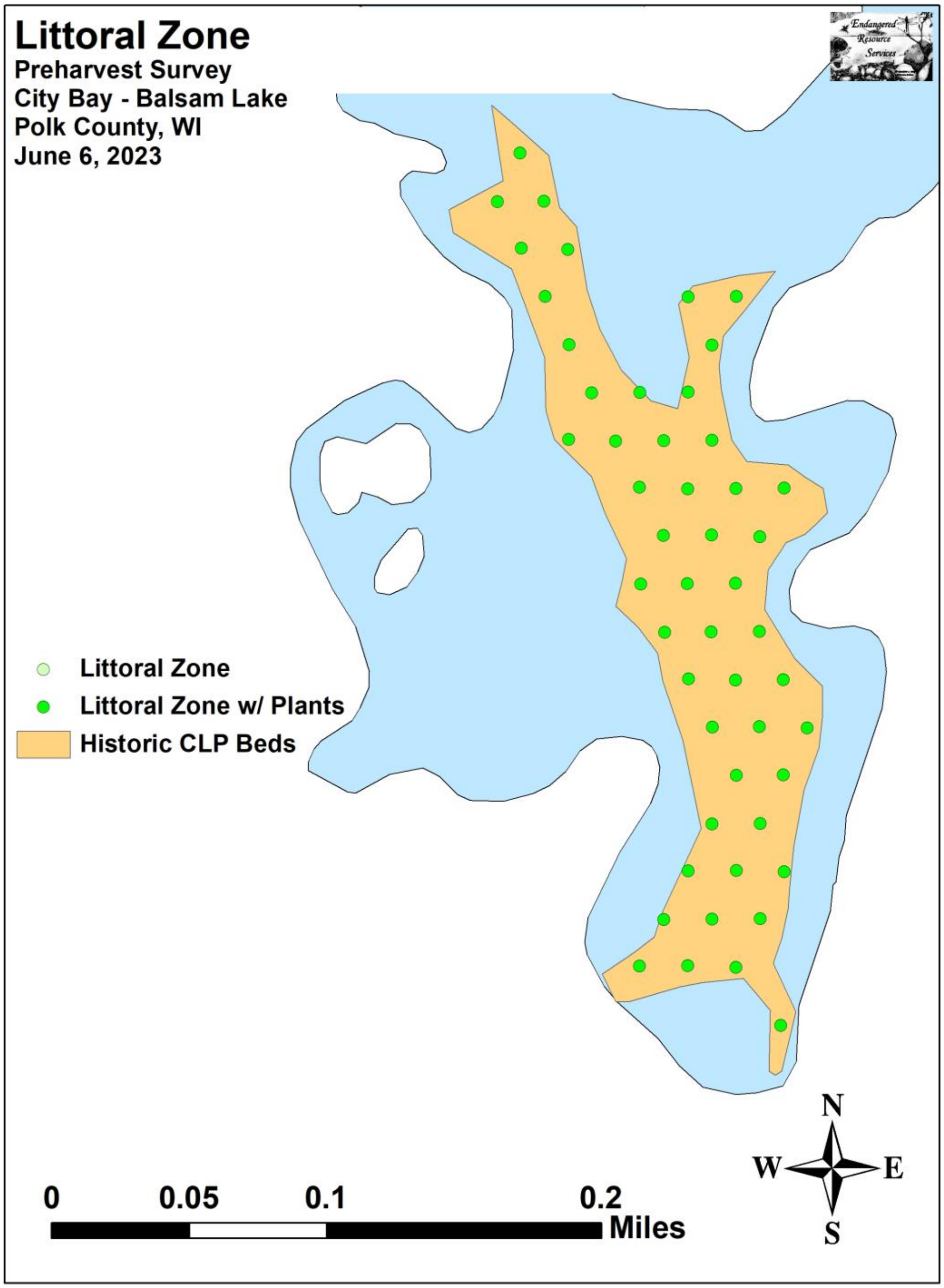

Bottom Substrate
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Endangered Resource Services
Substrate Type
Muck
Rock
Sand
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

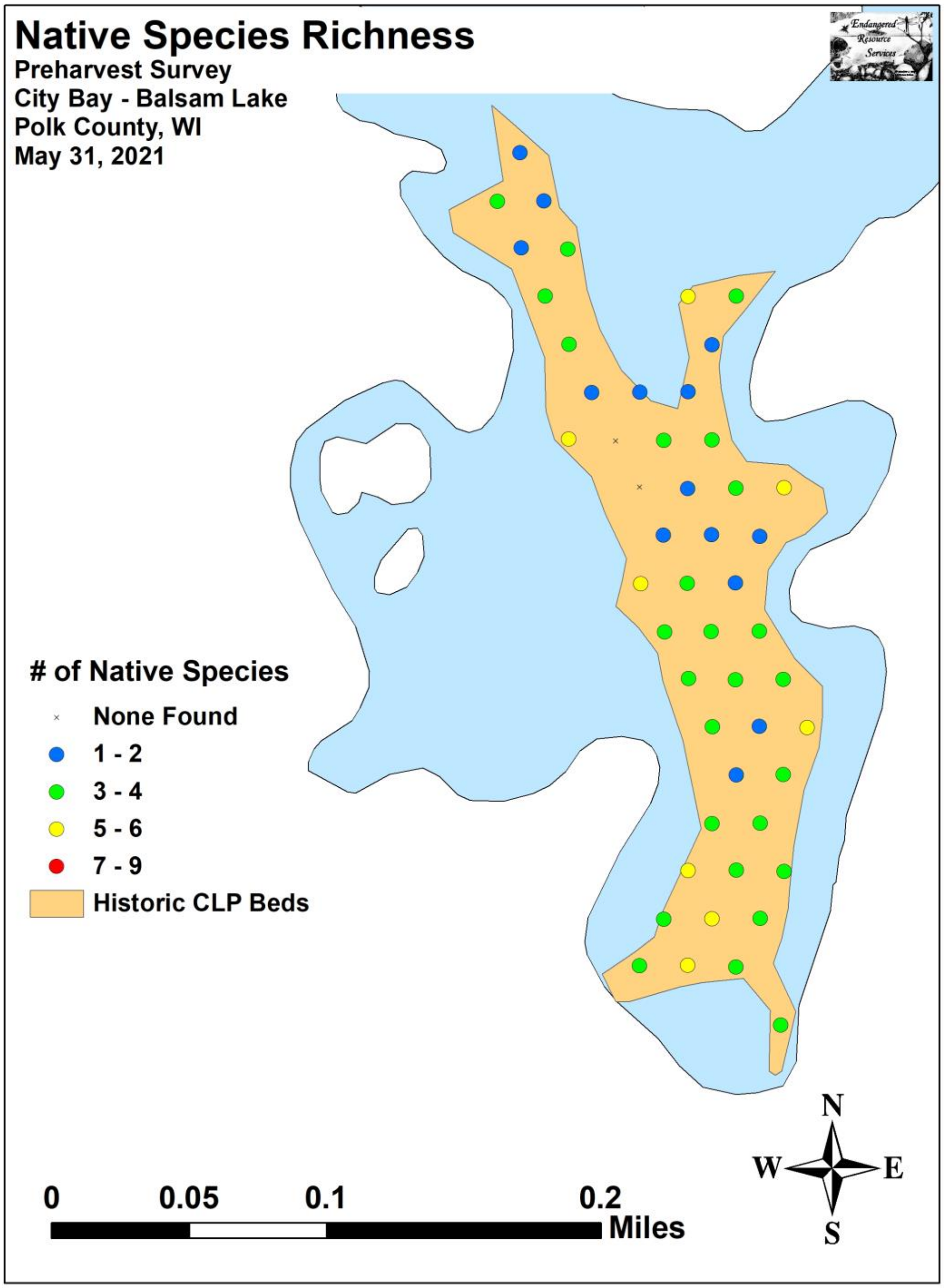
Appendix IV: 2021, 2022, and 2023 Preharvest Littoral Zone, Native Species Richness and Total Rake Fullness



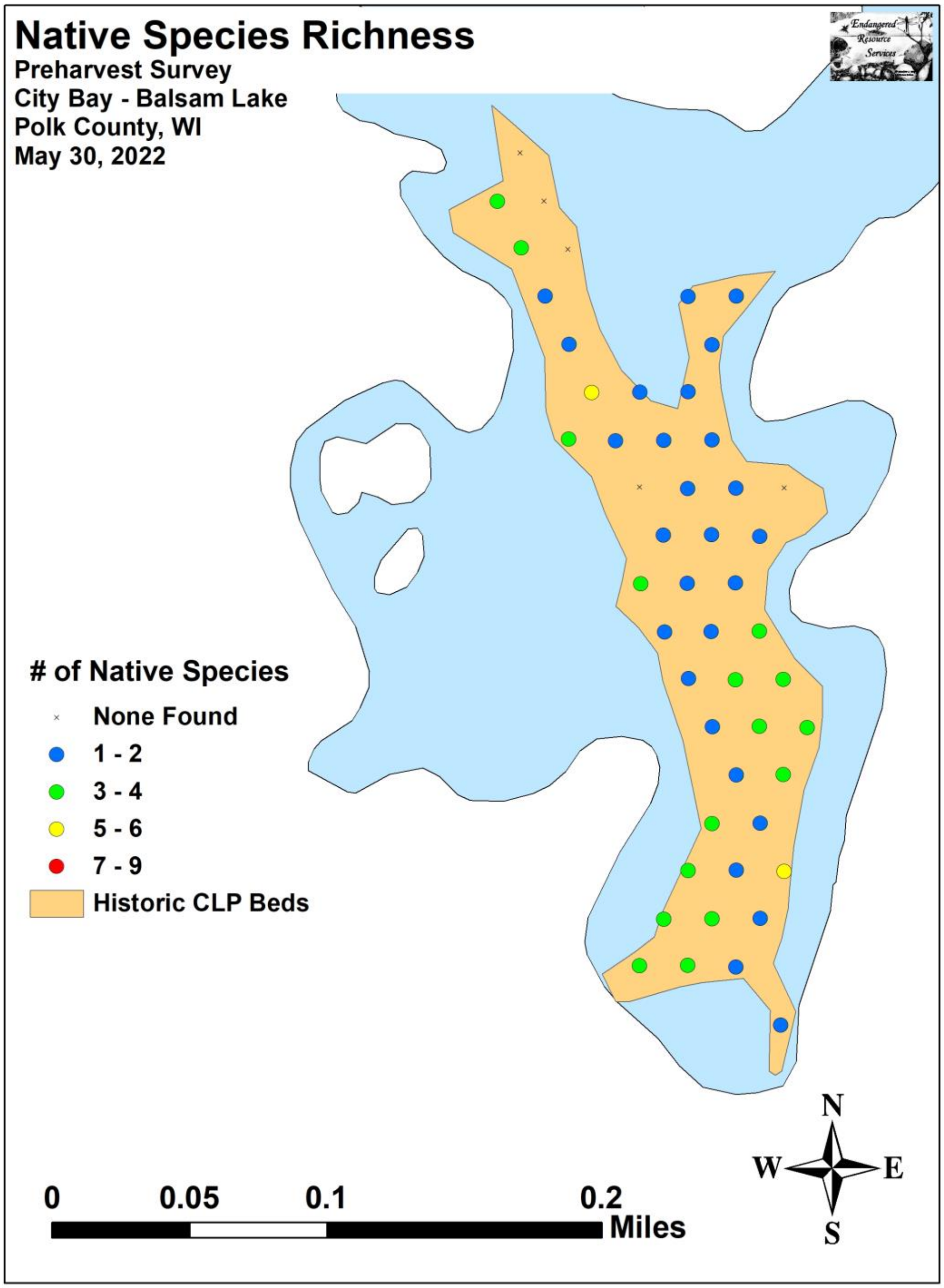
Littoral Zone
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Endangered Resource Services
Littoral Zone
Littoral Zone w/ Plants
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S


Littoral Zone
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Littoral Zone
Littoral Zone w/ Plants
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

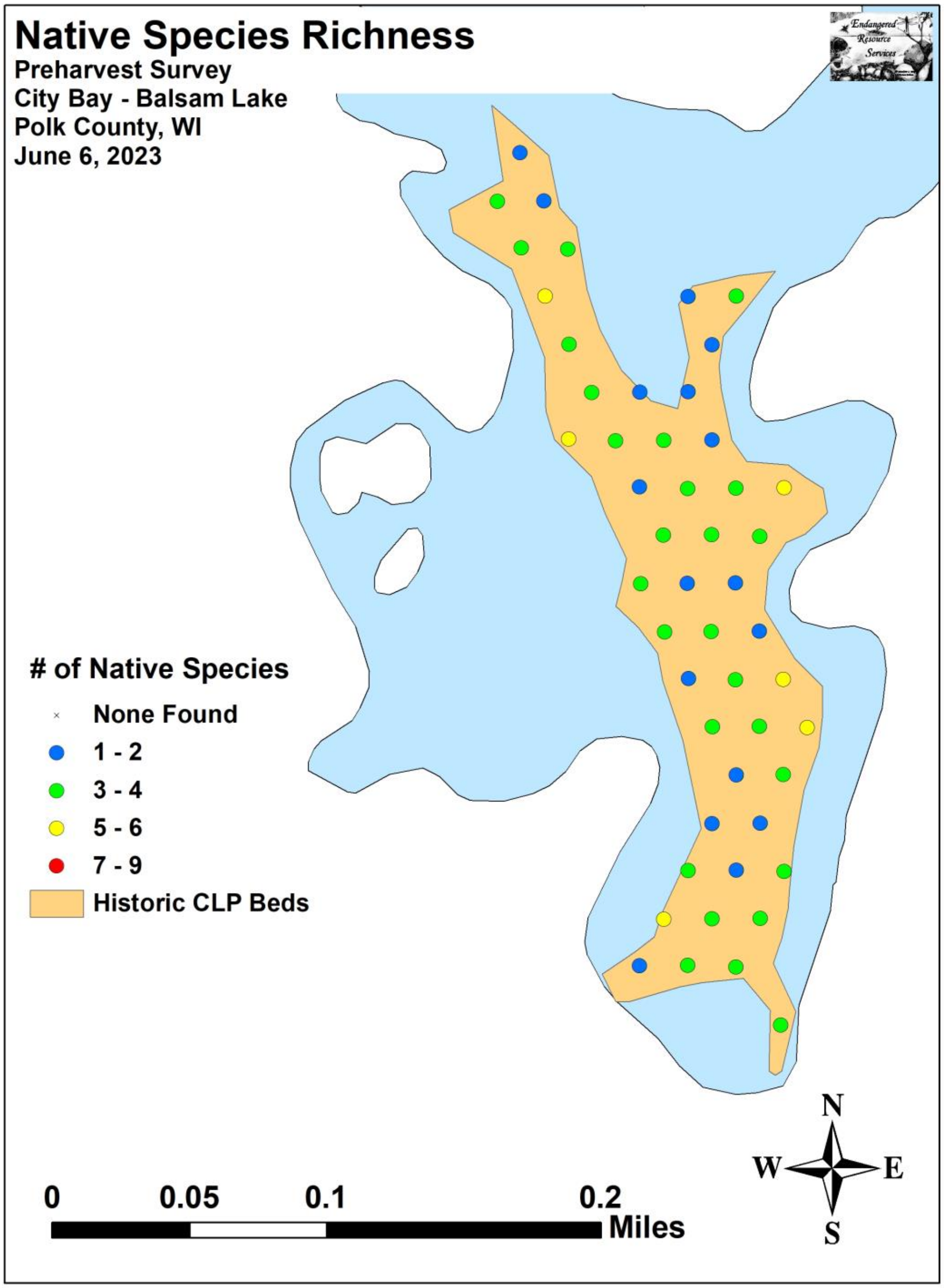

Littoral Zone
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Littoral Zone
Littoral Zone w/ Plants
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

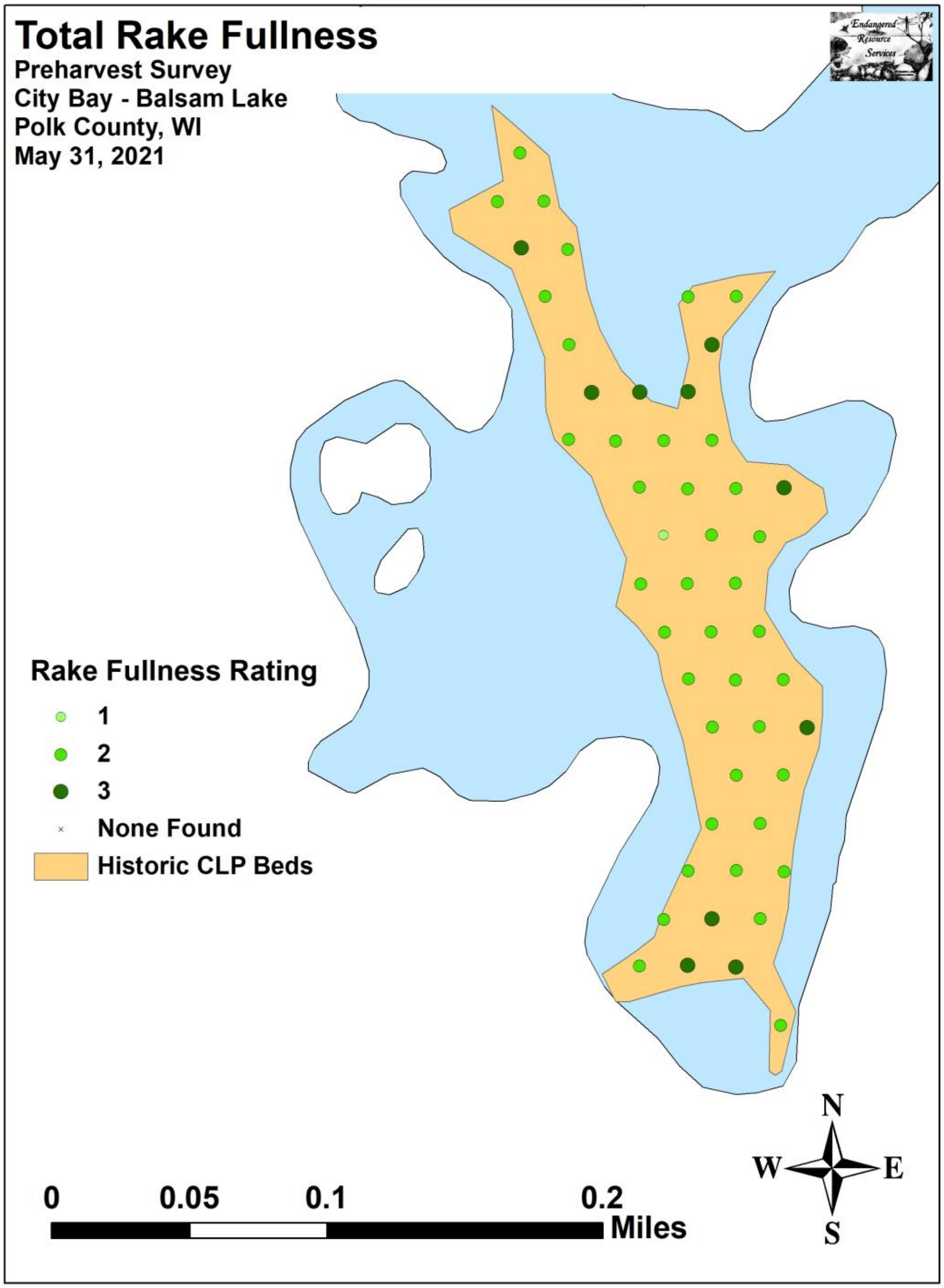


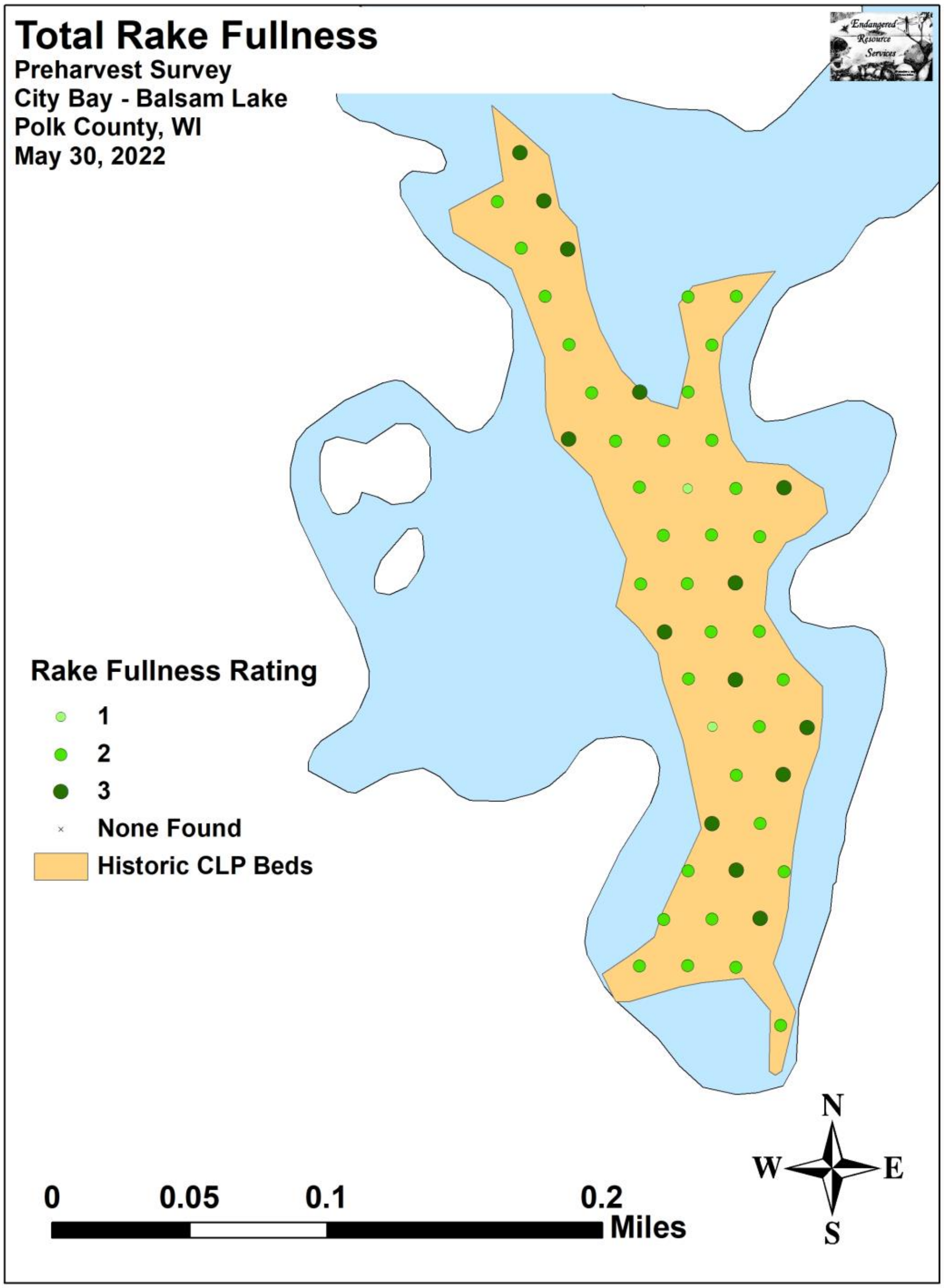
Native Species Richness
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 9
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S



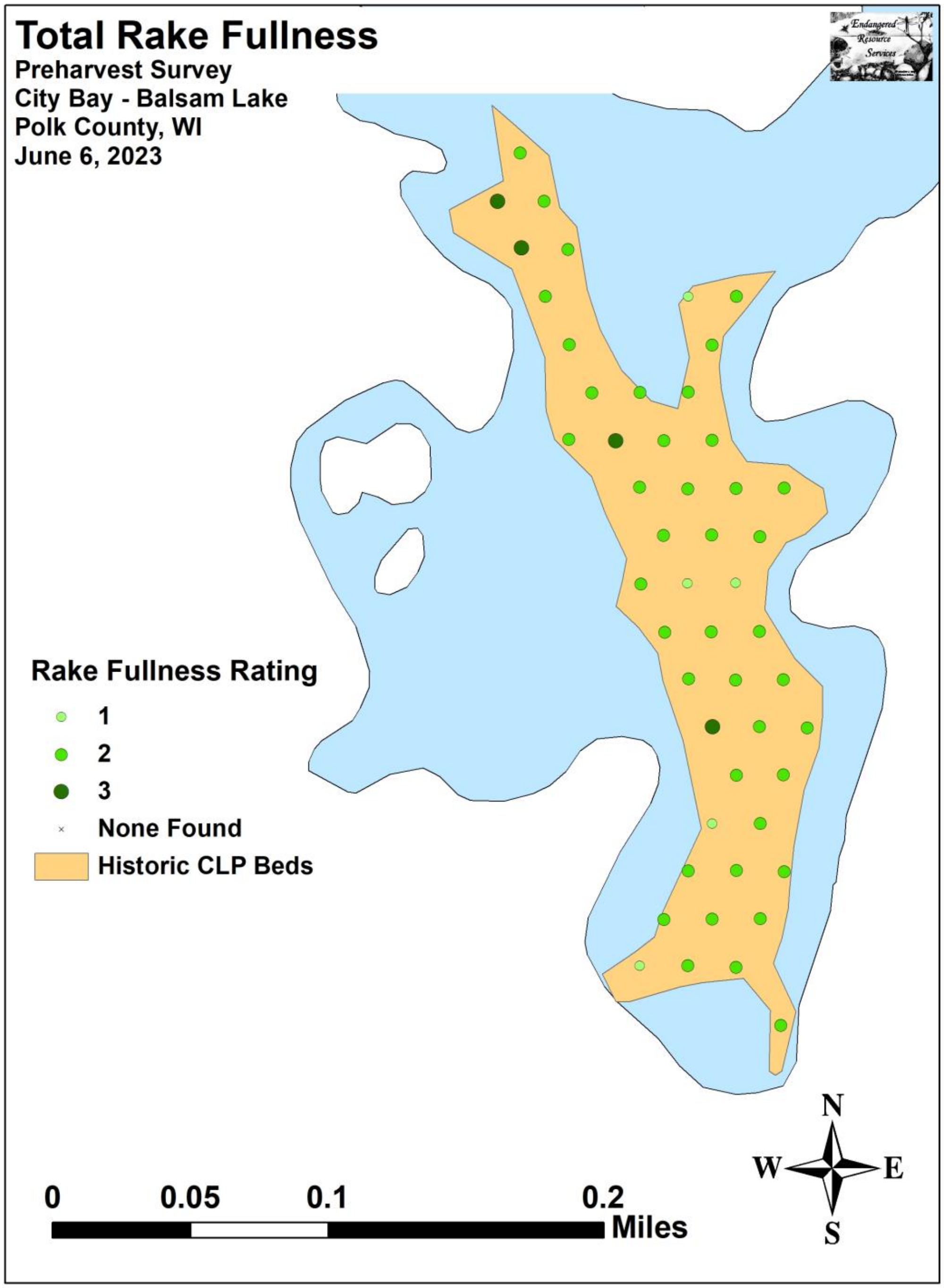
Native Species Richness
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 9
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S


Native Species Richness
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Endangered Resource Services
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 9
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

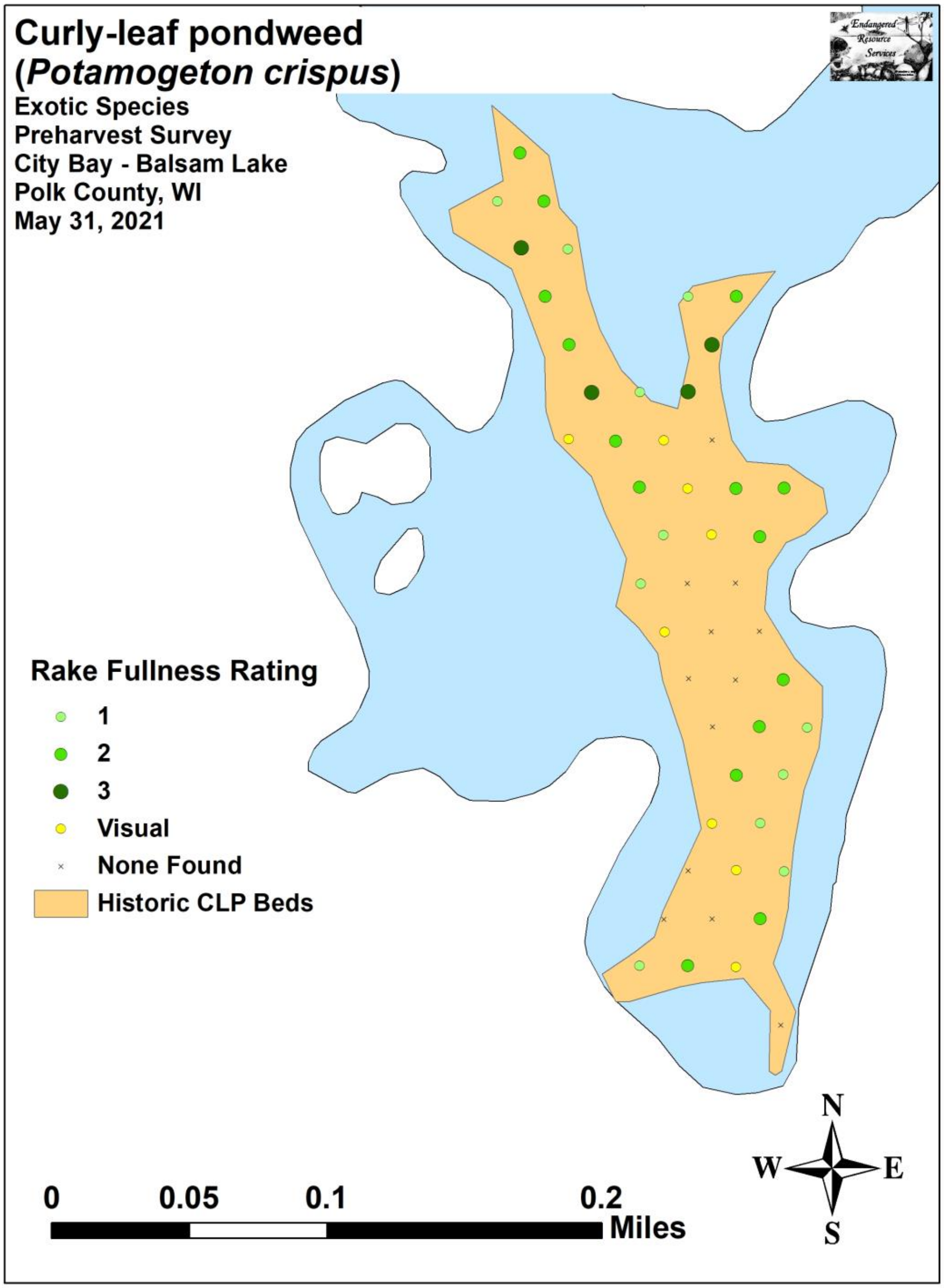

Total Rake Fullness
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

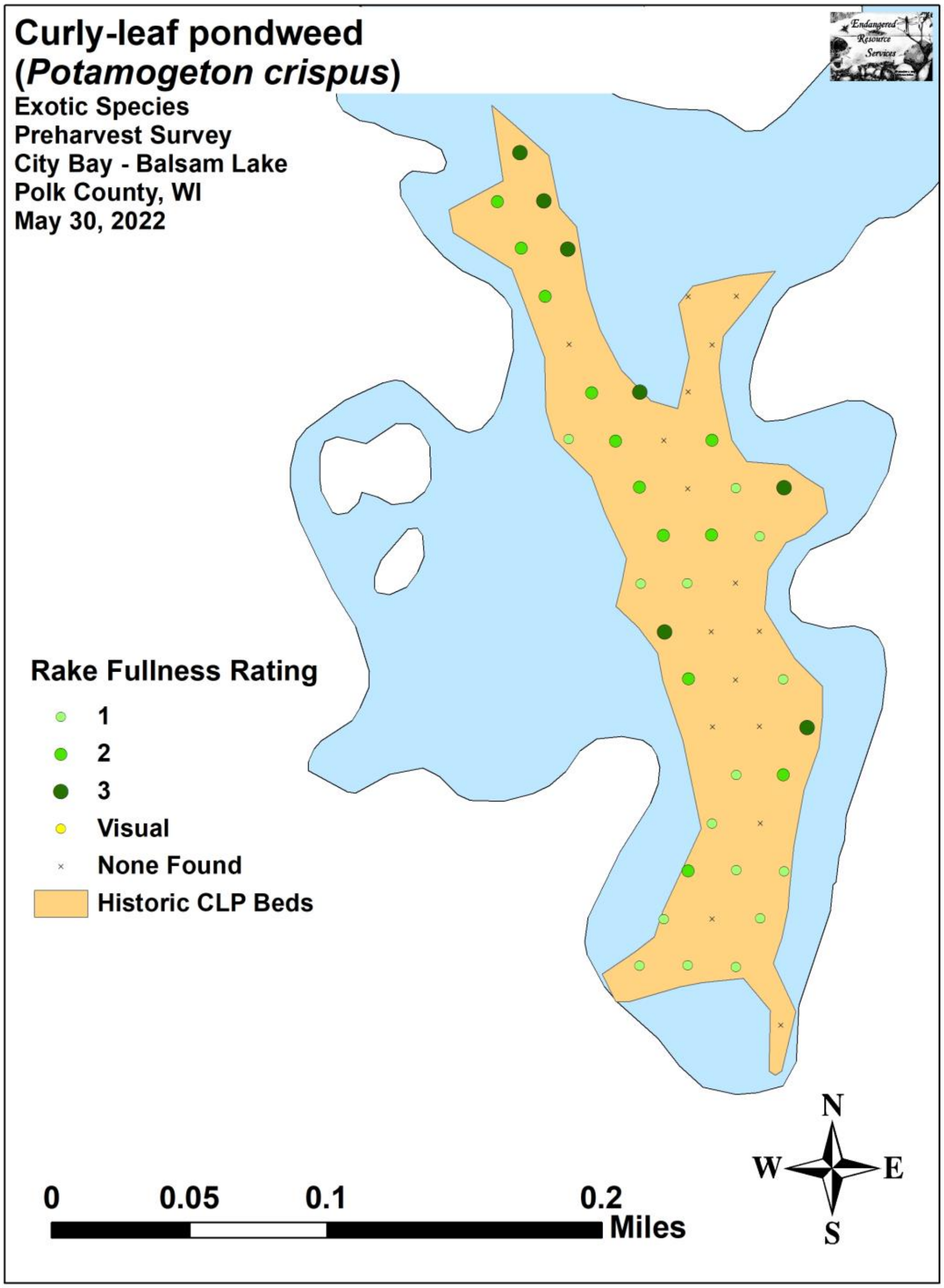


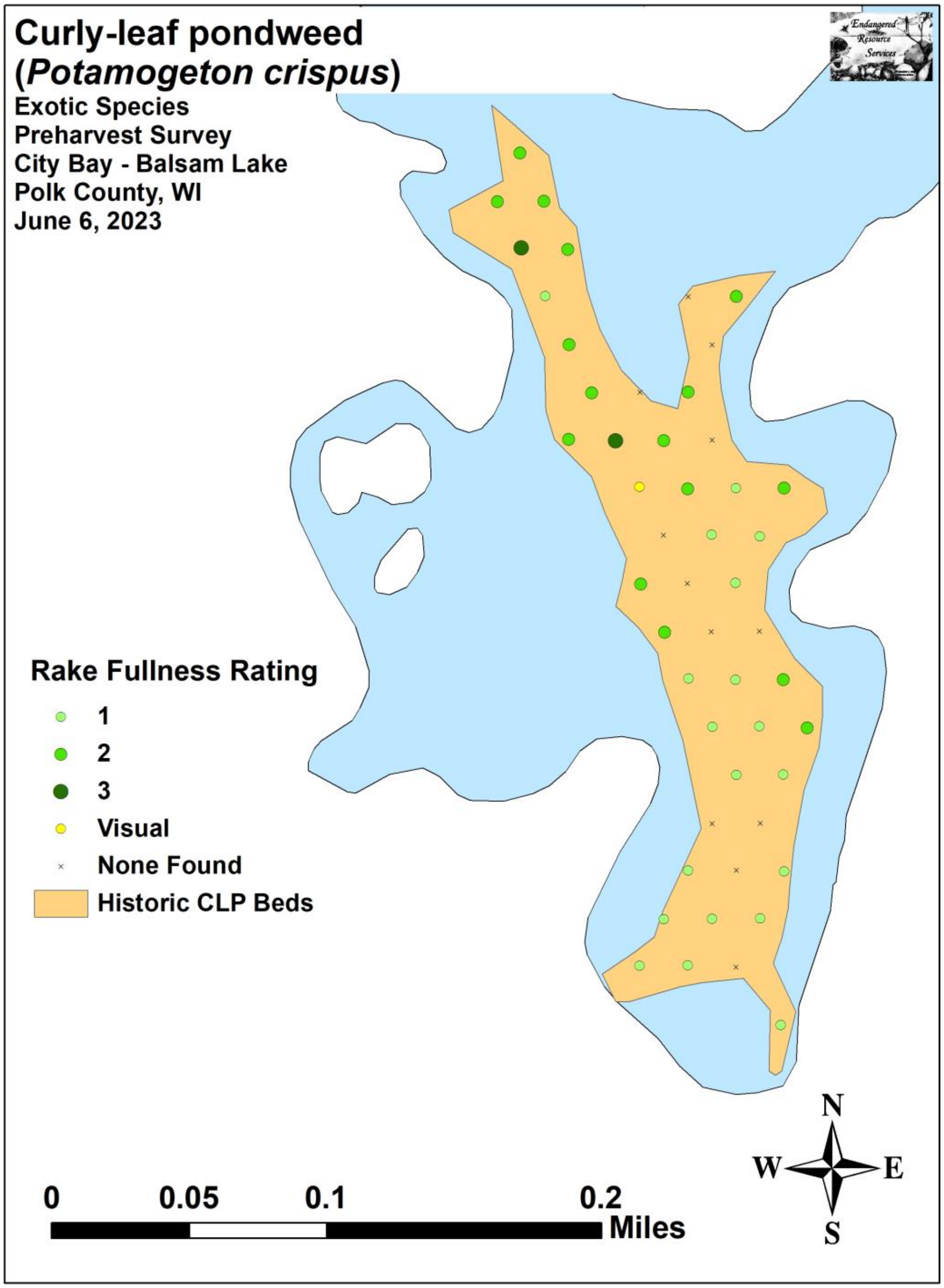
Total Rake Fullness
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S


Total Rake Fullness
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Rake Fullness Rating
1
2
3
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

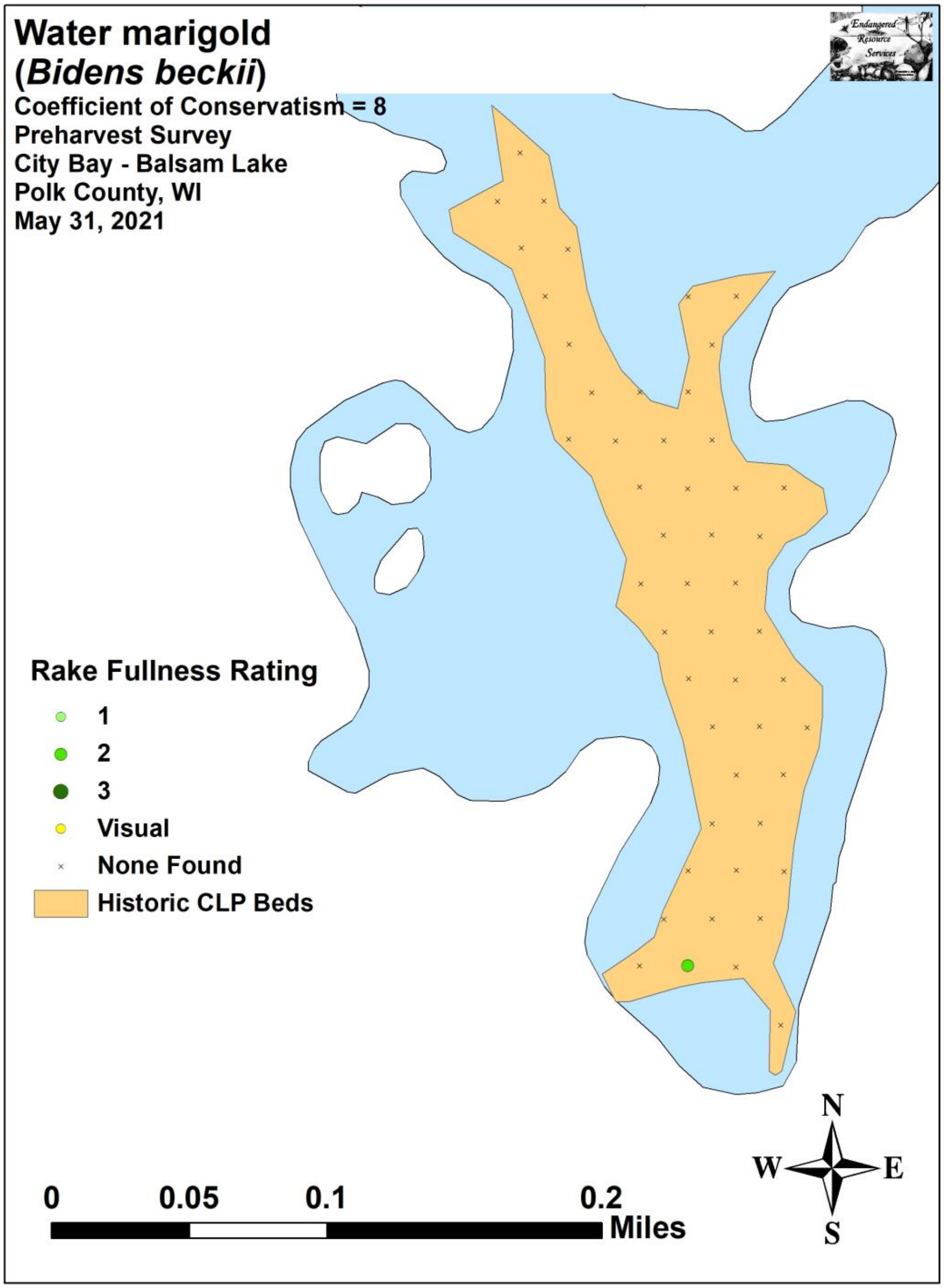
Appendix V: 2021, 2022, and 2023 Preharvest CLP Density and Distribution

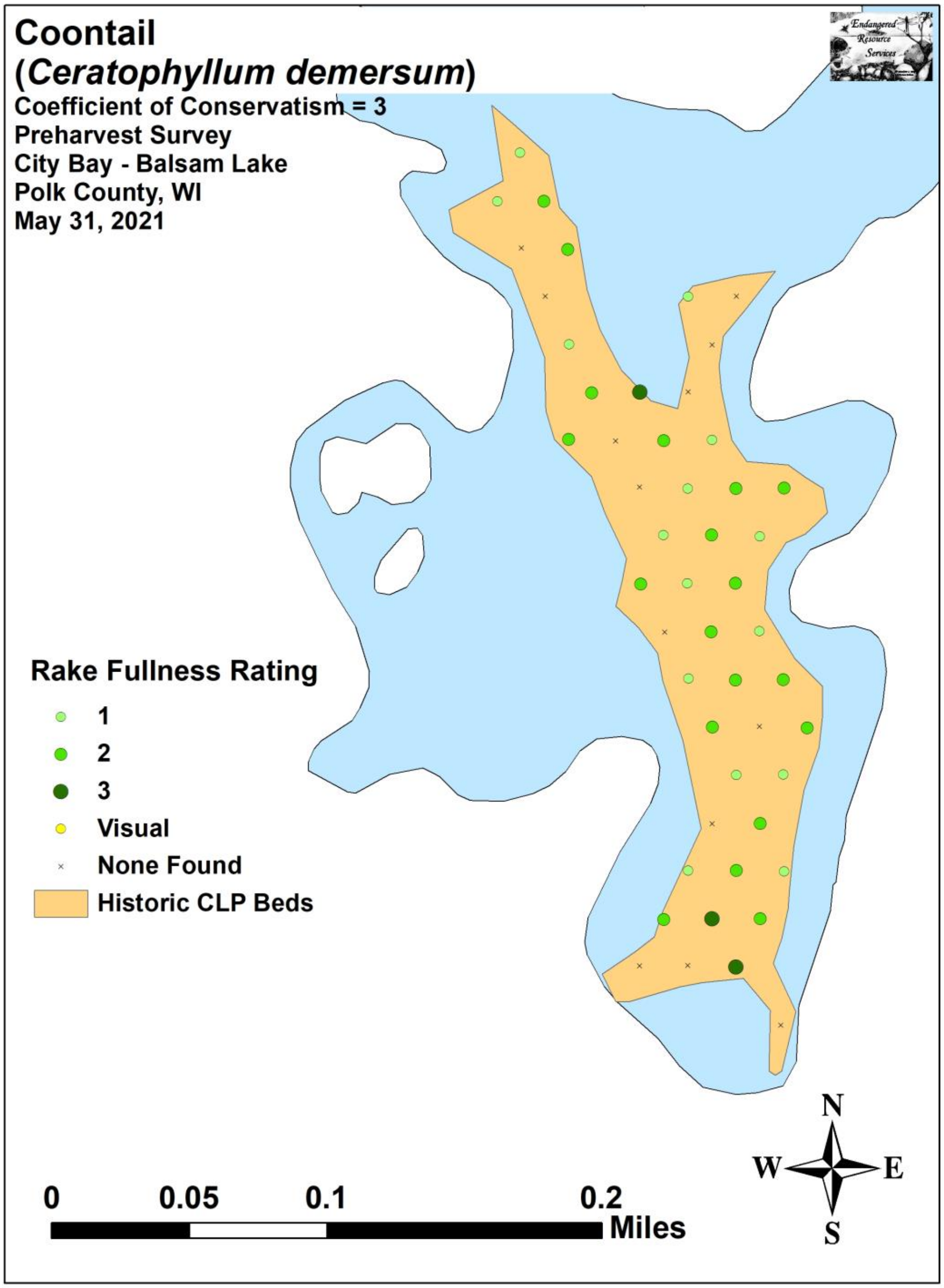

Curly-leaf pondweed
(*Potamogeton crispus*)
Exotic Species
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Endangered Resource Services
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

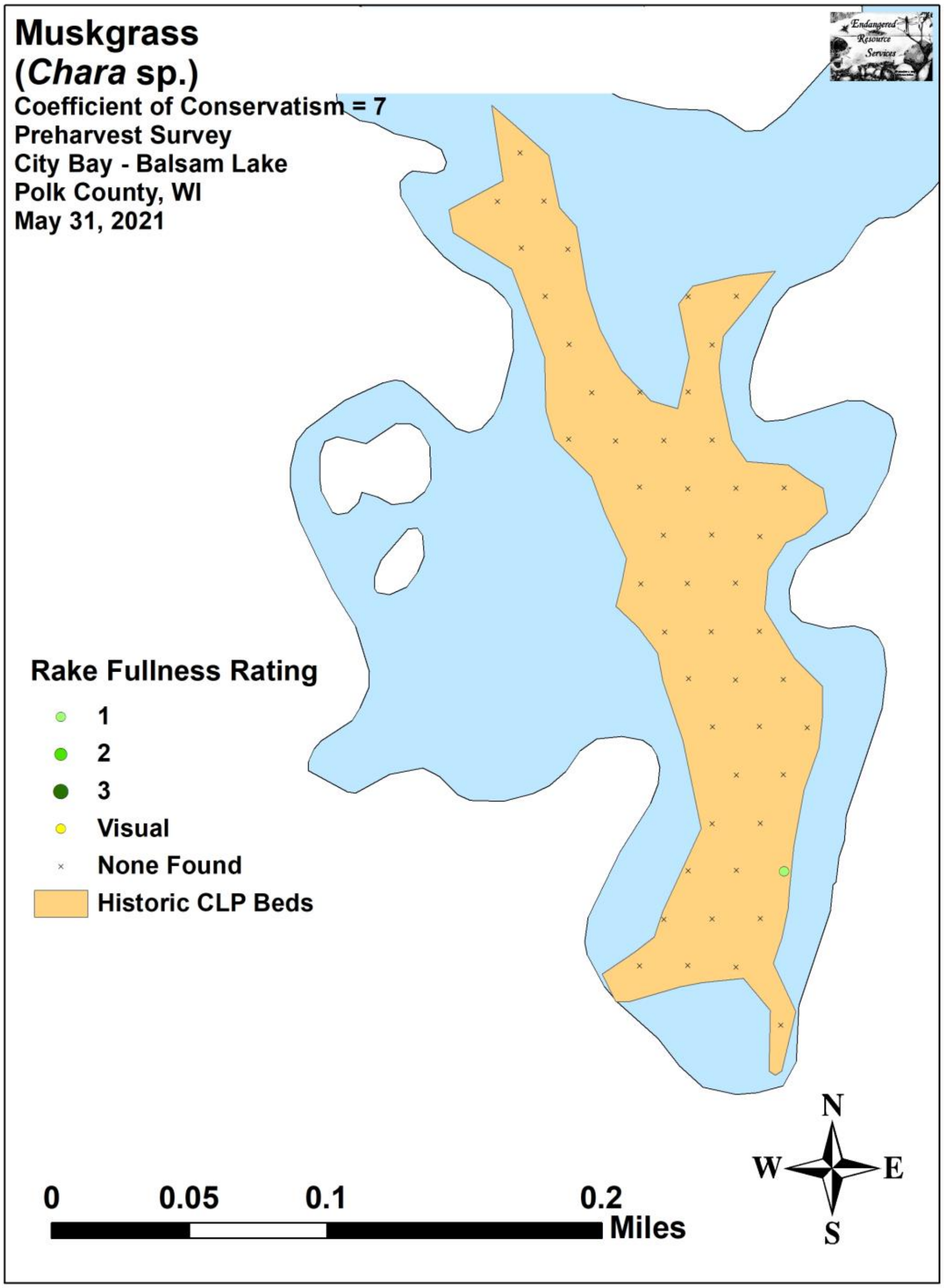

Curly-leaf pondweed
(*Potamogeton crispus*)
Exotic Species
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

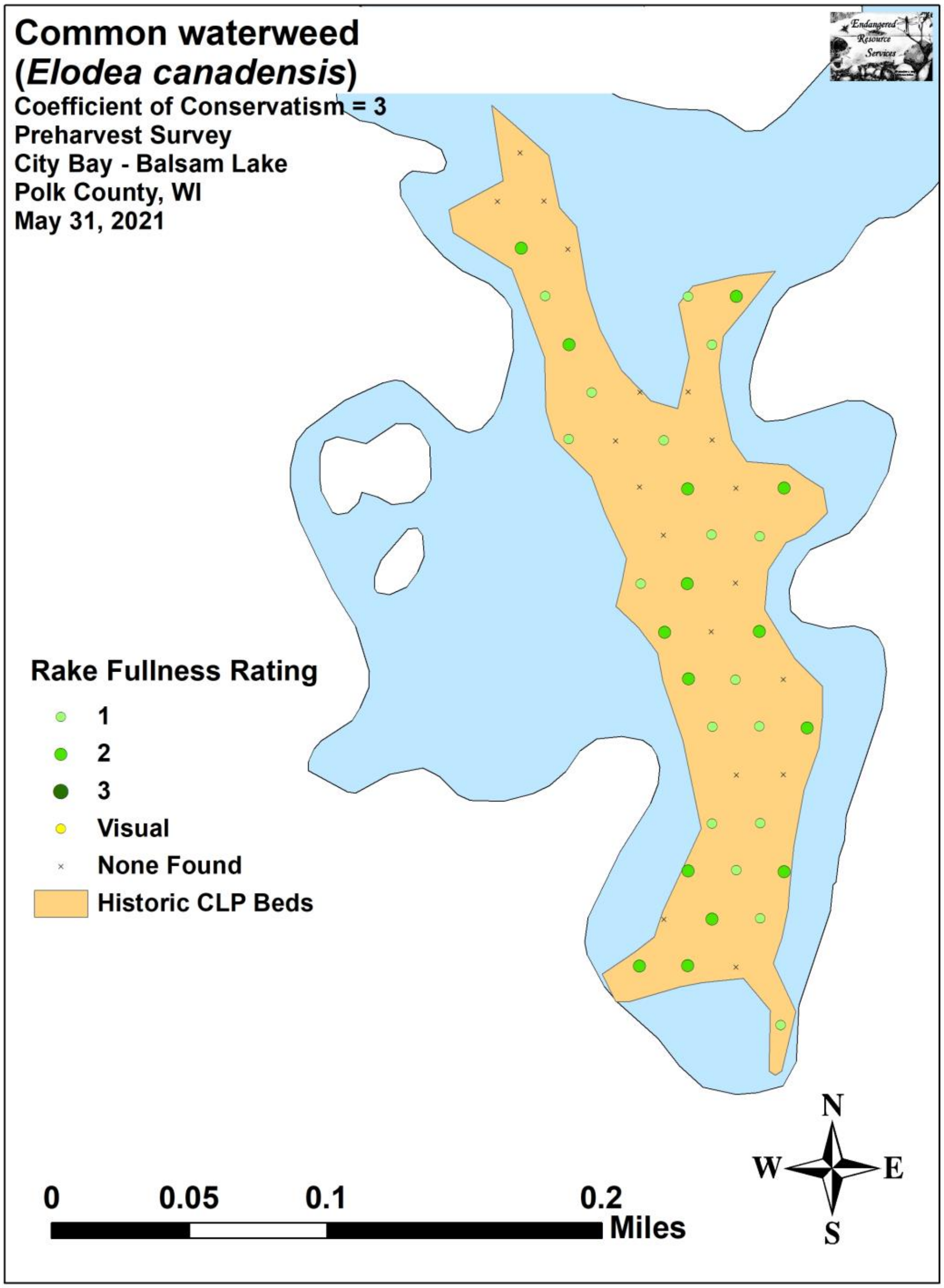

Curly-leaf pondweed
(*Potamogeton crispus*)
Exotic Species
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Endangered Resource Services
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

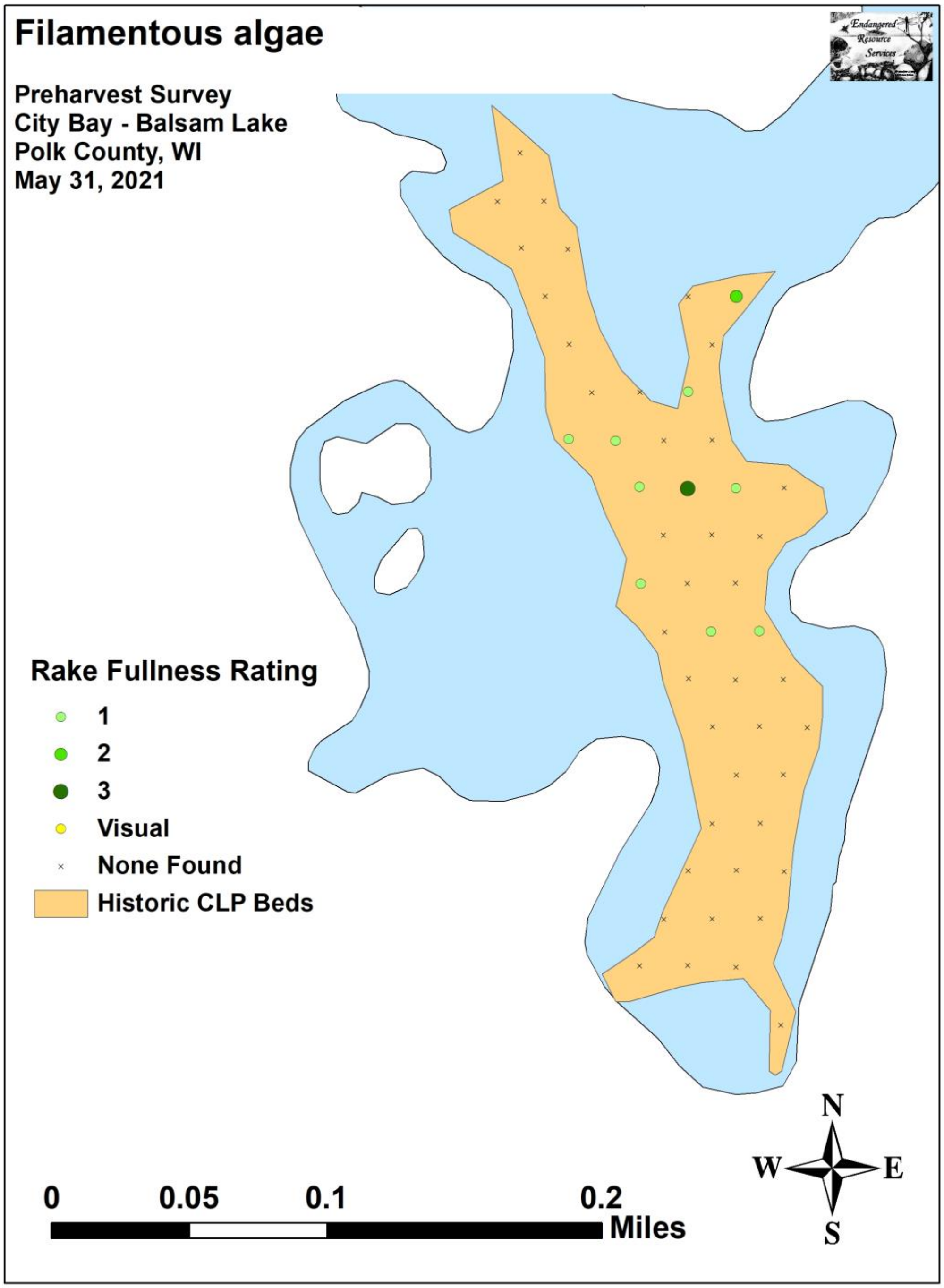
Appendix VI: 2021 Preharvest Native Species Density and Distribution

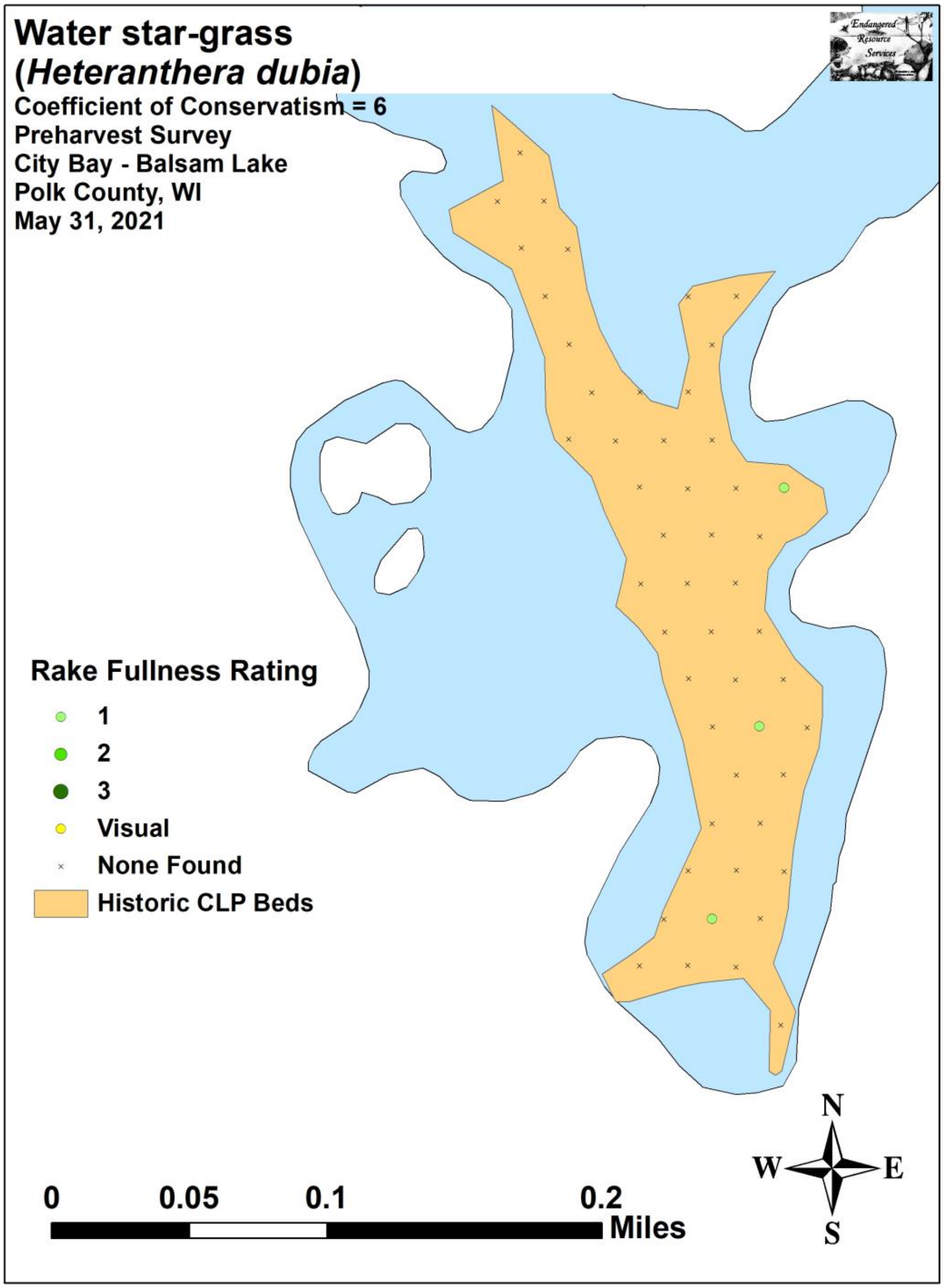

Water marigold
(*Bidens beckii*)
Coefficient of Conservatism = 8
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

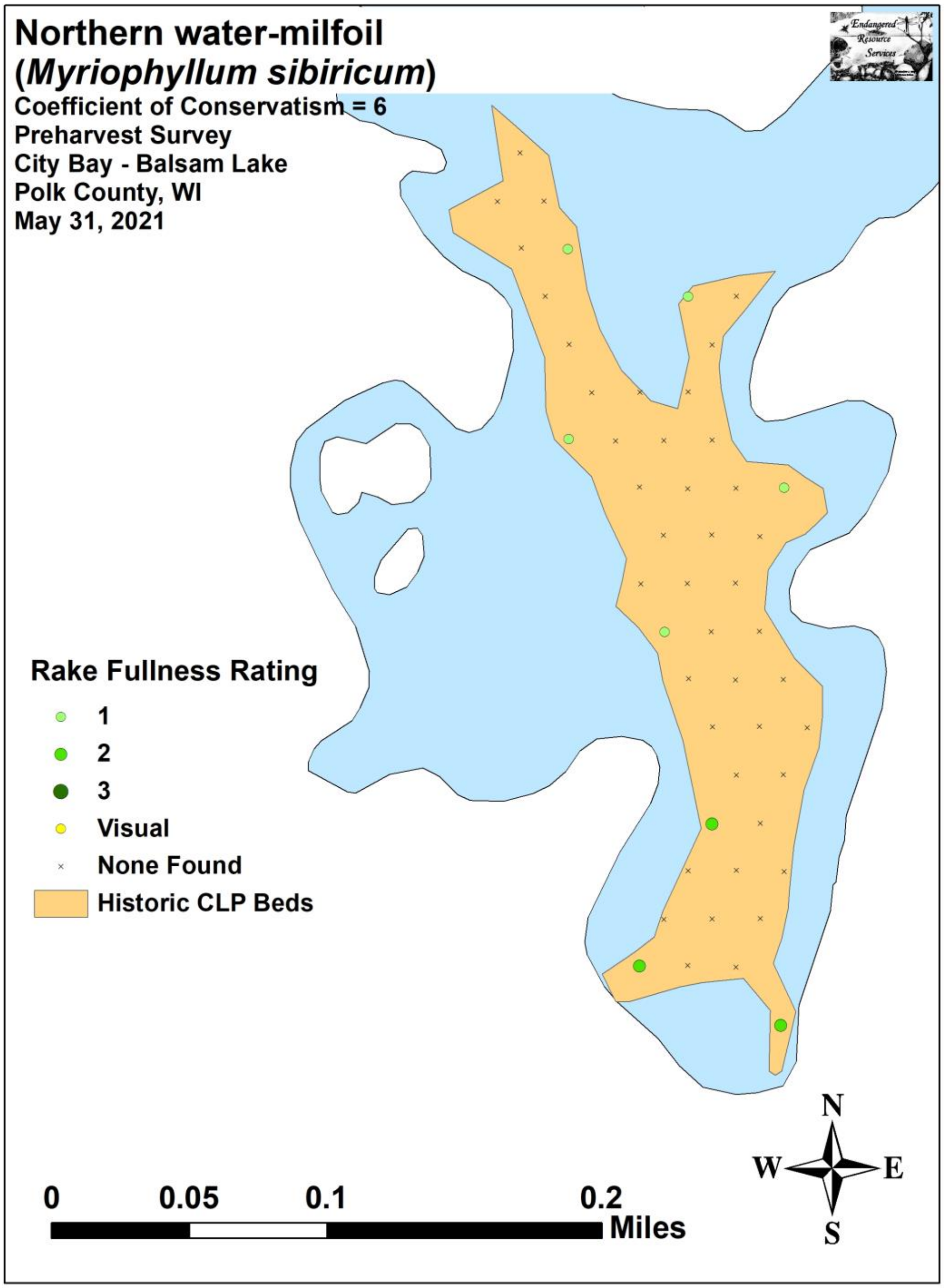

Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Endangered Resource Services
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

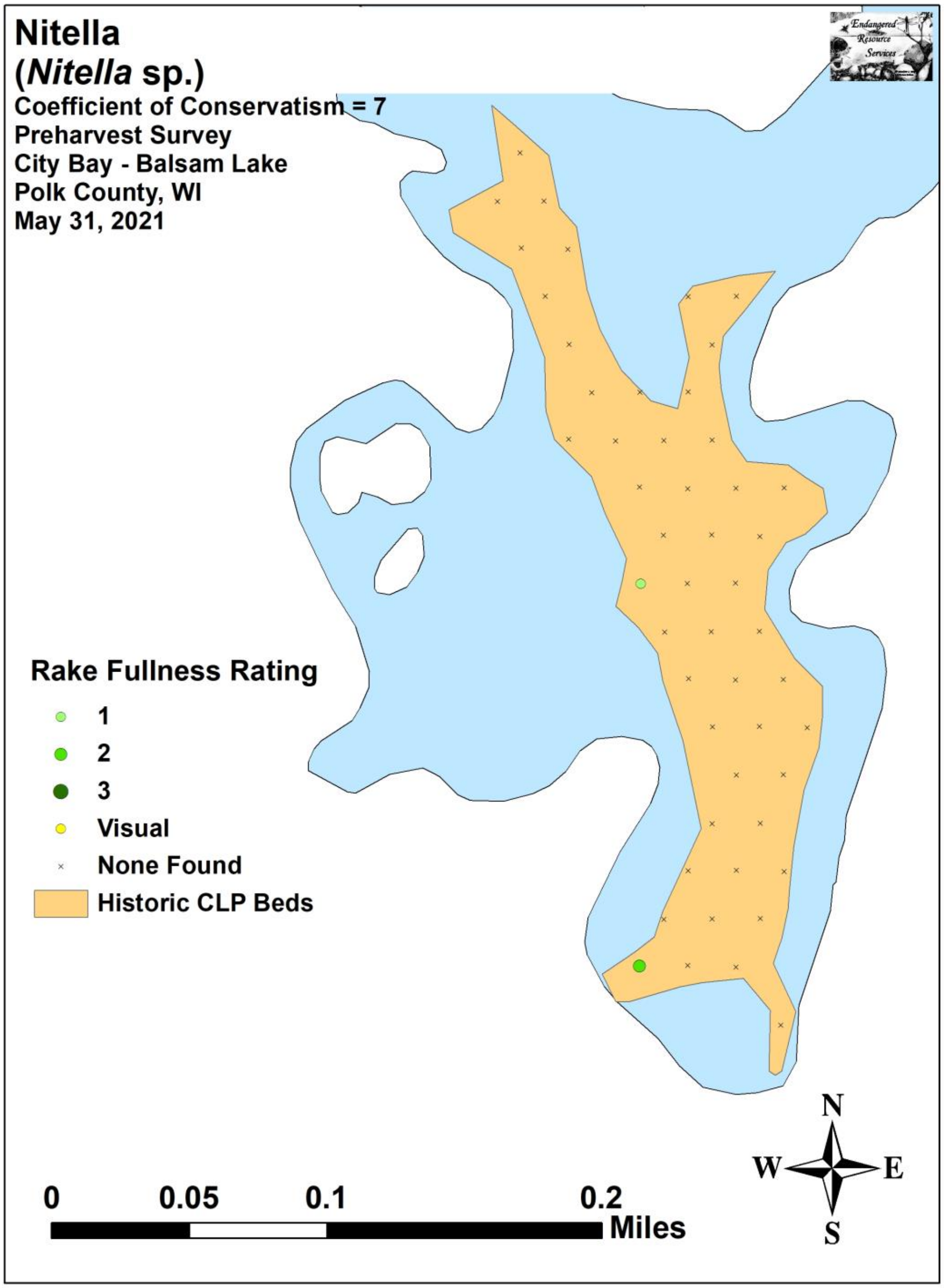

Muskgrass
(Chara sp.)
Coefficient of Conservatism = 7
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

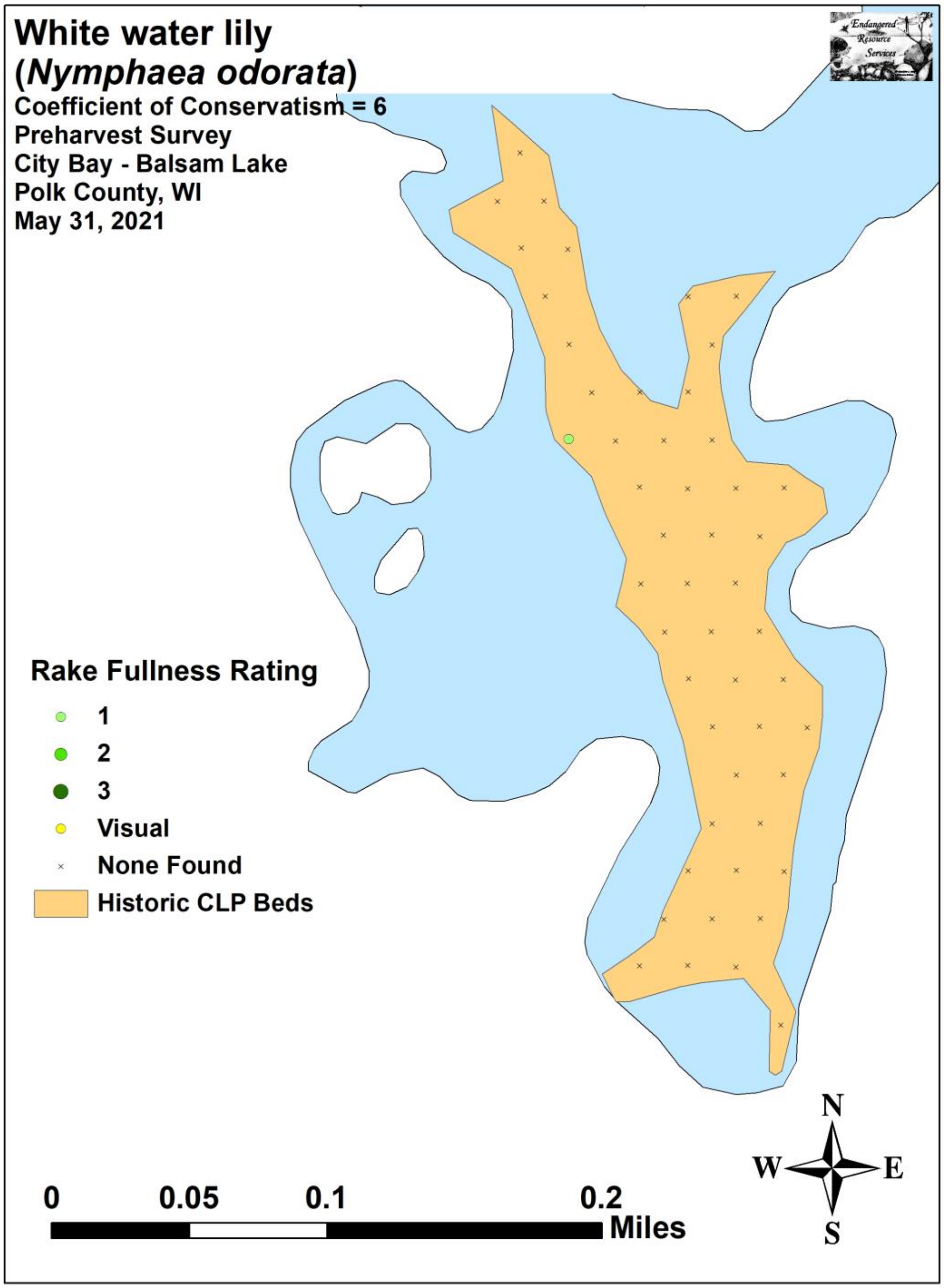

Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

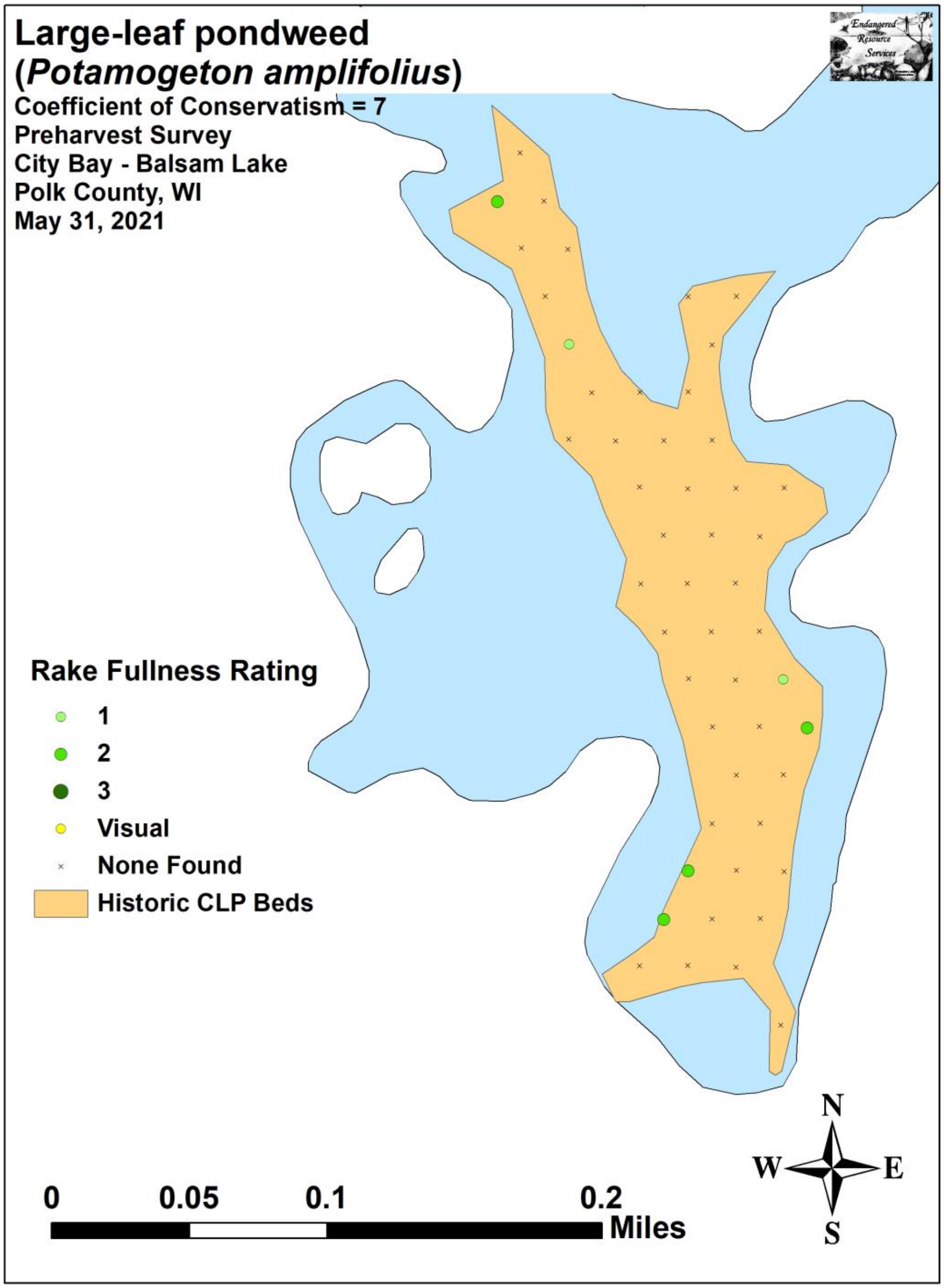

Filamentous algae
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

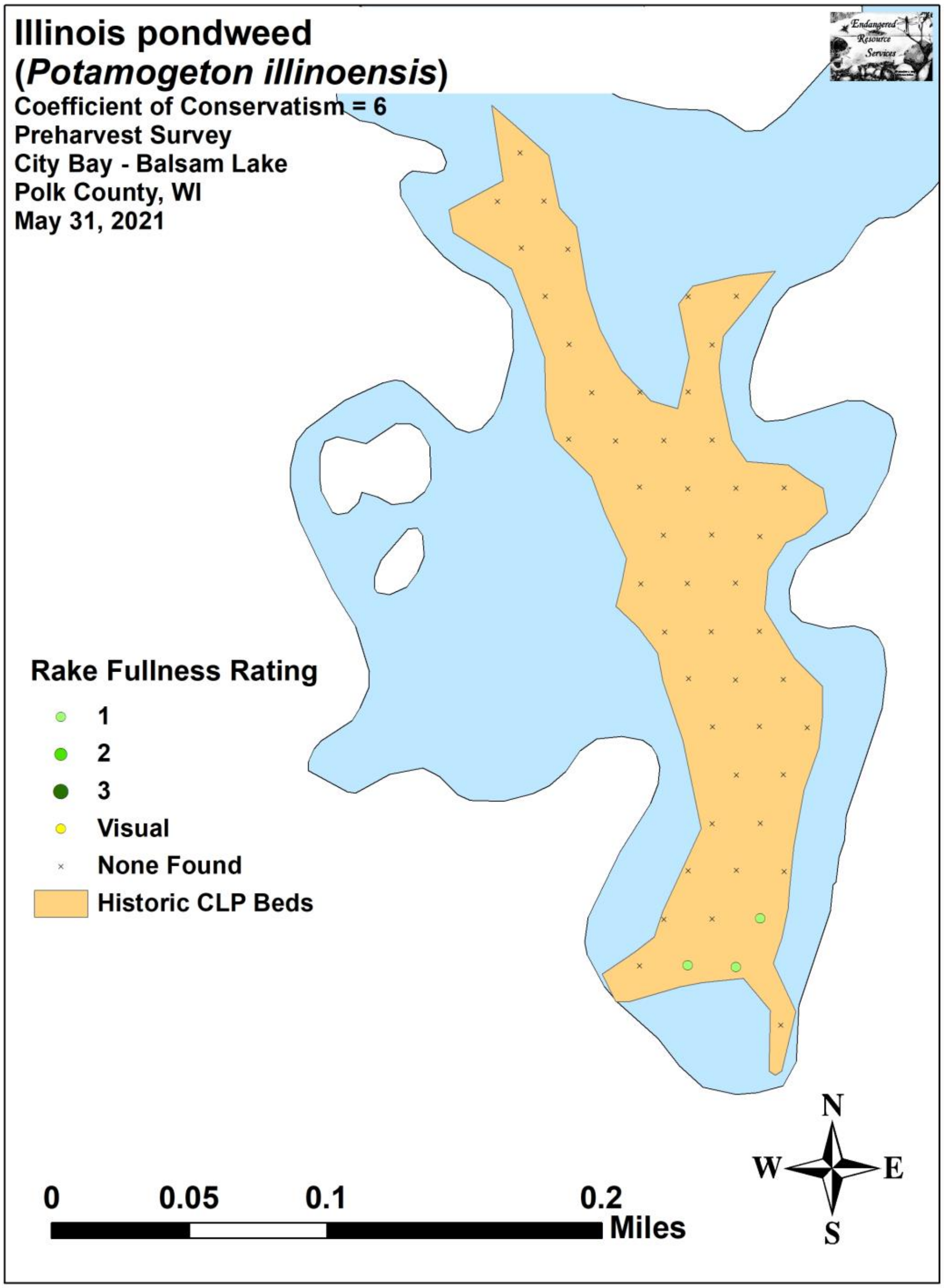

Water star-grass
(Heteranthera dubia)
Coefficient of Conservatism = 6
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S


Northern water-milfoil
(Myriophyllum sibiricum)
Coefficient of Conservatism = 6
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

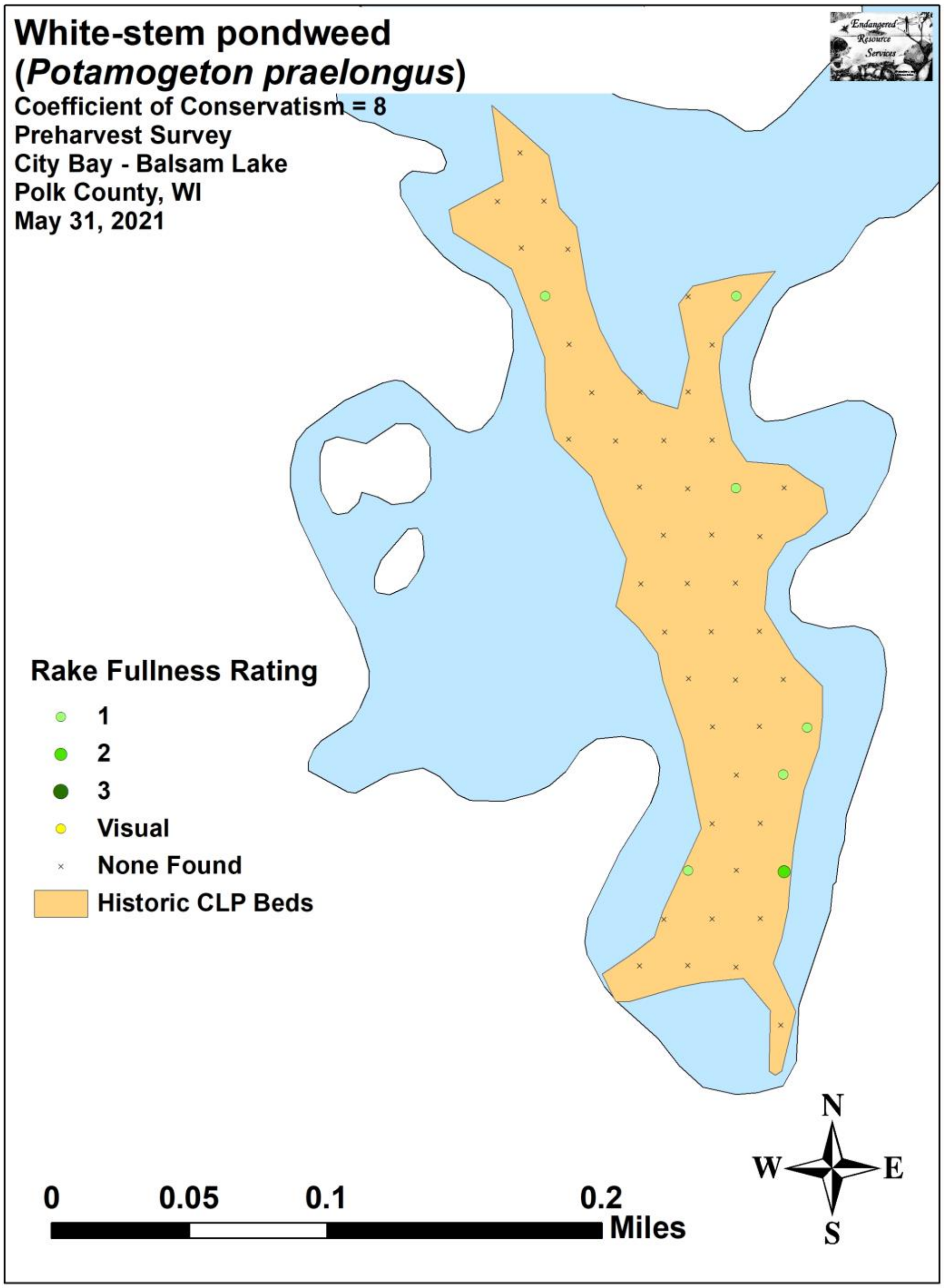

Nitella
(*Nitella* sp.)
Coefficient of Conservatism = 7
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

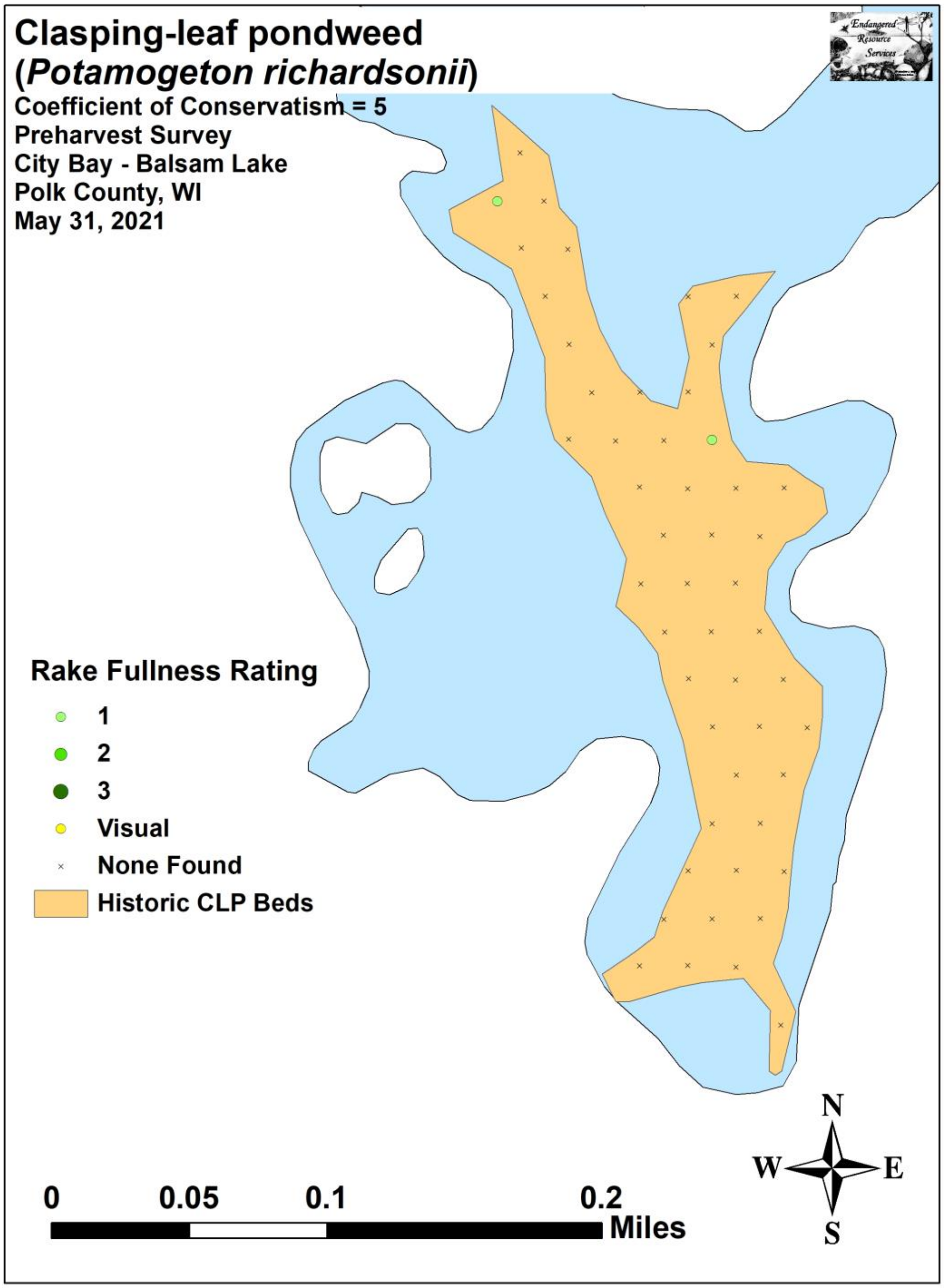

White water lily
(*Nymphaea odorata*)
Coefficient of Conservatism = 6
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Endangered Resource Services
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

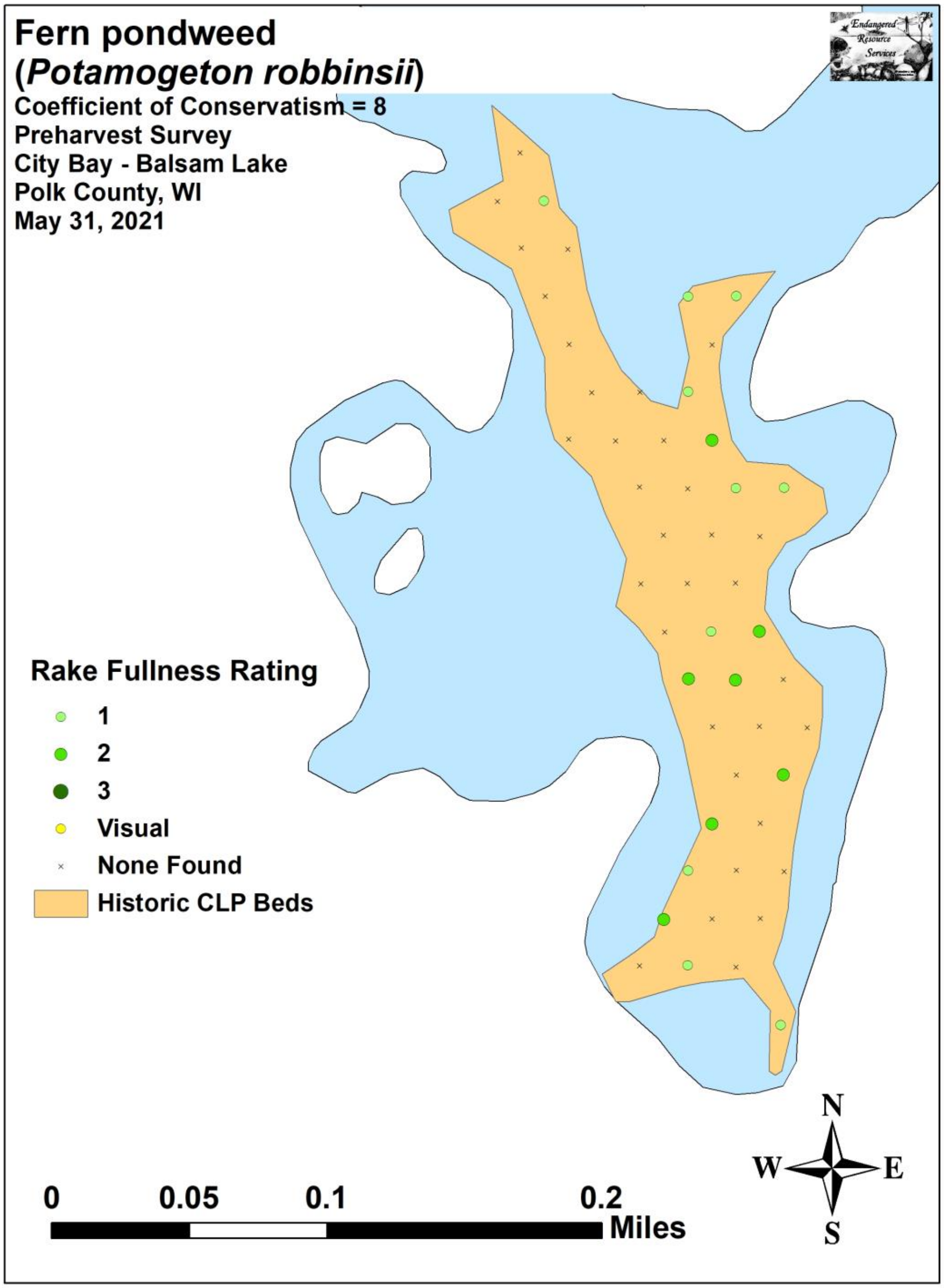

Large-leaf pondweed
(Potamogeton amplifolius)
Coefficient of Conservatism = 7
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

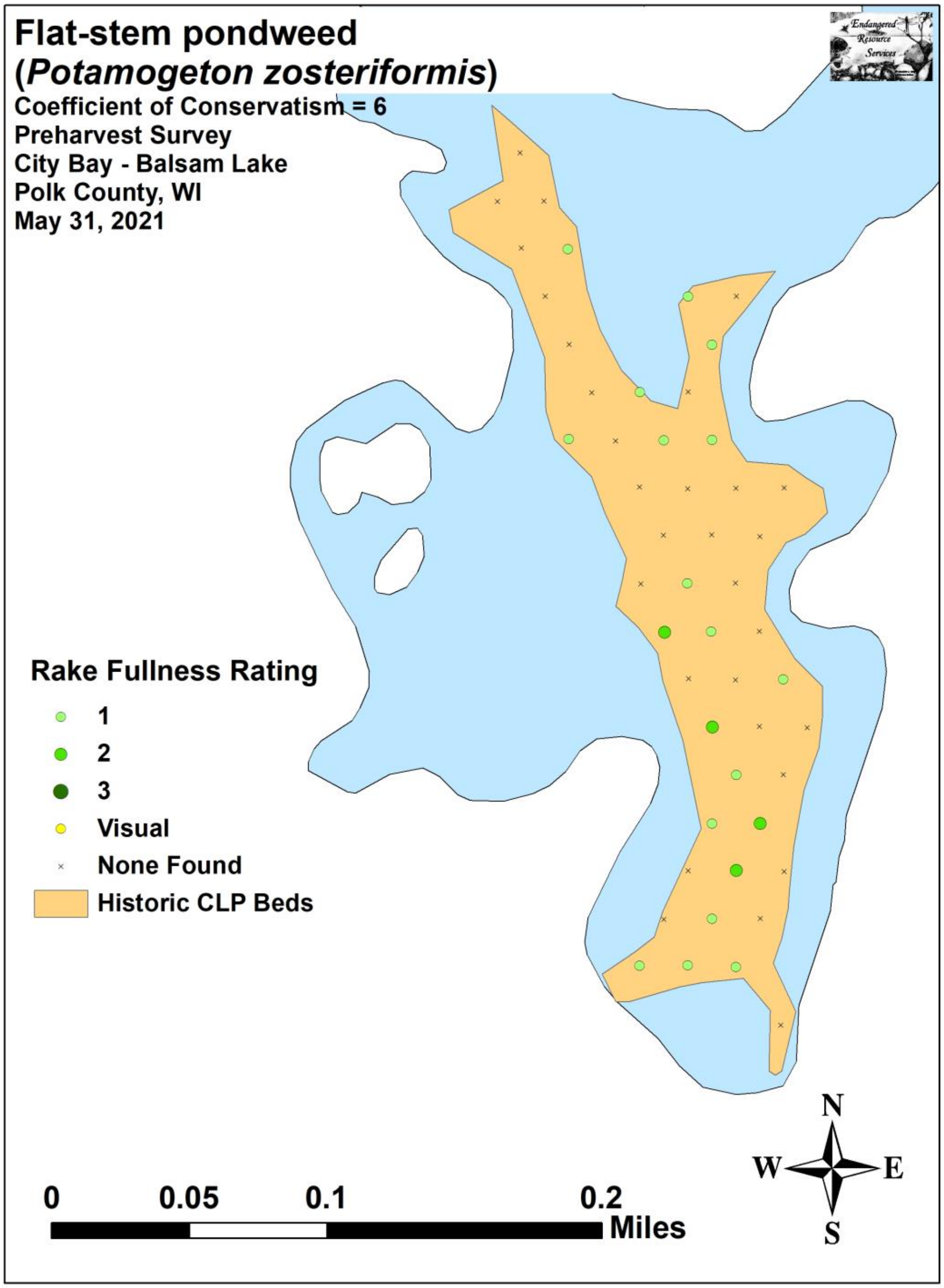


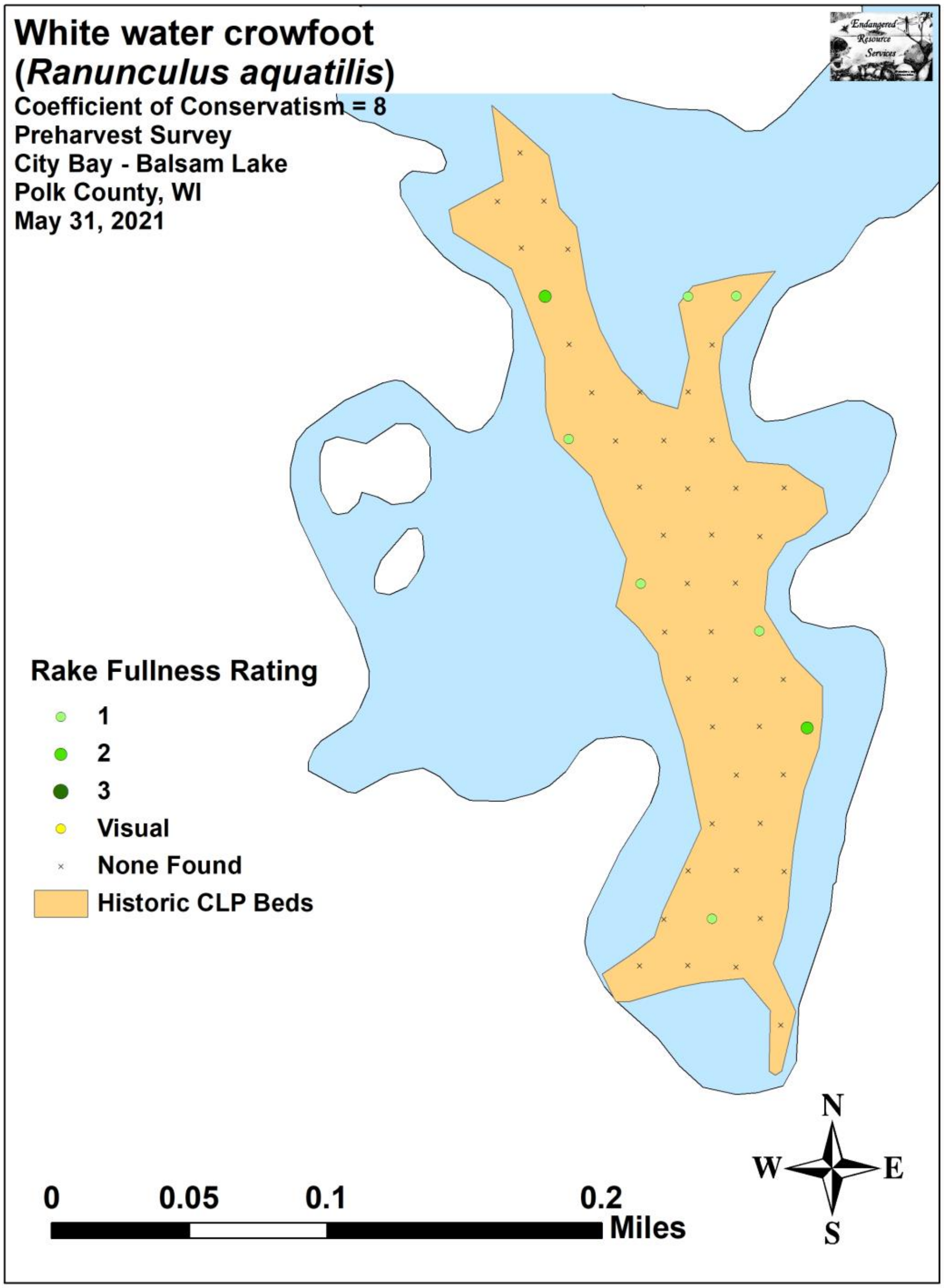
Illinois pondweed
(*Potamogeton illinoensis*)
Coefficient of Conservatism = 6
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

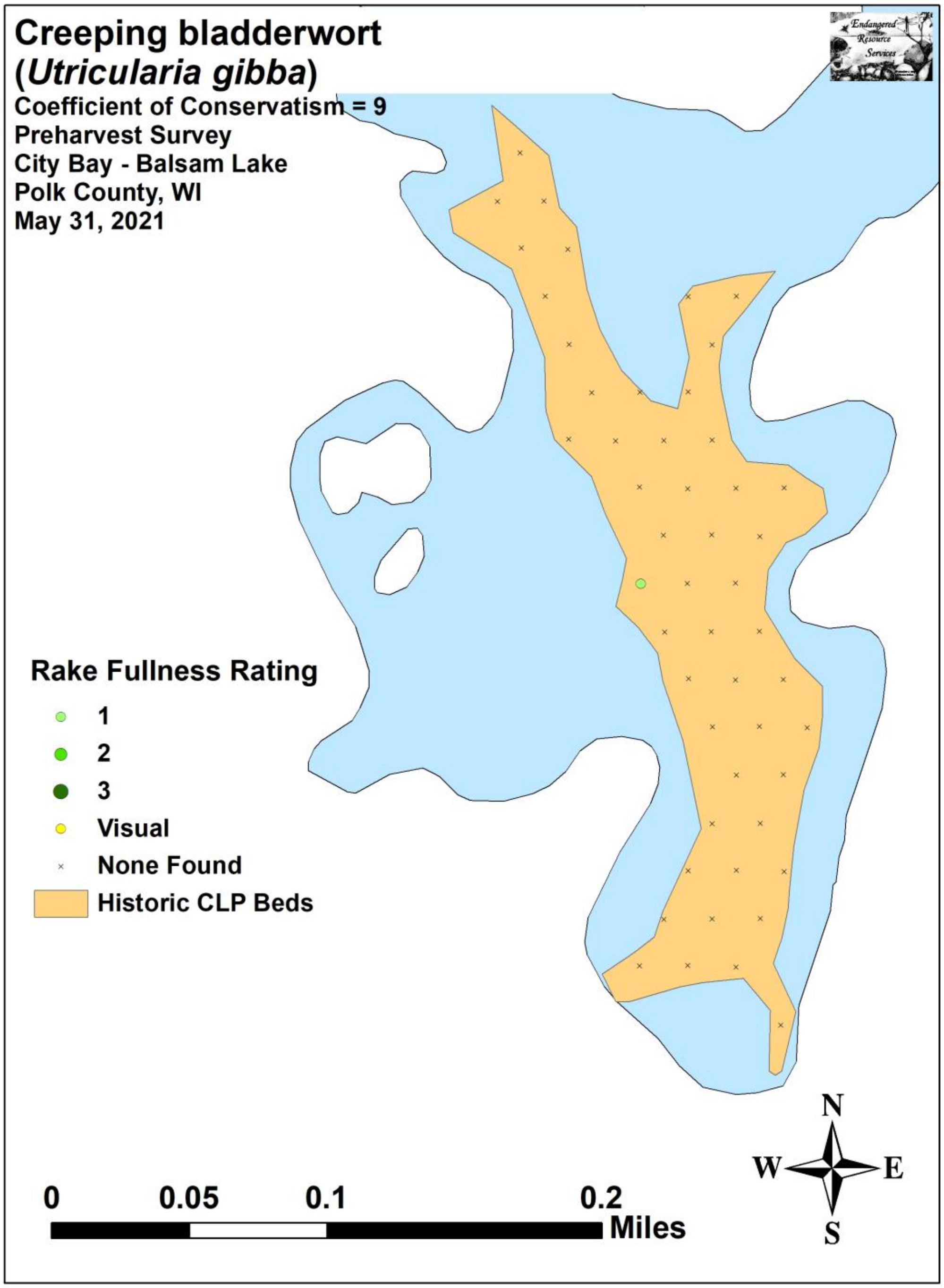

White-stem pondweed
(Potamogeton praelongus)
Coefficient of Conservatism = 8
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S


Clasping-leaf pondweed
(Potamogeton richardsonii)
Coefficient of Conservatism = 5
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S


Fern pondweed
(*Potamogeton robbinsii*)
Coefficient of Conservatism = 8
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Endangered Resource Services
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
N
W
E
S
0
0.05
0.1
0.2
Miles

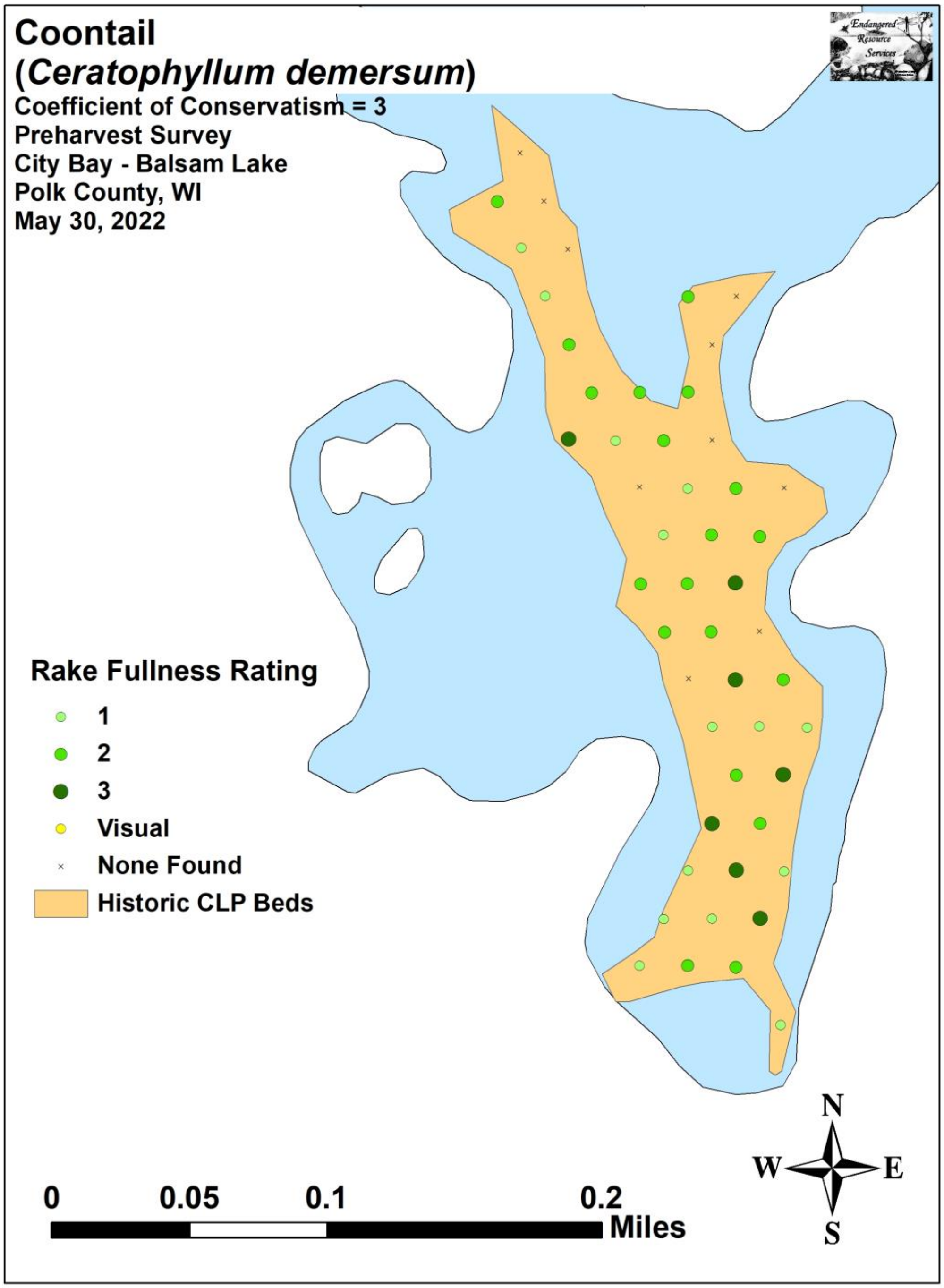

Flat-stem pondweed
(Potamogeton zosteriformis)
Coefficient of Conservatism = 6
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

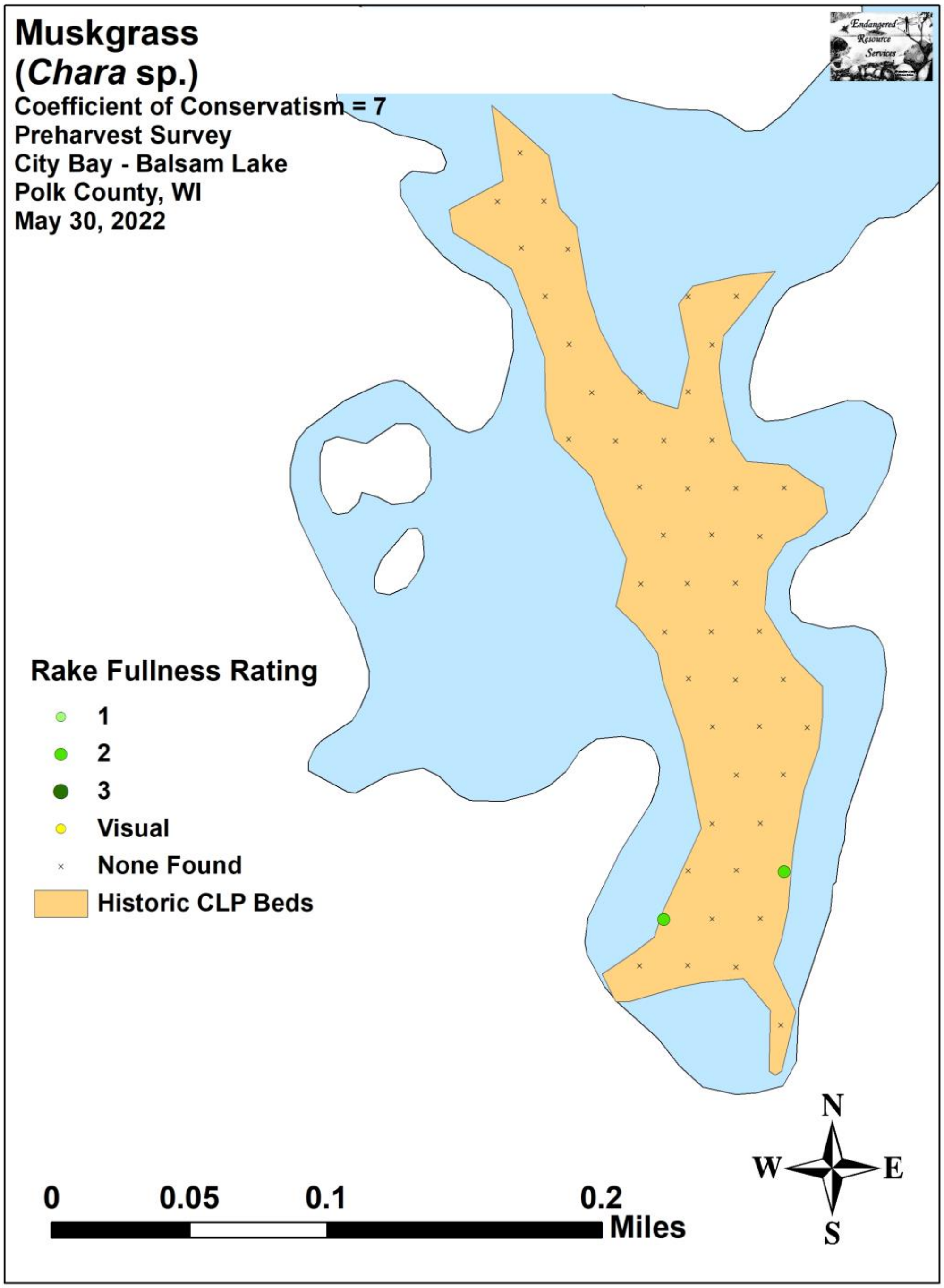

White water crowfoot
(*Ranunculus aquatilis*)
Coefficient of Conservatism = 8
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S



Creeping bladderwort
(Utricularia gibba)
Coefficient of Conservatism = 9
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 31, 2021
Endangered Resource Services
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S

Appendix VII: 2022 Preharvest Native Species Density and Distribution


Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
N
W
E
S


Muskgrass
(*Chara* sp.)
Coefficient of Conservatism = 7
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Rake Fullness Rating
1
2
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Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
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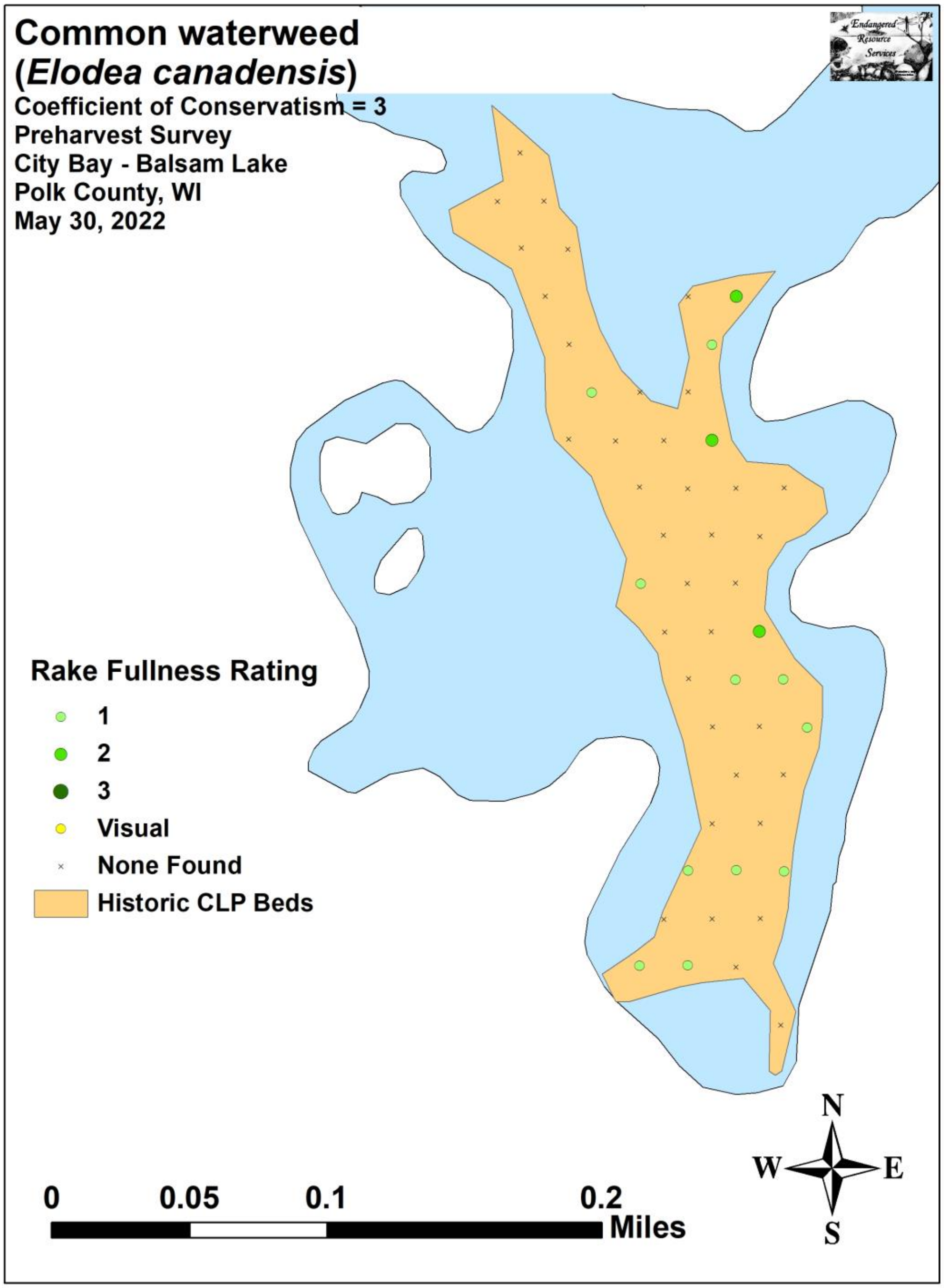
Common waterweed
(*Elodea canadensis*)
Coefficient of Conservatism = 3
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
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0.05
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0.2
Miles
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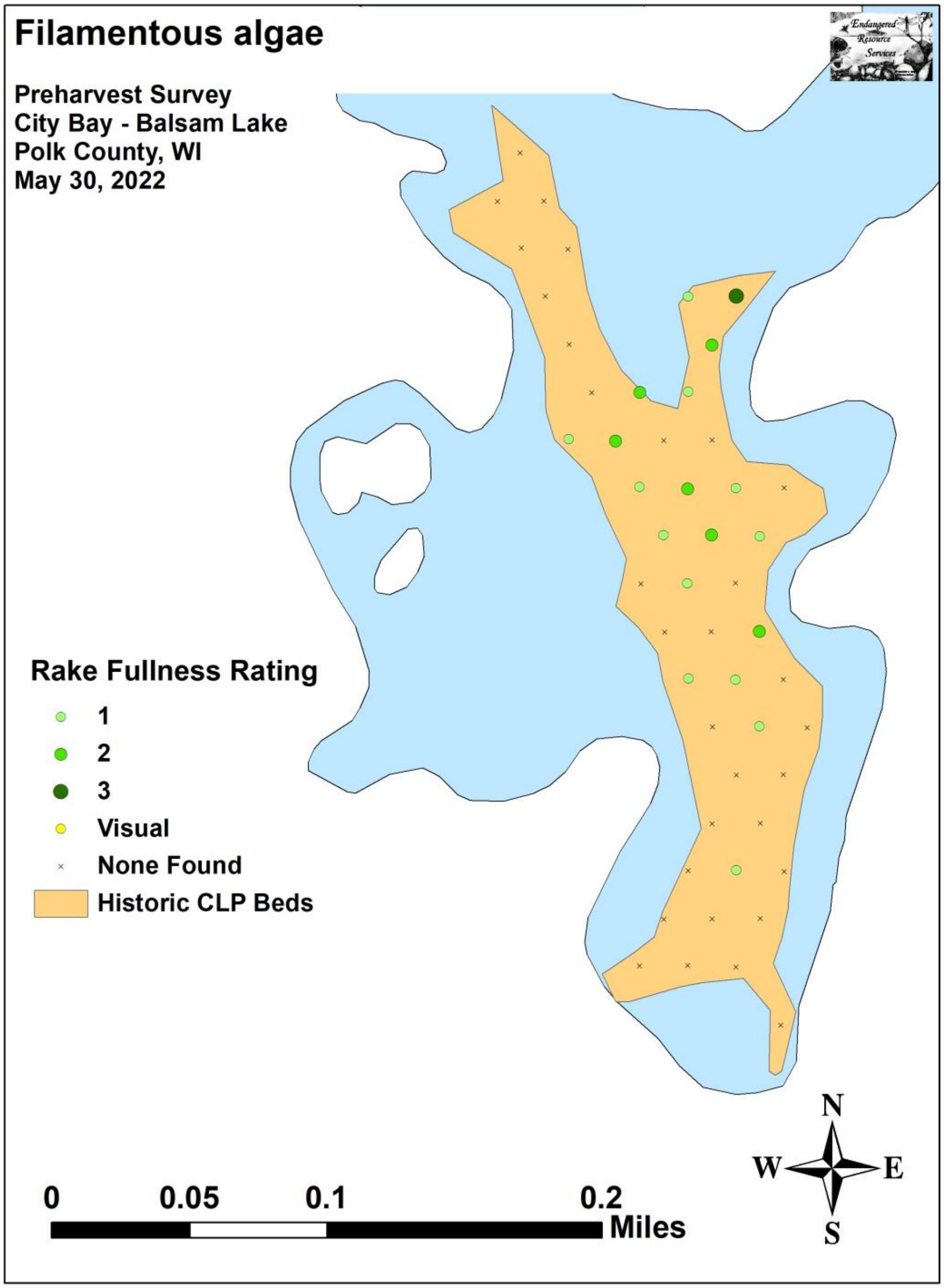
Filamentous algae
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
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0.1
0.2
Miles
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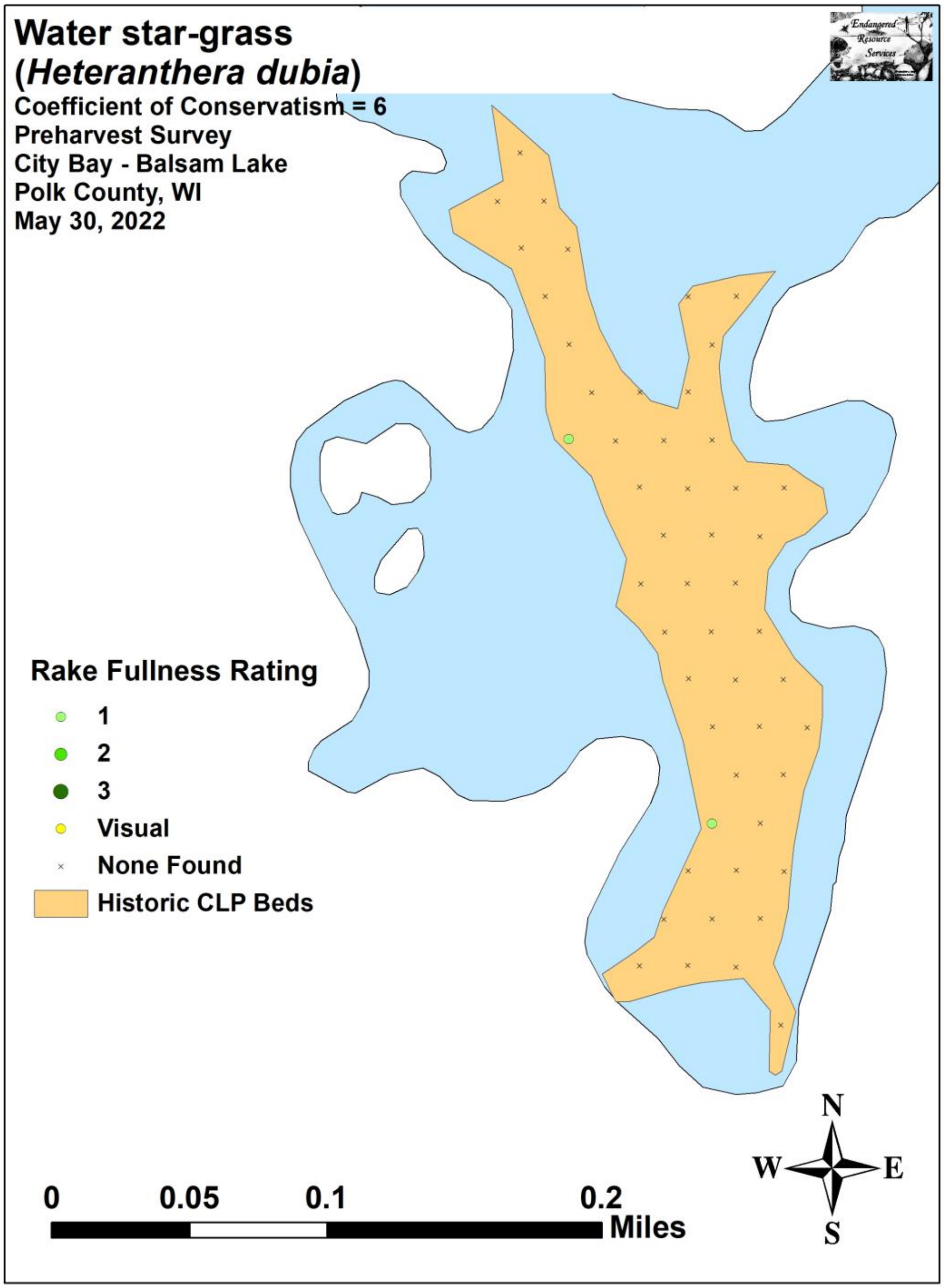
Water star-grass
(Heteranthera dubia)
Coefficient of Conservatism = 6
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Rake Fullness Rating
1
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3
Visual
None Found
Historic CLP Beds
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0.2
Miles
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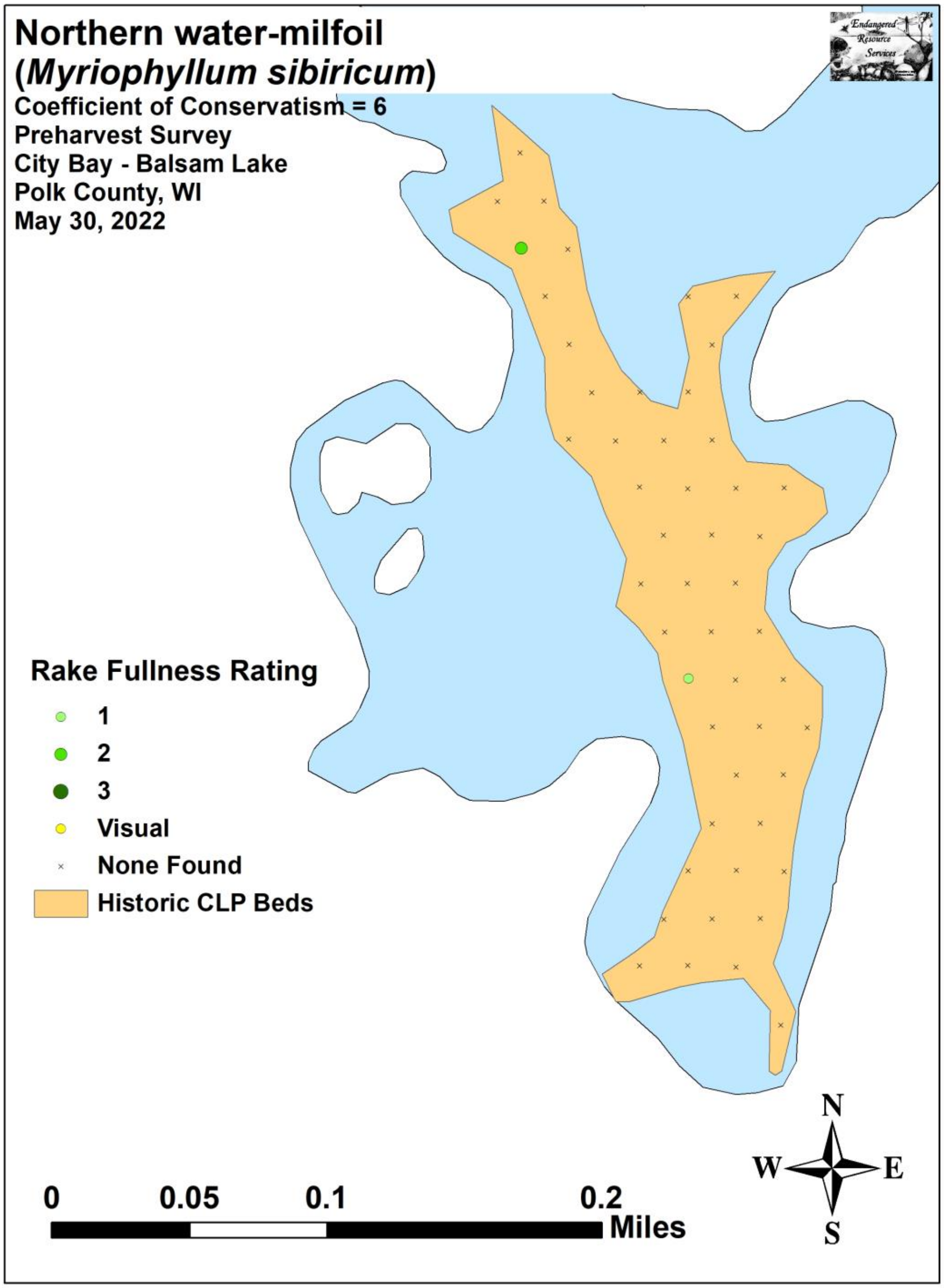
Northern water-milfoil
(*Myriophyllum sibiricum*)
Coefficient of Conservatism = 6
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
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Miles
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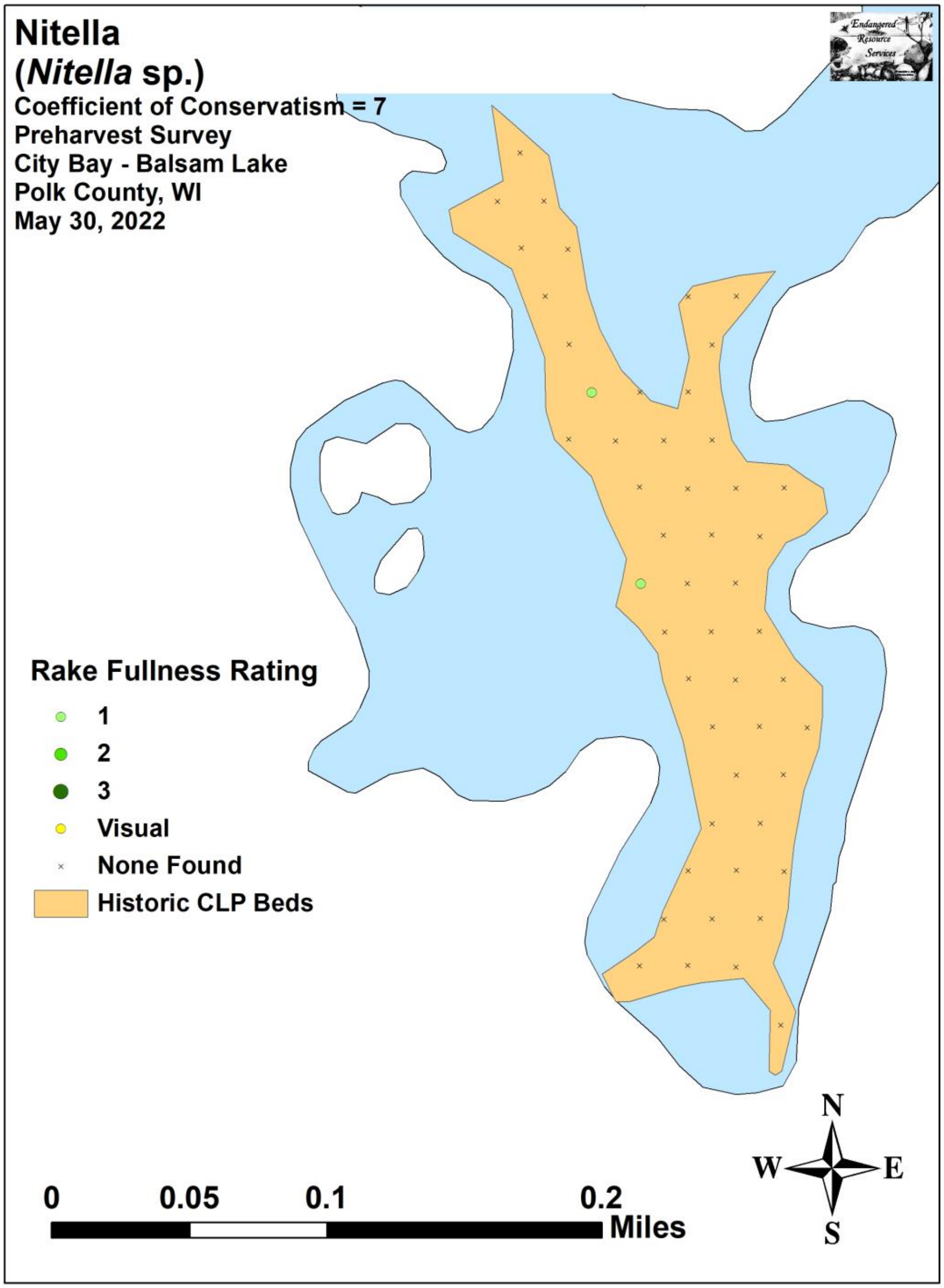
Nitella
(*Nitella* sp.)
Coefficient of Conservatism = 7
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Endangered Resource Services
Rake Fullness Rating
1
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Visual
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Historic CLP Beds
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Miles
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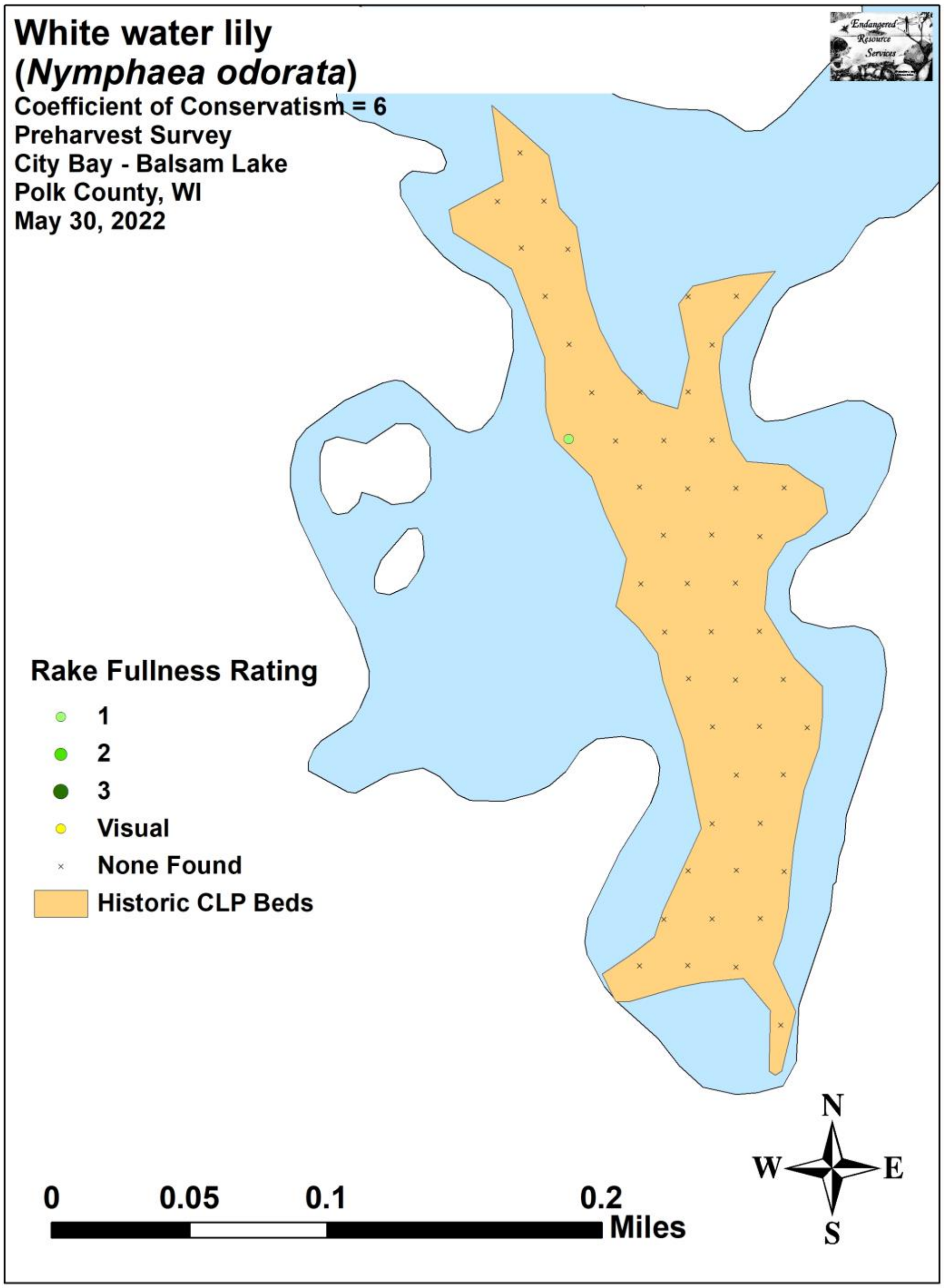
White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Rake Fullness Rating
1
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Visual
None Found
Historic CLP Beds
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Miles
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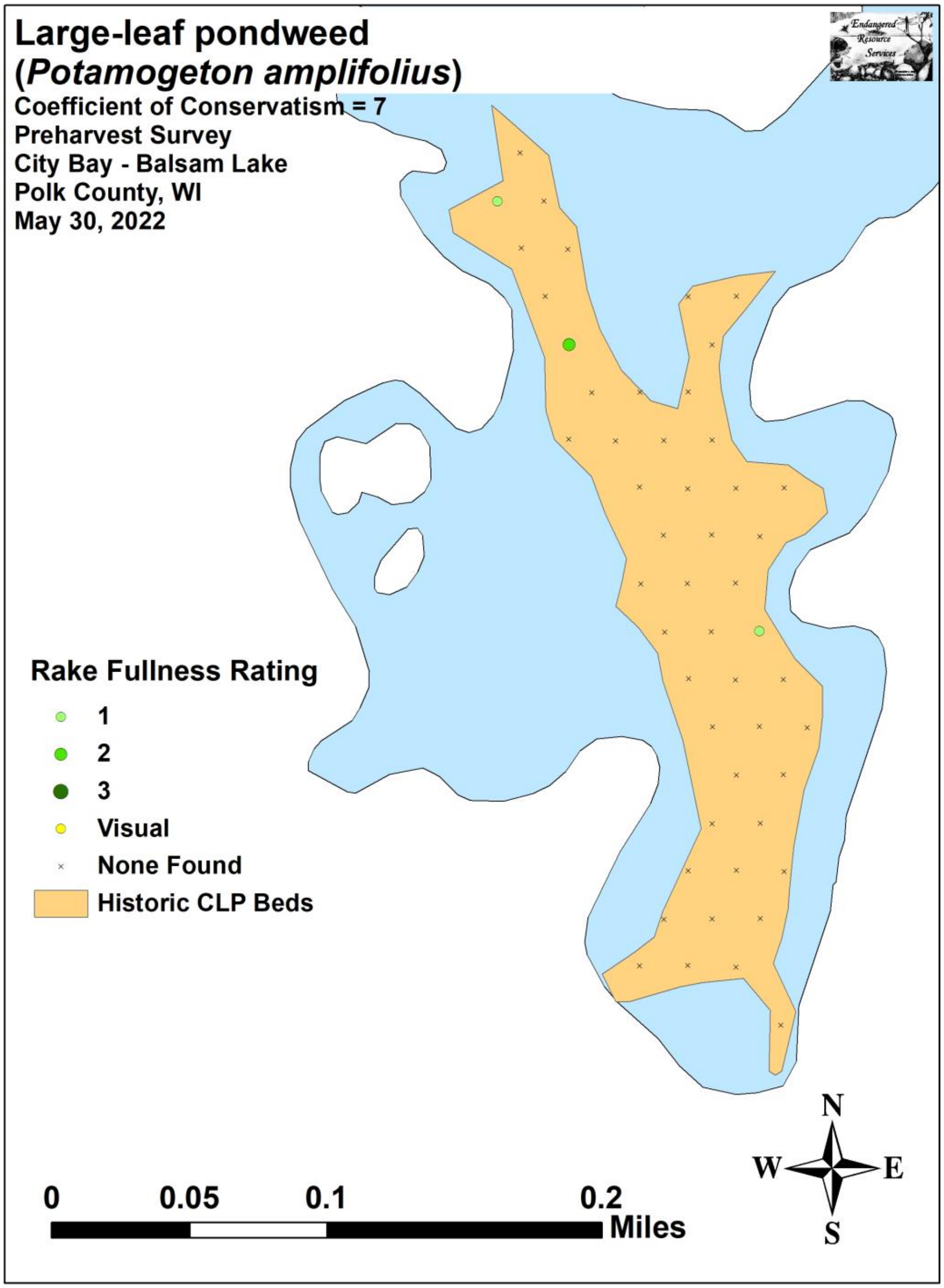
Large-leaf pondweed
(Potamogeton amplifolius)
Coefficient of Conservatism = 7
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Rake Fullness Rating
1
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Visual
None Found
Historic CLP Beds
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Miles
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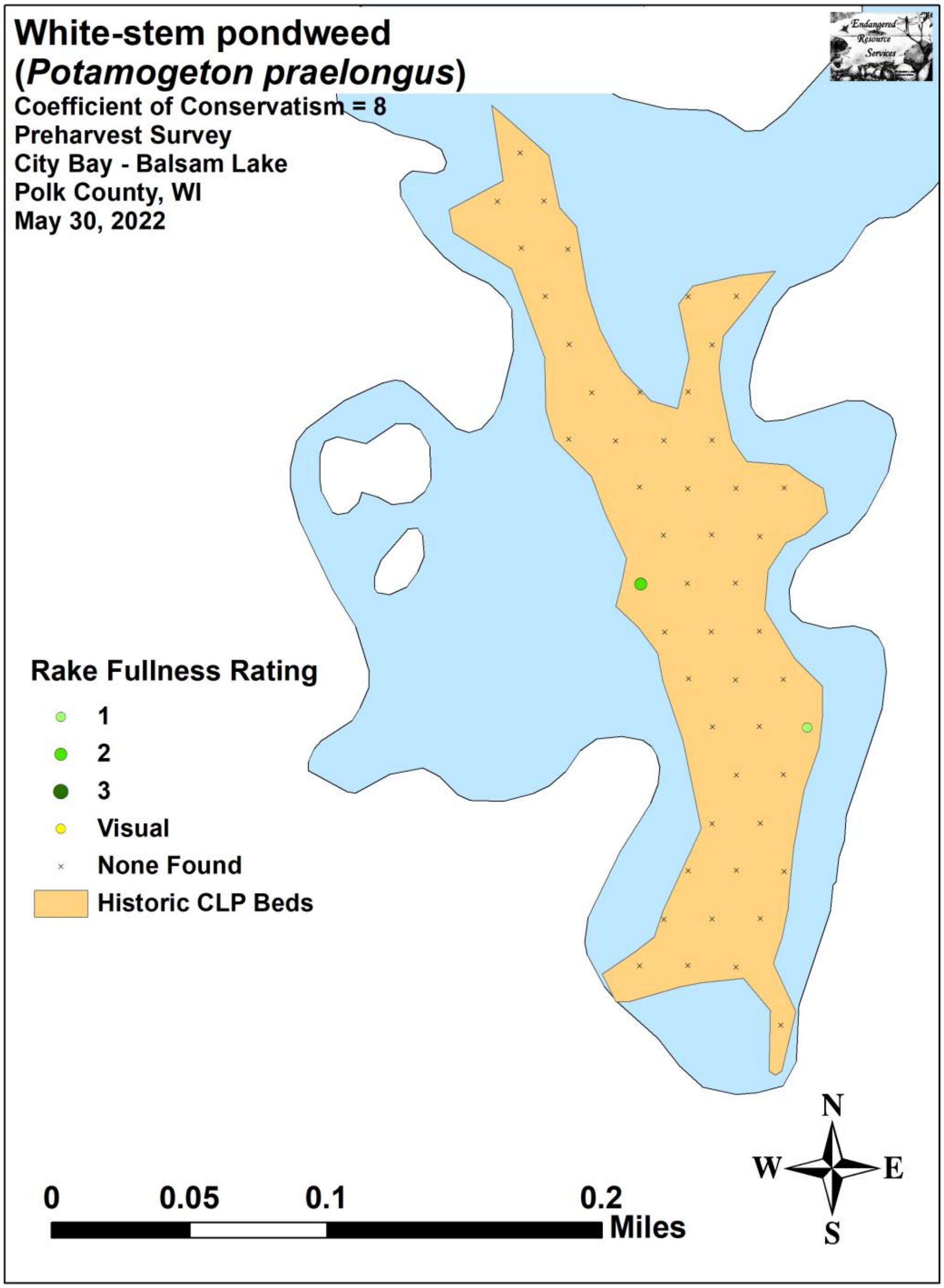
White-stem pondweed
(Potamogeton praelongus)
Coefficient of Conservatism = 8
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Rake Fullness Rating
1
2
3
Visual
None Found
Historic CLP Beds
0
0.05
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0.2
Miles
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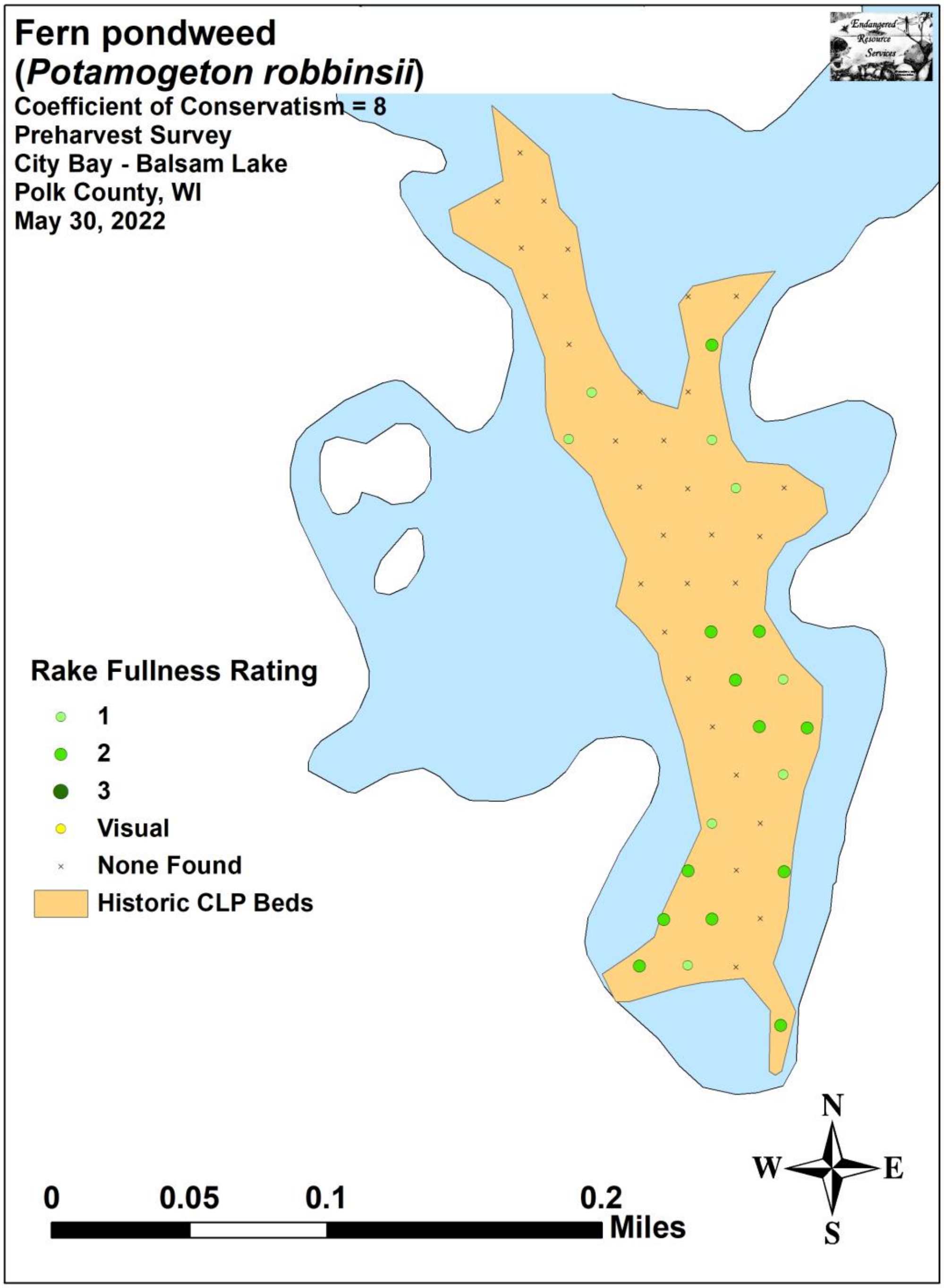

Fern pondweed
(*Potamogeton robbinsii*)
Coefficient of Conservatism = 8
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Rake Fullness Rating
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Visual
None Found
Historic CLP Beds
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0.2
Miles
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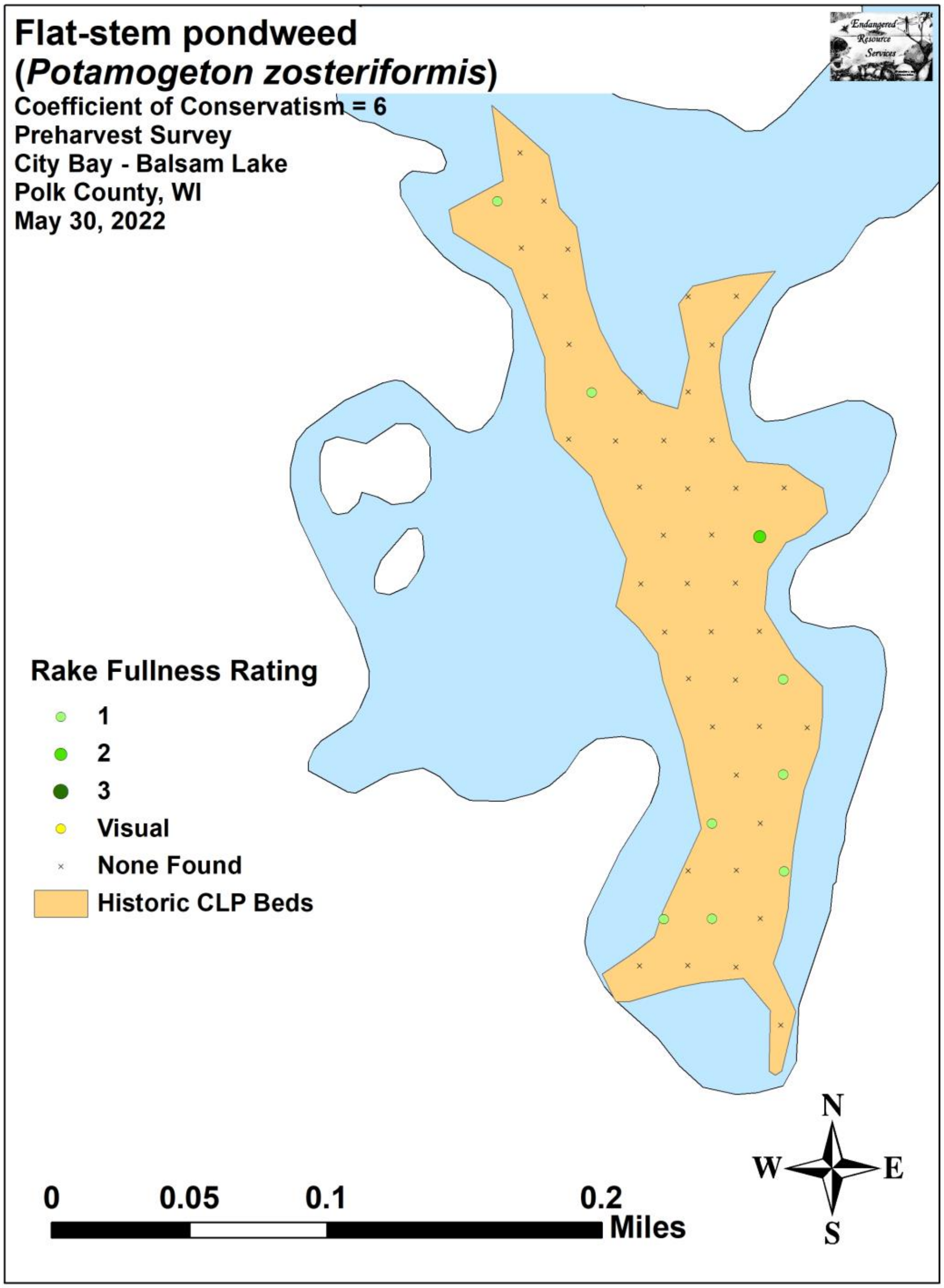

Flat-stem pondweed
(*Potamogeton zosteriformis*)
Coefficient of Conservatism = 6
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Rake Fullness Rating
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Visual
None Found
Historic CLP Beds
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Miles
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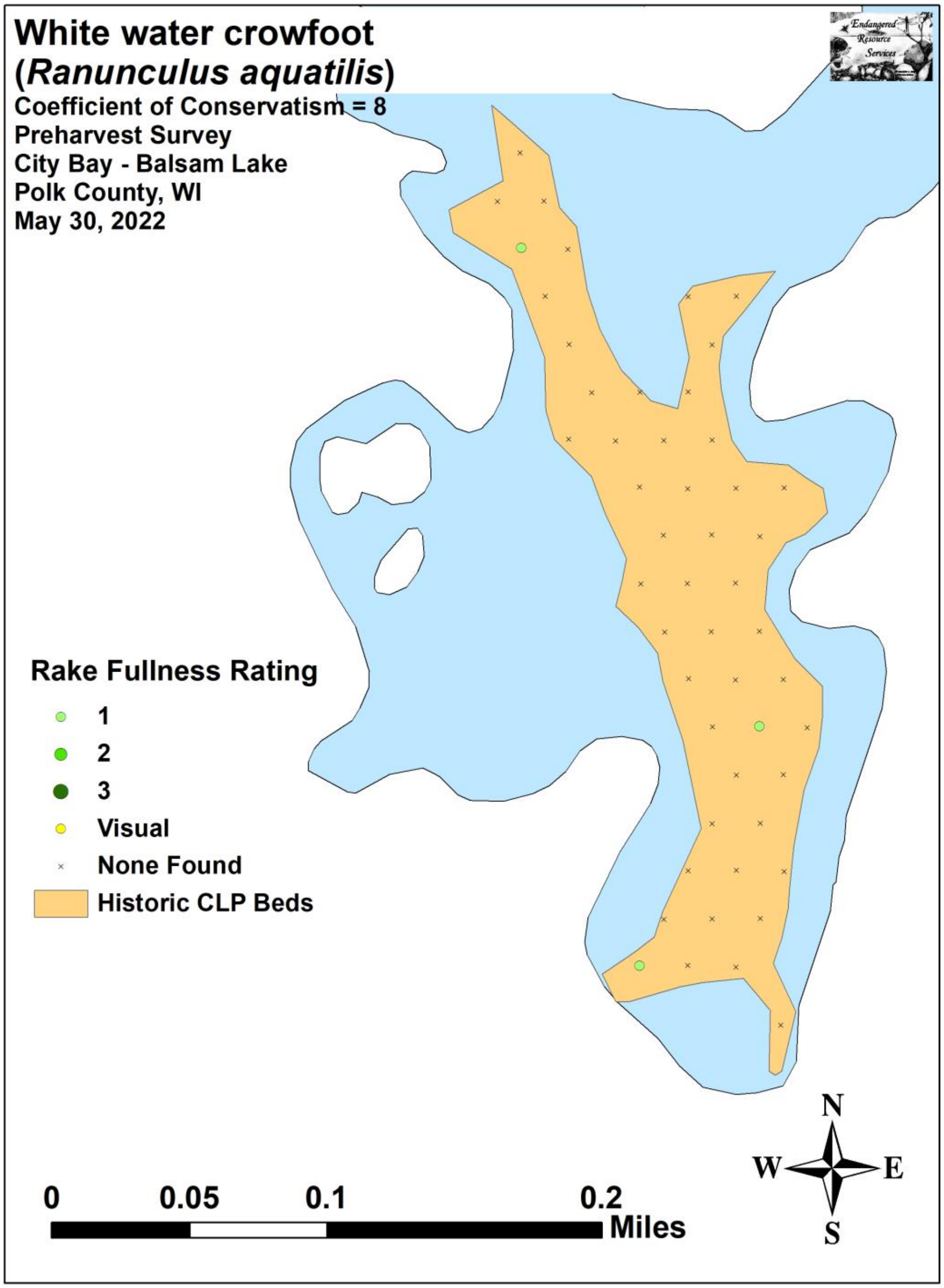
White water crowfoot
(Ranunculus aquatilis)
Coefficient of Conservatism = 8
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
May 30, 2022
Endangered Resource Services
Rake Fullness Rating
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Visual
None Found
Historic CLP Beds
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Miles
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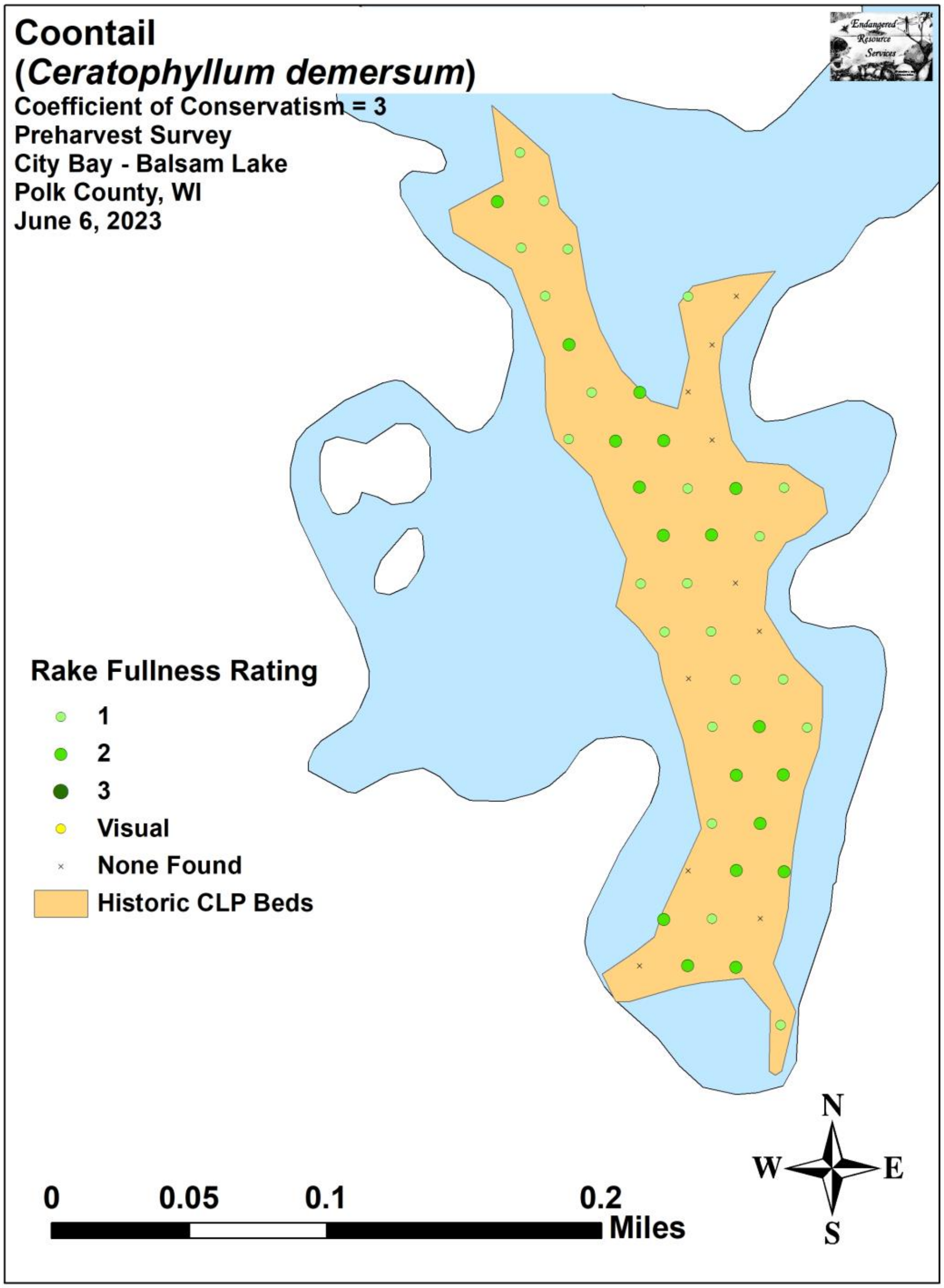
Appendix VIII: 2023 Preharvest Native Species Density and Distribution


Coontail
(*Ceratophyllum demersum*)
Coefficient of Conservatism = 3
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Endangered Resource Services
Rake Fullness Rating
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Visual
None Found
Historic CLP Beds
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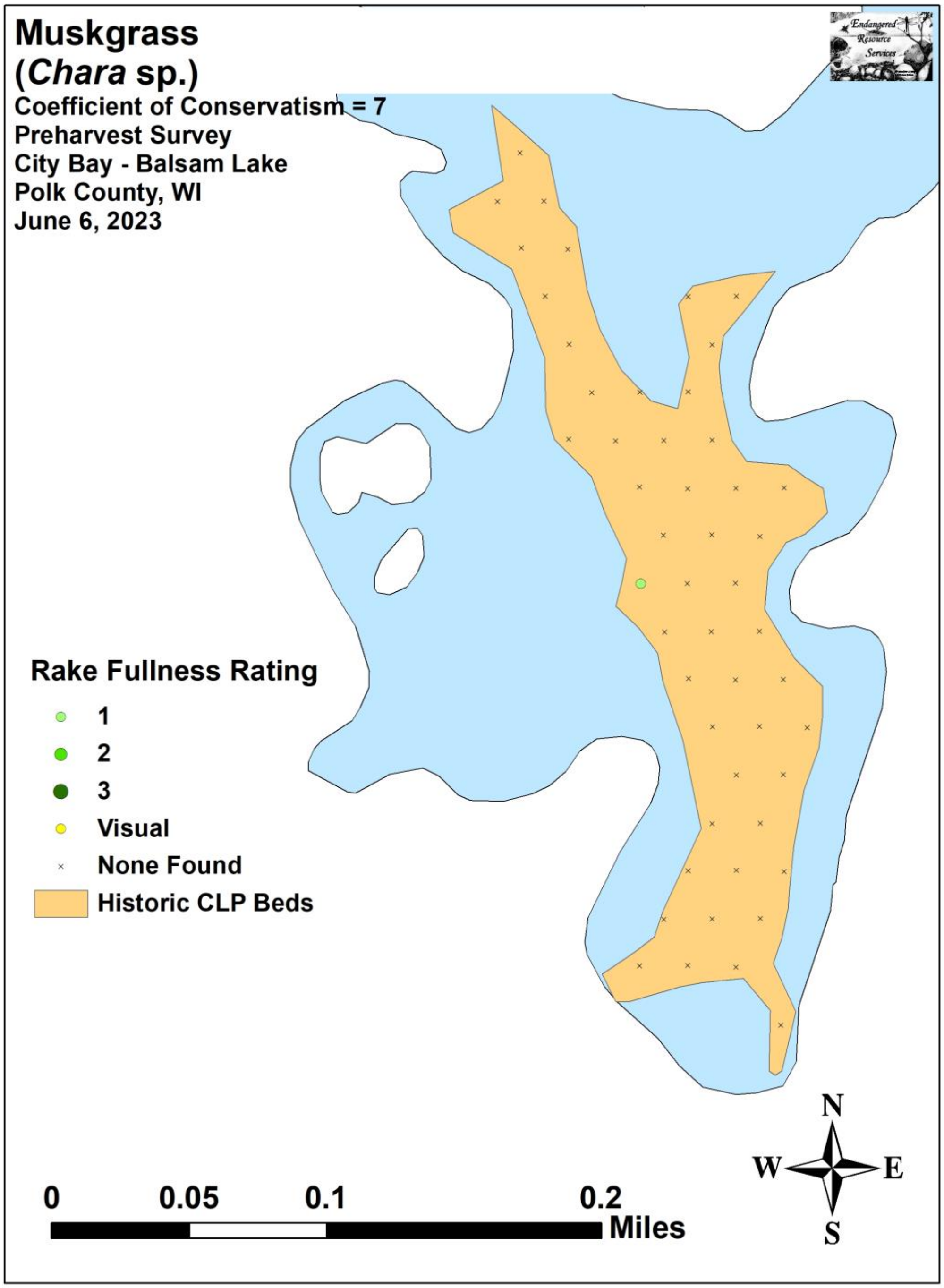
Muskgrass
(*Chara* sp.)
Coefficient of Conservatism = 7
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Endangered Resource Services
Rake Fullness Rating
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Visual
None Found
Historic CLP Beds
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Miles
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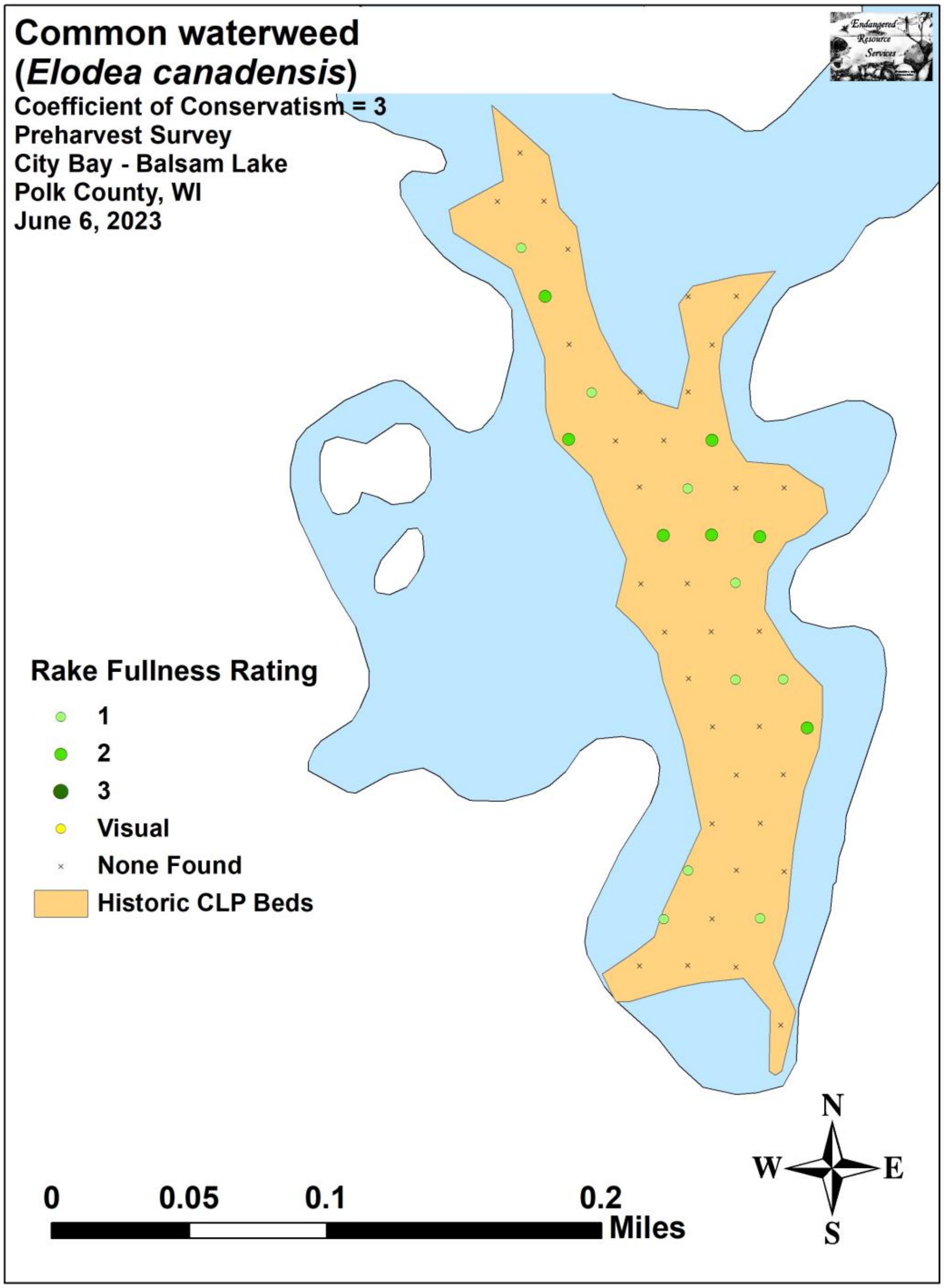

Common waterweed
(*Elodea canadensis*)
Coefficient of Conservatism = 3
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Endangered Resource Services
Rake Fullness Rating
1
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Visual
None Found
Historic CLP Beds
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Miles
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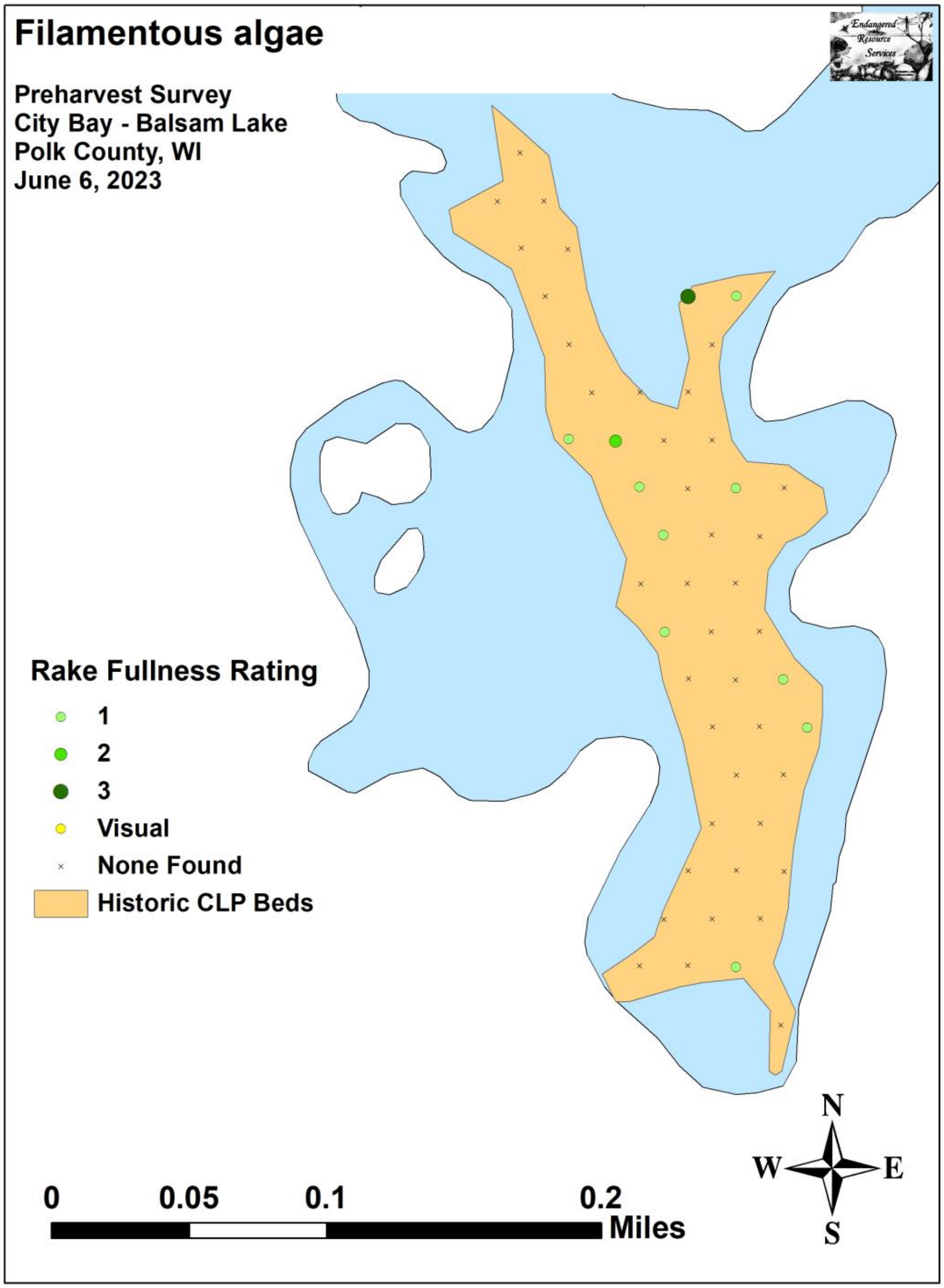
Filamentous algae
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Endangered Resource Services
Rake Fullness Rating
1
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Visual
None Found
Historic CLP Beds
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Miles
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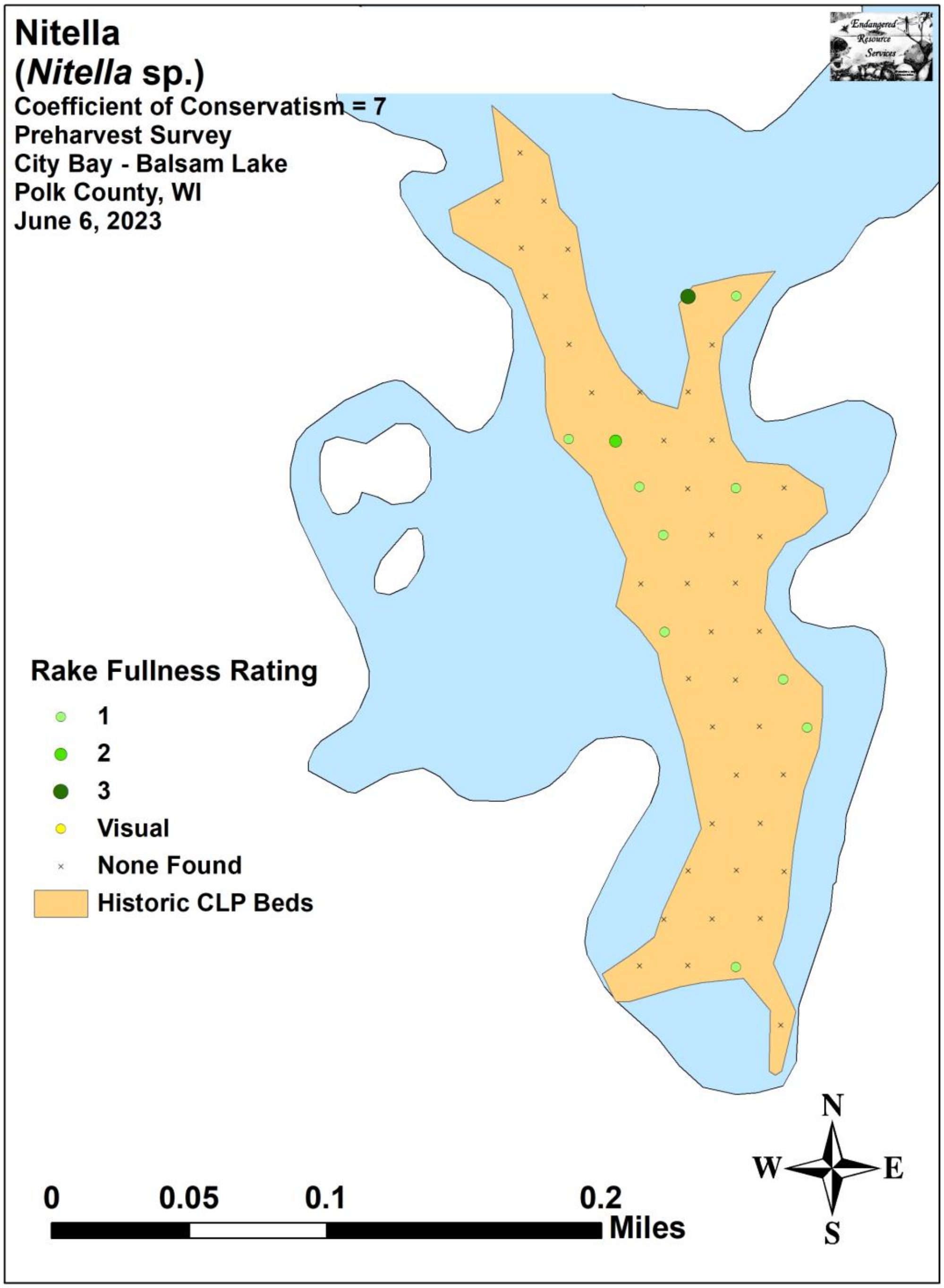
Nitella
(*Nitella* sp.)
Coefficient of Conservatism = 7
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Endangered Resource Services
Rake Fullness Rating
1
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Visual
None Found
Historic CLP Beds
0
0.05
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Miles
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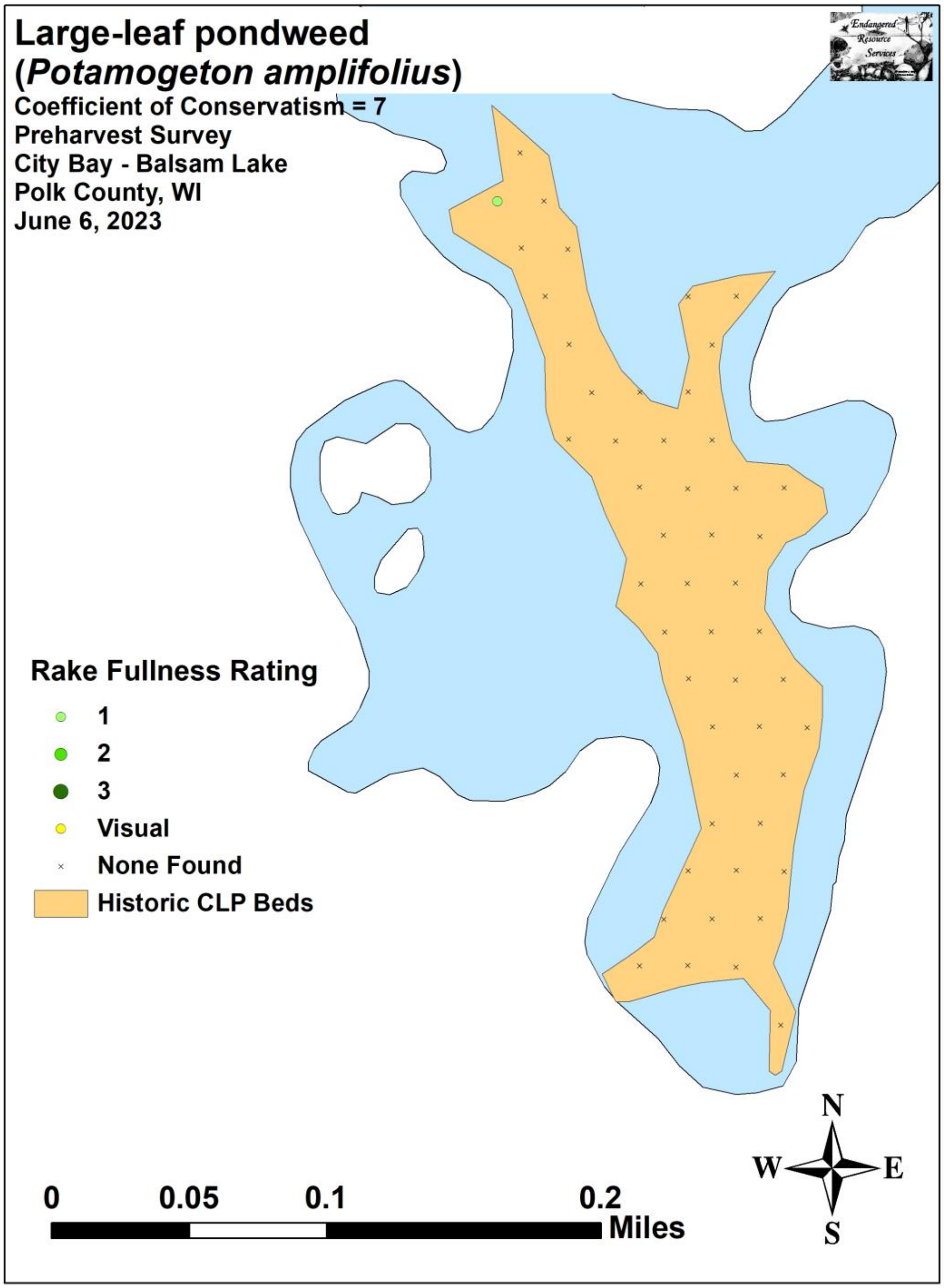

Large-leaf pondweed
(*Potamogeton amplifolius*)
Coefficient of Conservatism = 7
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Rake Fullness Rating
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Visual
None Found
Historic CLP Beds
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Miles
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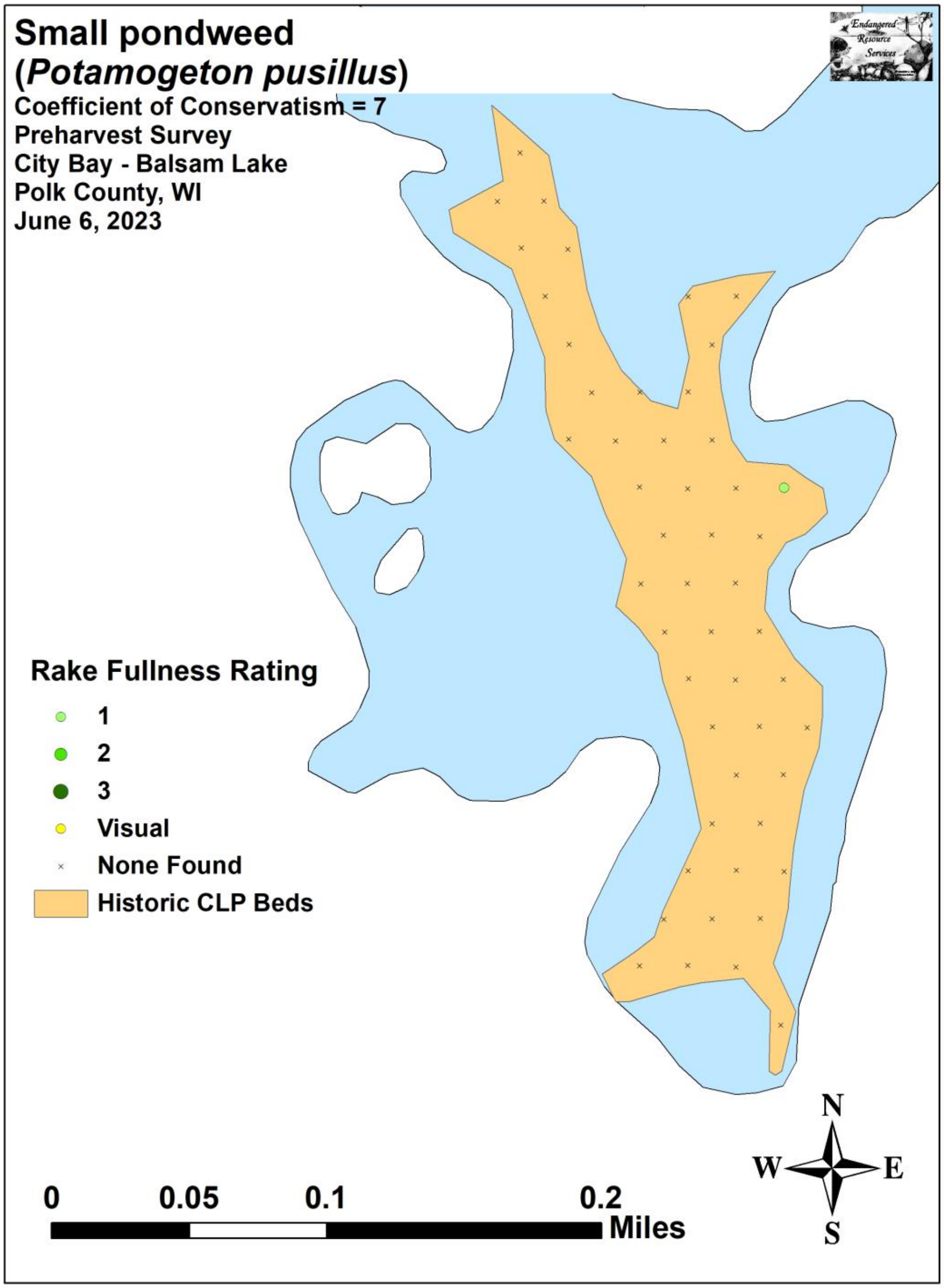
Small pondweed
(*Potamogeton pusillus*)
Coefficient of Conservatism = 7
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Endangered Resource Services
Rake Fullness Rating
1
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Visual
None Found
Historic CLP Beds
0
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Miles
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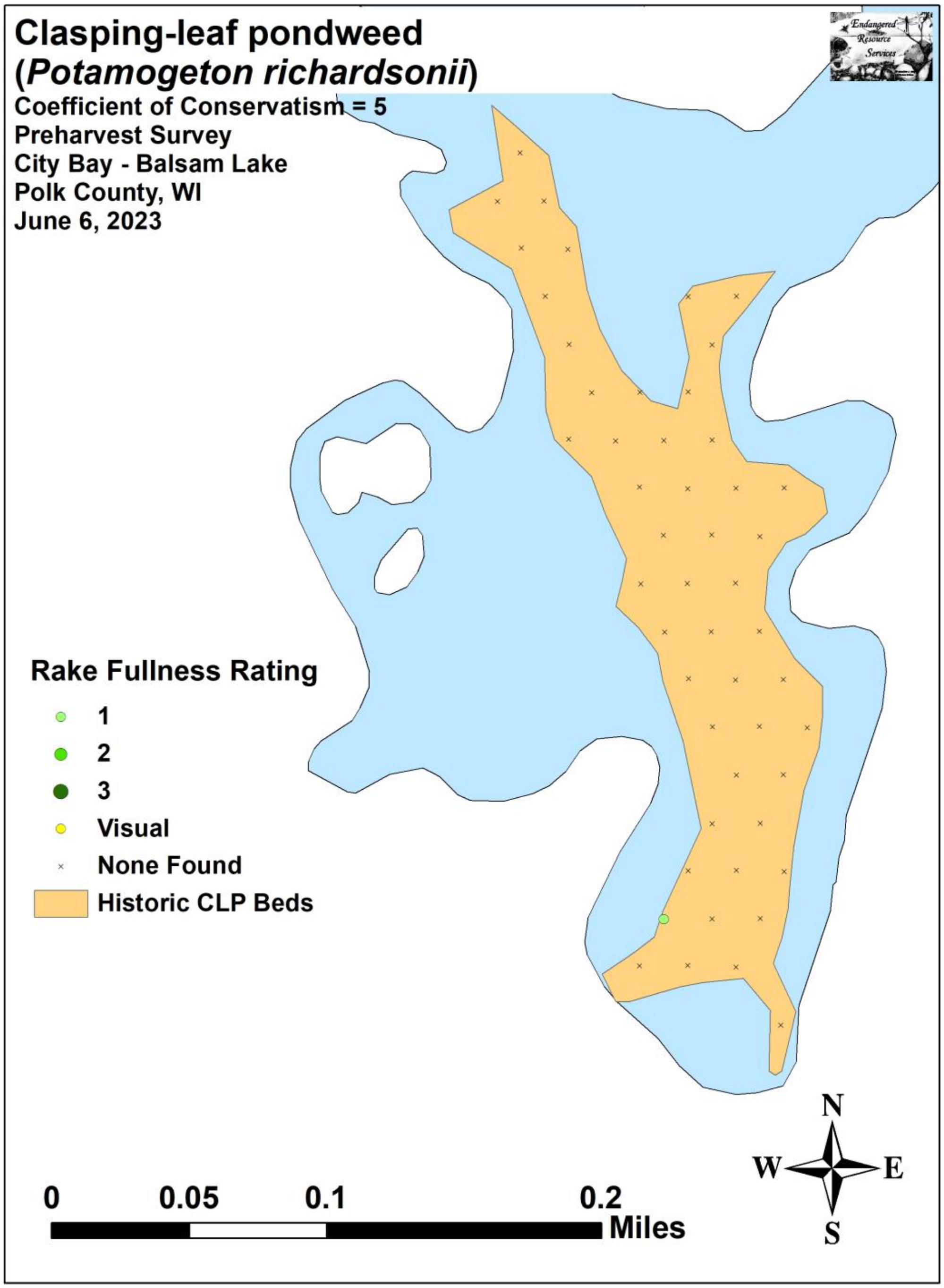
Clasping-leaf pondweed
(Potamogeton richardsonii)
Coefficient of Conservatism = 5
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Rake Fullness Rating
1
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3
Visual
None Found
Historic CLP Beds
0
0.05
0.1
0.2
Miles
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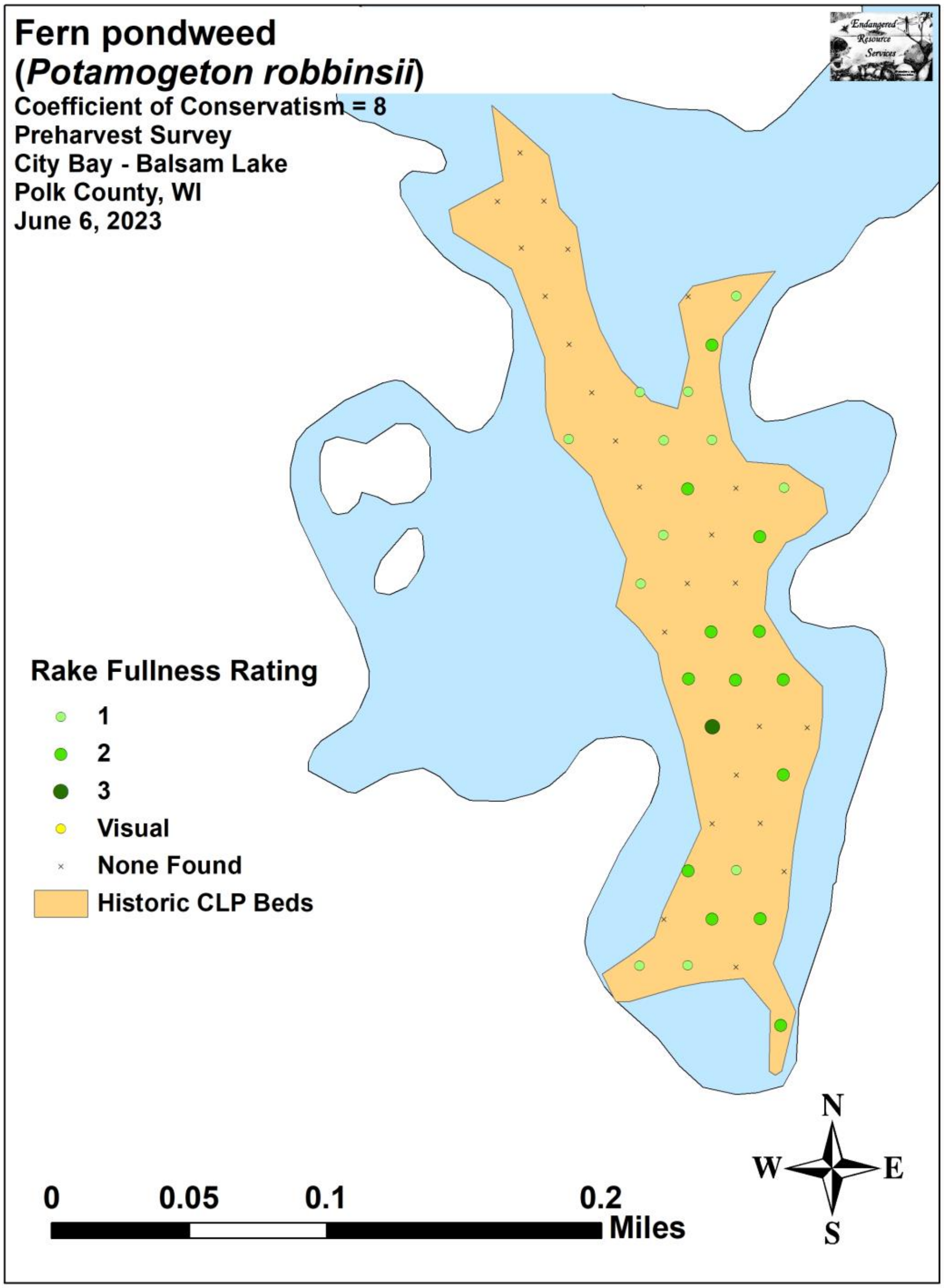
S


Fern pondweed
(*Potamogeton robbinsii*)
Coefficient of Conservatism = 8
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Rake Fullness Rating
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Visual
None Found
Historic CLP Beds
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Miles
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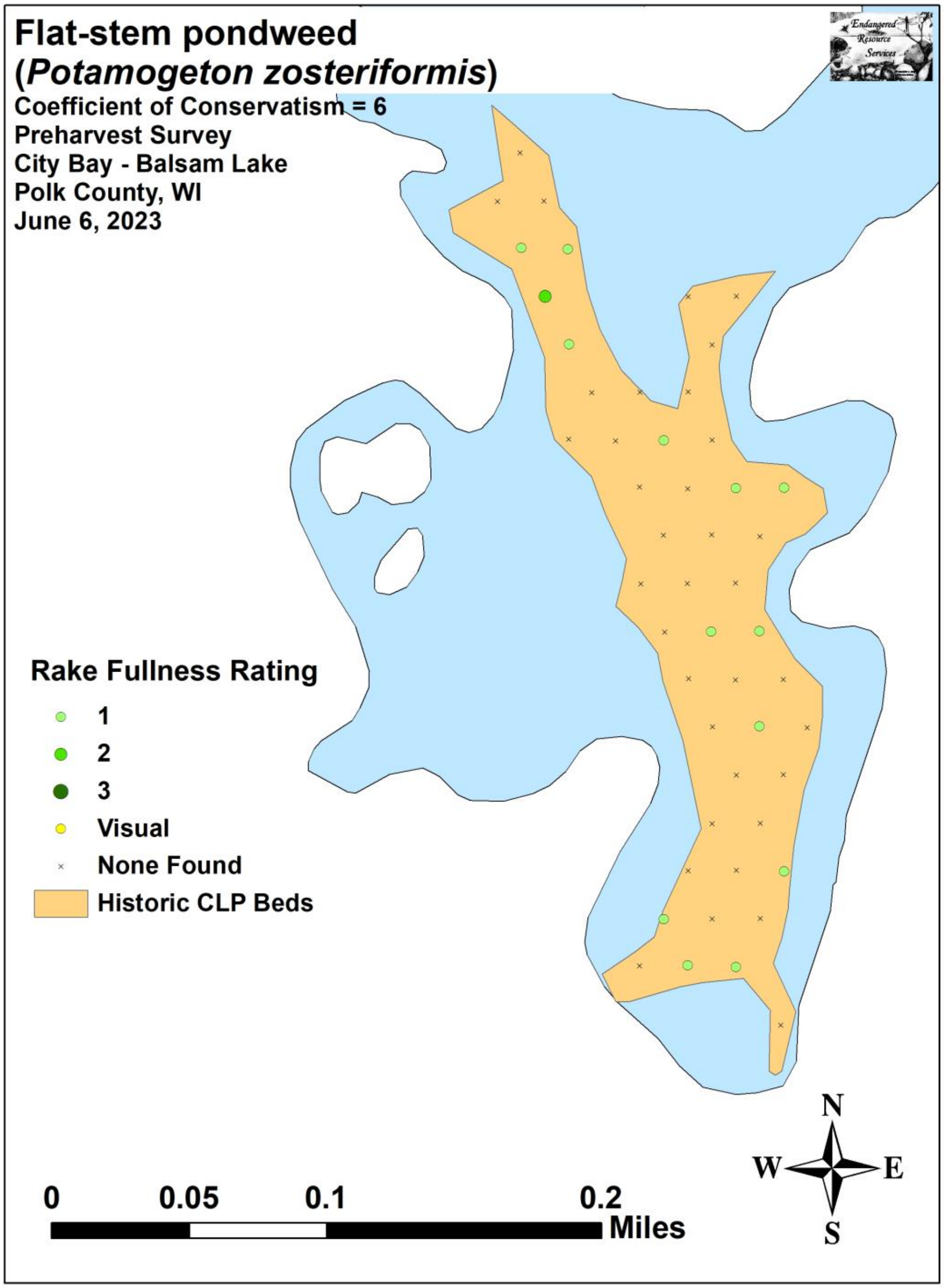
Flat-stem pondweed
(Potamogeton zosteriformis)
Coefficient of Conservatism = 6
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Endangered Resource Services
Rake Fullness Rating
1
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Visual
None Found
Historic CLP Beds
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0.2
Miles
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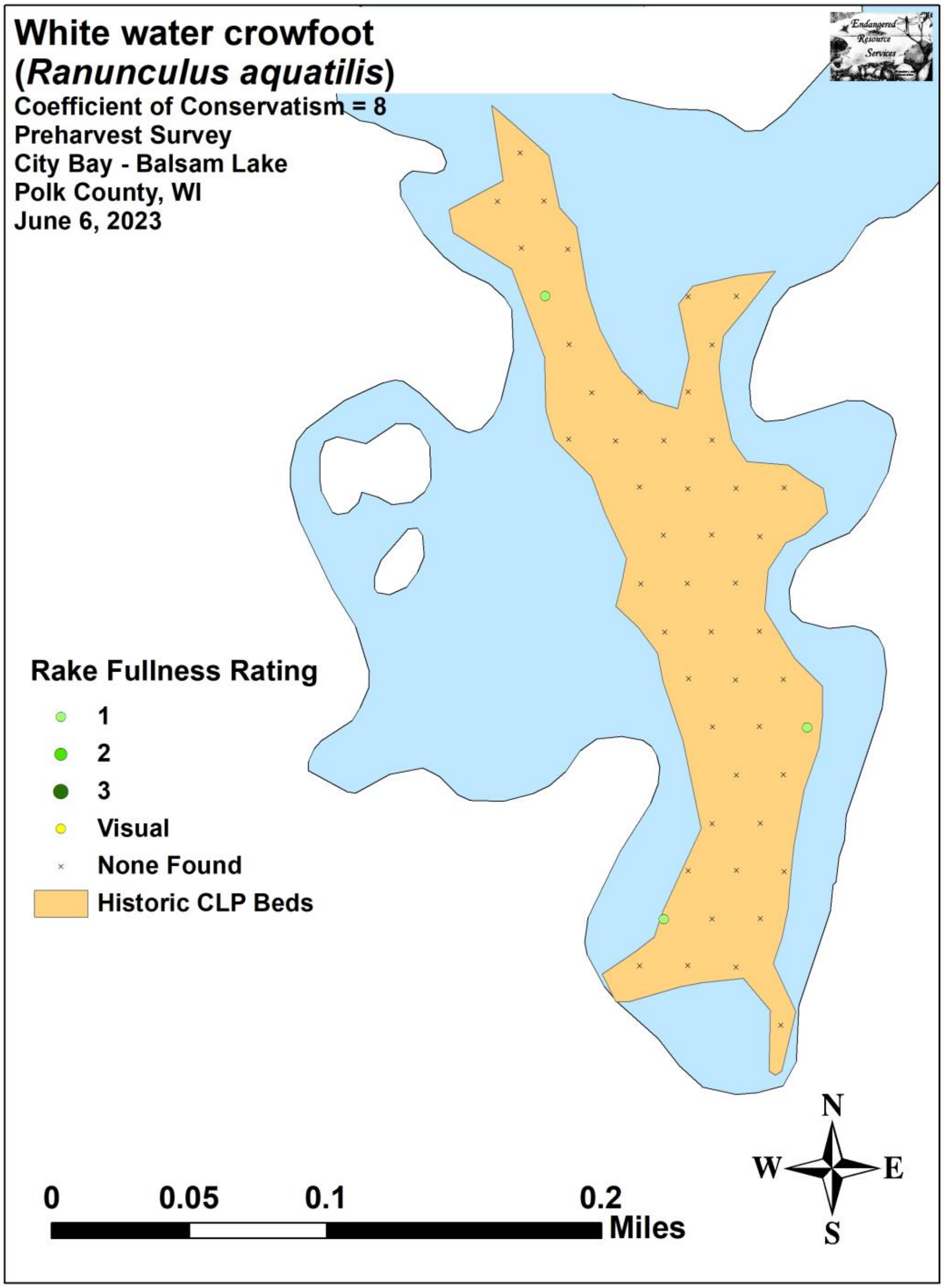
S


White water crowfoot
(Ranunculus aquatilis)
Coefficient of Conservatism = 8
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Rake Fullness Rating
1
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Visual
None Found
Historic CLP Beds
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Miles
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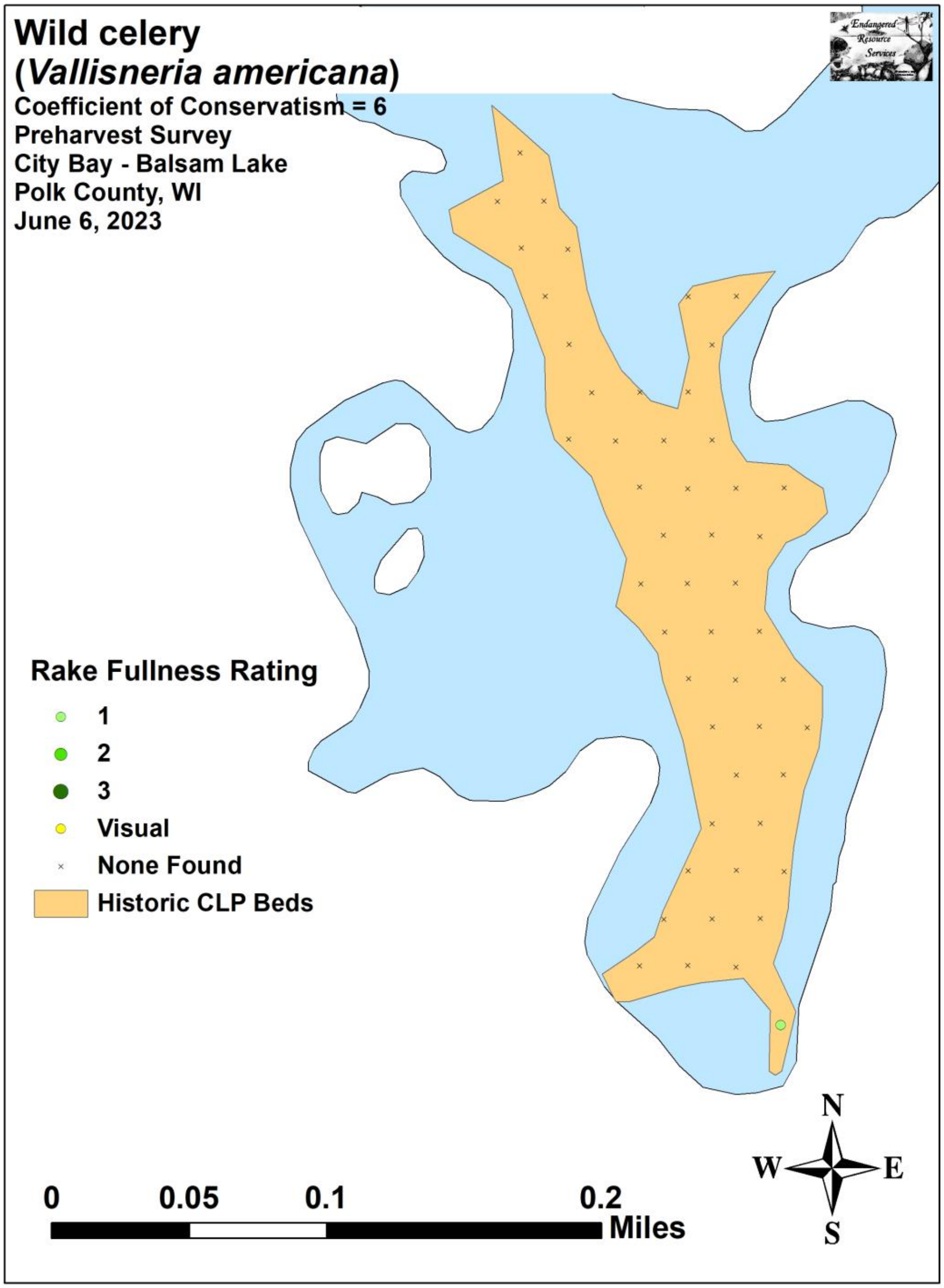
Wild celery
(Vallisneria americana)
Coefficient of Conservatism = 6
Preharvest Survey
City Bay - Balsam Lake
Polk County, WI
June 6, 2023
Endangered Resource Services
Rake Fullness Rating
1
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3
Visual
None Found
Historic CLP Beds
N
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Miles