High, Fishtrap, and Rush Lakes Stewardship Program

Report on 2019 Aquatic Plant Surveys and Aquatic Invasive Species Surveys on High, Fishtrap, and Rush Lakes

White Water Associates, Inc.
Contact: Dean Premo, Ph.D.
429 River Lane, P.O. Box 27
Amasa, MI 49903
(906) 822-7889

Report Prepared by:

Dean Premo, Ph.D. and Angie Stine, B.S.

Submitted to:

High-Fishtrap-Rush Lakes Association
Daniel C. Johnson
6114 Oswego-Fishtrap Lake Road
Boulder Junction, WI 54512

Date: December 6, 2019

1.0 Introduction & Overview

In 2019, the High-Fishtrap-Rush Lakes Association (HFRLA) undertook a major effort to monitor native aquatic plants and aquatic invasive species (AIS) in the three lakes. White Water Associates aquatic biologist Angie Stine worked with HFRLA volunteers to conduct the field work. Kent Premo, Dean Premo, and Angie Stine managed and analyzed the resulting data sets. In one instance (Fishtrap Lake AIS monitoring), the field work was conducted by the Wisconsin Department of Natural Resources (WDNR).

The deliverables for this effort include analyzed data and interpretation (this document), the Appendix C data for the point-intercept aquatic plant surveys, and the entry of data into the WDNR SWIMS database.

2.0 Contents

Fourteen exhibits document the results of the 2019 field work on High, Fishtrap, and Rush Lakes. The title of each exhibit is presented below

3.0 Methods

The field methods used included the (1) WDNR point-intercept aquatic plant survey protocol for monitoring native aquatic plants and (2) the WDNR AIS monitoring protocol for monitoring for non-native invasive aquatic plant and animal species.

4.0 Results

The fourteen exhibits included in this report contain the distillation of a tremendous amount of field data. In this section, we point out a few salient observations of each of the exhibits.

Exhibit 1 (summary statistics for High Lake) – This exhibit shows the summary statistics of the aquatic plant survey for each of three years when the lake was investigated (a thorough description of the ealier results is contained in the Aquatic Plant Management Plan for the lake and the overarching Adaptive Management Plan). In the present consideration, we focus on several statistics:

- Simpson Diversity Index – In 2019, this index is still moderately high, but is demonstrating a decreasing trend that probably results from the increasing frequency of the native plant called Southern Naiad.
- Average number of species per site categories – These values show a decreasing trend that probably results from the increasing frequency of Southern Naiad.
- Overall species richness categories – These values demonstrate high values and stable from one survey to another. This indicates that the native species are present and although their relative frequency may be depressed by the dominance of Southern Naiad, they are available and able to expand as the Southern Naiad population decreases.
- Floristic Quality Index – This index is high and stable, indicating a high quality native aquatic plant community comprised of several species that prefer more pristine environments.
- Relative frequency of Southern Naiad – In High Lake, the relative frequency of Southern Naiad is increasing over the three aquatic plant surveys conducted.
- Average rake fullness of Southern Naiad – Although the relative frequency of this species is high and increasing, it was the observation of the field biologist that it was not the dominating population that was observed in the 2013 survey. The average rake fullness values bear out this observation and shows the population size is on the decrease, even though the distribution of the species in the lake (as measured by relative frequency at sample points) is increasing.

Exhibit 2 (histogram graph of plant finds by year for High Lake) – This graph shows the relative frequencies of plants encountered at the sampling sites. In general, it shows a diverse native aquatic plant community. It also shows the changes over the years of the relative frequency of individual species and illustrates the dramatic increase of Southern Naiad and concomitant decrease in relative frequency of other species. It should be noted, however, that the relative frequency of Southern Naiad in 2019 in High Lake (44.1%) is still much lower than the peak occurrence of this species in Fishtrap Lake in 2013 (78.3%).

Exhibit 3 (all plant species recorded and distribution statistics for the 2019 survey) – This table shows the results by individual plant species for the 2019 survey effort. If the reader wishes to compare to similar tables for previous surveys, refer to the corresponding Aquatic Plant Management Plan.

Exhibit 4 (summary statistics for Fishtrap Lake) – This exhibit shows the summary statistics of the aquatic plant survey for each of three years when the lake was investigated (a thorough description of these results is contained in the Aquatic Plant Management Plan for the lake and the overarching Adaptive Management Plan). In the present consideration, we focus on several statistics:

- Total number of sites visited – This value for 2019 was less than in previous years because of the watercraft used for survey.
- Total number of sites shallower than maximum depth of plants – this lower value in 2019 likely resulted from a reduced water clarity.
- Simpson Diversity Index – In 2019, this index is high and demonstrating an increasing trend that likely resulted from the decreasing frequency of the Southern Naiad and increasing frequency of other native plants.
- Maximum depth of plants – The lower value of this parameter in 2019 also reflects a lower water transparency.
- Average number of species per site categories – These values show a increasing trend that probably results from the decreasing frequency of Southern Naiad.
- Overall species richness categories – These values demonstrate high values and stable from one survey to another. This indicates that a high diversity of native species is present.
- Floristic Quality Index – This index is high and stable, indicating a high quality native aquatic plant community comprised of several species that prefer more pristine environments.
- Relative frequency of Southern Naiad – In Fishtrap Lake, the relative frequency of Southern Naiad is has dramatically decreased since its high value in 2013. Although a relative frequency of 40.1% is still high, the domination of this plant is trending downward.
- Average rake fullness of Southern Naiad – In addition to the downward trend of relative frequency of Southern Naiad, the average rake fullness values demonstrate a similar decrease. Both the lakewide distribution of this species and its abundance seem to be decreasing. This was also the observation of the aquatic plant biologist and long-time lake residents.

Exhibit 5 (histogram graph of plant finds by year for Fishtrap Lake) – This graph shows the relative frequencies of plants encountered at the sampling sites. In general, it shows a diverse native aquatic plant community, but one that has been greatly dominated by the Southern Naiad. This condition, however, seems to be reversing and other individual plant species are rebounding in relative frequency.

Exhibit 6 (all plant species recorded and distribution statistics for the 2019 survey) – This table shows the results by individual plant species for the 2019 survey effort. If the reader wishes to compare to similar tables for previous surveys, refer to the corresponding Aquatic Plant Management Plan.

Exhibit 7 (summary statistics for Rush Lake) – This exhibit shows the summary statistics of the aquatic plant survey for each of two years when the lake was investigated (a thorough description of these

results is contained in the Aquatic Plant Management Plan for the lake and the overarching Adaptive Management Plan). In the present consideration, we focus on several statistics:

- Frequency of occurrence at sites shallower than maximum depth of plants – For each of the two surveys these values are very high and show the wide distribution of aquatic plants in this relatively shallow lake.
- Simpson Diversity Index – This index is very high and steady over the two surveys. It demonstrates a diverse native aquatic plant community.
- Average number of species per site categories – These values show are very high and indicate a diverse native aquatic plant community.
- Overall species richness categories – These values demonstrate high values and stable from one survey to another. This indicates an abundance of native species.
- Floristic Quality Index – This index is high and stable, indicating a high quality native aquatic plant community comprised of several species that prefer more pristine environments.
- Relative frequency of Southern Naiad – Over the period of observation on Rush Lake, the relative frequency of Southern Naiad has not reached the high relative frequency of occurrence as seen in Fishtrap and High Lakes. Nevertheless, there was a large decrease in this parameter between the 2013 and 2019 surveys dropping from 9% to less than 1%.
- Average rake fullness of Southern Naiad – The average rake fullness values for Southern Naiad in Rush Lake demonstrates a small decrease in 2019, but this measure of abundance for Southern Naiad has never been very high in this lake.

Exhibit 8 (histogram graph of plant finds by year for Rush Lake) – This graph shows the relative frequencies of plants encountered at the sampling sites. In general, it shows a diverse and fairly even native aquatic plant community. By "even," I mean that the relative frequencies do not have a broad range (from less than 1% to less than 12%). Over the course of our observations, Southern Naiad has never been the most frequently encountered plant at sample sites on Rush Lake.

Exhibit 9 (all plant species recorded and distribution statistics for the 2019 survey) – This table shows the results by individual plant species for the 2019 survey effort. If the reader wishes to compare to similar tables for previous surveys, refer to the corresponding Aquatic Plant Management Plan.

Exhibit 10 (relative frequencies of Southern Naiad in High, Fishtrap, and Rush Lakes over the survey years) – Since the native plant Southern Naiad has been a concern to the HFRLA over the past few years, we created this comparative histogram that shows the trends of relative frequency of occurrence in each of the lakes over time. High Lake increased since 2013 whereas Fishtrap and Rush decreased. This demonstrates the ebbs and flows of populations that are not unusual in natural ecosystems.

Exhibit 11 (average rake fullness ratings of Southern Naiad in High, Fishtrap, and Rush Lakes over the survey years) – This histogram shows the consistent decrease in rake fullness ratings of Southern Naiad across all the lakes since 2013 (and in Fishtrap Lake, since 2009).

Exhibit 12 (Aquatic Invasive Species Monitoring in High Lake) - In 2019, three AIS were documented on High Lake: Aquatic forget-me-not (documented for the first time on the lake), yellow iris, and banded

mystery snail. Also reported in the past from the lake, but not observed in 2019 are rusty crayfish and Chinese mystery snail.

Exhibit 13 (Aquatic Invasive Species Monitoring in Fishtrap Lake) - In 2019, two AIS were documented on Fishtrap Lake: Chinese mystery snail and banded mystery snail (both species have been documented in the past on Fishtrap Lake). Also reported from the lake, but not observed in 2019 is rusty crayfish.

Exhibit 14 (Aquatic Invasive Species Monitoring in Rush Lake) - In 2019, two AIS were documented on Rush Lake for the first time: Chinese mystery snail and banded mystery snail. No other AIS have been documented on Rush Lake.

5.0 Discussion and Conclusions

In general, the results from the 2019 monitoring of native plants and AIS show healthy ecosystems in all three subject lakes. The dominance of Southern Naiad seems to be ebbing and other native plant species seem to responding to the available habitat. High, Fishtrap, and Rush Lakes have provided a fascinating case study in the population dynamics of a single native plant species (Southern Naiad). It is of value to continue the monitoring of these wonderful lakes not only for its application to the stewardship activities of the HFRLA, but for the ecological knowledge it offers to lake scientists and lake stewards at other lakes.

6.0 Exhibits (found on following pages)

Exhibit 1. Comparison of summary statistics for 2008 and 2013 point-intercept aquatic plant surveys in High Lake.

Summary Statistic	2008	2013	2019
Total number of sites on grid	715	715	715
Total number of sites visited	395	685	510
Total number of sites with vegetation	304	306	271
Total number of sites shallower than maximum depth of plants	378	488	351
Frequency of occurrence at sites shallower than maximum depth of plants	80.42	62.70	77.21
Simpson Diversity Index	0.90	0.84	0.78
Maximum depth of plants (ft.)	17.50	24.50	16.50
Number of sites sampled with rake on rope	96	185	41
Number of sites sampled with rake on pole	136	319	324
Average number of all species per site (shallower than max depth)	2.95	1.62	1.39
Average number of all species per site (vegetated sites only)	3.68	2.58	1.80
Average number of native species per site (shallower than max depth)	2.95	1.62	1.39
Average number of native species per site (vegetated sites only)	3.68	2.58	1.80
Species Richness	36	32	36
Species Richness (including visuals)	41	34	48
Floristic Quality Index (FQI)	37.6	36.6	38.7
Southern Naiad - Relative Frequency (Percent)	0	32.1	44.1
Southern Naiad-Average Rake Fullness (Ratings are 1, 2, or 3 with 3 being the most dense.)	2.0	2.1	1.1

Exhibit 2. High Lake, Plant Finds in 2008, 2013, and 2019.

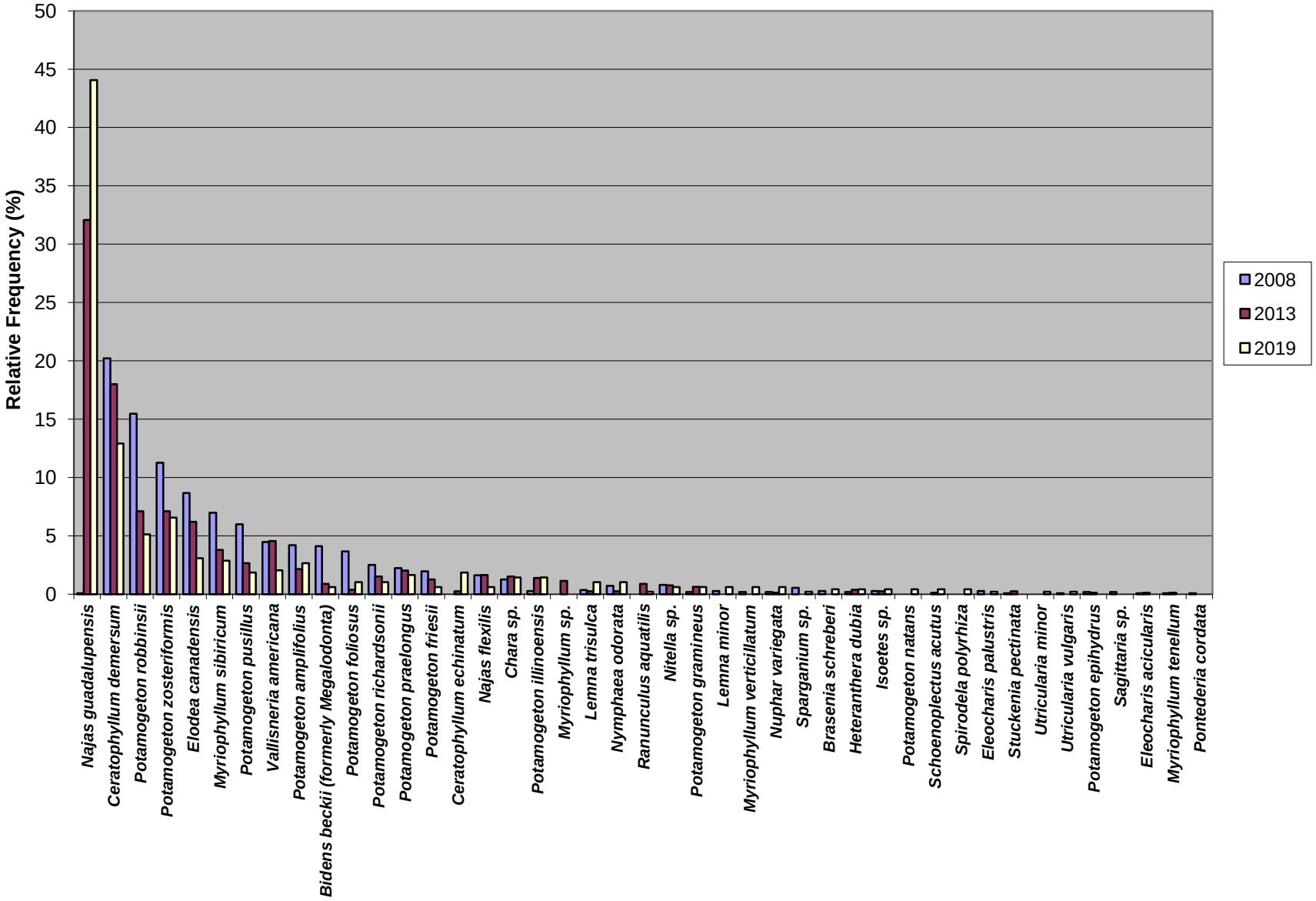


Exhibit 3. Plant species recorded and distribution statistics for the 2019 High Lake aquatic plant survey.

Common name	Scientific name	Frequency of occurrence at sites less than or equal to maximum depth of plants	Frequency of occurrence within vegetated areas (%)	Relative Frequency (%)	Number of sites where species found	Number of sites where species found (including visuals)	Average Rake Fullness
Southern naiad	*Najas guadalupensis*	61.25	79.34	44.06	215	218.00	1.06
Coontail	*Ceratophyllum demersum*	17.95	23.25	12.91	63	64.00	1.33
Flat-stem pondweed	*Potamogeton zosteriformis*	9.12	11.81	6.56	32	49.00	1.09
Fern pondweed	*Potamogeton robbinsii*	7.12	9.23	5.12	25	26.00	1.76
Common waterweed	*Elodea canadensis*	4.27	5.54	3.07	15	18.00	1.13
Northern water-milfoil	*Myriophyllum sibiricum*	3.99	5.17	2.87	14	22.00	1.00
Large-leaf pondweed	*Potamogeton amplifolius*	3.70	4.80	2.66	13	36.00	1.00
Wild celery	*Vallisneria americana*	2.85	3.69	2.05	10	11.00	1.00
Small pondweed	*Potamogeton pusillus*	2.56	3.32	1.84	9	11.00	1.00
Spiny hornwort	*Ceratophyllum echinatum*	2.56	3.32	1.84	9	9	1.00
White-stem pondweed	*Potamogeton praelongus*	2.28	2.95	1.64	8	21.00	1.00
Illinois pondweed	*Potamogeton illinoensis*	1.99	2.58	1.43	7	10.00	1.00
Muskgrasses	*Chara sp.*	1.99	2.58	1.43	7	8.00	1.00
White water lily	*Nymphaea odorata*	1.42	1.85	1.02	5	14.00	1.00
Clasping-leaf pondweed	*Potamogeton richardsonii*	1.42	1.85	1.02	5	13.00	1.40
Leafy pondweed	*Potamogeton foliosus*	1.42	1.85	1.02	5	6.00	1.00
Forked duckweed	*Lemna trisulca*	1.42	1.85	1.02	5	5	1.00
Spatterdock	*Nuphar variegata*	0.85	1.11	0.61	3	20.00	1.00
Small duckweed	*Lemna minor*	0.85	1.11	0.61	3	7.00	1.00
Variable pondweed	*Potamogeton gramineus*	0.85	1.11	0.61	3	7.00	1.00
Whorled water-milfoil	*Myriophyllum verticillatum*	0.85	1.11	0.61	3	4.00	1.00
Slender naiad	*Najas flexilis*	0.85	1.11	0.61	3	4.00	1.00
Water marigold	*Bidens beckii (formerly Megalodonta)*	0.85	1.11	0.61	3	3	1.00
Nitella	*Nitella sp.*	0.85	1.11	0.61	3	3	1.00

Frequency of occurrence within vegetated areas (%): Number of times a species was seen in a vegetated area divided by the total number of vegetated sites.

Exhibit 3. Continued.

Common name	Scientific name	Frequency of occurrence at sites less than or equal to maximum depth of plants	Frequency of occurrence within vegetated areas (%)	Relative Frequency (%)	Number of sites where species found	Number of sites where species found (including visuals)	Average Rake Fullness
Fries' pondweed	*Potamogeton friesii*	0.85	1.11	0.61	3	3	1.00
Floating-leaf pondweed	*Potamogeton natans*	0.57	0.74	0.41	2	9.00	1.00
Watershield	*Brasenia schreberi*	0.57	0.74	0.41	2	7.00	1.00
Hardstem bulrush	*Schoenoplectus acutus*	0.57	0.74	0.41	2	7.00	1.00
Large duckweed	*Spirodela polyrhiza*	0.57	0.74	0.41	2	7.00	1.00
Water star-grass	*Heteranthera dubia*	0.57	0.74	0.41	2	4.00	1.00
Quillwort	*Isoetes sp.*	0.57	0.74	0.41	2	4.00	1.00
Bur-reed	*Sparganium sp.*	0.28	0.37	0.20	1	9.00	1.00
Common bladderwort	*Utricularia vulgaris*	0.28	0.37	0.20	1	5.00	1.00
Creeping spikerush	*Eleocharis palustris*	0.28	0.37	0.20	1	2.00	1.00
White water crowfoot	*Ranunculus aquatilis*	0.28	0.37	0.20	1	1	1.00
Small bladderwort	*Utricularia minor*	0.28	0.37	0.20	1	1	1.00
Pickerelweed	*Pontederia cordata*				Visual	8.00	
Needle spikerush	*Eleocharis acicularis*				Visual	5.00	
Broad-leaved cattail	*Typha latifolia*				Visual	5.00	
Bottle brush sedge	*Carex comosa*				Visual	4.00	
Sago pondweed	*Stuckenia pectinata*				Visual	4.00	
Marsh cinquefoil	*Comarum palustre*				Visual	3.00	
Swamp loosestrife	*Decodon verticillatus*				Visual	1.00	
Yellow Iris	*Iris pseudacorus*				Visual	1.00	
Northern blue flag	*Iris versicolor*				Visual	1.00	
Water smartweed	*Persicaria amphibium*				Visual	1.00	
Arrowhead	*Sagittaria sp.*				Visual	1.00	
Creeping bladderwort	*Utricularia gibba*				Visual	1.00	
Northwest Territory sedge	*Carex utriculata*				Boat		
True forget-me-not	*Myosotis scorpioides*				Boat		

Frequency of occurrence within vegetated areas (%): Number of times a species was seen in a vegetated area divided by the total number of vegetated sites.

Exhibit 4. Comparison of summary statistics for 2009, 2013, and 2019 point-intercept aquatic plant surveys in Fishtrap Lake.

Summary Statistic	2009	2013	2019
Total number of sites on grid	620	620	620
Total number of sites visited	556	595	326
Total number of sites with vegetation	299	241	181
Total number of sites shallower than maximum depth of plants	521	451	216
Frequency of occurrence at sites shallower than maximum depth of plants	57.39	53.44	83.80
Simpson Diversity Index	0.62	0.38	0.81
Maximum depth of plants (ft.)	27.00	24.00	15.00
Number of sites sampled with rake on rope	335	278	31
Number of sites sampled with rake on pole	221	206	216
Average number of all species per site (shallower than max depth)	0.87	0.67	1.64
Average number of all species per site (vegetated sites only)	1.52	1.26	1.97
Average number of native species per site (shallower than max depth)	0.87	0.67	1.64
Average number of native species per site (vegetated sites only)	1.52	1.26	1.97
Species Richness	24	20	25
Species Richness (including visuals)	26	25	30
Southern Naiad - Relative Frequency (Percent)	60.8	78.3	40.1
Southern Naiad-Average Rake Fullness (Ratings are 1, 2, or 3 with 3 being the most dense.)	2.4	2.0	1.1

Exhibit 5. Fishtrap Lake, Plant Finds in 2009, 2013, and 2019.

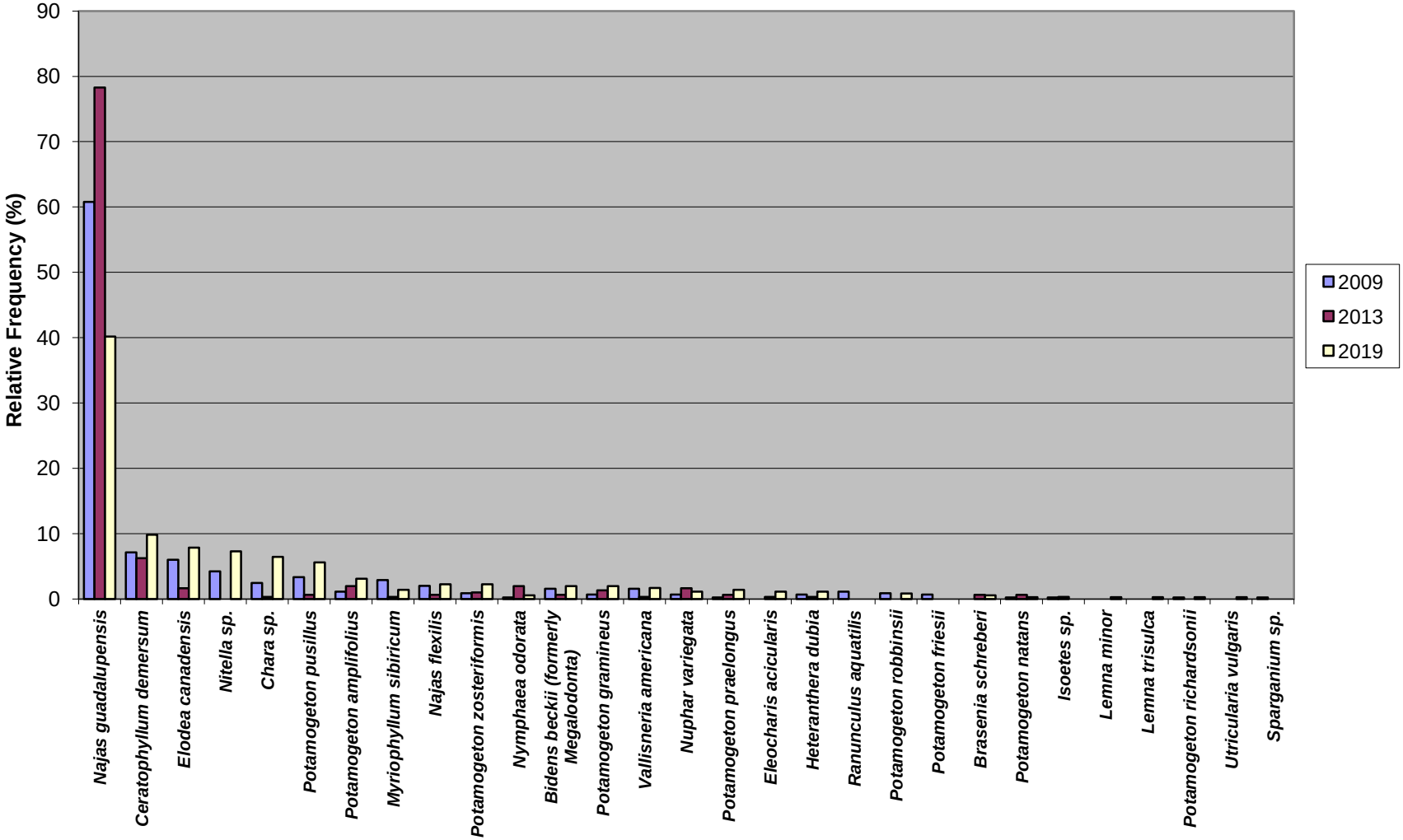


Exhibit 6. Plant species recorded and distribution statistics for the 2019 Fishtrap Lake aquatic plant survey.

Common name	Scientific name	Frequency of occurrence at sites less than or equal to maximum depth of plants	Frequency of occurrence within vegetated areas (%)	Relative Frequency (%)	Number of sites where species found	Number of sites where species found (including visuals)	Average Rake Fullness
Southern naiad	*Najas guadalupensis*	66.20	79.01	40.17	143	143	1.05
Coontail	*Ceratophyllum demersum*	16.20	19.34	9.83	35	35	1.11
Common waterweed	*Elodea canadensis*	12.96	15.47	7.87	28	29	1.11
Nitella	*Nitella sp.*	12.04	14.36	7.30	26	26	1.00
Muskgrasses	*Chara sp.*	10.65	12.71	6.46	23	25	1.00
Small pondweed	*Potamogeton pusillus*	9.26	11.05	5.62	20	22	1.00
Large-leaf pondweed	*Potamogeton amplifolius*	5.09	6.08	3.09	11	30	1.00
Flat-stem pondweed	*Potamogeton zosteriformis*	3.70	4.42	2.25	8	18	1.00
Slender naiad	*Najas flexilis*	3.70	4.42	2.25	8	9	1.00
Variable pondweed	*Potamogeton gramineus*	3.24	3.87	1.97	7	18	1.00
Water marigold	*Bidens beckii (formerly Megalodonta)*	3.24	3.87	1.97	7	7	1.00
Wild celery	*Vallisneria americana*	2.78	3.31	1.69	6	10	1.00
White-stem pondweed	*Potamogeton praelongus*	2.31	2.76	1.40	5	15	1.00
Northern water-milfoil	*Myriophyllum sibiricum*	2.31	2.76	1.40	5	14	1.00
Spatterdock	*Nuphar variegata*	1.85	2.21	1.12	4	47	1.00
Needle spikerush	*Eleocharis acicularis*	1.85	2.21	1.12	4	6	1.00
Water star-grass	*Heteranthera dubia*	1.85	2.21	1.12	4	5	1.00
Fern pondweed	*Potamogeton robbinsii*	1.39	1.66	0.84	3	3	1.33
White water lily	*Nymphaea odorata*	0.93	1.10	0.56	2	15	1.00
Watershield	*Brasenia schreberi*	0.93	1.10	0.56	2	4	1.00
Floating-leaf pondweed	*Potamogeton natans*	0.46	0.55	0.28	1	3	1.00
Clasping-leaf pondweed	*Potamogeton richardsonii*	0.46	0.55	0.28	1	3	1.00
Common bladderwort	*Utricularia vulgaris*	0.46	0.55	0.28	1	2	1.00
Small duckweed	*Lemna minor*	0.46	0.55	0.28	1	1	1.00

Frequency of occurrence within vegetated areas (%): Number of times a species was seen in a vegetated area divided by the total number of vegetated sites.

Exhibit 6. Continued.

Common name	Scientific name	Frequency of occurrence at sites less than or equal to maximum depth of plants	Frequency of occurrence within vegetated areas (%)	Relative Frequency (%)	Number of sites where species found	Number of sites where species found (including visuals)	Average Rake Fullness
Forked duckweed	*Lemna trisulca*	0.46	0.55	0.28	1	1	1.00
Pickerelweed	*Pontederia cordata*					5	
Bur-reed	*Sparganium sp.*					3	
Quillwort	*Isoetes sp.*					1	
Broad-leaved cattail	*Typha latifolia*					1	
Creeping bladderwort	*Utricularia gibba*					1	
Swamp loosestrife	*Decodon verticullatus*				Boat Survey		
Northern blue flag	*Iris versicolor*				Boat Survey		

Frequency of occurrence within vegetated areas (%): Number of times a species was seen in a vegetated area divided by the total number of vegetated sites.

Exhibit 7. Comparison of summary statistics for 2013 and 2019 point-intercept aquatic plant surveys in Rush Lake.

Summary Statistic	2013	2019
Total number of sites on grid	170	170
Total number of sites visited	31	32
Total number of sites with vegetation	30	31
Total number of sites shallower than maximum depth of plants	31	32
Frequency of occurrence at sites shallower than maximum depth of plants	96.77	96.88
Simpson Diversity Index	0.94	0.94
Maximum depth of plants (ft.)	8.50	9.00
Number of sites sampled with rake on rope	0	0
Number of sites sampled with rake on pole	31	32
Average number of all species per site (shallower than max depth)	4.65	4.16
Average number of all species per site (vegetated sites only)	4.80	4.29
Average number of native species per site (shallower than max depth)	4.65	4.16
Average number of native species per site (vegetated sites only)	4.80	4.29
Species Richness	32	26
Species Richness (including visuals)	35	39
Southern Naiad - Relative Frequency (Percent)	9.03	0.75
Southern Naiad-Average Rake Fullness (Ratings are 1, 2, or 3 with 3 being the most dense.)	1.3	1.0

Exhibit 8. Rush Lake, Plant Finds in 2013 and 2019.

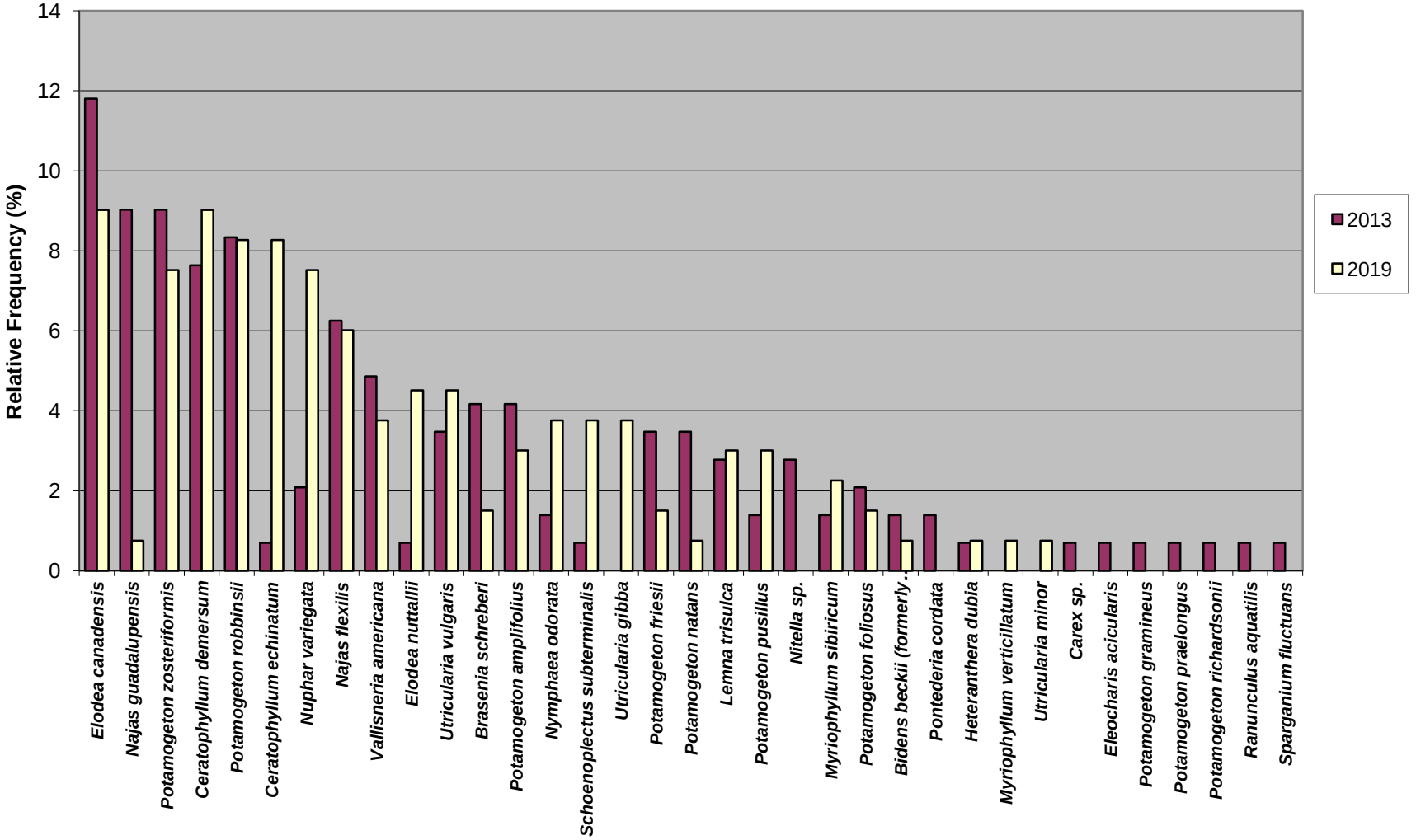


Exhibit 9. Plant species recorded and distribution statistics for the 2019 Rush Lake aquatic plant survey.

Common name	Scientific name	Frequency of occurrence at sites less than or equal to maximum depth of plants	Frequency of occurrence within vegetated areas (%)	Relative Frequency (%)	Number of sites where species found	Number of sites where species found (including visuals)	Average Rake Fullness
Common waterweed	*Elodea canadensis*	37.5	38.70967742	9.022556	12	13	1.083333333
Coontail	*Ceratophyllum demersum*	37.5	38.70967742	9.022556	12	12	1.25
Spiny hornwort	*Ceratophyllum echinatum*	34.375	35.48387097	8.270677	11	12	1.090909091
Fern pondweed	*Potamogeton robbinsii*	34.375	35.48387097	8.270677	11	11	1.181818182
Spatterdock	*Nuphar variegata*	31.25	32.25806452	7.518797	10	18	1
Flat-stem pondweed	*Potamogeton zosteriformis*	31.25	32.25806452	7.518797	10	13	1.2
Slender naiad	*Najas flexilis*	25	25.80645161	6.015038	8	8	1
Common bladderwort	*Utricularia vulgaris*	18.75	19.35483871	4.511278	6	10	1
Slender waterweed	*Elodea nuttallii*	18.75	19.35483871	4.511278	6	6	1
White water lily	*Nymphaea odorata*	15.625	16.12903226	3.759398	5	14	1
Wild celery	*Vallisneria americana*	15.625	16.12903226	3.759398	5	7	1
Water bulrush	*Schoenoplectus subterminalis*	15.625	16.12903226	3.759398	5	6	1
Creeping bladderwort	*Utricularia gibba*	15.625	16.12903226	3.759398	5	6	1
Large-leaf pondweed	*Potamogeton amplifolius*	12.5	12.90322581	3.007519	4	9	1
Forked duckweed	*Lemna trisulca*	12.5	12.90322581	3.007519	4	4	1
Small pondweed	*Potamogeton pusillus*	12.5	12.90322581	3.007519	4	4	1
Northern water-milfoil	*Myriophyllum sibiricum*	9.375	9.677419355	2.255639	3	3	1
Watershield	*Brasenia schreberi*	6.25	6.451612903	1.503759	2	7	1
Leafy pondweed	*Potamogeton foliosus*	6.25	6.451612903	1.503759	2	2	1
Fries' pondweed	*Potamogeton friesii*	6.25	6.451612903	1.503759	2	2	1
Floating-leaf pondweed	*Potamogeton natans*	3.125	3.225806452	0.75188	1	7	1
Water marigold	*Bidens beckii (formerly Megalodonta)*	3.125	3.225806452	0.75188	1	1	1
Water star-grass	*Heteranthera dubia*	3.125	3.225806452	0.75188	1	1	1
Whorled water-milfoil	*Myriophyllum verticillatum*	3.125	3.225806452	0.75188	1	1	1

Frequency of occurrence within vegetated areas (%): Number of times a species was seen in a vegetated area divided by the total number of vegetated sites.

Exhibit 9. Continued.

Common name	Scientific name	Frequency of occurrence at sites less than or equal to maximum depth of plants	Frequency of occurrence within vegetated areas (%)	Relative Frequency (%)	Number of sites where species found	Number of sites where species found (including visuals)	Average Rake Fullness
Southern naiad	*Najas guadalupensis*	3.125	3.225806452	0.75188	1	1	1
Small bladderwort	*Utricularia minor*	3.125	3.225806452	0.75188	1	1	1
Pickerelweed	*Pontederia cordata*				Visual	6	
Needle spikerush	*Eleocharis acicularis*				Visual	3	
Small duckweed	*Lemna minor*				Visual	3	
Flat-leaf bladderwort	*Utricularia intermedia*				Visual	2	
Wild calla	*Calla palustris*				Visual	1	
Bottle brush sedge	*Carex comosa*				Visual	1	
Three-way sedge	*Dulichium arundinaceum*				Visual	1	
Quillwort	*Isoetes sp.*				Visual	1	
Variable pondweed	*Potamogeton gramineus*				Visual	1	
Illinois pondweed	*Potamogeton illinoensis*				Visual	1	
Floating-leaf bur-reed	*Sparganium fluctuans*				Visual	1	
Narrow-leaf cattail	*Typha angustifolia*				Visual	1	
Broad-leaved cattail	*Typha latifolia*				Visual	1	
Northwest Territory sedge	*Carex utriculata*				Boat		
Swamp loosestrife	*Decodon verticillatus*				Boat		
Creeping spikerush	*Eleocharis palustris*				Boat		
Yellow iris	*Iris pseudacorus*				Boat		
Hardstem bulrush	*Schoenoplectus acutus*				Boat		

Frequency of occurrence within vegetated areas (%): Number of times a species was seen in a vegetated area divided by the total number of vegetated sites.

Exhibit 10. Relative frequencies of Southern Naiad in High, Fishtrap, and Rush Lakes in 2009, 2013, and 2019

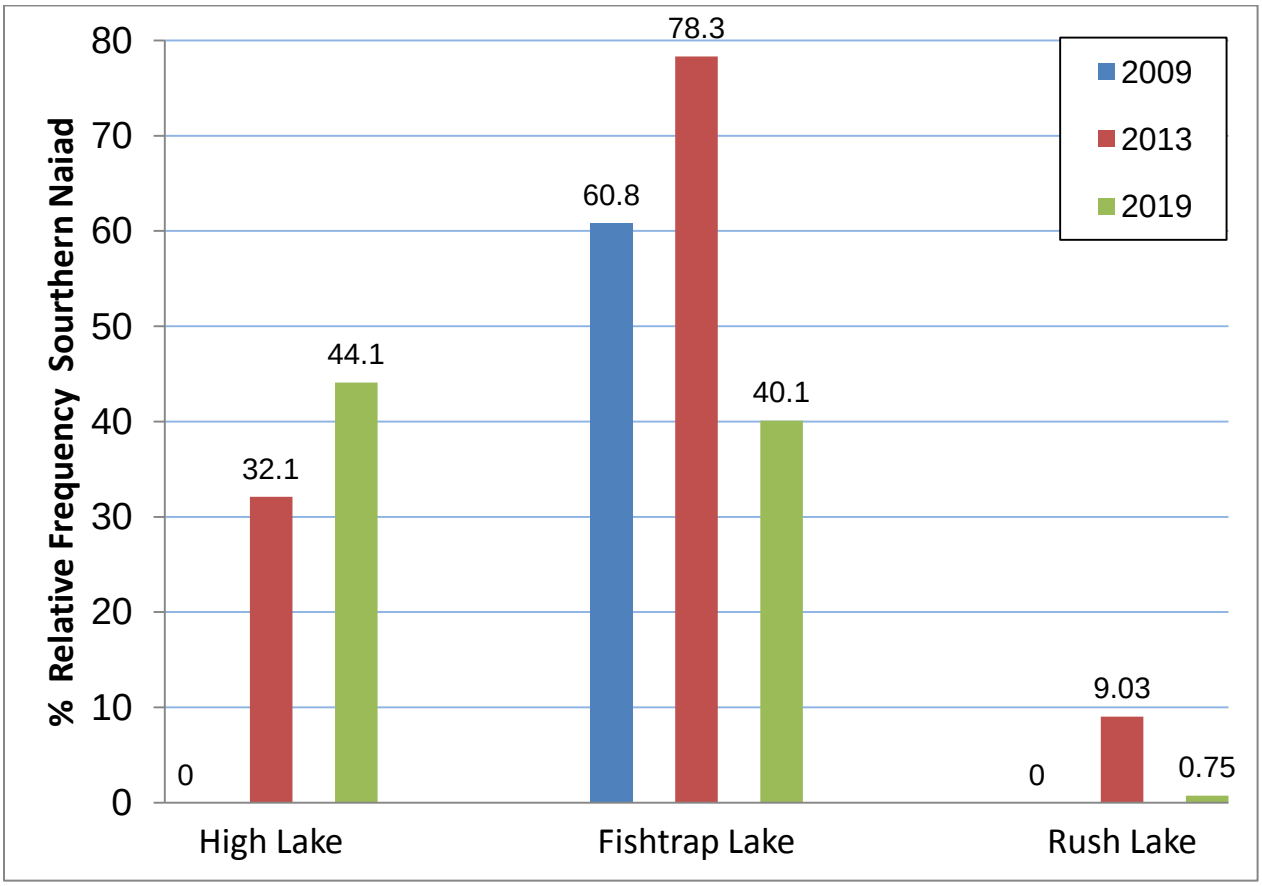


Exhibit 11. Average Rake Fullness Ratings of Southern Naiad in High, Fishtrap, and Rush Lakes in 2009, 2013, and 2019

Note: Ratings of Rake Fullness are 1, 2, and 3 with 3 being the most dense.

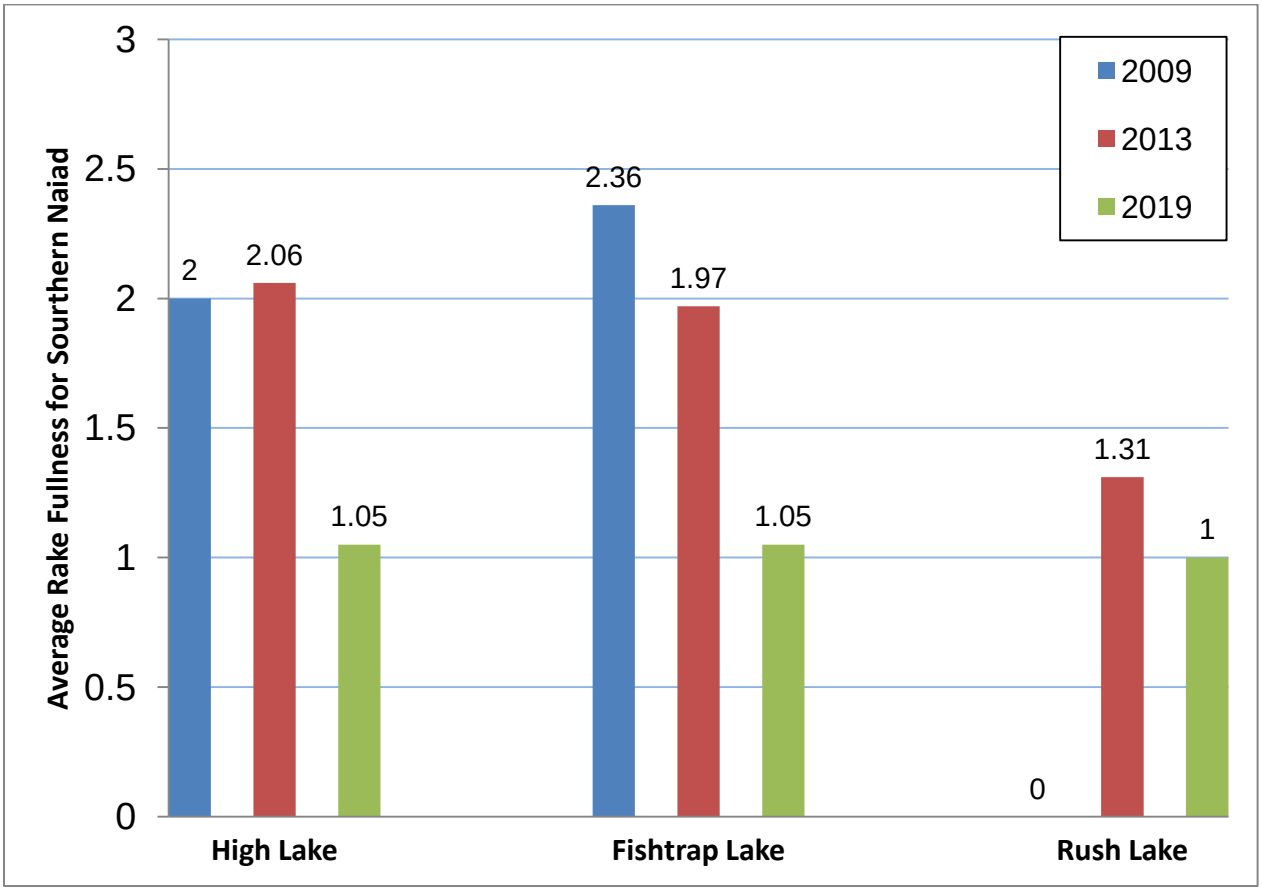
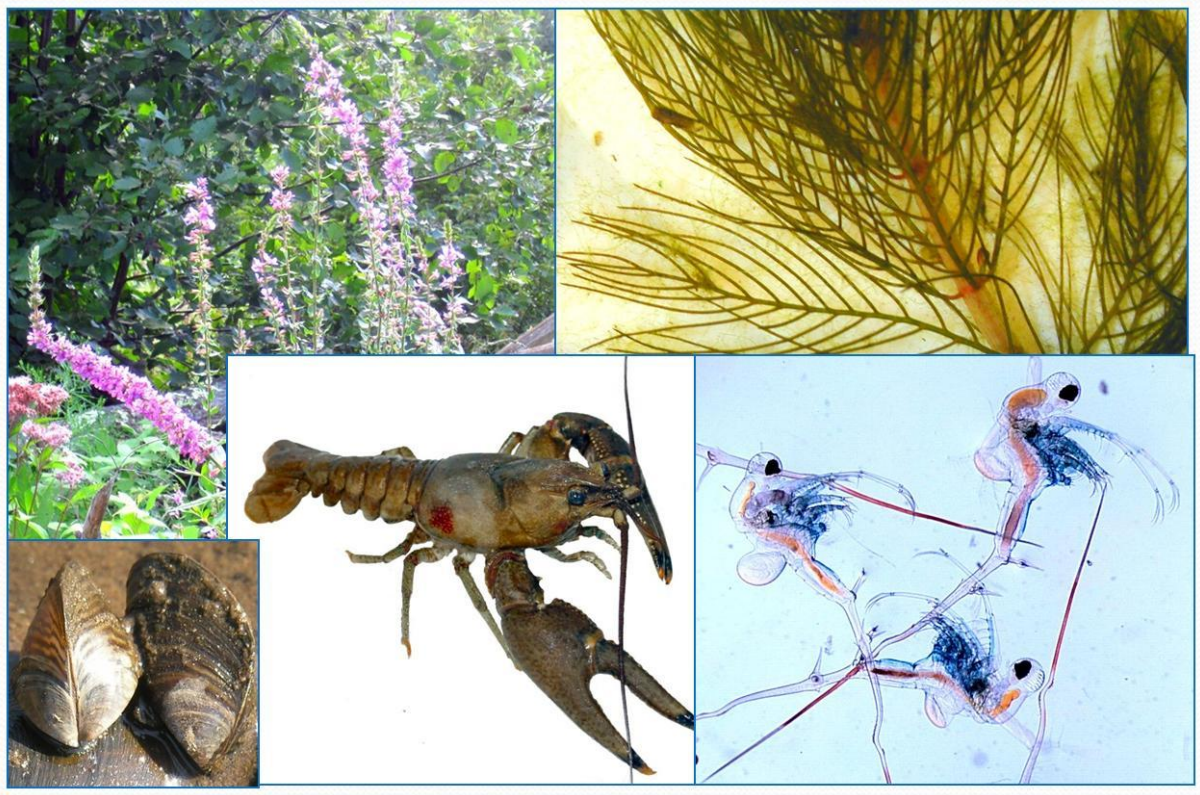


Exhibit 12

High Lake (Vilas County, Wisconsin)

Aquatic Invasive Species Report



WHITE WATER ASSOCIATES, INC.

Date: 2019

INTRODUCTION

White Water Associates, Inc. was retained by the High-Fishtrap-Rush Lakes Association to conduct aquatic invasive species (AIS) monitoring on High Lake. This work is intended to identify AIS early on in their colonization in a lake. It is also intended to increase the understanding of AIS as well as native species in High Lake, and prepares the High Lake stakeholders to undertake and continue stewardship actions that serve lake health. The Wisconsin Department of Natural Resources (WDNR) AIS monitoring protocol was used in this effort. This approach assesses the lake as to its vulnerability to AIS and documents aquatic invasive plant and animal species as detected. Findings from the survey were entered into the SWIMS database.

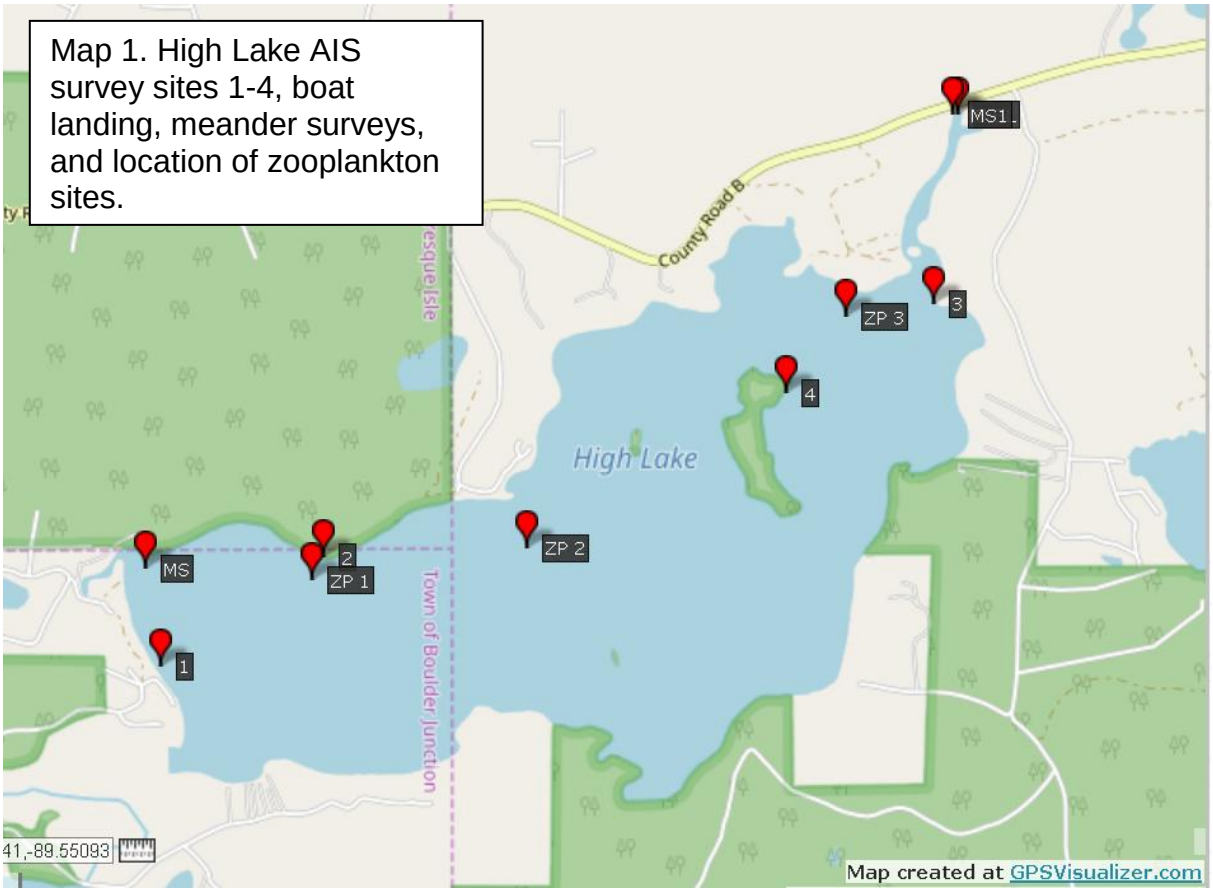
AQUATIC INVASIVE SPECIES EARLY DETECTION MONITORING

In order to determine if other aquatic invasive species (AIS) were present in study areas, a biologist followed the *Aquatic Invasive Species Early Detection Monitoring Standard Operating Procedure* (WDNR, 2014). This procedure outlines several types of monitoring techniques, including: boat landing searches, sample site searches, targeted searches, waterflea tows and/or a Ponar dredge, and a meander search. The High Lake Survey took place June 20, 2019.

Five sites around the lake shoreline were searched along with a meander search in between sites. The public boat landing was surveyed by checking the dock and walking the shoreline. The other four shoreline sites were randomly selected and are identified in Map 1 and Table 1. Snorkeling was not used to search for AIS due to the water temperature. A long rake was used to collect any suspicious aquatic plants for closer inspection and identification. A D-net was used to collect any suspicious invertebrate animals to look for AIS. Any invasive species observed were recorded. In the event of a new AIS record, specimens are collected for verification.

Spiny water fleas are an aquatic invasive zooplankton that is found in a few lakes in Wisconsin. They can be monitored by way of plankton tow nets or by an examination of sediment for dead waterflea exoskeleton fragments. In High Lake, three zooplankton tows were used to collect a composite sample of zooplankton (Map 1 and Table 2). The sample was brought back to the lab and filtered to look for spiny water fleas under magnification. No AIS were found.

Between sites a meander search is used to look for any AIS that may appear. A new find of the Aquatic Forget-me-not (*Myosotis scorpioides*) was found near the boat landing (Exhibit 1). A voucher was pressed and sent to Dr. Freckmann for verification.



Map 1. High Lake AIS survey sites 1-4, boat landing, meander surveys, and location of zooplankton sites.

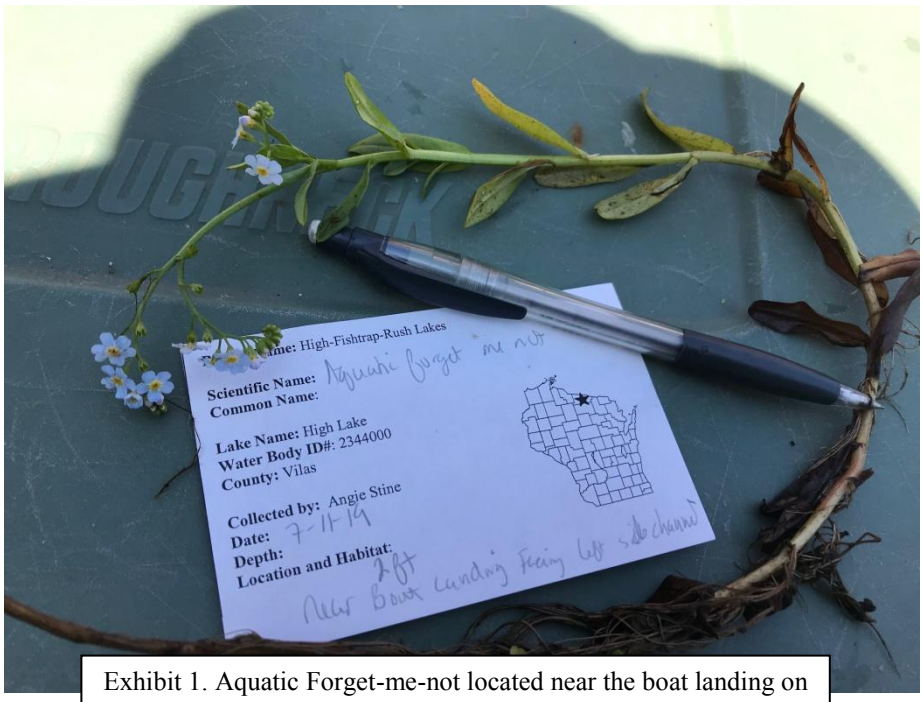


Exhibit 1. Aquatic Forget-me-not located near the boat landing on High Lake, Vilas County.

Photos by Angie Stine.

Exhibit 2. Yellow Iris located on High Lake, Vilas County.

Table 1. AIS Survey on High Lake 6/20/2019.			
Site	**Latitude**	**Longitude**	**Species found**
1	46.15213	-89.56797	Yellow Iris 1 (live)
2	46.15550	-89.56065	Banded Mystery Snail 1 (dead)
3	46.16341	-89.53317	Chinese Mystery Snail 1 (live)
4	46.16063	-89.53981	None
MS	46.15519	-89.56863	Yellow Iris 1 (live)
MS1	46.169303	-89.532282	Aquatic forget-me-not 1 (live)
BL	46.16932	-89.53209	Yellow Iris 2 (live)

Table 2. Spiny Water Flea Zooplankton Sample from High Lake			
Date: 6/20/2019	**GPS Coordinates**		**Depth of sample (feet)**
Site 1	46.15482	-89.56112	30
Site 2	46.15581	-89.55142	23
Site 3	46.16302	-89.53712	8

Four known AIS are established in High Lake; the rusty crayfish, Chinese mystery, Banded mystery snail, and the yellow iris (Exhibit 2). As Table 1 indicates, for the 2019 survey the yellow iris, Chinese mystery snail and banded mystery snail were found. The only new aquatic invasive was the Aquatic Forget-me-not (*Myosotis scorpioides*).

Rusty crayfish are native to parts of Ohio, Tennessee, Kentucky and Indiana, and were likely introduced to Wisconsin waters by fishermen using the crayfish as bait (Gunderson, 2014). Rusty crayfish negatively affect other native crayfish species, cause destruction to aquatic plant beds, reduce fish populations by eating eggs, and cause shoreland owners recreational problems (Gunderson, 2014). It is illegal to possess both live crayfish and angling equipment simultaneously on any inland Wisconsin water (except Mississippi River)

(WDNR, 2015). It is also illegal to release crayfish into a water body without a permit (WDNR, 2015).

Chinese mystery snails are from Southeast Asia and Eastern Russia and were likely released to the Great Lakes from an aquarium (Kipp et al., 2015). The snail does not seem to have a significant impact on native species, but its ecological and anthropological threat comes from its potential to transmit parasites and diseases (Kipp et al., 2015). It is illegal to introduce the Chinese mystery snail into Wisconsin waters.

Banded mystery snails are native to northeastern United States down to Florida, the Gulf of Mexico, and some states along the Mississippi River. Records show that an amateur conchologist (scientist of sea shells and the animals that inhabit them) intentionally released banded mystery snails in to the Hudson River, which lead to its dispersal throughout the Great Lakes area (Kipp et al., 2013).

The yellow iris (*Iris pseudacoris*) is a perennial aquatic plant native to Europe, western Asia and North Africa. It was first introduced to North America in the 1800s as an ornamental plant. Over time, the plant has spread too many wetlands and proliferated to the detriment of native plants and animals. Yellow iris is present on numerous Wisconsin lake margins and the Wisconsin Department of Natural Resources (WDNR) has listed this species as "Restricted" which prevents its sale, transfer, transportation and intentional cultivation. Yellow iris can reduce habitat needed by fish and waterfowl (Thomas 1980).

Aquatic Forget-me-not (*Myosotis scorpioides*) a quickly crowd out native plant species and is able to form large monocultures, especially in situations where it is in or near a stream (WDNR, 2019). This plant is restricted in Wisconsin.

The Wisconsin DNR has a very informative website that educates on invasive species. The High Lake stakeholders are the ones that frequent the lake and play a big role in protecting the lake. Stopping the spread of AIS and early detection is important is important when it comes to invasives. Please feel free to take the time to browse through the many links provided: https://dnr.wi.gov/topic/Invasives/.

Literature Cited

Gunderson, Jeff. 2014. *Rusty Crayfish: A Nasty Invader*. Minnesota Sea Grant. Retrieved 2017. <http://www.seagrant.umn.edu/ais/rustycrayfish_invader>

Kipp, R.M., A.J. Benson, J. Larson, and A. Fusaro. 2015. *Cipangopaludina chinensis malleata*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. Retrieved 2017. <http://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=1045>

Thomas, Lindsey Kay, Jr. 1980. The impact of three exotic plant species on a Potomac island. National Park Service Scientific Monograph Series No. 13. Washington, DC: U.S. Department of the Interior, National Park Service. 179 p.

Wisconsin Department of Natural Resources. 2014. *Aquatic Invasive Species Early Detection Monitoring Standard Operating Procedure.* Retrieved 2017. <http://dnr.wi.gov/water/wsSWIMSDocument.ashx?documentSeqNo=99459630>

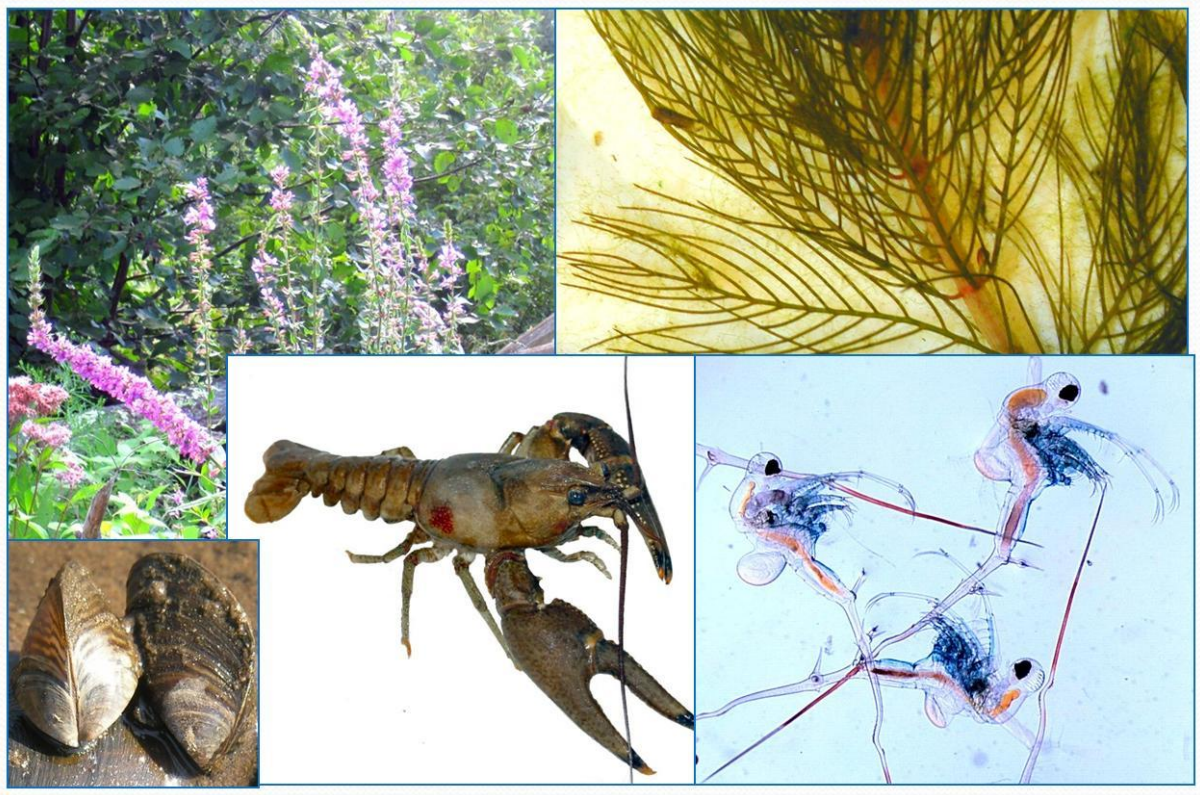
Wisconsin Department of Natural Resources. 2015. *Rusty Crayfish*. Retrieved 2017. <http://dnr.wi.gov/lakes/invasives/AISDetail.aspx?roiseq=22588740>

Wisconsin Department of Natural Resources. 2019. *Aquatic Forget-me-not*. Retrieved 2019. < https://dnr.wi.gov/topic/Invasives/fact/AquaticForgetMeNot.html>

Exhibit 13

Fishtrap Lake (Vilas County, Wisconsin)

Aquatic Invasive Species Report



WHITE WATER ASSOCIATES, INC.

Date: 2019

INTRODUCTION

White Water Associates, Inc. was retained by the High-Fishtrap-Rush Lakes Association to conduct aquatic invasive species (AIS) monitoring on Fishtrap Lake. This work is intended to identify AIS early on in their colonization in a lake. It is also intended to increase the understanding of AIS as well as native species in Fishtrap Lake, and prepares the Fishtrap Lake stakeholders to undertake and continue stewardship actions that serve lake health. The Wisconsin Department of Natural Resources (WDNR) AIS monitoring protocol was used in this effort. This approach assesses the lake as to its vulnerability to AIS and documents aquatic invasive plant and animal species as detected. Findings from the survey were entered into the SWIMS database.

AQUATIC INVASIVE SPECIES EARLY DETECTION MONITORING

In order to determine if other aquatic invasive species (AIS) were present in study areas, a biologist followed the *Aquatic Invasive Species Early Detection Monitoring Standard Operating Procedure* (WDNR, 2014). This procedure outlines several types of monitoring techniques, including: boat landing searches, sample site searches, targeted searches, waterflea tows and/or a Ponar dredge, and a meander search. The Fishtrap Lake Survey took place August 19, 2019 by the WDNR (Jeremy Bates and Tyler Mesalk).

Sites around the lake shoreline were searched along with a meander search done in between sites. Since there is no public boat landing on Fishtrap, the area where the culvert enters the lake was surveyed. The other shoreline sites were randomly selected and shown in Table 1. Snorkeling was used to search for AIS. A long rake was used to collect any suspicious aquatic plants for closer inspection and identification. Any invasive species observed were recorded. In the event of a new AIS record, specimens are collected for verification.

Spiny water fleas are an aquatic invasive zooplankton that is found in a few lakes in Wisconsin. They can be monitored by way of plankton tow nets or by an examination of sediment for dead waterflea exoskeleton fragments. In Fishtrap Lake, a dredge was used to collect sediment sample to look for spines (Table 2). The sample was brought back to the WDNR, but the samples have not been analyzed as of December 2, 2019. Three veliger tows (Table 1) were also conducted using a zooplankton net to look for zebra mussel veligers. The results have not been analyzed as of Dec. 2, 2019.

Between sites a meander search is used to look for any AIS that may appear. No new AIS were found in Fishtrap Lake.

Table 1. AIS Survey on Fishtrap Lake 8/19/2019. WDNR			
Site	**Latitude**	**Longitude**	**Species found**
1	46.14352	-89.58611	Banded Mystery Snail 4 (live), Chinese Mystery Snail 3 (live)
2	46°08.348	-89°35.071	Banded Mystery Snail 4 (live-dead), Chinese Mystery Snail 3 (live-dead)
3	46°08.165	-89°35.518	Banded Mystery Snail 3 (live), Chinese Mystery Snail 2 (live)
4	46°08.004	-89°35.258	None
5	46°08.138	-89°34.910	Banded Mystery Snail 3 (live), Chinese Mystery Snail 2 (live)
BL	46°08.698	-89°34.275	None

Table 2. Veliger Tows and Dredge Sample Sites from Fishtrap Lake			
Date: 8/19/2019	**GPS Coordinates**		**Results**
Tow Site 1	46.143438	-89.572511	Waiting for analysis
Tow Site 2	46.140743	-89.578931	Waiting for analysis
Tow Site 3	46.136945	-89.587663	Waiting for analysis
Dredge 1	46.136887	-89.588156	Waiting for analysis

Three known AIS are established in Fishtrap Lake: the rusty crayfish, Chinese mystery, and the banded mystery snail. As Table 1 indicates, for the 2019 survey the Chinese mystery snail and banded mystery snail were found at four of the six sites searched.

Rusty crayfish are native to parts of Ohio, Tennessee, Kentucky and Indiana, and were likely introduced to Wisconsin waters by fishermen using the crayfish as bait (Gunderson, 2014). Rusty crayfish negatively affect other native crayfish species, cause destruction to aquatic plant beds, reduce fish populations by eating eggs, and cause shoreland owners

recreational problems (Gunderson, 2014). It is illegal to possess both live crayfish and angling equipment simultaneously on any inland Wisconsin water (except Mississippi River) (WDNR, 2015). It is also illegal to release crayfish into a water body without a permit (WDNR, 2015).

Chinese mystery snails are from Southeast Asia and Eastern Russia and were likely released to the Great Lakes from an aquarium (Kipp et al., 2015). The snail does not seem to have a significant impact on native species, but its ecological and anthropological threat comes from its potential to transmit parasites and diseases (Kipp et al., 2015). It is illegal to introduce the Chinese mystery snail into Wisconsin waters.

Banded mystery snails are native to northeastern United States down to Florida, the Gulf of Mexico, and some states along the Mississippi River. Records show that an amateur conchologist (scientist of sea shells and the animals that inhabit them) intentionally released banded mystery snails in to the Hudson River, which lead to its dispersal throughout the Great Lakes area (Kipp et al., 2013).

The Wisconsin DNR has a very informative website that educates on invasive species. The Fishtrap Lake stakeholders are the ones that frequent the lake and play a big role in protecting the lake. Stopping the spread of AIS and early detection is important is important when it comes to invasives. Please feel free to take the time to browse through the many links provided: https://dnr.wi.gov/topic/Invasives/.

Literature Cited

Gunderson, Jeff. 2014. *Rusty Crayfish: A Nasty Invader*. Minnesota Sea Grant. Retrieved 2017. <http://www.seagrant.umn.edu/ais/rustycrayfish_invader>

Kipp, R.M., A.J. Benson, J. Larson, and A. Fusaro. 2015. *Cipangopaludina chinensis malleata*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. Retrieved 2017. <http://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=1045>

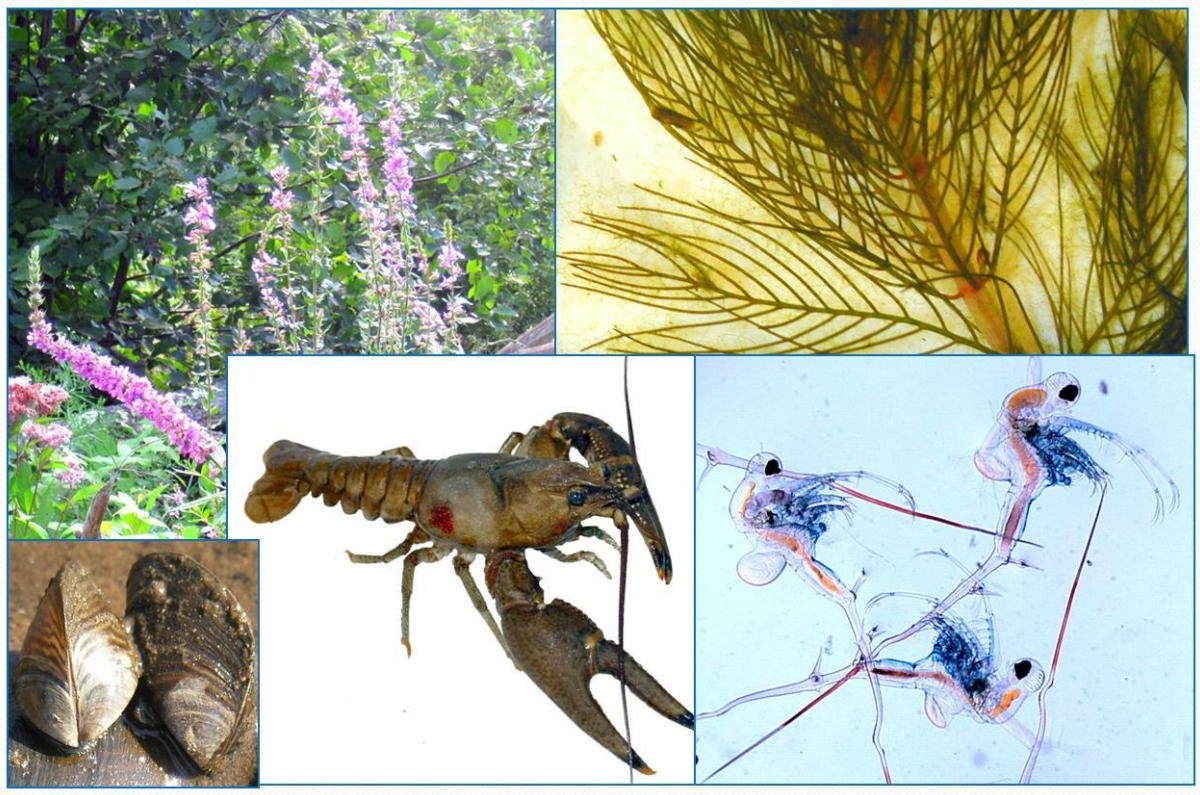
Wisconsin Department of Natural Resources. 2014. *Aquatic Invasive Species Early Detection Monitoring Standard Operating Procedure.* Retrieved 2017. <http://dnr.wi.gov/water/wsSWIMSDocument.ashx?documentSeqNo=99459630>

Wisconsin Department of Natural Resources. 2015. *Rusty Crayfish*. Retrieved 2017. <http://dnr.wi.gov/lakes/invasives/AISDetail.aspx?roiseq=22588740>

Exhibit 14

Rush Lake (Vilas County, Wisconsin)

Aquatic Invasive Species Report



WHITE WATER ASSOCIATES, INC.

Date: 2019

INTRODUCTION

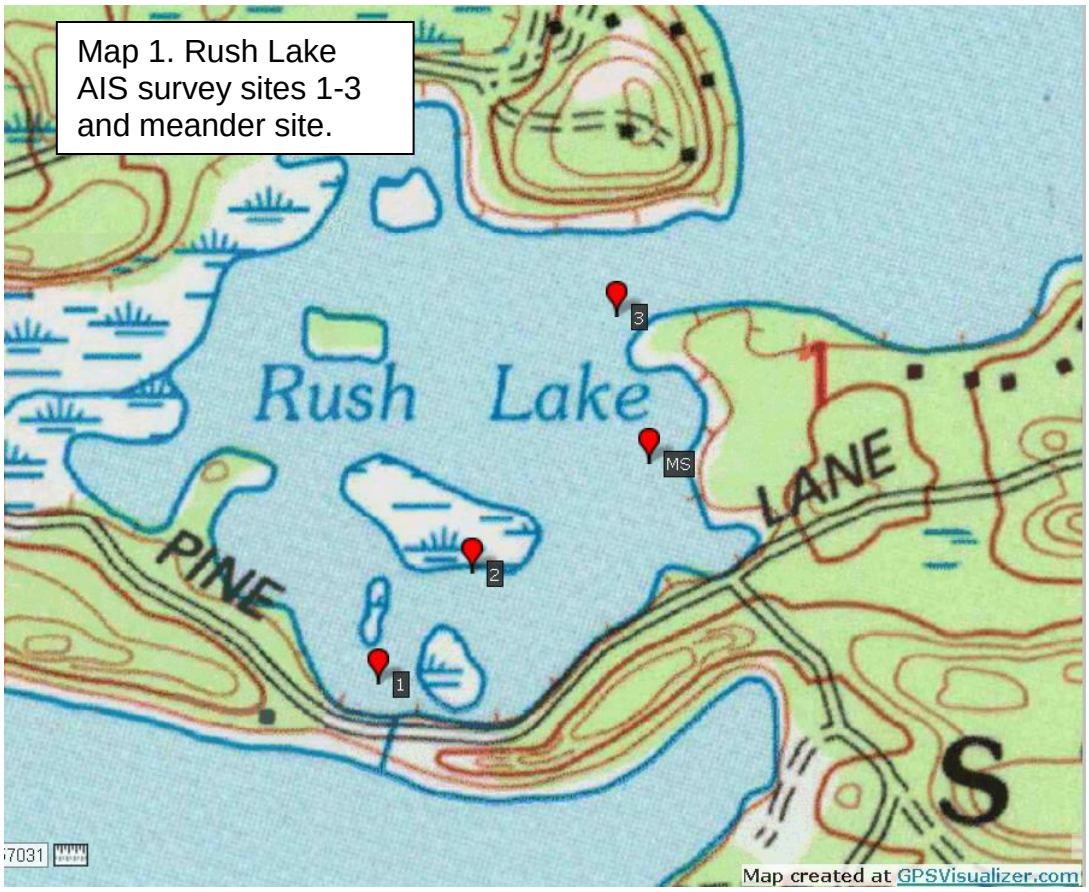
White Water Associates, Inc. was retained by the High-Fishtrap-Rush Lakes Association to conduct aquatic invasive species (AIS) monitoring on Rush Lake. This work is intended to identify AIS early on in their colonization in a lake. It is also intended to increase the understanding of AIS as well as native species in Rush Lake, and prepares the Rush Lake stakeholders to undertake and continue stewardship actions that serve lake health. The Wisconsin Department of Natural Resources (WDNR) AIS monitoring protocol was used in this effort. This approach assesses the lake as to its vulnerability to AIS and documents aquatic invasive plant and animal species as detected. Findings from the survey were entered into the SWIMS database.

AQUATIC INVASIVE SPECIES EARLY DETECTION MONITORING

In order to determine if other aquatic invasive species (AIS) were present in study areas, a biologist followed the *Aquatic Invasive Species Early Detection Monitoring Standard Operating Procedure* (WDNR, 2014). This procedure outlines several types of monitoring techniques, including: boat landing searches, sample site searches, targeted searches, waterflea tows and/or a Ponar dredge, and a meander search. The Rush Lake Survey took place June 20, 2019. A zooplankton tow was omitted due to the depth and size of the waterbody.

Three sites around the lake shoreline were searched along with a meander search in between sites. The three shoreline sites were randomly selected and are identified in Map 1 and Table 1. Snorkeling was not used to search for AIS due to the water temperature. A long rake was used to collect any suspicious aquatic plants for closer inspection and identification. A D-net was used to collect any suspicious invertebrate animals to look for AIS. Any invasive species observed were recorded. In the event of a new AIS record, specimens are collected for verification.

Between sites a meander search is used to look for any AIS that may appear. A new find of the Narrow-leaf cattail (*Typha angustifolia*) was found (Exhibit 1). A voucher was pressed and sent to Dr. Freckmann for verification. It was verified and now resides at the UW Stevens Point Herbarium.



Map 1. Rush Lake AIS survey sites 1-3 and meander site.

Exhibit 1. Narrow-leaf cattail located near the shore on Rush Lake, Vilas County.

Photo by Angie Stine.

Table 1. AIS Survey on Rush Lake 6/20/2019.

Site	Latitude	Longitude	Species found
1	46.14568	-89.57117	Banded mystery snail 1 (dead)
2	46.14659	-89.57005	None
3	46.14869	-89.56834	None
MS	46.14749	-89.56796	Narrow-leaf cattail

As Table 1 indicates, the banded mystery and the narrow-leaf cattail were found in Rush Lake in 2019. The snail was dead. Banded mystery snails are found in High Lake, but had not been previously found in Rush Lake. A new find of the narrow-leaf cattail was collected and vouchered. Yellow iris was observed on Rush Lake during the point-intercept aquatic plant survey.

The Wisconsin DNR has a very informative website that educates on invasive species. The High-Fishtrap-Rush Lakes stakeholders are the ones that frequent the lake and play a big role in protecting the lake. Stopping the spread of AIS and early detection is important is important when it comes to invasives. Please feel free to take the time to browse through the many links provided: https://dnr.wi.gov/topic/Invasives/.

Literature Cited

Wisconsin Department of Natural Resources. 2014. *Aquatic Invasive Species Early Detection Monitoring Standard Operating Procedure.* Retrieved 2017. <http://dnr.wi.gov/water/wsSWIMSDocument.ashx?documentSeqNo=99459630>