Hybrid Eurasian water-milfoil (*Myriophyllum spicatum* X *sibiricum*) Fall Bed Mapping Survey

Namekagon Lake - WBIC: 2732600 - Bayfield County, Wisconsin

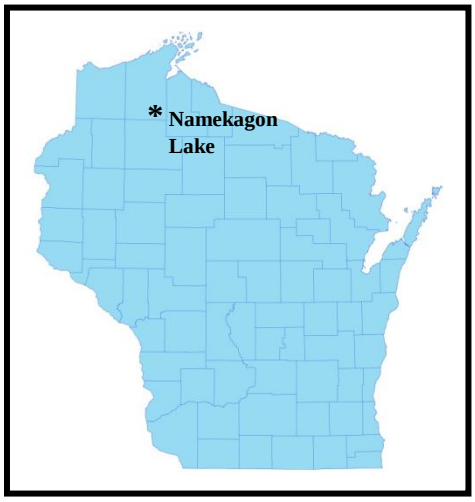
HWM Beds (Red) and HDAs (Yellow) Fall '18

Canopied HWM Cluster in Upper Lake (Berg 2018)

HWM with 24-30 Leaflets (Berg 2016)

Project Initiated by:

The Wisconsin Department of Natural Resources, the Namekagon Lake Association, the Bayfield County Land & Water Conservation Department, and Harmony Environmental



Yellow Iris Cluster along the Namekagon Lake Shoreline (10/7/18)

Survey Conducted by and Report Prepared by:

Endangered Resource Services, LLC
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Saint Croix Falls, Wisconsin
October 6-7, 2018

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INTRODUCTION:

Namekagon Lake (WBIC 2732600) is a 2,897 acre drainage lake in south-central Bayfield County, Wisconsin in the Towns of Namekagon and Grand View (T43/44N R5/6W). It has a maximum depth of 51ft and an average depth of approximately 16ft. The lake is eutrophic bordering on mesotrophic in nature, and water clarity is generally fair with Summer Secchi readings ranging from 6-14ft and averaging 8.1ft in the deep hole northeast of Paine's Island over the past 23 years (Figure 1) (WDNR 2016). This clarity produced a littoral zone that extended to approximately 8.0ft in August 2018. The lake's bottom substrate is variable with sand and rock occurring along the majority of shorelines and around the lake's numerous islands, while sandy and organic muck dominate the deep flats and sheltered bays (Holt et al. 1971).

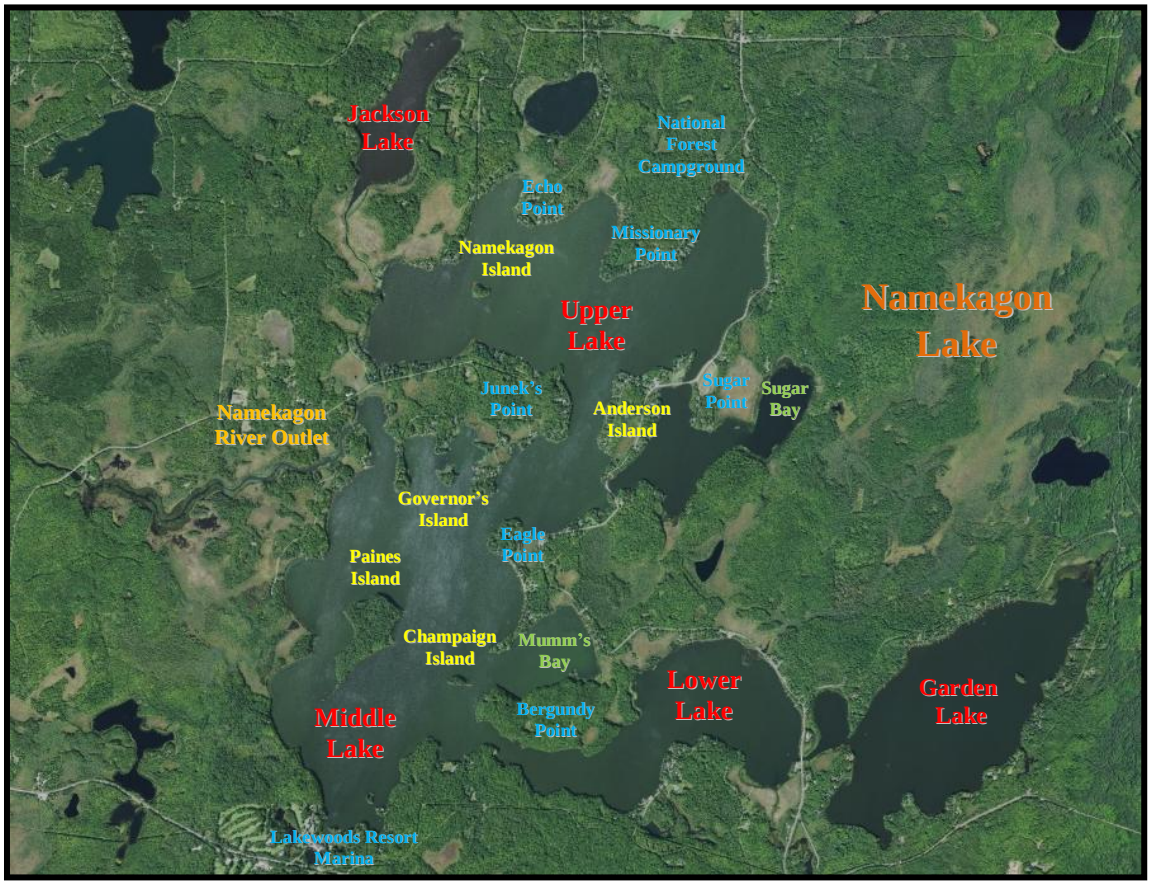

Figure 1: Namekagon Lake Aerial Photo

STUDY BACKGROUND AND RATIONALE:

On June 17, 2016, while doing bird surveys on the lake, we discovered plants at the Lakewoods Resort Marina boat landing that looked to be intermittent between the exotic invasive Eurasian water-milfoil (*Myriophyllum spicatum*) (EWM) and native Northern water-milfoil (*Myriophyllum sibiricum*) (NWM). Wisconsin Department of Natural Resources (WDNR) and Bayfield County Land and Water Conservation Department (BCLWCD) immediately followed-up with a collection of plants on June 20th that were sent to the state lab where DNA analysis confirmed them as Hybrid water-milfoil (HWM) on July 15th.

On August 15th, a team of professionals from the WDNR and BCLWCD conducted a shoreline survey of the lake. They found and rake removed a few scattered plants in the bay immediately northwest of the Lakewoods Resort Marina Landing/southwest of Paine's Island as well as two additional plants in the bay near the river outlet (Figure 2). This survey was followed by hand removal efforts coordinated and overseen by the WDNR (Pamela Toshner – Regional Lake Biologist), BCLWCD (Andrew Teal – Bayfield County Aquatic Invasive Species Coordinator), and the University of Wisconsin Extension (Paul Skawinski - Citizen Lake Monitoring Network) on both August 15th and 23rd. On these dates, volunteers from the Namekagon Lake Association (NLA) and employees from the Lakewoods Resort joined the professionals in rake removing dozens of HWM plants from the marina area.

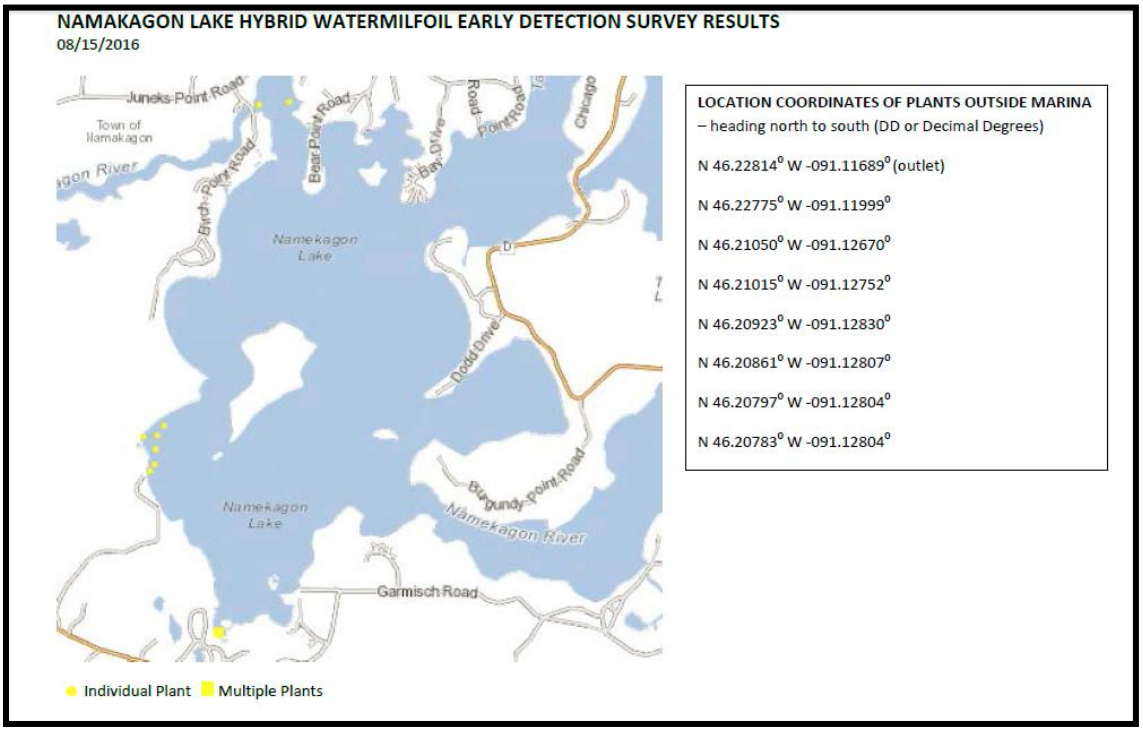

Figure 2: HWM Locations – Early Detection Survey - 8/15/16

In anticipation of developing an initial Aquatic Plant Management Plan (APMP) to guide a response to the new infestation, we were asked to complete a full warm-water point-intercept macrophyte survey on Namekagon Lake from August 23-25, 2016. The goals of this survey were to establish data on the richness, diversity, abundance and distribution of the lake's native aquatic plant populations and to determine the extent of the HWM infestation. At that time, we found HWM was still largely confined to the Lakewoods Marina, although we also found scattered plants in the bay southwest of Paine's Island. After continuing to manually remove plants from the marina in 2017 and 2018, we were asked to search the lake's littoral zone again in the fall of 2018 to see if the HWM infestation was spreading. This report is the summary analysis of that field survey conducted on October 6-7, 2018.

METHODS:

Fall Hybrid Water-milfoil Bed Mapping Survey:

During the fall survey, we searched the visible littoral zone throughout the entire lake. By definition, a "bed" was determined to be any area where we visually estimated that HWM made up >50% of the area's plants, was generally continuous with clearly defined borders, and was canopied or close enough to being canopied that it would likely interfere with boat traffic. After we located a bed, we motored around the perimeter taking GPS coordinates at regular intervals. We also estimated the rake density range and mean rake fullness of the bed (Figure 3), the range and mean depth of the bed, whether it was canopied, and the impact it was likely to have on navigation (**none** – easily avoidable with a natural channel around or narrow enough to motor through/**minor** – one prop clear to get through or access open water/**moderate** – several prop clears needed to navigate through/**severe** – multiple prop clears and difficult to impossible to row through). These data were then mapped using ArcMap 9.3.1, and we used the WDNR's Forestry Tools Extension to determine the acreage of each bed to the nearest hundredth of an acre. Because the infestation is a relatively new one, we also mapped "high density areas" where HWM plants were continuous, but didn't meet all of the other "bed" criteria. When isolated individual HWM plants were found outside of the mapped beds and high density areas, we GPS marked them and attempted to rake remove them as these satellite plants are likely to become beds in the near future.

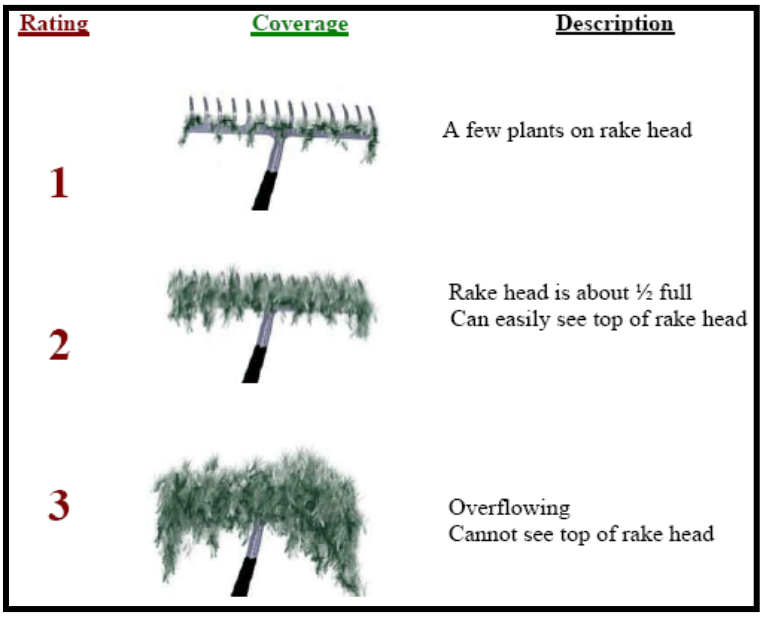

Figure 3: Rake Fullness Ratings (UWEX 2010)

Yellow Iris Shoreline Survey:

Yellow iris (*Iris pseudacorus*) is present throughout the Namekagon River corridor, and it appears to be increasing in both density and distribution (M. Berg, unpublished data). Once established, the plants tend to spread quickly, and they can eventually take over entire wetlands. Although there were previous unconfirmed reports of Yellow iris on the lake, we didn't see any during our original 2016. Because of this, we again looked for evidence of this species along the shoreline during the fall 2018 HWM survey.

RESULTS AND DISCUSSION:
Fall Hybrid Water-milfoil Bed Mapping Survey:

Nearly a month of poor weather forced us to delay the survey until October 6-7th. During this time, we searched 66.8km (41.5miles) of transects throughout the lake's visible littoral zone (Figure 4). Much to our disappointment, we found that Hybrid water-milfoil had undergone a significant expansion since 2016. In total, we mapped 17 areas covering 20.37 acres (0.70% of the lake's 2,897 acres) (Table 1). Of these, four were true beds (red areas) with continuous plants (6.89 acres), while the remaining 13 (13.48 acres) were better described as "high density areas" (yellow areas) as they had regular but only scattered plants. Outside of these areas, we marked and rake removed just three additional plants (Figure 5) (Appendix I).

As is often the case with new infestations, we found the majority of HWM plants were near highly developed and/or disturbed shorelines; especially near resort docks and boat landings. These areas have high volume watercraft traffic which tends to disturb the bottom making it easy for HWM to establish. Once canopied, these plants also frequently suffer prop-clipping which accelerates their natural spread from fragmentation.

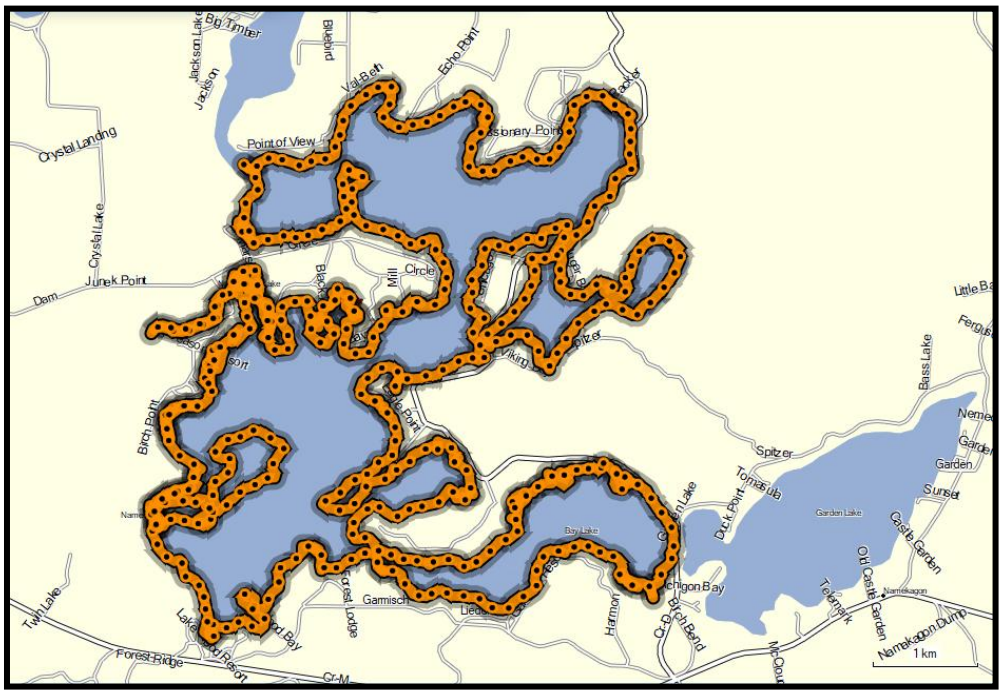

Figure 4: October 6-7, 2018 HWM Littoral Zone Survey – GPS Tracks

Table 1: Fall Hybrid Water-milfoil Bed Mapping Summary
Namekagon Lake, Bayfield County
October 6-7, 2018

Bed/HDA Number	2018 Fall Acreage	Rake Fullness Range	Mean Rake Fullness	Depth Range	Mean Depth	Canopied?	Navigation Impairment	2018 Field Notes
HDA 1	1.89	<<<1-1	<<<1	2-6	4	Yes	None	10 plants – widely scattered
HDA 2	0.38	<<<1-1	<<<1	4-6	5	Yes	None	6 plants – all raked out
HDA 3	0.11	<<<1-1	<<<1	4-6	5	Yes	None	8 plants – all raked out
Bed 4	0.05	<1-2	1	2-5	4	Yes	Minor	Many prop-clipped
HDA 5	0.32	<<<1-1	<<<1	2-6	4	Yes	None	10+ scattered plants
Bed 6	0.09	<<1-1	1	2-6	4	Yes	Minor	Microbed near shore
HDA 7	2.94	<<<1-3	<1	2-5	4	Yes	None	Regular towers/microbeds
HDA 8	3.92	<<<1-3	<1	2-5	4	Yes	None	Regular towers/microbeds
Bed 9	6.54	<<1-3	1	3-8	5	Yes	Minor	Many prop-clipped
HDA 10	0.63	<<<1-1	<<<1	2-6	4	Yes	None	Dozens of towers
HDA 11	0.45	<<<1-2	<1	4-6	5	Yes	None	Several dozen towers
Bed 12	0.21	<<1-3	1	3-6	5	Yes	Minor	Many prop-clipped
HDA 13	0.04	<<<1-1	<<<1	3-5	4	Yes	None	4 large clusters
HDA 14	0.02	<<<1-1	<<<1	3-5	4	Yes	None	2 large clusters
HDA 15	0.83	<<<1-1	<<<1	3-5	4	Yes	None	7 large scattered clusters
HDA 16	1.85	<<<1-1	<<<1	3-5	4	Yes	None	Widely scattered plants
HDA 17	0.10	<<<1-1	<<<1	3-5	4	Yes	None	3 total plants – raked out
Total	**20.37**							

Descriptions of Hybrid Water-milfoil Beds:

HDA 1 – Hybrid water-milfoil continued to be scattered around the Lakewoods Marina, although no true beds existed suggesting past treatments and manual removal have been successful in keeping it in check. In total, we marked and rake removed just ten plants from this area (Figure 5) (Appendix I).

HDAs 2 and 3, and the West-central shoreline – We found and rake removed six and eight plants respectively from these HDAs. This was an unexpectedly low total as we also found scattered plants in these areas during the summer of 2016 (Perhaps volunteers have worked this area as well as near Lakewoods?). Equally surprising, we only found one additional plant in the bay directly west of Paine's Island. Apparently prevailing currents are carrying fragments to the outlet rather than depositing them in this area.

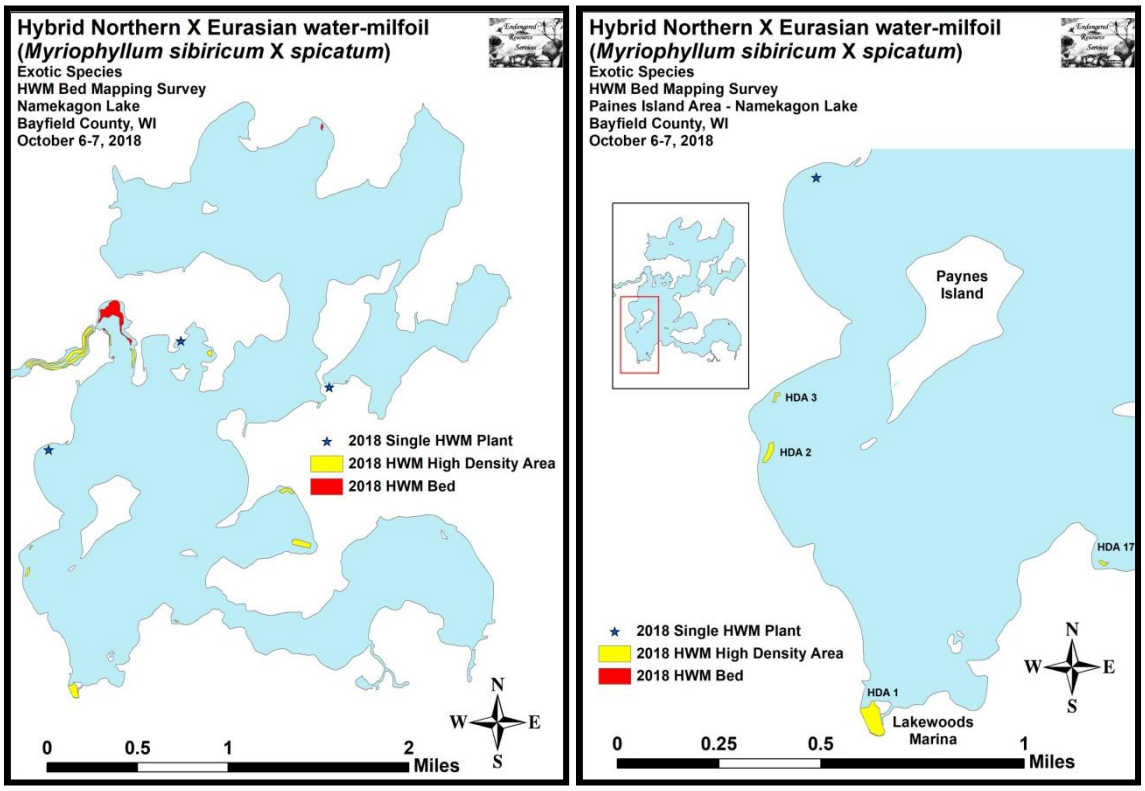

Figure 5: 2018 Fall HWM Bed Map/HDAs 1-3 and 17 – Southwest Bays

Bed 4 – Located just beyond the east shoreline docks of the Four Season's Resort, Bed 4 was little more than a dense collection of towers on the outside edge of a Hardstem bulrush (*Schoenoplectus acutus*) stand (Figure 6) (Appendix I). Collectively, we marked at least 30 different plants mixed in with the greater Northern water-milfoil bed. We also noted that many had been repeated prop-clipped by incoming/outgoing boat traffic.

HDA 5 and Bed 6 – These two small shoreline clusters of plants appeared to be the result of fragments coming from Bed 4. They each had regular clusters, but we found most were single-stemmed suggesting they were relatively recently established.

HDAs 7 and 8 – Although we were hired to just survey the lake and couldn't have made it all the way to the dam anyway due to our limited time, we ducked into the lake outlet to see if there were any plants in this area. We quickly discovered that HWM was expanding rapidly on both sides of the river channel. Collectively, we estimated there were 100's of plants in the 1km (0.6 miles) that we surveyed downstream from the bridge. Based on this, we expect that HWM has likely established all the way to the dam.

Bed 9 – This was easily the worst place on the lake as we estimated there were now 1,000's of plants. The bed had continuous well-established towers that were actively fragmenting, and we noted that many areas within the bed were forming a solid canopied mat. Plants were also prop-clipped throughout suggesting it was becoming at least a minor impairment to navigation.

HDA 10 – HDA 10 was simply an extension of the southeastern finger of Bed 9. In this area, HWM was still essentially continuous, but it tended to be much more fragmented with lower densities than in the north bay. This was likely at least partially due to the nutrient-poor sand and gravel substrates that dominated this shoreline.

HDA 11 – There were several dozen HWM plants in the northeast corner of this bay. At its core, the area could have been considered a bed as plants were nearly continuous and canopied; however, the outer edges were extremely fragmented with only scattered plants.

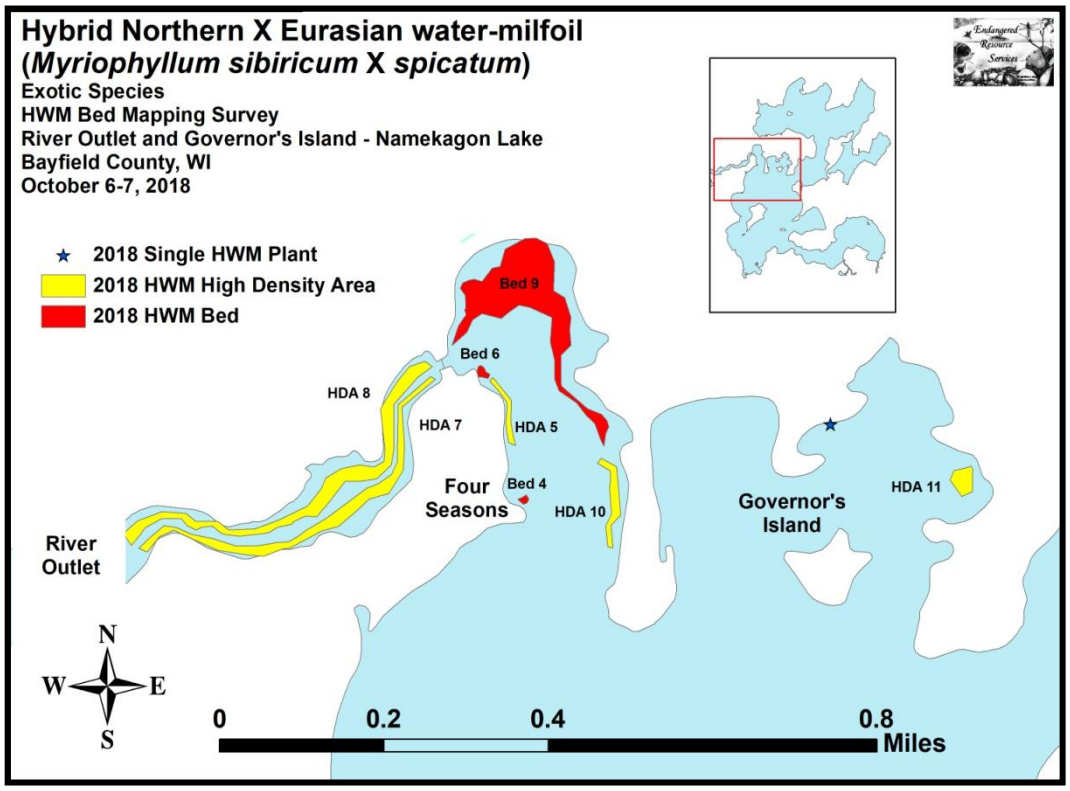

Figure 6: Bed 4-HDA 11 – River Outlet

Bed 12 – We found this tiny canopied bed already had many well-established multi-stemmed plants that were merging into a solid mat at its core (see front cover). Many were prop-clipped, and we saw several floating fragments throughout the area near Mogasheen Resort (Figure 7) (Appendix I).

HDAs 13 and 14 – These two areas were located along the south shoreline just east and west of the Anderson Island Bridge. Each was little more than a few large multi-stemmed towers, but they were already canopied and actively fragmenting.

HDAs 15 and 16 – Mumm's Bay had pioneering clusters located on both the northeast and southeast ends of the bay. Although neither area had many total HWM plants, Northern water-milfoil was common throughout the bay suggesting HWM will have ample habitat to expand into.

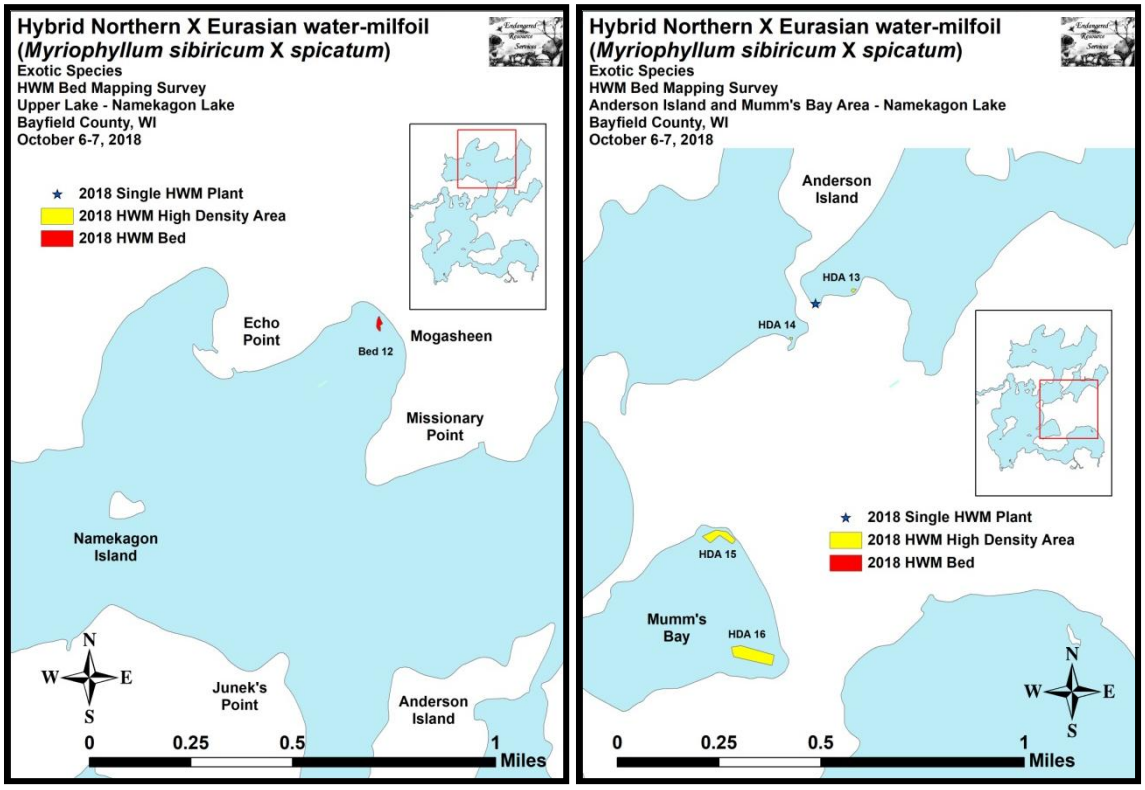

Figure 7: Bed 12 – Upper Lake/
HDAs 13-16 – Anderson Island and Mumm's Bay

Yellow Iris Shoreline Survey:

We found Yellow iris at two locations in Lower Lake (Figure 8) (Appendix II). Along the north shoreline near the entrance to Middle Lake, two large clusters were present in an undeveloped area of Bergundy Point. Although we pulled all the seed pods off these plants and tried to remove as many of the leaves as possible, we didn't have a shovel and couldn't get the majority of the roots. The other 10+ plants were located on private property along the south shoreline midlake. At this site, residents appeared to be landscaping around the plants as the rest of the vegetation was mowed right down to the lakeshore.

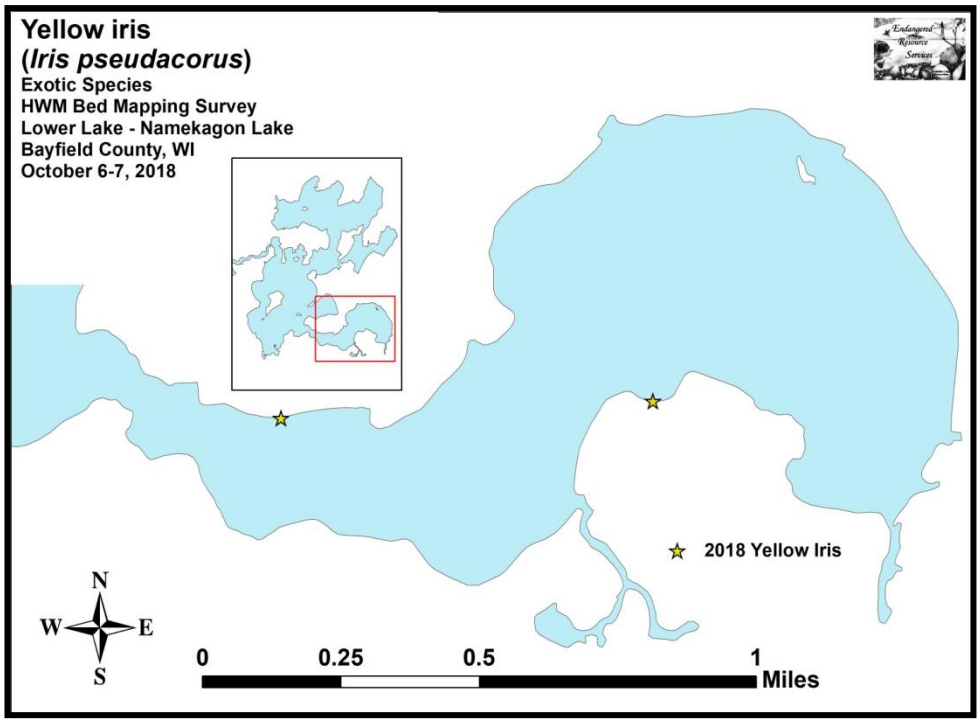

Figure 8: 2018 Yellow Iris Distribution – Lower Lake

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:

Hybrid water-milfoil:

Hybrid water-milfoil currently occupies a low overall percentage of Namekagon Lake's surface area, but it is now widely-established making eradication an unrealistic expectation. Complicating matters, HWM also appears to be spreading rapidly, and it will likely continue to do so without sustained active management. With these realities in mind, working to control its spread in the most cost effective manner possible while simultaneously minimizing its impact on the lake's aquatic ecosystem will likely be important goals for the lake association moving forward. To assist with these efforts, regular littoral zone surveys to locate new beds and address them before small problems become big ones will likely become an annual necessity prior to developing a management strategy for the following year. Educating as many residents as possible to be on the lookout for new plants/beds is also strongly encouraged as a way to assist with early detection. If volunteers find anything they think even looks suspicious, they are invited to promptly contact us (email at saintcroixdfly@gmail.com and/or text to 715-338-7502) with a picture, specimen, description of, and/or preferably GPS coordinates, and we will add these locations to the existing map for management consideration.

Because native Northern water-milfoil is widely distributed throughout the lake and closely resembles Hybrid water-milfoil, finding and identifying HWM will likely be challenging for volunteers. To assist in identification, surveyors should remember that NWM has leaflets numbering <24 whereas EWM normally has >26 with HWM tending to have leaflet numbers that range from 20-30 – intermittent between both parent species (Figure 9). EWM and HWM also tend to have a bright red growth tip on the top of the plant, whereas NWM has a bright lime-green growth tip. In the fall, NWM also forms winter buds on the tips of shoots whereas EWM/HWM have none (Figure 10).

Eurasian Water-milfoil **Hybrid Water-milfoil** **Northern Water-milfoil**

Figure 9: Eurasian, Hybrid, and Northern Water-milfoil Identification

Figure 10: Limp Nature of EWM/HWM Leaflets along Stem – Stiff Nature of NWM Leaflets along Stem and Overwintering Turions

Yellow Iris:

The presence of Yellow iris in Namekagon Lake is troubling. Because there are currently no biological control agents for this species, we STRONGLY encourage residents to look for and eliminate plants on their property before a minor problem becomes a significant one. Iris plants and pods should be dug out with a shovel, bagged to prevent seed dispersal, and then disposed of well away from the lake or any other wetland. June is the best month to look for plants as the bright yellow fleur-de-lis are most common and easily seen at this time of year. When not in bloom, Yellow iris can be identified by its tendency to grow in clumps which often have more than 15 total leaves. It also produces abundant seed pods which droop into the water at maturity. In the fall, its leaves remain green well after other plants have been knocked back by frost (Figure 11).

Figure 11: Yellow Iris Bloom, Mature Plant with Seed Pods Hanging in the Water, and an Iris Cluster Seen During the 2018 Fall Survey

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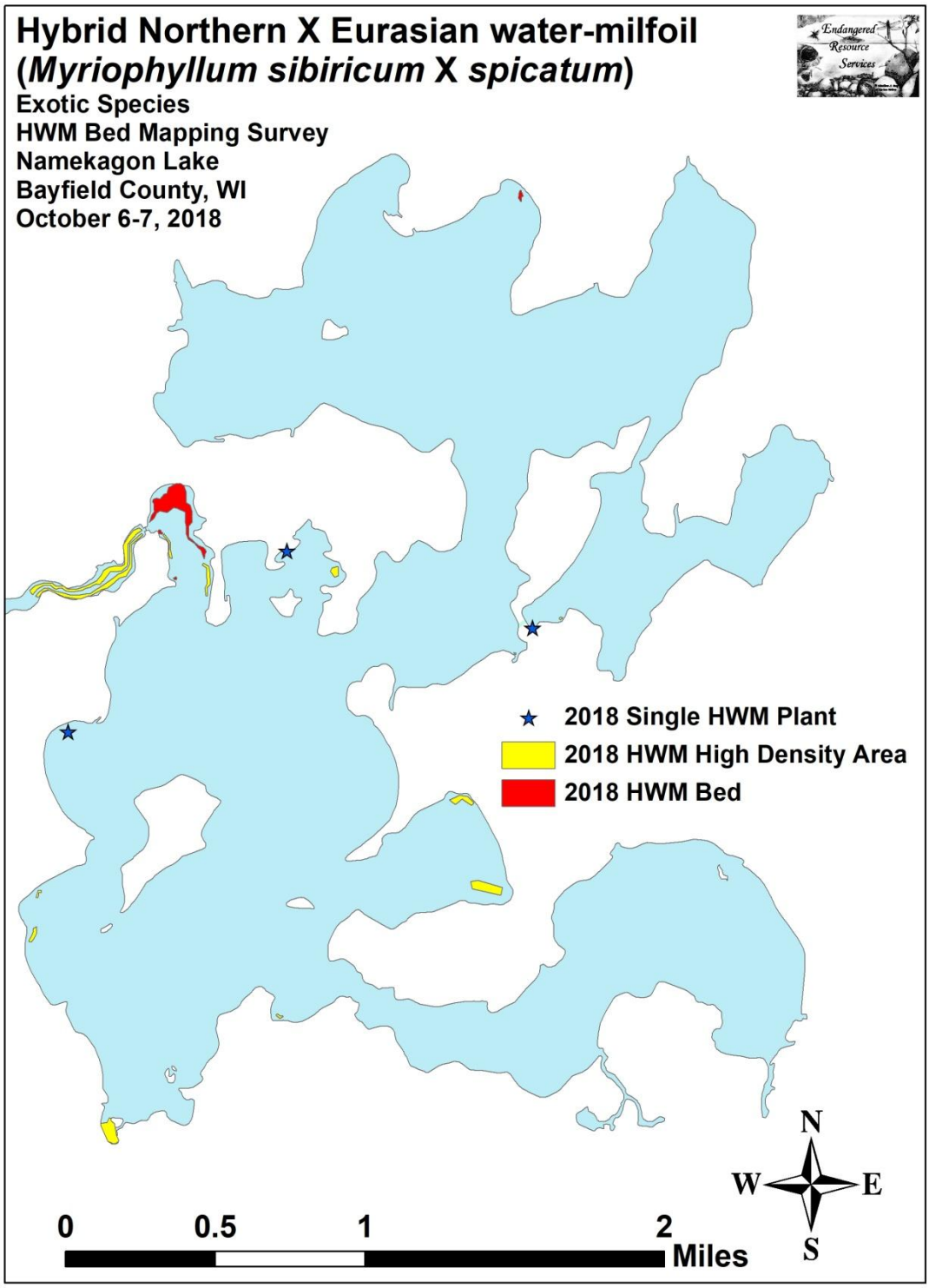
Appendix I: 2018 Hybrid Water-milfoil Fall Bed Maps


Hybrid Northern X Eurasian water-milfoil
(Myriophyllum sibiricum X spicatum)
Exotic Species
HWM Bed Mapping Survey
Namekagon Lake
Bayfield County, WI
October 6-7, 2018
Endangered Resource Services
2018 Single HWM Plant
2018 HWM High Density Area
2018 HWM Bed
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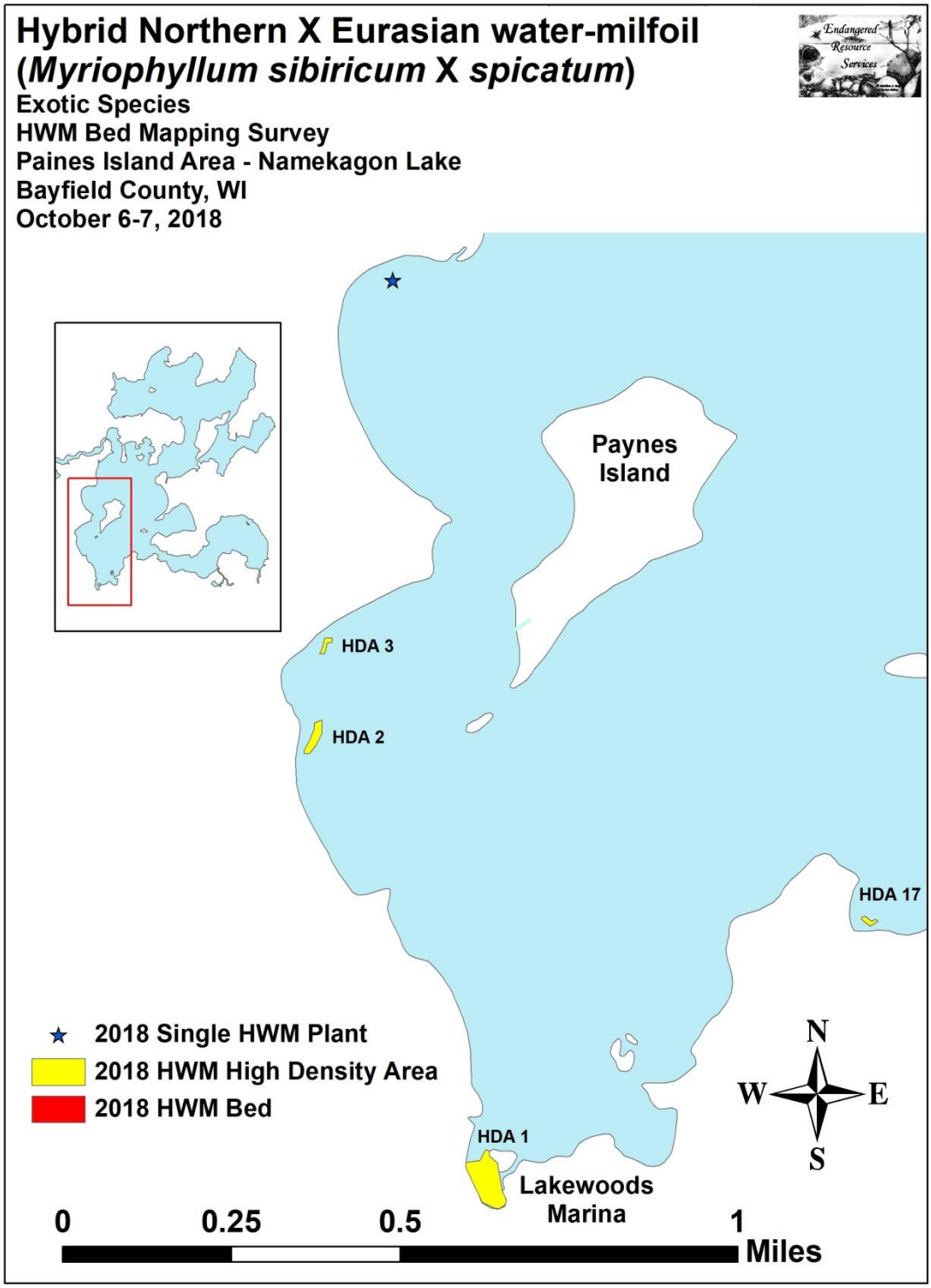
Hybrid Northern X Eurasian water-milfoil
(Myriophyllum sibiricum X spicatum)
Exotic Species
HWM Bed Mapping Survey
Paines Island Area - Namekagon Lake
Bayfield County, WI
October 6-7, 2018
Endangered Resource Services
Paynes Island
HDA 3
HDA 2
HDA 17
HDA 1
Lakewoods Marina
2018 Single HWM Plant
2018 HWM High Density Area
2018 HWM Bed
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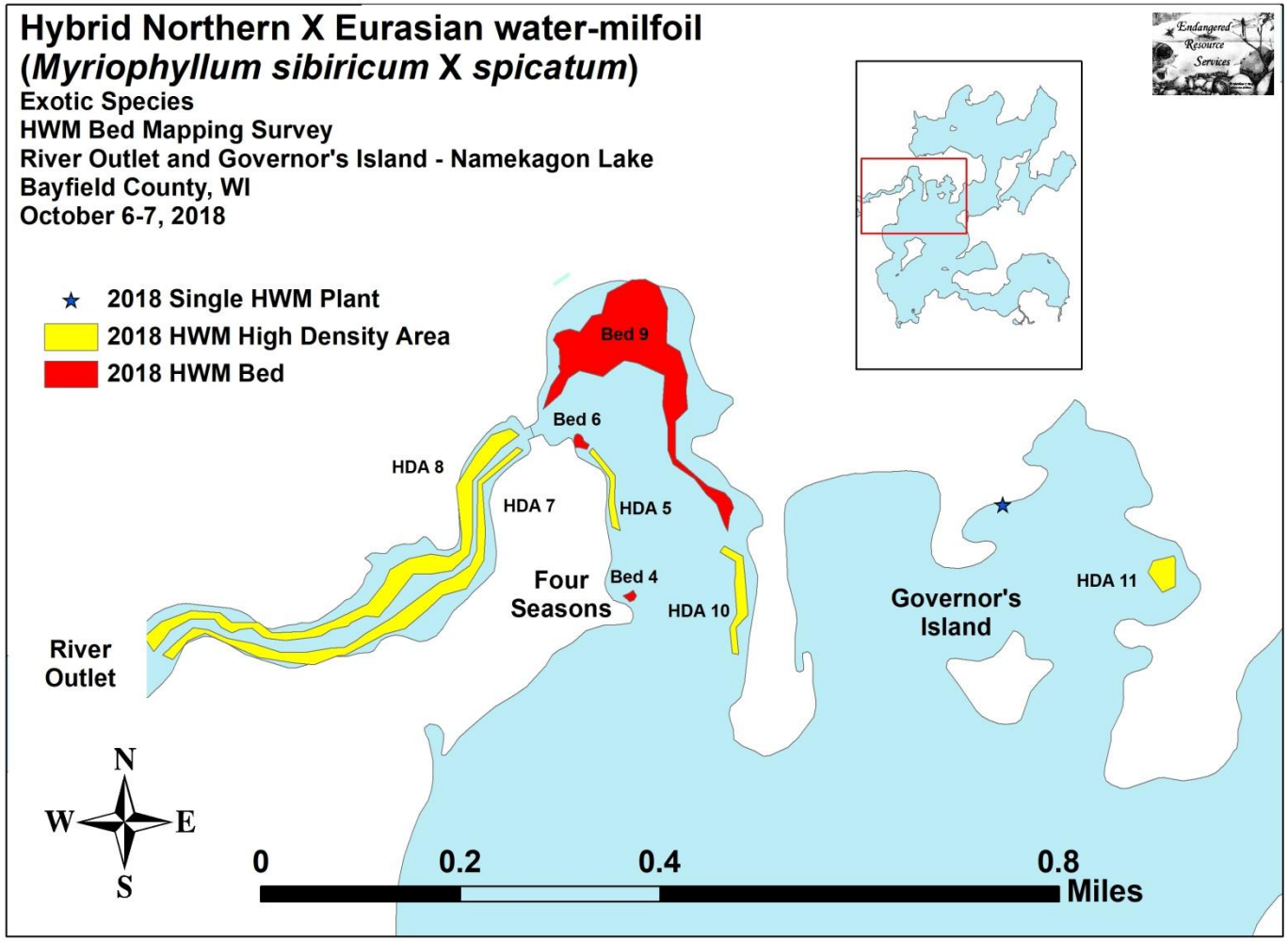
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(Myriophyllum sibiricum X spicatum)
Exotic Species
HWM Bed Mapping Survey
River Outlet and Governor's Island - Namekagon Lake
Bayfield County, WI
October 6-7, 2018
Endangered Resource Services
2018 Single HWM Plant
2018 HWM High Density Area
2018 HWM Bed
Bed 9
Bed 6
HDA 8
HDA 7
HDA 5
Four Seasons
Bed 4
HDA 10
River Outlet
Governor's Island
HDA 11
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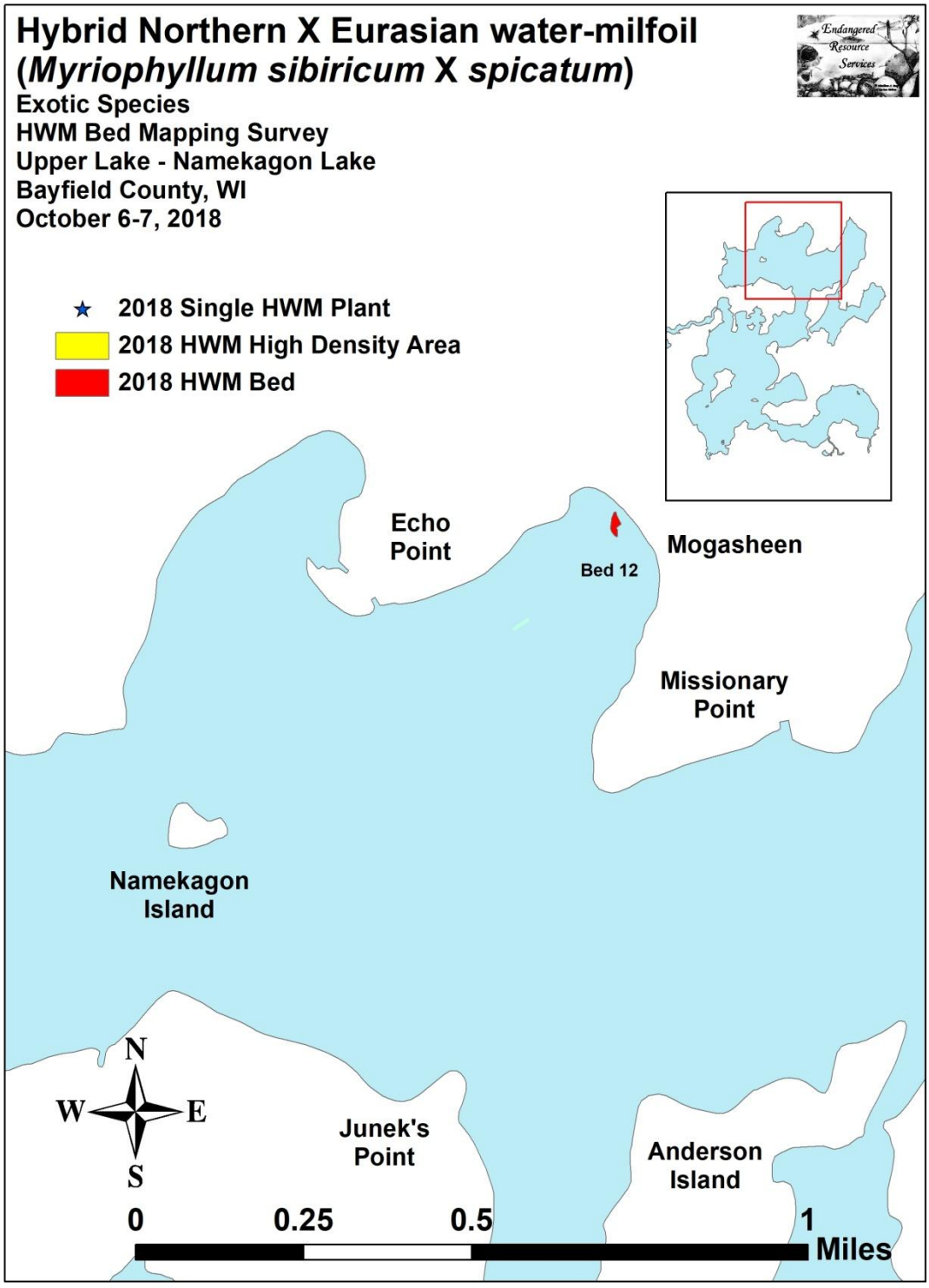
Hybrid Northern X Eurasian water-milfoil
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HWM Bed Mapping Survey
Upper Lake - Namekagon Lake
Bayfield County, WI
October 6-7, 2018
Endangered Resource Services
2018 Single HWM Plant
2018 HWM High Density Area
2018 HWM Bed
Echo Point
Bed 12
Mogasheen
Missionary Point
Namekagon Island
Junek's Point
Anderson Island
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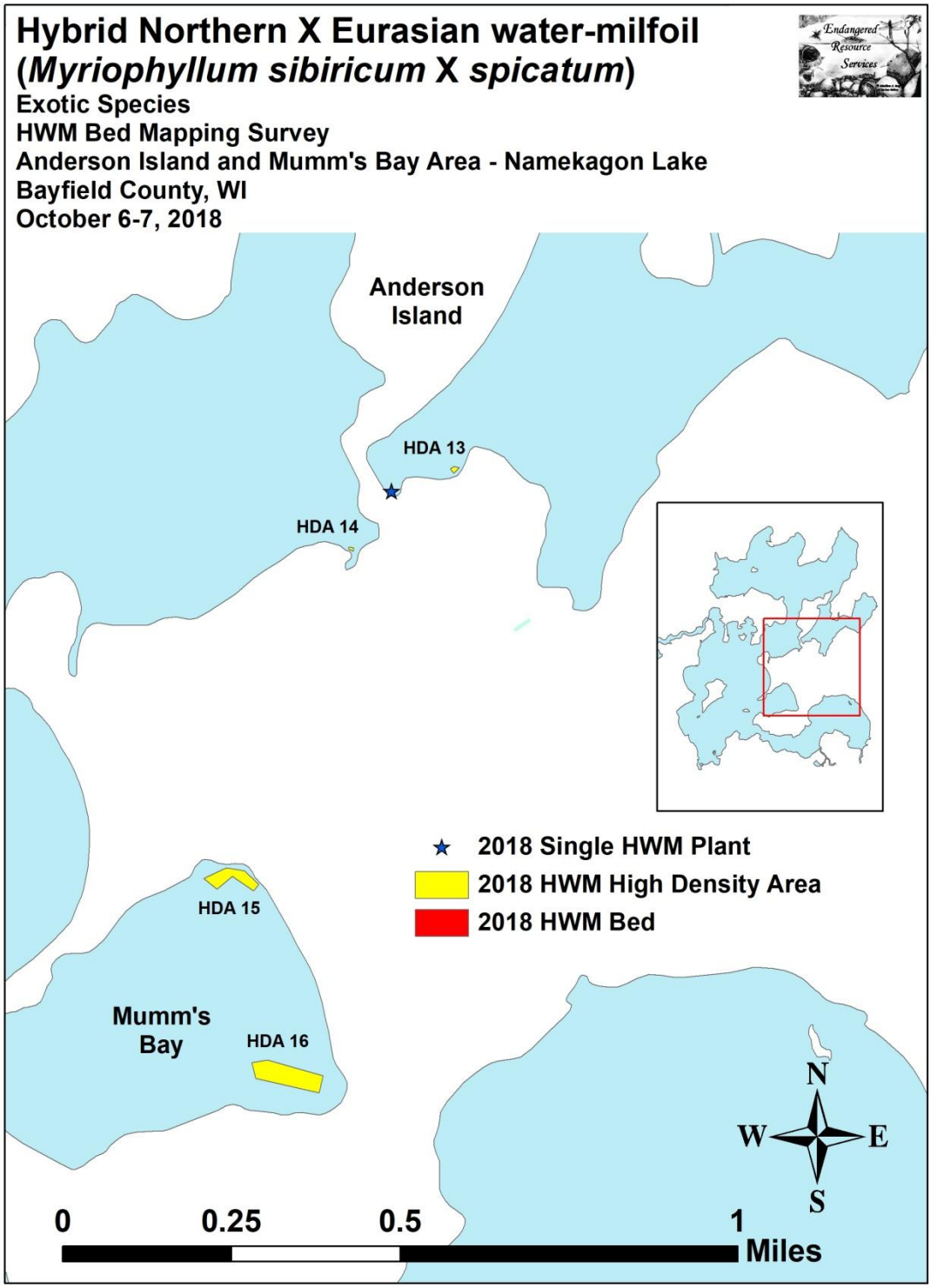
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Anderson Island and Mumm's Bay Area - Namekagon Lake
Bayfield County, WI
October 6-7, 2018
Endangered Resource Services
Anderson Island
HDA 13
HDA 14
HDA 15
HDA 16
Mumm's Bay
2018 Single HWM Plant
2018 HWM High Density Area
2018 HWM Bed
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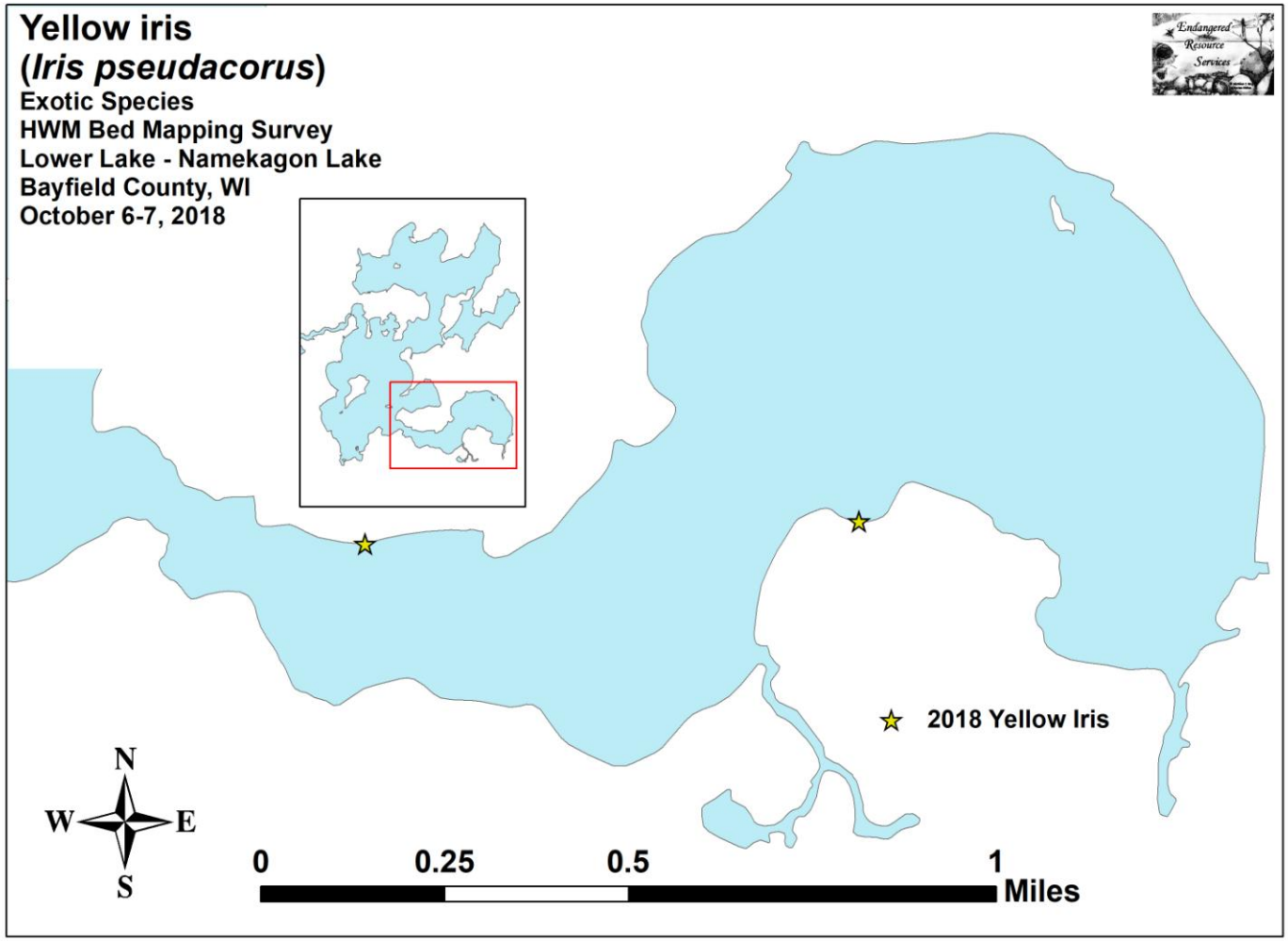
Appendix II: 2018 Yellow Iris Fall Distribution Map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