Eurasian Water-milfoil (*Myriophyllum spicatum*)
Fall Bed-mapping Survey
Half Moon Lake - WBIC: 2621100
Polk County, Wisconsin

Large EWM bed near the boat landing 10/30/21

EWM beds on Half Moon Lake 10/30/21

Project Initiated by:
The Half Moon Lake Protection and Rehabilitation District, the Polk County Land and Water Resources Department, and the Wisconsin Department of Natural Resources

Eurasian water-milfoil (Berg 2007)

Survey Conducted by and Report Prepared by:
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October 30, 2021

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INTRODUCTION:

Half Moon Lake (WBIC 2621100) is a 550-acre stratified drainage lake located in the Town of Milltown in central Polk County Wisconsin (T35N R17W S23, 24, 25, 36). It reaches a maximum depth of 60ft in the deep hole on the southeast end of the central basin and has an average depth of 25ft (WDNR 2021). The lake is oligotrophic in nature, and water clarity is good to very good with Secchi readings averaging 15.2ft from 1994-2021 (WDNR 2021). This clarity produced a littoral zone that extended to at least 25ft during the last full lake survey in 2018. The shoreline is dominated by sand and gravel with most areas transitioning to sandy muck at depths beyond 10ft. More nutrient-rich organic muck occurs in the lake inlet, in areas adjacent to the tamarack bogs, and on the west side of the south bay (Hopke et al. 1963) (Figure 1).

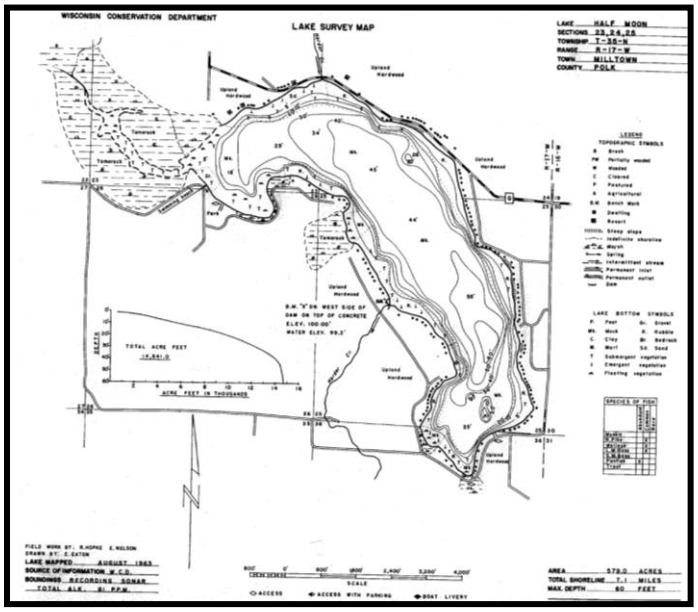

Figure 1: Half Moon Lake Bathymetric Map

BACKGROUND AND STUDY RATIONALE:

On June 21-23, 2018, at the request of the Half Moon Lake Protection and Rehabilitation District (HMLPRD) and the Wisconsin Department of Natural Resources (WDNR) while working as a subcontractor for Barr Engineering, we conducted the most recent warm-water point-intercept survey of all aquatic plants in Half Moon Lake. This extensive study established data on the richness, diversity, abundance, and distribution of the lake's aquatic macrophyte populations. At that time, we found no evidence of Eurasian water-milfoil (*Myriophyllum spicatum*) (EWM), an invasive exotic aquatic plant, anywhere in the lake.

Unfortunately, in October 2021, biologists from the Polk County Land and Water Resources Department (PCLWRD) found a few EWM plants near the public boat landing on the lake's northwest side. A follow-up survey also located a bed just north of the landing. Because of this, we were asked to complete an exhaustive littoral zone survey to look for additional plants and beds. This survey will be used to determine where active management might be considered in 2022. This report is the summary analysis of that field survey counducted on October 30, 2021.

METHODS:

Fall Eurasian Water-milfoil Bed Mapping Survey:

During the survey, we searched the lake's visible littoral zone. By definition, a "bed" was determined to be any area where we visually estimated that EWM 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 2), 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). Because this is a new infestation, we also mapped "High Density Areas" that didn't meet the bed criteria, but still had regular EWM plants. These data were then mapped in 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. When isolated individual EWM plants were found well outside of the mapped beds and high-density areas, we GPS marked them as well because these satellite plants are likely to become beds in the near future.

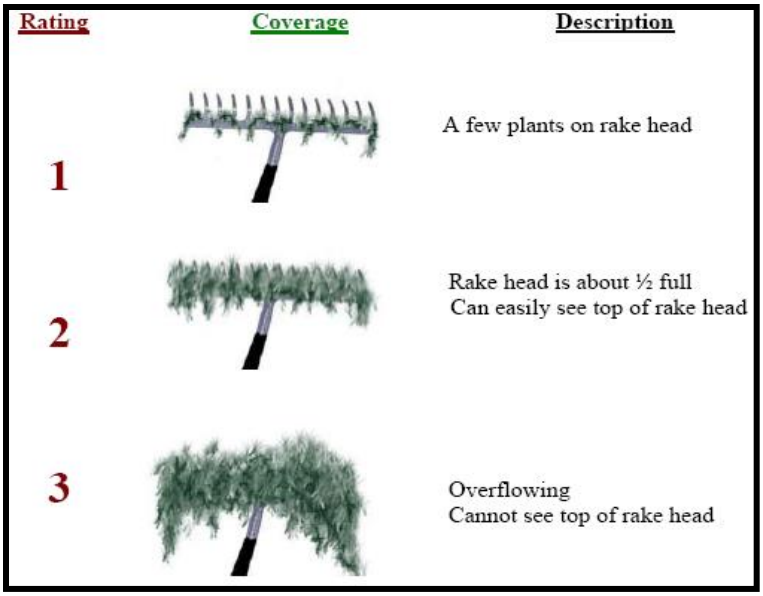

Figure 2: Rake Fullness Ratings (UWEX 2010)

RESULTS:

Fall Eurasian Water-milfoil Bed Mapping Survey:

On October 30th, we surveyed transects covering 25.4km (15.8 miles) spending extra time in the shallow areas in the northern half of the lake nearest the public boat landing (Figure 3). In the southern half of the lake, steep drop-offs and rocky shorelines provided less habitat for milfoil so we were able to use a single zigzag transect in most areas (Figure 4). Despite the late date for a survey and a minor algal bloom, the day's conditions proved nearly ideal as we had calm winds and fair to good water clarity with mostly sunny skies during the majority of the survey. This allowed us to see down 7-8ft into the water column (Figure 5).

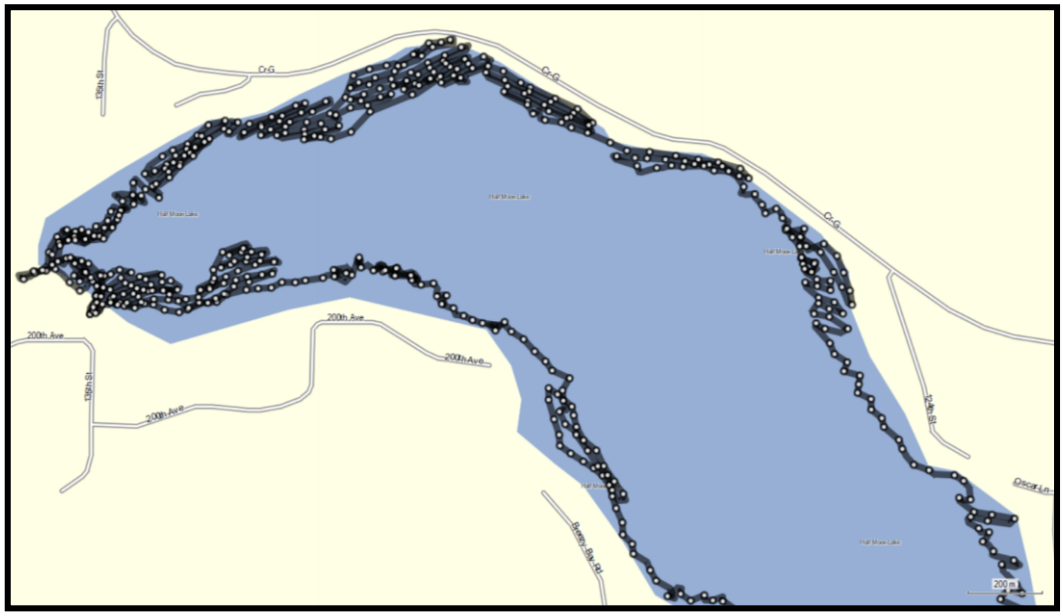

Figure 3: Littoral Zone EWM Survey Transects – North Half of the Lake

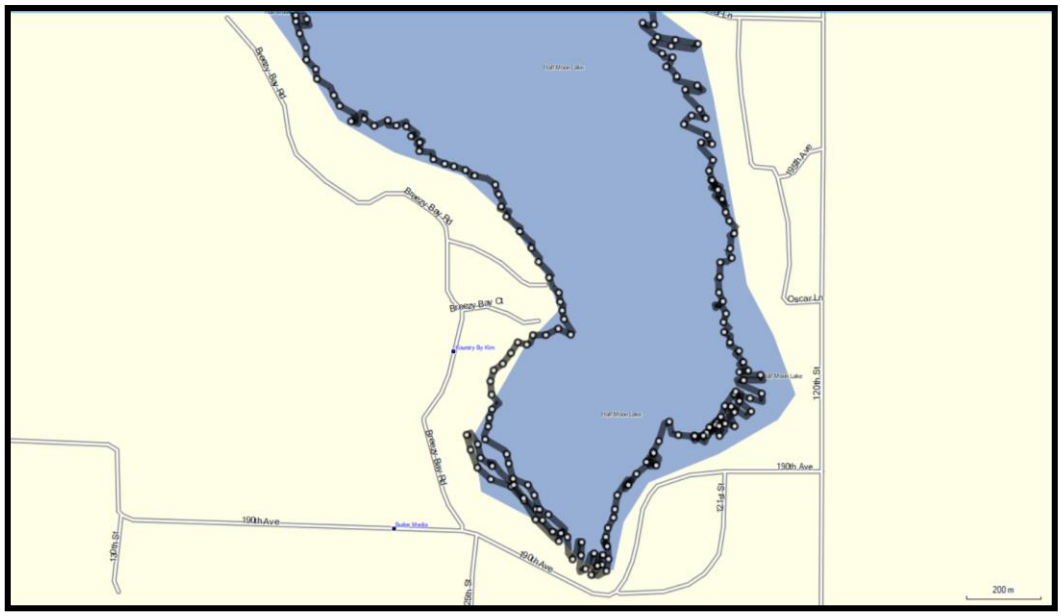

Figure 4: Littoral Zone EWM Survey Transects – South Half of the Lake

Figure 5: Calm and Mostly Sunny Survey Conditions 10/30/21

Even before launching our boat, we found evidence of Eurasian water-milfoil at the northwest public boat landing where several floating fragments had washed up on shore, and a couple of 6-inch sprouts were rooted in a foot of water (Figure 6). Further searching in this area located over 30 pioneer plants scattered among the Northern water-milfoil (*Myriophyllum sibiricum*) (NWM), native pondweeds (*Potamogeton* spp.), and lilypads of Spatterdock (*Nuphar variegata*) and White water lily (*Nymphaea odorata*). Immediately north of the landing, a small but moderately dense bed was canopied in up to 8ft of water (Figure 7). After finding another handful of plants in the channel leading to the active beaver lodge in the lake's northwest corner, we located the main bed expanding along the north shoreline. These plants were almost all growing in a narrow band on the outer edge of the rooted littoral zone in 8-13ft of water. In from this, plants tended to be more scattered; especially as the bottom substrate transitions from muck to sand and gravel. Further down the shoreline, we found only a few scattered individuals before plants disappeared entirely (Figure 8) (Appendix I).

Figure 6: Rooted EWM Sprouts at the Landing 10/30/21

Figure 7: Dense Canopied EWM in Bed 4 North of the Landing 10/30/21

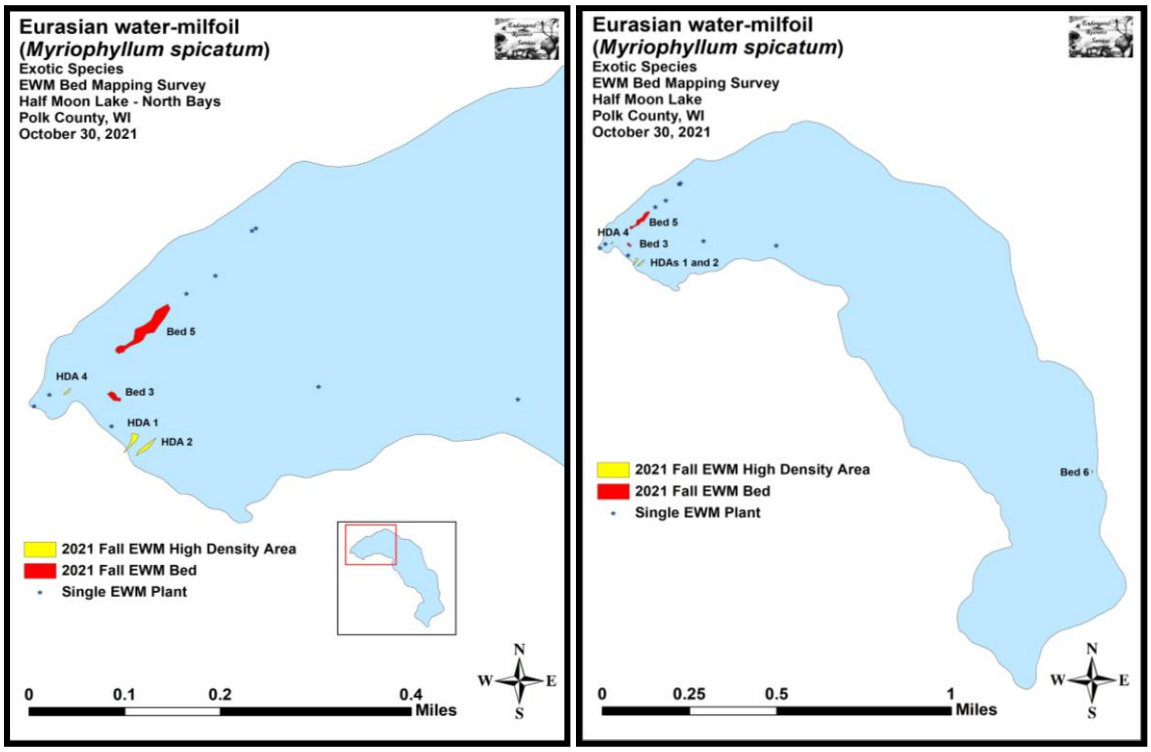

Figure 8: 2021 October Eurasian Water-milfoil Bed Maps

Combing the north bay and northeastern shoreline produced no additional plants. However, we noticed that Northern water-milfoil was abundant suggesting EWM will have ample habitat to expand into in this area. As the littoral zone narrowed on the eastern shoreline, NWM became increasingly less common. Unfortunately, we located a small but already expanding microbed just north of the lake's southeast bay (Figure 8) (Appendix I). These plants were actively fragmenting, and we found scattered satellite plants radiating out on the margins (Figure 9).

Somewhat surprisingly, we didn't find any EWM in the south bays despite there being suitable habitat in many areas. Searching the western shoreline also didn't turn up any new plants, but we did locate two additional single-stemmed plants along the south shoreline of the northwest bay (Figure 9).

Figure 9: Rooted EWM Sprouts in the Southeast Bay/Floating Fragment along the South Shoreline of the Northwest Bay - 10/30/21

Collectively, the October survey found three true beds totaling 0.48 acre and three "high EWM density areas" covering 0.11 acre for a total impact of 0.59 acre (approximately 0.11% of the lake's surface area) (Table 1). Outside of these areas, we marked just nine additional single-stemmed plants.

Table 1: Fall Eurasian Water-milfoil Bed Mapping Summary
Half Moon Lake, Polk County
October 30, 2021

Bed/HDA Number	2021 Fall Acreage	Rake Range and Mean Rake Fullness	Depth Range and Mean Depth	Canopied?	Navigation Impairment	2021 Field Notes
HDA 1	0.05	<<<1-1; <1	1-6; 3	Yes	None	Regular but scattered plants south of landing
HDA 2	0.05	<<<1-1; <1	1-5; 3	Yes	None	Regular but scattered plants north of landing
Bed 3	0.05	<<1-3; 2	4-8; 6	Yes	Minor	Narrow but moderately dense satellite bed
HDA 4	<0.01	<<<1-1; <1	1-4; 3	Yes	None	Scattered plants in beaver channel
Bed 5	0.43	<<1-3; 2	8-13; 11	Yes	Moderate	Dense and monotypic at core; scattered to NE
Bed 6	<0.01	<<1-2; 1	4-8; 6	Near	Minor	Newly established microbed
Total	**0.59**					

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:

Eurasian water-milfoil currently occupies only a small percentage of the lake's surface area, but it is already widely-established making eradication an unrealistic expectation. With this 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 Half Moon Lake Protection and Rehabilitation District moving forward.

The dense nature and total acreage of the current beds likely mean that SCUBA divers and/or rake removal are unlikely to provide satisfactory control of the current infestation or prevent its further spread. If an herbicide treatment does occur, it could and likely should be very limited in scope as the vast majority of plants are currently restricted to just two locations – near the landing and in the southeast bay. Following a treatment, annual fall bed-mapping surveys will likely be needed to determine what, if any, management will occur the following year. Summer and/or fall rake or dive removal could also be employed to maintain EWM at low levels following a potential future herbicide treatment. This of course assumes the plant does not spread aggressively throughout the system. Unfortunately, how this species responds likely won't be known for several years.

Residents should know that Half Moon Lake has a significant amount of the very similar looking Northern water-milfoil – a valuable native plant that provides important fish habitat and is likely to be heavily impacted by any future chemical treatments. NWM is widely distributed throughout the lake's rooted littoral zone, but it does best over sandy and organic muck often just inshore from EWM in 6-10ft of water. Despite its superficial resemblance to EWM, Northern water-milfoil can be told apart by its leaflets numbering <24 that are usually held rigidly at 90 degree angles off the stem when out of water. Conversely, EWM normally has >26 leaflets that fall limp against the stem when out of water (Figure 10). EWM also tends to have a bright red growth tip on the top of the plant whereas NWM has a bright lime green growth tip. NWM on Half Moon Lake is often mixed with other plants, is seldom bed-forming, and rarely canopies on the surface; whereas EWM was often found in nearly monotypic beds that excluded most native species and canopied even in deep water. In the fall, NWM also forms winter buds on the tips of shoots whereas EWM has none. These buds were readily visible during the fall survey (Figure 11).

Because there is so much available habitat for Eurasian water-milfoil on the lake, we encourage all residents to be on the lookout for new beds and promptly contact us (saintcroixdfly@gmail.com and/or 715-338-7502) with a picture, specimen, description of, and/or preferably GPS coordinates of anything they find that looks suspicious. These locations could then be added to the existing map for management consideration and help keep small beds from becoming large ones. To assist with this effort, annually presenting all residents on the lake with "WANTED" posters that show the differences between native Northern water-milfoil and exotic Eurasian water-milfoil along with our contact information is another idea for the HMLPRD to consider. Even if it's only in an email, a reminder at the start of the growing season in June could help us, or others, eliminate plants early in the growing season before they spread.

Eurasian water-milfoil Northern water-milfoil

Figure 10: EWM and Northern Water-milfoil Identification (Berg 2007)

**Figure 11: Limp Nature of EWM Leaflets along Stem –
Stiff Nature of NWM Leaflets along Stem and Overwintering Turions**

LITERATURE CITED

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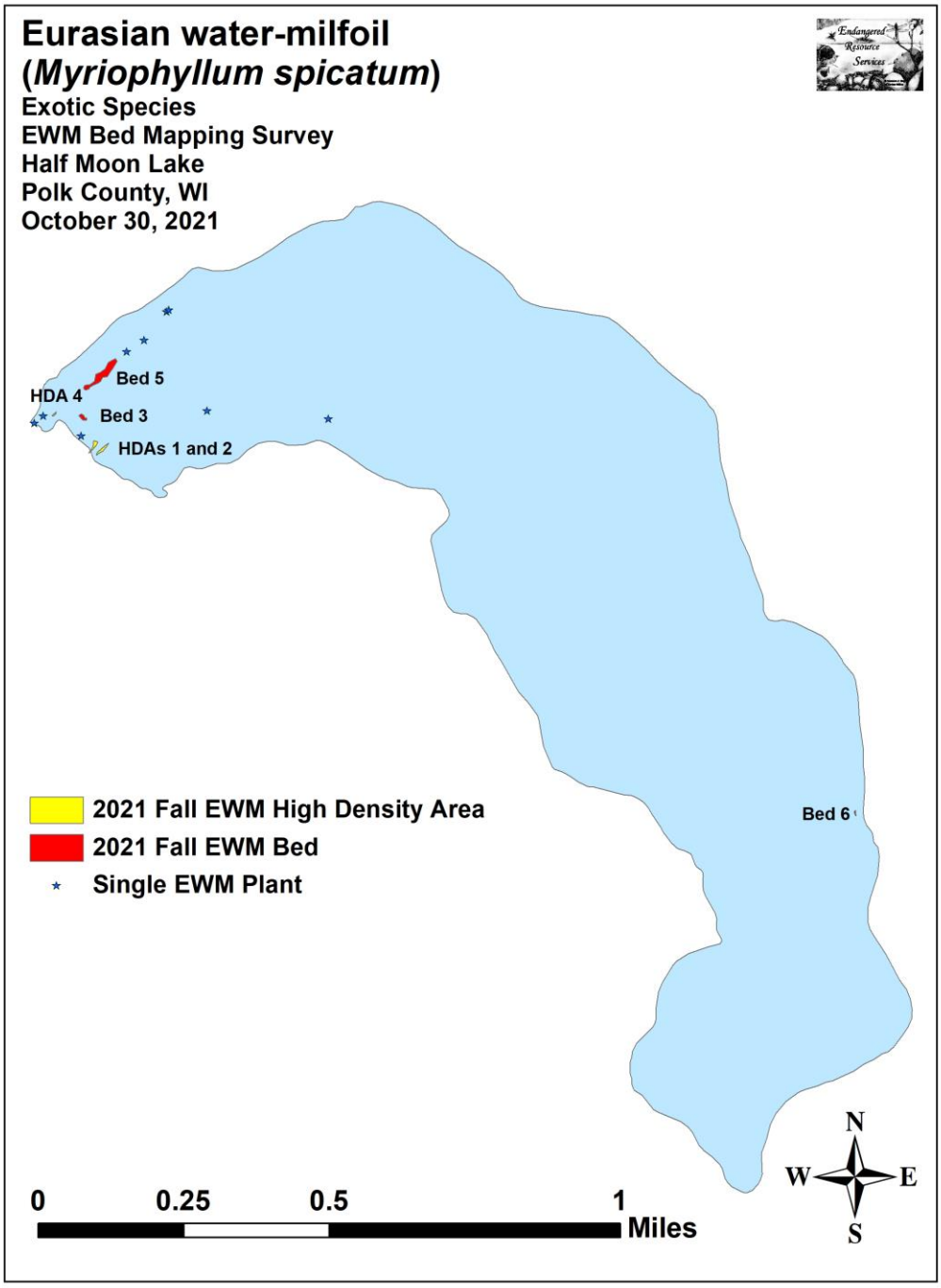
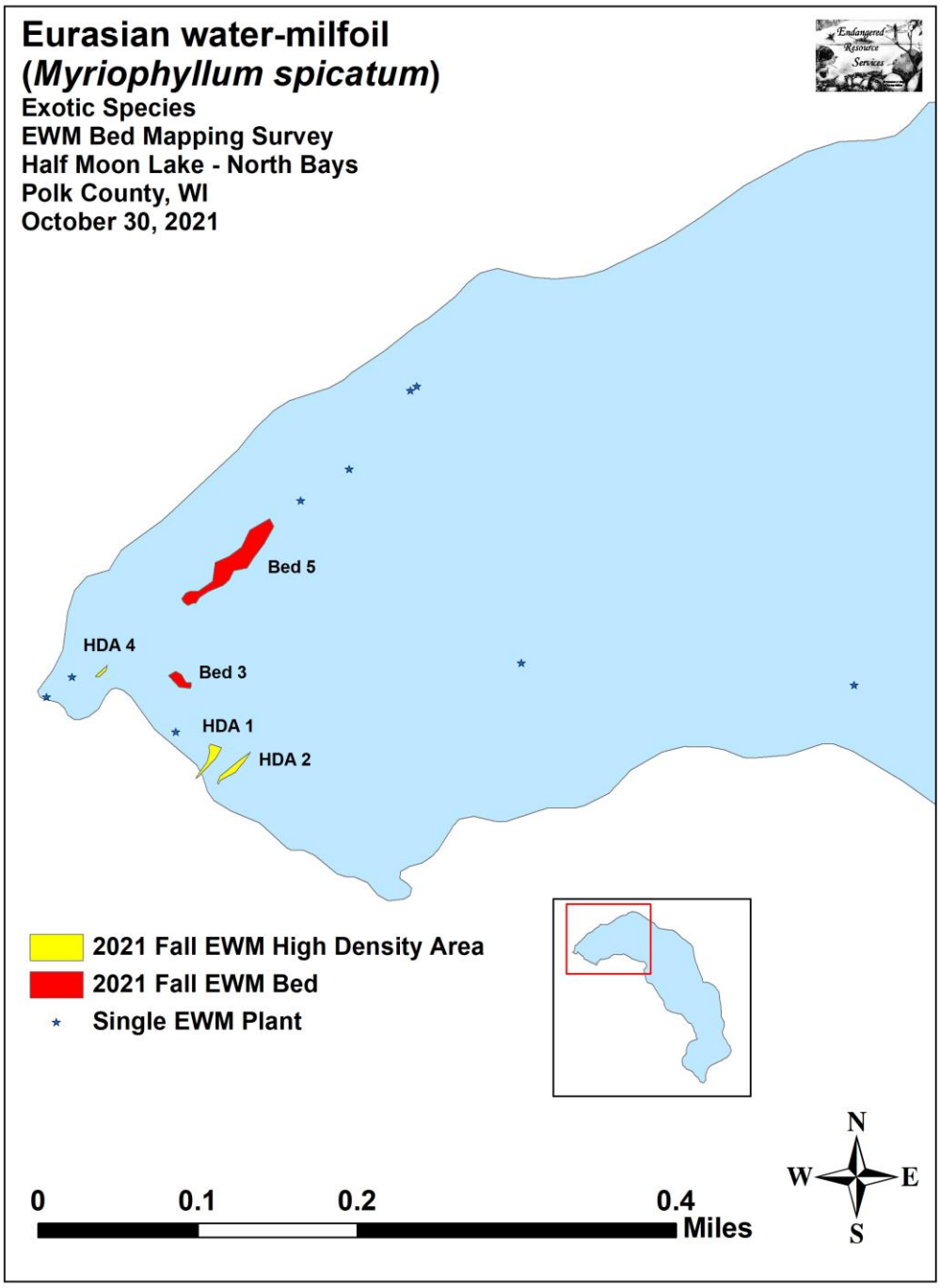
WDNR. [online]. 2021. Wisconsin Lakes Information – Half Moon Lake – Polk County. https://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=2621100 (2021, October).

Appendix I: Fall 2021 Eurasian Water-milfoil Bed Maps


Eurasian water-milfoil
(Myriophyllum spicatum)
Exotic Species
EWM Bed Mapping Survey
Half Moon Lake
Polk County, WI
October 30, 2021
Endangered Resource Services
HDA 4
Bed 5
Bed 3
HDAs 1 and 2
Bed 6
2021 Fall EWM High Density Area
2021 Fall EWM Bed
Single EWM Plant
0
0.25
0.5
1
Miles
N
W
E
S


Eurasian water-milfoil
(Myriophyllum spicatum)
Exotic Species
EWM Bed Mapping Survey
Half Moon Lake - North Bays
Polk County, WI
October 30, 2021
Endangered Resource Services
Bed 5
HDA 4
Bed 3
HDA 1
HDA 2
2021 Fall EWM High Density Area
2021 Fall EWM Bed
Single EWM Plant
0
0.1
0.2
0.4
Miles
N
W
E
S