MEMORANDUM REPORT NO. 249

SCHOOL SECTION LAKE AQUATIC PLANT MANAGEMENT PLAN UPDATE

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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SCHOOL SECTION LAKE AQUATIC PLANT MANAGEMENT PLAN UPDATE
WAUKESHA COUNTY, WISCONSIN

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INTRODUCTION 1

Credit: SEWRPC Staff

The Southeastern Wisconsin Regional Planning Commission (Commission) completed this aquatic plant inventory and management study on behalf of the School Section Lake Management District (the District). The Wisconsin Department of Natural Resources (WDNR) financed much of the project cost through a *Wisconsin Administrative Code* NR 190 *Lake Management Planning Grants* award (project ID LPL172520). This memorandum is the Commission's second study focusing on Waukesha County's School Section Lake.[1]

1.1 PROJECT SETTING, BACKGROUND, SCOPE, AND INTENT

School Section Lake is a 122-acre drained lake located in the Town of Ottawa in Waukesha County. The Lake forms part of a network of drainage channels originating in the vicinity of Pretty Lake and flowing northward and westward to the Bark River, a tributary stream to the Rock River. Attaining only a maximum depth of 15.5 feet, the entire Lake is capable of supporting abundant growth of rooted aquatic plants and emergent vegetation.

The Lake is used for a diverse array of water-based recreation. To help support a wide variety of recreational uses, the District manages aquatic plant populations under a permit issued by the WDNR. The ongoing management program relies primarily upon mechanical aquatic plant harvesting. According to available data, the aquatic plant community is responding well to current management practices, and lake recreational use has not been unduly restricted in most areas.

The District's aquatic plant management (APM) permit was granted for a five-year period beginning in 2014. A new permit was needed, which required a comprehensive on-the-water aquatic plant inventory. To support this endeavor, the Commission completed an aquatic plant inventory during 2020. The resultant data were used to evaluate the Lake's plant community conditions and apparent reaction to recent management practices. This information was then used to update the previous APM plan. The draft plan update was reviewed in 2021 by the District and regulators.

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[1] *SEWRPC Community Assistance Planning Report No. 319,* A Lake Protection Plan for School Section Lake, Waukesha County, Wisconsin*, December 2014*.

This updated APM plan summarizes information and recommendations needed to manage nuisance plants (including Eurasian watermilfoil and curly-leaf pondweed). The plan covers four main topics:

- APM Goals and Objectives
- Aquatic Plant Community Changes and Quality
- Aquatic Plant Control Alternatives
- Recommended Aquatic Plant Management Plan

This memorandum focuses on approaches to monitor and control actively growing nuisance populations of aquatic plants and presents a range of alternatives that could potentially be used to achieve desired APM goals. It also provides specific recommendations related to each alternative. These measures focus on those that the District can implement and collaborate with Lake residents/users and the WDNR.

The current study is not intended to be a comprehensive evaluation of the myriad factors influencing the Lake's overall health and recreational use potential and therefore does not address watershed issues, land use, in-depth water quality or quantity interpretations, history, recreational use, fish and wildlife, and other such topics typical of comprehensive lake plans.

In summary, this document helps interested parties understand the particular plant management measures to be used in and around the Lake. These data and suggestions can be valuable resources when developing requisite APM permit applications and implementing future aquatic plant management efforts.

INVENTORY FINDINGS AND RELEVANCE TO RESOURCE MANAGEMENT 2

Credit: SEWRPC Staff

Natural resource planning relies upon data to quantify conditions, identify management challenges and limitations, and predict the influence of potential courses of action. These factors are collectively considered to evaluate and recommend practices that promote sustainable use, help safeguard human and environmental health, balance diverse lake user interests, address conflicting lake user desires, and comply with regulatory objectives and requirements. The following sections briefly describe data collection efforts, summarize, and highlight resultant data, interpret data trends and relationships, and make conclusions useful to guide resource planning.

2.1 AQUATIC PLANT MANAGEMENT GOALS AND OBJECTIVES

Aquatic plant management (APM) programs are designed to further a variety of lake user and riparian land owner goals and desires. For example, most APM programs aim to improve lake navigability. However, APM programs must also be sensitive to other lake uses and must maintain or enhance a lake's ecological integrity. Consequently, APM program objectives are commonly developed in close consultation with many interested parties. The School Section Lake APM plan considered input from many entities including the School Section Lake Management District (the District) and the WDNR. Objectives of the School Section Lake APM program include the following:

- Effectively control the quantity and density of nuisance aquatic plant growth in well-targeted portions of School Section Lake. This objective helps:
    - Enhance water-based recreational opportunities.
    - Improve community-perceived aesthetic values.
    - Maintain or enhance the Lake's natural resource value.
- Manage the Lake in an environmentally sensitive manner in conformance with *Wisconsin Administrative Code* standards and requirements under Chapters NR 103 *Water Quality Standards for Wetlands*, NR 107 *Aquatic Plant Management*, and NR 109 *Aquatic Plants: Introduction, Manual*

Removal & Mechanical Control Regulations. Following these rules helps the District preserve and enhance the Lake's water quality, biotic communities, habitat value, and essential structure and relative function in relation to adjacent areas.

- Protect and maintain public health and promote public comfort, convenience, and welfare while safeguarding the Lake's ecological health through environmentally sound management of vegetation, wildlife, fish, and other aquatic/semi-aquatic organisms in and around the Lake.

- Promote a high-quality water-based experience for residents and visitors to the Lake consistent with the policies and practices of the WDNR, as described in the regional water quality management plan, as amended.[2]

To meet these objectives, the District executed an agreement with the Southeastern Wisconsin Regional Planning Commission (Commission) to investigate the characteristics of School Section Lake and to develop an aquatic plant management update. As part of this planning process, surveys of the aquatic plant community and comparison to results of previous surveys were conducted. This chapter presents the results of each of these inventories.

2.2 AQUATIC PLANT COMMUNITY COMPOSITION, CHANGE, AND QUALITY

The Lake's aquatic plant community was evaluated several times since the 1970s. WDNR staff surveyed the aquatic plant community during 1980 and 2011. Aron & Associates surveyed the Lake in 1994 and 2004. Commission staff surveyed the Lake's aquatic plants in 1976, 2003, 2012, and 2020. Species lists and abundance data derived from the 2012 and 2020 surveys are compared in Table 2.1. The 2012 and 2020 surveys both used the same point-intercept grid and methodology.[3,4,5] Therefore, the same points were sampled using the same techniques on roughly the same date approximately eight years apart. Such consistency enables more detailed evaluation of aquatic plant abundance and distribution change than has been possible in the past.

Each aquatic plant species has preferred habitat conditions in which that species generally thrives as well as conditions that limit or completely inhibit its growth. For example, water conditions (e.g., depth, clarity, source, alkalinity, and nutrient concentrations), substrate composition, the presence or absence of water movement, and pressure from herbivory and/or competition all can influence the type of aquatic plants found in a water body. All other factors being equal, water bodies with a diverse array of habitat variables are more likely to host a diverse aquatic plant community. For similar reasons, some areas of a particular lake may contain plant communities with very little diversity, while other areas of the same lake may exhibit high diversity. Historically, human manipulation has often favored certain plants and reduced biological diversity (biodiversity). Thoughtful aquatic plant management can help maintain or even enhance aquatic plant biodiversity.

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[2] *SEWRPC Planning Report No. 30,* A Regional Water Quality Management Plan for Southeastern Wisconsin—2000, Volume One, Inventory Findings, *September 1978,* Volume Two, Alternative Plans*, February 1979,* Volume Three, Recommended Plan*, June 1979, and SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report*, March 1995.*

[3] *It is noteworthy that sampling methodology changed from transect-based methods in the earlier surveys (1967 through 2008) to a point-intercept method beginning in 2014.*

[4] *R. Jesson, and R. Lound, Minnesota Department of Conservation Game Investigational Report No. 6,* An Evaluation of a Survey Technique for Submerged Aquatic Plants*, 1962; as refined in the Memo from Stan Nichols to J. Bode, J. Leverence, S. Borman, S. Engel, and D. Helsel, entitled "Analysis of Macrophyte Data for Ambient Lakes-Dutch Hollow and Redstone Lakes Example," University of Wisconsin-Extension, February 4, 1994.*

[5] *J. Hauxwell, S. Knight, K. Wagner, A. Mikulyuk, M. Nault, M. Porzky, and S. Chase,* Recommended Baseline Monitoring of Aquatic Plants in Wisconsin: Sampling Design, Field and Laboratory Procedures, Data Entry and Analysis, and Applications*, Wisconsin Department of Natural Resources, Bureau of Science Services, Publication No. PUB-SS-1068 201, March 2010.*

Table 2.1
Aquatic Plant Abundance, School Section Lake: July 2012 Versus August 2020

Aquatic Plant Species	Native or Invasive	Number of Points Found[a] (2012/2020)	Frequency of Occurrence Within Vegetated Areas[b] (2012/2020)	Average Rake Fullness[c] (2012/2020)	Relative Frequency of Occurrence[d] (2012/2020)	Visual Sightings[e] (2012/2020)
Myriophyllum spicatum (eurasian watermilfoil)	Invasive	58/41	42.3/31.3	1.9/1.3	13.8/12.5	0/22
Potamogeton crispus (curly-leaf pondweed)	Invasive	5/2	3.6/1.5	1.4/1.0	1.2/0.6	0/2
Bidens beckii (water marigold)*	Native	0/1	0/0.8	0/1.0	0/0.3	0/0
Ceratophyllum demersum (coontail)	Native	49/38	35.8/29.0	2.1/1.6	11.7/11.6	0/2
Chara spp. (muskgrasses)*	Native	91/80	66.4/61.1	2.8/2.5	21.7/24.3	0/0
Elodea canadensis (common waterweed)	Native	3/16	2.2/12.2	1.0/1.3	0.7/4.9	0/2
Heteranthera dubia (water stargrass)	Native	2/1	1.5/0.8	2.0/1.0	0.5/0.3	0/0
Najas flexilis (slender naiad)	Native	8/19	5.8/14.5	1.1/1.1	1.9/5.8	0/2
Najas guadalupensis (southern naiad)*	Native	0/1	0/0.8	0/1.0	0/0.3	0/0
Najas marina (spiny naiad)[f]	Naturalized	10/19	7.3/14.5	1.5/1.3	2.4/5.8	0/4
Nitella flexilis (slender nitella)	Native	0/16	0/12.2	0/1.3	0/4.9	0/0
Nuphar variegata (spatterdock)	Native	8/1	5.8/0.8	2.0/1.0	1.9/0.3	0/7
Nymphaea odorata (white water lily)	Native	26/4	19.0/3.1	2.7/1.5	6.2/1.2	0/19
Potamogeton friesii (fries' pondweed)*	Native	0/2	0/1.5	0/1.0	0/0.6	0/0
Potamogeton gramineus (variable pondweed)*	Native	10/1	7.3/0.8	2.0/1.0	2.4/0.3	0/3
Potamogeton illinoensis (illinois pondweed)	Native	2/0	1.5/0	1.0/0	0.5/0	0/0
Potamogeton natans (floating-leaf pondweed)	Native	9/0	6.6/0	1.9/0	2.1/0	0/2
Potamogeton nodosus (long-leaf pondweed)*	Native	3/1	2.2/0.8	2.7/2.0	0.7/0.3	0/1
Potamogeton praelongus (white-stem pondweed)*[g]	Native	2/0	1.5/0	1.0/0	0.5/0	0/0
Potamogeton richardsonii (clasping-leaf pondweed)	Native	1/0	0.7/0	1.0/0	0.2/0	0/0
Potamogeton zosteriformis (flat-stem pondweed)	Native	0/5	0/3.8	0/1.2	0/1.5	0/4
Ranunculus aquatilis (white water crowfoot)*	Native	1/0	0.7/0	3.0/0	0.2/0	0/0
Stuckenia pectinata (sago pondweed)[g]	Native	25/7	18.2/5.3	1.4/1.0	6.0/2.1	0/22
Utricularia minor (small bladderwort)*	Native	0/2	0/1.5	0/1.0	0/0.6	0/1
Utricularia vulgaris (common bladderwort)*	Native	43/36	31.4/27.5	1.7/1.5	10.3/10.9	0/26
Vallisneria americana (eelgrass/water celery)[g]	Native	30/33	21.9/25.2	2.1/1.2	7.2/10.0	0/2

Notes:

- During the 2012 survey, sampling occurred at 173 sampling points on July 24 to 26, 2012. Of the sampling points visited, 137 were vegetated. During the 2020 survey, sampling occurred at 164 sampling points on August 11 and 14, 2020. Of the sampling points visited, 131 had vegetation.
- Red text indicates non-native and/or invasive species.
- An asterisk (*) next to a species name indicates that the species is considered "sensitive," with a coefficient of conservatism C value of seven or greater.

Table continued on next page.

Table 2.1 (Continued)

[a] Number of Points *refers to the number of points at which the species was retrieved and identified on the rake during sampling*

[b] Frequency of Occurrence Within Vegetated Areas, *expressed as a percent, is the percentage of times a particular species occurred when there was aquatic vegetation present at the sampling site.*

[c] Average Rake Fullness is the average amount, *on a scale of 0 to 3, of a particular species at each site where that species was retrieved by the rake*.

[d] Relative Frequency of Occurrence, *expressed as a percent, is the frequency of that particular species compared to the frequencies of all species present.*

[e] Visual Sightings *is the number of points where that particular species was visually observed within six feet of the actual rake haul location, but was not actually retrieved on the rake and was not, therefore assigned a rake fullness measurement for that site. At points where this occurred, the species was simply marked as "present" at that site. Recording the number of visual sightings helps give a better picture of species distribution throughout the lake. (It is likely that visual sightings were not taken in 2011*).

[f] *Spiny naiad was added to the NR 40 list as a restricted species in 2015, meaning it is not allowed to be transported, transferred, or introduced without a permit. Because the species is not native to Wisconsin and can become quite abundant, especially in lakes of poor water quality with hard water, it is currently considered a "naturalized" native species that can provide good habitat and food for fish and macroinvertebrates. Paul M. Skawinski, Aquatic Plants of the Upper Midwest 2nd Edition 2014; Through the Looking Glass: A Field Guide to Aquatic Plants 2nd Edition 2013.*

[g] *Considered a high-value aquatic plant species known to offer important values in specific aquatic ecosystems under Section NR 107.08 (4) of the* Wisconsin Administrative Code.

Source: Wisconsin Department of Natural Resources and SEWRPC

Several metrics are useful to describe aquatic plant community condition and design management strategies. These metrics include maximum depth of colonization, species richness, biodiversity, evaluation of sensitive species, and relative species abundance. Metrics derived from the 2012 and 2020 point-intercept surveys are described below.

Maximum Depth of Colonization

The maximum depth to which aquatic plants grow in a lake, known as the maximum depth of colonization (MDC), is a useful indicator of water quality, as turbid and/or eutrophic (nutrient-rich) lakes generally have shallower MDC than lakes with clear water.[6] The MDC of School Section Lake was generally 13-15 feet below the water surface during 2012 and 2020, indicating generally high water clarity and plant growth throughout the Lake since its maximum depth is approximately 15 feet. It is important to note that for surveys using the point-intercept protocol, the protocol allows sampling to be discontinued at depths greater than the maximum depth of colonization for vascular plants. However, aquatic moss and macroalgae, such as *Chara* spp. and *Nitella* spp., frequently colonize deeper than vascular plants and thus may be under-sampled in some lakes. For example, *Chara globularis* and *Nitella flexilis* have been found growing as deep as 37 feet and 35 feet, respectively, in Silver Lake, Washington County.

Species Richness

The number of different types of aquatic plants present in a lake is referred to as the *species richness* of the lake. Larger lakes with diverse lake basin morphology, less human disturbance, and/or healthier, more resilient lake ecosystems generally have greater species richness. Aquatic plants provide a wide variety of benefits to lakes, examples of which are briefly described in Table 2.2. School Section Lake exhibits high species richness.

School Section Lake exhibited low species richness overall during the initial plant inventory completed in 1976 (Table 2.3). At that time species were not as highly differentiated by observers. The Lake has maintained high species richness throughout the surveys that followed with only slight increases or decreases from year to year. A slight increase in species richness in the last three surveys is likely attributable to more specific identification of species. For example, bladderworts were often grouped together but are now more clearly defined during surveys. It is not uncommon for aquatic plant community diversity to fluctuate in response to a variety of drivers such as weather/climate, predation, and lake-external stimuli such as nutrient supply. This is especially true in the case of a lake's individual pondweed species, which tend to vary in abundance throughout the growing season in response to temperature, insolation, and other ecological factors. The 2020 aquatic plant survey identified 17 native submerged species in School Section Lake.

Biodiversity and Species Distribution

Species richness is often incorrectly used as a synonym for biodiversity. The difference in meaning between these terms is both subtle and significant. Biodiversity is based on the number of species present in a habitat along with the abundance of each species. For the purposes of this study, abundance was determined as the percent of observations of each species compared to the total number of observations made. Aquatic plant biodiversity can be measured with the Simpson Diversity Index (SDI), a metric that ranges from 0 (no diversity) to 1 (infinite diversity). Using this measure, a community dominated by one or two species would be considered less diverse than one in which several different species have similar abundance. In general, more diverse biological communities are better able to maintain ecological integrity. Promoting biodiversity not only helps sustain an ecosystem, but preserves the spectrum of options useful for future management decisions.

Data collected during 2020 reveal that School Section Lake's SDI was 0.88, very close to the 0.89 measured during 2012. The SDI values reveals considerable biodiversity in the Lake. As mentioned above, the 2020 aquatic plant survey of School Section Lake identified 17 native submerged aquatic plant species. Actions that conserve and promote aquatic plant biodiversity are critical to the long term health of the Lake. Such actions not only help sustain and increase the robustness and resilience of the existing ecosystem, but also promote efficient and effective future aquatic plant management.

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[6] *D.E. Canfield Jr, L. Langeland, W.T. and Haller, "Relations Between Water Transparency and Maximum Depth of Macrophyte Colonization in Lakes,"* Journal of Aquatic Plant Management, *23, 1985.*

Table 2.2
Examples of Positive Ecological Qualities Associated with Aquatic Plant Species Present in School Section Lake

Aquatic Plant Species Present	Ecological Significance
Ceratophyllum demersum (coontail)	Provides good shelter for young fish; supports insects valuable as food for fish and ducklings; native
Chara spp. (muskgrasses)	A favorite waterfowl food and fish habitat, especially for young fish; native
Elodea canadensis (common waterweed)	Provides shelter and support for insects which are valuable as fish food; native
Heteranthera dubia (water stargrass)	Locally important food source for waterfowl and forage for fish; native
Myriophyllum spicatum (eurasian watermilfoil)	None known. Invasive nonnative. Hinders navigation, outcompetes desirable aquatic plants, reduces water circulation, depresses oxygen levels, and reduces fish/invertebrate populations
Najas flexilis (slender naiad)	Important food source for waterfowl, marsh birds, and muskrats; provides food and shelter for fish; native
Najas guadalupensis (southern naiad)	Important food source for waterfowl, marsh birds, and muskrats; provides food and shelter for fish; native
Najas marina (spiny naiad)	Important food source for waterfowl, marsh birds, and muskrats; provides food and shelter for fish; native
Nitella flexilis (slender nitella)	Sometimes grazed by waterfowl; forage for fish; native
Potamogeton crispus (curly-leaf pondweed)	Adapted to cold water; mid-summer die-off can impair water quality; invasive nonnative
Potamogeton gramineus (variable pondweed)	The fruit is an important food source for many waterfowl; also provides food for muskrat, deer, and beaver; native
Potamogeton natans (floating-leaf pondweed)	The late-forming fruit provides important food source for ducks; provides good fish habitat due to its shade and foraging opportunities; native
Potamogeton zosteriformis (flat-stem pondweed)	Provides some food for ducks; native
Stuckenia pectinata (sago pondweed)	This plant is the most important pondweed for ducks, in addition to providing food and shelter for young fish; native
Utricularia vulgaris (common bladderwort)	Stems provide food and cover for fish; native
Vallisneria americana (eelgrass/water celery)	Provides good shade and shelter, supports insects, and is valuable fish food; native

Note: Information obtained from A Manual of Aquatic Plants by Norman C. Fassett, University of Wisconsin Press; Guide to Wisconsin Aquatic Plants, Wisconsin Department of Natural Resources; and, Through the Looking Glass: A Field Guide to Aquatic Plants, Wisconsin Lakes Partnership, University of Wisconsin-Extension.

Source: SEWRPC

Even though the Lake exhibits good species richness and biodiversity, no one location in the Lake contained all identified aquatic plant species. During 2020, between one and nine aquatic plant species were found at any one sampling point throughout the Lake (Figure 2.1). School Section Lake's greatest species richness occurred in the northern and southern reaches.

Sensitive Species

Aquatic plant metrics, such as species richness and the floristic quality index (FQI), can be useful for evaluating lake health. In hard water lakes, such as those common in Southeastern Wisconsin, species richness generally increases with water clarity and decreases with nutrient enrichment.[7] The FQI is an assessment metric used to evaluate how closely a lake's aquatic plant community matches that of undisturbed, pre-settlement conditions.[8] To formulate this metric, Wisconsin aquatic plant species were assigned conservatism (C) values on a scale from zero to ten that reflect the likelihood that each species occurs in undisturbed habitat. These values were assigned based on the species substrate preference, tolerance of water turbidity, water drawdown tolerance, rooting strength, and primary reproductive means. Native "sensitive" species that are intolerant of ecological disturbance receive high C values, while natives that are disturbance tolerant receive low C values. Invasive species are assigned a C value of 0. A lake's FQI is calculated as the average C value of

[7] *O. Vestergaard and K. Sand-Jensen, "Alkalinity and Trophic State Regulate Aquatic Plant Distribution in Danish lakes,"* Aquatic Botany 67*, 2000.*

[8] *S. Nichols, "Floristic Quality Assessment of Wisconsin Lake Plant Communities with Example Applications,"* Lake and Reservoir Management*, 15(2), 1999.*

Table 2.3
Submerged Aquatic Plant Species Observed in School Section Lake: 1976-2020

Submerged Aquatic Plant Species	1976	1980	1994	2003	2004	2011	2012	2020
Invasive Aquatic Plants								
Myriophyllum spicatum (eurasian watermilfoil)	X	X	X	X	X	X	X	X
Najas marina (spiny naiad)	--	--	X	X	X	X	X	X
Potamogeton crispus (curly-leaf pondweed)	--	--	X	X	X	X	X	X
Total Invasive Species Observed	1	1	3	3	3	3	3	3
Native Aquatic Plants								
Bidens beckii (water marigold)	--	--	--	--	--	--	--	X
Ceratophyllum demersum (coontail)	--	X	X	X	X	X	X	X
Chara spp. (muskgrasses)	X	X	X	X	X	X	X	X
Elodea canadensis (common waterweed)	X	X	X	X	--	X	X	X
Heteranthera dubia (water stargrass)	--	--	--	--	--	--	X	X
Myriophyllum heterophyllum (various-leaved watermilfoil)	--	--	--	--	--	X	--	--
Myriophyllum sibiricum (northern watermilfoil)	--	--	--	--	--	--	X	--
Myriophyllum verticillatum (whorled watermilfoil)	--	--	X	--	--	--	--	--
Najas flexilis (slender naiad)	--	X	X	X	X	X	X	X
Najas guadalupensis (southern naiad)	--	--	--	--	--	X	--	X
Nitella spp. (stonewort)	--	--	--	--	X	X	X	X
Potamogeton alpinus (alpine pondweed)	--	--	X	--	X	--	--	--
Potamogeton friesii (fries' pondweed)	--	--	X	--	X	X	--	X
Potamogeton gramineus (variable pondweed)	--	X	X	X	X	X	X	X
Potamogeton illinoensis (Illinois pondweed)	--	--	--	--	--	--	X	--
Potamogeton natans (floating-leaf pondweed)	--	X	X	X	X	X	X	X
Potamogeton nodosus (long-leaf pondweed)	--	--	--	--	--	X	X	X
Potamogeton praelongus (white-stem pondweed)	--	--	--	--	X	--	X	--
Potamogeton pusillus (small pondweed)	--	--	--	--	--	X	--	--
Potamogeton richardsonii (clasping-leaf pondweed)	--	--	--	--	--	--	X	--
Potamogeton spp. (pondweed)	--	X	--	--	--	--	--	--
Potamogeton zosteriformis (flat-stem pondweed)	X	X	--	--	--	X	--	X
Ranunculus aquatilus (white water crowfoot)	--	--	--	--	--	--	X	--
Stuckenia pectinata (sago pondweed)	X	X	X	X	X	X	X	X
Utricularia spp. (bladderwort)	--	X	X	X	X	--	X	--
Utricularia geminiscapa (twin-stemmed bladderwort)	--	--	--	--	--	X	--	--
Utricularia minor (small bladderwort)	--	--	--	--	--	--	--	X
Utricularia vulgaris (common bladderwort)	--	--	--	--	--	X	--	X
Vallisneria americana (eelgrass/water celery)	--	X	X	X	X	X	X	X
Total Native Species Observed	4	11	12	9	12	17	17	17
Total Species Richness	5	12	15	12	15	20	20	20

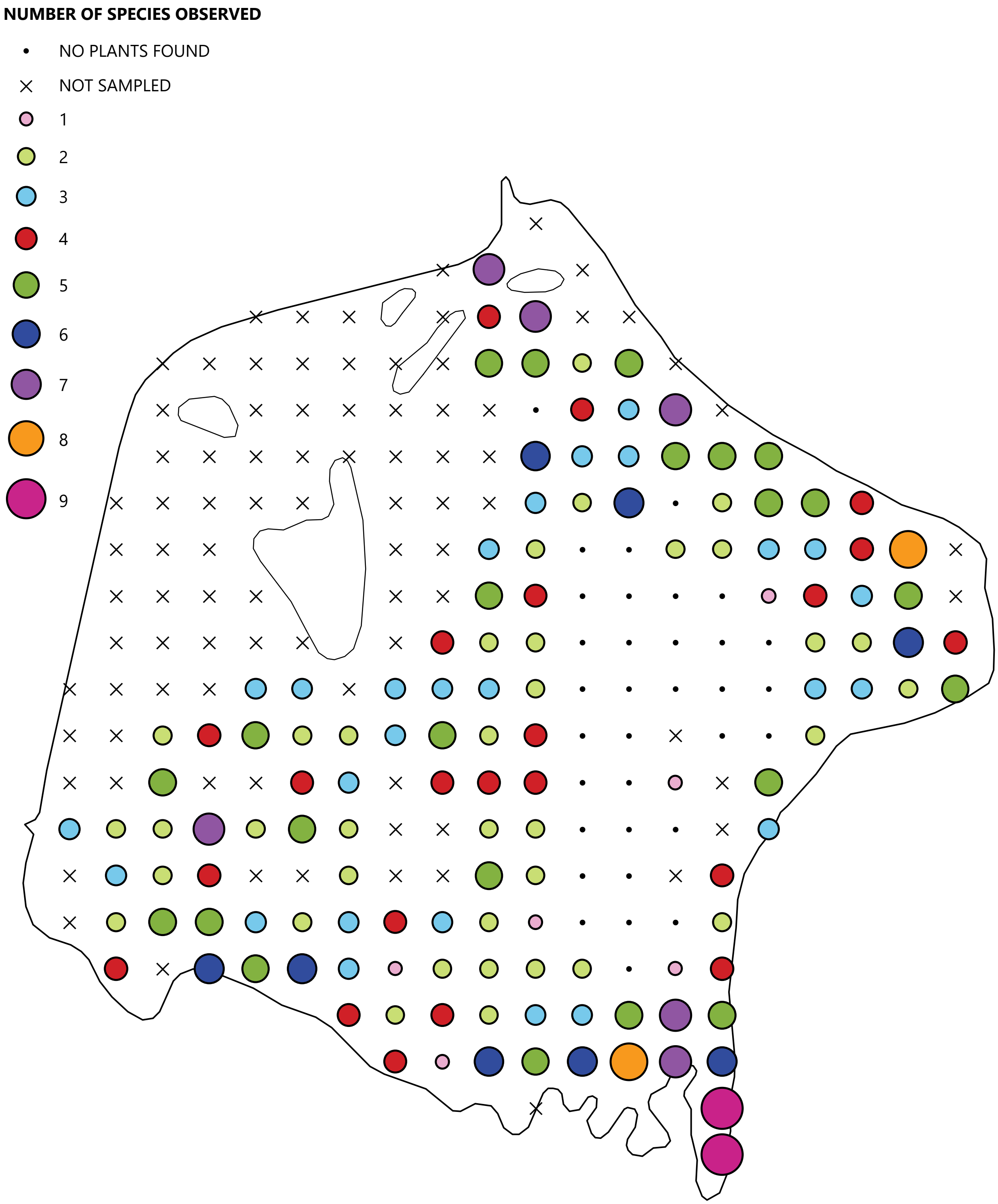
Source: Wisconsin Department of Natural Resources, Aron & Associates, and SEWRPC

species identified in the lake, divided by the square root of the lake's species richness. The FQI increased in School Section Lake between 2012 and 2020 from 27.7 to 29.2. As mentioned previously, plant communities naturally fluctuate based on many different factors and slight changes in FQI may be reflective of these fluctuations rather than a persistent trend in the aquatic plant community. In general, recent surveys had FQI values that are higher than average for the Southeastern Wisconsin Till Plains ecoregion of 20.0, indicating that the lake has a stable and healthy aquatic plant community.

Relative Species Abundance

Over the past 50 years, muskgrass (*Chara* spp.), a type of macroalgae, has consistently been either the most or one of the most abundant aquatic plants in the Lake. This is a critical species to protect, as muskgrass has several unique environmental preferences as well as beneficial functions in lakes. Muskgrass is nearly always associated with hard water lakes, particularly those with significant groundwater seepage and springs. This species has been found to promote marl formation and induce dissolved phosphorus to be precipitated to the lake bottom, reducing phosphorus concentrations in the water column and thus

Figure 2.1
Aquatic Plant Species Richness, School Section Lake: August 2020



Note: Samples were collected in School Section Lake between August 11, and August 14, 2020.

Source: Wisconsin Department of Natural Resources and SEWRPC

improving water clarity.[9] Additionally, muskgrass is a favorite waterfowl food and helps stabilize lake-bottom sediment, as it has been observed to grow deeper than most vascular plants. Its prevalence in a lake's aquatic plant community may tangibly contribute to lake water quality, promoting the growth of other desirable native plant species.

A wide variety of high value and oftentimes sensitive pondweed species (*Potamogeton* spp.) are also found in the Lake. Other native aquatic plants that have been found over the years in varying abundance include eelgrass or water celery (*Vallisneria americana*), slender naiad (*Najas flexilis*), and Sago pondweed (*Stuckenia pectinata*). Exotic Eurasian watermilfoil (EWM) (*Myriophyllum spicatum*) has been found throughout the Lake since the 1970s and in the most recent surveys exhibits the second highest abundance of all plant species found. However, overall EWM abundance has decreased.

Changing aquatic plant communities, such as those described in the preceding paragraphs, are often the result of change in and around the lake. Causes of change include aquatic plant management practices, land use (which in turn commonly affects nutrient and water supply and availability), lake use, climate, and natural biological processes such as natural population cycles of specific plants. In regard to plant-specific population cycles, it is not uncommon for various pondweed species to succeed each other during the growing season, with some species being more prevalent in cooler water, while others are more prevalent in warmer water. In contrast to such seasonal succession, aquatic plants such as EWM are known to have year-to-year abundance and relative scarcity cycles, possibly as a consequence of climatic factors and/or predation cycles related to the relative abundance of milfoil weevils (*Eurhychiopsis lecontei*).

Based on the 2020 point-intercept survey, the four most abundant submerged aquatic plant species in School Section Lake were, in decreasing order of abundance: 1) muskgrass, 2) EWM, 3) coontail (*Ceratophyllum demersum*), and 4) common bladderwort (*Utricularia vulgaris*).

Apparent Changes in Observed Aquatic Plant Communities: 2012 Versus 2020

The distribution of each aquatic plant species identified as part of the 2019 survey is mapped in Appendix A. Both the 2012 and 2020 aquatic plant inventories identified 17 native species of submerged aquatic plants in School Section Lake indicating a stable aquatic plant community (Table 2.3).

As was described earlier, sensitive aquatic plant species are likely the most vulnerable to human disturbance. Therefore, changes in sensitive species abundance can indicate the general magnitude of human disturbance derived stress on a waterbody's ecosystem. The number of sensitive species (i.e., species with C value of seven or greater) at each sample point during 2012 and 2020 were contrasted (Figure 2.2). Overall, sensitive species richness only slightly increased or decreased reflecting a stable and healthy plant community and the natural periodicity of plant communities.

In addition to the number of different aquatic plant species detected in the Lake, several other comparisons can be drawn between the 2012 and 2020 aquatic plant survey results, as examined below.

General Trends

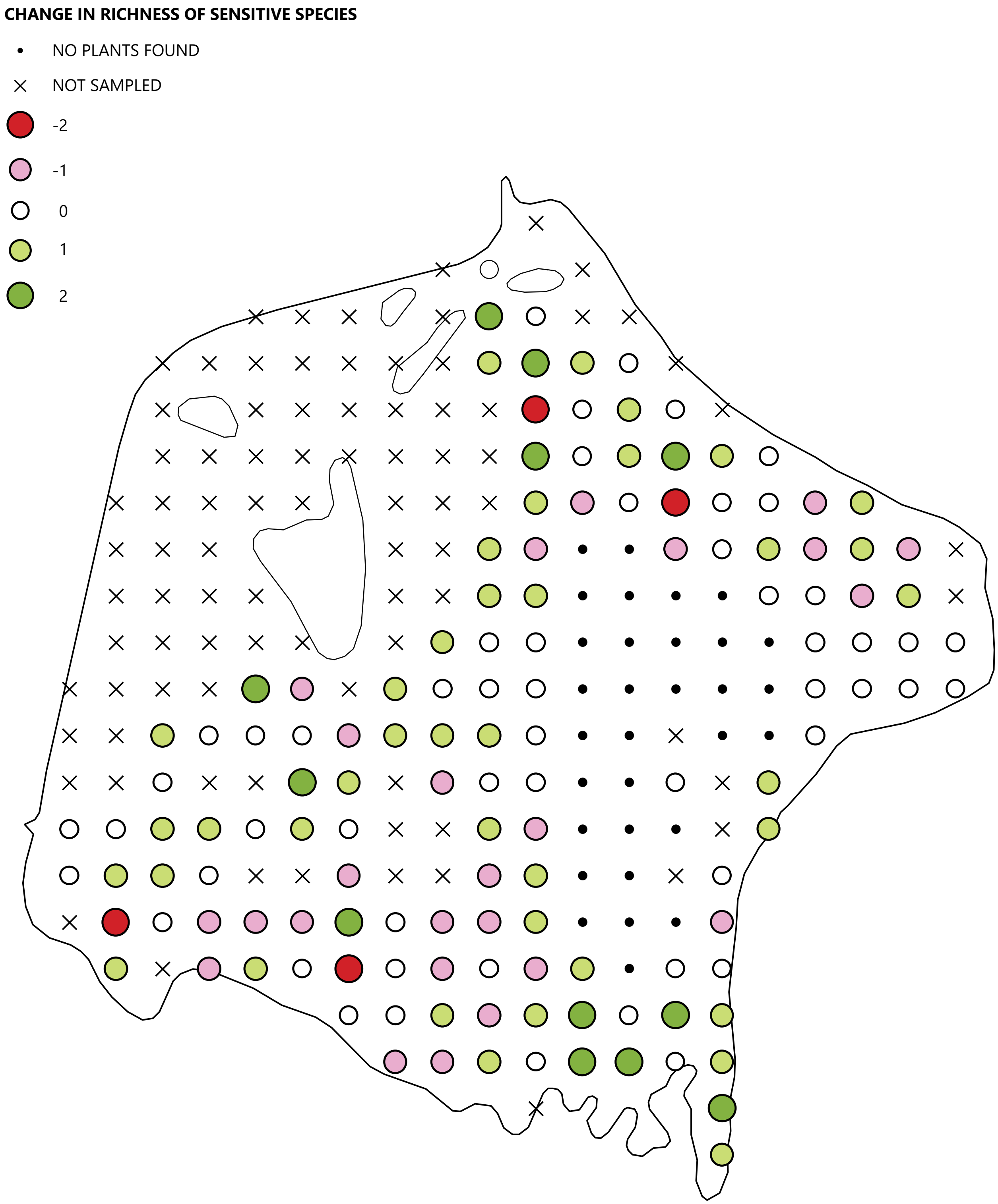
- Of the eleven native species of submerged aquatic plants sampled in both 2012 and 2020, eight were found to be growing at fewer points, while three were found at more points during 2020. Furthermore, six native species of submerged species were found in 2020 but not in 2012. Overall, these data suggest the natural variations in plant communities and reflect yearly changes in weather conditions.

- Based on average rake fullness, plant density slightly decreased from 2012 to 2020. Most of the species exhibited only slightly lower rake fullness averages, one species exhibited no change in rake fullness, and one species exhibited a slightly higher average rake fullness average.

- EWM and curly-leaf pondweed were found at fewer points in 2020 than 2012, while spiny naiad was found at slightly more points.

[9] *M. Scheffer, and E.H. van Ness, "Shallow Lakes Theory Revisited: Various Alternative Regimes Driven by Climate, Nutrient, Depth, and Lake Size,"* Hydrobiologia, *584, 2007.*

Figure 2.2
Change in Sensitive Species Richness, School Section Lake: 2012 Versus 2020



Note: Samples were collected in School Section Lake between August 11, and August 14, 2020.

Source: Wisconsin Department of Natural Resources and SEWRPC

- Muskgrass remains the most widespread plant in the Lake and its frequency of occurrence relative to all other species in the Lake was similar in both surveys.

- Invasive EWM remained the second most abundant plant in the Lake in both 2012 and 2020. The lake use, habitat value threats, and attendant management challenges posed by EWM can be serious. EWM must continue to be monitored and managed vigilantly.

Relative Abundance of Milfoil Species

Four milfoil species have been reported in School Section Lake during the past 50 years. These include native or northern watermilfoil (*Myriophyllum sibiricum*, formerly known as *Myriophyllum exalbescens*), native whorled watermilfoil (*Myriophyllum verticillatum*), native various-leaved watermilfoil (*Myriophyllum heterophyllum*), and exotic EWM (*Myriophyllum spicatum*). The native milfoil species can appear similar to EWM and can hybridize with EWM, conditions confounding identification.

Each native milfoil species has only been noted once throughout the surveys conducted on the Lake over the years. This suggests the variation in native *Myriophyllum* species abundance may be related to identification procedures rather than actual fluctuation in native milfoil species abundance. Given the ability of EWM to hybridize with at least northern milfoil, it is also possible that the relative abundance of EWM and native watermilfoil may be somewhat blurred, especially in the historical surveys. Therefore, year-to-year variation in *Myriophyllum* species abundance should be viewed with some skepticism.

Eurasian Watermilfoil

EWM is an ongoing and serious concern in many Wisconsin lakes, especially nutrient-rich lakes such as those common in Southeastern Wisconsin. EWM has been one of the District's primary targets for control through its ongoing aquatic plant management program. Additionally, riparian landowners also direct substantial effort to EWM control.

EWM is one of eight milfoil species found in Wisconsin and is the only exotic or nonnative milfoil species. EWM favors mesotrophic to moderately eutrophic waters, fine organic-rich lake-bottom sediment, warmer water with moderate clarity and high alkalinity, and tolerates a wide range of pH and salinity.[10,11] In Southeastern Wisconsin, EWM can grow rapidly and has few natural enemies to inhibit its growth. Furthermore, it can grow explosively following major environmental disruptions, as small fragments of EWM can grow into entirely new plants.[12] For reasons such as these, EWM can grow to dominate an aquatic plant community in as little as two years.[13,14] In such cases, EWM can displace native plant species and interfere with the aesthetic and recreational use of waterbodies. However, established populations may rapidly decline after approximately 10 to 15 years.[15]

EWM is a significant recreational use problem in Southeastern Wisconsin lakes. For example, boating through dense EWM beds can be difficult and unpleasant. Because EWM can reproduce from stem fragments, recreational use conflicts can help spread EWM. Human produced EWM fragments (e.g., fragments created by power boating through EWM), as well as fragments generated from natural processes (e.g., wind-induced turbulence, animal feeding/disturbance) readily colonize new sites, especially disturbed sites, contributing to EWM spread. EWM fragments can remain buoyant for two to three days in summer and two to six days

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[10] *U. S. Forest Service, Pacific Islands Ecosystems at Risk (PIER), 2019. May be downloaded at the following website: hear.org/pier/species/myriophyllum_spicatum.htm*

[11] *S.A. Nichols, and B. H. Shaw, "Ecological Life Histories of the Three Aquatic Nuisance Plants* Myriophyllum spicatum*,* Potamogeton crispus*, and* Elodea canadensis*,"* Hydrobiologia*, 131(1), 1986.*

[12] Ibid.

[13] *S.R. Carpenter, "The Decline of* Myriophyllum spicatum *in a Eutrophic Wisconsin (USA) Lake,"* Canadian Journal of Botany, *58(5), 1980.*

[14] *D.H. Les, and L. J. Mehrhoff, "Introduction of Nonindigenous Vascular Plants in Southern New England: a Historical Perspective,"* Biological Invasions*, 1: 284-300, 1999.*

[15] *S.R. Carpenter,* op. cit.

in fall, with larger fragments remaining buoyant longer than smaller ones.[16] The fragments can also cling to boats, trailers, motors, and/or bait buckets where they can remain alive for weeks contributing to transfer of milfoil to other lakes. For these reasons, it is very important to remove all vegetation from boats, trailers, and other equipment after removing them from the water and prior to launching in other waterbodies.

EWM is evenly spread in School Section Lake, occurring slightly more often at the northern and northeastern ends of the Lake. EWM was observed at 58 points of 173 points visited, in School Section Lake during 2012 and 41 points of the 164 points visited (i.e., about 8.8 percent of points shallower than the MDC) during 2020 (Table 2.1). Therefore, the area occupied by EWM relative to other plants remained the approximately the same between 2012 and 2020. However, EWM average rake fullness decreased in many locations between 2012 and 2020 (Figure 2.3).

Other Exotic Submergent Aquatic Plants

CLP continues to be present in School Section Lake. This plant, like EWM, is identified in Chapter NR 109 of the *Wisconsin Administrative Code* as a nonnative invasive aquatic plant. Although survey data suggests that it is presently a relatively minor species in terms of dominance, and, as such, is less likely to interfere with recreational boating activities, the plant can grow dense stands that exclude other high value aquatic plants. For this reason, CLP must continue to be monitored and managed as an invasive member of the aquatic community. Lastly, it must be remembered that CLP senescence by midsummer, and therefore may be underrepresented in the inventory data presented in this report.

Spiny naiad is native to North America but was introduced to, and has become naturalized in, Wisconsin. Spiny naiad is sparse in the Lake. Spiny naiad is a restricted species in Wisconsin and is therefore identified as an established invasive species that has the potential to cause significant environmental or economic harm.[17] Spiny naiad is reported to be used as a food source for waterfowl, marsh birds, muskrat, and shelter/forage area for fish.

2.3 PAST AND PRESENT AQUATIC PLANT MANAGEMENT PRACTICES

Records of aquatic plant management efforts on Wisconsin lakes were first maintained by the WDNR beginning in 1950. Prior to 1950, aquatic plant management interventions are likely, but were not recorded. Currently, all forms of aquatic plant management are subject to permitting by the WDNR pursuant to authorities granted the Department under Chapters NR 107 and NR 109 of the *Wisconsin Administrative Code*.

Past aquatic plant management practices on School Section Lake are not well documented. Chemical applications have been sparse, and no chemical treatments have been conducted since 2012.[18] Unlike many waterbodies in southeastern Wisconsin, there are no records of the use of sodium arsenide as an aquatic herbicide on School Section Lake.[19] Since about 1985, the primary method of aquatic plant control on School Section Lake has been through the use of a mechanical plant harvesting machine that is owned and operated by the District. Aquatic plants are removed from the harvester by an onshore conveyor that loads the plant material onto a dump truck for transport to the disposal site. Individual shoreline property owners are responsible for raking floating plant material from around their piers and removing it from the Lake.

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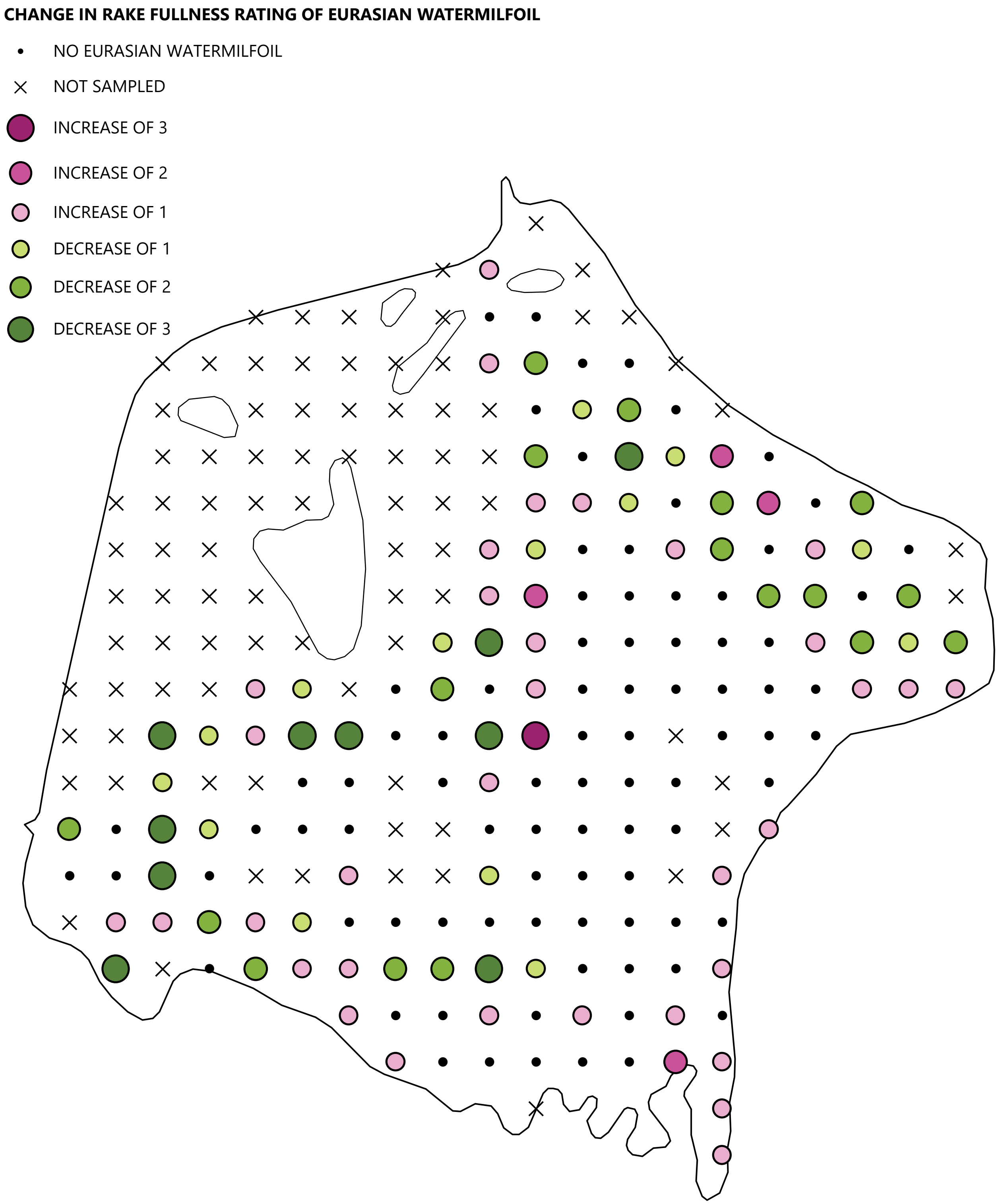
[16] *J. D. Wood and M. D. Netherland, "How Long do Shoot Fragments of Hydrilla (*Hydrilla verticillata*) and Eurasian watermilfoil (*Myriophyllum spicatum*) Remain Buoyant?,"* Journal of Aquatic Plant Management*, 55: 76-82, 2017.*

[17] *Wisconsin Department of Natural Resources, Chapter NR 40,* Invasive Species Identification, Classification and Control*, April 2017.*

[18] *SEWRPC Community Assistance Planning Report No. 319,* A Lake Protection Plan for School Section Lake, Waukesha County, Wisconsin*, December 2014.*

[19] *Sodium arsenide was typically sprayed onto the surface of a lake, within an area of up to 200 feet from the shoreline, between mid-June and mid-July in a volume sufficient to result in a concentration of about 10 mg/L sodium arsenide (about 5.0 mg/l arsenic) in the treated lake water. The sodium arsenide typically remained in the water column for less than 120 days, during which period the arsenic residue was naturally converted from a highly toxic form to a less toxic, less biologically active form that subsequently was deposited in the lake sediments. By 1969, it became apparent that arsenic was accumulating in the sediments of treated lakes, so the use of sodium arsenide was discontinued in the State.*

Figure 2.3
Change in Eurasian Watermilfoil Rake Fullness, School Section Lake: 2012 Versus 2020



Note: Samples were collected in School Section Lake between August 11, and August 14, 2020.

Source: Wisconsin Department of Natural Resources and SEWRPC

The volume of aquatic plants harvested each year varies substantially (Table 2.4). A benefit of harvesting versus chemical treatment is that harvesting physically removes plant mass and the nutrients contained therein. The Commission calculated the pounds of total phosphorus removed through harvesting in the Lake by multiplying the annual mass of aquatic plants removed by the phosphorus concentration of those aquatic plants, with the following notes and assumptions:

- The density of the wet harvested plants was assumed to be approximately 900 pounds per cubic yard.

- The amount of phosphorus contained by aquatic plants varies by species, lake, and time. The phosphorus content of harvested plants used estimates from the Wisconsin Lutheran College (WLC) on Pewaukee Lake, the U.S. Geological Survey on Whitewater and Rice lakes (Whitewater-Rice), and a study conducted on a eutrophic lake in Minnesota (Minnesota). The WLC study assumed that plant wet weight is 6.7 percent of dry weight and that total phosphorus constitutes 0.2 percent of the total dry weight of the plant. The Whitewater-Rice and Minnesota studies assumed that dry weight is 15 and 7 percent of the wet weight, respectively, and phosphorus constituted 0.31 and 0.30 percent of the dry plant weight, respectively. Assumed values for the percent of dry weight to wet weight and the total phosphorus concentrations are similar to those found other studies.[20, 21]

Using these methods, the Commission estimates that aquatic plant harvesting removes approximately 300 - 600 pounds of phosphorus from the Lake during the summer on an annual basis (Figure 2.4). The WDNR's Presto-Lite tool estimates that the average total annual phosphorus load to the Lake is 639 pounds. Therefore, aquatic plant harvesting may remove about 48 - 93 percent of the phosphorus from the Lake than is contributed annually by runoff and tributary streams.

2.4 PURPLE LOOSESTRIFE

Purple loosestrife (*Lythrum salicaria*) is a wetland plant that originated in Europe. The plant was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties. It can often be mistaken for native species such as blue vervain (*Verbena hastata*) and swamp loosestrife (*Decodon vertiillatus)*.

Purple loosestrife is a three to nine foot semi-woody plant that has a square stem with smooth, opposite leaves. It has showy purple to pink flowers with five to six petals that are formed into numerous long spikes that bloom from July to September. It also has a large woody taproot with fibrous rhizomes that form a dense underground mat. Its optimal habitat includes marshes, stream and lake edges, and wet prairies.
This plant species can germinate in a variety of soil types, although optimum sites for growth include moist soil with neutral to slightly acidic pH. It spreads mainly by seeds, but also by its large underground taproot. Mature plants can release more than two million seeds in a single year. Plants may be quite large and several years old before they begin flowering. It is difficult to look for non-flowering plants, so the best time to spot purple loosestrife is mid-summer when they are flowering.

Often, purple loosestrife grows faster and taller than most native wetland plants. Once established on a lakeshore or adjacent wetland, it displaces native plants and reduces wildlife habitat. As native vegetation is displaced, rare plants are often the first to disappear. Thick stands of purple loosestrife can choke out recreational waterways, and eventually overrun large acres of wetlands. This can result in a loss of open water habitat.

This invasive nonnative wetland species was found along the northeast portion of the Lake (Appendix A). There are three kinds of approved controls for purple loosestrife, including manual, chemical, and biological controls. The first two are typically used on smaller infestations, as they can be very labor intensive and/or expensive on large sites. These measures may require follow-up work in subsequent years.

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[20] *K.M. Carvalho and D.F. Martin, "Removal of Aqueous Selenium by Four Aquatic Plants,"* Journal of Aquatic Plant Management*, 39: 33-36, 2001.*

[21] *G. Thiébaut, "Phosphorus and Aquatic Plants." In: P.J. White and J.P. Hammond (eds), The Ecophysiology of Plant-Phosphorus Interactions,* Plant Ecophysiology, *7, 2008.*

Prevention is the best way to control the spread of purple loosestrife. Small young plants can be hand pulled, while older and taller plants can be dug up with a shovel. It is important to try to dig up as much of the root as possible because it may re-sprout. Plants should be controlled prior to seed dispersal (usually before the first week in August), and flowers should be cut, and tightly bagged. Glyphosate (Round Up/Rodeo) is the most commonly used chemical for killing loosestrife. It should be applied in late July or August and should only be sprayed on 25 percent of each plant's foliage to be effective. It is best used on freshly cut stems. Any herbicide applied on or near surface water requires a permit from the regional WDNR Aquatic Plant Coordinator.

Table 2.4
Volume of Aquatic Plants Harvested from School Section Lake

Year	Plant Material Removed (cubic yards)
2017	2,449
2018	None Reported
2019	1,267
2020	2,379

Source: School Section Lake Management District

Biological control is considered the most effective and cheapest option for controlling larger-scale infestations of purple loosestrife. Purple loosestrife beetles and their larvae (*Galerucella calmariensis* and *G. pusilla*) feed almost exclusively on loosestrife buds, stems, and leaves, reducing plant height and seed output, thereby allowing native plants to successfully grow within a few years. Beetle populations remain relatively localized, and it may take three to five years for the beetle population to build up to levels that will affect the purple loosestrife plant population. Periodic beetle re-stocking may be required to maintain high genetic diversity and account for winter die-offs. Use of chemical treatments should not be combined with this method because purple loosestrife beetles are very susceptible to chemical pesticides.

The rearing of new beetle populations has been the focus of many citizen and classroom based projects throughout Wisconsin. Written protocol for successful and economical beetle rearing has been established (Appendix B) and can be facilitated through the county Aquatic Invasive Species Coordinator.

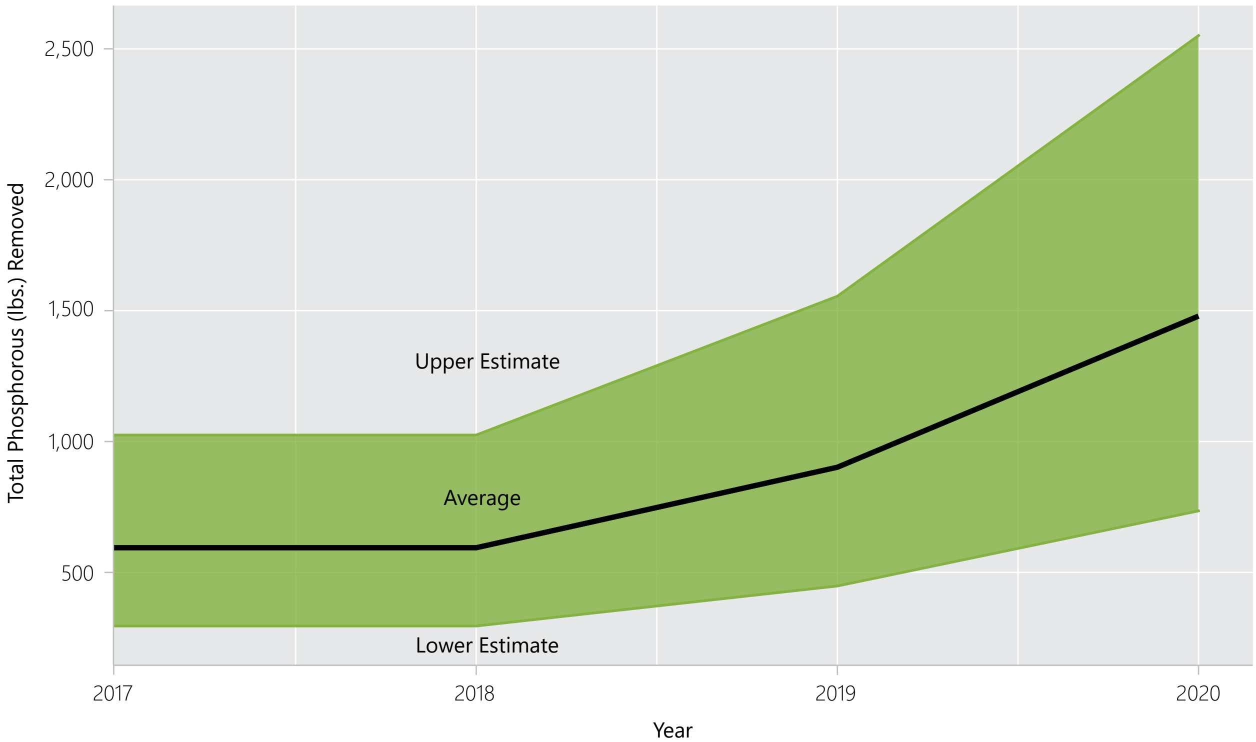
2.5 POTENTIAL AQUATIC PLANT CONTROL METHODOLOGIES

Aquatic plant management techniques can be classified into six categories.

1. *Physical measures* include lake bottom coverings
2. *Biological measures* include the use of organisms such as herbivorous insects
3. *Manual measures* involve physically removing plants by hand or using hand-held tools such as rakes
4. *Mechanical measures* rely on artificial power sources and remove aquatic plants with a machine known as a harvester or by suction harvesting
5. *Chemical measures* use aquatic herbicides to kill nuisance and nonnative plants *in-situ*
6. *Water level manipulation measures* use lake drawdowns to kill aquatic plants through freezing and desiccation.

All aquatic plant control measures are stringently regulated and most require a State of Wisconsin permit. Chemical controls, for example, require a permit and are regulated under *Wisconsin Administrative Code* Chapter NR 107, "Aquatic Plant Management" while placing bottom covers (a physical measure) requires a WDNR permit under Chapter 30 of the *Wisconsin Statutes*. All other aquatic plant management practices are regulated under *Wisconsin Administrative Code* Chapter NR 109, "Aquatic Plants: Introduction, Manual Removal and Mechanical Control Regulations." Furthermore, the aquatic plant management measures described in this plan are consistent with the requirements of Chapter NR 7, "Recreational Boating Facilities Program," and with the public recreational boating access requirements relating to eligibility under the State cost-share grant programs set forth in *Wisconsin Administrative Code* Chapter NR 1, "Natural Resources Board Policies." More details about aquatic plant management each are discussed in the following sections while recommendations are provided later in this document.

Figure 2.4
School Section Lake Cumulative Phosphorus Removal by Harvesting: 2017, 2019, and 2020



Note: Total aquatic harvesting volumes were not reported for 2018.

Source: School Section Management District and SEWRPC

Non-compliance with aquatic plant management permit requirements is an enforceable violation of Wisconsin law and may lead to fines and/or complete permit revocation. The information and recommendations provided in this memorandum help frame permit requirements. Permits can cover up to a five-year period.[22] At the end of that period, the aquatic plant management plan must be updated. The updated plan must consider the results of a new aquatic plant survey and should evaluate the success, failure, and effects of earlier plant management activities that have occurred on the lake.[23] These plans and plan execution are reviewed and overseen by the WDNR regional lakes and aquatic invasive species coordinators.[24]

Physical Measures

Lake-bottom covers and light screens provide limited control of rooted plants by creating a physical barrier that reduces or eliminates plant-available sunlight. Various materials such as pea gravel or synthetics like polyethylene, polypropylene, fiberglass, and nylon can be used as covers. The longevity, effectiveness, and overall value of some physical measures is questionable. The WDNR does not permit these kinds of controls. Consequently, lake-bottom covers are not a viable aquatic plant control strategy for the Lake.

[22] *Five-year permits allow a consistent aquatic plant management plan to be implemented over a significant length of time. This process allows the selected aquatic plant management measures to be evaluated at the end of the permit cycle.*

[23] *Aquatic plant harvesters must report harvesting activities as one of the permit requirements.*

[24] *Information on the current aquatic invasive species coordinator is found on the WDNR website.*

Biological Measures

Biological control offers an alternative to direct human intervention to manage nuisance or exotic plants. Biological control techniques traditionally use herbivorous insects that feed upon nuisance plants. This approach has been effective in some Southeastern Wisconsin lakes.[25] For example, milfoil weevils have been used to control EWM. Milfoil weevils do best in waterbodies with balanced panfish populations,[26] where dense EWM beds reach the surface close to shore, where natural shoreline areas include leaf litter that provides habitat for over-wintering weevils, and where there is comparatively little boat traffic. This technique is not presently commercially available making the use of milfoil weevils non-viable.

Manual Measures

Manually removing specific types of vegetation is a highly selective means of controlling nuisance aquatic plant growth, including invasive species such as EWM. Two commonly employed methods include hand raking and hand pulling. Both physically remove target plants from a lake. Since plant stems, leaves, roots and seeds are actively removed from the lake, the reproductive potential and nutrients contained by pulled/raked plants material is also removed. These plants, seeds, and nutrients would otherwise re-enter the lake's water column or be deposited on the lake bottom. Hence, this aquatic plant management technique helps incrementally maintain water depth, improves water quality, and can help decrease the spread of nuisance/exotic plants. Since hand raking and hand pulling are readily allowed by WDNR, and since both are practical methods to control riparian landowner scale problems, these methods are described in more detail in the following paragraphs.

Raking with specially designed hand tools is particularly useful in shallow nearshore areas. This method allows nonnative plants to be removed and also provides a safe and convenient aquatic plant control method in deeper nearshore waters around piers and docks. Advantages of this method include:

- Tools are relatively inexpensive ($100 to $150 each)
- The method is easy to learn and use
- It may be employed by riparian landowners without a permit if certain conditions are met
- Results are immediately apparent
- Plant material is immediately removed from a lake (including seeds)

The second manual control method, hand-pulling whole plants (stems, roots, leaves, seeds) where they occur in isolated stands, is a simple means to control nuisance and invasive plants in shallow nearshore areas that may not support large-scale initiatives. This method is particularly helpful when attempting to target nonnative plants (e.g., EWM, CLP) during the high growth season when native and nonnative species often commingle. Hand pulling is more selective than raking, mechanical removal, and chemical treatments, and, if carefully applied, is less damaging to native plant communities. Recommendations regarding hand-pulling, hand-cutting, and raking are discussed later in this document.

Mechanical Measures

Two methods of mechanical harvesting are currently employed in Wisconsin - mechanical harvesting and suction harvesting. Both are regulated by WDNR and require a permit.[27]

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[25] *B. Moorman, "A Battle with Purple Loosestrife: A Beginner's Experience with Biological Control,"* LakeLine*, 17(3), 20-21, 34-37, 1997; see also, C.B. Huffacker, D.L. Dahlsen, D.H. Janzen, and G.G. Kennedy,* Insect Influences in the Regulation of Plant Population and Communities*, pp. 659-696, 1984; and C.B. Huffacker and R.L. Rabb, (eds),* Ecological Entomology, *John Wiley, New York, New York, USA.*

[26] *Panfish such as bluegill and pumpkinseed are predators of herbivorous insects. High populations of panfish lead to excess predation of Milfoil weevils.*

[27] *Mechanical control permit conditions depend upon harvesting equipment type and specific equipment specifications.*

Mechanical Harvesting

Aquatic plants can be mechanically gathered using specialized equipment commonly referred to as harvesters. Harvesters use an adjustable depth cutting apparatus that can cut and remove plants from the water surface to up to about five feet below the water surface. The harvester gathers cut plants with a conveyor, basket, or other device. Mechanical harvesting is often a very practical and efficient means to control nuisance plant growth and is widely employed in Southeastern Wisconsin.

In addition to controlling plant growth, gathering and removing plant material from a lake reduces in-lake nutrient recycling, sedimentation, and targets plant reproductive potential. In other words, harvesting removes plant biomass, which would otherwise decompose and release nutrients, sediment, and seeds or other reproductive structures (e.g., turions, bulbils, plant fragments) into a lake. Mechanical harvesting is particularly effective and popular for large-scale open-water projects. However, small harvesters are also produced that are particularly suited to working around obstacles such as piers and docks in shallow nearshore areas.

An advantage of mechanical harvesting is that the harvester, when properly operated, "mows" aquatic plants and, therefore, typically leaves enough living plant material in place to provide shelter for aquatic wildlife and stabilize lake-bottom sediment. Harvesting, when done properly, does not kill aquatic plants, it simply trims plants back. Aside from residual plant mass remaining because of imperfect treatment strategy execution, none of the other aquatic plant management methods purposely leave living plant material in place after treatment. Aquatic plant harvesting has been shown to allow light to penetrate to the lakebed and stimulate regrowth of suppressed native plants. This is particularly effective when controlling invasive plant species that commonly grow quickly very early in the season (e.g., EWM, CLP) when native plants have not yet emerged or appreciably grown.

A disadvantage of mechanical harvesting is that the harvesting process may fragment plants and thereby unintentionally propagate EWM and CLP. EWM fragments are particularly successful in establishing themselves in areas where plant roots have been removed. This underscores the need to avoid harvesting or otherwise disrupting native plant roots. Harvesting may also agitate bottom sediments in shallow areas, thereby increasing turbidity and resulting in deleterious effects such as smothering fish breeding habitat and nesting sites. To this end, most WDNR-issued permits do not allow deep-cut harvesting in water less than three feet deep,[28] which limits the utility of this alternative in many littoral and shoal areas. Nevertheless, if employed correctly and carefully under suitable conditions, harvesting can benefit navigation lane maintenance and can ultimately reduce regrowth of nuisance plants while maintaining, or even enhancing, native plant communities.

Cut plant fragments can escape the harvester's collection system and form mats or accumulate on shorelines. This negative side effect is fairly common. To compensate for this, most harvesting programs include a plant pickup program. Some plant pickup programs use a harvester to gather and collect significant accumulations of floating plant debris as well as sponsor regularly scheduled aquatic plant pick up from lakefront property owner docks. Property owners are encouraged to actively rake plant debris along their shorelines and place these piles on their docks for collection. This kind of program, when applied systematically, can reduce plant propagation from plant fragments and can help alleviate the negative aesthetic consequences of plant debris accumulating on shorelines. Nevertheless, it is important to remember that normal boating activity (particularly during summer weekends) often creates far more plant fragments than generated from mechanical harvesting. Therefore, a plant pickup program is often essential to protect a lake's health and aesthetics, even in areas where harvesting has not recently occurred.

Suction Harvesting and DASH

Another mechanical plant harvesting method uses suction to remove aquatic plants from a lake. Suction harvesting removes sediment, aquatic plants, plant roots, and anything else from the lake bottom and disposes this material outside the lake. Since bottom material is removed from the lake, this technique also requires a dredging permit in addition to the aquatic plant management permit.

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[28] *Deep-cut harvesting is harvesting to within one foot of the lake bottom. This is not allowed in shallow water because it is challenging to ensure that the harvester avoids lake-bottom contact in such areas.*

An alternative aquatic plant suction harvesting method has emerged called Diver Assisted Suction Harvesting (DASH). First permitted in 2014, DASH is a mechanical process where divers identify and pull select aquatic plants and roots from the lakebed and then insert the entire plant into a suction hose that transports the plant to the surface for collection and disposal. The process is essentially a mechanically assisted method for hand-pulling aquatic plants. Such labor-intensive work by skilled professional divers is, at present, a costly undertaking and long-term monitoring will need to evaluate the efficacy of the technique. Nevertheless, many apparent advantages are associated with this method including: 1) lower potential to release plant fragments when compared to mechanical harvesting, raking, and hand-pulling, thereby reducing spread and growth of invasive plants like EWM; 2) increased selectivity of plant removal when compared to mechanical techniques and hand raking which in turn reduces native plant loss; and 3) lower potential for disturbing fish habitat.

Given how costly DASH can be and how widespread EWM is found in some portions of the Lake, DASH is not considered a viable control option for managing EWM throughout the Lake. Nevertheless, DASH can provide focused relief of nuisance native and non-native plants around piers and other critical areas. If individual property owners chose to employ DASH, a NR 109 permit is required.

Chemical Measures

Aquatic chemical herbicide use is stringently regulated. A WDNR permit and direct WDNR staff oversight is required during application. Chemical herbicide treatment is used for short time periods to temporarily control excessive nuisance aquatic plant growth. Chemicals are applied to growing plants in either liquid or granular form. Advantages of chemical herbicides aquatic plant growth control include relatively low cost as well as the ease, speed, and convenience of application. However, many drawbacks are also associated with chemical herbicide aquatic plant control including the following examples.

- **Unknown and/or conflicting evidence about the effects of long-term chemical exposure on fish, fish food sources, and humans.** The U.S. Environmental Protection Agency, the agency responsible for approving aquatic plant treatment chemicals, studies aquatic plant herbicides to evaluate short-term exposure (acute) effects on human and wildlife health. Some studies also examine long-term (chronic) effects of chemical exposure on animals (e.g., the effects of being exposed to these herbicides for many years). However, it is often impossible to conclusively state that no long-term effects exist due to the animal testing protocol, time constraints, and other factors. Furthermore, long-term studies cannot address all potentially affected species.[29] For example, conflicting studies/opinions exist regarding the role of the chemical 2,4-D as a human carcinogen.[30] Some lake property owners judge the risk of using chemicals as being excessive despite legality of use. Consequently, the concerns of lakefront owners should be considered whenever chemical treatments are proposed. Moreover, if chemicals are used, they should be applied as early in the season as practical. This helps assure that the applied chemical decomposes before swimming, water skiing, and other active body-contact lake uses begin.[31] Early season application also is generally the best time to treat EWM and CLP for a variety of technical reasons explained in more detail as part of the "loss of native aquatic plants and related reduction or loss of desirable aquatic organisms" bullet below.

- **Reduced water clarity and increased risk of algal blooms.** Water-borne nutrients promote growth of both aquatic plants and algae. If rooted aquatic plant populations are depressed, demand for dissolved nutrients will be lessened. In such cases, algae tends to become more abundant, a situation reducing water clarity. For this reason, lake managers must avoid needlessly eradicating native plants and excessive chemical use. Lake managers must strive to maintain balance between rooted aquatic plants and algae - when the population of one declines, the other may increase in abundance to

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[29] *U.S. Environmental Protection Agency, EPA-738-F-05-002, 2,4-D RED Facts, June 2005.*

[30] *M.A. Ibrahim, G.G. Bond, T.A. Burke, et al., "Weight of the Evidence on the Human Carcinogenicity of 2,4-D,"* Environmental Health Perspectives*, 96, 213-222, 1991.*

[31] *Though the manufacturers indicate that swimming in 2,4-D-treated lakes is allowable after 24 hours, it is possible that some swimmers may want more of a wait time to lessen chemical exposure. Consequently, allowing extra wait time is recommended to help lake residents and lake users can feel comfortable that they are not being unduly exposed to aquatic plant control chemicals.*

nuisance levels. In addition to upsetting the nutrient balance between rooted aquatic plants and algae, dead chemically treated aquatic plants decompose and contribute nutrients to lake water, a condition that may exacerbate water clarity concerns and algal blooms.

- **Reduced dissolved oxygen/oxygen depletion.** When chemicals are used to control large mats of aquatic plants, the dead plant material generally settles to the bottom of a lake and decomposes. Plant decomposition uses oxygen dissolved in lake water, the same oxygen that supports fish and many other vital beneficial lake functions. In severe cases, decomposition processes can deplete oxygen concentrations to a point where desirable biological conditions are no longer supported.[32] Ice covered lakes and the deep portions of stratified lakes are particularly vulnerable to oxygen depletion. Excessive oxygen loss can inhibit a lake's ability to support certain fish and can trigger processes that release phosphorus from bottom sediment, further enriching lake nutrient levels. These concerns emphasize the need to limit chemical control and apply chemicals in *early* spring, when EWM and CLP have not yet formed dense mats.

- **Increased organic sediment deposition.** Dead aquatic plants settle to a lake's bottom, and, because of limited oxygen and/or rapid accumulation, may not fully decompose. Flocculent organic rich sediment often results, reducing water depth. Care should be taken to avoid creating conditions leading to rapid thick accumulations of dead aquatic plants so as to promote more complete decomposition of dead plant material.

- **Loss of native aquatic plants and related reduction or loss of desirable aquatic organisms.** EWM and other invasive plants often grow in complexly intermingled beds. Additionally, EWM is physically similar to, and hybridizes with, native milfoil species. Native plants, such as pondweeds, provide food and spawning habitat for fish and other wildlife. A robust and diverse native plant community forms the foundation of a healthy lake and the conditions needed to provide and host desirable gamefish. Fish, and the organisms fish eat, require aquatic plants for food, shelter, and oxygen. If native plants are lost due to insensitive herbicide application, fish and wildlife populations often suffer. For this reason, if chemical herbicides are applied to the Lake, these chemicals must target EWM or CLP and therefore should be applied in early spring when native plants have not yet emerged. Early spring application has the additional advantage of being more effective due to colder water temperatures, a condition enhancing herbicidal effects and reducing the dosing needed for effective treatment. Early spring treatment also reduces human exposure concerns (e.g., swimming is not particularly popular in very early spring).

- **Need for repeated treatments.** Chemical herbicides are not a one-time silver-bullet solution – instead, treatments generally need to be regularly repeated to maintain effectiveness. Treated plants are not actively removed from the lake, a situation increasing the potential for viable seeds/fragments to remain after treatment, allowing target species resurgence in subsequent years. Additionally, leaving large expanses of lake bed devoid of plants (both native and invasive) creates a disturbed area without an established plant community. EWM thrives in disturbed areas. In summary, applying chemical herbicides to large areas can provide opportunities for exotic species re infestation and new colonization that necessitates repeated and potentially expanded herbicide applications.

- **Hybrid watermilfoil's resistance to chemical treatment**. The presence of hybrid watermilfoil complicates chemical treatment programs. Research suggests that certain hybrid strains may be more tolerant to commonly utilized aquatic herbicides such as 2,4-D and Endothall.[33,34] Consequently, further research regarding hybrid watermilfoil treatment efficacy is required to apply appropriate herbicide doses. This increases the time needed to acquire permits and increases application program costs. Hybrid watermilfoil has not been verified to exist in School Section Lake, but is likely present.

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[32] *The WDNR's water quality standard to support healthy fish communities is 5 mg/L for warmwater fish communities and 7 mg/L for coldwater fish communities.*

[33] *L.M. Glomski and M.D. Netherland, "Response of Eurasian and Hybrid Watermilfoil to Low Use Rates and Extended Exposures of 2,4-D and Triclpyr",* Journal of Aquatic Plant Management, *48, 12-14, 2010.*

[34] *E.A. LaRue, M/P/ Zuellig, M.D. Netherland, et al., 'Hybrid Watermilfoil Lineages are More Invasive and Less Sensitive to a Commonly Used Herbicide than Their Exotic Parent (Eurasian Watermilfoil),'* Evolutionary Applications*, 6, 462-471, 2013.*

- **Effectiveness of small-scale chemical treatments**. Small-scale EWM treatments using 2,4-D have yielded highly variable results. A study completed in 2015 concluded that less than half of 98 treatment areas were effective, or had more than a 50 percent EWM reduction.[35] For a treatment to be effective, a target herbicide concentration must be maintained for a prescribed exposure time. However, wind, wave, and other oftentimes difficult to predict mixing actions often dissipate herbicide doses. Therefore, when deciding to implement small-scale chemical treatments, the variability in results and treatment cost of treatment should be examined and contrasted.

Considering the expanse of EWM in School Section Lake, a whole-lake treatment, or large spot treatment may be utilized.[36] In addition, small spot treatments enclosed with a barrier (e.g., turbidity barrier) could be a viable alternative for treating shoreline areas and navigation lanes if determined feasible by the District. Whatever the case, monitoring should continue to ensure that EWM does not become more problematic. If further monitoring suggests a dramatic change in these invasive species populations, management recommendations should be reviewed.

Water Level Manipulation

Manipulating water levels can also be an effective method for controlling aquatic plant growth and restoring native aquatic plant species, particularly emergent species such as bulrush and wild rice.[37] In Wisconsin, water level manipulation is generally considered to be most effective by using winter lake drawdowns, which expose lake sediment to freezing temperatures while avoiding conflict with summer recreational uses. One to two months of lake sediment exposure can damage or kill aquatic plant roots, seeds, and turions through freezing and/or desiccation. As large areas of lake sediment need to remain exposed for long periods, water level manipulation is most cost effective in lakes with operable dam gates that can provide fine levels of control of water elevations within the lake. In lakes without dams, high capacity water pumping can be used to reduce lake levels at generally much greater cost.

While water level manipulation affects all aquatic plants within the drawdown zone, not all plants are equally susceptible to drawdown effects. Abundance of water lilies (*Nymphaea* spp. and *Nuphar* spp.) and milfoils (*Myriophyllum* spp.) can be greatly reduced by winter drawdowns while other species, such as duckweeds (*Lemna* spp.), may increase in abundance.[38] Two studies from Price County, Wisconsin show reduced abundance of invasive EWM and CLP and increased abundance of native plant species following winter drawdowns.[39,40] Thus, drawdowns can be used to dramatically alter the composition of a lake's aquatic plant community. Many emergent species rely upon the natural fluctuations of water levels within a lake. Conducting summer and early fall drawdowns have effectively been used to stimulate the growth of desired emergent vegetation species, such as bulrush, burreeds, and wild rice, in the exposed lake sediments, which subsequently provide food and habitat for fish and wildlife. However, undesired emergent species, such as invasive cattails and phragmites, can also colonize exposed sediment, so measures should be taken to curtail their growth during a drawdown.[41]

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[35] *M. Nault, S. Knight, S. Van Egeren, et al., "Control of Invasive Aquatic Plants on a Small Scale,"* LakeLine*, 35: 35-39, 2015.*

[36] *WDNR has been studying the efficacy of spot treatments versus whole lake treatments for the control of EWM and it has been found that spot treatments are not an effective measure for reducing EWM populations, while whole lake treatments have proven effective depending on conditions.*

[37] *For detailed literature reviews on water level manipulation as an aquatic plant control measure, see C. Blanke, A. Mikulyuk, M. Nault, et al.,* Strategic Analysis of Aquatic Plant Management in Wisconsin*, Wisconsin Department of Natural Resources, pp. 167-171, 2019 as well as J.R. Carmignani and A.H. Roy, "Ecological Impacts of Winter Water Level Drawdowns on Lake Littoral Zones: A Review,"* Aquatic Sciences*, 79, 803-824, 2017.*

[38] *G.D. Cooke, "Lake Level Drawdown as a Macrophyte Control Technique,"* Water Resources Bulletin*, 16(2): 317-322, 1980.*

[39] *Onterra, LLC, Lac Sault Dore, Price County, Wisconsin: Comprehensive Management Plan, 2013.*

[40] *Onterra, LLC, Musser Lake Drawdown Monitoring Report, Price County, Wisconsin, 2016.*

[41] *Blanke et al.,* op. cit*.*

Water level manipulation can also have unintended impacts on water chemistry and lake fauna.[42,43] Decreased water clarity and dissolved oxygen concentrations as well as increased nutrient concentrations and algal abundance have all been reported following lake drawdowns. Rapid drawdowns can leave lake macroinvertebrates and mussels stranded in exposed lake sediment, increasing their mortality and subsequently reducing prey availability for fish and waterfowl. Similarly, drawdowns can disrupt the habitat and food sources of mammals, birds, and reptiles, particularly when nests are flooded as water levels are raised in the spring. Therefore, thoughtful consideration of drawdown timing, rates, and elevation as well as the life history of aquatic plants and fauna within the lake is highly recommended. Mimicking the natural water level regime of the lake as closely as possible may be the best approach to achieve the desired drawdown effects and minimize unintended and detrimental consequences.

[42] Ibid.

[43] *Cooke,* op. cit.

MANAGEMENT RECOMMENDATIONS AND PLAN IMPLEMENTATION

3

Credit: SEWRPC Staff

School Section Lake generally contains a robust and fairly diverse aquatic plant community. Although EWM is present throughout the Lake its general density remains low. On account of this and other factors, aquatic plant management continues to be an important approach to maintaining the excellent natural resource service the Lake provides.

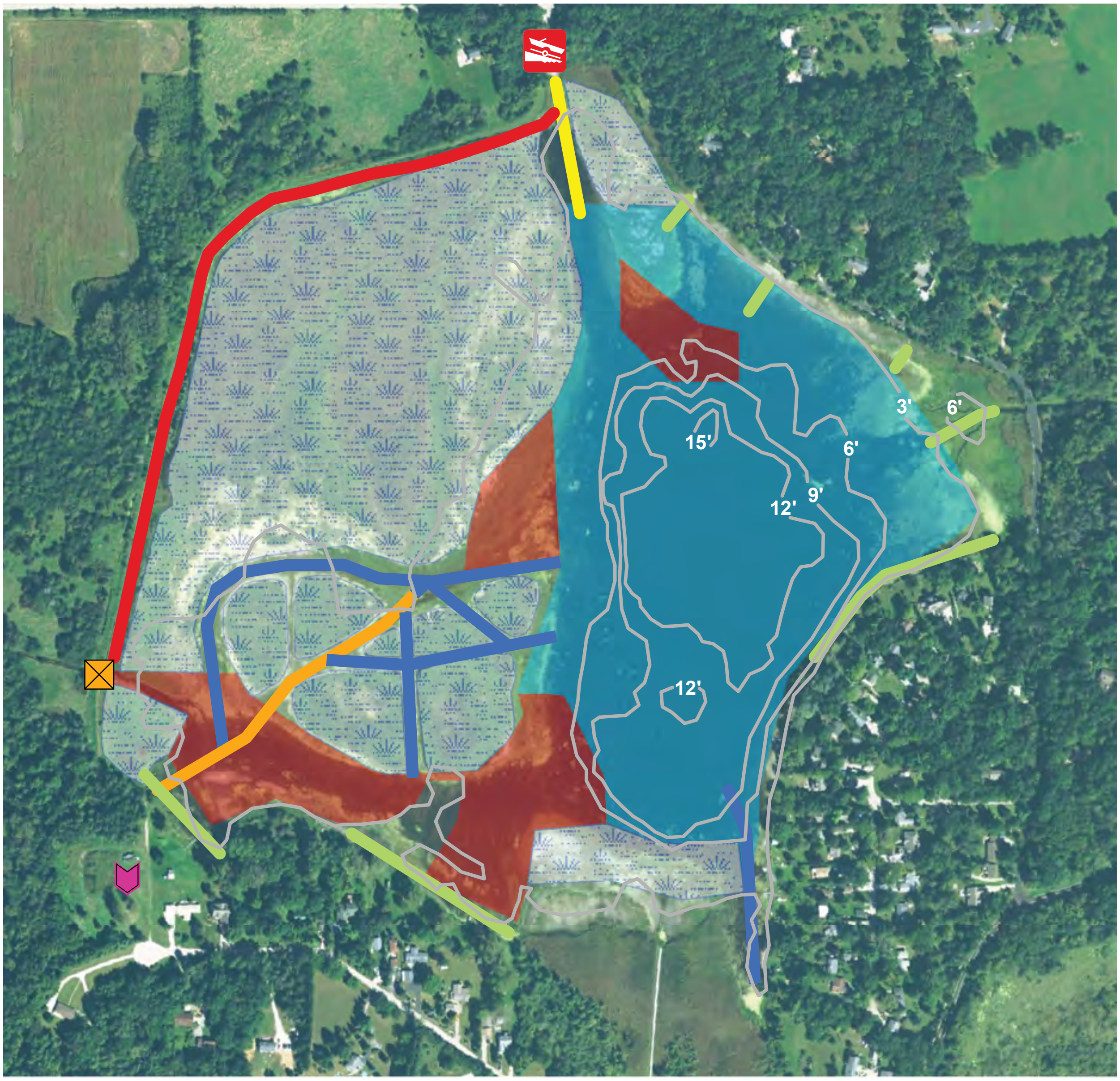
Holistic management alternatives and recommended refinements to the existing aquatic plant management plan are presented in this chapter. Given the scope of this study, little emphasis is given to measures whose scope and location are more suitably taken up by other governmental agencies. For example, agencies with jurisdiction over areas tributary to the Lake (e.g., Town or County government) may be better suited to address measures to reduce nutrient inputs to the Lake. Reduced nutrient input can passively reduce aquatic plant abundance and thereby tangibly influence aquatic plant management. Nevertheless, to most effectively manage aquatic plants, the District should actively seek out and collaborate with such agencies.

3.1 RECOMMENDED AQUATIC PLANT MANAGEMENT PLAN

The most effective plans to manage nuisance and invasive aquatic plant growth generally rely on a combination of methods and techniques. A single-minded "silver bullet" strategy rarely produces the most efficient, most reliable, or best overall result. Therefore, to enhance lake access, recreational use, and lake health, this plan recommends a combination of several aquatic plant management techniques. For the reader's convenience, the various elements of the recommended aquatic plant management plan are schematically presented (Figure 3.1) and are briefly summarized in the following paragraphs. The WDNR will use data and conclusions generated as part of the Commission's study to help evaluate the Lake's aquatic plant community and draft the 2021 – 2025 Aquatic Plant Control permit which outlines WDNR-approved aquatic plant control practices. Additional details useful to implement the plant management plan follow this summary.

1. **Mechanically harvest invasive and nuisance aquatic plants.** Mechanical harvesting should remain the primary means to manage invasive and nuisance aquatic plants on School Section Lake. Harvesting must avoid, or must be substantially restricted, in certain areas of the Lake. This includes areas of particular ecological value, areas that provide unique habitat, areas that are difficult to

Figure 3.1
School Section Lake Harvesting Plan: 2021



50-FOOT WIDE ACCESS LANE FROM BOAT LAUNCH SHOULD EXTEND APPROXIMATELY 250 FEET INTO CENTER OF LAKE

10-FOOT WIDE NAVIGATION LANES THROUGH HIGH-VALUE NATURAL AREAS

10-FOOT WIDE NAVIGATION LANE - UTILIZE DASH WITH PERMIT AND/OR HAND REMOVAL. USE OF HARVESTER NOT RECOMMENDED

10-FOOT WIDE NAVIGATION LANE TO MAINTAIN ACCESS TO OFFLOADING SITE

10-FOOT WIDE NAVIGATION LANES TO MAINTAIN LAKE ACCESS FOR RESIDENTS

DEEP CUT AREAS DOMINATED BY EURASIAN WATERMILFOIL AND COONTAIL MUST LEAVE 12" INCHES OF PLANT GROWTH ON LAKE BOTTOM

TOP CUT IN AREAS WITH HIGH NATIVE PLANT COMMUNITIES - CUT TO ONLY 3 FEET BELOW SURFACE AND LEAVE AT LEAST 12 INCHES OF PLANTS ON LAKE BOTTOM

HIGH-VALUE NATURAL AREAS TO BE PROTECTED - CUT CATTAILS AND BULRUSH ONLY AREAS WHERE THEY IMPEDE NAVIGATION LANES

BOAT LAUNCH

DAM

DISPOSAL SITE

10' BATHYMETRY

Source: Wisconsin Department of Natural Resources and SEWRPC
Date of Photography: April 2018

harvest due to lake morphology (e.g., excessively shallow water depth), and where boat access is not desired or necessary (e.g., marshland areas). Much of School Section Lake is composed of wetland, a situation restricting mechanical harvesting to lanes that protect sensitive areas yet allows riparian residents and boat launch users to access and navigate the Lake, engage in a variety of water-related recreational pursuits, and access open water areas. Care should be taken to avoid harvesting native aquatic plants – harvesting should focus on areas of profuse invasive plant growth.

2. **Manually remove nearshore invasive and nuisance plant growth.** Manual removal involves controlling aquatic plants by hand or using hand-held non-powered tools. Riparian landowners should consider manual removal of undesirable plants an integral and vital part of the Lake's overall plant management plan. Manual removal is often the plan element that yields the transitional interface between landowner uses, desires, and concerns, and public management of the overall waterbody. Manual removal does not require a permit if riparian landowners remove only invasive plants without injuring native plants or remove nuisance native aquatic plants along 30 or less feet of shoreline (inclusive of dock, pier, and other lake access areas) and generally not more than 100 feet into the lake.

3. **Chemically treat nonnative plants around private piers**. Large-scale chemical treatment is not part of the District's aquatic plant management plan. Nevertheless, the District may want to consider a rapid response chemical treatment for Chapter NR 40 prohibited species (e.g., hydrilla, *Hydrilla verticillata)*, where appropriate, if such a species were to appear in the Lake in the future. In addition, because EWM frequency in the littoral zone of the Lake was greater than 30 percent in 2020 (Table 2.1) the District may choose to pursue a whole-lake chemical treatment to reduce the population. This method of aquatic plant control has a number of drawbacks (e.g., water quality, comparatively nonselective, chemical side effects, and more) and should only be considered under special circumstances.

4. **Use DASH in high-use, congested, nearshore areas.** Riparian landowners could supplement or supplant manual harvesting by using DASH. If an individual landowner chooses to implement DASH, the activity is typically confined to the same area undergoing manual aquatic plant control – it is not a method to increase the amount of lakefront undergoing active management. DASH requires a Chapter NR 109 permit.

5. **Consider participation in the Clean Boats Clean Waters program** (a State program targeting invasive species prevention) to proactively encourage Lake users to clean boats and equipment before launching and using them in School Section Lake.[43] This will help lower the probability of invasive species entering the Lake.

Mechanical Harvesting

The District operates one Aquarius Systems brand harvester on the Lake: Model LH-650. This full-size harvester is well suited to open water areas where water is generally greater than 36-inches deep. In shallow waters, slow speed operation and extreme diligence must be taken to avoid contacting the lake bottom with the cutter head. In all areas, at least one foot of living plant material must remain attached to the lake bottom after cutting.

The approximate orientation and extent of proposed harvesting lanes within School Section Lake are similar those published in the 2014 aquatic plant management plan. The general locations of harvesting lanes are schematically illustrated in Figure 3.1. The precise locations of the harvest lanes must be chosen carefully and must be maintained in a fixed position throughout the year to avoid unintentional disturbance to adjacent sensitive areas. Lane position should consider water depth, plant species present, lane use, and boating habits/practices on the Lake. For example, whenever possible, lanes should favor deeper water areas, should support the Lake's recreational uses, and should attempt to focus plant harvest on invasive species. Additional information regarding cutting patterns and depth is provided below.

[43] *Further information about Clean Boats Clean Waters can be found on the WDNR website at: dnr.wi.gov/lakes/cbcw/.*

1. **Except for navigational access lanes, harvesters must not be operated nearshore in water less than 36 inches feet deep**. Mechanical harvesting may be possibly be expanded in shallow, obstacle-prone nearshore areas throughout the Lake if a small-scale harvester is available. Even though the District's harvester may be able to navigate in waters in as shallow as 12 inches when empty, at least 12 inches of plant growth should remain standing after harvesting. Therefore, aside from regulatory restrictions, mechanically harvesting aquatic plants in extremely shallow water (e.g., areas with less than 18 inches of water depth) is not practical.

2. **Maintain at least 12 inches of living plant material after harvesting**. The District's current aquatic plant harvester can cut aquatic plants up to 60 inches below the water surface. Harvesting equipment operators must not intentionally denude the lakebed. Instead, the goal of harvesting is to maintain and promote healthy native aquatic plant growth. Harvesting invasive aquatic plants can promote native plant regrowth since many invasive aquatic plants grow very early in the season depriving later emerging native plants of light and growing room.

3. **Collect and properly dispose harvested plants and collected plant fragments**. Outside of mapped areas, the harvester may surface skim free-floating vegetation that has been previously cut or uprooted, but not collected, to a depth of one foot. Use of the cutter head is not permitted for this action. In addition, plant cuttings and fragments must be immediately collected upon cutting to the extent practicable. Plant fragments accumulating along shorelines should be collected by riparian landowners. Fragments collected by the landowners can be used as garden mulch or compost.

   All harvested and collected plant material will be deposited at the approved primary disposal site– the School Section Lake Management District Property located on Dolmar Park Road (adjacent to S35W38226 Dolmar Park Road). Map 3.1. Disposing any aquatic plant material within identified floodplain and wetland areas is prohibited.

   Plant material will be collected and disposed daily to reduce undesirable odors and pests, to avoid leaching nutrients back into waterbodies, and to minimize visual impairment of lakeshore areas. Operators will stringently police the off-loading to assure efficient, neat operation.

4. **Adapt harvester cutting patterns and depths to support lake use and promote ecological health**. Aquatic plant harvesting techniques should vary in accordance with the type and intensity of human recreational use, lake characteristics, the distribution and composition of aquatic plants, and other biological considerations. For example, in sensitive areas, relatively wide transit lanes connect boat launches, highly populated shorelines, and open-water areas. Narrower access lanes connect less trafficked areas and sparsely populated shorelines to open-water areas and transit lanes. The approaches to employ in differing management areas are summarized in Table 3.1 and described below.

   a. <u>Launch access lane us given high priority</u>: A channel about 50-feet wide should be prioritized to maintain navigation access lane to and from the boat landing to provide travel thoroughfares for recreational watercraft. This channel is generally parallel the shoreline. Plant cutting depths vary from 18 to 60 inches, as water depth allows. At least one foot of plant material must remain on the Lake bottom to minimize resuspension of lake-bottom sediment and maintain desirable plant communities.

   b. <u>Harvester offloading access lane is given high priority</u>: A channel about 10-feet wide should be prioritized to maintain navigation access to and from the harvester offloading location. At least one foot of plant material must remain on the Lake bottom to minimize resuspension of lake-bottom sediment and maintain desirable plant communities.

      i. Water level fluctuations of up to one foot should be expected

      ii. Installation of buoys in the offloading access lane may be considered to warn boaters of low water level periods

Map 3.1
School Section Lake Harvesting Disposal Site

Source: Wisconsin Department of Natural Resources and SEWRPC
Date of Photography: April 2015

Table 3.1
General Guidance for Harvester Operation

ONLY CUT IN DEPTHS MORE THAN THREE FEET—Map provides bathymetry of Lake, but lake levels change, so you will need to monitor this as you cut.
TOP CUT IN AREAS WITH HIGH NATIVE PLANT COMMUNITIES—Map areas labeled in red indicate where these areas will most likely be; however, identifying these regions will require plant identification knowledge. In these areas restrict cutting to only three feet below the water's surface.
DEEP CUT AREAS DOMINATED BY EURASIAN WATER MILFOIL AND COONTAIL—Map area in light blue indicates where this region is most likely, however identifying these regions will require plant identification knowledge. In this area you must leave 12 inches of plant on the lake bottom.
CUT 50-FOOT-WIDE ACCESS LANE FROM BOAT ACCESS SITE—This lane should extend approximately 250 feet into the center of the Lake. In this area you must leave 12 inches of plant on the lake bottom. Map Area in yellow shows where this is located.
CUT 10-FOOT-WIDE NAVIGATION LANES THROUGH HIGH-VALUE NATURAL AREA—In this area you must leave 12 inches of plant on the lake bottom. These lanes should only be cut if depths are more than three feet. Map areas in dark blue indicate where these lanes should be located, while map areas labeled as wetland indicate the high-value areas.
CUT 10-FOOT-WIDE NAVIGATION LANE TO MAINTAIN ACCESS TO HARVESTER OFFLOADING SITE—In this area you must leave 12 inches of plant on the lake bottom. This lane should only be cut if depths are more than three feet. Water level fluctuations of up to one foot should be expected and installation of buoys in the offloading access lane may be considered to warn boaters of low water level periods. Map Area in orange shows where this is located.
CUT 10-FOOT-WIDE NAVIGATION LANES TO MAINTAIN ACCESS FOR LAKE RESIDENTS—In this area you must leave 12 inches of plant on the lake bottom. These lanes should only be cut if depths are more than three feet. Map Areas in light green show where this is located.
CUT CATTAILS AND BULRUSH ONLY IN AREAS WHERE THEY IMPEDE NAVIGATION LANES—This may occur when cutting access lane at the north end of the Lake, when cutting the navigation lanes at the southern end of the Lake, or when performing the "top cut" at the south end of the Lake. The area labeled as wetland on the map indicated a potential area where this will likely occur.
UTILIZE DASH AND MANUAL REMOVAL TO CLEAR NORTHWEST NAVIGATION LANE—In this map area indicated with a red line mechanical harvesting is not recommended.
ALL CUT MATERIAL SHOULD BE INSPECTED FOR FISH AND ANIMALS. ANY ORGANISMS FOUND SHOULD IMMEDIATELY BE RETURNED TO THE LAKE—This should be completed as soon as the harvester returns to land.
ALL CUT MATERIALS SHOULD BE DEPOSITED ON DESIGNATED DISPOSAL SITE—This area is indicated in the southwest corner of the map. Precaution should be made to ensure that the plant material does not get placed in the wetland region to the west of the disposal site.

Source: Wisconsin Department of Natural Resources and SEWRPC

c. Lake resident access lanes are given high priority: Lanes about 10-feet wide should be maintained by piers in areas 3 feet or deeper to maintain navigation access for lake residents. At least one foot of plant material must remain on the Lake bottom to minimize resuspension of lake-bottom sediment and maintain desirable plant communities.

d. EWM Management Areas are given medium priority: EWM Management Areas should be top cut to a maximum depth of four feet to control surface matting of EWM growth and promote native species growth. Again, at least one foot of plant material must remain on the Lake bottom to minimize resuspension of lake-bottom sediment and maintain desirable plant communities.

e. Recreation areas are given low priority: These areas are for alleviating nuisance, surface-matting growth for riparian owners. Surface cutting should be employed and restricted from pier heads to open water for riparian access. Harvesting from pier heads to shore will not be mechanically harvested; only manual methods will be used. Avoid harvesting wild celery except in areas that reach "nuisance" conditions – when water celery is closer than two feet from the water's surface. To reduce the risk for water quality degradation, special effort should be taken to avoid cutting wild celery wherever and whenever possible. Conversely, harvesting intensity should be increased during times of the year (i.e., spring and early summer) when invasive aquatic plant growth predominates and within areas where invasive species are most abundant. For example, CLP may be particularly abundant early in the cutting season but is largely absent by midsummer, a growth cycle that may require changes to harvesting routes and schedules over the season.

f. Northwest channel is given low priority: This passage should be cleared utilizing DASH with an associated WDNR permit and then maintained utilizing hand removal through recruitment of volunteers. Mechanical harvesting is not recommended in this area.

5. **Harvesting native pondweeds and muskgrasses is prohibited**. These plants provide habitat for young fish, reptiles, and insects in the Lake.

6. **Immediately return incidentally captured living animals to the water**. As harvested plants are brought on board the harvester, plant material must be actively examined for live animals. Animals such as turtles, fish, and amphibians commonly become entangled within harvested plants, particularly when cutting large plant mats. A second deckhand equipped with a net should accompany and help the harvester operator rescue animals incidentally collected during aquatic plant harvesting. If a second deckhand is not available, the harvester operator shall halt harvesting and remove animals incidentally collected during plant harvesting. Such stop-and-start work can dramatically decrease harvesting efficiency. Therefore, the WDNR recommends two staff be present on operating harvesters.

7. **Insurance, maintenance, repair, and storage**. Appropriate insurance covering the harvester and ancillary equipment will be incorporated into the District's policy. The District will provide liability insurance for harvester operators and other staff. Insurance certificates will be procured and held by the District. Routine day-to-day equipment maintenance will be performed by the harvester operator or other individuals identified by the District in accordance with the manufacturer's recommendations and suggestions. To this end, harvester operators shall be familiar with equipment manuals and appropriate maintenance/manufacturer contacts. Operators will immediately notify District staff of any equipment malfunctions, operating characteristics, or sounds suggesting malfunction and/or the need for repair. Equipment repair beyond routine maintenance will be arranged by the District. Maintenance and repair costs will be borne by the District. The District will be responsible for properly transporting and storing harvesting equipment during the off season.

8. **Management, record keeping, monitoring, and evaluation**. District staff manage harvesting operations, and, although they may delegate tasks, are ultimately responsible for overall plan execution and logistics. Nevertheless, daily harvesting activities will be documented in writing by the harvester operator in a permanent harvester operations log. Harvesting patterns, harvested plant volumes, weed pickup, plant types, and other information will be recorded. Daily maintenance and service logs recording engine hours, fuel consumed, lubricants added, oil used, and general comments will be recorded. Furthermore, this log should include a section to note equipment performance problems, malfunctions, or anticipated service. Monitoring information will be summarized in an annual summary report prepared by the District, submitted to the WDNR, and available to the general public. The report will also present information regarding harvesting operation and maintenance, equipment acquisitions and/or needs, expenditures, and budgets.

9. **Logistics, supervision, and training**. Harvesting equipment is owned and operated by the District. District staff or delegated board members are responsible for overall harvesting program oversight and supervision. Although District staff are ultimately responsible for equipment operation, they may delegate tasks to competent individuals when technically and logistically feasible. The District must assure such individuals are appropriately trained to successfully and efficiently carry out their respective job functions. For example, District members/staff likely have extensive experience operating and maintaining harvesting equipment and have detailed knowledge of lake morphology, plant growth, and overall lake biology. These individuals should actively share this knowledge through an on-the-job training initiative. The equipment manufacturer may also be able to provide advice, assistance, and insight regarding equipment operation and operation. Boating safety courses are available through many media and are integral to individuals involved with on-the-water work.

   All harvester operators must successfully complete appropriate training, must be thoroughly familiar with equipment function, must be able to rapidly respond to equipment malfunction, must be familiar with the Lake's morphology and biology, and must recognize landmarks to help assure adherence to harvesting permit specifications and limitations. Additionally, harvester operators must be able to recognize the various native and invasive aquatic plants present in the Lake. Such training may be provided through printed and on-line study aids, plant identification keys, and the regional WDNR aquatic species coordinator. At a minimum, training should:

- Explain "deep-cut" versus "shallow-cut" techniques and when to employ each in accordance with this plan

- Discuss equipment function, capabilities, limitations, hazards, general maintenance, and the similarities and differences between the various pieces of equipment they may be expected to operate

- Review the aquatic plant management plan and associated permits with special emphasis focused on the need to restrict cutting in shallow and nearshore areas

- Assure operators can confidentially identify aquatic plants and understand the positive values such plants provide to the Lake's ecosystem which in turn encourages preservation of native plant communities

- Reaffirm that all harvester operators are legally obligated to accurately track and record their work to include in permit-requisite annual reports

The training program must integrate other general and job-specific items such as boating navigational conventions, safety, courtesy and etiquette, and State and local boating regulations. Other topics that should be covered include first aid training, safety training, and other elements that help promote safe, reliable service.

Nearshore Manual Aquatic Plant Removal

In nearshore areas where other management efforts are not feasible, raking may be a viable and practical method to manage overly abundant and/or undesirable plant growth. Should School Section Lake residents decide to utilize raking to manually remove aquatic plants, the District or other interested party could acquire a number of specially designed rakes for riparian owners to use on a trial basis and/or rent or loan. If those rakes satisfy users' needs and objectives, additional property owners would be encouraged to purchase their own rakes.

Hand-pulling EWM and CLP is considered a viable option in School Section Lake and should be employed wherever practical. Volunteers or homeowners could employ this method, as long as they are properly trained to identify EWM, CLP, or any other invasive plant species of interest. WDNR provides a wealth of guidance materials (including an instructional video describing manual plant removal) to help educate volunteers and homeowners.[44]

Pursuant to Chapter NR 109 *Aquatic Plants: Introduction, Manual Removal and Mechanical Control Regulations* of the *Wisconsin Administrative Code*, riparian landowners may rake or hand pull aquatic plants without a WDNR permit under the following conditions:

- EWM, CLP, and purple loosestrife may be removed by hand if the native plant community is not harmed in the process.

- Raked, hand-cut, and hand-pulled plant material must be removed from the lake.

- No more than 30 lineal feet of shoreline may be cleared, however, this total must include shoreline lengths occupied by docks, piers, boatlifts, rafts, and areas undergoing other plant control treatment. In general, regulators allow vegetation to be removed up to 100 feet out from the shoreline.

- Plant material that drifts onto the shoreline must be removed.

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[44] *Visit dnr.wi.gov/lakes/plants for more information on identification and control of invasive aquatic plants.*

Any other manual removal technique requires a State permit, unless specifically used to control designated nonnative invasive species such as EWM. Mechanical equipment (e.g., dragging equipment such as a rake behind a motorized boat or the use of weed rollers) is not authorized for use in Wisconsin at this time. Nevertheless, riparian landowners may use mechanical devices to cut or mow exposed lakebed. Furthermore, purple loosestrife may also be removed with mechanical devices if native plants are not harmed and if the control process does not encourage spread or regrowth of purple loosestrife or other nonnative vegetation.

Prior to the hand-pulling season, shoreline residents should be reminded of the utility of manual aquatic plant control through an educational campaign. This campaign should also foster shoreline resident awareness of native plant values and benefits, promote understanding of the interrelationship between aquatic plants and algae (i.e., if aquatic plants are removed, more algae may grow), assist landowners identify the types of aquatic plants along their shorelines, and familiarize riparian landowners with the specific tactics they may legally employ to "tidy up" their shorelines.[45]

Suction Harvesting and DASH

Suction harvesting may be a practical method to control aquatic plants, but it is not likely to be a cost-effective, environmentally friendly, or practical method to manage aquatic plants alone. For this reason, suction harvesting is not practical for widespread application at the Lake. However, it may provide a practical alternative in excessively shallow nearshore areas where increased water depth could meaningfully improve navigability.

Given how time consuming and costly DASH can be to employ, and given the limited presence of invasive and nuisance plant growth across the Lake, DASH will never likely be a primary component part of the District's general nuisance and invasive plant management strategy. Nevertheless, some lake districts have employed DASH to aggressively combat small-scale pioneer infestations of invasive species. The District may wish to consider using DASH should such a situation arise in the future.

DASH may be of interest to private parties in specific situations. For example, DASH could be employed by individuals to control nuisance native and nonnative plants around piers and other congested areas. If an individual landowner or groups of landowners choose to utilize DASH, the activity is typically confined to the same area as riparian landowner manual aquatic plant manual control (30 feet of shoreline per property generally extending no more than 100 feet in areas including piers and other navigation aids). DASH requires a permit under *Wisconsin Administrative Code* Chapter NR 109 *Aquatic Plants: Introduction, Manual Removal and Mechanical Control Regulations*.

Chemical Treatment

Considering the expanse of EWM in School Section Lake, a whole-lake treatment may be beneficial.[46] In addition, small spot treatments enclosed with a barrier (e.g., turbidity barrier) could be a viable alternative for treating shoreline areas and navigation lanes if determined feasible by the District. Whatever the case, monitoring should continue to ensure that EWM does not become more problematic. If further monitoring suggests a dramatic change in these invasive species populations, management recommendations should be reviewed.

Water Level Manipulation

The School Section Lake Dam is a stop log system in a concrete spillway on the southwest corner of the Lake. As such, a winter drawdown could be used to control invasive species. However, the previous breach of the dam by muskrats in 2018 did not result in a long term reduction in EWM and is therefore not recommended in School Section Lake at this time.

[45] *Commission and WDNR staff could help review documents developed for this purpose.*

[46] *WDNR has been studying the efficacy of spot treatments versus whole lake treatments for the control of Eurasian watermilfoil and it has been found that spot treatments are not an effective measure for reducing Eurasian watermilfoil populations, while whole lake treatments have proven effective depending on conditions.*

3.2 SUMMARY AND CONCLUSIONS

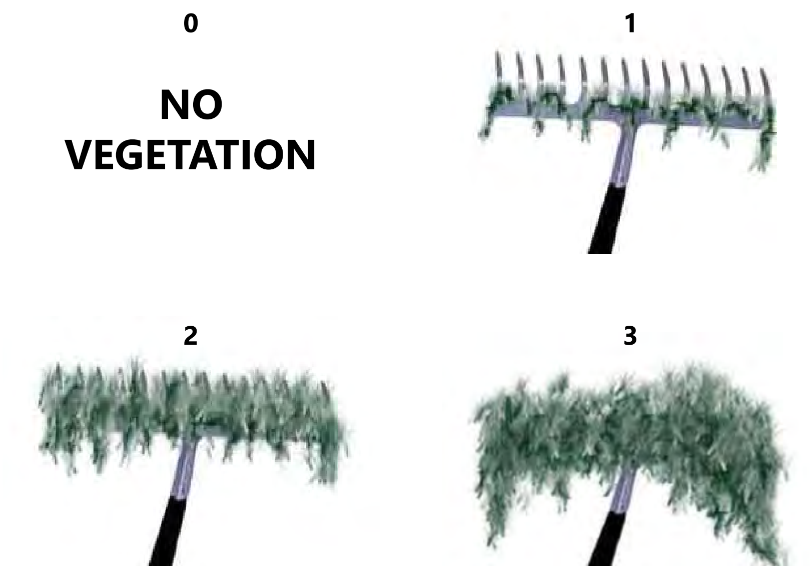
As requested by the District, the Commission worked with the District to develop a scope of work and secure funding to provide information useful to short- and long-term lake management. The primary motivation for this effort was to gather information needed to renew the District's aquatic plant management permit. This report, which documents the findings and recommendations of the study, examines existing and anticipated conditions, potential aquatic plant management problems, and lake-use. Conformant with the study's intent, the plan includes recommended actions and management measures. Figure 3.1 summarizes and generally locates where aquatic plant management recommendations should be implemented.

Successfully implementing this plan will require vigilance, cooperation, and enthusiasm, not only from local management groups, but also from State and regional agencies, Waukesha County, municipalities, and residents/users of the Lake. The recommended measures help foster conditions sustaining and enhancing the natural beauty and ambiance of the School Section Lake ecosystem while promoting a wide array of water-based recreational activities suitable for the Lake's intrinsic characteristics.

APPENDIX A

LAKE AQUATIC PLANT SPECIES DETAILS

Figure A.1
Rake Fullness Ratings



Source: Wisconsin Department of Natural Resources and SEWRPC

SOURCES OF INFORMATION:

Borman, S., Korth, R., & Temte, J. (2014). Through the Looking Glass: A Field Guide to Aquatic Plants, Second Edition. Stevens Point, WI, USA: Wisconsin Lakes Partnership.

Robert W. Freckman Herbarium: wisplants.uwsp.edu

Skawinski, P. M. (2014). Aquatic Plants of the Upper Midwest: A Photographic Field Guide to Our Underwater Forests, Second Edition. Wausau, Wisconsin, USA: Self-Published.

University of Michigan Herbarium: michiganflora.net/home.aspx

UW-System WisFlora. 2016. wisflora.herbarium.wisc.edu/index.php

Native

COMMON BLADDERWORT

Utricularia vulgaris

Credit: Wikimedia Commons User Leonhard Lenz

Identifying Features

- Flowers snapdragon-like, yellow, held on stalks above the water surface
- *Producing bladders* (small air chambers on the stem) that capture prey and give buoyancy to the stem
- Stems floating (due to air bladders; branches finely divided

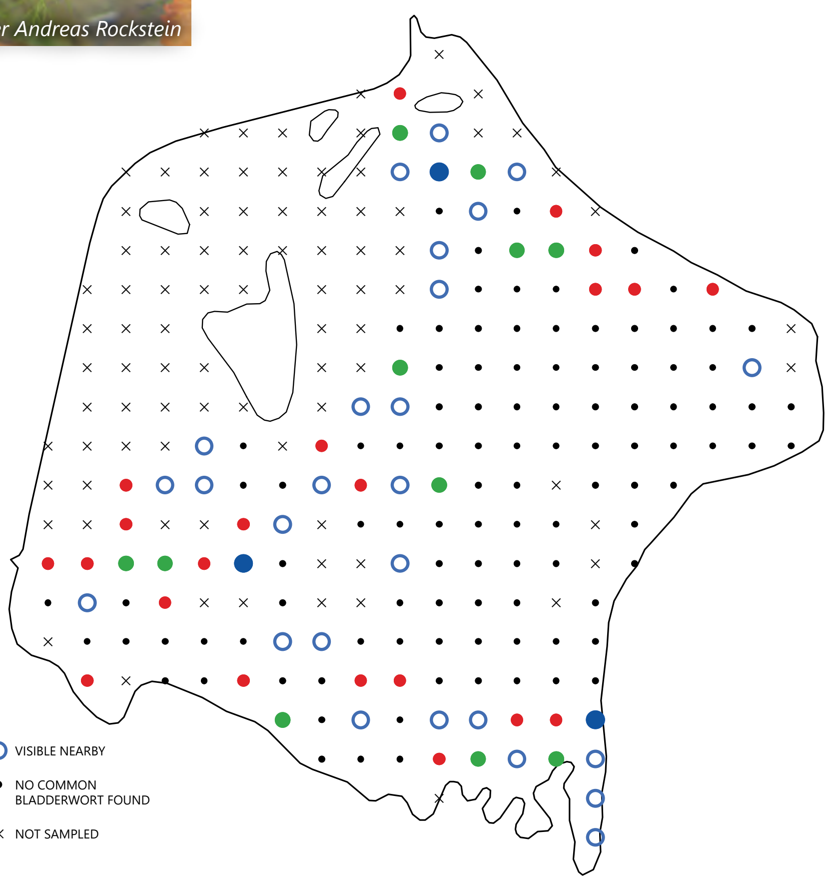
Several similar bladderworts occur in southeastern Wisconsin

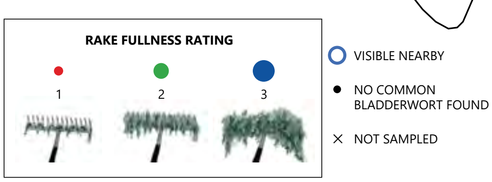
Ecology

- Most often found in quiet shallows and along shores, but common bladderwort sometimes occurs in water several feet deep
- Provides forage and cover for a wide range of aquatic organisms
- Bladders capture and digest prey, including small invertebrates and protozoans

Credit: Flickr User Andreas Rockstein

Credit: Flickr User Joshua Mayer





Native

COMMON WATERWEED

Elodea canadensis

Credit: Flickr User Corey Raimond

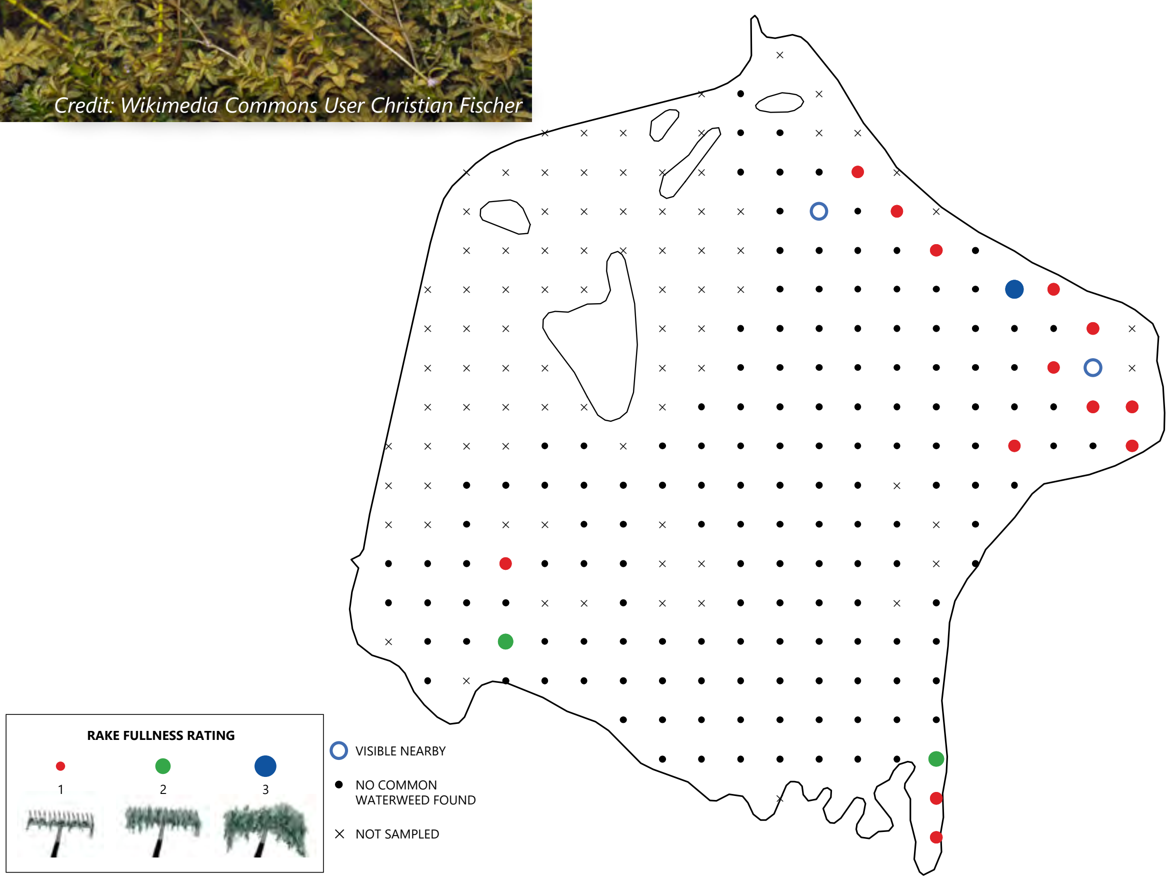
Identifying Features

- Slender stems, occasionally rooting
- Leaves lance-shaped, in whorls of three (rarely two or four), 6.0 to 17 mm long and averaging 2.0 mm wide
- When present, tiny male and female flowers on separate plants (females more common), raised to the surface on thread-like stalks

Ecology

- Found in lakes and streams over soft substrates tolerating pollution, eutrophication and disturbed conditions
- Often overwinters under the ice
- Produces seeds only rarely, spreading primarily via stem fragments
- Provides food for muskrat and waterfowl
- Habitat for fish or invertebrates, although dense stands can obstruct fish movement

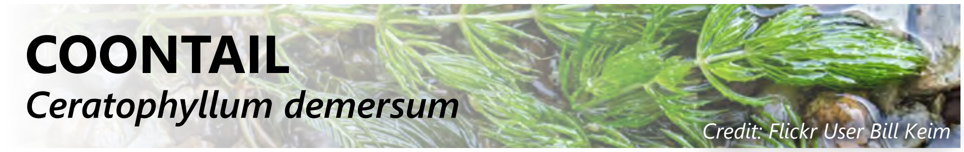
Credit: Wikimedia Commons User Christian Fischer



Native

COONTAIL

Ceratophyllum demersum



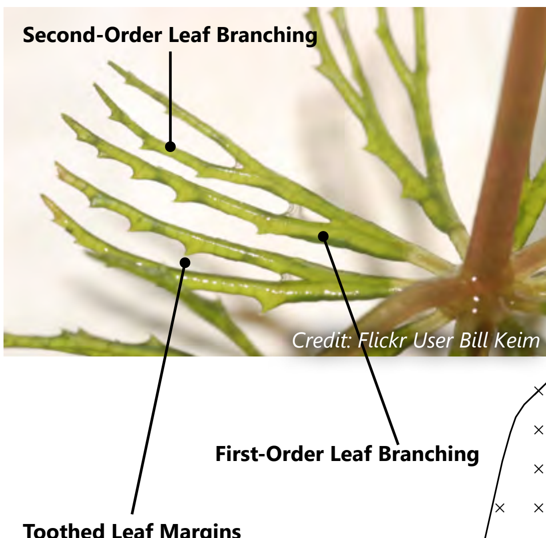
Identifying Features

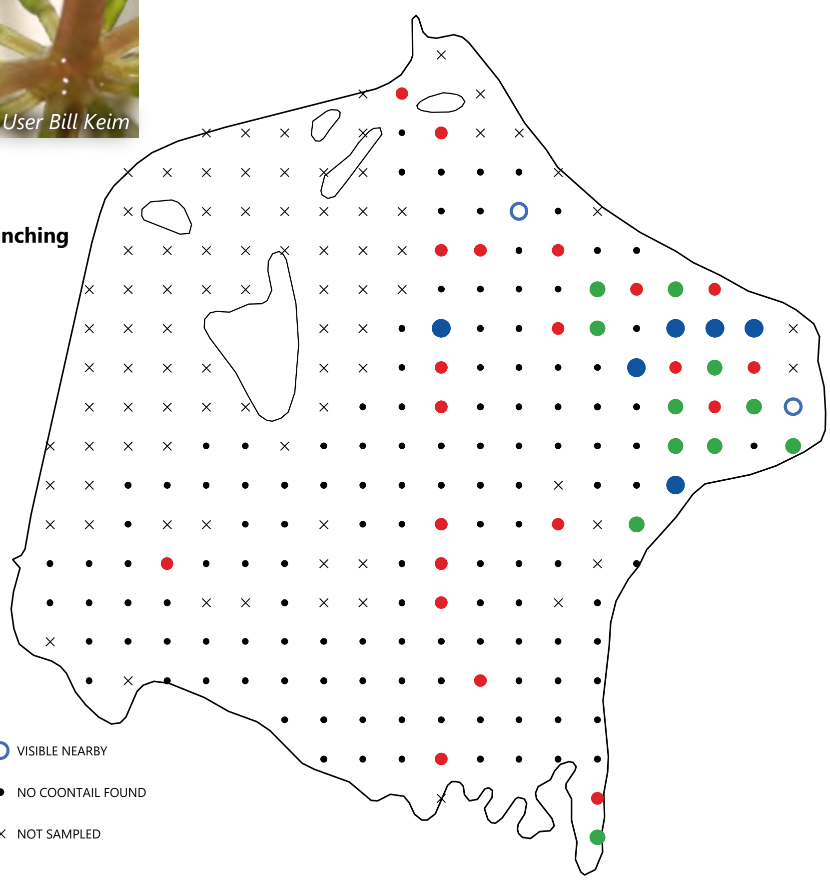
- Often bushy near tips of branches, giving the raccoon tail-like appearance (“coontail”)
- Whorled leaves with one to two orders of
- branching and small teeth on their margins
- Flowers (rare) small and produced in leaf axils

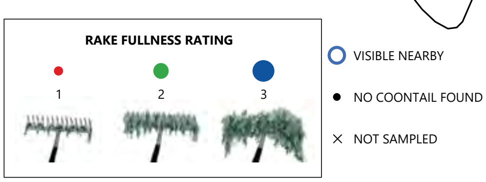
Coontail is similar to spiny hornwort (C. echinatum) and muskgrass (Chara spp.), but spiny hornwort has some leaves with three to four orders of branching, and coontail does not produce the distinct garlic-like odor of muskgrass when crushed

Ecology

- Common in lakes and streams, both shallow and deep
- Tolerates poor water quality (high nutrients, chemical pollutants) and disturbed conditions
- Stores energy as oils, which can produce slicks on the water surface when plants decay
- Anchors to the substrate with pale, modified leaves rather than roots
- Eaten by waterfowl, turtles, carp, and muskrat







Nonnative/ Exotic

CURLY-LEAF PONDWEED

Potamogeton crispus

Credit: Paul Skawinski

Identifying Features

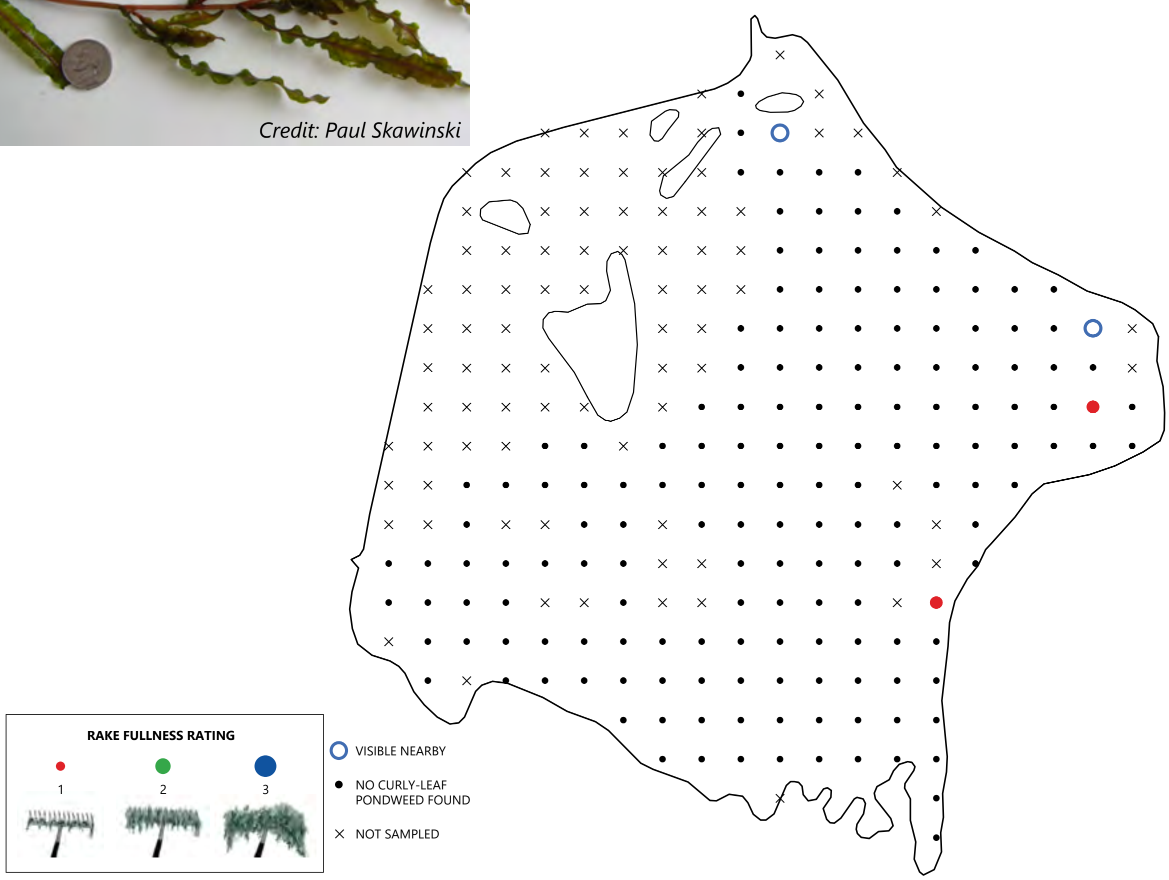
- Stems slightly flattened and both stem and leaf veins often somewhat pink
- Leaf margins very wavy and finely serrated
- Stipules (3.0 to 8.0 mm long) partially attached to leaf bases, disintegrating early in the season
- Produces pine cone-like overwintering buds (turions)

Curly-leaf pondweed may resemble clasping-leaf pondweed (*P. richardsonii*), but the leaf margins of the latter are not serrated

Ecology

- Found in lakes and streams, both shallow and deep
- Tolerant of low light and turbidity
- Disperses mainly by turions
- Adapted to cold water, growing under the ice while other plants are dormant, but dying back during mid-summer in warm waters
- Produces winter habitat, but mid-summer die-offs can degrade water quality and cause algal blooms
- Maintaining or improving water quality can help control this species, because it has a competitive advantage over native species when water clarity is poor

Credit: Paul Skawinski



Nonnative/ Exotic

EURASIAN WATERMILFOIL

Myriophyllum spicatum


Credit: Paul Skawinski

Identifying Features

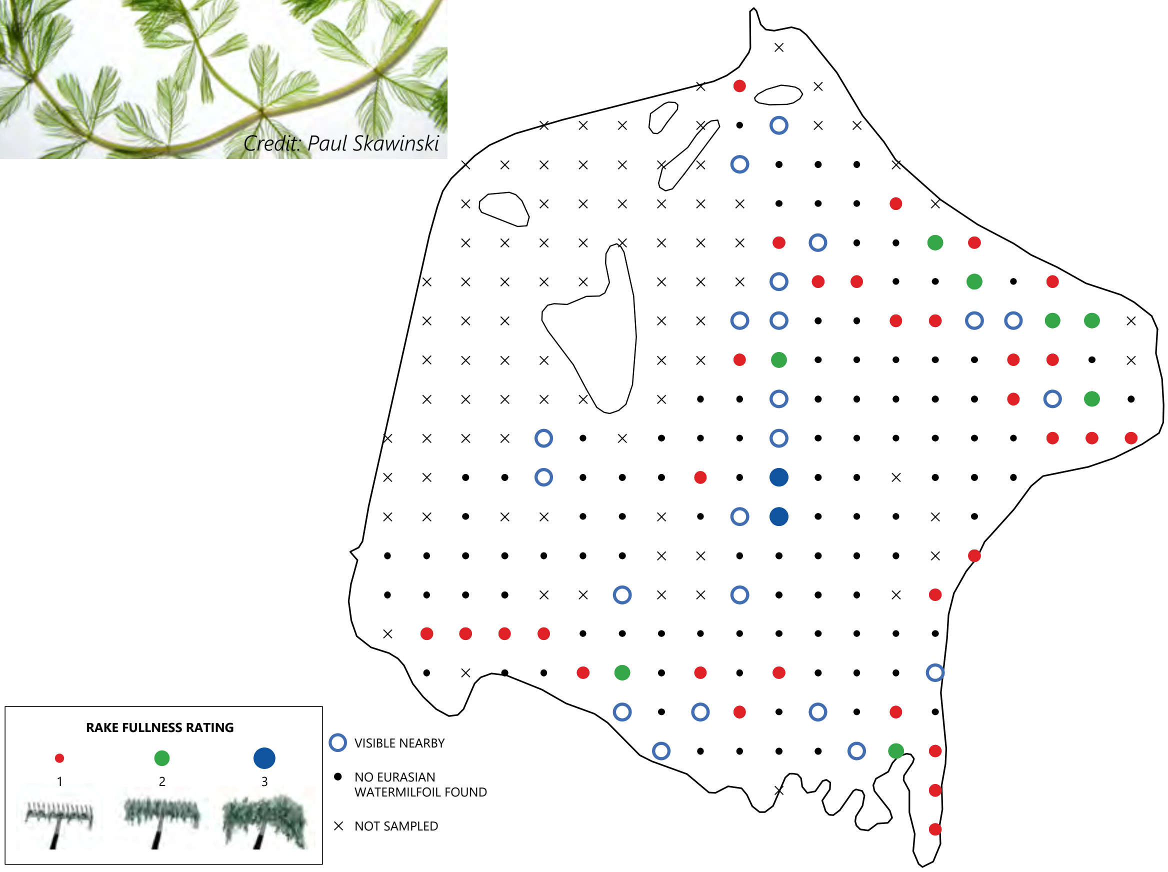
- Stems spaghetti-like, often pinkish, growing long with many branches near the water surface
- Leaves with 12 to 21 pairs of leaflets
- Produces no winter buds (turions)

Eurasian watermilfoil is similar to northern watermilfoil (*M. sibiricum*). However, northern watermilfoil has five to 12 pairs of leaflets per leaf and stouter white or pale brown stems

Ecology

- Hybridizes with northern (native) watermilfoil, resulting in plants with intermediate characteristics
- Invasive, growing quickly, forming canopies, and getting a head-start in spring due to an ability to grow in cool water
- Grows from root stalks and stem fragments in both lakes and streams, shallow and deep; tolerates disturbed conditions
- Provides some forage to waterfowl, but supports fewer aquatic invertebrates than mixed stands of aquatic vegetation


Credit: Paul Skawinski



Native

FLAT-STEM PONDWEED

Potamogeton zosteriformis

Credit: Donald Cameron

Identifying Features

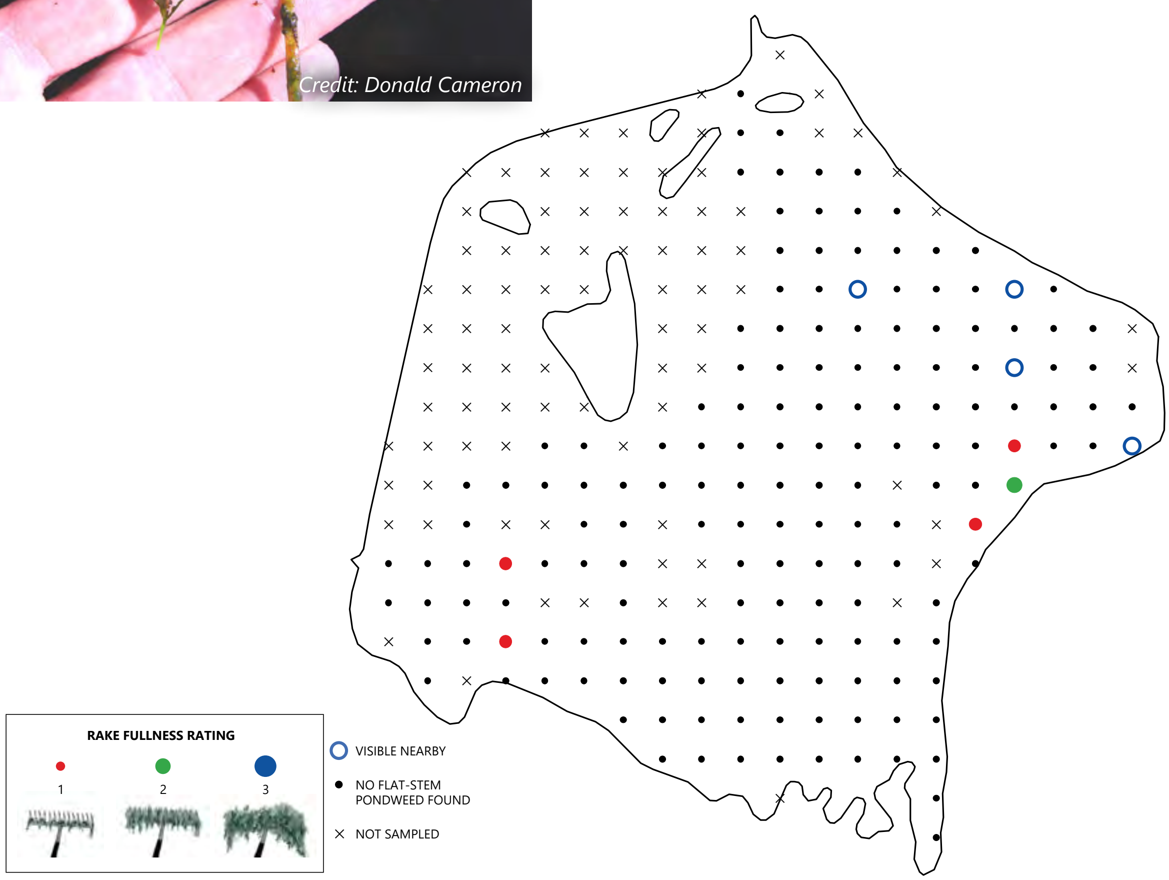
- Stems strongly flattened
- Leaves up to four to eight inches long, pointed, with a prominent midvein and many finer, parallel veins
- Stiff winter buds consisting of tightly packed ascending leaves

Flat-stem pondweed may be confused with yellow stargrass (*Heteranthera dubia*), but the leaves of yellow stargrass lack a prominent midvein.

Ecology

- Found at a variety of depths over soft sediment in lakes and streams
- Overwinters as rhizomes and winter buds
- Has antimicrobial properties
- Provides food for waterfowl, muskrat, beaver, and deer
- Provides cover for fish and aquatic invertebrates

Credit: Donald Cameron



Native

FLOATING-LEAF PONDWEED

Potamogeton natans

Credit: Wikimedia Commons User Stefan.lefnaer

Identifying Features

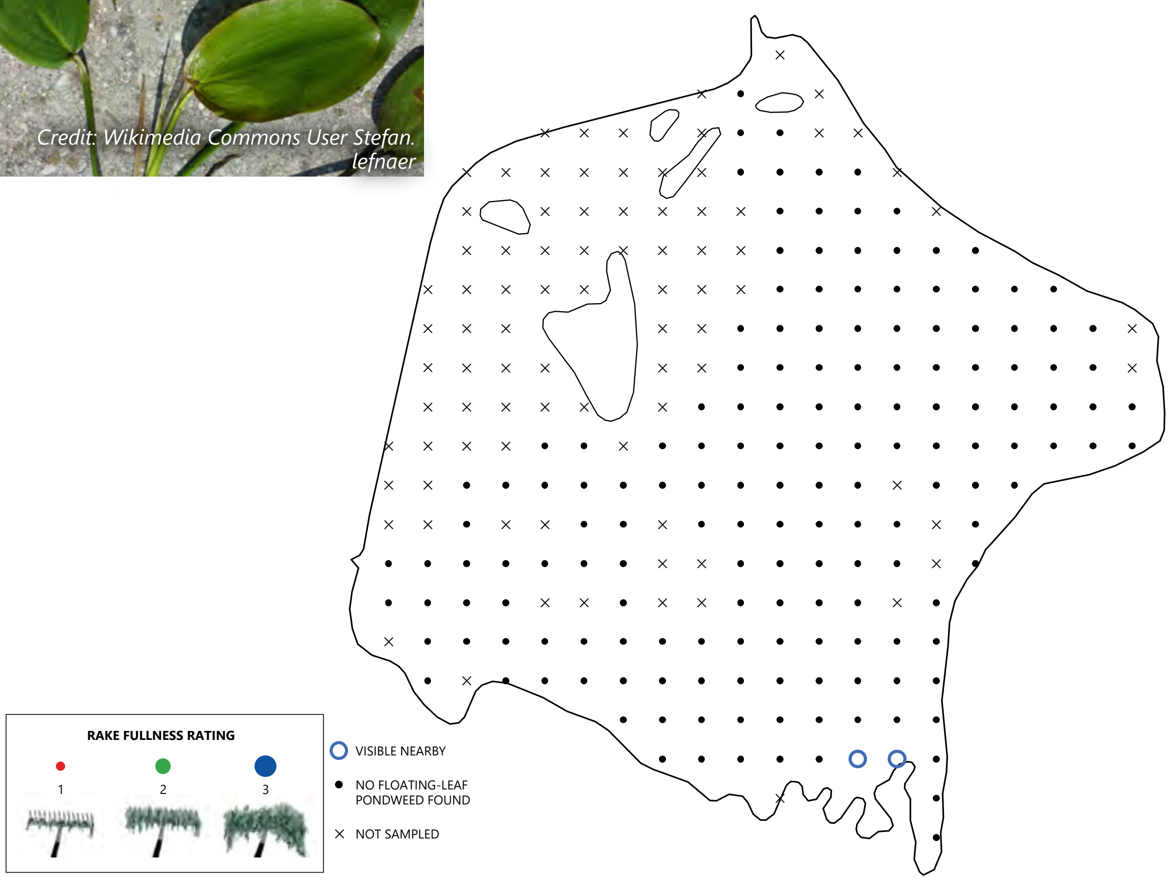
- Floating leaves (5.0 to 10 cm long) with heart-shaped bases and 17 to 37 veins
- Floating leaf stalks bent where they meet the leaf, causing the leaf to be held at roughly a 90-degree angle to the stalk
- Submersed leaves (1.0 to 2.0 mm wide) linear and stalk-like, with three to five veins

Floating-leaf pondweed is similar to Oakes' pondweed (*P. oakesianus*) and spotted pondweed (*P. pulcher*). Oake's pondweed is smaller, with floating leaves 2.5 to 6.0 cm long and submersed leaves 0.25 to 1.0 mm wide. Spotted pondweed differs in having small black spots on its stems and leaf stalks and lance-shaped submersed leaves with wavy margins

Ecology

- Usually in shallow waters (<2.5 m) over soft sediment
- Emerges in spring from buds formed along rhizomes
- Provides food for waterfowl, muskrat, beaver, and deer
- Holds fruit on stalks until late in the growing season, which provides valuable feeding opportunities for waterfowl
- Provides good fish habitat

Credit: Wikimedia Commons User Stefan. lefnaer



Native

FRIES' PONDWEED

Potamogeton friesii

Credit: Flickr User Lliam Rooney

Identifying Features

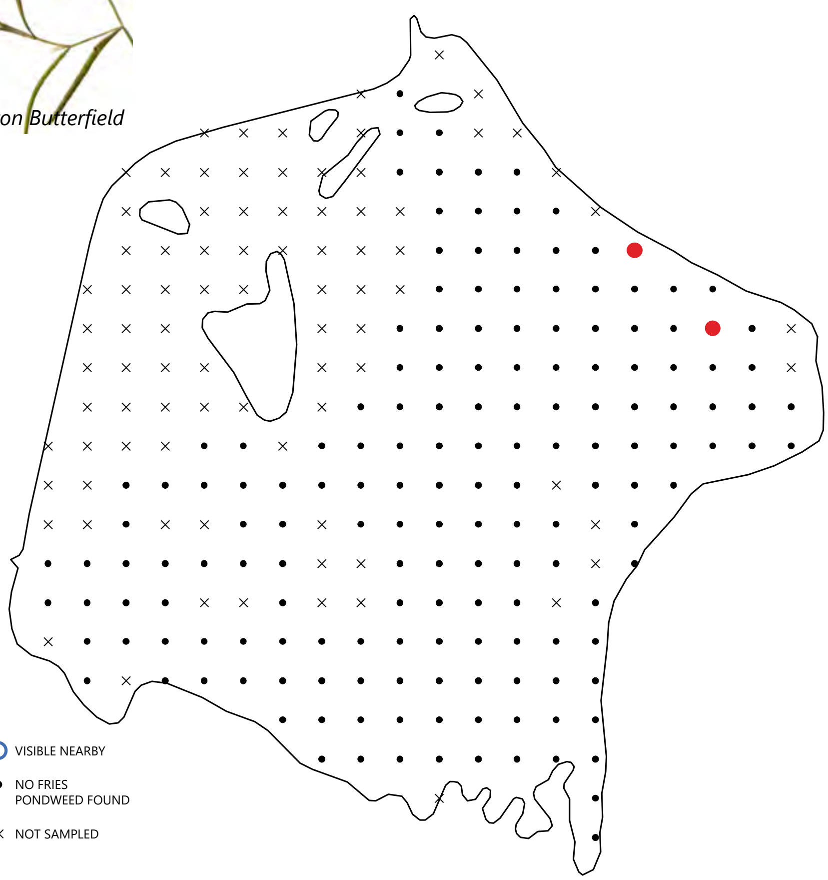
- Slender stems slightly compressed
- Submerged leaves linear with no petiole, one row of lacunar cells on each side of midvein, and 5-7 veins
- Tip of leaf rounded with short bristle
- Winter bud fan shaped and in two planes, with inner leaves at 90 degrees from outer leaves

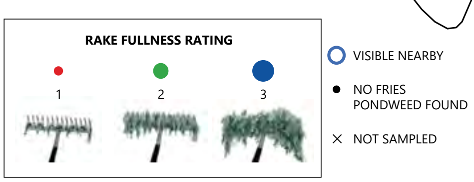
Fries' pondweed is similar to other narrow-leaved pondweeds such as small pondweed (*P. pusillis*) and stiff pondweed (*P. strictifolius*) but other narrow pondweeds do not create a fan shaped winter bud

Ecology

- Common in calcareous lakes and slow-moving streams
- Overwinters largely as winter buds (turions)
- Provides food for waterfowl,
- Provides habitat for fish and aquatic invertebrates

Credit: Flickr User Brenton Butterfield





Native

LARGE DUCKWEED

Spirodela polyrrhiza

Credit: Flickr User gailhampshire

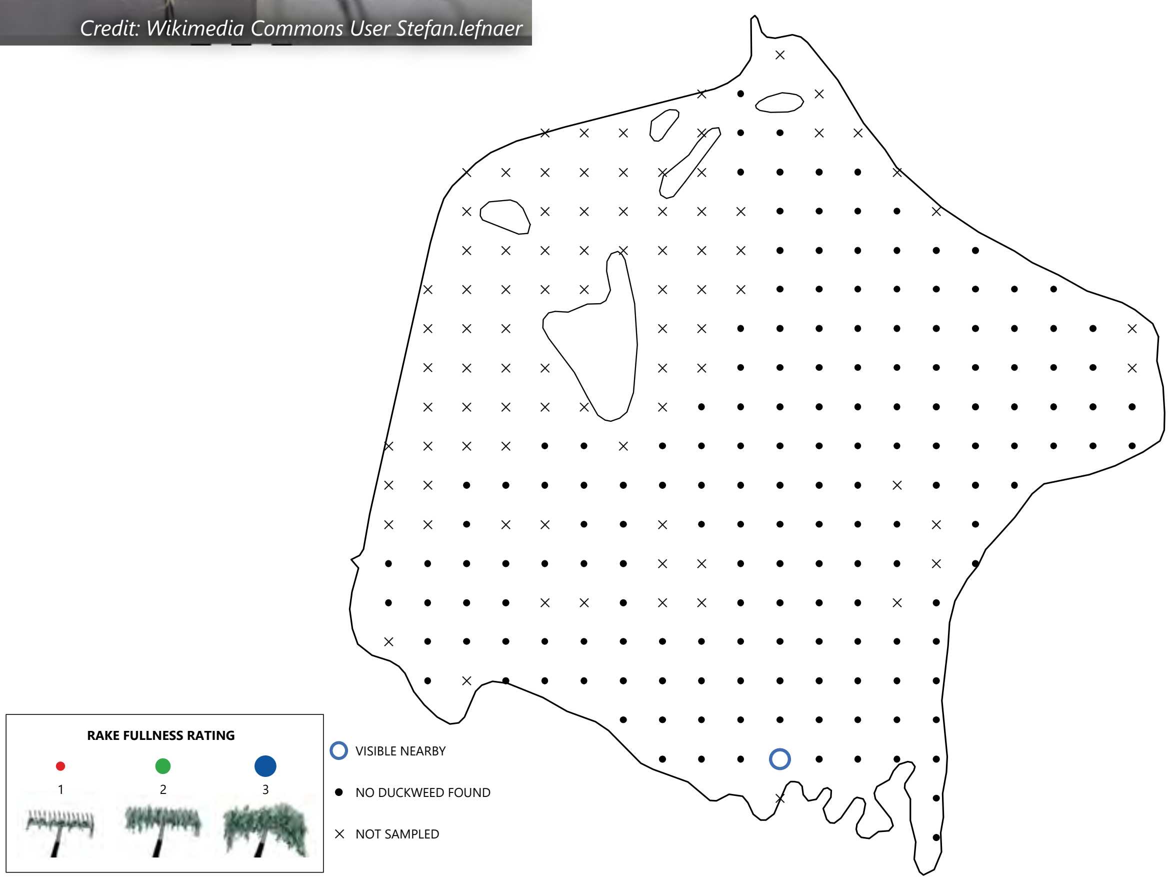
Identifying Features

- Free-floating, nearly cicular fronds with 5 – 15 veins
- Often has several fronds in a cluster, with multiple roots
- Typically green above and a reddish-purple beneath

Ecology

- Found throughout Wisconsin
- Often found with duckweed species
- Not dependent on depth, sediment type, or water clarity
- Requires adequate nutrients in the water to sustain growth

Credit: Wikimedia Commons User Stefan.lefnaer



Native

LONG-LEAF PONDWEED

Potamogeton nodosus

Credit: Wikimedia Commons User Stefan.lefnaer

Identifying Features

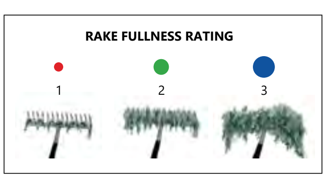
- Floating leaves 5.0 to 13 cm long, tapering to leaf stalks that are longer than the attached leaf blades
- Submersed leaves up to 30 cm long and 1.0 to 2.5 mm wide, with seven to 15 veins, and long leaf stalks
- Stipules 4.0 to 10 cm long, free from the leaves, disintegrating by mid-summer

Long-leaf pondweed may be distinguished from other pondweeds that have similar floating leaves (e.g., *P. illinoensis* and *P. natans*) by the long leaf stalks of its submersed leaves. The floating leaves of *P. natans* also differ by having a heart-shaped base and by being held to the leaf stalks at roughly 90-degree angles. In *P. illinoensis* the stalks of floating leaves, if produced, are shorter than the leaf blades

Ecology

- Streams and lakes, shallow and deep, but more often in flowing water
- Emerges in spring from buds formed along rhizomes
- Provides food for waterfowl, muskrat, beaver, and deer
- Harbors large numbers of aquatic invertebrates, which provide food for fish

Credit: Wikimedia Commons User Stefan.lefnaer



Native

MUSKGRASSES

Chara spp.

Credit: Flickr User Jeremy Halls

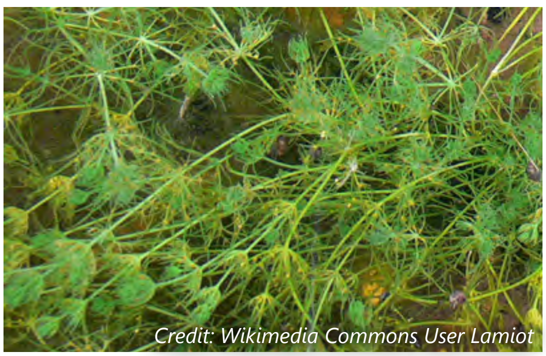
Identifying Features

- Leaf-like, ridged side branches develop in whorls of six or more
- Often encrusted with calcium carbonate, which appears white upon drying (see photo below)
- Yellow reproductive structures develop along the whorled branches in summer
- Emits a garlic-like odor when crushed

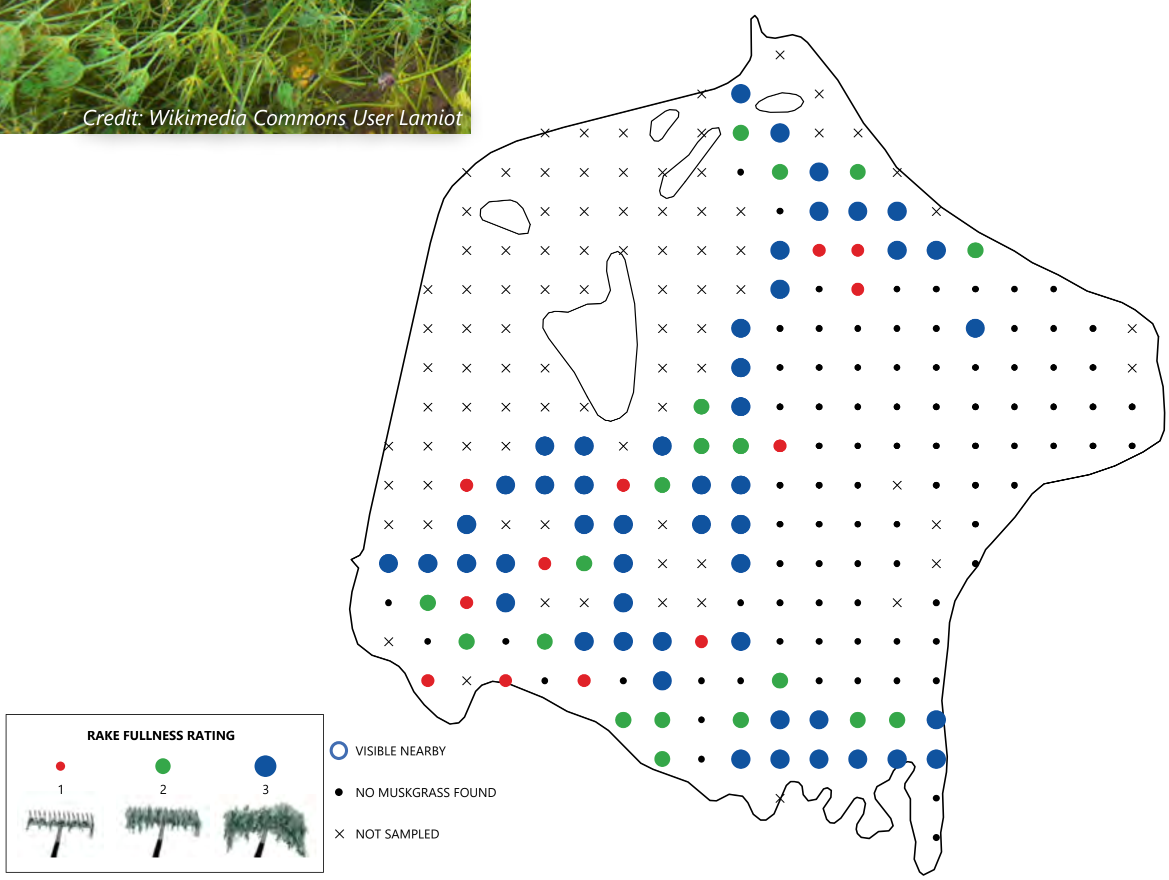
Stoneworts (*Nitella* spp.) are similar large algae, but their branches are smooth rather than ridged and more delicate

Ecology

- Found in shallow or deep water over marl or silt, often growing in large colonies in hard water
- Overwinters as rhizoids (cells modified to act as roots) or fragments
- Stabilizes bottom sediments, often among the first species to colonize open areas
- Food for waterfowl and excellent habitat for small fish



Credit: Wikimedia Commons User Lamiot



Native

NITELLAS OR STONEWORTS

Nitella spp.

Credit: Wikimedia Commons User Show_ryu

Identifying Features

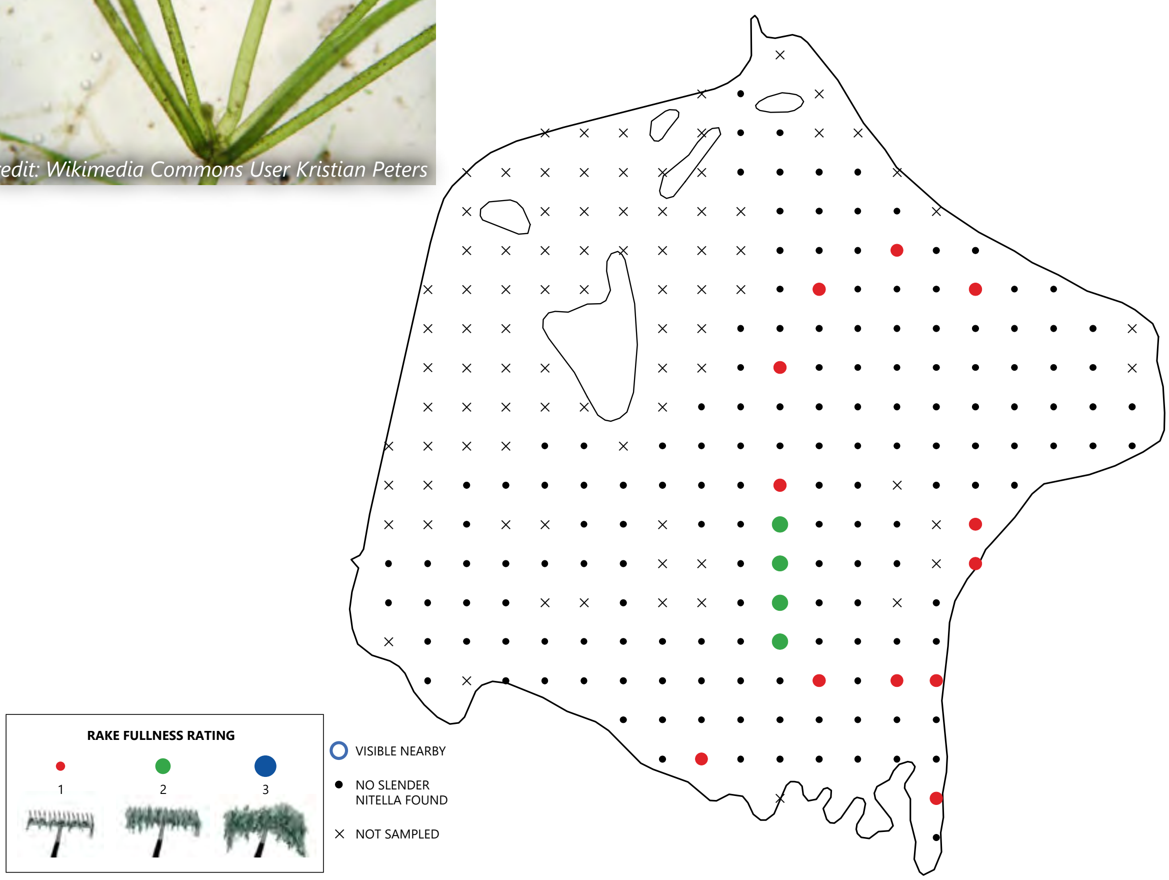
- Stems and leaf-like side branches delicate and smooth, side branches arranged in whorls
- Bright green
- Reproductive structures developing along the whorled branches

Muskgrasses (*Chara* spp.) are large algae similar to stoneworts (*Nitella* spp.), but their branches are ridged and more robust than those of stoneworts. Another similar group of algae, *Nitellopsis* spp., differ from stoneworts by having whorls of side branches that are at more acute angles to the main stem and star-shaped, pale bulbils that, when present, are near where side branches meet the main stem

Ecology

- Often found in deep lake waters over soft sediments
- Overwinters as rhizoids (cells modified to act as roots) or fragments
- Habitat for invertebrates, creating foraging opportunities for fish
- Sometimes browsed upon by waterfowl

Credit: Wikimedia Commons User Kristian Peters



Nonnative/ Exotic

PURPLE LOOSESTRIFE

Lythrum salicaria

Credit: Wikimedia Commons User Liz West

Identifying Features

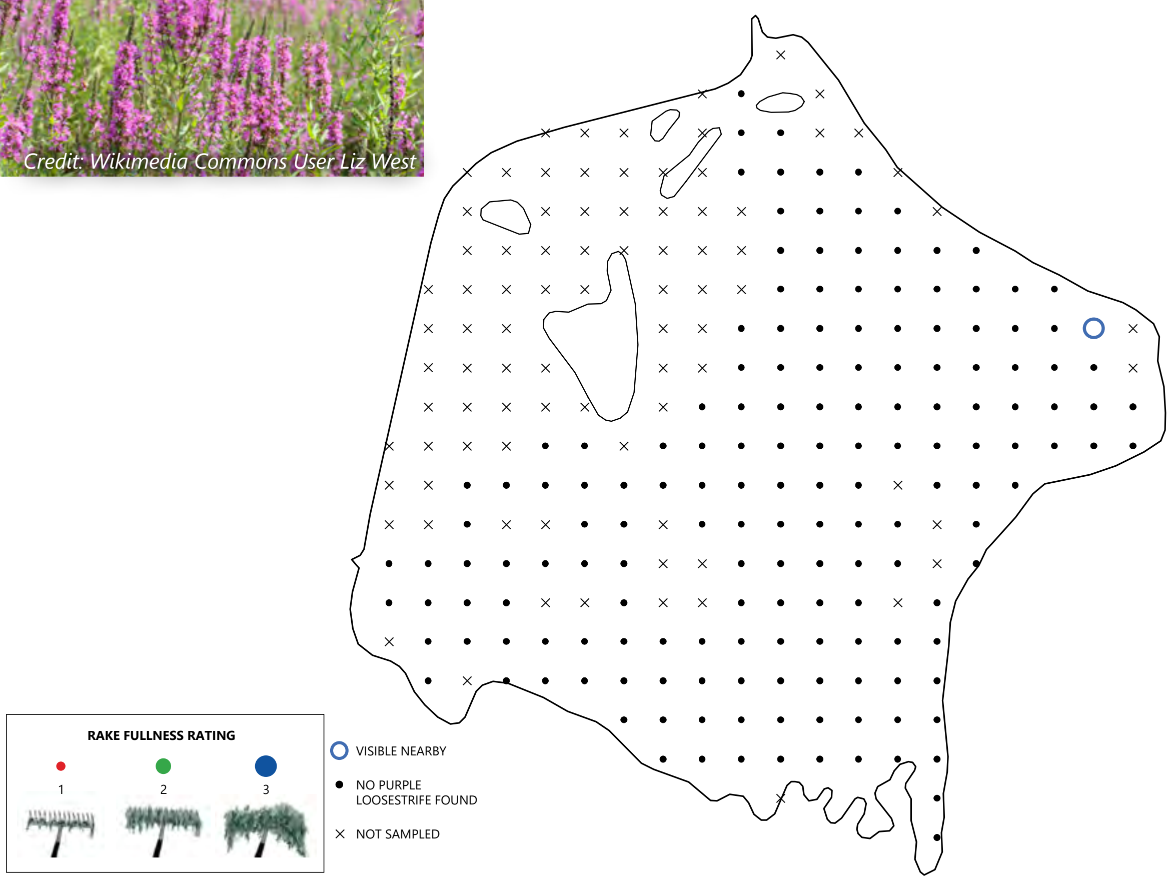
- Terrestrial or semi-aquatic, emergent forb
- Stems often angled with four, five, or more sides, and growing one to two meters tall
- Flowers deep pink or purple, six-parted, 12 to 25 mm wide, and in groups
- Leaves lance-like, four to 11 cm long and either opposite or in whorls of three

Purple loosestrife, if small, is similar to winged loosestrife (Lythrum alatum), but winged loosestrife differs in having leaves generally smaller (<5.0 cm long), leaves mostly alternate (only lower leaves opposite), and flowers mostly held singly in the leaf axils rather than in pairs or groups

Ecology/Control

- Found in shallows, along shores, and in wet to moist meadows and prairies
- Invasive and continues to escape from ornamental plantings
- Galerucella beetles have been successfully used to control purple loosestrife. Plants may also be dug or pulled when small, but they subsequently should be placed in a landfill or burned. Several herbicides are effective, but application near water may require permits and aquatic-use formulas

Credit: Wikimedia Commons User Liz West



Native

SAGO PONDWEED

Stuckenia pectinata

Credit: Flickr User Christian Fischer

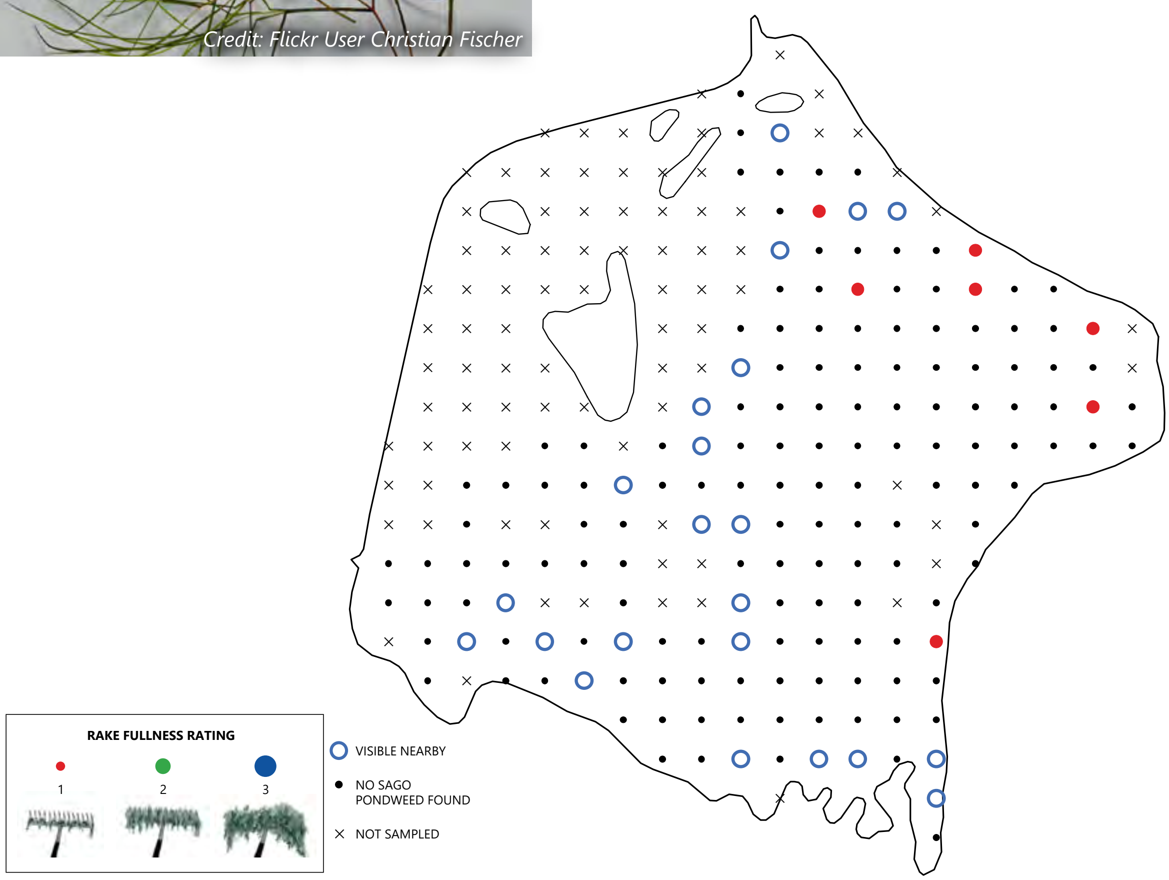
Identifying Features

- Stems often *slightly zig-zagged* and forked multiple times, yielding a fan-like form
- Leaves one to four inches long, very thin, and ending in a sharp point
- Whorls of fruits spaced along the stem may appear as beads on a string

Ecology

- Lakes and streams
- Overwinters as rhizomes and starchy tubers
- Tolerates murky water and disturbed conditions
- Provides abundant fruits and tubers, which are an *important food for waterfowl*
- Provides habitat for juvenile fish

Credit: Flickr User Christian Fischer



Native

SLENDER NAIAD

Najas flexilis

Credit: Flickr User Tab Tannery

Identifying Features

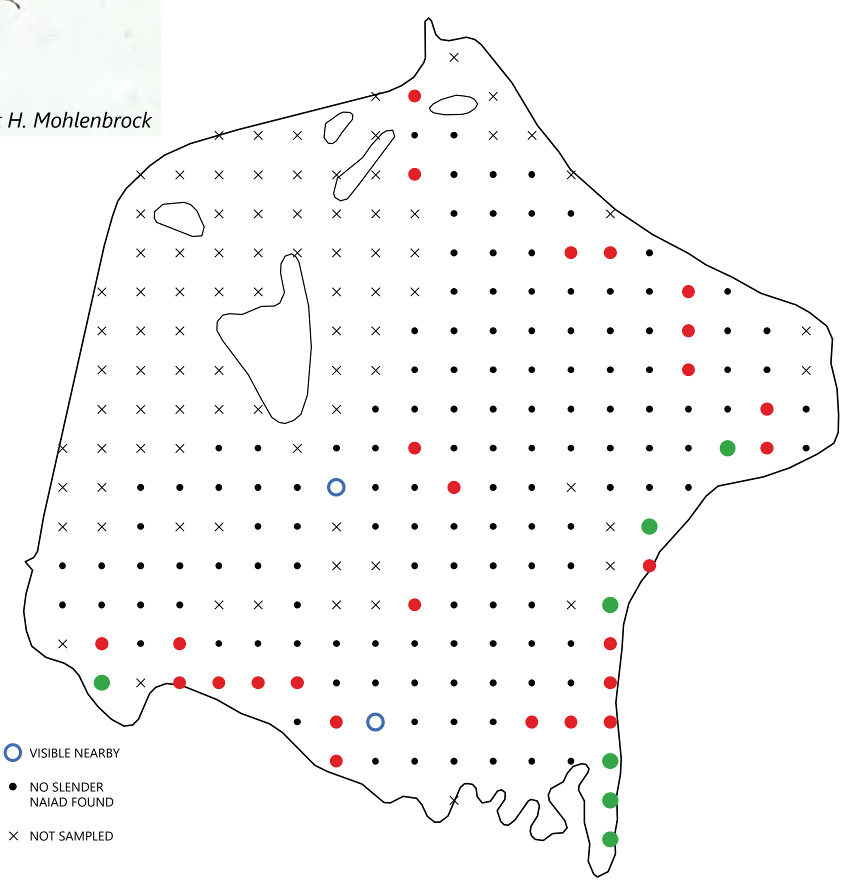
- Leaves narrow (0.4 to 1.0 mm) and pointed with broader bases where they attach to the stem and finely serrated margins
- Flowers, when present, tiny and located in leaf axils
- Variable size and spacing of leaves, as well as compactness of plant, depending on growing conditions

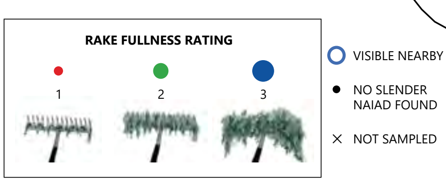
Two other Najas occur in southeastern Wisconsin. Southern naiad (N. guadalupensis) has wider leaves (to 2.0 mm). Spiny naiad (N. marina) has coarsely toothed leaves with spines along the midvein below

Ecology

- In lakes and streams, shallow and deep, often in association with wild celery
- One of the most important forages of waterfowl
- An annual plant that completely dies back in fall and regenerates from seeds each spring; also spreading by stem fragments during the growing season

Credit: Wikimedia Commons User Robert H. Mohlenbrock





Native

SOUTHERN NAIAD

Najas guadalupensis

Credit: Wikimedia Commons User Robert H. Mohlenbrock

Identifying Features

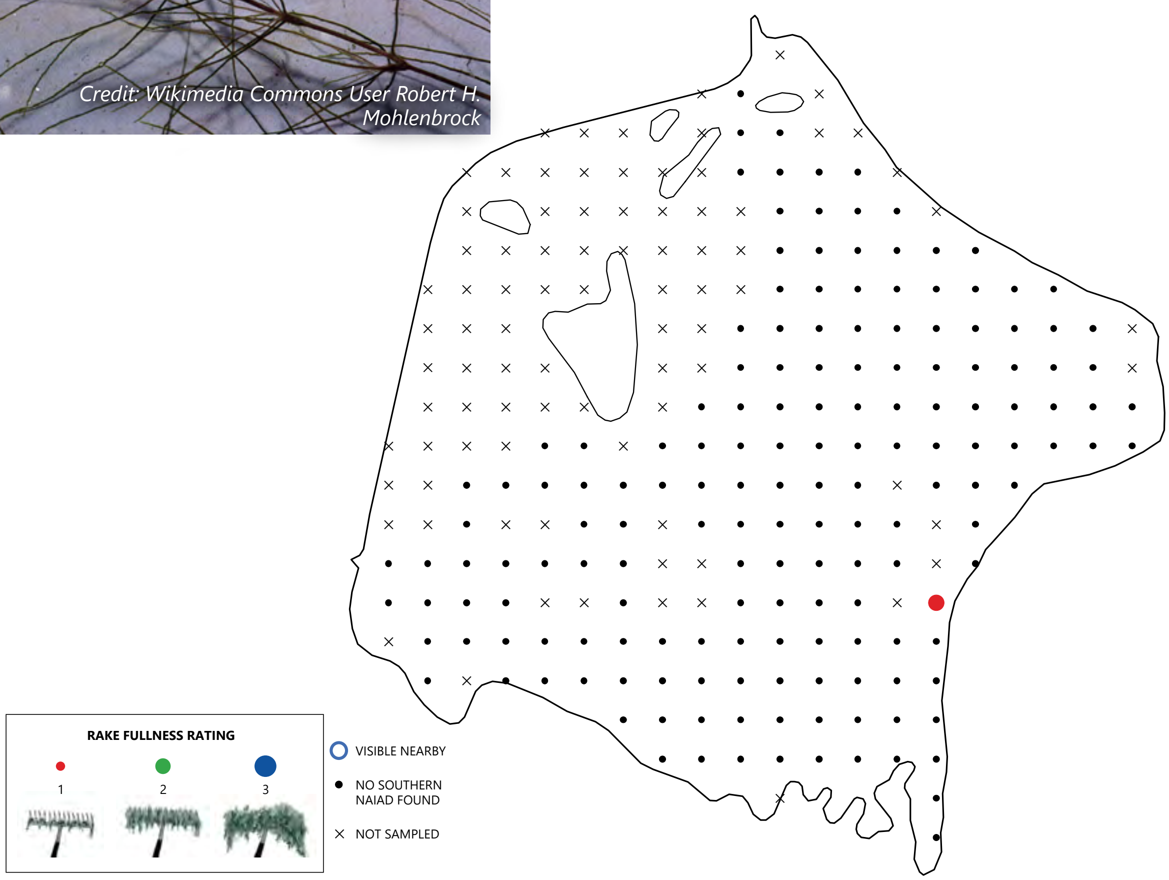
- Leaves 0.2 to 2.0 mm wide and blunt with slight shoulder bases where they attach to the stem and finely serrated margins
- Flowers, when present, tiny and located in leaf axils
- Leaves opposite and may appear loosely whorled

Two other Najas occur in southeastern Wisconsin. Slender naiad (*N. flexilis*) has narrower leaves (to 0.6 mm) with a pointed tip. Spiny naiad (*N. marina*) has coarsely toothed leaves with spines along the midvein below

Ecology

- In shallow to deep lakes and sandy, gravelly soil
- An annual plant that completely dies back in fall and regenerates from seeds each spring; also spreading by stem fragments during the growing season

Credit: Wikimedia Commons User Robert H. Mohlenbrock



Native

SPATTERDOCK
Nuphar variegata

Credit: Wikimedia Commons User Cephas

Identifying Features

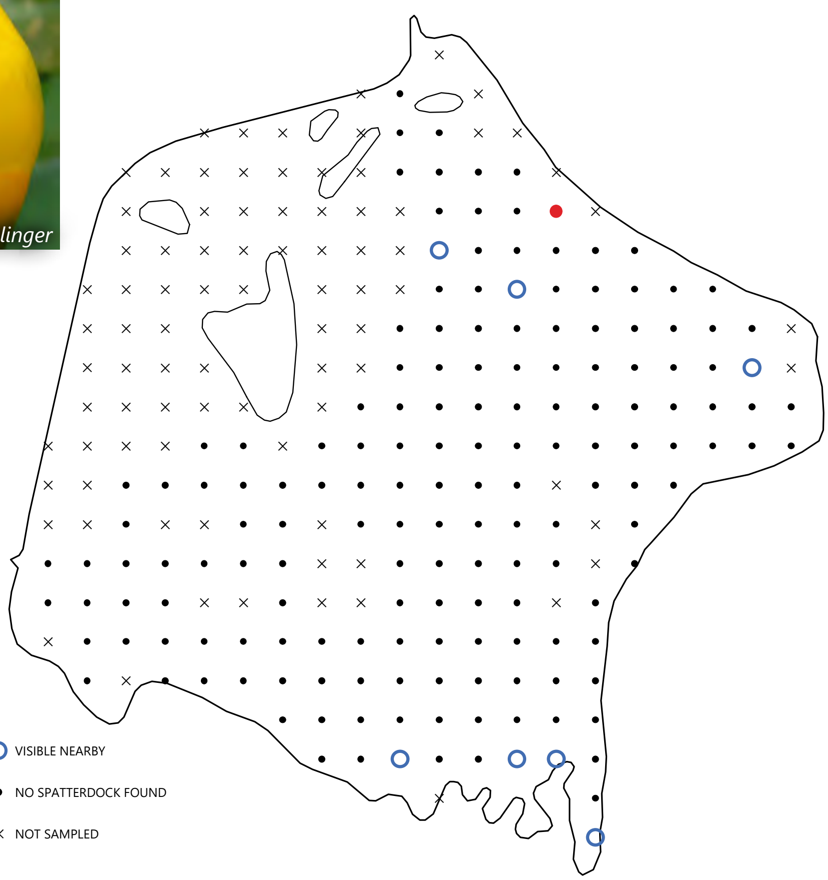
- Leaf stalks winged in cross-section
- Most leaves floating on the water surface, heart-shaped, and notched, with rounded lobes at the base
- Yellow flowers, 2.5 to 5.0 cm wide, often with maroon patches at the bases of the sepals (petal-like structures) when viewed from above

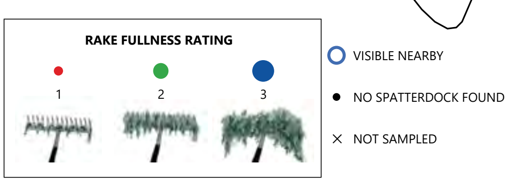
Unlike spatterdock, the similar yellow pond lily (Nuphar advena) has leaf stalks that are not winged in cross-section, leaves that more often emerge above the water surface, and leaf lobes that are more pointed. Spatterdock is superficially similar to water lilies (Nymphea spp.), but it has yellow versus white flowers and leaves somewhat heart-shaped versus round. American lotus (Nelumbo lutea) is also similar, but its leaves are round and un-notched, and its flowers are much larger

Ecology

- In sun or shade and mucky sediments in shallows and along the margins of ponds, lakes, and slow-moving streams
- Overwinters as a perennial rhizome
- Flowers opening during the day, closing at night, and with the odor of fermented fruit
- Buffers shorelines
- Provides food for waterfowl (seeds), deer (leaves and flowers), and muskrat, beaver, and porcupine (rhizomes)
- Habitat for fish and aquatic invertebrates

Credit: Flickr User Jason Hollinger





Nonnative/ Exotic

SPINY NAIAD

Najas marina

Credit: Wikimedia Commons User Pascale Guinchard

Identifying Features

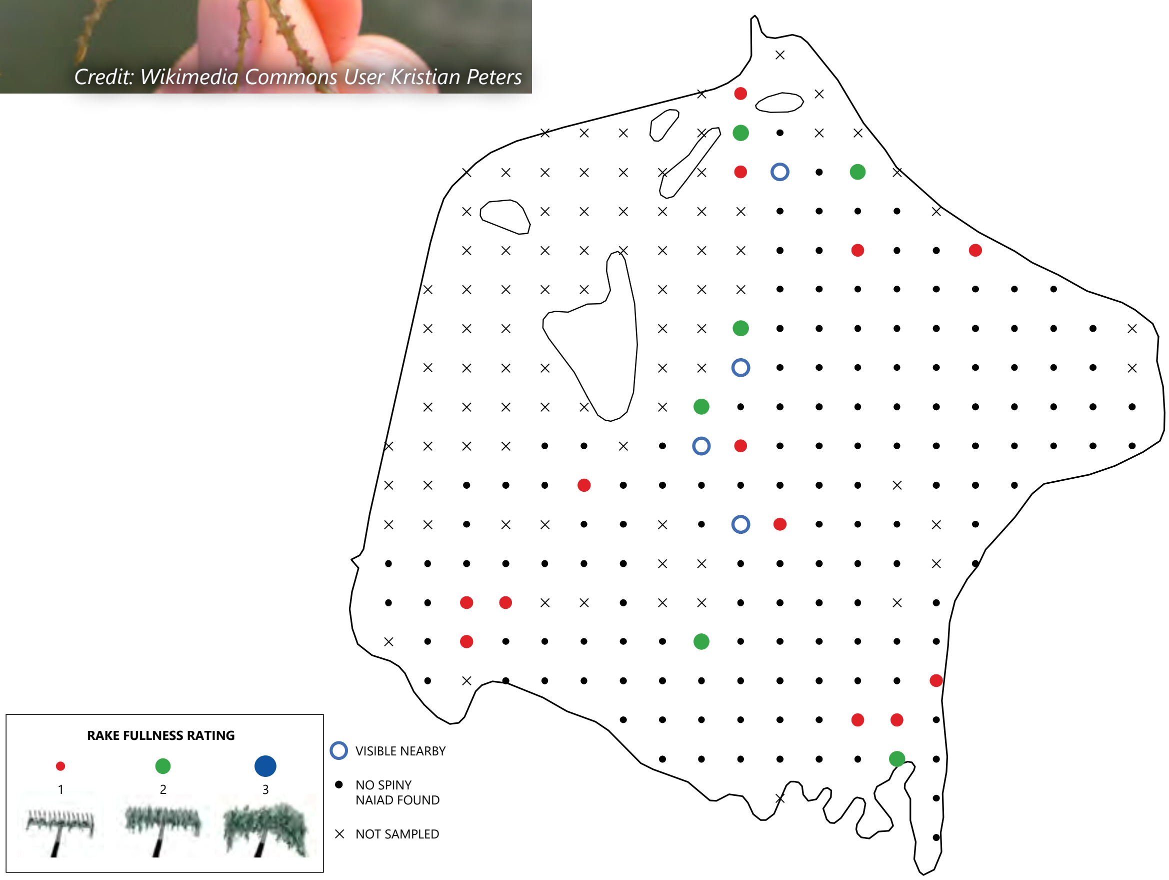
- Stems stiff and spiny, often branching many times
- Leaves stiff, 1.0 to 4.0 mm thick, with coarse teeth along the margins and midvein on the underside

Spiny naiad is quite distinct from other naiads due to its larger, coarsely toothed leaves and the irregularly pitted surface of its fruits. Spiny naiad is presumably introduced in Wisconsin, but it is considered native in other states, including Minnesota

Ecology

- Alkaline lakes, water quality ranging from good to poor
- An annual, regenerating from seed each year
- Occurs as separate male and female plants
- Capable of growing aggressively

Credit: Wikimedia Commons User Kristian Peters



Native

VARIABLE PONDWEED

Potamogeton gramineus

Credit: Wikimedia Commons User Tristan He

Identifying Features

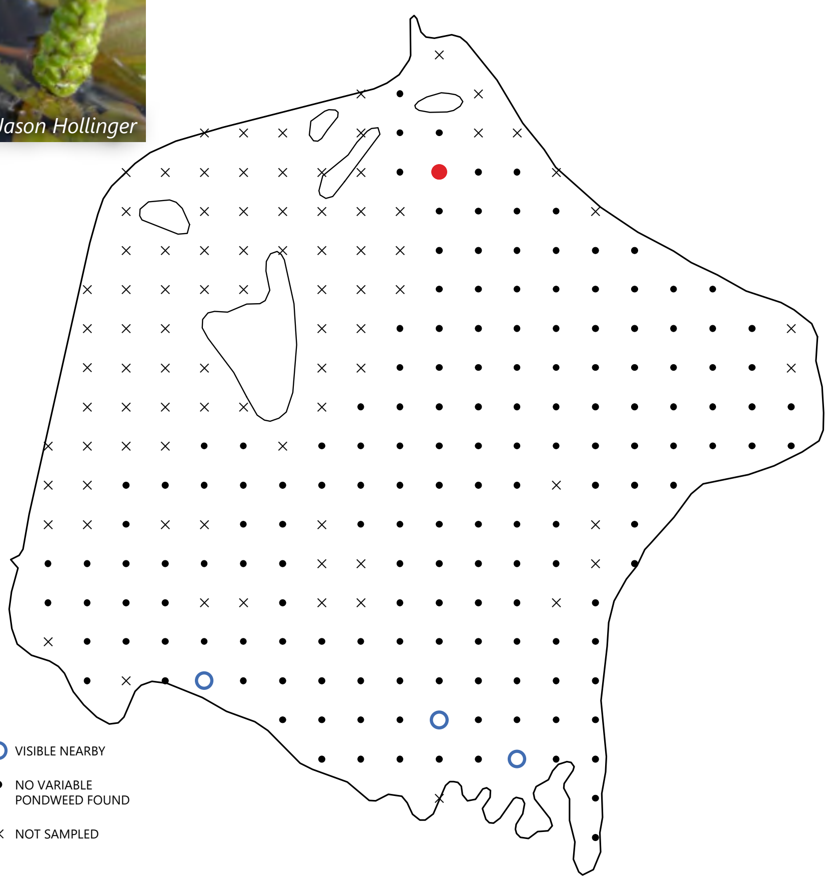
- Often heavily branched
- Submerged leaves narrow to lance-shaped, with three to seven veins, smooth margins, without stalks, but the blade tapering to the stem
- Floating leaves with 11 to 19 veins and a slender stalk that is usually longer than the blade
- Often covered with calcium carbonate in hard water

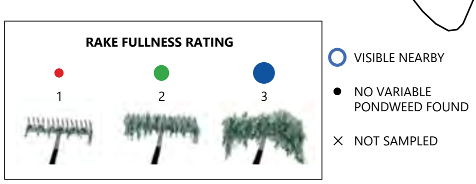
Variable pondweed is similar to Illinois pondweed (*P. illinoensis*), but Illinois pondweed has submerged leaves with nine to 19 veins

Ecology

- Shallow to deep water, often with muskgrass, wild celery, and/or slender naiad; requires more natural areas that receive little disturbance
- Overwinters as rhizomes or winter buds (turions)
- Provides food for waterfowl, muskrat, deer, and beaver
- Provides habitat for fish and aquatic invertebrates

Credit: Flickr User Jason Hollinger





Native

WATER BULRUSH

Schoenoplectus subterminalis

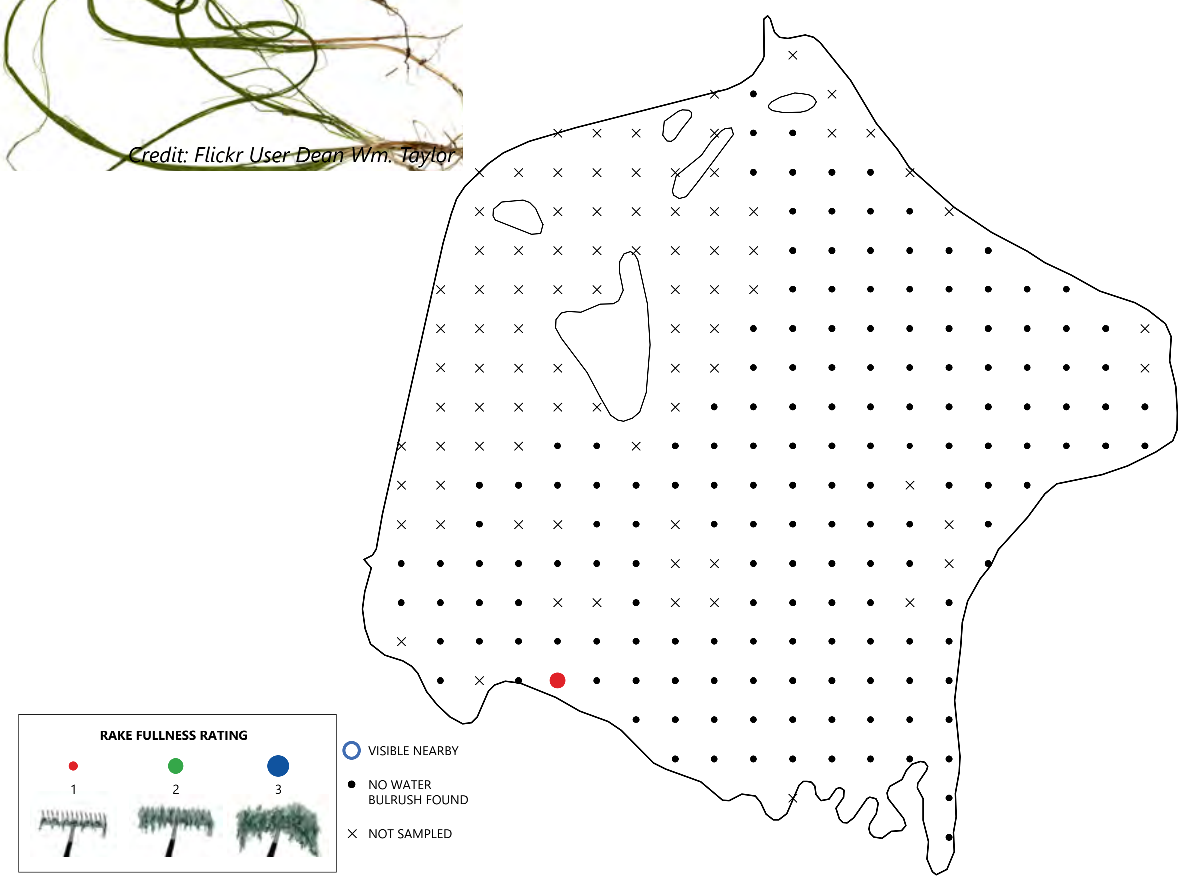
Identifying Features

- Leaves hair-like, with one to five veins length-wise and some perpendicular "cross veins"
- Leaves sheathing one another at the base
- Spikelets (fertile structures), when present, 7.0 to 12 mm long, with a floral leaf extending above the spikelet

The fine submersed leaves of water bulrush could be confused with the fine, submersed stems of Robbins' spikerush (*Eleocharis robbinsii*). However, the stems of Robbins' spikerush are separate from one another, unlike the fine leaves of water bulrush, which sheath each other at the base of each shoot

Ecology

- Found in a variety of shallow to deep waters
- Spreading by rhizomes, forming grass-like, submersed meadows
- Provides phosphorus to algae that grow on its surface, which, in turn, are important for invertebrate growth
- Provides habitat for invertebrates and fish



Native

WATER STARGRASS

Heteranthera dubia

Credit: Wikimedia Commons User Fritzflohrreynolds

Identifying Features

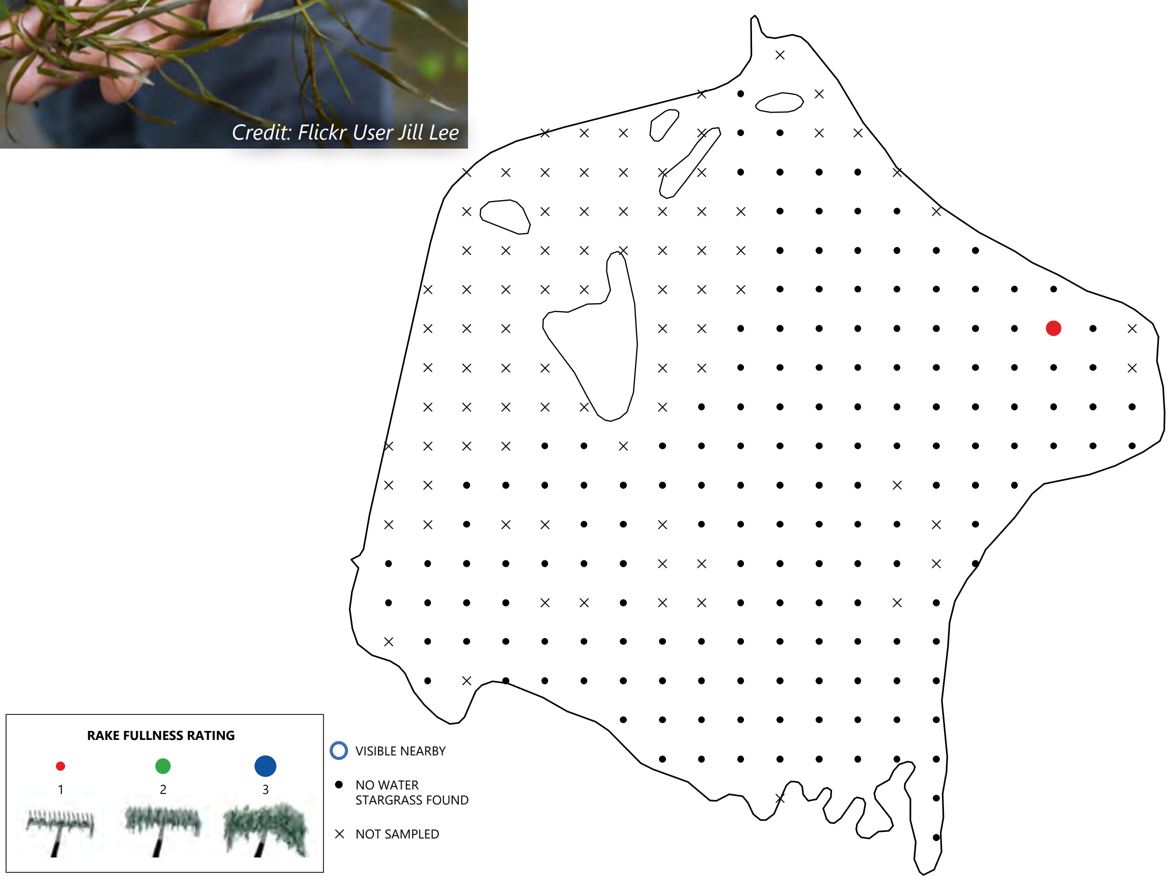
- Stems slender, slightly flattened, and branching
- Leaves narrow, alternate, with no stalk, and lacking a prominent midvein
- When produced, flowers conspicuous, yellow, and star-shaped (usually in shallow water) or inconspicuous and hidden in the bases of submersed leaves (in deeper water)

Yellow stargrass may be confused with pondweeds that have narrow leaves, but it is easily distinguished by its lack of a prominent midvein and, when present, yellow blossoms

Ecology

- Found in lakes and streams, shallow and deep
- Tolerates somewhat turbid waters
- Overwinters as perennial rhizomes
- Limited reproduction by seed
- Provides food for waterfowl and habitat for fish

Credit: Flickr User Jill Lee



Native

WHITE WATER LILY

Nymphaea odorata

Credit: Flickr User Ryan Hodnett

Identifying Features

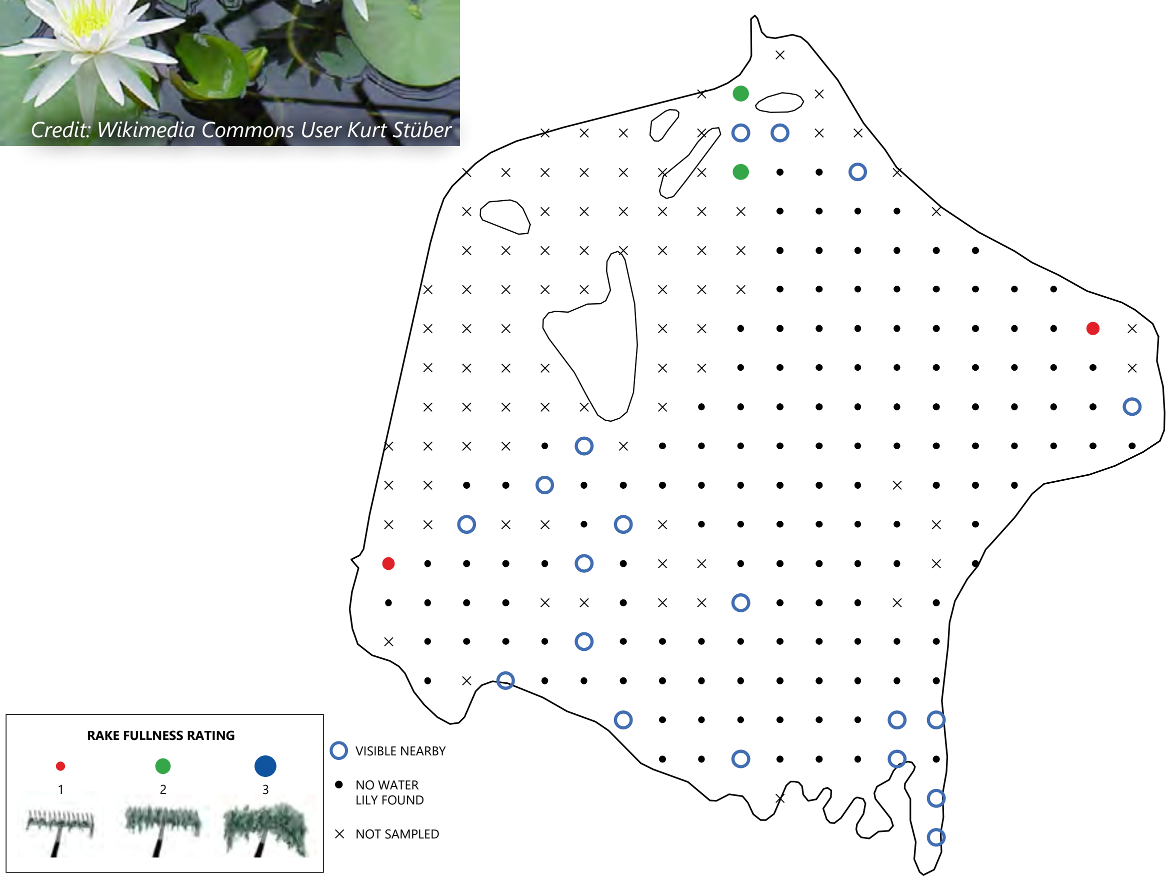
- Leaf stalks round in cross-section with four large air passages
- Floating leaves round (four to 12 inches wide under favorable conditions), *with a notch* from the outside to the center, and reddish-purple underneath
- Flowers white with a yellow center, three to nine inches wide

Pond lilies (*Nuphar* spp.) are superficially similar, but have yellow flowers and leaves somewhat heart-shaped. American lotus (*Nelumbo lutea*) is also similar, but its leaves are unnotched

Ecology

- Found in shallow waters over soft sediments
- Leaves and flowers emerge from rhizomes
- Flowers opening during the day, closing at night
- Seeds consumed by waterfowl, rhizomes consumed by mammals

Credit: Wikimedia Commons User Kurt Stüber



PURPLE LOOSESTRIFE BIOLOGICAL CONTROL

APPENDIX B

Purple Loosestrife Biological Control

Helping Native Plants Battle Invasive Species

Golden Sands
Resource Conservation
& Development Council, Inc.

February to March — Plan

Meet with local partners to gauge interest

Locate and solidify needed permission for root digging, beetle collection, and release area work sites

Submit DNR permit authorization application

Contact potential volunteers, explain process, and confirm intention to help dig and/or raise beetles

April — Spring Dig

Collect purple loosestrife roots and shoots in April

Place potted plants in a pool filled with water

Keep water two inches below the top of the soil so to not drown larvae

Cover with nets to keep predators out

Mid-May — Add Beetles

Collect beetles from the wild in mid-May

Collect 8-10 beetles for every potted plant

Place beetles on plant inside the net

By mid-summer, the beetles will have reproduced into as many as 1,000 beetles per plant!

May to June — Watch and Maintain

Keep pools filled with water

Make sure beetles do not eat their entire food source

Once the food source is almost gone, the plant can be moved to an existing stand, and nets can be removed

Late June to Early July — Release

Release beetles into a stand of purple loosestrife when their food source is low, usually late June to early July

The beetles can then go to work on controlling the existing stand!

After releasing, fill out and return the DNR insect release form to the state

Throughout the summer — Biological Control

By eating the plant, the beetles stress the plant so it does not flower

This helps native plants take back the wetland, as every year, each purple loosestrife plant produces over 1 million seeds from pollinated flowers

Remember to collect the plant pots for rearing next year!

Forms and addresses can be found online at http://dnr.wi.gov/topic/Invasives/loosestrife.html

To learn more, find and contact your local Aquatic Invasive Species Coordinator at http://dnr.wi.gov/lakes/invasives/topics.aspx