Ohio Invasive Plant Assessment Protocol - 2015

Botanical Name: *Myriophyllum spicatum L.*
Common Name: Eurasian water-milfoil
Family Name: Haloragaceae
Assessment conducted by: Allison Mastalerz, Theresa Culley

Step I Outcome: **Invasive**
Step II Score: **69**
Step II Outcome: **Invasive**

		Team Score	Notes	References
Step I	*Directions: Place an "X" in the Score column next to the selected answer to each of the four questions.*			
1. Is this plant known to occur in the state and listed as "noxious" on any federal or Ohio Department of Agriculture plant list?	Yes. *Place on invasive plant list, no further investigation needed.* ***STOP***			
	No. *Continue on to question 2.*	x		
2. Has this plant demonstrated widespread dispersion and establishment (i.e. high numbers of individuals forming dense stands) in natural areas across two or more regions in Ohio?[a]	Yes. *Place on invasive plant list, no further investigation needed.* ***STOP***	x	Species is in all five regions in Ohio	7
	No. *Continue on to question 3.*			
3. Does this plant form self-replicating populations outside of cultivation in Ohio and is it documented to alter the composition, structure, or normal processes or functions of a natural ecosystem?	Yes	x	See references under Step II below.	
	No			
	Unknown			
4. Is the plant listed as invasive in an adjoining state or a nearby state east of the Mississippi within the USDA Plant Hardiness zones 5-6?[b,c]	Yes	x	PA, IN, MI, WV (moderate threat)	2,3,4,5
	No			
	Unknown			
	If the answer was yes for both questions 3 and 4, the plant is placed on the invasive plant list and no further research is needed. Stop here. If the answer is no for both questions 3 and 4, the plant is not considered invasive and no further investigation is warranted. Otherwise, proceed to Step II.			
	Step II: Invasion Status			
	Directions: Place the appropriate numerical score (or "U") in the Score column next to the selected answer to each of these 18 questions.			
1. Current Invasion in Ohio - plant is not found in natural areas (**0 pts.**) - plant is found in natural areas but only because it persist from previous planting in that location (e.g. old home sites) (**0 pts.**) - plant is only expanding from sites of previous planting (**1 pt.**) - plant occurs in natural areas away from site of planting (**3 pts.**) - Information unknown (**U**)		3	Plant was introduced via cultivation and has now spread out of cultivation.	10,11
2. State Distribution[a] - plant is not naturalized in any region of Ohio (**0 pts.**) - plant is naturalized in only one region in Ohio (**1 pt.**) - plant is naturalized in two regions in Ohio (**2 pts.**) - plant is naturalized in three regions in Ohio (**3 pts.**) - plant is naturalized in four regions in Ohio (**4 pts.**) - plant is naturalized in five regions in Ohio (**5 pts.**) - Information unknown (**U**)		5		7
3. Regional/US Distribution - plant is not considered to be a problem in any other state (**0 pts.**) - plant has been reported as a widespread problem in another non-neighboring state within the USDA Plant Hardiness Zones 5-6 (**1 pt.**) - plant has been reported to be a widespread problem in 1-2 adjoining states (**3 pts.**) - plant has been reported to be a widespread problem in 3 or more adjoining states (**5 pts.**) - plant has been reported to be a widespread problem in similar habitat outside the US (**1 pt.**) - Information unknown (**U**)		5	PA, IN, MI, WV (moderate threat)	2,3,4,5
	Step II: Biological Characters			
4. Vegetative Reproduction - no vegetative reproduction (**0 pts.**) - reproduces readily within the original site (**1 pt.**) - has runners or spreading rhizomes that root easily (**3 pts.**) - fragments easily and fragments can be easily dispersed (**4 pts.**) - has runners or spreading rhizomes that root easily AND fragments easily and fragments can be easily dispersed (**5 pts.**) - Information unknown (**U**)		5	14: fragmentation and flowering were increased at decreased salinities. 17: vegetative propagation is prevalent and highly visible, plant is often considered to spread by fragmentation.	8,9,10,11,14,17,18
5. Sexual Reproduction - no sexual reproduction (**0 pts.**) - infrequent sexual reproduction (**1 pt.**)			9: Species can produce viable seeds, and some researchers believe that clonal diversity in natural populations may be higher than previously thought. 14:	

- frequent sexual reproduction, but high variation among years in seed production (**3 pts.**) - frequent sexual reproduction (one or more events per year) (**5 pts.**) - Information unknown (**U**)	1	Additionally, hybrids from M. spicatum x M. sibiricum produce viable seed. 17: seeds can germinate but it depends on the degree of sedimentation; plants produce 112 seeds per stalk.	9,14,17
6. Number of Viable Seeds or Propagules per Plant - few (0-10) (**1 pt.**) - moderate (11-1,000) (**3 pts.**) - prolific (>1,000) (**5 pts.**) - Information unknown (**U**)	3	11:"Variations in annual [reproduction] patterns result from differences in climate, water clarity and rooting depth. Plants growing in shallow water can reach the surface within a month or less of initiating growth, and are particularly likely to exhibit several biomass maxima and fragmentation periods. In deep clear water, plants typically grow continuously throughout the summer and reach the surface late in the growing season, if at all....fragmentation does not occur until after the single, late-summer biomass peak." 17: in NY, a young population produced 112 seeds per stalk with multiple stalks per population. [This answer is conservative for Ohio until we have estimates from our state.]	11,17
7. Flowering Period - one month or less per year (**0 pts.**) - two months (**1 pt.**) - three to five months (**2 pts.**) - longer than five months (**3 pts.**) - Information unknown (**U**)	2	10: June-September, but this depends on various environmental conditions. 17: in NY, flowering occurs once or twice annually, usually in mid to late July and in August. [The answer is considered conservative, and with more data regarding Ohio populations, answer will likely increase.] 18: in WI, flowering occurs in mid to late June and then again in mid-August.	10,11,17,18
8. Dispersal Ability - low potential for long-distance seed/propagule dispersal (>1km) (**0 pts.**) - medium potential for long-distance seed/propagule dispersal (**3 pts.**) - high potential for long-distance seed/propagule dispersal (**5 pts.**) - Information unknown (**U**)	5	seeds and propagules disperse via water, but are transported between wetlands via anthropogenic transfer of plant fragments. Migratory ducks are also known to transport seeds through their digestive track.	8
9. Generation Time - long juvenile period (>5 or more years for trees, 3 or more years for other growth forms) (**0 pts.**) - short juvenile period (<5 years for trees, <3 years for other forms) (**3 pts.**) - Information unknown (**U**)	3	18: Species is a perennial and overwinters under ice cover.	11,18
10. Establishment - unable to invade natural areas (**0 pts.**) - can only colonize certain habitat stages (e.g. early successional habitats) (**1 pt.**) - aggressively colonizes and establishes in edge habitats (**3 pts.**) - aggressively colonizes and establishes in intact and healthy natural areas (**6 pts.**) - Information unknown (**U**)	6	20: Dense canopy growth can reduce growth but not establishment of this very aggressive species.	11,20
Step II: Ecological Importance			
11. Impact on Ecosystem Processes - no known effect on ecosystem-level processes (**0 pts.**) - moderate effects on ecosystem-level processes (e.g., changes in nutrient cycling)(**3 pts.**) - causes long-term, substantial alterations in the ecosystem (e.g., changing fire regime of an area, changing hydrology of wetlands) (**6 pts.**)	6	Large populations can alter temperature profiles in a lake by as much as 10 Celsius degrees/m in shallow water. Lowers dissolved oxygen concentrations. Degrades fish habitat (negatively impacts spawning and foodwebs). 13: In Egypt in its native range, the species is used for bioremediation to remove heavy metals from waterways. 15: "alters the community composition of aquatic macroinvertebrates and may impair the ability of some fish to spawn..." 16: in the Pacific Northwest, the species reduced dissolved oxygen concentrations and increased pH >10.	10,11,12,13,14,15,16
12. Impact on Rare Organisms - no known negative impact on Ohio State-listed or federal-listed plants or animals (**0 pts.**) - negatively impacts listed species, such as through displacement or interbreeding (**3 pts.**)	3	milfoil impacts rare species in lakes	22
13. Impact on Native Animals - no known negative impact on animals (**0 pts.**) - documented direct or indirect negative effects on animal taxa (**3 pts.**)	3	8:"Zooplankton densities averaged over 20 times higher in mesocosms with M. sibiricum compared to those with the invasive M. spicatum." 10: "through competition it can reduce the quantities of desirable duck food species" 11: reduces the quality of sport fisheries. 15: "alters the community composition of aquatic macroinvertebrates and may impair the ability of some fish to spawn..." 19: Species had short-term inhibitory patterns on phytoplankton and green algae but consistent negative effects on cyanobacteria biomass (indicates that M. spicatum is allelopathic). 21: species produces allelopathic effects on cyanobacteria dank chlorophytes.	8,10,11,12,15,19,21
14. Impact on Native Plants - no known negative effects on native plants (**0 pts.**)		10:"invades communities of submerged aquatic plants and within 2-3 years	

Step II

- negatively impacts some native plants (increasing their mortality and/or recruitment of certain taxa) (**3 pts.**) - impacts native plants to such an extent that community structure is greatly altered (**6 pts.**)	6	competitively displaces most other plants, forming a weed bed that may cover a larger area than was originally present. 15: an increase in the species over a decade in Lake George, NY resulted in a decline in species richness (13 of 20 native plant species were eliminated) and abundance of native species (expansion was only curtailed by a physical barrier).	10,11,12,15,21
15. Hybridization - no known instances of hybridization with other plant species (**0 pts.**) - can hybridize with native Ohio plants or commercially-available species, but seeds are inviable (**1 pt.**) - can hybridize with native Ohio plants or commercially-available species, producing viable seed (**3 pts.**)	3	9: can cross with native northern watermilfoil (Myriophyllum sibiricum)	9
16. Population Density - occurs only as small, sporadic populations or individuals (**1 pt.**) - typically forms small, monospecific patches (**3 pts.**) - is a dominant plant in area where population occurs (absolute cover 15-50%) (**4 pts.**) - forms an extensive, monospecific stand (absolute cover >50%) (**5 pts.**)	5		10,12
17. Role in Succession in Natural Areas - successional information is unknown (**0 pts.**) - is an early successional species that temporarily invades a disturbed site but does not persist as the site matures (**0 pts.**) - readily invades disturbed sites and persists, but does not interfere with succession (**1 pt.**) - readily invades disturbed sites, persists and interferes with succession of native plants (**4 pts.**)	4	Although specific information on succession was not found in the literature, the species is so invasive that it creates expansive, monospecific beds that suppress native communities over years. For example, reference 15 reports that the species persisted (and expanded) over 11 years in a single lake. Therefore the maximum points are given for this answer.	15
18. Number of Habitats Invaded ***Forestlands:*** Floodplain forest, hemlock-hardwood forest, mixed mesophytic forest, beech-maple forest, oak-maple forest, oak-hickory forest. ***Grasslands:*** Alvar*, beach-dune community*, bur oak savanna*, slough-grass-bluejoint prairie*, sand barren*, big bluestem prairie, little bluestem prairie (xeric limestone prairie*+), post oak opening*+ ***Wetlands:*** Bog*, fen*, twigrush-wiregrass wet prairie*, marsh, buttonbush swamp, mixed shrub swamp, hemlock-hardwood swamp*, maple-ash-oak swamp, white pine-red maple swamp* * Considered a rare plant community in Ohio by ODW's Biodiversity Database Program. + = xeric limestone prairies or cedar glades and post oak openings are unique to the Interior Low Plateau Region of Adams, Highland and Pike counties, and are not included in Schneider and Cochrane (1997). - not found in any natural habitats in Ohio (**0 pts.**) - only found in 1 broad category (**1 pt.**) - found in 2 broad categories or 2 rare habitat types (**3 pts.**) - found in 3 broad categories or 3 rare habitat types (**4 pts.**) - found in 4 or more rare habitat types (**5 pts.**)	1	Species is aquatic.	8,9,10,11,12
	Total Score:	**69**	
	Number of Unknowns:	**0**	
	Outcome:	**Invasive**	

Total Points	Assessment Decision
4 or more U	Insufficient Data
0-34	Not Known to be Invasive
35-44	Pending Further Review
45-80	Invasive