

Australia/New Zealand Weed Risk Assessment adapted for Florida.

Data used for analysis published in: Gordon, D.R., D.A. Onderdonk, A.M. Fox, R.K. Stocker, and C. Gantz. 2008. Predicting Invasive Plants in Florida using the Australian Weed Risk Assessment. *Invasive Plant Science and Management* 1: 178-195.

<i>Myriophyllum spicatum</i> (Eurasian water-milfoil)			
Question number	Question	Answer	Score
1.01	Is the species highly domesticated?	n	0
1.02	Has the species become naturalised where grown?		
1.03	Does the species have weedy races?		
2.01	Species suited to Florida's USDA climate zones (0-low; 1-intermediate; 2-high)	2	
2.02	Quality of climate match data (0-low; 1-intermediate; 2-high)	2	
2.03	Broad climate suitability (environmental versatility)	y	1
2.04	Native or naturalized in habitats with periodic inundation	y	1
2.05	Does the species have a history of repeated introductions outside its natural range?	y	
3.01	Naturalized beyond native range	y	0
3.02	Garden/amenity/disturbance weed	n	0
3.03	Weed of agriculture	y	0
3.04	Environmental weed	y	0
3.05	Congeneric weed	y	0
4.01	Produces spines, thorns or burrs	n	0
4.02	Allelopathic	n	0
4.03	Parasitic	n	0
4.04	Unpalatable to grazing animals		
4.05	Toxic to animals	n	0
4.06	Host for recognised pests and pathogens		
4.07	Causes allergies or is otherwise toxic to humans	n	0
4.08	Creates a fire hazard in natural ecosystems	n	0
4.09	Is a shade tolerant plant at some stage of its life cycle	y	1
4.1	Grows on infertile soils (oligotrophic, limerock, or excessively draining soils)	n	0
4.11	Climbing or smothering growth habit	n	0
4.12	Forms dense thickets	y	1
5.01	Aquatic	y	5

5.02	Grass	n	0
5.03	Nitrogen fixing woody plant	n	0
5.04	Geophyte	n	0
6.01	Evidence of substantial reproductive failure in native habitat		
6.02	Produces viable seed	y	1
6.03	Hybridizes naturally	y	1
6.04	Self-compatible or apomictic		
6.05	Requires specialist pollinators	n	0
6.06	Reproduction by vegetative fragmentation	y	1
6.07	Minimum generative time (years)		
7.01	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y	1
7.02	Propagules dispersed intentionally by people	y	1
7.03	Propagules likely to disperse as a produce contaminant	n	-1
7.04	Propagules adapted to wind dispersal	n	-1
7.05	Propagules water dispersed	y	1
7.06	Propagules bird dispersed	y	1
7.07	Propagules dispersed by other animals (externally)		
7.08	Propagules dispersed by other animals (internally)		
8.01	Prolific seed production		
8.02	Evidence that a persistent propagule bank is formed (>1 yr)	?	
8.03	Well controlled by herbicides	y	-1
8.04	Tolerates, or benefits from, mutilation or cultivation	y	1
8.05	Effective natural enemies present in Florida, or east of the continental divide	y	-1
<b>Total Score</b>			<b>25</b>

<b>Outcome</b>	<b>Reject*</b>
----------------	----------------

\*Used secondary screen from: Daehler, C. C., J.L. Denslow, S. Ansari, and H. Kuo. 2004. A risk assessment system for screening out harmful invasive pest plants from Hawaii's and other Pacific islands. *Conserv. Biol.* 18: 360-368.

section	# questions answered	satisfy minimum?
A	8	yes
B	10	yes
C	17	yes
total	35	yes

Data collected 2006-2007

Question number	Reference	Source data
1.01		no evidence of selection for reduced weediness
1.02		
1.03		
2.01	Weber (2003) Invasive Plant Species of the World. CABI Publishing.	Native or naturalized from temperate to tropical climates around the world.
2.02		
2.03	Weber (2003) Invasive Plant Species of the World. CABI Publishing.	Native from temperate to tropical climates in Europe, north Africa, and Asia; naturalized throughout North America.
2.04	Preston and Croft (1997) Aquatic Plants in Britain and Ireland. Harley Books.	submersed aquatic
2.05	1. Weber (2003) Invasive Plant Species of the World. CABI Publishing. 2. Huxley (1992) The New Royal Horticultural Society Dictionary of Gardening. Stockton Press, New York.	Exotic in North America, southern Africa, and tropical South America (1), and used in aquaculture (2).
3.01	Weber (2003) Invasive Plant Species of the World. CABI Publishing.	Naturalized or invasive in North America, southern Africa, and tropical South America.
3.02		no evidence
3.03	Holm, Doll, Holm, Pancho, and Herberger (1997) World weeds: natural histories and distribution. John Wiley & Sons, New York.	"It is a weed of rice in China, the Phillipines, Portugal, the United States, and the former Yugoslavia."
3.04	1. Madsen, Sutherland, Bloomfield, Eichler, and Boylen (1991) The decline of native vegetation under dense Eurasian watermilfoil canopies. Journal of Aquatic Plant Management 29: 94-99. 2. Weber (2003) Invasive Plant Species of the World. CABI Publishing.	1. "the proliferation of this species adversely impacts aquatic ecosystems...dense canopies formed by Eurasian watermilfoil often shade out native vegetation...this study clearly documents the intrusion of Eurasian watermilfoil into a healthy native littoral zone plant community" 2. <i>M. spicatum</i> also considered an invader of natural areas in Canada.
3.05	Richardson, Macdonald, Hoffman, and Henderson (1997) Alien plant invasions. Pp. 535-570 in Cowling, Richardson, and Pierce (eds) Vegetation of Southern Africa,	<i>M. aquaticum</i> is considered one of 84 important environmental weeds in southern African biomes.

	Cambridge University Press.	
4.01	Preston and Croft (1997) Aquatic Plants in Britain and Ireland. Harley Books.	no description of these traits
4.02		no evidence
4.03		no evidence
4.04		
4.05		no evidence
4.06		
4.07		no evidence
4.08	Preston and Croft (1997) Aquatic Plants in Britain and Ireland. Harley Books.	submersed aquatic
4.09	Preston and Croft (1997) Aquatic Plants in Britain and Ireland. Harley Books.	submersed aquatic
4.1	1. Preston and Croft (1997) Aquatic Plants in Britain and Ireland. Harley Books. 2. Smith and Barko (1990) Ecology of Eurasian Watermilfoil. Journal of Aquatic Plant Management 28: 55-64.	1. " <i>M. spicatum</i> usually grows in water which is...meso-eutrophic or eutrophic." 2. "Over the spectrum of infertile to enriched aquatic systems, Eurasian watermilfoil appears to prefer an approximate midpoint...the most oligotrophic of the Okanagan Lakes, Kalamalka Lake, supports only relatively sparse, scattered Eurasian watermilfoil." See Fig. 1 - the oligotrophic end of the trophic status spectrum corresponds to the lowest relative abundance of Eurasian watermilfoil.
4.11	Preston and Croft (1997) Aquatic Plants in Britain and Ireland. Harley Books.	submersed aquatic
4.12	1. Holm, Doll, Holm, Pancho, and Herberger (1997) World weeds: natural histories and distribution. John Wiley & Sons, New York. 2. Sheldon and Creed (1995) Use of a native insect as a biological control for an introduced weed. Ecological Applications 5: 1122-1132.	1. "As it approaches the surface, the plant branches profusely, spreading horizontally to form large masses called 'milfoil meadows' that may be several kilometers in size. Some masses are several decimeters in thickness." 2. "... <i>M. spicatum</i> beds grow as thick, impenetrable walls of uniform height and leaf form."
5.01	Holm, Doll, Holm, Pancho, and Herberger (1997) World weeds: natural histories and distribution. John Wiley & Sons, New York.	" <i>M. spicatum</i> is a...submersed, aquatic herb"
5.02	Preston and Croft (1997) Aquatic Plants in Britain and Ireland. Harley Books.	Haloragaceae
5.03	Preston and Croft (1997) Aquatic Plants in Britain and Ireland. Harley Books.	Haloragaceae
5.04	Holm, Doll, Holm, Pancho, and Herberger (1997) World weeds: natural histories and distribution. John Wiley & Sons, New York.	"adventitious roots on lower side of stem when on or in mud"
6.01		
6.02	Holm, Doll, Holm, Pancho, and Herberger (1997) World weeds: natural histories and distribution. John Wiley & Sons, New York.	Seedlings are rarely if ever observed in nature, but "seeds gathered from plants or substrates germinated readily when

		taken into laboratories." [seeds produced in nature germinate]
6.03	Moody and Les (2002) Evidence of hybridity in invasive watermilfoil ( <i>Myriophyllum</i> ) populations. PNAS 99: 14867-14871.	<i>M. spicatum</i> confirmed to hybridize with native <i>M. sibiricum</i> in Wisconsin and Minnesota lakes.
6.04		
6.05	Holm, Doll, Holm, Pancho, and Herberger (1997) World weeds: natural histories and distribution. John Wiley & Sons, New York.	"Data are lacking, but most workers speculate that a significant portion of the pollination is by wind; there is some pollination by insects."
6.06	Smith and Barko (1990) Ecology of Eurasian Watermilfoil. Journal of Aquatic Plant Management 28: 55-64.	"Vegetative spread of Eurasian watermilfoil by stem fragmentation and stolon formation is thought to be the major means of both intra- and interlake dispersal."
6.07		
7.01	1. Smith and Barko (1990) Ecology of Eurasian Watermilfoil. Journal of Aquatic Plant Management 28: 55-64. 2. Holm, Doll, Holm, Pancho, and Herberger (1997) World weeds: natural histories and distribution. John Wiley & Sons, New York.	1. "...human activities, such as recreational boat traffic, are believed to be one of the most important means of dispersal". <i>M. spicatum</i> has also been spread through ballast dumped from ships (2).
7.02	Huxley (1992) The New Royal Horticultural Society Dictionary of Gardening. Stockton Press, New York.	" <i>M. spicatum</i> and <i>M. verticillatum</i> are useful as oxygenators and as shelter for fish spawn in cold water pools and aquaria."
7.03		no evidence
7.04	1. Henderson (2001) Alien Weeds and Invasive Plants: a Complete Guide to Declared Weeds and Invaders in South Africa. Plant Protection Research Institute Handbook No. 12. 2. Grime, Hodgson, and Hunt (1988) Comparative Plant Ecology: a Functional Approach to Common British Species. Unwin Hyman Ltd., London.	1. fruit is a small nut (about 3 mm in diameter) 2. fruit is unspecialized (morphological features facilitating dispersal absent or undetected)
7.05	1. Smith and Barko (1990) Ecology of Eurasian Watermilfoil. Journal of Aquatic Plant Management 28: 55-64. 2. Holm, Doll, Holm, Pancho, and Herberger (1997) World weeds: natural histories and distribution. John Wiley & Sons, New York.	1. "Within lakes and river systems, fragments are readily dispersed by water currents." 2. "Mature fruits (with seeds) normally separate and fall from the spike, but sometimes, as decay takes place, the spikes may float on the surface for a time, and thus spread the propagules during water movement. The achenes normally sink upon release, but those adhering to fruits, some of which may also float freely for a time, may travel to distant places."
7.06	1. Holm, Doll, Holm, Pancho, and Herberger (1997) World weeds: natural histories and distribution. John Wiley & Sons, New York. 2. Preston and Croft (1997) Aquatic Plants in Britain and Ireland. Harley Books.	1. "Fragments that adhere to the feet of birds, aided by a sticky glucoside layer on some terminal leaves, may account for long-distance dispersal." 2. "The seeds of <i>Myriophyllum</i> are eaten by wildfowl, including pochard and teal, and these might act as dispersal agents."

7.07		
7.08		
8.01		
8.02	1. Preston and Croft (1997) Aquatic Plants in Britain and Ireland. Harley Books. 2. Holm, Doll, Holm, Pancho, and Herberger (1997) World weeds: natural histories and distribution. John Wiley & Sons, New York.	seeds "exhibit prolonged dormancy" (1) but seedlings are rarely if ever observed in nature (2)
8.03	Nelson and Shearer (2005) 2,4-D and <i>Mycoleptodiscus terrestris</i> for control of Eurasian watermilfoil. Journal of Aquatic Plant Management 43: 29-34.	2,4-D used in combination with a fungal pathogen effectively controlled Eurasian watermilfoil.
8.04	Smith and Barko (1990) Ecology of Eurasian Watermilfoil. Journal of Aquatic Plant Management 28: 55-64.	"Human activities (e.g. harvesting) may increase the production of fragments"
8.05	1. Creed (2000) Is there a new keystone species in North American lakes and rivers? Oikos 91: 405-408. 2. Sheldon and Creed (1995) Use of a native insect as a biological control for an introduced weed. Ecological Applications 5: 1122-1132.	1. "the herbivorous weevil <i>Euhrychiopsis lecontei</i> ...attacks the exotic aquatic plant Eurasian watermilfoil in North America...Plants attacked by weevils frequently die and substantial reductions in watermilfoil cover and biomass have been observed... <i>E. lecontei</i> is a watermilfoil specialist." 2. "The results from these studies suggest that a North American insect [ <i>Euhrychiopsis lecontei</i> ] may be a suitable control agent for this introduced aquatic weed."