Plant Assessment Form

For use with the "Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands" by the California Exotic Pest Plant Council and the Southwest Vegetation Management Association (Warner et al. 2003)

Printable version, February 28, 2003
(Modified for use in Arizona, 07/02/04)

Table 1. Species and Evaluator Information

Species name (Latin binomial)**:**	*Myriophyllum spicatum* L. (USDA 2005)
Synonyms:	None identified in USDA (2005).
Common names:	Eurasian watermilfoil, spike watermilfoil, spiked water milfoil, myriophylle en epi
Evaluation date (mm/dd/yy)**:**	04/12/04
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Committee review date:	04/16/04 and 06/23/04
List date:	06/23/04
Re-evaluation date(s):	

Table 2. Scores, Designations, and Documentation Levels

	Question	Score	Documentation Level	Section Scores	Overall Score & Designations
1.1	Impact on abiotic ecosystem processes	**A**	Reviewed scientific publication	**“Impact”** **Section 1 Score:** **A**	**“Plant Score”** **Overall Score:** **High** **Alert Status:** **Alert**
1.2	Impact on plant community	**A**	Reviewed scientific publication		
1.3	Impact on higher trophic levels	**A**	Reviewed scientific publication		
1.4	Impact on genetic integrity	**U**	Other published material		
2.1	Role of anthropogenic and natural disturbance	**A**	Other published material	**“Invasiveness”** *For questions at left, an A gets 3 points, a B gets 2, a C gets 1, and a D or U gets=0. Sum total of all points for Q2.1-2.7:* **14 pts** **Section 2 Score:** **B**	
2.2	Local rate of spread with no management	**C**	Observational		
2.3	Recent trend in total area infested within state	**C**	Observational		
2.4	Innate reproductive potential	**A**	Reviewed scientific publication		
2.5	Potential for human-caused dispersal	**A**	Reviewed scientific publication		
2.6	Potential for natural long-distance dispersal	**B**	Other published material		
2.7	Other regions invaded	**C**	Other published material		 RED FLAG NO Something you should know.
3.1	Ecological amplitude	**C**	Observational	**“Distribution”** **Section 3 Score:** **C**	
3.2	Distribution	**D**	Observational		

Table 3. Documentation

Question 1.1 Impact on abiotic ecosystem processes *Score:* **A** *Doc'n Level:* **Rev. sci. pub.**
Identify ecosystem processes impacted: Uncontrolled growth of *Myriophyllum spicatum* is detrimental to abiotic processes in natural waters for the following reasons: (1) restricts (slows) water flow in streams, (2) increases sediment and organic matter deposition, (3) reduces availability of light to submerged plants and animals, and (4) alters water quality.
Rationale: No impacts on Arizona's natural waters have been reported for Eurasian watermilfoil; however, observations in other states have documented definite impacts. Because of *M. spicatum* and hydrilla's (*Hydrilla verticillata*) growth and colony similarities, these two submerged aquatic species have similar impacts (Bossard 2000, Florida Department of Environmental Protection Undated). Both species fill water columns with numerous stems (300/m^2 for *M. spicatum*; Aiken et.al.1979). These stems grow toward the water surface and produce dense, tangled mats which physically impede (slow) water flow and increase sedimentation. Furthermore, flood damage increases in streams with extensive infestations of these species (Bossard 2000, Rhoads and Block 2000). As vertical *M. spicatum* stems grow from mud/sediment toward water surface, shoots branch laterally. A dense vegetative mat forms which severely reduces sunlight penetration (Jacono and Richardson 2003). Because *M. spicatum*'s photosynthetic system can function at low light intensities (<1% of sunlight), this species can colonize deeper areas of water bodies (9 to 15 meters) than most aquatic macrophytes (Batcher 2000). As a result, this species can occupy portions of aquatic habitats that have no native submerged plant life; however, *M. spicatum* typically infests waters <5 meters deep (Johnson and Blossey 2002). In situations where *M. spicatum* is the predominate macrophyte biomass, pH is raised, dissolved oxygen concentrations decrease and water temperature increases (Honnell et al. 1992, Jacono and Richardson 2003).
Sources of information: See cited literature. Also considered information from the Florida Department of Environmental Protection. Undated. Weed Alert: Hydrilla. Available online at: http://www.dep.state.fl.us/lands/invaspec/2ndlevpags/wedalrt.htm; accessed 2004.

Question 1.2 Impact on plant community composition, structure, and interactions *Score:* **A** *Doc'n Level:* **Rev. sci. pub.**
Identify type of impact or alteration: Seventeen *M. spicatum* sites have been confirmed with botanical specimens since 1957 in Arizona. *Myriophyllum spicatum* displaces native species and biomass production by *M. spicatum* excludes light from reaching native plants. This latter factor is probably part of the reason native plant densities decrease in the presence of *M. spicatum*.
Rationale: Seventeen *M. spicatum* sites have been confirmed with botanical specimens since 1966 in Arizona (SEINet 2004), but no detrimental impacts have been verified in Arizona. Impacts documented in other North American natural areas, however, indicate the species poses a direct threat to Arizona lakes and stream biota. *Myriophyllum spicatum* has been shown to have the capability to replace native species of eelgrass (*Vallisneria*) and niaid (*Najas*) in Alabama (Jacono and Richardson 2003). Colonies of *M. spicatum* have been shown to reduce native species density from 5.5 to 2.2 species per m^2 in two years at Lake George, New York (Madsen et al. 1991). *Myriophyllum spicatum*'s mat-forming ability at water surfaces intercept (block) light to other submerged plants (Madsen 1994, Jacono and Richardson 2003).
Sources of information: See cited literature. Also considered information from SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed April 2004).

Question 1.3 Impact on higher trophic levels *Score:* **A** *Doc'n Level:* **Rev. sci. pub.**
Identify type of impact or alteration: *Myriophyllum spicatum* increases mosquito habitat, which increases the potential for mosquito-borne diseases. Dense infestations are detrimental to fish habitat. *Myriophyllum spicatum* provides non-native forage for water fowl.
Rationale: Tennessee Valley streams clogged with dense Eurasian watermilfoil populations stagnate to the point that mosquito larvae survive in previously unsuitable habitat (Bates et al. 1985). This situation is assumed to be possible in Arizona streams; however it has not yet been documented in Arizona. As *M. spicatum* growth produces dense colonies, mosquito habitat increases which becomes potential breeding sites for vectors of arthropod borne diseases such as West Nile virus, malaria and encephalitis (Bates et al. 1985, NWHC 2001, Center for Disease Control). At high densities of *M. spicatum,* abundance and diversity of invertebrates (fish food) was less than in native plant communities (Keast 1984). Wildlife biologists have detected waterfowl utilizing *M. spicatum* as forage plant in Alabama (McNight and Hepp 1998, Benedict and Hepp 2000).
Sources of information: See cited literature. Also considered information from the Center for Disease Control, Division of Vector-Borne Infectious Diseases, Arboviral Encephalitides. Undated. Available online at: http://www.cdc.gov/ncidod/dvbid/arbor/indes.htm; accessed 2004.

Question 1.4 Impact on genetic integrity *Score:* **U** *Doc'n Level:* **Other pub.**
Identify impacts: Hybridization is unknown, but potentially could occur.
Rationale: A closely related native species, *M. sibiricum* Komarov (= M. exalbescens Fern.) or shortspike watermilfoil, is present in Arizona waters (Kearney and Peebles 1960, USDA 2005). Forty-six collections from 25 sites are recorded in Arizona herbaria for *M. sibiricum* (SEINet 2004). Both *M. spicatum* and *M. sibiricum* are present in Cochise, Coconino, Graham, Navajo and Yavapai Counties. *Myriophyllum sibiricum* has been considered a variety or subspecies of *M. spicatum* in the past (Kearney and Peebles 1960, USDA 2005). No reports exist of *M. spicatum* hybridization with the native *Myriophyllum*, but the close taxonomic relationship between these to taxa does not enable ruling out the potential for hybridization.
Sources of information: See cited literature. Also considered information from SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed April 2004).

Question 2.1 Role of anthropogenic and natural disturbance in establishment *Score:* **A** *Doc'n Level:* **Other pub.**
Describe role of disturbance: Habitat disturbance is not necessary for establishment of this species.
Rationale *Myriophyllum spicatum* grows in a wide range of water quality conditions, including oligotrophic near-pristine habitats (Bossard 2000). Water quality is rarely a limiting factor for establishment, but *M. spicatum* is most common in nutrient rich lakes and waterways in Canada (Aiken et al. 1979). Initial establishment of pioneer colonies in an ecosystem requires direct human intervention or animal (usually waterfowl) transport from another ecosystem.
Sources of information: See cited literature.

Question 2.2 Local rate of spread with no management *Score:* **C** *Doc'n Level:* **Obs.**
Describe rate of spread: Stable.
Rationale: No known reports of spread found for Arizona waters (F. Northam, personal observation, 2004).
Sources of information: Personal observations by F. Northam (Weed Biologist, Tempe, Arizona, 2004).

Question 2.3 Recent trend in total area infested within state *Score:* **C** *Doc'n Level:* **Obs.**
Describe trend: Stable.
Rationale: No reports exist of recent increases or decreases of total area infested in Arizona (F. Northam, personal observation, 2004). Collections of *M. spicatum* deposited in Arizona herbaria started in 1957 and the latest record was for 1997 (SEINet 2004). Of seventeen sites reported, only two were collected after 1990 (1991 and 1997).
Sources of information: Personal observations by F. Northam (Weed Biologist, Tempe, Arizona, 2004) and information from SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed April 2004).

Question 2.4 Innate reproductive potential *Score:* **A** *Doc'n Level:* **Rev. sci. pub.**
Describe key reproductive characteristics: New infestations are easily started by small fragments of stem. Seed production is possible, but seeds have a minor impact on dispersal of new infestations.
Rationale: Vegetative reproduction by fragment transport is credited as the predominant dispersal method (Johnson and Blossey 2002). Seed production is common through out its range, but seedlings are rarely seen (Bossard 2000). See Worksheet A.
Sources of information: See cited literature; also see Aiken et al. 1979.

Question 2.5 Potential for human-caused dispersal *Score:* **A** *Doc'n Level:* **Rev. sci. pub.**
Identify dispersal mechanisms: Vegetative fragment transport via watercraft and trailers; ornamental plant used by aquarium and backyard pond hobbyists; contaminate of other commercially traded aquatic ornamental species, including aquarium plants.
Rationale: All authors cited in previous questions acknowledge the threat of new infestations being established by moving *M. spicatum* fragments on boats, boat trailers, bait buckets/boxes, fishing gear, anchors, swamp buggies, etc. They also affirm these human activities are the primary source of extant infestations in the U.S.
Sources of information: See cited literature in previous questions; in particular, see Aiken et al. (1979), Bossard (2000), and Johnson and Blossey (2002).

Question 2.6 Potential for natural long-distance dispersal *Score:* **B** *Doc'n Level:* **Other pub.**
Identify dispersal mechanisms: Downstream movement of stem fragments or seed; wildlife transport of stem fragments.
Rationale: Once initial human-induced *M. spicatum* populations are established in non-infested regions, natural transport mechanisms are effective dispersers because of the ease with which stem fragments produce roots (Johnson and Blossey 2002).
Sources of information: See cited literature; also see Haber (1997) and Bossard (2000).

Question 2.7 Other regions invaded *Score:* **C** *Doc'n Level:* **Other pub.**
Identify other regions: Wide amplitude of aquatic conditions are infested in North America; only invades areas within same ecological type as in Arizona.
Rationale: *Myriophyllum spicatum* can infest any freshwater aquatic system in California from desert waters to upper estuaries to mountain lakes (Bossard 2000). The cool northern waters of Washington, North Dakota, Minnesota, Michigan, Ohio, New York, and the New England states are heavily infested (Jacono and Richerson 2003). Warm temperate and humid subtropical areas of the southeastern U.S. have documented populations (USDA 2005). Introduction date in North America is uncertain (from late 1800s to 1942; Johnson and Blossey 2002); however, since first confirmed in Washington DC in 1942, *M. spicatum* has spread from the northeastern U.S. through the southern and Midwestern U.S. and down the west coast states to where it now infests 44 states.

Sources of information: See cited literature.

Question 3.1 Ecological amplitude *Score:* **C** *Doc'n Level:* **Obs.**
Describe ecological amplitude, identifying date of source information and approximate date of introduction to the state, if known: Limited to permanent freshwater habitats; see question 2.7 rationale.
Rationale: Based on *M. spicatum*'s distribution in temperate regions of North America (see question 2.7 rationale and sources of information), this species seems capable of colonizing any Arizona aquatic sites, below alpine ecological types, which have permanent sources of water. Distribution records, which start in Phoenix during early 1960s, are in the elevation range of 200 to 6500 feet.
Sources of information: SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed April 2004).
Question 3.2 Distribution *Score:* **D** *Doc'n Level:* **Obs.**
Describe distribution: Ponds, reservoirs, and streams from Rocky Mountain forests above 5000 feet to the lower Colorado River below 500 feet.
Rationale: This species infests both types of freshwater ecological types in Arizona, but has a limited distribution in each. See Worksheet B.
Sources of information: SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed April 2004).

Worksheet A. Reproductive Characteristics

Complete this worksheet to answer Question 2.4.

Reaches reproductive maturity in 2 years or less	**[Yes]**	**No**	**1 pt.**
Dense infestations produce >1,000 viable seed per square meter	**Yes**	**No**	**2 pt.**
Populations of this species produce seeds every year.	**[Yes]**	**No**	**1 pt.**
Seed production sustained for 3 or more months within a population annually	**Yes**	**[No]**	**1 pt.**
	Yes	**No**	**2 pt.**
Viable seed produced with *both* self-pollination and cross-pollination	**Yes**	**No**	**1 pt.**
Has quickly spreading vegetative structures (rhizomes, roots, etc.) that may root at nodes	**[Yes]**	**No**	**1 pt.**
Fragments easily and fragments can become established elsewhere	**[Yes]**	**No**	**2 pt.**
Resprouts readily when cut, grazed, or burned	**[Yes]**	**No**	**1 pt.**
	Total pts: 6	**Total unknowns: 3**	
	Score : A		

Note any related traits: Seed production is not considered an important part of Eurasian watermilfoil reproduction.

Worksheet B. Arizona Ecological Types
(*sensu* Brown 1994 and Brown et al. 1998)

Major Ecological Types	Minor Ecological Types	Code*
Dunes	dunes	
Scrublands	Great Basin montane scrub	
	southwestern interior chaparral scrub	
Desertlands	Great Basin desertscrub	
	Mohave desertscrub	
	Chihuahuan desertscrub	
	Sonoran desertscrub	
Grasslands	alpine and subalpine grassland	
	plains and Great Basin shrub-grassland	
	semi-desert grassland	
Freshwater Systems	lakes, ponds, reservoirs	**D**
	rivers, streams	**D**
Non-Riparian Wetlands	Sonoran wetlands	
	southwestern interior wetlands	
	montane wetlands	
	playas	
Riparian	Sonoran riparian	
	southwestern interior riparian	
	montane riparian	
Woodlands	Great Basin conifer woodland	
	Madrean evergreen woodland	
Forests	Rocky Mountain and Great Basin subalpine conifer forest	
	montane conifer forest	
Tundra (alpine)	tundra (alpine)	

*A means >50% of type occurrences are invaded; B means >20% to 50%; C means >5% to 20%; D means present but ≤5%; U means unknown (unable to estimate percentage of occurrences invaded).

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