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)**:**	*Verbascum thapsus* L. (USDA 2005)
Synonyms:	None identified in USDA (2005).
Common names:	Common mullein, woolly mullein, velvet plant, flannel plant, big taper, velvet dock
Evaluation date (mm/dd/yy)**:**	05/11/03
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Committee review date:	06/24/03 and 08/26/03
List date:	08/26/03
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	**D**	Observational	**"Impact"** **Section 1 Score:** **D**	**"Plant Score"** **Overall Score:** **Evaluated but not listed** **Alert Status:** **None**
1.2	Impact on plant community	**D**	Other published material		
1.3	Impact on higher trophic levels	**D**	Observational		
1.4	Impact on genetic integrity	**D**	Other published material		
2.1	Role of anthropogenic and natural disturbance	**B**	Reviewed scientific publication	**"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:* **10 pts** **Section 2 Score:** **C**	
2.2	Local rate of spread with no management	**B**	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	**C**	Other published material		
2.6	Potential for natural long-distance dispersal	**D**	Reviewed scientific publication		
2.7	Other regions invaded	**C**	Other published material		
3.1	Ecological amplitude	**A**	Observational	**"Distribution"** **Section 3 Score:** **A**	RED FLAG **NO** Something you should know.
3.2	Distribution	**A**	Observational		

Table 3. Documentation

Question 1.1 Impact on abiotic ecosystem processes *Score:* **D** *Doc'n level:* **Obs.**
Identify ecosystem processes impacted: Not considered a threat to abiotic processes.
Rationale: From the literature reviewed, no mention was made of abiotic ecosystem processes and system-wide parameters being significantly diminished. The assumption of Working Group members was that *V. thapsus* has been studied by several researchers and if there were impacts on ecosystem processes they would have been mentioned; therefore, the absence of such information suggests there are no known impacts.
Sources of information: Score based on inference of the literature (or lack there of) by the Working Group members; no direct information available. Literature reviewed: Gross (1980), Gross and Werner (1982), Hoshovsky (1986),and Pitcairn (2000).

Question 1.2 Impact on plant community composition, structure, and interactions *Score:* **D** *Doc'n level:* **Other pub.**
Identify type of impact or alteration: A visual alteration of the community structure does occur but impacts in the long-term have not been documented. *Verbascum thapsus* is easily out competed in areas with a densely vegetated ground cover but readily grows in disturbed sites. Some observed impact on displacing native herbs and grasses in Sierra Nevada during early succession.
Rationale: From research conducted on *V. thapsus* and summarized below, *V. thapsus* requires disturbance to establish, preferring bare ground. It is an early successional plant and will be out competed during the course of the successional process. Therefore, the long-term impacts may not be significant but definitive information on this question was not available in the literature or from interviews of knowledgeable individuals. Observations do suggest an impact to the horizontal structural component during the early successional phase. From Pitcairn (2000; an observational account of change in plant composition and interaction is described in Sierra Nevada): "Not considered a weed of most wildlands and natural areas; however, in the sparsely vegetated soils of the eastern Sierra Nevada it is abundant and has invaded pristine meadows with undisturbed soils, displacing native herbs and grasses. Appears to be an early colonizer after forest fire in western Sierra Nevada preventing the establishment of native herbs and grasses but eventually these give way to a developing shrub canopy. In this situation, mullein appears to disrupt the normal sequence of ecological succession." Other observations from ponderosa pine forest in northern Arizona suggest mullein may out compete native seedlings during early years of restoration (thinning, burning) when seedlings are germinating from the original seed bank (J. Springer, personal communication, 2003). In Michigan, Gross (1984) compared seedling emergence on bare and vegetated sites. On bare soil 50% of the total emergence occurred within nine days of sowing. This took 30 days on vegetated soils. Seedling growth rates were four to seven times faster on bare soils, producing 2000 times more biomass within the same time period (Gross 1984). Seedlings did not establish in small experimentally created openings (15 x 15 cm), but they did colonize larger openings (0.5 m^2or more) such as those created by animal digging. The necessity of bare ground for seedling emergence and establishment means that only a narrow "window in time" is available during which mullein colonization may occur (Gross and Werner 1982). In an ecological system undergoing succession, the proportion of open ground will decrease with time, and the probability of an individual mullein seedling becoming established will also decrease (Gross 1980). In experiments conducted in Michigan and Ohio, *V. thapsus* establishes only in patches of bare ground (Gross and Werner 1982). Gross (unpublished data) showed mullein did not become established in small experimentally-created openings (15 x 15cm) in a 15-year old-fields but did colonize larger openings (≥0.5

m^2) created by animal digging (Gross 1980). Competition will reduce the numbers of successfully germinating seeds (Gross 1980). *Verbascum thapsus* is an earlier colonizer; local populations become established, reproduce and become locally extinct within two to three years after disturbance (Salisbury 1942, Gross and Werner 1978). If seeds are not present in the soil when a disturbance occurs then the limited spatial dispersal ability is probably insufficient to ensure the arrival of propagules rapidly enough for a population to become established while bare ground is still abundant (Gross and Werner 1982).
Sources of information: See cited literature; also see Hoshovsky (1986). Also considered personal communication with J. Springer (Senior Research Specialist, Ecological Restoration Institute, Northern Arizona University, Flagstaff, Arizona, observations of work conducted by W. Chancellor [Northern Arizona University] and J. Crawford [National Park Service], 2003).

Question 1.3 Impact on higher trophic levels	*Score:* **D** *Doc'n level:* **Obs.**
Identify type of impact or alteration: No known impact or alteration.	
Rationale: No mention was made in the literature reviewed of the impacts of *V. thapsus* on higher trophic levels. The Working Group made the assumption that because *V. thapsus* has been studied by several researchers, if impacts occurred to other species they would have been mentioned; therefore, the absence of such information suggests a lack of impacts. Other comments: thought to serve as a host for insects that are themselves economic pests (Maw 1980). Unpalatable to cattle (Fogg 1945 in Gross and Werner 1978) and some phytophagous insects (P. Harris, personal communication in Gross and Werner 1978). Julie Crawford (personal communication, 2003) reports having seen mice nesting in the rosette.	
Sources of information: See cited literature. Also considered personal communication with J. Crawford (Botanist, National Park Service, Grand Canyon National Park, Flagstaff, Arizona, 2003). Score based on inference drawn from the literature and observations.	

Question 1.4 Impact on genetic integrity	*Score:* **D** *Doc'n level:* **Other pub.**
Identify impacts: No known hybridization.	
Rationale: Although *Verbascum* does hybridize with *V. lychnitus* and *V. nigrum* (Clapham et al. 1952), it is not common nor do these species exist in Arizona.	
Sources of information: See cited literature; also see Kearney and Peebles (1960).	

Question 2.1 Role of anthropogenic and natural disturbance in establishment	*Score:* **B** *Doc'n level:* **Rev. sci. pub.**
Describe role of disturbance: Bare ground needed to establish (human or natural).	
Rationale: *Verbascum thapsus* tends to be an initial colonist in newly disturbed sites. Local populations become established, reproduce and become locally extinct within two to three years after disturbance (Salisbury 1942, Gross and Werner 1978).The necessity of bare ground for seedling emergence and establishment means only a narrow "window in time" is available during which mullein may colonize (Gross and Werner 1982). If seeds are not present in the soil when a disturbance occurs, then the limited spatial dispersal ability is probably insufficient to ensure the arrival of propagules rapidly enough for a population to become established while bare ground is still abundant (Gross and Werner 1982). *Verbascum thapsus* can colonize larger openings (0.5 m^2or more), such as those created by animals (Gross 1984). *Verbascum thapsus* is perpetuated by the disturbances created by elk, cattle, and fire (J. Crawford, personal communication, 2003)	
Sources of information: See cited literature. Also considered personal communication with J. Crawford (Botanist, National Park Service, Grand Canyon National Park, Flagstaff, Arizona, 2003). Score based on inference drawn from the literature and observations.	

Question 2.2 Local rate of spread with no management *Score:* **B** *Doc'n level:* **Obs.**
Describe rate of spread: Increasing but less rapidly than doubling in <10 years.
Rationale: Rate of spread would depend on the rate of disturbance. *Verbascum thapsus* is limited to a type of microhabitat—bare ground of newly disturbed areas, by its lack of dispersal mechanisms, and by its inability to compete with other plants. The preceding suggests that plant spread is stable. However, in ephemeral riparian systems, it has been observed to spread (e.g., in Tuckup Canyon, Grand Canyon National Park [K. Watters, personal communication, 2003] and tributaries to Oak Creek Canyon: Munds and Kelly Canyons [K. Thomas, personal communication, 2003]). Seeds need to be present in the soil when the disturbance occurs. The limited dispersal ability of *Verbascum thapsus* is probably insufficient to ensure the arrival of propagules rapidly enough for a population to become established while bare ground is still abundant (Gross and Werner 1982). *Verbascum thapsus* rapidly establishes following forest fire in western Sierra Nevada. High densities of rosettes appear to prevent the reinvasion of native herbs and grasses in burned areas but eventually these give way to a developing shrub canopy (Pitcairn 2000). Similar observations were made in ponderosa pine by J. Crawford (personal communication, 2003).
Sources of information: See cited literature. Also considered personal communications with K. Watters (Research Technician, National Park Service, Southern Colorado Plateau Network, Flagstaff, Arizona, 2003), K. Thomas (Vegetation Ecologist, U.S. Geological Survey, Southwest Biological Science Center, Colorado Plateau, Flagstaff, Arizona, 2003), and J. Crawford (Botanist, National Park Service, Grand Canyon National Park, Flagstaff, Arizona, 2003). Score based on inference drawn from the literature and observations.

Question 2.3 Recent trend in total area infested within state *Score:* **C** *Doc'n level:* **Obs.**
Describe trend: Stable.
Rationale: Does not seem to be increasing or decreasing. *Verbascum thapsus* currently occurs within all 50 states (USDA 2005) and is believed to have been brought to the U.S. in the mid-1700s. In Arizona it is identified as occurring in Coconino, Yavapai, Apache, Mohave, Gila, and Cochise counties (Kearney and Peebles 1960, McDougall 1973). A curculinoid weevil (*Gymnaetron tetrum* Fab.) specific to *V. thapsus* was introduced to North America (Burcham 1937) and ends up destroying up to 50% of the seeds (Gross and Werner 1978). Several micro-organisms (USDA 1960) and leaf -inhibit parasitic fungi (USDA 1953) exist that potentially affect *V. thapsus*, but their specific impacts or effects were not reported by Gross and Werner (1978).
Sources of information: See cited literature. Specific information to address trend was not available. Score is based on inference drawn from the literature cited above.

Question 2.4 Innate reproductive potential *Score:* **A** *Doc'n level:* **Rev. sci. pub.**
Describe key reproductive characteristics: Greater than 100,000 seeds per plant; biennial; seed viability 35 years, self- and cross-pollination.
Rationale: See documentation in Worksheet A.
Sources of information: See Worksheet A.

Question 2.5 Potential for human-caused dispersal *Score:* **C** *Doc'n level:* **Other pub.**
Identify dispersal mechanisms: Used as medicinal plant; tobacco use by Navajo Nation individuals.
Rationale: Not known to be a popular ornamental. Used as remedy for coughs and diarrhea.
Sources of information: See Hoshovsky (1986).

Question 2.6 Potential for natural long-distance dispersal *Score:* **D** *Doc'n level:* **Rev. sci. pub.**
Identify dispersal mechanisms: Seeds dispersed as far as 11 m, though 93% fall within 5 m and 75% fall within 1 m of parent plant (Gross and Werner 1978).
Rationale: Requires movement of stalk by wind or large animal to release seeds from plant (McLean and Ivimey-Cook 1956 in Gross and Werner 1978). Seeds posses no specialized morphological adaptations for dispersal by wind or animals (Gross and Werner 1978). Seeds are small and lie on surface or sift below surface relatively rapidly (Harper 1977).
Sources of information: See cited literature.

Question 2.7 Other regions invaded *Score:* **C** *Doc'n level:* **Other pub.**
Identify other regions: Only those where it is known to exist in Arizona.
Rationale: The literature was limited in identifying the ecological types in which *V. thapsus* occurs except those in which it is already known to occur. *Verbascum thapsus* is currently occurs within all 50 states (USDA 2005) From Pitcairn (2000): occurs throughout California but is particularly abundant in dry valleys on the eastern side of Sierra Nevada. High population densities have been observed in moist meadows and creek drainages new Mono Lake and Owens Valley. Found from sea level to 8000 feet (2440 m) elevation. In Canada *V. thapsus* is reported to grow abundantly in soils with a pH range of 6.5 to 7.8 (Gross and Werner 1978).
Sources of information: See cited literature.

Question 3.1 Ecological amplitude *Score:* **A** *Doc'n level:* **Obs.**
Describe ecological amplitude, identifying date of source information and approximate date of introduction to the state, if known: From Hoshovsky (1986): probably introduced into North America (from Europe) as a medicinal herb. Introduced into Virginia in mid-1700s as piscicide. Became so well established that in a 1818 flora of the East Coast it was described as native. It became naturalized (i.e., self-sustaining populations occur without direct intervention by humans, but the species does not necessarily invade natural, semi-natural, human-made ecosystems [Richardson et al. 2000]) along the West Coast by 1876 (Brewer et al. 1876). First recorded in California in 1880 as being widely naturalized in old fields in Siskyou County (Watson 1880 in Pitcairn 2000). First dated record for Arizona at the University of Arizona herbarium is 1905 (SEINet 2003). From Gross and Werner (1978): Habitat: climatic conditions of cool summers (mean temperature of warmest month <22°C but with at least 4 months over 10°C. Mean annual precipitation is 500 to 1500 mm and 140-day minimum growing season. Found mainly on dry, sandy soils; in England common in chalk and limestone districts (Furneaux 1909, Good 1948).
Rationale: Found in open sites, along roadsides, neglected meadows, waste areas, river bottoms, and industrial areas (Spencer 1957 and Semenza et al. 1978, both in Hoshovsky 1986) and moist meadows and drainages (in California; Pitcarin 2000). Requires light and moisture to germinate and germination inhibited bellow 50°F and constant temps over 104°F; requires 50 to 150 cm precipitation annually. In Arizona *V. thapsus* occurs in Coconino, Yavapai, Apache, Mohave, Gila and Cochise Counties (Kearney and Peebles 1960, McDougall 1973).
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 2003) and personal communications with L. Makarick (Below the Rim Vegetation Program Manager, National Park Service, Grand Canyon National Park Science Center, Flagstaff, Arizona, 2003), L. Moser (Botanist, U.S. Department of Agriculture, Forest Service, Coconino National Forest, Flagstaff, Arizona, 2003), J. Springer (Senior Research Specialist, Ecological Restoration Institute, Northern Arizona University, Flagstaff, Arizona, 2003), and J. Crawford (Botanist, National Park Service, Grand Canyon National Park, Flagstaff, Arizona, 2003).

Question 3.2 Distribution	*Score:* **A** *Doc'n level:* **Obs.**
Describe distribution: See question 3.1 and Worksheet B.	
Rationale: Based on observations of those listed below and Working Group consensus.	
Sources of information: Personal communications with L. Makarick (Below the Rim Vegetation Program Manager, National Park Service, Grand Canyon National Park Science Center, Flagstaff, Arizona, 2003), L. Moser (Botanist, U.S. Department of Agriculture, Forest Service, Coconino National Forest, Flagstaff, Arizona, 2003), F. Northam (Weed Biologist [former Arizona Department of Agriculture Noxious Weed Coordinator], Tempe, Arizona, 2003), J. Springer (Senior Research Specialist, Ecological Restoration Institute, Northern Arizona University, Flagstaff, Arizona, 2003), and J. Crawford (Botanist, National Park Service, Grand Canyon National Park, Flagstaff, Arizona, 2003).	

Research Needs (from Hoshovsky 1986)

Detailed observations focused on the vegetational change of the affected area over time will help to determine what method of control would be most efficient.

No quantitative monitoring studies of mullein were discovered in this research. Because it is not considered a major agricultural weed in California, apparently little interest or funding is available for detailed sampling programs. Whatever monitoring may be done is probably qualitative: has it invaded a site? Does it re-establish itself following control treatment?

Does mullein significantly outcompete native plant species? Does the establishment of mullein alter the local natural plant succession? Casual observation suggests the persistence of mullein in open, sunny areas. Does mullein truly persist in the same area for many years? What factors contribute to its persistence?

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.**
Seeds remain viable in soil for three or more years	**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: 8 Total unknowns: 0

Score : A

Note any related traits: Only seeds that lie at or near the surface (0.5 cm or less) will germinate (Gross 1980). Seeds viable for over 100 years (Kivilaan and Bandurski 1981). Produces 100,000 to 180,000 seeds per plant (Gross 1980, Gross and Werner 1982), average of 223,200 (Stevens 1932). Only short- and long-tongued bees are effective vectors for cross pollination; flowers are also self-pollinating (Gross and Werner 1978). After single reproductive event entire plant dies (Baskin and Baskin 1981). Seeds remain viable up to 35 years (Darlington and Steinbauer) 1961). Mullein is monocarpic and has no means of vegetative reproduction (Gross 1980). Flowering begins in late June of second year and peaks in early August; rarely do plants remain a third year (Gross 1981). The length of flowering period appears to be a function of stalk height and taller stalks continue to flower into late September and early October (Gross and Werner 1978).

Cutting the rosette below the crown will prevent species from flowering (Darlington et al. 1940). Repeated mowing prevents the flower stalk from bolting but the basal rosette will increase in size. If moving is discontinued, the plant will then bolt and produce flowers (Gross and Werner 1978).
From Gross (1980): seeds can germinate over a wide range of environmental conditions (Semenza et al. 1978), requiring only moisture and exposure to light to germinate (Gardner 1921, Semenza et al. 1978).

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	**U**
	plains and Great Basin shrub-grassland	
	semi-desert grassland	
Freshwater Systems	lakes, ponds, reservoirs	
	rivers, streams	
Non-Riparian Wetlands	Sonoran wetlands	
	southwestern interior wetlands	**C**
	montane wetlands	**A**
	playas	
Riparian	Sonoran riparian	
	southwestern interior riparian	**C**
	montane riparian	**A**
Woodlands	Great Basin conifer woodland	**B**
	Madrean evergreen woodland	**A**
Forests	Rocky Mountain and Great Basin subalpine conifer forest	**C**
	montane conifer forest	**A**
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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