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)**:**	*Brassica tournefortii* Gouan (USDA 2005)
Synonyms:	*Brassica tournefortii* Gouan var. *sisymbrioides* (Fisch.) Grossh. (USDA 2005)
Common names:	Sahara mustard, African mustard, Morrocan mustard, Asian mustard, Mediterranean mustard, wild turnip
Evaluation date (mm/dd/yy)**:**	11/11/2003
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List committee members:	D. Backer, C. Barclay, K. Brown, D. Casper, P. Guertin, F. Northam, R. Paredes, W. Sommers, J. Ward, P. Warren
Committee review date:	09/19/03
List date:	09/19/03
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	**B**	Observational	**"Impact"** **Section 1 Score:** **B**	**"Plant Score"** **Overall Score:** **Medium** **Alert Status:** **None**
1.2	Impact on plant community	**B**	Observational		
1.3	Impact on higher trophic levels	**U**	No information		
1.4	Impact on genetic integrity	**U**	Other published material		
2.1	Role of anthropogenic and natural disturbance	**B**	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:* **16 pts** **Section 2 Score:** **B**	
2.2	Local rate of spread with no management	**A**	Observational		
2.3	Recent trend in total area infested within state	**B**	Observational		
2.4	Innate reproductive potential	**A**	Other published material		
2.5	Potential for human-caused dispersal	**B**	Other published material		
2.6	Potential for natural long-distance dispersal	**A**	Other published material		
2.7	Other regions invaded	**C**	Observational		RED FLAG **YES** Something you should know.
3.1	Ecological amplitude	**A**	Other published material	**"Distribution"** **Section 3 Score:** **A**	
3.2	Distribution	**A**	Observational		

Red Flag Annotation

Abundant rainfall during the latter part of 2004 and early 2005 resulted in an undocumented response by *Brassica tournefortii* in terms of number of individuals and total biomass. These increases potentially contributed to the altered fire regimes (that is, increased number and areal extent of fires) that occurred in Arizona at lower elevations during 2005. Should these trends persist in future years, then the scores and rank reported here for *B. tournefortii* should be revisited.

Table 3. Documentation

Question 1.1 Impact on abiotic ecosystem processes *Score:* **B** *Doc'n Level:* **Obs.**
Identify ecosystem processes impacted: Fire regime, microclimates.
Rationale: Possible increase in fuel abundance along roadsides and in heavily disturbed areas. During years with favorable precipitation, *B. tournefortii* along with a suite of other annuals native to Mediterranean areas that are pre-adapted to the winter rainfall climate and fire regimes of the chaparral vegetation in the Mohave Desert can alter the fuel loads and fire frequency of tropical desertscrub, thornscrub, and tropical deciduous forest As they move into the Mojave Desert, they directly compete with the native spring flora and introduce fire. As they move eastward into the bi-seasonal climatic regimes of the Sonoran Desert, their ecological interactions are more complex (Van Devender et al. 1997). Increase in fuel loads and continuity in inter-spaces creates a new type of fuel bed that may promote fire and change fire regimes (Matt Brooks, personal observations made within the California Plant Assessment Form for this species, 2003) Sahara mustard increases fuel loads and fire hazard in desert scrub and coastal sage scrub [did not cite any studies nor were any found during a literature search]. It also establishes from a soil seedbank after fire (Minnich and Sanders 2000). Individuals are amazingly variable in size, depending upon the availability of soil moisture. Drought-stressed plants can reproduce with leaves as small as 8 cm long. On sandy soils with sufficient moisture the leaves can grow to more than 50 cm long, giving the plant a 1 m spread, making it the largest herbaceous rosette plant in the region (Van Devender et al. 1997).
Sources of information: Inferred from the cited literature and personal observations by C. McCasland (Assistant Refuge Manager, U.S. Fish and Wildlife Service, Cabeza Prieta National Wildlife Refuge, 2003) and M. Brooks (Research Ecologist, U.S. Geological Survey, Reno Nevada, 2003).

Question 1.2 Impact on plant community composition, structure, and interactions *Score:* **B** *Doc'n Level:* **Obs.**
Identify type of impact or alteration: Changes in community composition and species abundance.
Rationale: *Brassica tournefortii* (Sahara mustard) and *Schismus arabicus/S. barbatus* (Arabian and Mediterranean grasses) are important exotic winter-spring annuals that compete with native annuals and grasses for rainfall, nutrients and microhabitats. The primary impacts are changes in community composition and species abundance (Van Devender et al. 1997). *Brassica tournefortii* has a strategy of early and quick growth therefore using resources before competition occurs on site. *Brassica tournefortii* appears to effectively capturing available soil moisture, building a canopy, reproducing, and maturing before the neighboring native species begin their reproductive phases (Minnich and Sanders 2000). From Guertin and Halvorson (2003): Sue Rutman (personal communication) reports that at Cabeza Prieta National Wildlife Refuge in Arizona, Big Galleta grass-Creosotebush and dunal plant associations have been completely disrupted by *Brassica tournefortii*. From Minnich and Sanders (2000): The density of Sahara mustard plants can vary with annual climate and fire history. For example, two years of drought during 1989–91 in Riverside County killed off existing red brome (*Bromus rubens*) cover on a dry southern exposure. Sahara mustard populations in this area subsequently increased by almost thirty-five times. During the wet winters of 1991–92 and 1992–93, while plant densities increased, overall biomass decreased, apparently reduced by intraspecific competition.

Sources of information: See cited literature; however, neither of the citations above are based on specifics, empirical studies, or documented evidence; therefore, the level of documentation is inference (observational). Observations are by S. Rutman (Plant Ecologist, Organ Pipe Cactus National Monument).

Question 1.3 Impact on higher trophic levels *Score:* **U** *Doc'n Level:* **No info.**
Identify type of impact or alteration: Unknown
Rationale: No information available. Sue Rutman (personal communication in Guertin and Halvorson 2003) suggests that lizards potentially will decline in numbers and kangaroo rats might also with increases in plant cover of this plant; kangaroo rats require open habitats to survive, and 'have trouble keeping it out of the mound sites' in their efforts to keep it clipped back.
Sources of information: None that support providing a score.

Question 1.4 Impact on genetic integrity *Score:* **U** *Doc'n Level:* **Other pub.**
Identify impacts: The genus *Brassica* is known to hybridize within the genera and across genera within the family *Brassica*ceae (see Warwick et al. 2000). Arizona has no native species in the *Brassica* genus but many native species in the family (Kearney and Peebles 1960).
Rationale: May hybridize with other mustards. On the basis of chromosome number and crossing ability, Harberd (1976) defined the *Brassica* coenospecies as "the group of wild species sufficiently related to the six cultivated species of *Brassica* to be potentially capable of experimental hybridization with them."
Sources of information: See cited literature.

Question 2.1 Role of anthropogenic and natural disturbance in establishment *Score:* **B** *Doc'n Level:* **Other pub.**
Describe role of disturbance: Moderate invasive potential. Establishes readily in dune ecosystems, desert washes, and disturbed areas near roadways.
Rationale: *Brassica tournefortii* establishes readily in disturbed areas (see below) and can establish in natural areas of *Larrea-Ambrosia* flats, primarily in areas with sandy soil (McCasland, pers. obser., 2003). Sahara mustard is most common in disturbed sites such as roadsides and abandoned fields (Minnich and Sanders 2000) and in sandy lowland habitats across the Sonoran Desert, including low dunes, interdune troughs, sandy flats, and sandy-gravelly washes (Van Devender et al. 1997). Sahara mustard plants are highly drought tolerant, and they are found in dry pastures, along roadsides, disturbed soils, and in fields and crops (Warwick et al. 2000). Border Patrol in southwestern AZ frequently drag roads with tires creating a an anthropogenic disturbance in a seeming natural area, thus providing the preferred germination conditions (burying seeds) for *Brassica* (Malusa et al. 2003).
Sources of information: See cited literature; also observations by C. McCasland (Assistant Refuge Manager, U.S. Fish and Wildlife Service, Cabeza Prieta National Wildlife Refuge, 2003).

Question 2.2 Local rate of spread with no management *Score:* **A** *Doc'n Level:* **Obs.**
Describe rate of spread: Increasing rapidly (doubling > 10years).
Rationale: In California, appeared to have a population explosion from 1977 to 1983, during successive years of above-normal precipitation (Minnich and Sanders 2000). *Brassica tournefortii* has spread almost explosively into lowland desert regions, especially in places with sandy soils (for example, Organ Pipe National Monument; Felger 1990).
Sources of information: See cited literature. Score based on Working Group discussion.

Question 2.3 Recent trend in total area infested within state	*Score:* **B** *Doc'n Level:* **Obs.**
Describe trend: Increasing, but less rapidly. Species is spreading rapidly along roadsides, but in native undisturbed habitats the speed of infestation is lower.	
Rationale: The earliest record in Arizona is 1957 (Mason 1960 in Van Devender et al. 1997) and by the 1970s it was widespread and will established in the lowland deserts of northern Baja California, southeastern California, southwestern Arizona and western Sonora (Van Devender et al. 1997). As noted from an early study (reported in Malusa et al. 2003), 180 miles during the wet spring of 2001, a variety of habitats between the southern Mohawk and Bryan Mountains and the Growler Mountains were hiked (much of the area is roadless and wilderness) and no *B. tournefortii* were noted.	
Sources of information: See cited literature. Score based on Working Group discussion and personal observations by C. McCasland (Assistant Refuge Manager, U.S. Fish and Wildlife Service, Cabeza Prieta National Wildlife Refuge, 2003).	

Question 2.4 Innate reproductive potential	*Score:* A *Doc'n Level:* **Other pub.**
Describe key reproductive characteristics: An annual that produces between 750–9000 seeds/plant; self-compatible; produces seed for more than 3 months a year.	
Rationale: See worksheet A.	
Sources of information: See citations in worksheet A.	

Question 2.5 Potential for human-caused dispersal	*Score:* **B** *Doc'n Level:* **Other pub**.
Identify dispersal mechanisms: Potential for seeds to be present as a contaminant in bulk hay. Road construction and maintenance and transportation corridors also affect dispersal. Seeds are also carried along by vehicle tires.	
Rationale: *Brassica* is found in disturbed areas including agricultural areas, construction/maintenance (including dragging of border roads) of roads moves seeds; seeds may adhere to vehicle tires travelling off-road. Border Patrol agents use a technique in which they drag tires along sandy roads where Brassica is present, further dispersing the seed (and burying it) both along these "roads" and off roads as well (Malusa et al. 2003).	
Sources of information: See cited literature; also see Minnich and Sanders (2000) and West and Nabhan (2002).	

Question 2.6 Potential for natural long-distance dispersal	*Score:* **A** *Doc'n Level*: **Other pub.**
Identify dispersal mechanisms: Animals, water, and wind.	
Rationale: Dead plants containing viable seeds will often break off at the base and act as a tumble weed. *Brassica* plants have been caught in dust-devils and transported large distances from their origin (Observational). Seeds are carried in washes during significant rain events. Sahara mustard is most common in wind-blown sand deposits (Minnich and Sanders 2000). During the rains, a sticky gel forms over the seed case that permits seeds to disperses long distances by adhering to animals (Minnich and Sanders 2000). From Guertin and Halvorson 2003: After senescence and drying, the *Brassica tournefortii* plants can break off at the soil surface to tumble with the wind across the landscape dispersing its seeds. Although Felger (1990) notes this may occur in open, sandy places, it does not occur in other environments.	
Sources of information: See cited literature.	

Question 2.7 Other regions invaded	*Score:* **C** *Doc'n Level:* **Obs.**
Identify other regions: No other ecological types invaded that aren't already invaded in AZ.	
Rationale: Sahara mustard is native to the Mediterranean (Albania, Algeria, Egypt, Greece, Israel, Italy, Lebanon, Libya, Morocco, Syria, Tunisia, and Turkey) and the broad desert belt stretching from	

northwest Africa to the Saudi Arabian peninsula (Warwick et al. 2000). Sahara mustard is commonly found in Arizona, California, Louisiana, New Mexico, Nevada and Texas, as well as Europe, Africa, Asia, Australia, and Mexico (Warwick et al. 2000).

Brassica tournefortii was first collected in 1927 in California by J.B. Feudge (#1600, RSA); it was probably introduced in the early 1900's with date palms imported into Coachella, California from the Middle East (Minnich and Sanders 2000). In California, it is found up to 3300 feet (1000 m) elevation, but is more common below 1000 feet (305 m) in the deserts and the semi-arid south coastal area. Along with desert environments, it is invading annual grassland and coastal sage scrub (Minnich and Sanders 2000). *Brassica tournefortii* thrives in sandy locations (Felger 1990). In California, it can often form monospecific stands on abandoned sandy fields (Minnich and Sanders 2000). *Brassica tournefortii* appears to be highly susceptible to salinity; in greenhouse trials in India (Dhawan et al. 1987).

Sources of information: See cited literature. Score based on inference from California ecological types.

Question 3.1 Ecological amplitude *Score:* **A** *Doc'n Level:* **Other pub.**

Describe ecological amplitude, identifying date of source information and approximate date of introduction to the state, if known: Introduced to the United States in the 1930s, Sahara mustard has spread to many areas of the Southwest (Warwick et al. 2000). The earliest record for it in Arizona is 1957 (Mason 1960 in Van Devender et al. 1997) while Sonora, Mexico collections date from 1966 (Van Devender et al. 1997). Earliest record in Arizona herbaria is 1965 (SEINet 2004).

Preferred habitat: Found in semi-arid to arid coastal and riparian sands, dunes, and other sandy soils (though it is also found on non-sandy soils), Sahara mustard can be found from sea level up to 7,200 feet elevation (Warwick et al. 2000). It is especially common in sandy lowland habitats across the Sonoran Desert, including low dunes, interdune troughs, sandy flats, and sandy-gravelly washes (Van Devender et al. 1997). Sahara mustard plants are highly drought tolerant, and are found in dry pastures, along roadsides, disturbed soils, and in fields and crops (Warwick et al. 2000). Jim Malusa (personal communication, 2004) notes that roads that run perpendicular to the slope result in the partial damming of water (upslope); here there are often very large creosote or bursage, with *Brassica tournerfortii* beneath. The point is: they grow where the water is.

Seeds are adversely affected by light and have optimal emergence (germination) when seeda are buried at a depth of 0.5 cm (seed depth trials ranged up to 4 cm). Total inhibition of germination occurred for seeds on the soil surface (Thanos et al. 1991 in Guertin and Halvorson 2003).

In the Mohawk Dunes and Mountains of southwestern Arizona, in 2001 it was absent from stony slopes and alluvial fan pavements, rare in creosote flats, common in sandy flats, emphemeral water courses, and dunes; and most common on the north slopes of dunes (Malusa et al. 2003; spatial data layer for this region is available at: http://sdrsnet.srnr.arizona.edu/).

Rationale: Counties in Arizona: Maricopa, Pinal (Kearney and Peebles 1960), and Mohave (Kearney and Peebles 1960, McDougall 1973). Arizona herbaria records (www.seinet.asu.edu, accessed July 21, 2004) also have records from the additional counties of Yuma, Coconino, Pima, and Yavapai.

Preferred habitat: Found in semi-arid to arid coastal and riparian sands, dunes, and other sandy soils (though it is also found on non-sandy soils), Sahara mustard can be found from sea level up to 7,200 feet elevation (Warwick et al. 2000). It is especially common in sandy lowland habitats across the Sonoran Desert, including low dunes, interdune troughs, sandy flats, and sandy-gravelly washes (Van Devender

et al. 1997). Sahara mustard plants are highly drought tolerant, and are found in dry pastures, along roadsides, disturbed soils, and in fields and crops (Warwick et al. 2000).
Sources of information: See cited literature; also considered personal communication from J. Malusa (U.S. Geological Survey, Sonoran Desert Research Station, Tucson, Arizona, 2004), personal observations by Working Group members, and information from SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed July 21, 2004).

Question 3.2 Distribution *Score:* **A** *Doc'n Level:* **Obs.**
Describe distribution: Present in all dunes in Arizona.
Rationale: An estimated 80 to 90% of the Mohawk Dunes are host to *B. tournefortii* (Malusa et al. 2003). Records from Arizona herbaria (SEINet 2004) describe some of the additional places where *B. tournefortii* is found in Arizona (most collections along roads, those records are not recorded here): Tonto National Forest-Canyon Lake Overlook, Superstition Wilderness Area, and along Apache Trail, Sedona (Cook's Hill); Cabeza Prieta Wildlife Refuge (west of Charlie Bell Pass); Mt Nutt (Bureau of Land Management Wildlife Study Area, Kingman); along trail in White Tank Mountains Park, sandy dry wash above Horse Tanks (Yuma County); dry wash of Harquahala Mountains.
Sources of information: See cited literature and information from SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed July 21, 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.**
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: 7 Total unknowns: 1		
	Score : A		

Note any related traits: In Arizona *Brassica tournefortii* flowers from late winter to early spring (Epple 1995); generally from February to May (Felger 1990, Van Devender et al. 1997). In California it flowers as early as December into January, and it sets seed by February, fruiting or senesced by April (Minnich and Sanders 2000). From Guertin and Halvorson (2003): *Brassica tournefortii*'s is a self-compatible species (autogamous; can self-pollinate) (Hinata et al. 1974, Minnich and Sanders 2000), with nearly 100% fruit set on most plants (Minnich and Sanders 2000). Well developed plant produces between 750 and 9000 seeds (Minnich and Sanders 2000).

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

Major Ecological Types	Minor Ecological Types	Code*
Dunes	dunes	**A**
Scrublands	Great Basin montane scrub	
	southwestern interior chaparral scrub	
Desertlands	Great Basin desertscrub	
	Mohave desertscrub	**C**
	Chihuahuan desertscrub	
	Sonoran desertscrub	**C**
Grasslands	alpine and subalpine grassland	
	plains and Great Basin shrub-grassland	
	semi-desert grassland	
Freshwater Systems	lakes, ponds, reservoirs	
	rivers, streams	
Non-Riparian Wetlands	Sonoran wetlands	
	southwestern interior wetlands	
	montane wetlands	
	playas	
Riparian	Sonoran riparian	**D**
	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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