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)**:**	*Acroptilon repens* (L.) DC. (USDA 2005)
Synonyms:	*Centaurea picris* Pallas ex Willd., *Centaurea repens* L. (USDA 2005)
Common names:	Russian knapweed, Turkestan thistle, creeping knapweed, mountain bluet, hardheads
Evaluation date (mm/dd/yy)**:**	02/02/04
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Committee review date:	06/23/04 and 08/06/04
List date:	08/06/04
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	**B**	Observational	**"Impact"** **Section 1 Score:** **A**	**"Plant Score"** **Overall Score:** **High** **Alert Status:** **None**
1.2	Impact on plant community	**A**	Reviewed scientific publication		
1.3	Impact on higher trophic levels	**A**	Other published material		
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:* **17 pts** **Section 2 Score:** **A**	
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	**A**	Other published material		
2.6	Potential for natural long-distance dispersal	**B**	Other published material		
2.7	Other regions invaded	**B**	Other published material		
3.1	Ecological amplitude	**A**	Observational	**"Distribution"** **Section 3 Score:** **B**	RED FLAG **NO** Something you should know.
3.2	Distribution	**C**	Observational		

Table 3. Documentation

Question 1.1 Impact on abiotic ecosystem processes *Score:* **B** *Doc'n Level:* **Obs.**
Identify ecosystem processes impacted: Russian knapweed's extensive root system can alter the soil water table level, and change soil chemistry due to allelopathy, especially in fine-textured soils. Dense infestations of Russian knapweed may change the fire regime by changing the fuel characteristics and fire return interval at a given site.
Rationale: Russian knapweed has a well-developed root system, which functions as the major means of propagation and spreading. Stands of Russian knapweed can grow to densities of 100–300 shoots/m^2, The plant extends radially in all directions and can cover an area of 12 m^2 within two years. The roots of Russian knapweed can extend more than 7 meters below the soil surface with 2 to 2.5 meters of growth occurring the first year and 5 to 7 meters in the second year (Watson 1980). This deep and dense root system can change the levels of the soil water table. Russian knapweed contains an allelopathic polyacetylene compound which inhibits the growth of competing plants (Watson 1980). This compound can remain in the soil at some level for several years and tends to dominate on fine-textured soils, while forming a persistent mixture with other species on coarse soils. Allelopathy is likely to have more impact on fine-textured soils (Goslee et al. 2001). The hypothesis that allelopathic chemicals metabolized by soil microorganisms could release compounds into the soil affecting plant species has not been tested, yet soil scientists hypothesize that there are indirect interactions that might affect (positively or negatively) the plant species. Neither have the effects of allelopathy on mycorrhizal systems, which allow plant species to explore more soil resources (Pellissier 1998). Information regarding fire adaptations of Russian knapweed is not available in the literature. The historic fire regimes of the more native communities in which Russian knapweed sometimes occurs are of varied frequency and severity. Russian knapweed did not occur in these communities at the time in which historic fire regimes were functioning, but has established since fire exclusion began. It is unclear how historic fire regimes might affect Russian knapweed populations. It is also unclear how the presence of Russian knapweed might affect these fire regimes. Dense infestations of Russian knapweed may change the fire regime by changing the fuel characteristics and fire return interval at a given site. Research in this area is needed.
Sources of information: See cited literature; also see Whitson (1999), Stevens (1986), Carpenter and Murray (Undated), and U.S. Forest Service Weed Info Sheets for *Acroptilon repens*. Score based on inference drawn from the literature.

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: Russian knapweed's rapidly spreading root system compete with native vegetation for soil moisture and nutrients. Russian knapweed forms dense stands through allelopathic effects that occlude native canopy and reduce and inhibit the growth of native plant communities in disturbed and undisturbed habitats.
Rationale: Stands of Russian knapweed can grow to densities of 100–300 shoots/m^2, which can completely crowd out competing native plant species. Russian knapweed's spreading root system can spread as much as 14.4 square yards (12 m^2) in only two seasons, thus successfully out competing native vegetation for water and nutrient resources (Whitson 1999). Plants can survive indefinitely through rhizomatous systems; stands of Russian knapweed have been reported to survive for more than 75 years (Watson 1980), which may interrupt the natural succession of a native plant community. Russian knapweed invades disturbed grassland and shrubland communities, as well as riparian forests. Examples of some perennial grass species that are commonly driven out by Russian knapweed include rough fescue (*Festuca scabrella*), Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass (*Agropyron spicatum*), western needlegrass (*Stipa occidentalis*), and Richardson's needlegrass (*Stipa richardsonii*)

(Rice et al. 1992). Russian knapweed has been found to have allelopathic effects that inhibit the growth of crops and other plants. The examination of soil surrounding Russian knapweed roots revealed the presence of an inhibitor in sufficient concentration to have an appreciable effect on the surrounding plant community (Watson 1980). In a study done by Stermitz et al. (2003), root exudates of in vitro-grown Russian knapweed plants were tested for their effect on *Gaillardia aristata* Pursh, *Linaria dalmatica* (L.) Mill*, Centaurea. diffusa*, *C. maculosa* and the model plant *Arabidopsis thaliana* (L.) Heynh. All the species showed mortality on the seventh day after addition of root exudates from Russian knapweed. Plants showed wilting symptoms prior to senescence with reduced shoot and root differentiation after administration of the root exudates. In a modeling study done by Goslee (2001) in Colorado grassland communities, simulation results showed that Russian knapweed dominated the aboveground biomass on a plot only if native species were affected by allelopathic interactions. At moderate levels of plant sensitivity, Russian knapweed became dominant faster and reached a higher proportion of the total biomass on fine, rather than on coarse-textured soils. Community composition and rate of Russian knapweed dominance were more affected by the sensitivity of plant growth to allelochemicals than the sensitivity of species recruitment. Allelopathic interactions therefore proved to be an important component of the invasion dynamics (Goslee 2001). Grant et al. (2003) found that in several sites in Colorado seedling survival of *Bouteloua gracilis, Kohleria cristata, and Sporabulous cryptandrus* were suppressed by the presence of Russian knapweed over a 5 to 7 week period at several sites (Grant et al. 2003).

Sources of information: See cited literature; also see Carpenter and Murray (Undated).

Question 1.3 Impact on higher trophic levels *Score:* **A** *Doc'n Level:* **Other pub.**

Identify type of impact or alteration: Russian knapweed greatly reduces biodiversity for wildlife forage and lowers habitat quality.

Rationale: By replacing native plants that are preferred as forage by big game species and as habitat by smaller wildlife species, Russian knapweed has negative effects on wildlife (Kurtz et al. 1995). Populations of Russian knapweed have drastically reduced the availability of key winter range for wildlife in the Disappointment Creek area in Colorado (FICMNEW 1998). Russian knapweed is avoided by grazing animals due to its bitter taste. It is so bitter that as little as 0.01% contamination by weight reduces the quality of flour and other grain products. Russian knapweed is poisonous to horses and can cause a neurological disorder called "chewing disease." Birds and rodents eat the seeds. (Zouhar 2001). Russian knapweed is considered a serious habitat invader and a single patch or infestation of Russian knapweed can grow quite rapidly. Once established, it can form dense infestations that reduce desirable vegetation through a combination of competition and allelopathy. The presence of Russian knapweed can thereby reduce forage for livestock and biodiversity for wildlife habitat (Whitson 1999, Zouhar 2001). Although two studies of white-tailed deer in north-central Montana and Rocky Mountain bighorn sheep in British Colombia showed that wildlife species utilize Russian knapweed as an element of their forage, it is unclear whether the animals are showing a preference, or they are utilizing it when other native species are not available. More information is needed to determine this (Allen 1968, Balfour 1988).

Sources of information: See cited literature.

Question 1.4 Impact on genetic integrity *Score:* **D** *Doc'n Level:* **Other pub.**

Identify impacts: No known hybridization

Rationale: In neither of the genera of *Acroptilon* or its former genus, *Centaurea*, has there been any report of hybridization between non-native and native species, despite a number of studies that have investigated these occurrences.

Sources of information: Kearney and Peebles (1960). Also considered personal communication with R. Scott (Professor, Biological Sciences, Northern Arizona University, Flagstaff, Arizona, 2004).

Question 2.1 Role of anthropogenic and natural disturbance in establishment *Score:* **B** *Doc'n Level:* **Rev. sci. pub.**
Describe role of disturbance: Russian knapweed establishes readily in open lands disturbed by grazing, and along roadsides and in cultivated fields and waste places. It also invades riparian habitats with natural flooding disturbance.
Rationale: Russian knapweed invades many disturbed western grassland and shrubland communities, as well as riparian forests. Russian knapweed readily occupies disturbed sites previously dominated by annual grasses (DiTomaso 1999). Russian knapweed invades open, disturbed land but because Russian knapweed produces few seeds and has poor dispersal mechanisms, it does not colonize new sites efficiently (Watson 1980, Goslee et al. 2001).
Sources of information: See cited literature; also see Carpenter and Murray (Undated).

Question 2.2 Local rate of spread with no management *Score:* **A** *Doc'n Level:* **Obs.**
Describe rate of spread: Increases, rapidly-potential to double in <10 years.
Rationale: Bureau of Land Management estimated the average annual rate of spread to be 8% in the northwestern U.S. Wyoming infestations have increased annually by an 11% average rate (Whitson 1999). The Working Group reached consensus that Arizona's infestations are similar to those of other western states.
Sources of information: See cited literature. Score based on Working Group consensus.

Question 2.3 Recent trend in total area infested within state *Score:* **B** *Doc'n Level*: **Obs**.
Describe trend: Increasing, but less rapidly. Russian knapweed is reported from all but five of Arizona's 15 counties; however, there are several ecotypes that have been invaded in other states, that have not yet been invaded in Arizona, suggesting that populations have the potential to spread and increase.
Rationale: Committee agrees that all niches are filled within the state.
Sources of information: Southwest Exotic Plant Mapping Program (SWEMP) data (available online at: http://www.usgs.nau.edu/SWEPIC/swemp/swempA.asp), Whitson (1999), and Esser (1994). Score based on Working Group consensus.

Question 2.4 Innate reproductive potential *Score:***A** *Doc'n Level:* **Other pub.**
Describe key reproductive characteristics: Russian knapweed reproduces by seed and by adventitious buds on horizontally spreading roots.
Rationale: A patch of Russian knapweed may have 9 to 27 shoots per square foot (100–300/m^2). Little or no information is known about seed viability and germination in the field. Most literature notes that it primarily reproduces vegetatively. There is some disagreement over seed viability. A study by Watson (1980) revealed they were viable for three years, while another by Selleck (1964) showed they could be viable up to eight years. Russian knapweed is probably top-killed by fire, while the roots are likely to remain unharmed (Zouhar 2001).
Sources of information: See cited literature; also see Carpenter and Murray (Undated).

Question 2.5 Potential for human-caused dispersal *Score:* **A** *Doc'n Level:* **Other pub.**
Identify dispersal mechanisms: Seed is present as a contaminant in hay; Russian knapweed spread is hastened by cultivation. It can spread via root fragments or seeds transported by farm machinery or along travel corridors by other vehicles.
Rationale: There are numerous opportunities for dispersal to new areas as infestations are common on disturbed rangelands and because it is in so many alfalfa fields.
Sources of information: See Zouhar (2001) and Carpenter and Murray (Undated).

Question 2.6 Potential for natural long-distance dispersal *Score:* ***B*** *Doc'n Level:* **Other pub.**
Identify dispersal mechanisms: Russian knapweed propagules (root fragments) are dispersed in flowing water or flooding events.
Rationale: Various studies have also shown that entire plants can move downstream in river systems during the event of a flood. These plants then become established in the disturbed soils of the riverbank and form new, isolated infestations.
Sources of information: See Zouhar (2001) and Carpenter and Murray (Undated).

Question 2.7 Other regions invaded *Score:* ***B*** *Doc'n Level:* **Other pub.**
Identify other regions: Russian knapweed is native to Mongolia, western Turkestan, Iran, Turkish Armenia, and Asia Minor. In the Western states of Utah, Colorado and Nevada, New Mexico, Russian knapweed occupies several semiarid portions. It is found in sagebrush, semi-desert grassland, montane conifer forest, pinyon juniper, and desert scrub as well as riparian areas in all of those habitat types. In Colorado the most severe infestations of Russian knapweed occur in mountain and western slope counties, with lighter infestations associated with blue grama on the eastern plains. According to Weber and Whittman (1996) roadsides in the Colorado-Gunnison River valleys are dominated with populations of Russian knapweed and on roadsides of the San Luis Valley. Habitats in which Russian knapweed may be found include riparian woodlands dominated by cottonwood (*Populus* spp.), skunkbush sumac, and willow; riparian shrubland; and sagebrush/fourwing saltbush (*Atriplex canescens*) shrublands. In Utah, Russian knapweed is found in cottonwood/willow and tamarisk (*Tamarix* spp.) communities. Russian knapweed is found in all Utah counties except Washington, Sevier, Piute, Wayne, Sevier and Juab. In Nevada, Russian knapweed can be found with creosotebush (*Larrea tridentata*) and saltgrass, and it may threaten plants found in ash (*Fraxinus* spp.) meadows.
Rationale: According to SWEMP observations and Zouhar (2001), Russian knapweed invades two ecotypes in Nevada (Mohave desertscrub and southwest interior wetlands) that have not yet been invaded in Arizona.
Sources of information: See cited literature. Also considered SWEMP data (available online at: http://www.usgs.nau.edu/SWEPIC/swemp/swempA.asp). Also see the Atlas of the Vascular Plants of Utah (accessed online on February 10, 2004 at: http://www.gis.usu.edu/Geography-Department/utgeog/utvatlas/ut-vascatlas.html.)

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: First collection of Russian knapweed in Arizona was from Holbrook in 1934. Russian knapweed was first introduced into Canada around 1900 and was introduced to the United States as a result of impure Turkestan alfalfa seed, and possibly sugarbeet seed (Maddox et al. 1985). It was first introduced in California between 1910 to 1914. Since then it has become widespread in the United States and is currently found in at least 412 counties in 21 states (Maddox et al. 1985). It is most common in the semi-arid portions of the western U.S. and adjacent Canada, but infestations have also been reported in South Dakota, Minnesota, and Virginia (Maddox et al. 1985). The worst-infested states are California, Idaho, Montana, Oregon, and Washington. In Arizona it is found in Great Basin habitat types, Chihuahuan desert scrub, and plains and Great Basin grassland as well as semidesert grassland, pinyon-juniper and montane forests and riparian drainages. Russian knapweed thrives in clay soils in its native habitat. In the U.S. it tolerates both saline and alkaline soils and tends to dominate drier, fine-textured soils while forming a persistent mixture with other species on coarse soils. Found from 1430 to 2280 m in Utah and up to 2165 m in Arizona. In New Mexico it is reported from 1370 to 1828 m in elevation.

Rationale: This species is widespread and invades 5 major ecological types and 9 minor types.
Sources of information: See cited literature.

Question 3.2 Distribution	*Score:* **C** *Doc'n Level:* **Obs.**
Describe distribution: In Arizona infestations are densest in Coconino, Apache and Navajo counties.	
Rationale: Russian knapweed is reported from National Park species databases of 11 parks on the Colorado Plateau including Grand Canyon	
Sources of information: Welsh et al. (1987), Kearney and Peebles (1960), SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; February 10, 2004), and SWEMP-Cain Crisis map (available online at: http://cain.nbii.gov/cgibin/mapserv?map=../html/cain/crisis/crisismaps/crisis.map&mode=browse&layer=state&layer=county; accessed February 10, 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: 9 Total unknowns: 0		
	Score : A		

Note any related traits:

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	**D**
	southwestern interior chaparral scrub	
Desertlands	Great Basin desertscrub	**D**
	Mohave desertscrub	
	Chihuahuan desertscrub	**D**
	Sonoran desertscrub	
Grasslands	alpine and subalpine grassland	
	plains and Great Basin shrub-grassland	**C**
	semi-desert grassland	**D**
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	**D**
	montane riparian	**D**
Woodlands	Great Basin conifer woodland	**C**
	Madrean evergreen woodland	
Forests	Rocky Mountain and Great Basin subalpine conifer forest	
	montane conifer forest	**D**
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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