

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):	<i>Centaurea solstitialis</i> L. (USDA 2005)
Synonyms:	<i>Leucantha solstitialis</i> (L.) A.& D. Löve (USDA 2005)
Common names:	Yellow starthistle, St. Barnaby's thistle
Evaluation date (mm/dd/yy):	05/29/03
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List committee members:	D. Backer, C. Barclay, K. Brown, P. Guertin, F. Northam, R. Parades, 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	A	Reviewed scientific publication	<p>“Impact”</p> <p>Section 1 Score:</p> <p>A</p>	<p>“Plant Score”</p> <p>Overall Score:</p> <p>High</p> <p>Alert Status:</p> <p>None</p>
1.2	Impact on plant community	A	Other published material		
1.3	Impact on higher trophic levels	B	Other published material		
1.4	Impact on genetic integrity	U	No information		
				<p>“Invasiveness”</p> <p><i>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:</i></p> <p>15 pts</p> <p>Section 2 Score:</p> <p>B</p>	<p>Something you should know.</p>
2.1	Role of anthropogenic and natural disturbance	C	Observational		
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	Reviewed scientific publication		
2.5	Potential for human-caused dispersal	A	Other published material		
2.6	Potential for natural long-distance dispersal	B	Reviewed scientific publication		
2.7	Other regions invaded	C	Observational		
				<p>“Distribution”</p> <p>Section 3 Score:</p> <p>B</p>	
3.1	Ecological amplitude	A	Observational		
3.2	Distribution	D	Observational		

Table 3. Documentation

Question 1.1 Impact on abiotic ecosystem processes	<i>Score: A Doc'n Level: Rev. sci. pub.</i>
Identify ecosystem processes impacted: Hydrologic regime (soil water table levels); soil erosion and surface runoff.	
Rationale: Research in California indicates that yellow starthistle infestations can deplete soil moisture more than rangeland dominated by annual grasses or perennial wheatgrass (DiTomaso et al. 2000). This results in less soil moisture recharge the following season. Furthermore, yellow starthistle, like other knapweed (<i>Centaurea</i>) species may accelerate soil erosion and surface runoff by virtue of a deep taproot (Lacey et al. 1989). Yellow starthistle roots extended beyond six feet after two months of growth when grown in tubes in a greenhouse (DiTomaso 2001). Yellow starthistle develops a single root which grows straight down relative to grasses which have a multi-branching fibrous root system. A single taproot holds less soil in place relative to fibrous roots.	
Sources of information: See cited literature.	
Question 1.2 Impact on plant community composition, structure, and interactions	<i>Score: A Doc'n Level: Other pub.</i>
Identify type of impact or alteration: Ability to form stands dominated by the species; creation of a substantial thatch or litter layer; capability of germinating and flowering over a relatively long time period during the growing season even during dry conditions.	
Rationale: This plant can form very dense stands which displace native plant communities and reduce plant diversity (Sheley et al. 1999). These stands also yield much litter or thatch that may reduce available sunlight to native seedlings. Yellow starthistle has also been observed germinating and flowering over much of the growing season. Yellow starthistle typically germinates in October, before many wildland plants, and harvests moisture when other species are not actively growing. This earlier germination period shifts the competitive balance in the favor of starthistle. In addition, yellow starthistle infestations can have taller plants (up to 3 feet) relative to native grass stands.	
Sources of information: See cited literature. Also considered personal observation of dry-land pasture in Gila, New Mexico by W. Sommers (Graduate Research Assistant, University of Arizona, School of Renewable Natural Resources, 2001 to 2003).	
Question 1.3 Impact on higher trophic levels	<i>Score: B Doc'n Level: Other pub.</i>
Identify type of impact or alteration: Spines that damage the mouth of native wildlife; reduction in forage production for native animals; provision of pollen and nectar for pollinators.	
Rationale: The stiff and sharp spines on the flower of yellow starthistle discourage livestock grazing and are likely to have similar effects on native species such as elk, deer, and pronghorn antelope. Stiff, sharp spines can damage the mouth of these wildlife species. In addition, dense yellow starthistle stands in the Pacific Northwest reduce and eliminate forage production when compared to perennial grasslands (Lass et al. 1999). Therefore, it is likely that yellow starthistle infested areas will be avoided by wildlife. On the other hand, starthistle flowers provide nectar and pollen for bees (Sheley et al. 1999) and butterflies. However, research has shown that yellow starthistle flowers are very low in nectar production compared to many other plants used by honeybees (Lass et al. 1999). In addition, seed production can increase by more than 20 times when plants are visited by bees (Lass et al. 1999).	
Sources of information: See cited literature.	
Question 1.4 Impact on genetic integrity	<i>Score: U Doc'n Level: No info.</i>
Identify impacts: Unknown	
Rationale: There are eight <i>Centaurea</i> species in Arizona, of which only two are native to the state (Kearny and Peebles 1960). The remaining species are from Europe and Asia. It is unknown whether <i>C. solstitialis</i> can impact the genetic integrity of the natives.	

Sources of information: No information on possible hybridization between <i>C. solstitialis</i> and <i>Centaurea</i> natives.	
Question 2.1	Role of anthropogenic and natural disturbance in establishment <i>Score: C Doc'n Level: Obs.</i>
Describe role of disturbance: Soil disturbance by cultivation and grazing, and altered hydrology due to dams, diversions, irrigation, etc.	
Rationale: In Cliff-Gila, New Mexico yellow starthistle grows only in pastures and fallow fields, and along roadsides and ditch banks. In this area, many farm fields were rested and this allowed yellow starthistle to establish (W. Sommers, personal observations, 2001 to 2003). Fields were rested because the land was acquired by a mining company for the water rights. In much of central and northern California, yellow starthistle is the most important roadside weed problem (DiTomaso 2001). There is concern that yellow starthistle could establish in undisturbed areas such as wilderness in the Gila National Forest which borders the Cliff-Gila River valley (BLM 1999). I have not seen any reports of yellow starthistle establishing in undisturbed areas.	
Sources of information: See cited literature. Also considered personal observation of dry-land pasture in Gila, New Mexico by W. Sommers (Graduate Research Assistant, University of Arizona, School of Renewable Natural Resources, 2001 to 2003).	
Question 2.2	Local rate of spread with no management <i>Score: A Doc'n Level: Obs.</i>
Describe rate of spread: Yellow starthistle populations can increase rapidly and double in less than 10 years even in the southwestern U.S.	
Rationale: In the Cliff-Gila River valley of southwest New Mexico (elevation around 4500 feet; semidesert grassland) the estimated yellow starthistle infestation has doubled from 500 to 1000 acres since 1999 (R. Lamb, personal communication, 2002). Between 1991 and 2003, the estimated infestation in Young, Arizona (5200 feet; semidesert grassland) has increased from 300 to over 3,000 acres (F. Northam, personal communication, 2003).	
Sources of information: Score based on personal observations by R. Lamb (County Program Director and Extension Agent, New Mexico State University, Grant County Cooperative Extension Service, 2002) and F. Northam (Noxious Weed Coordinator, Arizona Department of Agriculture, 2003).	
Question 2.3	Recent trend in total area infested within state <i>Score: B Doc'n Level: Obs.</i>
Describe trend: Increasing but not doubling in less than 10 years.	
Rationale: A 2001 map of the distribution and abundance of yellow starthistle in the west displays the plant in five counties (Lane 2001). The county with the most yellow starthistle, Gila County, has over a thousand acres impacted, and the other four counties have <100 acres impacted. Now Gila County has 3,000 to 4,000 acres of yellow starthistle and the other counties have a few hundred acres (F. Northam, personal communication, 2003).	
Sources of information: See cited literature and personal observations by F. Northam (Noxious Weed Coordinator, Arizona Department of Agriculture, 2003).	
Question 2.4	Innate reproductive potential <i>Score: A Doc'n Level: Rev. sci. pub.</i>
Describe key reproductive characteristics: Very prolific seed production; reaches reproductive maturity in less than one year; dense infestations can produce 50 to 100 million seeds per acre (DiTomaso 2001). A single large plant can produce over 100,000 seeds in less than a year (Sheley et al. 1999, DiTomaso 2001).	
Rationale: See Worksheet A	
Sources of information: See cited literature.	

Question 2.5 Potential for human-caused dispersal	<i>Score: A Doc'n Level: Other pub.</i>
Identify dispersal mechanisms: Presence as a contaminant in bulk seed, hay, feed, and soil; spread along transportation corridors.	
Rationale: Contaminated hay is suspected of bringing yellow starthistle to the Cliff-Gila area where it now thrives (BLM 1999). "Human activities are the primary mechanism for long distance movement of yellow starthistle seed (DiTomaso 2001:2)." Seed can be moved by road maintenance equipment, vehicles, and the transportation of contaminated hay or uncertified seed. Because yellow starthistle is found along highway rights-of-way in Arizona (F. Northam, personal communication, 2003), it is possible that seed will be moved by either motorists or the highway department.	
Sources of information: See cited literature and personal observations by F. Northam (Noxious Weed Coordinator, Arizona Department of Agriculture, 2003).	

Question 2.6 Potential for natural long-distance dispersal	<i>Score: B Doc'n Level: Rev. sci. pub.</i>
Identify dispersal mechanisms: Birds, mammals, and flowing water.	
Rationale: Seed is consumed by pheasants, quail, house finches, and goldfinches and may take seeds several miles (Roche 1991). In southwest New Mexico, yellow starthistle has spread from Cliff-Gila down the Gila River several miles (BLM 1999). There is also a population of yellow starthistle further downriver in Duncan, Arizona, which may be the result of seed moving in the river water. "The short, stiff, pappus bristles are covered with microscopic, stiff, appressed, hair-like barbs that can adhere to clothing, hair, and fur (DiTomaso 2001:2)." Both seed types, however, have no long distance wind dispersal mechanism.	
Sources of information: See cited literature.	

Question 2.7 Other regions invaded	<i>Score: C Doc'n Level: Obs.</i>
Identify other regions: Yellow starthistle has invaded parts of Colorado, Utah, and New Mexico, but only in ecological types already invaded in Arizona.	
Rationale: Yellow starthistle has scattered, small (<1000 acres) populations in each the four corners states.	
Sources of information: Score based on Lane (2001) and consensus of Working Group.	

Question 3.1 Ecological amplitude	<i>Score: A Doc'n Level: Obs.</i>
Describe ecological amplitude, identifying date of source information and approximate date of introduction to the state, if known: In Arizona, it is unknown when yellow starthistle was introduced to the state. Yellow starthistle can be found in seven minor ecological types. Introduced to Arizona in 1925 in Yuma County (SEINet 2004)	
Rationale: See Worksheet B.	
Sources of information: Score based on observations by F. Northam (Noxious Weed Coordinator, Arizona Department of Agriculture, 2003), W. Sommers (Graduate Research Assistant, University of Arizona, School of Renewable Natural Resources, 2001 to 2003), other Working Group members, and information from SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections ; accessed January 2004).	

Question 3.2 Distribution	<i>Score: D Doc'n Level: Obs.</i>
Describe distribution: Scattered yellow starthistle populations occur throughout Arizona from high elevation Sonoran Desert (Arizona Upland subdivision) to montane conifer forest and the total invaded area is estimated to be less than 15,000 acres. In the Sonoran and Chihuahuan Desert portions of Arizona, yellow starthistle has invaded river valleys.	
Rationale: Not widely established in any one particular ecological type.	

Sources of information: Score based on observations by F. Northam (Noxious Weed Coordinator, Arizona Department of Agriculture, 2003), W. Sommers (Graduate Research Assistant, University of Arizona, School of Renewable Natural Resources, 2001 to 2003), and other Working Group members.

Research in Arizona

Research on yellow starthistle biology/control in Arizona has only occurred in Young, Arizona. Dr. Larry Howery (University of Arizona) and Dr. Richard Lee (formerly New Mexico State University, but now with the Bureau of Land Management) conducted an experiment involving integrated management of yellow starthistle using combinations of native grass reseeding and weed suppression treatments. The results of this study were not published. Because of the lack of detailed scientific studies, much of the information used in this evaluation comes from research and observations from California and New Mexico.

Misidentification (comments by W. Sommers)

I have seen two books where the authors or contributors may have confused *Centaurea solstitialis* and *C. melitensis* (Malta starthistle). Sheley et al. (1999) provide a map of the distribution of *C. solstitialis* by county in the west. This map has *C. solstitialis* occurring in Maricopa, Pima, and Yuma counties. I believe the weed authority surveyed in Arizona may have lumped together both of these starthistle species. Epple (1995) identified a photo of *C. solstitialis* as occurring at the Granite Reef Dam near the confluence of the Salt and Verde Rivers. The plant in the photograph is actually *C. melitensis*.

Worksheet A. Reproductive Characteristics

Complete this worksheet to answer Question 2.4.

Reaches reproductive maturity in 2 years or less	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	1 pt.
Dense infestations produce >1,000 viable seed per square meter	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	2 pt.
Populations of this species produce seeds every year.	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	1 pt.
Seed production sustained for 3 or more months within a population annually	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	1 pt.
Seeds remain viable in soil for three or more years	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	2 pt.
Viable seed produced with <i>both</i> self-pollination and cross-pollination	Yes	<input type="checkbox"/> No	1 pt.
Has quickly spreading vegetative structures (rhizomes, roots, etc.) that may root at nodes	Yes	<input type="checkbox"/> No	1 pt.
Fragments easily and fragments can become established elsewhere	Yes	<input type="checkbox"/> No	2 pt.
Resprouts readily when cut, grazed, or burned	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	1 pt.
Total pts: 8 Total unknowns: 0			
Score : A			

Note any related traits: The time period from flower initiation to the production of mature viable seed is only eight days; large plants can produce over 100,000 seeds (DiTomaso 2001). Over 90% of yellow starthistle achenes are germinable one week after dispersal (Benefield et al. 2001). Yellow starthistle produces dimorphic achenes, one type with a distinct pappus, and the other with a pappus either poorly developed or absent. The average longevity of non-pappus-bearing and pappus-bearing achenes was six and ten years, respectively (Callihan et al. 1993). In Cliff-Gila, New Mexico yellow starthistle seed production lasts June to August (W. Sommers, personal observation).

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	D
Desertlands	Great Basin desertscrub	
	Mohave desertscrub	
	Chihuahuan desertscrub	
	Sonoran desertscrub	
Grasslands	alpine and subalpine grassland	
	plains and Great Basin shrub-grassland	
	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	
	southwestern interior riparian	
	montane riparian	
Woodlands	Great Basin conifer woodland	D
	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).

Note: The Peeples Valley population occurs in interior chaparral; the Camp Verde, Young, and Tonto Basin populations occur in semi-desert grassland; the Payson population is in the Great Basin conifer woodland; the Flagstaff population occurs in the montane conifer forest.

Distribution: In a telephone conversation with Dr. Francis E. Northam (F. Northam, Noxious Weed Coordinator, Arizona Department of Agriculture, 2003) he provided the locations of all known *Centaurea solstitialis* populations in the state. The populations with an asterisk (*) occur on or near roadsides or in suburban/rural areas and are not perceived to threaten wildlands.

1. Young – an infestation that was 300 acres in 1991 is now 3,000 to 4,000 acres
2. Tonto Basin (Pumpkin Center area) – a few hundred acres
3. Flagstaff – less than 100 acres
4. Wikieup* – less than 1/10 acre on a roadside
5. Payson – less than 100 acres
6. Camp Verde – a few hundred acres

7. Peeples Valley – 25 to 30 acres in irrigated pasture; 2 to 3 acres on rangeland
8. I-40 in Apache and Navajo counties* – small populations encountered by Arizona Department of Transportation
9. Duncan* – less than 10 acres
10. Phoenix* – small infestation

Literature Citations

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