WEED RISK ASSESSMENT FORM

Botanical name: *Bromus tectorum* L.

Common name: Cheatgrass, downy brome

Assessors:

Irina Lapina
Botanist, Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street,
Anchorage, Alaska 99501
tel: (907) 257-2710; fax (907) 257-2789

Matthew L. Carlson
Assistant Research Professor, Botany
Alaska Natural Heritage Program, University of Alaska Anchorage
707 A Street
Anchorage, Alaska 99501
tel: (907) 257-2790; fax (907) 257-2789

Reviewers:

Michael Shephard
Vegetation Ecologist Forest Health Protection State & Private Forestry, 3301 C Street, Suite 202, Anchorage, AK 99503
(907) 743-9454; fax 907 743-9479

Jeff Conn, Ph.D.
Weed Scientist, USDA Agricultural Research Service PO Box 757200
Fairbanks, Alaska 99775 tel: (907) 474-7652; fax (907) 474-6184

Julie Riley
Horticulture Agent, UAF Cooperative Extension Service
2221 E. Northern Lights Blvd. #118
Anchorage, AK 99508-4143
tel: (907) 786-6306

Jeff Heys
Exotic Plant Management Program Coordinator, National Park Service, Alaska Region - Biological Resources Team, 240 W. 5th Ave, #114, Anchorage, AK 99501
tel: (907)644-3451, fax: 644-3809

Page Spencer, Ph.D.
Ecologist, National Park Service, Alaska Region - Biological Resources Team, 240 W. 5th Ave, #114, Anchorage, AK 99501
tel: (907) 644-3448

Outcome score:

A.	**Climatic Comparison**		
	This species is present or may potentially establish in the following eco-geographic regions:		
1	South Coastal	Yes	
2	Interior-Boreal	Yes	
3	Arctic-Alpine	Yes	
	This species is unlikely to establish in any region in Alaska		

B.	**Invasiveness Ranking**	Total (Total Answered*) Possible	Total
1	Ecological impact	40 (40)	34
2	Biological characteristic and dispersal ability	25 (25)	15
3	Ecological amplitude and distribution	25 (25)	23
4	Feasibility of control	10 (10)	6
	Outcome score	100 (100)[b]	78[a]
	Relative maximum score†		0.78

* For questions answered "unknown" do not include point value for the question in parentheses for "Total Answered Points Possible."

† Calculated as [a]/[b].

A. CLIMATIC COMPARISON:

1.1 Has this species ever been collected or documented in Alaska?

Yes — Yes – continue to 1.2

No – continue to 2.1

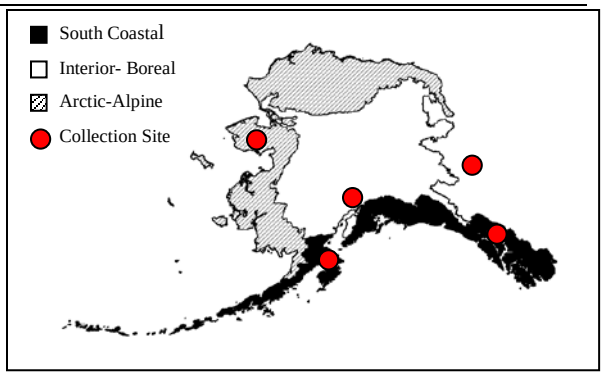
1.2. Which eco-geographic region has it been collected or documented (see inset map)?

Proceed to Section B. Invasiveness Ranking.

Yes — South Coastal

Yes — Interior-Boreal

Yes — Arctic-Alpine



Documentation: Has been collected in South Coastal (Juneau, Kodiak – Hultén 1968), Interior-Boreal (Anchorage – UAM, Dawson – Hultén 1968), and Arctic-Alpine (Nome – Hultén 1968) eco regions in Alaska.
Sources of information:
Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, CA. 1008 p.
University of Alaska Museum. University of Alaska Fairbanks. 2003. http://hispida.museum.uaf.edu:8080/home.cfm

2.1. Is there a 40% or higher similarity (based on CLIMEX climate matching) between climates any where the species currently occurs and

a. Juneau (South Coastal Region)?
Yes – *record locations and similarity; proceed to Section B. Invasiveness Ranking*
No

b. Fairbanks (Interior-Boreal)?
Yes – *record locations and similarity; proceed to Section B. Invasiveness Ranking*
No

c. Nome (Arctic-Alpine)?
Yes – *record locations and similarity; proceed to Section B. Invasiveness Ranking*
No
– *If "No" is answered for all regions, reject species from consideration*

Documentation:
Sources of information:

B. INVASIVENESS RANKING

1. ECOLOGICAL IMPACT

1.1. Impact on Natural Ecosystem Processes

A.	No perceivable impact on ecosystem processes	0
B.	Influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability)	3
C.	Significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, reduces open water that are important to waterfowl)	7
D.	Major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., the species alters geomorphology; hydrology; or affects fire frequency, altering community composition; species fixes substantial levels of nitrogen in the soil making soil unlikely to support certain native plants or more likely to favor non-native species)	10
U.	Unknown	

Score 10

Documentation:
Identify ecosystem processes impacted:
Cheatgrass infestation closes communities to the establishment of seedlings of perennial herbaceous species. It also changes the frequency and timing of wildfires in native communities (Carpenter and Murray 2005). Infestations of cheatgrass alter soil nutrient dynamics (Blank and Young 2004).
Rational:

Sources of information:
Blank, R.R. and J.A. Young. 2004. Influence of three weed species on soil nutrient dynamics. Soil Science 169(5): 385-397.
Carpenter, A.T., and T.A. Murray. 2005. Element Stewardship Abstract for *Bromus tectorum* L. (*Anisantha tecrorum* (L.) Nevski). The Nature Conservancy. Arlington, VA.

1.2. Impact on Natural Community Structure

A.	No perceived impact; establishes in an existing layer without influencing its structure	0
B.	Influences structure in one layer (e.g., changes the density of one layer)	3
C.	Significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer)	7
D.	Major alteration of structure (e.g., covers canopy, eradicating most or all layers below)	10
U.	Unknown	

Score 10

Documentation:
Identify type of impact or alteration:
Cheatgrass forms monoculture, creating a new layer (Carpenter and Murray 2005).
Rational:

Sources of information:
Carpenter, A.T., and T.A. Murray. 2005. Element Stewardship Abstract for *Bromus tectorum* L. (*Anisantha tecrorum* (L.) Nevski). The Nature Conservancy. Arlington, VA.

1.3. Impact on Natural Community Composition

A.	No perceived impact; causes no apparent change in native populations	0
B.	Influences community composition (e.g., reduces the number of individuals in one or more native species in the community)	3
C.	Significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community)	7
D.	Causes major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community composition towards species exotic to the natural community)	10
U.	Unknown	

Score 7

Documentation:
Identify type of impact or alteration:
Cheatgrass closes communities to the establishment of native perennial herbaceous species, causing reduction of biodiversity of natural community (Warner et al. 2003).
Rational:

Sources of information:
Warner, P.J., C.C. Bossard, M.L. Brooks, J.M. DiTomaso, J.A. Hall, A.M. Hawald, D.W. Johnson, J.M. Randall, C.L. Roye, M.M. Ryan, and A.E. Stanton. 2003 Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. (www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.

1.4. Impact on higher trophic levels (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades)

A.	Negligible perceived impact	0
B.	Minor alteration	3
C.	Moderate alteration (minor reduction in nesting/foraging sites, reduction in habitat connectivity, interference with native pollinators, injurious components such as spines, toxins)	7
D.	Severe alteration of higher trophic populations (extirpation or endangerment of an existing native species/population, or significant reduction in nesting or foraging sites)	10
U.	Unknown	

Score 7

Documentation:
Identify type of impact or alteration:
The sharp spikelets and rough awns damage the mouth and eyes of livestock. The effects on native game species are unknown. Over twenty diseases of cheatgrass have been reported (Carpenter and Murray 2005, Royer and Dickinson 1999).
Rational:

Sources of information:

Carpenter, A.T., and T.A. Murray. 2005. Element Stewardship Abstract for *Bromus tectorum* L. (*Anisantha tecrorum* (L.) Nevski). The Nature Conservancy. Arlington, VA.

Royer, F. and R. Dickinson. 1999. Weeds of the Northern U.S. and Canada. The University of Alberta press. 434 pp.

Total Possible	40
Total	34

---

2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

2.1. Mode of reproduction

A.	Not aggressive reproduction (few [0-10] seeds per plant and no vegetative reproduction)	0
B.	Somewhat aggressive (reproduces only by seeds (11-1,000/m^2)	1
C.	Moderately aggressive (reproduces vegetatively and/or by a moderate amount of seed, <1,000/m^2)	2
D.	Highly aggressive reproduction (extensive vegetative spread and/or many seeded, >1,000/m^2)	3
U.	Unknown	

Score 1

Documentation:

Describe key reproductive characteristics (including seeds per plant):

Cheatgrass establishes by seeds only. Seed production capacity can be over 300 seeds per plant (Butterfield et al. 1996, Rutledge and McLendon 1996, Warner et al. 2003). Stevens (1957) reported seed production of 700 per plant.

Rational:

Sources of information:

Butterfield, C., J. Stubbendieck, J. Stumpf. 1996. Species abstract of highly disruptive exotic plants. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/exoticab/exoticab.htm (Version 16JUL97).

Rutledge, C.R. and T. McLendon. 1996. An Assessment of Exotic Plant Species of Rocky Mountain National Park. Department of Rangeland Ecosystem Science, Colorado State University. 97 pp. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/Explant/explant.htm (Version 15DEC98).

Stevens, O.A. 1957. Weights of seeds and numbers per plant. Weeds 5: 46-55.

Warner, P.J., C.C. Bossard, M.L. Brooks, J.M. DiTomaso, J.A. Hall, A.M. Hawald, D.W. Johnson, J.M. Randall, C.L. Roye, M.M. Ryan, and A.E. Stanton. 2003 Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. (www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.

2.2. Innate potential for long-distance dispersal (bird dispersal, sticks to animal hair, buoyant fruits, wind-dispersal)

A.	Does not occur (no long-distance dispersal mechanisms)	0
B.	Infrequent or inefficient long-distance dispersal (occurs occasionally despite lack of adaptations)	2
C.	Numerous opportunities for long-distance dispersal (species has adaptations such as pappus, hooked fruit-coats, etc.)	3
U.	Unknown	

Score 3

Documentation:

Identify dispersal mechanisms:

Cheatgrass can be spread by wind, and attachment to animal fur (Warner et al. 2003).

Rational:
Seeds are hairy.
Sources of information:
Warner, P.J., C.C. Bossard, M.L. Brooks, J.M. DiTomaso, J.A. Hall, A.M. Hawald, D.W. Johnson, J.M. Randall, C.L. Roye, M.M. Ryan, and A.E. Stanton. 2003 Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. (www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.

2.3. Potential to be spread by human activities (both directly and indirectly – possible mechanisms include: commercial sales, use as forage/revegetation, spread along highways, transport on boats, contamination, etc.)

A.	Does not occur	0
B.	Low (human dispersal is infrequent or inefficient)	1
C.	Moderate (human dispersal occurs)	2
D.	High (there are numerous opportunities for dispersal to new areas)	3
U.	Unknown	

Score 3

Documentation:
Identify dispersal mechanisms:
Cheatgrass spreads attached to human clothing, along transportation corridors such as highways and railroads. It also contaminates grain seed, hay, straw, and soil (Warner et al. 2003).
Rational:

Sources of information:
Warner, P.J., C.C. Bossard, M.L. Brooks, J.M. DiTomaso, J.A. Hall, A.M. Hawald, D.W. Johnson, J.M. Randall, C.L. Roye, M.M. Ryan, and A.E. Stanton. 2003 Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. (www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.

2.4. Allelopathic

A.	No	0
B.	Yes	2
U.	Unknown	

Score 0

Documentation:
Describe effect on adjacent plants:
Cheatgrass has not been recorded as an allelopathic.
Rational:

Sources of information:

2.5. Competitive ability

A.	Poor competitor for limiting factors	0
B.	Moderately competitive for limiting factors	1
C.	Highly competitive for limiting factors and/or nitrogen fixing ability	3
U.	Unknown	

Score 3

Documentation:
Evidence of competitive ability:
Cheatgrass is highly competitive with perennial grasses for soil moisture and nutrient (Carpenter and Murray 2005).
Rational:

Sources of information:
Carpenter, A.T., and T.A. Murray. 2005. Element Stewardship Abstract for *Bromus*

tectorum L. (*Anisantha tecrorum* (L.) Nevski). The Nature Conservancy. Arlington, VA.

2.6. Forms dense thickets, climbing or smothering growth habit, or otherwise taller than the surrounding vegetation

A.	No	0
B.	Forms dense thickets	1
C.	Has climbing or smothering growth habit, or otherwise taller than the surrounding vegetation	2
U.	Unknown	

Score 0

Documentation:
Describe grow form:
Cheatgrass tends to form dominant stands (Carpenter and Murray 2005).
Rational:

Sources of information:
Carpenter, A.T., and T.A. Murray. 2005. Element Stewardship Abstract for *Bromus tectorum* L. (*Anisantha tecrorum* (L.) Nevski). The Nature Conservancy. Arlington, VA.

2.7. Germination requirements

A.	Requires open soil and disturbance to germinate	0
B.	Can germinate in vegetated areas but in a narrow range or in special conditions	2
C.	Can germinate in existing vegetation in a wide range of conditions	3
U.	Unknown	

Score 2

Documentation:
Describe germination requirements:
Seeds require fall, winter, or early spring moisture to germinate. Germinates best in the dark or in diffuse light, and readily germinates under a wide range of temperatures. Optimal germination occurs in the top 2.5 cm of soil, no emergence occurs from seeds buried four inches below the surface (Anderson 1996, Mack and Pyke 1983, Warner et al. 2003).
Rational:

Sources of information:
Anderson, R.L. 1996. Downy brome (*Bromus tectorum*) emergence variability in a Semiarid Region. Weed Technology. 10:750-753.
Mack, R. N. and D. A. Pyke. 1983. The demography of Bromus tectorum: variation in time and space. Journal of Ecology, 71:69-93.
Warner, P.J., C.C. Bossard, M.L. Brooks, J.M. DiTomaso, J.A. Hall, A.M. Hawald, D.W. Johnson, J.M. Randall, C.L. Roye, M.M. Ryan, and A.E. Stanton. 2003 Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. (www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.

2.8. Other species in the genus invasive in Alaska or elsewhere

A.	No	0
B.	Yes	3
U.	Unknown	

Score 3

Documentation:
Species:
Bromus commutatus Schrad., *B. hordeaceus* L., *B. inermis* Leyss., *B. secalinus* L.
Sources of information:
Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, CA. 1008 p.
USDA (United States Department of Agriculture), NRCS (Natural Resource Conservation Service). 2002. The PLANTS Database, Version 3.5

(http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

2.9. Aquatic, wetland, or riparian species

A.	Not invasive in wetland communities	0
B.	Invasive in riparian communities	1
C.	Invasive in wetland communities	3
U.	Unknown	

Score 0

Documentation:
Describe type of habitat:
Cheatgrass is common in pastures, rangeland, winter crops, sand dunes, shrub-steppe areas, roadsides, and waste places (Carpenter and Murray 2005, Royer and Dickinson 1999).
Rational:

Sources of information:
Carpenter, A.T., and T.A. Murray. 2005. Element Stewardship Abstract for *Bromus tectorum* L. (*Anisantha tecrorum* (L.) Nevski). The Nature Conservancy. Arlington, VA.
Royer, F. and R. Dickinson. 1999. Weeds of the Northern U.S. and Canada. The University of Alberta press. 434 pp.

Total Possible 25
Total 15

---

3. DISTRIBUTION

3.1. Is the species highly domesticated or a weed of agriculture

A.	No	0
B.	Is occasionally an agricultural pest	2
C.	Has been grown deliberately, bred, or is known as a significant agricultural pest	4
U.	Unknown	

Score 4

Documentation:
Identify reason for selection, or evidence of weedy history:
Cheatgrass is a weed of croplands, especially winter wheat and alfalfa (Royer and Dickinson 1999).
Rational:

Sources of information:
Royer, F. and R. Dickinson. 1999. Weeds of the Northern U.S. and Canada. The University of Alberta press. 434 pp.

3.2. Known level of impact in natural areas

A.	Not known to cause impact in any other natural area	0
B.	Known to cause impacts in natural areas, but in dissimilar habitats and climate zones than exist in regions of Alaska	1
C.	Known to cause low impact in natural areas in similar habitats and climate zones to those present in Alaska	3
D.	Known to cause moderate impact in natural areas in similar habitat and climate zones	4
E.	Known to cause high impact in natural areas in similar habitat and climate zones	6
U.	Unknown	

Score 6

Documentation:
Identify type of habitat and states or provinces where it occurs:
Cheatgrass forms dominant stands in sagebrush rangelands, juniper, and pine woodlands, less commonly in aspen and conifer communities (Colorado and California) (Rutledge and McLendon 1996, Warner et al. 2003). In has invaded

undisturbed grassland communities in eastern Washington, Idaho, eastern Oregon, Nevada, and Utah (Carpenter and Murray 2005).

Sources of information:

Carpenter, A.T., and T.A. Murray. 2005. Element Stewardship Abstract for *Bromus tectorum* L. (*Anisantha tecrorum* (L.) Nevski). The Nature Conservancy. Arlington, VA.

Rutledge, C.R. and T. McLendon. 1996. An Assessment of Exotic Plant Species of Rocky Mountain National Park. Department of Rangeland Ecosystem Science, Colorado State University. 97 pp. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/Explant/explant.htm (Version 15DEC98).

Warner, P.J., C.C. Bossard, M.L. Brooks, J.M. DiTomaso, J.A. Hall, A.M. Hawald, D.W. Johnson, J.M. Randall, C.L. Roye, M.M. Ryan, and A.E. Stanton. 2003 Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. (www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.

3.3. Role of anthropogenic and natural disturbance in establishment

A.	Requires anthropogenic disturbances to establish	0
B.	May occasionally establish in undisturbed areas but can readily establish in areas with natural disturbances	3
C.	Can establish independent of any known natural or anthropogenic disturbances	5
U.	Unknown	

Score 3

Documentation:

Identify type of disturbance:

Disturbance, typically heavy grazing, allows cheatgrass to invade and proliferate (Carpenter and Murray 2005, Warner et al. 2003).

Rational:

Sources of information:

Carpenter, A.T., and T.A. 2005. Murray. Element Stewardship Abstract for *Bromus tectorum* L. (*Anisantha tecrorum* (L.) Nevski). The Nature Conservancy. Arlington, VA.

Warner, P.J., C.C. Bossard, M.L. Brooks, J.M. DiTomaso, J.A. Hall, A.M. Hawald, D.W. Johnson, J.M. Randall, C.L. Roye, M.M. Ryan, and A.E. Stanton. 2003 Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. (www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.

3.4. Current global distribution

A.	Occurs in one or two continents or regions (e.g., Mediterranean region)	0
B.	Extends over three or more continents	3
C.	Extends over three or more continents, including successful introductions in arctic or subarctic regions	5
U.	Unknown	

Score 5

Documentation:

Describe distribution:

Originally from the Mediterranean region and Eurasia, cheatgrass has spread throughout Europe, Southern Russia, west central Asia, North America, Japan, South Africa, Australia, New Zealand, Iceland, and Greenland. Populations have established in Northern Norway, Iceland, and Greenland (Carpenter and Murray 2005, Warner et al. 2003).

Rational:

Carpenter, A.T., and T.A. Murray. 2005. Element Stewardship Abstract for *Bromus tectorum* L. (*Anisantha tecrorum* (L.) Nevski). The Nature Conservancy. Arlington, VA.

Warner, P.J., C.C. Bossard, M.L. Brooks, J.M. DiTomaso, J.A. Hall, A.M. Hawald, D.W. Johnson, J.M. Randall, C.L. Roye, M.M. Ryan, and A.E. Stanton. 2003 Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. (www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.

3.5. Extent of the species U.S. range and/or occurrence of formal state or provincial listing

A.	0-5% of the states	0
B.	6-20% of the states	2
C.	21-50%, and/or state listed as a problem weed (e.g., "Noxious," or "Invasive") in 1 state or Canadian province	4
D.	Greater than 50%, and/or identified as "Noxious" in 2 or more states or Canadian provinces	5
U.	Unknown	

Score 5

Documentation:

Identify states invaded:

Bromus tectorum is listed as a noxious weed in Colorado, Alberta, Manitoba, and Saskatchewan (Invaders Database System 2003, Royer and Dickinson 1999, USDA, NRCS 2002).

Rational:

Sources of information:

Invaders Database System. The University of Montana. 2003. Montana Noxious Weed Trust Fund. Department of Agricultural. http://invader.dbs.umt.edu/

Royer, F. and R. Dickinson. 1999. Weeds of the Northern U.S. and Canada. The University of Alberta press. 434 pp.

USDA (United States Department of Agriculture), NRCS (Natural Resource Conservation Service). 2002. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Total Possible 25

Total 23

---

4. FEASIBILITY OF CONTROL

4.1. Seed banks

A.	Seeds remain viable in the soil for less than 3 years	0
B.	Seeds remain viable in the soil for between 3 and 5 years	2
C.	Seeds remain viable in the soil for 5 years and more	3
U.	Unknown	

Score 2

Documentation:

Identify longevity of seed bank:

Seeds remain viable in the soil for two to five years (Burnside et al. 1996, Carpenter and Murray 2005, Chepil 1946).

Rational:

Sources of information:

Burnside, O.C., R.G. Wilson, S. Weisberg and K.G. Hubbard. 1996. Weed Science 44: 74-86.

Carpenter, A.T., and T.A. Murray. 2005. Element Stewardship Abstract for *Bromus tectorum* L. (*Anisantha tecrorum* (L.) Nevski). The Nature Conservancy. Arlington, VA.

Chepil, W.S. 1946. Germination of weed seeds. I. Longevity, periodicity of germination, and vitality of seeds in cultivated soil. Scientific Agriculture 26: 307-346.

4.2. Vegetative regeneration

A.	No resprouting following removal of aboveground growth	0
B.	Resprouting from ground-level meristems	1
C.	Resprouting from extensive underground system	2
D.	Any plant part is a viable propagule	3
U.	Unknown	

Score 0

Documentation:
Describe vegetative response:
Cheatgrass has no ability to resprouting after removal of aboveground growth (Carpenter and Murray 2005, Warner et al. 2003).
Rational:

Sources of information:
Carpenter, A.T., and T.A. Murray. Element Stewardship Abstract for *Bromus tectorum* L. (*Anisantha tecrorum* (L.) Nevski). The Nature Conservancy. Arlington, VA.
Warner, P.J., C.C. Bossard, M.L. Brooks, J.M. DiTomaso, J.A. Hall, A.M. Hawald, D.W. Johnson, J.M. Randall, C.L. Roye, M.M. Ryan, and A.E. Stanton. 2003 Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. (www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.

4.3. Level of effort required

A.	Management is not required (e.g., species does not persist without repeated anthropogenic disturbance)	0
B.	Management is relatively easy and inexpensive; requires a minor investment in human and financial resources	2
C.	Management requires a major short-term investment of human and financial resources, or a moderate long-term investment	3
D.	Management requires a major, long-term investment of human and financial resources	4
U.	Unknown	

Score 4

Documentation:
Identify types of control methods and time-term required:
Control of cheatgrass will require a combination of chemical, mechanical methods, and proper livestock management. Native perennial grasses should be seeded after treatment. Monitoring is recommended for a few years after treatment (Carpenter and Murray 2005).
Rational:

Sources of information:
Carpenter, A.T., and T.A. Murray. 2005. Element Stewardship Abstract for *Bromus tectorum* L. (*Anisantha tecrorum* (L.) Nevski). The Nature Conservancy. Arlington, VA.

Total Possible	10
Total	6

Total for 4 sections Possible	100
Total for 4 sections	78

References:
Anderson, R.L. 1996. Downy brome (*Bromus tectorum*) emergence variability in a Semiarid Region. Weed Technology. 10:750-753.
Blank, R.R. and J.A. Young. 2004. Influence of three weed species on soil nutrient dynamics. Soil Science 169(5): 385-397.

Burnside, O.C., R.G. Wilson, S. Weisberg and K.G. Hubbard. 1996. Weed Science 44: 74-86.
Carpenter, A.T., and T.A. Murray. 2005. Element Stewardship Abstract for *Bromus tectorum* L. (*Anisantha tecrorum* (L.) Nevski). The Nature Conservancy. Arlington, VA.
Chepil, W.S. 1946. Germination of weed seeds. I. Longevity, periodicity of germination, and vitality of seeds in cultivated soil. Scientific Agriculture 26: 307-346.
Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, CA. 1008 p.
Invaders Database System. The University of Montana. 2003. Montana Noxious Weed Trust Fund. Department of Agricultural. http://invader.dbs.umt.edu/
Mack, R. N. and D. A. Pyke. 1983. The demography of *Bromus tectorum*: variation in time and space. Journal of Ecology, 71:69-93.
Royer, F. and R. Dickinson. 1999. Weeds of the Northern U.S. and Canada. The University of Alberta press. 434 pp.
Rutledge, C.R., and T. McLendon. 1996. An Assessment of Exotic Plant Species of Rocky Mountain National Park. Department of Rangeland Ecosystem Science, Colorado State University. 97 pp. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/Explant/explant.htm (Version 15DEC98).
Stevens, O.A. 1957. Weights of seeds and numbers per plant. Weeds 5: 46-55.
University of Alaska Museum. University of Alaska Fairbanks. 2003. http://hispida.museum.uaf.edu:8080/home.cfm
USDA (United States Department of Agriculture), NRCS (Natural Resource Conservation Service). 2002. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.
Warner, P.J., C.C. Bossard, M.L. Brooks, J.M. DiTomaso, J.A. Hall, A.M. Hawald, D.W. Johnson, J.M. Randall, C.L. Roye, M.M. Ryan, and A.E. Stanton. 2003 Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. (www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.