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)**:**	*Lepidium latifolium* L. (USDA 2005)
Synonyms:	*Cadaria latifolia* (L.) Spach (USDA 2005)
Common names:	Perennial pepperweed, tall whitetop, perennial peppercress (or peppergrass), broadleaved peppergrass (or pepperweed), peppergrass, slender perennial peppercress, dittander, giant whiteweed, ironweed
Evaluation date (mm/dd/yy)**:**	01/15/04
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Committee review date:	03/26/04 and 03/01/05
List date:	03/26/04; revised 03/01/05
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**	Other published material	**"Impact"** **Section 1 Score:** **A**	**"Plant Score"** **Overall Score:** **High** **Alert Status:** **Alert**
1.2	Impact on plant community	**A**	Other published material		
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:* **14 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	**U**	No information		
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	**B**	Observational		
2.7	Other regions invaded	**B**	Other published material		RED FLAG **YES** Something you should know.
3.1	Ecological amplitude	**B**	Other published material	**"Distribution"** **Section 3 Score:** **C**	
3.2	Distribution	**D**	Observational		

Red Flag Annotation

Lepidium latifolium is not widely distributed in Arizona. Established populations occur mostly near the northern borders of the state. Land managers should be on the alert for isolated plants or small nascent populations that can be eradicated before they can spread. *Lepidium latifolium* is a difficult species to eradicate so addressing infestations while they are small is critical.

Table 3. Documentation

Note: *Lepidium latifolium* is widespread through many of New Mexico *Tamarix* spp patches and much concern exists for *Tamarix* spp. management causing increases in the spread of perennial pepperweed (M. Renz, personal communication, New Mexico State Noxious Weed Coordinator, Albuquerque, New Mexico, 2005).

Question 1.1 Impact on abiotic ecosystem processes *Score:* **A** *Doc'n Level:* **Other pub**.
Identify ecosystem processes impacted: *Lepidium latifolium* grows large monotypic stands that reduce light to the soil surface. It can alter the soil salinity and chemistry. Its root system allows erosion to occur along river banks.
Rationale: All of the information that follows is based on studies in California and Nevada. These studies show that *L. latifolium* grows large monotypic stands that reduce light to the soil surface by both the dense upper foliage and a layer of senesced woody stems. Soil salinity is altered by roots that draw salt ions from deep in the soil to deposit on the surface. Soil stability is decreased on riverbanks by an extensive root system that fragments easily. The dense stands of *L. latifolium* reduce light to the soil surface in more than one way. "Structurally, a stand consists of from 4 to 8 stems per 0.1 m^2 resulting in nearly complete foliar crown closure…" (Young et al. 1995a). "Old stems take several years to degrade, and can form a layer impenetrable to light…upwards of 10 cm in depth which prevents the emergence of annual plants in these areas (Renz and DiTomaso 1998 in Renz 2000). "Few plants besides *L. latifolium* have enough stored energy to grow through this dense litter layer." (Renz 2000). It forms "tall dense stands, with the surface soil packed with creeping stems" (Young et al. 1995a). *Lepidium latifolium* acts as a "salt pump" transporting salt ions from deeper soil to the surface, which favors halophytes over other species (Blank and Young 1997 in Renz 2000). Annual biomass production by perennial pepperweed builds a dense organic layer on the soil surface, which may have a significant consequence on carbon-nitrogen ratios over time (Washington State Noxious Weed Control Board 1999). *Lepidium latifolium* has both surface and penetrating roots. However, "the combination of the low root density and perennial roots fragmenting easily allows soil erosion to occur more frequently along riverbanks that they infest" (Renz 2000).
Sources of information: See cited literature.

Question 1.2 Impact on plant community composition, structure, and interactions *Score:* **A** *Doc'n Level:* **Other pub.**
Identify type of impact or alteration: *Lepidium latifolium* can grow large monospecific stands, which can displace native plants or interfere with regeneration. It competes with other plants for resources. It alters the soil to favor more halophytic plants. It also adds structure of dense senescent and persistent material that prevents emergence of annual plants.
Rationale: *Lepidium latifolium* appears to successfully compete with other plant species for moisture, nutrients, and light (Young et al. 1995a). Large colonies replace native grasses, sedges, and rushes (Washington State Noxious Weed Control Board 1999). From Renz (2000): Young and others (1995b) have also shown that *L. latifolium* interferes with the regeneration of plant species such as willows and cottonwoods. Studies from California and Nevada show that *L. latifolium* populations displace and/or interfere with the regeneration of native plants through competition, exclusion, and possibly allelopathy. *Lepidium latifolium* allelopathic research so far has failed to isolate the substance (Young et al. 1995a). It also alters the soil to favor more halophytic plants (Young et al. 1995b).

Its ability to act as a "salt pump" can shift plant composition toward more halophytic plants (Blank and Young 1997), thereby decreasing diversity. "Experimental evidence suggests that plants extract salts from deep soil and deposit them on the soil surface with leaf litter, inhibiting the germination and growth of other species (DiTomaso and Healy 2003).

In the Suisun Marsh (Grizzly Island Wildlife Area in California) it is encroaching on rare plant populations in salt marshes (Skinner and Pavlik 1994 in Howald 2000). *Lepidium latifolium* "spreads by creeping underground roots which may grow to a length of ten feet, sending up shoots and enabling dense monocultures to form" (Krueger and Sheley 1999).

Sources of information: See cited literature.

Question 1.3 Impact on higher trophic levels *Score:* **U** *Doc'n Level:* **No info.**

Identify type of impact or alteration: Potentially reduces habitat and frequency of nesting waterfowl; alters forage.

Rationale: Trumbo (1994) documented that at Suisun Marsh (Grizzly Island Wildlife Area in California), perennial pepperweed competes with pickleweed, which supports populations of endangered salt marsh harvest mouse. The tall stature and dense growth pattern of perennial pepperweed make it unsuitable use for waterfowl as nesting cover. In addition to the endangered salt marsh harvest mouse, Howald (2000) also suggests it poses a threat to habitat to California black rail and California clapper rail. In waterfowl nesting areas, it outcompetes grasses that provide food for waterfowl. *Lepidium latifolium* displaces native forage and nesting vegetation (Krueger and Sheley 1999).

Because Arizona has limited salt marshes and coastal wetlands, it is unknown how *L. latifolium* impacts Ariizona's higher trophic levels.

Sources of information: See cited literaure.

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

Identify impacts: The potential to hybridize does exist but it is not know whether it can or does hybridize with Arizona's native *Lepidium*.

Rationale: Young et al (1995a) mention that there are approximately 75 native Lepidium in North America. Arizona has several native *Lepidium* (Kearney and Peebles 1960). *Lepidium* species can hybridize (Lee et al. 2002, A. Salywon, personal communication, 2005).

Sources of information: See cited literature. Also considered personal communication with A. Salywon (Research Geneticist, U.S. Department of Agriculture, Agricultural Research Service, Water Conservation Laboratory, Phoenix, Arizona, 2005).

Question 2.1 Role of anthropogenic and natural disturbance in establishment *Score:* **B** *Doc'n Level:* **Other pub.**

Describe role of disturbance: Populations of *L. latifolium* have not been known to establish without some form of disturbance. Prior disturbance may facilitate the colonization.

Rationale: Various sources suggest (see below) that disturbance, prior or current, human or natural, is required for *L. latifolium* to establish. Disturbance that moves root stock from one location to another will more likely result in colonization than will opportunism by seeds in newly opened land.

Studies in California and Nevada indicate that many of the places that *L. latifolium* invades are already not in good ecological condition (e.g., overgrazed, abandoned crop land) (Young et al. 1995a, Washington State Noxious Weed Control Board 1999). In western Nevada, investigators had "difficulty finding high condition areas without perennial pepperweed to serve as experimental controls" (Young et al. 1995a). "Perennial pepperweed will have a difficult time encroaching upon a healthy, functioning ecosystem in which few niches are left unoccupied" (Krueger and Sheley 1999).

Washington State Noxious Weed Control Board (1999) states that *L. latifolium* readily invades disturbed areas and bare soils. It also states that "in addition to natural areas, dense colonies are formed in disturbed areas such as roadsides, rangelands, pastures, agricultural fields, and irrigation canals." Populations have not been observed in Arizona where some sort of disturbance has not occurred (Working Group discussion).

Sources of information: See cited literature; also see Renz (2000), DiTomaso and Healy (2003), and Trumbo (1994). Also considered Working Group discussion.

Question 2.2 Local rate of spread with no management *Score:* **A** *Doc'n Level:* **Obs.**

Describe rate of spread: Doubling in <10 years.

Rationale: Based on observations by L. Stevens and G. Rink contained in SEINet (2004) around the 1990s and those of L. Makarick and C. Deuser in the last few years, populations have been doubling in less than ten years (L. Makarick, personal communication, 2005). Makarick was unaware *of L. latifolium* infestations until recent years (2003 and 2004) that were documented along the upper stretches of the Colorado River below Lee's Ferry (personal communication, 2005).

At three sites in California, *L. latifolium* infestations spread clonally 1 to 2 m per year, expanding 44% to 129% over a two-year time period (Renz 2002). Once established, in an optimum location, a plant can spread 1 to 2 m (sometimes 3 m) per year; in a less optimum location, spread rate will be less (M. Renz, personal communication, 2004 and 2005).

Trumbo (1994) stresses the need to eradicate small populations quickly before they have a chance to spread.

Sources of information: See cited literature. Also considered personal communications with L. Makarick (Below the Rim Vegetation Program Manager, Grand Canyon National Park, Science Center Flagstaff, Arizona, 2005) and M. Renz (New Mexico State Noxious Weed Coordinator, Albuquerque, New Mexico, 2004 and 2005).

Question 2.3 Recent trend in total area infested within state *Score:* **U** *Doc'n Level:* **No info.**

Describe trend: Unknown

Rationale: Individuals familiar with this species are not comfortable making an estimate in the total area infested within the state.

Sources of information: Personal communication with L. Makarick (Below the Rim Vegetation Program Manager, Grand Canyon National Park, Science Center Flagstaff, Arizona, 2005) and Working Group discussion.

Question 2.4 Innate reproductive potential *Score:* **A** *Doc'n Level:* **Other pub.**

Describe key reproductive characteristics: *Lepidium latifolium* is a prolific seed producer however, it relies heavily upon regeneration by offshoots from the root structures.

Rationale: Perennial pepperweed reproduces from seed, as well as vegetatively from intact root systems or from pieces of rootstock (Howald 2000). Seedlings are extremely rare in established stands. Plants form large spreading clones, with new stems arising from creeping root system (Young et al. 1995a).

Flowering is from May to July, lasting for several weeks, and seeds mature by June or July. Seedlings grow rapidly and can produce flowering stems the first year. (Howald 2000). Others state it as shorter flowering periods of late June to early July (Young et al. 1995a); mid spring to early summer with flowering and fruit set occurring for several months (Renz 2000). Plants can self- and cross-pollinate (M. Renz, personal communication, 2005 and A. Salywon, personal communication, 2005).

Seeds have a high rate of germination following winter periods of fluctuating temperatures; however, "seeds lack a hard seed coat and do not seem to be capable of surviving long periods in the soil, thus seed viability may be short. This suggests that reinfestations from the seed bank may not be a problem once control is achieved" (Miller et al. 1986 in Renz 2000). Seed production highly variable: measured to be as high as 1.6×10^{10} seeds/ha (unpublished research, U.S. Department of Agriculture, Agricultural Research Service, Reno, Nevada in Renz 2000). Krueger and Sheley (1999) report seed production of six billion seeds per acre of infestation. California studies have indicated that perennial pepperweed can produce over 16 million seeds per hectare (Young et al. 1997 in Washington State Noxious Weed Control Board 1999).

From Renz (2000): Plant can fragment easily (usually through disturbance along water courses) and can establish elsewhere. Mowing is not an effect means of control. Burning does not appear to harm below-ground perennial roots (Trumbo 1994). Biomass of resprouting stems may even increase in subsequent years due to the removal of the litter layer (Renz and DiTomaso 1998).

Sources of information: See cited literature. Also considered personal communications with M. Renz (New Mexico State Noxious Weed Coordinator, Albuquerque, New Mexico, 2005) and A. Salywon (Research Geneticist, U.S. Department of Agriculture, Agricultural Research Service, Water Conservation Laboratory, Phoenix, Arizona, 2005).

Question 2.5 Potential for human-caused dispersal *Score:* **B** *Doc'n Level:* **Other pub.**

Identify dispersal mechanisms: Dried flower arrangements; movement of root or seed in contaminated dirt, machinery, feed, straw or other materials; hay and seed contaminate.

Rationale: Moving dirt or machinery that are contaminated with root fragments can initiate an invasion. Hay, feed stock, dried flowers arrangements, and straw used in stabilization projects can also be contaminated with weed seed and/or rhizomes (Washington State Noxious Weed Control Board 1999).

Krueger and Sheley (1999): Flood irrigation carries plant propagules into hay meadows, pastures and other irrigated lands. Also carried in contaminated topsoil used as fill for construction and landscaping. Often used by florists in fresh and dried flower arrangements.

Once established, *L. latifolium* follows water routes to other areas (could be irrigation ditches and canals) (Young et. al. 1995a). It is said to be able to reach fields from riparian areas via irrigation ditches (Washington State Noxious Weed Control Board 1999).

Sources of information: See cited literature.

Question 2.6 Potential for natural long-distance dispersal *Score:* **B** *Doc'n Level:* **Obs.**

Identify dispersal mechanisms: Seasonal flooding or bank erosion, wind, and waterfowl.

Rationale: *Lepidium latifolium* typically invades along riparian areas and other water courses and wet areas (Renz 2000). When flooding events or natural flow occur, roots can breaks off and colonize downstream. Distribution corresponds to river systems and riparian zones, which are the primary areas of invasion in most states though not limited to these areas. Travels in rivers and irrigation systems as seeds and rhizomes from eroded banks. (Krueger and Sheley 1999). Howald (2000) states that the small seeds have no special adaptations for long-distance dispersal, but they are capable of being transported by wind, water, and possibly waterfowl.

Sources of information: See cited literature. Working Group members used inference to assign the score.

Question 2.7 Other regions invaded	*Score:* **B** *Doc'n Level:* **Other pub.**
Identify other regions: Great Basin grasslands and Chihuahuan desertscrub.	
Rationale: The draft California plant assessment for *Lepidium latifolium* by C. Roye and J. DiTomaso (reviewed by the California list committee on March 19, 2004) listed ecological types invaded in California. A number of these, riparian scrub (desert washes), riparian woodlands, riparian forests, and Great Basin grasslands, likely have ecological equivalents in Arizona. Based on this information, the plains and Great Basin shrub-grassland type and at least one of the riparian types in Arizona seem to be equivalent ecological types invaded in California but not yet invaded in Arizona. In addition, in New Mexico *L. latifolium* can be found in Chihuahuan desertscrub along Rio Grande (M. Renz, personal communication, 2004) and along the south side of the San Juan River, between Slickhorn Canyon and Grand Gulch (collection by D. Roth 2003 in SEINet 2005). *Lepidium latifolium* is currently in Utah on the Arizona border in the Arizona Strip area (L. Walker, personal communication, 2004). Also exists along the San Juan River, Utah (see above) and in the Chuska Mountains, New Mexico on the Navajo Nation (D. Roth, personal communication, 2005). "In New Mexico it is prevalent in riparian areas and high elevation spots with a very high water-table. I have seen it in Nevada (Las Vegas) established in a floodplain area with a high water-table, so it can withstand hot temps, the establishment conditions likely need to be ideal, causing infrequent establishment" (D. Roth, personal communication, 2005). Chihuahuan desertscrub is thus another ecological type invaded elsewhere that is not yet invaded in Arizona. From the Washington State Noxious Weed Control Board (1999): Native range of perennial pepperweed extends from the Mediterranean basin, to temperate Europe, and east to the Middle East, Asia and the Himalayas (Kloot 1973). In North America it has been introduced to diverse locations from New England to Mexico (Miller et al. 1986) and now covers thousands of acres across the West. (Young et al. 1997). Infestations in North America have been reported in coastal New England and throughout all of the states west of the Rocky Mountains. California lists it widespread throughout (Howald 2000).	
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 February 2005), the draft California *Lepidium latifolium* plant assessment by C. Roye and J. DiTomaso (available online at: http://www.cal-ipc.org/list_revision/completed_pafs.html; information current as of March 19, 2004), and personal communications with M. Renz (New Mexico State Noxious Weed Coordinator, Albuquerque, New Mexico, 2004), L. Walker (Weed Specialist, Bureau of Land Management, Arizona Strip, St. George, Utah, 2004), and D. Roth (Botanist, Navajo Natural Heritage Program, Flagstaff, Arizona, 2005).	

Question 3.1 Ecological amplitude	*Score:* **B** *Doc'n Level:* **Other pub.**
Describe ecological amplitude, identifying date of source information and approximate date of introduction to the state, if known: First sighted in California in 1936 sugar beet seed (Bellue 1936 in Howald 2000). First herbarium record in Arizona (as of February 2005) was collected by L. Stevens in 1987 along the Colorado River in the Grand Canyon (river mile 194-left, SEINet 2005). *Lepidium latifolium* is adapted to sites that are at least seasonally moist in riparian and wetland areas. *Lepidium latifolium* is particularly adapted to salt affected soils. (Young et al 1995a, Howald 2000).	
Rationale: Observations of *L. latifolium* have occurred in southwestern interior riparian, in "scattered locations along the Colorado River beaches and shoreline from river mile 24.5 to 170" (L. Makarick, personal communication, 2005). Great Basin desertscrub and Mohave desertscrub (L. Walker, personal communication, 2004) populations were treated and no longer exist. *Lepidium latifolium* is currently in Utah on the Arizona border in the Arizona Strip area (Walker, personal communication, 2004). Also exists in San Juan River, Utah and Chuska Mountains, New Mexico on the Navajo Nation (D. Roth, personal communication, 2005).	

Collections in Arizona herbaria include include two from L.E. Stevens, in 1991 and 1987, along the Colorado River in the Grand Canyon National Park and G. Rink in 2000 at the high water mark (river mile 31) just above South Canyon (SEINet 2005).
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 February 2005) and personal communications with L. Makarick (Below the Rim Vegetation Program Manager, Grand Canyon National Park, Science Center Flagstaff, Arizona, 2005), L. Walker (Weed Specialist, Bureau of Land Management, Arizona Strip, St. George, Utah, 2004), and D. Roth (Botanist, Navajo Natural Heritage Program, Flagstaff, Arizona, 2005).

Question 3.2 Distribution	*Score:* **D** *Doc'n Level:* **Obs.**
Describe distribution: *Lepidium latifolium* is not currently widely distributed in Arizona nor does it occupy any one ecological type more than 5%.	
Rationale: Based on communications with several individuals who are familiar with the species, *L. latifolium* does not yet seem to have taken a permanent hold in Arizona. However, there are established populations near the northern borders (L. Walker, personal communication, 2004). One important note: pepperweed is widespread through many of New Mexico *Tamarix* spp. patches and much concern exists for *Tamarix* spp. management causing increases in the spread of perennial pepperweed. (M. Renz, personal communication, 2005)	
Sources of information: Personal communications with L. Walker (Weed Specialist, Bureau of Land Management, Arizona Strip, St. George, Utah, 2004) and with M. Renz (New Mexico State Noxious Weed Coordinator, Albuquerque, New Mexico, 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: 1

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	
	southwestern interior chaparral scrub	
Desertlands	Great Basin desertscrub	**D** (Virgin River)
	Mohave desertscrub	**D**
	Chihuahuan desertscrub	
	Sonoran desertscrub	
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	
	southwestern interior riparian	**D** (Colorado River-Grand Canyon)
	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).

Literature Cited

Bellue, M.K. 1936. *Lepidium latifolium* L., a new perennial peppergrass. California Department of Agriculture Bulletin. 25:359.

Blank, R.R., and J.A. Young. 1997. *Lepidium latifolium:* Influences on soil properties, rate of spread, and competitive stature. Pages 69–80 in J.H. Brock, M. Wade, P. Pysek, and D. Green (eds.), Plant Invasions: Studies from North America and Europe. Backhuys Publishers, Leiden, The Netherlands.

Brown, D.E. (ed.). 1994. Biotic Communities: Southwestern United States and Northwestern Mexico. University of Utah Press, Salt Lake City. 342 p. [Plus companion 60-inch by 48-inch map, Biotic Communities of the Southwest].

Brown, D., F. Reichenbacher, and S. Franson, S. 1998. A Classification of North American Biotic Communities. University of Utah Press, Salt Lake City. 141 p.

DiTomaso, J.M., and E.A. Healy. 2003. Aquatic and Riparian Weeds of the West. Publication 3421. University of California, Agriculture and Natural Resources, Davis. 442 p.

Howald, A. 2000. *Lepidium latifolium.* Pages 222–227 in C.C. Bossard, J.M. Randall, and M. Hoshovsky (eds.), Invasive Plants of California's Wildlands. University of California Press, Berkeley.

Kearney, T.H., and R.H. Peebles (and collaborators). 1960. Arizona Flora. 2nd edition with supplement by J.T. Howell and E. McClintock and collaborators. University of California Press, Berkeley. 1085 p.

Kloot, P.M. 1973. Perennial peppercress…a warning. Journal of Agriculture South Australia 76:72–73.

Krueger, J., and R. Sheley 1999. Montguide MT 9906 Agriculture-perennial pepperweed (*Lepidium latifolium*). Montana State University Extension Service, Bozeman. Available online at: http://www.montana.edu/wwwpb/pubs/mt9906.html; accessed March 2003.

Lee, J.-Y., K. Mummenhoff, and J.L. Bowman. 2002. Allopolyploidzation and evolution of species with reduced floral structures in *Lepidium* (Brassicaceae). Proceedings of the National Academy of Science 99:16835–16840.

Miller, G.K., J.A. Young, and R.A. Evans. 1986. Germination of seeds of perennial pepperweed (*Lepidium latifolium*). Weed Science 34:252–255.

Renz, M.J., and J.M. DiTomaso. 1998. The effectiveness of mowing & herbicides to control perennial pepperweed (*Lepidium latifolium*) in rangeland & roadside habitats. Proceedings from the 1998 California Weed Science Conference.

Renz, M.J. 2000. *Lepidium latifolium* L. Element Stewardship Abstract. The Nature Conservancy. Available online at: http://tncweeds.ucdavis.edu/esadocs; accessed March 2003.

Renz, M.J. 2002. Biology, Ecology and Control of Perennial Pepperweed (*Lepidium latifolium* L.). Doctoral dissertation. University of California, Davis.

Skinner, M.W., and B.M. Pavlik. 1994. Inventory of Rare and Endangered Vascular Plants of California. Special Publication No. 1. 5th ed. California Native Plant Society, Sacramento.

Trumbo, J. 1994. Perennial pepperweed: A threat to wildland areas. CalEPPC Newsletter 2:4–5.

[USDA] U.S. Department of Agriculture, Natural Resources Conservation Service. 2005. The PLANTS Database, Version 3.5. Available online at: http://plants.usda.gov. Data compiled from various sources by Mark W. Skinner. National Plant Data Center, Baton Rouge, Louisiana.

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

Washington State Noxious Weed Control Board. 1999. Perennial Pepperweed (*Lepidium latifolium* L.). Available online at: http://www.nwcb.wa.gov/weed_info/pepperweedwf.html; accessed February 2005.

Young, J.A., D.E. Palmquist, R.S. Blank, and C.E. Turner. 1995a. Ecology and control of perennial pepperweed (*Lepidium latifolium* L.). California Exotic Pest Plant Council 1995 Symposium Proceedings:1–3.

Young, J.A., C.E. Turner, and L.F. James. 1995b. Perennial pepperweed. Rangelands 17:121–123.

Young, J.A., D.E. Palmquist, and S.O. Wotring. 1997. The invasive nature of *Lepidium latifolium:* A review. Pages 59–68 in J.H. Brock, M. Wade, P. Pysek, and D. Green (eds.), Plant Invasions: Studies from North America and Europe. Backhuys Publishers, Leiden, The Netherlands.