Key Words: High Risk, Ornamental Grass, Grazing tolerant, Fire-tolerant, Ethnobotanical Uses

Family: ***Poaceae***

Taxon: ***Muhlenbergia rigens***

Synonym: *Crypsinna rigens (Benth.) M.E. Jones*
Crypsinna setiglumis M.E. Jones
Epicampes leptoura Piper
Epicampes rigens Benth.
Muhlenbergia leptoura (Piper) Hitchc.
Muhlenbergia marshii I.M. Johnst.
Muhlenbergia mundula I.M. Johnst.

Common Name: Deer grass
Deer muhly

Questionaire : current 20090513 **Assessor:** Chuck Chimera **Designation:** H(HPWRA)
Status: Assessor Approved **Data Entry Person:** Chuck Chimera **WRA Score** 7

101	**Is the species highly domesticated?**	**y=-3, n=0**	**n**
102	**Has the species become naturalized where grown?**	**y=1, n=-1**	
103	**Does the species have weedy races?**	**y=1, n=-1**	
201	**Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"**	**(0-low; 1-intermediate; 2-high) (See Appendix 2)**	**Intermediate**
202	**Quality of climate match data**	**(0-low; 1-intermediate; 2-high) (See Appendix 2)**	**High**
203	**Broad climate suitability (environmental versatility)**	**y=1, n=0**	**y**
204	**Native or naturalized in regions with tropical or subtropical climates**	**y=1, n=0**	**y**
205	**Does the species have a history of repeated introductions outside its natural range?**	**y=-2, ?=-1, n=0**	**?**
301	**Naturalized beyond native range**	**y = 1*multiplier (see Appendix 2), n= question 205**	**n**
302	**Garden/amenity/disturbance weed**	**n=0, y = 1*multiplier (see Appendix 2)**	**n**
303	**Agricultural/forestry/horticultural weed**	**n=0, y = 2*multiplier (see Appendix 2)**	
304	**Environmental weed**	**n=0, y = 2*multiplier (see Appendix 2)**	**n**
305	**Congeneric weed**	**n=0, y = 1*multiplier (see Appendix 2)**	**y**
401	**Produces spines, thorns or burrs**	**y=1, n=0**	
402	**Allelopathic**	**y=1, n=0**	
403	**Parasitic**	**y=1, n=0**	**n**
404	**Unpalatable to grazing animals**	**y=1, n=-1**	**n**
405	**Toxic to animals**	**y=1, n=0**	**n**
406	**Host for recognized pests and pathogens**	**y=1, n=0**	**n**
407	**Causes allergies or is otherwise toxic to humans**	**y=1, n=0**	**n**
408	**Creates a fire hazard in natural ecosystems**	**y=1, n=0**	**y**

409	**Is a shade tolerant plant at some stage of its life cycle**	**y=1, n=0**	
410	**Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)**	**y=1, n=0**	**y**
411	**Climbing or smothering growth habit**	**y=1, n=0**	**n**
412	**Forms dense thickets**	**y=1, n=0**	**y**
501	**Aquatic**	**y=5, n=0**	**n**
502	**Grass**	**y=1, n=0**	**y**
503	**Nitrogen fixing woody plant**	**y=1, n=0**	**n**
504	**Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)**	**y=1, n=0**	**n**
601	**Evidence of substantial reproductive failure in native habitat**	**y=1, n=0**	**n**
602	**Produces viable seed**	**y=1, n=-1**	**y**
603	**Hybridizes naturally**	**y=1, n=-1**	
604	**Self-compatible or apomictic**	**y=1, n=-1**	
605	**Requires specialist pollinators**	**y=-1, n=0**	**n**
606	**Reproduction by vegetative fragmentation**	**y=1, n=-1**	**y**
607	**Minimum generative time (years)**	**1 year = 1, 2 or 3 years = 0, 4+ years = -1**	**2**
701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**y=1, n=-1**	
702	**Propagules dispersed intentionally by people**	**y=1, n=-1**	**y**
703	**Propagules likely to disperse as a produce contaminant**	**y=1, n=-1**	
704	**Propagules adapted to wind dispersal**	**y=1, n=-1**	
705	**Propagules water dispersed**	**y=1, n=-1**	**y**
706	**Propagules bird dispersed**	**y=1, n=-1**	**n**
707	**Propagules dispersed by other animals (externally)**	**y=1, n=-1**	**n**
708	**Propagules survive passage through the gut**	**y=1, n=-1**	
801	**Prolific seed production (>1000/m2)**	**y=1, n=-1**	
802	**Evidence that a persistent propagule bank is formed (>1 yr)**	**y=1, n=-1**	
803	**Well controlled by herbicides**	**y=-1, n=1**	**y**
804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	**y=1, n=-1**	**y**
805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	**y=-1, n=1**	

Designation: H(HPWRA) **WRA Score** 7

Supporting Data:

101	1996. Anderson, M.K.. The Ethnobotany of Deergrass, Muhlenbergia rigens (Poaceae): Its Uses and Fire Management by California Indian Tribes. Economic Botany. 50(4): 409-422.	[Is the species highly domesticated? No] No evidence
102	2012. WRA Specialist. Personal Communication.	NA
103	2012. WRA Specialist. Personal Communication.	NA
201	1964. Shreve, F./Wiggins, I.L.. Vegetation and Flora of the Sonoran Desert, Volume 1. Stanford University Press, Stanford, CA	[Species suited to tropical or subtropical climate(s) 1-Intermediate] "Rocky canyons and hillsides, southern California to Texas and northern Mexico." [marginally subtropical]
202	1964. Shreve, F./Wiggins, I.L.. Vegetation and Flora of the Sonoran Desert, Volume 1. Stanford University Press, Stanford, CA	[Quality of climate match data? 0-Low]
203	2004. Harlow, N./Jakob, K./Raiche, R.. Wild Lilies, Irises, and Grasses: Gardening With California Monocots. University of California Press, Berkeley and Los Angeles, CA	[Broad climate suitability (environmental versatility)? Yes] "It tolerates almost any climate, soil, and watering regime, and it is incomparable at filling open space with a tough, good-looking plant that suppresses weeds and holds the soil."
203	2007. Randall, R.P.. Global Compendium of Weeds - Muhlenbergia rigens. http://www.hear.org/gcw/species/muhlenbergia_rigens/	[Broad climate suitability (environmental versatility)? Yes] "Muhlenbergia rigens grows in sandy washes, gravelly canyon bottoms, rocky drainages, and moist, sandy slopes, often along small streams, at elevations of 90-2500 m. Its geographic range extends to central Mexico."
203	2012. Calflora. The Calflora database - Muhlenbergia rigens. http://www.calflora.org/cgi-bin/species_query.cgi?where-taxon=Muhlenbergia+rigens	[Broad climate suitability (environmental versatility)? Yes] "Elevation: between 0 and 7000 feet" [Elevation range exceeds 1000 m]
204	1964. Shreve, F./Wiggins, I.L.. Vegetation and Flora of the Sonoran Desert, Volume 1. Stanford University Press, Stanford, CA	[Native or naturalized in regions with tropical or subtropical climates? Yes] "Rocky canyons and hillsides, southern California to Texas and northern Mexico." [marginally subtropical. Would probably do well at higher elevations of tropical and subtropical island ecosystems]
204	2012. Missouri Botanical Garden. Muhlenbergia rigens. http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/plant-finder/plant-details/kc/y300/muhlenbergia-rigens.aspx	[Native or naturalized in regions with tropical or subtropical climates? No] "Many nurseries rate this grass as only winter hardy to USDA Zones 7-10 which is consistent with where it grows in nature. However, it may be able to withstand the colder winter condition of USDA Zones 5 and 6. In the St. Louis area, it may be best to grow this grass in a protected area due to the current uncertainty regarding the limits of its winter hardiness."
205	2012. WRA Specialist. Personal Communication.	[Does the species have a history of repeated introductions outside its natural range? Questionable] Used as an ornamental within its native range, but information about is introduction elsewhere was not found.
301	2007. Randall, R.P.. Global Compendium of Weeds - Muhlenbergia rigens. http://www.hear.org/gcw/species/muhlenbergia_rigens/	[Naturalized beyond native range? No evidence]
302	2012. Sonoma County Master Gardeners. Muhlenbergia rigens. Agriculture and Natural Resources, University of California, http://ucanr.org/sites/scmg/Plant_of_the_Month/Muhlenbergia_Rigens/	[Garden/amenity/disturbance weed? No evidence from native range] "One of its finest characteristics is that it does not “seed around” and become invasive like pampas grass (which can take over yards, roadsides, and vineyards)."
303	2007. Randall, R.P.. Global Compendium of Weeds - Muhlenbergia rigens. http://www.hear.org/gcw/species/muhlenbergia_rigens/	[Agricultural/forestry/horticultural weed? Unknown] Identified as an agricultural weed [Subsequent literature searches found no evidence of detrimental impacts to agriculture]
304	2007. Randall, R.P.. Global Compendium of Weeds - Muhlenbergia rigens. http://www.hear.org/gcw/species/muhlenbergia_rigens/	[Environmental weed? No] No evidence

305	2007. Sikkema, P.H./Kramer, C./Vyn, J.D./Kells, J.J./Hillger, D.E./Soltani, N.. Control of Muhlenbergia frondosa (wirestem muhly) with post-emergence sulfonylurea herbicides in maize (Zea mays). Crop Protection. 26: 1585-1588.	[Congeneric weed? Yes] "Muhlenbergia frondosa (Poiret) Fernald (wirestem muhly) is a warm-season perennial grass native to North America, known to infest the Midwest and Northeast areas of the United States, as well as Southwestern Ontario, Canada. M. frondosa invasions were thought to be agriculturally insignificant until the 1950s. Infestations in new areas have increased since the 1980s (Salzman et al., 1997). Reproduction is by both seed and rhizomes. Each plant is capable of producing as many as 140,000 seeds (Doll et al., 1986). Spread of M. frondosa can result from cultivation pulling the rhizomes apart and dispersing them from the original plant."
401	1996. Anderson, M.K.. The Ethnobotany of Deergrass, Muhlenbergia rigens (Poaceae): Its Uses and Fire Management by California Indian Tribes. Economic Botany. 50(4): 409-422.	[Produces spines, thorns or burrs? No, but possesses barbs on florets] "The last preparation step is to remove the panicle of seeds by rubbing a piece of thick leather, deerskin, or denim along the stalk from the apex toward the base. The florets have barbs and there are barbs along the panicle branches that can burrow their way into fingers (Beecher Crampton, pers. comm. 1992). Thus, cleaning is done with caution."
402	2012. WRA Specialist. Personal Communication.	[Allelopathic? Unknown]
403	1996. Anderson, M.K.. The Ethnobotany of Deergrass, Muhlenbergia rigens (Poaceae): Its Uses and Fire Management by California Indian Tribes. Economic Botany. 50(4): 409-422.	[Parasitic? No] No evidence
404	1974. Crampton, B.. Grasses in California. University of California Press, Berkeley and Los Angelese, CA	[Unpalatable to grazing animals? Older foliage unpalatable] "…the older and coarse clumps scarcely if at all palatable to livestock, although sometimes cattle and horses graze the tender new foliage of the younger clumps but soon pass on to more succulent plants."
404	1996. Anderson, M.K.. The Ethnobotany of Deergrass, Muhlenbergia rigens (Poaceae): Its Uses and Fire Management by California Indian Tribes. Economic Botany. 50(4): 409-422.	[Unpalatable to grazing animals? Young foliage palatable] "Foliage of deergrass does not drop during senescence in autumn; it accumulates, shutting out sunlight to the new growth. It is removed only by fire, flooding, or grazing."
404	2002. USDA NRCS. Plant Guide - Deergrass - Muhlenbergia rigens. USDA NRCS National Plant Data Center, http://plants.usda.gov/plantguide/pdf/cs_muri2.pdf	[Unpalatable to grazing animals? No] "The younger palatable tufts are grazed by deer, horses, and cattle and can remain palatable if continually grazed. It is particularly sought for forage by animals when first resprouting after a burn. Older tufts are poor feed for livestock."
404	2012. Sonoma County Master Gardeners. Muhlenbergia rigens. Agriculture and Natural Resources, University of California, http://ucanr.org/sites/scmg/Plant_of_the_Month/Muhlenbergia_Rigens/	[Unpalatable to grazing animals? Unpalatable to some animals] "Though deer do not usually forage on deergrass, rabbits and ground squirrels have been known to nibble on young plants; protect as needed."
405	1996. Anderson, M.K.. The Ethnobotany of Deergrass, Muhlenbergia rigens (Poaceae): Its Uses and Fire Management by California Indian Tribes. Economic Botany. 50(4): 409-422.	[Toxic to animals? No evidence] "Foliage of deergrass does not drop during senescence in autumn; it accumulates, shutting out sunlight to the new growth. It is removed only by fire, flooding, or grazing."
406	2002. USDA NRCS. Plant Guide - Deergrass - Muhlenbergia rigens. USDA NRCS National Plant Data Center, http://plants.usda.gov/plantguide/pdf/cs_muri2.pdf	[Host for recognized pests and pathogens? Possibly] "There are several fungi that infect the leaves of deergrass, causing debilitation, but usually not death. These include tar spot (Phyllachora epicampis), two rusts (Puccinia schedonnardi and Uromyces epicampis), and stripe smut (Ustilago striiformis). Fire eliminates these pathogens."
406	2012. Missouri Botanical Garden. Muhlenbergia rigens. http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/plant-finder/plant-details/kc/y300/muhlenbergia-rigens.aspx	[Host for recognized pests and pathogens? No evidence] "Problems - No serious insect or disease problems."
407	2008. Wagstaff, D.J.. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	[Causes allergies or is otherwise toxic to humans? No] No evidence
407	2012. Sonoma County Master Gardeners. Muhlenbergia rigens. Agriculture and Natural Resources, University of California, http://ucanr.org/sites/scmg/Plant_of_the_Month/Muhlenbergia_Rigens/	[Causes allergies or is otherwise toxic to humans? No evidence of toxicity] "Historically, its long stems have been used by many Native American tribes for coiled baskets or the seeds ground and used with corn meal for bread or mush."
408	2002. USDA NRCS. Plant Guide - Deergrass - Muhlenbergia rigens. USDA NRCS National Plant Data Center, http://plants.usda.gov/plantguide/pdf/cs_muri2.pdf	[Creates a fire hazard in natural ecosystems? Probably Yes] "The bunchgrass is found in dense, large clumps, but can occur as a continuous cover in areas that are subjected to light or frequent ground fires." [Benefits from fire, and grass is flammable. Could increase fire risk in introduced habitats]

409	1996. Anderson, M.K.. The Ethnobotany of Deergrass, Muhlenbergia rigens (Poaceae): Its Uses and Fire Management by California Indian Tribes. Economic Botany. 50(4): 409-422.	[Is a shade tolerant plant at some stage of its life cycle? Possibly No] "Additionally, deergrass is somewhat shade-intolerant and also occurs in anthropogenic grassland openings within chaparral, mixed conifer forests, and oak woodland plant communities, maintained with indigenous burning."
409	2002. USDA NRCS. Plant Guide - Deergrass - Muhlenbergia rigens. USDA NRCS National Plant Data Center, http://plants.usda.gov/plantguide/pdf/cs_muri2.pdf	[Is a shade tolerant plant at some stage of its life cycle? Possibly No] "Additionally, deergrass is shade-intolerant and occurs in grassland openings within chaparral, mixed conifer forests, and oak woodland plant communities, maintained with human-set or lightning fires."
409	2012. Schmidt, M.G./Greenberg, K.L.. Growing California Native Plants, Second Edition: Expanded and Updated. University of California Press, Berkeley and Los Angeles	[Is a shade tolerant plant at some stage of its life cycle? Possibly] "Deer grass performs best in sun, although it will tolerate light shade."
410	1986. Medina, A.L.. Riparian Plant Communities of the Fort Bayard Watershed in Southwestern New Mexico. The Southwestern Naturalist. 31(3): 345-359.	[Tolerates a wide range of soil conditions? Yes] The grass Muhlenbergia rigens was common on the streambanks in the absence of S. exigua. Unlike S. exigua, M. rigens was found to occupy a more varied substrate from rubble to loamy-clay banks."
410	2012. Missouri Botanical Garden. Muhlenbergia rigens. http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/plant-finder/plant-details/kc/y300/muhlenbergia-rigens.aspx	[Tolerates a wide range of soil conditions ? Yes] "Wide range of soil tolerance except for consistently wet conditions."
410	2012. Schmidt, M.G./Greenberg, K.L.. Growing California Native Plants, Second Edition: Expanded and Updated. University of California Press, Berkeley and Los Angeles	[Tolerates a wide range of soil conditions? Yes] "Soil: Adaptable."
411	1964. Shreve, F./Wiggins, I.L.. Vegetation and Flora of the Sonoran Desert, Volume 1. Stanford University Press, Stanford, CA	[Climbing or smothering growth habit? No] "Perennial; culms densely tufted, slender or coarse, 37 cm. to nearly 1 m. high, glabrous; sheaths longer than internodes, rounded, glabrous; ligule about 1 mm. long, decurrent; blades firm, attenuate, strongly recurved, becoming involute, scabrous above, smooth below…"
412	2002. USDA NRCS. Plant Guide - Deergrass - Muhlenbergia rigens. USDA NRCS National Plant Data Center, http://plants.usda.gov/plantguide/pdf/cs_muri2.pdf	[Forms dense thickets? Yes] "Deergrass is a valuable streambank stabilizer, as it has an extensive root system, and if grown in dense enough colonies, it can be an effective weed suppresser." [Could be detrimental to native species when planted outside native range]
412	2005. Klein, A./Evens, J.. Vegetation Alliances of Western Riverside County, California. Final report prepared for The California Department of Fish & Game Habitat Conservation Division. California Native Plant Society, Sacramento. CA	[Forms dense thickets? Yes] "Stands of Muhlenbergia rigens form an open to continuous herbaceous layer (23-92%, mean 57.5%) at 0- 1m tall, where Muhlenbergia rigens dominates or co-dominates. The shrub layer is open (10%, mean 10%) at 0-2m tall. Total vegetation cover is 34 92% (mean 63%). Stands of this alliance may have Muhlenbergia rigens as the dominant grass, or may include other graminoids such as Elymus glaucus and Juncus spp. An open shrub layer may include Eriogonum fasciculatum or Eriogonum wrightii."
501	2007. Clarke, O.F.. Flora of the Santa Ana River and Environs: With References to World Botany. Heyday Books, Berkeley, CA	[Aquatic? No, but frequent in riparian areas] "…frequently forms large, long-lived clumps and is common in seasonally moist creek beds."
502	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl	[Grass? Yes] Poaceae
503	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl	[Nitrogen fixing woody plant? No] Poaceae
504	1974. Crampton, B.. Grasses in California. University of California Press, Berkeley and Los Angelese, CA	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No] "Coarse, perennial, densely tufted from a knotty, close-rhizomatous base; culms 60-150 cm tall, erect to widely spreading in the clump; blades scabrous and ordinarily elongate 20-50 cm. long and long-tapering to a fine tip…"
601	1996. Anderson, M.K.. The Ethnobotany of Deergrass, Muhlenbergia rigens (Poaceae): Its Uses and Fire Management by California Indian Tribes. Economic Botany. 50(4): 409-422.	[Evidence of substantial reproductive failure in native habitat? No evidence]
602	1996. Anderson, M.K.. The Ethnobotany of Deergrass, Muhlenbergia rigens (Poaceae): Its Uses and Fire Management by California Indian Tribes. Economic Botany. 50(4): 409-422.	[Produces viable seed? Yes] "Deergrass also produces abundant viable seed (Sampson et al. 1951). Yet, this seed often does not get established in the wild."

602	2004. Master Gardeners of the University of Arizona Pima County Cooperative Extension. Muhlenbergia rigens - Deer grass. http://ag.arizona.edu/pima/gardening/aridplants/Muhlenbergia_rigens.html	[Produces viable seed? Yes] "Propagation: divisions or seed"
603	2003. Peterson, P.M.. Muhlenbergia. published in Barkworth et al. (eds.), Flora of North America vol. 25. http://herbarium.usu.edu/webmanual	[Hybridizes naturally? Unknown] No hybrids documented
604	1981. Connor, H.E.. Evolution of Reproductive Systems in the Gramineae. Annals of the Missouri Botanical Garden. 68(1): 48-74.	[Self-compatible or apomictic? Possibly Yes] "Clandestine axillary spikelets are known in 13 genera, viz., Aristida, Calyptochloa, Cleistochloa, Cleistogenes, Cottea, Danthonia, Diplachne, Enneapogon, Microlaena, Muhlenbergia, Sieglingia, Stipa, Triplasis; full references are in Connor (1980). Aerial inflorescences in all these genera bear both cleistogamic and chasmogamous florets, except Cleistochloa where only chasmogamic flowers are known (Hubbard, 1933)." [Genus Muhlenbergia documented to have cleistogamous flowers. Unknown for M. rigens]
605	1994. Zomlefer, W.B.. Guide to Flowering Plant Families. The University of North Carolina Press, Chapel Hill & London	[Requires specialist pollinators? No] "The reduced flowers are anemophilous…"
606	1996. Anderson, M.K.. The Ethnobotany of Deergrass, Muhlenbergia rigens (Poaceae): Its Uses and Fire Management by California Indian Tribes. Economic Botany. 50(4): 409-422.	[Reproduction by vegetative fragmentation? Yes] "If subjected to herbivory, flooding, or fires, deergrass responds to the disturbance by vegetative reproduction in the form of leaf buds that occur in the axils of the old tillers or by vegetative buds activating on short rhizomes that gradually spread the plant (Crampton 1974)."
607	2012. Sonoma County Master Gardeners. Muhlenbergia rigens. Agriculture and Natural Resources, University of California, http://ucanr.org/sites/scmg/Plant_of_the_Month/Muhlenbergia_Rigens/	[Minimum generative time (years)? 2] "This is a fast-growing grass that can reach maturity in two seasons."
701	1974. Crampton, B.. Grasses in California. University of California Press, Berkeley and Los Angelese, CA	[Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)? Possibly] "Along streams, edges of meadows, seeps on hillslopes, ditches and roads from low elevations to about 7000 feet;" [May be dispersed along heavily trafficked corridors, or may just be adapted to colonizing disturbed areas]
702	2007. Clarke, O.F.. Flora of the Santa Ana River and Environs: With References to World Botany. Heyday Books, Berkeley, CA	[Propagules dispersed intentionally by people? Yes] "It is now sold in the nursery trade."
703	2002. USDA NRCS. Plant Guide - Deergrass - Muhlenbergia rigens. USDA NRCS National Plant Data Center, http://plants.usda.gov/plantguide/pdf/cs_muri2.pdf	[Propagules likely to disperse as a produce contaminant? Unknown] "The ligule (where the leaf blade meets the stem) is firm and blunt, 1/8 inch long. The leaves are 1/16 to 5/16 inch wide. The seeds are small, requiring about 2.5 million to make one pound." [No evidence, but small seeds could potentially contaminate other seed crops if grown in close proximity]
704	2003. Peterson, P.M.. Muhlenbergia. published in Barkworth et al. (eds.), Flora of North America vol. 25. http://herbarium.usu.edu/webmanual	[Propagules adapted to wind dispersal? Unknown] "Spikelets 3.8-5 mm, grayish green. Glumes equal, (1.8)2-3 mm, shorter than the florets, glabrous and smooth proximally, scabridulous distally, faintly 1-veined, acute; lemmas 3.8-5 mm, narrowly lanceolate, calluses hairy, hairs to 0.5 mm, lemma bodies glabrous and smooth below, scabrous distally, apices acuminate, unawned or awned, awns to 6 mm, straight; paleas 3.8-5 mm, narrowly lanceolate, glabrous below, acuminate; anthers 1.5-2.2 mm, greenish. Caryopses 2.5-3.5 mm, fusiform, brownish." [No specific information was found in the available literature. Because the seeds lack appendages to aid in long-distance dispersal by wind or animals, most are probably dispersed by gravity in the area near the parent plant]
705	2003. Peterson, P.M.. Muhlenbergia. published in Barkworth et al. (eds.), Flora of North America vol. 25. http://herbarium.usu.edu/webmanual	[Propagules water dispersed? Probably Yes] "Muhlenbergia rigens grows in sandy washes, gravelly canyon bottoms, rocky drainages, and moist, sandy slopes, often along small streams, at elevations of 90-2500 m."
705	2007. Clarke, O.F.. Flora of the Santa Ana River and Environs: With References to World Botany. Heyday Books, Berkeley, CA	[Propagules water dispersed? Possibly Yes] "…frequently forms large, long-lived clumps and is common in seasonally moist creek beds."
705	2012. Calflora. The Calflora database - Muhlenbergia rigens. http://www.calflora.org/cgi-bin/species_query.cgi?where-taxon=Muhlenbergia+rigens	[Propagules water dispersed? Probably yes] "Usually occurs in wetlands, but occasionally found in non wetlands"

706	2002. USDA NRCS. Plant Guide - Deergrass - Muhlenbergia rigens. USDA NRCS National Plant Data Center, http://plants.usda.gov/plantguide/pdf/cs_muri2.pdf	[Propagules bird dispersed? No] "The seeds provide food for songbirds and probably other birds as well." [Bird act as predators, rather than dispersers]
707	2003. Peterson, P.M.. Muhlenbergia. published in Barkworth et al. (eds.), Flora of North America vol. 25. http://herbarium.usu.edu/webmanual	[Propagules dispersed by other animals (externally)? Probably No] "Spikelets 3.8-5 mm, grayish green. Glumes equal, (1.8)2-3 mm, shorter than the florets, glabrous and smooth proximally, scabridulous distally, faintly 1 veined, acute; lemmas 3.8-5 mm, narrowly lanceolate, calluses hairy, hairs to 0.5 mm, lemma bodies glabrous and smooth below, scabrous distally, apices acuminate, unawned or awned, awns to 6 mm, straight; paleas 3.8 5 mm, narrowly lanceolate, glabrous below, acuminate; anthers 1.5-2.2 mm, greenish. Caryopses 2.5-3.5 mm, fusiform, brownish." [No specific information was found in the available literature. Because the seeds lack appendages to aid in long-distance dispersal by wind or animals, most are probably dispersed by gravity in the area near the parent plant]
708	1974. Crampton, B.. Grasses in California. University of California Press, Berkeley and Los Angelese, CA	[Propagules survive passage through the gut? Unknown if seeds are consumed when being grazed by animals, or if they retain viability after gut passage] "…the older and coarse clumps scarcely if at all palatable to livestock, although sometimes cattle and horses graze the tender new foliage of the younger clumps but soon pass on to more succulent plants."
801	2002. USDA NRCS. Plant Guide - Deergrass - Muhlenbergia rigens. USDA NRCS National Plant Data Center, http://plants.usda.gov/plantguide/pdf/cs_muri2.pdf	[Prolific seed production (>1000/m2)? Possibly Yes] "The ligule (where the leaf blade meets the stem) is firm and blunt, 1/8 inch long. The leaves are 1/16 to 5/16 inch wide. The seeds are small, requiring about 2.5 million to make one pound."
802	2008. Royal Botanic Gardens Kew. Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/	[Evidence that a persistent propagule bank is formed (>1 yr)? Potentially] "Storage Behaviour: Orthodox Storage Conditions: Long-term storage under IPGRI preferred conditions at RBG Kew, WP" [Insufficient evidence to conclude persistent seed bank is formed in natural settings]
803	1996. Anderson, M.K.. The Ethnobotany of Deergrass, Muhlenbergia rigens (Poaceae): Its Uses and Fire Management by California Indian Tribes. Economic Botany. 50(4): 409-422.	[Well controlled by herbicides? Probably Yes] "Other causes for the decline of deergrass include off-road vehicles, droughts, state or county scraping of roadsides, herbicide spraying, channelization and damming of streams, agriculture, and urban development…" [Sensitive to herbicide applications]
803	2007. Willis, J.B./Beam, J.B./Barker, W.L./Askew, S.D. and J. Scott McElroy. Selective Nimblewill (Muhlenbergia schreberi) Control in Cool-Season Turfgrass. Weed Technology. 21: 886-889.	[Well controlled by herbicides? Probably Yes] "However, it was concluded that isoxaflutole and mesotrione at appropriate rates and applied in sequence selectively control nimblewill without harming desirable turf." [Related species effectively controlled with herbicides]
804	1996. Anderson, M.K.. The Ethnobotany of Deergrass, Muhlenbergia rigens (Poaceae): Its Uses and Fire Management by California Indian Tribes. Economic Botany. 50(4): 409-422.	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes. Benefits from fire] "The Cahuilla, Foothill Yokuts, Kumeyaay (Tipai- Ipai), Sierra Miwok, and Western Mono tribes historically and probably prehistorically enhanced deergrass populations through firing deergrass stands and gathering flower stalks (Anderson 1992a; Lee 1989; Shipek 1989). Indian- set fires increased flower stalk yields, recycled nutrients, cleared away detritus, and promoted seedling production in the midst of reduced competition from other plants. According to native elders, these fires maintained the bunchgrass in greater densities and abundance than would have occurred under natural conditions (Anderson, interview notes, unpublished)."
804	2004. Harlow, N./Jakob, K./Raiche, R.. Wild Lilies, Irises, and Grasses: Gardening With California Monocots. University of California Press, Berkeley and Los Angeles, CA	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "Its extremely tough root system makes this a permanent plant in the landscape."
804	2012. Schmidt, M.G./Greenberg, K.L.. Growing California Native Plants, Second Edition: Expanded and Updated. University of California Press, Berkeley and Los Angeles	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "Plants should be cut back every three or four years in late summer or fall and raked to remove thatch, and they will quickly start to produce new growth."
805	2012. WRA Specialist. Personal Communication.	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? Unknown] No native Muhlenbergia present in Hawaiian Islands, and no reports of pests or pathogens from Muhlenbergia mexicana or M. microsperma, the two species currently naturalized in the Hawaiian Islands

Summary of Risk Traits

High Risk / Undesirable Traits

- Tolerates a wide range of climates and elevations (environmentally versatile)
- Can survive in subtropical climates
- Other *Muhlenbergia* species are documented to be invasive weeds
- Tolerates many soil conditions (and potentially able to exploit many different habitat types)
- Tolerates fire and could increase fire risks
- Can form almost pure ground cover in native range (could exclude other species)
- Reproduces by seeds and vegetatively via rhizomes
- Seeds likely dispersed by water, and possibly wind

Low Risk / Desirable Traits

- No records of naturalization outside widespread native range
- Evidence of weediness unconfirmed
- Non-toxic & palatable to grazing animals when young
- Landscaping and ornamental value
- Ethnobotanical uses (baskets, corn meal) for Native Americans
- Genus *Muhlenbergia* susceptible to herbicides