United States Department of Agriculture

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Animal and Plant Health Inspection Service

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Version 1

Weed Risk Assessment for *Delairea odorata* Lem. (Asteraceae) – Cape ivy

Left: Smothering habit of *D. odorata* (photographers: Forest and Kim Starr; Starr and Starr, 2013). Right: Leaves and flowers of *D. odorata* (photographer: Jonathan Boow; Anonymous, 2013).

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Introduction Plant Protection and Quarantine (PPQ) regulates noxious weeds under the authority of the Plant Protection Act (7 U.S.C. § 7701-7786, 2000) and the Federal Seed Act (7 U.S.C. § 1581-1610, 1939). A noxious weed is defined as "any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment" (7 U.S.C. § 7701-7786, 2000). We use weed risk assessment (WRA)—specifically, the PPQ WRA model (Koop et al., 2012)—to evaluate the risk potential of plants, including those newly detected in the United States, those proposed for import, and those emerging as weeds elsewhere in the world.

Because the PPQ WRA model is geographically and climatically neutral, it can be used to evaluate the baseline invasive/weed potential of any plant species for the entire United States or for any area within it. As part of this analysis, we use a stochastic simulation to evaluate how much the uncertainty associated with the analysis affects the model outcomes. We also use GIS overlays to evaluate those areas of the United States that may be suitable for the establishment of the plant. For more information on the PPQ WRA process, please refer to the document, *Background information on the PPQ Weed Risk Assessment*, which is available upon request.

Delairea odorata **Lem. – Cape ivy**

Species Information

Family: Asteraceae

Synonyms: *D. scandens* (DC.) Lem.; *Senecio mikanioides* Otto ex Walp.; *S. scandens* DC. (APD, 2013; NGRP, 2013). The name *S. mikanioides* is still commonly used (Robison, 2006).

Initiation: Recently, a California state senator inquired about the status of the permit application to PPQ for the release of a biocontrol species for *D. odorata*. Because preliminary analysis indicated that this weed species poses a High Risk, PPQ prioritized this species for analysis.

Foreign distribution: This species is native to Lesotho and South Africa (APD, 2013; NGRP, 2013). It has been introduced to and become naturalized in several countries or territories, including Algeria, Argentina, Australia, Canary Islands, Chile, France, Ireland, Italy, New Zealand, Portugal, Spain, the United Kingdom, and Uruguay (Gallo et al., 2008; NGRP, 2013). It is also adventive in Sweden (NGRP, 2013).

U.S. distribution and status: *Delairea odorata* was first introduced into the United States in the 1850s as an ornamental houseplant (Robison et al., 2011). It was first collected from California in 1892 (Robison and DiTomaso, 2010) and naturalized there by the 1960s (Bossard et al., 2000). Since then, this species has become naturalized in all coastal counties in California, one coastal county in Oregon, and much of Hawaii (CISEH, 2013; Kartesz, 2013; NRCS, 2013; Robison and DiTomaso, 2010). It is also reported from one county in Montana (Kartesz, 2013), but this record is doubtful) because that location is well outside the range of plant hardiness zones suitable for its survival (Appendix A). In Hawaii, it was first collected in 1910 and is now considered naturalized (Wagner et al., 1999). *Delairea odorata* is managed in California and Hawaii (Bossard et al., 2000; Elliott; Motooka et al., 2003), and biocontrol options are being explored (Balciunas and Mehelis, 2010). It is commercially grown and sold in the United States (Univ. of Minn., 2013), but it does not appear to be sold by any of the major distributors (e.g., Monrovia, Green Leaf, Bailey). It is sold as both Cape ivy and German ivy (CABI, 2013).

WRA area[1]: Entire United States, including territories.

1. *Delairea odorata* analysis

Establishment/Spread Potential *Delairea odorata* is widely recognized as an invasive vine species (Bossard et al., 2000; Randall, 2007; Weber, 2003). In California, it readily establishes in riparian areas and then spreads into drier sites (CABI, 2013). One California infestation expanded from 9 acres to 67 acres in nine years (Alvarez, 1998). Alvarez and Cushman (2002) stated that rapid growth (0.35 to 1.35 meters per month), clonal reproduction, and pronounced tolerance to environmental conditions have contributed to its invasiveness. It is tolerant to shade (Robison et al., 2011) and mutilation (Bossard et al., 2000), and is dispersed by wind, water, and people (Alvarez, 1998; CABI, 2013; Robison et al., 2011). Stem fragments resist desiccation, and if they contain a node can root and create a new infestation (Bossard et al., 2000). We had below average uncertainty for this risk element.
Risk score = 14 Uncertainty index = 0.11

Impact Potential Although *D. odorata* is considered an agricultural weed (Holm et al., 1979; Randall, 2007) and some concern exists about its potential toxicity (CABI, 2013), our analysis indicates it primarily impacts natural systems (Appendix A). As with other vine species, *D. odorata* forms dense mats that blanket and smother vegetation (Elliott, 1994), including small trees (Bossard et al., 2000), and reduces native species diversity (Alvarez and Cushman, 2002). This species may also affect ecosystem processes (Alvarez, 1998; Bossard et al., 2000). Consequently, *D. odorata* is a threat to sensitive species (Robison and DiTomaso, 2010) and plant communities (Csurhes and Edwards, 1998). Weed managers are trying to contain and eradicate this species where possible in California (Alvarez, 1998; Elliott, 1994). To help management efforts, scientists are searching for biological control agents (Balciunas and Mehelis, 2010). We had above average uncertainty for this risk element.
Risk score = 3.4 Uncertainty index = 0.26

Geographic Potential Based on three climatic variables, we estimate that about 23 percent of the United States is suitable for the establishment of *D. odorata* (Fig. 1). This predicted distribution is based on the species' known distribution elsewhere in the world and includes point-referenced localities and areas of occurrence. The map for *D. odorata* represents the joint distribution of Plant Hardiness Zones 8-13, areas with 10-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savanna, humid subtropical, Mediterranean, marine west coast, and steppe.

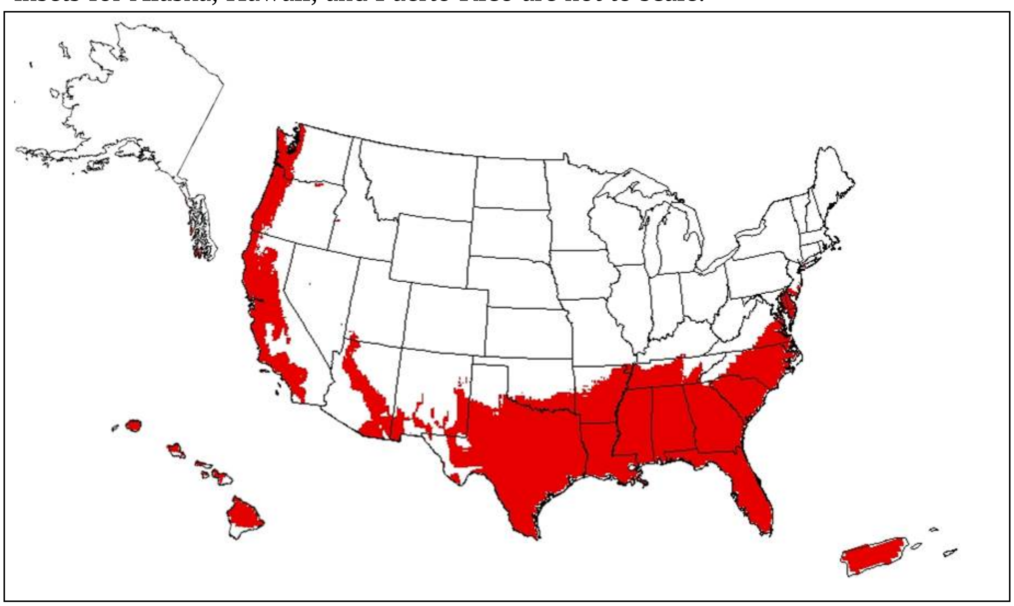
The area estimated likely represents a conservative estimate as it only uses three climatic variables. Other environmental variables, such as soil and habitat type,

[1] "WRA area" is the area in relation to which the weed risk assessment is conducted [definition modified from that for "PRA area"] (IPPC, 2012).

may further limit the areas in which this species is likely to establish. In its native range in southern Africa, this species occurs in mist-veldt regions (CABI, 2013). In California, it occurs in riparian forest, coastal scrub, salt marsh, oak woodland, conifer forest, agricultural, and non-native forests (Robison and DiTomaso, 2010). In Hawaii, it encompasses an elevation range of 1600 to 8200 feet (Jacobi and Warschauer, 1992). Experimental work suggests that Cape ivy will not persist in areas with full or prolonged sun exposure, but could invade areas with reduced light, including coastal regions with frequent fog or cloudy conditions (Robison et al., 2011). It prefers shady disturbed sites with ample year-round moisture (Bossard et al., 2000). In habitats without year-round moisture, it dies back during dry seasons and then regrows during wet seasons (Bossard et al., 2000). A CLIMEX model of its world distribution did not predict that any areas in the southeastern United States were suitable (Robison, 2006). However, our model suggests the southeastern United States is suitable, based on the distribution of *D. odorata* in humid subtropical habitats elsewhere in the world.

Entry Potential We did not assess entry potential for *D. odorata* because this species is already present in the United States (Robison and DiTomaso, 2010).

Figure 1. Predicted distribution of *Delairea odorata* in the United States. Map insets for Alaska, Hawaii, and Puerto Rico are not to scale.



2. Results and Conclusion

Model Probabilities: P(Major Invader) = 77.0%
P(Minor Invader) = 22.1%
P(Non-Invader) = 0.9%

Risk Result = High Risk
Secondary Screening = Not Applicable

Figure 2. *Delairea odorata* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

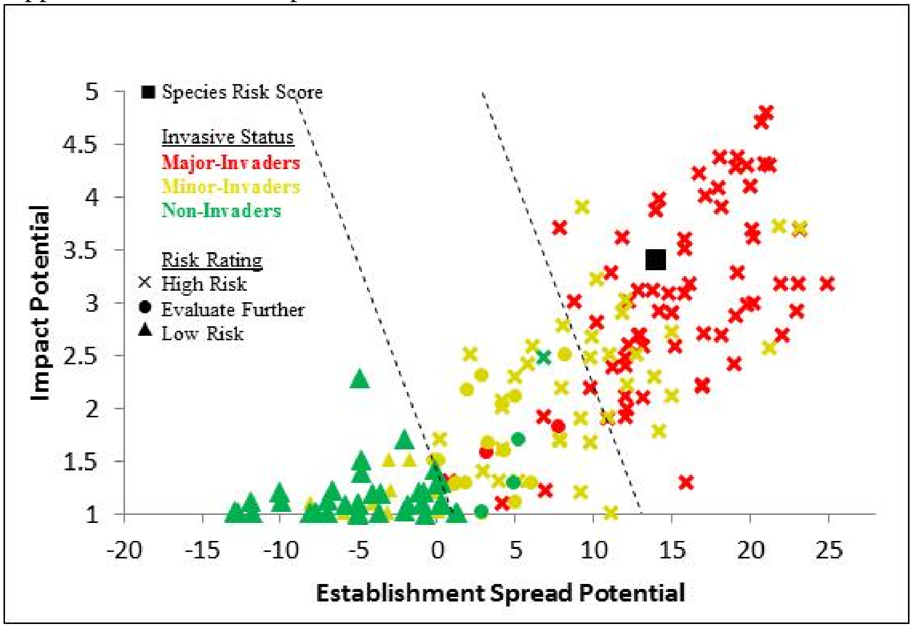
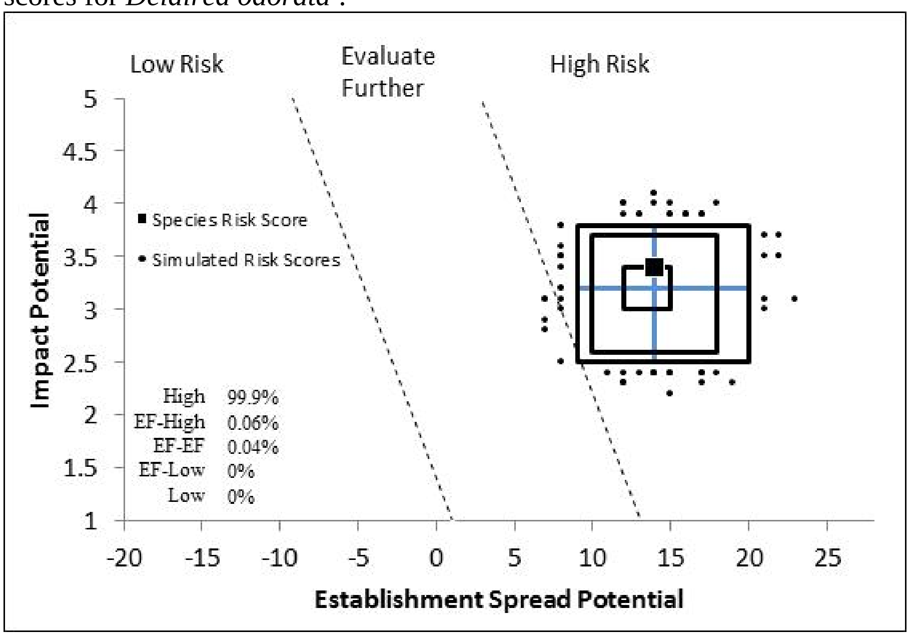


Figure 3. Monte Carlo simulation results (N=5,000) for uncertainty around the risk scores for *Delairea odorata*[a].



[a] The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

3. Discussion

The result of the weed risk assessment for *Delairea odorata* is High Risk (Fig. 2). Although we had above average uncertainty for the impact potential risk element, we are confident in our conclusion based on the results of our uncertainty analysis (Fig. 3). Analysis with the Hawaiian version of the Australian weed risk assessment also led to a conclusion of high risk (University of Hawaii, 2013). Finally, in a study ranking species for their potential to impact biodiversity in New South Wales, *D. odorata* ranked 16th out of 340 species (Downey et al., 2010).

Delairea odorata is particularly troublesome because of its ability to root at stem nodes (Bossard et al., 2000; Elliott, 1994). "Ninety-five percent of fragments of green stolons containing only one node establish, and drying stolon fragments in full sun for ten weeks does not stop them from rooting" (Bossard et al., 2000). Removal from a site requires frequent follow-up visits for a few years to eliminate all resprouts. Early detection and rapid response strategies are critical for this species (Bossard et al., 2000). In California, populations of *D. odorata* are expanding rapidly (Alvarez, 1998). In one area, populations covering a total of 9-acres expanded to 67 acres in nine years (Alvarez, 1998). For Hawaii, Wagner et al. (1999) state that its spread should be controlled.

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Appendix A. Weed risk assessment for *Delairea odorata* Lem. (Asteraceae). The following information came from the original risk assessment, which is available upon request (full responses and all guidance). We modified the information to fit on the page.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ESTABLISHMENT/SPREAD POTENTIAL			
ES-1 (Status/invasiveness outside its native range)	f - negl	5	*Delairea odorata* is native to Lesotho and South Africa (APD, 2013; NGRP, 2013). It began to naturalize in some places in the late 1800s and early 1900s (CABI, 2013). It is naturalized in Ireland, particularly along cliffs (Reynolds, 2002), and in England (Reynolds, 2002), particularly in the southwest and increasing in abundance (Clement and Foster, 1994). It is also naturalized in Chile (Castro et al., 2005), and New Zealand (Cheeseman, 1906), where it is widely distributed (Tomson, 1922), which we interpreted to mean it has spread in the past. It and naturalized and possibly spreading in France (Brunel et al., 2010; Fried, 2010). It is widely naturalized in Australia (Csurhes and Edwards, 1998), and classified as invasive, which means it has or is spreading rapidly (Randall, 2007). Invasive in Italy (Bossard et al., 2000; Weber, 2003). It is naturalized and spreading into natural areas in the Canary Islands (Gallo et al., 2008), and naturalized in Hawaii (first collected in 1910) (Motooka et al., 2003). It is naturalized and spreading in coastal California (Elliott, 1994), sometimes rapidly (e.g., a 9 acre infestation expanded to 67 acres in nine years; Alvarez, 1998). Alternate answers for the Monte Carlo simulation were both "e."
ES-2 (Is the species highly domesticated)	n - low	0	The species is cultivated as a hanging basket plant (Robison et al., 2011) and a ground cover (Brunel et al., 2010), and has been cultivated in Australia (Csurhes and Edwards, 1998; Groves et al., 2005). Cultivated for more than a 100 years in New Zealand and the United States (CABI, 2013). It is commercially grown and sold in the United States (Univ. of Minn., 2013). Despite all that, we found no evidence it has been domesticated or bred to reduce traits associated with weed potential.
ES-3 (Weedy congeners)	y - mod	1	*Delairea odorata* is the only species in this genus (Mabberley, 2008), but if we include species in the genus *Senecio*, in which *D. odorata* was once placed, several significant congeneric weeds exist (Holm et al., 1979; Randall, 2007; Weber, 2003). For example, *S. jacobaea* is highly toxic to livestock (Bossard et al., 2000), and *S. vulgaris* is a serious and principal weed in many countries (Holm et al., 1979). *Senecio angulatus* changes community structure, alters species composition (Newton, 1996; Weber, 2003; WMC, 2013), and reduces regeneration of native species (Williams and Hayes, 2007). Because these taxa aren't truly congeners of *D. odorata*, we answered yes but with moderate uncertainty.
ES-4 (Shade tolerant at some stage of its life cycle)	y - negl	1	In California, this species prefers shady moist sites (Bossard et al., 2000). In experiments the species did not grow well in full sunlight (Robison et al., 2011).
ES-5 (Climbing or smothering growth form)	y - negl	1	It is a climbing vine (Alvarez and Cushman, 2002; APD, 2013; Bossard et al., 2000).
ES-6 (Forms dense thickets)	y - negl	2	This species forms a solid, dense mat (Brunel et al., 2010; Elliott, 1994) that can be up to 30 cm thick (CABI, 2013). In its introduced range, it commonly forms large patches several

Question ID	Answer - Uncertainty	Score	Notes (and references)
			hectares in size (Alvarez and Cushman, 2002).
ES-7 (Aquatic)	n - negl	0	This is a terrestrial vine, not an aquatic species (Bossard et al., 2000).
ES-8 (Grass)	n - negl	0	This Asteraceae species is not a grass (NGRP, 2013).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	We found no direct evidence about nitrogen fixation. Species is a perennial herb, and not woody (APD, 2013). Furthermore, its plant family is not known to fix nitrogen (Martin and Dowd, 1990).
ES-10 (Does it produce viable seeds or spores)	y - negl	1	Early on it was believed that this species did not produce fertile seed in California (Bossard et al., 2000). More recently, however, it is reportedly producing viable seed in the United States (Robison et al., 2011). In one study, seeds were sampled from a diverse range of populations, and 66 percent produced viable seed (Robison, 2006). It is not clear if this species produces seeds in Hawaii (Motooka et al., 2003).
ES-11 (Self-compatible or apomictic)	n - negl	-1	Species is self-incompatible (Bossard et al., 2000), and outcrosses (Robison, 2006; Robison et al., 2011).
ES-12 (Requires special pollinators)	n - mod	0	We found no direct evidence. This species is presumed to be insect pollinated and is visited by a large array of insects (CABI, 2013). Possibly used as a source of nectar by honeybees in New Zealand (Butz Huryn and Moller, 1995). Because this species is producing seed in the United States (see ES-10), it probably does not require specialized pollinators.
ES-13 (Minimum generation time)	b - high	1	It is a perennial herb (APD, 2013; Bossard et al., 2000). We found no information on its generation time from seed to seed, although another weed risk assessment concluded it flowers within two years (DPI, 2013). This species reproduces and spreads vegetatively from stem fragments that readily root at nodes (Robison, 2006) and by the extension of the plant through stolons (Alvarez, 1998). Individual stems can average about a foot of growth per month (Alvarez, 1998). Above and belowground parts will readily fragment when being removed (Bossard et al., 2000). Because of lateral vegetative growth, we answered "b" with high uncertainty. Specific data on how often it roots along nodes and whether those rooted nodes produce new stems during the following growing season would reduce the uncertainty. Alternate answers for the Monte Carlo simulation were both "c."
ES-14 (Prolific reproduction)	n - high	-1	This species was once believed to not reproduce sexually in California (e.g., Bossard et al., 2000), but field studies show some seed production (Robison, 2006). Flowers are arranged in groups of 20 or more (Bossard et al., 2000). The vast majority of seeds produced in North America and possibly elsewhere are not viable (CABI, 2013). Even though we found no quantitative data to support an answer, we answered no with high uncertainty based on the observations of limited seed production.
ES-15 (Propagules likely to be dispersed unintentionally by people)	y - negl	1	This species may have established in California from discarded houseplants (Robison et al., 2011). "Careless disposal of garden waste has led to many waste sites and dumping grounds, both legal and illegal, becoming heavily infested with *D. odorata*" (CABI, 2013). It can also be spread by landscape machinery (Alvarez, 1998).
ES-16 (Propagules likely to	n - mod	-1	We found no evidence.

Question ID	Answer - Uncertainty	Score	Notes (and references)
disperse in trade as contaminants or hitchhikers)			
ES-17 (Number of natural dispersal vectors)	2	0	Fruit and seed traits for questions ES-17a through ES-17e: Seeds glabrous with a pappus (Bossard et al., 2000). Seeds are small, white bearded achenes (Motooka et al., 2003). "Fruit is a ribbed, reddish-brown, cylindrical achene, about 2 mm long, with a circle of white pappus, 5-6 mm long, at the distal end. Pappus is easily broken, and soon lost" (CABI, 2013).
ES-17a (Wind dispersal)	y - negl		Seeds are spread by wind (Brunel et al., 2010; Staples et al., 2000), probably aided by the silky pappus (CABI, 2013). Seeds can be spread by wind but it is more likely to spread vegetatively (Csurhes and Edwards, 1998).
ES-17b (Water dispersal)	y - high		Stem fragments can disperse downstream into new areas (Alvarez, 1998; CABI, 2013), and those as short as one half inch are still viable (Alvarez, 1998). This has been observed during flooding along Big Sur River in California (Starr et al., 2003). Although not based on evidence for particular adaptations for water dispersal, we answered yes, but with high uncertainty.
ES-17c (Bird dispersal)	n - low		We found no evidence, but it is not likely given seed characteristics.
ES-17d (Animal external dispersal)	n - mod		We found no evidence.
ES-17e (Animal internal dispersal)	n - low		We found no evidence, but it is not likely given seed characteristics.
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	? - high	0	Unknown.
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	y - negl	1	These plants have extensive, waxy stolons running above- and belowground (Bossard et al., 2000). Stems readily root from nodes (Bossard et al., 2000; Elliott, 1994). "Ninety-five percent of fragments of green stolons containing only one node establish, and drying stolon fragments in full sun for ten weeks does not stop them from rooting" (Bossard et al., 2000). After flowering and a period of vegetative growth, it stores sugars in underground storage organs (Bossard et al., 2000). Experiments in California indicate it readily diverts resources from source to sink areas (Bossard et al., 2000). Above- and belowground parts can easily fragment when being removed (Bossard et al., 2000). Rhizomes grow to a depth of 90 cm (Weber, 2003). Plants form a persistent rootstock from which new stems arise (CABI, 2013).
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - low	0	We found no evidence, and this species is not listed by Heap (2013). Furthermore, one report states that chemical control can be effective (Starr et al., 2003).
ES-21 (Number of cold hardiness zones suitable for its survival)	6	0	
ES-22 (Number of climate types suitable for its survival)	6	2	
ES-23 (Number of precipitation bands suitable for its survival)	10	1	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - low	0	We found no evidence. Because an independent assessment also

Question ID	Answer - Uncertainty	Score	Notes (and references)
			found no evidence of allelopathy (DPI, 2013), we used low uncertainty.
Imp-G2 (Parasitic)	n - negl	0	Species is in the Asteraceae (NGRP, 2013), which is not known to contain parasitic species (Heide-Jorgensen, 2008; Nickrent, 2009).
Impacts to Natural Systems			
Imp-N1 (Change ecosystem processes and parameters that affect other species)	y - high	0.4	In its introduced range, it commonly forms large patches several hectares in size (Alvarez and Cushman, 2002). "Due to its shallow root system, cape ivy can contribute to serious soil erosion problems on hillsides" (cited in Bossard et al., 2000). Possibly affects ecosystem function, including nutrient cycling along streams (Alvarez, 1998). We used high uncertainty because we could not obtain the original document cited in Bossard et al. (2000) and because one reference speculated about impacts on ecosystem processes.
Imp-N2 (Change community structure)	y - negl	0.2	In coastal California, it covers the understory of riparian forests in a solid mat (Elliott, 1994). Forms a solid cover that blocks light and smothers vegetation (Bossard et al., 2000). The weight of the ivy sometimes causes trees to fall (Bossard et al., 2000). Affects some plant life forms (e.g., grasses and forbs) more than others (Alvarez and Cushman, 2002). Affects community structure (Alvarez, 1998). Displaces native forests in state parks in California (Elliott, 1994).
Imp-N3 (Change community composition)	y - negl	0.2	Reduces biodiversity in state parks in California (Elliott, 1994). In areas that have not become monospecific, *D. odorata* impacts non-native native species, and reduces native species richness by 50 percent, seedling diversity by about 90 percent, with greater impacts on annual than woody species (Alvarez and Cushman, 2002). Smothers vegetation in the low scrub, and grass/forb level (Csurhes and Edwards, 1998). In a study ranking species for their potential to impact biodiversity in New South Wales, *D. odorata* ranked 16th out of 340 species (Downey et al., 2010).
Imp-N4 (Is it likely to affect federal Threatened and Endangered species)	y - negl	0.1	One GIS study identified six sensitive California plant species in close proximity to invasive populations of *D. odorata* (Robison and DiTomaso, 2010). Four Federally listed species are threatened by this species in California (Alvarez, 1998). Given this evidence, and the impacts cited under Imp-N1 through Imp-N3, we answered yes with negligible uncertainty.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions)	y - low	0.1	A serious threat to a number of vegetation types in Australia (Csurhes and Edwards, 1998). This species has demonstrated an ability to invade globally outstanding ecoregions in the western United States (Ricketts et al., 1999; and references in Imp-N1 through Imp-N3).
Imp-N6 (Weed status in natural systems)	c - negl	0.6	Major environmental weed in Australia (Groves et al., 2005; Randall, 2007). Being treated with herbicides in state parks in California, but other herbicide formulations and management strategies are being explored because herbicides are not highly effective (Elliott, 1994). Biological control is being explored (Balciunas and Mehelis, 2010; Balciunas and Smith, 2006). Recommended for control in the Canary Islands (Gallo et al., 2008). Controlled in Hawaii vegetation (Motooka et al., 2003). Being managed in Golden Gate National Recreation Area, which is an urban national park administered by the National Park

Question ID	Answer - Uncertainty	Score	Notes (and references)
			Service (Bossard et al., 2000). Several control options are described (Bossard et al., 2000). "Golden Gate National Recreation Area near San Francisco, California, USA has spent over US$600,000 over three years trying to eradicate this vine" (CABI, 2013). From these references for the Golden Gate Park, the plant is probably being managed for its impact to biodiversity and not recreational amenities. Alternate answers for the Monte Carlo simulation were both "b."
Impact to Anthropogenic Systems (cities, suburbs, roadways)			
Imp-A1 (Impacts human property, processes, civilization, or safety)	y - high	0.1	"Flood control function along streams is impacted by [C]ape ivy infestations" (cited in Bossard et al., 2000). We used high uncertainty because we could not obtain the original document cited in Bossard et al.
Imp-A2 (Changes or limits recreational use of an area)	n - high	0	We found no evidence, but another weed risk assessment speculates it could limit access to recreational areas (DPI, 2013).
Imp-A3 (Outcompetes, replaces, or otherwise affects desirable plants and vegetation)	? - max		One gardener on Dave's Garden forum says it is twining into her plantings (Dave's Garden, 2013), but doesn't explicitly state if it is having any impacts.
Imp-A4 (Weed status in anthropogenic systems)	c - high	0.4	Clambering over hedges and walls in England (Reynolds, 2002). Two gardeners on Dave's Garden (2013) stated they are trying to get rid of it. Consequently we answered "c," but used high uncertainty as we found little evidence for control in garden environments. Alternate answers for the Monte Carlo simulation were "b" and "a."
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	n - low	0	We found no evidence.
Imp-P2 (Lowers commodity value)	n - low	0	We found no evidence.
Imp-P3 (Is it likely to impact trade)	n - mod	0	Regulated in Australia (Randall, 2007). Regulated (i.e., a declared weed) in New South Wales where it must be controlled according to local management plans and it must not be sold, propagated, or knowingly distributed (The University of Queensland, 2013), but we found no evidence it is likely to follow a pathway as a contaminant.
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	n - high	0	May be present in irrigation channels and drains (CABI, 2013), but we found no evidence it causes any types of impacts.
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	y - high	0.1	Contains pyrollizidine alkaloids, which are toxic to many animals (Bossard et al., 2000). "It has also been implicated in having caused cattle poisoning in New Zealand" (CABI, 2013). "*D[elairea] odorata* contains many chemical compounds including xanthones ... and pyrrolizidine alkaloids.... The latter, if ingested in sufficient quantity are toxic to the liver and can lead to renal malfunction. Although mammalian poisoning does not appear to be well documented, there are a large number of unsubstantiated reports concerning poisoning by *D. odorata*. A variety of web sites warn of the possible toxic impacts of this plant to infants ... and pets ..." (CABI, 2013). May be toxic to fish (Alvarez, 1998) but Burrows and Tyrl (2001) report it is not known to be of toxicological risk. Based on the known presence

Question ID	Answer - Uncertainty	Score	Notes (and references)
			of toxic compounds we answered yes, but used high uncertainty because we found no strong evidence of actual cases.
Imp-P6 (Weed status in production systems)	b - high	0.2	Agricultural weed in Australia (Randall, 2007), but not listed as serious or principal (Holm et al., 1979). Not frequently a weed in crops and pasture, though it may be present in irrigation channels (CABI, 2013). In "Silvics of North America," *D. odorata* was described as difficult to control under the entry for *Acacia koa* (Burns and Honkala, 1990). Unfortunately, that brief statement does not clarify if *D. odorata* is a problem in forest plantations. Alternate answers for the Monte Carlo simulation were "a" and "c."
GEOGRAPHIC POTENTIAL			Unless otherwise indicated, the following evidence represents geographically referenced, point references obtained from the Global Biodiversity Information Facility (GBIF, 2013).
Plant cold hardiness zones			
Geo-Z1 (Zone 1)	n - negl	N/A	We found no evidence that it occurs here.
Geo-Z2 (Zone 2)	n - negl	N/A	We found no evidence that it occurs here.
Geo-Z3 (Zone 3)	n - negl	N/A	We found no evidence that it occurs here.
Geo-Z4 (Zone 4)	n - mod	N/A	One report of this species in northeastern Montana (Kartesz, 2013), but this is very doubtful as no other reports exist for Montana and nothing indicates this species could tolerate temperatures in this zone.
Geo-Z5 (Zone 5)	n - negl	N/A	We found no evidence that it occurs here.
Geo-Z6 (Zone 6)	n - negl	N/A	We found no evidence that it occurs here.
Geo-Z7 (Zone 7)	n - mod	N/A	We found no evidence that it occurs here.
Geo-Z8 (Zone 8)	y - low	N/A	Australia and Spain. A few points on edge in South Africa.
Geo-Z9 (Zone 9)	y - negl	N/A	One point in California, some points in New Zealand, and many points in South Africa, Spain, and Australia. One gardener living in this zone reports having to control this species (Dave's Garden, 2013).
Geo-Z10 (Zone 10)	y - negl	N/A	California, South Africa, Australia, and Spain. Tolerates drought and freezing temperatures (Alvarez and Cushman, 2002). Frost tender (CABI, 2013).
Geo-Z11 (Zone 11)	y - negl	N/A	The United States (California), South Africa, and Australia.
Geo-Z12 (Zone 12)	y - low	N/A	Points in the United States (Hawaii) (Robison, 2006).
Geo-Z13 (Zone 13)	y - mod	N/A	Points in Hawaii (Robison, 2006).
Köppen-Geiger climate classes			
Geo-C1 (Tropical rainforest)	y - mod	N/A	Points in Hawaii (Robison, 2006). In Hawaii, it occurs in diverse habitat types, including dry scrub and rainforest (Jacobi and Warschauer, 1992).
Geo-C2 (Tropical savanna)	y - low	N/A	Points in Hawaii (Robison, 2006).
Geo-C3 (Steppe)	y - low	N/A	One point in South Africa, and a few points in Spain and Hawaii (Robison, 2006).
Geo-C4 (Desert)	n - high	N/A	Species has a restricted distribution in South Africa, but grows in moist forests in diverse habitats from deserts to high mountain forests (Robison et al., 2011). We answered no because we found no other evidence that it occurs in this climate type.
Geo-C5 (Mediterranean)	y - negl	N/A	Australia, The United States (California), and Spain.
Geo-C6 (Humid subtropical)	y - negl	N/A	Australia and South Africa.
Geo-C7 (Marine west coast)	y - negl	N/A	Australia, New Zealand, South Africa, and Spain.
Geo-C8 (Humid cont. warm	n - low	N/A	We found no evidence that it occurs here.

Question ID	Answer - Uncertainty	Score	Notes (and references)
sum.)			
Geo-C9 (Humid cont. cool sum.)	n - negl	N/A	We found no evidence that it occurs here.
Geo-C10 (Subarctic)	n - negl	N/A	We found no evidence that it occurs here.
Geo-C11 (Tundra)	n - negl	N/A	We found no evidence that it occurs here.
Geo-C12 (Icecap)	n - negl	N/A	We found no evidence that it occurs here.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	n - high	N/A	One point on edge in California, and one point near edge in South Africa. *Delairea odorata* occurs in the western United States in areas receiving from 232 and 2270 mm of annual precipitation (Robison and DiTomaso, 2010). It has recently become established in coastal sites in South Africa that receive 100 mm per year annual precipitation, but supplemental moisture is suspected (CABI, 2013).
Geo-R2 (10-20 inches; 25-51 cm)	y - negl	N/A	California, South Africa, and Spain. *Delairea odorata* occurs in the western United States in areas receiving from 232 and 2270 mm of annual precipitation (Robison and DiTomaso, 2010).
Geo-R3 (20-30 inches; 51-76 cm)	y - negl	N/A	Australia, California, South Africa, and Spain.
Geo-R4 (30-40 inches; 76-102 cm)	y - negl	N/A	Australia, California, and South Africa.
Geo-R5 (40-50 inches; 102-127 cm)	y - negl	N/A	Australia, California, and South Africa.
Geo-R6 (50-60 inches; 127-152 cm)	y - negl	N/A	New Zealand and Spain.
Geo-R7 (60-70 inches; 152-178 cm)	y - negl	N/A	One point each in Oregon and Spain.
Geo-R8 (70-80 inches; 178-203 cm)	y - negl	N/A	Near a narrow band in New Zealand.
Geo-R9 (80-90 inches; 203-229 cm)	y - negl	N/A	New Zealand. *Delairea odorata* occurs in the western United States in areas receiving from 232 and 2270 mm of annual precipitation (Robison and DiTomaso, 2010).
Geo-R10 (90-100 inches; 229-254 cm)	y - negl	N/A	New Zealand. In a survey in Hawaii, it was found only at stations with less than 100 inches annual precipitation (Jacobi and Warschauer, 1992).
Geo-R11 (100+ inches; 254+ cm))	y - negl	N/A	New Zealand.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	y - negl	1	Naturalized along much of the U.S. western coast (Robison and DiTomaso, 2010).
Ent-2 (Plant proposed for entry, or entry is imminent)	-	N/A	
Ent-3 (Human value & cultivation/trade status)	-	N/A	Escaped from cultivation in the Canary Islands (Gallo et al., 2008). Widely cultivated for more than 100 years, and available through major chain supermarkets (CABI, 2013).
Ent-4 (Entry as a contaminant)			
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	-	N/A	
Ent-4b (Contaminant of plant propagative material (except	-	N/A	

Question ID	**Answer - Uncertainty**	**Score**	**Notes (and references)**
seeds))			
Ent-4c (Contaminant of seeds for planting)	-	N/A	
Ent-4d (Contaminant of ballast water)	-	N/A	
Ent-4e (Contaminant of aquarium plants or other aquarium products)	-	N/A	
Ent-4f (Contaminant of landscape products)	-	N/A	
Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances)	-	N/A	
Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing)	-	N/A	
Ent-4i (Contaminant of some other pathway)	-	N/A	
Ent-5 (Likely to enter through natural dispersal)	-	N/A	