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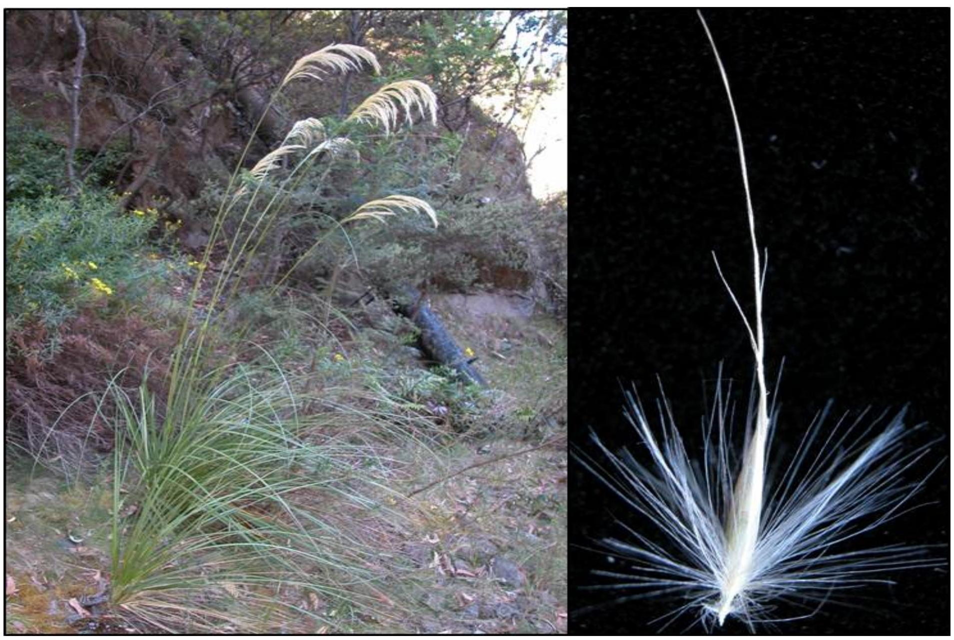
Version 1

Weed Risk Assessment for *Austroderia richardii* (Endl.) N. P. Barker & H. P. Linder (Poaceae) – New Zealand pampas grass



Left: Habit *of A. richardii*. Right: Floret with associated silky hairs that aid in wind dispersal [source: Dr. Greg Jordan, University of Tasmania (Jordan, 2014)].

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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.

***Austroderia richardii* (Endl.) N. P. Barker & H. P. Linder – New Zealand pampas grass**

Species Information

Family: Poaceae

Synonyms: *Cortaderia richardii* (Endl.) Zotov (Linder et al., 2010); *Arundo richardii* Endl. (basionym; NGRP, 2013) and *Gynerium zeelandicum* Steud. (The Plant List, 2014). In 2010, all of the New Zealand *Cortaderia* species were placed in the new genus *Austroderia*, with *C. richardii* renamed as *Austroderia richardii* (Endl.) N. P. Barker & H. P. Linder (Linder et al., 2010). Because this name change was relatively recent, any government documents or rules should list both names for clarity. Almost all of the literature we found for this WRA used the synonym.

Common Names: New Zealand pampas grass (Richardson et al., 2006); Toetoe (Research, 2014); Early pampas grass (Stace, 2010).

Initiation: While doing weed risk assessments for *Cortaderia jubata* and *C. selloana*, the PERAL Weed Team determined that *A. richardii* posed an unknown plant health threat to the United States, and decided to analyze it as well.

Foreign distribution: *Austroderia richardii* is native to New Zealand (NGRP, 2013). It has been introduced to and become naturalized in Australia (Tasmania), France (DAISIE, 2014), and the United Kingdom (NGRP, 2013).

U.S. distribution and status: *Austroderia richardii* is not known to be naturalized in the United States (Kartesz, 2013; NRCS, 2013). This species is present in the United States, but we believe it is quite rare. We found no comments about it from gardeners on Dave's Garden (Dave's Garden, 2014) but it is listed in a book of garden plants for the Pacific Northwest (McNeilan and MecNeilan, 1997). Furthermore, it is listed for sale by two nurseries: one in California that specializes in hard-to-find plants (Anonymous, 2013a), and another in Ohio (Anonymous, 2014a). Seeds of *A. richardii* are listed on eBay under the name silver plume pampas grass (eBay, 2014). This species is also in the collection of the University of Washington's Botanic Garden (Reyes, 2013).

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

1. *Austroderia richardii* analysis

Establishment/Spread Potential *Austroderia richardii* is a perennial, tussock-forming grass that has become naturalized beyond its native range in Tasmania and the United Kingdom (Duckett, 1989; GBIF, 2013). In Tasmania, this species has proven to be invasive, as plants have spread from roadside plantings (Duckett, 1989). *Austroderia richardii* produces seeds and rhizomes (Parsons and Cuthbertson, 2001), is self-compatible (Connor, 1973), and spreads by wind (Parsons and Cuthbertson, 2001) and garden waste (Australian Weeds Committee, 2014). Because it is used in dry floral arrangements (Anonymous, 2014b), it may be able to spread if arrangements are discarded in the outdoor environment. We had greater than average uncertainty for this risk element due to the limited amount of biological information available for this species.
Risk score = 9 Uncertainty index = 0.22

Impact Potential We found little information on the specific impacts of this species. *Austroderia richardii* competes with and excludes native species (Anonymous, 2011; Csurhes and Edwards, 1998; Duckett, 1989), and it clogs drains and chokes waterways (Anonymous, 2011). The majority of the accumulated points in this risk score resulted from the three questions that relate to perceived impacts (i.e., Imp-N6, Imp-A4, and Imp-P6). These questions evaluate whether a species is considered a weed and is managed in natural, anthropogenic, and production systems. *Austroderia richardii* is a noxious weed in Tasmania, where it is widely recognized as a weed of these three systems (Anonymous, 2011; Parsons and Cuthbertson, 2001; Richardson et al., 2006). People are particularly concerned about its impacts in the World Heritage Area in southwestern Tasmania (Duckett, 1989; Parsons and Cuthbertson, 2001). Within Tasmania, a large campaign strategy against all pampas species, including *A. richardii*, was developed in the late 1980s (Duckett, 1989). Targeting natural, anthropogenic, and production systems, the strategy aimed at eradication, containment, and education, depending on the local scenario. We had very high uncertainty for this risk element.
Risk score = 3 Uncertainty index = 0.38

Geographic Potential Based on three climatic variables and the available evidence, we estimate that about 3 percent of the United States is suitable for the establishment of *A. richardii* (Fig. 1). That is based on the species' known distribution elsewhere in the world and includes point-referenced localities and areas of occurrence. This species occurs in only marine west coast climates in its native and naturalized ranges. The map for *A. richardii* represents the joint distribution of Plant Hardiness Zones 7-11, areas with 20-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: marine west coast and Mediterranean. We included the Mediterranean climate because it occurs at the University of British Columbia Botanical Garden

[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).

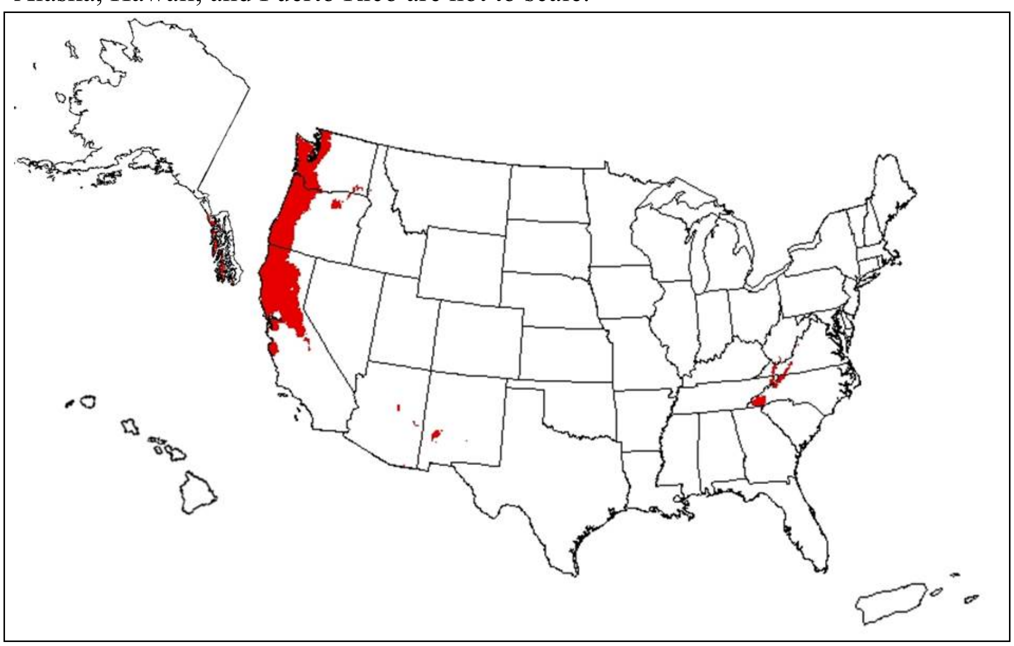
(GBIF, 2013), which is just a few miles away from a region characterized by a Mediterranean climate class, and because it is being sold by a California nursery located in a Mediterranean climate (Anonymous, 2013a).

Overall, we had high uncertainty and suspect that the predicted area in Fig. 1 has been underestimated. This species is reported to grow in humid cool to warm temperate regions in open streambanks, riverbeds, shrublands, coastal cliffs, beaches, and other wet areas (Landcare Research, 2014; Linder et al., 2010; Parsons and Cuthbertson, 2001). Seeds of this species are being sold by an Ohio nursery (Anonymous, 2014a), which is located in the humid continental, cold summer climate class, but we do not know if they are growing the species outdoors or merely redistributing the seeds.

Entry Potential *Austroderia richardii* is present in the United States, where it exists in a botanical garden (Reyes, 2013) and is being sold by two retail nurseries (Anonymous, 2013a, 2014a). Because we believe it is rare in the United States, however, we assessed this risk element as though it were not present. The most likely pathway for introduction and spread is as an ornamental plant. It is listed in a book of garden plants for the Pacific Northwest (McNeilan and MecNeilan, 1997) and received an Award of Garden Merit by the Royal Horticultural Society in 2002 (Meyer, 2011). It may also enter in dried floral arrangements or naturally from Canada (perhaps as wind-blown seed; see Appendix A).

Risk score = 0.6 Uncertainty index = 0.09

Figure 1. Predicted distribution of *A. richardii* 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) = 44.8%
P(Minor Invader) = 51.6%
P(Non-Invader) = 3.6%

Risk Result = High Risk

Secondary Screening = Not Applicable

Figure 2. *Austroderia richardii* 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.

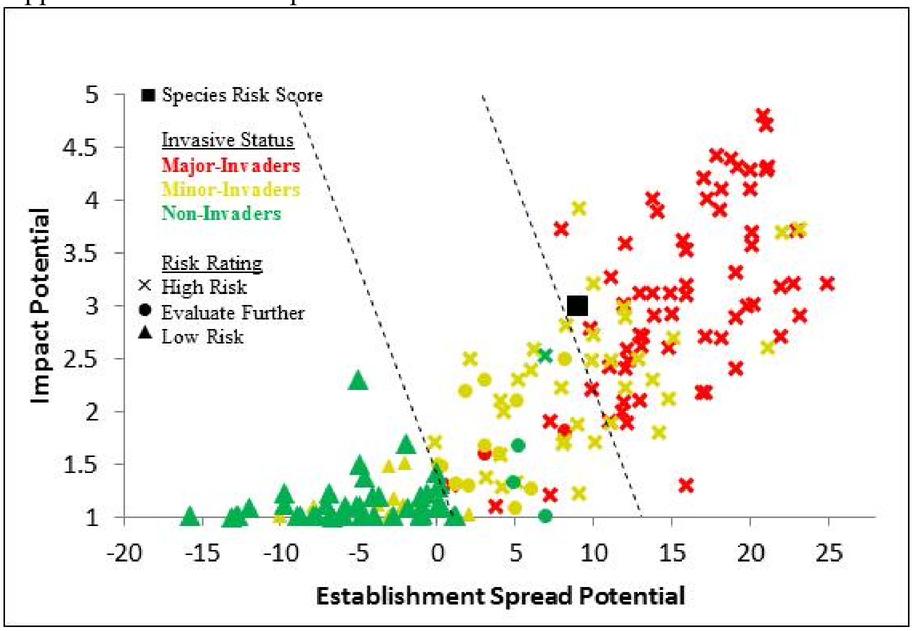
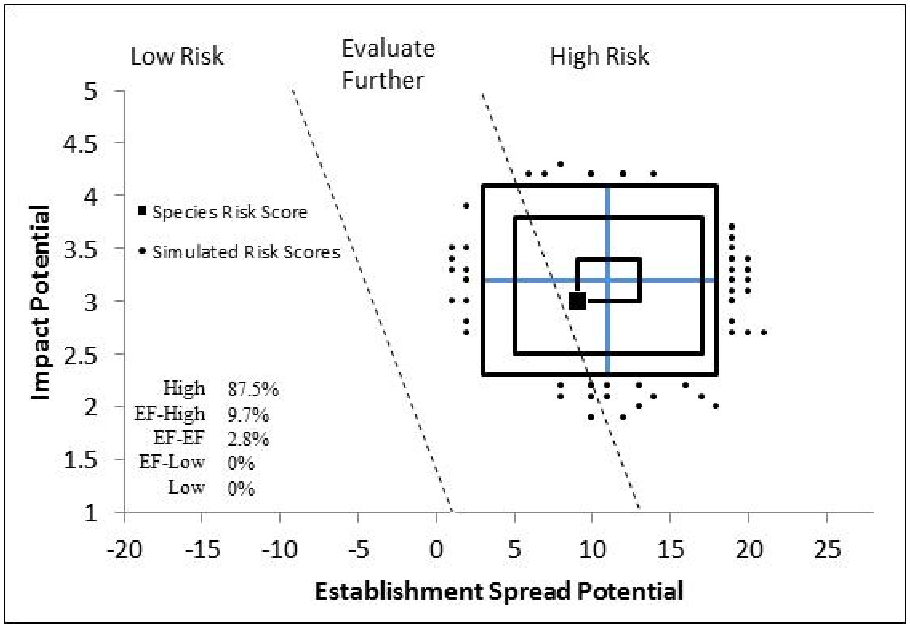


Figure 3. Model simulation results (N=5,000) for uncertainty around the risk score for *A. richardii*[a].



[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 *A. richardii* was High Risk (Fig. 2). An evaluation with the Australian WRA system also resulted in a conclusion of high risk (Pheloung, 1995). Although the analysis had great uncertainty, our conclusion is supported by the uncertainty simulation, which had 97 percent of the simulations leading to a high risk outcome (Fig. 3). The uncertainty came from the limited amount of information available on this species: we could not answer six questions for the establishment/spread and impact risk elements, and many other questions that we did answer had high uncertainty. We suspect *A. richardii* has received limited attention from researchers and managers because it is overshadowed by its more widely known invasive relatives, *C. selloana* and *C. jubata*. Still, additional information would likely shift the risk scores further into the high risk region (Fig. 3). As stated under the geographic potential section, we are also unsure whether other U.S. regions are climatically suitable for it.

Some measure of the invasive potential of *A. richardii* might be indicated by its close relatives. *Cortaderia jubata* and *C. selloana* are widely recognized as major U.S. invaders (Bossard et al., 2000; Dave's Garden, 2013; Lambrinos, 2001). Generally, disturbance events promote their invasion, possibly due to reduced competition from existing species (Lambrinos, 2002). Within the grass family, *C. jubata* and *C. selloana* are closely related to the newly described genus of *Austroderia*, and all are large tussock-forming grasses that are primarily gynodioecious (Linder et al., 2010). Although we cannot know if *A. richardii* has the same potential as the two *Cortaderia* species, it is noteworthy that "*A. richardii* is more competitive than either of the other two species in that it can colonise areas where the existing vegetation is only slightly disturbed, e.g., on river margins or as a result of a low intensity fire" (Duckett, 1989).

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Appendix A. Weed risk assessment for *Austroderia richardii* (Endl.) N. P. Barker & H. P. Linder (Poaceae). 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 - mod	5	This species is native to New Zealand (Landcare Research, 2014). It has been introduced to and become naturalized in Australia (Tasmania) (Landcare Research, 2014; The University of Queensland, 2014), France (DAISIE, 2014), and the United Kingdom (NGRP, 2013). "Roadside plantings in 1962 have become the source of invasion into the World Heritage Area and higher altitude forests in south-west Tasmania. In 1988 this infestation had extended its range over 70 km of roadsides" (Duckett, 1989). The last source indicates that this species is behaving invasively (i.e., spreading) in Tasmania. We did not find much more evidence about this species' status in its introduced range. Its relatively widespread distribution in the United Kingdom may be due to species spread, or it may represent widespread escape and naturalization from gardens. One account from the United Kingdom said the species is naturalized in some places, and regenerating vigorously in one site (Ryves et al., 1996). Based on its behavior in both locations, we answered "f" with moderate uncertainty. The alternate answers for the Monte Carlo simulation were both "e."
ES-2 (Is the species highly domesticated)	n - low	0	This species is cultivated (Anonymous, 2013a; Reyes, 2013; RHS, 2014), but we found no evidence of breeding resulting in reduced weed potential.
ES-3 (Weedy congeners)	y - negl	1	The genus *Austroderia* was recently described from species in the genus *Cortaderia* (Linder et al., 2010). There are four other species in *Austroderia*. Two of these are considered weeds, *A. fulvida* and *A. splendens*; however, we do not consider them significant weeds due to the limited amount of supporting references (Randall, 2012). Because *Austroderia* and *Cortaderia* are closely related genera composed of large tussock-forming grasses (Linder et al., 2010), we expanded the scope of this question to include *Cortaderia*. This genus has about 19 species (Linder et al., 2010). Two of these species (*Cortaderia jubata* and *C. selloana*) cause significant impacts in natural, anthropogenic, and production systems (Bossard et al., 2000; Domènech et al., 2006; Gadgil et al., 1992; Knowles, 1991; Lambrinos, 2000; MPI, 2012; Parsons and Cuthbertson, 2001). Both species are quarantine pests in Australia (Parsons and Cuthbertson, 2001).
ES-4 (Shade tolerant at some stage of its life cycle)	n - mod	0	Occurs in open habitats (Parsons and Cuthbertson, 2001). Takes full sun (Reyes, 2013). We answered no since we found no evidence of shade tolerance.
ES-5 (Climbing or smothering growth form)	n - negl	0	It is a tussock-forming grass about three to six meters tall (Linder et al., 2010; Parsons and Cuthbertson, 2001).
ES-6 (Forms dense thickets)	n - high	0	We found no evidence that this species forms dense thickets. But given the limited information on its status where it is naturalized, and given that its congeners form dense thickets (Bossard et al., 2000; DiTomaso et al., 2008; Drewitz and

Question ID	Answer - Uncertainty	Score	Notes (and references)
			DiTomaso, 2004), we used high uncertainty.
ES-7 (Aquatic)	n - low	0	Plants occur on streambanks, shrublands, and other wet areas (Parsons and Cuthbertson, 2001), but the species is not described as an aquatic.
ES-8 (Grass)	y - negl	1	This species is a grass (NGRP, 2013).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	We found no evidence that this species fixes nitrogen. Furthermore, Poaceae do not fix nitrogen (Martin and Dowd, 1990; Santi et al., 2013).
ES-10 (Does it produce viable seeds or spores)	y - negl	1	Reproduces by seeds (Parsons and Cuthbertson, 2001). Can reseed (Reyes, 2013).
ES-11 (Self-compatible or apomictic)	y - low	1	Plants are gynodiocious, meaning individual plants are either female or hemaphroditic (Connor, 1965, 1973; Parsons and Cuthbertson, 2001). In general, "[g]ynodioecism is an outbreeding system of interbreeding females and hermaphrodites, though hermaphrodites may often be self-compatible as well" (Connor, 1973). At least under experimental conditions, this species can self (Connor, 1973; Connor and Charlesworth, 1989). Seed set from selfing can be as high as 80 percent (Connor, 1973).
ES-12 (Requires special pollinators)	n - low	0	We found no direct evidence about pollination in this species. Because grasses in general are wind-pollinated (Faegri and Van der Pijl, 1979), we answered no and used low uncertainty.
ES-13 (Minimum generation time)	c - high	0	Reproduces by seeds and vegetative offshoots (Parsons and Cuthbertson, 2001). Under cultivation plants take 3-4 years to reproduce (Connor, 1973). An Australian reference (Parsons and Cuthbertson, 2001) states that "[s]eeds germinate in autumn and seedlings develop slowly at first. Growth increases rapidly the following spring as flowering stems develop. Flowering begins in November and continues into January." This makes it seem like seeds will produce flowering stems in their first year, but this seems doubtful given the evidence from Connor. Furthermore, Parsons and Cuthbertson (2001) were likely referring to the general flowering period of populations in Australia. If plants take 3-4 years to reach reproductive maturity in cultivation, they likely take longer under natural conditions. Consequently, we answered "c," with high uncertainty. Alternate choices for the Monte Carlo simulation were "d" and "b."
ES-14 (Prolific reproduction)	? - max	0	"Seed-set is abundant on bisexual plants" (Stace, 2010). Without specific evidence regarding the number of seeds produced per square meter, we answered unknown.
ES-15 (Propagules likely to be dispersed unintentionally by people)	y - low	1	Spreads in garden waste (Australian Weeds Committee, 2014).
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	y - low	2	Like its relative *C. selloana* (Lambrinos, 2001), inflorescences of *A. richardii* are used in dried floral arrangements (Anonymous, 2014b). Dried plumes of pampas grass (exact species is unknown) are available for sale on the internet (e.g., Anonymous, 2013b). Because *A. richardii* is also known as New Zealand pampas grass (Richardson et al., 2006), its flowers and associated seeds are likely to move in trade.
ES-17 (Number of natural dispersal vectors)	1	-2	Seed and fruit description for ES-17a through ES-17e: Seeds are about 2 mm long (Parsons and Cuthbertson, 2001).

Question ID	Answer - Uncertainty	Score	Notes (and references)
			Caryopsis is 3-4 mm (Landcare Research, 2014).
ES-17a (Wind dispersal)	y - negl		Seeds of female and bisexual plants are readily dispersed by wind (Parsons and Cuthbertson, 2001). Seeds of two other *Cortaderia* species are also wind-dispersed (Drewitz and DiTomaso, 2004; MPI, 2012; Saura-Mas and Lloret, 2005).
ES-17b (Water dispersal)	n - mod		We found no evidence. This species and two of its congeners are adapted for wind-dispersal (see evidence under ES-17a). However, because *A. richardii* grows on streambanks, riverbeds, beaches, and other wet areas (Landcare Research, 2014; Linder et al., 2010; Parsons and Cuthbertson, 2001), it is possible it is also dispersed by water. Consequently, we used moderate uncertainty.
ES-17c (Bird dispersal)	n - low		We found no evidence, and bird dispersal is unlikely given that this species is adapted for wind dispersal.
ES-17d (Animal external dispersal)	n - mod		We found no evidence.
ES-17e (Animal internal dispersal)	n - low		We found no evidence. Unlikely given that this species is adapted for wind dispersal.
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	? - max	0	Unknown.
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	? - max	0	Unknown. Because it produces rhizomes (Parsons and Cuthbertson, 2001), it may be able to respond well to these types of disturbances.
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - low	0	We found no evidence of herbicide resistance. Furthermore, it is not listed by Heap (2013). This species has been artificially hybridized with *A. toetoe* and the resulting progeny backcrossed to both parents (Connor and Purdie, 1976). Thus, it may be able to obtain herbicide resistance through outcrossing with other species, if they possess herbicide resistance.
ES-21 (Number of cold hardiness zones suitable for its survival)	5	0	
ES-22 (Number of climate types suitable for its survival)	2	-2	
ES-23 (Number of precipitation bands suitable for its survival)	9	1	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - mod	0	We found no evidence.
Imp-G2 (Parasitic)	n - negl	0	We found no positive evidence this species is parasitic. Because it is not a member of one of the plant families known to contain parasitic species (Heide-Jorgensen, 2008; Nickrent, 2009), we answered no with negligible uncertainty.
Impacts to Natural Systems			
Imp-N1 (Change ecosystem processes and parameters that affect other species)	? - max		A general report of invasive plant species in Australia states that all species of *Cortaderia* in Australia, including *A. richardii*, which was moved to a new genus 12 years after the report was published, alter fire regime (Csurhes and Edwards, 1998). A South Australia government factsheet also states it is a fire hazard (Anonymous, 2011). These accounts are not

Question ID	Answer - Uncertainty	Score	Notes (and references)
			surprising given that invasive exotic grasses generally alter fire regimes in natural communities (D'Antonio and Vitousek, 1992). However, we found no direct evidence in the primary literature supporting the claims that *A. richardii* changes fire regimes. Changes to ecosystem fire regimes are significant impacts; thus we were surprised not to see additional evidence of it. Consequently, we answered unknown.
Imp-N2 (Change community structure)	? - max		We found no evidence of this impact. Because so little is known about this species, and because two closely related *Cortaderia* species change community structure (Domènech et al., 2006; Lambrinos, 2000), we answered unknown.
Imp-N3 (Change community composition)	y - low	0.2	"Swamplands and moorlands are readily invaded and their natural communities are severely affected, thus reducing their conservation value. *C. richardii* successfully competes on a large range of sites extending from coastal areas to the higher (around 700 metres) altitude forest" (Duckett, 1989). *Austroderia richardii* is taking over streambanks at the World Heritage site in Tasmania (p. 156; Low, 2002). This species, in addition to the two exotic *Cortaderia* species in Australia, competes with native species (Csurhes and Edwards, 1998). *Austroderia richardii* excludes native vegetation (Anonymous, 2011).
Imp-N4 (Is it likely to affect federal Threatened and Endangered species)	y - mod	0.1	Based on the ability of this species to compete and invade natural areas (see evidence under Imp-N3), we answered yes.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions)	y - high	0.1	*Austroderia richardii* is threatening World Heritage sites in western Tasmania (The University of Queensland, 2014). Because the United States has globally outstanding ecoregions (Ricketts et al., 1999) where we expect this species to be able to establish (i.e., coastal Oregon and Washington), we answered yes, but with high uncertainty because of the limited evidence demonstrating how this species is threatening these valuable sites.
Imp-N6 (Weed status in natural systems)	c - mod	0.6	*Austroderia richardii* is naturalizing in maritime cliffs and dunes in the United Kingdom (Stace, 2010). Considered a threat to a World Heritage Area in Tasmania (Parsons and Cuthbertson, 2001). An environmental weed in Australia (Randall, 2007). Weed of disturbed bushlands in Australia (Richardson et al., 2006). Within Tasmania, a large campaign strategy against all pampas species, including *A. richardii* was developed in the late 1980s (Duckett, 1989). Within state forests and national parks the aim was to eradicate all known infestations and maintain an exclusion program (Duckett, 1989). 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	A South Australia government factsheet states that this species clogs drains (Anonymous, 2011); unfortunately, it didn't provide any other description of how it does this, what kinds drains are clogged, and how extensive the problem is. Given that *A. richardii* has an affinity for wet habitats (Landcare Research, 2014; Linder et al., 2010; Parsons and Cuthbertson, 2001), this impact is conceivable. Consequently, despite very

Question ID	Answer - Uncertainty	Score	Notes (and references)
			weak evidence we answered yes, but with high uncertainty.
Imp-A2 (Changes or limits recreational use of an area)	y - high	0.1	A South Australia government factsheet states that this species chokes waterways (Anonymous, 2011); unfortunately, it didn't provide any additional information. Under the same reasoning provided in Imp-A1, we answered yes, with high uncertainty. Clogged waterways reduce recreational access to boating and fishing.
Imp-A3 (Outcompetes, replaces, or otherwise affects desirable plants and vegetation)	n - mod	0	We found no evidence.
Imp-A4 (Weed status in anthropogenic systems)	c - mod	0.4	Weed of drainage lines, roadsides, and bare damp ground (Richardson et al., 2006). Naturalizing in rough ground, waysides, and old gardens in the United Kingdom (Stace, 2010). Within Tasmania, a large campaign strategy against all pampas species, including *A. richardii*, was developed in the late 1980s (Duckett, 1989). On road easements that are under government control, the strategy aimed to control plant spread (Duckett, 1989). Also under the campaign strategy, authorities encouraged and worked with private landowners to remove plants from private gardens (Duckett, 1989). Alternate answers for the Monte Carlo simulation were both "b."
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	n - mod	0	We found no evidence.
Imp-P2 (Lowers commodity value)	n - mod	0	We found no evidence.
Imp-P3 (Is it likely to impact trade)	y - low	0.2	This species is prohibited in Tasmania, where it is a noxious weed (Duckett, 1989; Rozefelds et al., 1999). Because it may be able to move in trade associated with dried inflorescences (see evidence under ES-16), it may impact trade.
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	? - max		Given the report that this species clogs drains and chokes waterways (Anonymous, 2011), and that it occurs in wet habitats (Duckett, 1989; Low, 2002), it is likely that it may be or become problematic in similar sites in production systems. However, without positive evidence of this impact, we answered unknown.
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	n - low	0	We found no evidence. Furthermore, the genus is not listed by Burrows and Tyrl (2001). Given that the genus is relatively well known, and two species are cultivated, we used low uncertainty.
Imp-P6 (Weed status in production systems)	b - high	0.2	"High risk potential to forestry operations" (Anonymous, 2011). Within Tasmania, a large campaign strategy against all pampas species, including *A. richardii*, was developed in the late 1980s (Duckett, 1989). "In rural areas where pampas grass removal would cause commercial losses, the long-term objective is to encourage plant removal through the development of an assistance package and replacement with more suitable species" (Duckett, 1989). Because it is not as clear that this species is a weed in production systems and is being managed in those types of systems, we answered "b." Alternate answers for the Monte Carlo simulation were "c" and "a."

Question ID	Answer - Uncertainty	Score	Notes (and references)
GEOGRAPHIC POTENTIAL			Unless otherwise indicated, the following evidence represents geographically referenced points 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 in this zone.
Geo-Z2 (Zone 2)	n - negl	N/A	We found no evidence that it occurs in this zone.
Geo-Z3 (Zone 3)	n - negl	N/A	We found no evidence that it occurs in this zone.
Geo-Z4 (Zone 4)	n - negl	N/A	We found no evidence that it occurs in this zone.
Geo-Z5 (Zone 5)	n - negl	N/A	We found no evidence that it occurs in this zone.
Geo-Z6 (Zone 6)	n - high	N/A	One point on edge in New Zealand.
Geo-Z7 (Zone 7)	y - low	N/A	Some points in New Zealand.
Geo-Z8 (Zone 8)	y - negl	N/A	New Zealand and the United Kingdom.
Geo-Z9 (Zone 9)	y - negl	N/A	New Zealand and the United Kingdom. One point on edge in Australia (Tasmania).
Geo-Z10 (Zone 10)	y - negl	N/A	Ireland, New Zealand, and the United Kingdom. Australia (Tasmania).
Geo-Z11 (Zone 11)	y - low	N/A	New Zealand. One point in Australia (Tasmania).
Geo-Z12 (Zone 12)	n - low	N/A	We found no evidence that it occurs in this zone.
Geo-Z13 (Zone 13)	n - negl	N/A	We found no evidence that it occurs in this zone.
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	n - negl	N/A	We found no evidence that it occurs in this climate class.
Geo-C2 (Tropical savanna)	n - mod	N/A	We found no evidence that it occurs in this climate class.
Geo-C3 (Steppe)	n - mod	N/A	We found no evidence that it occurs in this climate class.
Geo-C4 (Desert)	n - negl	N/A	We found no evidence that it occurs in this climate class.
Geo-C5 (Mediterranean)	y - high	N/A	We found no evidence it occurs in this climate class. Because this species is cultivated at the University of British Columbia Botanical Garden (GBIF, 2013), which is just a few miles away from areas in this climate class, we answered yes with high uncertainty.
Geo-C6 (Humid subtropical)	n - high	N/A	We found no evidence that it occurs in this climate class. Based on the range of Plant Hardiness Zones and precipitation bands in which *A. richardii* occurs, we suspect this climate class may be suitable for it.
Geo-C7 (Marine west coast)	y - negl	N/A	Australia (Tasmania), Ireland, New Zealand, and the United Kingdom.
Geo-C8 (Humid cont. warm sum.)	n - high	N/A	We found no evidence that it occurs in this climate class. Based on the range of Plant Hardiness Zones and precipitation bands in which *A. richardii* occurs, we suspect this climate class may be suitable for it.
Geo-C9 (Humid cont. cool sum.)	n - high	N/A	We found no evidence that it occurs in this climate class. Based on the range of Plant Hardiness Zones and precipitation bands in which *A. richardii* occurs, we suspect this climate class may be suitable for it. Also, its seeds are listed for retail by a nursery located in this climate class (Anonymous, 2014a), but it is unknown if the plant is being grown outside by the nursery or if it is redistributing its seeds.
Geo-C10 (Subarctic)	n - negl	N/A	We found no evidence that it occurs in this climate class.
Geo-C11 (Tundra)	n - negl	N/A	We found no evidence that it occurs in this climate class.
Geo-C12 (Icecap)	n - negl	N/A	We found no evidence that it occurs in this climate class.

Question ID	Answer - Uncertainty	Score	Notes (and references)
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	n - negl	N/A	We found no evidence that it occurs in this precipitation band.
Geo-R2 (10-20 inches; 25-51 cm)	n - high	N/A	We found no evidence that it occurs in this precipitation band.
Geo-R3 (20-30 inches; 51-76 cm)	y - negl	N/A	New Zealand.
Geo-R4 (30-40 inches; 76-102 cm)	y - negl	N/A	New Zealand.
Geo-R5 (40-50 inches; 102-127 cm)	y - negl	N/A	New Zealand and the United Kingdom.
Geo-R6 (50-60 inches; 127-152 cm)	y - negl	N/A	Australia (Tasmania), New Zealand, and the United Kingdom.
Geo-R7 (60-70 inches; 152-178 cm)	y - negl	N/A	Australia (Tasmania), New Zealand.
Geo-R8 (70-80 inches; 178-203 cm)	y - low	N/A	One point in the United Kingdom
Geo-R9 (80-90 inches; 203-229 cm)	y - negl	N/A	New Zealand.
Geo-R10 (90-100 inches; 229-254 cm)	y - negl	N/A	New Zealand.
Geo-R11 (100+ inches; 254+ cm))	y - negl	N/A	New Zealand.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	n - negl	0	*Austroderia richardii* is present in the United States, where it is cultivated at the University of Washington Botanic Garden (Reyes, 2013) and sold by two nurseries (Anonymous, 2013a, 2014a). However, because we estimate it is rare in the United States, we proceeded with this analysis as though it were not present.
Ent-2 (Plant proposed for entry, or entry is imminent)	n -	0	
Ent-3 (Human value & cultivation/trade status)	d - negl	0.5	This species is cultivated (RHS, 2014) and has been documented to escape from cultivation (Randall, 2007). The Royal Horticultural Society bestowed its Award of Garden Merit to *A. richardii* in 2002 (Meyer, 2011; RHS, 2014). It was introduced to Tasmania as an ornamental, and for windbreaks and soil stabilization (Anonymous, 2011).
Ent-4 (Entry as a contaminant)			
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	y - negl		This species is cultivated at the University of British Columbia Botanical Garden in a perennial border (GBIF, 2013). However, we found no other evidence of its presence in Canada, or in any of the other countries.
Ent-4b (Contaminant of plant propagative material (except seeds))	n - mod	0	We found no evidence.
Ent-4c (Contaminant of seeds for planting)	n - mod	0	We found no evidence.
Ent-4d (Contaminant of ballast water)	n - high	0	We found no evidence but we note that this species occurs in riparian and coastal habitats (GBIF, 2013; Landcare Research, 2014; Linder et al., 2010; Parsons and Cuthbertson, 2001); thus, it is possible that seeds may be taken up in ballast water.
Ent-4e (Contaminant of	n - mod	0	We found no evidence.

Question ID	Answer - Uncertainty	Score	Notes (and references)
aquarium plants or other aquarium products)			
Ent-4f (Contaminant of landscape products)	n - high	0	We found no evidence.
Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances)	n - mod	0	We found no evidence.
Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing)	? - max	0	We found no species evidence for *A. richardii*. However, because the seeds of *C. selloana* cling to kiwi fruit destined for export (Knowles and Tombleson, 1987 cited in ISSG, 2013) and because the inflorescences of both species are similar (plumose, silky, and hairy; Landcare Research, 2014), seeds of *A. richardii* may also stick to kiwi fruit and other articles. Consequently, we answered unknown.
Ent-4i (Contaminant of some other pathway)	c - low	0.04	Like its relative *C. selloana* (Lambrinos, 2001), inflorescences of *A. richardii* are used in dried floral arrangements (Anonymous, 2014b). Dried plumes of pampas grass (exact species is unknown) are available for sale on the internet (e.g., Anonymous, 2013b). Because *A. richardii* is also known as New Zealand pampas grass (Richardson et al., 2006), its flowers and associated seeds are likely to move in trade.
Ent-5 (Likely to enter through natural dispersal)	y - high	0.6	This species is wind-dispersed (Parsons and Cuthbertson, 2001). The botanical garden where it is grown in British Colombia is relatively close to the U.S. border (GBIF, 2013). "The seed-bearing florets of the female plant [of *C. selloana*] are particularly hairy and readily dispersed by wind, often being carried for up to 25 km" (Parsons and Cuthbertson, 2001). Because the inflorescences of both species are similar (plumose, silky, and hairy; Landcare Research, 2014), we believe *A. richardii* is just as likely to enter naturally through wind dispersal