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Animal and Plant
Health Inspection
Service

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Version 1

Weed Risk Assessment for *Echinodorus uruguayensis* Arechav. (Alismataceae) – Uruguay sword plant

Habit of *E. uruguayensis* in an aquarium (source: http://www.aquariumfish.co.za/pisces/plant_detail.php?details=10).

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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.

***Echinodorus uruguayensis* Arechav. – Uruguay sword plant**

Species Family: Alismataceae

Synonyms: This species has several synonyms: *E. africanus* Rataj, *E. aschersonianus* Graebn., *E. barthii* H. Mühlberg, *E. grandiflorus* var. *pusillus* Micheli, *E. horemanii* Rataj, *E. janii* Rataj, *E. martii* var. *uruguayensis* (Arechav.) Hauman, *E. multiflorus* Rataj, *E. opacus* Rataj, *E. osiris* Rataj, *E. portoalegrensis* Rataj, *E. uruguayensis* var. *minor* Kasselm., *E. veronikae* Rataj, and *E. viridis* Rataj [The Plant List, 2013]. The synonyms appearing most frequently in the literature are *E. osiris*, *E. horemanii*, and *E. aschersonianus*. All of the names authored by Rataj are considered dubious as they were based on sterile cultivated material (Haynes and Holm-Nielsen, 1994). Also, Rataj divided the taxon into three species (*E. uruguayensis*, *E. osiris*, and *E. horemanii*), but a later researcher found that this division could not be supported (Lehtonen, 2008).

Information Initiation: PPQ received a market access request for aquatic plants of *Echinodorus uruguayensis* for propagation from the Ministry of Food, Agriculture and Fisheries, The Danish Plant Directorate (MFAF, 2009). Because this species is not native to the United States (NGRP, 2013) and may pose a phytosanitary risk, the PERAL Weed Team initiated this assessment.

Foreign distribution: Native to northern Argentina, southern Brazil and Paraguay, eastern Chile, and Uruguay (Haynes and Holm-Nielsen, 1994; Lehtonen, 2008; NGRP, 2013). Cultivated in Australia (Randall, 2007), Germany (Haynes and Holm-Nielsen, 1994), China (Li et al., 2011), Denmark (MFAF, 2009), and the United Kingdom (Thomas, 2010). Plant is cultivated and sold under various common names. Additionally, other cultivars are sold as '*E. horemanii,*' '*E. osiris,*' '*E. barthii,*' '*E. janii,*' '*E. africanus,*' '*E. veronikae,*' '*E. pellucidus,*' '*E. opacus,*' and '*E. portoalegrensis*' (Haynes and Holm-Nielsen, 1994).

U.S. distribution and status: This species is cultivated in the United States under a variety of different names, including *E. osiris* (Anonymous, 2013c; APC, 2003; Martin and Coetzee, 2011; SanMarcosGrowers, 2013). We found no evidence that *E. uruguayensis* is established outside of cultivation in the United States.

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

1. *Echinodorus uruguayensis* analysis

Establishment/Spread Potential Despite its dissemination by the aquarium industry, we found no evidence that *E. uruguayensis* has escaped from cultivation. This species reproduces through rhizomes, seeds, and adventitious shoots that develop on inflorescences (Haynes and Holm-Nielsen, 1994; Quester, 2013). We found no evidence that it is dispersed by any of the five natural dispersal vectors we consider, but we think it is probably dispersed by water, since it occurs in streams and rivers (Lehtonen, 2008; Rataj, 1970). The strongest evidence for establishment/spread potential is that it forms dense populations in its native range (MBG, 2013; Rataj, 1970), suggesting it suffers relatively little from intraspecific competition. Overall, this species obtained a low risk score, but we had very high uncertainty due to the lack of ecological studies for this species. We were unable to answer nine questions relating to reproduction, dispersal, and tolerance in this risk element.
Risk score = 1 Uncertainty index = 0.37

Impact Potential We found no evidence of impacts caused by *E. uruguayensis*. This is not surprising given the limited information available on this species and that it has apparently not escaped outside of its native range. Uncertainty was high for this risk element.
Risk score = 1 Uncertainty index = 0.25

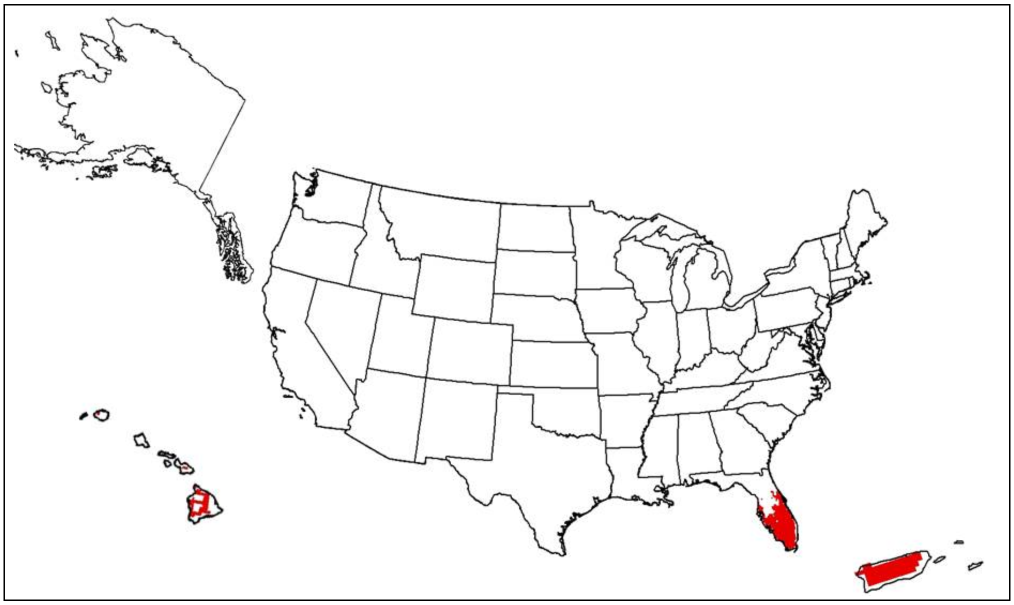
Geographic Potential Based on three climatic variables, we estimate that about one percent of the United States is suitable for the establishment of *E. uruguayensis* (Fig. 1). This predicted distribution is based on the species' known distribution elsewhere in the world and includes point-referenced localities and areas of occurrence. The map for *E. uruguayensis* represents the joint distribution of Plant Hardiness Zones 10-12, areas with 30-80 inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savanna, humid subtropical, and marine west coast.

The area estimated likely represents a conservative estimate as it uses three climatic variables to estimate the area of the United States that is suitable for establishment of the species. Other environmental variables, such as soil and habitat type, may further limit the areas in which this species is likely to establish. *Echinodorus uruguayensis* is a tropical aquatic species that grows in small, clear water rivers, rapids, and other bodies with flowing water (Lehtonen, 2008; Rataj, 1970). Information from an aquarium community website suggests that this species may do better in environments with relatively high CO_2 concentrations (APC, 2003).

[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).

Entry Potential We did not assess *E. uruguayensis'* entry potential because this species is already present in the United States, where it is cultivated by the aquarium industry (Anonymous, 2013c; APC, 2003; Martin and Coetzee, 2011; SanMarcosGrowers, 2013).

Figure 1. Predicted distribution of *E. uruguayensis* 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) = 3.6%
P(Minor Invader) = 51.4%
P(Non-Invader) = 45.0%

Risk Result = Low Risk
Secondary Screening = Not Applicable

Figure 2. *Echinodorus uruguayensis* 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.

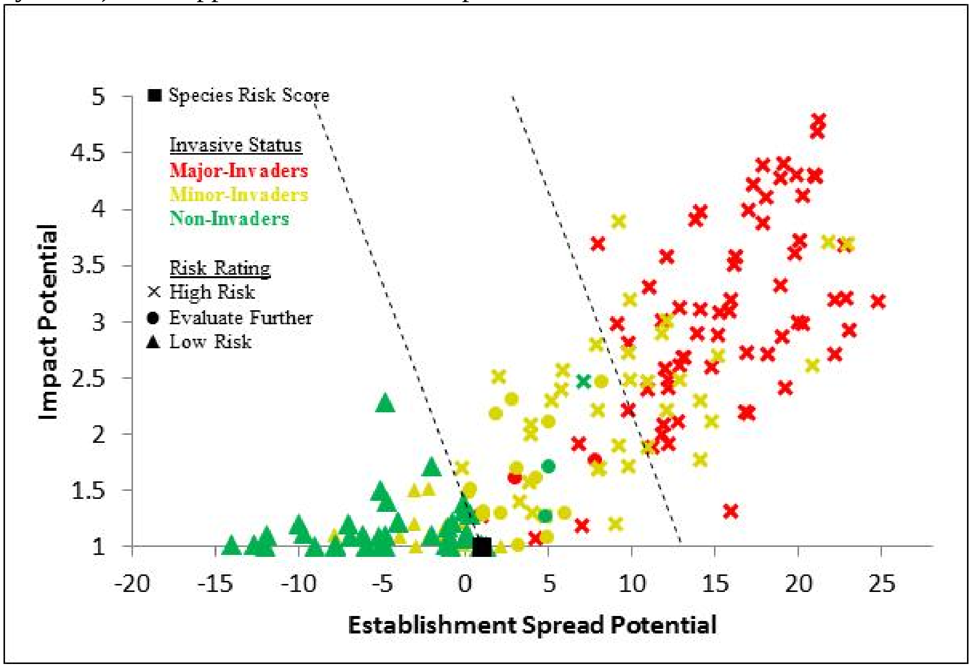
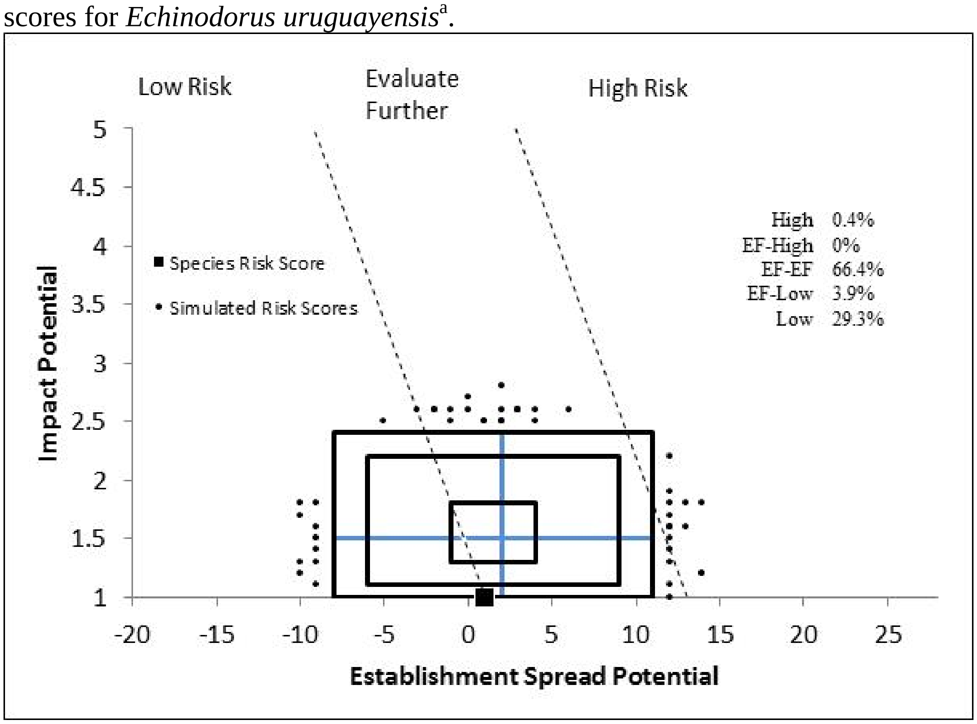


Figure 3. Monte Carlo simulation results (N=5,000) for uncertainty around the risk scores for *Echinodorus uruguayensis*[a].



[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 *E. uruguayensis* is Low Risk (Fig. 2). One more positive point in either risk element would have resulted in a determination of Evaluate Further. Based on the available evidence, our predictive model indicates *E. uruguayensis* has a 45 percent probability of being a non-invader and a 51 percent probability of being a minor-invader. Because of the high level of uncertainty associated with this assessment, the simulated risk scores were highly variable (Fig. 3). About 66 percent of the simulated scores resulted in outcomes of Evaluate Further. Two other weed risk assessments of *E. uruguayensis* have resulted in conclusions similar to those obtained here. An evaluation with the Australian WRA modified for the United States resulted in a conclusion of Evaluate Further; however, this model results in many false positives for aquatic species (Gordon and Gantz, 2011). A second evaluation with the New Zealand Aquatic WRA, which was modified for the United States and is more accurate, gave a result of Low Risk (Gordon et al., 2012).

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Appendix A. Weed risk assessment for *Echinodorus uruguayensis* Arechav. (Alismataceae). The following information was obtained from the species' risk assessment, which was conducted using Microsoft Excel. The information shown in this appendix was modified to fit on the page. The original Excel file, the full questions, and the guidance to answer the questions are available upon request.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ESTABLISHMENT/SPREAD POTENTIAL			
ES-1 (Status/invasiveness outside its native range)	b - low	-2	Native to Argentina, southern Brazil, Uruguay and westward to eastern Chile (Haynes and Holm-Nielsen, 1994; NGRP, 2013). Cultivated in China (Li et al., 2011), Germany (Haynes and Holm-Nielsen, 1994), Australia (Randall, 2007), and the United Kingdom (Thomas, 2010). Introduced to and cultivated in the United States (Anonymous, 2013c; APC, 2003; Martin and Coetzee, 2011), with no evidence of escape. One study reports it was introduced into the United States as early as 1950 (Gordon and Gantz, 2011). Without specific evidence that it has been cultivated outside its native range earlier than 1950, we are answering "b." The alternate answers for the Monte Carlo simulation are both "a."
ES-2 (Is the species highly domesticated)	n - low	0	Plant is cultivated and sold under the following names: "Rote-Amazonaspflanzea" and "Horemans Amazonaspflanze" ("Red-Amazon plant" and "Horeman's Amazon plant," transl.). Additionally, other cultivars are sold as '*E. horemanii,*' '*E. osiris,*' '*E. barthii,*' '*E. janii,*' '*E. africanus,*' '*E. veronikae,*' '*E. pellucidus,*' '*E. opacus,*' and '*E. portoalegrensis*' (Haynes and Holm-Nielsen, 1994; Rataj, 1970). However, there is no evidence of breeding for reduced weed potential.
ES-3 (Weedy congeners)	y - high	1	There are about 30 species in this genus, all native to the western hemisphere (Mabberley, 2008). Some references list *E. berteroi* and *E. grandiflorus* as weeds (Randall, 2012). *Echinodorus berteroi* is considered a major weed in California rice (IRRI/IWSS, 1983; Smith and Shaw, 1966). Several southeast Asia countries consider *E. ridleyi* a weed of rice (Moody, 1989). Because we failed to identify specific evidence of why these species are weeds, answering with "high" uncertainty.
ES-4 (Shade tolerant at some stage of its life cycle)	? - max		Unknown. Some aquarium websites report that the plant requires medium to bright light for good growth (Anonymous, 2013b, 2013c). However, other sites state that it will grow in shade (Anonymous, 2013a; SanMarcosGrowers, 2013).
ES-5 (Climbing or smothering growth form)	n - negl	0	This plant is not a vine. It is a primarily submerged herbaceous aquatic perennial to about 85 cm tall (Haynes and Holm-Nielsen, 1994).
ES-6 (Forms dense thickets)	y - low	2	Collection notes on an herbarium record states it forms fairly dense populations where it occurs in Bolivia (MBG, 2013). The species' description for *E. osiris* (a synonym of *E. uruguayensis*) says it forms colonies of hundreds of individuals (Rataj, 1970).
ES-7 (Aquatic)	y - negl	1	An aquatic plant with leaves either floating or submersed (Haynes and Holm-Nielsen, 1994). The genus *Echinodorus* is composed of aquatic plants that grow emersed in water (Acevedo-Rodriguez and Strong, 2005). The genus is composed of aquatic and semi-aquatic plants (Lehtonen, 2008).

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-8 (Grass)	n - negl	0	Species not a grass; species in the Alismataceae family (Haynes and Holm-Nielsen, 1994).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	Species is in the Alismataceae family (Haynes and Holm-Nielsen, 1994), which is not a family known to contain nitrogen-fixing species (Martin and Dowd, 1990).
ES-10 (Does it produce viable seeds or spores)	y - high	1	Seeds are described from a flora treatment, but viability is not mentioned (Haynes and Holm-Nielsen, 1994). An aquarist said that *E. aschersonianus* (synonym of *E. uruguayensis*) can produce viable seeds (Quester, 2013).
ES-11 (Self-compatible or apomictic)	? - max	0	Unknown. *Echinodorus* produces bisexual flowers (Acevedo-Rodriguez and Strong, 2005).
ES-12 (Requires special pollinators)	? - max		Unknown.
ES-13 (Minimum generation time)	c - high	0	Plant is an herbaceous perennial from short rhizomes (Haynes and Holm-Nielsen, 1994; Lehtonen, 2008). Nothing is known about its reproductive biology in the wild, other than that it also reproduces vegetatively through rhizome production and plantlets that develop on inflorescences (Haynes and Holm-Nielsen, 1994; Quester, 2013). It is highly unlikely that this species takes more than 3 years for a generation, particularly when it can reproduce vegetatively. Consequently answering "c" for 2-3 years, with "high" uncertainty. Alternate answers for the Monte Carlo simulation are "b" and "a."
ES-14 (Prolific reproduction)	? - max	0	Unknown.
ES-15 (Propagules likely to be dispersed unintentionally by people)	? - max	0	Unknown.
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	n - mod	-1	No evidence. It does not seem likely that seeds or vegetative propagules of this aquatic plant would disperse in trade as a contaminant.
ES-17 (Number of natural dispersal vectors)	1	-2	For ES17a-ES17e: The genus *Echinodorus* produces fruit which are terete achenes (Acevedo-Rodriguez and Strong, 2005). *Echinodorus uruguayensis*: "Fruit linear-obovate, 2-3-ribbed, cylindric, without keel, glandular, separating when mature, 1.5-2 mm long, 0.5-0.7 mm wide, the glands 2, linear to linearelliptic, between the ribs, the beak lateral, erect, 0.1-0.7 mm long" (Haynes and Holm-Nielsen, 1994)
ES-17a (Wind dispersal)	n - mod		Fruit is an achene with no obvious adaptations for wind dispersal (Acevedo-Rodriguez and Strong, 2005; Haynes and Holm-Nielsen, 1994).
ES-17b (Water dispersal)	y - mod		Although there is no direct evidence of water dispersal, because this is an aquatic species living in rivers and streams with potentially fast-moving water (Lehtonen, 2008; Rataj, 1970), it is highly likely seeds and vegetative fragments are dispersed by water.
ES-17c (Bird dispersal)	? - max		Unknown.
ES-17d (Animal external dispersal)	n - mod		No evidence. Fruit is an achene with no obvious adaptations for attachment to animals (Acevedo-Rodriguez and Strong, 2005; Haynes and Holm-Nielsen, 1994).
ES-17e (Animal internal dispersal)	? - max		Unknown.
ES-18 (Evidence that a	? - max	0	Unknown.

Question ID	Answer - Uncertainty	Score	Notes (and references)
persistent (>1yr) propagule bank (seed bank) is formed)			
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	? - max	0	Unknown.
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - mod	0	No evidence. Neither this species nor its genus are listed as one of the few hundred taxa documented to be herbicide resistant (Heap, 2013).
ES-21 (Number of cold hardiness zones suitable for its survival)	3	-1	
ES-22 (Number of climate types suitable for its survival)	4	2	
ES-23 (Number of precipitation bands suitable for its survival)	5	0	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - negl	0	No evidence, and highly unlikely for an aquatic species that lives in rivers and streams.
Imp-G2 (Parasitic)	n - negl	0	Species is in the Alismataceae family (Haynes and Holm-Nielsen, 1994), which is not in a family 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)	n - high	0	No evidence. There is no evidence of impact for any of the impact questions across all three subsystems. Because there is no biological information available on this species from its native range, and because this species has no history elsewhere, other than being grown in aquaria, using "high" uncertainty for most questions in this sub-element.
Imp-N2 (Change community structure)	n - high	0	No evidence (see Imp-N1 for reasoning for uncertainty level).
Imp-N3 (Change community composition)	n - high	0	No evidence (see Imp-N1 for reasoning for uncertainty level).
Imp-N4 (Is it likely to affect federal Threatened and Endangered species)	n - high	0	No evidence (see Imp-N1 for reasoning for uncertainty level).
Imp-N5 (Is it likely to affect any globally outstanding ecoregions)	n - high	0	No evidence (see Imp-N1 for reasoning for uncertainty level).
Imp-N6 (Weed status in natural systems)	a - mod	0	No strong evidence it is considered a weed. In a weed risk assessment (Thomas, 2010), it was categorized as a natural areas weed in the United Kingdom, but supporting information is not provided; furthermore, under naturalized status, the authors answered unknown. Consequently, given this questionable evidence, answering "a" but with "mod" uncertainty. Alternate choices for the Monte Carlo simulation are both "b."
Impact to Anthropogenic Systems (cities, suburbs, roadways)			
Imp-A1 (Impacts human property, processes,	n - high	0	No evidence. There is no evidence of impact for any of the impact questions across all three subsystems. Because there is

Question ID	Answer - Uncertainty	Score	Notes (and references)
civilization, or safety)			no biological information available on this species from its native range, and because this species has no history elsewhere, other than being grown in aquaria, using "high" uncertainty for most questions in this sub-element.
Imp-A2 (Changes or limits recreational use of an area)	n - high	0	No evidence (see Imp-A1 for reasoning for uncertainty level).
Imp-A3 (Outcompetes, replaces, or otherwise affects desirable plants and vegetation)	n - high	0	No evidence (see Imp-A1 for reasoning for uncertainty level).
Imp-A4 (Weed status in anthropogenic systems)	a - low	0	No evidence. This species is widely cultivated by the aquarium industry. Alternate choices for the Monte Carlo simulation are both "b."
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	n - mod	0	No evidence. Despite the little information available on this species, it seems unlikely to affect crop yield.
Imp-P2 (Lowers commodity value)	n - mod	0	No evidence. Despite the little information available on this species, it seems unlikely to affect crop yield.
Imp-P3 (Is it likely to impact trade)	n - mod	0	No evidence. The species is regulated under the name of *E. osiris* in South Africa by the Department of Agriculture under the Agricultural Pests Act (Martin and Coetzee, 2011); however, this legislation relates to arthropod and pathogen pests and not weeds per se.
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	n - high	0	*Echinodorus andrieuxii* is a congeneric weed occurring in rice irrigation channels (Rojas and Agüero, 1996). *Echinodorus uruguayensis* could potentially also be a weed of irrigation channels, but because its niche appears to be fast-moving streams and rivers (Lehtonen, 2008; Rataj, 1970), it seems unlikely that it would be a weed of irrigation channels, which typically don't have any significant water currents.
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	n - mod	0	No evidence.
Imp-P6 (Weed status in production systems)	a - low	0	No evidence of weed potential in production systems. Alternate choices for the Monte Carlo simulation are both "b."
GEOGRAPHIC POTENTIAL			Unless otherwise stated, all evidence cited below is based on point, geo-referenced occurrences from GBIF (2013).
Plant cold hardiness zones			
Geo-Z1 (Zone 1)	n - negl	N/A	No evidence.
Geo-Z2 (Zone 2)	n - negl	N/A	No evidence.
Geo-Z3 (Zone 3)	n - negl	N/A	No evidence.
Geo-Z4 (Zone 4)	n - negl	N/A	No evidence.
Geo-Z5 (Zone 5)	n - negl	N/A	No evidence.
Geo-Z6 (Zone 6)	n - negl	N/A	No evidence.
Geo-Z7 (Zone 7)	n - negl	N/A	No evidence.
Geo-Z8 (Zone 8)	n - negl	N/A	No evidence.
Geo-Z9 (Zone 9)	n - high	N/A	No evidence.
Geo-Z10 (Zone 10)	y - negl	N/A	Argentina and Uruguay (GBIF, 2013; Haynes and Holm-Nielsen, 1994).
Geo-Z11 (Zone 11)	y - negl	N/A	Argentina and Bolivia.
Geo-Z12 (Zone 12)	y - high	N/A	One point in Brazil.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-Z13 (Zone 13)	n - high	N/A	No evidence.
Köppen-Geiger climate classes			
Geo-C1 (Tropical rainforest)	y - high	N/A	One point in Bolivia.
Geo-C2 (Tropical savanna)	y - negl	N/A	Bolivia and Brazil.
Geo-C3 (Steppe)	n - low	N/A	No evidence.
Geo-C4 (Desert)	n - low	N/A	No evidence.
Geo-C5 (Mediterranean)	n - low	N/A	No evidence.
Geo-C6 (Humid subtropical)	y - negl	N/A	Argentina, Brazil, and Uruguay (GBIF, 2013; Haynes and Holm-Nielsen, 1994).
Geo-C7 (Marine west coast)	y - high	N/A	Regional occurrence in Brazil (Haynes and Holm-Nielsen, 1994).
Geo-C8 (Humid cont. warm sum.)	n - negl	N/A	No evidence.
Geo-C9 (Humid cont. cool sum.)	n - negl	N/A	No evidence.
Geo-C10 (Subarctic)	n - negl	N/A	No evidence.
Geo-C11 (Tundra)	n - negl	N/A	No evidence.
Geo-C12 (Icecap)	n - negl	N/A	No evidence.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	n - negl	N/A	No evidence.
Geo-R2 (10-20 inches; 25-51 cm)	n - negl	N/A	No evidence.
Geo-R3 (20-30 inches; 51-76 cm)	n - high	N/A	No evidence.
Geo-R4 (30-40 inches; 76-102 cm)	y - mod	N/A	One point in Bolivia.
Geo-R5 (40-50 inches; 102-127 cm)	y - low	N/A	Two points in Bolivia.
Geo-R6 (50-60 inches; 127-152 cm)	y - low	N/A	One point in Brazil.
Geo-R7 (60-70 inches; 152-178 cm)	y - negl	N/A	Argentina.
Geo-R8 (70-80 inches; 178-203 cm)	y - low	N/A	Brazil.
Geo-R9 (80-90 inches; 203-229 cm)	n - high	N/A	No evidence.
Geo-R10 (90-100 inches; 229-254 cm)	n - negl	N/A	No evidence.
Geo-R11 (100+ inches; 254+ cm))	n - negl	N/A	No evidence.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	y - negl	1	Species is cultivated in aquaria in the United States under a variety of different names (Anonymous, 2013c; APC, 2003; Martin and Coetzee, 2011; SanMarcosGrowers, 2013).
Ent-2 (Plant proposed for entry, or entry is imminent)	-	N/A	Proposed for import into the United States from Denmark (MFAF, 2009).
Ent-3 (Human value & cultivation/trade status)	-	N/A	
Ent-4 (Entry as a			

Question ID	**Answer - Uncertainty**	**Score**	**Notes (and references)**
contaminant)			
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	-	N/A	
Ent-4b (Contaminant of plant propagative material (except seeds))	-	N/A	
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	