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Weed Risk Assessment for *Bacopa australis* V.C. Souza (Scrophulariaceae)

Bacopa australis in an aquarium. (source: TROPICA, 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.

Bacopa australis **V.C. Souza**

Species Information

Family: Scrophulariaceae

Synonyms: None.

Initiation: PPQ received a market access request for aquatic plants of *Bacopa australis* 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 (Souza, 2001) and may pose a phytosanitary risk, the PERAL Weed Team initiated this assessment.

Foreign distribution: This species was described as a new species in 2001 (Souza, 2001). It is native to Argentina and southern Brazil (Souza, 2001), but may occur in other South American countries. It has been introduced for cultivation in Singapore (Anonymous, 2013b), Denmark (TROPICA, 2013), the United Kingdom (Anonymous, 2013c), and likely elsewhere.

U.S. distribution and status: This species has been introduced into the United States for aquarium cultivation (Anonymous, 2008, 2013d). It is not widely available commercially, but it can be obtained from hobbyists in the United States (APC, 2003). We found no evidence that this species has escaped or become naturalized in the United States.

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

[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).

1. *Bacopa australis* analysis

Establishment/Spread Potential Because *B. australis* was first described in 2001 (Souza, 2001), we know very little about its biology. Like other *Bacopa* species it is an herbaceous aquatic plant that roots along stem nodes and can live either submersed in water or along the edge of aquatic bodies (Souza, 2001). Based on information from aquarium websites and information about other *Bacopa* species, *B. australis* is likely to be shade tolerant, have an annual life cycle, produce viable seed, possess a long-term seed bank, and tolerate mutilation (Anonymous, 2009; APC, 2003; Barrett and Strother, 1978; Wetzel et al., 2001). We found no evidence that it has escaped from cultivation but that does not conclusively indicate low invasive potential, because this species was only recently introduced into the aquarium trade (Anonymous, 2009). Our uncertainty was very high for this risk element due to lack of information.
Risk score = 5 Uncertainty index = 0.46

Impact Potential We found no evidence that *B. australis* causes any specific kind of impact. Without a long history of introduction and cultivation, it is difficult to determine if this is an artifact of its recent discovery or if this reflects the true biotic potential of the species. A few species of *Bacopa* are considered weeds, including some weeds of rice (Acuña Galé, 1974; Kent et al., 2001; Moody, 1989), but we found no information about how those species affect rice or to what degree. *Bacopa caroliniana, B. lanigeri, and B. monnieri* are considered weeds of the natural environment in Australia (Anonymous, 2012; Hussey et al., 2007; Randall, 2007). Because this species was recently described and lacks any history in cultivation, we had very high uncertainty for this risk element.
Risk score = 1.0 Uncertainty index = 0.71

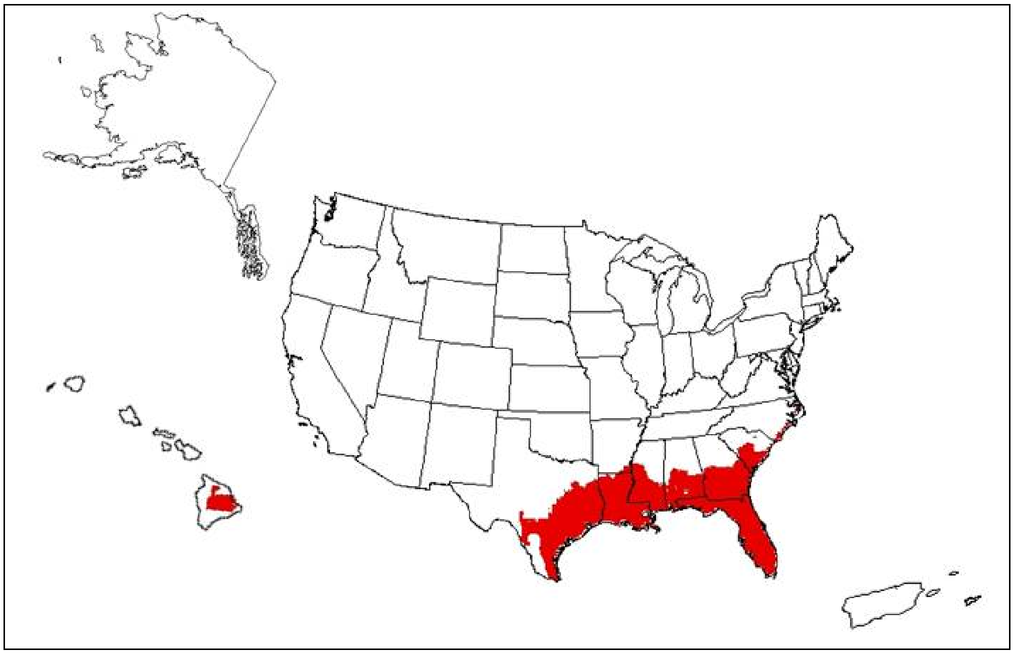
Geographic Potential Based on three climatic variables, we estimate that about 8 percent of the United States is suitable for the establishment of *B. australis* (Fig. 1). This predicted distribution is based on the species' known distribution elsewhere in the world and includes point-referenced localities and reported areas of occurrence. The map for *B. australis* represents the joint distribution of Plant Hardiness Zones 9-11, areas with 20-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savanna, and humid subtropical.

Our assessment of this species' geographic potential was very uncertain due to limited information on its distribution. Our assessment was based on only three point-referenced occurrences in GBIF (2013) and a general distribution from southern Brazil to northern Argentina (Souza, 2001). Based on this regional distribution, we assumed it could occur in tropical rainforests, Plant Hardiness Zone 9, and precipitation bands of 40-50 and 60-100+ inches.

As an aquatic plant, *B. australis* would be restricted to lakes, ponds, floodplains (Souza and Giulietti, 2009), wetlands, and other similar habitats. However, because aquatic habitats tend to insulate plants from excessive cold temperatures, we believe this species may be able to survive outside the region shown on the map (e.g., the entire southern United States and portions of the western coast). We also expect that it could establish in Puerto Rico and on other tropical islands. Puerto Rico was not classified as suitable for establishment in our analysis because we did not find any evidence that this species occurs in Plant Hardiness Zones 12 and 13.

Entry Potential We did not assess the entry potential of *B. australis* because it is already present in the United States (Anonymous, 2008, 2013d).

Figure 1. Predicted distribution of *Bacopa australis* 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) = 8.7%
P(Minor Invader) = 67.2%
P(Non-Invader) = 24.2%

Risk Result = Evaluate Further
Secondary Screening = Evaluate Further

Figure 2. *Bacopa australis* 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.

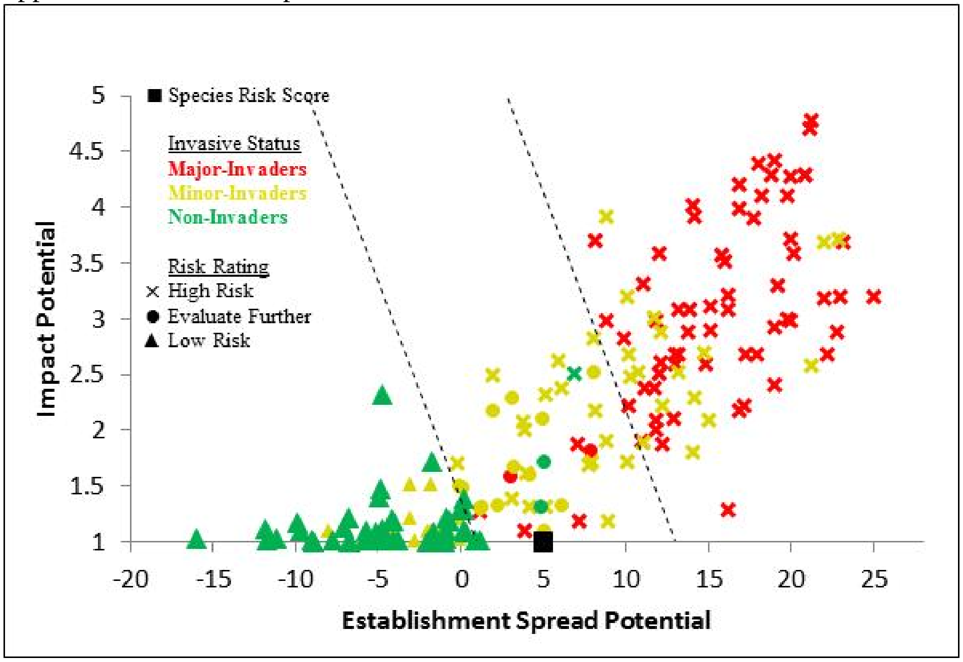
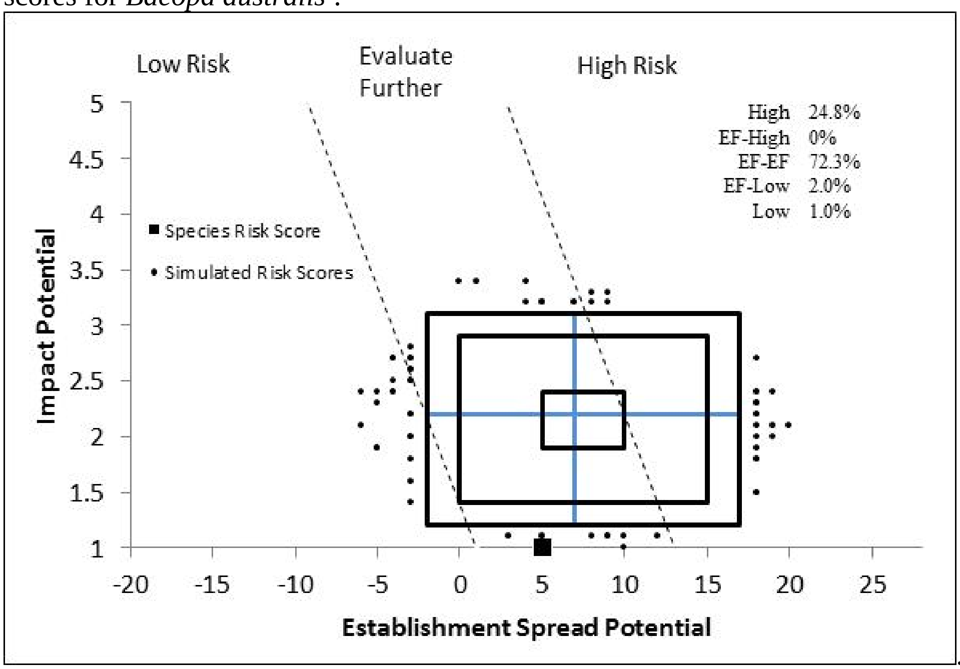


Figure 3. Monte Carlo simulation results (N=5,000) for uncertainty around the risk scores for *Bacopa australis*[a].



[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 *B. australis* is Evaluate Further, even after secondary screening (Fig. 2). Very high uncertainty is reflected by not only the size of the boxes in Fig. 3, but also by the location of the observed risk score outside of the 99th percentile box of simulated risk scores. It is noteworthy that the distribution of simulated risk scores encompasses both the low and high risk regions of our risk space (Fig. 3). Uncertainty was very high because there is very little known about the biology of this species. Furthermore, because this species was described only a few years ago (Souza, 2001), we have little confidence about the history of the species elsewhere. We answered 19 of 46 questions used in our predictive model (i.e., questions in Establishment/Spread and Impact Potential risk elements) as unknown, and many of the others we answered with high uncertainty. Where we answered questions with evidence supporting invasiveness, most answers and justification were based on congeneric information.

A survey done in the native range of *B. australis* found that it occurs much less than other local aquatic plants (dos Santos and de Barros Costacurta, 2011). This suggests that in its native range it is limited by herbivores or disease, or that it does not have an intrinsically high population growth rate. *Bacopa australis* was first introduced to the aquatic plant hobby trade in 2000, and it readily grows in a wide range of aquarium conditions (Anonymous, 2009). Private growers report that it can grow very quickly under the right conditions (Anonymous, 2013a; APC, 2003). Currently, *B. australis* is not widely available commercially but its popularity is expected to increase (APC, 2003).

So far as we know, 56 species of *Bacopa* exist (Mabberley, 2008). Fourteen of these have been classified weedy by one or more sources (Randall, 2012). Yet none of these appear to be major invaders or weeds like other more widely known aquatic weeds such as *Eichhornia crassipes* or *Hydrilla verticillata* (CABI, 2013a, 2013b; Pieterse and Murphy, 1990). Several species of *Bacopa* are considered weeds of rice (Acuña Galé, 1974; Kent et al., 2001; Moody, 1989). In Nigeria, *B. crenata* is considered a serious weed (Holm et al., 1979). Except for one footnote in a general reference noting *Bacopa* species cause moderate yield or quality losses in rice (Smith, 1983), we did not find any information on how these weedy congeners affect rice or to what degree. A study of the weed flora of rice in California found that *B. rotundifolia* is a common weed (Barrett and Seaman, 1980). *Bacopa rotundifolia* and two other *Bacopa* species spread quickly through the California rice-growing region after they were introduced (Barrett and Seaman, 1980; Barrett and Strother, 1978); however, we found no reports of damage to rice crops, and certainly no recent reports. In conclusion, *Bacopa* species appear to have a moderate to high capacity to establish and spread, but they do not appear to behave like major aquatic weeds. Because of their low stature, they are probably readily outcompeted by other plants, including rice.

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Appendix A. Weed risk assessment for *Bacopa australis* V. C. Souza (Scrophulariaceae). 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)	b - high	-2	This species was described as a new species in 2001 (Souza, 2001); thus uncertainty will be higher for this and many other questions. It is native to southern Brazil and Argentina (Souza, 2001), but it may also occur in other South American countries. It has been introduced for cultivation in Singapore (Anonymous, 2013b), Denmark (TROPICA, 2013), the United Kingdom (Anonymous, 2013c), and likely elsewhere. Cultivated in the United States by hobbyists (Anonymous, 2008, 2013d; APC, 2003). We found no evidence this species has escaped or become naturalized in the United States or elsewhere. Alternate answers for the Monte Carlo simulation were both "d."
ES-2 (Is the species highly domesticated)	n - negl	0	No. This species was just described to science in 2001, and has been in the aquarium trade since 2000 (Anonymous, 2009).
ES-3 (Weedy congeners)	y - low	1	*Bacopa caroliniana*, *B. monnieri*, *B. procumbens*, and *B. rotundifolia* are considered weeds (Randall, 2012; Villasenor Rios and Espinosa Garcia, 1998). Several species are considered weeds of rice (Acuña Galé, 1974; Kent et al., 2001; Moody, 1989), but we did not find any information on how they affect rice or to what degree. *Bacopa monnieri* and *B. caroliniana* are considered weeds of the natural environment in Australia (Hussey et al., 2007; Randall, 2007). Also, *B. crenata* is considered a serious weed in Nigeria (Holm et al., 1979). *Bacopa* species cause moderate yield or quality losses in rice (Smith, 1983).
ES-4 (Shade tolerant at some stage of its life cycle)	y - high	1	Can grow under low light levels by aquarium standards (Anonymous, 2009; APC, 2003). It is not clear whether this species can grow under natural low light conditions.
ES-5 (Climbing or smothering growth form)	n - low	0	Plant is a scrambling, aquatic herb (Anonymous, 2009). It is neither a vine nor an herb with a basal rosette (Souza, 2001).
ES-6 (Forms dense thickets)	? - max	0	Unknown. *Bacopa australis* can form mats in aquaria (Anonymous, 2009), but we found no evidence it does this under natural conditions. The congeners *B. monnieri* and *B. lanigera* form dense mats in Australia (Anonymous, 2012; Hussey et al., 2007). However, without additional information, we answered no with high uncertainty.
ES-7 (Aquatic)	y - negl	1	A submersed aquatic plant (dos Santos and de Barros Costacurta, 2011; Oyedeji and Abowei, 2012) that grows near the border of aquatic bodies (Thomaz and Bini, 2003). This species is also considered amphibious (Moreira et al., 2011), suggesting it is capable of living on land during low water conditions.
ES-8 (Grass)	n - negl	0	Not a grass; this species is in the Scrophulariaceae (Souza, 2001).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	No evidence found. Scrophulariaceae is not one of the plant families known to contain nitrogen-fixing species (Martin and Dowd, 1990). Furthermore, this isn’t a woody species (Souza,

Question ID	Answer - Uncertainty	Score	Notes (and references)
			2001).
ES-10 (Does it produce viable seeds or spores)	y- high	0	This species produces flowers and fruit (Souza, 2001), but we found no information about seed viability or recruitment from seeds. Because *Bacopa eisenii*, *B. lanigera* and *B. rotundifolia* produce viable seeds (Anonymous, 2012; Barrett and Strother, 1978; Wetzel et al., 2001), we assumed that *B. australis* is able to as well.
ES-11 (Self-compatible or apomictic)	? - max	0	Unknown. Two other species of *Bacopa* that are weeds of rice in California (*B. repens*, and *B. rotundifolia*) are either self-compatible or apomictic (Barrett and Strother, 1978). Furthermore, *B. repens* and *B. rotundifolia* produce both chasmogamous and cleistogamous flowers, with the latter type being produced either under submersed conditions or under deep shade (Barrett and Seaman, 1980). Chasmogamous flowers are those that open to promote cross pollination. Cleistogamous flowers are flowers that don't open and are self-pollinated. Pollination experiments indicate that *B. eisenii* is self-compatible (Barrett and Strother, 1978). Because the botanical description for *B. australis* does not state it has cleistogamous flowers, we did not assume this species is self-compatible.
ES-12 (Requires special pollinators)	? - max		Honeybees pollinate *B. eisenii* in California, but rarely visit *B. rotundifolia* or *B. repens* (Barrett and Strother, 1978).
ES-13 (Minimum generation time)	b - mod	1	We found no direct information about generation time. However, because this is an herbaceous species that roots along stem nodes (Souza, 2001), with clear evidence that it can be propagated from cuttings (Anonymous, 2009), it is very likely that stem fragments could readily give rise to new plants in one year. Consequently answering "b" with moderate uncertainty. *Bacopa rotundifolia* and *B. repens* are annuals, while *B. eisenii* lives for longer than a year (Barrett and Strother, 1978). Alternate answers for the Monte Carlo simulation were "a" and "c."
ES-14 (Prolific reproduction)	? - max	0	Unknown.
ES-15 (Propagules likely to be dispersed unintentionally by people)	y - high	1	We found no evidence for this species but seems likely. Many aquatic plant species are unintentionally dispersed by people through recreational activities (e.g., fishing, boating, etc.). *Bacopa lanigera* is establishing in Australia due to dumping of aquarium waste (Anonymous, 2012).
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	? - max	0	Unknown. Some researchers argue that *B. repens* and *B. rotundifolia* were introduced to California rice cultivation as seed contaminants of rice (Barrett and Seaman, 1980; Barrett and Strother, 1978).
ES-17 (Number of natural dispersal vectors)	1	-2	Fruit and seed descriptions for ES17a-ES17e: Fruit a capsule, 3.5 mm long (Souza, 2001). *Bacopa* seeds are numerous, 0.1 to 0.3 mm long (Barrett and Strother, 1978).
ES-17a (Wind dispersal)	n - low		We found no evidence of adaptations facilitating wind dispersal (Souza, 2001), and it seems unlikely. Although *Bacopa* seeds are small (Barrett and Strother, 1978), these low-stature plants live in aquatic environments, and are unlikely to be dispersed by wind.
ES-17b (Water dispersal)	y - negl		Propagules of *Bacopa* are dispersed by water (Souza and Giulietti, 2009). Given that this is an aquatic plant, we used

Question ID	Answer - Uncertainty	Score	Notes (and references)
			negligible uncertainty.
ES-17c (Bird dispersal)	? - max		Unknown. Ducks feed on *Bacopa* spp. (Barrett and Seaman, 1980). The authors state that birds are an important dispersal vector for aquatic plants (Barrett and Seaman, 1980). *Bacopa monnieri* has a pantropical native distribution, including Hawaii (Starr et al., 2008; Wagner et al., 1999), which would most likely have involved bird dispersal. In another study, the authors found one duck with 1,015 seeds of *B. monnieri*, but none germinated (Powers et al., 1978).
ES-17d (Animal external dispersal)	? - max		Unknown. The seeds are small, and it is conceivable they may stick to wet fur on animals getting in and out of water bodies.
ES-17e (Animal internal dispersal)	? - max		Unknown.
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	y - high	1	*Bacopa monnieri* and *B. caroliniana* have persistent seed banks (Wetzel et al., 2001).
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	y - mod	1	The species is propagated by stem cuttings (Anonymous, 2009) and produces roots along stem nodes (Souza, 2001). It seems very likely it would be tolerant of mutilation and resprout from individual fragments. The congeners *B. monnieri* and *B. lanigera* are spreading rapidly from fragments in Australia (Anonymous, 2012; Hussey et al., 2007).
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	y - high	1	We found no evidence that *B. australis* is resistant to herbicides. However, its congener *B. rotundifolia* is (Heap, 2013). Because *B. rotundifolia* has hybridized with another *Bacopa* species, *B. einsii*, herbicide resistance may be transferred via hybridization. Consequently we answered yes but with high uncertainty.
ES-21 (Number of cold hardiness zones suitable for its survival)	3	-1	
ES-22 (Number of climate types suitable for its survival)	3	0	
ES-23 (Number of precipitation bands suitable for its survival)	8	1	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - low	0	We found no evidence it is allelopathic. Furthermore, it seems highly unlikely an aquatic plant would be allelopathic.
Imp-G2 (Parasitic)	n - negl	0	The Scrophulariaceae is a plant family known to contain parasitic plants (Heide-Jorgensen, 2008; Nickrent, 2009); however, we found no evidence this species is a parasitic plant. Given that this plant has become relatively well known in the aquarium industry, we used negligible uncertainty.
Impacts to Natural Systems			
Imp-N1 (Change ecosystem processes and parameters that affect other species)	? - max		Unknown. The congener *B. lanigera* has escaped in Australia and is beginning to form dense monospecific patches (Anonymous, 2012). Because *B. australis* is new to science and horticulture, it has not had a sufficiently long opportunity to escape, naturalize, and express any potential impacts. Consequently, we answered most questions in this section as unknown. However, we note that in its native range this species is not very common (dos Santos and de Barros Costacurta,

Question ID	Answer - Uncertainty	Score	Notes (and references)
			2011).
Imp-N2 (Change community structure)	? - max		No evidence found.
Imp-N3 (Change community composition)	? - max		No evidence found.
Imp-N4 (Is it likely to affect federal Threatened and Endangered species)	? - max		No evidence found.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions)	? - max		No evidence found.
Imp-N6 (Weed status in natural systems)	a - high	0	We found no evidence this species is considered a weed or managed in natural systems. *Bacopa monnieri* and *B. caroliniana* are considered weeds of the natural environment in Australia (Hussey et al., 2007; Randall, 2007). 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)	? - max		Unknown. Because *B. australis* is new to science and horticulture, it has not had a sufficiently long opportunity to escape, naturalize, and express any potential impacts. Because many aquatic weeds have these kinds of impacts, we answered most questions in this section as unknown (Pieterse and Murphy, 1990).
Imp-A2 (Changes or limits recreational use of an area)	? - max		Unknown.
Imp-A3 (Outcompetes, replaces, or otherwise affects desirable plants and vegetation)	? - max		Unknown.
Imp-A4 (Weed status in anthropogenic systems)	a - high	0	We found no evidence this species is considered a weed in anthropogenic areas. Because it is new to science, we used high using high uncertainty. 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)	? - max		We found no evidence for this species. A few species of *Bacopa* are considered weeds of rice, including *B. monnieri*, *B. repens*, and *B. rotundifolia* (Acuña Galé, 1974; Barrett and Seaman, 1980; Moody, 1989; Waterhouse, 1993). Because *Bacopa* species cause moderate yield or quality losses in rice (Smith, 1983), and because this species is relatively new to science, it may, if it escapes into rice cultivation, have similar impacts in rice. Consequently we answered this question as well as some other questions below as unknown.
Imp-P2 (Lowers commodity value)	? - max		We found no evidence for this species, so we answered unknown (see reasoning under Imp-P1).
Imp-P3 (Is it likely to impact trade)	n - high	0	Not likely. We found no evidence this species is regulated by another country (APHIS, 2013).
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	? - max		We found no evidence for this species, and answered as unknown. *Bacopa repens* occurs in rice irrigation canals in Costa Rica (Rojas and Agüero, 1996).
Imp-P5 (Toxic to animals, including livestock/range	n - mod	0	No evidence found. *Bacopa australis* is eaten by the Pampas deer (Reis Lacerda, 2008).

Question ID	Answer - Uncertainty	Score	Notes (and references)
animals and poultry)			
Imp-P6 (Weed status in production systems)	a - high	0	We found no evidence this species is considered a weed. However, other species of *Bacopa* are considered weeds of rice and are generally managed in rice cultivation (Acuña Galé, 1974; Barrett and Strother, 1978; Kent et al., 2001; Moody, 1989). We used high uncertainty because this species was recently described and because some of its congeners are considered agricultural weeds. The alternate answers for the Monte Carlo simulation are both "b."
GEOGRAPHIC POTENTIAL			Unless otherwise noted, all evidence below represents point-referenced occurrences obtained from GBIF (2013).
Plant cold hardiness zones			
Geo-Z1 (Zone 1)	n - negl	N/A	No evidence found.
Geo-Z2 (Zone 2)	n - negl	N/A	No evidence found.
Geo-Z3 (Zone 3)	n - negl	N/A	No evidence found.
Geo-Z4 (Zone 4)	n - negl	N/A	No evidence found.
Geo-Z5 (Zone 5)	n - negl	N/A	No evidence found.
Geo-Z6 (Zone 6)	n - negl	N/A	No evidence found.
Geo-Z7 (Zone 7)	n - negl	N/A	No evidence found.
Geo-Z8 (Zone 8)	n - negl	N/A	No evidence found. We used negligible uncertainty because Zone does not occur in the general region.
Geo-Z9 (Zone 9)	y - high	N/A	This species is native to southern Brazil and Argentina (Souza, 2001), which includes this climate zone.
Geo-Z10 (Zone 10)	y - negl	N/A	Argentina.
Geo-Z11 (Zone 11)	y - negl	N/A	Brazil
Geo-Z12 (Zone 12)	n - high	N/A	No evidence found.
Geo-Z13 (Zone 13)	n - high	N/A	No evidence found.
Köppen-Geiger climate classes			
Geo-C1 (Tropical rainforest)	y - high	N/A	This species is native to southern Brazil and Argentina (Souza, 2001). The region between the known occurrences of this species (GBIF, 2013) includes a tropical rainforest in Paraguay.
Geo-C2 (Tropical savanna)	y - negl	N/A	Brazil (GBIF, 2013). Occurs in climate Aw of Köppen-Geiger in Mato Grosso do Sul in Brazil (Moreira et al., 2011), which corresponds to this climate class.
Geo-C3 (Steppe)	n - mod	N/A	No evidence found. We used moderate uncertainty because it seems that aquatic habitats of steppe climates would be suitable.
Geo-C4 (Desert)	n - negl	N/A	No evidence found.
Geo-C5 (Mediterranean)	n - mod	N/A	No evidence found. We used moderate uncertainty because it seems that aquatic habitats of Mediterranean climates would be suitable.
Geo-C6 (Humid subtropical)	y - negl	N/A	Argentina.
Geo-C7 (Marine west coast)	n - mod	N/A	No evidence found. We used moderate uncertainty because it seems that aquatic habitats of marine west coast climates would be suitable.
Geo-C8 (Humid cont. warm sum.)	n - mod	N/A	No evidence found. We used moderate uncertainty because it seems that aquatic habitats of this climate type would be suitable.
Geo-C9 (Humid cont. cool sum.)	n - negl	N/A	No evidence found.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-C10 (Subarctic)	n - negl	N/A	No evidence found.
Geo-C11 (Tundra)	n - negl	N/A	No evidence found.
Geo-C12 (Icecap)	n - negl	N/A	No evidence found.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	n - negl	N/A	No evidence found.
Geo-R2 (10-20 inches; 25-51 cm)	n - mod	N/A	No evidence found.
Geo-R3 (20-30 inches; 51-76 cm)	y - mod	N/A	Brazil.
Geo-R4 (30-40 inches; 76-102 cm)	y - mod	N/A	Brazil.
Geo-R5 (40-50 inches; 102-127 cm)	y - negl	N/A	This species is native to southern Brazil and Argentina (Souza, 2001). This region includes this precipitation band.
Geo-R6 (50-60 inches; 127-152 cm)	y - negl	N/A	Argentina.
Geo-R7 (60-70 inches; 152-178 cm)	y - negl	N/A	This species is native to southern Brazil and Argentina (Souza, 2001). This region includes this precipitation band.
Geo-R8 (70-80 inches; 178-203 cm)	y - mod	N/A	This species is native to southern Brazil and Argentina (Souza, 2001). This region includes this precipitation band.
Geo-R9 (80-90 inches; 203-229 cm)	y - high	N/A	This species is native to southern Brazil and Argentina (Souza, 2001). This region includes this precipitation band.
Geo-R10 (90-100 inches; 229-254 cm)	y - high	N/A	We found no evidence this species grows in areas with this amount of precipitation, but there is no reason an aquatic plant wouldn't be able to grow in a high rainfall region.
Geo-R11 (100+ inches; 254+ cm))	y - high	N/A	We found no evidence this species grows in areas with this amount of precipitation, but there is no reason an aquatic plant wouldn't be able to grow in a high rainfall region.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	y - negl	1	Species is in the U.S. aquarium plant trade (Anonymous, 2008, 2013d).
Ent-2 (Plant proposed for entry, or entry is imminent)	-	N/A	
Ent-3 (Human value & cultivation/trade status)	-	N/A	
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 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	-	N/A	

Question ID	Answer - Uncertainty	Score	Notes (and references)
containers, packing materials, trade goods, equipment or conveyances)			
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	