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Version 1

Weed Risk Assessment for *Lilaeopsis mauritiana* G. Petersen & Affolter (Apiaceae) – Mauritius micro sword

Left: Lawn-like habit of *Lilaeopsis mauritiana* under high light in an aquarium. Right: Drawing of a clump without rhizomes. All photos obtained with permission (Nelson, 2017) from Tropica's (2017) website.

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1. 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 the PPQ weed risk assessment (WRA) process (PPQ, 2015) 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.

The PPQ WRA process includes three analytical components that together describe the risk profile of a plant species (risk potential, uncertainty, and geographic potential; PPQ, 2015). At the core of the process is the predictive risk model that evaluates the baseline invasive/weed potential of a plant species using information related to its ability to establish, spread, and cause harm in natural, anthropogenic, and production systems (Koop et al., 2012). Because the predictive model is geographically and climatically neutral, it can be used to evaluate the risk of any plant species for the entire United States or for any area within it. We then use a stochastic simulation to evaluate how much the uncertainty associated with the risk analysis affects the outcomes from the predictive model. The simulation essentially evaluates what other risk scores might result if any answers in the predictive model might change. Finally, we use Geographic Information System (GIS) overlays to evaluate those areas of the United States that may be suitable for the establishment of the species. For a detailed description of the PPQ WRA process, please refer to the *PPQ Weed Risk Assessment Guidelines* (PPQ, 2015), which is available upon request.

We emphasize that our WRA process is designed to estimate the baseline—or unmitigated—risk associated with a plant species. We use evidence from anywhere in the world and in any type of system (production, anthropogenic, or natural) for the assessment, which makes our process a very broad evaluation. This is appropriate for the types of actions considered by our agency (e.g., Federal regulation). Furthermore, risk assessment and risk management are distinctly different phases of pest risk analysis (e.g., IPPC, 2015). Although we may use evidence about existing or proposed control programs in the assessment, the ease or difficulty of control has no bearing on the risk potential for a species. That information could be considered during the risk management (decision-making) process, which is not addressed in this document.

2. Plant Information and Background

SPECIES: *Lilaeopsis mauritiana* G. Petersen & Affolter (Petersen and Affolter, 1999; The Plant List, 2017).

According to The Plant List, this is an unresolved name. Bone et al. (2011) examined ITS and chloroplast DNA sequences of 13 *Lilaeopsis* species and found that in all cladograms, *L. brasiliensis* and *L. mauritiana* were very closely allied. Although the fruit types of these two species are distinct, their molecular data suggest that the morphologically unique plants of Mauritius may actually be aberrant members of *L. brasiliensis* (Bone et al., 2011). For the purpose of this WRA, we treated *L. mauritiana* as a distinct species to be consistent with its current taxonomic status (Petersen and Affolter, 1999).

FAMILY: Apiaceae.

SYNONYMS: None.

COMMON NAMES: Micro sword (PAC, 2017), Mauritius micro sword (Anonymous, 2017).

BOTANICAL DESCRIPTION: *Lilaeopsis mauritiana* is an herbaceous, perennial herb with creeping rhizomes that are 0.5-1.2 mm in diameter (Petersen and Affolter, 1999; Windeløv, 2004). Leaves arise individually or in 2-4-leaved clusters directly from the rhizomes. Leaves are linear to subulate, hollow, and round to elliptical in cross section, and 2.8-13.0 cm long (Petersen and Affolter, 1999). Inflorescences are simple umbels borne on the axils along the horizontal rhizome. Umbels are 3-6-flowered. Fruit are globose to ellipsoid/obovoid schizocarps, 1.9-2.5 mm long by 1.7-2.0 mm wide. Fruit lack any spongy cells (Petersen and Affolter, 1999). The chromosome number is 2n = 22 (Petersen and Affolter, 1999). *Lilaeopsis mauritiana* was discovered in 1992 on Mauritius by the owner of Tropica, an aquatic plant nursery in Denmark (Windeløv, 2004). For a more detailed description and drawings of the species, see Petersen and Affolter (1999).

INITIATION: PPQ received a market access request for *L. mauritiana* for propagation from the Ministry of Food, Agriculture and Fisheries of the Danish Plant Directorate (MFAF, 2009). Because this species is not native to the United States (Petersen and Affolter, 1999), the PPQ Weeds Cross-Functional Working Group initiated this assessment to determine if *L. mauritiana* poses a significant pest risk to the United States.

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

FOREIGN DISTRIBUTION: *Lilaeopsis mauritiana* has only been collected from a single location, in a nature park in the southeast side of Mauritius (Petersen and Affolter, 1999). It may also be present on

[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).

Madagascar, but that identification is tentative since it is based on a 1920s specimen of a sterile plant (Bone et al., 2011; Raynal, 1977). *Lilaeopsis mauritiana* has been introduced to Denmark, where it is commercially propagated (Bone et al., 2011). It has also been introduced into Canada, where it is commonly sold at a volume of 276 sales across 20 retail stores in 2010 (Azan, 2011).

U.S. DISTRIBUTION AND STATUS: We found no evidence that *L. mauritiana* is naturalized in the United States (e.g., EDDMapS, 2017; Kartesz, 2017; NRCS, 2017; Weakley, 2015). This species is sold by online retailers in Arizona (PAC, 2017), California (AFA, 2017), and Florida (Aquarium Plants, 2017), as well as by sellers on eBay (2017). Because *L. mauritiana* was discovered on Mauritius in 1992 (Petersen and Affolter, 1999), it has not been in the U.S. trade for more than 25 years. We found no evidence that this species is regulated in the United States (e.g., NPB, 2016; USDA-AMS, 2016).

3. Analysis

ESTABLISHMENT/SPREAD POTENTIAL

We found no evidence that *L. mauritiana* has escaped or spread anywhere outside of cultivation. This is not surprising given that the species was only recently discovered (Windeløv, 2004) and described (Petersen and Affolter, 1999), and has had a limited opportunity to escape. Other than its botanical description (Petersen and Affolter, 1999) and what little information is available on aquarium forums, nothing is known about its biology. Our risk assessment is based primarily on information from congeners and the genus as a whole. *Lilaeopsis mauritiana* has some traits that may promote invasiveness outside of cultivation. For example, it can form a dense “lawn” in aquaria (Windeløv, 2004), reproduces sexually and vegetatively (Azan, 2011; Winterton and Scher, 2007), and is dispersed by water. Like other *Lilaeopsis* species, it is likely self-compatible (Affolter, 1985) and is probably dispersed by birds (Bone et al., 2011). Overall, we had very high uncertainty for this risk element and could not answer six of the questions.

Risk score = 0 Uncertainty index = 0.38

IMPACT POTENTIAL

We found no evidence that this species is considered weedy or has had any specific impacts. Rather than answering the questions as no based on a lack of evidence, we answered most of the impact questions as unknown because this species has not had a sufficient opportunity to demonstrate any invasive or harmful behaviors. Some plant species have a long lag-phase before becoming invasive (Baker, 1965; Kowarik, 1995). Answering the questions as unknown versus no does not affect the final risk score, but it does increase uncertainty, which is appropriate in this case. Not surprisingly, we had a very high uncertainty level for this risk element.

Risk score = 1.0 Uncertainty index = 0.47

GEOGRAPHIC POTENTIAL

Based on three climatic variables, we estimate that about 0.02 percent of the United States is suitable for the establishment of *L. mauritiana* (Fig. 1). This predicted distribution is based solely on the species' known distribution on the island of Mauritius (Petersen and Affolter, 1999) and represents the joint distribution of Plant Hardiness Zone 13, areas with 30-40 inches of annual precipitation, and the Köppen-Geiger climate class corresponding to tropical rainforests. The area of the United States shown to be climatically suitable (Fig. 1) for species establishment considered only three climatic variables. Other variables, for example, soil and habitat type, novel climatic conditions, or plant genotypes, may alter the areas in which this species is likely to establish. On Mauritius, *L. mauritiana* was found growing in moderately flowing, clear-watered streams (Bone et al., 2011). It is very likely that it would be able to grow in similar habitat types such as ponds, bogs, marshes, etc.

Because the small island of Mauritius (788 square miles) does not experience a wide range of climates, our predicted distribution for the United States was very small. Almost all other species of *Lilaeopsis* have wider distributions (Affolter, 1985) and experience a broader range of climates. It is very likely that *L. mauritiana* is adapted to a broader range of climates than indicated by our analysis. Because it is very closely related to *L. brasiliensis* (Bone et al., 2011), we expect that its climatic tolerance may closely resemble that of *L. brasiliensis* (Fig. 2). Using the same process described above, we estimated that about 8 percent of the United States is suitable for the establishment of *L. brasiliensis* (PPQ, 2017). Given the high uncertainty associated with our original geographic potential analysis for *L. mauritiana*, we recommend that the area shown in Figure 2 as a potential distribution for *L. brasiliensis* be considered as the potential distribution for *L. mauritiana*.

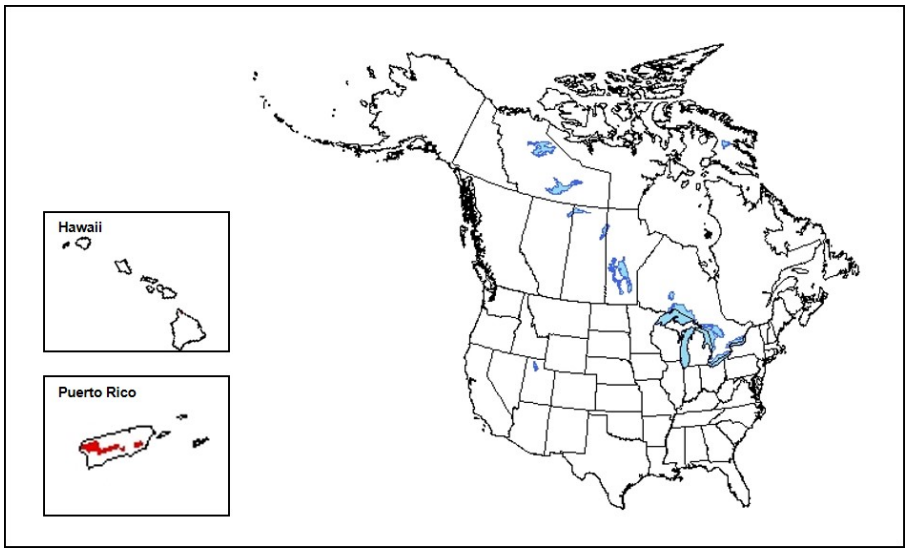

Figure 1. Potential geographic distribution of *Lilaeopsis mauritiana* in the United States and Canada. Map insets for Hawaii and Puerto Rico are not to scale.

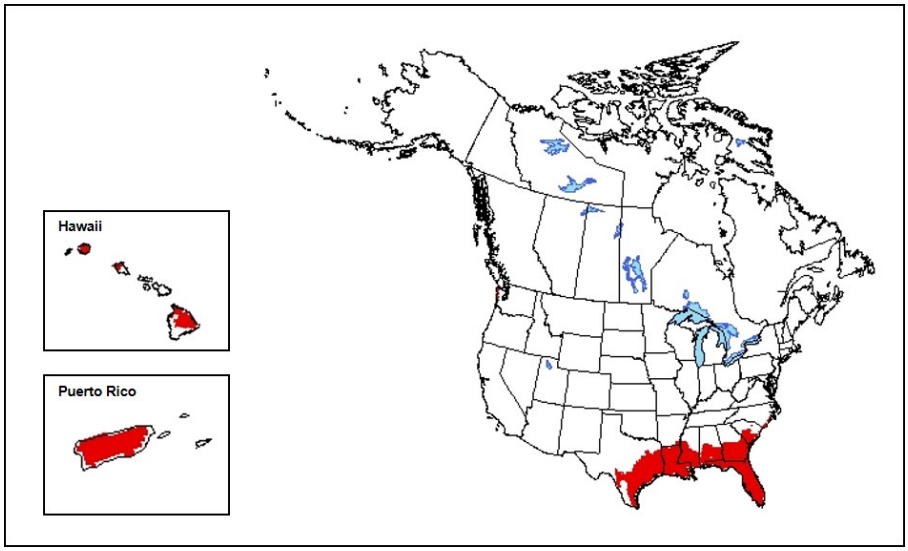

Figure 2. Potential geographic distribution of *Lilaeopsis brasiliensis* in the United States and Canada. Map insets for Hawaii and Puerto Rico are not to scale.

ENTRY POTENTIAL

Lilaeopsis mauritiana is present in the United States, where it is cultivated and sold as an aquarium ornamental (e.g., AFA, 2017; PAC, 2017). APHIS-PPQ is currently considering a market access request for *L. mauritiana* plants rooted in rock wool from Denmark (MFAF, 2009). If approved, additional plant material would be guaranteed entry into the United States, resulting in the maximum risk score of 1.0 indicated below. We found no evidence that this species is likely to enter the United States as a contaminant or through natural dispersal from nearby regions.

Risk score = 1 Uncertainty index = 0.00

4. Predictive Risk Model Results

Model Probabilities: P(Major Invader) = 2.8%
P(Minor Invader) = 46.3%
P(Non-Invader) = 50.9%
Risk Result = Low Risk
Secondary Screening = Not Applicable

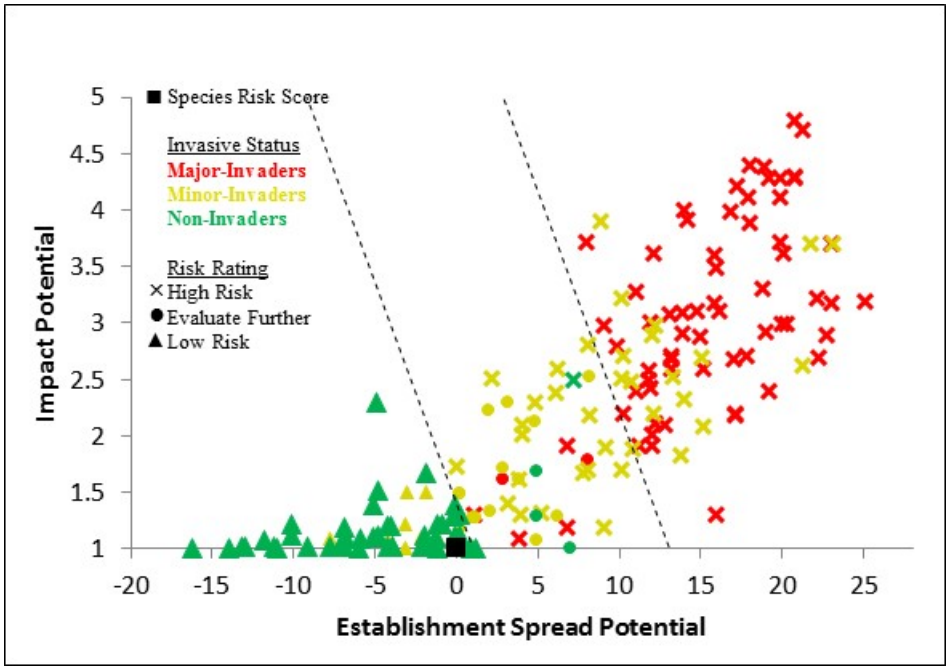

Figure 3. *Lilaeopsis mauritiana* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

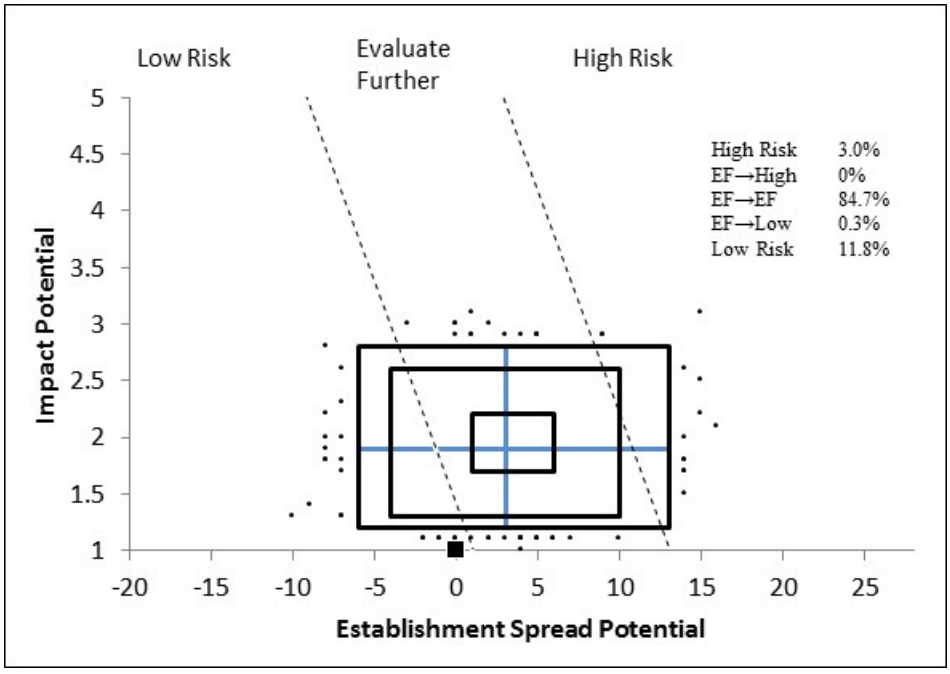

Figure 4. Model simulation results (N=5,000) for uncertainty around the risk score for *L. mauritiana*. The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

5. Discussion

The result of the weed risk assessment for *L. mauritiana* is Low Risk (Fig. 3). Because its risk score is located close to the decision threshold of Evaluate Further, and because the species has some biological traits that would facilitate escape and spread, the majority of the simulated risk scores in our uncertainty simulation were located in the Evaluate Further region of our risk space (Fig. 4). Thus, taking uncertainty into account, our analysis suggests that this species may pose a risk for becoming a minor-invader. Because *L. mauritiana* was recently discovered, there is very little known about its biology and how it may behave if it escapes beyond its native range. If *L. mauritiana* is adapted to a broader range of climates as we expect, its risk score would shift to the right along the establishment/spread axis by several points, placing it in the Evaluate Further region of our risk space.

6. Acknowledgements

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SUGGESTED CITATION

PPQ. 2017. Weed risk assessment for *Lilaeopsis mauritiana* Petersen & Affolter (Apiaceae) – Mauritius micro sword. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (PPQ), Raleigh, NC. 20 pp.

DOCUMENT HISTORY

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Appendix A. Weed risk assessment for *Lilaeopsis mauritiana* G. Petersen & Affolter (Apiaceae)

Below is all of the evidence and associated references used to evaluate the risk potential of this taxon. We also include the answer, uncertainty rating, and score for each question. The Excel file, where this assessment was conducted, is available upon request.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ESTABLISHMENT/SPREAD POTENTIAL			
ES-1 [What is the taxon's establishment and spread status outside its native range? (a) Introduced elsewhere =>75 years ago but not escaped; (b) Introduced <75 years ago but not escaped; (c) Never moved beyond its native range; (d) Escaped/Casual; (e) Naturalized; (f) Invasive; (?) Unknown]	b - low	-2	*Lilaeopsis mauritiana* has been collected from only a single location in a nature park on the southeast side of Mauritius (Petersen and Affolter, 1999). It may also be present on Madagascar, but that identification is tentative since it is based on a 1920s specimen of a sterile plant (Bone et al., 2011; Raynal, 1977). *Lilaeopsis mauritiana* has been introduced to Denmark (Bone et al., 2011), Canada (Azan, 2011), and the United States (AFA, 2017; Aquarium Plants, 2017). We found no evidence that it has escaped from cultivation. Because it was only recently (1992) described to science and is unlikely to have been cultivated prior to this, we answered this question as "b" with low uncertainty. The alternate answers for the uncertainty simulation were "d" and "a." We chose "d" because it is possible that this species may have escaped somewhere and it has not been reported yet. We chose "a" as our second alternate because it is possible that this species has been propagated somewhere for longer than 75 years, but under a different name.
ES-2 (Is the species highly domesticated)	n - low	0	Although *L. mauritiana* is cultivated (PAC, 2017; Tropica, 2017), we found no evidence that this species has been bred for reduced weed potential.
ES-3 (Significant weedy congeners)	n - low	0	*Lilaeopsis* is a genus of about 13-15 warm-temperate to tropical herb species, most of which are native to the Americas (Bone et al., 2011; Mabberley, 2008; Weakley, 2015). Five species are listed under the Global Compendium of Weeds with one reference each about weediness, and one species (*L. carolinensis*) is listed with 11 references (Randall, 2017), suggesting that, overall, the genus does not pose a significant or major weed threat. *Lilaeopsis carolinensis* is native to the southeastern United States (Weakley, 2015) and has become naturalized on the Iberian peninsula (Bone et al., 2011). *Lilaeopsis brasiliensis* has become naturalized in New Zealand and Taiwan, and beyond its native

Question ID	Answer - Uncertainty	Score	Notes (and references)
			range in Brazil (GBIF, 2017). We found no information indicating that any of these species are considered significant weeds.
ES-4 (Shade tolerant at some stage of its life cycle)	? - max		We found no information about shade tolerance under natural settings. In an aquarium plant guide, Windeløv (2004) states that *L. mauritiana* requires less light than *L. brasiliensis*, which has been documented to have naturalized in shady spots in New Zealand (GBIF, 2017). In contrast, *L. mauritiana* is reported to grow emerged and submerged in moderately flowing clear-watered streams on Mauritius, which suggests it may not be as tolerant of shade as *L. brasiliensis* (Petersen and Affolter, 1999). Without additional information, we answered this question as unknown.
ES-5 (Plant a vine or scrambling plant, or forms tightly appressed basal rosettes)	n - negl	0	The genus *Lilaeopsis* consists of small, perennial creeping herbs (Affolter, 1985; Britton, 1907); they are neither vines nor herbs with a basal rosette of leaves.
ES-6 (Forms dense thickets, patches, or populations)	y - low	2	High light conditions favor denser growth of *L. mauritiana* (Windeløv, 2004). *Lilaeopsis* "[p]lants growing in sunny, relatively well-drained sites, such as exposed sand or mud flats, often form a low, dense turf" (Affolter, 1985). Plants in the field often grow in dense patches due to clonal vegetative growth along their creeping rhizomes (Affolter, 1985). For example, *Lilaeopsis brasiliensis* can form lawn-like carpets under very high light (Charlton, 1992; Windeløv, 2004). Where it has become naturalized in New Zealand, it was described as forming a sward (GBIF, 2017), which is a dense patch of grass. For the California native *L. masonii*, a single occurrence may consist of either a single ramet (< 1 cm^2) to a patch that is about 18 m^2 (Grewell et al., 2013). The U.S. native *L. chinensis* can form dense mats in intertidal mudflats (Moore et al., 2009).
ES-7 (Aquatic)	y - low	1	*Lilaeopsis mauritiana* grows as both a submerged and emergent plant (Petersen and Affolter, 1999). Because it grows submerged and has adaptions for aquatic environments (i.e., hollow leaves), we answered yes, even though it is not an obligate aquatic plant.
ES-8 (Grass)	n - negl	0	This species is not a grass. It is an herb in the Apiaceae family (Affolter, 1985).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	We found no evidence that this species fixes nitrogen. Furthermore, it is not a member of a plant family known to contain nitrogen-fixing species (e.g., Martin and Dowd, 1990; Santi et al., 2013), nor is it woody.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-10 (Does it produce viable seeds or spores)	y - high	1	We found no quantitative evidence about seed viability in the genus or in *L. mauritiana*. Two sources indicate that *L. mauritiana* reproduces by seeds (Azan, 2011; Winterton and Scher, 2007). In his monograph on the genus, Affolter (1985) made an indirect comment indicating that plants produce viable seed. *Lilaeopsis schaffneriana* subsp. *recurva* produces viable seed (Titus and Titus, 2008a). Based on this evidence, we answered yes with high uncertainty.
ES-11 (Self-compatible or apomictic)	y - high	1	We found no information for this species on self-compatibility. Affolter (1985) concluded that plants of *L. carolinensis* were likely self-compatible or apomictic because isolated clones were able to set fruit. He also cited additional information that most plants in the Apiaceae are self-compatible (cited in Affolter, 1985).
ES-12 (Requires specialist pollinators)	n - high	0	We found no specific information for this species. In his monograph on the genus, Affolter (1985) argued that *Lilaeopsis* species are likely able to self-pollinate based on the frequent fruiting of plants under cultivation and the fact that flowers are relatively small, so gravity alone could transfer pollen to the stigmas. He conducted a pollinator exclusion experiment where he showed that plants of *L. carolinensis* that were covered with nylon stocking still set fruit. He had a plant of this same species produce a single umbel under water that then produced a fruit (Affolter, 1985). Based on this evidence we answered no, but with high uncertainty since the observations were not based on *L. mauritiana*.
ES-13 [What is the taxon's minimum generation time? (a) less than a year with multiple generations per year; (b) 1 year, usually annuals; (c) 2 or 3 years; (d) more than 3 years; or (?) unknown]	a - high	2	*Lilaeopsis mauritiana* reproduces vegetatively, and possibly sexually (Azan, 2011; Winterton and Scher, 2007); however, we found no specific information about generation time for this species. The genus *Lilaeopsis* consists of small, creeping, rhizomatous perennial herbs (Bone et al., 2011). Although other *Lilaeopsis* species can expand significantly in size between years, seasons, or both (Affolter, 1985; Titus and Titus, 2008b), it is not clear to us what constitutes an individual plant/generation since the plants do not produce distinct ramets, as other rhizomatous plants (e.g., bananas, irises, running bamboos). *Lilaeopsis* plants essentially consist of leaves emerging from an underground stem. In a way, they are like vines that root along each node. Grewell et al. (2013) consider each node along the rhizome as a ramet. If we adopted this perspective, then there would be multiple generations per year given Affolter's observations about expansion.

Question ID	Answer - Uncertainty	Score	Notes (and references)
			Without additional information we answered this question as "a" with high uncertainty. Alternate answers for the uncertainty simulation were both "b."
ES-14 (Prolific seed producer)	? - max	0	Unknown. The inflorescences in *Lilaeopsis* are simple and have 2 to 15 flowers (Affolter, 1985). Increased shading or submergence in water reduces the number of flowers per umbel (Affolter, 1985). We found no other information on reproductive effort.
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	We found no evidence. Because *L. mauritiana* is not reported to grow in agricultural areas where contamination is more likely, we answered no, with moderate uncertainty.
ES-17 (Number of natural dispersal vectors)	2	0	Propagule description for ES-17a through ES-17e: Fruit of *Lilaeopsis* species are schizocarps (Bone et al., 2011). *Lilaeopsis mauritiana* produces globose to ellipsoid/obovoid fruit that are 1.9-2.5 mm long and 1.7-2.0 mm wide, and that lack spongy cells in the ribs (Petersen and Affolter, 1999). While there is evidence of water and bird dispersal in *Lilaeopsis* in general (see below), there is a tendency for the peduncles and pedicles of most species of *Lilaeopsis*, including *L. brasiliensis*, to recurve as the fruit mature, causing the fruit to either be brought back under water or be pressed against the soil surface (Affolter, 1985).
ES-17a (Wind dispersal)	n - negl		"The fruits of *Lilaeopsis* are too heavy to be blown great distances by wind" (Affolter, 1985).
ES-17b (Water dispersal)	y - low		We found no direct evidence indicating this species is dispersed by water. Although the fruit of *L. mauritiana* lack spongy cells, which would help them to float, because this species is an aquatic plant living in flowing streams (Bone et al., 2011; Petersen and Affolter, 1999), we answered yes with low uncertainty. Other species of *Lilaeopsis* are dispersed by water (Grewell et al., 2013), including as fruit (Affolter, 1985; Hill, 1927) and vegetative clumps (Stevenson, 1947; Titus and Titus, 2008b).
ES-17c (Bird dispersal)	y - high		We found no direct evidence that *L. mauritiana* is dispersed by birds. In explaining the amphitropic (disjunct native distribution in the northern and southern hemispheres) distribution of *L. carolinensis*, Affolter (1985) speculated that long-distance dispersal via migrating birds may be the cause. Indeed, a "minimum of seven dispersal events is required to explain the present-day

Question ID	Answer - Uncertainty	Score	Notes (and references)
			distribution of *Lilaeopsis*" across the New World and Australasia (Bone et al., 2011). Although these intercontinental dispersal events have occurred over geologic time scales (Spalik et al., 2010), they support the idea of the likelihood and importance of bird dispersal for the genus. "The fruits of *Lilaeopsis* lack spines or other adhesive structures and they are not sticky. They are small enough, however, to become attached to the feet, bills, or feathers of birds when encased in mud or organic debris. Thus affixed, they could occasionally be transported between suitable habitats" (Affolter, 1985). Affolter (1985) noted one report of a fruit of an unknown *Lilaeopsis* species being obtained from the stomach of a New Zealand duck, although it is unknown whether the seeds of ingested fruit would remain viable after gut passage. Based on this very broad evidence, we answered yes.
ES-17d (Animal external dispersal)	? - max		We found no evidence for *L. mauritiana*. However, because seeds may become embedded in mud that is stuck on animals moving through aquatic environments, we answered unknown.
ES-17e (Animal internal dispersal)	? - max		Unknown.
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	? - max	0	We found no information about long-term seed dormancy in this species. *Lilaeopsis schaffneriana* subsp. *recurva* appears to produce a persistent seed bank (Titus and Titus, 2008b). Fruit of *L. carolinensis* were viable after 15 months (Affolter, 1985).
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	? - max	0	*Lilaeopsis mauritiana* is a rhizomatous perennial that grows along a rhizome and roots at each node (Petersen and Affolter, 1999). We found no direct evidence that this species is tolerant of mutilation, but speculate that it may be if fragments readily reroot. In *L. schaffneriana* subsp. *recurva*, "weakly rooted clumps of the plant tear off as a result of scouring during flood events and float downstream to take root elsewhere. Some of these clumps survive, depending on specific conditions where the clump is deposited" (Titus and Titus, 2008b). Small patches of a *Lilaeopsis* species in New Zealand can become detached, float to the surface, and reroot elsewhere in a given body of water (Stevenson, 1947). Without specific evidence about this species' behavior in the wild, we answered unknown.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - mod	0	We found no evidence that this species is resistant to herbicides (e.g., Heap, 2017). Because it is not reported to occur in agricultural areas and subjected to routine applications of herbicides, it seems unlikely that the species has developed resistance.
ES-21 (Number of cold hardiness zones suitable for its survival)	1	-1	
ES-22 (Number of climate types suitable for its survival)	1	-2	
ES-23 (Number of precipitation bands suitable for its survival)	1	-1	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - high	0	We found no evidence that this species or any species in the genus is allelopathic.
Imp-G2 (Parasitic)	n - negl	0	We found no evidence that this species is parasitic. It is also not a member of a plant family known to contain parasitic plants (Heide-Jorgensen, 2008; Nickrent, 2009; Walker, 2014).
Impacts to Natural Systems			
Imp-N1 (Changes ecosystem processes and parameters that affect other species)	? - max		We found no evidence of this impact. Because this species was described only 25 years ago and has not been in cultivation for that long, there is very little basis on which to evaluate its impact potential because it has not had sufficient opportunity to escape, spread, and cause impacts; some plant species have a long lag-phase before becoming invasive (Baker, 1965; Kowarik, 1995). Consequently, we answered most questions in this risk element as unknown.
Imp-N2 (Changes habitat structure)	? - max		Unknown.
Imp-N3 (Changes species diversity)	? - max		Unknown.
Imp-N4 (Is it likely to affect federal Threatened and Endangered species?)	? - max		Unknown.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions?)	? - max		Unknown.
Imp-N6 [What is the taxon's weed status in natural systems? (a) Taxon not a weed; (b) taxon a weed but no evidence of control; (c) taxon a weed and evidence of control efforts]	a - mod	0	We found no evidence that this species is considered a weed. Because it has not been reported to escape from cultivation, we used moderate uncertainty. Alternate answers for the uncertainty simulation were both "b."
Impact to Anthropogenic Systems (e.g., cities, suburbs, roadways)			
Imp-A1 (Negatively impacts personal property, human safety, or public infrastructure)	? - max		Unknown. In New Zealand, an unidentified *Lilaeopsis* species can form dense mats if the plants are uprooted through natural processes from the soft mud of lakes and reservoirs

Question ID	Answer - Uncertainty	Score	Notes (and references)
			(Stevenson, 1947). Affolter (1985) states, "While walking around the shore of Lake Marymeri, we failed to find any rooted *Lilaeopsis*. However, fresh plants ... were piled up along the shore of the lake in thick clumps. In places, armloads of *Lilaeopsis* could be gathered from a few meters of shoreline." We answered unknown because floating mats of aquatic vegetation could clog pipes, drainages, culverts, etc., and this may affect storm water drainage.
Imp-A2 (Changes or limits recreational use of an area)	? - max		Unknown. If this species becomes uprooted and forms large, floating mats (see evidence under Imp-A1), then it might limit recreational use of an area.
Imp-A3 (Affects desirable and ornamental plants, and vegetation)	? - max		Unknown. One aquarium keeper said about *L. brasiliensis*: "As this plant is very invasive, runners that grow into neighboring plant groupings will need to be regularly pruned off" (APC, 2016).
Imp-A4 [What is the taxon's weed status in anthropogenic systems? (a) Taxon not a weed; (b) Taxon a weed but no evidence of control; (c) Taxon a weed and evidence of control efforts]	a - mod	0	We found no evidence that this species is considered a weed by aquarium keepers. The alternate answers for the uncertainty simulation were both "b."
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	n - high	0	We found no evidence of this impact for this species. Because this species is not reported to occur in agricultural areas, we answered most of the questions in this risk subelement as no with high uncertainty.
Imp-P2 (Lowers commodity value)	n - high	0	We found no evidence.
Imp-P3 (Is it likely to impact trade?)	n - low	0	We found no evidence that any member of this genus is regulated by a U.S. state government (e.g., NPB, 2016; USDA-AMS, 2016), or a foreign government (e.g., APHIS, 2017). Consequently, it is unlikely to impact trade.
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	n - high	0	We found no evidence.
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	n - mod	0	We found no evidence that this species or genus is toxic to animals (e.g., Burrows and Tyrl, 2013).
Imp-P6 [What is the taxon's weed status in production systems? (a) Taxon not a weed; (b) Taxon a weed but no evidence of control; (c) Taxon a weed and evidence of control efforts]	a - low	0	We found no evidence that this species is considered a weed of production systems. Alternate answers for the uncertainty simulation were both "b."

Question ID	Answer - Uncertainty	Score	Notes (and references)
GEOGRAPHIC POTENTIAL			
Plant hardiness zones			
Geo-Z1 (Zone 1)	n - negl	N/A	We found no evidence that this species occurs in this hardiness zone.
Geo-Z2 (Zone 2)	n - negl	N/A	We found no evidence.
Geo-Z3 (Zone 3)	n - negl	N/A	We found no evidence.
Geo-Z4 (Zone 4)	n - negl	N/A	We found no evidence.
Geo-Z5 (Zone 5)	n - negl	N/A	We found no evidence.
Geo-Z6 (Zone 6)	n - negl	N/A	We found no evidence.
Geo-Z7 (Zone 7)	n - negl	N/A	We found no evidence.
Geo-Z8 (Zone 8)	n - low	N/A	We found no evidence.
Geo-Z9 (Zone 9)	? - max	N/A	We found no evidence that this species occurs in this hardiness zone. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this zone (PPQ, 2017), we answered unknown.
Geo-Z10 (Zone 10)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this zone (PPQ, 2017), we answered unknown.
Geo-Z11 (Zone 11)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this zone (PPQ, 2017), we answered unknown.
Geo-Z12 (Zone 12)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this zone (PPQ, 2017), we answered unknown.
Geo-Z13 (Zone 13)	y - low	N/A	Mauritius (Petersen and Affolter, 1999).
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	y - low	N/A	Mauritius (Petersen and Affolter, 1999).
Geo-C2 (Tropical savanna)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this climate type (PPQ, 2017), we answered unknown.
Geo-C3 (Steppe)	n - negl	N/A	We found no evidence.
Geo-C4 (Desert)	n - negl	N/A	We found no evidence.
Geo-C5 (Mediterranean)	n - high	N/A	We found no evidence that this species occurs in this climate type, but think that it may be able to if it occurs in an appropriate habitat where the climate is warm enough.
Geo-C6 (Humid subtropical)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this climate type (PPQ, 2017), we answered unknown.
Geo-C7 (Marine west coast)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this climate type (PPQ, 2017), we answered unknown.
Geo-C8 (Humid cont. warm sum.)	n - low	N/A	We found no evidence.
Geo-C9 (Humid cont. cool sum.)	n - negl	N/A	We found no evidence.
Geo-C10 (Subarctic)	n - negl	N/A	We found no evidence.
Geo-C11 (Tundra)	n - negl	N/A	We found no evidence.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-C12 (Icecap)	n - negl	N/A	We found no evidence.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	n - negl	N/A	We found no evidence.
Geo-R2 (10-20 inches; 25-51 cm)	n - high	N/A	We found no evidence.
Geo-R3 (20-30 inches; 51-76 cm)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this precipitation band (PPQ, 2017), we answered unknown.
Geo-R4 (30-40 inches; 76-102 cm)	y - low	N/A	Mauritius (Petersen and Affolter, 1999).
Geo-R5 (40-50 inches; 102-127 cm)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this precipitation band (PPQ, 2017), we answered unknown.
Geo-R6 (50-60 inches; 127-152 cm)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this precipitation band (PPQ, 2017), we answered unknown.
Geo-R7 (60-70 inches; 152-178 cm)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this precipitation band (PPQ, 2017), we answered unknown.
Geo-R8 (70-80 inches; 178-203 cm)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this precipitation band (PPQ, 2017), we answered unknown.
Geo-R9 (80-90 inches; 203-229 cm)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this precipitation band (PPQ, 2017), we answered unknown.
Geo-R10 (90-100 inches; 229-254 cm)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this precipitation band (PPQ, 2017), we answered unknown.
Geo-R11 (100+ inches; 254+ cm)	? - max	N/A	We found no evidence. Because the very closely related (Bone et al., 2011) *L. brasiliensis* occurs in this precipitation band (PPQ, 2017), we answered unknown.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	n - negl	0	*Lilaeopsis mauritiana* is already present in the United States where it is cultivated and sold as an aquarium ornamental (e.g., AFA, 2017; PAC, 2017). However, we answered this question as no to allow us to evaluate its likelihood of entry via other pathways.
Ent-2 (Plant proposed for entry, or entry is imminent)	y - negl	1	PPQ received a market access request for *L. mauritiana* for propagation from the Ministry of Food, Agriculture and Fisheries of the Danish Plant Directorate (MFAF, 2009). Thus, if approved, its entry is imminent.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Ent-3 [Human value & cultivation/trade status: (a) Neither cultivated or positively valued; (b) Not cultivated, but positively valued or potentially beneficial; (c) Cultivated, but no evidence of trade or resale; (d) Commercially cultivated or other evidence of trade or resale]	d - negl	N/A	*Lilaeopsis mauritiana* is commercially propagated in Denmark (Tropica, 2017). It has also been introduced into Canada, where it is commonly sold at a volume of 276 sales across 20 retail stores in 2010 (Azan, 2011). This species is sold by online retailers in Arizona (PAC, 2017), California (AFA, 2017), and Florida (Aquarium Plants, 2017), as well as by sellers on eBay (2017).
Ent-4 (Entry as a contaminant)			
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	y - negl	N/A	It has been introduced into Canada where it is cultivated (Azan, 2011).
Ent-4b (Contaminant of plant propagative material (except seeds))	n - high	N/A	We found no evidence.
Ent-4c (Contaminant of seeds for planting)	n - high	N/A	We found no evidence.
Ent-4d (Contaminant of ballast water)	n - high	N/A	We found no evidence.
Ent-4e (Contaminant of aquarium plants or other aquarium products)	? - max	N/A	Unknown.
Ent-4f (Contaminant of landscape products)	n - high	N/A	We found no evidence.
Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances)	n - mod	N/A	We found no evidence.
Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing)	n - low	N/A	We found no evidence, and think that this pathway is unlikely.
Ent-4i (Contaminant of some other pathway)	a - high	N/A	We found no evidence.
Ent-5 (Likely to enter through natural dispersal)	n - mod	N/A	We found no evidence, and do not think this pathway is currently very likely, as the species is not known to be naturalized in a nearby region.