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Weed Risk Assessment for *Limnophila sessiliflora* (Plantaginaceae) – Ambulia

Left: Emergent *Limnophila sessiliflora* plants (Garg, 2008); right: submerged *L sessiliflora* plants (Shaun Winterton, Aquarium and Pond Plants of the World, Edition 3, USDA APHIS PPQ, Bugwood.org)

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Executive Summary

The result of the weed risk assessment for *Limnophila sessiliflora* is High Risk of becoming weedy or invasive in the United States. *Limnophila sessiliflora* is a submerged to emergent perennial aquatic herb that is primarily a weed of shallow water in natural areas. It is invasive in Florida, Georgia, and Texas. It can reproduce both vegetatively and by seed, has cleistogamous flowers, and forms dense stands and mats. In natural areas, it can overshade and outcompete other aquatic species. If it covers the surface of the water, the resulting oxygen depletion can kill fish. We estimate that 11 to 25 percent of the United States is suitable for this species to establish. It could spread further on machinery that is used in waterways and in trade as an aquarium plant.

Plant Information and Background

PLANT SPECIES: *Limnophila sessiliflora* Blume (Plantaginaceae) (NPGS, 2020).

SYNONYMS: Basionym *Hottonia sessiliflora* Vahl (NPGS, 2020).

COMMON NAMES: Ambulia (NPGS, 2020), Asian marshweed (Kartesz, 2015; NRCS, 2020).

BOTANICAL DESCRIPTION: *Limnophila sessiliflora* is a submerged to emergent perennial aquatic herb that can grow up to 12 ft. long. The leaf shape varies significantly depending on whether the leaf is underwater or emergent (Ramey, 2001). *Limnophila sessiliflora* closely resembles *L. heterophylla* and is distinguished primarily by its sessile flowers and divided upper aerial leaves (Philcox, 1970). The plant roots in mud (Stone, 1970) and grows primarily in shallow ponds, ditches, and rice paddies (Ohwi, 1984).

INITIATION: *Limnophila sessiliflora* was listed as a Federal Noxious Weed in 1981. We evaluated it with a weed risk assessment to evaluate the current status of this species in the United States and document its ability to establish, spread, and cause harm.

WRA AREA[1]: United States and Territories.

FOREIGN DISTRIBUTION: *Limnophila sessiliflora* is native to most of eastern and southeastern Asia, including China, Japan, India, Vietnam, and Indonesia (NPGS, 2020). It is naturalized in Hungary, likely as an escape from cultivation, but is not invasive there (Lukacs et al., 2014). In the aquarium plant trade, it is often sold under the name *L. heterophylla* (Champion et al., 2008), which is an accepted name for an entirely different species (NPGS, 2020). It is regulated by South Africa (Champion et al., 2008) and Australia (Koncki and Aronson, 2015).

U.S. DISTRIBUTION AND STATUS: *Limnophila sessiliflora* is a Federal Noxious Weed (7 CFR § 360, 2011) and is regulated by five states (NPB, 2020). It is naturalized in two counties in Georgia, four in Texas, and 22 in Florida (Kartesz, 2015). Although it is an FNW, it has been sold in the United States (Kay and Hoyle, 2001). It is offered for sale from a site in Nevada (GreenSeedGarden, 2020) and from a site in Canada, with no indication that the seller would be unable to ship to the United States (J&L Aquatics, 2020). We found little interest among gardeners on a popular forum (Dave's Garden, 2020), though it was frequently mentioned on an aquarium site ({Fishlore, 2020 #61}), so we are unsure of how commonly it is grown. Small populations are managed in Orange County, FL (Jackson, 2020).

[1] The "WRA area" is the area in relation to which the weed risk assessment is conducted (definition modified from that for "PRA area") (IPPC, 2017).

Analysis

ESTABLISHMENT/SPREAD POTENTIAL: *Limnophila sessiliflora* is invasive in Florida, Georgia, and Texas (Langeland et al., 2008; Philcox, 1970; Westbrooks and Eplee, 1989). It reproduces both vegetatively (Ramey, 2001) and by seeds, which are produced by cleistogamous flowers (Philcox, 1970; Yang and Yen, 1997). The stems form dense stands in the water (Ramey, 2001), and the plant can also produce mats on the water surface (Spencer and Bowes, 1985). It is shade-tolerant (Spencer and Bowes, 1985; Tropica, n.d.), and herbicides have a limited effect on it (Scher et al., 2015; Spencer and Bowes, 1985), with some populations showing resistance (Heap, 2020; Wang et al., 2000). We had average uncertainty for this risk element.

Risk score = 18.0 Uncertainty index = 0.10

IMPACT POTENTIAL: *Limnophila sessiliflora* is most likely to impact natural areas. If it covers the water surface, it can shade out submerged species and deplete oxygen in the water, killing fish (Ramey, 2001; TAMU, 2020a). It can outcompete both native plants and the invasive *Hydrilla verticillata* (Langeland et al., 2008; Scher et al., 2015; Swearingen and Bargeron, 2016). It can clog canals and pump and power stations (Ramey, 2001; Scher et al., 2015). It is also described as a major weed of rice in several countries (Spencer and Bowes, 1985; Takematusu et al., 1976), but we found no evidence of a specific impact on agriculture. We had high uncertainty for this risk element due to sparse evidence for most types of impact.

Risk score = 3.4 Uncertainty index = 0.30

Risk Model Results

Model Probabilities: P(Major Invader) = 89.6%
P(Minor Invader) = 10.1%
P(Non-Invader) = 0.4%
Risk Result = High Risk

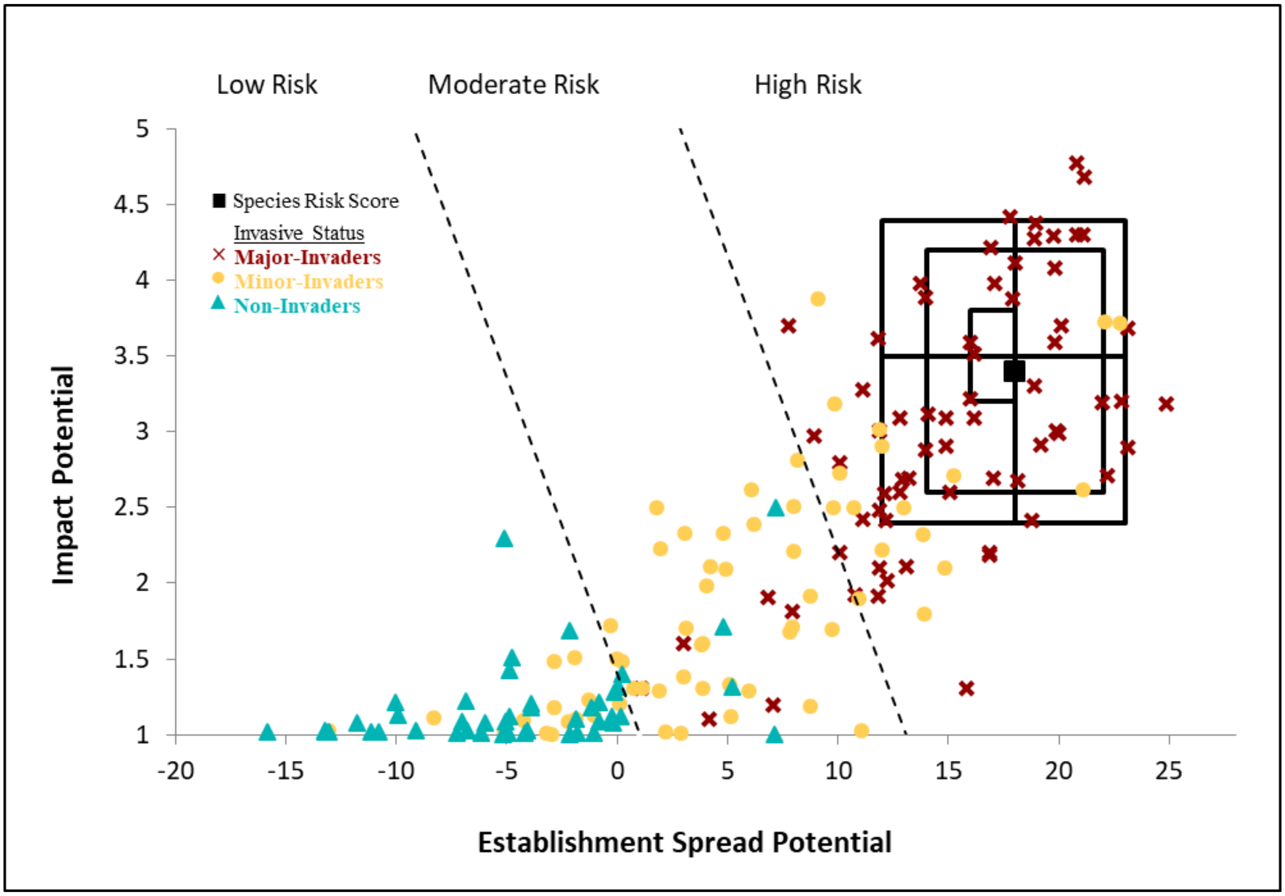

Figure 1. Risk and uncertainty results for *Limnophila sessiliflora*. The risk score for this species (solid black symbol) is plotted relative to the risk scores of the species used to develop and validate the PPQ WRA model (Koop et al., 2012). The results from the uncertainty analysis are plotted around the risk score for *L. sessiliflora*. The smallest, black box contains 50 percent of the simulated risk scores, the second 95 percent, and the largest 99 percent. The black vertical and horizontal lines in the middle of the boxes represent the medians of the simulated risk scores (N=5000). For additional information on the uncertainty analysis used, see Caton et al. (2018)

GEOGRAPHIC POTENTIAL: Using the PPQ climate-matching model for weeds (Magarey et al., 2017), we estimate that about 11 to 25 percent of the United States is suitable for the establishment of *L. sessiliflora* (Fig. 2). This area represents the joint distribution of Plant Hardiness Zones 6-13, areas with 30-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savanna, humid subtropical, and humid continental warm summers. We found the greatest climate match for Plant Hardiness Zones 8-13, areas with 40-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savanna, and humid subtropical. The area of the United States shown to be climatically suitable was determined using only these three climatic variables. Other factors, such as soil, hydrology, disturbance regime, and species interactions may alter the areas in which this species is likely to establish. *Limnophila sessiliflora* is an aquatic plant and most likely to grow in still, shallow water.

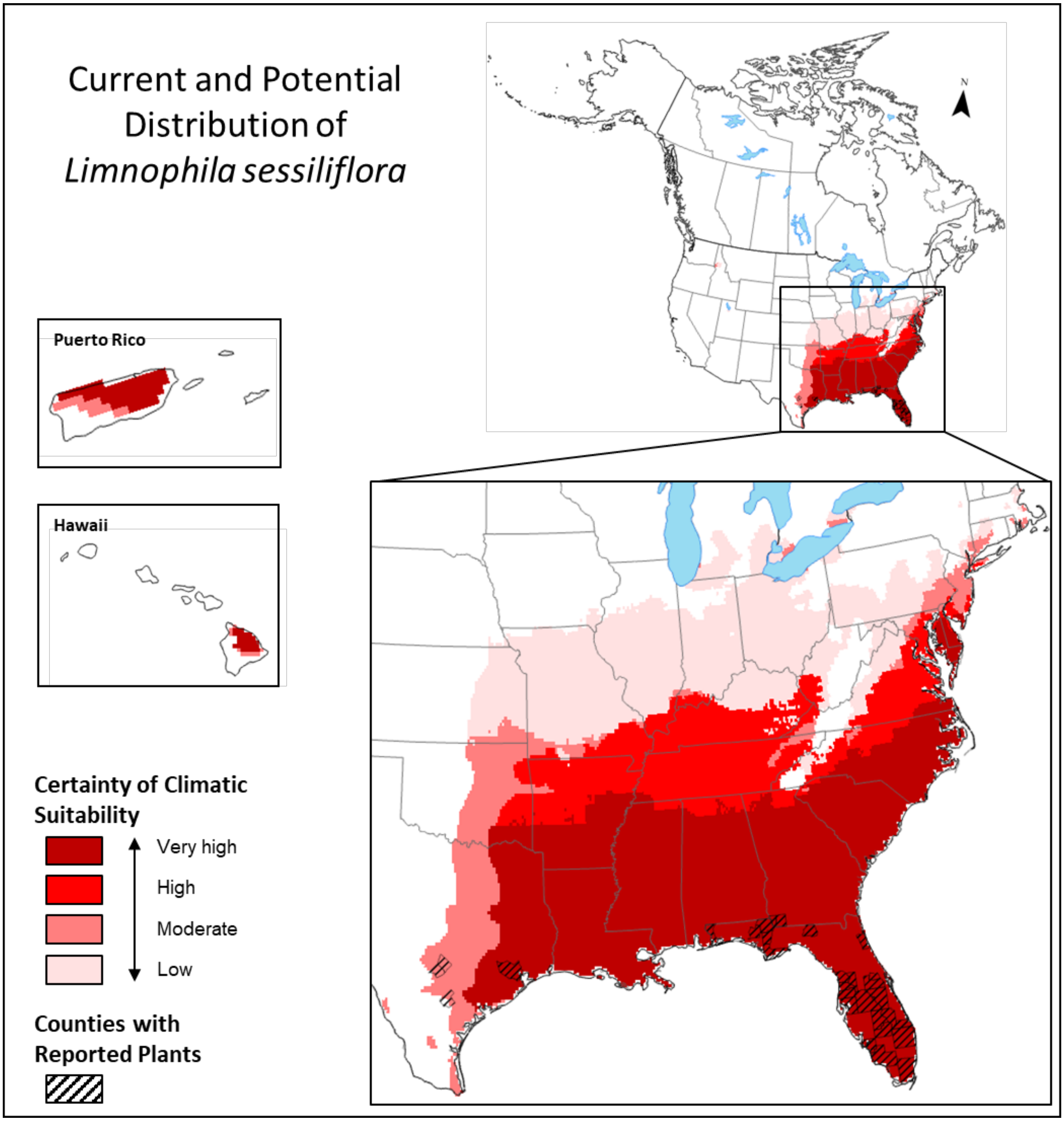

Figure 2. Current and potential distribution of *Limnophila sessiliflora* in the United States. Climatic suitability was determined using the APHIS-PPQ climate matching tool for invasive plants (Magarey et al., 2017). The known distribution of *L. sessiliflora* was based on county distribution records from an online database (see text). Map components are shown at different scales.

ENTRY POTENTIAL: We did not assess the entry potential of *L. sessiliflora* because it is already present in the United States.

Discussion

The result of the weed risk assessment for *Limnophila sessiliflora* is High Risk of spreading and causing harm in the United States. It is present in Florida, Georgia, and Texas and can outcompete native aquatic plants (Kartesz, 2015; Langeland et al., 2008). It can be a nuisance in anthropogenic systems and is described as a weed of rice in Asia (Koncki and Aronson, 2015; Moody, 1989; Ramey, 2001). The evidence for impact, however, is sparse; this is the main source of uncertainty in our assessment. Although it is a Federal Noxious Weed, it is sold in the United States (GreenSeedGarden, 2020; Kay and Hoyle, 2001). Since it probably escaped from cultivation in Florida (Philcox, 1970), its continued sale poses a risk of spread to other areas in the country.

Suggested Citation

PPQ. 2020. Weed risk assessment for *Limnophila sessiliflora* Blume (Plantaginaceae) – Ambulia. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (PPQ), Raleigh, NC. 18 pp.

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Appendix. Weed risk assessment for *Limnophila sessiliflora* Blume (Plantaginaceae)

The following table includes 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.

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]	f - negl	5	*Limnophila sessiliflora* is native to most of eastern and southeastern Asia, including China, Japan, India, Vietnam, and Indonesia. It likely escaped from cultivation in Florida (Philcox, 1970) and was first recorded in Hillsborough County, FL in 1961; in 1989, it was reported from eight additional counties (Westbrooks and Eplee, 1989). It is also spreading in Georgia and Texas (Kartesz, 2015; Langeland et al., 2008). In Hungary, it is naturalized but not invasive and likely an escape from cultivation (Lukacs et al., 2014). Alternate choices for the uncertainty simulation were both "e."
ES-2 (Is the species highly domesticated)	n - negl	0	*Limnophila sessiliflora* occurs in the wild in its native range (Fang et al., 2006; Yang and Yen, 1997). It is sold in the aquarium trade (Brunel, 2009), but it does not appear to have been bred for any traits that would reduce its weed potential.
ES-3 (Significant weedy congeners)	y - negl	1	The genus *Limnophila* includes 37 species (Mabberley, 2008). In India, *Limnophila heterophylla* is a serious weed; *L. conferta, L. gratioloides*, and *L. micrantha* are principal weeds (Holm et al., 1991). *Limnophila aromatica* and *L. indica* are common weeds of rice (Les, 2017)
ES-4 (Shade tolerant at some stage of its life cycle)	y - low	1	The submerged leaves are adapted to shade and will continue to take up carbon dioxide with little light (Spencer and Bowes, 1985). The species is described as a good alternative to aquarium plants that need a lot of light (Tropica, n.d.).
ES-5 (Plant a vine or scrambling plant, or forms tightly appressed basal rosettes)	n - negl	0	It is an aquatic herb (NPGS, 2020), not a vine.
ES-6 (Forms dense thickets, patches, or populations)	y - low	2	The submerged stems form dense stands (Ramey, 2001). It can also produce dense mats on the water surface (Spencer and Bowes, 1985).
ES-7 (Aquatic)	y - negl	1	It is a perennial aquatic herb (NPGS, 2020).

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-8 (Grass)	n - negl	0	It is in the Plantaginaceae (NPGS, 2020).
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 that is known to contain nitrogen-fixing species (Santi et al., 2013).
ES-10 (Does it produce viable seeds or spores)	y - negl	1	Each flower can produce 150-300 seeds with a germination rate of up to 96 percent (Hall et al., 2006; Spencer and Bowes, 1985). It is reported to reproduce both vegetatively and by seed (Hall et al., 2006). A triploid genotype, found in Malaya, the United States, and the United Kingdom, is sterile and presumably reproduces vegetatively (Philcox, 1970). Seed production was observed in plants collected from Florida and Georgia (Spencer and Bowes, 1985). Philcox (1970) notes a hybrid between *L. sessiliflora* and *L. indica* in the United States.
ES-11 (Self-compatible or apomictic)	y - negl	1	Members of the genus *Limnophila* are self-compatible (Les, 2017). *Limnophila sessiliflora* has both submerged cleistogamous flowers, which do not open but still self-pollinate and set seed, and aerial chasmogamous flowers, which can be cross-pollinated (Les, 2017; Yang and Yen, 1997).
ES-12 (Requires specialist pollinators)	n - negl	0	Since it is cleistogamous and self-pollinating, it likely does not require pollinators for seed production (Bhowmik and Datta, 2013; Philcox, 1970)
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]	b - high	1	The plant is a perennial, so it is unlikely to produce multiple generations per year (NPGS, 2020). We found no information, however, on the time it takes to reproduce by seed. It seems unlikely that it could grow from a seed to an emergent plant and set seed in one year. It also reproduces by fragmentation, however (Hall et al., 2006), and aquatic plants grow quickly. A fragment could likely grow enough to produce new fragments of the same size within a year. Therefore, our answer is "**b**." Alternate choices for the uncertainty simulation were both **"c."**
ES-14 (Prolific seed producer)	y - high	1	Each flower can produce up to 300 seeds with a germination rate of up to 96 percent (Spencer and Bowes, 1985). The image in Yang and Yen (1997) suggests four to six flowers per plant, making 1200-1800 seeds per plant. To meet the threshold of 5000 seeds/m^2 would then require about five plants/m^2, which seems likely with stems that form dense stands (Ramey, 2001).

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-15 (Propagules likely to be dispersed unintentionally by people)	y - negl	1	Boats and machinery used in waterways can spread it (EPPO, 2013; Ramey, 2001). In general, boats can disperse aquatic weeds (Cornell Cooperative Extension, 2019; NY DEC, 2020).
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	n - mod	-1	We found one record of interception of seed as a contaminant in personal baggage from 1985 (AQAS, 2020), but we found no evidence that it is commonly dispersed this way.
ES-17 (Number of natural dispersal vectors)	1	-2	Propagule traits for questions ES-17a through ES-17e: Fruit is a round capsule about 4 mm in diameter, containing many oblong seeds, each about 0.7 mm long (Reed, 1977).
ES-17a (Wind dispersal)	n - low		We found no evidence for this dispersal method.
ES-17b (Water dispersal)	y - low		Mats break loose from the soil in the fall and spread the seeds of the mature fruit as they float (Hall et al., 2006). Spencer and Bowes (1985) describe the fragments as easily dispersed, presumably on the water.
ES-17c (Bird dispersal)	n - mod		We found no evidence for this dispersal method.
ES-17d (Animal external dispersal)	n - mod		We found no evidence for this dispersal method.
ES-17e (Animal internal dispersal)	n - mod		We found no evidence for this dispersal method.
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	y - mod	1	Seeds can remain viable in the soil for up to 30 years (Les, 2017). In a lakeshore marsh in China, researchers found an average of 440 seeds per sq. m of soil sampled, but the plant was absent from the flood-season vegetation observed later in the year (Liu et al., 2006); thus, their function as a seed bank is unclear.
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	y - low	1	It can regrow from small fragments (Ramey, 2001), so it is highly likely that mutilation would benefit the plant as it does for other aquatics such as hydrilla (Langeland, 1996).
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	y - negl	1	Effectiveness of herbicides has been limited (Scher et al., 2015; Spencer and Bowes, 1985). SU-herbicide resistant *L. sessiliflora* has been found in Japan but only in two percent of tested rice fields. It appears to be highly resistant but spreading slowly (Wang et al., 2000). *Limnophila sessiliflora* resistant to ALS inhibitors was found in rice in Japan in 1996 (Heap, 2020).
ES-21 (Number of cold hardiness zones suitable for its survival)	7	0	

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-22 (Number of climate types suitable for its survival)	4	2	
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 of allelopathy.
Imp-G2 (Parasitic)	n - negl	0	*Limnophila sessiliflora* is not reported to be parasitic and is not in any of the families known to include parasitic plants (Heide-Jorgensen, 2008).
Impacts to Natural Systems			
Imp-N1 (Changes ecosystem processes and parameters that affect other species)	y - mod	0.4	If it covers the water surface, it can result in oxygen depletion, killing fish (TAMU, 2020a).
Imp-N2 (Changes habitat structure)	y - low	0.2	It can form dense stands that fill the entire water column (Ramey, 2001), eliminating other vegetation layers.
Imp-N3 (Changes species diversity)	y - negl	0.2	It can shade out submerged species (Ramey, 2001), and it outcompetes native water lilies, bladderwort (Langeland et al., 2008) and other aquatic plants (Swearingen and Bargeron, 2016; Wisconsin DNR, 2020). It can compete with *Hydrilla verticillata* (EPPO, 2013; Scher et al., 2015).
Imp-N4 (Is it likely to affect federal Threatened and Endangered species?)	y - mod	0.1	We did not find evidence of impact on particular threatened or endangered species. If it invaded an aquatic area with endangered plants or fish, however, it could affect them based on its impact on natural areas.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions?)	? - max	0.1	Unknown. Since *L. sessiliflora* is present in southern and central Florida (Kartesz, 2015) and has an environmental impact, it could affect globally outstanding ecoregions in that state (Ricketts et al., 1999). We have little evidence, however, of direct impact from this species.
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]	c - mod	0.6	It is considered less of a threat than hydrilla (Spencer and Bowes, 1985), and we found no evidence of impacts in Texas (Lemke, 1994). It is described as a noxious invader in the southern United States (Koncki and Aronson, 2015) and listed among the aquatic and wetland plants that pose the greatest environmental threats (Illinois-Indiana Sea Grant, n.d.). Small populations are managed in Orange County, FL (Jackson, 2020). Alternate choices for the uncertainty simulation were both "**b**."

Question ID	Answer - Uncertainty	Score	Notes (and references)
Impact to Anthropogenic Systems (e.g., cities, suburbs, roadways)			
Imp-A1 (Negatively impacts personal property, human safety, or public infrastructure)	y – low	0.1	It clogs canals and pump and power stations (Ramey, 2001; Scher et al., 2015).
Imp-A2 (Changes or limits recreational use of an area)	y – low	0.1	Large surface mats interfere with recreation and navigation (EPPO, 2013; Koncki and Aronson, 2015). It causes difficulty for boating, fishing, and other water activities (Wisconsin DNR, 2020).
Imp-A3 (Affects desirable and ornamental plants, and vegetation)	n – mod	0	We found no evidence of this impact.
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]	b – high	0.1	Ramey (2001) says it has not been a problem in Florida, but Scher et. al (2015) report that it has had an impact there. We found one reference describing methods of control in ponds (TAMU, 2020b). Alternate choices were the uncertainty simulation were "**c**" and "**a**".
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.
Imp-P2 (Lowers commodity value)	n – low	0	We found no evidence of this impact.
Imp-P3 (Is it likely to impact trade?)	n – mod	0	It is prohibited in South Africa (Champion et al., 2008) and Australia (Koncki and Aronson, 2015). We found no evidence that it can follow the pathway on a traded commodity.
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	n – mod	0	We found no evidence of this impact.
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	? – max	0.1	Unknown. The stems contain a toxin that may prevent fish from eating the plant (Spencer and Bowes, 1985), but we found no evidence of fish actually being harmed.
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]	c – high	0.6	*Limnophila* spp., including *L. sessiliflora*, are major weeds of rice in India, China, Japan, and Philippines (Spencer and Bowes, 1985). It is a weed of rice in Bangladesh, India, Malaysia, Philippines, and Sri Lanka (Moody, 1989) and was listed as a major weed of rice paddies in a survey of agricultural weeds in China (Takematusu et al., 1976). Herbicides have been used for control (ISSG, 2020). We found no other information about specific control measures. Alternate choices for the uncertainty simulation were both "**b**."

Question ID	Answer - Uncertainty	Score	Notes (and references)
GEOGRAPHIC POTENTIAL			Unless otherwise indicated, the following evidence represents geographically referenced points obtained from the Global Biodiversity Information Facility (GBIF Secretariat, 2020).
Plant hardiness zones			
Geo-Z1 (Zone 1)	n - negl	N/A	We found no evidence for presence of the species in this Zone.
Geo-Z2 (Zone 2)	n - negl	N/A	We found no evidence for presence of the species in this Zone.
Geo-Z3 (Zone 3)	n - negl	N/A	We found no evidence for presence of the species in this Zone.
Geo-Z4 (Zone 4)	n - negl	N/A	We found no evidence for presence of the species in this Zone.
Geo-Z5 (Zone 5)	n - negl	N/A	We found no evidence for presence of the species in this Zone.
Geo-Z6 (Zone 6)	n - high	N/A	Two points in Japan. Since *L.sessiliflora* is an aquatic plant that could easily be moved around and appear temporarily, this is not sufficient evidence of establishment. Also, because Japan is very mountainous, the zone could be the result of a mapping error.
Geo-Z7 (Zone 7)	y - mod	N/A	About ten points in Japan, two in South Korea. Also reported from Hungary, which is mostly within this Zone (Lukacs et al., 2014).
Geo-Z8 (Zone 8)	y - negl	N/A	Many points in Japan, four in South Korea
Geo-Z9 (Zone 9)	y - negl	N/A	Many points in Japan and the United States (many in Florida, one in Texas)
Geo-Z10 (Zone 10)	y - negl	N/A	Many points in Japan, some in the United States (Florida), two in China, two in Taiwan
Geo-Z11 (Zone 11)	y - negl	N/A	A few points in the United States (Florida), four in China, one in Brazil, Taiwan, and Vietnam. Described as a weed of rice throughout southeastern Asia (Moody, 1989).
Geo-Z12 (Zone 12)	y - negl	N/A	One point in Brazil, one in Cameroon, one in Papua New Guinea; described as a weed of rice throughout southeastern Asia (Moody, 1989).
Geo-Z13 (Zone 13)	y - negl	N/A	Four points in Indonesia; described as a weed of rice throughout southeastern Asia (Moody, 1989).
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	y - negl	N/A	A few points in the United States (Florida), five in Indonesia; described as a weed of rice throughout southeastern Asia (Moody, 1989)
Geo-C2 (Tropical savanna)	y - negl	N/A	Two points in Brazil, one in Cameroon, Thailand, and India; described as a weed of rice throughout southeastern Asia (Moody, 1989)
Geo-C3 (Steppe)	n - mod	N/A	One point in India on the edge of tropical savanna

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-C4 (Desert)	n - negl	N/A	We found no evidence for the presence of the species in this climate class.
Geo-C5 (Mediterranean)	n - high	N/A	We found no points in this climate class, but we also have no reason to believe it could not establish here.
Geo-C6 (Humid subtropical)	y - negl	N/A	Many points in Japan and the United States (many in Florida, one in Texas)
Geo-C7 (Marine west coast)	n - high	N/A	We found no points in this climate class, but we also have no reason to believe it could not establish here.
Geo-C8 (Humid cont. warm sum.)	y - mod	N/A	Six points in South Korea, four in Japan
Geo-C9 (Humid cont. cool sum.)	n - mod	N/A	Two points in Japan about 2 mi from the humid subtropical class. Present in Hungary, which is largely within this climate class, but grows in thermal waters (Lukacs et al., 2014), which are not representative of the climate class.
Geo-C10 (Subarctic)	n - negl	N/A	We found no evidence of presence of the species in this climate class.
Geo-C11 (Tundra)	n - negl	N/A	We found no evidence of presence of the species in this climate class.
Geo-C12 (Icecap)	n - negl	N/A	We found no evidence of presence of the species in this climate class.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	n - low	N/A	We found no evidence of presence of the species in this precipitation band.
Geo-R2 (10-20 inches; 25-51 cm)	n - low	N/A	We found no evidence of presence of the species in this precipitation band.
Geo-R3 (20-30 inches; 51-76 cm)	n - high	N/A	Present in Hungary, which is about 80 percent within this precipitation band, but grows in thermal waters (Lukacs et al., 2014) fed by springs; precipitation is unlikely to be a direct factor in suitability.
Geo-R4 (30-40 inches; 76-102 cm)	y - mod	N/A	Four points in Japan near wetter areas, one in India near the 40-50 band, one in the United States (Texas).
Geo-R5 (40-50 inches; 102-127 cm)	y - negl	N/A	Present in Japan in precipitation bands ranging from 40 to 100+ inches and in the United States (Florida) in precipitation bands ranging from 40-90 inches.
Geo-R6 (50-60 inches; 127-152 cm)	y - negl	N/A	Present in Japan in precipitation bands ranging from 40 to 100+ inches and in the United States (Florida) in precipitation bands ranging from 40-90 inches; one point in Brazil
Geo-R7 (60-70 inches; 152-178 cm)	y - negl	N/A	Present in Japan in precipitation bands ranging from 40 to 100+ inches and in the United States (Florida) in precipitation bands ranging from 40-90 inches
Geo-R8 (70-80 inches; 178-203 cm)	y - negl	N/A	Present in Japan in precipitation bands ranging from 40 to 100+ inches and in the

Question ID	Answer - Uncertainty	Score	Notes (and references)
			United States (Florida) in precipitation bands ranging from 40-90 inches; one point in Brazil and Cameroon
Geo-R9 (80-90 inches; 203-229 cm)	y - negl	N/A	Present in Japan in precipitation bands ranging from 40 to 100+ inches and in the United States (Florida) in precipitation bands ranging from 40-90 inches
Geo-R10 (90-100 inches; 229-254 cm)	y - negl	N/A	Present in Japan in precipitation bands ranging from 40 to 100+ inches; one point in Indonesia
Geo-R11 (100+ inches; 254+ cm)	y - negl	N/A	Present in Japan in precipitation bands ranging from 40 to 100+ inches; three points in Indonesia, one in Papua New Guinea
ENTRY POTENTIAL			
Ent-1 (Plant already here)	y - negl	1	Because it is established in parts of Florida and Georgia (Spencer and Bowes, 1985), we did not evaluate its entry potential into the United States.
Ent-2 (Plant proposed for entry, or entry is imminent)	-	N/A	
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]	-	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 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	