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Animal and Plant Health Inspection Service

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Version 2

Weed Risk Assessment for *Phyllanthus fluitans* Benth. ex Müll. Arg. (Phyllanthaceae) – Red root floater

A small clump of *Phyllanthus fluitans* growing in the Peace River system in Florida. [source: Michael Sowinski, Florida Fish and Wildlife Conservation Commission (Sowinski, 2017a)]. Additional photos in Appendix B.

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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, 2016). 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: *Phyllanthus fluitans* Benth. ex Müll. Arg. (NGRP, 2017).

FAMILY: Phyllanthaceae

SYNONYMS: *Diasperus fluitans* (Benth. ex Müll. Arg.) Kuntze (The Plant List, 2017).

COMMON NAMES: Red root floater, floating spurge (NGRP, 2017).

BOTANICAL DESCRIPTION: *Phyllanthus fluitans* is a free-floating aquatic plant species similar to the water fern *Salvinia* (MacBride, 1951). It is also able to grow and root in damp soil in river floodplains (Sowinski, 2017b). Its stems are 3-5 cm long, with many rootlets emerging from the nodes (MacBride, 1951). Leaves are sessile, cordate-orbicular, and about 1.3 by 2.0 cm in size (Lot et al., 1980). The leaf surface forms a pocket on each side of the midrib that traps air and helps plants float (Lot et al., 1980; Webster, No Date). Plants produce 2-4 unisexual flowers on a cyme inflorescence and are nearly 1.5 mm long (MacBride, 1951). Seed capsules are depressed-globular in shape and nearly 3 mm wide (MacBride, 1951). There are six triangular seeds per capsule, 1.7 mm long by 1.1 mm wide (Lot et al., 1980). For a more detailed botanical description, see Lot et al. (1980) and Holm-Nielsen (1980). *Phyllanthus fluitans* may be initially confused with other free-floating aquatic species, such as water fern (*Salvinia minima*), duckweed (*Lemna valdiviana*, *Spirodela polyrhiza*, and *Landoltia punctata*), and immature water lettuce (*Pistia stratiotes*) (Sowinski, 2011).

INITIATION: In 2011, PPQ Field Operations asked whether this newly detected species could be listed as a Federal Noxious Weed (Larkins, 2011). An article describing the detection reported it in the Peace River system of southern Florida (Wilder and Sowinski, 2010). PERAL completed the analysis in June 2011. Then in 2017, PPQ Policy Management requested that PERAL develop a Not Authorized Pending Pest Risk Analysis datasheet for this species. As part of the process, PERAL updated the weed risk assessment to determine whether the species' status had changed.

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

FOREIGN DISTRIBUTION: *Phyllanthus fluitans* is native to the Amazon basin and ranges from Colombia and Venezuela southward through Brazil, Ecuador, Peru, Bolivia, Paraguay, and northern Argentina (Landolt, 1999; Leon and Young, 1996; Murillo-A, 2004; NGRP, 2017). In the 1970s, it was collected for the first time on the west side of the Andes, north of Guayaquil, Ecuador (Holm-Nielsen, 1980). It is commercially cultivated by the aquatic plant company Tropica in Denmark (Windeløv, 2004). It has become naturalized at one site in Mexico, which is similar to the species' native habitats in the Amazon basin (Lot et al., 1980; Steinmann, 2002).

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

U.S. DISTRIBUTION AND STATUS: On Aug. 27, 2010, George Wilder (Naples Botanical Garden) found *P. fluitans* growing abundantly in a canal by the Peace River in Desoto County, Florida. By October, Michael Sowinski (Florida Fish and Wildlife Conservation Commission) observed it at 35 additional locations within the Peace River and its tributaries, including a major infestation within a narrow channel just north of the junction of the Peace River and Horse Creek. All known localities were from Desoto County, and the two most distant ones were 26 river-miles apart (Wilder and Sowinski, 2010). In 2015, it was found growing and rooting in damp soil in the Peace River floodplain (Sowinski, 2017b). Then in 2016, it was discovered in an adjacent county downriver from original locations (Wunderlin and Hansen, 2017). Currently, it is known to range from five miles north of Arcadia to an area near Harbor Heights (Sowinski, 2017b). Over the last six years, a total of 67 acres have been treated by the Southwest Florida Water Management District, representing 272.5 hours in labor and $15,559.73 in direct costs (Sowinski, 2017a). *Phyllanthus fluitans* is cultivated in the United States as an aquarium plant (AGA Forum, 2006; APC, 2011; Aquatic Scapes, 2011). It is available from online vendors posting on Amazon and eBay (Amazon, 2017; eBay, 2017). It may have been introduced to the Peace River system either intentionally as discarded plants or unintentionally by plants escaping from backyard ponds (Sowinski, 2011). We found no evidence that this species is regulated in the United States (e.g., NPB, 2016; NRCS, 2017; USDA-AMS, 2016), but this is not surprising given that most states are likely unaware of this new invader. Figure 1 shows the current U.S. distribution of *P. fluitans.*

3. Analysis

ESTABLISHMENT/SPREAD POTENTIAL

Phyllanthus fluitans is an aquatic species that has become naturalized in Mexico and Florida (Steinmann, 2002; Wilder and Sowinski, 2010). Based on its ability to recolonize areas (Lot et al., 1980; Sowinski, 2017a) and spread downriver in Florida (Sowinski, 2017b; Wunderlin and Hansen, 2017), we consider this species to be behaving invasively. Its ability to form dense mats, reproduce vegetatively, be dispersed by water, and tolerate mutilation contributed to its risk score (Wilder and Sowinski, 2010). This species has a broad distribution in its native range in South America, suggesting it is widely adaptable. We had very high uncertainty for this risk element because so little is known about its biology. Five of the questions considered in this risk element could not be definitively answered.

Risk score = 13 Uncertainty index = 0.28

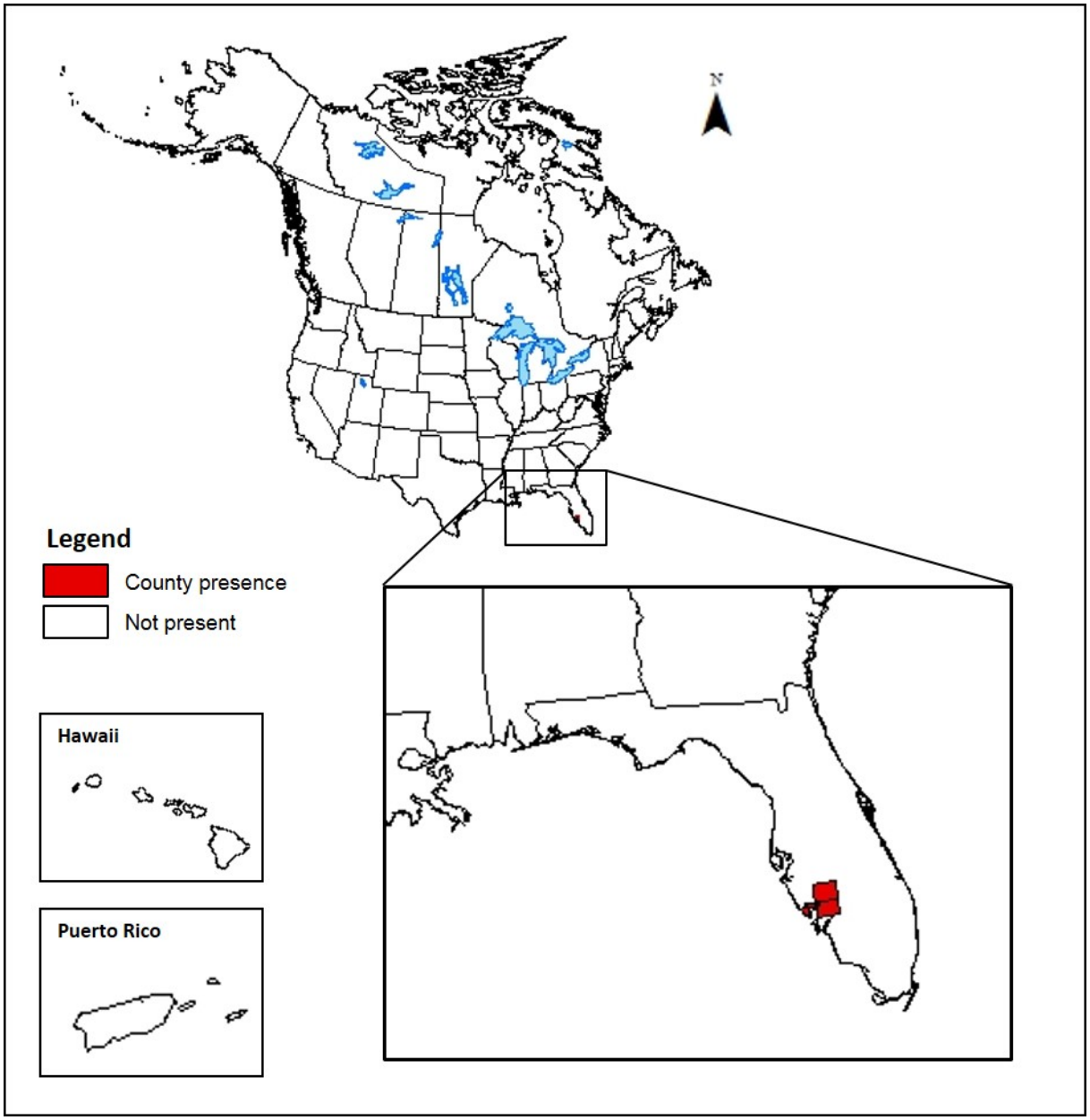

Figure 1. Known naturalized distribution of *Phyllanthus fluitans* in the United States and Canada. The records shown here were obtained from herbarium records at the University of South Florida (Wunderlin and Hansen, 2017). Scales differ for Hawaii, Puerto Rico, and North America.

IMPACT POTENTIAL

Because *P. fluitans* has only recently become naturalized beyond its native range (Lot et al., 1980; Wilder and Sowinski, 2010), its impacts have not been well characterized, nor has it had enough time to express its potential impacts. In Florida, as in the Amazon, this species forms a dense mat of vegetation at the water's surface (FWC, 2011; Piranha-Fury, 2006; Wilder and Sowinski, 2010; also see Fig. B3) that shades out species growing below (Sowinski, 2011) and changes the vegetation structure

of aquatic communities. Currently this species, along with three other exotic aquatic plants, are being continuously managed on the Peace River to prevent them from hampering navigation, covering backwater areas, and causing other impacts (Sowinski, 2017b). Densely growing, free-floating aquatic plant species often limit light, change dissolved oxygen concentrations, hinder navigation, and have other impacts (e.g., Akers, 2010; DiTomaso, 2010; Fernández et al., 1990; Madsen et al., 1998; Tall et al., 2011; Zhu et al., 2014). Over the last six years, a total of 67 acres along the Peace River have been treated by the Southwest Florida Water Management District, representing 272.5 hours in labor and $15,559.73 in direct costs (Sowinski, 2017a). We had very high uncertainty for this risk element because so little is known about this species.

Risk score = 2.4 Uncertainty index = 0.40

GEOGRAPHIC POTENTIAL

Based on three climatic variables, we estimate that about 8 percent of the United States is suitable for the establishment of *P. fluitans* (Fig. 2). This predicted distribution is based on the species' known distribution elsewhere in the world and includes point-referenced localities and general areas of occurrence. The map for *P. fluitans* represents the joint distribution of Plant Hardiness Zones 9-13, areas with 10-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savanna, humid subtropical, and marine west coast. Although we found no evidence that this species occurs in steppe and Mediterranean climates, we believe it may be able to if the Hardiness Zone is warm enough and if there are suitable habitats with flowing or standing water. If these climates types were suitable, then additional areas on the U.S. west coast may be susceptible to invasion by this species.

The area of the United States shown to be climatically suitable (Fig. 2) for species establishment considered only three climatic variables. Other variables, for example, water quality, water pH, habitat type, novel climatic conditions, or plant genotypes, may alter the areas in which this species is likely to establish. *Phyllanthus fluitans* is an aquatic species that occurs in grassy floodplains, flooded forests, forested wetlands, rivers, streams, and ponds (Junk, 1986; Lot et al., 1980; Sowinski, 2011; Webster, No Date). It is also able to grow and root in damp soil in river floodplains (Sowinski, 2017b). Flood waters are able to disperse plants to isolated suitable habitats (Sowinski, 2011). In South America, this species is associated with other free-floating aquatic species such as *Lemna*, *Pistia*, *Azolla*, and *Salvinia* (Landolt, 1999).

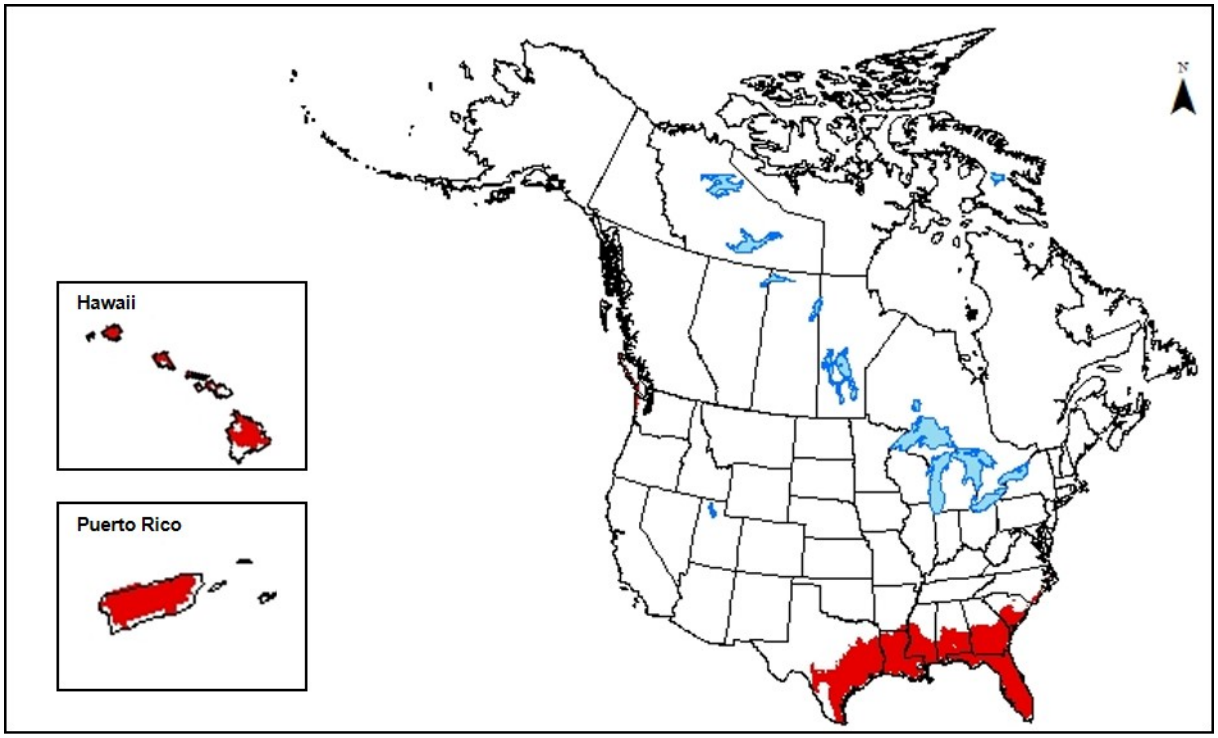

Figure 2. Potential geographic distribution of *Phyllanthus fluitans* in the United States and Canada. Map insets for Hawaii and Puerto Rico are not to scale.

ENTRY POTENTIAL

Phyllanthus fluitans is cultivated and naturalized in the United States (AGA Forum, 2006; Aquatic Scapes, 2011; Wilder and Sowinski, 2010); however, we evaluated this risk element to determine how additional material may enter the United States. On a scale of 0 to 1, where 1 represents the maximum risk score, *P. fluitans* obtained a value of 0.5 on our assessment scale. The only pathway of entry for which we found evidence was in the ornamental trade. *Phyllanthus fluitans* is a popular aquarium plant that is cultivated in aquaria (AGA Forum, 2006; APC, 2011; Aquatic Scapes, 2011; FWC, 2011) and is suitable for growing in ponds (MBG, 2011). It is currently produced by one major international vendor (APC, 2017), a Denmark company (TROPICA, 2011) that exports aquarium plants to the United States. It is also possible that *P. fluitans* may enter the United States as a contaminant of aquarium plants, as those shipments are often contaminated with other aquatic plants (e.g., Maki and Galatowitsch, 2004). We had low uncertainty for this risk element.

Risk score = 0.5 Uncertainty index = 0.12

4. Predictive Risk Model Results

Model Probabilities: P(Major Invader) = 53.4%
P(Minor Invader) = 44.0%
P(Non-Invader) = 2.6%
Risk Result = High Risk
Secondary Screening = Not applicable

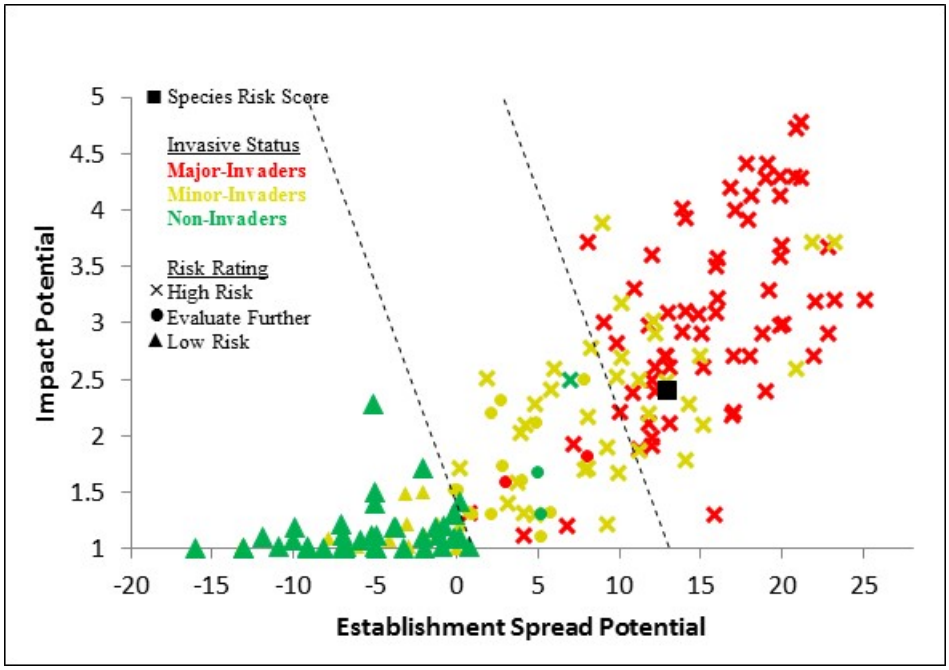

Figure 3. *Phyllanthus fluitans* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

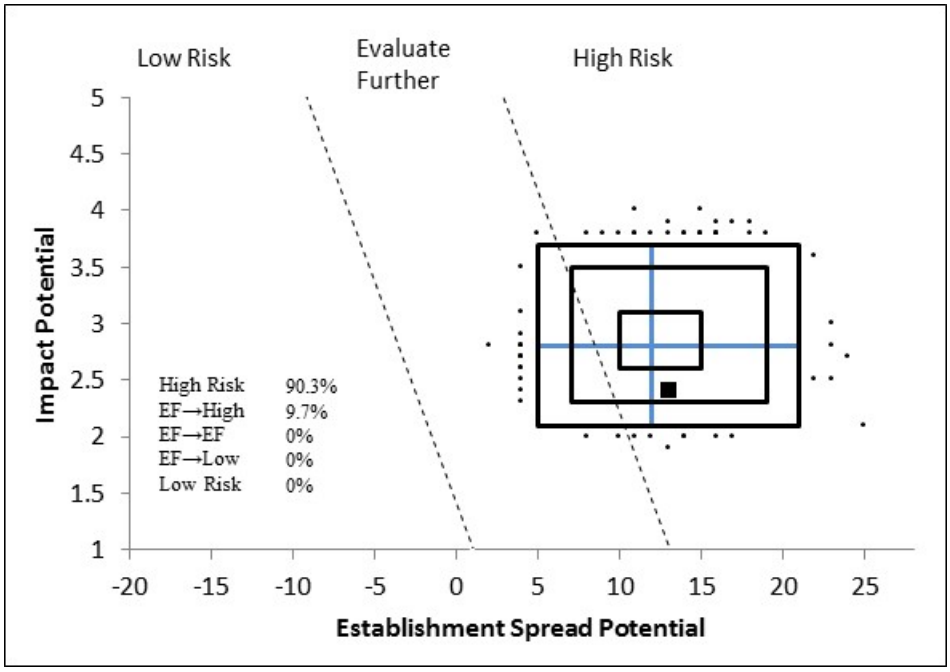

Figure 4. Model simulation results (N=5,000) for uncertainty around the risk score for *P. fluitans*. The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

5. Discussion

The result of the weed risk assessment for *Phyllanthus fluitans* is High Risk (Fig. 3). Despite the limited amount of information available for this species, the results of our uncertainty simulation indicate that our conclusion is robust, as 90 percent of the simulated risk scores were classified as High Risk (Fig. 4). *Phyllanthus fluitans* is ecologically very similar to other free-floating aquatic species (e.g., *Pistia stratiotes*, *Salvinia molesta*, and *Eichhornia crassipes*) that are considered significant weeds and invaders. In the Peruvian Amazon, this species forms vegetation mats with other floating aquatics in the following genera: *Azolla*, *Salvinia*, *Pistia*, and *Lemna* (Gómez P., 2006). The two biologists who first reported the species in Florida fear that if treatments fail to control *P. fluitans*, it may become as problematic as these other aquatic invaders (Wilder and Sowinski, 2010). Because summer floods can disperse plants into wetlands and other areas away from the main water channel that are more difficult to access and treat, it is unlikely it would ever be eradicated because these areas will simply reinoculate the main channel (Sowinski, 2011). However, south Florida resource managers will continue to monitor and treat this species in an effort to prevent it from spreading to other areas (Sowinski, 2011).

6. Acknowledgements

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SUGGESTED CITATION

PPQ. 2017. Weed risk assessment for *Phyllanthus fluitans* Benth. ex Müll. Arg. (Phyllanthaceae) – Red root floater. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (PPQ), Raleigh, NC. 23 pp.

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7. Literature Cited

7 U.S.C. § 1581-1610. 1939. The Federal Seed Act, Title 7 United States Code § 1581-1610.

7 U.S.C. § 7701-7786. 2000. Plant Protection Act, Title 7 United States Code § 7701-7786.

AGA Forum. 2006. *Phyllanthus fluitans*. Aquatic Gardeners Association (AGA): An international society dedicated to keeping aquatic plants. Last accessed April 18, 2011, http://forum.aquatic-gardeners.org/index.php.

Akers, P. 2010. Draft pest profile for *Limnobium laevigatum*. Unpublished Report. California Department of Food and Agriculture, Sacramento, CA.

Amazon. 2017. Listings Database. Amazon. Last accessed April 3, 2017, http://www.amazon.com.

APC. 2011. *Phyllanthus fluitans*. Aquatic Plant Center (APC). Last accessed April 15, 2011, http://www.aquaticplantcentral.com/.

APC. 2017. Aquatic Plant Finder [Online Database]. Aquatic Plant Central (APC). http://www.aquaticplantcentral.com/forumapc/plantfinder/index.php. (Archived at PERAL).

APD. 2017. African Plants Database (APD), version 3.4.0. Conservatoire et Jardin Botaniques de la Ville de Genève and South African National Biodiversity Institute. http://www.ville-ge.ch/musinfo/bd/cjb/africa. (Archived at PERAL).

APHIS. 2017. Phytosanitary Certificate Issuance & Tracking System (PCIT). United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS). https://pcit.aphis.usda.gov/pcit/. (Archived at PERAL).

AQAS. 2017. Agriculture Quarantine Activity Systems (AQAS) Database. United States Department of Agriculture - Plant Protection and Quarantine. https://mokcs14.aphis.usda.gov/aqas/login.jsp. (Archived at PERAL).

Aquatic Scapes. 2011. *Phyllanthus fluitans* (beautiful red floating plant!). Aquatic Scapes. Last accessed April 18, 2011, http://freshwateraquariumplants.com/index.html.

CABI. 2011. Crop Protection Compendium, Online Database. CAB International (CABI). http://www.cabi.org/cpc/. (Archived at PERAL).

DiTomaso, J. M. 2010. Watch out for these Red Alert weeds! Cal IPC News 17(4):4-7.

eBay. 2017. Listings Database. eBay.com. Last accessed April 4, 2017, http://www.ebay.com/.

Fernández, O. A., D. L. Sutton, V. H. Lallana, M. R. Sabbatini, and J. H. Irigoyen. 1990. Aquatic weed problems and management in South and Central America. Pages 406-425 *in* A. H. Pieterse and K. J. Murphy (eds.). Aquatic Weeds: The Ecology and Management of Nuisance Aquatic Vegetation. Oxford University Press, New York.

FWC. 2011. Weed alert: Red root floater (*Phyllanthus fluitans*). Florida Fish and Wildlife Conservation Commission (FWC), Tallahassee, FL., U.S.A. 1 pp.

GBIF. 2017. GBIF, Online Database. Global Biodiversity Information Facility (GBIF). http://www.gbif.org/. (Archived at PERAL).

Gómez P., L. D. 2006. Novedades en la Amazonia Peruana. Lankesteriana 6(1):5-7.

GWAPA. 2004. Discussion forum: *Phyllanthus fluitans*. Greater Washington Aquatic Plants Association (GWAPA). Last accessed April 18, 2011, http://www.gwapa.org/forum/viewtopic.php?t=305&highlight=phyllanthus+fluitans.

Heap, I. 2017. The international survey of herbicide resistant weeds. Weed Science Society of America. http://weedscience.org/. (Archived at PERAL).

Heide-Jorgensen, H. S. 2008. Parasitic Flowering Plants. Brill, Leiden, The Netherlands. 438 pp.

Holm-Nielsen, L. B. 1980. Una extraña planta acuática: *Phyllanthus fluitans* Benth ex Muell Agr. de la flora ecuatoriana Revista de la Universidad Catolica 27:125-137.

Holm, L. G., J. V. Pancho, J. P. Herberger, and D. L. Plucknett. 1979. A Geographical Atlas of World Weeds. Krieger Publishing Company, Malabar, FL. 391 pp.

IPPC. 2016. International Standards for Phytosanitary Measures No. 2: Framework for Pest Risk Analysis. Food and Agriculture Organization of the United Nations, Secretariat of the International Plant Protection Convention (IPPC), Rome, Italy. 16 pp.

IPPC. 2017. International Standards for Phytosanitary Measures No. 5: Glossary of Phytosanitary Terms. Food and Agriculture Organization of the United Nations, Secretariat of the International Plant Protection Convention (IPPC), Rome, Italy. 34 pp.

Johnson, L. E., A. Ricciardi, and J. T. Carlton. 2001. Overland dispersal of aquatic invasive species: A risk assessment of transient recreational boating [Abstract]. Ecological Applications 11(6):1789-1799.

Johnstone, I. M., B. T. Coffey, and C. Howard-Williams. 1985. The role of recreational boat traffic in interlake dispersal of macrophytes: A New Zealand case study [Abstract]. Journal of Environmental Management 20(3):263-279.

Junk, W. J. 1986. Aquatic plants of the Amazon system. Pages 319-337 *in* B. R. Davies and K. F. Walker (eds.). The Ecology of River Systems. Dr. W. Junk Publishers, Dordrecht, The Netherlands.

Koop, A., L. Fowler, L. Newton, and B. Caton. 2012. Development and validation of a weed screening tool for the United States. Biological Invasions 14(2):273-294.

Landolt, E. 1999. Pleustonic communities with Lemnaceae in South America. Applied Vegetation Science 2:7-16.

Leon, B., and K. R. Young. 1996. Aquatic plants of Peru: Diversity, distribution and conservation. Biodiversity and Conservation 5:1169-1190.

Lot, A., A. Novelo, and C. P. Cowan. 1980. Hallazgo en México de una euforbiacea acuática (*Phyllanthus fluitans*) originaria de sudamérica. Boletin de la Sociedad Botanica de Mexico 39:83-90.

MacBride, J. F. 1951. Flora of Peru. Chicago Field Museum of Natural History, Chicago, U.S.A. 290 pp.

Madsen, J. D., C. S. Owens, and K. D. Getsinger. 1998. Evaluation of four herbicides for management of American frogbit (*Limnobium spongia*). Journal of Aquatic Plant Management 36:148-150.

Maki, K., and S. Galatowitsch. 2004. Movement of invasive aquatic plants into Minnesota (USA) through horticultural trade. Biological Conservation 118(3):389-396.

Martin, P. G., and J. M. Dowd. 1990. A protein sequence study of the dicotyledons and its relevance to the evolution of the legumes and nitrogen fixation. Australian Systematic Botany 3:91-100.

MBG. 2011. Kemper Center for home gardening. Missouri Botanical Garden (MBG), St. Louis, MO, USA. Last accessed Apirl 18, 2011, http://www.mobot.org/gardeninghelp/plantfinder/Plant.asp?code=R320.

Montgomery, G. G., R. C. Best, and M. Yamakoshi. 1981. A radio-tracking study of the Amazonian manatee *Trichechus inuguis* (Mammalia: Sirenia). Biotropica 13(2):81-85.

Murillo-A, J. 2004. Las Euphorbiaceae de Colombia. Biota Colombiana 5(2):183-200.

NGRP. 2017. Germplasm Resources Information Network (GRIN). United States Department of Agriculture, Agricultural Research Service, National Genetic Resources Program (NGRP). https://npgsweb.ars-grin.gov/gringlobal/taxon/taxonomysearch.aspx?language=en. (Archived at PERAL).

Nickrent, D. 2009. Parasitic plant classification. Southern Illinois University Carbondale, Carbondale, IL. Last accessed June 12, 2009, http://www.parasiticplants.siu.edu/ListParasites.html.

NPB. 2016. Laws and regulations. The National Plant Board (NPB). Last accessed September 28, 2016, http://nationalplantboard.org/laws-and-regulations/.

NRCS. 2017. The PLANTS Database. United States Department of Agriculture, Natural Resources Conservation Service (NRCS), The National Plant Data Center. http://plants.usda.gov/cgi_bin/. (Archived at PERAL).

Piranha-Fury. 2006. Piranha information site and discussion forum. Piranha-Fury. Last accessed Apirl 18, 2001, http://www.piranha-fury.com/information/index.php?Act=index.

PPQ. 2015. Guidelines for the USDA-APHIS-PPQ Weed Risk Assessment Process. United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ). 125 pp.

Randall, J. M. 2007. The Introduced Flora of Australia and its Weed Status. CRC for Australian Weed Management, Department of Agriculture and Food, Western Australia, Australia. 528 pp.

Randall, R. P. 2017. A Global Compendium of Weeds, 3rd edition. Department of Agriculture and Food, Western Australia, Perth, Australia. 3654 pp.

Ricketts, T. H., E. Dinerstein, D. M. Olson, C. J. Loucks, W. Elchbaum, D. DellaSala, K. Kavanagh, P. Hedao, P. T. Hurley, K. M. Carney, R. Abell, and S. Walters. 1999. Terrestrial Ecoregions of North America: A Conservation Assessment. Island Press, Washington D.C. 485 pp.

Rothlisberger, J. D., W. L. Chadderton, J. McNulty, and D. M. Lodge. 2010. Aquatic invasive species transport via trailered boats: What is being moved, who is moving it, and what can be done. Fisheries 35(3):121-132.

Santi, C., D. Bogusz, and C. Franche. 2013. Biological nitrogen fixation in non-legume plants. Annals of Botany 111(5):743-767.

Sowinski, M. P. 2011. Red root floater, *Phyllanthus fluitans* (Euphorbiaceae): Another aquatic invader for Florida. Aquatics 33(3):7-10.

Sowinski, M. P. 2017a. Looking for information on *Phyllanthus fluitans*. Personal communication to A. Koop on August 10, 2017, from Michael Sowinski, Biological Scientist, Florida Fish and Wildlife Conservation Commission, Invasive Plant Management Section.

Sowinski, M. P. 2017b. Red root floater update. Aquatics 39(1):5-7.

Steinmann, V. W. 2002. Diversidad y endemismo de la famlia Euphorbiaceae en Mexico. Acta Botanica Mexicana 61:61-93.

Tall, L., N. Caraco, and R. Maranger. 2011. Denitrification hot spots: Dominant role of invasive macrophyte *Trapa natans* in removing nitrogen from a tidal river. Ecological Applications 21(8):3104-3114.

The Plant List. 2017. The Plant List, Version 1 [Online Database]. Kew Botanic Gardens and the Missouri Botanical Garden. http://www.theplantlist.org/. (Archived at PERAL).

TPT. 2006. *Phyllanthus* (*Phyllanthus fluitans*). The Planted Tank (TPT). Last accessed April 18, 2001, http://www.plantedtank.net/forums/plants/35209-phyllanthus-phyllanthus-fluitans.html.

TROPICA. 2011. Tropica Aquarium Plants. TROPICA. Last accessed April 18, 2011, http://www.tropica.com/home.aspx.

USDA-AMS. 2016. State Noxious-Weed Seed Requirements Recognized in the Administration of the Federal Seed Act. United States Department of Agriculture (USDA), Agricultural Marketing Service (AMS), Washington D.C. 121 pp.

Webster, G. L. No Date. Outline of the neotropical infrageneric taxa of *Phyllanthus* (Euphorbiaceae). University of California, Davis, California. 88 pp.

Wilder, G. J., and M. P. Sowinski. 2010. *Phyllanthus fluitans* Benth. (Euphorbiaceae): A newly reported invasive species in Florida. Wildland Weeds (Fall 2010):14-15.

Windeløv, H. 2004. Tropica Aquarium Plants Catalogue. Tropica Aquarium Plants, Egå, Denmark. 97 pp.

Wunderlin, R. P., and P. F. Hansen. 2017. Atlas of Florida Vascular Plants. University of South Florida, Department of Biology, Institute for Systematic Botany. http://florida.plantatlas.usf.edu/Default.aspx. (Archived at PERAL).

Zhu, B., M. S. Ellis, K. L. Fancher, and L. G. Rudstam. 2014. Shading as a control method for invasive European frogbit (*Hydrocharis morsus-ranae* L.). PLoS ONE 9(6):1-6.

Appendix A. Weed risk assessment for *Phyllanthus fluitans* Benth. ex Müll. Arg. (Phyllanthaceae)

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]	f - negl	5	*Phyllanthus fluitans* is native to the Amazon basin, and ranges from Colombia and Venezuela southward through Brazil, Ecuador, Peru, Bolivia, Paraguay, and northern Argentina (Landolt, 1999; Leon and Young, 1996; Murillo-A, 2004; NGRP, 2017). It has been introduced to Denmark, where it is commercially propagated (Windeløv, 2004). It has naturalized in Mexico (Lot et al., 1980; Steinmann, 2002) and Florida (Wilder and Sowinski, 2010). In a period of a few months after its initial detection in Florida in 2010, it was found at 36 separate sites along the Peace River system and its tributaries in Florida, but in only one county (Desoto) (Wilder and Sowinski, 2010). Then in 2016, it was detected in an adjacent county, downriver from the initial discovery (Wunderlin and Hansen, 2017). In Florida, during flooding events, "the plants get pushed into private pastures, ponds, ditches, depressions, etc. [and] then become trapped once the water levels recede. The next rainy season when the river floods again these trapped populations are released into the main river allowing it to re-infest previously controlled backwater areas" (Sowinski, 2017a). Because the species is easily spreading along the river, we answered "f" with negligible uncertainty. Alternate answers for the uncertainty simulation, were both "e".
ES-2 (Is the species highly domesticated)	n - low	0	*Phyllanthus fluitans* is cultivated (Wilder and Sowinski, 2010) as an ornamental plant for freshwater aquaria (AGA Forum, 2006; APC, 2011; Aquatic Scapes, 2011). We found no evidence that it is highly domesticated or has been bred for reduced weed potential.
ES-3 (Significant weedy congeners)	n - low	0	There are approximately 800 species in the genus *Phyllanthus* (Webster, No Date), many of which are agricultural and ruderal weeds of significance (CABI, 2011; Holm et al., 1979; Randall, 2007). However, as an aquatic plant, *P. fluitans* is ecologically very distinct from these. The only other aquatic *Phyllanthus* species are *P. irriguus* and *P. leonardianus*, which are native to tropical Africa (APD, 2017). We found no evidence that these species are considered significant weeds (e.g., Randall, 2017).
ES-4 (Shade tolerant at some stage of its life cycle)	n - low	0	*Phyllanthus fluitans* grows at the margin of flooded forests in the Amazon River, and in small open patches (Junk, 1986). Where it has become naturalized in Mexico, it was found growing in a flooded pasture (Lot et al., 1980). Under

Question ID	Answer - Uncertainty	Score	Notes (and references)
			cultivation, this species requires high to very high-light environments (MBG, 2011; Windeløv, 2004). Together, this evidence suggests it is shade intolerant.
ES-5 (Plant a vine or scrambling plant, or forms tightly appressed basal rosettes)	n - negl	0	*Phyllanthus fluitans* is not a vine nor does it form rosettes; it is a free-floating aquatic (Wilder and Sowinski, 2010).
ES-6 (Forms dense thickets, patches, or populations)	y - negl	2	This species forms dense floating mats in Florida [(Sowinski, 2011); also see Fig. B2] and in Peru (Gómez P., 2006). The wind can blow individual plants together to form dense mats (Lot et al., 1980).
ES-7 (Aquatic)	y - negl	1	*Phyllanthus fluitans* is a free-floating, obligate aquatic plant (Leon and Young, 1996; Murillo-A, 2004; Wilder and Sowinski, 2010). The leaf surface is densely papillate, water repellant, and contains two air pocket on the underside (Wilder and Sowinski, 2010), all of which help plants float. Adventitious roots develop from nodes (Wilder and Sowinski, 2010). Although *P. fluitans* is a free-floating aquatic, it is also able to grow and root in damp soil in river floodplains (Sowinski, 2017b).
ES-8 (Grass)	n - negl	0	This species is not a grass. It is a member of the Phyllanthaceae (NGRP, 2017), which is sometimes considered part of the Euphorbiaceae (Murillo-A, 2004).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	We found no evidence that this species fixes nitrogen. The Phyllanthaceae or Euphorbiaceae is not known to contain nitrogen-fixing species (Martin and Dowd, 1990; Santi et al., 2013).
ES-10 (Does it produce viable seeds or spores)	y - high	1	*Phyllanthus fluitans* produces seed (Lot et al., 1980). One aquarium hobbyist reports that it can be propagated by seed (GWAPA, 2004). In Florida, it is not known whether the seeds that are produced each fall are viable (Sowinski, 2011). As an annual species, the aquatic congener, *P. leonardianus* (APD, 2017), may be dependent on seed propagation. We answered yes for *P. fluitans* but used high uncertainty because this evidence is very weak.
ES-11 (Self-compatible or apomictic)	? - max	0	Unknown
ES-12 (Requires specialist pollinators)	? - max		Unknown
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	Lot et al. (1980) report that depending on habitat conditions (wind, water currents, and seasonality of water inundations), *P. fluitans* can behave as either an annual or perennial. However, it is not clear from their description whether they were referring to plant life history, or the seasonality of plant populations in a given area. As Sowinski (2017a) points out for Florida, during the rainy season, plants growing in depressions, ponds, and other protected areas can recolonize seasonally inundated areas or sites where plants were previously eradicated. Because it is not clear whether this species undergoes sexual reproduction, we based this answer on its ability to reproduce vegetatively (Wilder and Sowinski, 2010). Plant stems produce lateral stems and are brittle (Wilder and Sowinski, 2010). Aquarium hobbyists

Question ID	Answer - Uncertainty	Score	Notes (and references)
			report that plants "[g]row like crazy" (AGA Forum, 2006; APC, 2011). Because of its fast growth, growers must periodically thin out these plants from their tanks (TPT, 2006). Based on its behavior in aquaria, this species is very likely able to produce multiple generations per year. We answered "a" but with high uncertainty. Alternate answers for the uncertainty simulation were "b" and "c."
ES-14 (Prolific seed producer)	? - max	0	Unknown. Each fruit capsule contains six seeds (FWC, 2011). We found no other evidence on seed production that would allow us to answer this question.
ES-15 (Propagules likely to be dispersed unintentionally by people)	y - high	1	Unknown. Because of its fast growth, aquarium hobbyists must periodically thin out these plants from their tanks (TPT, 2006). It is not unreasonable that some hobbyists that live behind rivers, streams, and canals may discard plants into these water bodies rather than disposing of them properly. This species is believed to have been introduced into Florida through the aquarium trade (Wilder and Sowinski, 2010), but it is not known if this was accidental or intentional. Also, as an aquatic plant, *P. fluitans* may also be spread by recreational boating, similar to what has happened with other aquatic macrophytes (e.g., Johnson et al., 2001; Johnstone et al., 1985; Rothlisberger et al., 2010). Based on how easily other aquatics plant species are dispersed unintentionally, we answered yes with high uncertainty.
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	n - mod	-1	We found no evidence that *P. fluitans* moves as contaminant of trade (e.g., AQAS, 2017).
ES-17 (Number of natural dispersal vectors)	1	-2	Propagule traits for questions ES-17a through ES-17e: The fruit is a depressed-globose capsule that is about 3 mm wide. The capsule is trilocular and six-seeded, with two seeds filling each locule (Wilder and Sowinski, 2010). Seeds are 1.7 mm long by 1.1 mm wide (Lot et al., 1980).
ES-17a (Wind dispersal)	n - negl		We found no evidence of wind dispersal. Because the fruit do not possess any traits typically associated with wind-dispersed propagules (e.g., wings, plumes, etc.), we answered no. We do not consider evidence of floating plants being pushed by wind across a water body (Lot et al., 1980) as qualifying evidence for this question.
ES-17b (Water dispersal)	y - negl		The plant itself is a free floating aquatic (Wilder and Sowinski, 2010); thus it can be dispersed via water. The pedicels of female flowers curve down into the water as fruit develop (Lot et al., 1980), suggesting that the fruit and seeds may also be water dispersed.
ES-17c (Bird dispersal)	n - high		We found no evidence of bird dispersal. Some water fowl may consume and disperse the seeds.
ES-17d (Animal external dispersal)	n - mod		We found no evidence of this type of dispersal. Because there is no obvious morphological adaptions for this, we answered no.
ES-17e (Animal internal dispersal)	? - max		This species grows in areas where manatees are present (Montgomery et al., 1981) and thus may be consumed and dispersed by them.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	? - max	0	Unknown.
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	y - high	1	Because the stems are brittle (FWC, 2011; Wilder and Sowinski, 2010) and it reproduces vegetatively (Wilder and Sowinski, 2010), it is highly likely that this species would benefit from anything that breaks up the plant.
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - mod	0	We found no evidence that this species or any other *Phyllanthus* species is resistant to herbicides (Heap, 2017). At one site, herbicide treatments with diquat dibromide killed some plants but not all (Wilder and Sowinski, 2010).
ES-21 (Number of cold hardiness zones suitable for its survival)	5	0	
ES-22 (Number of climate types suitable for its survival)	4	2	
ES-23 (Number of precipitation bands suitable for its survival)	10	1	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - mod	0	We found no evidence of this plant being allelopathic.
Imp-G2 (Parasitic)	n - negl	0	We found no evidence that this free-floating aquatic plant is parasitic. It is not a member of a plant family known to contain parasitic plants (Heide-Jorgensen, 2008; Nickrent, 2009).
Impacts to Natural Systems			
Imp-N1 (Changes ecosystem processes and parameters that affect other species)	? - max		Unknown. The potential ecosystem effects of this species have not been studied. *Phyllanthus fluitans* forms dense floating mats of vegetation (Gómez P., 2006; Lot et al., 1980; Sowinski, 2011), which we suspect could change ecosystem processes. Densely growing, free-floating aquatic plant species often limit light, change dissolved oxygen concentrations, and affect other ecosystem properties (e.g., Tall et al., 2011; Zhu et al., 2014).
Imp-N2 (Changes habitat structure)	y - mod	0.2	In the Amazon, this species covers rivers and lakes (Piranha-Fury, 2006). In Florida, it can produce a closed canopy at the water's surface (FWC, 2011; also see Fig. B3). Because this is creating a vegetation layer where none existed before, we answered yes with moderate uncertainty.
Imp-N3 (Changes species diversity)	y - mod	0.2	Dense mats shade out species growing below (Sowinski, 2011). "If red root floater is not successfully controlled, it has the potential to become a problematic species comparable to water fern, water lettuce, and water hyacinth (*Eichhornia crassipes*). By covering large swaths of stagnant backwater areas, this noxious species may limit or totally block all ambient light penetration to the bottom of the system, which can stunt and potentially kill submersed plants growing below" (Sowinski, 2011). In the Peruvian Amazon, this species forms vegetation mats with other floating aquatics in the following genera: *Azolla*, *Salvinia*, *Pistia*, and *Lemna* (Gómez P., 2006).

Question ID	Answer - Uncertainty	Score	Notes (and references)
Imp-N4 (Is it likely to affect federal Threatened and Endangered species?)	y - high	0.1	Because it forms mats (Gómez P., 2006) that cover rivers and lakes (Piranha-Fury, 2006), it seems likely to affect T&E species in these ecosystems.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions?)	? - max		This species is capable of surviving in Florida, most of which is classified as a globally outstanding ecoregion (Ricketts et al., 1999). However, without specific evidence of significant impacts to entire ecosystems or ecosystem processes, we answered 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]	c - negl	0.6	*Phyllanthus fluitans* is considered a weed of natural areas in Florida (FWC, 2011). Over the last six years, a total of 67 acres along the Peace River have been treated by the Southwest Florida Water Management District, representing 272.5 hours in labor and $15,559.73 in direct costs (Sowinski, 2017a).
Impact to Anthropogenic Systems (e.g., cities, suburbs, roadways)			
Imp-A1 (Negatively impacts personal property, human safety, or public infrastructure)	? - max		Unknown. Because this is a free-floating, aquatic plant that forms large, dense mats, (Piranha-Fury, 2006; Wilder and Sowinski, 2010), it may interfere with water distribution and discharge in canals. Other free-floating aquatic plants have these kinds of impacts (Akers, 2010; DiTomaso, 2010).
Imp-A2 (Changes or limits recreational use of an area)	y - mod	0.1	Currently this species, along with three other aquatic plants, are being continuously managed on the Peace River to prevent them from hampering navigation, and other impacts (Sowinski, 2017b). Other free floating aquatics such as *Limnobium spondias* (Madsen et al., 1998) and *Eichhornia crassipes* (Fernández et al., 1990) limit access.
Imp-A3 (Affects desirable and ornamental plants, and vegetation)	y - high	0.1	One aquarium site states that "due to its fast growth, the aquarist will have to remove excess plants quite frequently to prevent it from overshadowing plants below it" (APC, 2011). Another site states that "[i]f growth is good the plant needs thinning to prevent it overshadowing plants on the bottom" (TROPICA, 2011). One grower on an aquatic gardening site was glad to share it with others because it seems she was "infested" with it (AGA Forum, 2006). We answered yes because this species can impact desirable plants; however, because the plant is cultivated and viewed as desirable in aquaria and ponds (MBG, 2011), we used high uncertainty.
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	*Phyllanthus fluitans* was found growing in a canal by the Peace River (Wilder and Sowinski, 2010), and it is considered a weed in the region (FWC, 2011). We used high uncertainty because there is no other indication it is considered a weed of anthropogenic areas. Alternate answers for the uncertainty simulation were "c" and "a."
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	n - mod	0	We found no evidence of this type of impact.
Imp-P2 (Lowers commodity value)	n - mod	0	We found no evidence of this type of impact.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Imp-P3 (Is it likely to impact trade?)	n - mod	0	We found no evidence that it can contaminate a trade pathway or that it is regulated elsewhere (e.g., APHIS, 2017; NPB, 2016; USDA-AMS, 2016).
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	? - max		Unknown. Although not reported growing in agricultural areas, because it has been found growing in a canal in Florida (Wilder and Sowinski, 2010) and has been identified as a weed (FWC, 2011), it may become problematic in canals and ditches that supply water to agricultural areas.
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	n - high	0	We found no evidence that it is toxic, and used high uncertainty because there is little known about this species.
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 - high	0	The authors that report it for the first time in Mexico (in flooded pastures used by cattle) say it has weed characteristics and is associated with other aquatic weeds such as *Salvinia* and *Pistia* (Lot et al., 1980). However, because there was no evidence that it was interfering with cattle production, we answered "a" with high uncertainty. Alternate answers for the uncertainty simulation were both "b."
GEOGRAPHIC POTENTIAL			Unless otherwise indicated, the following evidence represents geographically referenced points obtained from the Global Biodiversity Information Facility (GBIF, 2017).
Plant hardiness zones			
Geo-Z1 (Zone 1)	n - negl	N/A	We found no evidence that it occurs in this zone.
Geo-Z2 (Zone 2)	n - negl	N/A	We found no evidence that it occurs in this zone.
Geo-Z3 (Zone 3)	n - negl	N/A	We found no evidence that it occurs in this zone.
Geo-Z4 (Zone 4)	n - negl	N/A	We found no evidence that it occurs in this zone.
Geo-Z5 (Zone 5)	n - negl	N/A	We found no evidence that it occurs in this zone.
Geo-Z6 (Zone 6)	n - negl	N/A	We found no evidence that it occurs in this zone.
Geo-Z7 (Zone 7)	n - negl	N/A	We found no evidence that it occurs in this zone.
Geo-Z8 (Zone 8)	n - high	N/A	We found no evidence that it occurs in this zone.
Geo-Z9 (Zone 9)	y - high	N/A	The species is hardy to zones 9-11 (MBG, 2011).
Geo-Z10 (Zone 10)	y - negl	N/A	One to two points each for Argentina, Brazil, and Paraguay. Three points in Florida, United States. Hardy to zones 9-11 (MBG, 2011). Distributed throughout the Amazon basin, which includes zones 10-13 (Holm-Nielsen, 1980).
Geo-Z11 (Zone 11)	y - negl	N/A	Brazil, and two points in Mexico. Hardy to zones 9-11 (MBG, 2011)
Geo-Z12 (Zone 12)	y - negl	N/A	One point in Peru and two in Brazil.
Geo-Z13 (Zone 13)	y - negl	N/A	Points in Brazil, Colombia, and Venezuela. Distributed throughout the Amazon basin, which includes zones 10-13 (Holm-Nielsen, 1980).
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	y - negl	N/A	Brazil, Colombia, Peru, and Venezuela.
Geo-C2 (Tropical savanna)	y - negl	N/A	Bolivia, Brazil, and Paraguay.
Geo-C3 (Steppe)	n - high	N/A	This species occurs in the state of Guayas, Ecuador in tropical savanna climate and along a river that flows to the edge of an area with steppe climate (GBIF, 2017). It may be able to occur in steppe climates if there is sufficient water.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-C4 (Desert)	n - high	N/A	This species occurs in the state of Guayas, Ecuador (GBIF, 2017), which includes this climate type; but we found no specific evidence that it occurs in deserts.
Geo-C5 (Mediterranean)	n - high	N/A	Two points in Colombia occur near this climate type. If conditions are warm enough and there are suitable habitats, this species should be able to occur in this climate type.
Geo-C6 (Humid subtropical)	y - negl	N/A	Two points in Argentina and three in Florida, United States.
Geo-C7 (Marine west coast)	y - mod	N/A	One point in Colombia.
Geo-C8 (Humid cont. warm sum.)	n - mod	N/A	We found no evidence that it occurs in this climate type.
Geo-C9 (Humid cont. cool sum.)	n - low	N/A	We found no evidence that it occurs in this climate type.
Geo-C10 (Subarctic)	n - negl	N/A	We found no evidence that it occurs in this climate type.
Geo-C11 (Tundra)	n - negl	N/A	We found no evidence that it occurs in this climate type.
Geo-C12 (Icecap)	n - negl	N/A	We found no evidence that it occurs in this climate type.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	n - low	N/A	No evidence.
Geo-R2 (10-20 inches; 25-51 cm)	y - high	N/A	One point in Bolivia.
Geo-R3 (20-30 inches; 51-76 cm)	y - negl	N/A	Many points in Brazil and two in Paraguay.
Geo-R4 (30-40 inches; 76-102 cm)	y - negl	N/A	One point in Paraguay and one in Argentina. Although there were relatively few points for this precipitation band (and the others below), we used negligible uncertainty for this band and the others below because this species is distributed throughout the Amazon basin, which includes a wide range of precipitation levels (Holm-Nielsen, 1980).
Geo-R5 (40-50 inches; 102-127 cm)	y - negl	N/A	One point in Argentina.
Geo-R6 (50-60 inches; 127-152 cm)	y - negl	N/A	Two points in Florida, United States.
Geo-R7 (60-70 inches; 152-178 cm)	y - negl	N/A	Three points in Brazil and one each in Colombia and Florida, United States.
Geo-R8 (70-80 inches; 178-203 cm)	y - negl	N/A	One point in Mexico.
Geo-R9 (80-90 inches; 203-229 cm)	y - negl	N/A	One point in Brazil.
Geo-R10 (90-100 inches; 229-254 cm)	y - negl	N/A	Three points in Brazil.
Geo-R11 (100+ inches; 254+ cm)	y - negl	N/A	Two points in Venezuela, one in Ecuador, three in Colombia, and one in Mexico.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	n - negl	0	*Phyllanthus fluitans* is cultivated and naturalized in the United States (AGA Forum, 2006; Aquatic Scapes, 2011; Wilder and Sowinski, 2010). To evaluate its entry potential to the United States, we set this answer to no.
Ent-2 (Plant proposed for entry, or entry is imminent)	n - mod	0	We found no evidence that this species has been proposed for entry into the United States or that its entry is imminent.
Ent-3 [Human value & cultivation/trade status: (a) Neither cultivated or positively valued; (b) Not cultivated, but positively valued or potentially	d - negl	0.5	*Phyllanthus fluitans* is a popular aquarium plant that is cultivated in aquaria (AGA Forum, 2006; APC, 2011; Aquatic Scapes, 2011; FWC, 2011) and is suitable for growing in ponds (MBG, 2011). It is commercially

Question ID	Answer - Uncertainty	Score	Notes (and references)
beneficial; (c) Cultivated, but no evidence of trade or resale; (d) Commercially cultivated or other evidence of trade or resale]			cultivated by a Denmark company (TROPICA, 2011) that exports aquarium plants to the United States.
Ent-4 (Entry as a contaminant)			
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	y - negl		This species has become naturalized in Mexico (Lot et al., 1980).
Ent-4b (Contaminant of plant propagative material (except seeds))	n - high	0	We found no evidence of this pathway, but see Ent-4e.
Ent-4c (Contaminant of seeds for planting)	n - high	0	We found no evidence of this pathway.
Ent-4d (Contaminant of ballast water)	n - high	0	We found no evidence of this pathway.
Ent-4e (Contaminant of aquarium plants or other aquarium products)	? - max		We found no evidence of this pathway, but aquatic plant shipments are often contaminated with other aquatic plants (e.g., Maki and Galatowitsch, 2004).
Ent-4f (Contaminant of landscape products)	n - mod	0	We found no evidence of this pathway.
Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances)	n - mod	0	We found no evidence of this pathway.
Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing)	n - low	0	We found no evidence of this pathway. Because this pathway seems unlikely, we used low uncertainty.
Ent-4i (Contaminant of some other pathway)	a - mod	0	We found no evidence of any other pathway.
Ent-5 (Likely to enter through natural dispersal)	n - high	0	Although this species is present in Mexico, it seems unlikely to disperse via natural dispersal vectors into the United States, as it is only known to be present in the state of Tabasco (Lot et al., 1980), which is located at the base of the Yucatan Peninsula and not near the U.S. border.

Appendix B. Additional photographs of *Phyllanthus fluitans* in Florida from the Peace River system.

Figure B1. Close up of a stem showing distichously arranged leaves, large air pockets in the leaf surface, and inflorescences. [photographer: Kelle Sullivan, Florida Fish and Wildlife Conservation Commission (provided by Sowinski, 2017a)].

Figure B2. A dense population of *P. fluitans* [source: Michael Sowinski, Florida Fish and Wildlife Conservation Commission (Sowinski, 2017a)].

Fig B3. Comparison of the coverage that *P. fluitans* can achieve at a site along the Peace River [source: Michael Sowinski, Florida Fish and Wildlife Conservation Commission (Sowinski, 2017a)].