United States Department of Agriculture

United States Department of Agriculture

Animal and Plant Health Inspection Service

April 25, 2017

Version 1

Weed Risk Assessment for *Pogostemon erectus* (Dalzell) Kuntze and *P. helferi* (Hook. f.) Press (Lamiaceae)

Habit of *P. erectus* (top) and *P. helferi* (bottom) in aquaria. All photos obtained with permission (Nelson, 2017) from Tropica's (2017) website.

AGENCY CONTACT

Plant Epidemiology and Risk Analysis Laboratory
Center for Plant Health Science and Technology
Plant Protection and Quarantine
Animal and Plant Health Inspection Service
United States Department of Agriculture
1730 Varsity Drive, Suite 300
Raleigh, NC 27606

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:

Pogostemon erectus (Dalzell) Kuntze (The Plant List, 2017)

Pogostemon helferi (Hook. f.) Press (The Plant List, 2017)

FAMILY: Lamiaceae

SYNONYMS:

Pogostemon erectus: *Anuragia erecta* (Dalzell) Raizada, *A. gracilis* (Dalzell) Raizada, *Dysophylla erecta* Dalzell, *D. gracilis* Dalzell, *Eusteralis erecta* (Dalzell) Panigrahi, *E. gracilis* (Dalzell) Panigrahi, *E. tomentosa* var. *gracilis* (Dalzell) Bennet & Raizada, *Pogostemon gracilis* (Dalzell) F. Muell. [illegit.] (The Plant List, 2017).

Pogostemon helferi: *Anuragia helferi* (Hook. f.) Raizada, *Dysophylla helferi* Hook. f., *Eusteralis helferi* (Hook. f.) Panigrahi (The Plant List, 2017).

COMMON NAMES:

Pogostemon erectus: None found.

Pogostemon helferi: Its Thai name is "Dao Noi," which means "little star" (Wangwibulkit and Vajrodaya, 2016). Both names are used in the aquarium trade but its Thai name is commonly spelled as "downoi" in English (e.g., Anonymous, 2017a; TPT, 2017).

BOTANICAL DESCRIPTION:

Pogostemon erectus is an aquatic herb that forms spikes of conifer-like stems (Tropica, 2017) and whorled needle-like leaves (Flowgrow, 2017). Stems grow 15-40 cm tall and 1-3 cm wide (Tropica, 2017). It has terminal spikes of purple flowers (Dogan et al., 2016; Flowgrow, 2017). Species in the genus *Pogostemon* produce nutlets (Ingrouille and Bhatti, 1998), but we found no information on their size. This species superficially resembles and has been confused with *Rotala verticillaris* and some forms of *R. mexicana* (APC, 2017).

Pogostemon helferi is an aquatic herb that grows above and below the surface of the water in river systems in its native range (Christensen et al., 2008). It forms compact rosettes (5 cm tall by 10 cm wide) of whorled, wavy leaves, earning it the common name of "little star" in Thailand (Shappard, 2011; Tropica, 2017). It forms side shoots that develop their own roots, and eventually will form a compact carpet of vegetation (Christensen et al., 2008; Tropica, 2017). Except when it is blooming, its growth form is the same above as below the water (Christensen et al., 2008).

INITIATION: PPQ received a market access request for *P. erectus and P. helferi plants* for propagation from the Ministry of Food, Agriculture and Fisheries, the Danish Plant Directorate (MFAF, 2009). Because these species are not native to the United States (NGRP, 2015), the PPQ Weeds Cross-Functional Working Group initiated this assessment to determine if they pose a significant pest risk to the United States. Both species are closely related and placed in subgenus *Dysophyllus* section *Verticillatus* (Ingrouille and Bhatti, 1998), which until recently was recognized as a separate genus (El-Gazzar and Watson, 1967; Panigrahi, 1984). Because there was so little information available on these species, and because they have very similar biology, we evaluated them together in this assessment.

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

FOREIGN DISTRIBUTION:

Pogostemon erectus is native to India (Dogan et al., 2016; Ingrouille and Bhatti, 1998) and has been collected from the states of Maharashtra, Kerala, and Karnataka (GBIF, 2017). It is cultivated and gaining popularity as an aquatic ornamental (Dogan et al., 2016). It has been introduced to Germany (Flowgrow, 2017), Denmark (Tropica, 2017) and the United Kingdom (Aqua Essentials, 2017). This species is sold online in foreign countries (Aqua Essentials, 2017) and is relatively new to the aquarium trade, having appeared within the last 10 years (Aqua Essentials, 2017).

Pogostemon helferi is native to Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016). It may also be native to southern Vietnam and the Indian state of West Bengal (GBIF, 2017). It is also becoming popular in the global aquarium trade (Wangwibulkit and Vajrodaya, 2016). It has been introduced to Germany (Anonymous, 2017a), Denmark (Tropica, 2017), the United Kingdom (Aqua Essentials, 2017), Australia (Aquarium Life, 2017), and probably other countries for cultivation. Most stock of this plant available in the market is from wild collected plants, which prompted a study to examine the feasibility of tissue culture for plant propagation (Wangwibulkit and Vajrodaya, 2016). Due to deforestation and harvest of wild plants, this species has become rare in Thailand (Wangwibulkit and Vajrodaya, 2016).

U.S. DISTRIBUTION AND STATUS:

Pogostemon erectus: We found no evidence that *P. erectus* is naturalized in the United States (e.g., EDDMapS, 2017; GBIF, 2017; Kartesz, 2017; NRCS, 2017). This species is cultivated in the United States (Flowgrow, 2017) and sold by several vendors (e.g., Florida Aquatic Nurseries, 2017), including some that list with Amazon (2017) and eBay (2017). We found no evidence that any species in this genus is regulated in the United States (e.g., NPB, 2016; USDA-AMS, 2016).

Pogostemon helferi: We found no evidence that *P. helferi* is naturalized in the United States (e.g., EDDMapS, 2017; GBIF, 2017; Kartesz, 2017; NRCS, 2017). This species is cultivated in the United

---

[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).

States and is relatively new to the market, being sold by only a few commercial nurseries (AAG, 2017; Shappard, 2011). It can be obtained from online U.S. businesses, hobbyists (Shappard, 2011), or directly from Thailand-based companies that have listed plants on the internet (Amazon, 2017; eBay, 2017). *Pogostemon helferi* is cultivated by hobbyists in several states (AAG, 2017; TPT, 2017).

3. Analysis

ESTABLISHMENT/SPREAD POTENTIAL

Pogostemon erectus and *P. helferi* have recently been moved beyond their native range for cultivation in fresh water aquaria (Aqua Essentials, 2017; Christensen et al., 2008; Wangwibulkit and Vajrodaya, 2016). We found no evidence that these species have escaped or become naturalized anywhere in the world. Both species are annual/perennial aquatic plants (Ohwi, 1984; Yao et al., 2016). We found evidence that *P. helferi* produces viable seed (Anonymous, 2017b), and we believe that *P. erectus* does as well. In the aquarium trade, these species are propagated through cuttings (Anonymous, 2017b; APC, 2017) and may be able to reproduce through stem fragmentation in the wild. Because both are aquatic plants, they are most likely dispersed by water. In the wild, *P. helferi* forms dense mats (Christensen et al., 2008), and under cultivation both species can form dense clumps if conditions are right (Florida Aquatic Nurseries, 2017; Shappard, 2011). Overall, we found very little information on the biology and ecology of these species, and could not answer eight of the questions for this risk element, resulting in a very high level of uncertainty.

Risk score = 5 Uncertainty index = 0.36

IMPACT POTENTIAL

We found no evidence that either of these species is considered a weed or causes any type of impact in natural, anthropogenic, or production systems. We had very high uncertainty for this risk element because there is very little information available on these species. This greatly raises our uncertainty about how they would behave if they escaped from cultivation.

Risk score = 1.0 Uncertainty index = 0.35

GEOGRAPHIC POTENTIAL

Based on three climatic variables, we estimate that about 1 percent of the United States is suitable for the establishment of *P. erectus* and *P. helferi* (Fig. 1). This predicted distribution is based on the species' known distribution elsewhere in the world. The map for these species represents the joint distribution of Plant Hardiness Zones 10-13, areas with 40-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savanna, humid subtropical, and marine west coast. Because there was so little information available on the distribution of these species, and because they are closely related, we combined the available information to develop one predicted distribution. For clarity, we separated the evidence for each species in Appendix A. Both species occur in similar climates, except that *P. helferi* is able to occur in Plant Hardiness Zone 10 and in marine west coast and humid subtropical climates.

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 these species are likely to establish. Both species are aquatic plants. *Pogostemon helferi* grows in rivers in Thailand (Christensen et al., 2008). It is not clear if *P. erectus* grows in similar river systems in India, but it is reported to grow in brackish water (APC, 2017; Flowgrow, 2017).

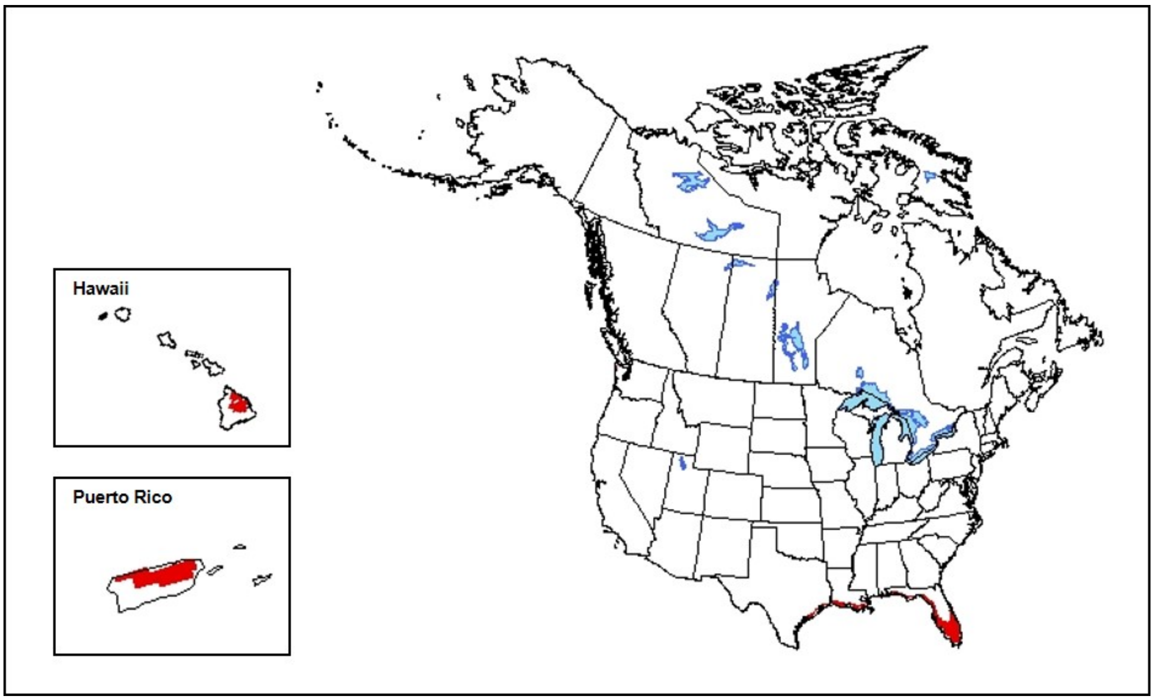

Figure 1. Potential geographic distribution of *P. erectus and P. helferi* in the United States and Canada. Map insets for Hawaii and Puerto Rico are not to scale.

ENTRY POTENTIAL

Pogostemon erectus and *P. helferi* are cultivated and available for sale in the United States (e.g., Florida Aquatic Nurseries, 2017; Flowgrow, 2017; Shappard, 2011). APHIS-PPQ is currently considering a market access request for plants of both species rooted in rock wool from Denmark (MFAF, 2009). If approved, additional plant material would be guaranteed entry into the United States, resulting in the risk score of 1.0 indicated below. We found no evidence that these species are likely to enter the United States as contaminants or through natural dispersal from nearby regions.

Risk score = 1.0 Uncertainty index = 0.0

4. Predictive Risk Model Results

Model Probabilities: P(Major Invader) = 8.7%
P(Minor Invader) = 67.2%
P(Non-Invader) = 24.2%
Risk Result = Evaluate Further
Secondary Screening = Evaluate Further

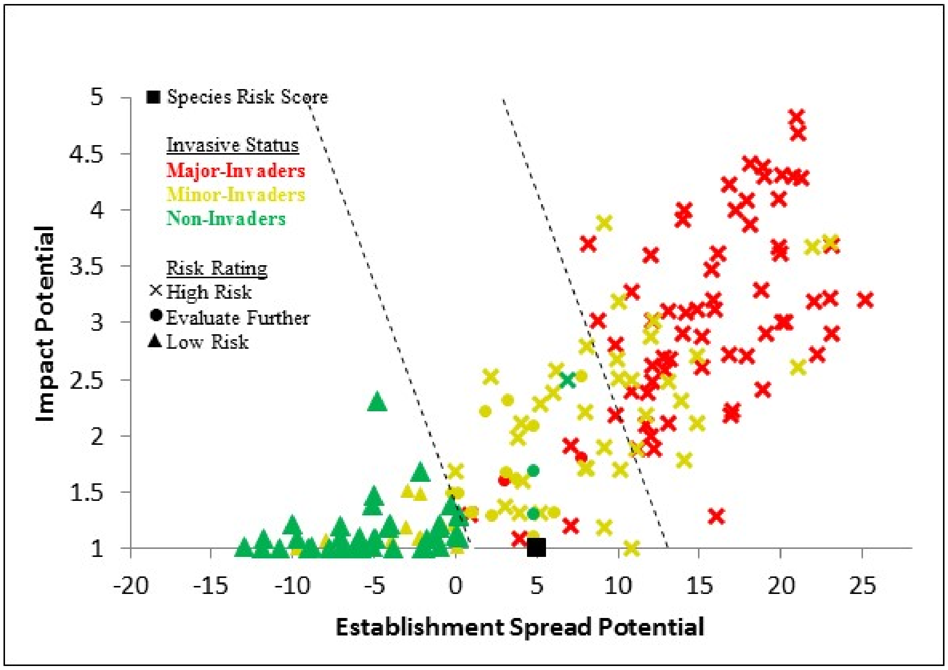

Figure 2. Combined risk score (black box) for *P. erectus* and *P. helferi* relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

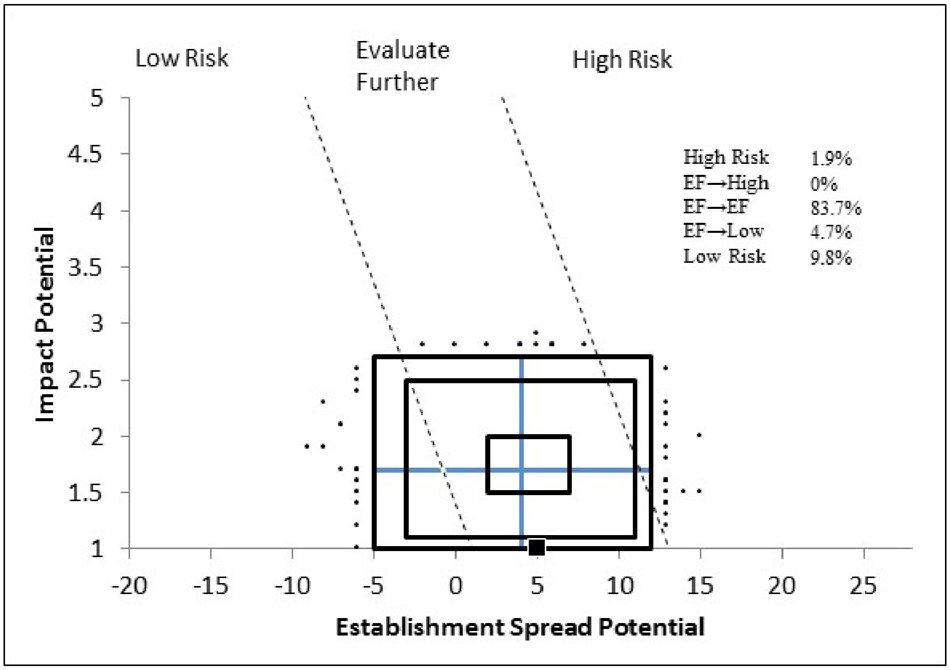

Figure 3. Model simulation results (N=5,000) for uncertainty around the combined risk score for *P. erectus* and *P. helferi*. The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

5. Discussion

The result of the combined weed risk assessment for *Pogostemon erectus* and *P. helferi* is Evaluate Further after secondary screening (Fig. 2). Due to the limited amount of biological information available for these species, uncertainty was very high, which resulted in the wide range of simulated risk scores in our uncertainty simulation (Fig. 3). Contributing to the high level of uncertainty is the fact that these species may have only recently been moved outside of their native range for use in freshwater aquaria. Thus, they have had only a limited opportunity to express any potential invasive or weedy behavior. Additional information about the basic biology of these species would help to resolve their weed risk potential.

Our approach to analyzing the U.S. geographic potential for these species was to combine the very limited information about their global distribution to obtain a combined climatic profile. While our analysis showed that these species have very similar biological traits, their climatic tolerances may be a little different. We found that *P. helferi* is able to grow in one more Plant Hardiness Zone and two more Köppen-Geiger climate classes than *P. erectus*. Although a separate geographic potential analysis for *P. erectus* would have had a minimal impact on the percentage of the United States suitable for its establishment, it would have lowered its establishment/spread risk score by three points, placing the final outcome in the Low Risk region of Figure 2. However, given the high uncertainty associated with these species' distributions, it is possible that *P. erectus* is able to survive in those other climates, or that *P. helferi* may not be able to (see evidence in Appendix A).

6. Acknowledgements

AUTHOR

Anthony Koop, Risk Analyst[a]

REVIEWERS

Sherrie Emerine, Research Associate[b]
Leslie Newton, Risk Analyst[a]

[a] USDA APHIS PPQ CPHST Plant Epidemiology and Risk Analysis Laboratory, Raleigh, NC
[b] North Carolina State University, Center for Integrated Pest Management, Raleigh, NC

SUGGESTED CITATION

PPQ. 2017. Weed risk assessment for *Pogostemon erectus* (Dalzell) Kuntze and *P. helferi* (Hook. f.) Press (Lamiaceae). United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (PPQ), Raleigh, NC. 20 pp.

DOCUMENT HISTORY

April 25, 2017: Version 1.

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.

AAG. 2017. Listings Database. Arizona Aquatic Gardens (AAG), Oro Valley, Arizona. Last accessed April 4, 2017, https://www.azgardens.com/.

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

Anonymous. 2017a. *Pogostemon helferi* downoi. Aquasabi. Last accessed April 3, 2017, https://www.aquasabi.com/aquatic-plants/middle-ground/pogostemon-helferi.

Anonymous. 2017b. *Pogostemon helferi* guide. The Aquarium Guide. Last accessed April 3, 2017, http://www.theaquariumguide.com/articles/pogostemon-helferi-guide.

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

Aqua Essentials. 2017. Aquatic plants. Aqua Essentials, United Kingdom. Last accessed April 3, 2017, https://www.aquaessentials.co.uk/blog/about.

Aquarium Gardens. 2017. *Pogostemon stellatus* tissue culture - Hortilab. Aquarium Gardens, Planted Aquarium Specialists, United Kingdom. Last accessed April 6, 2017, http://www.aquariumgardens.co.uk/pogostemon-stellatus-tissue-culture---hortilab-875-p.asp.

Aquarium Life. 2017. How to grow *Pogostemon helferi*. Aquarium Life, Australia. Last accessed April 3, 2017, http://www.aquariumlife.com.au/showthread.php/21566-HOW-TO-quot-Grow-Pogostemon-Helferi.

Bhatt, J. R., J. S. Singh, S. P. Singh, R. S. Tripathi, and R. K. Kohli (eds.). 2012. Invasive Alien Plants: An Ecological Appraisal for the Indian Subcontinent. CABI International, Wallingford, Oxfordshire. 314 pp.

Bruneton, J. 1999. Toxic Plants Dangerous to Humans and Animals. Lavoisier Publishing, Paris, France. 545 pp.

Burrows, G. E., and R. J. Tyrl. 2013. Toxic Plants of North America, 2nd ed. Wiley-Blackwell, Ames, IA. 1383 pp.

Chowdhury, M., and A. P. Das. 2014. Plant diversity and community structure of Hazar Takia palustrine of central West Bengal, India. Plant Sciences 8(1):25-35.

Christensen, C., T. Andersen, and O. Pedersen. 2008. Hunting for *Pogostemon helferi*. The Aquatic Gardener 21(2):31-41.

Dogan, M., M. Karatas, and M. Aasim. 2016. In vitro shoot regeneration from shoot tip and nodal segment explants of *Pogostemon erectus* (Dalzell) Kuntze, a multipurpose ornamental aquatic plant. Fresenius Environmental Bulletin 25(11):4777-4782.

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

EDDMapS. 2017. Early Detection & Distribution Mapping System (EDDMapS) [Online Database]. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org/. (Archived at PERAL).

El-Gazzar, A., and L. Watson. 1967. Consequences of an escape from floral minutiae and floristics in certain Labiatae. Taxon 16(3):186-189.

Florida Aquatic Nurseries. 2017. Listings Database. Florida Aquatic, Davie, Florida. Last accessed April 4, 2017, http://www.floridaaquatic.com/index.htm.

Flowgrow. 2017. Website and database. Flowgrow, Germany. Last accessed April 4, 2017, https://www.flowgrow.de/.

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

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.

Ingrouille, M., and G. R. Bhatti. 1998. Infrageneric relationships within *Pogostemon* Desf. (Labiatae). Botanical Journal of the Linnean Society 128(2):159-183.

IPPC. 2012. 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. 38 pp.

IPPC. 2015. 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. 18 pp.

Jiang, X. W., and H. Q. Li. 2015. Effects of exogenous salicylic acid on seed germination and seedling growth of *Pogostemon cablin* under salt stress [Abstract]. Chinese Traditional and Herbal Drugs 46(15):2303-2308.

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.

Kartesz, J. 2017. The Biota of North America Program (BONAP). North American Plant Atlas. http://bonap.net/tdc. (Archived at PERAL).

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.

Leonida, E. 2009. Plant of the month: *Pogostemon stellatus*. Tropical Fish Magazine. Last accessed April 6, 2017, http://www.tfhmagazine.com/details/plant-of-the-month/pogostemon-stellatus.htm.

Li, X.-W., and I. C. Hedge. 2017. Lamiaceae Lindley. Missouri Botanical Garden. http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=10476. (Archived at PERAL).

Mabberley, D. J. 2008. Mabberley's Plant-Book: A Portable Dictionary of Plants, Their Classification and Uses (3rd edition). Cambridge University Press, New York. 1021 pp.

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.

MFAF. 2009. Aquarium plants in growing medium – Denmark – Pre-Requisite requirements for commodity risk assessments. Ministry of Food, Agriculture and Fisheries (MFAF), The Danish Plant Directorate, Denmark, Lyngby, Denmark. 4 pp.

Moody, K. 1989. Weeds reported in rice in south and southeast Asia. International Rice Research Institute, Manila, The Philippines. 442 pp.

Nelson, K. 2017. Permission to use photographs and images of your plants. Personal communication to A. Koop on April 3, 2017, from Kyle Nelson, Chief Executive Officer, Tropica.

NGRP. 2015. Germplasm Resources Information Network (GRIN). United States Department of Agriculture, Agricultural Research Service, National Genetic Resources Program (NGRP). http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl?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).

Ohwi, J. 1984. Flora of Japan (edited English version, reprint. Original 1954). National Science Museum, Tokyo, Japan. 1067 pp.

Panigrahi, G. 1984. Nomenclatural notes on *Pogostemon* Desf. (Lamiaceae). Taxon 33:102-102.

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

Razi, B. A. 1950. A contribution towards the study of the dispersal mechanisms in flowering plants of Mysore (South India). Ecology 31(2):282-286.

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.

Shappard, A. 2011. Plant of the month: *Pogostemon helferi*. Tropical Fish Magazine. Last accessed April 3, 2017, http://www.tfhmagazine.com/details/plant-of-the-month/pogostemon-helferi.htm.

Souza Filho, A. P. S., M. A. M. de Vasconcelos, M. G. B. Zoghbi, and R. L. Cunha. 2009. Potentially allelopathic effects of the essential oils of *Piper hispidinervium* C. DC. and *Pogostemon heyneanus* (Benth) on weeds [Abstract]. Acta Amazonica 39(2):389-396.

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. 2017. Growing downoi (*Pogostemon helferi*) The Planted Tank (TPT). Last accessed April 18, 2001, http://www.plantedtank.net/forums/33-plants/124001-growing-downoi-pogostemon-helferi.html.

Tropica. 2017. Tropica Aquarium Plants. Tropica. Last accessed April 3, 2017, http://www.tropica.com/en/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.

Wangwibulkit, M., and S. Vajrodaya. 2016. Ex-situ propagation of *Pogostemon helferi* (Hook. f.) Press using tissue culture and a hydroponics system. Agriculture and Natural Resources 50(1):20-25.

Yamada, S., Y. Kusumoto, Y. Tokuoka, and S. Yamamoto. 2011. Landform type and land improvement intensity affect floristic composition in rice paddy fields from central Japan. Weed Research 51(1):51-62.

Yao, G., B. T. Drew, T.-S. Yi, H.-F. Yan, Y.-M. Yuan, and X.-J. Ge. 2016. Phylogenetic relationships, character evolution and biogeographic diversification of *Pogostemon* s.l. (Lamiaceae). Molecular Phylogenetics and Evolution 98:184-200.

Appendix A. Weed risk assessment for *Pogostemon erectus* (Dalzell) Kuntze and *P. helferi* (Hook. f.) Press (Lamiaceae)

Below is all of the evidence and associated references used to evaluate the risk potential of these taxa. 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	*Pogostemon erectus* is native to India (Dogan et al., 2016; Ingrouille and Bhatti, 1998) and has been introduced to Germany (Flowgrow, 2017), Denmark (Tropica, 2017), the United Kingdom (Aqua Essentials, 2017), and the United States (Flowgrow, 2017). *Pogostemon helferi* is native to Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016). It may also be native to southern Vietnam and the Indian state of West Bengal (GBIF, 2017). It has been introduced to Germany (Anonymous, 2017a), Denmark (Tropica, 2017), the United Kingdom (Aqua Essentials, 2017), Australia (Aquarium Life, 2017), and the United States (Shappard, 2011). Since we found no evidence that these species have been in the trade for more than 75 years, we answered "b" with low uncertainty. Alternate answers for the uncertainty simulation were "a" and "d."
ES-2 (Is the species highly domesticated)	n - low	0	Both species are cultivated (Aquarium Gardens, 2017; Flowgrow, 2017; Wangwibulkit and Vajrodaya, 2016) and are reported to be relatively new to and becoming popular in the aquarium trade (Aqua Essentials, 2017; Christensen et al., 2008; Wangwibulkit and Vajrodaya, 2016). We found no evidence indicating that these species are highly domesticated, have been bred for reduced weed potential, or are even part of any breeding programs. Consequently, we answered no with low uncertainty.
ES-3 (Significant weedy congeners)	n - low	0	The genus *Pogostemon* includes about 85 species native to Asia and Africa (Mabberley, 2008), with a center of diversity in India (Ingrouille and Bhatti, 1998). *Pogostemon auricularius*, *P. brachystachys*, and *P. cablin* have been reported as weedy or invasive somewhere in the world (Randall, 2017). *Pogostemon auricularius* and *P. brachystachys* are weeds of rice in southeast Asia (Moody, 1989), and *P. cablin* has escaped from cultivation, forming naturalized populations (Yao et al., 2016). However, we found no evidence suggesting that any of these species are significant weeds.
ES-4 (Shade tolerant at some stage of its life cycle)	y - high	1	We did not find any direct evidence that these species are shade tolerant. Information from aquarium sites

Question ID	Answer - Uncertainty	Score	Notes (and references)
			generally state that they prefer strong light for good growth and coloration (Anonymous, 2017b; APC, 2017). One hobbyist noted that *P. helferi* plants do not tolerate shade very well (TPT, 2017). The lower leaves of the congener *P. stellatus* begin to shed if the plants do not get enough light (Leonida, 2009). While this evidence suggests that these species do not tolerate low light conditions in aquaria, it does not indicate whether they can survive under low light conditions under natural settings. In its native range, *P. helferi* grows from above the water surface to two meters deep depending on whether it is the rainy season or not (Christensen et al., 2008). Because both species at times grow as completely submersed aquatics (El-Gazzar and Watson, 1967), it is possible they are tolerant of shady conditions, at least for a short while. Based on our guidelines for this question, we answered yes because they grow as submersed aquatics, but used high uncertainty.
ES-5 (Plant a vine or scrambling plant, or forms tightly appressed basal rosettes)	n - negl	0	Neither of these species are vines, nor do either of them form basal rosettes of leaves. They are aquatic herbs with short (e.g., *P. helferi*; Shappard, 2011; Tropica, 2017) to long stems (e.g., *P. erectus*; Li and Hedge, 2017; Tropica, 2017).
ES-6 (Forms dense thickets, patches, or populations)	y - high	2	Anecdotal comments indicate that both species can form dense patches. For example, in its native range *P. helferi* forms dense stands as carpet and cushion formations over several square meters (Christensen et al., 2008). "Observations at the biotope compared with experience from Tropica's own tests and reports from aquarists show that nutrition in the water is extremely important if the plant is to achieve the dense growth with broad leaves that we saw in its natural surroundings" (Christensen et al., 2008). *Pogostemon helferi* forms dense mats (Shappard, 2011). Under cultivation, *P. erectus* can form a dense group of stems (Florida Aquatic Nurseries, 2017). However, because the extent to which these species form dense patches under natural conditions and whether these dense patches represent a single individual or a population is not clear, we answered yes with high uncertainty.
ES-7 (Aquatic)	y - negl	1	Both species are aquatic plants (Chowdhury and Das, 2014; Christensen et al., 2008; Tropica, 2017) with arenchyma (spongy) tissue in the stems (El-Gazzar and Watson, 1967) that help them stay buoyant.
ES-8 (Grass)	n - negl	0	These species are not grasses. They are aquatic herbs in the Lamiaceae family (Yao et al., 2016).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	We found no evidence that either species fixes nitrogen. Because they are neither woody nor members of a plant family known to contain nitrogen-

Question ID	Answer - Uncertainty	Score	Notes (and references)
			fixing species (Martin and Dowd, 1990; Santi et al., 2013), we answered no with negligible uncertainty.
ES-10 (Does it produce viable seeds or spores)	y - high	1	We found no information on seed production for wild plants of *P. helferi*. When grown immersed in aquaria, *P. helferi* flowers and produces seeds that will result in new plants in the tank (Anonymous, 2017b). We found no information about seed production for *P. erectus*. Because the congeners *P. cablin* (Jiang and Li, 2015) and *P. stellatus* (Chowdhury and Das, 2014; Yamada et al., 2011) produce viable seed, *P. erectus* may as well.
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]	b - high	1	We found no specific information on the generation time for either species. Plant species in the *Dysophyllus* subgenus of *Pogostemon* (which includes both of these species) are reported to be herbaceous annuals and perennials (Ohwi, 1984; Yao et al., 2016). None of the dozens of aquarium blogs and forum discussions that we examined made any comments about these species dying off periodically, which suggests that under culture these species can survive for long periods of time. Based on the limited evidence, we answered "b" with high uncertainty. Alternate answers for the uncertainty simulation were both "c."
ES-14 (Prolific seed producer)	? - max	0	Unknown.
ES-15 (Propagules likely to be dispersed unintentionally by people)	? - max	0	We found no specific evidence of this dispersal pathway for these two species. Because recreational boating is an important pathway for the movement of aquatic macrophytes (e.g., Johnson et al., 2001; Johnstone et al., 1985; Rothlisberger et al., 2010), it is possible that they may be dispersed in this fashion. *Pogostemon helferi* grows in streams and rivers (Christensen et al., 2008), and *P. erectus* occasionally grows in brackish water conditions (APC, 2017). However, it is unknown how readily these two species establish from fragments under natural conditions (see ES-19).
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	n - mod	-1	We found no evidence. Because we found no evidence that these species grow in agricultural areas, dispersal in trade seems unlikely.
ES-17 (Number of natural dispersal vectors)	1	-2	Fruit and propagule traits for questions ES-17a through ES-17e: The genus *Pogostemon* produces nutlets (Ingrouille and Bhatti, 1998) that are generally self-dispersed (autochory; Bhatt et al., 2012). We found no information on the size of the nutlets.
ES-17a (Wind dispersal)	n - low		We found no evidence. Because nutlets in general do not possess any specialized mechanisms for wind

Question ID	Answer - Uncertainty	Score	Notes (and references)
			dispersal (e.g., wings, long hairs), we answered no with low uncertainty.
ES-17b (Water dispersal)	y - mod		We found no direct evidence indicating that the seeds are buoyant or are generally dispersed by water. Because these species are aquatic plants that live in and along streams (Christensen et al., 2008; Li and Hedge, 2017), it is very likely that they are being dispersed by water.
ES-17c (Bird dispersal)	? - max		Unknown.
ES-17d (Animal external dispersal)	y - high	1	A publication of the dispersal mechanisms of plants in southern India listed both *Pogostemon* and *Dysophylla* as being dispersed epizootically (on animals) (Razi, 1950). It is feasible that small seeds could easily be caught in the fur of passing animals, however, without additional evidence we used high uncertainty.
ES-17e (Animal internal dispersal)	n - high		We found no evidence indicating that the seeds are consumed by dispersers. Because the plants are not producing any obvious rewards for dispersal agents (e.g., a fleshy fruit), we answered no with high uncertainty.
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)	? - max	0	*Pogostemon helferi* produces side shoots that can be clipped and planted to produce new plants (Anonymous, 2017b; APC, 2017), even before they produce roots (TPT, 2017). One hobbyist noted that individual leaves of *P. helferi* that have been separated from the parent plant will sometimes root (TPT, 2017). Another commenter said that they will grow from leaves (TPT, 2017). *Pogostemon erectus* also produces many side shoots (APC, 2017). While the ability to re-establish from vegetative fragments may make a plant tolerant to mutilation, we found no information about how these species would respond to mutilation in the field where conditions are very different from that of aquaria. Consequently, we answered unknown.
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - mod	0	We found no evidence that these species are tolerant to herbicides (e.g., Heap, 2017).
ES-21 (Number of cold hardiness zones suitable for its survival)	4	0	
ES-22 (Number of climate types suitable for its survival)	4	2	
ES-23 (Number of precipitation bands suitable for its survival)	7	0	
IMPACT POTENTIAL			
General Impacts			

Question ID	Answer - Uncertainty	Score	Notes (and references)
Imp-G1 (Allelopathic)	n - mod	0	We found no evidence of allelopathy for either *P. erectus* or *P. helferi*. Because it seems unlikely that allelopathy would evolve or have a significant effect in an aquatic system, particularly streams and rivers, we answered no with moderate uncertainty. In a laboratory experiment, essential oils from *P. heyneanus* had a significant inhibitory effect on the germination of seeds of two weed species (Souza Filho et al., 2009), but this is not directly relevant since these data are based on laboratory and not field conditions.
Imp-G2 (Parasitic)	n - negl	0	We found no evidence that these taxa are parasitic. Furthermore, these species are not members of a plant family that include parasitic species (Heide-Jorgensen, 2008; Nickrent, 2009).
Impacts to Natural Systems			
Imp-N1 (Changes ecosystem processes and parameters that affect other species)	n - high	0	We found no evidence of this impact. Although these species have not escaped where they have been introduced, because there is so little known about them and because they have only recently been introduced to cultivation and moved outside of their native range, we used high uncertainty for most of the questions in this risk element.
Imp-N2 (Changes habitat structure)	n - high	0	We found no evidence.
Imp-N3 (Changes species diversity)	n - high	0	We found no evidence.
Imp-N4 (Is it likely to affect federal Threatened and Endangered species?)	n - high	0	We found no evidence.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions?)	n - high	0	We found no evidence.
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 these species are weeds of natural systems. Alternate answers for the uncertainty simulation are both "b."
Impact to Anthropogenic Systems (e.g., cities, suburbs, roadways)			
Imp-A1 (Negatively impacts personal property, human safety, or public infrastructure)	n - high	0	We found no evidence.
Imp-A2 (Changes or limits recreational use of an area)	n - high	0	We found no evidence.
Imp-A3 (Affects desirable and ornamental plants, and vegetation)	n - high	0	We found no evidence.

Question ID	Answer - Uncertainty	Score	Notes (and references)
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. Alternate answers for the uncertainty simulation are 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.
Imp-P2 (Lowers commodity value)	n - high	0	We found no evidence.
Imp-P3 (Is it likely to impact trade?)	n - high	0	We found no evidence that these species or any species of *Pogostemon* is regulated (e.g., APHIS, 2017) or that they move in trade as contaminants.
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 - low	0	We found no evidence that any *Pogostemon* species is toxic to animals (e.g., Bruneton, 1999; 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 - mod	0	We found no evidence that these species occur in agricultural areas. Consequently we answered "a" and selected "b" as both alternate answers.
GEOGRAPHIC POTENTIAL			*Pogostemon erectus* and *P. helferi* have restricted geographic ranges, and we found no latitude-longitude points for either species. Our analysis of their climatic tolerances relied on information about their regional distribution in Southeast Asia.
Plant hardiness zones			
Geo-Z1 (Zone 1)	n - negl	N/A	We found no evidence.
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 - mod	N/A	*Pogostemon helferi* occurs in Myanmar (GBIF, 2017). A very small portion of this country is in Zone 8, but because this area is small and because there is no indication this species can survive under these colder climatic conditions, we answered no.
Geo-Z9 (Zone 9)	n - high	N/A	*Pogostemon helferi* occurs in Myanmar (GBIF, 2017). A small portion of this country is in Zone 9, but

Question ID	Answer - Uncertainty	Score	Notes (and references)
			because this area is small and because there is no indication this species can survive under these colder climatic conditions, we answered no.
Geo-Z10 (Zone 10)	y - low	N/A	*Pogostemon helferi*: Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016).
Geo-Z11 (Zone 11)	y - low	N/A	*Pogostemon erectus*: India (GBIF, 2017). *Pogostemon helferi*: Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016).
Geo-Z12 (Zone 12)	y - low	N/A	*Pogostemon erectus*: India (GBIF, 2017). *Pogostemon helferi*: Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016).
Geo-Z13 (Zone 13)	y - low	N/A	*Pogostemon erectus*: India (GBIF, 2017). *Pogostemon helferi*: Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016).
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	y - negl	N/A	*Pogostemon erectus*: India (GBIF, 2017). *Pogostemon helferi*: Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016).
Geo-C2 (Tropical savanna)	y - negl	N/A	*Pogostemon erectus*: India (GBIF, 2017). *Pogostemon helferi*: Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016).
Geo-C3 (Steppe)	n - high	N/A	*Pogostemon erectus* occurs in India in the state of Karnataka (GBIF, 2017), half of which is represented by a steppe climate. Because we found no information that this aquatic species specifically occurs in these drier climates, and because the closely related *P. stellatus*, which has a much wider distribution and is well sampled, also does not appear to occur in this climate type, we answered no with high uncertainty.
Geo-C4 (Desert)	n - negl	N/A	We found no evidence.
Geo-C5 (Mediterranean)	n - high	N/A	We found no evidence that these species occur in this climate type, but suspect that they may be able to if they occur in warm regions.
Geo-C6 (Humid subtropical)	y - low	N/A	*Pogostemon helferi*: Myanmar (Wangwibulkit and Vajrodaya, 2016) and India (West Bengal, GBIF, 2017).
Geo-C7 (Marine west coast)	y - high	N/A	*Pogostemon helferi* occurs in Myanmar (Wangwibulkit and Vajrodaya, 2016) and India (West Bengal, GBIF, 2017). A small portion of these regions is represented by this climate type.
Geo-C8 (Humid cont. warm sum.)	n - negl	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.
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.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-R2 (10-20 inches; 25-51 cm)	n - negl	N/A	We found no evidence.
Geo-R3 (20-30 inches; 51-76 cm)	n - low	N/A	We found no evidence.
Geo-R4 (30-40 inches; 76-102 cm)	n - high	N/A	*Pogostemon erectus* occurs in India in the states of Karnataka and Maharashtra (GBIF, 2017), which include this precipitation band. However, this band occurs in regions characterized as steppe climate. Because we found no information that this aquatic species specifically occurs in this drier climate, and because the closely related *P. stellatus*, which has a wider distribution and is well sampled, also does not appear to occur in this climate type, we answered no with high uncertainty.
Geo-R5 (40-50 inches; 102-127 cm)	y - low	N/A	*Pogostemon erectus*: India (GBIF, 2017). *Pogostemon helferi*: Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016).
Geo-R6 (50-60 inches; 127-152 cm)	y - negl	N/A	*Pogostemon erectus*: India (GBIF, 2017). *Pogostemon helferi*: Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016).
Geo-R7 (60-70 inches; 152-178 cm)	y - negl	N/A	*Pogostemon erectus*: India (GBIF, 2017). *Pogostemon helferi*: Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016).
Geo-R8 (70-80 inches; 178-203 cm)	y - negl	N/A	*Pogostemon erectus*: India (GBIF, 2017). *Pogostemon helferi*: Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016).
Geo-R9 (80-90 inches; 203-229 cm)	y - negl	N/A	*Pogostemon erectus*: India (GBIF, 2017). *Pogostemon helferi*: Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016).
Geo-R10 (90-100 inches; 229-254 cm)	y - negl	N/A	*Pogostemon erectus*: India (GBIF, 2017). *Pogostemon helferi*: Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016).
Geo-R11 (100+ inches; 254+ cm)	y - negl	N/A	*Pogostemon erectus*: India (GBIF, 2017). *Pogostemon helferi*: Thailand and Myanmar (Wangwibulkit and Vajrodaya, 2016).
ENTRY POTENTIAL			
Ent-1 (Plant already here)	n - negl	0	*Pogostemon erectus* and *P. helferi* are cultivated and available for purchase in the United States (e.g., Florida Aquatic Nurseries, 2017; Flowgrow, 2017; Shappard, 2011). However, to evaluate other pathways by which they may enter the United States, we answered this question as no.
Ent-2 (Plant proposed for entry, or entry is imminent)	y - negl	1	PPQ received a market access request for *P. erectus* and *P. helferi* plants for propagation from the Ministry of Food, Agriculture and Fisheries, the Danish Plant Directorate (MFAF, 2009). Thus, if the request is approved, these plants will be entering country.
Ent-3 [Human value & cultivation/trade status: (a) Neither cultivated or positively valued; (b) Not cultivated, but	d - negl	N/A	These species are cultivated internationally (Aqua Essentials, 2017; Tropica, 2017). Researchers are trying to develop tissue culture protocols for *P. erectus* (Dogan et al., 2016).

Question ID	Answer - Uncertainty	Score	Notes (and references)
positively valued or potentially beneficial; (c) Cultivated, but no evidence of trade or resale; (d) Commercially cultivated or other evidence of trade or resale]			
Ent-4 (Entry as a contaminant)			
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	n - mod	N/A	We found no evidence these species are present in these regions.
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 - high	N/A	We found no evidence.
Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing)	n - high	N/A	We found no evidence.
Ent-4i (Contaminant of some other pathway)	a - high	N/A	We found no evidence.
Ent-5 (Likely to enter through natural dispersal)	n - low	N/A	Because we found no evidence that these species are present or even naturalized in neighboring regions, it seems unlikely that they would enter the United States through this pathway.