United States Department of Agriculture

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Animal and Plant Health Inspection Service

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Version 2

Weed Risk Assessment for *Persicaria chinensis* (L.) H. Gross (Polygonaceae) – Chinese knotweed

Left: Flowers of *P. chinensis*. Right: Leaves of *P. chinensis* (source: Suehiro, 2012).

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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: *Persicaria chinensis* (L.) H. Gross (NGRP, 2011).

FAMILY: Polygonaceae

SYNONYMS: *Polygonum chinense* L. (basionym) (NGRP, 2011).

COMMON NAMES: Chinese knotweed (NGRP, 2011)

BOTANICAL DESCRIPTION: *Persicaria chinensis* is a perennial (eFloras, 2011c), herbaceous vine (Biosecurity New Zealand, 2011b). When not scrambling over other plants or structures, it grows 70 cm to 1 m tall (Biosecurity New Zealand, 2011b); otherwise it can climb over other vegetation up to 10 m high (Goodland and Healey, 1996). Its leaves are 4–16 cm in length with a lanceolate to ovate or elliptic shape (eFloras, 2011b); the stems are pinkish in color; and the cream/pink colored flowers grow in clusters (Biosecurity New Zealand, 2011b). The achenes (i.e., one-seeded indehiscent fruit) are 2.8–4 × 2–3 mm (eFloras, 2011b). For a full botanical description, see eFloras (2011b) or Flora of North America Editorial Committee (2005).

INITIATION: On July 28, 2011, the Exotic Pest Information Collection and Analysis (EPICA) team reported that *Persicaria chinensis*, Chinese knotweed, was detected for the first time in New Zealand (Biosecurity New Zealand, 2011c; Galloway and Lepper, 2010). The New Zealand infestations that were distributed across multiple home gardens were eradicated (Biosecurity New Zealand, 2011c; Galloway and Lepper, 2010). Because of these developments, PERAL initially evaluated the risk potential of this plant in 2012. In this document, we revised that assessment to incorporate new information regarding the species' distribution in the United States.

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

FOREIGN DISTRIBUTION: *Persicaria chinensis* originated in eastern Asia (Evenhuis and Eldredge, 2008; U.S. Forest Service, 2010), but it has been introduced to other geographic areas. It is native to Bhutan, China, India, Indonesia, Japan, Malaysia, Myanmar, Nepal, North Korea, Papua New Guinea, the Philippines, South Korea, Sri Lanka, Taiwan, and Thailand (NGRP, 2011; U.S. Forest Service, 2010). It has been introduced into Pakistan (eFloras, 2011c), Jamaica (Goodland and Healey, 1996; Kairo et al., 2003), La Réunion (Soubeyran, 2008), Singapore (U.S. Forest Service, 2010), and New Zealand (MPI, 2015). Although it was reported to be under eradication (2009-2010) in New Zealand after its initial detection (Biosecurity New Zealand, 2011c; Galloway and Lepper, 2010), the species is now established in a limited area of that country (Auckland and Waikato) (MPI, 2015).

[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: *Persicaria chinensis* is naturalized in Hawaii where it was first collected in 1977 (Evenhuis and Eldredge, 2008; NRCS, 2011; Wagner et al., 1999). Although it was previously reported as being present in the continental United States in Maryland, Massachusetts, and New Jersey (eFloras, 2011b; Flora of North America Editorial Committee, 2005; Weakley, 2010), a recent detailed investigation by Doug Goldman (botanist with the USDA Natural Resources Conservation Service) revealed that these reports were likely erroneous (Goldman, 2016). Furthermore, other sources (Kartesz, 2016; NRCS, 2016), including a more recent version of eFloras (2016), do not report *P. chinensis* in the continental United States. We found no evidence that this species is regulated or listed as a noxious weed by any U.S. state (e.g., AMS, 2016; NPB, 2017; NRCS, 2016), nor that it is in cultivation or in commercial trade (horticultural, ornamental, or other) in the United States (e.g., Bailey and Bailey, 1976; Dave's Garden, 2017; UMN, 2017).

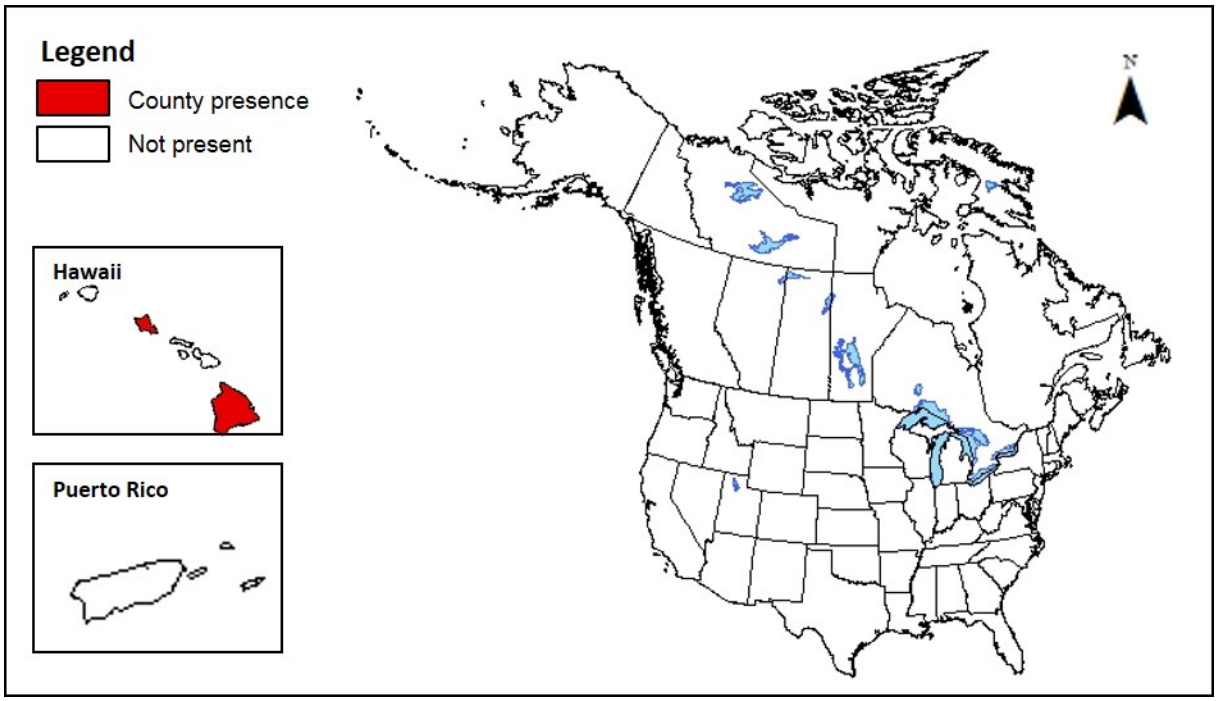

Figure 1. Known naturalized distribution of *P. chinensis* in the United States and Canada based on the sources described above. Scales differ for Hawaii, Puerto Rico, and the continental United States and Canada.

3. Analysis

ESTABLISHMENT/SPREAD POTENTIAL

Persicaria chinensis is closely related to other important invasive *Persicaria* species (e.g., *P. orientalis, P. capitata*, and *P. perfoliata*) (Alien Plant Working Group, 2010; CISEH and NPS, 2011; NISIC, 2011; Randall, 2007a). Beyond its native range, it has established in La Réunion in southern Africa, Jamaica,

Hawaii, and, most recently, New Zealand. This plant is a rapidly growing vine (Biosecurity New Zealand, 2011c; PROSEA Foundation, 2011; van Valkenburg and Bunyapraphatsara, 2001) that forms dense mats (Goodland and Healey, 1996; Waugh, 2008), tolerates diverse environmental conditions (Galloway and Lepper, 2010; Goodland and Healey, 1996), and reproduces by seed and by re-sprouting from broken stem or root fragments (Biosecurity New Zealand, 2011c; U.S. Forest Service, 2010; Zhang and Hirota, 2000). Propagules are dispersed by birds (Goodland and Healey, 1996; Royal Botanic Gardens Kew, 2008), and accidentally by people (Biosecurity New Zealand, 2011c). We had a high level of uncertainty for this risk element, as we did not find many primary source references describing its biology, and we answered some questions using congeneric information.

Risk score = 19 Uncertainty index = 0.24

IMPACT POTENTIAL

Persicaria chinensis is a common weed requiring control in tea plantations (Barbora, 1972; Chakravartee, 1994; Haridas and Sharma, 1974; Rao et al., 1977; Saikia et al., 1998), where it covers tea bushes and blocks drainage systems. We found no clear evidence that it is a weed in other agricultural settings. *Persicaria chinensis* occurs in disturbed areas, such as home gardens, abandoned gardens, and roadsides (Galloway and Lepper, 2010; U.S. Forest Service, 2010). In natural environments, it occurs on riverbanks and in forests, especially in natural clearings and areas of regrowth (eFloras, 2011a; Goodland and Healey, 1996; U.S. Forest Service, 2010) where it may disrupt forest regeneration (Goodland and Healey, 1996). It is perceived as an environmental weed that suppresses other plant species with its dense mats (Goodland and Healey, 1996; Randall, 2007b; Waugh, 2008). Despite that, we found no reports of control activities for it in natural areas. We had a very high level of uncertainty for this risk element, because there was little information available in the primary literature and we had to rely on non-primary references that lacked supporting evidence.

Risk score = 3.3 Uncertainty index = 0.31

GEOGRAPHIC POTENTIAL

Based on three climatic variables, we estimate that about 28 percent of the United States is suitable for the establishment of *P. chinensis* (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. chinensis* represents the joint distribution of Plant Hardiness Zones 6-13, areas with 30-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savanna, humid subtropical, humid continental warm summers, humid continental cool summers, and marine west coast. The discrepancy between the current distribution (Fig. 1) and the predicted distribution (Fig. 2) for the Hawaiian islands is likely due to microhabitats on the islands that are not reflected in the global precipitation spatial dataset.

Other variables that may influence species establishment include soil and habitat type, novel climatic conditions, or plant genotypes. Its general habitats include riverbanks, natural clearings and areas of regrowth in forests (eFloras, 2011a; Goodland and Healey, 1996; U.S. Forest Service, 2010), and

disturbed areas, such as home gardens, abandoned gardens, roadsides, and tea plantations (Galloway and Lepper, 2010; Saikia et al., 1998; U.S. Forest Service, 2010).

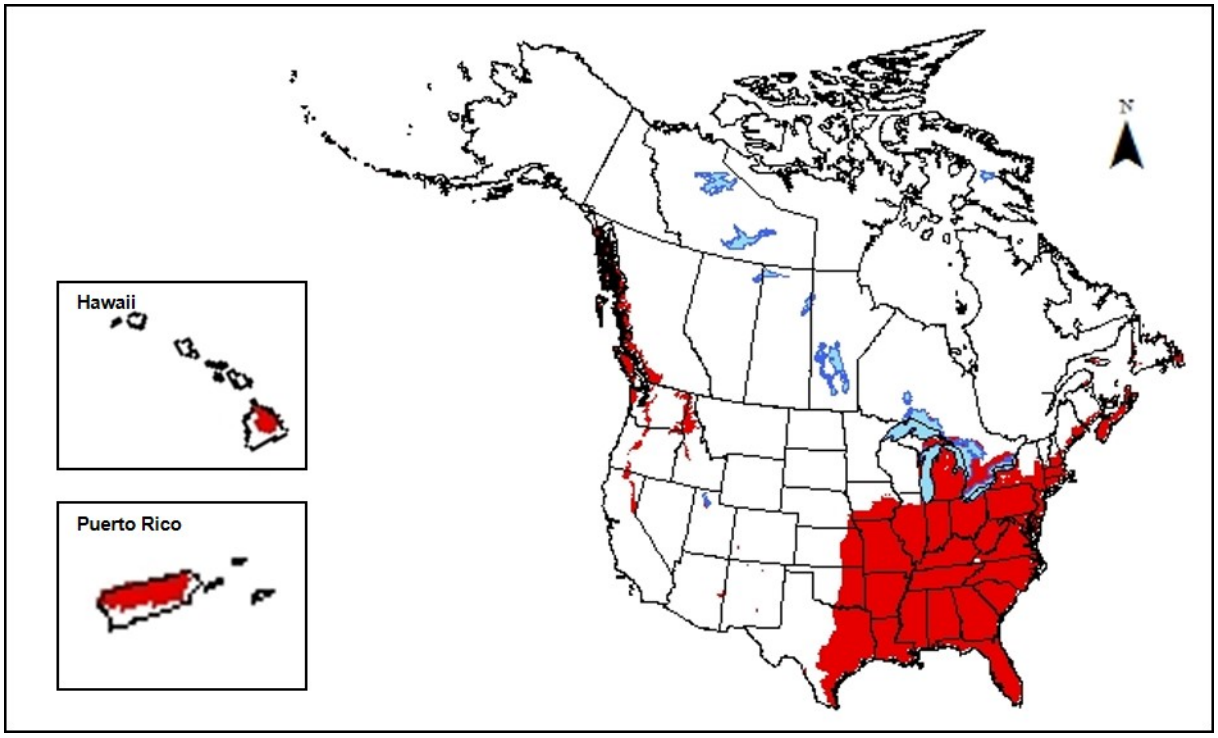

Figure 2. Potential geographic distribution of *P. chinensis* in the United States and Canada. Map insets for Hawaii and Puerto Rico are not to scale.

ENTRY POTENTIAL

Even though this species is naturalized in Hawaii (Evenhuis and Eldredge, 2008; NRCS, 2011; Wagner et al., 1999), we assessed its entry potential anyway because it is not known to be present in the continental United States or U.S. Caribbean territories, and because assessment of the entry potential can provide potentially useful information for risk managers and policy makers. The most likely pathways for entry appear to be either the importation of contaminated garden tools and equipment (Biosecurity New Zealand, 2011b, 2011c) or the intentional introduction of plants by people who use it as a medicinal herb (Keng, 1990; PROSEA Foundation, 2011). Officials in New Zealand believe the species was introduced intentionally for use as a medicinal herb (Galloway and Lepper, 2010). Although congeners may move in trade as a contaminant of material for plant propagation and consumption (NISIC, 2011; PestID, 2016; U.S. Forest Service, 2011), we do not know if *P. chinensis* is likely to move in this manner as well. It is present in Jamaica (Goodland and Healey, 1996; Kairo et al., 2003) and its seeds are dispersed by birds (Goodland and Healey, 1996; Royal Botanic Gardens Kew, 2008); however, it is unknown if the birds that would be likely to disperse the seeds are capable of or likely to fly from Jamaica to the continental United States or U.S. territories in the Caribbean. On a

scale of 0 to 1, where one represents the maximum risk score, we ranked this species with a score of 0.29.

Risk score = 0.29 Uncertainty index = 0.27

4. Predictive Risk Model Results

Model Probabilities: P(Major Invader) = 91.1%
P(Minor Invader) = 8.6%
P(Non-Invader) = 0.3%
Risk Result = High Risk
Secondary Screening = Not Applicable

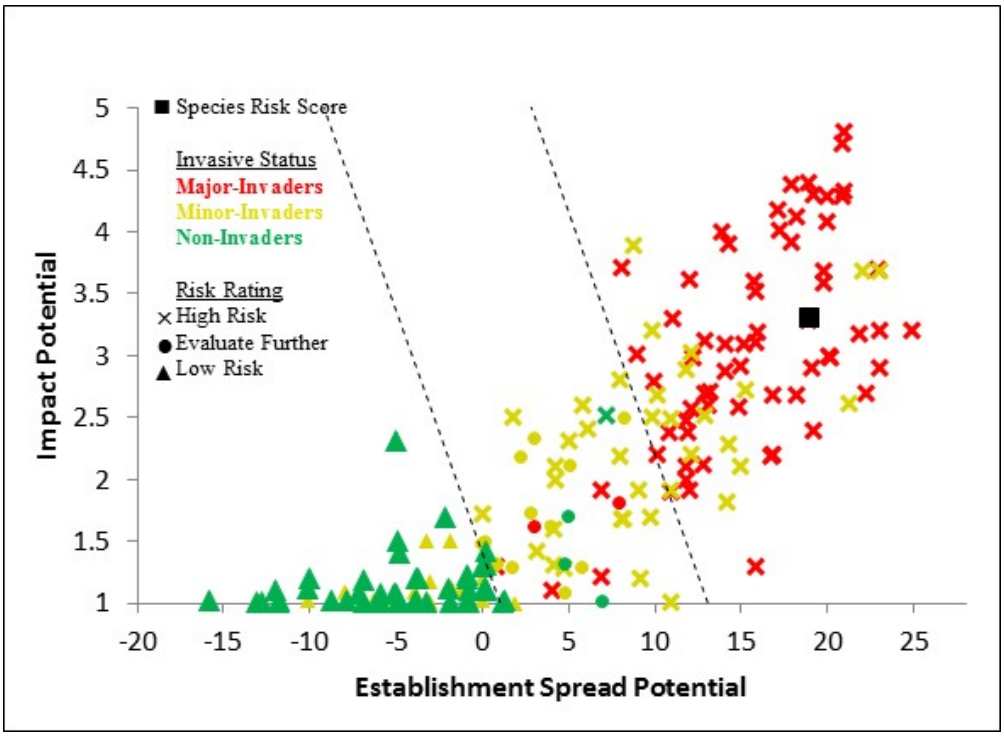

Figure 3. *Persicaria chinensis* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

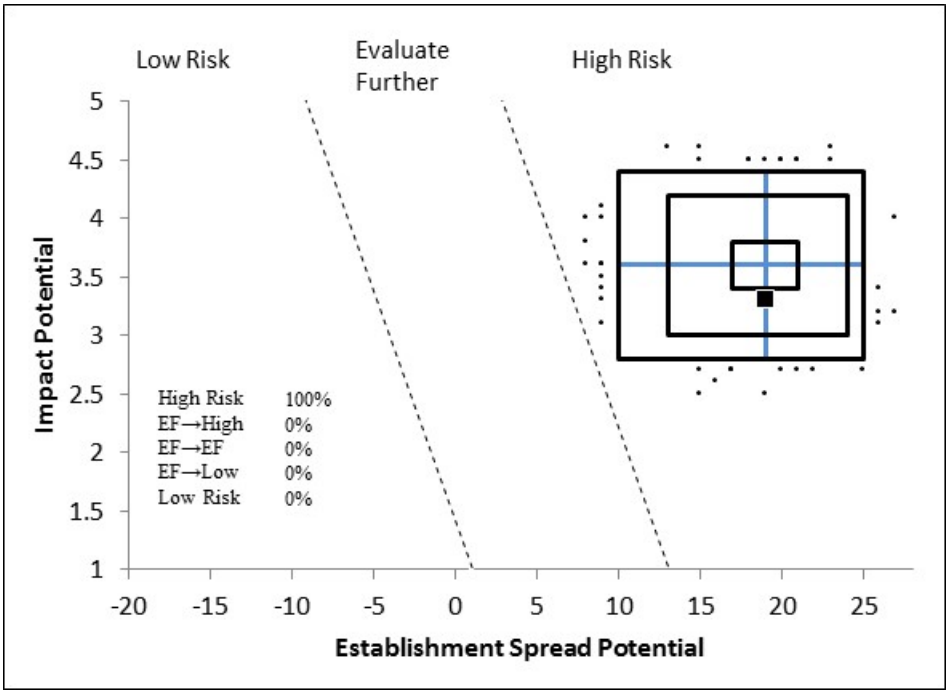

Figure 4. Model simulation results (N=5,000) for uncertainty around the risk score for *P. chinensis*. The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

5. Discussion

The result of the weed risk assessment for *P. chinensis* is High Risk (Fig. 3). This species tolerates a wide range of environmental conditions. Although we found no evidence of significant negative impacts in natural and anthropogenic areas, it is an important weed in tea production in its native range. Therefore, at least under certain environmental and ecological conditions, it has high growth and spread potential and the ability to smother other plants, potentially affecting plant community structure and composition. Also, this species is in the same genus as the mile-a-minute weed, *P. perfoliata*, which is a significant invader in the United States (e.g., Alien Plant Working Group, 2010; CISEH and NPS, 2011; NISIC, 2011). Although the overall level of uncertainty in this analysis was high, our result was robust (Fig. 4). Thus, even if some of the answers in the assessment were to change based on new evidence, the result of the assessment is likely to remain High Risk.

We found no evidence that this species is in cultivation or in commercial trade (horticultural, ornamental, or other) in the United States, but it might be introduced and/or dispersed by people for use as a medicinal herb (Keng, 1990; PROSEA Foundation, 2011). That pathway is suspected in the recent detection in New Zealand (Galloway and Lepper, 2010). It could also potentially be introduced or spread via the movement of contaminated garden tools and equipment (Biosecurity New Zealand, 2011b, 2011c).

6. Acknowledgements

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SUGGESTED CITATION

PPQ. 2017. Weed risk assessment for *Persicaria chinensis* (L.) H. Gross (Polygonaceae) – Chinese knotweed. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (PPQ), Raleigh, NC. 25 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.

Alien Plant Working Group. 2010. Fact Sheet: Mile-a-Minute Weed. United States Department of the Interior, National Park Service, Plant Conservation Alliance. 4 pp.

AMS. 2016. State Noxious-Weed Seed Requirements Recognized in the Administration of the Federal Seed Act. United States Department of Agriculture, Agricultural Marketing Service (AMS), Livestock, Poultry, and Seed Program, Seed Regulatory and Testing Division. 127 pp.

APHIS. 2016. Phytosanitary Certificate Issuance and Tracking System (PCIT) United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS). https://pcit.aphis.usda.gov/PExD/faces/ViewPExD.jsp. (Archived at PERAL).

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

Bailey, L. H., and E. Z. Bailey. 1976. Hortus Third: A Concise Dictionary of Plants Cultivated in the United States and Canada (revised and expanded by The Staff of the Liberty Hyde Bailey Hortorium). Cornell University. 1290 pp.

Barbora, B. C. 1972. Chemical control of weeds in drains, drain sides and other non-tea pockets. Two and a Bud 19(1):25-28.

Biosecurity New Zealand. 2011a. The Biosecurity Organisms Register for Imported Commodities (BORIC). New Zealand Government, Biosecurity New Zealand. http://www.biosecurity.govt.nz/pests/registers/boric. (Archived at PERAL).

Biosecurity New Zealand. 2011b. Chinese knotweed, *Persicaria chinensis*. New Zealand Government, Biosecurity New Zealand. Last accessed October 14, 2011, http://www.biosecurity.govt.nz/pests/chinese-knotweed.

Biosecurity New Zealand. 2011c. Community help needed to find and weed out pest plant. July 22, 2011. New Zealand Government, Biosecurity New Zealand. Last accessed September 16, 2011, http://www.biosecurity.govt.nz/media/22-07-11/find-and-weed-out-pest-plant.

Chakravartee, J. 1994. Weed control in tea. Two and a Bud 41(1):2-11.

CISEH, and NPS. 2011. Invasive Plant Atlas of the United States: Mile-a-minute weed, *Persicaria perfoliata* (L.) H. Gross The University of Georgia's Center for Invasive Species and Ecosystem Health (CISEH) and the National Park Service (NPS). Last accessed October 14, 2011, http://www.invasiveplantatlas.org/subject.html?sub=3065.

Dave's Garden. 2017. Plant Files. Dave's Garden. http://davesgarden.com/guides/pf/. (Archived at PERAL).

eFloras. 2011a. Flora of China. Missouri Botanical Garden, St. Louis, Missouri & Harvard University Herbaria, Cambridge, Massachusetts. http://www.efloras.org/flora_page.aspx?flora_id=2. (Archived at PERAL).

eFloras. 2011b. Flora of North America. Missouri Botanical Garden, St. Louis, Missouri & Harvard University Herbaria, Cambridge, Massachusetts. http://www.efloras.org/flora_page.aspx?flora_id=1. (Archived at PERAL).

eFloras. 2011c. Flora of Pakistan. Missouri Botanical Garden, St. Louis, Missouri & Harvard University Herbaria, Cambridge, Massachusetts. http://www.efloras.org/flora_page.aspx?flora_id=5. (Archived at PERAL).

eFloras. 2016. Flora of North America. Missouri Botanical Garden, St. Louis, Missouri & Harvard University Herbaria, Cambridge, Massachusetts. http://www.efloras.org/flora_page.aspx?flora_id=1. (Archived at PERAL).

EPPO. 2015. PQR - EPPO's Plant Quarantine Data Retrieval System Version 5.3.5. European and Mediterranean Plant Protection Organization (EPPO). http://www.eppo.int/DATABASES/pqr/pqr.htm. (Archived at PERAL).

Evenhuis, N. L., and L. G. Eldredge. 2008. Records of the Hawaii biological survey for 2007. Bishop Museum Occasional Papers 100:88 pp.

Flora of North America Editorial Committee. 2005. Flora of North America, Volume 5, Magnoliophyta: Caryophyllidae, part 2. Oxford University Press, New York. 656 pp.

Galloway, D. J., and V. E. Lepper. 2010. *Persicaria chinensis* - a new alien Asian invader? Proceedings of the 17th Australasian Weeds Conference, pp. 174-175. Last accessed September 16, 2011, http://www.caws.org.au/awc/2010/awc201011741.pdf.

GBIF. 2011. GBIF, Online Database. Global Biodiversity Information Facility (GBIF). http://data.gbif.org/welcome.htm. (Archived at PERAL).

Goldman, D. 2016. Correspondence for *Persicaria chinensis*. Personal communication to A. Koop on August 9, 2016 from Doug Goldman (Botanist, USDA NRCS). Archived at the PERAL Library, Raleigh, NC.

Goodland, T., and J. R. Healey. 1996. The Invasion of Jamaican Montane Rainforests by the Australian Tree *Pittosporum Undulatum* in the Blue Mountains of Jamaica. School of Agricultural and Forest Sciences University of Wales, Bangor, UK. 55 pp.

Haridas, P., and V. S. Sharma. 1974. Some common weeds of South Indian tea fields. 14. *Polygonum chinense* L. and *Calceolaria mexicana* Benth. Planters' Chronicle 69(18/19):379-380.

Heap, I., H. Glick, L. Glasgow, and W. Vencill. 2011. International Survey of Herbicide Resistant Weeds. Herbicide Resistance Action Committee, the North American Herbicide Resistance Action Committee, and the Weed Science Society of America. http://www.weedscience.org/In.asp. (Archived at PERAL).

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

IPK. 2011. Mansfeld's World Database of Agriculture and Horticultural Crops Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK), Gatersleben http://mansfeld.ipk-gatersleben.de/pls/htmldb_pgrc/f?p=185:3:392103834526686. (Archived at PERAL).

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.

Kairo, M., B. Ali, O. Cheesman, K. A. Haysom, and S. T. Murphy. 2003. Invasive Species Threats in the Caribbean Region - Report to the Nature Conservancy. CAB International. 132 pp.

Kartesz, J. T. 2016. Taxonomic Data Center [maps generated from Kartesz, J.T. 2013. Floristic Synthesis of North America, Version 1.0. Biota of North America Program (BONAP). (in press)]. The Biota of North America Program (BONAP), Chapel Hill, N.C. http://www.bonap.net/tdc. (Archived at PERAL).

Keng, H. 1990. The Concise Flora of Singapore: Gymnosperms and Dicotyledons. Singapore University Press, Singapore. 222 pp.

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.

Mitra, B., P. Parui, A. Ghosh, and M. Mukherjee. 2005. Dipteran pollinators from some medicinal plants at Narendrapur, West Bengal. Bionotes 7(4):131.

MPI. 2015. Chinese Knotweed, New Zealand Government, Ministry of Primary Industries (MPI). 1 pp.

MPI. 2017. The Biosecurity Organisms Register for Imported Commodities (BORIC). New Zealand Government, Ministry for Primary Industries (MPI). http://www.mpi.govt.nz/news-and-resources/resources/registers-and-lists/biosecurity-organisms-register-for-imported-commodities/. (Archived at PERAL).

NGRP. 2011. 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. http://www.parasiticplants.siu.edu/ListParasites.html. (Archived at PERAL).

NISIC. 2011. Species Profiles: mile-a-minute weed. United States Department of Agriculture, National Agricultural Library, National Invasive Species Information Center (NISIC), Beltsville, MD. Last accessed October 14, 2011, http://www.invasivespeciesinfo.gov/plants/mileminute.shtml.

NPB. 2017. Laws and regulations. The National Plant Board (NPB). Last accessed September 14, 2017, http://nationalplantboard.org/laws-and-regulations/.

NRCS. 2011. The PLANTS Database. United States Department of Agriculture, Natural Resources Conservation Service (NRCS), The National Plant Data Center. http://plants.usda.gov. (Archived at PERAL).

NRCS. 2016. The PLANTS Database. United States Department of Agriculture, Natural Resources Conservation Service (NRCS), The National Plant Data Center. http://plants.usda.gov. (Archived at PERAL).

PestID. 2011. Pest Identification Database (PestID). United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine. https://mokcs14.aphis.usda.gov/aqas/login.jsp. (Archived at PERAL).

PestID. 2016. Pest Identification Database (PestID). United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine. https://aqas.aphis.usda.gov/aqas/. (Archived at PERAL).

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.

PROSEA Foundation. 2011. Plant Resources of Southeast Asia (PROSEA), electronic online databank. PROSEA Foundation, Bogor, Indonesia. http://www.proseanet.org/prosea/eprosea.php. (Archived at PERAL).

Randall, J. M. 2007a. 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. 2007b. A Global Compendium of Weeds. Hawaiian Ecosystems at Risk and Department of Agriculture of Western Australia. Last accessed September 16, 2011, http://www.hear.org/gcw/.

Rao, V. S., F. Rahman, S. N. Sharma, and H. S. Singh. 1977. Control of persistent weeds of tea. Proceedings 28th Tocklai Biennial Conference 1977. (1977):61-64.

Rao, V. S., F. Rahman, H. S. Singh, A. K. Dutta, M. C. Saikia, S. N. Sharma, and B. C. Phukan. 1976. Effective weed control in tea by glyphosate. Indian Journal of Weed Science 8(1):1-14.

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.

Royal Botanic Gardens Kew. 2008. Seed Information Database (SID) Version 7.1. http://data.kew.org/sid/. (Archived at PERAL).

Saikia, A., and A. Shadeque. 1996. Propagation methods of some under-exploited leaf vegetables of north east India. Journal of Hill Research 9(1):59-61.

Saikia, S., S. Baruah, and A. C. Barbora. 1998. Bioefficacy and economics of herbicidal combinations for control of *Polygonum chinense* (Linn.). Two and a Bud 45(2):15-18.

Sinha, M. P. 1985. A perspective of weed control in tea. Two and a Bud 32(1-2):35-39.

Soubeyran, Y. 2008. Espèces Exotiques Envahissantes dans les Collectivités Françaises D'outre-Mer: Etat des Lieux et Recommandations. Comité Français de l'UICN, Paris, France. 204 pp.

Suehiro, S. 2012. "Tsuru-soba" (*Persicaria chinensis*). Botanic Garden (online garden site in Japan). http://www.botanic.jp/plants-ta/tusoba.htm. (Archived at PERAL).

Swearingen, J., B. Slattery, K. Reshetiloff, and S. Zwicker. 2010. Plant Invaders of Mid-Atlantic Natural Areas, 4th ed. National Park Service and U.S. Fish and Wildlife Service, Washington, DC. 168 pp.

Tabish, and T. Girija. 2011. Flowers of India (an online community site for flower enthusiasts). http://www.flowersofindia.net/. (Archived at PERAL).

U.S. Forest Service. 2010. Pacific Island Ecosystems at Risk (PIER): Plant threats to Pacific ecosystems. United States Forest Service, United States Department of Agriculture. http://www.hear.org/pier/index.html. (Archived at PERAL).

U.S. Forest Service. 2011. Fire Effects Information System. United States Department of Agriculture, United States Forest Service. http://www.fs.fed.us/database/feis/index.html. (Archived at PERAL).

UFZ. 2011. Information System BiolFlor 1.1. The Helmholtz Centre for Environmental Research (UFZ), Centre for Environmental Research Leipzig-Halle, Department of Community Ecology. http://www2.ufz.de/biolflor/index.jsp. (Archived at PERAL).

UMN. 2017. Plant Information Online. University of Minnesota (UMN) Libraries. https://plantinfo.umn.edu/. (Archived at PERAL).

van Valkenburg, J. L. C. H., and N. Bunyapraphatsara. 2001. Plant Resources of South-East Asia No. 12(2): Medicinal and Poisonous Plants 2. Backhuys Publishers, Leiden. 782 pp.

Wagner, W. L., D. R. Herbst, and S. H. Sohmer. 1999. Manual of the Flowering Plants of Hawai'i, Revised Edition, Volume 2. Bishop Museum Press, Honolulu. 1919 pp.

Waugh, J. 2008. Trade Related Pathways to the Introduction of Terrestrial Invasive Species in the Insular Caribbean (Report to International Programs, US Forest Service) (Draft). International Union for Conservation of Nature. 37 pp.

Weakley, A. S. 2010. Flora of the Carolinas, Virginia, Georgia, Northern Florida, and Surrounding Areas (2010 Draft). University of North Carolina Herbarium, Chapel Hill, NC, U.S.A. 994 pp.

Yun Wu. 2009. Pest Alert: Mile-a-Minute Weed (*Persicaria perfoliata* (L.) H. Gross) (NA-PR-01-09). United States Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry, Newton Square, PA. 2 pp.

Zhang, Z., and Hirota. 2000. Chinese Colored Weed Illustrated Book. Institute for the Control of Agrochemica. 432 pp.

Appendix A. Weed risk assessment for *Persicaria chinensis* (L.) H. Gross (Polygonaceae)

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 - mod	5	*Persicaria chinensis* is native to eastern Asia (Evenhuis and Eldredge, 2008; U.S. Forest Service, 2010), but it has been introduced to other geographic areas (e.g., La Réunion in southern Africa, Jamaica, and Hawaii) (Goodland and Healey, 1996; Kairo et al., 2003; Soubeyran, 2008; Evenhuis and Eldredge, 2008; NRCS, 2011; Wagner et al., 1999). In Hawaii, it is "sparingly naturalized in agricultural lands and disturbed areas...on windward Hawai'i" (Wagner et al., 1999), and is now known from Oahu, where in 2007 it was "found as a lushly growing scandent subshrub in full flower...along a country road in Kalihi Valley" (Evenhuis and Eldredge, 2008). In Jamaica, it is "naturalized and invasive"; this reference defines "invasive" as "established in the wild and reported to be spreading, and/or regarded as a threat to a native species, ecosystem or causing a socio-economic impact" (Kairo et al., 2003); however, no references were cited nor was any additional information given on what exactly this plant is doing in Jamaica, and, therefore, we cannot know which part of the definition of "naturalized and invasive" applies to this plant in Jamaica. On the other hand, Goodland and Healey (1996) state that *P. chinensis* "seriously threaten[s] the forests of Blue Mountains" in Jamaica and that it has "spread" into primary forest in some places; according to these authors, a collector in 1905 described the plant as "rapidly spreading and becoming quite naturalized." The alternate answers for the uncertainty simulation were both "e."
ES-2 (Is the species highly domesticated)	n - low	0	We found limited evidence that this plant is cultivated but no evidence that it has been bred to reduce its likelihood of becoming a weed. It is cultivated in Korea as a medicinal plant (IPK, 2011). It is sometimes planted as an ornamental or medicinal plant (Keng, 1990). For *Persicaria* species, "plants are collected from the wild when needed," and "neither germplasm collections nor breeding programmes are known to exist" (van Valkenburg and Bunyapraphatsara, 2001).
ES-3 (Weedy congeners)	y - negl	1	The following species are listed as "Category 5" in Randall (2007a): *Persicaria orientalis* and *Persicaria*

Question ID	Answer - Uncertainty	Score	Notes (and references)
			capitata (definition of "Category 5": plants that have been recorded as invasive species; “This is the most serious criterion that can be applied to a plant and is generally used for serious high impact environmental and/or agricultural weeds that spread rapidly and often create monocultures.”). Also, *Persicaria perfoliata* (common name: mile-a-minute) is a serious invasive weed in the United States (e.g., Alien Plant Working Group, 2010; CISEH and NPS, 2011; NISIC, 2011).
ES-4 (Shade tolerant at some stage of its life cycle)	y - low	1	*Persicaria chinensis* "can tolerate a wide range of environmental conditions, including shade" (Galloway and Lepper, 2010). "Once it has established it can be moderately shade tolerant, surviving (but not thriving) beneath light canopies" (Goodland and Healey, 1996). "*Persicaria* species prefer...half shade or full sunlight" (van Valkenburg and Bunyapraphatsara, 2001).
ES-5 (Plant a vine or scrambling plant, or forms tightly appressed basal rosettes)	y - negl	1	*Persicaria chinensis* is a vine (Biosecurity New Zealand, 2011c). Its stems are "often very long and climbing" (PROSEA Foundation, 2011; van Valkenburg and Bunyapraphatsara, 2001). It is a "hardy creeper" (Barbora, 1972). It “can grow rapidly to varying heights depending on what it is scrambling over” (Galloway and Lepper, 2010). It "can scramble up trees to about 10 m" (Goodland and Healey, 1996). It climbs over tea bushes (Haridas and Sharma, 1974). It is a “vigorous climber with the ability to smother native plants, forest areas and horticulture operations” (Biosecurity New Zealand, 2011c).
ES-6 (Forms dense thickets, patches, or populations)	y - mod	2	*Polygonum chinense* (synonym of *P. chinensis*) “can form dense mats" (Goodland and Healey, 1996; Waugh, 2008). It "can form dense mats in disturbed areas two to three metres thick" (Goodland and Healey, 1996). We answered yes, but used moderate uncertainty because these references do not provide documentation or supporting evidence, and the Waugh (2008) reference represents an anecdotal report in a larger work about invasive species in the Caribbean. The related species *Persicaria perfoliata* (mile-a-minute) forms "dense thickets" (Yun Wu, 2009).
ES-7 (Aquatic)	n - negl	0	*Persicaria chinensis* is not an aquatic species; rather it is a terrestrial vine (Biosecurity New Zealand, 2011c; Waugh, 2008).
ES-8 (Grass)	n - negl	0	This plant is not in the family Poaceae (NGRP, 2011).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	This plant is not a woody plant and is not in a nitrogen-fixing family (NGRP, 2011).
ES-10 (Does it produce viable seeds or spores)	y - low	1	*Persicaria chinensis* reproduces by seed (U.S. Forest Service, 2010), or "by seed and rhizome" (Zhang and Hirota, 2000). However, there is also some evidence

Question ID	Answer - Uncertainty	Score	Notes (and references)
			that it does not reproduce by seed, or at least not primarily by seed. “Within New Zealand this plant is believed to spread by vegetative means only” (Galloway and Lepper, 2010). "Plants grow from rhizomes (or tubers) and stem fragments" (Biosecurity New Zealand, 2011b). In India, in trials comparing various methods of propagating four leafy vegetable species, seed propagation of *Polygonum chinense* (synonym of *P. chinensis*) was unsuccessful; suckers gave the best performance with 100 percent field establishment, and leaf-bud cuttings and runners were viable alternatives (Saikia and Shadeque, 1996). Because of the contradictory evidence, we rate the uncertainty low instead of negligible.
ES-11 (Self-compatible or apomictic)	y - high	1	We found no specific evidence for *P. chinensis*. The related species *Persicaria perfoliata* (mile-a-minute weed) "is primarily a self-pollinating plant (supported by its inconspicuous, closed flowers and lack of a detectable scent), with occasional out-crossing" (Alien Plant Working Group, 2010). Other related species (e.g., *P. scabra, P. pensylvanica, P. minor, P. maculosa*) are "self-compatible" (UFZ, 2011). Based on the use of congeneric information and the fact that a variety of pollinators visit the flowers of *P. chinensis* (see ES-12), we answered yes with a high uncertainty rating.
ES-12 (Requires specialist pollinators)	n - low	0	Mitra et al. (2005) report the following dipteran pollinators for *Polygonum chinense* (synonym of *P. chinensis*): *Culex* sp. (Culicidae), *Syritta indica* (Syrphidae), *Mesembrius quadrivittatus*, *M. bengalensis*, *Asarkina ericetorum*, *Eristalinus arvorum* (Syrphidae), *Stomorhina discolor*, *Hemipyrellia liguiriens* (Calliphoridae), and *Campiglossa cribellata* (Tephritidae). We found no other evidence regarding pollinators of this species, and no indication that it requires specialist pollinators. Considering the number and taxonomic diversity of the pollinators recorded by Mitra et al. (2005), *P. chinensis* probably does not require any specialist pollinators. The related species *Persicaria perfoliata* produces viable seed without the assistance of pollinators (Alien Plant Working Group, 2010).
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]	c - high	0	We found no specific information on the minimum generation time for this species. We only found information regarding it being a perennial (eFloras, 2011c; eFloras, 2011b; Flora of North America Editorial Committee, 2005; PROSEA Foundation, 2011; van Valkenburg and Bunyapraphatsara, 2001). Based on the available evidence, “c” provides the best choice for an herbaceous vine, but because some perennials may produce offspring in their first

Question ID	Answer - Uncertainty	Score	Notes (and references)
			year, we chose “b” as both alternate answers for the uncertainty simulation.
ES-14 (Prolific seed producer)	? - max	0	Unknown. We found no information on the number of seeds produced by *Persicaria chinensis*.
ES-15 (Propagules likely to be dispersed unintentionally by people)	y - low	1	“This plant is likely to be spread ...on contaminated garden tools, so people treating it themselves could accidentally spread it further" (Biosecurity New Zealand, 2011c). "It can be moved with garden rubbish and on contaminated gardening tools, including lawnmowers" (Biosecurity New Zealand, 2011b).
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	? - max	0	Unknown. We found no evidence of propagules of this species being dispersed in trade as contaminants and hitchhikers. However, based on the evidence presented in ES-15, it might be able to disperse in trade.
ES-17 (Number of natural dispersal vectors)	2	0	Information relevant for ES-17a through ES-17e: The fruits of *P. chinensis* are "baccate, fleshy, fruiting perianth c. 2 mm thick, fleshy...Nuts trigonous 2-3 (-4) x 1.5-2 mm, included in the fleshy perianth” (eFloras, 2011c). Achenes included in fleshy, bluish black perianth, 2.8-4 x 2-3 mm (Flora of North America Editorial Committee, 2005). The fruits of *P. chinensis* "are berries, globose in shape. Enclosed in the enlarged and fleshy calyx at maturity...Seeds small, black, fruits edible, sour tasting" (Tabish and Girija, 2011).
ES-17a (Wind dispersal)	n - negl		We found no evidence of wind dispersal. Because the fruit is a berry and possesses no obvious adaptations for wind dispersal, we answered no with negligible uncertainty. Dispersed via other vectors (see ES-17c and ES-17e).
ES-17b (Water dispersal)	? - max		Unknown. There are no obvious fruit/seed adaptations for water dispersal. The plant lives in a variety of environments, not just streamsides or lake edges. van Valkenburg and Bunyapraphatsara (2001) say all *Persicaria* spp. are dispersed by water, but they provide no supporting information. Also, Swearingen et al. report that for the related species *Persicaria perfoliata* (mile-a-minute weed), "water is an important mode of dispersal as fruits can remain buoyant for seven to nine days" (Swearingen et al., 2010).
ES-17c (Bird dispersal)	y - negl		The seeds of *Polygonum chinense* (synonym of *P. chinensis*) are dispersed by birds intentionally eating the fruit (Royal Botanic Gardens Kew, 2008). "It’s fruits are bird dispersed" (Goodland and Healey, 1996). Additionally, the related species, *Persicaria perfoliata* (mile-a-minute weed) is spread as seeds by birds (Swearingen et al., 2010).
ES-17d (Animal external dispersal)	n - low		We found no evidence found that the propagules of *Persicaria chinensis* are dispersed externally by

Question ID	Answer - Uncertainty	Score	Notes (and references)
			animals other than birds, or that they have any particular adaptations to be dispersed in this manner.
ES-17e (Animal internal dispersal)	y - mod		For the related species *Persicaria longiseta*: "animals may disperse Oriental lady's thumb; in Connecticut, Oriental lady's thumb seeds germinated from white-tailed deer fecal pellets" (U.S. Forest Service, 2011). For the related species *Persicaria perfoliata* (mile-a-minute weed), other animals besides birds "eating mile-a-minute weed fruits are chipmunks, squirrels and deer and viable seeds have been found in deer scat" (Alien Plant Working Group, 2010). Based on the use of congeneric information, we gave a moderate uncertainty rating.
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	y - mod	1	We found no evidence of a persistent seed bank for *P. chinensis*. However, the related species *P. longiseta* "forms a persistent seed bank" (U.S. Forest Service, 2011). Also *P. perfoliata* (mile-a-minute weed), "seeds may persist in the soil seed bank for several years; one review suggests that seeds persist for up to 4 years" (U.S. Forest Service, 2011); “the seeds may survive in the soil for up to 6 years” (Yun Wu, 2009). Based on the use of congeneric information, we answered yes with moderate uncertainty rating.
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	y - mod	1	*Persicaria chinensis* “is likely to be spread through fragments breaking off and re-sprouting into new plants" (Biosecurity New Zealand, 2011c). In terms of tolerance to fire, we did not find any information on *Persicaria chinensis*, and we found no clear evidence that other species within the genus *Persicaria* are tolerant of mutilation, fire, or other major disturbances.
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	y - high	1	In tea production, *Polygonum chinense* (synonym of *P. chinensis*) is reported as "becoming somewhat resistant" to the herbicide Gramoxone and is "becoming predominant where weeds are controlled by using other herbicides" (Barbora, 1972); however, we do not know whether this reference is referring to herbicide resistance or tolerance. Heap et al. (2011) do not list any species in the genus *Persicaria* as having herbicide resistance; however, multiple species of *Polygonum* are reported as having herbicide resistance.
ES-21 (Number of cold hardiness zones suitable for its survival)	8	0	
ES-22 (Number of climate types suitable for its survival)	6	2	
ES-23 (Number of precipitation bands suitable for its survival)	8	1	
IMPACT POTENTIAL			

Question ID	Answer - Uncertainty	Score	Notes (and references)
General Impacts			
Imp-G1 (Allelopathic)	n - mod	0	We found no evidence that this species is allelopathic.
Imp-G2 (Parasitic)	n - negl	0	*Persicaria chinensis* does not belong to a family known to contain parasitic plants (Heide-Jorgensen, 2008; NGRP, 2011; Nickrent, 2009).
Impacts to Natural Systems			
Imp-N1 (Changes ecosystem processes and parameters that affect other species)	n - high	0	We found no direct evidence or statements of it causing changes to ecosystem processes. In the Blue Mountains of Jamaica, it is in introduced gap colonizer that can suppress other species with its dense mats; while it mainly occurs in disturbed areas around the fringes of the forest, it has spread to a few large natural gaps in primary forest (Goodland and Healey, 1996). While these authors do not state what species *P. chinensis* is suppressing, they hypothesize that under certain circumstances invasion by *P. chinensis*, along with another weed (a rhizomatous herb), may lead in the future to a loss of tree cover. Therefore, they appear to suggest that *P. chinensis* may disrupt forest succession. Based on this evidence, we used high uncertainty.
Imp-N2 (Changes habitat structure)	? - max	0	We found no evidence of it changing community structure in natural environments. However, the fact that this species is a vine (ES-5), forms dense mats (ES-6), can change community composition (Imp-N3), and can grow over tea bushes (Haridas and Sharma, 1974) suggest that it could also change community structure in natural areas, in particular if the species being suppressed are trees or shrubs; therefore, we answered unknown.
Imp-N3 (Changes species diversity)	y - negl	0.2	*Polygonum chinense* (synonym of *P. chinensis*): "the denseness and thickness of the mat it forms suppresses other species" (Waugh, 2008). "It seems to prevent the establishment of other plant species for perhaps an indefinite period because of the density and thickness of the mat it forms" (Goodland and Healey, 1996).
Imp-N4 (Is it likely to affect federal Threatened and Endangered species?)	y - mod	0.1	This species grows in a variety of natural environments (eFloras, 2011a; PROSEA Foundation, 2011; U.S. Forest Service, 2010; van Valkenburg and Bunyapraphatsara, 2001) that are likely to contain at least some rare species. Because this species can change species diversity (see Imp-N3), it is likely to affect these rare species.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions?)	? - max	0.1	Its predicted distribution in the United States includes globally outstanding ecoregions as defined by Ricketts et al. (1999, p. 34, Fig. 3.1). While we found no evidence of it changing ecosystem processes and parameters (Imp-N1), changing habitat structure (Imp-N2), or forming extensive populations in natural

Question ID	Answer - Uncertainty	Score	Notes (and references)
			areas, because it has been suggested it may disrupt forest succession (Goodland and Healey, 1996), 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]	b - low	0.2	Reported as an "environmental weed" in Jamaica (Randall, 2007b). Goodland and Healey (1996) "think" that the "alien weed" *Polygonum chinense* (synonym of *P. chinensis*) "seriously threaten[s] the forests of Blue Mountains" in Jamaica." We found no evidence that this plant is being controlled in natural areas. The alternate answers for the uncertainty simulation are both "c."
Impact to Anthropogenic Systems (e.g., cities, suburbs, roadways)			
Imp-A1 (Negatively impacts personal property, human safety, or public infrastructure)	? - max		This plant smothers trees and "other structures" (Biosecurity New Zealand, 2011c). It "could become a nuisance plant in … lifestyle properties" (Biosecurity New Zealand, 2011b). Because the first reference does not give details as to what "other structures" are, and because the second reference uses the word "could," we rated this question as "unknown".
Imp-A2 (Changes or limits recreational use of an area)	y - mod	0.1	We found one reference indicating that this species' "rampant growth …can quickly make trails impassable" (Goodland and Healey, 1996). Because we found no other evidence of this type of impact, we gave a moderate uncertainty.
Imp-A3 (Affects desirable and ornamental plants, and vegetation)	? - max		Unknown. It "could become a nuisance plant in home gardens" (Biosecurity New Zealand, 2011b). Because this reference uses the word "could", we rated this question as "unknown."
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]	c - negl	0.4	In New Zealand, it was recently reported as an "invasive weed growing rampantly" in an "area of damp wasteland behind several residential properties," and "because of its suspected invasiveness and with no other naturalised sites known within New Zealand, steps were immediately put in place to eradicate this plant...A contractor was engaged to immediately carry out control over the eight affected properties"; this same reference refers to this plant species as "an invasive weed" (Galloway and Lepper, 2010). The alternate answers for the uncertainty simulation are "b" and "a."
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	y - high	0.4	In tea production in India, weeds "constitute a major yield-limiting factor," the extent of yield loss ranging from 10 to 50 per cent; although this reference does not state specifically what amount of yield loss *Polygonum chinense* (synonym of *P. chinensis*) causes, it does list *P. chinense* as among the "particularly persistent and problem weeds" (Rao et al., 1977). Because of the lack of specific yield loss information for *P. chinensis*, we rated the uncertainty as high.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Imp-P2 (Lowers commodity value)	y - mod	0.2	Control measures for this weed in tea production are reported (e.g., Barbora, 1972; Chakravartee, 1994; Rao et al., 1977; Rao et al., 1976; Saikia et al., 1998; Sinha, 1985), which we assume can increase the cost of production and therefore lower commodity value. Because we found no specific information on this impact, we used moderate uncertainty.
Imp-P3 (Is it likely to impact trade?)	? - max		This plant species is not listed as a quarantine pest for any country by EPPO (2015) or APHIS (2016, 2017). Although the New Zealand government does not list *P. chinensis* as a "regulated pest" for commodity imports into its country (Biosecurity New Zealand, 2011a; MPI, 2017), it does list it as an "Unwanted Organism" ["An "unwanted organism" is ”any organism a chief technical officer believes capable of causing unwanted harm to any natural and physical resources or human health..."], and New Zealand recently implemented an eradication program when the plant was detected in the country (Biosecurity New Zealand, 2011b, 2011c). We found no interceptions of this plant species at U.S. ports-of-entry; however, there have been interceptions of seed of other species in the genus *Persicaria* in permit cargo (commercial plant products) (PestID, 2011; query Sept 21, 2011). Although congeners may move in trade as a contaminant, we do not know if *P. chinensis* can. Because we did not find evidence that this species moves as a contaminant in trade, we rated this element "unknown."
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	y - high	0.1	In tea production, this species is a common weed often found in drains and drain sides/edges (Barbora, 1972). It is included among other weed species in a publication describing weeds affecting drains, drain sides, and other non-tea pockets in tea production; as these weeds "grow, multiply, mature and seed, these pockets become permanent sources of infestation of the tea areas.[and] profuse weed growth in the drains and drain edges also restricts the free flow of surplus water and thereby reduce the efficiency of an otherwise adequate drainage system" (Barbora, 1972). Because we do not know for sure if it is *P. chinensis* or some other weeds that affect water in tea production, we gave a high uncertainty level.
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	n - low	0	We found no evidence that it is toxic to animals. Its economic importance includes being used as for fodder (IPK, 2011); therefore, we assume it is not toxic to livestock/range animals and poultry.
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)	c - negl	0.6	In tea production, *Polygonum chinense* (a synonym of *P. chinensis*) is a common weed. A mixture of the herbicides 2,4-D at 2 kg and 2,4,5-T at 1 kg/ha controls *P. chinense* and gives good results, while the best control is achieved by combining chemical

Question ID	Answer - Uncertainty	Score	Notes (and references)
Taxon a weed and evidence of control efforts]			control with hand removal (Barbora, 1972). Chakravartee (1994) refers to *P. chinense* as an "obnoxious weed" in tea production and recommends an herbicide (glyphosate) for its control. This plant is a "noxious weed" in tea production in southern India (Haridas and Sharma, 1974). It is one of the "problem weeds in tea" that are controlled with the herbicide glyphosate (Sinha, 1985). Other evidence of herbicide control of this "weed" in tea production: Rao et al., 1977; Rao et al., 1976; Saikia et al., 1998; Sinha, 1985. This plant is one of the "most persistent weeds of tea" and can "severely" infest mature tea (Rao et al., 1977). "It has the potential to affect forestry, orchard and nursery operations" (Biosecurity New Zealand, 2011b). It is listed as an "agricultural weed" in Taiwan and Thailand (Randall, 2007b). The alternate answers for the uncertainty simulation were both “b.”
GEOGRAPHIC POTENTIAL			Unless otherwise stated, all geographic information used below was obtained from GBIF (2011) and is based on point-source (PS) data (geo-referenced data points) and areas of occurrence (Occ).
Plant hardiness zones			
Geo-Z1 (Zone 1)	n - negl	N/A	We found no evidence that it occurs in this hardiness zone.
Geo-Z2 (Zone 2)	n - negl	N/A	We found no evidence that it occurs in this hardiness zone.
Geo-Z3 (Zone 3)	n - mod	N/A	We found no evidence that it occurs in this hardiness zone.
Geo-Z4 (Zone 4)	n - mod	N/A	We found no evidence that it occurs in this hardiness zone.
Geo-Z5 (Zone 5)	n - mod	N/A	We found no evidence that it occurs in this hardiness zone.
Geo-Z6 (Zone 6)	y - mod	N/A	Occ: South Korea (Jeju).
Geo-Z7 (Zone 7)	y - negl	N/A	PS: Japan; Occ: South Korea (Jeju).
Geo-Z8 (Zone 8)	y - negl	N/A	PS: China (Yunnan), Japan; Occ: the United States (Hawaii) (Wagner et al., 1999).
Geo-Z9 (Zone 9)	y - negl	N/A	PS: Nepal, Taiwan, China (Yunnan); Occ: the United States (Hawaii) (Wagner et al., 1999).
Geo-Z10 (Zone 10)	y - negl	N/A	PS: Nepal, Taiwan, Thailand; Occ: the United States (Hawaii) (Wagner et al., 1999), New Zealand (North Auckland).
Geo-Z11 (Zone 11)	y - negl	N/A	PS: Nepal, Thailand, Taiwan; Occ: the United States (Hawaii) (Wagner et al., 1999), Jamaica (Blue Mountains) (Goodland and Healey, 1996; Kairo et al., 2003), La Reunion (Soubeyran, 2008), India (Tamil Nadu).
Geo-Z12 (Zone 12)	y - negl	N/A	Occ: the United States (Hawaii) (Wagner et al., 1999), La Reunion (Soubeyran, 2008), India (Tamil Nadu).

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-Z13 (Zone 13)	y - negl	N/A	PS: Indonesia; Occ: the United States (Hawaii) (Evenhuis and Eldredge, 2008), Singapore (U.S. Forest Service, 2010).
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	y - negl	N/A	PS: Indonesia; Occ: the United States (Hawaii) (Evenhuis and Eldredge, 2008; Wagner et al., 1999), Jamaica (Blue Mountains) (Goodland and Healey, 1996; Kairo et al., 2003), La Reunion (Soubeyran, 2008), Singapore (U.S. Forest Service, 2010).
Geo-C2 (Tropical savanna)	y - negl	N/A	PS: Thailand, Taiwan, the United States (Hawaii); Occ: the United States (Hawaii) (Evenhuis and Eldredge, 2008; Wagner et al., 1999).
Geo-C3 (Steppe)	n - high	N/A	We found no evidence that it occurs in this climate type.
Geo-C4 (Desert)	n - negl	N/A	We found no evidence that it occurs in this climate type.
Geo-C5 (Mediterranean)	n - mod	N/A	We found no evidence that it occurs in this climate type.
Geo-C6 (Humid subtropical)	y - negl	N/A	PS: Japan, Nepal, Taiwan; Occ: South Korea (Jeju) .
Geo-C7 (Marine west coast)	y - negl	N/A	PS: China (Yunnan); Occ: India (Tamil Nadu), New Zealand.
Geo-C8 (Humid cont. warm sum.)	y - low	N/A	PS: Japan.
Geo-C9 (Humid cont. cool sum.)	y - mod	N/A	PS: Japan.
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 - negl	N/A	We found no evidence that it occurs in this precipitation band.
Geo-R2 (10-20 inches; 25-51 cm)	n - negl	N/A	We found no evidence that it occurs in this precipitation band.
Geo-R3 (20-30 inches; 51-76 cm)	n - low	N/A	We found no evidence that it occurs in this precipitation band.
Geo-R4 (30-40 inches; 76-102 cm)	y - low	N/A	PS: China (Yunnan), India.
Geo-R5 (40-50 inches; 102-127 cm)	y - negl	N/A	PS: China (Yunnan), Thailand.
Geo-R6 (50-60 inches; 127-152 cm)	y - negl	N/A	PS: China (Yunnan); Occ: South Korea (Jeju).
Geo-R7 (60-70 inches; 152-178 cm)	y - negl	N/A	PS: Japan, Nepal, Thailand, the United States (Hawaii); Occ: the United States (Hawaii) (Evenhuis and Eldredge, 2008; Wagner et al., 1999), Jamaica (Blue Mountains) (Goodland and Healey, 1996; Kairo et al., 2003), India (Tamil Nadu), South Korea (Jeju), New Zealand.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-R8 (70-80 inches; 178-203 cm)	y - negl	N/A	PS: Japan, Nepal, Taiwan; Occ: India (Tamil Nadu).
Geo-R9 (80-90 inches; 203-229 cm)	y - negl	N/A	PS: Japan, Taiwan; Occ: La Reunion (Soubeyran, 2008).
Geo-R10 (90-100 inches; 229-254 cm)	y - negl	N/A	PS: Japan; Occ: La Reunion (Soubeyran, 2008), Singapore (U.S. Forest Service, 2010).
Geo-R11 (100+ inches; 254+ cm)	y - negl	N/A	PS: Indonesia.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	n - low	0	*Persicaria chinensis* is naturalized in Hawaii (Evenhuis and Eldredge, 2008; NRCS, 2011; Wagner et al., 1999). Although it has been reported in the past as being introduced in the continental United States in Maryland, Massachusetts, and New Jersey (eFloras, 2011b; Flora of North America Editorial Committee, 2005; Weakley, 2010), a recent detailed investigation by Doug Goldman (botanist with the USDA Natural Resources Conservation Service) revealed that these reports were likely based on an original error in the literature (Goldman, 2016). Furthermore, other sources (Kartesz, 2016; NRCS, 2016), including a more recent version of eFloras (eFloras, 2016), do not report *P. chinensis* as occurring in the continental United States. We found no evidence that this species is in cultivation or in commercial trade (horticultural, ornamental, or other) in the United States. Even though this species is naturalized in the United States, we decided to assess its entry potential anyway because it is not known to be present in the continental United States and U.S. Caribbean territories, and because assessment of the entry potential can provide potentially useful information for risk managers and policy makers.
Ent-2 (Plant proposed for entry, or entry is imminent)	n - low	0	We found no evidence.
Ent-3 (Human value & cultivation/trade status)	c - mod	0.25	This plant is cultivated. It is used as a medicinal herb (Keng, 1990; PROSEA Foundation, 2011) and cultivated in Korea for this purpose (IPK, 2011). It is suspected to have been introduced to New Zealand for use as a medicinal herb (Galloway and Lepper, 2010). It is also sometimes planted as an ornamental plant (Keng, 1990). However, we found no evidence of *P. chinensis* propagules being in trade. For *Persicaria* species, "plants are collected from the wild when needed," and "neither germplasm collections nor breeding programmes are known to exist" (van Valkenburg and Bunyapraphatsara, 2001). Based on this evidence, we answered “c” (i.e., cultivated, but no evidence of trade or resale).
Ent-4 (Entry as a contaminant)			

Question ID	Answer - Uncertainty	Score	Notes (and references)
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	y - negl		It is native to China (NGRP, 2011; U.S. Forest Service, 2010), and it has been introduced into Jamaica (Goodland and Healey, 1996; Kairo et al., 2003).
Ent-4b (Contaminant of plant propagative material (except seeds))	? - max		We found no interceptions of this plant species at U.S. ports-of-entry (PestID, 2016; query Sept 26, 2016), nor any evidence in the literature of it being a weed of nursery stock or a contaminant of non-seed, plant propagative material. We also found no interceptions of the genus *Persicaria* associated with non-seed propagative material at U.S. ports-of-entry (PestID, 2016; query Sept 26, 2016). However, the related species *Persicaria perfoliata*, whose seeds are similar in size to that of *P. chinensis* (eFloras, 2016), is thought to have been introduced accidentally to the United States as a “contaminant of ornamental stock” (NISIC, 2011), and its spread is "facilitated by contaminated nursery stock" (U.S. Forest Service, 2011). Based on this congeneric evidence, we answered unknown.
Ent-4c (Contaminant of seeds for planting)	? - max		We found no interceptions of this plant species at U.S. ports-of-entry; however, there have been interceptions of related species such as *Persicaria lapathifolia*, whose seeds are similar in size to that of *P. chinensis* (eFloras, 2016), in imported seeds for planting (PestID, 2016; query Sept 26, 2016). Also, the related species *Persicaria perfoliata*, whose seeds are also similar in size to that of *P. chinensis* (eFloras, 2016), has spread in the United States in part as a seed contaminant (U.S. Forest Service, 2011). Based on this evidence, we answered unknown.
Ent-4d (Contaminant of ballast water)	n - mod	0	We found no evidence.
Ent-4e (Contaminant of aquarium plants or other aquarium products)	n - low	0	We found no evidence. Furthermore, contamination of such products seems unlikely since *P. chinensis* is not an aquatic or wetland species, or otherwise associated with such species.
Ent-4f (Contaminant of landscape products)	n - mod	0	We found no evidence.
Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances)	y - mod	0.04	“This plant is likely to be spread ...on contaminated garden tools" (Biosecurity New Zealand, 2011c). "It can be moved...on contaminated gardening tools, including lawnmowers" (Biosecurity New Zealand, 2011b).
Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing)	? - max		Although we found no evidence for *P. chinensis*, related *Persicaria* species such as *Persicaria lapathifolia*, whose seeds are similar in size to that of *P. chinensis* (eFloras, 2016), have been intercepted numerous times in plant products for consumption at U.S. ports of entry (PestID, 2016; query Sept 26, 2016).

Question ID	Answer - Uncertainty	Score	Notes (and references)
Ent-4i (Contaminant of some other pathway)	a - mod	0	We found no evidence.
Ent-5 (Likely to enter through natural dispersal)	? - max		*Persicaria chinensis* is present in Jamaica (Goodland and Healey, 1996; Kairo et al., 2003), and its seeds are dispersed by birds (Goodland and Healey, 1996; Royal Botanic Gardens Kew, 2008). However, it is unknown if the birds (that would be likely to disperse the seeds) are capable or likely to fly from Jamaica to the continental United States or U.S. territories in the Caribbean.