United States Department of Agriculture

Weed Risk Assessment for *Persicaria nepalensis* (Meisn.) H. Gross (Polygonaceae) – Nepal knotweed

United States Department of Agriculture

Animal and Plant Health Inspection Service

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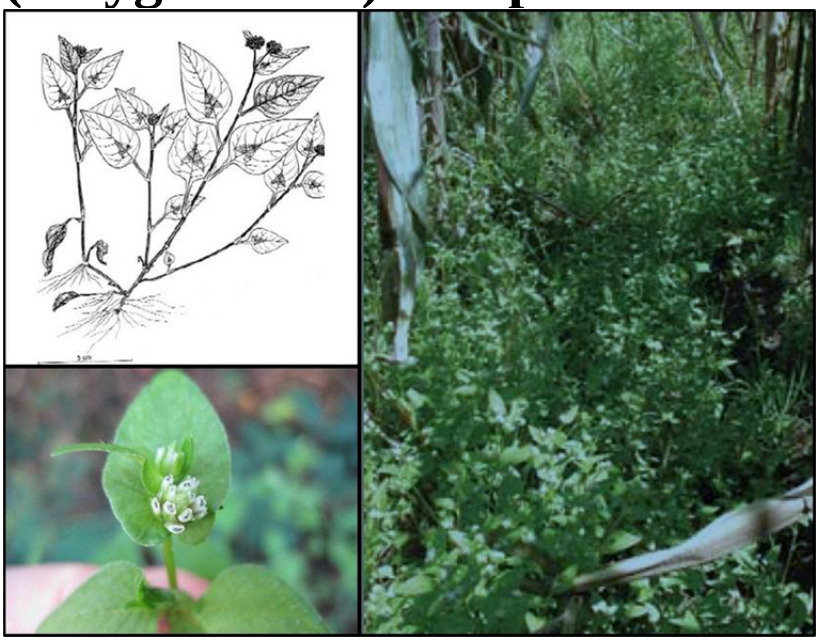

Top left: habit of *Persicaria nepalensis* (source: Meier, 2006). Bottom left: inflorescence (source: Verloove, 2011). Right: *Persicaria nepalensis* forming dense population in maize crop (source: Vibrans and Hanan Alipi, 2008).

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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 weed risk assessment (WRA)—specifically, the PPQ WRA model (Koop et al., 2012)—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.

Because the PPQ WRA model is geographically and climatically neutral, it can be used to evaluate the baseline invasive/weed potential of any plant species for the entire United States or for any area within it. As part of this analysis, we use a stochastic simulation to evaluate how much the uncertainty associated with the analysis affects the model outcomes. We also use GIS overlays to evaluate those areas of the United States that may be suitable for the establishment of the plant. For more information on the PPQ WRA process, please refer to the document, *Background information on the PPQ Weed Risk Assessment*, which is available upon request.

***Persicaria nepalensis* (Meisn.) H. Gross – Nepal knotweed**

Species Information

Family: Polygonaceae

Synonyms: *Persicaria alata* (Buch.-Ham. ex D. Don) Nakai, *Polygonum alatum* (Buch.-Ham. ex D. Don) Spreng., *Polygonum nepalense* Meisn. (basionym) (NGRP, 2014b)

Common names: Nepal knotweed, Nepal persicaria, renouée du Népal, Nepal-Knöterich, poligono de Nepal (NGRP, 2014b)

Botanical description: *Persicaria nepalensis* is an annual erect herb with a decumbent to ascending stem (eFloras, 2014a, 2014b) that grows 15-50 cm tall (CABI, 2014; eFloras, 2014b). Its leaves are up to 5 cm in length and frequently have a pair of dark blotches on each side of the mid-rib; the flowers are 2-3 mm long and are usually pink but can be white (CABI, 2014). For a full botanical description, see eFloras (2014a, 2014b) or Flora of North America Editorial Committee (2005).

Initiation: APHIS received a market access request from South Africa for corn seeds for planting in the United States (South Africa Department of Agriculture Forestry and Fisheries, 2012). During the development of that commodity risk analysis, *P. nepalensis* was identified as a weed of potential concern to the United States. The PPQ Weeds Cross-Functional Working Group decided to evaluate this species with a weed risk assessment.

Foreign distribution: *Persicaria nepalensis* is native to temperate and tropical areas of Asia (NGRP, 2014b) and has naturalized in parts of central and southern Africa, Europe (Belgium, Italy, Germany, Russia, United Kingdom), North America (Mexico, Canada) (CABI, 2014; Kartesz, 2013; Meier, 2006; NGRP, 2014b; Stace, 2010), and South America (Colombia, Ecuador, Venezuela) (Vibrans and Hanan Alipi, 2008).

U.S. distribution and status: It is naturalized in the United States in a small number of counties in multiple states (i.e., a few counties each in Pennsylvania and New York, and one county each in Connecticut, Florida, Maine, and Massachusetts) (eFloras,

2014a; Kartesz, 2013; NRCS, 2014). It has also been found in southwestern ponderosa pine ecosystems (in Arizona and New Mexico) in the United States (Friederici, 2003), and one report places it in Washington state near the shore of Squalicum Lake in Whatcom County (GBIF, 2014)but we do not know if it has established in these states. We found no evidence about when and how it may have been introduced to the country. Although we found no evidence that this species is sold commercially in the United States, it may be cultivated privately to some extent [i.e., one person in Florida stated they have the plant available for private trade on the gardening forum, Dave's Garden (2014)]. We found no evidence that this species is regulated or listed as a noxious weed by any U.S. state (NGRP, 2014a).

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

1. *Persicaria nepalensis* analysis

Establishment/Spread Potential *Persicaria nepalensis* 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, 2007). Beyond its native range it has established in Africa, Europe, North America (Kartesz, 2013; NGRP, 2014b; Stace, 2010), and South America (Vibrans and Hanan Alipi, 2008). It is an erect herb that can spread very quickly (Vibrans and Hanan Alipi, 2008), is shade tolerant (e.g., Meier, 2006), forms dense mats (Vibrans and Hanan Alipi, 2008), reproduces by seed (Everaarts, 1981), and forms a persistent seed bank (Plaza and Pedraza, 2007; Sahoo et al., 1994). Propagules can be dispersed as seed contaminants in trade (Meier, 2006; PestID, 2014), by grazing cattle that consume the seeds (Woldu and Mohammed Saleem, 2000), and probably also by birds (Lu et al., 2011) and people (unintentionally) (Moore, 2011). We had low uncertainty for this risk element.
Risk score = 17 Uncertainty index = 0.12

Impact Potential *Persicaria nepalensis* is a weed of multiple crops (e.g., potato, soybean, rice, corn, strawberry) (Ishikawa and Takenaka, 2002; Moody, 1989; Radosevich and Holt, 1984; Zhang and Hirota, 2000). It is a major weed of wheat in Ethiopia (Kassahun et al., 2005; Tessema et al., 1999), resulting in reduced crop yield (Gebre et al., 1987) and increased weed control measures (Vibrans and Hanan Alipi, 2008). Because it is a quarantine or regulated pest for multiple countries (APHIS, 2014; Vibrans and Hanan Alipi, 2008) and can be dispersed as a contaminant, it could impact trade. It is perceived as an environmental weed, resulting in control efforts in natural areas (Verloove, 2011). In those areas it can increase the density of the herb layer (Moore, 2011), but we found no evidence of it replacing other species. In anthropogenic systems, it can obstruct access for water sports in South Africa (Wells et al., 1986) and can be a weed of flower gardens and lawns in India (Datta and Banerjee, 1954). We had high uncertainty for this risk element.
Risk score = 3.8 Uncertainty index = 0.23

Geographic Potential Based on three climatic variables, we estimate that about 80 percent of the United States is suitable for the establishment of *P. nepalensis* (Fig. 1). This predicted

[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).

distribution is based on the species' known distribution elsewhere in the world and includes point-referenced localities and areas of occurrence. The map for *P. nepalensis* represents the joint distribution of Plant Hardiness Zones 3-13, areas with 10-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savanna, steppe, desert, Mediterranean, humid subtropical, marine west coast, humid continental warm summers, and humid continental cool summers.

The estimated area is likely conservative since it only uses three climatic variables. Other environmental variables, such as soil and habitat type, may further limit the areas in which this species is likely to establish. Habitats of this plant include wetland areas (Shin et al., 2008), shores of rivers and lakes (NEWFS, 2014), and non-aquatic environments (e.g., roadsides, dirt roads, grassland, meadow, woodlands, cliffs, cultivated areas) (GBIF, 2014; Meier, 2006; Reed, 1977; Vibrans and Hanan Alipi, 2008; Weldy et al., 2014). It apparently thrives in high altitude tropics (CABI, 2014).

Entry Potential We did not assess the entry potential of *P. nepalensis* because it is already present in the United States (eFloras, 2014a; Friederici, 2003; GBIF, 2014; Kartesz, 2013; NRCS, 2014; Weldy et al., 2014).

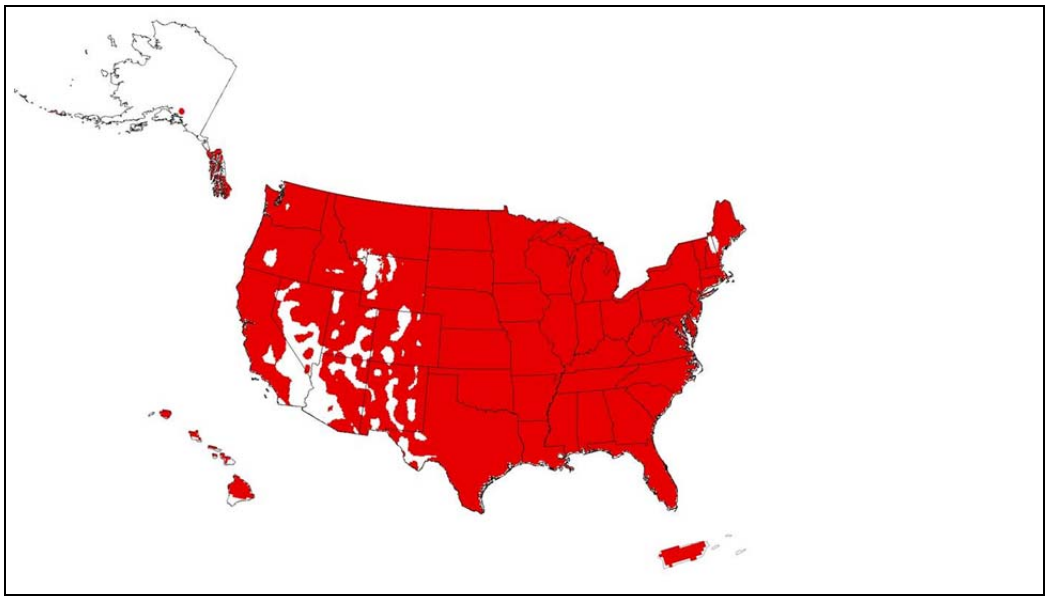

Figure 1. Predicted distribution of *Persicaria nepalensis* in the United States. Map insets for Alaska, Hawaii, and Puerto Rico are not to scale.

2. Results

Model Probabilities: P(Major Invader) = 89.6%
P(Minor Invader) = 10.0%
P(Non-Invader) = 0.3%

Risk Result = High Risk
Secondary Screening = Not Applicable

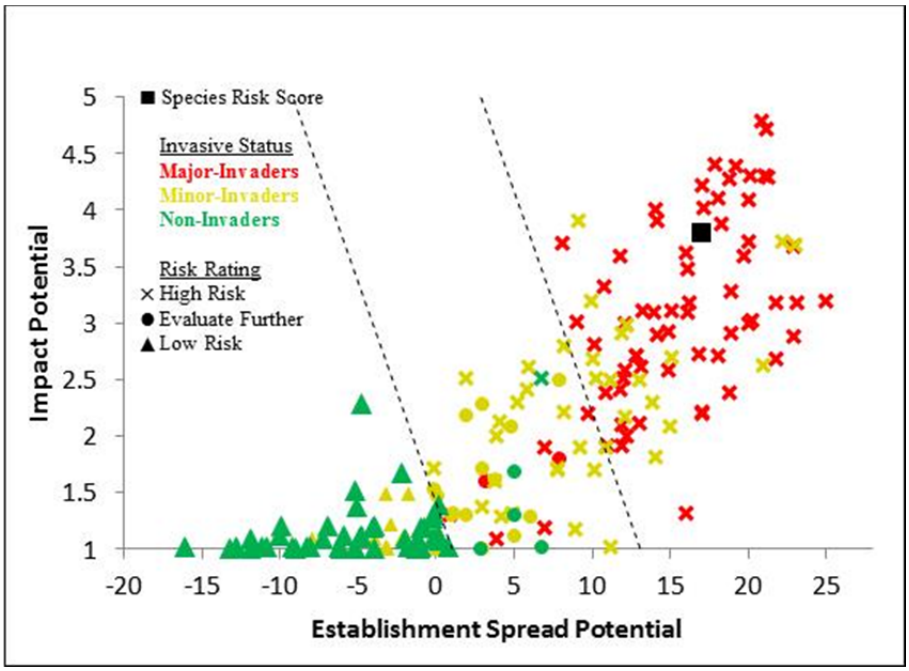

Figure 2. *Persicaria nepalensis* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

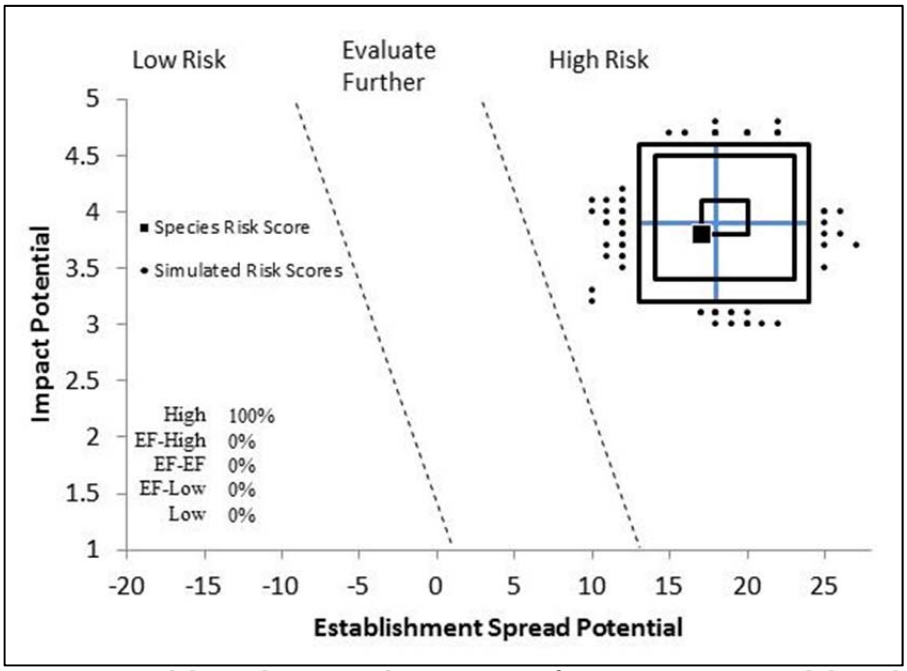

Figure 3. Model simulation results (N=5,000) for uncertainty around the risk score for *Persicaria nepalensis*. The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

3. Discussion

The result of the weed risk assessment for *P. nepalensis* is High Risk (Figures 2 and 3). This species tolerates a wide range of environmental conditions. It is an important weed of multiple crops (e.g., Holm et al., 1991; Mena et al., 1984; Nimje, 1988; Vibrans and Hanan Alipi, 2008), including wheat in particular (Kassahun et al., 2005; Tessema et al., 1999). It is also an invasive environmental weed, and populations in natural areas of Belgium are monitored and controlled (Verloove, 2011). In Mexico, where it arrived in 2004, it has been found mainly in crops but also in natural areas (pine forest, grassland) and has spread very quickly (Vibrans, 2012; Vibrans and Hanan Alipi, 2008). Although the uncertainty in this analysis was average to high, the uncertainty analysis (Fig. 3) indicated the results were still robust, as all of the simulated assessments resulted in conclusions of High Risk.

This species is naturalized in a small number of counties across multiple states in the United States (Florida, Pennsylvania, New York, Massachusetts, Connecticut, Maine) (Kartesz, 2013 eFloras, 2014a). We found no evidence of it causing significant impacts or being controlled where it occurs in the country, or of it being regulated or listed as a noxious weed by any U.S. state. However, at least in one part of New York (i.e., the Catskill region), it is becoming very common and is “potentially a highly invasive plant” (Weldy et al., 2014). The state of New York recently assessed *P. nepalensis* using their ranking system for evaluating non-native plant species for invasiveness (Moore, 2011); the focus of this ranking system is to assess consequences to native species and natural ecosystems in that state (Jordan et al., 2012). The final New York Invasiveness Rank for *P. nepalensis* was “unknown” because of a lack of sufficient information on the species (Moore, 2011).

4. 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.

APHIS. 2014. Phytosanitary Certificate Issuance and Tracking System (PCIT). United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS). https://pcit.aphis.usda.gov/pcit/faces/index.jsp. (Archived at PERAL).

Asres, B., and T. K. Das. 2011. Diversity and integrated management of weeds in highland wheat of Northern Ethiopia [Abstract]. Plant Protection Quarterly 26(1):8-16.

CABI. 2014. Crop Protection Compendium. Commonwealth Agricultural Bureau International (CABI). http://www.cabi.org/cpc/. (Archived at PERAL).

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.

Datta, S. K., and G. Banerjee. 1954. Chemical control of some weeds of Darjeeling. Science and Culture 20:191-193.

Dave's Garden. 2014. Dave's Garden. http://davesgarden.com/. (Archived at PERAL).

Eden, T., and T. E. Bond. 1945. The effects of manurial treatment on the growth of weeds in tea. Empire Journal of Experimental Agriculture 13:141-157.

eFloras. 2014a. 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. 2014b. 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).

Everaarts, A. P. 1981. Weeds of vegetables in the highlands of Java. Lembaga Penelitian Hortikultura, Jakarta. 121 pp.

Exclusive Plants. 2013. *Persicaria nepalensis*. Last accessed April 11, 2014, http://www.exclusiveplants.co.uk/product_page.php?id=323.

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

Friederici, P. 2003. Ecological Restoration of Southwestern Ponderosa Pine Forests. Society for Ecological Restoration International, Ecological Restoration Institute. 561 pp.

GBIF. 2014. GBIF, Online Database. Global Biodiversity Information Facility (GBIF). http://data.gbif.org/welcome.htm. (Archived at PERAL).

Gebre, H., A. Tarekegne, and E. Asmare. 1987. Preliminary indications on the importance of yield limiting factors on wheat. Fifth Regional Wheat Workshop for Eastern, Central and Southern Africa and the Indian Ocean:189-193.

Gleason, H. A., and A. Cronquist. 1991. Manual of vascular plants of northeastern United States and adjacent Canada, Second Edition. The New York Botanical Garden, Bronx. 910 pp.

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.

Hanson, C. G., and J. L. Mason. 1985. Bird seed aliens in Britain. Watsonia 15:237-252.

Heap, I., H. Glick, L. Glasgow, and W. Vencill. 2014. 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.

Holm, L. G., J. V. Pancho, J. P. Herberger, and D. L. Plucknett. 1991. A geographical atlas of world weeds. Krieger Publishing Company, Malabar, Florida. 330 pp.

Inoka, W. A., P. Karunaratne, J. P. Edirisinghe, and C. V. S. Gunatilleke. 2005. Floral relationshipes of bees in selected areas of Sri Lanka. Cey. J. Sci. (Bio. Sci.) 34:27-45.

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.
Ishikawa, S., and S. Takenaka. 2002. Weed community response to drilled sugar beet crop [Abstract]. Proceedings of the Japanese Society of Sugar Beet Technologists (44):59-65.
Jordan, M. J., G. Moore, and T. W. Weldy. 2012. New York State Ranking System for Evaluating Non-Native Plant Species for Invasiveness. Cornell Cooperative Extension Invasive Species Program, Cornell University. 7 pp.
Kak, A. M. 1984. Aquatic know weeds of the Kashmir Himalayas India. Journal of the Bombay Natural History Society 81(2):514-518.
Kantachot, C., P. Chantaranothai, and D. A. Simpson. 2010. A synopsis of the genus *Persicaria* (Polygonaceae) in Thailand. Thai For. Bull. (Bot.) 38:128-149.
Kartesz, J. T. 2013. 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).
Kassahun, Z., R. Suwanketnikom, S. Chinawong, C. Suwannarat, S. Juntakool, and V. Vichukit. 2005. Influence of tillage, fertilizer, and weed management on weed seed bank at various soil depth of wheat production field in Ethiopia. Kasetsart journal, natural sciences 39(1):12-23.
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.
Kulakkattolickal, A. T. 1987. Piscicidal plants of nepal: Preliminary toxicity screening using grass carp (*Ctenopharyngodon idella*) fingerlings. Journal of Ethnopharmacology 21(1):1-9.
Kuwabara, Y. 1955. On the weed communities of cultivated fields of Solanum tuberosum in Shiribeshi district. Hokkaido. Japanese jour ecol 4((4)):157-161.
Li-Min, M., T. Yan-Ping, Z. Ming, T. Yan-Hang, L. Dong-Yan, and Z. Jian-Fu. 2009. Evaluation of adaptability of plants in water-fluctuation-zone of the threeg gorges reservoir [Abstract]. Shengtai xuebao/ acta ecologica sinica 29(4):1885-1892.
Lu, X., G. Gong, and X. Ma. 2011. Niche Segregation Between Two Alpine Rosefinches: To Coexist in Extreme Environments. Evolutionary Biology 38(1):79-87.
Medley, V. F. 1961. Preventive weed control in tea [Abstract]. World crops 13(3).
Meier, W. 2006. Contribution to the knowledge of *Persicaria nepalensis* (Meisn.) H. Gross and *P. capitata* (Buch.-Ham. ex D.Don) H. Gross, invasive species in the Avila National Park, Venezuela. Acta Botanica Venezuelica 29(1):1-15.
Mena, F., E. Madroñero, A. Salcedo-Z, and H. Criollo-E. 1984. A study of the critical period of competition between weeds and carrot (*Daucus carota* L.) crops on the Pasto plateau, Nariño Department. Revista de Ciencias Agricolas 8(1/14):114-120.
Mitra, B., P. Parui, A. Ghosh, and M. Mukherjee. 2005. Dipteran pollinators from some medicinal plants at Narendrapur, West Bengal. Bionotes 7(4):131.
Moody, K. 1989. Weeds reported in rice in south and southeast Asia. International Rice Research Institute, Manila, The Philippines. 442 pp.
Moore, G. 2011. New York non-native plant invasiveness ranking form: *Persicaria nepalensis* (Meisn.) H. Gross (=*Polygonum nepalense* Meisn.). Cornell Cooperative Extension Invasive Species Program, Cornell University. 11 pp.
Mukasa, Y. 2002. Weed growth and the low dose system of herbicide application in

the zero-tilled sugar beet [*Beta vulgaris*] cultivation [Abstract]. Japanese Journal of Farm Work Research (Japan) 111:73-79.

Naturalmedicinalherbs.net. 2014. Medicinal herbs: *Polygonum nepalense*. Last accessed May 28, 2014, http://www.naturalmedicinalherbs.net/herbs/p/polygonum-nepalense.php.

New England Wild Flower Society. 2013. Go Botany [2.1]: *Persicaria nepalensis* (Meisn.) H. Gross, Nepalese smartweed. New England Wild Flower Society, Framingham, MA. Last accessed April 15, 2014, https://gobotany.newenglandwild.org/species/persicaria/nepalensis/.

NEWFS. 2014. Go Botany [2.1]. New England Wild Flower Society (NEWFS). (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).

NGRP. 2014a. Federal and State Noxious Weeds in GRIN United States Department of Agriculture, Agricultural Research Service, National Genetic Resources Program (NGRP). http://www.ars-grin.gov/cgi-bin/npgs/html/taxweed.pl. (Archived at PERAL).

NGRP. 2014b. 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, U.S.A. Last accessed June 12, 2009, http://www.parasiticplants.siu.edu/ListParasites.html.

Nimje. 1988. Weed survey of potato fields of the higher hills of Nilgiris. Indian Journal of Weed Science 20(4):26-31.

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

NRCS. 2014. 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).

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

PestID. 2014. 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).

Plaza, G. A., and M. Pedraza. 2007. Recognition and ecological characterization of weeds associated with culture of cape gooseberry. Agronomía Colombiana 25(2):306-313.

Puerto, L. R. n.d. Plagas reportadas y de importancia cuarentenaria en Honduras. Programa Nacional de Vigilancia Fitosanitaria-Sanidad Vegetal. 1-86 pp.

Radosevich, S. R., and J. S. Holt. 1984. Weed Ecology: Implications for Vegetation Management. John Wiley & Sons, New York, U.S.A. 265 pp.

Rai, I. D., B. S. Adhikari, and G. S. Rawat. 2012. Floral diversity along sub-alpine and alpine ecosystems in Tungnath area of Kedarnath Wildlife Sanctuary, Uttarakhand. Indian Forester 138(10):927-940.

Randall, J. M. 2007. The introduced flora of Australia and its weed status. CRC for

Australian Weed Management, Department of Agriculture and Food, Western Australia, Australia. 528 pp.

Randall, R. P. 2012. A Global Compendium of Weeds, 2nd Edition. Department of Agriculture and Food, Western Australia. 1115 pp.

Reed, C. F. 1977. Economically important foreign weeds (Agriculture Handbook No. 498). United States Department of Agriculture, Agricultural Research Service. 746 pp.

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

Roberts, H. A., and F. G. Stokes. 1966. Studies on the weeds of vegetable crops. 6. Seed populations of soil under commercial cropping. Journal of Applied Ecology 3(1):181-190.

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

Sahoo, U. K., R. S. Tripathi, H. N. Pandey, and J. Misra. 1994. Population dynamics of buried weed seeds as influenced by shifting and terrace cultivation in the humid subtropics of India. Weed Research 34(3):157-165.

Shin, Y., Y. Choung, S. Kim, and T. Hwang. 2008. Effects of surrounding pastureland on Jilmoe moor vegetation in Mt. Odae National Park, Korea. Journal of Plant Biology 51(5):379-385.

South Africa Department of Agriculture Forestry and Fisheries. 2012. Request for market access for maize (*Zea mays*) seeds for planting from South Africa into the USA. South Africa Department of Agriculture Forestry and Fisheries, Directorate of Plant Health, Pretoria, South Africa.

Stace, C. 2010. New Flora of the British Isles (2nd ed.). Cambridge University Press, Cambridge, United Kingdom. 1130 pp.

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.

Tessema, T., Y. Lemma, and B. Admasu. 1999. Qualitative and quantitative determination of weed occurrence in wheat in West Shewa Zone of Ethiopia. Proceedings of the tenth regional wheat workshop for eastern, central and southern africa, university of stellenbosch, south africa, 14-18 september, 1998:160-172.

The Plantsman's Preference. 2014. *Persicaria nepalensis*. The Plantsman's Preference, South Lopham, Norfolk, England. Last accessed April 11, 2014, http://www.plantpref.co.uk/all-perennials/persicaria-nepalensis.html.

Tropicos.org. 2014. Catalogue of the Vascular Plants of Madagascar. Missouri Botanical Garden. http://www.tropicos.org/project/mada. (Archived at PERAL).

U.S. Forest Service. 2011. Fire Effects Information System. United States Forest Service, United States Department of Agriculture. 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).

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.

Verloove, F. 2011. Manual of the Alien Plants of Belgium: *Persicaria nepalensis*. National Botanic Garden of Belgium. Last accessed April 11, 2014, http://alienplantsbelgium.be/content/persicaria-nepalensis.

Vibrans, H. 2012. *Polygonum nepalense* también en Veracruz. Last accessed April 14, 2014, http://jehuite.blogspot.com/2012/02/polygonum-nepalense-tambien-en-veracruz.html.

Vibrans, H., and A. M. Hanan Alipi. 2008. Notas sobre neófitas 4. *Polygonum nepalense* (Polygonaceae), una planta invasora nueva para México. Acta Botanica Mexicana 82(1):1-6.

Wagstaff, D. J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Taylor & Francis Group, Boca Raton, Florida. 444 pp.

Watanabe, Y. 1978. Physiological and ecological studies on upland weeds in Hokkaido [Abstract]. Research Bulletin of the Hokkaido National Agricultural Experiment Station (123):17-77.

Weldy, T., D. Werier, and A. Nelson. 2014. New York Flora Atlas [S. M. Landry and K. N. Campbell (original application development), Florida Center for Community Design and Research. University of South Florida]. New York Flora Association, Albany, New York. http://newyork.plantatlas.usf.edu/. (Archived at PERAL).

Wells, M., A. A. Balsinhas, H. Joffe, V. M. Engelbrecht, G. Harding, and C. H. Stirton. 1986. A Catalogue of Problem Plants in Southern Africa, incorporating The National Weed List of South Africa. Memoirs of the Botanical Survey of South Africa No. 53. Botanical Research Institute, Department of Agriculture and Water Supply, Republic of South Africa. 658 pp.

Wen, J., W. Chen, Y. Lu, and L. Xiao. 2013. Pests and their species in tobacco growing period in Guiyang. Guizhou Agricultural Sciences (4):98-100.

Woldu, Z., and M. A. Mohammed Saleem. 2000. Grazing induced biodiversity in the highland ecozone of East Africa. Agriculture, Ecosystems and Environment 79(1):43-52.

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.

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 nepalensis* (Meisn.) H. Gross (Polygonaceae). The following information came from the original risk assessment, which is available upon request (full responses and all guidance). We modified the information to fit on the page.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ESTABLISHMENT/SPREAD POTENTIAL			
ES-1 (Status/invasiveness outside its native range)	f - negl	5	*Persicaria nepalensis* is native to temperate and tropical areas of Asia (NGRP, 2014b) and has naturalized in Africa, Europe, North America (Kartesz, 2013; NGRP, 2014b; Stace, 2010), and South America (Colombia, Ecuador, Venezuela) (Vibrans and Hanan Alipi, 2008). It originated in the Himalayas and is now “quite widespread” in Asia, Africa, and the Americas (CABI, 2014). It is reported as a “garden escape” (Randall, 2012). In New York, Connecticut, and Pennsylvania, it "occasionally escaped into relatively stable habitats" (Gleason and Cronquist, 1991). Discovered in Belgium in 2010, it "is increasingly recorded in neighbouring countries as well" (Verloove, 2011). It was first collected in Colombia in 1943 and today appears to be widely distributed in different locations (e.g., corn fields, potato fields, roadsides) (Meier, 2006). In Mexico, where it arrived in 2004, it has spread very quickly; two populations that appeared to be in expansion were detected by 2008 (Vibrans and Hanan Alipi, 2008), and an additional population was found in 2012 (Vibrans, 2012). In New York, it "spreads rapidly in damp shade, along roadsides, dirt roads in forests, logging areas, thickets" (Dave's Garden, 2014). In the Catskill region of New York, it is “[b]ecoming very common” (Weldy et al., 2014). The alternate answers for the Monte Carlo simulation were both “e.”
ES-2 (Is the species highly domesticated)	n - low	0	We found some evidence that this species is cultivated but no evidence it has been bred to reduce its likelihood of becoming a weed. It is "cultivated" (NGRP, 2014b; Randall, 2012) and is important as an ornamental (as ground-cover) (NGRP, 2014b). Sold in the UK for ground-cover (Exclusive Plants, 2013; The Plantsman's Preference, 2014), and regarded as a good ground-cover for tea production (CABI, 2014; Eden and Bond, 1945). For *Persicaria* species, germplasm collections and breeding programs are not 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 (2007): *Persicaria orientalis* and *P. capitata* (definition of "Category 5": “This plant has been recorded as an 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, *P. 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 - mod	1	Multiple sources state that it grows in shade (Exclusive Plants, 2013; Gleason and Cronquist, 1991; Meier, 2006; Vibrans and Hanan Alipi, 2008). "[S]hade tolerant" (Moore, 2011). "[It]s predominance in tea must suggest that it has some shade tolerance" (CABI, 2014). It also occurs in sun (Exclusive Plants, 2013; Ohwi, 1984) and prefers open or lightly shaded situations (CABI, 2014). Eden and Bond state that it is "not particularly tolerant of shade" (Eden and Bond, 1945). Considering its apparent preference for sun or light shade and the statement by Eden and Bond, we used moderate uncertainty.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-5 (Climbing or smothering growth form)	n - negl	0	It is neither a vine nor an herb with a basal rosette. It is an erect herb (Kak, 1984; Wells et al., 1986). It is a forb/herb (Kartesz, 2013; NRCS, 2014) with a decumbent [= "lying along the ground or along a surface, with the extremity curving upward"] to ascending stem (eFloras, 2014a) and growing 15-50 cm high (CABI, 2014; eFloras, 2014b).
ES-6 (Forms dense thickets)	y - negl	2	It is reported "forming carpets" in eucalyptus plantations (Meier, 2006). In Mexico, it forms "dense populations" and "mats" in corn fields (Vibrans and Hanan Alipi, 2008) and "densely" covers the ground in potato crops (Vibrans, 2012). "[D]ense infestations...can occur under suitable conditions" (CABI, 2014).
ES-7 (Aquatic)	n - negl	0	It is not an obligate aquatic species. Although it is a "wetland plant" (Shin et al., 2008), having a high tolerance for flooding (Li-Min et al., 2009) and growing along shores of rivers and lakes (NEWFS, 2014), its habitats also include non-aquatic environments (e.g., roadsides, dirt roads, grassland, meadow, woodlands, cliffs, cultivated areas) (GBIF, 2014; Meier, 2006; Reed, 1977; Vibrans and Hanan Alipi, 2008; Weldy et al., 2014). In India, its habitats include subalpine forest and alpine meadow (Rai et al., 2012).
ES-8 (Grass)	n - negl	0	This plant is not in the family Poaceae (NGRP, 2014b).
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, 2014b).
ES-10 (Does it produce viable seeds or spores)	y - negl	1	It reproduces by seed (Kassahun et al., 2005; Wells et al., 1986; Zhang and Hirota, 2000). "Reproduction is solely by seeds" (CABI, 2014). Reproduces mainly by seed (Everaarts, 1981).
ES-11 (Self-compatible or apomictic)	? - max	0	We found no information about *P. nepalensis*' breeding system or whether it is self-compatible or apomictic. However, all flowers of this species have both carpels and stamens (New England Wild Flower Society, 2013). Also, other related species (e.g., *P. scabra*, *P. pensylvanica*, *P. minor*, *P. maculosa*) are self-compatible (UFZ, 2011). The related species *P. 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).
ES-12 (Requires special pollinators)	n - mod	0	We found no evidence of *P. nepalensis* requiring specialist pollinators. In a field study in Sri Lanka, flowers of *P. nepalensis* were visited by multiple bee species (*Apis cerana*, *Braunsapis* sp., *Lasioglossum alphenum*) (Inoka et al., 2005). The related species *P. chinensis* is pollinated by a wide range of dipteran pollinators (Mitra et al., 2005), and *P. perfoliata* produces viable seed without the assistance of pollinators (Alien Plant Working Group, 2010).
ES-13 (Minimum generation time)	b - low	1	The species is an annual (CABI, 2014; Eden and Bond, 1945; eFloras, 2014a; Gleason and Cronquist, 1991; Kak, 1984; Kassahun et al., 2005; Ohwi, 1984; Stace, 2010; Tessema et al., 1999; Vibrans and Hanan Alipi, 2008; Wells et al., 1986). It is a "short cycle annual with a duration of some 4-5 months only" (Eden and Bond, 1945), and "the plant lives only a single year or less" (New England Wild Flower Society, 2013). However, it is also reported as a perennial (Kartesz, 2013; NRCS, 2014), and in Venezuela it "appears" that the climate allows several generations per year (Meier, 2006). Alternate answers for the Monte Carlo simulation were “c” and “a.”

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-14 (Prolific reproduction)	n - high	-1	Over 15 million seeds per acre have been recorded (Eden and Bond, 1945), which translates to approximately 3,706 seeds per square meter (given that 1 acre equals 4,047 square meters). In one study on weed seed populations in different crop fields, the viable seed population in the soil did not exceed 4,000 per meter square "under normally weeded plots," according to the graphs presented (Sahoo et al., 1994). It has "[e]xtensive production of seeds (1000s) on individual plants" (Moore, 2011). Seeds are "produced in great abundance" (CABI, 2014). "*P[ersicaria] nepalense* produces lots of seeds (approximately 27.900/m^2) (Roberts and Stokes, 1966)" (Plaza and Pedraza, 2007); however, we could not confirm this data in the cited reference (i.e., Roberts and Stokes, 1966). One study from Japan indicated 50 percent viability of seed (Watanabe, 1978). Royal Botanic Gardens Kew (2008) reports germination rates of 75-100 percent. While it appears to have relatively abundant seed production, we did not find evidence that it produces >5,000/m^2 crown area per year.
ES-15 (Propagules likely to be dispersed unintentionally by people)	y - mod	1	"Small seeds could easily be spread indirectly by humans....Weldy suggest it may be spreading along logging roads" (Moore, 2011, citing Weldy personal communication and personal observation). In England, it is found in waste dumps (Meier, 2006), indicating people are moving it. Although it mainly reproduces by seed, stem fragments left on the soil can root at the nodes and establish in soil (Everaarts, 1981; Medley, 1961).
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	y - negl	2	It was introduced to England in birdseed (Hanson and Mason, 1985; Meier, 2006), and it is thought to have been introduced to Germany as a contaminant in seed mixtures that were planted for wildlife (Meier, 2006). "Several recent German records were associated with birdseed (for gaming) ... This most likely is the vector of introduction in Averbode [Belgium] as well" (Verloove, 2011). At U.S. ports-of-entry, *P. nepalensis* has been intercepted in imported seed of *Raphanus* sp., and there have been interceptions of seed of other species in the genus *Persicaria* in permit cargo (commercial plant products) (PestID, 2014).
ES-17 (Number of natural dispersal vectors)	2	0	Information relevant for ES-17a through ES-17e: The fruit is an achene, which is dry, indehiscent, usually one-seeded (New England Wild Flower Society, 2013), dark brown to black (Flora of North America Editorial Committee, 2005), and 1.5-2 mm by 1-2 mm in size (eFloras, 2014b; Flora of North America Editorial Committee, 2005).
ES-17a (Wind dispersal)	n - mod		We found no direct evidence of wind dispersal. Fruit possesses no obvious adaptations for wind dispersal. Datta and Banerjee (1954) state that in the hill area of Darjeeling (India) the "seeds disperse far and wide from their numerous dry flowers towards the beginning of winter and germinate again when the first rain falls on the hills," with no mention of how exactly it is dispersed.
ES-17b (Water dispersal)	? - max		Unknown. We found no direct evidence that this species is dispersed by water, or that the propagules are buoyant. Plus, there are no obvious fruit/seed adaptations for water dispersal, and the plant lives in a variety of environments, not just by water. However, this plant is often reported by water sources (e.g., eFloras, 2014b; NEWFS, 2014; Reed, 1977; Wells et al., 1986) and is even described as a wetland plant (Shin et al., 2008; Tropicos.org, 2014) with high tolerance for flooding (Li-Min et al., 2009), which suggests it may likely be

Question ID	Answer - Uncertainty	Score	Notes (and references)
			dispersed by water. Van Valkenburg and Bunyapraphatsara (2001) say all *Persicaria* spp. are dispersed by water, but they provide no supporting information. Also, Swearingen et al. (2010) 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."
ES-17c (Bird dispersal)	y - mod		In a field study, *Polygonum nepalense* (synonym of *P. nepalensis*) was one of three herbaceous species constituting the majority of the diet of pink-rumped rosefinch (*Carpodacus eos*) nestlings (Lu et al., 2011). Also, Polygonaceae are often dispersed by birds (Vibrans and Hanan Alipi, 2008). For instance, the seeds of the related species *P. chinensis* (Goodland and Healey, 1996; Royal Botanic Gardens Kew, 2008) and *P. perfoliata* (Swearingen et al., 2010) are dispersed by birds eating the seed (Goodland and Healey, 1996; Royal Botanic Gardens Kew, 2008). Although we did not find direct evidence that the seed of *P. nepalensis* are dispersed by birds, based on the evidence that birds do consume the seed plus the congeneric evidence for dispersal, we answered yes with moderate uncertainty.
ES-17d (Animal external dispersal)	n - low		We found no evidence that the propagules of *P. nepalensis* are dispersed externally by animals, or that they have any particular adaptations to be dispersed in this manner.
ES-17e (Animal internal dispersal)	y - low		In a field study in Ethiopia, *P. nepalensis* was one of many species that were grown from the manure of grazing cattle in grasslands (i.e., it was part of the manure seed bank) (Woldu and Mohammed Saleem, 2000). Other *Persicaria* species are dispersed by mammalian animals that consume the seeds, e.g., *P. longiseta* (U.S. Forest Service, 2011) and *P. perfoliata* (Alien Plant Working Group, 2010). The achenes of *Persicaria* species are eaten by wildlife (e.g., rabbits) and are viable after passage through the digestive tract (Moore, 2011).
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	y - low	1	In a one-year study on weed seed populations in different crop fields (Sahoo et al., 1994), *P. nepalensis* "maintained a fairly high proportion of viable seeds in the soil seed bank" throughout the study, with a loss of viable seed between 13.8 and 25.4 percent in frequently weeded plots. It has a "large reservoir of seed present in the soil" (Eden and Bond, 1945) and its seeds "survive for long periods in the soil" (Plaza and Pedraza, 2007). *Persicaria* species in general have seed that germinate within the first year but may remain viable for a few years (Moore, 2011). For instance, seed of the related species *P. perfoliata* can persist in the soil up to four (U.S. Forest Service, 2011) or six years (Yun Wu, 2009), and *P. longiseta* "forms a persistent seed bank" (U.S. Forest Service, 2011).
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	n - mod	-1	*Persicaria nepalensis* is not likely to grow back extensively after removal of aboveground parts (Moore, 2011, citing author's personal observation). As noted in ES-15, stem fragments left on the soil can root at the nodes and establish in soil (Everaarts, 1981; Medley, 1961); however, considering it reproduces predominantly by seed (see ES-10), we do not consider this sufficient evidence that the species resprouts more vigorously than most other species. We found no clear evidence that other species within the genus *Persicaria* tolerate or benefit from fire.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - mod	0	Heap et al. (2014) do not list any species in the genus *Persicaria* as having herbicide resistance; however, multiple species of *Polygonum* are reported as having herbicide resistance, although not *Polygonum nepalense* (the synonym of *Persicaria nepalensis*).
ES-21 (Number of cold hardiness zones suitable for its survival)	11	1	See evidence under geographic potential.
ES-22 (Number of climate types suitable for its survival)	9	2	See evidence under geographic potential.
ES-23 (Number of precipitation bands suitable for its survival)	10	1	See evidence under geographic potential.
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - mod	0	We found no evidence that this species is allelopathic.
Imp-G2 (Parasitic)	n - negl	0	*Persicaria nepalensis* does not belong to a family known to contain parasitic plants (Heide-Jorgensen, 2008; NGRP, 2011; Nickrent, 2009). It is not parasitic (New England Wild Flower Society, 2013).
Impacts to Natural Systems			
Imp-N1 (Change ecosystem processes and parameters that affect other species)	n - mod	0	We found no evidence of it having this type of impact.
Imp-N2 (Change community structure)	y - low	0.2	"Aggressive growth increases the density of the herb layer" in natural areas (Moore, 2011, citing Meier, 2006 and personal observation by Troy Weldy). Moore (2011, citing Meier, 2006) states that "[p]lants can have a...somewhat smothering growth habit, the weak stems lying on the surrounding vegetation." Also, as noted in ES-6, it forms dense populations or mats/carpets.
Imp-N3 (Change community composition)	? - max		Unknown. Although this type of impact has not been studied or reported, "large stands probably at least result in reduction of numbers of native plants" (Moore, 2011).
Imp-N4 (Is it likely to affect federal Threatened and Endangered species)	y - high	0.1	Although this plant occurs in a range of disturbed situations, in particular cultivated areas (CABI, 2014; Meier, 2006), it invades natural vegetation (Vibrans and Hanan Alipi, 2008), occurring in various environments, e.g., forests/woodlands (Friederici, 2003; Kantachot et al., 2010; Reed, 1977), lake and river edges (GBIF, 2014), streambanks (Wells et al., 1986), grassland (Vibrans and Hanan Alipi, 2008), and freshwater wetland areas (NEWFS, 2014; Shin et al., 2008; Tropicos.org, 2014). Therefore, this plant could likely survive in various natural environments in the United States. Also, we found evidence that it can affect community structure (see Imp-N2). Based on this evidence, we answered yes, but use high uncertainty because of the lack of evidence of it affecting community composition.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions)	n - high	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), and it has demonstrated an ability to change habitat structure by increasing the density of the herb layer (Imp-N2). However, because we found no evidence it can change ecosystem processes and parameters (Imp-N1) or evidence that it forms extensive populations in natural areas, and because of our uncertainty about whether it

Question ID	Answer - Uncertainty	Score	Notes (and references)
			impacts biodiversity (Imp-N3), we answered no with high uncertainty.
Imp-N6 (Weed status in natural systems)	c - low	0.6	It is “invasive” in natural vegetation (Vibrans and Hanan Alipi, 2008). "In several parts of the world [it] is increasingly reported as an invasive environmental weed, especially in the Americas” (Verloove, 2011, citing Vibrans and Hanan Alipi, 2008 and Meier, 2006). After *P. nepalensis* was reported as new to Mexico, where it has been found mainly in crops but also in natural areas (pine forest, grassland), an eradication effort was recommended (Vibrans and Hanan Alipi, 2008). Because of reports of it being an invasive environmental weed elsewhere, its populations in Belgium, which occur in natural areas (woodland), are “now monitored and controlled but its eradication does not seem successful so far" (Verloove, 2011). The alternate answers for the Monte Carlo simulation were both "b."
Impact to Anthropogenic Systems (cities, suburbs, roadways)			
Imp-A1 (Impacts human property, processes, civilization, or safety)	n - mod	0	We found no evidence.
Imp-A2 (Changes or limits recreational use of an area)	y - mod	0.1	In South Africa, it is listed as a "recreational (water-sport)" weed, and one of its undesirable characteristics is obstruction of access (Wells et al., 1986), but no other details given.
Imp-A3 (Outcompetes, replaces, or otherwise affects desirable plants and vegetation)	? - max		In India, it is a "a regular menace" of flower gardens and lawns in the Darjeeling hill area in India (Datta and Banerjee, 1954), but no information is given on whether it affects other plants in these settings.
Imp-A4 (Weed status in anthropogenic systems)	c - high	0.4	It is "recreational (water-sport)" weed (Wells et al., 1986). In India, it is a "regular menace" of flower gardens and lawns (in addition to cultivation) in the Darjeeling hill area in India, "so it has become a necessity, that some suitable method should be evolved in order to check the propagation of [this weed] in the...gardens and lawns”; laboratory tests of herbicides for the control of *P. nepalensis* were conducted (Datta and Banerjee, 1954). Because we found only these two pieces of evidence, only one of which mentions control efforts, we use high uncertainty. The alternate answers for the Monte Carlo simulation were both “b.”
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	y - low	0.4	In a study in Ethiopia, it was one of three most common and aggressive weeds in wheat plots, and the results of the study indicated that weed competition was one of the major constraints on crop yield (along with poor soil fertility and wheat variety); this competition (from all the weeds) caused a 26 percent reduction in yield (Gebre et al., 1987). In field trials in Colombia studying the impact of weeds on the cultivation of carrot, *P. nepalensis* was identified as one of the ten principal weeds, and "weeds caused a yield decrease of 60%" (Mena et al., 1984). In the Nilgiris district of India, it is one of the most abundant weed species in potato crops, and weeds in this area have been reported to cause an average of 20 percent or more reduction in tuber yield (Nimje, 1988). Although none of these sources state that *P. nepalensis* specifically caused yield loss, because it was one of the most important weeds and considering the high levels of yield loss, it seems highly likely that *P. nepalensis* contributed to at least some of the yield loss.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Imp-P2 (Lowers commodity value)	y - mod	0.2	*Persicaria nepalensis*, along with three other weed species in potato crops, “necessitate[s] great efforts in weeding" (Kuwabara, 1955). In Mexico, its presence complicates the management of crops (potato and corn) and often require changes in control measures (Vibrans and Hanan Alipi, 2008). There are multiple other reports of control efforts for this weed in crops (e.g., Ishikawa and Takenaka, 2002; Medley, 1961; Mukasa, 2002). We assume such control efforts can increase the cost of production and therefore lower commodity value. We found no specific information, however, on lowering commodity value, hence the moderate uncertainty rating.
Imp-P3 (Is it likely to impact trade)	y - low	0.2	*Persicaria nepalensis* is listed as a quarantine or regulated pest for Honduras (Puerto, n.d.), Australia (Vibrans and Hanan Alipi, 2008), and (under the synonym *Polygonum nepalense*) Brazil (APHIS, 2014). Because it is a quarantine for multiple countries, it can affect exports such as ornamental plants and grains (Vibrans and Hanan Alipi, 2008). Based on this evidence, plus the fact that it can be dispersed in trade as a contaminant (see ES-16), we answered yes.
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	n - mod	0	We found no evidence for this type of impact. It grows along irrigation canals in Pakistan (Vibrans and Hanan Alipi, 2008), but this source does not state that it affects the quality or availability of irrigation.
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	? - max		There is conflicting evidence. Cattle do not like to consume it because of its acid taste (Everaarts, 1981). Meier (2006) states that in Colombia it is considered poisonous to cattle, but without any supporting evidence. It is listed in the "International Poisonous Plants Checklist" (Wagstaff, 2008) based on it being toxic to fish when crushed and added to water (Kulakkattolickal, 1987), not because of toxicity to mammals or birds. In a field study in Ethiopia, *P. nepalensis* seeds were found in the manure of grazing cattle in grasslands (Woldu and Mohammed Saleem, 2000), suggesting that it can be consumed by cattle. Also, the plant is used in traditional Chinese and Indian medicine (Vibrans and Hanan Alipi, 2008), raw leaves and seed being edible (Naturalmedicinalherbs.net, 2014).
Imp-P6 (Weed status in production systems)	c - negl	0.6	It is listed as a "serious weed", "principal weed", and "common weed" of crops (Holm et al., 1991). There are numerous reports of *P. nepalensis* being a weed of crops, such as wheat, potato, soybean, rice, corn, strawberry, coffee, sugarbeet, cape gooseberry, tobacco (e.g., Ishikawa and Takenaka, 2002; Meier, 2006; Moody, 1989; Plaza and Pedraza, 2007; Radosevich and Holt, 1984; Vibrans and Hanan Alipi, 2008; Wen et al., 2013; Zhang and Hirota, 2000). It is a major weed species of wheat (Kassahun et al., 2005; Tessema et al., 1999). Herbicides are recommended for the control of *P. nepalensis* in sugarbeet cultivation (Mukasa, 2002). Weed management treatments (e.g., herbicides, hand weeding, tillage) for *P. nepalensis* in crops have been studied (e.g., Asres and Das, 2011; Ishikawa and Takenaka, 2002; Kassahun et al., 2005). The alternate answers for the Monte Carlo simulation were both "b."
GEOGRAPHIC POTENTIAL			The following data are geographically-referenced points obtained from the Global Biodiversity Information Facility (GBIF, 2014).
Plant cold 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 - low	N/A	We found no evidence that it occurs in this hardiness zone.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-Z3 (Zone 3)	y - low	N/A	Afghanistan, Pakistan, and India.
Geo-Z4 (Zone 4)	y - negl	N/A	Pakistan and India.
Geo-Z5 (Zone 5)	y - negl	N/A	Afghanistan, Pakistan, and India.
Geo-Z6 (Zone 6)	y - negl	N/A	Afghanistan, Pakistan, India, Nepal, China, and Japan.
Geo-Z7 (Zone 7)	y - negl	N/A	Germany, Afghanistan, Pakistan, India, Nepal, China, and Japan.
Geo-Z8 (Zone 8)	y - negl	N/A	Canada, Ecuador, the United Kingdom, Afghanistan, Pakistan, India, Nepal, China, and Japan.
Geo-Z9 (Zone 9)	y - negl	N/A	Colombia, the United Kingdom, South Africa, Madagascar, Ethiopia, Afghanistan, Pakistan, India, Japan, Taiwan, Nepal, and China.
Geo-Z10 (Zone 10)	y - negl	N/A	Colombia, Venezuela, Ecuador, the United Kingdom, Malawi, Ethiopia, Taiwan, Indonesia, and Papua New Guinea.
Geo-Z11 (Zone 11)	y - negl	N/A	Colombia, Ecuador, Cameroon, Malawi, Tanzania, Rwanda, Ethiopia, Taiwan, and Papua New Guinea.
Geo-Z12 (Zone 12)	y - low	N/A	Uganda, Kenya, and Taiwan.
Geo-Z13 (Zone 13)	y - mod	N/A	Equatorial Guinea (1 point), Taiwan (1), and Papua New Guinea (1).
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	y - negl	N/A	Colombia, Cameroon, Equatorial Guinea, Madagascar, Kenya, Indonesia, and Papua New Guinea.
Geo-C2 (Tropical savanna)	y - negl	N/A	Ecuador, Cameroon, Tanzania, Uganda, and Ethiopia.
Geo-C3 (Steppe)	y - low	N/A	Ethiopia, Afghanistan, and Pakistan.
Geo-C4 (Desert)	y - low	N/A	Pakistan and India.
Geo-C5 (Mediterranean)	y - negl	N/A	Canada, Colombia, Ecuador, Ethiopia, and Afghanistan.
Geo-C6 (Humid subtropical)	y - negl	N/A	South Africa, Malawi, India, Nepal, China, Taiwan, and Japan.
Geo-C7 (Marine west coast)	y - negl	N/A	Canada, Colombia, Ecuador, United Kingdom, Germany, South Africa, Ethiopia, Pakistan, India, Nepal, and China.
Geo-C8 (Humid cont. warm sum.)	y - negl	N/A	Pakistan, India, and Japan.
Geo-C9 (Humid cont. cool sum.)	y - negl	N/A	The United States, Pakistan, India, China, and Japan.
Geo-C10 (Subarctic)	n - low	N/A	We found no evidence that it occurs in this climate class.
Geo-C11 (Tundra)	n - negl	N/A	We found no evidence that it occurs in this climate class.
Geo-C12 (Icecap)	n - negl	N/A	We found no evidence that it occurs in this climate class.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	n - low	N/A	We found no evidence that it occurs in this precipitation band.
Geo-R2 (10-20 inches; 25-51 cm)	y - low	N/A	South Africa, Tanzania, Ethiopia, Afghanistan, Pakistan, and India.
Geo-R3 (20-30 inches; 51-76 cm)	y - negl	N/A	Ecuador, South Africa, Ethiopia, Afghanistan, Pakistan, India, and Nepal.
Geo-R4 (30-40 inches; 76-102 cm)	y - negl	N/A	The United Kingdom, Afghanistan, Pakistan, India, Nepal, and China.
Geo-R5 (40-50 inches; 102-127 cm)	y - negl	N/A	Canada, Ecuador, the United Kingdom, Germany, South America, Malawi, Tanzania, Pakistan, Nepal, India, and China.
Geo-R6 (50-60 inches; 127-152 cm)	y - negl	N/A	Canada, United Kingdom, Malawi, Kenya, Rwanda, Ethiopia, Pakistan, China, and Japan.
Geo-R7 (60-70 inches; 152-178 cm)	y - negl	N/A	United Kingdom, Ethiopia, Pakistan, Nepal, China, Taiwan, and Japan.
Geo-R8 (70-80 inches; 178-203 cm)	y - negl	N/A	Ecuador, Ethiopia, India, China, Taiwan, and Japan.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-R9 (80-90 inches; 203-229 cm)	y - negl	N/A	Colombia, Ethiopia, Taiwan, and Japan.
Geo-R10 (90-100 inches; 229-254 cm)	y - negl	N/A	Colombia, Ecuador, Tanzania, Taiwan, and Japan.
Geo-R11 (100+ inches; 254+ cm))	y - negl	N/A	Colombia Ecuador, Cameroon, Equatorial Guinea, Malawi, China, Taiwan, Indonesia, Papua New Guinea, and Japan.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	y - negl	1	It is naturalized in the United States (Florida, Pennsylvania, New York, Massachusetts, Connecticut, Maine) (eFloras, 2014a; Kartesz, 2013). It has also been found in southwestern ponderosa pine ecosystems (which are in Arizona and New Mexico) in the United States (Friederici, 2003), and there is one report of it in Washington near the shore of Squalicum Lake in Whatcom County (GBIF, 2014).
Ent-2 (Plant proposed for entry, or entry is imminent)	-	N/A	
Ent-3 (Human value & cultivation/trade status)	-	N/A	
Ent-4 (Entry as a contaminant)			
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	-	N/A	
Ent-4b (Contaminant of plant propagative material (except seeds))	-	N/A	
Ent-4c (Contaminant of seeds for planting)	-	N/A	
Ent-4d (Contaminant of ballast water)	-	N/A	
Ent-4e (Contaminant of aquarium plants or other aquarium products)	-	N/A	
Ent-4f (Contaminant of landscape products)	-	N/A	
Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances)	-	N/A	
Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing)	-	N/A	
Ent-4i (Contaminant of some other pathway)	-	N/A	
Ent-5 (Likely to enter through natural dispersal)	-	N/A	