Australia/New Zealand Weed Risk Assessment adapted for United States.

Data used for analysis published in: Gordon, D.R. and C.A. Gantz. 2008. Potential impacts on the horticultural industry of screening new plants for invasiveness. Conservation Letters 1: 227-235. Available at: http://www3.interscience.wiley.com/cgi-bin/fulltext/121448369/PDFSTART

Arnebia pulchra			
	Question	**Answer**	**Score**
1.01	Is the species highly domesticated?	N	0
1.02	Has the species become naturalised where grown?		
1.03	Does the species have weedy races?		
2.01	Species suited to U.S. climates (USDA hardiness zones; 0-low, 1-intermediate, 2-high)	2	
2.02	Quality of climate match data (0-low; 1-intermediate; 2-high)	2	
2.03	Broad climate suitability (environmental versatility)	N	0
2.04	Native or naturalized in regions with an average of 11-60 inches of annual precipitation	Y	1
2.05	Does the species have a history of repeated introductions outside its natural range?	Y	
3.01	Naturalized beyond native range	N	-2
3.02	Garden/amenity/disturbance weed	N	0
3.03	Weed of agriculture	N	0
3.04	Environmental weed	N	0
3.05	Congeneric weed	N	0
4.01	Produces spines, thorns or burrs	N	0
4.02	Allelopathic		
4.03	Parasitic	N	0
4.04	Unpalatable to grazing animals		
4.05	Toxic to animals	N	0
4.06	Host for recognised pests and pathogens		
4.07	Causes allergies or is otherwise toxic to humans	N	0
4.08	Creates a fire hazard in natural ecosystems		
4.09	Is a shade tolerant plant at some stage of its life cycle	?	
4.1	Grows on one or more of the following soil types: alfisols, entisols, or mollisols	Y	1
4.11	Climbing or smothering growth habit	N	0
4.12	Forms dense thickets	N	0
5.01	Aquatic	N	0
5.02	Grass	N	0
5.03	Nitrogen fixing woody plant	N	0
5.04	Geophyte		
6.01	Evidence of substantial reproductive failure in native habitat	N	0
6.02	Produces viable seed	Y	1
6.03	Hybridizes naturally		
6.04	Self-compatible or apomictic		
6.05	Requires specialist pollinators	n	0
6.06	Reproduction by vegetative fragmentation		
6.07	Minimum generative time (years)		
7.01	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)		

7.02	Propagules dispersed intentionally by people	Y	1
7.03	Propagules likely to disperse as a produce contaminant	N	-1
7.04	Propagules adapted to wind dispersal	N	-1
7.05	Propagules water dispersed		
7.06	Propagules bird dispersed		
7.07	Propagules dispersed by other animals (externally)	N	-1
7.08	Propagules dispersed by other animals (internally)		
8.01	Prolific seed production		
8.02	Evidence that a persistent propagule bank is formed (>1 yr)		
8.03	Well controlled by herbicides		
8.04	Tolerates, or benefits from, mutilation or cultivation		
8.05	Effective natural enemies present in U.S.		
Total Score			-1

Outcome	Accept

section	# questions answered	satisfy minimum?
A	11	Yes
B	7	Yes
C	10	Yes
total	28	Yes

Data collected 2008

Question number	Reference	Source data
1.01		used horticulturally, but no evidence of significant modification
1.02		
1.03		
2.01	1. PERAL NAPPFAST Global Plant Hardiness (http://www.nappfast.org/Plant_hardiness/NAPPFAST%20Global%20zones/10-year%20climate/PLANT_HARDINESS_10YR%20lgnd.tif). 2. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 3. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York. 4. Shishkin, BK (1953) Flora of the U.S.S.R. Volume XIX. P. 127. Izdatel'stvo Akademii Nauk SSSR, Moskva-Leningrad and Israel Program for Scientific	1. Global hardiness zones 5-8. 2. "Distribution: Northern Caucasus, northern Iran, north-east Turkey" 3. "NE Turkey, Caucasus, N Iran" 4. "Caucasus: everywhere, very frequent on Main Range, rare in Lesser Caucasus. Gen. distr.: Iran. (N. Iran), Arm.-Kurd., Bal.-As. Min. (Asia Minor)." [occurs within the same latitudes as much of the United States].

	Translations, Jerusalem (1974).	
2.02		
2.03	1. Köppen-Geiger climate map (http://www.hydrol-earth-syst-sci.net/11/1633/2007/hess-11-1633-2007.pdf). 2. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 3. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York. 4. Shishkin, BK (1953) Flora of the U.S.S.R. Volume XIX. P. 127. Izdatel'stvo Akademii Nauk SSSR, Moskva-Leningrad and Israel Program for Scientific Translations, Jerusalem (1974).	1. Two climatic regions. 2. "Distribution: Northern Caucasus, northern Iran, north-east Turkey" [3 biomes] 3. "NE Turkey, Caucasus, N Iran" 4. "Caucasus: everywhere, very frequent on Main Range, rare in Lesser Caucasus. Gen. distr.: Iran. (N. Iran), Arm.-Kurd., Bal.-As. Min. (Asia Minor)."
2.04	Microsoft Encarta World Precipitation and Average Rainfall (http://uk.encarta.msn.com/encnet/RefPages/RefMedia.aspx?refid=461530746&artrefid=761554737&pn=3&sec=-1).	For Iran, average annual precipitation ranges from less than 10 inches/year to 20 inches/year; For Turkey, average annual precipitation ranges from less than 10 inches/year to 40 inches/year.
2.05	1. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 2. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York.	1. "Only one species [Arnebia pulchra] is cultivated". 2. "A. pulchra also is suited to wall plantings and will thrive in an east- or north-facing niche or in open woodland."
3.01	Clement EJ and Foster MC (1994) Alien plants of the British Isles. Botanical Society of the British Isles: London.	"casual alien" [not sufficient evidence of naturalization]
3.02		no evidence
3.03		no evidence
3.04		no evidence
3.05		no evidence
4.01	1. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 2. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York.	unarmed [genus]
4.02		
4.03	1. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 2. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York.	no description of parasitism
4.04		
4.05	1. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 2. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York.	no evidence
4.06		

4.07	1. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 2. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York.	no evidence
4.08		
4.09	1. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 2. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York.	1. "Needs a sheltered, cool position in light shade" but "can tolerate full sun in cooler climates". 2. "Provide semi-shade…for A. pulchra."
4.1	1. USDA, National Resources Conservation Services (NRCS), Soil Survey Division, World Soil Resources (http://soils.usda.gov/use/worldsoils/mapindex/order.html). 2. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 3. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York.	1. All three soil orders are found in these regions. 2. "humus-rich, gritty soil, ideally with plenty of leaf mould". 3. "Provide semi-shade with a cool root-run in humus for A. pulchra."
4.11	1. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 2. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York. 3. Shishkin, BK (1953) Flora of the U.S.S.R. Volume XIX. P. 127. Izdatel'stvo Akademii Nauk SSSR, Moskva-Leningrad and Israel Program for Scientific Translations, Jerusalem (1974).	1. "Clump-forming perennial around 30 cm (12in) tall"; "Stems: 15-45 cm (6-18 in) high, few, sprawling". 2. "Perennial. Stems 15-45 cm." [species description]; "Perennial to annual herbs…stems erect." [genus description]. 3. "Perennial…stems usually 1-3, 20-40 cm high, erect, simple" [listed under synonym Macrotomia echioides].
4.12	1. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 2. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York. 3. Shishkin, BK (1953) Flora of the U.S.S.R. Volume XIX. P. 127. Izdatel'stvo Akademii Nauk SSSR, Moskva-Leningrad and Israel Program for Scientific Translations, Jerusalem (1974).	1. "Clump-forming perennial around 30 cm (12in) tall"; "Stems: 15-45 cm (6-18 in) high, few, sprawling". 2. "Perennial. Stems 15-45 cm." [species description]; "Perennial to annual herbs…stems erect." [genus description]. 3. "Perennial…stems usually 1-3, 20-40 cm high, erect, simple" [listed under synonym Macrotomia echioides].
5.01	Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon.	Terrestrial
5.02	Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon.	Boraginaceae
5.03	Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon.	Boraginaceae
5.04		
6.01		no evidence
6.02	1. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 2. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and	1. "Sow [seed] in mid-spring…germination is likely to be erratic". 2. "Propagation is by seed."

	New York.	
6.03		
6.04		
6.05	Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon.	"Pollination: by various bees".
6.06		
6.07		
7.01		
7.02	1. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 2. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York.	1. "Only one species [Arnebia pulchra] is cultivated". 2. "A. pulchra also is suited to wall plantings and will thrive in an east- or north-facing niche or in open woodland."
7.03		no evidence
7.04	1. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 2. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York. 3. Shishkin, BK (1953) Flora of the U.S.S.R. Volume XIX. P. 127. Izdatel'stvo Akademii Nauk SSSR, Moskva-Leningrad and Israel Program for Scientific Translations, Jerusalem (1974).	1. "Nutlets to 4.5 x 3.5 mm, ovoid to nearly spherical, pointed, with sharp keels, covered with small warts and pits". 2. "Nutlets ovoid to almost spherical, acute, with sharp ventral keels, the surfaces covered with tubercles and small pits." 3. "Nutlets 4 mm high, broadly (nearly globularly) ovoid...without distinct dorsal ridges, with sharp, longitudinal ventral keel, rather finely tuberculate-pitted, without lateral appendages." [no adaptations to wind dispersal]
7.05		
7.06		
7.07	1. Bennett M (2003) Pulmonarias and the Borage Family. Timber Press: Portland, Oregon. 2. Cullen, J et al (1984) The European Garden Flora. Volume VI. Dicotyledons (Part IV). Pp. 131-132. Cambridge University Press, Cambridge (Cambridgeshire) and New York. 3. Shishkin, BK (1953) Flora of the U.S.S.R. Volume XIX. P. 127. Izdatel'stvo Akademii Nauk SSSR, Moskva-Leningrad and Israel Program for Scientific Translations, Jerusalem (1974).	1. "Nutlets to 4.5 x 3.5 mm, ovoid to nearly spherical, pointed, with sharp keels, covered with small warts and pits". 2. "Nutlets ovoid to almost spherical, acute, with sharp ventral keels, the surfaces covered with tubercles and small pits." 3. "Nutlets 4 mm high, broadly (nearly globularly) ovoid...without distinct dorsal ridges, with sharp, longitudinal ventral keel, rather finely tuberculate-pitted, without lateral appendages." [no adaptations to external dispersal]
7.08		
8.01		
8.02		
8.03		
8.04		
8.05		