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Version 1

Weed Risk Assessment for *Adonis microcarpa* DC. (Ranunculaceae) – Pheasant's-eye

Left: Red flower of *Adonis microcarpa* (source: Evenor, 2010). Right: Yellow flower of *Adonis microcarpa* (source: Martin, 2011).

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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 the PPQ weed risk assessment (WRA) process (PPQ, 2015) to evaluate the risk potential of plants, including those newly detected in the United States, those proposed for import, and those emerging as weeds elsewhere in the world.

The PPQ WRA process includes three analytical components that together describe the risk profile of a plant species (risk potential, uncertainty, and geographic potential; PPQ, 2015). At the core of the process is the predictive risk model that evaluates the baseline invasive/weed potential of a plant species using information related to its ability to establish, spread, and cause harm in natural, anthropogenic, and production systems (Koop et al., 2012). Because the predictive model is geographically and climatically neutral, it can be used to evaluate the risk of any plant species for the entire United States or for any area within it. We then use a stochastic simulation to evaluate how much the uncertainty associated with the risk analysis affects the outcomes from the predictive model. The simulation essentially evaluates what other risk scores might result if any answers in the predictive model might change. Finally, we use Geographic Information System (GIS) overlays to evaluate those areas of the United States that may be suitable for the establishment of the species. For a detailed description of the PPQ WRA process, please refer to the *PPQ Weed Risk Assessment Guidelines* (PPQ, 2015), which is available upon request.

We emphasize that our WRA process is designed to estimate the baseline—or unmitigated—risk associated with a plant species. We use evidence from anywhere in the world and in any type of system (production, anthropogenic, or natural) for the assessment, which makes our process a very broad evaluation. This is appropriate for the types of actions considered by our agency (e.g., Federal regulation). Furthermore, risk assessment and risk management are distinctly different phases of pest risk analysis (e.g., IPPC, 2015). Although we may use evidence about existing or proposed control programs in the assessment, the ease or difficulty of control has no bearing on the risk potential for a species. That information could be considered during the risk management (decision making) process, which is not addressed in this document.

	***Adonis microcarpa* DC. – Pheasant's-eye**
Species Information	Family: Ranunculaceae Synonyms: *Adonis aestivalis* Link ex Webb & Bertherl.; *Adonis cretica* (Huth) Imam, Chrtek & A. Slavíková (The Plant List, 2013). Common names: Pheasant's-eye, red chamomile, small-fruit pheasant's-eye (NGRP, 2015). Botanical description: *Adonis microcarpa* is an annual herb, usually branched, with red or yellow flowers on a leafless stalk and with approximately 10-15 achenes. For a full botanical description see Parsons and Cuthbertson (2001) and Eichler (1965). Initiation: PPQ received a market access request for *Triticum aestivum* (wheat) and *T. durum* (durum wheat) seed for planting from Italy (MPAAF, 2010). A commodity risk assessment identified *Adonis microcarpa* as a potential contaminant of wheat seed from Italy. The PERAL Weed Team evaluated this species to determine its risk potential. Foreign distribution and status: *Adonis microcarpa* is native to northern Africa (the Canary Islands, Algeria, Egypt, Libya), western Asia (Cyprus, Iran, Iraq, Jordan, Lebanon, Syria, Turkey), and southern Europe (France, Greece, Crete, Italy, Sardinia, Sicily, Portugal, Spain) (NGRP, 2015). It is naturalized in New South Wales (Simmonds et al., 2000) and South Australia (Groves et al., 2005), and present in Kosovo (Rexhepi, 1997), Tasmania (Boersma et al., 1999), Israel (Heyn and Pazy, 1989), and Tunisia (Brandes, 2001). We were unable to determine if *A. microcarpa* is native or naturalized in Kosovo, Tunisia, and Israel based on the available evidence. U.S. distribution and status: Although one source indicates that this species was introduced to North America as an ornamental (Parsons and Cuthbertson, 2001) and another states that it can grow in Pennsylvania (Dave's Garden, 2015), we found no other evidence that it is currently cultivated or present in the United States (Kartesz, 2015; NGRP, 2015; Plant Information Online, 2007). The related species *Adonis aestivalis* and *A. annua* are confirmed as being present in the United States and, depending on their life stages, may be indistinguishable from *A. microcarpa* (Heyn and Pazy, 1989). Therefore, it is possible that the plant reported to grow in Pennsylvania is another species of *Adonis*. WRA area[1]: Entire United States, including territories.

<u>1. *Adonis microcarpa* analysis</u>

Establishment/Spread Potential

Adonis microcarpa is an annual herb that reproduces by seed (Parsons and Cuthbertson, 2001). Its seedlings require light to germinate (Parsons and Cuthbertson, 2001), and it can have high seed production (Hunter, 2014). *Adonis microcarpa* does not require any specialist pollinators (Martınez-Harms et al.,

[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).

2012; Menzel et al., 1997). While its dispersal vectors are not well understood, there is evidence that it disperses by sticking to clothing and machinery, as well as to wool and fur (Kloot, 1987; Parsons and Cuthbertson, 2001; Randall, 1999). Currently, it is easily controlled by herbicides (Simmonds et al., 2000) and cultivation practices (Parsons and Cuthbertson, 2001). For this risk element, we had very high uncertainty due to the lack of available biological information on the species. Also, little is known about the ability of *A. microcarpa* to disperse naturally.
Risk score = 10 Uncertainty index = 0.28

Impact Potential Very little is known about the impacts of *Adonis microcarpa* on natural and anthropogenic systems. The majority of information about its impacts relate to production systems. *Adonis microcarpa* competes for light, water, and space, and can reduce the available area for grazing (Parsons and Cuthbertson, 2001). It is toxic to horses, sheep, goats, and pigs, producing symptoms ranging from gastrointestinal distress to death (Davies and Whyte, 1989; Parsons and Cuthbertson, 2001; Simmonds et al., 2000). *Adonis microcarpa* may impact trade, as it is currently prohibited from sale in South Australia (Groves et al., 2005) and is regulated as a seed grain contaminant in New Zealand (Biosecurity New Zealand, 2011). Although little information is available about its impact in natural and anthropogenic systems, we found enough evidence of its impact in production systems to give us an average amount of uncertainty for this risk element.
Risk score = 2.4 Uncertainty index = 0.15

Geographic Potential Based on three climatic variables, we estimate that about 43 percent of the United States is suitable for the establishment of *Adonis microcarpa* (Fig. 1). This predicted distribution is based on the species' known distribution elsewhere in the world and includes point-referenced localities and areas of occurrence. The map for *Adonis microcarpa* represents the joint distribution of Plant Hardiness Zones 7-12, areas with 0-70 inches of annual precipitation, and the following Köppen-Geiger climate classes: steppe, desert, Mediterranean, humid subtropical, marine west coast, humid continental warm summers, and humid continental cool summers.

The area of the United States shown to be climatically suitable (Fig. 1) is likely overestimated since our analysis considered only 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. *Adonis microcarpa* is generally found in agricultural settings, pastures, and along roadsides and railways. In Australia, it prefers July temperatures above 40.1 °F (4.5 °C), rainfall in excess of 300 mm (30 cm), and alkaline soils free of lime (Parsons and Cuthbertson, 2001).

Entry Potential We did not find any evidence that *Adonis microcarpa* is present in the United States, Canada, or Mexico (Dave's Garden, 2015; GBIF, 2015; Kartesz, 2015; NGRP, 2015). Because it is an agricultural weed (Duretto, 2009; Parsons and Cuthbertson, 2001; Randall, 2007; Richardson et al., 2006), the most likely pathways for entry would be associated with agriculture. *Adonis microcarpa* has been unintentionally introduced to other countries as a contaminant of agricultural crops and in seed or hay for livestock consumption (Duretto, 2009; Hunter, 2014; Parsons and Cuthbertson, 2001; Offord, 2006; Randall, 2007; Richardson et al., 2006). It can also be unintentionally introduced by adhering to clothing, in mud attached to machinery and vehicles, and by sticking to wool and fur (Parsons and Cuthbertson, 2001). *Adonis microcarpa* was initially introduced into Australia as an ornamental (Kloot, 1987; Parsons and Cuthbertson, 2001), and one report indicated that it can grow in the United States in Pennsylvania (Dave's Garden, 2015). However, we found no evidence that it is currently cultivated anywhere in the world. For this risk element we had a very high level of uncertainty due to the lack of available information about *A. microcarpa* outside of agricultural systems.
Risk score = 0.1 Uncertainty index = 0.29

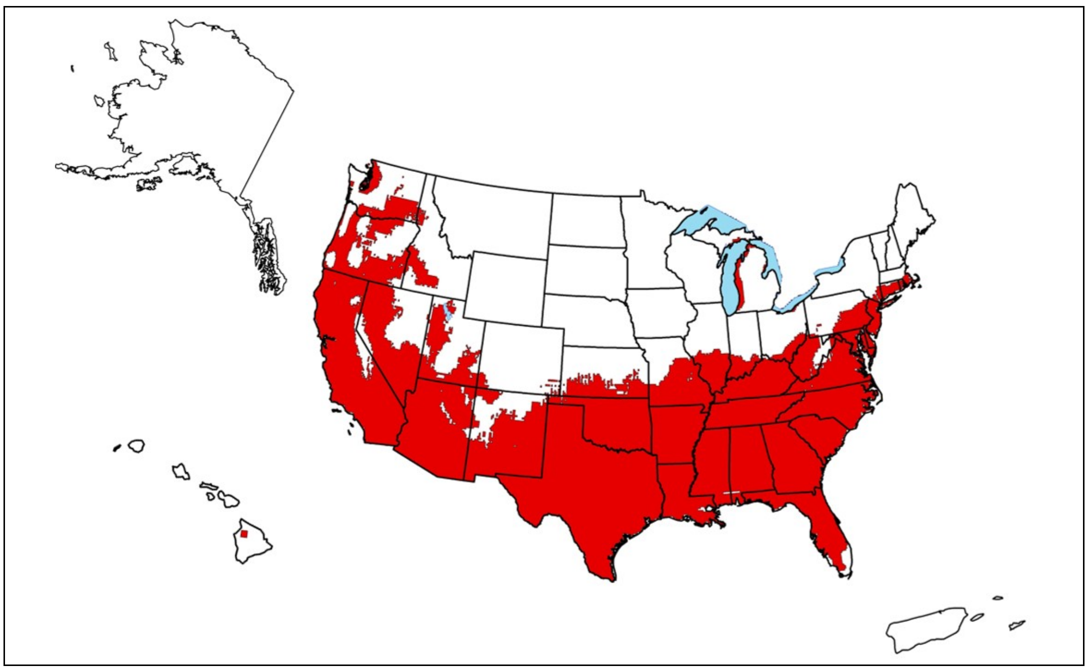

Figure 1. Predicted distribution of *Adonis microcarpa* in the United States. Map insets for Alaska, Hawaii, and Puerto Rico are not to scale.

2. Results

Model Probabilities: P(Major Invader) = 41.7%
P(Minor Invader) = 54.2%
P(Non-Invader) = 4.1%

Risk Result = High Risk

Secondary Screening = Not Applicable

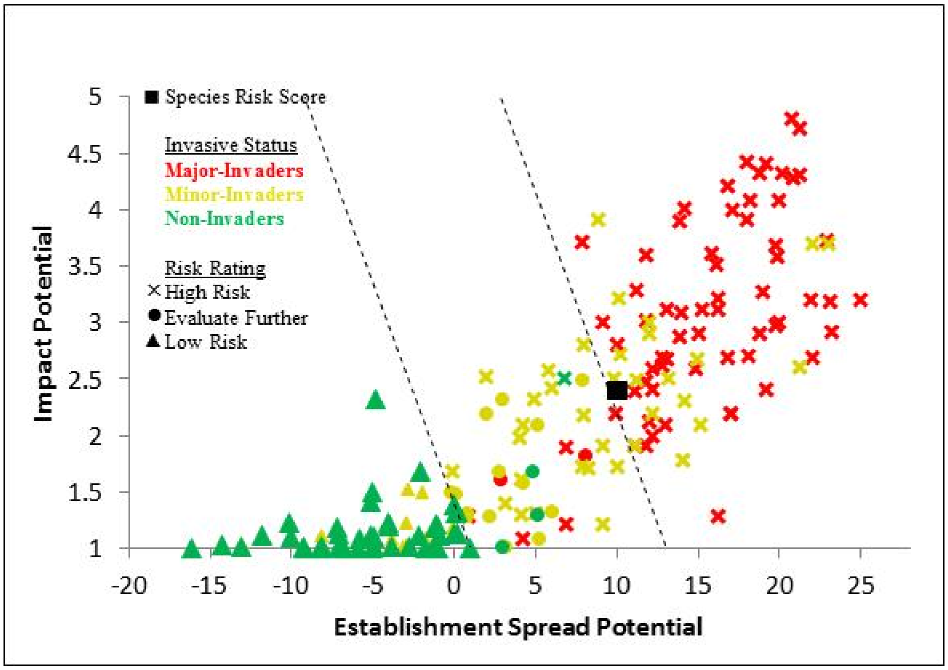

Figure 2. *Adonis microcarpa* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

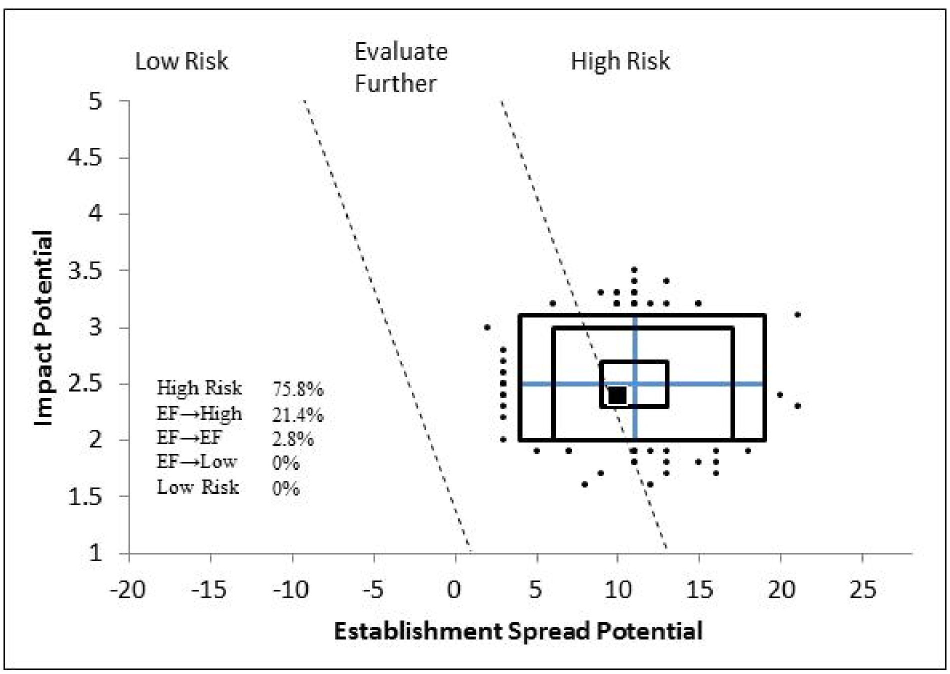

Figure 3. Model simulation results (N=5,000) for uncertainty around the risk score for *Adonis microcarpa*. The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

3. Discussion

The result of the weed risk assessment for *Adonis microcarpa* is High Risk (Fig. 2). Little is known about *A. microcarpa* outside of agricultural settings, which contributed to the high level of uncertainty during our analysis. However, despite this uncertainty, we are confident in our determination of high risk based on the results of our uncertainty analysis (Fig.3).

Over the course of about 60 years, the number of recorded *A. microcarpa* individuals has steadily increased in Australia (GBIF, 2015). Originally, *A. microcarpa* was introduced as an ornamental in South Australian suburbs (Kloot, 1987; Parsons and Cuthbertson, 2001) and has since spread into agricultural systems (Offord, 2006; Parsons and Cuthbertson, 2001; Randall, 2012; Simmonds et al., 2000). *Adonis microcarpa* is toxic to horses, sheep, goats, and pigs (Davies and Whyte, 1989; Parsons and Cuthbertson, 2001; Simmonds et al., 2000). It may impact trade, as it is currently prohibited from being sold in South Australia (Groves et al., 2005) and its seeds are prohibited in New Zealand (Biosecurity New Zealand, 2011). While *Adonis microcarpa* can be controlled with either herbicides or cultivation (Parsons and Cuthbertson, 2001; Simmonds et al., 2000), it can reestablish in fallow fields (GBIF, 2015; Parsons and Cuthbertson, 2001). Therefore, while it may be controlled in agricultural settings, it is not necessarily eliminated. The closely related *Adonis aestivalis*, *A. annua*, and *A. vernalis* are all present in the United States (Kartesz, 2015) and are considered to be toxic weeds (Burrows and Tyrl, 2013; Nelson et al., 2007; Woods et al., 2004).

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Appendix A. Weed risk assessment for *Adonis microcarpa* DC. (Ranunculaceae). Below is all of the evidence and associated references used to evaluate the risk potential of this *Adonis microcarpa*. 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 - high	5	*Adonis microcarpa* is native to northern Africa (the Canary Islands, Algeria, Egypt, Libya), western Asia (Cyprus, Iran, Iraq, Jordan, Lebanon, Syria, Turkey), and southern Europe (France, Greece, Crete, Italy, Sardinia, Sicily, Portugal, Spain, Baleares) (NGRP, 2015). It is naturalized in New South Wales (Simmonds et al., 2000) and South Australia (Groves et al., 2005), and is present in Kosovo (Rexhepi, 1997), Tasmania (Boersma et al., 1999), Israel (Heyn and Pazy, 1989), Tunisia (Brandes, 2001), and Portugal (NGRP, 2015; Sequeira et al., 2011). We were unable to determine if *A. microcarpa* is native or naturalized in Kosovo, Tunisia, and Israel based on the available evidence. Kloot (1987) mentioned that this species (using the name *Adonis microcarpus* DC) spread unaided after its introduction to South Australia as an ornamental. is now widespread over several large regions of the Australia (GBIF, 2015) and listed as an (Randall, 2001). The alternate answers for the Monte Carlo simulation were both "e."
ES-2 (Is the species highly domesticated)	n - negl	0	While *Adonis microcarpa* was cultivated in Australia (Randall, 2007), we found no evidence that it has been domesticated or bred for traits conferring reduced weed potential. Because we found no evidence that it is currently being cultivated, we used negligible uncertainty.
ES-3 (Weedy congeners)	y - negl	1	The genus *Adonis* consists of 35 species (Duretto, 2009). Randall (2012) lists several species of *Adonis* as weeds, and three of these appear to be significant weeds. *Adonis aestivalis*, *A. flammea*, and *A. annua* are agricultural weeds in the Mediterranean region of Europe (Hanf, 1983). In the United States *A. aestivalis*, *A. annua*, and *A. vernalis* are weedy and toxic (Burrows and Tyrl, 2013; Nelson et al., 2007; Kartesz, 2015). Three horses in California died after eating hay contaminated with *A. aestivalis* (Woods et al., 2004).
ES-4 (Shade tolerant at some stage of its life cycle)	n - low	0	We found no evidence indicating or suggesting that *A. microcarpa* is shade

Question ID	Answer - Uncertainty	Score	Notes (and references)
			tolerant. In fact, seedlings have a "positive requirement for light" in order to germinate (Parsons and Cuthbertson, 2001). *Adonis microcarpa* is found in fallow fields and paddocks along roadsides (GBIF, 2015), in arable land (Hanf, 1983), and in rangelands in Australia (Martin et al., 2006), all of which are high light environments.
ES-5 (Plant a vine or scrambling plant, or forms tightly appressed basal rosettes)	n - negl	0	*Adonis microcarpa* is not a vine or a plant that forms basal rosettes; it is an annual herb that can grow up to 60 cm high (Parsons and Cuthbertson, 2001).
ES-6 (Forms dense thickets, patches, or populations)	n - low	0	We found no information that *Adonis microcarpa* can form dense thickets, patches, or populations.
ES-7 (Aquatic)	n - negl	0	*Adonis microcarpa* is not an aquatic plant; it is a terrestrial herb found mainly in cereal crops and rangelands (Richardson et al., 2006; Martin et al., 2006).
ES-8 (Grass)	n - negl	0	It is not a grass. It is a member of the Ranunculaceae family (NGRP, 2015).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	We found no evidence that *Adonis microcarpa* is a nitrogen-fixing plant. It is not a member of a family known to contain nitrogen-fixing species (Martin and Dowd, 1990; Santi et al., 2013).
ES-10 (Does it produce viable seeds or spores)	y - negl	1	In Australia, seeds of *Adonis microcarpa* begin to germinate in autumn and continue germinating into the spring. In winter, seedlings can develop rapidly (Parsons and Cuthbertson, 2001).
ES-11 (Self-compatible or apomictic)	? - max	0	We found no evidence that *Adonis microcarpa* is self-compatible or apomictic. However, because its congener *A. aestivalis* is self-compatible (Meyer et al., 2015), we answered unknown instead of no.
ES-12 (Requires specialist pollinators)	n - high	0	We found no evidence that *Adonis microcarpa* requires specialist pollinators. In the southeast Mediterranean, plants are visited by glaphyrid beetles (Martınez-Harms et al., 2012). Other researchers report that the species is visited by beetles and hymenoptera (Menzel et al., 1997). While it is not clear if these taxa are acting merely as visitors or pollinators, because this species has naturalized in other countries (Australia), it seems unlikely to require specialist pollinators. Consequently, we answered no, but with high uncertainty.
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	b - low	1	*Adonis microcarpa* is an annual (Parsons and Cuthbertson, 2001). In Australia, the seeds will germinate in autumn (March-May), then sporadically througth mid-winter. The

Question ID	Answer - Uncertainty	Score	Notes (and references)
than 3 years; or (?) unknown]			seedlings develop fast in the winter and flower during the spring (August to November in Australia), with plants dying in early summer (Parsons and Cuthbertson, 2001). Based on this evidence we answered "b." The alternate answers for the Monte Carlo simulation were both "a."
ES-14 (Prolific seed producer)	? - max	0	Has high seed production (Hunter, 2014). The fruits have about "10-15 achenes [seeds] grouped into an oblong spike" (Parsons and Cuthbertson, 2001). Each flower consists of 10-50 individual achenes (Weeds in Australia, 2015). We were unable to find information about seed viability rates and the number of plants that grow per square meter, so we answered unknown.
ES-15 (Propagules likely to be dispersed unintentionally by people)	y - low	1	Seeds can adhere to clothing and in mud attached to machinery and vehicles (Parsons and Cuthbertson, 2001).
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	y - negl	2	It can contaminate hay (Offord, 2006). It can be a contaminant of fodder or seed (Hunter, 2014).
ES-17 (Number of natural dispersal vectors)	1	-2	Fruit and seed description for ES-17a through ES-17e: Seeds are a blackish green color and are plump and approximately 1.5 mm in diameter (Parsons and Cuthbertson, 2001). Individual seeds are "egg-shaped, but angular, 2.5-4 mm long, and have an irregular network of raised veins" (Weeds in Australia, 2015).
ES-17a (Wind dispersal)	n - mod		We found no evidence that *A. microcarpa* is wind dispersed. Because it doesn't possess any specific adaptations for wind dispersal such as wings or plumes, we answered no with moderate uncertainty.
ES-17b (Water dispersal)	n - mod		We found no evidence that *A. microcarpa* is water dispersed. Because it does not appear restricted to aquatic or riparian habitats, we answered no with moderate uncertainty.
ES-17c (Bird dispersal)	? - max		Unknown. We found no evidence that *A. microcarpa* is dispersed by birds.
ES-17d (Animal external dispersal)	y - negl		It adheres to wool and fur, and in muddy hooves (Parsons and Cuthbertson, 2001). Kloot (1987) mentioned it (using the name *Adonis microcarpus* DC) being dispersed by attaching to animals. Animals aid in reproduction by dispersing seeds (Simmonds et al., 2000). The seed adheres to wool and fur (Randall, 1999).
ES-17e (Animal internal dispersal)	? - max		Horses can ingest *A. microcarpa* through contaminated hay (Offord, 2006). Goats can ingest it (Simmonds et al., 2000). However, we found no evidence that the seeds can remain viable after passing through these

Question ID	Answer - Uncertainty	Score	Notes (and references)
			animals.
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	? - max	0	Seeds of *A. microcarpa* can survive unfavorable conditions and germinate when conditions are favorable again (Modzelevich, 2015); however, it is not clear from this source whether seeds form a persistent seed bank. *Adonis aestivalis* can produce seeds that remain dormant until the following year and can have a "persistent long-term" seedbank (Meyer et al., 2015).
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	n - low	-1	We found no evidence that *A. microcarpa* benefits from mutilation, cultivation, or fire. In Australia, cultivation alone can be effective in controlling *A. microcarpa* (Parsons and Cuthbertson, 2001; Simmonds et al., 2000). *Adonis flammea* is endangered in Poland due to an increase in cultivation practices such as long-term herbicide use, improved cleaning practices, and the introduction of "prolific cereal varieties" (Dostatny, 2013).
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - low	0	We found no evidence that *A. microcarpa* or any of its congeners have developed herbicide resistance (e.g., Heap, 2015). Currently *A. microcarpa* can be controlled with bomoxynil + MCPA or bomoxynil alone (Parsons and Cuthbertson, 2001) and broad leaf herbicides Group C (absorbed through the roots, transported to leaves, and activated by light) (Simmonds et al., 2000).
ES-21 (Number of cold hardiness zones suitable for its survival)	6	0	
ES-22 (Number of climate types suitable for its survival)	7	2	
ES-23 (Number of precipitation bands suitable for its survival)	7	0	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - low	0	We found no evidence that *Adonis microcarpa* is allelopathic. Reviews conducted on families and species that are allelopathic do not include *Adonis microcarpa* or its congeners (Radosevich et al., 2007; Qasem and Foy, 2001).
Imp-G2 (Parasitic)	n - negl	0	We found no evidence that *Adonis microcarpa* or its congeners are parasitic; the family Ranunculaceae is not known to contain parasitic plants (Nickrent and Musselman, 2004; Nickrent, 2009).
Impacts to Natural Systems			
Imp-N1 (Changes ecosystem processes and parameters that affect other species)	n - low	0	*Adonis microcarpa* is mainly found as a weed of agriculture systems (Offord, 2006; Parsons and Cuthbertson, 2001; Randall, 2007; Simmonds et al., 2000). Because we found no

Question ID	Answer - Uncertainty	Score	Notes (and references)
			evidence that it naturalizes or is weedy in natural systems, we used low uncertainty for all questions in this sub-element. We found no direct evidence that *A. microcarpa* changes ecosystem processes and parameters.
Imp-N2 (Changes habitat structure)	n - low	0	We found no direct evidence that it changes the habitat structure.
Imp-N3 (Changes species diversity)	n - low	0	We found no direct evidence that *Adonis microcarpa* changes species diversity.
Imp-N4 (Is it likely to affect federal Threatened and Endangered species?)	n - low	0	It is unlikely that it will affect Federal Threatened and Endangered species.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions?)	n - low	0	It is unlikely that it will affect U.S. globally outstanding ecoregions.
Imp-N6 [What is the taxon's weed status in natural systems? (a) Taxon not a weed; (b) taxon a weed but no evidence of control; (c) taxon a weed and evidence of control efforts]	a - low	0	We found no evidence that this species is weedy in natural systems, let alone being controlled in them. Currently, the only evidence of control is in relation to agricultural systems. The alternate answers for the Monte Carlo simulation were both "b."
Impact to Anthropogenic Systems (cities, suburbs, roadways)			
Imp-A1 (Negatively impacts personal property, human safety, or public infrastructure)	n - low	0	We found no evidence that *Adonis microcarpa* negatively impacts personal property, human safety, or public infrastructure. Currently, the majority of information about *A. microcarpa* focuses on its presence in agricultural systems. For this reason we used low uncertainty for this question, and questions Imp-A2 and Imp-A3.
Imp-A2 (Changes or limits recreational use of an area)	n - low	0	We found no evidence that *Adonis microcarpa* changes or limit recreational use of an area.
Imp-A3 (Affects desirable and ornamental plants, and vegetation)	n - low	0	We found no evidence that *Adonis microcarpa* affects desirable and ornamental plants and vegetation.
Imp-A4 [What is the taxon's weed status in anthropogenic systems? (a) Taxon not a weed; (b) Taxon a weed but no evidence of control; (c) Taxon a weed and evidence of control efforts]	b - mod	0.1	In Australia, *A. microcarpa* occurs as a weed along roadsides, under fence lines, and in waste places (Parsons and Cuthbertson, 2001). It was introduced into South Australia as an ornamental and has spread on its own (Kloot, 1987). Although it is prohibited from sale in South Australia (Groves et al., 2005), and despite its occurrence along roadsides and under fences, we found no direct evidence of control in anthropogenic systems. So far, the only documented control appears to be taking place in agricultural systems (Parsons and Cuthbertson, 2001; Simmonds et al., 2000). It is not clear to us why it is banned for sale as an ornamental; whether it is due to its impact in agricultural areas, or some unreported impact in anthropogenic areas is unknown to us. For this reason, we answered "b" with moderated uncertainty. The alternate answers

Question ID	Answer - Uncertainty	Score	Notes (and references)
			for the Monte Carlo simulation were "c" and "a."
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	y - high	0.4	In Australia, *A. microcarpa* can compete with medicago pastures for water, light, and space. This can reduce the area that is available for grazing (Parsons and Cuthbertson, 2001). It is a strong competitor in cereal crops and medicago pastures (Randall, 1999). Martin et al. (2006) list *A. microcarpa* as a potential threat to rangeland biodiversity, but evidence is lacking as to how it can change rangeland biodiversity. We answered yes with high uncertainty because while there is concern over *A. microcarpa* role in competing for resources and reducing grazing areas, there is not enough evidence indicating how it does this.
Imp-P2 (Lowers commodity value)	? - max		*Adonis microcarpa* is toxic to horses, pigs, and goats (Davies and Whyte, 1989; Parsons and Cuthbertson, 2001; Simmonds et al., 2000; and see evidence under Imp-P5). Symptoms range from gastrointestinal issues to death (Davies and Whyte, 1989; Parsons and Cuthbertson, 2001; Randall, 1999; Simmonds et al., 2000). It is not clear whether, or to what extent, this toxic species lowers the value of pastures or rangeland or the value of livestock themselves. Without direct evidence, we are only able to answer this question as unknown.
Imp-P3 (Is it likely to impact trade?)	y - low	0.2	*Adonis microcarpa* is a weed of cereal crops (Richardson et al., 2006; Randall, 1999), including wheat and barley (Duretto, 2009). *Adonis microcarpa* is prohibited from being sold in South Australia (Groves et al., 2005), and the New Zealand government regulates it as a contaminant of grains (Biosecurity New Zealand, 2011). Because it is likely to disperse as a contaminant of trade goods (see evidence under ES-16), it has the potential to impact trade.
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	? - max		In South Australia, it competes for water in medicago pastures (Parsons and Cuthbertson, 2001), but we found no evidence that this species is more competitive for water than other weeds or crop plants.
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	y - negl	0.1	This species is toxic due to adonin, a type of glycoside (Randall, 1999). It kills horses, sheep, and pigs. Poisoning symptoms include severe gastro-enteritis, which can lead to

Question ID	Answer - Uncertainty	Score	Notes (and references)
			death (Parsons and Cuthbertson, 2001). It is toxic to goats and potentially toxic to all grazing animals. It causes gastroenteritis, and death can occur within 12 hours. It is toxic fresh or dried (Simmonds et al., 2000). *Adonis microcarpa* was the cause of field poisoning in an Australian piggery; symptoms consisted of some degree of weight loss, vomiting, lethargy, shallow breath, and death (Davies and Whyte, 1989).
Imp-P6 [What is the taxon's weed status in production systems? (a) Taxon not a weed; (b) Taxon a weed but no evidence of control; (c) Taxon a weed and evidence of control efforts]	c - negl	0.6	*Adonis microcarpa* is an agricultural weed in Australia (Randall, 2007). It affects cereal crops in South Australia, New South Wales, Victoria, and Queensland (Randall, 2001; Richardson et al., 2006). Rare cereal weed in the Mediterranean region (Hanf, 1983). Present in Australian rangelands, but impacts are unknown (Martin et al., 2006). It is a serious weed in South Australia due to its occurrence in barley, wheat, and sown pastures (Duretto, 2009; Parsons and Cuthbertson, 2001). Cultivation alone can be effective in controlling *A. microcarpa* (Parsons and Cuthbertson, 2001; Simmonds et al., 2000). The herbicide bomoxynil + MCPA can also be used, just bromoxynil if medicagos are present or in pastures (Parsons and Cuthbertson, 2001), or broad leaf herbicides Group C (Simmonds et al., 2000). The alternate answers for the Monte Carlo simulation were both "b."
GEOGRAPHIC POTENTIAL			Unless otherwise indicated, the following evidence represents geographically referenced points obtained from the Global Biodiversity Information Facility (GBIF, 2015).
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 - negl	N/A	We found no evidence that it occurs in this hardiness zone.
Geo-Z4 (Zone 4)	n - negl	N/A	We found no evidence that it occurs in this hardiness zone.
Geo-Z5 (Zone 5)	n - negl	N/A	We found no evidence that it occurs in this hardiness zone.
Geo-Z6 (Zone 6)	n - negl	N/A	We found no evidence that it occurs in this hardiness zone.
Geo-Z7 (Zone 7)	y - low	N/A	Spain (multiple points).
Geo-Z8 (Zone 8)	y - negl	N/A	Spain, Morocco, and Greece.
Geo-Z9 (Zone 9)	y - negl	N/A	Australia, Syria, Great Britain, France, Spain, Morocco, Italy, Greece (GBIF, 2015), Turkey (Sanliurfa) (Parmaksiz et al., 2006), and Iran

Question ID	Answer - Uncertainty	Score	Notes (and references)
			(West Zagros) (Farouji and Khodayari, 2016).
Geo-Z10 (Zone 10)	y - negl	N/A	Australia, Israel, Jordan, Lebanon, Syria, France, Spain, Morocco, Greece (GBIF, 2015), Libya (Al Jabal Al Akhdar) (El-Barasi et al., 2003), and Tunisia (Sousse) (Brandes, 2001).
Geo-Z11 (Zone 11)	y - negl	N/A	Tasmania, Australia, Israel, Spain, Madeira, Greece (GBIF, 2015), and Libya (Al Jabal Al Akhdar) (El-Barasi et al., 2003).
Geo-Z12 (Zone 12)	y - low	N/A	Israel, Spain (Santa Cruz), and Madeira.
Geo-Z13 (Zone 13)	n - negl	N/A	We found no evidence that it occurs in this hardiness zone.
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	n - negl	N/A	We found no evidence that it occurs in this climate class.
Geo-C2 (Tropical savanna)	n - negl	N/A	We found no evidence that it occurs in this climate class.
Geo-C3 (Steppe)	y - negl	N/A	Australia, Israel, Greece, Spain, Morocco (GBIF, 2015), and Libya (Al Jabal Al Akhdar) (El-Barasi et al., 2003).
Geo-C4 (Desert)	y - negl	N/A	Australia, Israel, Greece, Spain, Morocco (GBIF, 2015), Libya (Al Jabal Al Akhdar) (El-Barasi et al., 2003), Tunisia (Sousse) (Brandes, 2001), and Iran (West Zagros) (Farouji and Khodayari, 2016).
Geo-C5 (Mediterranean)	y - negl	N/A	Australia, Syria, Jordan (West Bank), Israel, Greece, France, Spain, Morocco, Madeira (GBIF, 2015), Libya (Al Jabal Al Akhdar) (El-Barasi et al., 2003), and Turkey (Parmaksiz et al., 2006).
Geo-C6 (Humid subtropical)	y - negl	N/A	Australia, Italy, and Spain.
Geo-C7 (Marine west coast)	y - negl	N/A	Tasmania, Australia, Spain, and Great Britain.
Geo-C8 (Humid cont. warm sum.)	y - high	N/A	Turkey and Iran (NGRP, 2015).
Geo-C9 (Humid cont. cool sum.)	y - mod	N/A	Spain (three points).
Geo-C10 (Subarctic)	n - low	N/A	France (one point) and Spain (one point). We answered no for this climate class with a low uncertainty because *Adonis microcarpa* has been shown in Australia to prefer temperatures above 40.1 °F (4.5 °C) (Parsons and Cuthbertson, 2001).
Geo-C11 (Tundra)	n - low	N/A	France (one point) and Spain (one point). We answered no for this climate class with a low uncertainty because *Adonis microcarpa* has been shown in Australia to prefer temperatures above 40.1 °F (4.5 °C) (Parsons and Cuthbertson, 2001).
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)	y - negl	N/A	Australia, Israel, Jordan, Greece, Spain, Morocco (GBIF, 2015), Tunisia (Sousse) (Brandes, 2001), Libya (Al Jabal Al Akhdar)

Question ID	Answer - Uncertainty	Score	Notes (and references)
			(El-Barasi et al., 2003), and Iran (West Zagros) (Farouji and Khodayari, 2016).
Geo-R2 (10-20 inches; 25-51 cm)	y - negl	N/A	Australia, Israel, Jordan, Syria, Greece, Spain, Morocco, Madeira (GBIF, 2015), Turkey (Sanliurfa) (Parmaksiz et al., 2006), and Iran (West Zagros) (Farouji and Khodayari, 2016).
Geo-R3 (20-30 inches; 51-76 cm)	y - negl	N/A	Tasmania, Australia, Israel, Syria, Greece, France, Italy, Spain, Morocco (GBIF, 2015), and Turkey (Sanliurfa) (Parmaksiz et al., 2006).
Geo-R4 (30-40 inches; 76-102 cm)	y - negl	N/A	Australia, Greece, France, and Spain.
Geo-R5 (40-50 inches; 102-127 cm)	y - mod	N/A	Greece (one point), Great Britain (one point), and Spain (one point).
Geo-R6 (50-60 inches; 127-152 cm)	y - high	N/A	Great Britain (one point). We answered yes with a high uncertainty because while *Adonis microcarpa* has been shown to prefer areas with rainfall in excess of 300 mm (30 cm) in Australia (Parsons and Cuthbertson, 2001), we found no other evidence for it in this precipitation band.
Geo-R7 (60-70 inches; 152-178 cm)	y - high	N/A	Great Britain (one point). We answered yes with a high uncertainty because while *Adonis microcarpa* has been shown to prefer areas with rainfall in excess of 300 mm (30 cm) in Australia (Parsons and Cuthbertson, 2001), we found no other evidence for it in this precipitation band.
Geo-R8 (70-80 inches; 178-203 cm)	n - negl	N/A	We found no evidence that it occurs in this precipitation band.
Geo-R9 (80-90 inches; 203-229 cm)	n - negl	N/A	We found no evidence that it occurs in this precipitation band.
Geo-R10 (90-100 inches; 229-254 cm)	n - negl	N/A	We found no evidence that it occurs in this precipitation band.
Geo-R11 (100+ inches; 254+ cm)	n - negl	N/A	We found no evidence that it occurs in this precipitation band.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	n - mod	0	Although one source indicates that this species was introduced to North America as an ornamental (Parsons and Cuthbertson, 2001) and another states that it can grow in Pennsylvania (Dave's Garden, 2015), we found no other evidence that it is currently cultivated or present in the United States (Kartesz, 2015; NGRP, 2015; Plant Information Online, 2007).
Ent-2 (Plant proposed for entry, or entry is imminent)	n - low	0	We found no evidence that this species has been proposed for intentional import or that its entry is imminent.
Ent-3 (Human value & cultivation/trade status)	a - high	0	*Adonis microcarpa* was originally spread through Europe and introduced to Australia as an ornamental (Parsons and Cuthbertson, 2001). However, there is no evidence that it is currently being sold or spread as an

Question ID	Answer - Uncertainty	Score	Notes (and references)
			ornamental. Because it was cultivated in the past and because its flowers have some ornamental appeal, we answered "a" with high uncertainty.
Ent-4 (Entry as a contaminant)			
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	n - low		Currently, there is no evidence that *Adonis microcarpa* is present in Canada, Mexico, Central America, the Caribbean, or China. As stated under ES-1, it is present in western Asia, Australia, and the Mediterranean region.
Ent-4b (Contaminant of plant propagative material (except seeds))	n - low	0	We found no evidence that *Adonis microcarpa* is a contaminant of propagative plant material.
Ent-4c (Contaminant of seeds for planting)	y - low	0.04	It can be a contaminant of seed (Hunter, 2014). It is mainly found in agricultural systems such as wheat, barley, and cereal crops (Duretto, 2009; Parsons and Cuthbertson, 2001; Randall, 2007; Richardson et al., 2006).
Ent-4d (Contaminant of ballast water)	n - low	0	We found no evidence that *Adonis microcarpa* is a contaminant of ballast.
Ent-4e (Contaminant of aquarium plants or other aquarium products)	n - low	0	We found no evidence that *Adonis microcarpa* is a contaminant of aquarium plants or other aquarium products.
Ent-4f (Contaminant of landscape products)	? - max		We found no evidence that *Adonis microcarpa* is a contaminant of imported landscape products.
Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances)	y - low	0.02	Seeds can adhere to clothing and in mud attached to machinery and vehicles (Parsons and Cuthbertson, 2001).
Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing)	? - max		*Adonis microcarpa* can contaminate seed for livestock consumption (Hunter, 2014). Depending on whether such seed is processed into a meal or fed whole to animals, it may or may not present a significant pathway.
Ent-4i (Contaminant of some other pathway)	e - negl	0.04	*Adonis microcarpa* can contaminate hay (Offord, 2006). It can contaminate fodder (Hunter, 2014).
Ent-5 (Likely to enter through natural dispersal)	n - negl	0	Because *Adonis microcarpa* is not present in a region adjacent to the United States (GBIF, 2015; Kartesz, 2015; NGRP, 2015), it is very unlikely for it to enter through natural dispersal. Furthermore, Hunter (2014) states that *A. microcarpa* relies on transport as a contaminant for its dispersal.