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Weed Risk Assessment for *Calicotome spinosa* (Fabaceae) – Spiny-broom

Calicotome spinosa in Sardinia (Hillewaert, 2008)

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Executive Summary

The result of the weed risk assessment for *Calicotome spinosa* is High Risk of becoming weedy or invasive in the United States. *Calicotome spinosa* is a perennial nitrogen-fixing shrub in the family Fabaceae that can be a weed of natural areas and pastures. It was detected in California in 2016, but the plants were removed. It has been proposed for an “A” list pest rating in that state, but it has not been regulated yet. No other states regulate the species, but Idaho regulates the genus *Cytisus*, in which *Calicotome spinosa* was previously placed. It is not known to be present in the United States. Plants form dense patches and resprout from fire and clear cutting. Because they are highly flammable, they can also increase the risk of fire. The seeds can be dispersed on clothing, in garden waste, and on earth-moving machinery. *Calicotome spinosa* is an environmentally significant weed and a weed of agriculture in Australia, where it is managed with mechanical and chemical controls. It is also managed in New Zealand and regulated in both countries. The plant can prevent livestock from accessing water and reduce the productivity of pastures. It also prevents the growth of native species and is considered a serious threat to the native vegetation of Victoria, Australia. It is most likely to enter the United States on machinery or as a contaminant of seed or grain. We estimate that 6 to 20 percent of the United States is climatically suitable for the species to establish.

Plant Information and Background

PLANT SPECIES: *Calicotome spinosa* (L.) Link (Fabaceae) (NPGS, 2020)

SYNONYMS: Basionym: *Spartinum spinosum* L. Other synonyms: *Cytisus spinosus* (L.) Lam., *Calicotome fontanesii* Rothm., *Calycotome spinosa* Link. (Biosecurity Queensland, 2016; NPGS, 2020; The Plant List, 2013b)

COMMON NAMES: Spiny-broom (NPGS, 2020), thorny broom (Salmi et al., 2018)

BOTANICAL DESCRIPTION: *Calicotome spinosa* is a spiny shrub with many branches that grows up to 3 meters tall. The leaves are dark green to grayish green, the flowers are bright yellow, and the spines can be up to 7.5 cm long. The seed pods are 2.5 to 4 cm long and gray, black, or reddish brown with two ridges on one edge. Seeds are smooth, shiny, and yellowish brown, about 3.5 mm long and 2 mm wide (Biosecurity Queensland, 2016; Parsons and Cuthbertson, 2001; Salmi et al., 2018).

INITIATION: Due to potential concern about this species becoming invasive in the United States, the PPQ Weeds Cross-Functional Working Group requested that this species be evaluated with a weed characterization. Upon review, the characterization triggered the need for a more thorough weed risk assessment.

WRA AREA[1]: United States and Territories.

FOREIGN DISTRIBUTION: *Calicotome spinosa* is native to Algeria, Libya, Italy, France, and Spain (NPGS, 2020). It is naturalized in New Zealand and Australia (Victoria) (Biosecurity Queensland, 2016; Groves et al., 2005; Howell and Sawyer, 2006; NPGS, 2020). It was introduced to Australia in the 1860s as an ornamental and a hedge plant (Paynter et al., 2003a) and has escaped from cultivation (Randall, 2007). It is regulated in Victoria and Western Australia (Biosecurity Queensland, 2016; Groves et al., 2005}). In New Zealand, it is regulated and listed as a harmful organism (MAF Biosecurity New Zealand, 2012; PCIT, 2020)

U.S. DISTRIBUTION AND STATUS: *Calicotome spinosa* was detected in California in 2016 (Oki, 2016); the population was removed, though the seed bank has not been evaluated (Kelch, 2020). It is not known to be present anywhere else in the United States (EDDMaps, 2020; Kartesz, 2015; NRCS, 2020). The website Dave's Garden (2020) describes the plant as drought-tolerant and suitable for xeriscaping, but users on the forums have made no comments on the species. Garden Web (2020) has no discussions on the plant. We did not find it offered for sale online (Amazon, 2020; Plant Information Online, 2020). In California, it is proposed for an "A" list pest rating, but regulations are not yet in place (Kelch, 2020). Idaho regulates the genus *Cytisus* (ISDA, 2018),

[1] The "WRA area" is the area in relation to which the weed risk assessment is conducted (definition modified from that for "PRA area") (IPPC, 2017).

which previously included *Calicotome* (Cristofolini and Troia, 2006). The species is not otherwise regulated in the United States (NPB, 2021).

Analysis

ESTABLISHMENT/SPREAD POTENTIAL: *Calicotome spinosa* fixes nitrogen, using bacteria in the genus *Bradyrhizobium* (Cardinale et al., 2008; Salmi et al., 2018). It resprouts after fire and clear-cutting (Casal, 1987; Paula and Pausas, 2006), and soil disturbance and fire induce seeds in the soil to germinate (Weeds Australia, 2011). Long-term control requires exhausting the seed bank and eliminating new plants before they flower (Weeds Australia, 2011). Its dense growth and spiny branches make it an effective hedge (Parsons and Cuthbertson, 2001); it has formed dense patches in natural areas (Biosecurity Queensland, 2016). Earth-moving machinery can disperse it in soil; it can also move on clothing and in discarded garden waste (Biosecurity Queensland, 2016; Parsons and Cuthbertson, 2001). It is naturalized in Australia and New Zealand (Biosecurity Queensland, 2016; NPGS, 2020), and the seeds can be contaminants of agricultural products (Agriculture Victoria, 2020; Biosecurity Queensland, 2016), but we found no records of interception at U.S. ports of entry (AQAS, 2020). We had high uncertainty for this risk element, largely because it is not clear whether the species is actually spreading.

Risk score = 9.0 Uncertainty index = 0.26

IMPACT POTENTIAL: *Calicotome spinosa* is an environmental and agricultural weed in Australia (Biosecurity Queensland, 2016; Groves et al., 2005; Randall, 2007). Because it fixes nitrogen, it can change soil nutrient levels (Biosecurity Queensland, 2016). It is also highly flammable, and dense patches can increase the risk of fire (Biosecurity Queensland, 2016; Dehange et al., 2017). It is rated as a serious threat to native vegetation in Victoria (Weeds Australia, 2011). Groves et al. (2005) consider it to be an environmentally significant weed that warrants control in Australia, and it is also managed in Canterbury, New Zealand (Williams and Braithwaite, 2003). In agricultural systems, the weed can prevent livestock from accessing water and reduce the productivity of pastures (Biosecurity Queensland, 2016; Parsons and Cuthbertson, 2001). Livestock will eat young shoots but avoid mature plants because of the spines (Parsons and Cuthbertson, 2001). It is listed as a noxious weed in Australia (Randall, 2007) and as a harmful organism in New Zealand (PCIT, 2020). Parsons and Cuthbertson (2001) provide recommendations for mechanical and chemical control. We had low uncertainty for this risk element because the species has relatively few types of impact, but these are well documented.

Risk score = 3.5 Uncertainty index = 0.07

RISK MODEL RESULTS: The risk scores for establishment/spread and impact potential were used to estimate the probabilities of invasiveness and overall risk result (Figure 1).

Model Probabilities: P(Major Invader) = 52.3%
P(Minor Invader) = 45.0%
P(Non-Invader) = 2.7%
Risk Result = High Risk
Risk Result after Secondary Screening = Not Applicable

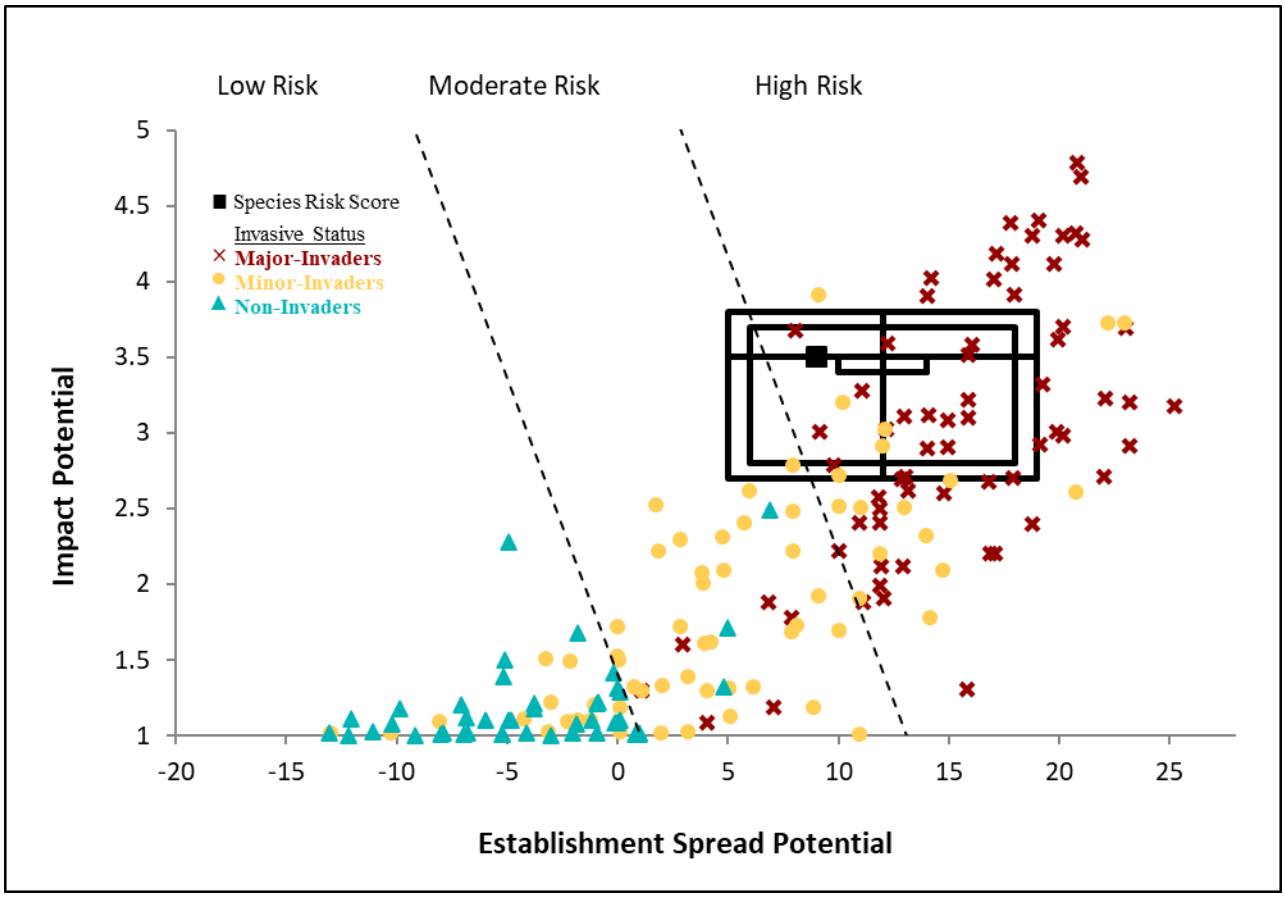

Figure 1. Risk and uncertainty results for *Calicotome spinosa*. The risk score for this species (solid black symbol) is plotted relative to the risk scores of the species used to develop and validate the PPQ WRA model (Koop et al., 2012). The results from the uncertainty analysis are plotted around the risk score for *C. spinosa*. The smallest, black box contains 50 percent of the simulated risk scores, the second 95 percent, and the largest 99 percent. The black vertical and horizontal lines in the middle of the boxes represent the medians of the simulated risk scores (N=5000). For additional information on the uncertainty analysis used, see Caton et al. (2018)

GEOGRAPHIC POTENTIAL: Using the PPQ climate-matching model for weeds (Magarey et al., 2017), we estimate that about 6 to 20 percent of the United States is suitable for the establishment of *C. spinosa* (Fig. 2). The smaller number is the percentage for which we have a very high certainty of climate suitability, while the larger percentage includes areas for which we have a lower certainty of climate suitability. The larger area represents the joint distribution of Plant Hardiness Zones 7-11,

areas with 0-50 inches of annual precipitation, and the following Köppen-Geiger climate classes: steppe, Mediterranean, humid subtropical, and marine west coast (See Appendix). The area of the United States shown to be climatically suitable was determined using only these three climatic variables. Other factors, such as soil, hydrology, disturbance regime, and species interactions may alter the areas in which this species is likely to establish. *Calicotome spinosa* grows on sunny, rocky slopes (Salmi et al., 2018); in woodlands, grasslands, pastures, and disturbed areas; and on roadsides (Agriculture Victoria, 2020; Biosecurity Queensland, 2016). The records in the Global Biodiversity Information Facility (GBIF Secretariat, 2019) indicate that it is largely a coastal species. It is a major component of degraded, overgrazed scrubland in Algeria (Kouider et al., 2014). Although it is typically found in dry, rocky places with well-drained soil (PFAF, 2020), it has escaped cultivation in wet temperate areas of Australia (Biosecurity Queensland, 2016) and is present on weedy roadsides and adjacent farms (Weeds Australia, 2011). It is reported to grow best in PHZ 7-11 (Dave's Garden, 2020; PFAF, 2020), but it can tolerate temperatures down to -10 °C if the soil drainage is ideal (PFAF, 2020).

ENTRY POTENTIAL: Seeds of *Calicotome spinosa* can be dispersed on machinery (Biosecurity Queensland, 2016) and as contaminants of agricultural products, including animal feed (Agriculture Victoria, 2020; Biosecurity Queensland, 2016). In New Zealand, the species is regulated in seed for sowing and of grain and seed for consumption (MAF Biosecurity New Zealand, 2009, 2012). We found no records, however, of interceptions at U.S. ports of entry (AQAS, 2020). The risk score for this risk element can range from 0 to 1, where 0 indicates that there is no evidence of any pathways for entry into the United States.

Risk score = 0.12 Uncertainty index = 0.26

Discussion

The result of the weed risk assessment for *Calicotome spinosa* is High Risk of becoming weedy or invasive in the United States. Although *C. spinosa* is naturalized in Australia and New Zealand (Groves et al., 2005; Howell and Sawyer, 2006), we did not find information indicating that it has spread beyond the initial regions of entry. If we did find evidence of spread, that would increase the risk score. *Calicotome spinosa* produces 3 to 15 seeds per pod (Parsons and Cuthbertson, 2001), but we did not find information on the number of pods produced. The risk score could increase or decrease with that information, depending on whether the plant is a prolific seed producer. Although we found evidence for environmental impact, the information is relatively sparse; therefore, we are unsure of whether threatened or endangered species in the United States would be at risk. The species can overshadow understory plants (Biosecurity Queensland, 2016), but we found no evidence that it actually eliminates vegetation layers, which would increase the risk score.

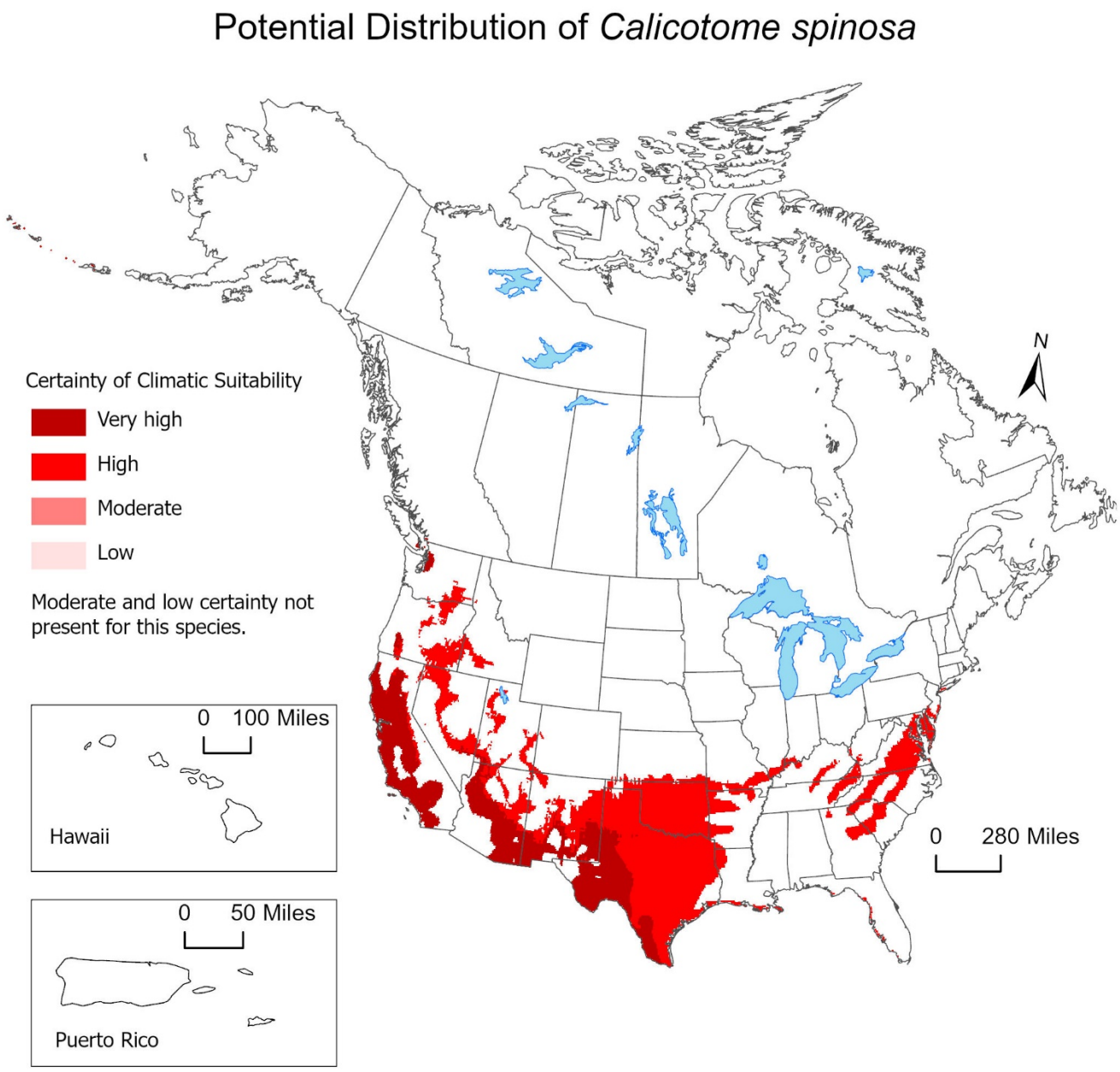

Figure 2. Potential distribution of *Calicotome spinosa* in the United States. Climatic suitability was determined using the APHIS-PPQ climate matching tool for invasive plants (Magarey et al., 2017).

Suggested Citation

PPQ. 2020. Weed risk assessment for *Calicotome spinosa* (L.) Link (Fabaceae) – Spiny-broom. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (PPQ), Raleigh, NC. 20 pp.

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Appendix. Weed risk assessment for *Calicotome spinosa* (L.) Link (Fabaceae)

The following table includes the evidence and associated references used to evaluate the risk potential of this taxon. We also include the answer, uncertainty rating, and score for each question.

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]	e - high	2	*Calicotome spinosa* is native to Algeria, Libya, Italy, France, and Spain and is naturalized in New Zealand (Howell and Sawyer, 2006; NPGS, 2020) and Australia (Victoria) (Biosecurity Queensland, 2016; Groves et al., 2005). Because we did not find information describing its spread or evidence of widespread naturalization, which suggests invasiveness (i.e., spread), we answered "e." Since we did find evidence of impact and spread into particular habitats (Biosecurity Queensland, 2016), we had high uncertainty, and we answered "f" for the uncertainty simulation.
ES-2 (Is the species highly domesticated)	n - low	0	It was historically grown as an ornamental and a hedge plant (Biosecurity Queensland, 2016; Paynter et al., 2003a), but we found no evidence of breeding for traits that would reduce its invasive potential.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-3 (Significant weedy congeners)	y - high	1	Salmi et al. (2018) list four species in the genus *Calicotome*: *Calicotome spinosa*, *Calicotome villosa*, *Calicotome intermedia*, and *Calicotome infesta*. The Plant List (2013a) includes *Calicotome infesta* as an accepted species, though the National Plant Germplasm System (NPGS, 2020) lists *Calicotome infesta* subsp. *intermedia* as a synonym of *Calicotome intermedia* and does not otherwise list *Calicotome spinosa*. We found no evidence that any *Calicotome* species other than *C. spinosa* are weeds. The genus *Calicotome* has been segregated from *Cytisus* (Cristofolini and Troia, 2006). *Cytisus*, including *Calicotome* and *Chamaecytisus*, encompasses about 60 species (Mabberley, 2008). *Cytisus scoparius* is a weed of natural areas (USDA, 2020) and pastures (Paynter et al., 2003b). It is regulated to varying degrees in Hawaii, Maryland, Utah, Montana, Wisconsin, Washington, Idaho, and Oregon (NPB, 2021). *Cytisus multiflorus* is on the Department of Environment and Heritage Alert List as a potential threat to natural ecosystems in Australia (Weber and Panetta, 2006); it is invasive in New Zealand (Sheppard et al., 2006). *Cytisus striatus* is invasive in the United States (Syrett et al., 1999) and regulated in Oregon (NPB, 2021). We answered “yes” with high uncertainty since the weedy species are from a closely-related genus.
ES-4 (Shade tolerant at some stage of its life cycle)	n - low	0	It is not shade-tolerant (PFAF, 2020) but requires exposure to full sun (Dave's Garden, 2020). The species is only known from open habitats (Agriculture Victoria, 2020).
ES-5 (Plant a vine or scrambling plant, or forms tightly appressed basal rosettes)	n - negl	0	It is a shrub (Salmi et al., 2018), not a vine. The leaves grow from the stems (Biosecurity Queensland, 2016) and do not form a basal rosette.
ES-6 (Forms dense thickets, patches, or populations)	y - low	2	It forms dense patches in invaded natural areas (Biosecurity Queensland, 2016). The dense growth combined with spiny branches makes it an effective hedge (Parsons and Cuthbertson, 2001).
ES-7 (Aquatic)	n - negl	0	It is a shrub that grows in sunny, rocky areas (Salmi et al., 2018); it is not an aquatic plant.
ES-8 (Grass)	n - negl	0	It is in the Fabaceae family (NPGS, 2020) and is not a grass.
ES-9 (Nitrogen-fixing woody plant)	y - negl	1	*Calicotome spinosa* is a shrub that fixes nitrogen using bacteria in the genus

Question ID	Answer - Uncertainty	Score	Notes (and references)
			Bradyrhizobium (Cardinale et al., 2008; Salmi et al., 2018).
ES-10 (Does it produce viable seeds or spores)	y - negl	1	It reproduces by seed (Agriculture Victoria, 2020; Biosecurity Queensland, 2016).
ES-11 (Self-compatible or apomictic)	n - high	-1	We did not find information specific to *Calicotome spinosa*. Arroyo et al. (2008) observed a high percentage of outcrossing in *Calicotome villosa*, which suggests partial self-incompatibility. Woody legumes are often self-incompatible (Arroyo et al., 2008). In its close relative, *Cytisus scoparius*, Parker (1997) observed four times more fruit production in cross-pollinated plants than in those that were self-pollinated, suggesting partial self-incompatibility. Rodriguez-Riano et al. (1999) observed very little fruit production in *Cytisus striatus* plants that were self-pollinated, and they note that *Cytisus multiflorus* and *Cytisus grandiflorus* are also self-incompatible. We answered "no" but had high uncertainty since our evidence is from congeners and close relatives.
ES-12 (Requires specialist pollinators)	n - mod	0	It is pollinated by insects (PFAF, 2020). We found no evidence of specialist pollinators, so we answered "no" with moderate 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 than 3 years; or (?) unknown]	c - low	0	It is a perennial (Biosecurity Queensland, 2016). Plants are unlikely to flower before they are two to three years old (Parsons and Cuthbertson, 2001). We answered "c" with low uncertainty. Our alternate answers were "b" and "d."
ES-14 (Prolific seed producer)	? - max	0	Unknown. Each fruit contains 3 to 15 seeds (Parsons and Cuthbertson, 2001), but we did not find information on fruit production or seed viability.
ES-15 (Propagules likely to be dispersed unintentionally by people)	y - low	1	Seeds can be dispersed on clothing, on machinery, in soil, and in discarded garden waste (Biosecurity Queensland, 2016; Parsons and Cuthbertson, 2001). They are spread in soil by earth-moving machinery (Parsons and Cuthbertson, 2001).
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	y - mod	2	Seeds can be contaminants of agricultural products (Biosecurity Queensland, 2016), including animal feed (Agriculture Victoria, 2020). We found no records, however, of interception at U.S. ports of entry (AQAS, 2020).
ES-17 (Number of natural dispersal vectors)	1	-2	Propagule traits for questions ES-17a through ES-17e. Fruits are pods 2.5 to 4 cm long; gray, black, or reddish brown in color

Question ID	Answer - Uncertainty	Score	Notes (and references)
			with two ridges on one edge. Seeds are smooth, shiny, and yellowish brown, 3.5 mm long and 2 mm wide (Parsons and Cuthbertson, 2001).
ES-17a (Wind dispersal)	n - low		Heat causes the pods to burst open, ejecting seeds up to 1 m away (Parsons and Cuthbertson, 2001). Based on images, however, they do not have any adaptations to be dispersed by wind (Biosecurity Queensland, 2016). We found no evidence of wind dispersal.
ES-17b (Water dispersal)	? - max		Unknown. Biosecurity Queensland (2016) reports that seeds are water-dispersed, but we found no evidence of adaptation for water dispersal.
ES-17c (Bird dispersal)	n - low		We found no evidence of dispersal by birds. Furthermore, the fruits do not appear to be fleshy and attractive to birds (Biosecurity Queensland, 2016).
ES-17d (Animal external dispersal)	n - high		Unknown; the Weeds of Australia database (Biosecurity Queensland, 2016) indicates that the seeds can be dispersed by animals, but it does not provide details. The fruits and seeds, however, do not appear to have any adaptations that would allow them to stick to fur (Biosecurity Queensland, 2016).
ES-17e (Animal internal dispersal)	? - max		Unknown; the Weeds of Australia database (Biosecurity Queensland, 2016) indicates that the seeds can be dispersed by animals, but it does not provide details.
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	y - mod	1	Long-term control requires exhausting the seed bank and eliminating new plants before they flower (Weeds Australia, 2011).
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	y - negl	1	It resprouts after fire and clear-cutting (Casal, 1987; Mazurek and Romane, 1986; Paula and Pausas, 2006). In Algeria, its presence indicates that fire has occurred (Baghdadi et al., 2019). Mechanical control requires removal of most of the root material because it can resprout (Weeds Australia, 2011), though the Plants for a Future database (PFAF, 2020) indicates that it does not tolerate root disturbance well. Plants that are damaged will resprout from the crown (Parsons and Cuthbertson, 2001). Although it is outside the scope of this question, it is important to note that fire and soil disturbance cause seeds in the soil to germinate (Weeds Australia, 2011).
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - negl	0	Picloram and glyphosate are effective against it (Parsons and Cuthbertson, 2001).

Question ID	Answer - Uncertainty	Score	Notes (and references)
			It is not listed in the International Herbicide-Resistant Weed Database (Heap, 2020).
ES-21 (Number of cold hardiness zones suitable for its survival)	6	0	
ES-22 (Number of climate types suitable for its survival)	6	2	
ES-23 (Number of precipitation bands suitable for its survival)	6	0	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - low	0	It is not known to be allelopathic (Agriculture Victoria, 2020).
Imp-G2 (Parasitic)	n - negl	0	We found no evidence that *C. spinosa* is parasitic, and it is not a member of a family known to include parasitic species (Heide-Jorgensen, 2008).
Impacts to Natural Systems			
Imp-N1 (Changes ecosystem processes and parameters that affect other species)	y - negl	0.4	Because it fixes nitrogen, it can change soil nutrient levels (Biosecurity Queensland, 2016). It is highly flammable (Dehange et al., 2017), and the large biomass of dense patches can increase the risk of fire (Biosecurity Queensland, 2016; Oki, 2016).
Imp-N2 (Changes habitat structure)	n - mod	0	It can shade out understory plants (Biosecurity Queensland, 2016), but we found no evidence that it actually eliminates vegetation layers; therefore, we answered "no" with moderate uncertainty.
Imp-N3 (Changes species diversity)	y - low	0.2	It prevents the growth of native species (Biosecurity Queensland, 2016). It is rated as a serious threat to native vegetation in Victoria, Australia (Weeds Australia, 2011).
Imp-N4 (Is it likely to affect federal Threatened and Endangered species?)	y - high		Although *C. spinosa* can have an environmental impact (Biosecurity Queensland, 2016; Oki, 2016), we found no evidence directly related to the United States. Therefore, we have high uncertainty.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions?)	n - mod	0	The area of the United States that is likely to be suitable for *C. spinosa* includes globally significant ecoregions (Ricketts et al., 1999), but we do not have enough evidence to indicate that it would have widespread ecological impacts.
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]	c - negl	0.6	In Australia, it is considered an environmentally significant sleeper weed that warrants control (Groves et al., 2005). Randall (2007) lists it as a weed of the natural environment in Australia. It is a significant environmental weed in Victoria,

Question ID	Answer - Uncertainty	Score	Notes (and references)
			Australia (Biosecurity Queensland, 2016). It is managed in Canterbury, New Zealand (Williams and Braithwaite, 2003). Our alternative answers for the uncertainty simulation were both "b."
Impact to Anthropogenic Systems (e.g., cities, suburbs, roadways)			
Imp-A1 (Negatively impacts personal property, human safety, or public infrastructure)	n - low	0	We found no evidence of this impact.
Imp-A2 (Changes or limits recreational use of an area)	n - low	0	We found no evidence of this impact.
Imp-A3 (Affects desirable and ornamental plants, and vegetation)	n - low	0	We found no evidence of this impact.
Imp-A4 [What is the taxon's weed status in anthropogenic systems? (a) Taxon not a weed; (b) Taxon a weed but no evidence of control; (c) Taxon a weed and evidence of control efforts]	a - low	0	In the Port Phillip East region of Victoria, Australia, landowners are required to control the species and prevent it from spreading to adjacent roadsides (Biosecurity Queensland, 2016). This is not, however, evidence of control in anthropogenic systems as much as a regulation to control the spread of the weed into natural or production systems. We found no evidence that this species is specifically considered to be a weed in anthropogenic systems. Therefore, we answered "a" with low uncertainty. Our alternate answers were both "b."
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	y - low	0.4	It can prevent livestock from accessing water and reduce the productivity of pastures (Biosecurity Queensland, 2016; Parsons and Cuthbertson, 2001)
Imp-P2 (Lowers commodity value)	n - low	0	We found no evidence of this impact.
Imp-P3 (Is it likely to impact trade?)	y - low	0.2	It is listed as a noxious weed in Australia (Randall, 2007), is prohibited in Western Australia, and is regulated in Victoria (Biosecurity Queensland, 2016). It is also regulated in New Zealand (MAF Biosecurity New Zealand, 2012) and listed as a harmful organism there (PCIT, 2020). Because the seeds can be contaminants of agricultural products (Agriculture Victoria, 2020; Biosecurity Queensland, 2016), we answered "yes".
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	n - low	0	We found no evidence for this impact.
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	n - low	0	The young plants have been claimed to be toxic, but no evidence is available (Parsons and Cuthbertson, 2001). Several related

Question ID	Answer - Uncertainty	Score	Notes (and references)
			genera produce quinolizidine alkaloids, but *Calicotome* does not, possibly because it has spines for defense instead (Wink, 2004). *Calicotome spinosa* is palatable to goats and is not known to be toxic to them (Mebirouk-Boudechiche et al., 2015; Simmonds et al., 2000). Horses, donkeys, and mules eat the bark and young leaves (Gulias et al., 2016). Based on the preponderance of evidence, we answered "no" with low uncertainty.
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 – mod	0.6	It is an agricultural weed in Australia (Randall, 2007). Parsons and Cuthbertson (2001) and Agriculture Victoria (Agriculture Victoria, 2021) provide recommendations for mechanical and chemical control. Our answers for the uncertainty simulation were both "b."
GEOGRAPHIC POTENTIAL			Unless otherwise indicated, the following evidence represents geographically referenced points obtained from the Global Biodiversity Information Facility (GBIF Secretariat, 2019).
Plant hardiness zones			
Geo-Z1 (Zone 1)	n – negl	N/A	We found no evidence of its presence in this zone.
Geo-Z2 (Zone 2)	n – negl	N/A	We found no evidence of its presence in this zone.
Geo-Z3 (Zone 3)	n – negl	N/A	We found no evidence of its presence in this zone.
Geo-Z4 (Zone 4)	n – negl	N/A	We found no evidence of its presence in this zone.
Geo-Z5 (Zone 5)	n – mod	N/A	We found no evidence of its presence in this zone.
Geo-Z6 (Zone 6)	n – high	N/A	2 points in France; this is not enough evidence for a "yes" answer.
Geo-Z7 (Zone 7)	y - low	N/A	A few points in Spain and France, 2 in Italy
Geo-Z8 (Zone 8)	y – negl	N/A	Many points in Spain and France, 3 in Corsica, 1 in Sicily
Geo-Z9 (Zone 9)	y – negl	N/A	Many points in Spain and France; some in Italy, Algeria, and Australia; 7 in Corsica; 5 in New Zealand; 3 in Sicily, Sardinia, and Crete; 2 in Portugal; 1 in Croatia, Tunisia, and Morocco
Geo-Z10 (Zone 10)	y - negl	N/A	Many points in Spain and France, a few in Corsica, 7 in Algeria, 6 in Crete, 4 in Italy and Australia, 3 in Sicily, 2 in Sardinia and Greece, 1 in New Zealand
Geo-Z11 (Zone 11)	y - negl	N/A	Many points in Spain, 5 in Crete and Australia, 4 in Greece, 3 in Sardinia, 1 in Sicily and Corsica

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-Z12 (Zone 12)	n - high	N/A	We found no evidence of its presence in this zone.
Geo-Z13 (Zone 13)	n - low	N/A	We found no evidence of its presence in this zone.
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	n - negl	N/A	We found no evidence of its presence in this climate class.
Geo-C2 (Tropical savanna)	n - negl	N/A	We found no evidence of presence in this climate class.
Geo-C3 (Steppe)	y - negl	N/A	Many points in Spain, 4 in Australia, 1 in Algeria
Geo-C4 (Desert)	n - high	N/A	We found no evidence of presence in this climate class, but we have high uncertainty because it does grow in warm climates with little precipitation.
Geo-C5 (Mediterranean)	y - negl	N/A	Many points in Algeria, France, and Spain; some in Crete, Corsica, and Italy; a few in Sicily; 6 in Greece; 5 in Sardinia; 2 in Portugal; 1 in Morocco and Tunisia
Geo-C6 (Humid subtropical)	y - low	N/A	9 points in Spain, 6 in France, 2 in Italy, 1 in Croatia
Geo-C7 (Marine west coast)	y - negl	N/A	Many points in Australia, France, and Spain; 4 in New Zealand
Geo-C8 (Humid cont. warm sum.)	n - high	N/A	We found no evidence of presence in this climate class; however, we answered "no" with high uncertainty because this climate is intermediate between others for which we did find evidence.
Geo-C9 (Humid cont. cool sum.)	n - high	N/A	1 point in France and Spain. This is not enough evidence for a “yes” answer.
Geo-C10 (Subarctic)	n - high	N/A	1 point in Spain. This is not enough evidence for a “yes” answer.
Geo-C11 (Tundra)	n - negl	N/A	We found no evidence of its presence in this climate class.
Geo-C12 (Icecap)	n - negl	N/A	We found no evidence of its presence in this climate class.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	y - negl	N/A	Many points in Spain, 3 in Crete
Geo-R2 (10-20 inches; 25-51 cm)	y - negl	N/A	Many points in Spain and France; a few in Crete; 5 in Sicily; 4 in Italy, Corsica, and Greece; 2 in Sardinia and Algeria
Geo-R3 (20-30 inches; 51-76 cm)	y - negl	N/A	Many points in Spain, France, and Australia; some in Italy; 6 in Sardinia and Algeria; 4 in Sicily, Corsica, and Greece; 2 in Portugal; 1 in Tunisia
Geo-R4 (30-40 inches; 76-102 cm)	y - negl	N/A	Many points in Spain, some in France and Algeria, 9 in Corsica, 5 in New Zealand, 2 in Australia, 1 in Italy and Morocco
Geo-R5 (40-50 inches; 102-127 cm)	y - negl	N/A	A few points in France; 9 in Corsica; 5 in Australia; 1 in Croatia, Greece, and New Zealand

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-R6 (50-60 inches; 127-152 cm)	n - high	N/A	2 points in Italy; this is not enough evidence for a “yes” answer.
Geo-R7 (60-70 inches; 152-178 cm)	n - mod	N/A	We found no evidence of its presence in this precipitation band.
Geo-R8 (70-80 inches; 178-203 cm)	n - negl	N/A	We found no evidence of its presence in this precipitation band.
Geo-R9 (80-90 inches; 203-229 cm)	n - negl	N/A	We found no evidence of its presence in this precipitation band.
Geo-R10 (90-100 inches; 229-254 cm)	n - negl	N/A	We found no evidence of its presence in this precipitation band.
Geo-R11 (100+ inches; 254+ cm)	n - negl	N/A	We found no evidence of its presence in this precipitation band.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	n - mod	0	*Calicotome spinosa* was previously detected in California (Oki, 2016), but the plants have been removed (Kelch, 2020). The seed bank, however, has not been assessed (Kelch, 2020).
Ent-2 (Plant proposed for entry, or entry is imminent)	n - low	0	We found no evidence that this species is proposed for importation.
Ent-3 [Human value & cultivation/trade status: (a) Neither cultivated or positively valued; (b) Not cultivated, but positively valued or potentially beneficial; (c) Cultivated, but no evidence of trade or resale; (d) Commercially cultivated or other evidence of trade or resale]	b - high	0.05	We found no evidence of current commercial sale of *C. spinosa* (Amazon, 2020; Plant Information Online, 2020) and minimal discussion of it on gardening forums (Dave's Garden, 2020; GardenWeb, 2020). It is, however, recommended for xeriscaping (Dave's Garden, 2020) and was introduced to Australia as an ornamental and hedge plant in the 1860s (Paynter et al., 2003a). We found no evidence that it is currently cultivated, but we did find evidence of it being valued; therefore, we answered "b" with high uncertainty.
Ent-4 (Entry as a contaminant)			
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	n - low		The plant is native to the Mediterranean (NPGS, 2020) and naturalized in Australia and New Zealand (Biosecurity Queensland, 2016; Howell and Sawyer, 2006). We found no evidence of its presence anywhere else.
Ent-4b (Contaminant of plant propagative material (except seeds))	n - low	0	We found no evidence that *C. spinosa* is a contaminant of propagative material.
Ent-4c (Contaminant of seeds for planting)	y - low	0.04	It is listed as a regulated weed seed contaminant of seed for sowing in New Zealand (MAF Biosecurity New Zealand, 2012).
Ent-4d (Contaminant of ballast water)	n - low	0	We found no evidence that *C. spinosa* is a contaminant of ballast.
Ent-4e (Contaminant of aquarium plants or other aquarium products)	n - negl	0	We found no evidence that *C. spinosa* is a contaminant of aquarium products. Furthermore, it is a terrestrial plant that grows in dry areas (Parsons and

Question ID	Answer - Uncertainty	Score	Notes (and references)
			Cuthbertson, 2001), so it is highly unlikely to be associated with aquariums.
Ent-4f (Contaminant of landscape products)	n - low	0	We found no evidence that *C. spinosa* is a contaminant of landscaping materials. Seeds can be dispersed in soil (Parsons and Cuthbertson, 2001), but this is in the context of earth-moving for road work, not trade of soil for landscaping.
Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances)	y - low	0.02	Seeds can be dispersed on machinery (Biosecurity Queensland, 2016).
Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing)	y - mod	0.01	Seeds can be contaminants of agricultural products (Biosecurity Queensland, 2016), including animal feed (Agriculture Victoria, 2020), and *C. spinosa* is listed as a regulated weed seed contaminant of grain and seed for consumption in New Zealand (MAF Biosecurity New Zealand, 2009). We found no records, however, of interception at U.S. ports of entry (AQAS, 2020).
Ent-4i (Contaminant of some other pathway)	a - low	0	We found no evidence that *C. spinosa* is likely to follow any pathway that is not already listed.
Ent-5 (Likely to enter through natural dispersal)	n - negl	0	We found no evidence that *C. spinosa* is present in Canada, Mexico, or the Caribbean (GBIF Secretariat, 2019; NPGS, 2020). Therefore, it is highly unlikely to disperse naturally into the United States.