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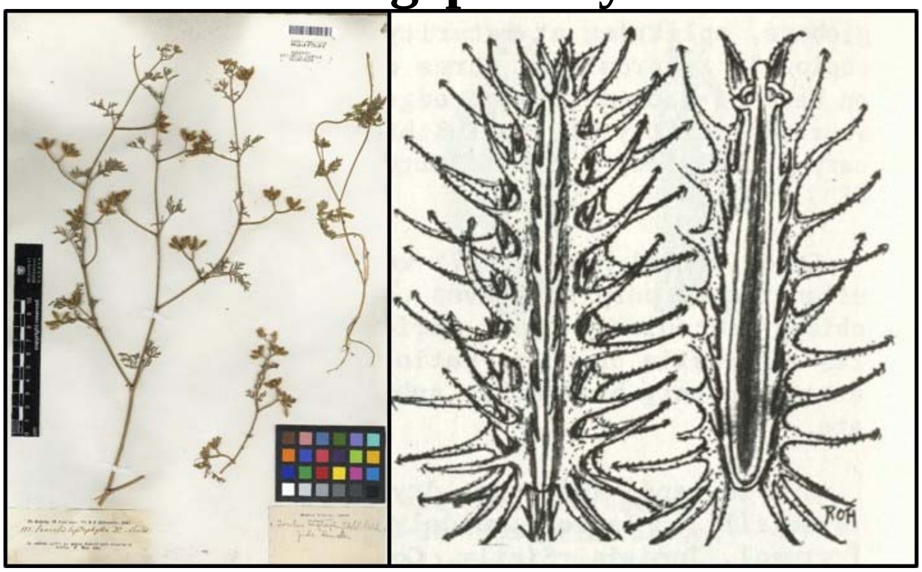
Version 1

Weed Risk Assessment for *Torilis leptophylla* (L.) Rchb. f. (Apiaceae) – Bristlefruit hedgeparsley



Left: Herbarium sample of the inflorescence of *T. leptophylla* [image obtained from the Missouri Botanical Garden under CC-BY-NC-SA 3.0 (MBG, 2017)]. Right: Detailed drawing of the fruit showing the barbs at the end of the spines (source: Reed, 1977).

Agency Contact:

Plant Epidemiology and Risk Analysis Laboratory
Center for Plant Health Science and Technology

Plant Protection and Quarantine
Animal and Plant Health Inspection Service
United States Department of Agriculture
1730 Varsity Drive, Suite 300
Raleigh, NC 27606

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.

Torilis leptophylla **(L.) Rchb. f. – Bristlefruit hedgeparsley**

Species Information

Family: Apiaceae

Synonyms: *Caucalis leptophylla* L. (NGRP, 2017), *Torilis xanthotricha* (Stev.) Schischkin (Bojňanský and Fargašová, 2007).

Common names: Bristlefruit hedgeparsley (NRCS, 2017), five-leaved bur-parsley (Reed, 1977).

Botanical description: *Torilis leptophylla* is an annual with erect stems that grow from 10 to 50 cm high (Bojňanský and Fargašová, 2007; Reed, 1977), and perhaps even 70 cm high (Koul et al., 1984; Nasir, 2017). Leaves are finely divided with linear segments (Hanf, 1983). The fruit type is a schizocarp[1] that is 6-7 mm long by 1.2-5 mm wide and covered in long spines that terminate in a minute rosette of backward-pointing barbs (Bojňanský and Fargašová, 2007; Reed, 1977). For description of the genus and other similar species see Stace (2010).

Initiation: PPQ received a market access request for wheat seed for human and animal consumption from the government of Ukraine (Government of Ukraine, 2013). A commodity import risk analysis revealed that *T. leptophylla* could be associated with this commodity as a seed contaminant. In a previous USDA study, Reed (1977) classified this species as an economically significant foreign weed that may pose a potential problem in the United States. In this assessment, PERAL evaluated the risk potential of this species to the United States, to help policy makers determine whether it should be regulated as a Federal Noxious Weed.

Foreign distribution and status: *Torilis leptophylla* is native to northern Africa (Madeira Islands, Egypt, Libya), western Asia (Afghanistan, Iran, Iraq, Israel, Jordan, Lebanon, Syria, and Turkey), the Caucasus (Armenia, Azerbaijan, and Dagestan), middle Asia (Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan), southern Europe (e.g., Bulgaria, France, Greece, Italy, Portugal, and Spain), Pakistan, Ukraine, and the Madeira Islands (Bojňanský and Fargašová, 2007; Danin, 2017; Nasir, 2017; NGRP, 2017; Nowak et al., 2015). It has been reported as a casual alien in Belgium, Switzerland (DAISIE, 2017; Verloove, 2006; Wittenberg et al., 2005), and the British Isles (Clement and Foster, 1994). It has also been reported as an alien of unknown status in Bulgaria (DAISIE, 2017), which contradicts NGRP (2017) that reports it as native in that country. It is naturalized elsewhere in Europe (NGRP, 2017), India (Andrabi et al., 2015; Gupta et al., 1991), and Japan (Mito and Uesugi, 2004). *Torilis leptophylla* is considered a common weed in Portugal (Holm et al., 1991).

U.S. distribution and status: *Torilis leptophylla* has been reported in one county each in Massachusetts, New York, and Pennsylvania (Kartesz, 2017; NRCS, 2017), and two counties in Oregon (Univ. of Washington,

[1] A schizocarp is a fruit that splits into smaller segments.

2017). The Massachusetts record represents a casual occurrence that was originally reported in 1902 from wasteland (Sorrie, 2005). Although it is currently listed in a New England plant database (Anonymous, 2017), it is not clear if this species persisted in the state. The Pennsylvania occurrence comes from two separate collections from a rubbish dump from 1950-1961 (Rhoads and Klein, 1993), and we found no recent records. We did not find the original record for New York, but currently the species is not naturalized in the state (Weldy et al., 2017). In Oregon, the species was collected twice in Multnomah County in the early 1900s and more recently in 2013 in Clackamas County, which just borders Multnomah County on the south (Univ. of Washington, 2017). In summary, this species is probably not established in the northeastern United States (DiTommaso et al., 2014); however, it is not clear whether the plants associated with the more recent report from Oregon have persisted or not. We found no evidence that *T. leptophylla* is cultivated in the United States (e.g., Bailey and Bailey, 1976; Dave's Garden, 2017; GardenWeb, 2017; Univ. of Minn., 2017).

WRA area[2]: Entire United States, including territories.

1. *Torilis leptophylla* analysis

Establishment/Spread Potential *Torilis leptophylla* has become established outside of its native range (Andrabi et al., 2015; Gupta et al., 1991; Mito and Uesugi, 2004; NGRP, 2017), indicating it has some capacity to be invasive, in the strict sense. It reproduces through seed (Kaul, 1986) and is likely self-compatible, like many other plants in the family (Koul et al., 1984). The seeds are readily dispersed by animals and people (Shmida and Ellner, 1983), and in trade as a contaminant of grain, birdseed, wool, and other commodities (Hanson and Mason, 1985; Stace, 2010; Verloove, 2006). Based on congeneric information (DiTomaso and Kyser, 2013) and the fact that it is an annual, it probably forms a persistent seed bank. Due to limited information about this species' biology and the use of congeneric information in some cases, we had a high level of uncertainty for this risk element.

Risk score = 11 Uncertainty index = 0.24

Impact Potential *Torilis leptophylla* is commonly regarded as an agricultural weed of a variety of production systems, including cereals (Hussain et al., 2009; Taleb et al., 1998), orchards (Andrabi et al., 2015; Kaul, 1986), and legumes (Linke, 1994)]. However, we found no evidence of any specific impacts. Because the congeners *Torilis arvensis* and *T. japonica* are prohibited in Wisconsin (Panke and Renz, 2012), and because *Torilis* species are able to move in trade (AQAS, 2017; Stace, 2010), it is possible that should *T.*

[2] "WRA area" is the area in relation to which the weed risk assessment is conducted (definition modified from that for "PRA area") (IPPC, 2012).

leptophylla be detected in Wisconsin or be intercepted by regulatory officials, it may also become prohibited and thereby affect trade going to that state. *Torilis leptophylla* also occurs in disturbed areas (Hanson and Mason, 1985; Rhoads and Klein, 1993), including graveyards, grassy areas, and wasteland (Andrabi et al., 2015); however, we found no evidence that it is considered a weed in these anthropogenic areas. Finally, we found no evidence that this species establishes in natural areas. Due to limited information about this species, we had a very high level of uncertainty for this risk element.
Risk score = 1.4 Uncertainty index = 0.35

Geographic Potential Based on three climatic variables, we estimate that about 63 percent of the United States is suitable for the establishment of *T. leptophylla* (Fig. 1). This predicted distribution is based on the species' known distribution elsewhere in the world and includes point-referenced localities and general areas of occurrence. The map for *T. leptophylla* represents the joint distribution of Plant Hardiness Zones 6-12, areas with 0-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: Mediterranean, steppe, desert, humid subtropical, marine west coast, humid continental warm summers, humid continental cool summers, subarctic, and tundra. Overall, we had a moderate amount of uncertainty for this analysis, because there were very few geographically referenced points for this species throughout most of its range in Asia, particularly in high elevation areas in Pakistan and India.

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. *Torilis leptophylla* grows in a variety of habitats such as dry arable land, semi-steppe shrublands, slopes, scree (rocky areas), waste places, rubbish heaps, fields, and plains (Bojňanský and Fargašová, 2007; Danin, 2017; Hanf, 1983; Hanson and Mason, 1985; Nasir, 2017; Reed, 1977).

Entry Potential While it is not clear if *T. leptophylla* is established in the United States, we evaluated its entry potential to determine how likely it is for additional material to be introduced. On a scale of 0 to 1, where 1 represents a maximum likelihood to enter through multiple pathways, *T. leptophylla* scored 0.1. The most likely pathway for its entry would be intentionally for use in traditional medicine (e.g., Maleki et al., 2008) or for biochemical research (Masoudi et al., 2012; Saeed et al., 2012). An almost equally likely pathway for entry would be as a contaminant of birdseed or wool (Stace, 2010; Verloove, 2006), or as a hitchhiker on clothing (Shmida and Ellner, 1983). It may also follow the pathway as a contaminant of grain (Stace, 2010; Verloove, 2006), spices (AQAS, 2017), or seeds for planting (AQAS, 2017). We had a low level of uncertainty for this risk element.
Risk score = 0.1 Uncertainty index = 0.10

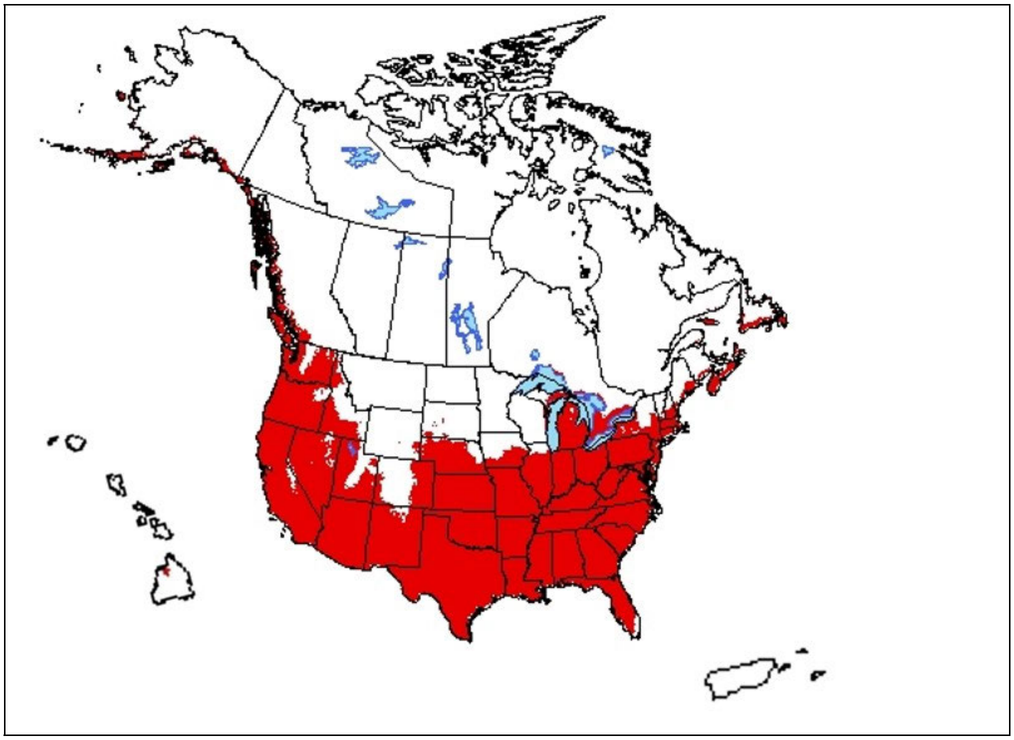


Figure 1. Potential geographic distribution of *Torilis leptophylla* in the United States and Canada. Map insets for Hawaii and Puerto Rico are not to scale.

<u>2. Results</u>

Model Probabilities: P(Major Invader) = 33.2%
P(Minor Invader) = 61.1%
P(Non-Invader) = 5.7%

Risk Result = Evaluate Further
Secondary Screening = High Risk

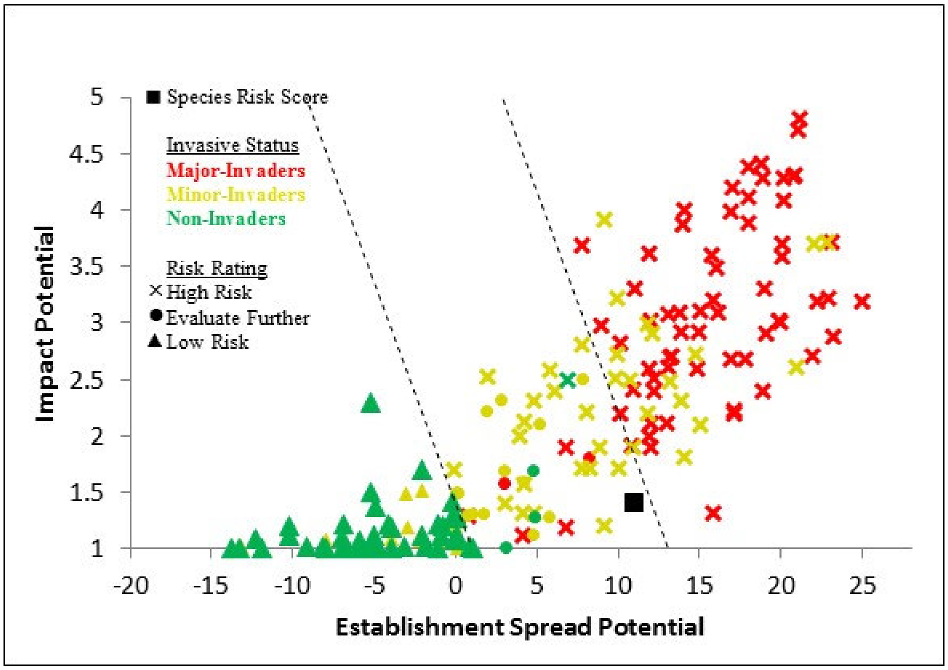


Figure 2. *Torilis leptophylla* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

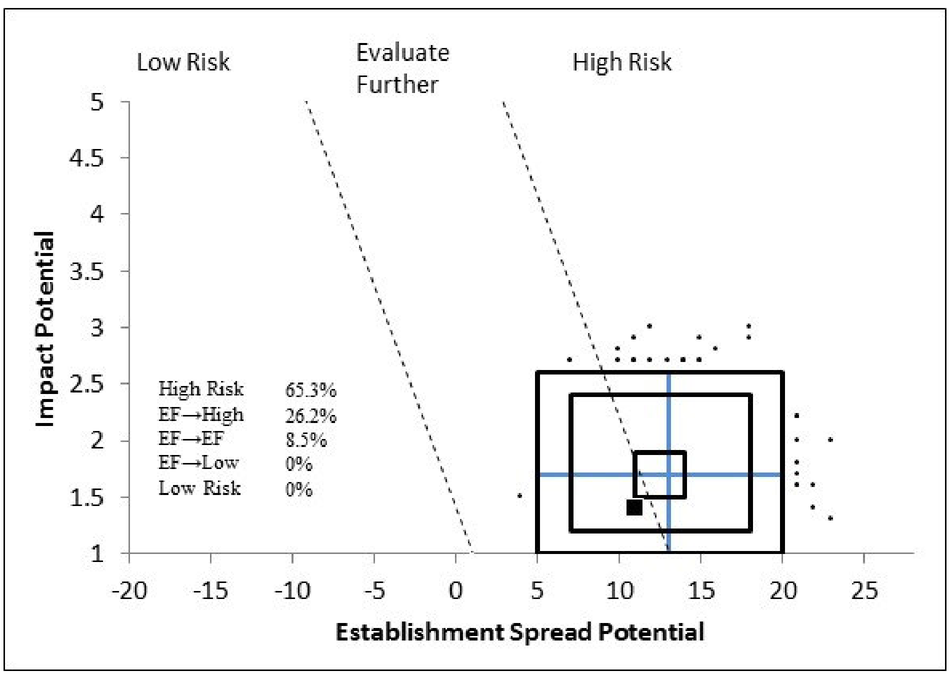


Figure 3. Model simulation results (N=5,000) for uncertainty around the risk score for *Torilis leptophylla*. The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

3. Discussion

The initial result of the weed risk assessment for *T. leptophylla* is Evaluate Further, but after secondary screening it resolved to High Risk (Fig. 2). Overall, we had a high to very high level of uncertainty associated with our answers to the WRA questions, and we could not answer four of the questions. Based on our uncertainty analysis, if we were to randomly change some of the answers in our WRA, the majority of the simulated risk scores would result in a conclusion of High Risk, even before secondary screening (Fig. 3). This is not surprising, given how close the original score is to the high risk decision threshold. However, it is important to consider that with respect to the potential range of risk scores for high risk species, the median simulated risk score for *T. leptophylla* (shown by the intersection of the blue lines in Fig. 3) is relatively low for both axes. *Torilis leptophylla*'s risk score was primarily driven by traits affecting its ability to establish and spread. With respect to its impact potential, we found no evidence of specific impacts. This species is frequently regarded as an agricultural weed, which suggests it must be having some minimum level of impact that has not been described yet. Overall, there was relatively little information available about this species.

Torilis leptophylla has escaped on at least five separate occasions in the United States, and thus far, it does not appear to have become permanently naturalized (see U.S. Distribution and Status above). This may indicate it has a limited capacity to establish and spread in the United States. However, it is important to consider that three other *Torilis* species (*T. arvensis*, *T. nodosa*, and *T. japonica*) have become naturalized in the United States and are present in at least 12 states each (Kartesz, 2017). All three species are considered weedy and invasive (DiTommaso et al., 2014). "The burs [of *T. arvensis*] stick to the fur and hair of animals and can cause mechanical injury by lodging in the nose, eyes, and ears of pets and livestock" (DiTomaso and Kyser, 2013). In agricultural fields, use of combines selected against tall forms of *T. japonica* and led to the development of a new biotype found in crops (Dekker, 2011). *Torilis arvensis* and *T. japonica* are now prohibited in Wisconsin (Panke and Renz, 2012).

In conclusion, it is not clear whether *T. leptophylla* may become as invasive or weedy in the United States as these other three species. Perhaps it has not yet been exposed to climatic conditions or other environmental factors favorable for its proliferation. This species is native from the Mediterranean region eastward through central Asia. Overall, these areas are relatively drier than the areas where it has been previously detected in the United States.

Prepared by: Anthony Koop, Risk Analyst

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Appendix A. Weed risk assessment for *Torilis leptophylla* (L.) Rchb. f. (Apiaceae). Below is all of the evidence and associated references used to evaluate the risk potential of this taxon. We also include the answer, uncertainty rating, and score for each question. The Excel file, where this assessment was conducted, is available upon request.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ESTABLISHMENT/SPREAD POTENTIAL			
ES-1 [What is the taxon's establishment and spread status outside its native range? (a) Introduced elsewhere =>75 years ago but not escaped; (b) Introduced <75 years ago but not escaped; (c) Never moved beyond its native range; (d) Escaped/Casual; (e) Naturalized; (f) Invasive; (?) Unknown]	e - mod	2	*Torilis leptophylla* is native to northern Africa (Madeira Islands, Egypt, Libya), western Asia (Afghanistan, Iran, Iraq, Israel, Jordan, Lebanon, Syria, and Turkey), the Caucasus (Armenia, Azerbaijan, and Dagestan), middle Asia (Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan), southern Europe (e.g., Bulgaria, France, Greece, Italy, Portugal, and Spain), Pakistan, Ukraine, and the Madeira Islands (Bojňanský and Fargašová, 2007; Danin, 2017; Nasir, 2017; NGRP, 2017; Nowak et al., 2015). It has been reported as a casual alien in Belgium and Switzerland (DAISIE, 2017; Verloove, 2006; Wittenberg et al., 2005) and the British Isles (Clement and Foster, 1994). It has also been reported as an alien of unknown status in Bulgaria (DAISIE, 2017), which contradicts NGRP (2017), which reports it as native in that country. It is naturalized elsewhere in Europe (NGRP, 2017), India (Andrabi et al., 2015; Gupta et al., 1991), and Japan (Mito and Uesugi, 2004). *Torilis leptophylla* is common in Portugal (Holm et al., 1991) and Pakistan (Nasir, 2017). This species is probably a waif in the United States (see U.S. Distribution and Status, above). There is sufficient evidence that this species has become naturalized outside its native range, but we did not find any clear evidence that it is behaving invasively (i.e., spreading) where it has naturalized. Consequently, we answered "e" with moderate uncertainty. Because it is clearly naturalized elsewhere, we chose "f" for both of our alternate answers because no other answer would be appropriate here.
ES-2 (Is the species highly domesticated)	n - negl	0	While this species has been used in folk medicine (Maleki et al., 2008), we found no evidence that it is cultivated, much less highly domesticated.
ES-3 (Weedy congeners)	y - low	1	The genus *Torilis* contains about 15 species that are native to the Mediterranean, Africa, and eastern Asia (Mabberley, 2008). Nine of these species have been reported as weeds, but only two may be significant weeds based on the number of times they have been reported as weeds in the *Global Compendium of Weeds*: *T. arvensis* and *T. nodosa* (Randall, 2012). *Torilis arvensis* and *T. nodosa* are weeds of cornfields and other arable land (Salisbury, 1961). *Torilis arvensis* is considered a principal agricultural weed in Ethiopia (Holm et al., 1991). It obtained a rating of "Moderate" with the California Invasive Plant Inventory assessment. Moderate species are those which have "have substantial and apparent-but generally not severe ecological impacts

Question ID	Answer - Uncertainty	Score	Notes (and references)
			on physical processes, plant and animal communities, and vegetation structure" (Cal-IPC, 2017). Although this rating is based on the species' impacts, inherent biology, and distribution in the state, its only documented impacts relate to the seeds, which can stick to wildlife and animal stock and "cause problems" (Cal-IPC, 2017). No additional information was provided in the California assessment. At an invasive plant conference in California, Oneto et. al. (2004) reported that *T. arvensis* is becoming an increasing concern in rangelands and natural areas, and that four different herbicides they examined completely controlled plants (Oneto et al., 2004). Since the early 1900s, *T. arvensis* has been described as a weed of agriculture in the United Kingdom (Dunn, 1905). *Torilis nodosa* was rated as posing a moderate threat to the native vegetation of the Juan Fernandez Islands (Swenson et al., 1997). Also, *T. japonica* is an emerging invader in the United States whose expanding populations have caused some concern in mid-western states (DiTommaso et al., 2014).
ES-4 (Shade tolerant at some stage of its life cycle)	n - high	0	*Torilis leptophylla* grows in a variety of open habitats such as dry arable land, semi-steppe shrublands, slopes, scree (rocky slopes), waste places, rubbish heaps, fields, and plains (Bojňanský and Fargašová, 2007; Danin, 2017; Hanf, 1983; Hanson and Mason, 1985; Nasir, 2017; Reed, 1977). We found no evidence that it is tolerant of shady conditions. However, because its congener *T. japonica* occurs in a wide range of light environments, including shady ones (Panke and Renz, 2012), we answered this question as no with high uncertainty.
ES-5 (Plant a vine or scrambling plant, or forms tightly appressed basal rosettes)	n - negl	0	*Torilis leptophylla* is not a vine; it is an herbaceous annual with erect stems that grow from 10 to 50 cm high (Bojňanský and Fargašová, 2007; Reed, 1977), and perhaps even 70 cm high (Koul et al., 1984; Nasir, 2017). We found no evidence that it produces a basal rosette.
ES-6 (Forms dense thickets, patches, or populations)	n - high	0	We found no evidence that *T. leptophylla* produces dense populations. Because the congener, *T. japonica* does (cited in DiTommaso et al., 2014), we answered this question with high uncertainty.
ES-7 (Aquatic)	n - negl	0	*Torilis leptophylla* is a terrestrial species (Bojňanský and Fargašová, 2007; Danin, 2017; Hanf, 1983; Hanson and Mason, 1985; Nasir, 2017; Reed, 1977).
ES-8 (Grass)	n - negl	0	This species is not in the Poaceae; it is a species in the Apiaceae family (Mabberley, 2008; NGRP, 2017).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	We found no evidence that this species fixes nitrogen. It is not a member of a plant family known to contain nitrogen-fixing species (Martin and Dowd, 1990; Santi et al., 2013), nor is it a woody plant (Britton, 1907).
ES-10 (Does it produce viable seeds or spores)	y - negl	1	This species produces viable seed that sprout in late autumn or early spring (Kaul, 1986).

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-11 (Self-compatible or apomictic)	y - high	1	Plants are andromonoecious, as they have both hermaphroditic and staminate flowers in the same umbel (Koul et al., 1984). In hermaphroditic flowers, the stamens mature first (protandry) such that by the time the pistils mature, the stamens will have dehisced (Koul et al., 1984). However, because of asynchronous flower maturation among the various umbels within an individual plant, there is always some self-pollen available for fertilization through geitonogamy (pollination of a flower through pollen of a different flower but of the same plant) (Koul et al., 1984). This study showed that plants are capable of self-pollination (Koul et al., 1984), but did not prove that it occurs. The authors also point out that plants in this family are generally self-compatible (cited in Koul et al., 1984) such as *T. japonica* (DiTommaso et al., 2014). Based on the weight of the evidence, we answered yes but with high uncertainty.
ES-12 (Requires specialist pollinators)	n - low	0	We found no evidence that this species requires specialized pollinators. Its flowers produce nectar and are visited by insects (Koul et al., 1984). Because the congener *T. japonica* is pollinated by unspecialized insects (DiTommaso et al., 2014), we used low 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]	b - negl	1	*Torilis leptophylla* is an annual (Bojňanský and Fargašová, 2007; Hanf, 1983; Stace, 2010). Alternate answers for the uncertainty simulation were "c" and "a" as neither alternative seems more likely than the other.
ES-14 (Prolific seed producer)	? - max	0	Unknown. We found very little information to help us answer this question. For example, we found no information about the number of seeds produced per plant, or the number of plants per square meter. For *T. leptophylla*, for every hermaphrodite flower, there are 2-73 staminate flowers (Koul et al., 1984). In *T. japonica*, each schizocarp splits into two locules, each with one seed (DiTommaso et al., 2014). Because this question requires specific evidence to answer yes or no, we answered it as unknown.
ES-15 (Propagules likely to be dispersed unintentionally by people)	y - negl	1	Researchers showed that the spiny fruit of *T. leptophylla* readily attaches to clothing and animal fur (Shmida and Ellner, 1983). *Torilis arvensis* and *T. nodosa* have bristly fruits that readily cling to clothing (Ansong and Pickering, 2014; Salisbury, 1961) and are dispersed by people (Kaul, 1986). Management guidelines for *T. japonica* in Wisconsin suggest that plants with mature fruit should not be mowed due to potential spread (Panke and Renz, 2012).
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	y - negl	2	*Torilis* species are classified as weed seed contaminants by the Association of Official Seed Analysts (AOSA, 2014). *Torilis leptophylla* is a rare birdseed, grain, and wool alien (Stace, 2010). This species has been cultivated from birdseed in the United Kingdom (Hanson

Question ID	Answer - Uncertainty	Score	Notes (and references)
			and Mason, 1985). It was introduced to Belgium in wool and grain (Verloove, 2006). We found no evidence that this species has been intercepted at U.S. ports; however, *T. japonica*, *T. arvensis*, *T. nodosa*, and *Torilis* sp. have been intercepted 70 times since 1985 at U.S. ports in cumin, carrot seed, and seed of other commodities (AQAS, 2017). It is unknown whether some of the unidentified interceptions of *Torilis* may represent *T. leptophylla*.
ES-17 (Number of natural dispersal vectors)	1	-2	Fruit and propagule traits for questions ES-17a through ES-17e: The fruit are a type of schizocarp that are 6-7 mm long by 1.2-5 mm wide and covered in long spines that terminate in a minute rosette of backward-pointing barbs (Bojňanský and Fargašová, 2007; Kaul, 1986; Reed, 1977).
ES-17a (Wind dispersal)	n - negl		We found no evidence that it is wind dispersed. Because its fruit do not possess any characters normally associated with wind-dispersal, we answered no with negligible uncertainty.
ES-17b (Water dispersal)	n - mod		We found no evidence that it is water dispersed.
ES-17c (Bird dispersal)	? - max		Although the fruit does not offer any fleshy rewards for birds, it may stick to bird feathers. But without specific evidence, we answered this question as unknown.
ES-17d (Animal external dispersal)	y - negl		*Torilis leptophylla* is dispersed by animals because of the hispid (sticky) fruit (Kaul, 1986). One experiment showed that the fruit were readily picked up by grazing animals (sheep and goats) and that some were retained for the maximum length of the study period, which was 48 hours (Shmida and Ellner, 1983). *Torilis arvensis* and *T. nodosa* have bristly fruit that readily cling to animals (Salisbury, 1961).
ES-17e (Animal internal dispersal)	n - mod		We found no evidence. Because it seems unlikely that bristly fruit would be consumed intentionally by animals, we answered no with moderate uncertainty.
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	y - high	1	We found no evidence for *T. leptophylla*. Some researchers expect that seeds of the congener, *T. arvensis*, should survive in the soil for several years (DiTomaso and Kyser, 2013). Seeds of *T. japonica* remain viable for 3 to 5 years (cited in DiTommaso et al., 2014). Based on this congeneric information, and because we expect seed dormancy is likely in an annual species, we answered yes with high uncertainty.
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	? - max	0	Unknown. In Wisconsin, fire is not recommended as a control strategy for *T. japonica* or *T. arvensis* because established plants will resprout (Panke and Renz, 2012).
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - mod	0	We found no evidence that *T. leptophylla* or any of its congeners are resistant to herbicides (e.g., Heap, 2017).
ES-21 (Number of cold hardiness zones suitable for its survival)	7	0	
ES-22 (Number of climate types suitable for its survival)	9	2	

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-23 (Number of precipitation bands suitable for its survival)	11	1	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - high	0	We found no evidence of allelopathy.
Imp-G2 (Parasitic)	n - negl	0	We found no evidence that this species is parasitic. Because it is not in a plant family known to contain parasitic plant species (Heide-Jorgensen, 2008; Nickrent, 2009; Walker, 2014), we answered this question as no with negligible uncertainty.
Impacts to Natural Systems			
Imp-N1 (Changes ecosystem processes and parameters that affect other species)	n - mod	0	We found no evidence of this impact. Because we found no evidence that this species establishes in natural areas, we used moderate uncertainty for most questions in this sub-element.
Imp-N2 (Changes habitat structure)	n - mod	0	We found no evidence that this species changes habitat structure.
Imp-N3 (Changes species diversity)	n - mod	0	We found no evidence that this species changes species diversity.
Imp-N4 (Is it likely to affect federal Threatened and Endangered species?)	n - mod	0	We found no evidence that this species is likely to affect Federally threatened and endangered species.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions?)	n - low	0	We found no evidence. Because there is no evidence of any kind of impact in natural areas, it seems unlikely that this species would significantly impact 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 - mod	0	We found no evidence that *T. leptophylla* is a weed or is even present in natural areas, so we answered "a." However, because in Wisconsin, *T. japonica* establishes in disturbed areas and then spreads to natural areas (DiTommaso et al., 2014), we used moderate uncertainty. Alternate 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 - mod	0	We found no evidence.
Imp-A2 (Changes or limits recreational use of an area)	n - mod	0	We found no evidence.
Imp-A3 (Affects desirable and ornamental plants, and vegetation)	n - mod	0	We found no evidence.
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 - high	0	*Torilis leptophylla* has been found in town rubbish heaps in the United Kingdom (Hanson and Mason, 1985), and graveyards, grasslands, and wastelands in India (Andrabi et al., 2015). In the United States, the Pennsylvania occurrence was from a rubbish heap (Rhoads and Klein, 1993). However, because we found no evidence it is considered a weed in these anthropogenic areas, we answered this question as "a" with high uncertainty. Alternate answers for the uncertainty simulation were both "b."

Question ID	Answer - Uncertainty	Score	Notes (and references)
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	n - high	0	We found no evidence that *T. leptophylla* reduces yield. Because it is generally viewed as an agricultural weed (see evidence under Imp-P6) and because there is little detailed information available about this species, we used high uncertainty in this sub-element.
Imp-P2 (Lowers commodity value)	? - max		We found no evidence that *T. leptophylla* lowers commodity value directly or indirectly. However, because it supports the complete development of the carrot nematode *Heterodera carotae* (Mugniery and Bossis, 1988) and may serve as an alternate host for this pest, we answered unknown.
Imp-P3 (Is it likely to impact trade?)	y - high	0.2	We found no evidence that any *Torilis* species is regulated by a foreign government. However, *T. arvensis* and *T. japonica* are prohibited in Wisconsin (Panke and Renz, 2012). Should *T. leptophylla* be detected in Wisconsin or be intercepted by regulatory officials, it may also become prohibited. Because *T. leptophylla* and other *Torilis* species have been documented to move in trade (see evidence under ES-16), it may impact trade going to that state.
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	n - mod	0	We found no evidence.
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	n - mod	0	We found no evidence that it is toxic to animals (e.g., Burrows and Tyrl, 2013).
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]	b - high	0.2	Across several countries, *Torilis leptophylla* is a weed of dry arable lands (Hanf, 1983), cereals (Taleb et al., 1998), orchards (Andrabi et al., 2015; Kaul, 1986), corn (Haywood and Druce, 1919), wheat (Hussain et al., 2009), and legumes (Linke, 1994). It is a common weed in Portugal (Holm et al., 1991) and a weed of traditional agriculture in Crete (Turland et al., 2004). In the Kashmir Valley of India it is considered a rare weed of orchards (Kaul, 1986), and it is rare in crops in France (Lonchamp, 2000). In Tajikistan, *T. leptophylla* is described as an agricultural weed generally occurring with low population size, and the species in general is considered near threatened (Nowak et al., 2014). However, this categorization may not be indicative of its potential behavior in the United States since this report is from the species' native range. For example, in that same study, *T. nodosa* is described as critically threatened (Nowak et al., 2014), yet it is commonly considered weedy (Randall, 2012) and has become naturalized in at least a dozen states in the United States (Kartesz, 2017). We found no evidence of targeted control for *T. leptophylla*, but it is moderately susceptible to solar heating (Linke, 1994). Based on this information, we answered "b" with high uncertainty. For the congener *T. arvensis* which is naturalized in the United States, DiTomaso and Kyser (2013) describe control options.

Question ID	Answer - Uncertainty	Score	Notes (and references)
			Alternate answers for the uncertainty simulation were "c" and "a."
GEOGRAPHIC POTENTIAL			Unless otherwise indicated, the following evidence represents geographically referenced points obtained from the Global Biodiversity Information Facility (GBIF, 2017).
Plant hardiness zones			
Geo-Z1 (Zone 1)	n - negl	N/A	We found no evidence that this species occurs in this hardiness zone.
Geo-Z2 (Zone 2)	n - negl	N/A	We found no evidence that this species occurs in this hardiness zone.
Geo-Z3 (Zone 3)	n - negl	N/A	We found no evidence that this species occurs in this hardiness zone.
Geo-Z4 (Zone 4)	n - high	N/A	This species is present in Tajikistan (Nowak et al., 2015) and the Kashmir Himalayas (Andrabi et al., 2015; Gupta et al., 1991), which include this zone. However, based on the overall distribution of this species, it seems unlikely that it occurs in this particular zone.
Geo-Z5 (Zone 5)	n - high	N/A	One point in France (GBIF, 2017). This species is present in Tajikistan (Nowak et al., 2015) and the Kashmir Himalayas (Andrabi et al., 2015; Gupta et al., 1991), which include this zone. However, based on the overall distribution of this species, it seems unlikely that it occurs in this particular zone.
Geo-Z6 (Zone 6)	y - mod	N/A	A few points in Armenia. Three points in France.
Geo-Z7 (Zone 7)	y - low	N/A	Some points in France and Greece. A few in Spain. Three points in Armenia.
Geo-Z8 (Zone 8)	y - negl	N/A	France and Spain.
Geo-Z9 (Zone 9)	y - negl	N/A	France and Spain.
Geo-Z10 (Zone 10)	y - negl	N/A	Some points in France and Spain. A few in Israel and Turkey.
Geo-Z11 (Zone 11)	y - low	N/A	Many points in Israel. A few points in Portugal and Spain.
Geo-Z12 (Zone 12)	y - high	N/A	A few points in coastal Israel and the Canary Islands.
Geo-Z13 (Zone 13)	n - negl	N/A	We found no evidence that this species occurs in this hardiness zone.
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	n - negl	N/A	We found no evidence that this species occurs in this climate class.
Geo-C2 (Tropical savanna)	n - negl	N/A	We found no evidence that this species occurs in this climate class.
Geo-C3 (Steppe)	y - negl	N/A	Spain. A few points in Israel.
Geo-C4 (Desert)	y - high	N/A	A few points in Spain. Two points each in Tunisia and Israel. One point each in Jordan, Iraq, and Iran. We used high uncertainty because it is not clear if these plants are occurring in rare or protected microhabitats.
Geo-C5 (Mediterranean)	y - negl	N/A	France, Morocco, Portugal, and Spain.
Geo-C6 (Humid subtropical)	y - mod	N/A	India (Srinagar) (Andrabi et al., 2015).
Geo-C7 (Marine west coast)	y - negl	N/A	France and Spain.
Geo-C8 (Humid cont. warm sum.)	y - high	N/A	A few points in Armenia, and one in Pakistan.
Geo-C9 (Humid cont. cool sum.)	y - mod	N/A	Some points in France and a few in Spain.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-C10 (Subarctic)	y - high	N/A	Some points in France and one in Greece. We used high uncertainty because it is not clear if these plants are occurring in protected microhabitats.
Geo-C11 (Tundra)	y - high	N/A	A few points in France in a mountainous area. We used high uncertainty because it is not clear if these plants are occurring in protected microhabitats.
Geo-C12 (Icecap)	n - negl	N/A	We found no evidence that this species occurs in this climate class.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	y - mod	N/A	A few points in Israel and Spain.
Geo-R2 (10-20 inches; 25-51 cm)	y - negl	N/A	Israel and Spain.
Geo-R3 (20-30 inches; 51-76 cm)	y - negl	N/A	Israel and Spain (GBIF, 2017). Occurs in an area of Israel receiving 600 mm of annual precipitation (Shmida and Ellner, 1983).
Geo-R4 (30-40 inches; 76-102 cm)	y - negl	N/A	France, Greece, and Spain.
Geo-R5 (40-50 inches; 102-127 cm)	y - negl	N/A	France, Greece, and Spain.
Geo-R6 (50-60 inches; 127-152 cm)	y - negl	N/A	Greece. A few points in France, and one in Portugal. In the United States, reported for Clackamas and Multnomah counties in Oregon, which include this precipitation band (Univ. of Washington, 2017), but it is not clear if it is naturalized there.
Geo-R7 (60-70 inches; 152-178 cm)	y - mod	N/A	In the United States, reported for Clackamas and Multnomah counties in Oregon, which include this precipitation band (Univ. of Washington, 2017), but it is not clear if it is naturalized there.
Geo-R8 (70-80 inches; 178-203 cm)	y - mod	N/A	Occurs in Srinagar, India (Andrabi et al., 2015), which encompasses this precipitation band. In the United States, reported for Clackamas and Multnomah counties in Oregon, which include this precipitation band (Univ. of Washington, 2017), but it is not clear if it is naturalized there.
Geo-R9 (80-90 inches; 203-229 cm)	y - high	N/A	Occurs in Srinagar, India (Andrabi et al., 2015), which encompasses this precipitation band. In the United States, reported for Clackamas and Multnomah counties in Oregon, which include this precipitation band (Univ. of Washington, 2017), but it is not clear if it is naturalized there.
Geo-R10 (90-100 inches; 229-254 cm)	y - high	N/A	Occurs in Srinagar, India (Andrabi et al., 2015), which encompasses this precipitation band. In the United States, reported for Clackamas and Multnomah counties in Oregon, which include this precipitation band (Univ. of Washington, 2017), but it is not clear if it is naturalized there.
Geo-R11 (100+ inches; 254+ cm)	y - high	N/A	Occurs in Srinagar, India (Andrabi et al., 2015), which encompasses this precipitation band. In the United States, reported for Clackamas and Multnomah counties in Oregon, which include this precipitation band (Univ. of Washington, 2017), but it is not clear if it is naturalized there.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	n - high	0	Although *T. leptophylla* may or not be established in the United States (see section on U.S. Distribution and

Question ID	Answer - Uncertainty	Score	Notes (and references)
			Status), we set this answer to no with high uncertainty, to evaluate the likelihood that it may enter.
Ent-2 (Plant proposed for entry, or entry is imminent)	n - low	0	We found no evidence that its entry is imminent.
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 - low	0.05	We found no evidence that this species is cultivated or traded on the internet. *Torilis leptophylla* has been used in folk medicine in Iran to treat gastrointestinal illness and has been confirmed to contain antibacterial properties (Maleki et al., 2008). There have been several studies examining its biochemical properties, for example, its essential oils (Masoudi et al., 2012), antioxidant activity (Saeed et al., 2012), and volatile constituents (Masoudi et al., 2012). The congener *T. japonica* also has medicinal properties (DiTommaso et al., 2014).
Ent-4 (Entry as a contaminant)			
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	n - low		We found no evidence it is present in any of these countries.
Ent-4b (Contaminant of plant propagative material (except seeds))	n - low	0	We found no evidence.
Ent-4c (Contaminant of seeds for planting)	? - max		We found no evidence that this species has been intercepted in seeds for planting; however, U.S. officials have intercepted *Torilis nodosa* and *Torilis* sp. in seed for planting (AQAS, 2017).
Ent-4d (Contaminant of ballast water)	n - low	0	We found no evidence. This pathway seems unlikely given that this species is not an aquatic plant or occurs in coastal habitats.
Ent-4e (Contaminant of aquarium plants or other aquarium products)	n - low	0	We found no evidence. This pathway seems unlikely given that this species is not an aquatic plant or occurs in coastal habitats.
Ent-4f (Contaminant of landscape products)	? - max		We found no evidence, but because this species occurs in disturbed areas (Andrabi et al., 2015; Hanson and Mason, 1985; Rhoads and Klein, 1993), it may become a contaminant or hitchhiker on landscape products.
Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances)	? - max		Unknown.
Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing)	y - low	0.01	*Torilis leptophylla* has been intercepted in grain (Stace, 2010; Verloove, 2006). U.S. officials have intercepted *T. arvensis*, *T. nodosa*, *T. japonica*, and *Torilis* sp. in cumin imports (AQAS, 2017).
Ent-4i (Contaminant of some other pathway)	e - negl	0.04	*Torilis leptophylla* is a rare birdseed and wool alien (Stace, 2010). It was introduced to Belgium in wool (Verloove, 2006). Researchers showed that the spiny fruit of *T. leptophylla* readily attaches to clothing and animal fur (Shmida and Ellner, 1983). Because birdseed is used in the landscape and is never completely consumed, we answered this risk element as "e," giving it the highest score possible.
Ent-5 (Likely to enter through natural dispersal)	n - negl	0	Because we found no evidence that this species is established in a region adjacent to the United States, we answered no.