United States Department of Agriculture

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Animal and Plant Health Inspection Service

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Version 1

Weed Risk Assessment For *Onopordum acaulon* L. (Asteraceae) – Stemless thistle

Left: section of *Onopordum acaulon* rosette: flower heads surrounded by spiny bracts and leaves. Top right: young rosette and a mature rosette with flower heads clustered in the center. Bottom right: infestation of *O. acaulon* in the field. (Photos: S. Wilkins, in Western Australian Herbarium, 1998).

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Executive Summary

The result of the weed risk assessment for *Onopordum acaulon* is High Risk of becoming weedy or invasive in the United States. *Onopordum acaulon* is a prostrate annual or biennial plant that grows in warm temperate regions. It is native to France, Spain, and northwestern Africa. In Australia, it is considered a weed of pastures, arable lands and roadsides. *Onopordum acaulon* occurs mainly in low-fertility soils in semi-arid areas and only occasionally reaches densities that seriously affect the carrying capacity of pasture. Each plant can produce 1200 seeds, which can be dispersed by wind, water, animals, vehicles, and agricultural products. We found no evidence that *O. acaulon* is present in the United States, and it is regulated as a Federal Noxious Weed. About 17 percent of the United States is climatically suitable for it to establish. *Onopordum acaulon* could enter the United States through hay, silage, chaff, and commercial seeds.

1. Plant Information and Background

SPECIES: *Onopordum acaulon* L. (NGRP, 2019; NRCS, 2019).

FAMILY: Asteraceae

SYNONYMS: *Onopordum pyrenaicum* DC., *O. uniflorum* Cav., *O. acaule* (Everett, 1981; Michael, 1996). The genus sometimes is spelled *Onopordon* (Everett, 1981).

COMMON NAMES: Stemless thistle (NRCS, 2019), horse thistle, stemless onopordon (NGRP, 2019).

BOTANICAL DESCRIPTION: *Onopordum acaulon* is a prostrate annual or biennial herb that grows in warm temperate regions (Parsons and Cuthbertson, 2001). Swirepik and Woodburn (2002) indicate that it "behaves more as a facultative perennial than a true biennial". Seeds germinate in autumn and develop small rosettes that expand up to 80 cm in diameter during spring. They then develop flower heads and later die during the summer. Some seeds can germinate during winter, and if conditions are favorable, they survive, and plants flower the second summer. The plant has no stem, and the leaves arranged in a rosette, are woolly with spiny lobes. White to purple flower heads are clustered in the middle of the rosette, and each one is surrounded by spined bracts. Achenes are brown to grey, 4-5 mm long with 20-25 mm long cream-colored pappi (Parsons and Cuthbertson, 2001).

INITIATION: *Onopordum acaulon* is listed on the Cooperative Agricultural Pest Survey Program (CAPS) Priority Pest List. The CAPS Program is re-evaluating all pests on the list and requested a Weed Risk Assessment for *O. acaulon* to determine whether the species should be removed from the Priority Pest List.

WRA AREA[1]: United States and Territories.

FOREIGN DISTRIBUTION: *Onopordum acaulon* is native to France, Morocco, northwestern Africa, and Spain (Girona-Garcia et al., 2019; Michael, 1996; O'hanlon et al., 1999; Parsons and Cuthbertson, 2001; Taleb and Fennane, 2016). Adams (2009) states that it is present in the United Kingdom (England), but this report has not been confirmed. *Onopordum acaulon* is only naturalized in Australia, where it is considered a weed of pastures, arable lands, and roadsides (Briese, 1990; Julien, 2006; Lane, 1976; Parsons and Cuthbertson, 2001; Western Australian Herbarium, 1998). It was originally introduced to Australia as a garden ornamental and was in cultivation in 1845 in Adelaide, South Australia (cited in Kloot, 1983). By 1871, it had escaped and was identified as a weed in a South Australian parliamentary hearing. It was in the northern cereal belt by the 1890s and had reached Victoria by 1925 (Parsons and Cuthbertson, 2001). *Onopordum acaulon* has spread in South Australia, Victoria, New South Wales, and Western Australia (Swirepik and Woodburn, 2002). More recently, it was detected in a field in Tasmania, where it was eradicated (HEAR, 2007). In Australia, *O. acaulon* is a

[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).

declared pest, which means that all reasonable measures must be taken to control its impact and spread (Government of Western Australia, 2017; Minehan, 1996; Tasmanian Government, 2019a, 2019b).

U.S. DISTRIBUTION AND STATUS: *Onopordum acaulon* is regulated as a Federal Noxious Weed (7 CFR §360.200, 2018). We found two sources indicating that this species is cultivated in the United States (Dave's Garden, 2019; Parker et al., 2007), but they did not provide citations. We found no other evidence that the species is cultivated or naturalized in the United States (GBIF, 2019; Kartesz, 2019; NRCS, 2019; Univ. of Minnesota, 2019). *Onopordum acaulon* has many prickles on its leaves and flowers (Parsons and Cuthbertson, 2001), which may reduce its appeal as an ornamental.

2. Analysis

ESTABLISHMENT/SPREAD POTENTIAL

Onopordum acaulon has demonstrated its ability to establish and spread in Australia. Since its introduction in 1845, it has invaded Victoria, South Australia, New South Wales, and Western Australia (Anonymous in Kloot, 1983; Parsons and Cuthbertson, 2001; Swirepik and Woodburn, 2002). This plant can form dense populations, annually producing 1,200 seeds per plant, which can survive in the soil for several years (Agriculture Victoria, 2017; Parsons and Cuthbertson, 2001; Swirepik and Woodburn, 2002). Seeds can be spread by wind, water, vehicles, and agricultural products (Moerkerk, 2006; Parsons and Cuthbertson, 2001; Randall, 2016). It seems very likely that *O. acaulon* was introduced in Tasmania as a contaminant of feed grain (HEAR, 2007). It is a declared pest in Australia and has been placed in the “W3” category, which means that the species must be prevented from spreading and its numbers and distribution reduced (Government of Western Australia, 2017; Minehan, 1996; Tasmanian Government, 2019a, 2019b). We had average uncertainty for this risk element because even though *O. acaulon* has shown the ability to become invasive beyond its native range in Australia, some of the spreading mechanisms are not well documented by primary literature (Briese, 1990; Government of Western Australia, 2017; Minehan, 1996; Parsons and Cuthbertson, 2001).

Risk score = 21 Uncertainty index = 0.14

IMPACT POTENTIAL

Onopordum acaulon is a weed of pastures, arable and cultivated lands, roadsides, channel banks, fallow ground, wastelands, and irrigated vegetable crops in Australia (Agriculture Victoria, 2017; Auld and Medd, 1987; Briese, 1990; Julien, 2006; Lanea, 1979; Parsons and Cuthbertson, 2001). It is unpalatable and competes with pasture species (Grice, 2004). “When livestock have been forced to eat the plant cases of impaction and suspected liver damage have occurred” (Government of Western Australia, 2017; Parsons and Cuthbertson, 2001), but goats will eat the plant during flowering (Simmonds et al., 2000). Occasionally, it reaches densities that seriously affect the carrying capacity of pastures (Kloot pers. comm., in Briese, 1990). Because of the impact that this weed has caused in Australia, the biological control program that was already in place for two congeners (*O. illyricum* and *O. acanthium*) in Western Australia was extended to include *O. acaulon* (Julien, 2006;Swirepik and

Woodburn, 2002). Because the extent of the impacts on production systems and anthropogenic areas and the frequency of control measures are not very well documented, we had very high uncertainty for this risk element.

Risk score = 2.4 Uncertainty index = 0.28

GEOGRAPHIC POTENTIAL

Using PPQ's Proto3 climate-matching tool (Magarey et al., 2017), we estimate that about 17 percent of the United States is suitable for the establishment of *O. acaulon* (Fig. 1). This 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, desert, Mediterranean, marine west coast, humid continental with cool summers, subarctic and tundra. The area of the United States shown to be climatically suitable (Fig. 1) was determined using only these three climate variables. Other factors, such as soil, hydrology, disturbance regime, and species interactions may alter the areas in which this species is likely to establish. *Onopordum acaulon* occurs mainly in low-fertility soils in semi-arid areas (Briese, 1990 Parsons and Cuthbertson, 2001) and in open habitats such as pastures, arable and cultivated lands, roadsides, channel banks, fallow ground, wastelands, and irrigated vegetable crops in Australia (Agriculture Victoria, 2017; Auld and Medd, 1987; Briese, 1990; Julien, 2006; Lanea, 1979; Parsons and Cuthbertson, 2001).

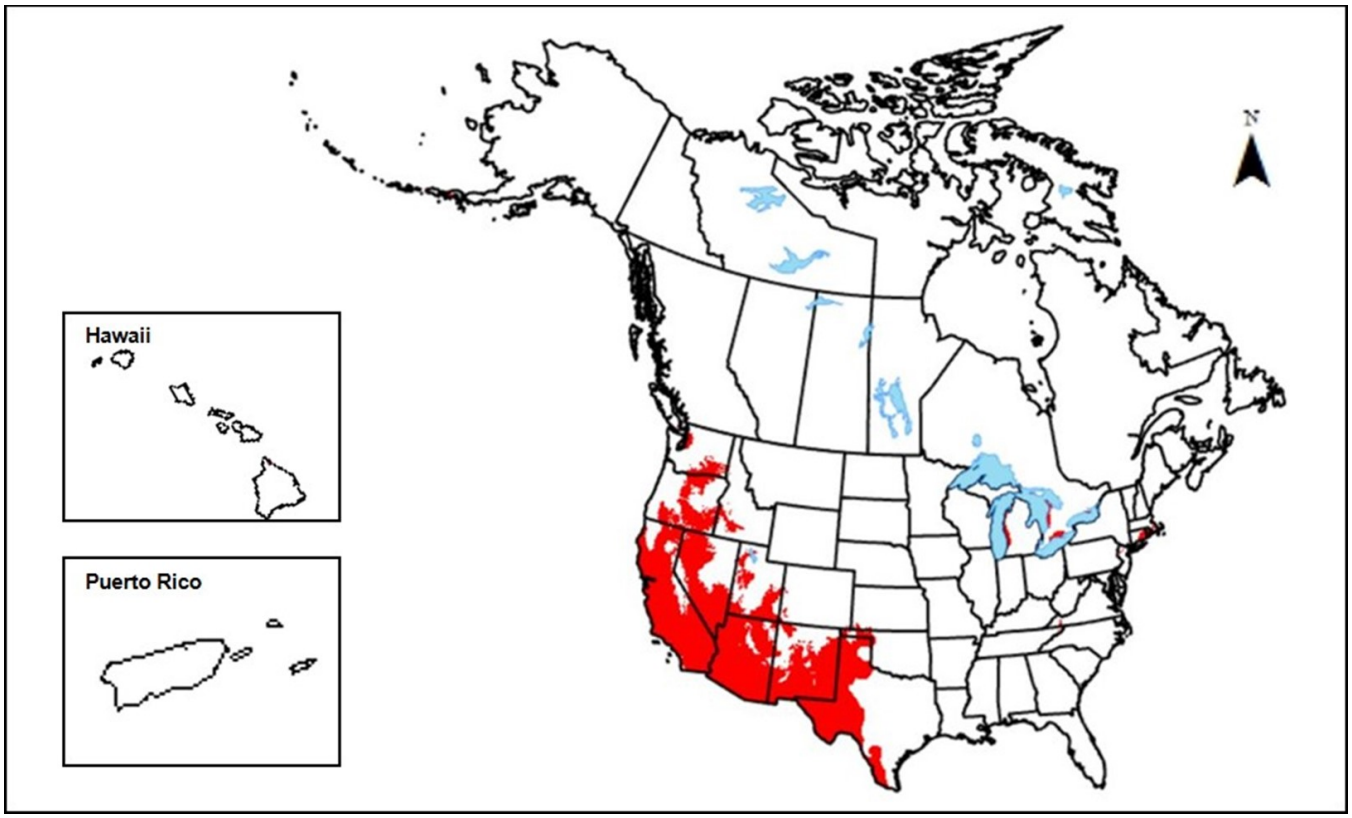

Figure 1. Potential geographic distribution of *Onopordum acaulon* in the United States and Canada. Map insets for Hawaii and Puerto Rico are not to scale. For additional on the PPQ climate-matching process see Magarey et al., (2017).

ENTRY POTENTIAL

Onopordum acaulon is not present in the United States. We found no evidence that *O. acaulon* has been intercepted at U.S. ports of entry (AQAS, 2019). Seeds can be dispersed by wind, animals, vehicles (Parsons and Cuthbertson, 2001 Randall, 2016), and as contaminants of hay, silage, chaff, and commercial seeds (Agriculture Victoria, 2017; HEAR, 2007). We had high uncertainty for entry potential because we could not corroborate some of the evidence. However, the entry of the species via natural dispersal is unlikely since we found no evidence that it is present in Canada or Mexico.

Risk score = 0.11 Uncertainty index = 0.20

3. Predictive Risk Model Results

Model Probabilities: P(Major Invader) = 90.5%
P(Minor Invader) = 9.2%
P(Non-Invader) = 0.3%
Risk Result = High Risk
Risk Result after Secondary Screening = Not Applicable

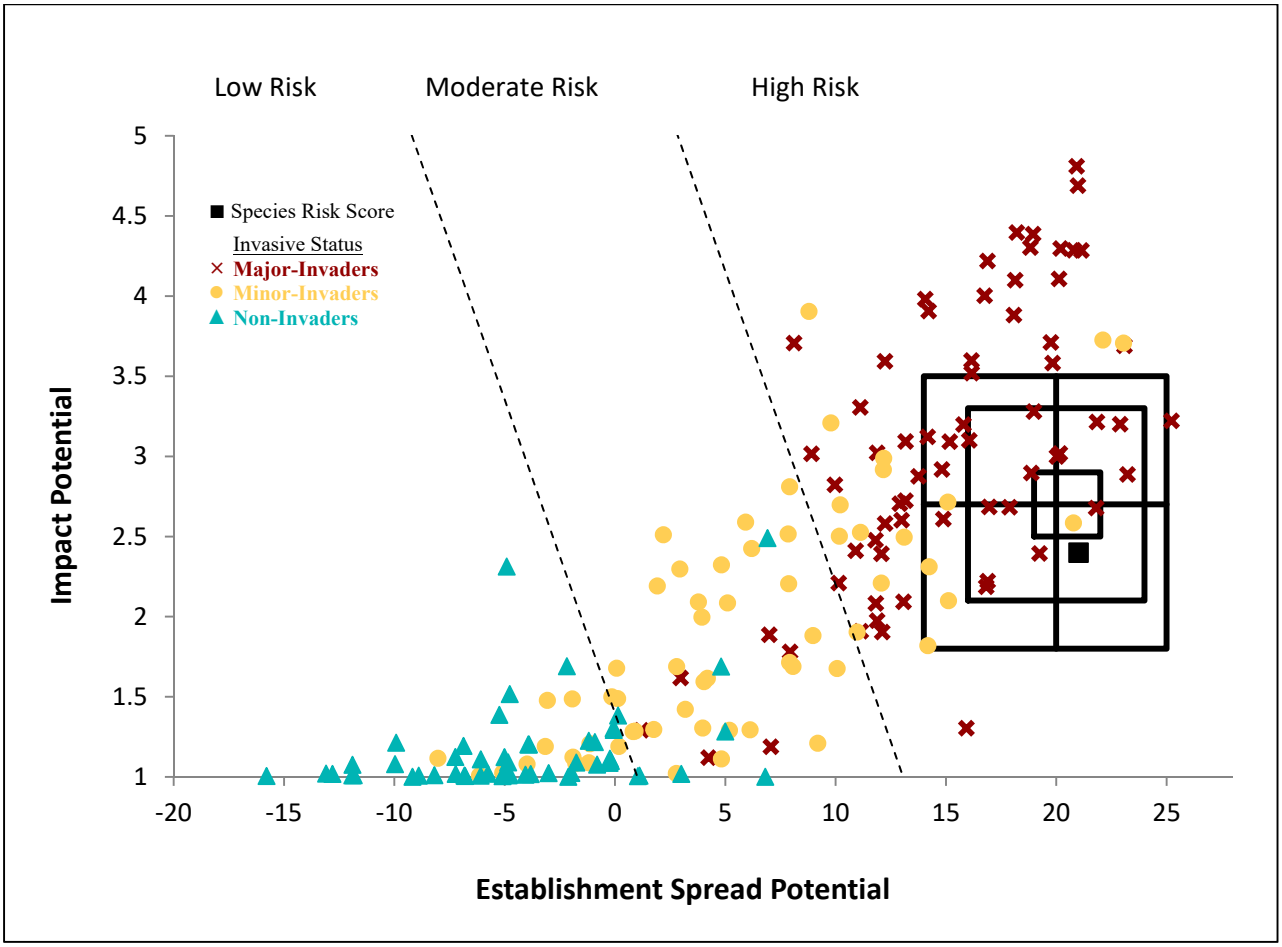

Figure 2. Risk and uncertainty results for *Onopordum acaulon*. The risk score (solid black symbol) is plotted relative to the risk scores of the species used to develop and validate the PPQ WRA model (Koop, 2012). The results from the uncertainty analysis are plotted around the risk score for *O. acaulon*. 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)

4. Discussion

The result of the weed risk assessment for *Onopordum acaulon* is High Risk of becoming weedy or invasive in the United States. This plant has readily escaped from cultivation in Australia and has spread throughout the country, becoming invasive (Briese, 1990; Government of Western Australia, 2017; Minehan, 1996; Parsons and Cuthbertson, 2001). We predict that this weed would behave

similarly in climatically suitable areas in the United State should this weed become established here. We had very high uncertainty for the impact potential of *O. acaulon* because the extent of the impacts on production systems and anthropogenic areas and the frequency of control measures are not very well documented. We know however, that this weed is unpalatable to animals and can occasionally reach densities that affect the carrying capacity of pastures (Briese, 1990; Grice, 2004). Further, the plant has caused enough impacts in Western Australia that a biological control program was established (Julien, 2006; Swirepik and Woodburn, 2002). We found no evidence that *O. acaulon* is present or cultivated in the United States, and the taxon is listed as a Federal Noxious Weed in the Code of Federal Regulations (7 CFR §360.200, 2018). The potential pathway by which the species could be introduced is as a contaminant of hay, silage, chaff, or commercial seeds.

5. Acknowledgements

This document was authored and reviewed by PPQ staff and cooperators.

SUGGESTED CITATION

PPQ. 2019. Weed risk assessment for *Onopordum acaulon* L. (Asteraceae) – Stemless thistle. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (PPQ), Raleigh, NC. 18 pp.

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Appendix A. Weed risk assessment for *Onopordum acaulon* L. (Asteraceae)

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. The Excel file in which 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 - negl	5	*Onopordum acaulon* is native to France, Spain, and northwestern Africa (Everett, 1981; Michael, 1996; Parsons and Cuthbertson, 2001). It has become very invasive in Australia, where it escaped as a garden ornamental in the mid-1800s and spread throughout the country (Anonymous in Kloot, 1983; Parsons and Cuthbertson, 2001; Swirepik and Woodburn, 2002). It occupies 1.6 million ha in Australia (Parsons and Cuthbertson, 2001; Western Australian Herbarium, 1998) and was recently detected in Tasmania (HEAR, 2007). *Onopordum acaulon* is not known to occur anywhere else outside its native range (Briese, 1990). Adams (2009) states that the taxon is present in the United Kingdom (England), but we found no other evidence for this. The alternate answers for the uncertainty simulation were both "e".
ES-2 (Is the species highly domesticated)	n - low	0	No evidence found.
ES-3 (Significant weedy congeners)	y - negl	1	In New South Wales, Scotch thistle (*Onopordum acanthium*) and Illyrian thistle (*O. illyricum*) are major weeds of pastures (Dellow and Holtkamp, 2005; Meat & Livestock Australia, 2009). *Onopordum acanthium* and *O. illyricum* cause economic losses, and biological control programs have been undertaken to contain these species (Briese, 1990; Briese et al., 1990; Briese et al., 2002).
ES-4 (Shade tolerant at some stage of its life cycle)	n - mod	0	We found no evidence that the species is shade tolerant at any stage of its life. *Onopordum acaulon* occurs in open habitats such pastures, arable and cultivated lands, roadsides, channel banks, fallow ground, wastelands, and irrigated vegetable crops in Australia (Agriculture Victoria, 2017; Auld and Medd, 1987; Briese, 1990; Julien, 2006; Lanea, 1979; Parsons and Cuthbertson, 2001). Other *Onopordum* spp. thrive in full sun or part shade (Everett, 1981).
ES-5 (Plant a vine or scrambling plant, or forms tightly appressed basal rosettes)	y - negl	1	*Onopordum acaulon* forms an appressed basal rosette (Dellow and Holtkamp, 2005; Parsons and Cuthbertson, 2001). Also see images on the cover page of this document.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-6 (Forms dense thickets, patches, or populations)	y - mod	2	In Western Australia, *O. acaulon* can form dense populations of up to 67 plants per square meter (Swirepik and Woodburn, 2002).
ES-7 (Aquatic)	n - negl	0	We found no evidence that *O. acaulon* is an aquatic plant. It occurs in pastures and roadsides (Briese, 1990; Parsons and Cuthbertson, 2001 Lanea, 1979).
ES-8 (Grass)	n - negl	0	This species is not a grass; it is an herb in the Asteraceae family.
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	We found no evidence that *O. acaulon* is a nitrogen fixing plant. *Onopordum acaulon* is not a woody plant.
ES-10 (Does it produce viable seeds or spores)	y - negl	1	*Onopordum acaulon* reproduces by seeds, which usually germinate during fall, with the plants developing during winter (Parsons and Cuthbertson, 2001; Swirepik and Woodburn, 2002).
ES-11 (Self-compatible or apomictic)	? - max	0	Unknown. We found no information about this for *O. acaulon*. The congener *O. illyricum* is self-compatible (Michalakis et al., 1993).
ES-12 (Requires specialist pollinators)	n - mod	0	We found no evidence about specialist pollinators.
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	*Onopordum acaulon* is a prostrate annual or biennial herb (Parsons and Cuthbertson, 2001). It has been described by Swirepik and Woodburn (2002) as a plant that "behaves more as a facultative perennial than a true biennial". Seeds germinate in autumn and develop small rosettes that expand up to 80 cm in diameter during spring. They then develops flower heads, and the plants die after flowering in the summer. Under favorable conditions, some plants survive their first summer and flower in a second summer (Parsons and Cuthbertson, 2001). The weed can form populations with densities up to 67 plants per square meter (Swirepik and Woodburn, 2002), and seed survives in the soil for several years (Parsons and Cuthbertson, 2001; Swirepik and Woodburn, 2002).The alternative answers were both "c."
ES-14 (Prolific seed producer)	y - negl	1	It usually produces eight flower heads per plant with 150 seeds per head, resulting in about 1,200 seeds per plant (Agriculture Victoria, 2017). Seed productions can vary from 240 to 15,882 seeds per square meter (Swirepik and Woodburn, 2002).
ES-15 (Propagules likely to be dispersed unintentionally by people)	y - negl	1	Seeds can be dispersed by vehicles (Moerkerk, 2006; Parsons and Cuthbertson, 2001).
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	y - low	2	The infestation in Tasmania was very likely due to the introduction of seed as a contaminant of feed grain that was imported during the 1999-2001 drought period (HEAR, 2007; Parsons and Cuthbertson, 2001).
ES-17 (Number of natural dispersal vectors)	3	2	
ES-17a (Wind dispersal)	y - negl		Seeds have large pappi that allow wind dispersal (Parsons and Cuthbertson, 2001). In Victoria, seeds have been dispersed over 200 m by wind (Agriculture Victoria, 2017).

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-17b (Water dispersal)	y - mod		Seeds can be dispersed by water (Parsons and Cuthbertson, 2001). *Onopordum acaulon* grows near water channels, and because the seeds are light, they are very likely to float.
ES-17c (Bird dispersal)	?– max		Agriculture Victoria (2017) reports that seeds can be dispersed by birds, but we found no additional evidence to support this. Consequently, we answered unknown.
ES-17d (Animal external dispersal)	y - high		Agriculture Victoria (2017) reports that seeds can be dispersed by animals. Even though we found no additional evidence to support this, we answered yes with high uncertainty because *O. illyricum* and *O. acanthium* can contaminate wool of sheep (Briese, 1990).
ES-17e (Animal internal dispersal)	n - mod		We found no evidence that propagules are dispersed internally by animals (e.g., Randall, 2016).
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	y - low	1	Seeds survive in the soil for several years (Parsons and Cuthbertson, 2001; Swirepik and Woodburn, 2002).
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	y - mod	1	A study conducted in Spain showed that *O. acaulon* resprouted after prescribed fire (Girona-Garcia et al., 2019). Agriculture Victoria (2017) states that "plants cut below the surface with cultivation equipment may re-sprout from root fragments, commonly producing multiple crowns". We found no evidence that *O. acaulon* benefits from fire. We chose yes because plants can re-sprout from root fragments.
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - low	0	We found no evidence that *O. acaulon* has acquired herbicide resistance (Heap, 2019). Herbicide-based control procedures have kept infestations small, but they have not prevented the spread of the weed (Briese et al., 1990).
ES-21 (Number of cold hardiness zones suitable for its survival)	5	0	
ES-22 (Number of climate types suitable for its survival)	7	2	
ES-23 (Number of precipitation bands suitable for its survival)	5	0	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - high	0	We found no evidence that *O. acaulon* is allelopathic. Flavonoids, lignans and sesquiterpenes have been isolated from *O. acaulon* (Cardona et al., 1992), but we found no evidence that they have allelopathic effect. Other congeners do show allelopathic effects: residues of *O. jordanicolum* have shown allelopathic inhibitory activity on wheat (Qasem, 1995 in Qasem and Foy, 2001), and sesquiterpene extracted from *O. acanthium* showed phytotoxic potential (Watanabe et al., 2014).
Imp-G2 (Parasitic)	n - negl	0	We found no evidence that *O. acaulon* or its congeners are parasitic (Heide-Jorgensen, 2008; Nickrent, 2009).
Impacts to Natural Systems			

Question ID	Answer - Uncertainty	Score	Notes (and references)
Imp-N1 (Changes ecosystem processes and parameters that affect other species)	n - mod	0	We found no evidence that *O. acaulon* changes ecosystem processes or parameters. Because this species is somewhat well-known in Australia, and because we found no evidence that it occurs in natural areas, we used moderate uncertainty for most of the questions in this risk subelement.
Imp-N2 (Changes habitat structure)	n - mod	0	We found no evidence that *O. acaulon* changes habitat structure.
Imp-N3 (Changes species diversity)	n - mod	0	We found no evidence that *O. acaulon* changes species diversity.
Imp-N4 (Is it likely to affect federal Threatened and Endangered species?)	n - mod	0	We found no evidence that *O. acaulon* affects Threatened and Endangered or other rare species.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions?)	n - low	0	We found no evidence.
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	Even though it has been placed under a "W3 category" for control in Australis, which means that the species must be prevented from spreading and its numbers and distribution reduced, we found no evidence that the taxon is a weed in a natural system (Government of Western Australia, 2017; Minehan, 1996). The alternate answers are "b" and "c".
Impact to Anthropogenic Systems (e.g., cities, suburbs, roadways)			
Imp-A1 (Negatively impacts personal property, human safety, or public infrastructure)	n- mod	0	*Onopordum acaulon* is found on roadsides and channel banks, but we found no evidence of impact (Agriculture Victoria, 2017; Parsons and Cuthbertson, 2001). Because it seems unlikely that a low-lying, herbaceous species would have these impacts, we used moderate uncertainty.
Imp-A2 (Changes or limits recreational use of an area)	?– max		The leaves of this plant are very prickly (Parsons and Cuthbertson, 2001), so it could create problems in a recreational area.
Imp-A3 (Affects desirable and ornamental plants, and vegetation)	n - mod	0	We found no evidence that it affects ornamental plants.
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 - high	0.1	*Onopordum acaulon* is found along roadsides and channel banks (Agriculture Victoria, 2017; Lanea, 1979). Lanea (1979) states that the main method of weed control on roadsides is annual spot spraying with herbicides. It is a declared pest in Australia, where it must be prevented from spreading and its numbers and distribution reduced (Government of Western Australia, 2017; Minehan, 1996; Tasmanian Government, 2019a, 2019b). It is a prohibited weed in Victoria and a controlled weed in two regions (Parsons and Cuthbertson, 2001). The New South Wales government (NSW Government, 2018) lists several herbicides that can be used to control *O. acaulon*. The alternate answers are "c" and "a".
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	y - mod	0.4	*Onopordum acaulon* occasionally reaches densities that seriously affect carrying capacity of pastures (Kloot

Question ID	Answer - Uncertainty	Score	Notes (and references)
			1986 in Briese, 1990). It is also described as an unpalatable weed that competes with pasture species (Grice, 2004). We chose yes because it can occasionally affect carrying capacity (Grice, 2004).
Imp-P2 (Lowers commodity value)	? – max	0.2	We found no evidence that the taxon may lower the commodity value.
Imp-P3 (Is it likely to impact trade?)	y - high	0.2	*Onopordum acaulon* is regulated as a Noxious Weed in Australia, where it must be prevented from spreading (Government of Western Australia, 2017; Minehan, 1996). Seeds can contaminate agricultural products, vehicles, animals, hay, silage, chaff, and commercial seeds (Agriculture Victoria, 2017). U.S. inspectors have intercepted seeds of *Onopordum* spp. (AQAS, 2019). *Onopordum acaulon* is listed as a harmful organism by New Zealand (USDA PCIT, 2019). If this species were to establish in the United States and contaminate our exports, trade with Australia, New Zealand, and possibly other countries could be affected.
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	n - mod	0	We found no evidence that *O. acaulon* reduces quality or availability of irrigation or strongly competes with plants for water.
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	y - high	0.1	Animals do not eat *O. acaulon* unless it is wilted. "When stock have been forced to eat the plant cases of impaction and suspected liver and kidney damage have occurred" (Government of Western Australia, 2017; Parsons and Cuthbertson, 2001). *Onopordum acaulon* is not toxic to goats, which eat the weed during flowering (Simmonds et al., 2000).
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 - low	0.6	In Australia *Onopordum acaulon* is found in pastures and fallow ground (Agriculture Victoria, 2017). It is unpalatable to animals and occasionally can reach densities that affect the carrying capacity of infested pastures (Briese, 1990; Grice, 2004) In Australia, it has been placed in a "W3 category," which means the species must be prevented from spreading, its numbers and distribution reduced (Government of Western Australia, 2017; Minehan, 1996). Also, a biological control program is in place for the management of this species (Julien, 2006; Swirepik and Woodburn, 2002). The alternate answers were both "b".
GEOGRAPHIC POTENTIAL			Unless otherwise indicated, the following evidence represents geographically referenced points obtained from the Global Biodiversity Information Facility (GBIF, 2019).
Plant hardiness zones			
Geo-Z1 (Zone 1)	n - negl	N/A	We found no evidence that it occurs in Zone 1.
Geo-Z2 (Zone 2)	n - negl	N/A	We found no evidence that it occurs in Zone 2.
Geo-Z3 (Zone 3)	n - negl	N/A	We found no evidence that it occurs in Zone 3.
Geo-Z4 (Zone 4)	n - negl	N/A	We found no evidence that it occurs in Zone 4.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-Z5 (Zone 5)	n - negl	N/A	We found no evidence that it occurs in Zone 5.
Geo-Z6 (Zone 6)	n - high	N/A	We found a few points on the edge of this Zone in mountainous regions of France. We answered no due to potential mapping error.
Geo-Z7 (Zone 7)	y - mod	N/A	Some points in Spain, some in France, and one in Andorra.
Geo-Z8 (Zone 8)	y - negl	N/A	Many points in Spain, one in Morocco.
Geo-Z9 (Zone 9)	y - negl	N/A	Many points in Spain, four in Morocco, and many in Australia.
Geo-Z10 (Zone 10)	y - negl	N/A	Many points in Australia, a few in Spain.
Geo-Z11 (Zone 11)	y - low	N/A	Four points in Spain, some in Australia.
Geo-Z12 (Zone 12)	n - high	N/A	One point in Australia near the edge of Zone 11.
Geo-Z13 (Zone 13)	n - negl	N/A	We found no evidence it occurs in Zone 13.
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	n - negl	N/A	We found no evidence it occurs in this climate class.
Geo-C2 (Tropical savanna)	n - negl	N/A	We found no evidence it occurs in this climate class.
Geo-C3 (Steppe)	y - negl	N/A	Many points in Australia.
Geo-C4 (Desert)	y - high	N/A	Some points in Australia near the edge of steppe habitats, one in Algeria, and one in Morocco.
Geo-C5 (Mediterranean)	y - negl	N/A	Many points in Australia, a few in Spain.
Geo-C6 (Humid subtropical)	n - high	N/A	Six points in Australia near the Marine west coast.
Geo-C7 (Marine west coast)	y - negl	N/A	Many points in Spain, some in France, and a few in Australia.
Geo-C8 (Humid cont. warm sum.)	n - high	N/A	Four points in France.
Geo-C9 (Humid cont. cool sum.)	y - mod	N/A	Few points in Spain.
Geo-C10 (Subarctic)	y - high	N/A	12 points in Spain, in a mountainous region.
Geo-C11 (Tundra)	y - high	N/A	11 points in France and Spain, in a mountainous region.
Geo-C12 (Icecap)	n - negl	N/A	We found no evidence it occurs in this climate class.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	y - high	N/A	Few points in Spain and Australia, one in Algeria, and one in Morocco on the edge of Geo-R2.
Geo-R2 (10-20 inches; 25-51 cm)	y - negl	N/A	Many points in Spain, many in Australia.
Geo-R3 (20-30 inches; 51-76 cm)	y - negl	N/A	Many points in Spain, some in Australia.
Geo-R4 (30-40 inches; 76-102 cm)	y - negl	N/A	Many points in Australia, a few in Spain and France.
Geo-R5 (40-50 inches; 102-127 cm)	y - mod	N/A	Few points in France.
Geo-R6 (50-60 inches; 127-152 cm)	n - high	N/A	One point in France.
Geo-R7 (60-70 inches; 152-178 cm)	n - high	N/A	One point in France.
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 – low	0	We found no evidence that *O. acaulon* is present in the United States (e.g., Kartesz, 2019; NRCS, 2019).

Question ID	Answer - Uncertainty	Score	Notes (and references)
Ent-2 (Plant proposed for entry, or entry is imminent)	n - low	0	*Onopordum acaulon* is listed as a Federal Noxious Weed (NRCS, 2019). We found no evidence that the plant has been proposed for import.
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]	a - mod	0	*Onopordum acaulon* escaped as a garden ornamental in 1845 (cited in Kloot, 1983), but we found no evidence that it is cultivated today. It is considered a weed in Australia, where it is under control (Agriculture Victoria, 2017; Minehan, 1996).
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 that *O. acaulon* is present in these countries.
Ent-4b (Contaminant of plant propagative material (except seeds))	n - high	0	We found no direct evidence that *O. acaulon* could be a contaminant of propagative plant material.
Ent-4c (Contaminant of seeds for planting)	y - high	0.04	Agriculture Victoria (2017) reports that *O. acaulon* seeds are spread in commercial seed, but we found no other evidence to support this, so we had high uncertainty. *Onopordum* spp. have been intercepted in seeds for propagation (AQAS, 2019).
Ent-4d (Contaminant of ballast water)	n - high	0	We found no evidence that *O. acaulon* is a contaminant of ballast.
Ent-4e (Contaminant of aquarium plants or other aquarium products)	n - mod	0	We found no evidence that *O. acaulon* is a contaminant of aquarium plants. Agriculture Victoria (2017) states that seed can spread by water.
Ent-4f (Contaminant of landscape products)	y - high	0.02	We found no direct evidence, but seed is spread in chaff (Agriculture Victoria, 2017). If chaff is used to cover the soil in landscape maintenance, then *O. acaulon* could be a contaminant.
Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances)	y - mod	0.02	*Onopordum acaulon* can spread on vehicles (Agriculture Victoria, 2017; Moerkerk, 2006; Parsons and Cuthbertson, 2001; Randall, 2016).
Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing)	y - high	0.01	We found no evidence that the taxon can be a contaminant of highly processed commodities. *Onopordum illyricum* and *O. acanthium* are contaminants of wool from sheep reared on thistle-infested pastures (Briese, 1990). *Onopordum acaulon* can be spread by animals (Agriculture Victoria, 2017; Parsons and Cuthbertson, 2001). *Onopordum* spp. were found as contaminants in seeds of products for consumption (AQAS, 2019). It is likely that *O. acaulon* was introduced into Tasmania as a contaminant of feed grain (Hear, 2007). Since we found no direct evidence, however, we had high uncertainty.
Ent-4i (Contaminant of some other pathway)	c -high	0	Seeds are spread in hay and silage (Agriculture Victoria, 2017). It is also very likely that *O. acaulon* was introduced into Tasmania as a contaminant of feed grain (HEAR, 2007).

Question ID	Answer - Uncertainty	Score	Notes (and references)
Ent-5 (Likely to enter through natural dispersal)	n - low	0	Even though wind is the most important means of dispersal for the taxon (Parsons and Cuthbertson, 2001), *O. acaulon* is not present in nearby regions (Canada and Mexico).