

<b>Taxon:</b> <i>Arnica montana</i>	<b>Family:</b> Asteraceae
<b>Common Name(s):</b> arnica European arnica leopardsbane mountain arnica mountain tobacco	<b>Synonym(s):</b> Senecio arnica E. H. L. Krause

<b>Assessor:</b> No Assessor	<b>Status:</b> Assessor Approved	<b>End Date:</b> 17 Jul 2014
<b>WRA Score:</b> -1.5	<b>Designation:</b> L	<b>Rating:</b> <span style="background-color: yellow;">Low Risk</span>

**Keywords:** Naturalized, Perennial Herb, Medicinal, Self-incompatible, Wind-dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	Low
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)		
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	n
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed		
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	n
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	n
305	Congeneric weed		
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals		
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans		

Qsn #	Question	Answer Option	Answer
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle		
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	n
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	n
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat		
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	y=1, n=-1	n
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	1
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)		
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant		
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	n
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut		
801	Prolific seed production (>1000/m <sup>2</sup> )	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	n
803	Well controlled by herbicides		
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	n
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

**Supporting Data:**

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	FAO. 2014. Grassland Species Profiles - Arnica Montana. <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 14 Jul 2014]	"In countries where arnica is indigenous, it has long been a popular remedy." [No evidence]

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2014. Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2014. Personal Communication	NA

201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	Low
	Source(s)	Notes
	USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: <a href="http://www.ars-grin.gov/">http://www.ars-grin.gov/</a> . [Accessed 3 Jul 2014]	"Native: EUROPE Northern Europe: Denmark; Norway; Sweden Middle Europe: Austria; Belgium; Czech Republic; Germany; Hungary [extinct?]; Netherlands; Poland; Switzerland East Europe: Belarus; Lithuania [extinct?]; Ukraine Southeastern Europe: Bosnia and Herzegovina; Bulgaria; Croatia; Italy; Montenegro; Romania; Slovenia Southwestern Europe: France; Portugal; Spain" [Temperate to Mediterranean]

202	Quality of climate match data	High
	Source(s)	Notes
	USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: <a href="http://www.ars-grin.gov/">http://www.ars-grin.gov/</a> . [Accessed ]	

203	Broad climate suitability (environmental versatility)	
	Source(s)	Notes

Qsn #	Question	Answer
	Phillips, B. 2006. The Book of Herbs: An Illustrated A-Z of the World's Most Popular Culinary and Medicinal Plants. Hobble Creek Press, Springville, UT	"As Arnica Montana is an alpine plant, it requires a cool, moist climate."
	Rarexoticseeds. 2014. Arnica Montana Seeds (Leopard's Bane Seeds). <a href="http://www.rarexoticseeds.com/en/arnica-montana-seeds-leopard-s-bane-seeds.html">http://www.rarexoticseeds.com/en/arnica-montana-seeds-leopard-s-bane-seeds.html</a> . [Accessed 16 Jul 2014]	"Hardiness zone: 5-8"
	Dave's Garden. 2014. PlantFiles: Leafy Arnica, European Arnica, Leopard's Bane, Mountain Tobacco, Mountain Snuff, Sneezewort - Arnica Montana. <a href="http://davesgarden.com/guides/pf/go/54285/">http://davesgarden.com/guides/pf/go/54285/</a> . [Accessed 14 Jul 2014]	"Hardiness: USDA Zone 4b: to -31.6 °C (-25 °F) USDA Zone 5a: to -28.8 °C (-20 °F) USDA Zone 5b: to -26.1 °C (-15 °F) USDA Zone 6a: to -23.3 °C (-10 °F) USDA Zone 6b: to -20.5 °C (-5 °F) USDA Zone 7a: to -17.7 °C (0 °F) USDA Zone 7b: to -14.9 °C (5 °F) USDA Zone 8a: to -12.2 °C (10 °F) USDA Zone 8b: to -9.4 °C (15 °F)"
	Dale, L., Fernandez, J. A., Vermeulen, P., Lecler, B., Bogdan A. D., Pacurar, F., Rotar, I., Thewis, A. & Baeten, V. 2012. Research on crude protein and digestibility of Arnica montana L. using conventional NIR spectrometry and hyperspectral imaging NIR. Journal of Food, Agriculture & Environment, 10(1): 391-396	[Possibly. Elevation range exceeds 1000 m, but restricted to temperate climates. May only be able to grow at higher elevations of tropics] "It is a small perennial herbaceous plant not exceeding half a metre in height, it is native of the temperate mountain regions (between 700 and 2500 m above sea level) of the northern hemisphere."

204	Native or naturalized in regions with tropical or subtropical climates	n
	Source(s)	Notes
	FAO. 2014. Grassland Species Profiles - Arnica Montana. <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 14 Jul 2014]	"Arnica montana L. is distributed from south Norway and Latvia southwards to south Portugal, the north Appennines and south Carpathians. It is naturalized in North America. "
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	FAO. 2014. Grassland Species Profiles - Arnica Montana. <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 16 Jul 2014]	"It is naturalized in North America."
	Smallfield, B.M. & Douglas, M.H. 2008. Arnica montana a grower's guide for commercial production in New Zealand. New Zealand Institute for Crop and Food Research Limited, Christchurch, New Zealand	"New Zealand has a good opportunity to commercially cultivate arnica flowers and roots for the international markets. Trading on its reputation for high quality and its natural „clean green“ image in Europe, is an advantage for promoting medicinal herb products. Arnica was first identified as a potential new crop for Otago when the Dunedin Botanical gardens were first established in 1863 (Dunlop 2003)."

Qsn #	Question	Answer
	Khan, I. A., & Abourashed, E. A. 2010. Leung's encyclopedia of common natural ingredients: used in food, drugs and cosmetics. John Wiley & Sons, Hoboken, New Jersey	"Perennial herb, up to about 0.6m high; native to mountainous regions of Europe; cultivated in northern India. Part used is the dried flower head."

301	Naturalized beyond native range	y
	Source(s)	Notes
	FAO. 2014. Grassland Species Profiles - Arnica Montana. <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 3 Jul 2014]	"Arnica montana L. is distributed from south Norway and Latvia southwards to south Portugal, the north Appennines and south Carpathians. It is naturalized in North America. "

302	Garden/amenity/disturbance weed	
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	[Listed as a weed in some citations, but unable to find detailed evidence of impacts]

303	Agricultural/forestry/horticultural weed	n
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

304	Environmental weed	n
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

305	Congeneric weed	
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	[Arnica angustifolia, Arnica chamissonis, Arnica cordifolia, Arnica fulgens, & Arnica lessingii are included in references listing naturalized, and/or weedy species, but uncertainty remains regarding detrimental impacts]

401	Produces spines, thorns or burrs	n
	Source(s)	Notes

Qsn #	Question	Answer
	FAO. 2014. Grassland Species Profiles - Arnica Montana. <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 3 Jul 2014]	[No evidence] "Arnica is a herbaceous perennial plant. The plant height ranges from 30 –60 cm. One or two pairs of leaves form a flat rosette. They are entire, bright green, toothed and somewhat hairy on the upper surface. The lower leaves are clustered, ovate, ciliated and have rounded tips. The upper leaves are smaller, lance-shaped, opposite and attached directly to the stem. From the centre of the rosette rises a round and hairy stalk that ends in 1-3 flower stalks bearing each one orange-yellow daisylike blossom. The fruits are bristly achenes. The rhizome is dark brown, cylindrical, usually curved, and bears brittle wiry rootlets on the under surface. "

402	Allelopathic	
	Source(s)	Notes
	WRA Specialist. 2014. Personal Communication	Unknown

403	Parasitic	n
	Source(s)	Notes
	FAO. 2014. Grassland Species Profiles - Arnica Montana. <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 3 Jul 2014]	"Arnica is a herbaceous perennial plant." [Asteraceae]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Dale, L., Fernandez, J. A., Vermeulen, P., Lecler, B., Bogdan A. D., Pacurar, F., Rotar, I., Thewis, A. & Baeten, V. 2012. Research on crude protein and digestibility of Arnica montana L. using conventional NIR spectrometry and hyperspectral imaging NIR. Journal of Food, Agriculture & Environment, 10(1): 391-396	"In countries like Romania the forage is composed almost of hay, which is rich in Arnica montana L. Sheep, horses and goats eat the AM like a fresh plant, but cattle rejects it because of the odder of leaves and flowers. As part of the hay, when it is dried, cattle would also consume it."

405	Toxic to animals	
	Source(s)	Notes
	Khan, I. A., & Abourashed, E. A. 2010. Leung's encyclopedia of common natural ingredients: used in food, drugs and cosmetics. John Wiley & Sons, Hoboken, New Jersey	[Reference reports toxic effects on humans. Unknown if animals, which may consume the plant in fodder, are adversely affected] "Arnica montana is not recommended for any internal uses. The plant is an irritant to mucous membranes, and ingestion may cause burning pain in the stomach, diarrhea, vomiting, giddiness, intense muscular weakness, collapse, decrease or increase of the pulse rate, shortness of breath, and death."

406	Host for recognized pests and pathogens	
	Source(s)	Notes

Qsn #	Question	Answer
	Smallfield, B.M. & Douglas, M.H. 2008. <i>Arnica montana</i> a grower's guide for commercial production in New Zealand. New Zealand Institute for Crop and Food Research Limited, Christchurch, New Zealand	" <i>Arnica</i> plants are very sensitive to crown rot and fungal diseases, the most serious of which are <i>Phytophthora</i> and <i>Phoma</i> . During the growing season, individual or patches of plants can collapse and die suddenly when conditions are unfavourable, particularly under hot wet or hot dry conditions. The first visible symptom of the disease is that the plant starts to wilt. There are no fungicides registered for use on <i>arnica</i> . Therefore good plant hygiene techniques need to be maintained right through the production cycle." ... "No major insect pest problems have been identified to date. The leaves are attacked by the caterpillars of the magpie moth and the green looper, but damage is relatively minor. Populations of grass grub larvae have also been found under mature plants but there has been little evidence of feeding damage to the roots. Aphids can be an issue on seedlings being propagated in the greenhouse, causing curling and distortion of the leaf. In some other daisy species the SL's have been shown to have insecticidal properties against some insects."
	FAO. 2014. Grassland Species Profiles - <i>Arnica Montana</i> . <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 3 Jul 2014]	"Diseases - Crown rot ( <i>Cylindrocarpon</i> sp.) may occur on <i>Arnica montana</i> L."
	Otago Regional Council. 2006. <i>Arnica (Arnica montana)</i> - Otago Crop Database. <a href="http://crops.orc.govt.nz/crop_print_version.php?cropid=1">http://crops.orc.govt.nz/crop_print_version.php?cropid=1</a> . [Accessed 17 Jul 2014]	"Growing <i>arnica</i> can be very challenging as the plants are susceptible to a range of fungal diseases, especially around the crown. Ensuring the soils are free draining and using regular applications of fungicides will minimise these risks. Slugs and snails are the main insect pests that attack the plants and eat the foliage. Trial work is currently looking at the best way of controlling this problem."

407	Causes allergies or is otherwise toxic to humans	
	Source(s)	Notes
	Plants for a Future. 2014. <i>Arnica Montana</i> . <a href="http://www.pfaf.org/user/Plant.aspx?LatinName=Arnica+montana">http://www.pfaf.org/user/Plant.aspx?LatinName=Arnica+montana</a> . [Accessed 14 Jul 2014]	" Although a very valuable remedy, it should be used with caution. It has been known to cause contact dermatitis when used externally and collapse when taken internally[238]. Only take it internally under the supervision of a qualified practitioner. The freshly crushed flowers cause sneezing if inhaled[232]."
	Smallfield, B.M. & Douglas, M.H. 2008. <i>Arnica montana</i> a grower's guide for commercial production in New Zealand. New Zealand Institute for Crop and Food Research Limited, Christchurch, New Zealand	[Can cause adverse skin reactions] "Flowers can be plucked from the flower stem using the thumb and index finger or sliding a group of flowers between the index finger and the second finger and pulling upwards in a sharp action." ... "Disposable gloves should be worn when picking flowers to avoid skin reactions and wearing long sleeves or arm guards will minimise brushing contact of the arms and wrist areas against the flowers and flower stems."
	FAO. 2014. Grassland Species Profiles - <i>Arnica Montana</i> . <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 3 Jul 2014]	[Possibly if taken internally] "Helenalin may cause dermatitis in some individuals. Internal use can exhibit a toxic action on the heart and cause very large increases in blood pressure."

Qsn #	Question	Answer
	Small, E. & Catling, P.M. 1999. Canadian Medicinal Crops. NRC Research Press, Ottawa, Canada	[Yes if taken internally] "Arnica should not be taken internally as it is sufficiently toxic that it can cause fatal poisoning." ... "Arnica, from the European Arnica Montana, is said to be one of the most frequently used homeopathic remedies for sports injuries, including "Tennis Elbow." Swiss mountain climbers have sought out the herb and chewed it to relieve sore, tired muscles (a dangerous practice in view of its poisonous and allergenic properties."
	Khan, I. A., & Abourashed, E. A. 2010. Leung's encyclopedia of common natural ingredients: used in food, drugs and cosmetics. John Wiley & Sons, Hoboken, New Jersey	[Yes, if taken internally] "Arnica montana is not recommended for any internal uses. The plant is an irritant to mucous membranes, and ingestion may cause burning pain in the stomach, diarrhea, vomiting, giddiness, intense muscular weakness, collapse, decrease or increase of the pulse rate, shortness of breath, and death."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Lázaro, A. 2010. Development of Prescribed Burning and Suppression Fire in Europe. Pp. 17-34 in Montiel, C. and Kraus, D. (eds.). Best Practices of Fire Use – Prescribed Burning and Suppression Fire Programmes in Selected Case-Study Regions in Europe. European Forest Institute, Joensuu, Finland	[No evidence of increased fire risk from this plant. Prescribed burning used to improve habitat for Arnica montana] "In the Netherlands, the use of prescribed burning is used in military areas to maintain open heathlands, since in some areas unexploded ammunition prevents the use of sod-cutting and mowing (e.g. Oldebroek and Harskamp shooting areas). The main objectives are to conserve particular heathland plant species (Arnica montana), black grouse and certain insects (van der Zee 2004)."
	FAO. 2014. Grassland Species Profiles - Arnica Montana. <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 17 Jul 2014]	[No evidence, and unlikely given growth habit & habitat] "Arnica is a herbaceous perennial plant." ... "Arnica grows on montane to alpine meadows and pastures and in light forests up to the alpine level. Arnica bears full light but prefers partial shade. The subspecies montana is widely distributed, occurs in mountainous areas and prefers poor meadows on acid soils, whereas subspecies atlantica (Bolós) is restricted to an area ranging from south-west France to south Portugal."

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	Notes
	FAO. 2014. Grassland Species Profiles - Arnica Montana. <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 3 Jul 2014]	"Arnica bears full light but prefers partial shade."
	Plants for a Future. 2014. Arnica Montana. <a href="http://www.pfaf.org/user/Plant.aspx?LatinName=Arnica+montana">http://www.pfaf.org/user/Plant.aspx?LatinName=Arnica+montana</a> . [Accessed 14 Jul 2014]	"Prefers a position in full sun"

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	Source(s)	Notes

Qsn #	Question	Answer
	Plants for a Future. 2014. <i>Arnica Montana</i> . <a href="http://www.pfaf.org/user/Plant.aspx?LatinName=Arnica+montana">http://www.pfaf.org/user/Plant.aspx?LatinName=Arnica+montana</a> . [Accessed 14 Jul 2014]	"Prefers a moist, well-drained humus rich soil, preferably lime-free [200]. One report says that it is often found in calcareous soils in the wild[7]. Tolerates a pH in the range 5.8 to 7.6. Prefers a mixture of sand, loam and peat[1]."
	FAO. 2014. Grassland Species Profiles - <i>Arnica Montana</i> . <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 3 Jul 2014]	"This species thrives in a mixture of dry and humusy loam, peat, and sand with a pH of 5-6 but not on limy soils."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	FAO. 2014. Grassland Species Profiles - <i>Arnica Montana</i> . <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 3 Jul 2014]	" <i>Arnica</i> is a herbaceous perennial plant. The plant height ranges from 30 –60 cm. One or two pairs of leaves form a flat rosette. They are entire, bright green, toothed and somewhat hairy on the upper surface. The lower leaves are clustered, ovate, ciliated and have rounded tips. The upper leaves are smaller, lance-shaped, opposite and attached directly to the stem."

412	Forms dense thickets	n
	Source(s)	Notes
	Venture Southland. 2014. Crops for Southland - <i>Arnica (Arnica montana)</i> . <a href="http://www.venturesouthland.co.nz/EconomicDevelopment/Regional-Projects/Agriculture-and-Food/Crops-for-Southland/articleType/ArticleView/articleId/240/Arnica-Arnica%20montana">http://www.venturesouthland.co.nz/EconomicDevelopment/Regional-Projects/Agriculture-and-Food/Crops-for-Southland/articleType/ArticleView/articleId/240/Arnica-Arnica montana</a> . [Accessed 16 Jul 2014]	"Weed control: Essential. <i>Arnica</i> is a very slow growing plant and competition from weeds such as white clover is a major problem. One of the main impediments to organic production." [No evidence, and unlikely given its slow growth rate and susceptibility to competition from other plants]
	Luijten, S. H., Dierick, A., Gerard, J., Oostermeijer, B., Raijmann, L. E., & Den Nijs, H. 2000. Population size, genetic variation, and reproductive success in a rapidly declining, self-incompatible perennial ( <i>Arnica montana</i> ) in The Netherlands. <i>Conservation Biology</i> , 14(6): 1776-1787	[No evidence] " <i>A. montana</i> L. (Asteraceae) is a long-lived, rosette-forming perennial that grows in unmanured, mown or grazed grasslands, and dry heathlands (Ferguson 1976). Its distribution is restricted to Europe, where it occurs from southern Scandinavia to northern Italy and in the Carpathians (Hulten & Fries 1986). Especially in northern parts of its distribution range, the species is becoming rare. Until about 1900, <i>A. montana</i> was a common species in The Netherlands, occurring on higher sandy soils in heathland and peat-moors (Heukels 1911)."

501	Aquatic	n
	Source(s)	Notes
	FAO. 2014. Grassland Species Profiles - <i>Arnica Montana</i> . <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 3 Jul 2014]	" <i>Arnica</i> grows on montane to alpine meadows and pastures and in light forests up to the alpine level." [Terrestrial]

502	Grass	n
	Source(s)	Notes

Qsn #	Question	Answer
	USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: <a href="http://www.ars-grin.gov/">http://www.ars-grin.gov/</a> . [Accessed 3 Jul 2014]	Asteraceae

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	FAO. 2014. Grassland Species Profiles - Arnica Montana. <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 3 Jul 2014]	"Arnica is a herbaceous perennial plant." [Asteraceae]

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	FAO. 2014. Grassland Species Profiles - Arnica Montana. <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 14 Jul 2014]	"Arnica is a herbaceous perennial plant." ... "The rhizome is dark brown, cylindrical, usually curved, and bears brittle wiry rootlets on the under surface."

601	Evidence of substantial reproductive failure in native habitat	
	Source(s)	Notes
	Sugier, D., Sugier, P., & Gawlik-Dziki, U. 2013. Propagation and Introduction of <i>Arnica montana</i> L. into Cultivation: A Step to Reduce the Pressure on Endangered and High-Valued Medicinal Plant Species. <i>The Scientific World Journal</i> 2013: 1-11	"A. Montana habitats have been fragmented, especially at the edge of its dense geographical range [11]. The negative influence on the arnica population comes from such competitors as <i>Dactylis glomerata</i> [12], <i>Agrostis capillaris</i> [7], <i>Deschampsia flexuosa</i> , and <i>Calamagrostis villosa</i> [10]. Additionally, the main serious damage is caused by slug herbivores and the specialist fly <i>Tephritis arnicae</i> —highly specialized on <i>A. montana</i> , the only parasite found in mountain arnica flower heads being a limiting factor for the geographical and mountain altitude range of this species [13, 14]."
	Kahmen, S., & Poschlod, P. 2000. Population size, plant performance, and genetic variation in the rare plant <i>Arnica Montana</i> L. in the Rhön, Germany. <i>Basic and Applied Ecology</i> , 1(1): 43-51	[Possibly experiencing reproductive failure] "Its distribution is restricted to Europe (Hultén & Fries 1986). In the past, <i>A. montana</i> was a common plant of acidic meadows, pastures and dry heathlands. Recently, habitat destruction has caused its decline. In Germany, <i>A. montana</i> is considered to be a threatened plant species (Korneck et al. 1996) that is abundant only in areas with low intensity land use practice nowadays. Such areas mostly occur in mountainous regions (see Haeupler & Schönfelder 1989, Beukert et al. 1996). The negative impact of acidifying or eutrophicating atmospheric deposition (especially NH <sub>x</sub> and SO <sub>2</sub> ) on <i>A. montana</i> poses an additional threat (Dueck & Elderson 1992, Fennema 1992, Pegtel 1994)."

602	Produces viable seed	y
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	FAO. 2014. Grassland Species Profiles - Arnica Montana. <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 3 Jul 2014]	"The plant can be propagated from root division, cuttings, or seeds, which are of short viability."

603	Hybridizes naturally	
	<b>Source(s)</b>	<b>Notes</b>
	Camp, W.H. and Gilly, C.L. 1943. A Monograph of the Genus Arnica: (Senecioneae, Compositae). Brittonia, 4(3): 386-510	[Unknown for <i>A. montana</i> . No evidence, but hybridization reported from other species in the genus] "The most difficult of interpretation and perhaps the least satisfactory large species in the genus is <i>A. diversifolia</i> " ... "Many times the writer has inclined toward interpreting the population as being genetically highly complex and probably much given to hybridizing. It is quite probable that experimental methods would shed much light concerning the true relationship of the plants of this uncertain population."

604	Self-compatible or apomictic	n
	<b>Source(s)</b>	<b>Notes</b>
	Luijten, S. H., Dierick, A., Gerard, J., Oostermeijer, B., Raijmann, L. E., & Den Nijs, H. 2000. Population size, genetic variation, and reproductive success in a rapidly declining, self-incompatible perennial ( <i>Arnica montana</i> ) in The Netherlands. Conservation Biology, 14(6): 1776-1787	"In a previous study, we found that <i>A. montana</i> is self-incompatible and pollinator-dependent (Luijten et al. 1996)." ... "In a small number of individuals, hand-selfing resulted in a seed set of up to 45%, which suggests a partial breakdown of the self-incompatibility system. Inbreeding depression was observed for seedling size but not for fruit weight or time to germination."
	Luijten, S. H., Kéry, M., Oostermeijer, J. G. B., & Den Nijs, H. 2002. Demographic consequences of inbreeding and outbreeding in <i>Arnica montana</i> : a field experiment. Journal of Ecology, 90(4): 593-603	"The species is highly self-incompatible (Luijten et al. 1996) and is visited by many different insect groups, but predominantly by hoverflies and various bees (Luijten 2001)."

605	Requires specialist pollinators	n
	<b>Source(s)</b>	<b>Notes</b>
	Kahmen, S., & Poschlod, P. 2000. Population size, plant performance, and genetic variation in the rare plant <i>Arnica montana</i> L. in the Rhön, Germany. Basic and Applied Ecology, 1(1): 43-51	"The flowers of <i>A. montana</i> are visited by several flying insects, especially butterflies and flies (field observations). Since <i>A. montana</i> seems to be a generalist in regard to its pollination, it can be assumed that the gene flow is supported mainly by pollen dispersal, even across barriers like forests and over distances of several hundred metres (Ellstrand 1992)."
	Luijten, S. H., Kéry, M., Oostermeijer, J. G. B., & Den Nijs, H. 2002. Demographic consequences of inbreeding and outbreeding in <i>Arnica montana</i> : a field experiment. Journal of Ecology, 90(4): 593-603	"The species is highly self-incompatible (Luijten et al. 1996) and is visited by many different insect groups, but predominantly by hoverflies and various bees (Luijten 2001)."

606	Reproduction by vegetative fragmentation	y
	<b>Source(s)</b>	<b>Notes</b>

Qsn #	Question	Answer
	Kahmen, S., & Poschlod, P. 2000. Population size, plant performance, and genetic variation in the rare plant <i>Arnica Montana</i> L. in the Rhön, Germany. <i>Basic and Applied Ecology</i> , 1(1): 43-51	" <i>A. montana</i> is a long-lived perennial that reproduces both sexually and asexually. It is an outcrossing species and clonal reproduction is by way of rhizomes." ... "As <i>A. montana</i> is a clonal species the majority of the offspring is possibly produced by relatively old individuals of the extant populations. One plant can produce several new stems by rhizomes each year (Schwabe 1990) so that it is quite likely that one individual can live for several decades."
	Luijten, S. H., Kéry, M., Oostermeijer, J. G. B., & Den Nijs, H. 2002. Demographic consequences of inbreeding and outbreeding in <i>Arnica montana</i> : a field experiment. <i>Journal of Ecology</i> , 90(4): 593-603	" <i>Arnica montana</i> L. (Asteraceae) is a rosette-forming perennial of nutrient-poor grasslands and dry heathlands, distributed mainly in the mountainous regions of Central Europe (Hulten & Fries 1986). The species reproduces vegetatively by means of short underground rhizomes, as well as sexually, flowering from the end of May until early July"
	Sugier, D., Sugier, P., & Gawlik-Dziki, U. 2013. Propagation and Introduction of <i>Arnica montana</i> L. into Cultivation: A Step to Reduce the Pressure on Endangered and High-Valued Medicinal Plant Species. <i>The Scientific World Journal</i> 2013: 1-11	"Our studies indicate that in very favourable field conditions, without inter- and intraspecific competition (common in natural habitats), <i>A. montana</i> can produce clumping ramets which are developed from the short rhizomes of the spreading ramets, thereby representing a phalanx growth form [42, 43]."

607	Minimum generative time (years)	1
	Source(s)	Notes
	Smallfield, B.M. & Douglas, M.H. 2008. <i>Arnica montana</i> a grower's guide for commercial production in New Zealand. New Zealand Institute for Crop and Food Research Limited, Christchurch, New Zealand	"The plants can produce some flowers in the autumn of the first season but the main production would be expected to start in the spring of year two."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	Source(s)	Notes
	Camp, W.H. and Gilly, C.L. 1943. A Monograph of the Genus <i>Arnica</i> : (Senecioneae, Compositae). <i>Brittonia</i> , 4(3): 386-510	[Unknown. No evidence found, but pappus may provide means of external attachment] "achenes tapering toward the base, 6.5 (6.0)-9 (10) mm. long, uniformly and sometimes densely hirsute with short double hairs, and stipitate-glandular; annulus 0.1-0.2 mm. long, inconspicuous, pappus ± length of corolla, stramineous, occasionally darker, barbellate, the setae 0.1-0.15(0.2) mm. long."

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Khan, I. A., & Abourashed, E. A. 2010. <i>Leung's encyclopedia of common natural ingredients: used in food, drugs and cosmetics</i> . John Wiley & Sons, Hoboken, New Jersey	"Perennial herb, up to about 0.6m high; native to mountainous regions of Europe; cultivated in northern India. Part used is the dried flower head."
	Dave's Garden. 2014. PlantFiles: Leafy <i>Arnica</i> , European <i>Arnica</i> , Leopard's Bane, Mountain Tobacco, Mountain Snuff, Sneezewort - <i>Arnica Montana</i> . <a href="http://davesgarden.com/guides/pf/go/54285/">http://davesgarden.com/guides/pf/go/54285/</a> . [Accessed 16 Jul 2014]	[Cultivated intentionally]

Qsn #	Question	Answer
703	Propagules likely to disperse as a produce contaminant	
	Source(s)	Notes
	WRA Specialist. 2014. Personal Communication	Unknown. No evidence of produce contamination found, but cultivation as a crop could result in inadvertent spread of seeds in other cultivated plant materials.

704	Propagules adapted to wind dispersal	y
	Source(s)	Notes
	Luijten, S. H., Dierick, A., Gerard, J., Oostermeijer, B., Raijmann, L. E., & Den Nijs, H. 2000. Population size, genetic variation, and reproductive success in a rapidly declining, self-incompatible perennial ( <i>Arnica montana</i> ) in The Netherlands. <i>Conservation Biology</i> , 14(6): 1776-1787	"The plumed achenes are wind-dispersed. The seeds have no dormancy and germinate from late summer through autumn or in the next spring."
	Kahmen, S., & Poschlod, P. 2000. Population size, plant performance, and genetic variation in the rare plant <i>Arnica Montana</i> L. in the Rhön, Germany. <i>Basic and Applied Ecology</i> , 1(1): 43-51	"The seeds of <i>A. montana</i> are dispersed by wind, but Strykstra et al. (1998) showed that heavy, well-developed achenes of <i>A. montana</i> are carried no more than a few metres."

705	Propagules water dispersed	n
	Source(s)	Notes
	Bakker, J. P., Poschlod, P., Strykstra, R. J., Bekker, R. M., & Thompson, K. 1996. Seed banks and seed dispersal: important topics in restoration ecology §. <i>Acta Botanica Neerlandica</i> , 45(4): 461-490	[Adapted for short distance wind dispersal] "Strykstra (unpublished data) measured in a wind tunnel experiment that 95% of seeds of <i>Arnica montana</i> reached the floor within 3 m. Of the seeds travelling more than 3 m only 5'10 turned out to be viable. compared with 60% of the seeds at 1 m distance."
	FAO. 2014. Grassland Species Profiles - <i>Arnica Montana</i> . <a href="http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm">http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000462.htm</a> . [Accessed 17 Jul 2014]	[Unlikely, given habitat & seed morphology] "The fruits are bristly achenes." ... " <i>Arnica</i> grows on montane to alpine meadows and pastures and in light forests up to the alpine level."

706	Propagules bird dispersed	n
	Source(s)	Notes
	Kahmen, S., & Poschlod, P. 2000. Population size, plant performance, and genetic variation in the rare plant <i>Arnica Montana</i> L. in the Rhön, Germany. <i>Basic and Applied Ecology</i> , 1(1): 43-51	"The seeds of <i>A. montana</i> are dispersed by wind, but Strykstra et al. (1998) showed that heavy, well-developed achenes of <i>A. montana</i> are carried no more than a few metres."

Qsn #	Question	Answer
707	<b>Propagules dispersed by other animals (externally)</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Small, E. & Catling, P.M. 1999. Canadian Medicinal Crops. NRC Research Press, Ottawa, Canada	[Generic description. Pappus of <i>A. montana</i> may aid in adherence to animals] "The seeds, actually achenes (one-seeded dry fruits), are 3-10 mm long with a whitish or brownish pappus. (The pappus refers to the hairs or bristles at the top of the achene, a feature possessed by many members of the daisy family, which serves for dispersal, for example, by wind or attachment to animals."

708	Propagules survive passage through the gut	
	<b>Source(s)</b>	<b>Notes</b>
	Luijten, S. H., Oostermeijer, J. G. B., van Leeuwen, N. C., & den Nijs, H. C. 1996. Reproductive success and clonal genetic structure of the rare <i>Arnica montana</i> (Compositae) in the Netherlands. <i>Plant Systematics and Evolution</i> , 201(1-4): 15-30	[Unknown, but unlikely to be dispersed internally] "The plumed achenes (cypselas) are wind-dispersed. The seeds of <i>A. montana</i> show no dormancy and mostly germinate immediately following dispersal which occurs from late summer through autumn."

801	Prolific seed production (>1000/m2)	n
	<b>Source(s)</b>	<b>Notes</b>
	Luijten, S. H., Dierick, A., Gerard, J., Oostermeijer, B., Raijmann, L. E., & Den Nijs, H. 2000. Population size, genetic variation, and reproductive success in a rapidly declining, self-incompatible perennial ( <i>Arnica montana</i> ) in The Netherlands. <i>Conservation Biology</i> , 14(6): 1776-1787	[Unlikely. Habitat fragmentation and pollen or mate limitation result in reduced seed set] "Fragmentation and deterioration of the habitat have resulted in a rapid decline of <i>A. montana</i> in The Netherlands. Gene flow between populations is extremely limited or even absent, and this probably will not improve in the near future. Reduced levels of genetic variation, especially in the smaller populations, will affect the species' ability to adapt to changes in its habitat. Seed production, offspring performance, and survival in the smaller populations clearly were reduced."

802	Evidence that a persistent propagule bank is formed (>1 yr)	n
	<b>Source(s)</b>	<b>Notes</b>
	Kahmen, S., & Poschlod, P. 2000. Population size, plant performance, and genetic variation in the rare plant <i>Arnica Montana</i> L. in the Rhön, Germany. <i>Basic and Applied Ecology</i> , 1(1): 43-51	"Seeds of <i>A. montana</i> show no dormancy (Kahmen & Poschlod 1998)."
	Luijten, S. H., Kéry, M., Oostermeijer, J. G. B., & Den Nijs, H. 2002. Demographic consequences of inbreeding and outbreeding in <i>Arnica montana</i> : a field experiment. <i>Journal of Ecology</i> , 90(4): 593-603	"There is no persistent seed bank (Thompson et al. 1996); germination occurs either directly after seed-shedding in autumn or in the following spring."

803	Well controlled by herbicides	
	<b>Source(s)</b>	<b>Notes</b>
	WRA Specialist. 2014. Personal Communication	Unknown. No information on herbicide efficacy or chemical control of this species

Qsn #	Question	Answer
804	Tolerates, or benefits from, mutilation, cultivation, or fire	n
	Source(s)	Notes
	Luijten, S. H., Kéry, M., Oostermeijer, J. G. B., & Den Nijs, H. 2002. Demographic consequences of inbreeding and outbreeding in <i>Arnica montana</i> : a field experiment. <i>Journal of Ecology</i> , 90(4): 593-603	[Does not tolerate cultivation or collecting] "Habitat fragmentation, eutrophication and agricultural intensification have led to a rapid decline of <i>Arnica</i> in the Netherlands. The species is also threatened because it was collected for medical use (Mennema et al. 1985), but since 1973 has been legally protected. It was placed on the Dutch Red List in 1990 (Weeda et al. 1990). Despite the protected status and restoration management of its habitat, the number of populations has declined by 70% over the last 30 years (van der Meijden et al. 2000). Today, 60% of all remaining populations in the Netherlands have fewer than 25 individuals,"

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. 2014. Personal Communication	Unknown

**Summary of Risk Traits:**

## High Risk / Undesirable Traits

- Elevation range exceeds 1000 m in temperate climates
- Reported to be naturalized in North America
- Possibly toxic if ingested & handling may cause dermatitis
- Seeds dispersed by wind & intentionally by people
- Able to spread vegetatively by rhizomes
- Able to reach maturity in 1-2 years

## Low Risk Traits

- No reports of invasiveness or detrimental impacts found
- Unarmed (no spines, thorns or burrs)
- Provides fodder for livestock (palatable despite reports of toxicity)
- Medicinal uses
- Self-incompatible
- Seeds lack dormancy, and does not form a persistent seed bank