

Taxon: <i>Araucaria hunsteinii</i> K. Schum.	Family: Araucariaceae
Common Name(s): klinki pine klinkii pine	Synonym(s): <i>Araucaria klinkii</i> Lauterb. <i>Araucaria schumanniana</i> Warb.

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 21 Dec 2018
WRA Score: 0.0	Designation: L	Rating: Low Risk

Keywords: Tropical Tree, Long-Lived, Light Demanding, Wind-Dispersed, Recalcitrant Seeds

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)	High
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	y
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	y
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		
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	n
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	y
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals		
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n
408	Creates a fire hazard in natural ecosystems		
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
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	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic		
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	>3
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
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)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m2)		
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	y
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
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"Araucaria hunsteinii has been grown as a plantation crop in New Guinea since 1948. The wood is used in the local sawmilling and plywood industries and for making aircraft frames." [Cultivated but not domesticated]

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2018. 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"	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 18 Dec 2018]	"Native Asia-Tropical PAPUASIA: Papua New Guinea (endemic)"

202	Quality of climate match data	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 18 Dec 2018]	

Qsn #	Question	Answer
203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes
	Thomas, P. 2013. <i>Araucaria hunsteinii</i> . The IUCN Red List of Threatened Species 2013: e.T32836A2825399. http://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T32836A2825399.en . [Accessed]	"Climatic amplitude (estimates) - Altitude range: 200 - 2000 m - Mean annual rainfall: 1600 - 4600 mm - Rainfall regime: uniform - Dry season duration: 0 - 2 months - Mean annual temperature: 20 - 27°C - Mean maximum temperature of hottest month: 24 - 32°C - Mean minimum temperature of coldest month: 12 - 24°C"
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"Its altitudinal range is (550-)750-1700(-2100) m a.s.l."
	WRA Specialist. 2018. Personal Communication	Elevation range in tropics exceeds 1000 m, demonstrating environmental versatility

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"Distribution - Papua New Guinea. In the central mountain range from an isolated population on the Wamira River in the east through the Owen Stanley Range and the Bismarck Range, with other isolated stands near Sattelburg in the Huon Peninsula and on the Tagari River in the Central Highlands."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Outside its natural range, it has been experimentally planted in Peninsular Malaysia (Ahmad Zuhaidi et al., 1996) - including an intercropping trial in which coffee plants were established in an -year-old <i>A. hunsteinii</i> plantation (Abd Razak Othman, 1991) - and Sarawak (Butt and Sia, 1982). It has also been planted on a trial basis in Tanzania (Madoffe, 1980), Puerto Rico (Francis, 1988), and Fiji (Soerianegara and Lemmens, 1993)."
	Skolmen, R.G. 1980. Plantings on the forest reserves of Hawaii: 1910–1960. Institute of Pacific Islands Forestry, Pacific Southwest Forest & Range Experiment Station, US Forest Service, Honolulu, HI	A total of 69 <i>Araucaria hunsteinii</i> trees were planted on Hawaii Island in 1958-1959: Waiakea Arboretum = 50 planted in 1958 Manuka in S. Kona Forest Reserve = 2 planted in 1959 Waiakea in Waiakea Forest Reserve = 17 planted in 1959

301	Naturalized beyond native range	
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"References: Ecuador-N-875." [Reported to be naturalized in Ecuador, but cited online reference is no longer available at the link provided. Confirmation needed]

302	Garden/amenity/disturbance weed	n
-----	--	----------

Qsn #	Question	Answer
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

303	Agricultural/forestry/horticultural weed	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

304	Environmental weed	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

305	Congeneric weed	
	Source(s)	Notes
	Richardson, D. M., & Rejmánek, M. 2004. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions, 10(5-6): 321-331	"A. columnaris (Hawaii); A. heterophylla (New Zealand)" [Naturalized, but no evidence of detrimental impacts]
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Multiple Araucaria species are listed as naturalized and/or invasive weeds, but evidence of impacts is generally unspecified.

401	Produces spines, thorns or burrs	y
	Source(s)	Notes
	FAO. 1986. Databook On Endangered Tree And Shrub Species And Provenances. Fao Forestry Paper 77. Forest Resources Division, FAO Forestry Department, Rome. Italy	"Cone covered with sharp spines."
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	[No evidence from tree and foliage. Cones with spines] "Monoecious trees to 90 m tall, to 2 m d.b.h. or more; trunk straight, very gradually tapering. Bark thick, rough and scaly, exfoliating in large plates and scales; inner bark reddish; outer bark dark brown to black." ... "Foliage branchlets spreading in all directions or pendent on ends of primary branches in mature trees, forming large tufts of up to 50 cm long foliage branchlets of very unequal width (including leaves) from base to apex. In mature trees leaves of two kinds: adult leaves on primary branches and semi-juvenile leaves on adventitious branches. Adult leaves of ultimate branchlets imbricate at base but spreading radially at a wide angle, often in 5 distinct rows, bifacially flattened, triangular to lanceolate, (2-)5-10(-15) cm x (8-)12-20(-25) mm, increasing in size from base to apex of branchlet; margins tapering to a sharply pungent apex."

402	Allelopathic	
------------	---------------------	--

Qsn #	Question	Answer
	Source(s)	Notes
	Braine, J. W., Curcio, G. R., Wachowicz, C. M., & Hansel, F. A. (2012). Allelopathic effects of <i>Araucaria angustifolia</i> needle extracts in the growth of <i>Lactuca sativa</i> seeds. <i>Journal of Forest Research</i> , 17(5), 440-445	[Unknown. Other <i>Araucaria</i> species have allelopathic properties] " <i>Araucaria</i> forest, named due to the high abundance of <i>Araucaria angustifolia</i> , occurs mainly in the southern Brazilian highlands, and the abundance of <i>A. angustifolia</i> in the forest is a current forest issue. The present study aimed at evaluating a potential allelopathic effect of <i>A. angustifolia</i> needle extracts that could mediate plant successional dynamics in the <i>Araucaria</i> forests. Senescent <i>araucaria</i> needles from <i>A. angustifolia</i> were evaluated for their allelopathic potential on <i>Lactuca sativa</i> through an in vitro study. The effect was evaluated by determining the germination of seeds, length of seedling and germination rate. The allelopathic potential of the <i>A. angustifolia</i> was confirmed for the highest doses tested (187.5 and 250 mg of the extracts). The potential allelochemical compounds identified were ent-kaurene and phyllocladene. In conclusion, <i>A. angustifolia</i> showed a potential allelopathic effect that may play an important role in successional dynamics of <i>Araucaria</i> forests."

403	Parasitic	n
	Source(s)	Notes
	Farjon, A. 2010. <i>A Handbook of the World's Conifers</i> . Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"Monoecious trees to 90 m tall, to 2 m d.b.h. or more; trunk straight, very gradually tapering." [<i>Araucariaceae</i> . No evidence]

404	Unpalatable to grazing animals	
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Unknown. <i>Araucaria araucana</i> is palatable at early stages of growth] "...although remaining stands are in National Parks, summer browsing by sheep and goats prevents regeneration (Anon, 1988; the photos show no young trees). The extent of the grazing must be considerable, as the government provides schooling for the shifting farmers' families. Once the leader shoot is out of reach, <i>A. araucana</i> is very resistant to browsing by animals."

405	Toxic to animals	n
	Source(s)	Notes
	Quattrocchi, U. 2012. <i>CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology</i> . CRC Press, Boca Raton, FL	No evidence
	NIH U.S. National Library of Medicine. 2018. TOXNET Toxicology Data Network. https://toxnet.nlm.nih.gov/ . [Accessed 19 Dec 2018]	No evidence

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

Qsn #	Question	Answer
	Ramsden, M., McDonald, J., & Wylie, F. R. (2002). Forest pests in the South Pacific region: A review of the major causal agents of tree disorders. ACIAR Project FST/2001/045. Department of Primary Industries, Agency for Food and Fibre Sciences, Forestry Research, Queensland, Australia	"Coptotermes elisae (Desneaux) – Subterranean termite Coptotermes elisae has caused considerable mortality among plantations of Araucaria cunninghamii and Araucaria hunsteinii in sub-montane areas of Papua New Guinea (Gray and Buchter, 1969). In some compartments incidence of infestation was about 7% and nearly all attacked trees died."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Pests recorded Insects: Coptotermes curvignathus (rubber termite) Pests recorded at the generic level (Araucaria): Insects: Coptotermes elisae Cydia araucariae Nematodes: Helicotylenchus dihystrera (common spiral nematode)"
	Gray, B. (1968). Forest tree and timber insect pests in the Territory of Papua and New Guinea. Pacific Insects, 10(2), 301-323	"The weevil honeycombs extensively the cones of A. hunsteinii seeds in the virgin forest (Havel 1962). Up to 30-40% of the seed may be damaged ; the damage varies considerably from area to area in the Wau-Bulolo area (J. Thompson, pers, comm., 1967)." ... "A. cunninghamii appears to be more susceptible to insects than A. hunsteinii. Several species—D. undata, H. araucariae, M. isodoxa and V. oberthuri—attack and cause the death of the former species, but they hardly affect or do not attack A. hunsteinii. For this reason, the Department of Forests intends to plant much more A. hunsteinii in the future." ... "The most serious pest in the plantations is H. araucariae which infests A. cunninghamii. Several species—C. elisae, Coptotermes, D. undata, M. isodoxa, and V. oberthuri, kill living A. cunninghamii trees, but in relatively small numbers. Only C. elisae appears to be the only species capable of killing A. hunsteinii; however, control measures now used are quite successful in lessening the damage caused by the termite. Owing to the non-susceptibility of A. hunsteinii to serious attack by several serious pests of A. cunninghamii, much more of the former tree species will be planted in future. There are several important species of timber borers in the Territory."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	NIH U.S. National Library of Medicine. 2018. TOXNET Toxicology Data Network. https://toxnet.nlm.nih.gov/ . [Accessed 19 Dec 2018]	No evidence
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence. Araucaria cunninghamii timber reported to cause dermatitis

408	Creates a fire hazard in natural ecosystems	
	Source(s)	Notes

Qsn #	Question	Answer
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"This species occurs in two types of forest, a drier and a wetter one; in the drier type the canopy of angiosperms reaches only 15-25 m of average height, with <i>A. hunsteinii</i> attaining twice that height." ... "Precipitation ranges from 800 mm to more than 4000 mm per year.' [Possibly burns in drier habitats, but precipitation amounts from native range suggest tree does not occur in fire prone areas]
	Havel, J. J. (1971). The Araucaria forests of New Guinea and their regenerative capacity. The Journal of Ecology, 59 (1): 203-214	[Grass-carrying fires may suppress establishment of Araucaria. No indication that Araucaria itself increases fire risk] "A study of secondary succession on cleared sites in relation to weed control in araucarian plantations (Havel 1960a) has brought out the important point that the grass <i>Imperata cylindrica</i> , normally the main component of pyrogenic grassland, very markedly suppresses the growth of Araucaria seedlings. Experimental plantings of araucarias in the grasslands have proved largely a failure, unless adequate weed control was carried out. Thus, quite apart from the fire danger, pyrogenic grasslands do not provide a good opportunity for colonization by Araucaria."

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"It is a light-demanding species, and frost tender."
	Eckenwalder, J.E. 2009. Conifers of the World: The Complete Reference. Timber Press, Portland, OR	"Klinki pine does not regenerate well in shade or deep organic soils so large disturbances seem to be required for establishment of stands."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"It is found on well-drained (though moist) sites on a variety of soils, often in sub-montane forests at altitudes between 500 and 2000 m. Soil descriptors - Soil texture: medium; heavy - Soil drainage: free - Soil reaction: acid; neutral"

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"Monoecious trees to 90 m tall, to 2 m d.b.h. or more; trunk straight, very gradually tapering."

412	Forms dense thickets	y
	Source(s)	Notes
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"This species forms 'groves' or stands, or occurs scattered in tropical montane monsoon forests on moist sites usually in inter-montane valleys."

Qsn #	Question	Answer
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[Natural dense stands formed in native range] "A. hunsteinii occurs naturally in Papua New Guinea and Irian Jaya (Indonesia) as isolated remnant pockets of forest or as fairly dense stands on mountain slopes and ridges."

501	Aquatic	n
	Source(s)	Notes
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	[Terrestrial tree] "This species occurs in two types of forest, a drier and a wetter one; in the drier type the canopy of angiosperms reaches only 15-25 m of average height, with A. hunsteinii attaining twice that height."

502	Grass	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 18 Dec 2018]	Family: Araucariaceae

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 18 Dec 2018]	Family: Araucariaceae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	FAO. 1986. Databook On Endangered Tree And Shrub Species And Provenances. Fao Forestry Paper 77. Forest Resources Division, FAO Forestry Department, Rome. Italy	"A large, unbuttressed, symmetrical tree, 50-80 m high, bole straight, cylindrical, self pruning, clear to 35 m or more, up to 2 m diameter. Crown pyramidal to rounded."

Qsn #	Question	Answer
601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Thomas, P. 2013. <i>Araucaria hunsteinii</i> . The IUCN Red List of Threatened Species 2013: e.T32836A2825399. http://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T32836A2825399.en . [Accessed 18 Dec 2018]	" <i>A. hunsteinii</i> 's extent of occurrence is estimated to be more than 20,000 km ² . Although no reliable estimates exist for its area of occupancy, it is likely to be less than 2,000 km ² . It is known from more than 10 locations and the populations are not yet severely fragmented in the context of the IUCN definitions. While there has been significant historic exploitation for its timber and recent losses due to fires, the extent of this decline is uncertain although it is likely to be at least 30%. In the absence of better information an assessment of Near Threatened is appropriate (it almost qualifies for listing as threatened under criteria A2cd and B2ab(iii))."

602	Produces viable seed	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Seeds have short viability."
	FAO. 1986. Databook On Endangered Tree And Shrub Species And Provenances. Fao Forestry Paper 77. Forest Resources Division, FAO Forestry Department, Rome. Italy	"There are 2000-2500 dry dewinged seeds per kg. Seedlings can be raised by the pregermination technique or by sowing into beds with overhead shade (White and Cameron 1965, Ntima, 1968; Howcroft, 1974)."

603	Hybridizes naturally	
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[Artificial hybrids attempted with other species. No evidence for <i>Araucaria hunsteinii</i>] "There have been hybridizing attempts with <i>A. angustifolia</i> (Tesdorff, 1953, 1956, 1961, 1978) but no later references were found. These crosses involved both female <i>A. araucana</i> and male <i>A. angustifolia</i> in Misiones in Central Argentina and vice versa. The pollen used retained its viability through cold storage. Some 68 seedlings from female <i>A. araucana</i> were raised but only 3 from the female <i>A. angustifolia</i> ."

604	Self-compatible or apomictic	
	Source(s)	Notes
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"Monoecious trees to 90 m tall" [Unknown, but possible]

Qsn #	Question	Answer
605	Requires specialist pollinators	n
	Source(s)	Notes
	de Laubenfels, D.J. 1988. Flora Malesiana. Series I, Spermatophyta: Flowering plants. Volume 10, part 3. Coniferales. Rijksherbarium / Hortus Botanicus, Leiden, The Netherlands	[Wind-dispersed] "Pollen cones subtended by a cluster of reduced, leaf-like, sterile bracts, often broadened at their bases and where the mature leaves are needle-like these bracts are at least somewhat broader and flatter. Fertile bract of the seed cone broad and often extended laterally into membranous wings, the apex provided with a prominent narrow spur above the thickened apical margin."
606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"- Vegetative propagation by grafting - Stand establishment using natural regeneration; planting stock" [No evidence of natural vegetative spread]
607	Minimum generative time (years)	>3
	Source(s)	Notes
	Bonner, F.T. & Karrfalt, R.P. (eds.). 2008. The Woody Plant Seed Manual. USDA FS Agriculture Handbook 727. Government Printing Office, Washington, D.C.	"Araucarias generally begin to flower and set seeds between the age of 15 to 20 years."
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"Seed scales not wider but longer than the seed; ligule small, 2-3 x mm. Seeds narrowly almond shaped, ca. 30 x 8 mm, distinctly flattened, smooth." [Seeds are fairly large and, lacking means of external dispersal, are unlikely to be inadvertently dispersed]
702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Outside its natural range, it has been experimentally planted in Peninsular Malaysia (Ahmad Zuhaidi et al., 1996) - including an intercropping trial in which coffee plants were established in an 8-year-old <i>A. hunsteinii</i> plantation (Abd Razak Othman, 1991) - and Sarawak (Butt and Sia, 1982). It has also been planted on a trial basis in Tanzania (Madoffe, 1980), Puerto Rico (Francis, 1988), and Fiji (Soerianegara and Lemmens, 1993)."
	Skolmen, R.G. 1980. Plantings on the forest reserves of Hawaii: 1910–1960. Institute of Pacific Islands Forestry, Pacific Southwest Forest & Range Experiment Station, US Forest Service, Honolulu, HI	A total of 69 <i>Araucaria hunsteinii</i> trees were planted on Hawaii Island in 1958-1959: Waiakea Arboretum = 50 planted in 1958 Manuka in S. Kona Forest Reserve = 2 planted in 1959 Waiakea in Waiakea Forest Reserve = 17 planted in 1959
703	Propagules likely to disperse as a produce contaminant	n

Qsn #	Question	Answer
	Source(s)	Notes
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"Seed scales not wider but longer than the seed; ligule small, 2-3 x mm. Seeds narrowly almond shaped, ca. 30 x 8 mm, distinctly flattened, smooth." [No evidence. The large size makes inadvertent dispersal or contamination highly unlikely]

704	Propagules adapted to wind dispersal	y
	Source(s)	Notes
	Bonner, F.T. & Karrfalt, R.P. (eds.). 2008. The Woody Plant Seed Manual. USDA FS Agriculture Handbook 727. Government Printing Office, Washington, D.C.	"Araucaria seeds may be carried a short distance from the mother tree by wind, but generally the seeds fall within the periphery of the crown (Ntima 1968)."
	Havel, J. J. (1971). The Araucaria forests of New Guinea and their regenerative capacity. The Journal of Ecology, 59 (1): 203-214	"Except for seed blown in from near-by unaffected areas, no further seeds would be available until the original colonizers reached maturity."
	Eckenwalder, J.E. 2009. Conifers of the World: The Complete Reference. Timber Press, Portland, OR	"Seed scales (3-)4-5(-6) cm long, 7-10 cm wide, including the huge, papery, triangular wings, extending out 3-4 cm on either side of the swollen, central seed-bearing portion, with an upturned, fragile, spinelike free tip up to 2 cm long but usually broken off in the mature cones."
	Trebrown Nurseries. (2018). Araucaria hunsteinii. http://www.trebrown.com/plant_info.php?species=Araucaria+hunsteinii . [Accessed 19 Dec 2018]	"seed wings broad to 4 cm wide on each side (total width to ca. 8 cm). Seeds are dispersed from the cones whilst on the tree, and seeds fly a considerable distance from the parent tree."

705	Propagules water dispersed	n
	Source(s)	Notes
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"Seed scales not wider but longer than the seed; ligule small, 2-3 x mm. Seeds narrowly almond shaped, ca. 30 x 8 mm, distinctly flattened, smooth." ... "This species forms 'groves' or stands, or occurs scattered in tropical montane monsoon forests on moist sites usually in inter-montane valleys" [No evidence. Wind-dispersed seeds. Not reported to occur in riparian habitats, so water is unlikely to be an important secondary dispersal vector]

706	Propagules bird dispersed	n
	Source(s)	Notes
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"Seed scales not wider but longer than the seed; ligule small, 2-3 x mm. Seeds narrowly almond shaped, ca. 30 x 8 mm, distinctly flattened, smooth." [No evidence. Wind-dispersed seeds]

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes

Qsn #	Question	Answer
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"Seed scales not wider but longer than the seed; ligule small, 2-3 x mm. Seeds narrowly almond shaped, ca. 30 x 8 mm, distinctly flattened, smooth." [Rodent seed predators sometimes transport seeds of other Araucaria species, a few of which may escape predation. No evidence of rodent dispersal found for Araucaria hunsteinii]
	Royal Botanic Gardens Kew. (2018) Seed Information Database (SID). Version 7.1. Available from: http://data.kew.org/sid/ . [Accessed 19 Dec 2018]	"Wind; Diaspore is blown by wind; Assumption based upon diaspore morphology; (Enright, 1995); Diaspore=seed. The diaspore has wings or wing-like features."

708	Propagules survive passage through the gut	n
	Source(s)	Notes
	Farjon, A. 2010. A Handbook of the World's Conifers. Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"Seed scales not wider but longer than the seed; ligule small, 2-3 x 5 mm. Seeds narrowly almond-shaped, ca. 30 x 8 mm, distinctly flattened, smooth." [Relatively large seeds unlikely to be internally dispersed. Seed predators might consume seeds]
	Royal Botanic Gardens Kew. (2018) Seed Information Database (SID). Version 7.1. Available from: http://data.kew.org/sid/ . [Accessed 19 Dec 2018]	"Wind; Diaspore is blown by wind; Assumption based upon diaspore morphology; (Enright, 1995); Diaspore=seed. The diaspore has wings or wing-like features."

801	Prolific seed production (>1000/m2)	
	Source(s)	Notes
	FAO. 1986. Databook On Endangered Tree And Shrub Species And Provenances. Fao Forestry Paper 77. Forest Resources Division, FAO Forestry Department, Rome. Italy	"There are 2000-2500 dry dewinged seeds per kg." [Large trees could produce large numbers of seeds, but short viability and relatively large seed size make it unlikely that seed densities in excess of 1000 per m2 would ever be reached]

Qsn #	Question	Answer
802	Evidence that a persistent propagule bank is formed (>1 yr)	n
	Source(s)	Notes
	Tompsett, P. (1982). The effect of desiccation on the longevity of seeds of <i>Araucaria hunsteinii</i> and <i>A. cunninghamii</i> . <i>Annals of Botany</i> , 50(5), 693-704	"In the present study, seeds of two <i>Araucaria</i> species were dried in a number of different ways in order to determine their storage physiology type with certainty. The results indicate that <i>A. cunninghamii</i> seed can safely be dried to 7 per cent moisture content with no loss of viability and can thus be classed as 'orthodox'. Seed of <i>A. hunsteinii</i> , on the other hand, showed loss of germination ability with desiccation at relatively high moisture contents, regardless of the method of drying employed, and thus falls into the 'recalcitrant' category."
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	"Seeds have short viability." ... "Stand establishment using natural regeneration; planting stock"
	Farjon, A. 2010. <i>A Handbook of the World's Conifers</i> . Volume 1. Koninklijke Brill NV, Leiden, The Netherlands	"The recalcitrant seeds cannot be stored for long periods making propagation from seed difficult."
	Havel, J. J. (1971). The <i>Araucaria</i> forests of New Guinea and their regenerative capacity. <i>The Journal of Ecology</i> , 59(1): 203-214	"There is absolutely no carry over of seed from year to year. Colonization of areas devastated by a large scale fire or other natural catastrophe, as postulated by Womersley, would need to take place immediately, as the seed source would also be destroyed and no viable araucarian seeds would remain on the ground for more than 4 months."

803	Well controlled by herbicides	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	Unknown. No information on herbicide efficacy or chemical control of this species, and no evidence that this tree has been targeted for control

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	Zuhaidi, Y. A., Afzal-Ata, M., & Weinland, G. (1996). Marking trial for thinning of <i>Araucaria hunsteinii</i> plantation in Peninsular Malaysia. <i>Journal of Tropical Forest Science</i> , 9(1): 6-15	[Coppices] "The stand contained a high proportion of straight trees with scattered diseased and forked stems. Self-pruning was very good. Some sapling size coppiced trees were also found." ... "All trees in the thinning plot were numbered, except for small size trees developed from coppices of uprooted and felled trees. "

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits

- Elevation range exceeds 1000 m, demonstrating environmental versatility
- Grows in tropical climates
- Possibly naturalized in Ecuador (unconfirmed)
- Cone covered with sharp spines
- Latex highly caustic to the skin, possibly poisonous if ingested
- Tolerates many soil types
- Forms dense stands in native range
- Reproduces by seeds
- Seeds dispersed by wind & intentionally by people
- Able to coppice & resprout after cutting

Low Risk Traits

- No reports of negative impacts where cultivated outside native range
- Non-toxic
- Light-demanding (unlikely to establish in intact forest understory)
- Not reported to spread vegetatively
- Long time to reproductive maturity
- Relatively large seeds unlikely to be inadvertently dispersed
- Recalcitrant seeds will not form a persistent seed bank