

Key Words: Low Risk, Naturalized, Slow-growing Tree, Large-seeded, Ornamental

Family: *Araucariaceae*

Taxon: *Araucaria araucana*

Synonym: *Araucaria imbricata* Pav.
Pinus araucana Molina (*basionym*)

Common Name: Chilean pine
Monkey puzzle tree

Questionnaire :	current 20090513	Assessor:	Chuck Chimera	Designation: L
Status:	Assessor Approved	Data Entry Person:	Chuck Chimera	WRA Score -1
101	Is the species highly domesticated?		y=-3, n=0	n
102	Has the species become naturalized where grown?		y=1, n=-1	
103	Does the species have weedy races?		y=1, n=-1	
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)	Intermediate
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	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		n=0, y = 1*multiplier (see Appendix 2)	
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		n=0, y = 1*multiplier (see Appendix 2)	
401	Produces spines, thorns or burrs		y=1, n=0	y
402	Allelopathic		y=1, n=0	
403	Parasitic		y=1, n=0	n
404	Unpalatable to grazing animals		y=1, n=-1	n
405	Toxic to animals		y=1, n=0	n
406	Host for recognized pests and pathogens		y=1, n=0	
407	Causes allergies or is otherwise toxic to humans		y=1, n=0	n
408	Creates a fire hazard in natural ecosystems		y=1, n=0	
409	Is a shade tolerant plant at some stage of its life cycle		y=1, n=0	y
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	y=1, n=-1	
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	>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	n
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	
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m2)	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	y=-1, n=1	
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)	y=-1, n=1	

Designation: L

WRA Score -1

Supporting Data:

101	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Is the species highly domesticated? No] No evidence
102	2012. WRA Specialist. Personal Communication.	NA
103	2012. WRA Specialist. Personal Communication.	NA
201	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Species suited to tropical or subtropical climate(s) 1-Intermediate] "A. araucana is a long-lived conifer native to Chile and Argentina. It is now restricted to a narrow range of latitudes, in Chile 37°30' to 39°30'S; and 37°45' to 40°20'S in Argentina (Aagesen, 1998). There are two disjunct populations, the main one straddles the Andes in Argentina, and the other is in the Nahuelbuta range in Chile. The latter population is very restricted and listed in CITES Appendix I. The Andean populations are severely fragmented and listed in CITES Appendix II (Oldfield et al., 1998). It is strongly straight-stemmed, strongly monopodial (multiple leaders are extremely rare) and grows to 30-40 m tall (occasionally up to 50 m) and 100-150 cm in diameter. It is long-lived (possibly >1000 years)."
202	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Quality of climate match data 2-High]
203	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Broad climate suitability (environmental versatility)? Yes] "A. araucana is tolerant of a wide range of sites where the summer temperatures are not very hot and where the annual rainfall ranges from 900 to 3500 mm. It is tolerant of the frost and snow conditions in the British Isles, but thrives best in the wetter and, in winter, more moderate cold of the west (Elwes and Henry, 1906). The most severe British winters generally kill off some trees. In Czechoslovakia, some A. araucana survived temperatures as low as -15°C but needed protection from frozen soil by a 20 cm deep leaf cover; by age 10 trees were 133 cm tall (Mottl, 1983). At the other end of the climatic scale, the tree survives as an exotic in the relatively arid/summer heat conditions from Santiago in Chile to just crossing the southern Queensland border in Australia (G. Nikles, personal communication). The South African climate is generally too warm for it to thrive there (Kotze, 1923)." ..."- Altitude range: 0 - 2000 m - Mean annual rainfall: 900 - 3500 mm - Rainfall regime: bimodal; uniform - Dry season duration: 0 - 2 months - Mean annual temperature: > 12°C - Mean maximum temperature of hottest month: > 20°C - Mean minimum temperature of coldest month: > 0°C - Absolute minimum temperature: > -15°C"
204	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Native or naturalized in regions with tropical or subtropical climates? No evidence] "The South African climate is generally too warm for it to thrive there (Kotze, 1923)."
204	2007. Randall, R.P.. Global Compendium of Weeds - Araucaria araucana. http://www.hear.org/gcw/species/araucaria_araucana/	[Native or naturalized in regions with tropical or subtropical climates? No] No evidence
205	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Does the species have a history of repeated introductions outside its natural range? Yes] "It has been widely planted as a specimen tree in temperate areas all over the world, but there are virtually no plantations. Streets (1962) reported that it had been trialled on a small scale in Kenya (where it failed), and in New Zealand (no further reports). A small scale plantation was established in southwest Scotland in 1916 (Williams and Winn, 1977). The plantation was near the coast and fully exposed to the wind, and had suffered from windblow. Moderate growth rates in comparison with other plantation species have been one of the reasons that the species has not been planted more widely."
301	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions. 10: 321-331.	[Naturalized beyond native range? Potentially] "The 15 non-pine conifers (out of 507 species; 3%) known to be invasive (seven in the Pinaceae; six in Cupressaceae, one in Araucariaceae, one in Podocarpaceae) are: Abies grandis, Abies procera, Araucaria araucana" ... "Araucaria araucana (Argentina; Great Britain*); [A. araucana = invasive in Great Britain, but this information in contradicted by Ison and Braithwaite (2009), who state that A. araucana is not fully naturalized]

301	2009. Ellis, G./Braithwaite, M.. BSBI Spring Conference on alien trees and shrubs, Berwick-upon-Tweed, 9th - 11th May. BSBI News. 112: 59-64.	[Naturalized beyond native range? Yes] "The afternoon was spent at Kyloe woods, almost 1,000 acres of conifers managed by Scottish Woodlands for the Fleming family, with harvesting by small coupes rather than large-scale clear-felling." ... "Notable species included <i>Araucaria araucana</i> (Monkey-puzzle), which had naturalised on the crags and self-seeded much more widely..."
301	2009. Ison, J./Braithwaite, M.. The Status of some Alien Trees and Shrubs in Britain (a report on a questionnaire to BSBI vice-county recorders). Botanical Society of the British Isles, http://www.bsbi.org.uk/TreesShrubsReport.pdf	[Naturalized beyond native range? Potentially] "Regeneration short of naturalisation All 148 species included in the project were recorded as regenerating somewhere to some extent, whether vegetatively or by seed. This is a remarkable result even given the bias in the sample of species selected." ... "The ten species least reported as regenerating, were: <i>Cedrus libani</i> , <i>C. deodara</i> , <i>Nothofagus alpina</i> , <i>Chamaecyparis pisifera</i> , <i>Pinus strobus</i> , <i>Cedrus atlantica</i> , <i>Sequoiadendron giganteum</i> , <i>Araucaria araucana</i> , <i>Nothofagus obliqua</i> and <i>Laburnum alpinum</i> ." ... "In contrast some species self-seed very rarely. For the cedars <i>Cedrus</i> spp., <i>Araucaria araucana</i> , <i>Sequoiadendron giganteum</i> and <i>X Cupressocyparis leylandii</i> this is what one might have come to expect."
301	2012. Manual of the Alien Plants of Belgium. <i>Araucaria araucana</i> . http://alienplantsbelgium.be/content/araucaria-araucana-0	[Naturalized beyond native range? Escape in Belgium] " <i>Araucaria araucana</i> (Molina) K. Koch (syn.: <i>Pinus araucana</i> Molina) (western S-Am.) – An exceptional escape from cultivation. Few saplings were recorded in the vicinity of a parental plant in Ukkel in 2009. <i>Araucaria araucana</i> only rarely escapes from cultivation in Europe. Similar records are available, for instance, from the British Isles (Stace 2010)."
302	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. <i>Diversity and Distributions</i> . 10: 321–331.	[Garden/amenity/disturbance weed? Possibly] " <i>Araucaria araucana</i> (Argentina; Great Britain*)" [<i>A. araucana</i> = invasive in Great Britain; but impacts are unspecified]
303	2007. Randall, R.P.. Global Compendium of Weeds - <i>Araucaria araucana</i> . http://www.hear.org/gcw/species/araucaria_araucana/	[Agricultural/forestry/horticultural weed? No] No evidence
304	2007. Randall, R.P.. Global Compendium of Weeds - <i>Araucaria araucana</i> . http://www.hear.org/gcw/species/araucaria_araucana/	[Environmental weed? No evidence]
304	2010. Carrillo-Gavilan, M.A./Vila, M.. Little evidence of invasion by alien conifers in Europe. <i>Diversity and Distributions</i> . 16: 203–213.	[Environmental weed? No evidence] "Table 1 General information on alien conifers in Europe found from an analysis of papers listed in the ISI Web of Science (date of access up to March 2009)." [Listed as present but not invasive in Spain and the UK]
305	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. <i>Diversity and Distributions</i> . 10: 321–331.	[Congeneric weed? No] " <i>A. columnaris</i> (Hawaii); <i>A. heterophylla</i> (New Zealand)" [Naturalized, but no evidence of invasiveness]
305	2007. Randall, R.P.. Global Compendium of Weeds - Index. http://www.hear.org/gcw/	[Congeneric weed? Possibly] Multiple <i>Araucaria</i> species are listed as naturalized and/or invasive weeds, but evidence of impacts is generally unspecified.
401	2008. Arnold, M.A.. <i>Landscape Plants for Texas and Environs</i> . Stipes Publishing L.L.C., Champaign, IL	[Produces spines, thorns or burrs? Yes] "females are spiny and rather formidable in appearance"
401	2012. Kew Royal Botanic Gardens. <i>Plants & Fungi - Araucaria araucana</i> (monkey puzzle). http://www.kew.org/plants-fungi/Araucaria-araucana.htm	[Produces spines, thorns or burrs? Yes] "Known hazards: The rigid spines on the trunk and leaf tips are potentially hazardous. This is a tree to avoid climbing!"
401	2012. Missouri Botanical Garden. <i>Araucaria araucana</i> . http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/plant-finder/plant-details/kc/d293/araucaria-araucana.aspx	[Produces spines, thorns or burrs? Yes] "Dense, leathery, triangular, radially-arranged leaves (to 2" long) have sharp points." [Functionally act like spines]

402	2012. Braine, J.W./Curcio, G.R./Wachowicz, C.M./Hansel, F.A.. Allelopathic effects of <i>Araucaria angustifolia</i> needle extracts in the growth of <i>Lactuca sativa</i> seeds. <i>Journal of Forest Research</i> . Online First: DOI 10.1007/s10310-011-0314-1.	[Allelopathic? 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	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Parasitic? No] " <i>A. araucana</i> is a long-lived conifer native to Chile and Argentina. It is now restricted to a narrow range of latitudes, in Chile 37°30' to 39°30'S; and 37°45' to 40°20'S in Argentina (Aagesen, 1998). There are two disjunct populations, the main one straddles the Andes in Argentina, and the other is in the Nahuelbuta range in Chile. The latter population is very restricted and listed in CITES Appendix I. The Andean populations are severely fragmented and listed in CITES Appendix II (Oldfield et al., 1998). It is strongly straight-stemmed, strongly monopodial (multiple leaders are extremely rare) and grows to 30-40 m tall (occasionally up to 50 m) and 100-150 cm in diameter. It is long-lived (possibly >1000 years)."
404	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Unpalatable to grazing animals? No] "...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	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Toxic to animals? No evidence] "...summer browsing by sheep and goats prevents regeneration..."
406	1993. Gilman, E.F./Watson, D.G.. <i>Araucaria araucana</i> - Monkey-Puzzletree. Fact Sheet ST-81. University of Florida IFAS Extension, Gainesville, FL hort.ufl.edu/database/documents/pdf/tree_fact_sheets/araaraa.pdf	[Host for recognized pests and pathogens? Possibly No] "No pests or diseases are of major concern. Scales, sooty mold, leaf spots."
406	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Host for recognized pests and pathogens? Possibly] "Pests recorded Nematodes: Pratylenchus vulnus (walnut root lesion nematode) Fungus diseases: Heterobasidion annosum sensu stricto Pests recorded at the generic level (<i>Araucaria</i>): Insects: Coptotermes elisae Cydia araucariae Nematodes: Helicotylenchus dihystrera (common spiral nematode)"
406	2012. <i>Plants for a Future Database</i> . <i>Araucaria araucana</i> . http://www.pfaf.org/user/Plant.aspx?LatinName=Araucaria+araucana	[Host for recognized pests and pathogens? Possibly] "Trees are notably susceptible to honey fungus[81, 200]."
407	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Causes allergies or is otherwise toxic to humans? No evidence] "Despite heavy resin exudations, there are no records of commercial use of resin. The resin has been attributed with a wide range of medicinal properties (Elwes and Henry, 1906), but there are no current medicinal uses (Aagesen, 1998). Lange (1996) reported on the potential use of conifer resins (including <i>A. araucana</i>) as a minor forest product. The seed is edible and available in commercially acceptable amounts. It is actively traded in Chile. A spiritous liquor was previously distilled from the seeds (Elwes and Henry, 1906)."
407	2012. <i>Plants for a Future Database</i> . <i>Araucaria araucana</i> . http://www.pfaf.org/user/Plant.aspx?LatinName=Araucaria+araucana	[Causes allergies or is otherwise toxic to humans? No] "Known Hazards: None Known"

408	2010. Gonzalez, M.E./Veblen, T.T./Sibold, J.S.. Influence of fire severity on stand development of <i>Araucaria araucana</i> – <i>Nothofagus pumilio</i> stands in the Andean cordillera of south-central Chile. <i>Austral Ecology</i> . 35: 597-615.	[Creates a fire hazard in natural ecosystems? Possibly. A component of a fire-adapted ecosystem, but may actually prevent fires from spreading further] "The fire resistant <i>Araucaria</i> commonly survive fires, especially larger individuals (i.e. >30 cm d.b.h.; Fig. 5a,b, stage i). This species has thick bark, which insulates and protects the cambium from fires, and a fire resistant crown that is several meters above the ground (generally >10 m)."
409	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Is a shade tolerant plant at some stage of its life cycle? Yes] "It tolerates moderate to heavy shade, eventually developing into a climax canopy species."
409	2008. Sanguinetti, J./Kitzberger, T.. Patterns and mechanisms of masting in the large-seeded southern hemisphere conifer <i>Araucaria araucana</i> . <i>Austral Ecology</i> . 33: 78–87.	[Is a shade tolerant plant at some stage of its life cycle? Yes] "This conifer is adapted to stressful conditions, is shade tolerant and grows mainly on poor volcanic soils or rocky places."
409	2008. Shepherd, J.D./Ditgen, R.S./Sanguinetti, J.. <i>Araucaria araucana</i> and the Austral parakeet: pre-dispersal seed predation on a masting species. <i>Revista chilena de historia natural</i> . 81(3): 395-401.	[Is a shade tolerant plant at some stage of its life cycle? Yes] "While young <i>A. araucana</i> can persist suppressed in deep shade, they grow faster when they are dispersed out from under the mother's canopy (Finckh & Paulsch 1995, Veblen et al. 1995)."
409	2010. Gonzalez, M.E./Veblen, T.T./Sibold, J.S.. Influence of fire severity on stand development of <i>Araucaria araucana</i> – <i>Nothofagus pumilio</i> stands in the Andean cordillera of south-central Chile. <i>Austral Ecology</i> . 35: 597-615.	[Is a shade tolerant plant at some stage of its life cycle? Yes] "Because of the limited dispersal range of its large seed and slow initial growth, the more shade tolerant <i>Araucaria</i> seedlings tend to establish beneath parent trees left by fires that did not kill all canopy trees (González & Veblen 2007)."
410	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Tolerates a wide range of soil conditions ? Yes] "Soil descriptors - Soil texture: light; medium - Soil drainage: free - Soil reaction: acid; neutral"
410	2012. Missouri Botanical Garden. <i>Araucaria araucana</i> . http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/plant-finder/plant-details/kc/d293/araucaria-araucana.aspx	[Tolerates a wide range of soil conditions ? Yes] "Trees perform well in a variety of different soils as long as they are well-drained."
411	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Climbing or smothering growth habit? No] "It is strongly straight-stemmed, strongly monopodial (multiple leaders are extremely rare) and grows to 30-40 m tall (occasionally up to 50 m) and 100-150 cm in diameter."
412	2008. Sanguinetti, J./Kitzberger, T.. Patterns and mechanisms of masting in the large-seeded southern hemisphere conifer <i>Araucaria araucana</i> . <i>Austral Ecology</i> . 33: 78–87.	[Forms dense thickets? Yes] "Within the study area, <i>A. araucana</i> occurs in pure stands and in mixed forests with <i>Nothofagus</i> spp. From 1200 m to tree line, <i>A. araucana</i> forms mixed forests with <i>N. pumilio</i> . In valleys and lower, drier, north-facing slopes, it is mixed with the tall shrub <i>N. antarctica</i> . Extensive pure stands of <i>A. araucana</i> occur on poor volcanic soils and rocky slopes from 1000 to 1800 m a.s.l. and in the eastern part of its range (Rechene et al. 2003)."
501	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Aquatic? No] "A. <i>araucana</i> is a long-lived conifer native to Chile and Argentina." [Terrestrial]
502	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Grass? No] Family: <i>Araucariaceae</i>
503	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Nitrogen fixing woody plant? No] Family: <i>Araucariaceae</i>
504	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No] "A. <i>araucana</i> is a long-lived conifer native to Chile and Argentina. It is now restricted to a narrow range of latitudes, in Chile 37°30' to 39°30'S; and 37°45' to 40°20'S in Argentina (Aagesen, 1998). There are two disjunct populations, the main one straddles the Andes in Argentina, and the other is in the Nahuelbuta range in Chile. The latter population is very restricted and listed in CITES Appendix I. The Andean populations are severely fragmented and listed in CITES Appendix II (Oldfield et al., 1998). It is strongly straight-stemmed, strongly monopodial (multiple leaders are extremely rare) and grows to 30-40 m tall (occasionally up to 50 m) and 100-150 cm in diameter."

601	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Evidence of substantial reproductive failure in native habitat? No, but in danger of over-exploitation] "The natural forests in Chile have been over exploited and the development of protective measures (including the protective Decree 29 of 9/2/76) has been complicated by the cutting rights given to concessionaires. (Kozdon, 1958; Montaldo, 1974; Puente, 1980; Martinez and Munoz, 1988; Martinez, 1992; Agesen, 1996; Bolte, 1997). The tree is now protected as a National Monument (by Decree 43 of 19/4/90), but there are still difficulties in applying effective protective measures in Chile. The Argentinian situation is similar (Schmaltz, 1992). For example, 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."
602	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Produces viable seed? Yes] "It regenerates well from seed, and can also be grown from cuttings from secondary stem shoots."
603	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Hybridizes naturally? Unknown] "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	2010. Sanguinetti, J./Kitzberger, T.. Factors controlling seed predation by rodents and non-native <i>Sus scrofa</i> in <i>Araucaria araucana</i> forests: potential effects on seedling establishment. Biological Invasions. 12: 689-706.	[Self-compatible or apomictic? No. Dioecious] " <i>Araucaria araucana</i> (Araucariaceae) is a long lived ([1,200 years), large seeded dioecious emergent conifer found in the temperate forest of South America (Veblen et al. 1995)."
604	2012. Plants for a Future Database. <i>Araucaria araucana</i> . http://www.pfaf.org/user/Plant.aspx?LatinName=Araucaria+araucana	[Self-compatible or apomictic? No] "The flowers are dioecious (individual flowers are either male or female, but only one sex is to be found on any one plant so both male and female plants must be grown if seed is required) and are pollinated by Wind. The plant is not self-fertile."
605	2008. Sanguinetti, J./Kitzberger, T.. Patterns and mechanisms of masting in the large-seeded southern hemisphere conifer <i>Araucaria araucana</i> . Austral Ecology. 33: 78–87.	[Requires specialist pollinators? No] "Female cones are wind-pollinated during summer and seed maturation takes between 16 and 18 months."
605	2012. Plants for a Future Database. <i>Araucaria araucana</i> . http://www.pfaf.org/user/Plant.aspx?LatinName=Araucaria+araucana	[Requires specialist pollinators? No] "The flowers are dioecious (individual flowers are either male or female, but only one sex is to be found on any one plant so both male and female plants must be grown if seed is required) and are pollinated by Wind."
606	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Reproduction by vegetative fragmentation? Yes] " <i>A. araucana</i> may produce sucker sprouts in natural stands (Lara and Fraver, 1997), and as an exotic."
607	2008. Sanguinetti, J./Kitzberger, T.. Patterns and mechanisms of masting in the large-seeded southern hemisphere conifer <i>Araucaria araucana</i> . Austral Ecology. 33: 78–87.	[Minimum generative time (years)? 30+] "Trees reach sexual maturity when they have trunks greater than 20 cm d.b.h. and are more than 30 years old (Muñoz Ibañez 1984)."
607	2012. Plants for a Future Database. <i>Araucaria araucana</i> . http://www.pfaf.org/user/Plant.aspx?LatinName=Araucaria+araucana	[Minimum generative time (years)? 20+] "Its main disadvantages are its slow rate of growth and the time it takes before the first crop is produced - this can be up to 40 years from seed though we have often seen plants less than 20 years old produce cones[K]."
701	2012. Plants for a Future Database. <i>Araucaria araucana</i> . http://www.pfaf.org/user/Plant.aspx?LatinName=Araucaria+araucana	[Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)? No] "Fairly large, the seeds are about the size of an almond and can be 3cm long x 1 cm wide." [Seeds are fairly large and, lacking means of external dispersal, are unlikely to be inadvertently dispersed]
702	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Propagules dispersed intentionally by people? Yes] "It has been widely planted as a specimen tree in temperate areas all over the world, but there are virtually no plantations. Streets (1962) reported that it had been trialled on a small scale in Kenya (where it failed), and in New Zealand (no further reports). A small scale plantation was established in southwest Scotland in 1916 (Williams and Winn, 1977). The plantation was near the coast and fully exposed to the wind, and had suffered from windblow. Moderate growth rates in comparison with other plantation species have been one of the reasons that the species has not been planted more widely. In maturing natural forest, annual growth rates up to 6 cubic metres/ha were observed."

703	2012. Plants for a Future Database. <i>Araucaria araucana</i> . http://www.pfaf.org/user/Plant.aspx?LatinName=Araucaria+araucana	[Propagules likely to disperse as a produce contaminant? No] "Fairly large, the seeds are about the size of an almond and can be 3cm long x 1cm wide. They are harvested in the autumn and, when kept in cool, dry conditions will store for at least 9 months[K]." [No evidence. Seeds themselves can be harvested as produce. The large size makes inadvertent dispersal or contamination highly unlikely]
704	2010. Sanguinetti, J./Kitzberger, T.. Factors controlling seed predation by rodents and non-native <i>Sus scrofa</i> in <i>Araucaria araucana</i> forests: potential effects on seedling establishment. <i>Biological Invasions</i> . 12: 689-706.	[Propagules adapted to wind dispersal? No] "Female cones contain 100–200 large nuts (piñones) weighting *3.5 g, which are dispersed by gravity only up to 13 m from the parent tree (Muñoz Ibañez 1984)."
705	2008. Sanguinetti, J./Kitzberger, T.. Patterns and mechanisms of masting in the large-seeded southern hemisphere conifer <i>Araucaria araucana</i> . <i>Austral Ecology</i> . 33: 78–87.	[Propagules water dispersed? No] "Female cones are very large (15–20 cm in diameter), and contain 100– 200 large seeds (3.5 g) that are dispersed by gravity over short distances."
706	2008. Shepherd, J.D./Ditgen, R.S./Sanguinetti, J.. <i>Araucaria araucana</i> and the Austral parakeet: pre-dispersal seed predation on a masting species. <i>Revista chilena de historia natural</i> . 81(3): 395-401.	[Propagules bird dispersed? No. Parakeets act as seed predators] "Pre-dispersal seed predation by Austral parakeets, <i>Enicognathus ferrugineus</i> , on <i>Araucaria araucana</i> , was studied to assess the relationship between predation and seed production. We collected falling seeds in four <i>araucaria</i> forests of southwestern Neuquén Province, Argentina during four years that included both mast and intermast years. Predation rates were negatively correlated with seed production. When seed production was high, predation rates ranged from 0.6 to 3.3 %; when it was low, predation rates ranged from 13.0 to 20.6 %. Years differed in the pattern of monthly seed fall with peak seed fall in March 2002 and April 2003. Predation rates were lower and more uniform in the year of higher seed production, but did not differ between sites. In an intermast year, predation rates increased during the season, reaching their highest rates after peak seed fall. Parakeets handled seeds differently in mast and intermast years, dropping fewer slightly-damaged seeds when production was low. We discuss these results in the context of the predator satiation hypothesis." ... "The parakeets take seeds from <i>Araucaria</i> cones and eat them while sitting on adjacent branches. They do not eat the large seeds whole, but hold the seed scale in a foot as they take bites out of the seed itself. Seed scales are often dropped during this process. The characteristic marks of the parakeet's lower mandible on the seed scales allowed us to identify those that were damaged by parakeets (Finckh & Paulsch 1995)."
707	2010. Sanguinetti, J./Kitzberger, T.. Factors controlling seed predation by rodents and non-native <i>Sus scrofa</i> in <i>Araucaria araucana</i> forests: potential effects on seedling establishment. <i>Biological Invasions</i> . 12: 689-706.	[Propagules dispersed by other animals (externally)? Possibly carried away by rodents] "Main native post dispersal seed predators are the greater long clawed mouse (<i>Chelemys macronyx</i>), the long haired mouse (<i>Abrotrix longipilis</i>), the long-tailed mouse (<i>Oligoryzomys longicaudatus</i>) and the arboreal mouse (<i>Irenomys tarsalis</i>) (Shepherd and Ditgen 2005). According to Shepherd and Ditgen (2008), <i>A. longipilis</i> may play a relevant role as a disperser of <i>Araucaria</i> seeds to favorable microsites for seedling germination."
708	2010. Sanguinetti, J./Kitzberger, T.. Factors controlling seed predation by rodents and non-native <i>Sus scrofa</i> in <i>Araucaria araucana</i> forests: potential effects on seedling establishment. <i>Biological Invasions</i> . 12: 689-706.	[Propagules survive passage through the gut? No. Rodents and pigs act as seed predators] "A dietary study shows that, in autumn, wild boar feces contain more than 90% of <i>Araucaria</i> seeds (Izquierdo et al. 2001)." ... "In our study area, although rodents were the main seed eaters, introduced <i>S. scrofa</i> consumed an important proportion of the total seeds, especially outside dense understorey vegetation and close to seeding trees, where wild boar predation was higher than 30%, equivalent to that of rodents." ... "Rodents were the main seed predators from March to June, and, according to trap data (Shepherd and Ditgen, unpublished data, 2008), increased seed predation during the fall seed seasons was caused by numerical responses of the rodent population. Lower rodent densities were observed during the lowest inter-mast years but this does not prevent the occurrence of the highest seed predation rates. During mast years, trap data suggest that rodents may not build-up their numerical response enough to increase seed predation. Wild boars became more preponderant from June onward and the fact that they started consuming <i>A. araucana</i> seeds at the peak of their availability, together with the difference in use intensity among years, may suggest that they could be maximizing food intake and minimizing travel and search costs by using the highest quality habitat during peak seed availability as was observed in USA (Singer et al. 1981)."
801	2010. Sanguinetti, J./Kitzberger, T.. Factors controlling seed predation by rodents and non-native <i>Sus scrofa</i> in <i>Araucaria araucana</i> forests: potential effects on seedling establishment. <i>Biological Invasions</i> . 12: 689-706.	[Prolific seed production (>1000/m ²)? No] "Seeds start to fall in March until June and exceptionally, September. <i>A. araucana</i> is a masting species with a low average fecundity (960 seeds per tree) and a moderate temporal variation in cone production that fluctuates annually between 2 and 45 mean cones per tree with a highly synchronized production among trees within population and among populations at a regional scale (Sanguinetti and Kitzberger 2008)."

802	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Evidence that a persistent propagule bank is formed (>1 yr)? No] "- Seed storage recalcitrant"
802	2008. Sanguinetti, J./Kitzberger, T.. Patterns and mechanisms of masting in the large-seeded southern hemisphere conifer <i>Araucaria araucana</i> . <i>Austral Ecology</i> . 33: 78–87.	[Evidence that a persistent propagule bank is formed (>1 yr)? No] "Short seed viability (less than 6 months), low fertility (fitness) and poor passive dispersal result in poor overall seed regeneration (Muñoz Ibañez 1984; Armesto et al. 1997; Donoso 1998)."
802	2012. Kew Royal Botanic Gardens. Plants & Fungi - <i>Araucaria araucana</i> (monkey puzzle). http://www.kew.org/plants-fungi/Araucaria-araucana.htm	[Evidence that a persistent propagule bank is formed (>1 yr)? No] "Seed storage behaviour: Recalcitrant. Sensitive to desiccation."
803	2012. WRA Specialist. Personal Communication.	[Well controlled by herbicides? Unknown] No information on herbicide efficacy or chemical control of this species
804	2008. Sanguinetti, J./Kitzberger, T.. Patterns and mechanisms of masting in the large-seeded southern hemisphere conifer <i>Araucaria araucana</i> . <i>Austral Ecology</i> . 33: 78–87.	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "Its adaptations to fire include a thick bark, epicormic buds that sprout after fire and terminal buds that are protected by modified leaves."
804	2010. Gonzalez, M.E./Veblen, T.T./Sibold, J.S.. Influence of fire severity on stand development of <i>Araucaria araucana</i> – <i>Nothofagus pumilio</i> stands in the Andean cordillera of south-central Chile. <i>Austral Ecology</i> . 35: 597-615.	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "Large <i>Araucaria</i> trees are highly resistant to fire, and this species typically survives moderate- to high severity fires either as dispersed individuals or as small groups of multi aged trees. Small post-fire cohorts of <i>Araucaria</i> may establish, depending on seed availability and the effects of subsequent fires. <i>Araucaria</i> 's great longevity (often >700 years) and resistance to fire allow some individuals to survive fires that kill and then trigger new <i>Nothofagus</i> cohorts. Even in relatively mesic habitats, where fires are less frequent, the oldest <i>Araucaria</i> – <i>Nothofagus pumilio</i> stands originated after high-severity fires. Overall, stand development patterns of subalpine <i>Araucaria</i> – <i>N. pumilio</i> forests are largely controlled by moderate- to high-severity fires, and therefore tree regeneration dynamics is strongly dominated by a catastrophic regeneration mode." ... "The fire-resistant <i>Araucaria</i> commonly survive fires, especially larger individuals (i.e. >30 cm d.b.h.; Fig. 5a,b, stage i). This species has thick bark, which insulates and protects the cambium from fires, and a fire resistant crown that is several meters above the ground (generally >10 m)."
804	2012. Kew Royal Botanic Gardens. Plants & Fungi - <i>Araucaria araucana</i> (monkey puzzle). http://www.kew.org/plants-fungi/Araucaria-araucana.htm	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes, to some extent] "The monkey puzzle is well-adapted to fire, volcanic activity having long caused wildfires in its natural habitat, so this is not a threat under natural circumstances. However, fires resulting from human activities (especially agricultural clearances) cause severe damage to remaining populations of the tree. Research in Chile, carried out under the auspices of the Flagship Species Fund of the U.K.'s Department of Environment, Food and Rural Affairs (Defra) and Flora & Fauna International (FFI), found at least 80% of the trees remaining in one study area had suffered fire damage."
804	2012. Plants for a Future Database. <i>Araucaria araucana</i> . http://www.pfaf.org/user/Plant.aspx?LatinName=Araucaria+araucana	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "Unlike most conifers, this tree can be coppiced[81]."
805	2012. WRA Specialist. Personal Communication.	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? Unknown] Probably No

Summary of Risk Traits

High Risk / Undesirable Traits

- Naturalized in the United Kingdom
- Rigid spines on the trunk and leaf tips
- Tolerates moderate to heavy shade
- Tolerates many soil conditions (and potentially able to exploit many different habitat types)
- Occurs in pure stands in native range
- Can produce sucker sprouts in natural stands (spread vegetatively)
- Able to coppice and tolerate fires

Low Risk / Desirable Traits

- Despite ability to naturalize, no negative impacts have been specified
- Palatable to grazing animals (may limit spread in introduced range, but threatens tree in native range)
- Non-toxic
- Self-incompatible (dioecious)
- Long time to reproductive maturity (20+ years)
- Landscaping and ornamental value
- Timber tree
- Large, edible seeds, unlikely to be inadvertently dispersed
- Seeds recalcitrant, and unlikely to persist in the soil