

<b>Taxon:</b> <i>Pinus patula</i>	<b>Family:</b> Pinaceae
<b>Common Name(s):</b> jelecote pine Mexican weeping pine Mexican yellow pine pino colorado	<b>Synonym(s):</b> <i>Pinus patula</i> var. <i>macrocarpa</i> Mast. <i>Pinus patula</i> var. <i>patula</i>

<b>Assessor:</b> Chuck Chimera	<b>Status:</b> Assessor Approved	<b>End Date:</b> 2 Jun 2015
<b>WRA Score:</b> 13.0	<b>Designation:</b> H(Hawai'i)	<b>Rating:</b> High Risk

**Keywords:** Tropical Pine, Environmental Weed, Dense Stands, Wind-Dispersed, Serotinous Cones

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	n
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	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)	y
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
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	y=1, n=0	n
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans		
408	Creates a fire hazard in natural ecosystems	y=1, n=0	y

Qsn #	Question	Answer Option	Answer
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	n
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	y
604	Self-compatible or apomictic	y=1, n=-1	y
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		
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	y
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	y
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	y=-1, n=1	n

**Supporting Data:**

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[No evidence that breeding has reduced actual or potential invasiveness of <i>P. patula</i> ] "Although most of the countries in which it is planted as an exotic have some form of breeding programmes for <i>P. patula</i> , by far the most advanced genetic improvement programmes supplying genetically improved seed are in South Africa and Zimbabwe. The focus of these breeding programmes has been to improve stem form, taper, volume, branch size, crown size and form. By and large, success has already be achieved in most of these traits where timber yields for example, have now been increased by as much as 35% after two generations of breeding and selection (Barnes, 1977)."
102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2015. Personal Communication	NA
103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2015. 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
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	" <i>P. patula</i> is a medium-size tree (usually to 20 m tall) native to eastern Mexico."
202	Quality of climate match data	High
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	
203	Broad climate suitability (environmental versatility)	n
	Source(s)	Notes

Qsn #	Question	Answer
	<p>Gillespie, A.J.R. 1992. <i>Pinus patula</i> Schiede and Deppe. <i>Patula pine</i>. SO-ITF-8M-64. Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Rio Piedras. PR</p>	<p>"In its natural range, patula pine is generally found in the warm to cool regions, often in moist upper mountain valleys (11,20,31). Mean annual rainfall ranges from 500 to 2000 mm/yr (20) with most rain occurring in the summer (June to October) and a zero- to 3-month dry season from December to February (31). Mean annual temperatures range from 12 to 18 °C, with mean maximum and minimum temperatures in the hottest and coldest months of 20 to 29 °C and 6 to 12 °C, respectively. <i>Patula pine</i> thrives as an exotic in frost free areas where rainfall is at least 750 mm, falling mostly in the summer, as well as in areas subjected to a monsoonal two-peak rainfall distribution with most of the rain coming in the cooler season (31) and on sites located within high elevation mist belts (25). <i>Patula pine</i> may not thrive on sites where dry periods exceed 3 months and soils are too shallow or too friable to hold moisture, or where maximum or minimum mean monthly temperatures are outside the zero -to 28-°C range (31)."</p>
	<p>CAB International, 2005. <i>Forestry Compendium</i>. CAB International, Wallingford, UK</p>	<p>[Adapted to higher elevation tropical &amp; subtropical climates] "It is best adapted to high altitudes with cool climates (mean annual precipitation greater than 1100 mm, a mean annual temperature of 14°C and summer rainfall). When planted in hot, humid conditions at low altitudes, it is susceptible to infection by <i>Sphaeropsis sapinea</i> after hail damage." ... "<i>P. patula</i> introductions have been planted in both the cool and wet tropical and subtropical regions of the world. In tropical regions the introductions are mostly at altitudes above 2000 m where conditions for optimum growth of this species are found. In the subtropical regions, the species has been planted in wetter but slightly lower altitudes of about 900 m. Overall <i>P. patula</i> is now grown from the equator (in Colombia) to as far as latitude 42°S latitude in New Zealand (Styles et al., 1975)."</p> <p>"Climatic amplitude (estimates)</p> <ul style="list-style-type: none"> <li>- Altitude range: 1250 - 3300 m</li> <li>- Mean annual rainfall: 1000 - 2200 mm</li> <li>- Rainfall regime: summer; winter; bimodal</li> <li>- Dry season duration: 0 - 4 months</li> <li>- Mean annual temperature: 9 - 23°C</li> <li>- Mean maximum temperature of hottest month: 15 - 28°C</li> <li>- Mean minimum temperature of coldest month: 6 - 14°C</li> <li>- Absolute minimum temperature: &gt; -10°C"</li> </ul>
	<p>Orwa C., Mutua, A., Kindt R., Jamnadass, R, &amp; Anthony, S. 2009 <i>Agroforestry Database: a tree reference and selection guide version 4.0</i>. <a href="http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp">http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp</a>. [Accessed 1 Jun 2015]</p>	<p>[Elevation range exceeds 1000 m, but restricted to higher elevation tropical climates] "Altitude: 1 000-3 000 m, Mean annual temperature: -10-28 deg. C, Mean annual rainfall: 1 000-2000 mm"</p>

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes

Qsn #	Question	Answer
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[Higher altitude tropics & subtropics] "Pinus patula var. patula This variety is found in a few localities in the state of Tamaulipas, in Quer�taro, Hidalgo, Mexico Distrito Federal, Morelos, Tlaxcala, Puebla, Vera Cruz, Oaxaca and Chiapas (Farjon and Styles, 1998). Its main distribution is on the Sierra Madre Oriental and the high mountains of east-central Mexico. The altitudinal range of distribution spans 1900 m, from altitude 1400 m to a high of 3300 m, but is concentrated between altitude 1800 and 2800 m (Perry, 1991; Farjon and Styles, 1998). This variety is generally restricted to humid, subtropical to warm temperate sites with an annual precipitation of 1000 to 2200 mm per annum. The species occurs in a variety of mesic forest types, associated with other pines such as Pinus pseudostrobus, P. greggii, P. maximinoi, P. hartwegii and P. ayacahuite. At some locations it also occurs together with Abies religiosa, mixed with pine-oak forests and also with Liquidambar. Pinus patula var. longipedunculata This variety is only known from two localities in the states of Hidalgo and Vera Cruz but is more wide spread in Oaxaca and central Chiapas. Its ecology is very similar to var. patula, but its ecological amplitude is however narrower."

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	"It is the most important pine species in southern and East Africa (Kenya, Malawi, Mozambique, Zambia, Zimbabwe, South Africa, Swaziland, Tanzania and Uganda) and is commercially planted in South America (Colombia, southern Brazil, Argentina) and, to a limited extent, in Asia (Nepal and India)." ... "Introductions of P. patula can be found in southern Africa (Malawi, Mozambique, South Africa, Swaziland, Zambia and Zimbabwe), east Africa (Burundi, Ethiopia, Kenya, Madagascar, Tanzania, Uganda, Rwanda), west and central Africa (Cameroon, Nigeria, Democratic Republic of Congo (Zaire), Asia (Australia, India, Sri Lanka, Papua New Guinea, New Zealand), South America and the Caribbean (Argentina, Brazil, Colombia, Ecuador, Venezuela, Jamaica) and in Mexico (Styles et al., 1975; Poynton, 1979). Most of these plantings were evaluation tests, pilot plantings and commercial plantings. P. patula is mainly intended for timber as well as for the pulp and paper industry."
	Oppenheimer, H. L. 2002. The Spread of Gymnosperms on Maui: A Neglected Element of the Modern Hawaiian Flora. Bishop Museum Occasional Papers 68: 19–23	"The Jelecote pine or Mexican weeping pine, native lo the mountains of eastem Mexico, has been planted on the islands of Maui and Hawai'i (Little & Skolmen, 1989: 58). "
	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	Total Planted By Island & Year: Oahu = 110 (1951); Maui = 14.029 (1933-1951); Hawaii = 1356 (1940-1960)

301	Naturalized beyond native range	y
	Source(s)	Notes

Qsn #	Question	Answer
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	" <i>P. patula</i> has almost naturalised itself in southern Africa (South Africa and Zimbabwe) where it naturally regenerates itself and has taken over as the dominant species on some grasslands as well as in some forests in cool wetter areas, where it produces viable seed."
	Oppenheimer, H. L. 2002. The Spread of Gymnosperms on Maui: A Neglected Element of the Modern Hawaiian Flora. Bishop Museum Occasional Papers 68: 19–23	"The Jelecote pine or Mexican weeping pine, native to the mountains of eastern Mexico, has been planted on the islands of Maui and Hawai'i (Little & Skolmen, 1989: 58). Between 5000 and 7000 ft. in the Kula Forest Reserve area, it is reproducing and spreading. Smith (1985: 198) reported an infestation adjacent to Hosmer Grove and the potential of the species to form monotypic stands. Loope et al. (1992: 554) also noted that, if unchecked, this species, along with <i>P. pinaster</i> and <i>P. radiata</i> , "would eventually convert large expanses of native shrubland to alien coniferous forest" in the Hosmer Grove area. This taxon is easily recognized by its distinctive drooping or "weeping" needles."
	Medeiros, A.C., Loope, L.L. & Chimera, C.G. 1998. Flowering Plants and Gymnosperms of Haleakala National Park. Technical Report 120. Pacific Cooperative Studies Unit, Honolulu, HI	[ <i>Pinus patula</i> ] "This is one of three naturalized species of pine in the Park that readily establish seedlings at 6800- 8000 ft, often distant from parent trees. See also <i>P. pinaster</i> and <i>P. radiata</i> . This species is readily identified by its very flexible needles in bundles of three which give the entire tree a drooping or "weeping" appearance."

302	Garden/amenity/disturbance weed	
	Source(s)	Notes
	Nigro, S.A., 2008. <i>Pinus patula</i> Schlttdl. & Cham. [Internet] Record from PROTA4U. Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 1 Jun 2015]	[A disturbance-adapted, pioneer tree with negative environmental impacts. See 3.04] " <i>Pinus patula</i> is strongly light-demanding. It is an aggressive pioneer species that grows readily in forest gaps created by fire."

303	Agricultural/forestry/horticultural weed	n
	Source(s)	Notes
	Nyoka, B.I. (ed.). 2003. Biosecurity in Forestry: A Case Study on the Status of Invasive Forest Tree Species in Southern Africa. Working Paper FBS/1E. Forestry Department, FAO, Rome	[Commercially important forestry tree] "Figures for the contribution of <i>Pinus patula</i> in isolation to the GDP of both Zimbabwe and South Africa are not readily available. Planted forests total about 118 000 ha in Zimbabwe and 1 400 000 ha in South Africa. The area planted with <i>P. patula</i> is about 49 000 ha in Zimbabwe and 337 000 ha in South Africa (see Tables 1 and 3). Forestry in these two countries contributes 3 and 2 percent respectively to national GDP. Everything being equal, <i>P. patula</i> then roughly contributes 1.2 percent to the GDP of Zimbabwe and 0.5 percent to South Africa's GDP. This a crude estimate, but good enough to indicate the economic importance of commercial <i>P. patula</i> plantings."
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

304	Environmental weed	y
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Qsn #	Question	Answer
	Source(s)	Notes
	Farjon, A. & Styles, B.T. 1997. <i>Pinus</i> (Pinaceae). <i>Flora Neotropica</i> 75: 1-291	"After <i>Pinus radiata</i> , <i>P. patula</i> has now become one of the most troublesome invasive species of pine threatening natural vegetation and biodiversity in the highlands of southern Africa."
	Loope, L.L., Nagata, R.J. & Medeiros, A.C. 1992, Alien plants in Haleakala National Park Pp. 551-576 in Stone et al (eds) Alien plant invasions in native ecosystems of Hawaii. Coop. Nat. Park Resources Studies Unit, University of Hawaii, Honolulu, HI	"Extensive plantings of pines and other conifers for "watershed improvement" (R. Hobdy, pers. comm.) on ranchland below Hosmer Grove in the early 1940s were the apparent source of invasive pines. Three planted pine species ( <i>Pinus radiata</i> , <i>P. patula</i> , and <i>P. pinaster</i> ) perpetually establish fast-growing seedlings on Park lands, and if unchecked these species would eventually convert large expanses of native shrubland to alien coniferous forest." ... " <i>Pinus radiata</i> from California, <i>Pinus patula</i> from Mexico, and <i>Pinus pinaster</i> from southern Europe are the only conifers (of many planted species in the Hosmer Grove area) to aggressively establish seedlings in native shrubland of the Park along the boundary adjacent to an experimental watershed improvement project on ranchland."
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	"It is an invasive species of both fire-climax grasslands and woodland in exotic situations where climatic conditions are close to those found in its natural range." ... "The major problem of <i>P. patula</i> is its aggressiveness and weediness. In South Africa, Swaziland and Zimbabwe, <i>P. patula</i> is now considered a serious weed that has invaded grasslands and other vegetation types."
	BioNET-EAFRINE. 2011. <i>Pinus patula</i> (Patula Pine). <a href="http://keys.lucidcentral.org/keys/v3/eafrinet/">http://keys.lucidcentral.org/keys/v3/eafrinet/</a> . [Accessed 1 Jun 2015]	" <i>Pinus patula</i> can rapidly invade grassland and shrubland (usually originating in production plantings) where they can compete with native plants, affect fire and hydrological regimes. In South Africa invasive pines have significantly reduced water availability and have had a very negative impact on plants in the fynbos, an area of global biodiversity significance. <i>Pinus patula</i> has been listed as a Category 2 invader in South Africa (invaders with certain qualities, e.g. commercial use or for woodlots, animal fodder, soil stabilisation, etc. These plants are allowed in certain areas under controlled conditions)."
	Nyoka, B.I. (ed.). 2003. <i>Biosecurity in Forestry: A Case Study on the Status of Invasive Forest Tree Species in Southern Africa</i> . Working Paper FBS/1E. Forestry Department, FAO, Rome	" <i>Pinus patula</i> has invaded an area estimated at 17 600 ha in South Africa (Richardson et al., 1994), while in Zimbabwe the area could be over 100 000 ha. The species is an aggressive invader in medium- to high-altitude areas (above 1 500 masl in Zimbabwe and above 1 200 masl in South Africa) where it flowers and seeds well. The species has invaded afro-montane forests, miombo woodlands, and grasslands. Although the area invaded by this species in South Africa is comparatively small, the species nonetheless is considered a serious potential invader. The area quoted in South Africa is low mainly because, although <i>P. patula</i> is currently planted in over 337 000 ha (see Table 1), much of the area was planted in the late 1960s to early 1970s, which coincided with greater awareness of problems posed by invasive species, as well as the start of deliberate control programmes against alien tree species invasion (Le Maitre, pers. comm.). It is therefore likely that <i>P. patula</i> was not allowed to reach its full potential for invasion. The species has all the attributes of a successful invader in both South Africa and Zimbabwe (Richardson et al., 1994; Rejmánek, 1996; Richardson and Higgins, 1998)."
	Medeiros, A.C., Loope, L.L. & Chimera, C.G. 1998. Flowering Plants and Gymnosperms of Haleakala National Park. Technical Report 120. Pacific Cooperative Studies Unit, Honolulu, HI	"The most serious weeds of the subalpine zone appear to be <i>Cortaderia jubata</i> (Andean pampas grass), <i>Eucalyptus globulus</i> (blue gum), <i>Pinus radiata</i> (Monterey pine), <i>Pinus pinaster</i> (maritime pine), <i>Pinus patula</i> (Mexican weeping pine), and <i>europaeus</i> (gorse);"



Qsn #	Question	Answer
305	<b>Congeneric weed</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Weber, E. 2003. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"It establishes well in burned areas and forms dense stands that may cover large areas. The native vegetation is eliminated and transformed into species poor woodland. A thick litter layer accumulates beneath stands of this tree, preventing establishment of native plants."
	Richardson, D. M., Williams, P. A., & Hobbs, R. J. (1994). Pine invasions in the Southern Hemisphere: determinants of spread and invadability. <i>Journal of Biogeography</i> 21(5): 511-527	" <i>Pinus banksiana</i> is invasive in New Zealand in scrub and open places on and near forest margins, shrublands, tussock grassland. At least 16 <i>Pinus</i> species are invasive in the Southern hemisphere: <i>P. banksia</i> , <i>P. canariensis</i> , <i>P. contorta</i> , <i>P. elliottii</i> , <i>P. halepensis</i> , <i>P. muricata</i> , <i>P. nigra</i> , <i>P. patula</i> , <i>P. pinaster</i> , <i>P. pinea</i> , <i>P. ponderosa</i> , <i>P. radiata</i> , <i>P. roxburghii</i> , <i>P. strobus</i> , <i>P. sylvestris</i> , <i>P. taeda</i> ."
	Richardson, D. M., & Rejmánek, M. 2004. Conifers as invasive aliens: a global survey and predictive framework. <i>Diversity and Distributions</i> , 10(5-6): 321-331	"We summarize information on naturalized and invasive conifers (class Pinopsida) worldwide (data from 40 countries, some with remote states/territories), and contrast these findings with patterns for other gymnosperms (classes Cycadopsida, Gnetopsida and Ginkgoopsida) and for woody angiosperms." ... "Twenty-eight of the known invasive conifers belong to one family (Pinaceae) and 21 of these are in one genus ( <i>Pinus</i> )."

401	<b>Produces spines, thorns or burrs</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[No evidence] "In its native range, <i>P. patula</i> is said to be a graceful tree, height 12-20 (30 m or occasionally to 30-40 m) with d.b.h. up to 120 cm. In plantations outside its native range, tree heights of between 35 and 50 m have been recorded, at ages ranging from 20 years to 50 years (Loock, 1950; Styles et al., 1975). The crown shape usually depends on both spacing as well as inherent variability of the trees. Open grown trees tend to have spreading crowns while closely spaced trees tend to have narrow crowns with good suppression of lower branches which subsequently die. Some trees will still have deep narrow crowns even when growing in the open. Although branching is said to be irregularly placed on the stem (Loock, 1950), in exotic environments branching tends to be regular with on average four branches per whorl, but the distance between whorls is variable. Foxtailing occasionally occurs but the majority of trees tend to be multi nodal with average distance between whorls of about 0.4 m. Within the native distribution range, branches have been reported to be pendent whereas in exotic environments, particularly Africa, the branches are borne at an angle above the horizontal. Branch size is very variable from fine branching to very thick branches."

402	<b>Allelopathic</b>	
	<b>Source(s)</b>	<b>Notes</b>



Qsn #	Question	Answer
	Pellissier, F., & Souto, X. C. (1999). Allelopathy in northern temperate and boreal semi-natural woodland. <i>Critical Reviews in Plant Sciences</i> , 18(5), 637-652	[ <i>P. patula</i> impacted by allelopathic properties of weeds] "Reinhardt et al. (1998) showed that ectomycorrhiza tips of <i>Pinus patula</i> differ in quantity and quality in old-lands, where three herbaceous species are abundant ( <i>Cyperus esculentus</i> , <i>Bidens pilosa</i> , and <i>Conyza sumatrensis</i> )."
	Feyera, S., Beck, E., & Lüttge, U. (2002). Exotic trees as nurse trees for the regeneration of natural tropical forests. <i>Trees</i> , 16(4-5): 245-249	[Reduced light, rather than allelopathy, attributed to any lack of regeneration observed] "Generally broad-leaved species, including <i>Eucalyptus</i> , appear to be more favourable "nurse trees" than conifers (Keenan et al. 1997) as is also borne out by comparing native woody species under canopies of <i>Eucalyptus</i> ( <i>E. saligna</i> , <i>E. globulus</i> ) with conifers ( <i>Pinus patula</i> , <i>Cupressus lusitanica</i> ) at Degaga in Ethiopia (Table 2). Regeneration of native woody species is a little better under <i>P. patula</i> than under <i>C. lusitanica</i> ." ... "In <i>Eucalyptus</i> plantations ground cover with forbs and graminoids may reach up to 100%, just as in natural forests, <i>P. patula</i> plantations may attain 77%, while the highest value recorded for <i>C. lusitanica</i> was only 6%."

403	Parasitic	n
	Source(s)	Notes
	Little Jr., E.L. & Skolmen, R.G. 1989. Common forest trees of Hawaii: (native and introduced). USDA Agriculture Handbook No. 679. USDA Forest Service, Washington, D.C.	"Large introduced narrow-leaf or needle-leaf evergreen tree of graceful shape, in forest plantations on moist slopes, with long slender drooping or "weeping" needles, many clustered cones remaining attached, and reddish bark on upper trunk and branches." [Pinaceae - No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	McNamara, L.M. 2005. Nutrient concentration of inner bark tissue in pine trees in Mpumalanga in relation to baboon damage. MSc Thesis. University of the Witwatersrand, Johannesburg, South Africa	"Blue monkeys ( <i>Cercopithecus mitis</i> ) are reported to strip bark from <i>Pinus patula</i> plantations in Tanzania (Maganga and Wright, 1991), and chimpanzees are reported to strip bark from a variety of trees, shrubs and wood vines in Tanzania (Nishida, 1976)."
	Gillespie, A.J.R. 1992. <i>Pinus patula</i> Schiede and Deppe. Patula pine. SO-ITF-8M-64. Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Rio Piedras. PR	"Domestic and feral pigs damage trees by digging and browsing on roots. Patula pine appears to be less susceptible to pig damage than does <i>P. patula</i> ssp. <i>tecunumanii</i> (26). Browsing animals can damage plantations by feeding on new shoots (31)."
	Afolayan, T. A. (1975). Effects of elephant activities on forest plantations In the Kilimanjaro forest-game reserve in northern Tanzania. <i>Oikos</i> , 26(3): 405-410	[Browsed by elephants in Africa] "In all the species studied <i>Pinus patula</i> was the most utilized by elephants. The damage to young plantations often resulted in almost every tree broken or pushed over with large parts of the stem completely eaten..."

Qsn #	Question	Answer
405	Toxic to animals	n
	Source(s)	Notes
	Gillespie, A.J.R. 1992. <i>Pinus patula</i> Schiede and Deppe. Patula pine. SO-ITF-8M-64. Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Rio Piedras. PR	[No evidence] "Domestic and feral pigs damage trees by digging and browsing on roots. Patula pine appears to be less susceptible to pig damage than does <i>P. patula</i> ssp. <i>tecunumanii</i> (26). Browsing animals can damage plantations by feeding on new shoots (31)."
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Diseases <i>Fusarium subglutinans</i> f. sp. <i>pini</i> , the fungus that causes pitch canker disease of several pine species, is known to cause a root disease of <i>P. patula</i> seedlings in South Africa. Thus far, the disease has not been observed in mature trees (TCP, 2002). Dwarf mistletoes, <i>Arceuthobium</i> spp. are important pests of conifers, especially in western North America. Species of <i>Arceuthobium</i> known to infest <i>P. patula</i> within its geographic range include <i>Arceuthobium aureum</i> ssp. <i>peteronii</i> in Oaxaca, Mexico, <i>A. globosum</i> ssp. <i>grandicaule</i> , <i>A. nigrum</i> and <i>A. vaginatum</i> ssp. <i>vaginatum</i> in central Mexico (Hawksworth and Wiens, 1996). Insects Cibrián Tovar et al. (1995) review the insects affecting <i>P. patula</i> . The most destructive insect pest of <i>P. patula</i> is the Mexican pine beetle, <i>Dendroctonus mexicanus</i> . This insect can develop into outbreaks and kill thousands of pines. Outbreaks often require direct control action consisting of cutting infested trees and stripping the bark. The round headed pine beetle, <i>Dendroctonus adjunctus</i> , is a pest of high elevation pine forests, generally at elevations in excess of 2800 m. However, this insect tends to be less aggressive than <i>D. mexicanus</i> . Several species of engraver beetles, <i>Ips</i> spp. also attack <i>P. patula</i> . Most attacks occur in trees that have recently died, been harvested, windthrown or are severely stressed. In Mexico, larvae of the longhorned beetle, <i>Monochamus clamator rubiginus</i> bore in the cambium and wood of pines, including <i>P. oocarpa</i> . Attacks generally occur in weakened or recently dead trees or freshly cut logs. <i>P. patula</i> is one of several exotic pine species attacked a pine woolly adelgid, <i>Pineus boernerii</i> in eastern and southern Africa (Murphy and Nair, 1996). <i>P. patula</i> is one of several tropical pines known to be a host of the European woodwasp, <i>Sirex noctilio</i> (Duraflora, 1993)."
	Orwa C., Mutua, A., Kindt R., Jamnadass, R., & Anthony, S. 2009 Agroforestry Database: a tree reference and selection guide version 4.0. <a href="http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp">http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp</a> . [Accessed 1 Jun 2015]	[Unknown if pests and pathogens impact other important native or commercial taxa] "The majority of insect pests that cause damage to <i>P. patula</i> are defoliators, mainly of the order Lepidoptera, the notorious families being Arctiidae, Lasiocampidae, Noctuidae and Saturniidae. Damage begins from the nursery stage through cutworms, several leaf rollers and defoliators. Plantation pests include leaf-eating adult beetles, adult bark beetles (mottled pine bark weevil) and sucking insects such as pine woolly aphid. Diseases of <i>P. patula</i> include foliage leaf cast, tip die-back of the branches and armillaria root rot."

Qsn #	Question	Answer
407	Causes allergies or is otherwise toxic to humans	
	Source(s)	Notes
	Global Species. 2015. <i>Pinus patula</i> (Jelecote pine; Mexican weeping pine; Spreading-leaved pine). <a href="http://www.globalspecies.org/ntaxa/386747">http://www.globalspecies.org/ntaxa/386747</a> . [Accessed 1 Jun 2015]	"Allergen Potential: Medium-Low"
	SelecTree. 1995-2015. " <i>Pinus patula</i> Tree Record." Jun 1, 2015. <a href="http://selectree.calpoly.edu/treedetail.lasso?rid=1064">http://selectree.calpoly.edu/treedetail.lasso?rid=1064</a> . [Accessed 1 Jun 2015]	"Health Hazard: Allergy" [Possibly to susceptible individuals]

408	Creates a fire hazard in natural ecosystems	y
	Source(s)	Notes
	Rodríguez-Trejo, D. A., & Fulé, P. Z. (2003). Fire ecology of Mexican pines and a fire management proposal. <i>International Journal of Wildland Fire</i> , 12(1): 23-37	" <i>P. patula</i> often forms pure stands or dominates stands, but can be codominant in a forest undergoing successional change. In the absence of recent fire, on deep and fertile soils with abundant precipitation in Puebla, <i>P. patula</i> was found mixed with <i>P. ayacahuite</i> var. <i>veitchii</i> , <i>Abies religiosa</i> and several <i>Quercus</i> species. The fuel load was high and vertically continuous, including herbs, shrubs, several tree strata and dead woody fuels of every size. This structure appears likely to support infrequent, high intensity crown fires that may favor the re-establishment of <i>P. patula</i> from seed protected in its serotinous cones, as observed by Mirov (1967) for other serotinous pine species."

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	Notes
	Gillespie, A.J.R. 1992. <i>Pinus patula</i> Schiede and Deppe. Patula pine. SO-ITF-8M-64. Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Rio Piedras. PR	"Patula pine is shade intolerant and sensitive to competition for water during extended droughts."
	Nigro, S.A., 2008. <i>Pinus patula</i> Schltld. & Cham. [Internet] Record from PROTA4U. Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 1 Jun 2015]	" <i>Pinus patula</i> is strongly light-demanding. It is an aggressive pioneer species that grows readily in forest gaps created by fire."

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

Qsn #	Question	Answer
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	<p>"Pinus patula grows on a wide range of soils. In its native range the species grows on deep fertile clay as well as loose, porous sandy loam soils. In exotic environments, the species thrives on young volcanic soils in South America and East Africa, mature leached infertile soils derived from the basement complex in South Africa, doleritic soils, as well as soils derived from schist. The species prefers acidic soils that have a good moisture supply (Poynton, 1979). Typically, deep soils that retain moisture throughout the dry season are ideal for P. patula. Besides soil depth, rooting depth is also critical as studies have shown that P. patula will grow on shallow soils of only 15 cm depth, by the ability to send roots through fissures of rock. The species grows on almost all major land forms. There are no known preferences for aspect and the species has been recorded growing on all kinds of slopes, ridges, flat plains and ravines."</p> <p>"Soil descriptors                      - Soil texture: light; medium; heavy                      - Soil drainage: free                      - Soil reaction: acid; neutral                      - Special soil tolerances: shallow; infertile                      - Soil types: clay soils; sandy soils; volcanic soils; luvisols; mountain soils; podzols; tropical soils; vertisols"</p>
	Orwa C., Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestry Database: a tree reference and selection guide version 4.0. <a href="http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp">http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp</a> . [Accessed 1 Jun 2015]	"Soil type: The common soil features include acidity and good moisture supply. In the east African highlands, is it found on young fertile volcanic soils and on mature leached infertile soils derived from basement complex on other sites in E. Africa and South Africa."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Little Jr., E.L. & Skolmen, R.G. 1989. Common forest trees of Hawaii: (native and introduced). USDA Agriculture Handbook No. 679. USDA Forest Service, Washington, D.C.	"Large introduced narrow-leaf or needle-leaf evergreen tree of graceful shape, in forest plantations on moist slopes, with long slender drooping or "weeping" needles, many clustered cones remaining attached, and reddish bark on upper trunk and branches."

Qsn #	Question	Answer
412	Forms dense thickets	y
	Source(s)	Notes
	Orwa C., Mutua, A., Kindt R., Jamnadass, R., & Anthony, S. 2009 Agroforestry Database: a tree reference and selection guide version 4.0. <a href="http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp">http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp</a> . [Accessed 1 Jun 2015]	"Often found in pure dense stands, but the occurrence is discontinuous, and now over much of its range it grows only in areas inaccessible to agriculture."
	Rodríguez-Trejo, D. A., & Fulé, P. Z. (2003). Fire ecology of Mexican pines and a fire management proposal. <i>International Journal of Wildland Fire</i> , 12(1): 23-37	"P. patula often forms pure stands or dominates stands, but can be codominant in a forest undergoing successional change."
	Gillespie, A.J.R. 1992. <i>Pinus patula</i> Schiede and Deppe. Patula pine. SO-ITF-8M-64. Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Rio Piedras. PR	"Patula pine can occasionally be found in pure, dense stands (31) but is more often associated with other pines"

501	Aquatic	n
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Terrestrial tree] "Vegetation types: cloud forests; deciduous forests; mixed forests; moist forests; mountain forests"

502	Grass	n
	Source(s)	Notes
	USDA, ARS, National Genetic Resources Program. 2015. 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 1 Jun 2015]	"Genus: <i>Pinus</i> subgenus: <i>Pinus</i> section: <i>Trifoliae</i> subsection: <i>Australes</i> Family: <i>Pinaceae</i> "

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, ARS, National Genetic Resources Program. 2015. 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 1 Jun 2015]	<i>Pinaceae</i> . No evidence

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Little Jr., E.L. & Skolmen, R.G. 1989. Common forest trees of Hawaii: (native and introduced). USDA Agriculture Handbook No. 679. USDA Forest Service, Washington, D.C.	"Large introduced narrow-leaf or needle-leaf evergreen tree of graceful shape, in forest plantations on moist slopes, with long slender drooping or "weeping" needles, many clustered cones remaining attached, and reddish bark on upper trunk and branches."

Qsn #	Question	Answer
601	<b>Evidence of substantial reproductive failure in native habitat</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Farjon, A. 2013. <i>Pinus patula</i> . The IUCN Red List of Threatened Species. Version 2015.1. <a href="http://www.iucnredlist.org">www.iucnredlist.org</a>	" <i>Pinus patula</i> is widespread and abundant despite exploitation for its timber. Regeneration is quick and the trees are fast growing. It is therefore assessed as Least Concern."
602	<b>Produces viable seed</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Observations on lack of natural regeneration at lower altitudes in Zimbabwe appear to indicate that at lower altitudes seed is probably empty (infertile); at higher altitudes natural regeneration occurs. Cones, which usually take two years to mature, are harvested in September October." ... " <i>P. patula</i> is propagated from seed, collected from either rogued seed stands, seedling seed orchards or clonal seed orchards. In countries such as Swaziland, Zimbabwe and South Africa, <i>P. patula</i> plantations have originated been from improved seed collected from clonal seed orchards since the establishment of orchards in the 1960s."
603	<b>Hybridizes naturally</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Orwa C., Mutua, A., Kindt R., Jamnadass, R., & Anthony, S. 2009 Agroforestry Database: a tree reference and selection guide version 4.0. <a href="http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp">http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp</a> . [Accessed 1 Jun 2015]	"Throughout its range, <i>P. patula</i> can be found associated with <i>P. gregorii</i> and <i>P. teocote</i> , with which it is reported to have hybridized."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[Artificial hybrids created] "Hybridisation <i>P. patula</i> has shown potential in interspecific hybrid combination with other pines and currently there are active programmes developing hybrids of <i>P. patula</i> with <i>P. greggii</i> , <i>P. pringlei</i> , <i>P. oocarpa</i> in Zimbabwean and South African breeding programmes. Most of the hybrid tests are still very young and therefore there are no conclusions as yet on the best interspecific combinations."
604	<b>Self-compatible or apomictic</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Orwa C., Mutua, A., Kindt R., Jamnadass, R., & Anthony, S. 2009 Agroforestry Database: a tree reference and selection guide version 4.0. <a href="http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp">http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp</a> . [Accessed 1 Jun 2015]	" <i>P. patula</i> is a monoecious plant. The female flowers are usually borne in the upper crown, and the male ones in the lower crown."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The species is predominantly wind pollinated and outcrossing but often tolerates a fair amount of inbreeding."
605	<b>Requires specialist pollinators</b>	<b>n</b>

Qsn #	Question	Answer
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[Pinaceae. Wind-pollinated] "Inflorescences, flowers and fruit Flowering in <i>P. patula</i> varies from site to site. In its native range, pollen shedding begins in January and lasts until April and wide tree to tree variation is observed. In Malawi, Zimbabwe and South Africa, flowering (both male and female flowers) occurs in spring, i.e., August to October. A secondary flush of only female flowers usually occurs earlier in the year (Barnes and Mullin, 1974; Drew, 1969). In Kenya which is very close to the equator, two flushes of both flowers occur coinciding with the two rainy seasons (April-May and October-November). Female flowers have also been recorded throughout the year. In Zimbabwe, studies showed that synchronisation of pollen shedding with female receptivity is good at altitude 1500 m, whereas pollen rain became progressively later at lower altitudes."

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[No evidence of natural vegetative spread] "Vegetative propagation Although there are studies looking at the potential of vegetative propagation of <i>P. patula</i> for commercial planting, most of the plantings are still made from seed. However, clonal orchards are established using clones propagated by grafting and, in a few cases of incompatibility, air layering has been used to propagate the clones (Barnes, 1974)."

607	Minimum generative time (years)	>3
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	" <i>P. patula</i> flowers as early as age 2 years with female flowers appearing first and male flowers appearing in the fourth year. Five-year old trees produce viable seeds and cone and seed production is prolific by the eighth to the tenth-year."
	Nigro, S.A., 2008. <i>Pinus patula</i> Schltldl. & Cham. [Internet] Record from PROTA4U. Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed ]	" <i>Pinus patula</i> grows very fast. Under favourable conditions it may attain a height of 15 m after 8 years and 35 m after 30 years. In southern Africa female flowering starts when trees are 2–3 years old, and male flowering 1–2 years later." ... "The production of viable seeds starts when trees are 5 years old, and is prolific in 8–10-year-old trees."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	Farjon, A. & Styles, B.T. 1997. <i>Pinus</i> (Pinaceae). <i>Flora Neotropica</i> 75: 1-291	[No evidence. Seeds lack means of external attachment] "Seeds obliquely ovoid, flattened, 4-6 x 2-4 mm, blackish grey. Seed wings articulate, held to the seed by two oblique claws which partly cover the seed on one side, obliquely ovate-oblong, 12-18 x 5- 8 mm, light brown with dark stripes."

702	Propagules dispersed intentionally by people	y
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"a popular ornamental and forest planting in the tropics." ... "...it is no longer used as a reforestation planting, although ornamental plantings can be seen on Maui."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"It is the most important pine species in southern and East Africa (Kenya, Malawi, Mozambique, Zambia, Zimbabwe, South Africa, Swaziland, Tanzania and Uganda) and is commercially planted in South America (Colombia, southern Brazil, Argentina) and, to a limited extent, in Asia (Nepal and India)."
	Oppenheimer, H. L. 2002. The Spread of Gymnosperms on Maui: A Neglected Element of the Modern Hawaiian Flora. Bishop Museum Occasional Papers 68: 19–23	"The Jelecote pine or Mexican weeping pine, native to the mountains of eastern Mexico, has been planted on the islands of Maui and Hawai'i (Little & Skolmen, 1989: 58)."

703	Propagules likely to disperse as a produce contaminant	n
	<b>Source(s)</b>	<b>Notes</b>
	Nigro, S.A., 2008. <i>Pinus patula</i> Schltdl. & Cham. [Internet] Record from PROTA4U. Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed ]	[No evidence. Unlikely, as not grown with other produce, and does not seed until 5 years] "Pinus patula grows very fast. Under favourable conditions it may attain a height of 15 m after 8 years and 35 m after 30 years. In southern Africa female flowering starts when trees are 2–3 years old, and male flowering 1–2 years later." ... "The production of viable seeds starts when trees are 5 years old, and is prolific in 8–10-year-old trees."

704	Propagules adapted to wind dispersal	y
	<b>Source(s)</b>	<b>Notes</b>
	BioNET-EAFRINE. 2011. <i>Pinus patula</i> (Patula Pine). <a href="http://keys.lucidcentral.org/keys/v3/eafrinet/">http://keys.lucidcentral.org/keys/v3/eafrinet/</a> . [Accessed 1 Jun 2015]	"Pinus patula reproduces through small, light wind-dispersed seeds."
	Little Jr., E.L. & Skolmen, R.G. 1989. Common forest trees of Hawaii: (native and introduced). USDA Agriculture Handbook No. 679. USDA Forest Service, Washington, D.C.	[Winged-seeds] "Seeds paired and exposed at base of cone-scales, with triangular mottled gray black body less than 1/4 inch (6 mm) long and wing 1/2–3/4 inch (13–19 mm) long."

705	Propagules water dispersed	n
	<b>Source(s)</b>	<b>Notes</b>
	Nigro, S.A., 2008. <i>Pinus patula</i> Schltdl. & Cham. [Internet] Record from PROTA4U. Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 1 Jun 2015]	"Seed dispersal is usually by wind, but sometimes also by birds, rodents or people."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[Wind-dispersed, and not occurring in riparian areas] "Vegetation types: cloud forests; deciduous forests; mixed forests; moist forests; mountain forests"

706	Propagules bird dispersed	

Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Nigro, S.A., 2008. <i>Pinus patula</i> Schltld. & Cham. [Internet] Record from PROTA4U. Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 1 Jun 2015]	"Seed dispersal is usually by wind, but sometimes also by birds, rodents or people." [Game birds may potentially disperse seeds in the Hawaiian Islands]

707	Propagules dispersed by other animals (externally)	
	<b>Source(s)</b>	<b>Notes</b>
	Nigro, S.A., 2008. <i>Pinus patula</i> Schltld. & Cham. [Internet] Record from PROTA4U. Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 1 Jun 2015]	"Seed dispersal is usually by wind, but sometimes also by birds, rodents or people." [Rodents would act as seed predators, but might cache seeds for later consumption. Those that may escape predation could be secondarily dispersed]

708	Propagules survive passage through the gut	
	<b>Source(s)</b>	<b>Notes</b>
	Nigro, S.A., 2008. <i>Pinus patula</i> Schltld. & Cham. [Internet] Record from PROTA4U. Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. <a href="http://www.prota4u.org/search.asp">http://www.prota4u.org/search.asp</a> . [Accessed 1 Jun 2015]	[Unknown. Birds and rodents likely act as seed predators] "Seed dispersal is usually by wind, but sometimes also by birds, rodents or people."

801	Prolific seed production (>1000/m <sup>2</sup> )	y
	<b>Source(s)</b>	<b>Notes</b>
	Rodríguez-Trejo, D. A., & Fulé, P. Z. (2003). Fire ecology of Mexican pines and a fire management proposal. <i>International Journal of Wildland Fire</i> , 12(1): 23-37	"Fire stimulates its serotinous cones to open (Vela-Gálvez 1980; Keeley and Zedler 1998). The seed bed created after the passage of fire allows hundreds of thousand of seeds per hectare to germinate during good seed years."
	Nyoka, B.I. (ed.). 2003. Biosecurity in Forestry: A Case Study on the Status of Invasive Forest Tree Species in Southern Africa. Working Paper FBS/1E. Forestry Department, FAO, Rome	[Prolific seed. Densities unspecified] "In South Africa and Zimbabwe, the species flowers and produces seeds within five years (i.e. short juvenile phase), is a prolific seeder every year and its seed averages only 0.127 seeds per milligram. The cone crop is nearly always good every year and the serotinous cones give the seed an extended storage life. The seed, which is winged, is blown by wind for several kilometres. "

802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	<b>Source(s)</b>	<b>Notes</b>

Qsn #	Question	Answer
	Orwa C., Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestry Database: a tree reference and selection guide version 4.0. <a href="http://www.worldagroforestry.org/sites/treedbs/treedata/bases.asp">http://www.worldagroforestry.org/sites/treedbs/treedata/bases.asp</a> . [Accessed 1 Jun 2015]	"Seed storage behaviour is orthodox; viability is maintained for at least 3 years in open storage; a few seeds survive after 21 years of hermetic storage at 5 deg. C; viability can be maintained in hermetic storage for 6 months when seed is stored at room temperature, and for several years when stored at 3 deg. C with 7-10% mc. The number of seeds per kg depends on the provenance and the climatic conditions of the ripening year. On average, there are 143 000 seeds/kg. A purity of 98% can be achieved."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[Orthodox seeds. Serotinous cones produce a "canopy" seed bank] "Percentage germination may be improved through seed pretreatment to break dormancy. Soaking in cold water for eight days has been reported to break dormancy in seed that was 1 to 7 years old (Barrett, 1973; Pudden, 1956). Soaking in hydrogen peroxide (1 kg of seed in 80 litres of 1.5% hydrogen peroxide for 4 days) was found to increase germination. Scarification was found to be ineffective for <i>P. patula</i> . Another method of improving germination is to separate empty seeds from filled seeds by floating out the empty seeds." ... "- Seed storage orthodox" ... "Several characteristics help make large <i>P. patula</i> moderately fire tolerant. These include thick bark and some self-pruning ability. This species can also produce serotinous cones, which do not open or cast seeds until exposed to high temperatures (Keeley and Zedler, 1998)."
	Nyoka, B.I. (ed.). 2003. Biosecurity in Forestry: A Case Study on the Status of Invasive Forest Tree Species in Southern Africa. Working Paper FBS/1E. Forestry Department, FAO, Rome	The cones of <i>P. patula</i> are serotinous and may remain unopened for one to two years after ripening. The seed may remain in the cone for seven years with loss of viability of less than 40 percent."

803	Well controlled by herbicides	y
	Source(s)	Notes
	Tu, M., Hurd, C., & Randall, J. M. (2001). Weed control methods handbook: tools & techniques for use in natural areas. The Nature Conservancy. <a href="http://digitalcommons.usu.edu/govdocs/533">http://digitalcommons.usu.edu/govdocs/533</a> . [Accessed ]	"Even though offsite movement of triclopyr acid through surface or sub-surface runoff is a possibility, triclopyr is one of the most commonly used herbicides against woody species in natural areas." ... "TNC preserves in Hawaii have successfully used triclopyr to control blackwood acacia ( <i>Acacia melanoxylon</i> ), bush honeysuckle ( <i>Lonicera maackii</i> ), Chinese banyan ( <i>Ficus microcarpa</i> ), corkystem passionflower ( <i>Passiflora suberosa</i> ), eucalyptus ( <i>Eucalyptus globulus</i> ), Florida prickly blackberry ( <i>Rubus argutus</i> ), Mexican weeping pine ( <i>Pinus patula</i> ), Monterey pine ( <i>Pinus radiata</i> ), strawberry guava ( <i>Psidium cattleianum</i> ), tropical ash ( <i>Fraxinus uhdei</i> ), and velvet leaf ( <i>Miconia calvescens</i> )."
	Macalister, A. 2014. Herbicide Injection of Wilding Conifers. Marlborough Sounds Restoration Trust, Nelson, NZ. <a href="http://marlboroughsounds-restora.squarespace.com/">http://marlboroughsounds-restora.squarespace.com/</a> . [Accessed ]	"High-strength metsulfuron-methyl (e.g.: Adama Metsulfuron at 600g/kg) has proven to be entirely effective against all sizes of <i>Pinus radiata</i> . A solution of 50g per litre is recommended." ... "Other species of wilding pine for which this method has been trialed include <i>Pinus patula</i> (Mexican weeping pine) and <i>Pinus muricata</i> (Bishop pine)."

Qsn #	Question	Answer
	BioNET-EAFRINE. 2011. <i>Pinus patula</i> (Patula Pine). <a href="http://keys.lucidcentral.org/keys/v3/eafrinet/">http://keys.lucidcentral.org/keys/v3/eafrinet/</a> . [Accessed 1 Jun 2015]	" <i>Pinus patula</i> will not re-grow if cut low to the ground and all green foliage is removed so physical control can be effective. Trees can be killed standing by ring barking, frilling (making deep cuts at regular intervals around the base of the tree and applying herbicide into the cuts) and tree injection. When using any herbicide always read the label first and follow all instructions and safety requirements. If in doubt consult an expert."
	Goodall, J. M., Denny, R. P., & Dicks, H. M. (1991). The Effects of Five Herbicides on <i>Pinus patula</i> Saplings when Applied "Over-the top" for Woody Weed Control. <i>South African Forestry Journal</i> , 1 (1), 38-46	[Sensitive to glyphosate, fosamine-ammonium and triclopyr ester] "Five herbicides were applied over-the-top to <i>Pinus patula</i> saplings to determine which ones are tolerated by pines. At concentrations adequate for woody weed suppression, clopyralid and metsulfuron methyl were found most promising; glyphosate, fosamine-ammonium and triclopyr ester resulted in excessive tree mortality. Clopyralid was the only herbicide that did not affect tree growth during the first year after application, but after two years metsulfuron methyl did not significantly reduce growth either. All herbicide treatments caused varying degrees of phytotoxicity initially, but surviving trees recovered after 10 to 18 months to a state of no visible effects or permanent distortion. Stem distortion occurred only in the second year and was greatest in clopyralid."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	Notes
	Gillespie, A.J.R. 1992. <i>Pinus patula</i> Schiede and Deppe. Patula pine. SO-ITF-8M-64. Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Rio Piedras. PR	"Coppicing and basal shoots (shoots arising from the root collar of established trees) are common for <i>P. patula</i> ssp. <i>tecunumanii</i> but not for patula pine (26)."
	Rodríguez-Trejo, D. A., & Fulé, P. Z. (2003). Fire ecology of Mexican pines and a fire management proposal. <i>International Journal of Wildland Fire</i> , 12(1): 23-37	"When in the seedling stage the tree is susceptible to fire, but its growth rate allows it to reach the minimum height to survive low intensity fires relatively soon and a thick bark develops to protect the cambium. Epicormic sprouts appear in the lower stem in some adult individuals."
	BioNET-EAFRINE. 2011. <i>Pinus patula</i> (Patula Pine). <a href="http://keys.lucidcentral.org/keys/v3/eafrinet/">http://keys.lucidcentral.org/keys/v3/eafrinet/</a> . [Accessed 1 Jun 2015]	[Does not tolerate cutting] " <i>Pinus patula</i> will not re-grow if cut low to the ground and all green foliage is removed so physical control can be effective."
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Tolerates fire] "Several characteristics help make large <i>P. patula</i> moderately fire tolerant. These include thick bark and some self-pruning ability. This species can also produce serotinous cones, which do not open or cast seeds until exposed to high temperatures (Keeley and Zedler, 1998)."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	n
	Source(s)	Notes
	BioNET-EAFRINE. 2011. <i>Pinus patula</i> (Patula Pine). <a href="http://keys.lucidcentral.org/keys/v3/eafrinet/">http://keys.lucidcentral.org/keys/v3/eafrinet/</a> . [Accessed 1 Jun 2015]	"There are a number of potential pests and pathogens that could be used as biological control agents but they are generalists and so are not suitable agents (A.B.R. Witt pers. comm.). "

Qsn #	Question	Answer
	<p>Moran, V. C., Hoffmann, J. H., Donnelly, D., Zimmermann, H. G., &amp; Van Wilgen, B. W. (2000). Biological control of alien invasive pine trees (<i>Pinus</i> species) in South Africa. In N. R. Spencer (Ed.), Proceedings of the X international symposium on biological control of weeds. Montana State University, Bozeman, Montana, USA, pp. 941-953</p>	<p>[Considered too important to industry] "There are seven <i>Pinus</i> species that are declared invaders or proposed as declared invaders in South Africa: <i>P. canariensis</i>, <i>P. elliottii</i>, <i>P. halepensis</i>, <i>P. patula</i>, <i>P. pinaster</i>, <i>P. pinea</i> and <i>P. radiata</i>. An early decision was taken to exclude <i>P. patula</i> and <i>P. elliotti</i> from further consideration as targets for biological control: this decision was taken because of the paramount importance of these two species in the forestry industry."</p>
	<p>Loope, L.L., Nagata, R.J. &amp; Medeiros, A.C. 1992, Alien plants in Haleakala National Park Pp. 551-576 in Stone et al (eds) Alien plant invasions in native ecosystems of Hawaii. Coop. Nat. Park Resources Studies Unit, University of Hawaii, Honolulu, HI</p>	<p>[No evidence of natural enemies impacting spread] "<i>Pinus radiata</i> from California, <i>Pinus patula</i> from Mexico, and <i>Pinus pinaster</i> from southern Europe are the only conifers (of many planted species in the Hosmer Grove area) to aggressively establish seedlings in native shrubland of the Park along the boundary adjacent to an experimental watershed improvement project on ranchland."</p>

**Summary of Risk Traits:**

## High Risk / Undesirable Traits

- Elevation range exceeds 1000 m, demonstrating environmental versatility
- Grows in higher elevations of regions with tropical to subtropical climates
- Naturalized on Maui, Hawaiian Islands, and South Africa
- An environmental weed in Haleakala National Park and South Africa
- Other *Pinus* species have become invasive
- Pollen may be allergenic to susceptible individuals
- Increases fire risk in areas where naturalized or invasive
- Tolerates many soil types
- Forms dense stands in native range
- Reproduces by seed
- Able to hybridize with other *Pinus* species
- Primarily outcrossing, but capable of self-pollination
- First flowers in 2 years. Able to produce seed in 5+ years
- Seeds dispersed by wind, intentionally by people and possibly by birds and rodents
- Prolific seed production
- Seeds able to be stored for extended periods; May form a persistent seed bank.
- Produces serotinous cones. Seeds may remain viable on trees for 7 years
- Older trees somewhat fire tolerant

## Low Risk Traits

- May only become invasive at higher elevations of tropical and subtropical climates
- Unarmed (no spines, thorns or burrs)
- Palatable to browsing & grazing animals
- Non-toxic
- Valued for timber and as an ornamental
- Light demanding & relatively shade intolerant
- Not reported to spread vegetatively
- Herbicides provide effective control
- Will not resprout if cut low to the ground and all foliage is removed

