

Taxon: Falcataria moluccana (Miq.) Barneby & J. W. Grimes	Family: Fabaceae
Common Name(s): albizia batai bataiwood Moluccan albizia Moluccan sau	Synonym(s): Adenanthera falcataria L. Albizia falcataria (L.) Fosberg Albizia moluccana Miq. Paraserianthes falcataria (L.) I. C. ...

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 4 Feb 2021
WRA Score: 8.0	Designation: H(Hawai'i)	Rating: High Risk

Keywords: Fast-Growing Tree, Naturalized, Environmental Weed, N-Fixing, Wind-Dispersed

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

Qsn #	Question	Answer Option	Answer
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	n
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		
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	y
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic		
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	3
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed		
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m ²)		
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	y=1, n=-1	y
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 of domestication] "It is native to the Moluccas, Papua New Guinea, the Bismarck Archipelago and the Solomon Islands from 10° South to 30° North. F. moluccana probably originated in the East Malesian region and is widely planted in the tropics."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. (2021). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. (2021). 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	"It is native to the Moluccas, Papua New Guinea, the Bismarck Archipelago and the Solomon Islands from 10° South to 30° North. F. moluccana probably originated in the East Malesian region and is widely planted in the tropics."
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 3 Feb 2021]	"Native Asia-Tropical PAPUASIA: Indonesia [Papua], Papua New Guinea, Solomon Islands MALESIA: Indonesia [Maluku]"

202	Quality of climate match data	High
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 3 Feb 2021]	

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

Qsn #	Question	Answer
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Latitude between 30°N and 10°S" ... "F. moluccana is adapted to perhumid to monsoon climates. It grows from sea level up to 2300 m above sea level with an annual rainfall of 2000-4000 mm, a temperature of 22°C to 34°C and a dry season of less than two months. The optimal temperature range is 22°C to 29 °C with a minimum of 22°C to 24°C and maximum of 30°C to 34°C (NFT, 1989; Soerianegara and Lemmens, 1993)."
	Krisnawati, H., Varis, E., Kallio, M. H., & Kanninen, M. (2011). <i>Paraserianthes falcataria</i> (L.) Nielsen: ecology, silviculture and productivity. CIFOR, Bogor, Indonesia	"The altitudinal range of the species' natural habitat is up to 1600 m above sea level but may extend up to 3300 m above sea level (Soerianegara and Lemmens 1993). A study conducted by the Agricultural Polytechnics College in Kupang (East Nusa Tenggara) indicated that the species could survive at lower altitudes on rocky, reef or coral-derived soils, but its growth was somewhat low (Djogo 1997). In Papua, the species is found at an elevation of 55 m above sea level at the lowest site in Manokwari (Charomaini and Suhaendi 1997)."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to the Moluccas, New Guinea, New Britain, and the Solomon Islands, widely planted for reforestation; in Hawai'i naturalized in disturbed mesic to wet areas, 25-600 m, on Kaua'i, O'ahu, Moloka'i, and Hawai'i."

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	"F. moluccana probably originated in the East Malesian region and is widely planted in the tropics."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"widely planted for reforestation; in Hawai'i naturalized in disturbed mesic to wet areas, 25-600 m, on Kaua'i, O'ahu, Moloka'i, and Hawai'i."

301	Naturalized beyond native range	y
	Source(s)	Notes
	Hughes, R. F., Uowolo, A. L., & Togia, T. P. (2012). Recovery of native forest after removal of an invasive tree, <i>Falcataria moluccana</i> , in American Samoa. <i>Biological Invasions</i> , 14(7), 1393-1413	"F. moluccana has invaded large areas of the forests of the NPSA and neighboring areas on Tutuila Island; it is also present in Independent (or Western) Samoa (Space and Flynn 2000; Space and Flynn 2004)."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to the Moluccas, New Guinea, New Britain, and the Solomon Islands, widely planted for reforestation; in Hawai'i naturalized in disturbed mesic to wet areas, 25-600 m, on Kaua'i, O'ahu, Moloka'i, and Hawai'i. Cultivated on O'ahu as early as 1930 (Caum et al. s.n., BISH)."

Qsn #	Question	Answer
	Starr, F., Starr, K.& Loope, L.L. 2003. New plant records from the Hawaiian Archipelago. Bishop Museum Occasional Papers 74: 23-34	[East Maui] "Falcataria moluccana (Miq.) Barneby Range extension & J.W. Grimes [Syn. Paraserianthes falcataria (L.) I. Nielsen] Previously known from Kaua'i, O'ahu, Moloka'i, West Maui, and Hawai'i (Wagner et al., 1990; Oppenheimer & Bartlett, 2002), F. moluccana (Moluccan albizia) is now also known from East Maui where it is escaping well beyond forestry plantings in Pe'ahi, Hā'iku. Material examined: MAUI: E. Maui, Hā'iku, E. Ku'iaha Rd, escaping from plantations into nearby pastures and gulches, 650 ft [200 m], Starr & Martz 000526-1."
	Oppenheimer, H.. 2007. New plant records from Moloka'i, Lāna'i, Maui, and Hawai'i for 2006. Bishop Museum Occasional Papers 96:17-34	[Lanai] "Falcataria moluccana (Miq.) Barneby New island record & J.W. Grimes [syn. Paraserianthes falcataria (L.)I. Nielsen] A large tree with a spreading crown and smooth gray bark, this species has been widely used in forestry plantings and has been documented as naturalized on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i (Wagner et al. 1999: 690; Oppenheimer & Bartlett 2002: 8; Starr et al. 2003: 27). On Lāna'i it is spreading onto the leeward benchlands in gulches outside of Lāna'i City near Kō'ele, and was observed in at least one of the windward canyon headwaters in the Puhī'elelū area. The change in taxonomy was reported by Herbarium Pacificum Staff (1998: 10). Staples et al. (2000: 21) reported the species to be wind dispersed and possibly by aquatic means as well. Material examined. LĀNA'I: Kea'aku Gulch, 430 m, 16 Aug 2006, Oppenheimer & K.R. Wood H80622."
	Oppenheimer, H. L. & Bartlett, R. T. 2002. New plant records from the main Hawaiian Islands. Bishop Museum Occasional Papers. 69: 1-14	[West Maui] "Falcataria moluccana (Miq.) Barneby New island record & J.W. Grimes Previously known to be naturalized (as Paraserianthes falcataria (L.) I. Nielsen) on the islands of Kaua'i, O'ahu, Moloka'i and Hawai'i (Wagner et al., 1999: 690), the change in taxonomy was reported by Herbarium Pacificum Staff (1998: 10). Little & Skolmen (1989: 136) reported that plants become established naturally wherever there are seed trees. So far, it is only known from one population on West Maui, spreading from what was a single tree 20 years ago (W. Nohara, pers. comm.). Material examined. MAUI: West Maui, Lahaina Distr., Honokōhau, Pōhakupule Gulch, 183 m, 2 May 2000, Oppenheimer H50003."
	Pacific Island Ecosystems at Risk (PIER). (2021). Falcataria moluccana. http://www.hear.org/Pier . [Accessed 4 Feb 2021]	In addition to the Hawaiian Islands, reported to be naturalized and/or invasive in the following locations: Tutuila Island (American Samoa); Rapa Nui (Easter) Island (Isla de Pasqua); Aitutaki Atoll, 'Atiu Island, Mangaia Island, Ma'uke Island, Rarotonga Island (Cook Islands); Weno (Moen) Island, Kosrae Island, Pohnpei Island, Yap (Waqab) Island (Federated States of Micronesia); Taveuni Island, Viti Levu Island (Fiji); Fatu Hiva Island, Nuku Hiva Island, Ua Huka (Huahuna, Uahuka) Island (French Polynesia, Marquesas Islands); Huahine, Maupiti, Moorea, Raiatea, Tahiti (French Polynesia, Society Islands); Rurutu (French Polynesia, Austral Islands); Guam; New Caledonia; Niue Island; Palau; Upolu Island (Western Samoa); Wallis ('Uvea) Island; Seychelles

302	Garden/amenity/disturbance weed	n
	Source(s)	Notes

Qsn #	Question	Answer
	Hughes, R. F., Johnson, M. T. and Uowolo, A.. (2013). The invasive alien tree <i>Falcataria moluccana</i> : its impacts and management. Pp. 218–223 in Wu et al. (eds.). Proceedings of the XIII International Symposium on Biological Control of Weeds. USDA Forest Service, Morgantown	[An environmental weed that also impacts human safety and infrastructure] " <i>Falcataria moluccana</i> (Miq.) Barneby and Grimes is a large tree that has become invasive in forests and developed landscapes across many Pacific islands. A fast-growing nitrogenfixing species, it transforms invaded ecosystems by dramatically increasing nutrient inputs, suppressing native species and facilitating invasion by other weeds. Individuals rapidly reach heights of 35 m, and their massive limbs break easily in storms or with age, creating significant hazards in residential areas and across infrastructure corridors such as roads and power lines. Their management is extremely costly for landowners, utilities, and local governments, since removal of hazardous trees can cost several thousand dollars apiece."

303	Agricultural/forestry/horticultural weed	n
	Source(s)	Notes
	Hughes, R. F., Johnson, M. T. and Uowolo, A.. (2013). The invasive alien tree <i>Falcataria moluccana</i> : its impacts and management. Pp. 218–223 in Wu et al. (eds.). Proceedings of the XIII International Symposium on Biological Control of Weeds. USDA Forest Service, Morgantown	[An environmental weed that also impacts human safety and infrastructure] " <i>Falcataria moluccana</i> (Miq.) Barneby and Grimes is a large tree that has become invasive in forests and developed landscapes across many Pacific islands. A fast-growing nitrogenfixing species, it transforms invaded ecosystems by dramatically increasing nutrient inputs, suppressing native species and facilitating invasion by other weeds. Individuals rapidly reach heights of 35 m, and their massive limbs break easily in storms or with age, creating significant hazards in residential areas and across infrastructure corridors such as roads and power lines. Their management is extremely costly for landowners, utilities, and local governments, since removal of hazardous trees can cost several thousand dollars apiece."

304	Environmental weed	y
	Source(s)	Notes
	Hughes, R. F., Uowolo, A. L., & Togia, T. P. (2012). Recovery of native forest after removal of an invasive tree, <i>Falcataria moluccana</i> , in American Samoa. <i>Biological Invasions</i> , 14(7), 1393-1413	" <i>F. moluccana</i> has invaded large areas of the forests of the NPSA and neighboring areas on Tutuila Island; it is also present in Independent (or Western) Samoa (Space and Flynn 2000; Space and Flynn 2004)."

Qsn #	Question	Answer
	<p>Hughes, R. F., Johnson, M. T. and Uowolo, A.. (2013). The invasive alien tree <i>Falcataria moluccana</i>: its impacts and management. Pp. 218–223 in Wu et al. (eds.). Proceedings of the XIII International Symposium on Biological Control of Weeds. USDA Forest Service, Morgantown</p>	<p>"<i>Falcataria moluccana</i> (Miq.) Barneby and Grimes is a large tree that has become invasive in forests and developed landscapes across many Pacific islands. A fast-growing nitrogen-fixing species, it transforms invaded ecosystems by dramatically increasing nutrient inputs, suppressing native species and facilitating invasion by other weeds. Individuals rapidly reach heights of 35 m, and their massive limbs break easily in storms or with age, creating significant hazards in residential areas and across infrastructure corridors such as roads and power lines. Their management is extremely costly for landowners, utilities, and local governments, since removal of hazardous trees can cost several thousand dollars apiece. Although efficient mechanical and chemical controls are being used with some success against incipient invasions of <i>F. moluccana</i>, biological control is needed to manage spread of populations and the massive seedling recruitment that occurs once mature individuals have been killed. The benefits of a biological control program for <i>F. moluccana</i> would likely extend to tropical islands throughout the Pacific, helping prevent further loss of native forest biodiversity and saving many millions of dollars in damage and maintenance associated with these trees growing near utilities, roads, homes and workplaces."</p>
	<p>Hughes, R. F., & Denslow, J. S. (2005). Invasion by a N₂-fixing tree alters function and structure in wet lowland forests of Hawaii. <i>Ecological Applications</i>, 15(5), 1615-1628</p>	<p>"Invasive species pose major threats to the integrity and functioning of ecosystems. When such species alter ecosystem processes, they have the potential to change the environmental context in which other species survive and reproduce and may also facilitate the invasion of additional species. We describe impacts of an invasive N₂-fixing tree, <i>Falcataria moluccana</i>, on some of the last intact remnants of native wet lowland forest undergoing primary succession on 48-, 213-, and 300-yr-old lava flows of Kilauea Volcano on the island of Hawai'i. We measured litterfall, soil nitrogen (N) and phosphorus (P) availability, light availability, species composition, and forest structure in native-dominated stands and in stands invaded by <i>Falcataria</i>. Litter inputs increased 1.3–8.6 times, N mass of litterfall increased 4–55 times, and P mass of litterfall increased 2–28 times in invaded stands relative to native stands. C:N and C:P ratios of litterfall were lower, and N:P ratios higher, in invaded stands relative to native stands. Resin-captured soil N and P values were 17–121 and 2–24 times greater, respectively, in invaded stands relative to native stands on each of the three lava flows. Native species accounted for nearly 100% of total basal area and stem density in native stands, while alien species accounted for 68– 99% of total basal area, and 82–91% of total stem density, in invaded stands. Compositional changes following <i>Falcataria</i> invasion were due both to increases in alien species, particularly <i>Psidium cattleianum</i>, and decreases in native species, particularly <i>Metrosideros polymorpha</i>. Results provide a clear example of how invasive tree species, by modifying the function and structure of the ecosystems that they invade, can facilitate invasion by additional nonnative species and eliminate dominant native species. Given the rarity and limited extent of remaining native-dominated wet lowland forests in Hawaii, and the degree to which <i>Falcataria</i> invasion alters them, we expect that the continued existence of these unique ecosystems will be determined, in large part, by the spread of this invasive species."</p>

Qsn #	Question	Answer
305	Congeneric weed	
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Species of Albizia and Paraserianthes, genera in which Falcataria moluccana has previously been placed, are reported to be invasive. Under current classification, no other Falcataria species are reported to be invasive weeds

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[No evidence] "Trees up to 40 m tall, bark white, gray, or greenish, smooth or slightly warty, young parts densely reddish brown tomentose or puberulent. Leaves with a large nectary below the lowermost pair of pinnae and smaller ones between or below most pairs of pinnae, pinnae (4-)8-15 pairs, leaflets 15-25 pairs per pinna, obliquely elliptic, falcate, 10-20 mm long, 3-6 mm wide, midrib strongly excentric near 1 of the margins. Flowers in panicles ca. 20 cm in diameter, often with 2 serial branches from 1 bract scar; calyx 1-1.5 mm long, silky pubescent, the teeth 0.5 mm long; corolla cream or greenish yellow, 3-4.5 mm long (excl. stamens); stamens 10-17 mm long."

402	Allelopathic	n
	Source(s)	Notes
	Krisnawati, H., Varis, E., Kallio, M. H., & Kanninen, M. (2011). Paraserianthes falcataria (L.) Nielsen: ecology, silviculture and productivity. CIFOR, Bogor, Indonesia	"As a nitrogen-fixing species, P. falcataria is also commonly planted for reforestation and afforestation to improve soil fertility (Heyne 1987). The natural drop of leaves and small branches contributes nitrogen, organic matter and minerals to the upper layers of soil (Orwa et al. 2009). The trees are sometimes interplanted with agricultural crops such as corn and cassava and fruit trees (Charomaini and Suhaendi 1997)."

403	Parasitic	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Trees up to 40 m tall, bark white, gray, or greenish, smooth or slightly warty, young parts densely reddish brown tomentose or puberulent." [Fabaceae. No evidence]

Qsn #	Question	Answer
404	Unpalatable to grazing animals	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The leaves of <i>F. moluccana</i> are used as feed for chicken and goats and green manure. The bark yields kino which has tanning properties and is also sometimes used as soap. The pods are also used as substitutes for <i>Parkia speciosa</i> and are edible (Soerianegara and Lemmens, 1993)."
	Krisnawati, H., Varis, E., Kallio, M. H., & Kanninen, M. (2011). <i>Paraserianthes falcataria</i> (L.) Nielsen: ecology, silviculture and productivity. CIFOR, Bogor, Indonesia	"They are often planted in home gardens for fuelwood (charcoal), and the leaves can be used as fodder for chickens and goats."

405	Toxic to animals	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The leaves of <i>F. moluccana</i> are used as feed for chicken and goats and green manure. The bark yields kino which has tanning properties and is also sometimes used as soap. The pods are also used as substitutes for <i>Parkia speciosa</i> and are edible (Soerianegara and Lemmens, 1993)."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Seedlings in nurseries are prone to damping-off caused by fungi <i>Sclerotium</i> , <i>Rhizoctonia</i> , <i>Fusarium</i> , <i>Phytophthora</i> and <i>Pythium</i> . Sterilization of the soil and applying fungicides to the seeds and soil may control the disease. Leaf-eating caterpillars and aphids are also occasional problems to seedlings and trees in plantations but they can be controlled by insecticides. Other fungal diseases include pink canker caused by <i>Corticium salmonicolor</i> and red root caused by <i>Ganoderma pseudoferreum</i> . Stem borer <i>Xystrocera festiva</i> (longicorn beetle) and red borer <i>Zeuzera coffea</i> (cossid moth) are amongst other pests found in plantations in Malaysia, Indonesia and the Philippines (Natawiria, 1973). Rapid extraction, conversion and seasoning of harvested wood is crucial to prevent infection by fungi, insect attack and sap-stain attack."
	Krisnawati, H., Varis, E., Kallio, M. H., & Kanninen, M. (2011). <i>Paraserianthes falcataria</i> (L.) Nielsen: ecology, silviculture and productivity. CIFOR, Bogor, Indonesia	"Surveys to evaluate insect pests in <i>P. falcataria</i> plantations have recorded that stem borer (<i>Xystrocera festiva</i>), small bagworm (<i>Pteroma plagiophleps</i>) and yellow butterfly (<i>Eurema</i> spp.) are the main threats (Nair and Sumardi 2000)." ... "The disease most recently reported to affect <i>P. falcataria</i> trees is gall rust (<i>Uromycladium tepperianum</i>), which has damaged some <i>P. falcataria</i> plantations in some parts of Java (Rahayu 2008)."

407	Causes allergies or is otherwise toxic to humans	n
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Qsn #	Question	Answer
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The leaves of <i>F. moluccana</i> are used as feed for chicken and goats and green manure. The bark yields kino which has tanning properties and is also sometimes used as soap. The pods are also used as substitutes for <i>Parkia speciosa</i> and are edible (Soerianegara and Lemmens, 1993)."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Hawaiian Alien Plant Studies. (1998). <i>Paraserianthes falcataria</i> . http://www.botany.hawaii.edu/faculty/cw_smith/par_fal.htm . [Accessed 4 Feb 2021]	"It is not susceptible to control by fire because the trees are rarely subjected to fires of sufficient intensity." [No evidence. Does not occur in areas subjected to frequent fires]
	Krisnawati, H., Varis, E., Kallio, M. H., & Kanninen, M. (2011). <i>Paraserianthes falcataria</i> (L.) Nielsen: ecology, silviculture and productivity. CIFOR, Bogor, Indonesia	[No evidence. Occurs in wetter areas less prone to fire] "In the species' natural habitat, annual rainfall ranges from 2000 to 2700 mm, and can be up to 4000 mm with a dry season of more than 4 months (Soerianegara and Lemmens 1993). The species is highly evapotranspiring, which requires a wet climate; therefore, an annual rainfall of 2000–3500 mm is considered optimal."

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	Notes
	Hughes, R. F., Johnson, M. T. and Uowolo, A.. (2013). The invasive alien tree <i>Falcataria moluccana</i> : its impacts and management. Pp. 218–223 in Wu et al. (eds.). Proceedings of the XIII International Symposium on Biological Control of Weeds. USDA Forest Service, Morgantown	"An important constraint to <i>F. moluccana</i> seedling recruitment is light availability; seedlings are very sensitive to shade and germinate in abundance only where the overstory canopy is open enough to allow sufficient light penetration (Soerianegara et al., 1994)."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	" <i>F. moluccana</i> is a strongly light demanding species which regenerates naturally when the soil is exposed to sunlight. The abundance of growth of wildings in the forest only occurs when the soil is cleared from the undergrowth and the canopy opened (Soerianegara and Lemmens, 1993)."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	Hughes, R. F., Uowolo, A. L., & Togia, T. P. (2012). Recovery of native forest after removal of an invasive tree, <i>Falcataria moluccana</i> , in American Samoa. <i>Biological Invasions</i> , 14(7), 1393-1413	"Aided by its N ₂ -fixing capacity, <i>F. moluccana</i> grows well on a variety of soil types, including degraded sites (Otsamo 1997; Otsamo 2002) and acidic or nutrient-poor soils (DeBell et al. 1989; Panjaitan et al. 1993)."

Qsn #	Question	Answer
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"F. moluccana thrives on comparatively poor soils without fertilizers, as long as they are well drained. Survival is poor on seasonally waterlogged sites. (Hocking and Islam, 1995). It also grows on both acidic and alkaline soils although it does better on alkaline soils (Ruskin, 1983). This species occurs more frequently in secondary forest than primary forest and on river flood terraces. It has been shown that the growth of young trees is promoted by the inoculation of mycorrhizal fungi <i>Gigaspora margarita</i> and <i>Glomus fasciculatum</i> in combination with <i>Rhizobium</i> , in phosphorus deficient soils (Soerianegara and Lemmens, 1993). The most important indicator of site quality for <i>F. moluccana</i> is the depth of top soil. The most productive sites have a 19-26 cm well drained topsoil with 3-8 % organic matter and exchangeable potassium of 0.36 meq/100 g soil (NFTA, 1989)."
	Krisnawati, H., Varis, E., Kallio, M. H., & Kanninen, M. (2011). <i>Paraserianthes falcataria</i> (L.) Nielsen: ecology, silviculture and productivity. CIFOR, Bogor, Indonesia	" <i>Paraserianthes falcataria</i> can grow on a wide range of soils. It does not require fertile soil; it can grow well on dry soils, damp soils and even on salty to acid soils as long as drainage is sufficient (Soerianegara and Lemmens 1993). In plantations in Java, it has been reported to grow on various soil types with exception of grumusols (Charomaini and Suhaendi 1997). On latosols, andosols, luvial and red-yellow podzolic soils, its growth is very robust. On marginal sites, fertiliser may be needed to accelerate initial growth. However, growth will be faster thereafter as the ability to fix nitrogen increases."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Trees up to 40 m tall, bark white, gray, or greenish, smooth or slightly warty, young parts densely reddish brown tomentose or puberulent."

412	Forms dense thickets	
	Source(s)	Notes
	Hughes, R. F., & Denslow, J. S. (2005). Invasion by a N2-fixing tree alters function and structure in wet lowland forests of Hawaii. <i>Ecological Applications</i> , 15(5), 1615-1628	[Forms monotypic canopies. Facilitates invasion by other invasive trees in understory and loss of native species] "In mature stands, the broad umbrella-shaped canopies of large individuals often coalesce into one extensive monotypic canopy capable of covering hectares to square kilometers. <i>Falcataria</i> naturalizes near recorded plantings (Nelson and Schubert 1976), and preliminary analysis of remotely sensed imagery indicates that <i>Falcataria</i> has spread from planted populations into native-dominated forests of both Malama Ki and Keauohana Forest Reserves (T. Benning, personal communication)."

Qsn #	Question	Answer
501	Aquatic	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Terrestrial tree] "widely planted for reforestation; in Hawai'i naturalized in disturbed mesic to wet areas, 25-600 m, on Kaua'i, O'ahu, Moloka'i, and Hawai'i. Cultivated on O'ahu as early as 1930 (Caum et al. s.n., BISH)."

502	Grass	n
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 3 Feb 2021]	Family: Fabaceae Subfamily: Caesalpinioideae Tribe: Ingeae Alternate family(ies): Mimosaceae

503	Nitrogen fixing woody plant	y
	Source(s)	Notes
	Krisnawati, H., Varis, E., Kallio, M. H., & Kanninen, M. (2011). <i>Paraserianthes falcataria</i> (L.) Nielsen: ecology, silviculture and productivity. CIFOR, Bogor, Indonesia	"As a nitrogen-fixing species, <i>P. falcataria</i> is also commonly planted for reforestation and afforestation to improve soil fertility (Heyne 1987). The natural drop of leaves and small branches contributes nitrogen, organic matter and minerals to the upper layers of soil (Orwa et al. 2009)."
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 3 Feb 2021]	Family: Fabaceae Subfamily: Caesalpinioideae Tribe: Ingeae Alternate family(ies): Mimosaceae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Trees up to 40 m tall, bark white, gray, or greenish, smooth or slightly warty, young parts densely reddish brown tomentose or puberulent."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[No evidence] "It is native to the Moluccas, Papua New Guinea, the Bismarck Archipelago and the Solomon Islands from 10° South to 30° North. <i>F. moluccana</i> probably originated in the East Malesian region and is widely planted in the tropics."

602	Produces viable seed	y
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Qsn #	Question	Answer
	Source(s)	Notes
	Parrotta, J. A. (1990). <i>Paraserianthes falcataria</i> (L.) Nielsen. Batai, Moluccan sau. SO- ITF-SM-31. USDA Forest Service, Southern Forest Experiment Station, New Orleans	"Seeds germinate readily in 2 to 10 days, provided there is sufficient soil moisture (40). Germination rates for undamaged, freshly extracted seeds range from 65 to 98 percent (40). Air-dried seeds stored at 4 to 8 °C in airtight containers retain their viability for up to 2 years (36, 40)."
	Bonner, F.T. & Karrfalt, R.P. (eds.). 2008. <i>The Woody Plant Seed Manual</i> . USDA FS Agriculture Handbook 727. Government Printing Office, Washington, D.C.	"The legumes can be picked from the tree after they turn from green to straw color or from the ground by shaking the branches. After being dried in the sun, the legumes should be run through a macerator or flailed by hand to extract the seeds. Debris can be removed with aspirators or air-screen cleaners or by simple winnowing. Empty, immature, and damaged seeds can removed by water flotation or by careful blowing in seed aspirators. There are usually 38,000 to 44,000 cleaned seeds/kg (17,000 to 20,000/lb) (Khullar and others 1992; Parrotta 1990; Wick and Walters 1974). Seeds of peacock-plume are orthodox in nature and can be easily stored when dried to about 8 to 10% moisture content. Dried seeds can be stored for at least 2 years in sealed containers at room temperature, but refrigeration at 3 to 5 °C should be used for longer storage (Parrotta 1990). There are no data on the long-term storage potential of these seeds."

603	Hybridizes naturally	
	Source(s)	Notes
	WRA Specialist. (2021). Personal Communication	Unknown. No evidence found

604	Self-compatible or apomictic	
	Source(s)	Notes
	Krisnawati, H., Varis, E., Kallio, M. H., & Kanninen, M. (2011). <i>Paraserianthes falcataria</i> (L.) Nielsen: ecology, silviculture and productivity. CIFOR, Bogor, Indonesia	[Possibly yes] "Inflorescence is axillary, consisting of pedunculate spikes or racemes; the spikes are sometimes arranged in panicles. The flowers are bisexual, 12 mm long, regular pentamerous, subtended to bracts, and funnel or bell shaped; their colour is cream to yellowish."

Qsn #	Question	Answer
605	Requires specialist pollinators	n
	Source(s)	Notes
	Plants for a Future. (2021). <i>Falcataria moluccana</i> . https://pfaf.org . [Accessed 4 Feb 2021]	"The flowers are pollinated by Insects."
	Parrotta, J. A. (1990). <i>Paraserianthes falcataria</i> (L.) Nielsen. Batai, Moluccan sau. SO- ITF-SM-31. USDA Forest Service, Southern Forest Experiment Station, New Orleans	[Prolific seed production, suggesting no pollinator limitations exist] "The sessile flowers are borne in the upper crown on the branches of axillary panicles up to 15 cm long (11, 23). Individual flowers are greenish yellow to creamy white in color, with a broadly campanulate-turbinate, sericeous, toothed calyx 1 to 2 mm long and stamens 3 to 5 mm long (11, 13)." ... "Seeds are produced in great abundance and are released from the open pods while attached to the tree and dispersed short distances by wind. Ripe pods may be collected prior to dehiscence and air-dried to release the seeds (40)."

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	Nair, P.K.R. (1993). <i>An Introduction to Agroforestry</i> . Kluwer Academic Publishers, Dordrecht / Boston / London	"propagated by seeds (after scarification) and seedlings; N2 fixing; coppices." [No evidence]

607	Minimum generative time (years)	3
	Source(s)	Notes
	Parrotta, J. A. (1990). <i>Paraserianthes falcataria</i> (L.) Nielsen. Batai, Moluccan sau. SO- ITF-SM-31. USDA Forest Service, Southern Forest Experiment Station, New Orleans	"Batai first produces flowers when trees are approximately 3 to 6 years of age (16, 24, 31). In its native range in Southeast Asia, batai has been reported to flower for a period of about 2 weeks between March and June and again from August to December (8, 11)."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	Hughes, R. F., Johnson, M. T. and Uowolo, A.. (2013). The invasive alien tree <i>Falcataria moluccana</i> : its impacts and management. Pp. 218–223 in Wu et al. (eds.). <i>Proceedings of the XIII International Symposium on Biological Control of Weeds</i> . USDA Forest Service, Morgantown	"Individuals reach reproductive maturity within four years and subsequently produce copious amounts of viable seed (Parrotta, 1990) contained within seed pods that can be wind-dispersed over substantial distances (i.e., > 200 m up- and down-slope during windy conditions)." [No means of external attachment]

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	CAB International, 2005. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	" <i>F. moluccana</i> probably originated in the East Malesian region and is widely planted in the tropics."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. <i>Manual of the flowering plants of Hawaii</i> . Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"widely planted for reforestation; in Hawai'i naturalized in disturbed mesic to wet areas, 25-600 m, on Kaua'i, O'ahu, Moloka'i, and Hawai'i."

703	Propagules likely to disperse as a produce contaminant	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Krisnawati, H., Varis, E., Kallio, M. H., & Kanninen, M. (2011). <i>Paraserianthes falcataria</i> (L.) Nielsen: ecology, silviculture and productivity. CIFOR, Bogor, Indonesia	"The fruit is a flat, straight pod, 10–13 cm long and 2 cm wide. It is not segmented, and is dehiscent along both sutures and winged along the ventral suture with many seeds (15–20). Seeds are subcircular to oblong, 6 mm long, flat to convex, without aril; their colour is a dull to dark brown and they are not winged (Soerianegara and Lemmens 1993)." [No evidence. Seeds and pods relatively large]

704	Propagules adapted to wind dispersal	y
	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.	"The lightweight pods are blown by winds, and seeds are abundant. This species has very rapid growth, as much as 15 ft (4.5 m) a year, but has a short life."

705	Propagules water dispersed	
	Source(s)	Notes
	Oppenheimer, H.. 2007. New plant records from Molokā'i, Lāna'i, Maui, and Hawai'i for 2006. Bishop Museum Occasional Papers 96:17-34	[Spreading in gulches. Potentially water dispersed, as well as by wind] "On Lāna'i it is spreading onto the leeward benchlands in gulches outside of Lāna'i City near Kō'ele, and was observed in at least one of the windward canyon headwaters in the Puhī'elelū area. The change in taxonomy was reported by Herbarium Pacificum Staff (1998: 10). Staples et al. (2000: 21) reported the species to be wind dispersed and possibly by aquatic means as well."

706	Propagules bird dispersed	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.	"The lightweight pods are blown by winds, and seeds are abundant."

707	Propagules dispersed by other animals (externally)	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.	"Fruits (pods) narrow, flat, 4-5 in (10-13 cm) long, 3/4 in (2 cm) wide, green, turning brown, thin-walled, splitting open. Seeds 15–20, beanlike, 1/4 in (6 mm) long, oblong, flattened, dull dark brown." ... "The lightweight pods are blown by winds, and seeds are abundant." [No evidence, and no means of external attachment]

Qsn #	Question	Answer
708	Propagules survive passage through the gut	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.	"Fruits (pods) narrow, flat, 4-5 in (10-13 cm) long, 3/4 in (2 cm) wide, green, turning brown, thin-walled, splitting open. Seeds 15--20, beanlike, 1/4 in (6 mm) long, oblong, flattened, dull dark brown." ... "The lightweight pods are blown by winds, and seeds are abundant." [No evidence. No adaptations for consumption or internal dispersal]

801	Prolific seed production (>1000/m2)	
	Source(s)	Notes
	Parrotta, J. A. (1990). <i>Paraserianthes falcataria</i> (L.) Nielsen. Batai, Moluccan sau. SO- ITF-SM-31. USDA Forest Service, Southern Forest Experiment Station, New Orleans	[Densities unknown] "Batai seeds are small (6 mm long; 38,000 to 44,000 per kilogram), flat, and obvate and have a hard, smooth testa with a distinct circular marking on each surface (32, 36, 40). Seeds are produced in great abundance and are released from the open pods while attached to the tree and dispersed short distances by wind. Ripe pods may be collected prior to dehiscence and air-dried to release the seeds (40)."

802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	Source(s)	Notes
	Bonner, F.T. & Karrfalt, R.P. (eds.). 2008. The Woody Plant Seed Manual. USDA FS Agriculture Handbook 727. Government Printing Office, Washington, D.C.	"Seeds of peacock-plume are orthodox in nature and can be easily stored when dried to about 8 to 10% moisture content. Dried seeds can be stored for at least 2 years in sealed containers at room temperature, but refrigeration at 3 to 5 °C should be used for longer storage (Parrotta 1990). There are no data on the long-term storage potential of these seeds."
	Parrotta, J. A. (1990). <i>Paraserianthes falcataria</i> (L.) Nielsen. Batai, Moluccan sau. SO- ITF-SM-31. USDA Forest Service, Southern Forest Experiment Station, New Orleans	"Under natural conditions, seeds may remain on the soil surface for months or years prior to germination; fire appears to be a natural scarifying agent (6)."

803	Well controlled by herbicides	y
	Source(s)	Notes
	Motooka, P., Castro, L., Nelson, D., Nagai, G. & Ching, L. 2003. Weeds of Hawaii's Pastures and Natural Areas: An Identification and Management Guide. CTAHR, UH Manoa, Honolulu, HI	"Very susceptible to hormone type herbicides. Severely injured by cut-surface application of 2,4-D and by glyphosate; killed by dicamba and triclopyr. Susceptible to basal bark applications of triclopyr. HAVO staff report control with triclopyr amine at 10% product in water applied to cut stumps (Chris Zimmer, HAVO)"

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The ability to coppice fairly well makes it suitable for pulpwood production."

Qsn #	Question	Answer
	Parrotta, J. A. (1990). <i>Paraserianthes falcataria</i> (L.) Nielsen. Batai, Moluccan sau. SO- ITF-SM-31. USDA Forest Service, Southern Forest Experiment Station, New Orleans	"Vegetative regrowth after cutting is vigorous and is an effective means of regeneration in plantations (24, 39); coppiced trees are commonly harvested on an 8-year cycle (23)"

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"widely planted for reforestation; in Hawai'i naturalized in disturbed mesic to wet areas, 25-600 m, on Kaua'i, O'ahu, Moloka'i, and Hawai'i." [Widely naturalized, and also naturalized on Maui and Lanai, with no evidence of limiting factors or effective natural enemies present]
	Haines, W. P., Barton, K. E., & Conant, P. (2013). Defoliation of the invasive tree <i>Falcataria moluccana</i> on Hawaii Island by the native koa looper moth (Geometridae: <i>Scotorythra paludicola</i>), and evaluation of five fabaceous trees as larval hostplants. <i>Proceedings of the Hawaiian Entomological Society</i> 45: 129–139	[The koa looper did not negatively impact populations of <i>F. moluccana</i>] "Because <i>F. moluccana</i> is considered invasive, and is widespread at low elevations on the islands of Hawaii and Oahu, it is tempting to suggest that the koa looper may serve as a natural, native biological control agent for this tree. However, at this point we consider it unlikely that <i>S. paludicola</i> will significantly impact populations of <i>F. moluccana</i> , considering that defoliation of trees was rare and patchy, and koa looper outbreaks are historically rare events. Damage to <i>F. moluccana</i> appeared to be restricted to one region, despite millions of moths surely being present following defoliation of koa near dense <i>F. moluccana</i> forests elsewhere (e.g. the Saddle Road near Kaumana). However, we cannot rule out the possibility that this represents a recent host range expansion, and that defoliation of <i>F. moluccana</i> will become more frequent."

Summary of Risk Traits:

High Risk / Undesirable Traits

- Elevation range exceeds 1000 m, demonstrating environmental versatility
- Thrives in tropical climates
- Naturalized on main Hawaiian Islands (except Kahoolawe and Niihau) and elsewhere in the tropics
- An environmental weed, modifying soil nutrients and facilitating invasion by other weedy plants
- Prone to breaking in high winds, threatening human safety and infrastructure
- Tolerates many soil types
- Nitrogen-fixing tree; facilitates invasion by other weeds
- Reproduces by numerous, wind-dispersed seeds
- Fast growth rate, reaching maturity in 3 years
- Seeds may persist in the soil for months to years
- Able to coppice and resprout after cutting

Low Risk Traits

- Unarmed (no spines, thorns, or burrs)
- Palatable to browsing animals
- Non-toxic
- Light-demanding; seedling will not tolerate dense shade
- Not reported to spread vegetatively
- Herbicides provide effective control