

Taxon: <i>Pteris vittata</i>	Family: Pteridaceae
Common Name(s): Chinese brake Chinese ladder brake ladder brake	Synonym(s): <i>Pteris diversifolia</i> Sw. <i>Pteris ensifolia</i> Poir. <i>Pteris inaequilateralis</i> Poir. <i>Pteris microdonata</i> Gaudin <i>Pycnodoria vittata</i> (L.) Small

Assessor: No Assessor	Status: Assessor Approved	End Date: 25 Nov 2014
WRA Score: 14.0	Designation: H(HPWRA)	Rating: High Risk

Keywords: Widely Naturalized, Weedy Fern, Toxic, Ornamental, 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)	y
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	n
304	Environmental weed		
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	y
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans		

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

Supporting Data:

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	Robinson, R.C. 2009. Invasive and Problem Ferns: A European Perspective. <i>International Urban Ecology Review</i> 4: 83-91	[No evidence that breeding is selecting for less invasive traits] "Strains of <i>P. vittata</i> are being bred with improved arsenic accumulating properties in the USA(18), despite its invasive tendencies."
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. <i>Flora of China</i> . Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Variable, but no evidence of domestication] "Plants of <i>Pteris vittata</i> are very different in shape and size, varying according to their habitats."

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

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

201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	High
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. <i>Flora of China</i> . Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Anhui, Fujian, SE Gansu (Kangxian), Guangdong, Guangxi, Guizhou, SW Henan, Hubei, Hunan, Jiangxi, Shaanxi, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang [widely distributed in tropics and subtropics of the Old World]."

202	Quality of climate match data	High
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. <i>Flora of China</i> . Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	

203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. <i>Identification & Biology of Non-Native Plants in Florida's Natural Areas</i> . Second Edition. IFAS Publications, Gainesville, FL	"Fast growing; produces large amounts of biomass; easily and rapidly adapts to a wide range of climates and substrates (Chen et al. 2002, Khare and Kaur 1987)."

Qsn #	Question	Answer
	Palmer, D.D. 2003. Hawaii's Ferns and Fern Allies. University of Hawaii Press, Honolulu, HI	[Elevation range exceeds 1000 m, demonstrating environmental versatility] "...near sea level to 1,310 m..."
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. Flora of China. Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Elevation range exceeds 1000 m, demonstrating environmental versatility] "Calcareous soils, on limestone, also on stone and on walls; below ca. 2000 m."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Palmer, D.D. 2003. Hawaii's Ferns and Fern Allies. University of Hawaii Press, Honolulu, HI	" <i>Pteris vittata</i> is native to Africa, Asia, and Australia and is now naturalized in scattered warm areas of the world. One of the first ferns naturalized in Hawaii, it was first collected on Oahu in 1887."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. Identification & Biology of Non-Native Plants in Florida's Natural Areas. Second Edition. IFAS Publications, Gainesville, FL	"Distribution: Herbarium specimens documented from 27 counties throughout Florida (Wunderlin and Hansen 2002). Established across the southeast from Texas (Stanford and Diggs 1998) to South Carolina and in California, Hawaii, Puerto Rico, the Virgin Islands (USDA NRCS 2002), and the Cayman Islands (Guala et al. 2002). Naturalized throughout the Caribbean, Central and South America (Nauman 1993b, MOBOT), Spain (Crespo et al. 1989), Italy (Mariotti 1988), South Africa (Wells et al. 1986), and New Zealand (LRNZ 2001). Rapidly spreading through India and other tropical areas (Devi and Singh 1986). Targeted for removal from commercial production by FNGA/TBWG growers associations (FNGA 2001)."
	Wagner, W. H., & Nauman, C. E. 1982. <i>Pteris xdelchampsii</i> , a Spontaneous Fern Hybrid from Southern Florida. American Fern Journal, 72(4): 97-102	" <i>P. vittata</i> "has escaped from cultivation and become well established in St. Thomas, Bermuda, Dominica, Martinique, Barbados, Trinidad, eastern Brasil, Florida, Alabama, and Louisiana." It is with the Florida occurrences that we are concerned here."
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. Flora of China. Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"widely distributed in tropics and subtropics of the Old World"

301	Naturalized beyond native range	y
	Source(s)	Notes
	Oppenheimer, H. L. 2004. New Hawaiian plant records for 2003. Bishop Museum Occasional Papers. 79: 8-20	"According to Palmer (2003: 229–230) this naturalized fern occurs on the islands of Kaua’i, O’ahu, Maui, and Hawai’i, and is probably present, but not yet collected, on Moloka’i and Lāna’i. The following collection represents a new record for Lāna’i. Material examined: LĀNA’I: Hulupo’e, on rock wall, 15 Apr 2001, Oppenheimer H40125."
	Palmer, D.D. 2003. Hawaii's Ferns and Fern Allies. University of Hawaii Press, Honolulu, HI	"Common in urban areas, often on rock walls and dry cliffs, near sea level to 1,310 m, on Kauai, Oahu, Maui and Hawaii."

Qsn #	Question	Answer
	Oppenheimer, H. 2008. New Hawaiian plant records for 2007. Bishop Museum Occasional Papers 100: 22-38	"Naturalized in Hawai'i since at least 1887 and now known from Kaua'i, O'ahu, Lāna'i, Maui, and Hawai'i (Palmer 2003: 229–230; Oppenheimer 2004: 17), this weedy fern is documented here from Moloka'i. Spores are easily wind dispersed, with plants commonly observed on rock walls, cliffs, and road cuts. Material examined. MOLOKA'I: Kalaupapa, W end of peninsula, N bank of Waihānau Stream, nursery weed, 10 m, 30 June 2007, Oppenheimer & B. Garnett H60728."
	Robinson, R.C. 2009. Invasive and Problem Ferns: A European Perspective. International Urban Ecology Review 4: 83-91	" <i>Pteris vittata</i> (native to China) is naturalised in the Mediterranean in lime-rich areas and has been described as an "urban weed" (3) due to its preference for calcareous sites offered by concrete, masonry and pavements in built-up areas."
	Wagner, W. H., & Nauman, C. E. 1982. <i>Pteris xdelchampsii</i> , a Spontaneous Fern Hybrid from Southern Florida. American Fern Journal, 72(4): 97-102	"The Chinese Ladder Brake, <i>P. vittata</i> , occurs scattered throughout Florida and other parts of the southeastern United States at least as far north as the Carolinas and as far west as Louisiana. The plants are frequent in disturbed locations on calcareous substrates, often on limestone ledges, walls, and sinks. The plants are generally more abundant and luxuriant (up to 1 m tall) in areas of high humidity, such as canal banks and limestone sinks with standing water. In dry places, the plants are sparser and dwarfed (usually less than 0.5 m tall)."

302	Garden/amenity/disturbance weed	y
	Source(s)	Notes
	Robinson, R.C. 2009. Invasive and Problem Ferns: A European Perspective. International Urban Ecology Review 4: 83-91	"...naturalised in the Mediterranean in lime-rich areas and has been described as an "urban weed" (3) due to its preference for calcareous sites offered by concrete, masonry and pavements in built-up areas."
	Morton, J.F. 1976. Pestiferous spread of many ornamental and fruit species in South Florida. Proceedings of the Florida State Horticultural Society 89: 348-353	" <i>Pteris vittata</i> L. CHINESE BRAKE. Eastern Asia. Invades masonry, rocky woods, pineland, canal banks, hammocks."
	Rumsey, F. 2008. Brake out! <i>Pteris</i> go wild in the British Isles. Pteridologist 5(1): 31-35	"This species is widely distributed in the Palaeo-tropics, occurring as a local rather weedy species of damp, mortared walls and wet limey rocks in parts of the Mediterranean and Macaronesia. Often associated with human habitation its native range is thus difficult to determine."
	Wilson, K.A. 1996. Alien Ferns in Hawaii. Pacific Science 50 (2): 127-141	[Disturbance adapted] "In Hawai'i it grows in open and abandoned areas, along roadsides, on old walls and buildings, and in fields and gardens."
	Wagner, W. H., & Nauman, C. E. 1982. <i>Pteris xdelchampsii</i> , a Spontaneous Fern Hybrid from Southern Florida. American Fern Journal, 72(4): 97-102	[Disturbance adapted] "The Chinese Ladder Brake, <i>P. vittata</i> , occurs scattered throughout Florida and other parts of the southeastern United States at least as far north as the Carolinas and as far west as Louisiana. The plants are frequent in disturbed locations on calcareous substrates, often on limestone ledges, walls, and sinks."

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

304	Environmental weed	
	Source(s)	Notes
	Center for Aquatic and Invasive Plants. 2014. Chinese ladder brake fern - <i>Pteris vittata</i> . http://plants.ifas.ufl.edu/node/353 . [Accessed 25 Nov 2014]	[Potential environmental weed. Impacts to native vegetation require further documentation] "Pteris can out-compete native vegetation due to its invasive nature."
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. Identification & Biology of Non-Native Plants in Florida's Natural Areas. Second Edition. IFAS Publications, Gainesville, FL	[Potential environmental weed] "Currently naturalized in 92 conservation areas across south Florida from habitats including marl prairies, pine rocklands, prairies and rockland hammocks, shell mounds, and sinkholes (Gann et al. 2001). Also documented from swampy roadsides, wet flatwoods, and growing in the harsh understory beneath <i>Casuarina</i> thickets on Key Biscayne (FLAS)."

305	Congeneric weed	y
	Source(s)	Notes
	Global Invasive Species Database. 2014. <i>Pteris cretica</i> , http://www.issg.org/database/species/impact_info.aspx?si=1672&fr=1&sts=&lang=EN . [Accessed 25 Nov 2014]	[Indigenous to Hawaiian Islands] "Little is known about the potential impacts of <i>Pteris cretica</i> . On the British Isles it is considered a threat more so for its progressive radial expansion in range that has been apparent since 1930 rather than any potential ecological and economic impacts (Robinson, 2009). In the ecologically fragile limestone grottoes of Florida, <i>P. cretica</i> and a range of other invasive exotic species can be problematic to rare native species if facilitated by shady, humid conditions (Florida Natural Areas Inventory, 2010)."
	Holm, L. G., Pancho, J.V., Herberger, J.P. & Plucknett, D.L. 1979. A Geographical Atlas of World Weeds. John Wiley and Sons, New York, NY	<i>P. ensiformis</i> is considered a common weed of agriculture in Indonesia and Taiwan

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

Qsn #	Question	Answer
	<p>Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. Flora of China. Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis</p>	<p>[No evidence] "Plants (20–)30–100(–150) cm tall. Rhizome erect, short and robust, 2–2.5 cm in diam., woody, apex densely clothed with yellow-brown scales. Fronds clustered; stipe firm, dark straw-colored or light brown, 10–30 cm or larger, 3–4 mm in diam., densely scaly when young, scales like those of rhizome, sparse; rachis straw-colored, sparsely scaly; lamina 1-pinnate, oblanceolate-oblong in outline, 20–90 × 5–25 cm or larger; lateral pinnae up to 40 pairs, alternate or sometimes subopposite; lower pinnae 3–4 cm apart, decumbent, sessile, not connate with rachises, progressively shorter toward base, basal pair auriculiform, middle pinnae longest, narrowly linear, 6–15 × 0.5–1 cm, base slightly expanded and cordate, both sides slightly auriculiform, upper ones larger and overlapping rachis; pinnae 1–1.5 cm apart, sterile margin minutely and evenly serrate, not cartilaginous, apex acuminate; midvein prominent abaxially and light straw-colored; veins slender, contiguous, oblique, simple or forked; terminal pinna similar to lateral pinnae in shape. Lamina pale green, opaque, thinly leathery, glabrous."</p>

402	Allelopathic	
	Source(s)	Notes
	<p>Peres, M. T. L. P., Silva, L. B., Faccenda, O., & Hess, S. C. 2004. Allelopathic potential of species of Pteridaceae (Pteridophyta). Acta Botanica Brasilica, 18(4): 723-730</p>	<p>[Unknown] "Estudos químicos realizados com pteridófitas do gênero <i>Pteris</i> levaram ao isolamento de diferentes classes de metabólitos secundários. De <i>P. vittata</i> Schkuhr. foi isolado um novo flavonóide derivado de apigenina (Imperato & Telesca 1999);" [Translation: Chemical studies with the ferns of the genus <i>Pteris</i> led to the isolation of different classes of secondary metabolites. <i>P. vittata</i> Schkuhr. was isolated as a new flavonoid derived from apigenin (Imperato & Telesca 1999)]</p>

403	Parasitic	n
	Source(s)	Notes
	<p>Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. Flora of China. Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis</p>	<p>No evidence. Pteridaceae] "Plants (20–)30–100(–150) cm tall. Rhizome erect, short and robust, 2–2.5 cm in diam., woody, apex densely clothed with yellow-brown scales."</p>

Qsn #	Question	Answer
404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Rathinasabapathi, B., Rangasamy, M., Froeba, J., Cherry, R. H., McAuslane, H. J., Capinera, J. L., Srivastava, M. & Ma, L. Q. 2007. Arsenic hyperaccumulation in the Chinese brake fern (<i>Pteris vittata</i>) deters grasshopper (<i>Schistocerca americana</i>) herbivory. <i>New Phytologist</i> , 175(2): 363-369	[Arsenic accumulation deters insect browsing. Palatability to browsing & grazing mammals unknown. Probably not palatable] "Brake fern, <i>Pteris vittata</i> , not only tolerates arsenic but also hyperaccumulates it in the frond. The hypothesis that arsenic hyperaccumulation in this fern could function as a defense against insect herbivory was tested." ... "Our results show that arsenic hyperaccumulation in brake fern is an elemental defense against grasshopper herbivory."
	Gaur, R. D., & Bhatt, B. P. 1994. Folk utilization of some pteridophytes of Deoprayag area in Garhwal Himalaya: India. <i>Economic Botany</i> , 48(2): 146-151	[Presumably palatable, but toxic] "if grazed in large amount cattle produce foaming saliva and appear anxious"

405	Toxic to animals	y
	Source(s)	Notes
	Gaur, R. D., & Bhatt, B. P. 1994. Folk utilization of some pteridophytes of Deoprayag area in Garhwal Himalaya: India. <i>Economic Botany</i> , 48(2): 146-151	" <i>Pteris vittata</i> L./ Bish Barun/ Pteridaceae/ a poisonous fern, if grazed in large amount cattle produce foaming saliva and appear anxious; young fronds are used in manuring*/ 1 150 m/ Chandi/ 2719 (Dagar and Dagar 1987; Jain 1991)."

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	Lansdown, R.V. 2013. <i>Pteris vittata</i> . The IUCN Red List of Threatened Species. Version 2014.3. www.iucnredlist.org	[No evidence] "There are no known significant past, ongoing or future threats to this species."

407	Causes allergies or is otherwise toxic to humans	
	Source(s)	Notes
	Robinson, R.C. 2009. Invasive and Problem Ferns: A European Perspective. <i>International Urban Ecology Review</i> 4: 83-91	[Could be toxic if accidentally ingested, but this would be an unlikely occurrence as the fern has no history of human consumption] "Both <i>Pteris cretica</i> and <i>Pteris vittata</i> (19) can accumulate arsenic (a toxic heavy metal) as well as being potentially invasive. Both ferns have the ability to bioremediate soils contaminated with arsenic while <i>P. cretica</i> is also resistant to antimony (1). Recent studies in the UK show that three successive crops of <i>Pteris vittata</i> can reduce soil arsenic levels by 13% under a low phosphate regime."
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. Identification & Biology of Non-Native Plants in Florida's Natural Areas. Second Edition. IFAS Publications, Gainesville, FL	[Possibly to susceptible individuals] "Spores cause allergic reactions in humans (Geller et al. 1987, Singh et al. 1989) and spore extracts are damaging to human DNA (Siman et al. 2000)."

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

Qsn #	Question	Answer
	Kubiak, P. J. 2009. Fire responses of bushland plants after the January 1994 wildfires in northern Sydney. <i>Cunninghamia</i> , 11(1): 131-165	[Resprouts after fires. Contribution to fire risk or fuel load unspecified] "Appendix 1. Observations on fire responses (after 100% leaf scorch) of vascular plants in the Lane Cove River (LCR) (observations mainly Jan 1994 – Oct 1999) and Narrabeen Lagoon (NL) (Mar – Oct 1994) catchments, following the fires of January 1994." [Pteris vittata: R = majority of adult plants resprouted after the fires;]
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. Flora of China. Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Unlikely. No evidence and rocky habitats may be less fire prone] "Calcareous soils, on limestone, also on stone and on walls"

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	Notes
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. Identification & Biology of Non-Native Plants in Florida's Natural Areas. Second Edition. IFAS Publications, Gainesville, FL	"Prefers full sun but will grow in shaded locations (Small 1938)."
	Jones, D. L. 1987. Encyclopedia of Ferns. Timber Press, Portland, OR	[In contrast to other references] "It is a hardy garden plant which shuns shade and revels in sunshine."
	Center for Aquatic and Invasive Plants. 2014. Chinese ladder brake fern - <i>Pteris vittata</i> . http://plants.ifas.ufl.edu/node/353 . [Accessed 25 Nov 2014]	[Longer fronds in shade] "Fronds of brake fern are dark green in color and only once divided, growing generally < 12 inches in a sunny site but > 20 inches in shade."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. Identification & Biology of Non-Native Plants in Florida's Natural Areas. Second Edition. IFAS Publications, Gainesville, FL	"Fast growing; produces large amounts of biomass; easily and rapidly adapts to a wide range of climates and substrates (Chen et al. 2002, Khare and Kaur 1987)." ... "Tolerates a variety of soils, including acidic (to pH 4.5), alkaline, and arsenic rich soils (Chen et al. 2002)."
	Flora of North America Editorial Committee. 1993. Flora of North America: Volume 2: Pteridophytes and Gymnosperms. Oxford University Press, Oxford, UK	" <i>Pteris vittata</i> has escaped from cultivation. It is found on almost any calcareous substrate, such as old masonry, sidewalks, building crevices, and nearly every habitat in southern Florida with exposed limestone, notably pinelands."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. Flora of China. Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Plants (20–)30–100(–150) cm tall. Rhizome erect, short and robust, 2–2.5 cm in diam., woody, apex densely clothed with yellow-brown scales. Fronds clustered; stipe firm, dark straw-colored or light brown, 10–30 cm or larger, 3–4 mm in diam., densely scaly when young, scales like those of rhizome, sparse"

412	Forms dense thickets	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. Identification & Biology of Non-Native Plants in Florida's Natural Areas. Second Edition. IFAS Publications, Gainesville, FL	[Characteristic habitat distribution in invaded range. No evidence of dense stand formation where it is regarded as a weed] "Now found throughout the state in a variety of habitats, including pine flatwoods, hammocks, roadsides, canal banks, and very commonly on limestone substrates (Nelson 2000, Nauman 1993b). Establishes in calcareous masonry, including walls, buildings, and cracks in sidewalks (Nauman 1993b). One of the most frequently occurring nonnative plants, it was discovered in 45% of preserves surveyed in south Florida (Bradley and Gann 1999)."
	Palmer, D.D. 2003. Hawaii's Ferns and Fern Allies. University of Hawaii Press, Honolulu, HI	No evidence

501	Aquatic	n
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. Flora of China. Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Terrestrial fern] "Calcareous soils, on limestone, also on stone and on walls; below ca. 2000 m."

502	Grass	n
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. Flora of China. Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	Pteridaceae

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. Flora of China. Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	Pteridaceae

Qsn #	Question	Answer
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. Flora of China. Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Plants (20–)30–100(–150) cm tall. Rhizome erect, short and robust, 2–2.5 cm in diam., woody, apex densely clothed with yellow-brown scales."
	Gordon, D. R., Mitterdorfer, B., Pheloung, P. C., Ansari, S., Buddenhagen, C., Chimera, C., ... & Williams, P. A. 2010). Guidance for addressing the Australian Weed Risk Assessment questions. Plant Protection Quarterly, 25(2): 56-74	"This question addresses taxa that have specialized organs and should not include plants with just rhizomes/ stolons (see 6.06)."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. Flora of China. Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence. Widespread] "Calcareous soils, on limestone, also on stone and on walls; below ca. 2000 m. Anhui, Fujian, SE Gansu (Kangxian), Guangdong, Guangxi, Guizhou, SW Henan, Hubei, Hunan, Jiangxi, Shaanxi, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang [widely distributed in tropics and subtropics of the Old World]."

602	Produces viable seed	y
	Source(s)	Notes
	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	"Chinese brake is easily grown from spores, which germinate readily and often give rise to volunteer plants in gardens."
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. Identification & Biology of Non-Native Plants in Florida's Natural Areas. Second Edition. IFAS Publications, Gainesville, FL	"Spores are dispersed great distances by wind and may germinate in almost any moist habitat (Devi and Singh 1986). Spores produced year round; plants average 12-30 fronds, and each frond can produce over 140 million spores (Devi and Singh 1986). Germination decreases in spores stored over 30 days at room temperature, most likely because of water and nutrient loss during storage (Beri and Bir 1993). Over 95% germination recorded for fresh spores, while spores stored 100 days had 60% germination (Beri and Bir 1993). Storage at 0°C (32°F) and 40°C (104°F) also decreased germination (Ambika et al. 1995)."

Qsn #	Question	Answer
603	Hybridizes naturally	y
	Source(s)	Notes
	Wagner, W. H., & Nauman, C. E. 1982. <i>Pteris x delchampsii</i> , a Spontaneous Fern Hybrid from Southern Florida. <i>American Fern Journal</i> , 72(4): 97-102	[Hybridizes with <i>P. bahamensis</i>] "Hybrids found in open, disturbed areas in full sun more closely resemble <i>P. bahamensis</i> in their stiffly erect habit and slightly revolute pinnae. Under shaded conditions, the fronds are more lax and arching and the pinnae are not revolute, and so closely resemble those of <i>P. vittata</i> ." ... : "Unless the hybrids develop some means of reproduction, the fate of <i>P. x delchampsii</i> in years to come depends upon the success of <i>P. bahamensis</i> in surviving man-made changes. In all likelihood, the weedy <i>P. vittata</i> will be the ultimate survivor."

604	Self-compatible or apomictic	y
	Source(s)	Notes
	Nasto, A.L. 2008. Growth of <i>Pteris Vittata</i> as a Function of Light Levels, Nutrients, and Soil pH. MSc Thesis. The University of Texas at San Antonio	"Some species of ferns, for example the brake ferns (<i>Pteris</i>), are also able to reproduce asexually, or apogamously (Moran 2004). Instead of forming 64 haploid cells, they form 32 diploid cells, some can also form triploid or polyploidy cells (Moran 2004). When these cells are released from the sporangium as spores, if they land on a proper substrate, they grow into a smaller prothallus that will grow a root, then a leaf, becoming a full grown plant, completely skipping the gametophyte stage (Moran 2004). This important evolutionarily trait can allow plants in arid environments to reproduce with out the need of water for sperm to swim (Moran 2004)."

605	Requires specialist pollinators	n
	Source(s)	Notes
	Nasto, A.L. 2008. Growth of <i>Pteris Vittata</i> as a Function of Light Levels, Nutrients, and Soil pH. MSc Thesis. The University of Texas at San Antonio	[Water required for fertilization] "The prothallus and its sex organs is the gametophyte (Mickel 1979; Jones 1987). When released, the flagellated sperm swim down though a thin film of water to the egg and fertilize it, forming the zygote (Moran 2004; Campbell and Reece 2005). Sperm can fertilize egg cells on the same prothallus or on other prothalli (Moran 2004)."

606	Reproduction by vegetative fragmentation	y
	Source(s)	Notes
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. Identification & Biology of Non-Native Plants in Florida's Natural Areas. Second Edition. IFAS Publications, Gainesville, FL	[Can spread via rhizomes] "Terrestrial or epilithic fern; stems (rootstock) rhizomatous, stout, short-creeping, branched, often appearing knotted, covered with light brown scales."

Qsn #	Question	Answer
607	Minimum generative time (years)	
	Source(s)	Notes
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. Identification & Biology of Non-Native Plants in Florida's Natural Areas. Second Edition. IFAS Publications, Gainesville, FL	[Time to maturity unknown] "Life History: Fast growing; produces large amounts of biomass; easily and rapidly adapts to a wide range of climates and substrates (Chen et al. 2002, Khare and Kaur 1987)."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	Notes
	Center for Aquatic and Invasive Plants. 2014. Chinese ladder brake fern - <i>Pteris vittata</i> . http://plants.ifas.ufl.edu/node/353 . [Accessed 25 Nov 2014]	"Steps to prevent spore movement or formation are the key in controlling brake fern. Since the microscopic spores are easily transported via clothing, wind and possibly water, contamination is a constant threat. Control measures should be employed when the fern is not producing spores, which occurs year-round in Florida. If control measures must be employed during spore formation and dispersal, then these areas should be treated at a time when workers will not be traveling to other sites in the same day. Take care not to drive equipment through the fern foliage, as this will also help to minimize spore movement. "

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Wilson, K.A. 1996. Alien Ferns in Hawaii. <i>Pacific Science</i> 50 (2): 127-141	" <i>Pteris vittata</i> is native to Africa, Asia, and Australia and is now widely naturalized in scattered warm regions of the Americas. It is widely cultivated and readily escapes, and its spread is anticipated in areas where it does not yet occur."

703	Propagules likely to disperse as a produce contaminant	
	Source(s)	Notes
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. Identification & Biology of Non-Native Plants in Florida's Natural Areas. Second Edition. IFAS Publications, Gainesville, FL	[Unknown. Potentially could occur if growing with other potted or ornamental plants] "Spores produced year round; plants average 12-30 fronds, and each frond can produce over 140 million spores (Devi and Singh 1986)."

704	Propagules adapted to wind dispersal	y
	Source(s)	Notes
	Oppenheimer, H. 2008. New Hawaiian plant records for 2007. <i>Bishop Museum Occasional Papers</i> 100: 22-38	"Spores are easily wind dispersed, with plants commonly observed on rock walls, cliffs, and road cuts."

705	Propagules water dispersed	y
	Source(s)	Notes

Qsn #	Question	Answer
	Wagner, W. H., & Nauman, C. E. 1982. <i>Pteris xdelchampsii</i> , a Spontaneous Fern Hybrid from Southern Florida. <i>American Fern Journal</i> , 72(4): 97-102	[Distribution near water suggests water dispersal] "The Chinese Ladder Brake, <i>P. vittata</i> , occurs scattered throughout Florida and other parts of the southeastern United States at least as far north as the Carolinas and as far west as Louisiana." ... "The plants are generally more abundant and luxuriant (up to 1 m tall) in areas of high humidity, such as canal banks and limestone sinks with standing water. In dry places, the plants are sparser and dwarfed (usually less than 0.5 m tall)."
	Wagner Jr, W. H. (1950). Ferns Naturalized in Hawaii. <i>Bishop Museum Occasional Papers</i> 20(8): 95-121	[Distribution suggests movement of spores by water] "Lyon informs me that when he first visited Maui he found it in abundance on rocky banks and walls adjacent to irrigation canals in the immediate vicinity of Wailuku. He notes that even though he later found it farther afield, it was not far removed from irrigation developments." ... "In the University of California Herbarium are specimens from taro patches at the mouth of Waihee Valley, Maui (5300) ; near Puu Anu, Maui (Degener and Wiebke 3118); and from exposed stream banks along the road in Punaluu Valley, Oahu (5767)."
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2013. <i>Flora of China</i> . Vol. 2-3 (Lycopodiaceae through Polypodiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Possible that spores may be transported by water] "Calcareous soils, on limestone, also on stone and on walls; below ca. 2000 m."

706	Propagules bird dispersed	n
	Source(s)	Notes
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. <i>Identification & Biology of Non-Native Plants in Florida's Natural Areas</i> . Second Edition. IFAS Publications, Gainesville, FL	[Wind-dispersed] "Spores are dispersed great distances by wind and may germinate in almost any moist habitat (Devi and Singh 1986)."

707	Propagules dispersed by other animals (externally)	
	Source(s)	Notes
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. <i>Identification & Biology of Non-Native Plants in Florida's Natural Areas</i> . Second Edition. IFAS Publications, Gainesville, FL	[Tiny, wind-dispersed spores might be able to adhere to animals and be externally dispersed] "Steps to prevent spore movement or formation are the key in controlling brake fern. Since the microscopic spores are easily transported via clothing, wind and possibly water, contamination is a constant threat. Control measures should be employed when the fern is not producing spores, which occurs year-round in Florida. If control measures must be employed during spore formation and dispersal, then these areas should be treated at a time when workers will not be traveling to other sites in the same day. Take care not to drive equipment through the fern foliage, as this will also help to minimize spore movement. "

708	Propagules survive passage through the gut	n
	Source(s)	Notes

Qsn #	Question	Answer
	Gordon, D. R., Mitterdorfer, B., Pheloung, P. C., Ansari, S., Buddenhagen, C., Chimera, C., ... & Williams, P. A. 2010). Guidance for addressing the Australian Weed Risk Assessment questions. Plant Protection Quarterly, 25(2): 56-74	[Unlikely to be internally dispersed] "Answer 'yes' if propagules of the taxon pass through the digestive tract of animals (other than birds except flightless birds and including bats) in a viable form. Answer 'no' where the taxon is unlikely to be eaten by animals or if seeds are not viable following passage through the gut. Answer 'unknown' if no data clarify whether this means of dispersal is likely."

801	Prolific seed production (>1000/m2)	y
	Source(s)	Notes
	Center for Aquatic and Invasive Plants. 2014. Chinese ladder brake fern - <i>Pteris vittata</i> . http://plants.ifas.ufl.edu/node/353 . [Accessed 25 Nov 2014]	"Millions of spores are produced during the life cycle of a single fern, safeguarding the persistence of fern populations."
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. Identification & Biology of Non-Native Plants in Florida's Natural Areas. Second Edition. IFAS Publications, Gainesville, FL	"Spores produced year round; plants average 12-30 fronds, and each frond can produce over 140 million spores (Devi and Singh 1986)."

802	Evidence that a persistent propagule bank is formed (>1 yr)	n
	Source(s)	Notes
	Langeland, K.A., Cherry, H.M., McCormick, C.M. & Craddock Burks, K.A. 2008. Identification & Biology of Non-Native Plants in Florida's Natural Areas. Second Edition. IFAS Publications, Gainesville, FL	"Germination decreases in spores stored over 30 days at room temperature, most likely because of water and nutrient loss during storage (Beri and Bir 1993). Over 95% germination recorded for fresh spores, while spores stored 100 days had 60% germination (Beri and Bir 1993). Storage at 0°C (32°F) and 40°C (104°F) also decreased germination (Ambika et al. 1995)."
	Beri, A., & Bir, S. S. 1993. Germination of stored spores of <i>Pteris vittata</i> L. American Fern Journal, 83(3): 73-78	[Spores lose viability at room temperature, suggesting they will not persist in the soil] "The effects of storage at room temperature on spores of <i>Pteris vittata</i> L. are studied. In case of stored spores, germination percentage and protonemal tube length decline markedly. There is also marked decrease in number of rhizoidal and protonemal cells of stored spores when compared with fresh spores. Stored spores when put in germination medium fail to attain the size comparable to fresh spores. Biochemical analysis of fresh and stored spores indicated gradual loss in the contents of total soluble sugars, total free amino acids and proteins on storage. Thus reduced germination of stored fern spores appears associated with biochemical impairments"

Qsn #	Question	Answer
803	Well controlled by herbicides	
	Source(s)	Notes
	Center for Aquatic and Invasive Plants. 2014. Chinese ladder brake fern - <i>Pteris vittata</i> . http://plants.ifas.ufl.edu/node/353 . [Accessed 25 Nov 2014]	[Efficacy unknown] "There has been very little work performed on chemical control of brake fern. Ferns can be very difficult to control, and regrowth often occurs from the underground rhizoids. A 2 to 3% solution of glyphosate (Roundup, etc.) will probably be the most effective treatment, although triclopyr may also provide control (Garlon 4 at 0.5 to 2% solution plus surfactant at 0.25%)."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	n
	Source(s)	Notes
	Center for Aquatic and Invasive Plants. 2014. Chinese ladder brake fern - <i>Pteris vittata</i> . http://plants.ifas.ufl.edu/node/353 . [Accessed 25 Nov 2014]	"Mechanical controls, such as mowing or pulling the fronds, can reduce spore production and reduce fern populations. Rouging small, isolated patches may also be cost-effective."
	Kubiak, P. J. 2009. Fire responses of bushland plants after the January 1994 wildfires in northern Sydney. <i>Cunninghamia</i> , 11(1): 131-165	[Adult ferns tolerate fires] " <i>Pteris vittata</i> : R = majority of adult plants resprouted after the fires"

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	Oppenheimer, H. 2008. New Hawaiian plant records for 2007. <i>Bishop Museum Occasional Papers</i> 100: 22-38	[Widespread in the Hawaiian Islands] "Naturalized in Hawai'i since at least 1887 and now known from Kaua'i, O'ahu, Lāna'i, Maui, and Hawai'i (Palmer 2003: 229–230; Oppenheimer 2004: 17), this weedy fern is documented here from Moloka'i. Spores are easily wind dispersed, with plants commonly observed on rock walls, cliffs, and road cuts."

Summary of Risk Traits:

High Risk / Undesirable Traits

- Elevation range exceeds 1000 m, demonstrating environmental versatility
- Thrives in tropical climates
- Widely naturalized in the Hawaiian Islands and elsewhere
- Weedy fern of disturbed habitats
- Potential environmental weed
- Other *Pteris* species have become invasive
- Accumulates arsenic from soil, becoming toxic
- Spores a possible human allergen
- Tolerates many soil types
- Produces viable spores that are dispersed by wind, water & probably externally by humans and animals
- Hybridizes with other *Pteris* species
- Can reproduce asexually by agamospermy & vegetatively by rhizomes
- Prolific spore production

Low Risk Traits

- Unarmed (no spines, thorns or burrs)
- Palatable to animals despite potential toxicity
- Ornamental
- Spores may be short-lived in the soil & are unlikely to form a persistent spore bank