

<b>Taxon:</b> <i>Dryopteris erythrosora</i> (D. C. Eaton) Kuntze	<b>Family:</b> Dryopteridaceae
<b>Common Name(s):</b> autumn fern Japanese shield fern	<b>Synonym(s):</b> <i>Aspidium erythrosorum</i> D. C. Eaton

<b>Assessor:</b> Chuck Chimera	<b>Status:</b> Approved	<b>End Date:</b> 15 Apr 2024
<b>WRA Score:</b> 12.0	<b>Designation:</b> H(HPWRA)	<b>Rating:</b> High Risk

**Keywords:** Rhizomatous Fern, Naturalized, Shade-Tolerant, Apogamous, 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		
303	Agricultural/forestry/horticultural weed	y = 2*multiplier (see Appendix 2), n = 0	n
304	Environmental weed		
305	Congeneric weed		
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	y
405	Toxic to animals	y = 1, n = 0	n
406	Host for recognized pests and pathogens	y = 1, n = 0	n
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	y
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y = 1, n = 0	n

Qsn #	Question	Answer Option	Answer
411	Climbing or smothering growth habit	y = 1, n = 0	n
412	Forms dense thickets	y = 1, n = 0	y
501	Aquatic	y = 5, n = 0	n
502	Grass	y = 1, n = 0	n
503	Nitrogen fixing woody plant	y = 1, n = 0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y = 1, n = 0	n
601	Evidence of substantial reproductive failure in native habitat	y = 1, n = 0	n
602	Produces viable seed	y = 1, n = -1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	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)		
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)	y = 1, n = -1	n
708	Propagules survive passage through the gut	y = 1, n = -1	n
801	Prolific seed production (>1000/m2)	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		
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

**Supporting Data:**

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	<b>Source(s)</b>	<b>Notes</b>
	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	"Subtropical broad-leaved evergreen forests. Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan, Zhejiang [Japan, Korea]." [No evidence of domestication]

102	Has the species become naturalized where grown?	
	<b>Source(s)</b>	<b>Notes</b>
	WRA Specialist. (2024). Personal Communication	NA

103	Does the species have weedy races?	
	<b>Source(s)</b>	<b>Notes</b>
	WRA Specialist. (2024). 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
	<b>Source(s)</b>	<b>Notes</b>
	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	"Subtropical broad-leaved evergreen forests. Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan, Zhejiang [Japan, Korea]."

202	Quality of climate match data	High
	<b>Source(s)</b>	<b>Notes</b>
	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	"Subtropical broad-leaved evergreen forests. Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan, Zhejiang [Japan, Korea]."

Qsn #	Question	Answer
203	Broad climate suitability (environmental versatility)	y
	<b>Source(s)</b>	<b>Notes</b>
	Wyatt, R. (2020). On the Spread of Five Nonnative Ferns in Georgia. <i>American Fern Journal</i> , 110(3), 95-111	" <i>Dryopteris erythrosora</i> .—This fern is very popular in the horticultural trade and is “hardy with minimal protection in all but the coldest of the United States” (Lellinger, 1985). Mickel (2003) states that it can grow in USDA hardiness zones 5 to 8. It is a recent introduction to the United States, prompting Olsen (2007) to remark “40 years ago, when amazingly by today’s market standards, it was unavailable.” Olsen (2007) gives its native range as East Asia from Japan, China, and Korea to the Philippines."
	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	"Subtropical broad-leaved evergreen forests. Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan, Zhejiang [Japan, Korea]."
	WRA Specialist. (2024). Personal Communication	Able to grow in temperate and subtropical climates

204	Native or naturalized in regions with tropical or subtropical climates	y
	<b>Source(s)</b>	<b>Notes</b>
	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	"Subtropical broad-leaved evergreen forests. Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan, Zhejiang [Japan, Korea]."

205	Does the species have a history of repeated introductions outside its natural range?	y
	<b>Source(s)</b>	<b>Notes</b>
	Umstead, H., & Diggs, J. T. (2018). An Ornamental Plant Found Spreading Aggressively: Potential Invasiveness of <i>Dryopteris erythrosora</i> (Dryopteridaceae) in North America. <i>American Fern Journal</i> , 108(4), 176-179	"It has been widely planted in North America as an ornamental fern, frequently in large commercial landscape plantings. <i>Dryopteris erythrosora</i> is widely sold at garden centers and is frequently recommended by gardeners and even botanical gardens as a maintenance-free, easy-to-grow fern."

301	Naturalized beyond native range	y
	<b>Source(s)</b>	<b>Notes</b>
	Rothfels, C. J., Sigel, E. M., & Windham, M. D. (2012). <i>Cheilanthes feei</i> T. Moore (Pteridaceae) and <i>Dryopteris erythrosora</i> (DC Eaton) Kunze (Dryopteridaceae) new for the flora of North Carolina. <i>American Fern Journal</i> , 102(2), 184-186	"In North America, it has been reported from Georgia (Weakley, 2011) and Arkansas (Simpson et al., <i>Amer. Fern J.</i> 98:111- 112. 2008). We found it growing in a typical habitat—a disturbed suburban woodlot—in Durham County, North Carolina. It was uncommon, in the company of other native and nonnative taxa, without any indication of it (or anything else) having been planted on the site or in the vicinity (Fig. 1)."
	Gallaher, T.J., Brock, K., Kennedy, B.H., Imada, C.T., Imada, K., & Walvoord, N. (2023). <i>Plants of Hawai'i</i> . <a href="http://www.plantsofhawaii.org..">http://www.plantsofhawaii.org..</a> [Accessed 12 Apr 2024]	"Only found in cultivation "

Qsn #	Question	Answer
	<p>Umstead, H., &amp; Diggs, J. T. (2018). An Ornamental Plant Found Spreading Aggressively: Potential Invasiveness of <i>Dryopteris erythrosora</i> (Dryopteridaceae) in North America. <i>American Fern Journal</i>, 108(4), 176-179</p>	<p>"There are increasing numbers of reports of this species naturalizing in the southeastern United States. Two occurrences of <i>D. erythrosora</i> outside of cultivation in Georgia were entered in to the Early Detection &amp; Distribution Mapping System, an invasive species distribution map, by Jane Trentin (Bargeron, et al., EDDMAPS 2017). The first author visited one of these sites and observed numerous autumn ferns along creek banks on the Cherokee Trail at Stone Mountain Park. Autumn fern is beginning to spread in the same way through Fernbank Forest in Decatur, GA, and can be found on the banks of Lullwater Creek; a tributary of Peavine Creek in Atlanta, GA (Trentin, pers. comm. 2017). We have also been informed that <i>D. erythrosora</i> is naturalizing in several units of the Chattahoochee River National Recreation Area, north of Atlanta, Georgia (Hightower, pers. comm. 2017). Six recent collections have been made from three other Georgia counties in the Atlanta and Athens areas (Zomlefer, et al. <i>Castanea</i> 83:124-139, 2018). Beyond Georgia, a single plant is reported to have grown to eight leaves, four of which were fertile, and had persevered through at least two winters in Hot Spring County, Arkansas. The source of this plant is unknown, the closest potential source being 10 miles away (Simpson, et al., <i>American Fern Journal</i> 98:111-112. 2008). <i>Dryopteris erythrosora</i> was also found growing in disturbed suburban woods, in Durham County, North Carolina; there was no indication that the ferns had been planted in the vicinity (Rothfels, et al., <i>American Fern Journal</i> 102:184-186, 2012). However, it has been collected in several counties nearby and could have escaped from cultivation (SERNEC Data Portal, <a href="http://sernecportal.org/portal/index.php">http://sernecportal.org/portal/index.php</a>, 2018). <i>Dryopteris erythrosora</i> has been included in the New Invaders of the Southeast field guide (Rawlins, et al., 2018). Additional records of this taxon in North America are listed on Global Biodiversity Information Facility, especially near New York City and Washington D.C. (GBIF.org, <a href="https://doi.org/10.15468/dl.fpwlzt">https://doi.org/10.15468/dl.fpwlzt</a>, 2018)."</p>
	<p>Wyatt, R. (2020). On the Spread of Five Nonnative Ferns in Georgia. <i>American Fern Journal</i>, 110(3), 95-111</p>	<p>[Georgia, Arkansas &amp; North Carolina] "The first instance of <i>D. erythrosora</i> escaping from cultivation was reported by Simpson, Crank, and Peck (2008). They found a single plant at the edge of an old timber access road in Hot Springs County, Arkansas. They suggested that it must have colonized via long-distance dispersal of spores because the nearest potential source of cultivated ferns was more than 16 km to the east. More recently, Rothfels et al. (2012) found two plants of <i>D. erythrosora</i> growing in a disturbed suburban lot in Durham County, North Carolina. They noted that there was no "indication of it (or anything else) having been planted on the site or in the vicinity." In Georgia neither McVaugh and Pyron (1951) nor Snyder and Bruce (1986) listed this fern as occurring in Georgia. Zomlefer et al. (2018) reported it, as an escape from cultivation, from six sites in three counties based on specimens collected by James R. Allison and myself. All of these were very recent collections dating from 2012 to 2017 and came from suburban landscapes mostly associated with stream banks. Since their report of plants from Clarke, Gwinnett, and Rockdale Counties, I have added Oconee County to the list."</p>
	<p>Kees, J. (2022). Fifteen Noteworthy Collections From Mississippi, U.S.A. <i>Journal of the Botanical Research Institute of Texas</i>, 16(1), 223-226</p>	<p>[Mississippi] "<i>Dryopteris erythrosora</i> (D.C. Eaton) Kuntze (DRYOPTERIDACEAE)—Voucher specimen: Lincoln Co.: J.C. Kees 4 (MMNS, NCU). This is the first report of <i>D. erythrosora</i> in the state of Mississippi, collected while conducting an inventory of a tract in Lincoln County in 2018. Umstead &amp; Diggs (2018) speculate <i>D. erythrosora</i> is likely to become a serious invasive species in the southeast; its aggressive spread in Lincoln County, along with <i>Deparia petersenii</i>, would support such a conclusion. Since it was collected, the population has expanded from several isolated plants to a dense colony, aggressively displacing a number of native ferns, and dispersed to three new locations along a small stream. It presumably arrived by long-distance spore dispersal, as there are no cultivated plants in the vicinity."</p>

Qsn #	Question	Answer
302	<b>Garden/amenity/disturbance weed</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Umstead, H., & Diggs, J. T. (2018). An Ornamental Plant Found Spreading Aggressively: Potential Invasiveness of <i>Dryopteris erythrosora</i> (Dryopteridaceae) in North America. <i>American Fern Journal</i> , 108(4), 176-179	"In the summer of 2017 one of the authors noticed a dense population of <i>D. erythrosora</i> in a disturbed suburban woodlot, located in Alpharetta, Georgia."
	Rothfels, C. J., Sigel, E. M., & Windham, M. D. (2012). <i>Cheilanthes feei</i> T. Moore (Pteridaceae) and <i>Dryopteris erythrosora</i> (DC Eaton) Kunze (Dryopteridaceae) new for the flora of North Carolina. <i>American Fern Journal</i> , 102(2), 184-186	"Just above scour zone of small suburban creek, on disturbed, steep sandy banks"
	Wyatt, R. (2020). On the Spread of Five Nonnative Ferns in Georgia. <i>American Fern Journal</i> , 110(3), 95-111	"More recently, Rothfels et al. (2012) found two plants of <i>D. erythrosora</i> growing in a disturbed suburban lot in Durham County, North Carolina."
	Rawlins, K.A., R.L. Winston, C.T. Barger, D.J. Moorhead, and R. Carroll. (2018). New Invaders of the Southeast. USDA Forest Service, Forest Health Assessment and Applied Sciences Team, Morgantown, West Virginia	[Potential disturbance adapted weed] "Autumn fern tolerates drier conditions better than many other ferns, but it grows best in moist soil high in organic matter in partial to full shade. It can be found invading moist forests, tree plantations, rock walls, and roadsides."
303	<b>Agricultural/forestry/horticultural weed</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence
304	<b>Environmental weed</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Rawlins, K.A., R.L. Winston, C.T. Barger, D.J. Moorhead, and R. Carroll. (2018). New Invaders of the Southeast. USDA Forest Service, Forest Health Assessment and Applied Sciences Team, Morgantown, West Virginia	[Potential environmental weed] "Autumn fern tolerates drier conditions better than many other ferns, but it grows best in moist soil high in organic matter in partial to full shade. It can be found invading moist forests, tree plantations, rock walls, and roadsides."
	Umstead, H., & Diggs, J. T. (2018). An Ornamental Plant Found Spreading Aggressively: Potential Invasiveness of <i>Dryopteris erythrosora</i> (Dryopteridaceae) in North America. <i>American Fern Journal</i> , 108(4), 176-179	[Potentially] "To this point, <i>D. erythrosora</i> has not been considered invasive, but the data collected suggests that it is capable of self-replicating and maturing into well-established colonies in the wild similar to <i>Macrothelypteris torresiana</i> , another ornamental fern that is invasive to the southeastern United States"
305	<b>Congeneric weed</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Yañez, A., Gutierrez, D. G., & Ponce, M. M. (2020). Weedy ferns (Polypodiopsida) in Argentina: diversity, distribution and impact on human activities and ecosystems. <i>Anais da Academia Brasileira de Ciências</i> , 92, e20180983	[ <i>Dryopteris filix-mas</i> ] "Weed type: Ecological weed, toxic" ... "Populations in Argentina were originated from ornamental culture of northwestern Patagonia that escaped in the region of Nahuel Huapi Lake, Neuquén and Río Negro provinces. Also, it has been registered as an invader of degraded and anthropically altered sites in New Zealand like urban and suburban areas (e.g. Christchurch and Dunedin), rural vegetation from unimproved hill country pasture, exotic forest and indigenous forest remnants (Ure 2014). Its role as a colonizing species is due to the tolerance to a wide range of environmental conditions, including soils compacted by livestock, and the long-distance dispersal of its spores."

Qsn #	Question	Answer
	Ure, G. A. (2014). An investigation into the habitat requirements, invasiveness and potential extent of male fern, <i>Dryopteris filix-mas</i> (L.) Schott, in Canterbury, New Zealand. Master's Thesis. University of Canterbury, Christchurch	[Potentially] "D. filix-mas is most likely to have appreciable impacts on indigenous ecosystems east of the Main Divide of the South Island in areas that have a history of disturbance (e.g. fire and grazing) but are no longer subjected to disturbance. D. filix-mas has the potential to become a large part of the ground species on retired and regenerating lands and may become a factor for consideration when undertaking restoration of remnants, revegetation and extension of existing protected natural areas. Insufficient knowledge was gained in this study to comment on the North Island situation, however as with the South Island D. filix-mas is widespread and appears to be associated with past disturbance on soils with moderate to high phosphorous."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	A number of species listed as naturalized and/or weedy

401	Produces spines, thorns or burrs	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	"Rhizome ascending, 3-4 cm in diam. Fronds caespitose. Stipes stramineous or light castaneous, 20-30 cm, 3-4 mm in diam., densely scaly at base; scales castaneous with a brown margin, lanceolate, 1-1.5 cm × 1-2 mm, entire. Lamina oblonglanceolate, 40-60 × 15-25 cm, bipinnate. Pinnae 10-15 pairs, opposite or subopposite, lanceolate, 15-20 × 4-6 cm, 6-8 cm apart, remote. Pinnules 10-15 pairs, ascending, lanceolate, 2-3 cm × 8-12 mm, serrulate or pinnatifid; basal basiscopic pinnules on lowest pinnae less than half as long as next. Segments distinctly ascending, 1- or 2-toothed at apex. Rachis sparsely covered with lanceolate, dark brown scales, pinna rachis and costa densely covered with brown, bullate scales. Veins pinnate, obscure abaxially. Lamina herbaceous, subglabrous adaxially, scaly abaxially. Sori in 1 row or scattered on either side of costa, nearer costa than to margin; indusia reddish at center, pale brown on edges, reniform, entire, persistent."

402	Allelopathic	n
	Source(s)	Notes
	WRA Specialist. (2024). Personal Communication	Unknown. No evidence found

403	Parasitic	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	"Rhizome ascending. Fronds caespitose. Stipes dark or castaneous, ca. 30 cm, with lanceolate, dark brown, entire scales at base; upper part of stipe with sparse, smaller, light brown scales." [No evidence]

Qsn #	Question	Answer
404	Unpalatable to grazing animals	y
	<b>Source(s)</b>	<b>Notes</b>
	NC State Extension. (2024). <i>Dryopteris erythrosora</i> . <a href="https://plants.ces.ncsu.edu/plants/dryopteris-erythrosora/">https://plants.ces.ncsu.edu/plants/dryopteris-erythrosora/</a> . [Accessed 12 Apr 2024]	"It is a low maintenance fern that withstands full shade is resistant to browsing by rabbits. Protect plants from drying winds. This plant is seldom damaged by deer."
	Missouri Botanical Garden. (2024). <i>Dryopteris erythrosora</i> . <a href="https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?taxonid=285661">https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?taxonid=285661</a> . [Accessed 12 Apr 2024]	"Tolerate: Rabbit, Heavy Shade"

405	Toxic to animals	n
	<b>Source(s)</b>	<b>Notes</b>
	Gardenersworld.com (2024). <i>Dryopteris erythrosora</i> . <a href="https://www.gardenersworld.com/plants/dryopteris-erythrosora/">https://www.gardenersworld.com/plants/dryopteris-erythrosora/</a> . [Accessed 15 Apr 2024]	"Is <i>Dryopteris</i> poisonous? <i>Dryopteris</i> has no toxic effects reported. No reported toxicity to: Birds, Cats, Dogs, Horses, Livestock, People"

406	Host for recognized pests and pathogens	n
	<b>Source(s)</b>	<b>Notes</b>
	Harrison, M. (2006). <i>Groundcovers for the South</i> . Pineapple Press Inc., Sarasota, FL	"Autumn fern is rarely bothered by pests or diseases."
	NC State Extension. (2024). <i>Dryopteris erythrosora</i> . <a href="https://plants.ces.ncsu.edu/plants/dryopteris-erythrosora/">https://plants.ces.ncsu.edu/plants/dryopteris-erythrosora/</a> . [Accessed 12 Apr 2024]	"Insects, Diseases, and Other Plant Problems: No serious problems."
	Missouri Botanical Garden. (2024). <i>Dryopteris erythrosora</i> . <a href="https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?taxonid=285661">https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?taxonid=285661</a> . [Accessed 12 Apr 2024]	"No serious insect or disease problems."

407	Causes allergies or is otherwise toxic to humans	n
	<b>Source(s)</b>	<b>Notes</b>
	Gardenersworld.com (2024). <i>Dryopteris erythrosora</i> . <a href="https://www.gardenersworld.com/plants/dryopteris-erythrosora/">https://www.gardenersworld.com/plants/dryopteris-erythrosora/</a> . [Accessed 15 Apr 2024]	"Is <i>Dryopteris</i> poisonous? <i>Dryopteris</i> has no toxic effects reported. No reported toxicity to: Birds, Cats, Dogs, Horses, Livestock, People"
	Quattrocchi, U. (2012). <i>CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology</i> . CRC Press, Boca Raton, FL	No information

Qsn #	Question	Answer
408	Creates a fire hazard in natural ecosystems	n
	<b>Source(s)</b>	<b>Notes</b>
	Central County Fire Department. (2021). Wildland Urban Interface CCFD Vegetation Lists. <a href="https://ccfd.org/wp-content/uploads/2021/07/CCFD-WUI-Vegetation-Lists-2021.pdf">https://ccfd.org/wp-content/uploads/2021/07/CCFD-WUI-Vegetation-Lists-2021.pdf</a> . [Accessed ]	[ <i>Dryopteris erythrosora</i> on an approved planting list for fire prone areas] "Approved Vegetation List Each species on the approved vegetation list is provided with the required distance from structures. The "required distance from structure" for each planting is how far the given species is required to be away from a structure based on state and local code requirements."
	Umstead, H., & Diggs, J. T. (2018). An Ornamental Plant Found Spreading Aggressively: Potential Invasiveness of <i>Dryopteris erythrosora</i> (Dryopteridaceae) in North America. <i>American Fern Journal</i> , 108(4), 176-179	[No evidence. Unlikely given moist habitats in which it typically grows] "Autumn fern tolerates drier conditions better than many other ferns, but it grows best in moist soil high in organic matter in partial to full shade. It can be found invading moist forests, tree plantations, rock walls, and roadsides."

409	Is a shade tolerant plant at some stage of its life cycle	y
	<b>Source(s)</b>	<b>Notes</b>
	Missouri Botanical Garden. (2024). <i>Dryopteris erythrosora</i> . <a href="https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?taxonid=285661">https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?taxonid=285661</a> . [Accessed 12 Apr 2024]	"Easily grown in average, slightly acidic, medium to wet soils in part shade to full shade."
	Umstead, H., & Diggs, J. T. (2018). An Ornamental Plant Found Spreading Aggressively: Potential Invasiveness of <i>Dryopteris erythrosora</i> (Dryopteridaceae) in North America. <i>American Fern Journal</i> , 108(4), 176-179	"It is valued for its striking coppery new growth, its hardiness, shade tolerance, and its evergreen habit."
	Xu Bing, X. B., Jin ShuiHu, J. S., & Ding BingYang, D. B. (2006). Selection for shade-tolerance ferns and horticultural utilization. <i>Journal of Zhejiang University (Agriculture and Life Sciences)</i> 32(3): 329-333	"Ten ferns, which were considered to be used in horticulture, were cultivated under three treatments. These ferns were: <i>Cibotium barometz</i> , <i>Pteris multifida</i> , <i>Pteris vittata</i> , <i>Angiopteris fokiensis</i> , <i>Polystichum polyblepharum</i> , <i>Dryopteris erythrosora</i> , <i>Plagiogyria dentimarginata</i> , <i>Coniogramme emeiensis</i> , <i>Asplenium wrightii</i> and <i>Woodwardia japonica</i> . The ratio of leaf weight and area, chlorophyll (Chl) content, ratio of Chl a and Chl b, and rate of photosynthesis were measured. Based on these values, the results showed that: (i) among the ferns, <i>Pteris vittata</i> , <i>Angiopteris fokiensis</i> , and <i>Dryopteris erythrosora</i> were the best shade-tolerant species, while the remaining were the second best ones; (ii) five species were selected for horticultural use, i.e. <i>Angiopteris fokiensis</i> , <i>Pteris multifida</i> , <i>Coniogramme emeiensis</i> , <i>Plagiogyria dentimarginata</i> , and <i>Asplenium wrightii</i> . Constructive proposals are provided as well."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	<b>Source(s)</b>	<b>Notes</b>
	NC State Extension. (2024). <i>Dryopteris erythrosora</i> . <a href="https://plants.ces.ncsu.edu/plants/dryopteris-erythrosora/">https://plants.ces.ncsu.edu/plants/dryopteris-erythrosora/</a> . [Accessed 12 Apr 2024]	" Grown in acidic high organic matter soils that stay moist. " .
	Harrison, M. (2006). <i>Groundcovers for the South</i> . Pineapple Press Inc., Sarasota, FL	"Autumn fern does best in highly organic soils, so poor soils should be amended by adding organic matter."
	Missouri Botanical Garden. (2024). <i>Dryopteris erythrosora</i> . <a href="https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?taxonid=285661">https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?taxonid=285661</a> . [Accessed 12 Apr 2024]	"Easily grown in average, slightly acidic, medium to wet soils in part shade to full shade."

411	Climbing or smothering growth habit	n
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Hoshizaki, B.J. & Moran, R.C. (2001). Fern Grower's Manual. Revised and Expanded Edition. Timber Press, Portland, OR	"A medium-sized fern, to 1 m (3 ft.), with evergreen fronds and ascending to erect or prostrate, branching rhizomes."
<b>412</b>	<b>Forms dense thickets</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Shannon, P. (2023). Invasive Ferns Species You Should Avoid Planting Outdoors. Southern Living. <a href="https://www.southernliving.com/garden/invasive-fern-species">https://www.southernliving.com/garden/invasive-fern-species</a> . [Accessed 15 Apr 2024]	"(Dryopteris erythrosora) You'll know this fern when you spot its copper fronds in the fall—a reason why it's so appealing to home gardeners. But don't let that glorious foliage fool you. "Recently, dense stands have been found to be naturalizing in north Georgia, and it is spreading in other states," says Possley. "
	Umstead, H., & Diggs, J. T. (2018). An Ornamental Plant Found Spreading Aggressively: Potential Invasiveness of Dryopteris erythrosora (Dryopteridaceae) in North America. American Fern Journal, 108(4), 176-179	"In the summer of 2017 one of the authors noticed a dense population of D. erythrosora in a disturbed suburban woodlot, located in Alpharetta, Georgia. A population survey at the site documented a large number of fertile leaves and the recruitment of young plants."
<b>501</b>	<b>Aquatic</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	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] "Subtropical broad-leaved evergreen forests."
<b>502</b>	<b>Grass</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	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	Dryopteridaceae
<b>503</b>	<b>Nitrogen fixing woody plant</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	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	Dryopteridaceae
<b>504</b>	<b>Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Hoshizaki, B.J. & Moran, R.C. (2001). Fern Grower's Manual. Revised and Expanded Edition. Timber Press, Portland, OR	"A medium-sized fern, to 1 m (3 ft.), with evergreen fronds and ascending to erect or prostrate, branching rhizomes."
<b>601</b>	<b>Evidence of substantial reproductive failure in native habitat</b>	<b>n</b>

Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	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	"Subtropical broad-leaved evergreen forests. Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan, Zhejiang [Japan, Korea]."

602	Produces viable seed	y
	<b>Source(s)</b>	<b>Notes</b>
	Jang, B. K., Cho, J. S., Kwon, H. J., & Lee, C. H. (2019). Optimal conditions for spore germination and gametophyte and sporophyte production in the autumn fern <i>Dryopteris erythrosora</i> . Horticulture, Environment, and Biotechnology, 60, 115-123	" <i>Dryopteris erythrosora</i> (D. C. Eaton) Kuntze is used as an ornamental horticultural crop and landscaping plant, and it is a plant with high development value as an herbal medicine, but there are few studies to proliferate a large amount of plants. This study aimed to determine a suitable method for spore germination, gametophyte proliferation, sporophyte formation, and seedling production in <i>D. erythrosora</i> . Spore germination rate was highest in 1/2 × Murashige and Skoog (MS) medium (92.8%). A suitable medium for prothallus proliferation was selected based on gametophytes produced from germinated spores. A 1 × MS medium was most effective for gametophyte proliferation and active organ formation; moreover, 1 × MS medium containing 1% sucrose without activated charcoal was the most effective growth condition for inducing gametophyte growth and development. The suitable culture soil composition for sporophyte formation was investigated by varying the ratio of horticultural substrate, peat moss, perlite, and decomposed granite. We found that a 2:1 (v:v) mixture of horticultural substrate and perlite accelerated sporophyte formation (155 units). Furthermore, suitable seedlings and transplants for sporophyte seedling growth were determined by varying the ratio of horticultural substrate and decomposed granite, as well as plug tray cell size. For sporophyte seedlings, the greatest growth in root length (92.9 mm) and the most aerial and underground fresh weight (234.1 and 40.3 g, respectively) were observed in a mixture of horticultural substrate and decomposed granite at a 1:2 (v:v) ratio. Our results using tissue culture technology will be provided as a mass production method for substantial industrialization of <i>D. erythrosora</i> plants."
	Rawlins, K.A., R.L. Winston, C.T. Barger, D.J. Moorhead, and R. Carroll. (2018). New Invaders of the Southeast. USDA Forest Service, Forest Health Assessment and Applied Sciences Team, Morgantown, West Virginia	"Spreads by spores and vegetatively via rhizomes. Spores are typically viable for at least one year."
	Wyatt, R. (2020). On the Spread of Five Nonnative Ferns in Georgia. American Fern Journal, 110(3), 95-111	"The first instance of <i>D. erythrosora</i> escaping from cultivation was reported by Simpson, Crank, and Peck (2008). They found a single plant at the edge of an old timber access road in Hot Springs County, Arkansas. They suggested that it must have colonized via long-distance dispersal of spores because the nearest potential source of cultivated ferns was more than 16 km to the east."

603	Hybridizes naturally	
	<b>Source(s)</b>	<b>Notes</b>
	Hori, K. et al. (2018). Hybridization of the <i>Dryopteris erythrosora</i> complex (Dryopteridaceae, Polypodiidae) in Japan and adjacent areas. Hikobia, 17(4), 299-313	"Many apogamous fern species show morphological and genetic variation because of hybridization with sexual species. In this study, we determined the relationships among species comprising the <i>Dryopteris erythrosora</i> complex (Dryopteridaceae) in Japan and adjacent areas using two plastid DNA markers, rbcL and ndhF, and two nuclear DNA markers, G6PD and PgiC. This study resolved several species are of hybrid origin in the <i>D. erythrosora</i> complex."

Qsn #	Question	Answer
	Hoshizaki, B. J., & Wilson, K. A. (1999). The Cultivated Species of the Fern Genus <i>Dryopteris</i> in the United States. <i>American Fern Journal</i> , 89(1), 1-98	[Potentially. No documented <i>Dryopteris erythrosora</i> hybrids in this publication] "The difficulties in understanding <i>Dryopteris</i> , particularly its many species complexes, are well known to pteridologists. Work continues on the genus, and some new species and hybrids have yet to be delineated and older ones reassessed."

604	Self-compatible or apomictic	y
	Source(s)	Notes
	Wyatt, R. (2020). On the Spread of Five Nonnative Ferns in Georgia. <i>American Fern Journal</i> , 110(3), 95-111	"The likelihood of range expansion is enhanced for species that are apogamous, like triploid <i>C. fortunei</i> (2n ¼ 123: Yatskievych, 1993) and tetraploid <i>P. multifida</i> (2n = 116: Nauman, 1993). This may also be true for <i>Dryopteris erythrosora</i> , which Rothfels, Sigel, and Windham (2012) assumed to be an apogamous triploid. It is also possible, however, that cultivated North American plants of <i>D. erythrosora</i> are apogamous tetraploids (2n = 164), as such plants have recently been reported from Japan by Hori and Murakami (2019)." [apogamy: a type of reproduction, occurring in some ferns, in which the sporophyte develops from the gametophyte without fusion of gametes]

605	Requires specialist pollinators	n
	Source(s)	Notes
	Rothfels, C. J., Sigel, E. M., & Windham, M. D. (2012). <i>Cheilanthes feei</i> T. Moore (Pteridaceae) and <i>Dryopteris erythrosora</i> (DC Eaton) Kunze (Dryopteridaceae) new for the flora of North Carolina. <i>American Fern Journal</i> , 102(2), 184-186	"Like <i>C. feei</i> , <i>Dryopteris erythrosora</i> is an apomictic triploid." [No fertilization required]

606	Reproduction by vegetative fragmentation	y
	Source(s)	Notes
	Harrison, M. (2006). <i>Groundcovers for the South</i> . Pineapple Press Inc., Sarasota, FL	"Planted on 18-inch centers, it will eventually cover the entire space with its graceful, upright fronds." ... "Propagation Autumn fern spreads slowly by short, creeping rhizomes. It is a clumping fern, so division of mature clumps is the easiest means of propagation for the home gardener."
	NC State Extension. (2024). <i>Dryopteris erythrosora</i> . <a href="https://plants.ces.ncsu.edu/plants/dryopteris-erythrosora/">https://plants.ces.ncsu.edu/plants/dryopteris-erythrosora/</a> . [Accessed 12 Apr 2024]	"Plants will spread slowly over time through underground creeping rhizomes."
	Rawlins, K.A., R.L. Winston, C.T. Barger, D.J. Moorhead, and R. Carroll. (2018). <i>New Invaders of the Southeast</i> . USDA Forest Service, Forest Health Assessment and Applied Sciences Team, Morgantown, West Virginia	"Spreads by spores and vegetatively via rhizomes. Spores are typically viable for at least one year."

607	Minimum generative time (years)	
	Source(s)	Notes
	NC State Extension. (2024). <i>Dryopteris erythrosora</i> . <a href="https://plants.ces.ncsu.edu/plants/dryopteris-erythrosora/">https://plants.ces.ncsu.edu/plants/dryopteris-erythrosora/</a> . [Accessed 15 Apr 2024]	"Growth Rate: Slow"
	Hoshizaki, B.J. & Moran, R.C. (2001). <i>Fern Grower's Manual</i> . Revised and Expanded Edition. Timber Press, Portland, OR	[Unknown] " <i>Dryopteris erythrosora</i> is an apogamous triploid species from eastern Asia, where it grows in woods on low mountains and hills."

Qsn #	Question	Answer
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	<b>Source(s)</b>	<b>Notes</b>
	Rawlins, K.A., R.L. Winston, C.T. Barger, D.J. Moorhead, and R. Carroll. (2018). New Invaders of the Southeast. USDA Forest Service, Forest Health Assessment and Applied Sciences Team, Morgantown, West Virginia	[Colonizes roadsides, and small spores might be carried in mud on vehicles or footwear] "Autumn fern tolerates drier conditions better than many other ferns, but it grows best in moist soil high in organic matter in partial to full shade. It can be found invading moist forests, tree plantations, rock walls, and roadsides."

702	Propagules dispersed intentionally by people	y
	<b>Source(s)</b>	<b>Notes</b>
	Wyatt, R. (2020). On the Spread of Five Nonnative Ferns in Georgia. American Fern Journal, 110(3), 95-111	" <i>Dryopteris erythrosora</i> .—This fern is very popular in the horticultural trade and is “hardy with minimal protection in all but the coldest of the United States” (Lellinger, 1985). Mickel (2003) states that it can grow in USDA hardiness zones 5 to 8. It is a recent introduction to the United States, prompting Olsen (2007) to remark “40 years ago, when amazingly by today’s market standards, it was unavailable.” Olsen (2007) gives its native range as East Asia from Japan, China, and Korea to the Philippines."
	Oppenheimer, H. L. (2024). Plant Extinction Prevention Program. Maui Nui Coordinator. Pers. Comm. 09 Feb	"Saw it for sale at the farmers market at Kaahumanu SC." [Sold on Maui]

703	Propagules likely to disperse as a produce contaminant	
	<b>Source(s)</b>	<b>Notes</b>
	Wyatt, R. (2020). On the Spread of Five Nonnative Ferns in Georgia. American Fern Journal, 110(3), 95-111	" <i>Dryopteris erythrosora</i> .—This fern is very popular in the horticultural trade ..." [It may be possible that spores get dispersed as a contaminant in soil of other potted or cultivated plants]

704	Propagules adapted to wind dispersal	y
	<b>Source(s)</b>	<b>Notes</b>
	Wyatt, R. (2020). On the Spread of Five Nonnative Ferns in Georgia. American Fern Journal, 110(3), 95-111	[Presumably wind-dispersed] "The first instance of <i>D. erythrosora</i> escaping from cultivation was reported by Simpson, Crank, and Peck (2008). They found a single plant at the edge of an old timber access road in Hot Springs County, Arkansas. They suggested that it must have colonized via long-distance dispersal of spores because the nearest potential source of cultivated ferns was more than 16 km to the east."

705	Propagules water dispersed	y
	<b>Source(s)</b>	<b>Notes</b>
	Wyatt, R. (2020). On the Spread of Five Nonnative Ferns in Georgia. American Fern Journal, 110(3), 95-111	[Common along stream banks. Spores presumably capable of dispersal by water] "Zomlefer et al. (2018) reported it, as an escape from cultivation, from six sites in three counties based on specimens collected by James R. Allison and myself. All of these were very recent collections dating from 2012 to 2017 and came from suburban landscapes mostly associated with stream banks."

706	Propagules bird dispersed	n
	<b>Source(s)</b>	<b>Notes</b>

Qsn #	Question	Answer
	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	"Sori in 1 row or scattered on either side of costa, nearer costa than to margin; indusia reddish at center, pale brown on edges, reniform, entire, persistent." [Not fleshy-fruited]
<b>707</b>	<b>Propagules dispersed by other animals (externally)</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	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	"Sori in 1 row or scattered on either side of costa, nearer costa than to margin; indusia reddish at center, pale brown on edges, reniform, entire, persistent." [Presumably wind, and possibly water dispersed]
<b>708</b>	<b>Propagules survive passage through the gut</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	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	"Sori in 1 row or scattered on either side of costa, nearer costa than to margin; indusia reddish at center, pale brown on edges, reniform, entire, persistent." [Presumably wind-dispersed]
<b>801</b>	<b>Prolific seed production (&gt;1000/m<sup>2</sup>)</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	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	"Assume 'yes' for fern taxa unless contradictory evidence exists."
	Rawlins, K.A., R.L. Winston, C.T. Barger, D.J. Moorhead, and R. Carroll. (2018). New Invaders of the Southeast. USDA Forest Service, Forest Health Assessment and Applied Sciences Team, Morgantown, West Virginia	"Spreads by spores and vegetatively via rhizomes. Spores are typically viable for at least one year."
<b>802</b>	<b>Evidence that a persistent propagule bank is formed (&gt;1 yr)</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Rawlins, K.A., R.L. Winston, C.T. Barger, D.J. Moorhead, and R. Carroll. (2018). New Invaders of the Southeast. USDA Forest Service, Forest Health Assessment and Applied Sciences Team, Morgantown, West Virginia	"Spreads by spores and vegetatively via rhizomes. Spores are typically viable for at least one year."
<b>803</b>	<b>Well controlled by herbicides</b>	
	<b>Source(s)</b>	<b>Notes</b>
	WRA Specialist. (2024). Personal Communication	Unknown. No information on herbicide efficacy or chemical control of this species.

Qsn #	Question	Answer
804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	<b>Source(s)</b>	<b>Notes</b>
	WRA Specialist. (2024). Personal Communication	Unknown

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	<b>Source(s)</b>	<b>Notes</b>
	WRA Specialist. (2024). Personal Communication	Unknown

**Summary of Risk Traits:**

*Dryopteris erythrosora* (autumn fern) is an herbaceous, perennial fern growing from short, creeping rhizomes. It is native to subtropical broad-leaved evergreen forests of China and Japan and is widely planted in North America as an ornamental fern, frequently in large commercial landscape plantings. It is now reported as naturalized in several locations in the southeastern United States but is currently only known from cultivation in the Hawaiian Islands. Its ability to spread by wind-dispersed spores and rhizomes suggests it could escape and potentially impact native ecosystems in the islands.

**High Risk / Undesirable Traits**

- Broad climate suitability
- Naturalized in the Southeastern United States (but no evidence from the Hawaiian Islands to date)
- A potential disturbance and environmental weed
- Other species may be invasive
- Unpalatable to deer and rabbits
- Shade tolerant (and may be able to invade understory of native ecosystems)
- Forms dense cover (and may exclude other vegetation)
- Reproduces by spores and vegetatively by rhizomes
- Apogamous (fertilization is bypassed, allowing for rapid reproduction)
- Spores dispersed by wind, water, and possibly other vectors
- Ferns also spread through intentional cultivation
- Prolific spore production
- Spores may remain viable for >1 year

**Low Risk Traits**

- Unarmed (no spines, thorns, or burrs)
- Non-toxic
- Prefers shaded, moist habitats. May not thrive in hot, dry, and sunny habitats.