

<b>Taxon:</b> <i>Dicksonia squarrosa</i> (G. Forst.) Sw.	<b>Family:</b> Dicksoniaceae
<b>Common Name(s):</b> harsh tree fern rough tree fern wheki	<b>Synonym(s):</b> <i>Trichomanes squarrosus</i> G. Forst.

<b>Assessor:</b> Chuck Chimera	<b>Status:</b> Assessor Approved	<b>End Date:</b> 11 Sep 2019
<b>WRA Score:</b> 18.0	<b>Designation:</b> H(HPWRA)	<b>Rating:</b> High Risk

**Keywords:** Tree Fern, Invades Pastures, Dense Stands, Suckering, 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	n
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	?
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)	y
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	n
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans		
408	Creates a fire hazard in natural ecosystems	y=1, n=0	y
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	y

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
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		
801	Prolific seed production (>1000/m2)	y=1, n=-1	y
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides		
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)		

**Supporting Data:**

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. Flora of New Zealand — Ferns and Lycophytes. Fascicle 11. Manaaki Whenua Press, Lincoln	[No evidence of domestication] "Dicksonia squarrosa occurs throughout the North Island in coastal to montane forest. It grows from near sea-level to 860 m in the Kaweka and Ruahine ranges. In the South Island it is largely confined to coastal and lowland sites, but reaches 500 m near Haast, and 900 m at Jordan Stream, Marlborough."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. (2019). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. (2019). 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
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. Flora of New Zealand — Ferns and Lycophytes. Fascicle 11. Manaaki Whenua Press, Lincoln	"Dicksonia squarrosa occurs throughout the North Island in coastal to montane forest. It grows from near sea-level to 860 m in the Kaweka and Ruahine ranges. In the South Island it is largely confined to coastal and lowland sites, but reaches 500 m near Haast, and 900 m at Jordan Stream, Marlborough." [Range extends from subtropical to temperate climates]

202	Quality of climate match data	High
	Source(s)	Notes
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. Flora of New Zealand — Ferns and Lycophytes. Fascicle 11. Manaaki Whenua Press, Lincoln	

203	Broad climate suitability (environmental versatility)	n
	Source(s)	Notes
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. Flora of New Zealand — Ferns and Lycophytes. Fascicle 11. Manaaki Whenua Press, Lincoln	"Altitudinal range: 0–900 m. Dicksonia squarrosa occurs throughout the North Island in coastal to montane forest. It grows from near sea-level to 860 m in the Kaweka and Ruahine ranges. In the South Island it is largely confined to coastal and lowland sites, but reaches 500 m near Haast, and 900 m at Jordan Stream, Marlborough."

Qsn #	Question	Answer
	Dave's Garden. (2019). <i>Dicksonia</i> Species, Harsh Tree Fern, Rough Tree Fern, Wheki - <i>Dicksonia squarrosa</i> . <a href="https://davesgarden.com/guides/pf/go/58592/">https://davesgarden.com/guides/pf/go/58592/</a> . [Accessed 11 Sep 2019]	"Hardiness: USDA Zone 9a: to -6.6 °C (20 °F) USDA Zone 9b: to -3.8 °C (25 °F) USDA Zone 10a: to -1.1 °C (30 °F) USDA Zone 10b: to 1.7 °C (35 °F)"
204	<b>Native or naturalized in regions with tropical or subtropical climates</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Brownsey, P. J. & Perrie, L. R. (2015). <i>Dicksoniaceae</i> . In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. <i>Flora of New Zealand — Ferns and Lycophytes</i> . Fascicle 11. Manaaki Whenua Press, Lincoln	[Range extends from subtropical to temperate climates] " <i>Dicksonia squarrosa</i> occurs throughout the North Island in coastal to montane forest. It grows from near sea-level to 860 m in the Kaweka and Ruahine ranges. In the South Island it is largely confined to coastal and lowland sites, but reaches 500 m near Haast, and 900 m at Jordan Stream, Marlborough."
205	<b>Does the species have a history of repeated introductions outside its natural range?</b>	<b>?</b>
	<b>Source(s)</b>	<b>Notes</b>
	Staples, G.W. & Herbst, D.R. 2005. <i>A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places</i> . Bishop Museum Press, Honolulu, HI	" <i>Dicksonia</i> L'Heritier is a genus of about 25 species from temperate South Pacific and tropical America." ... "At least five species are grown in Hawai'i," [Includes <i>Dicksonia squarrosa</i> ]
	Dave's Garden. (2019). <i>Dicksonia</i> Species, Harsh Tree Fern, Rough Tree Fern, Wheki - <i>Dicksonia squarrosa</i> . <a href="https://davesgarden.com/guides/pf/go/58592/">https://davesgarden.com/guides/pf/go/58592/</a> . [Accessed 11 Sep 2019]	"This plant has been said to grow in the following regions: Eureka, California Mckinleyville, California Thousand Oaks, California Portland, Oregon"
301	<b>Naturalized beyond native range</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Parker, J. (2019). BIISC Early Detection Botanist. Pers. Comm. 09 September	"We got notification from David Benitez that <i>Dicksonia squarrosa</i> has been found naturalizing in Volcano Village." ... "They're definitely coming from cultivated plants that somebody felt inclined to stick out there in a tree fern jungle."
302	<b>Garden/amenity/disturbance weed</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	New Zealand Plant Conservation Network. (2014). <i>Flora Details - Dicksonia squarrosa</i> . <a href="http://nzpcn.org.nz/flora_details.aspx?ID=1791">http://nzpcn.org.nz/flora_details.aspx?ID=1791</a> . [Accessed 10 Sep 2019]	[Aggressive in gardens] " <i>Dicksonia squarrosa</i> needs room to spread and can become aggressive in some garden situations. This species often naturally appears in garden situations."
	WRA Specialist. (2019). Personal Communication	A native fern that invades and impacts pastures in New Zealand. See 3.03
303	<b>Agricultural/forestry/horticultural weed</b>	<b>y</b>

Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Arosa, M. L., Ceia, R. S., Quintanilla, L. G., & Ramos, J. A. 2012. The tree fern <i>Dicksonia antarctica</i> invades two habitats of European conservation priority in São Miguel Island, Azores. <i>Biological Invasions</i> , 14(7): 1317-1323	"Of over 12,000 described fern species, about 60 are problematic due to their invasive nature, affecting resource use, human health and plant communities (Robinson et al. 2010). Of these 60 species, only two are tree ferns, <i>Dicksonia squarrosa</i> and <i>Sphaeropteris cooperi</i> ."
	Robinson, R.C., Sheffield, E, & Sharpe, J.M. (2010). Problem ferns: their impact and management. Pp. 255–322 In: Mehlreter K., Walker L. R., & Sharpe, J. M. (eds.). <i>Fern Ecology</i> . Cambridge University Press, New York	[ <i>Dicksonia squarrosa</i> is a native agricultural weed] "In New Zealand, the herbaceous <i>Paesia scaberula</i> (ring fern) and the arborescent <i>Dicksonia squarrosa</i> sometimes have a strong association after forest clearance and occupy pastures where they represent successional changes back to woodland. <i>Paesia scaberula</i> has been described as one of the worst indigenous weeds of improved pasture (i.e., exotic grassland) in New Zealand (Silvester, 1964). Its thin, superficial rhizomes spread from all sides of the circular patches that are characteristic of this fern, whereas the clumping, colonial habit of <i>Dicksonia squarrosa</i> arises from its ability to reproduce vegetatively by runners arising from subterranean adventitious buds. The spread and formation of <i>Dicksonia</i> groves is a slow process but the emergence of <i>Dicksonia</i> through either grass or <i>Paesia</i> is often observed (Silvester, 1964). Both native fern species create problems in productive grassland comprising exotic grass species (e.g., hybrids of <i>Lolium multiflorum</i> and <i>L. perenne</i> raised in New Zealand as "short rotation ryegrass", Hubbard, 1968). This situation is different from the usual circumstances where invasive alien ferns threaten native species (see Section 8.3) and illustrates the subjective decision of whether the invader is welcome or not."

<b>304</b>	<b>Environmental weed</b>	<b>n</b>
	<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

<b>305</b>	<b>Congeneric weed</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Arosa, M. L., Ceia, R. S., Quintanilla, L. G., & Ramos, J. A. 2012. The tree fern <i>Dicksonia antarctica</i> invades two habitats of European conservation priority in São Miguel Island, Azores. <i>Biological Invasions</i> , 14(7): 1317-1323	[ <i>Dicksonia antarctica</i> invasive] "The species has invaded forest plantations, exotic forests and two habitats of European conservation priority: native laurel forests and blanket bogs. <i>Dicksonia antarctica</i> plantlets (individuals with no trunk) were predominant in exotic forests, <i>D. antarctica</i> shrubs (trunk height\1 m) were most frequent in blanket bogs and forest plantations whereas trees (trunk height[1 m) in gardens. Blanket bogs had the maximum percentage (90%) of fertile individuals (i.e. with sporangia). The large size and poor access of invaded area makes full eradication from the island impossible. We recommend complete elimination in blanket bogs and to take control measures in native laurel forests as these are priority conservation habitats."

<b>401</b>	<b>Produces spines, thorns or burrs</b>	<b>n</b>
------------	---	----------

Qsn #	Question	Answer
	Source(s)	Notes
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. Flora of New Zealand — Ferns and Lycophytes. Fascicle 11. Manaaki Whenua Press, Lincoln	[No evidence] "Rhizomes erect, forming a woody trunk up to 7 m tall, 90–200 mm diam., covered in dark brown hairs and persistent black stipe bases; forming aerial buds that sometimes grow out to form multiple trunks; bearing underground stolons and often forming extensive groves. Fronds 1250–2400 mm long, falling when old; dead fronds orange-brown. Stipes 210–660 mm long, dark purple-brown, rough, often bearing fine golden-brown hairs at the junction with the trunk, densely covered in red-brown or yellowbrown multicellular hairs up to 45 mm long proximally, and red-brown hairs to 10 mm long distally. Laminae 2-pinnate-pinnatifid (sterile) to 3-pinnate-pinnatifid (fertile), elliptic or obovate, 1000–1400 mm long, 400–600 mm wide, dark green on adaxial surfaces, paler green on abaxial surfaces, coriaceous, very harsh, densely hairy on abaxial surfaces of rachis, pinna midribs and costae; hairs rigid, multicellular, red- or purple-brown, more or less straight, up to 5 mm long, uniformly distributed, with finer yellow-brown hairs near costa junctions; rachis red-brown or purple brown. Primary pinnae in 35–45 pairs, narrowly ovate or narrowly triangular; the longest at or above the middle, 200–420 mm long, 55–145 mm wide, stalked; the basal pair 100–250 mm long. Secondary pinnae narrowly triangular, the longest 30–75 mm long, 8–20 mm wide, stalked. Longest tertiary pinnae 4–12 mm long, 2–3 mm wide, decurrent to form a narrow wing along the costa of the secondary pinna, divided less than halfway to midrib; ultimate segments sharply angled. Sori terminating veins at margins of lamina, ovate, c. 1 mm long, slightly elongated along the lamina margin."

402	Allelopathic	n
	Source(s)	Notes
	Brock, J. M., Perry, G. L., Lee, W. G., & Burns, B. R. (2016). Tree fern ecology in New Zealand: A model for southern temperate rainforests. <i>Forest Ecology and Management</i> , 375, 112-126	[Potentially] "Froude (1980) showed that aqueous extracts from green frond material of tree ferns ( <i>C. medullaris</i> , <i>C. smithii</i> , <i>D. squarrosa</i> ) stunted the radicle development of salad cress ( <i>Lepidium sativum</i> );"

403	Parasitic	n
	Source(s)	Notes
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. Flora of New Zealand — Ferns and Lycophytes. Fascicle 11. Manaaki Whenua Press, Lincoln	No evidence. Dicksoniaceae

404	Unpalatable to grazing animals	n
	Source(s)	Notes

Qsn #	Question	Answer
	Stewart, G. H., & Burrows, L. E. (1989). The impact of white-tailed deer <i>Odocoileus virginianus</i> on regeneration in the coastal forests of Stewart Island, New Zealand. <i>Biological Conservation</i> , 49(4), 275-293	" <i>Dicksonia squarrosa</i> was a feature of deer diet in both years, and several species not browsed in 1979 (e.g. <i>Coprosma areolata</i> and <i>Fuchsia excorticata</i> ) were browsed in 1985. In contrast, some species such as <i>Senecio reinoldii</i> were rarely browsed. Many of the browse records for the species listed in Table 7 (except <i>Senecio reinoldii</i> ) were for epicormic sprouts or adventitious suckers ( <i>Dicksonia squarrosa</i> ) that proliferated after the removal of deer in 1981."
	Coleman, J. D., Green, W. Q., & Polson, J. G. (1985). Diet of brushtail possums over a pasture-alpine gradient in Westland, New Zealand. <i>New Zealand Journal of Ecology</i> , 8: 21-35	"Of the minor contributions to the diet, 2.2% were Pteridophyta, and included 11 fern species, each from a different family. Most were ground ferns, although the consumption of tree ferns ( <i>Cyathea smithii</i> and <i>Dicksonia squarrosa</i> ) and of epiphytic Polypodiaceae reflected the wide range of feeding sites used by possums."
	Mark, A. F. (1989). Responses of indigenous vegetation to contrasting trends in utilization by red deer in two southwestern New Zealand National Parks. <i>New Zealand Journal of Ecology</i> , 12: 103-114	[Described in study as "obviously palatable"] The responses of rain-forest vegetation on Secretary Island (Fiordland National Park) which was subjected to low but sustained browsing by red deer, are compared with those of the full range of mountain vegetation in Mt Aspiring National Park where deer numbers had been reduced substantially from previously high numbers." ... "more detailed descriptions were obtained of some obviously vulnerable communities and species, by combining quantitative measurements and photographs of permanently marked plots, with general observations"... "a 200 m2 permanent quadrat to study responses in four herbaceous species, two obviously palatable ( <i>Asplenium bulbiferum</i> and <i>Dicksonia squarrosa</i> ) and two apparently nonpalatable ( <i>Blechnum discolor</i> and <i>Cyathea smithii</i> );"

405	Toxic to animals	n
	Source(s)	Notes
	Stewart, G. H., & Burrows, L. E. (1989). The impact of white-tailed deer <i>Odocoileus virginianus</i> on regeneration in the coastal forests of Stewart Island, New Zealand. <i>Biological Conservation</i> , 49(4), 275-293	[Palatable to deer. No reports of toxicity] " <i>Dicksonia squarrosa</i> was a feature of deer diet in both years, and several species not browsed in 1979 (e.g. <i>Coprosma areolata</i> and <i>Fuchsia excorticata</i> ) were browsed in 1985. In contrast, some species such as <i>Senecio reinoldii</i> were rarely browsed. Many of the browse records for the species listed in Table 7 (except <i>Senecio reinoldii</i> ) were for epicormic sprouts or adventitious suckers ( <i>Dicksonia squarrosa</i> ) that proliferated after the removal of deer in 1981."
	SelecTree. " <i>Dicksonia squarrosa</i> Tree Record." 1995-2019. Sep 11, 2019. <a href="https://selectree.calpoly.edu/tree-detail/dicksonia-squarrosa">https://selectree.calpoly.edu/tree-detail/dicksonia-squarrosa</a> . [Accessed 11 Sep 2019]	Known Health Hazard - None
	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 evidence

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	The Royal Horticultural Society. (2019). <i>Dicksonia squarrosa</i> - New Zealand tree fern. <a href="https://www.rhs.org.uk/Plants/5797/New-Zealand-tree-fern/Details">https://www.rhs.org.uk/Plants/5797/New-Zealand-tree-fern/Details</a> . [Accessed 11 Sep 2019]	"Pests Generally pest free outdoors Diseases Generally disease free outdoors "

Qsn #	Question	Answer
	SelecTree. "Dicksonia squarrosa Tree Record." 1995-2019. Sep 11, 2019. <a href="https://selecttree.calpoly.edu/tree-detail/dicksonia-squarrosa">https://selecttree.calpoly.edu/tree-detail/dicksonia-squarrosa</a> . [Accessed 11 Sep 2019]	"Susceptible to Spider Mites, Root Rot."

407	Causes allergies or is otherwise toxic to humans	
	Source(s)	Notes
	Dave's Garden. (2019). Dicksonia Species, Harsh Tree Fern, Rough Tree Fern, Wheki - Dicksonia squarrosa. <a href="https://davesgarden.com/guides/pf/go/58592/">https://davesgarden.com/guides/pf/go/58592/</a> . [Accessed 11 Sep 2019]	"Danger: Handling plant may cause skin irritation or allergic reaction" [May be referring to scales, but severity of irritation, or allergic reaction, unknown]
	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	y
	Source(s)	Notes
	Brock, J. M., Perry, G. L., Lee, W. G., & Burns, B. R. (2016). Tree fern ecology in New Zealand: A model for southern temperate rainforests. <i>Forest Ecology and Management</i> , 375, 112-126	"Tree ferns are fire-prone and are categorized as moderate-high flammability by the New Zealand Fire Service, indicating they will burn readily during moderate to high forest fire danger conditions and partially ignite during moderate conditions (Fogarty, 2001). This flammability is due to heavy accumulations of litter, elevated dead material and flammable green foliage on tree ferns (Fogarty, 2001). A physical assessment of frond material by Wyse et al. (2016) comparing plant trait flammability ranked <i>C. medullaris</i> as moderate, <i>C. dealbata</i> as moderate-high and <i>D. squarrosa</i> as having high flammability."



Qsn #	Question	Answer
409	Is a shade tolerant plant at some stage of its life cycle	y
	<b>Source(s)</b>	<b>Notes</b>
	Dave's Garden. (2019). Dicksonia Species, Harsh Tree Fern, Rough Tree Fern, Wheki - Dicksonia squarrosa. <a href="https://davesgarden.com/guides/pf/go/58592/">https://davesgarden.com/guides/pf/go/58592/</a> . [Accessed 11 Sep 2019]	"Sun Exposure: Light Shade Partial to Full Shade"
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. Flora of New Zealand — Ferns and Lycophytes. Fascicle 11. Manaaki Whenua Press, Lincoln	[Occurs in forested, and presumably shaded, as well as more open sites] "Occurs under mānuka, tawa, pōhutukawa, podocarp, beech and broadleaved forest, or in second-growth forest, open scrub, on forest margins, and occasionally in dune hollows or open pasture. It often grows along creek banks, or on poorly-drained or swampy soil."
	Norton, D. A. (1991). Seedling and sapling distribution patterns in a coastal podocarp forest, Hokitika Ecological District, New Zealand. New Zealand Journal of Botany, 29 (4), 463-466	[Occurs in lower forest strata. Presumably shaded] "The forest canopy at the study site, at 15-20 m, is dominated by the podocarps <i>Dacrydium cupressinum</i> * and <i>Podocarpus totara</i> , and the angiosperm trees <i>Weinmannia racemosa</i> and <i>Elaeocarpus dentatus</i> . The canopies of many of the podocarp trees are severely windshom. <i>Hedycarya arborea</i> is dominant in the sulx:anopy, and tree ferns ( <i>Dicksonia squarrosa</i> and <i>Cyathea smithii</i> ) are abundant in the lower forest strata."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	<b>Source(s)</b>	<b>Notes</b>
	Richardson, S. J., & Walker, L. R. (2010). Nutrient ecology of ferns. Pp. 111-139 In: Mehltreter K., Walker L. R., & Sharpe, J. M. (eds.). Fern Ecology. Cambridge University Press, New York	"In a cool-temperate, New Zealand rain forest, the two most widespread tree fern species, <i>Cyathea smithii</i> (katote or soft tree fern) and <i>Dicksonia squarrosa</i> (wheki or rough tree fern), were present on soils ranging in total P from <5 g m <sup>-2</sup> to >180 g m <sup>-2</sup> , but stem density and basal area of both species were greater at higher total soil P, such that on fertile alluvial terraces (total soil P >50 g m <sup>-2</sup> ), tree ferns reached stem densities of 610 stems ha <sup>-1</sup> (Figs. 4.3, 4.4; Coomes et al., 2005)."
	New Zealand Plant Conservation Network. (2014). Flora Details - <i>Dicksonia squarrosa</i> . <a href="http://nzpcn.org.nz/flora_details.aspx?ID=1791">http://nzpcn.org.nz/flora_details.aspx?ID=1791</a> . [Accessed 10 Sep 2019]	"Tolerant of a wide range of situations and soil types."

411	Climbing or smothering growth habit	n
	<b>Source(s)</b>	<b>Notes</b>
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. Flora of New Zealand — Ferns and Lycophytes. Fascicle 11. Manaaki Whenua Press, Lincoln	"Rhizomes erect, forming a woody trunk up to 7 m tall, 90–200 mm diam., covered in dark brown hairs and persistent black stipe bases; forming aerial buds that sometimes grow out to form multiple trunks; bearing underground stolons and often forming extensive groves."

412	Forms dense thickets	y
-----	----------------------	---

Qsn #	Question	Answer
	Source(s)	Notes
	Richardson, S. J., & Walker, L. R. (2010). Nutrient ecology of ferns. Pp. 111-139 In: Mehltreter K., Walker L. R., & Sharpe, J. M. (eds.). Fern Ecology. Cambridge University Press, New York	"In a cool-temperate, New Zealand rain forest, the two most widespread tree fern species, <i>Cyathea smithii</i> (katote or soft tree fern) and <i>Dicksonia squarrosa</i> (wheki or rough tree fern), were present on soils ranging in total P from <5 g m <sup>-2</sup> to >180 g m <sup>-2</sup> , but stem density and basal area of both species were greater at higher total soil P, such that on fertile alluvial terraces (total soil P >50 g m <sup>-2</sup> ), tree ferns reached stem densities of 610 stems ha <sup>-1</sup> (Figs. 4.3, 4.4; Coomes et al., 2005)."
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. Flora of New Zealand — Ferns and Lycophytes. Fascicle 11. Manaaki Whenua Press, Lincoln	"It often grows along creek banks, or on poorly-drained or swampy soil. It frequently forms extensive groves; the dense shade, combined with the dead fronds that cover the ground, tends to discourage germination of any other species underneath the grove."
	Page, C., & Brownsey, P. (1986). Tree-Fern Skirts: A Defence Against Climbers and Large Epiphytes. <i>Journal of Ecology</i> , 74(3), 787-796	"Mature plants of <i>Dicksonia squarrosa</i> (Forst. f.) Sw. are characterized by somewhat untidy crowns that include a variable number of persistent, dead fronds according to exposure. Trunks of juvenile plants are often partially surrounded by fallen dead fronds, but those of older individuals growing up to 8 m high have little protection. The species has a quite different habit to other New Zealand tree-ferns in that it grows in thick groves as a result of its ability to produce buds on underground runners; the ground beneath such groves becomes densely littered with old fronds (Dobbie 1921; Pope 1924; Dobbie & Crookes 1951; Salmon 1980). In the absence of a pronounced skirt, this habit provides some protection against climbers. The thick groves cast a dense shade and the litter of fronds decays only slowly, creating an environment in which there is little opportunity for climbing plants to become established. However, the habit does not prevent the germination of epiphytes on the trunks of older trees, and <i>D. squarrosa</i> is one of the species which frequently supports large epiphytes."
	Brock, J. M., Perry, G. L., Lee, W. G., & Burns, B. R. (2016). Tree fern ecology in New Zealand: A model for southern temperate rainforests. <i>Forest Ecology and Management</i> , 375, 112-126	"The sheer depth of frond litter around tree fern stands, which can be up to 90 cm deep (Brock, Unpublished raw data), will suppress seedlings under tree fern canopies (Beveridge, 1973; Gillman et al., 2004); an absence of seedlings is particularly notable beneath <i>D. squarrosa</i> and <i>C. medullaris</i> , both of which can form dense stands or thickets (Fig. 2)."
	Walker, L. R., & Sharpe, J. M. (2010). Ferns, disturbance and succession. Pp. 177-219 In: Mehltreter K., Walker L. R., & Sharpe, J. M. (eds.). Fern Ecology. Cambridge University Press, New York	"Tree ferns can also greatly impact their light environments because of their height and long leaves. Frequent colonists of open areas such as the tree ferns <i>Dicksonia squarrosa</i> and <i>Cyathea smithii</i> can grow densely, reducing incident radiation by 44–51% in southern New Zealand (Coomes et al., 2005)."

501	Aquatic	n
	Source(s)	Notes
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. Flora of New Zealand — Ferns and Lycophytes. Fascicle 11. Manaaki Whenua Press, Lincoln	[Terrestrial] "Occurs under mānuka, tawa, pōhutukawa, podocarp, beech and broadleaved forest, or in second-growth forest, open scrub, on forest margins, and occasionally in dune hollows or open pasture. It often grows along creek banks, or on poorly-drained or swampy soil."

Qsn #	Question	Answer
502	Grass	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 10 Sep 2019]	Family: Dicksoniaceae

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 10 Sep 2019]	Family: Dicksoniaceae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. Flora of New Zealand — Ferns and Lycophytes. Fascicle 11. Manaaki Whenua Press, Lincoln	"Rhizomes erect, forming a woody trunk up to 7 m tall, 90–200 mm diam., covered in dark brown hairs and persistent black stipe bases; forming aerial buds that sometimes grow out to form multiple trunks; bearing underground stolons and often forming extensive groves."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	New Zealand Plant Conservation Network. (2014). Flora Details - <i>Dicksonia squarrosa</i> . <a href="http://nzpcn.org.nz/flora_details.aspx?ID=1791">http://nzpcn.org.nz/flora_details.aspx?ID=1791</a> . [Accessed 10 Sep 2019]	"Current Conservation Status 2012 - Not Threatened Previous Conservation Status 2009 - Not Threatened 2004 - Not Threatened"
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. Flora of New Zealand — Ferns and Lycophytes. Fascicle 11. Manaaki Whenua Press, Lincoln	[No evidence] "Distribution: North Island: Northland, Auckland, Volcanic Plateau, Gisborne, Taranaki, Southern North Island. South Island: Western Nelson, Sounds–Nelson, Marlborough, Westland, Canterbury, Otago, Fiordland, Southland. Three Kings Islands, Chatham Islands, Stewart Island. Altitudinal range: 0–900 m. <i>Dicksonia squarrosa</i> occurs throughout the North Island in coastal to montane forest. It grows from near sea-level to 860 m in the Kaweka and Ruahine ranges. In the South Island it is largely confined to coastal and lowland sites, but reaches 500 m near Haast, and 900 m at Jordan Stream, Marlborough."

Qsn #	Question	Answer
602	Produces viable seed	y
	Source(s)	Notes
	New Zealand Plant Conservation Network. (2014). Flora Details - <i>Dicksonia squarrosa</i> . <a href="http://nzpcn.org.nz/flora_details.aspx?ID=1791">http://nzpcn.org.nz/flora_details.aspx?ID=1791</a> . [Accessed 10 Sep 2019]	[Produces viable spores] "Fruiting - Not applicable - spore producing" ... "Easily grown from fresh spores, by division of plantlets and by transplanting the mature trunks."

603	Hybridizes naturally	
	Source(s)	Notes
	Shepherd, L. D., Brownsey, P. J., Stowe, C., Newell, C., & Perrie, L. R. (2019). Genetic and morphological identification of a recurrent <i>Dicksonia</i> tree fern hybrid in New Zealand. <i>PLoS One</i> , 14(5), e0216903	" <i>Dicksonia squarrosa</i> and <i>D. lanata</i> , which are widely sympatric and much more closely related to each other than either is to <i>D. fibrosa</i> [6], are not known to hybridise."
	Brownsey, P. J. & Perrie, L. R. (2015). <i>Dicksoniaceae</i> . In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. <i>Flora of New Zealand — Ferns and Lycophytes</i> . Fascicle 11. Manaaki Whenua Press, Lincoln	No hybrids reported

604	Self-compatible or apomictic	y
	Source(s)	Notes
	Stokey, A. G. (1918). Apogamy in the Cyatheaceae. <i>Botanical Gazette</i> , 65(1), 97-102	"The only case of obligate apogamy was found in a prothallium of <i>Dicksonia squarrosa</i> (Forst.) Sw. This prothallium had numerous antheridia and, although it was sufficiently large and had a well developed cushion, it had no archegonia. It produced two apogamous buds on the ventral side in the region where the archegonia usually appear (figs. 1, 2, 3). Behind one of the buds was a region where the thallus had thickened considerably and the outer cells had died. The presence of the characteristic cyatheoid antheridia makes it certain that this is not a polypod prothallium." ... " <i>D. squarrosa</i> sometimes produced embryos as the result of fertilization, but these were not found on prothallia which had archegonial projections." [Described as apogamous - capable of development of a sporophyte from a gametophyte without fertilization]

605	Requires specialist pollinators	n
	Source(s)	Notes

Qsn #	Question	Answer
	Stokey, A. G. (1918). Apogamy in the Cyatheaceae. Botanical Gazette, 65(1), 97-102	[Apogamous. Produces spores without fertilization, but requires water for gametophytes] "The only case of obligate apogamy was found in a prothallium of <i>Dicksonia squarrosa</i> (Forst.) Sw. This prothallium had numerous antheridia and, although it was sufficiently large and had a well developed cushion, it had no archegonia. It produced two apogamous buds on the ventral side in the region where the archegonia usually appear (figs. 1, 2, 3). Behind one of the buds was a region where the thallus had thickened considerably and the outer cells had died. The presence of the characteristic cyatheoid antheridia makes it certain that this is not a polypod prothallium." ... "D. squarrosa sometimes produced embryos as the result of fertilization, but these were not found on prothallia which had archegonial projections."

606	Reproduction by vegetative fragmentation	y
	Source(s)	Notes
	Dave's Garden. (2019). <i>Dicksonia</i> Species, Harsh Tree Fern, Rough Tree Fern, Wheki - <i>Dicksonia squarrosa</i> . <a href="https://davesgarden.com/guides/pf/go/58592/">https://davesgarden.com/guides/pf/go/58592/</a> . [Accessed 11 Sep 2019]	"On Sep 13, 2003, palmbob from Acton, CA (Zone 8b) wrote:" ... " It can sucker, which, to me is a little unusual for a tree fern."
	Robinson, R.C., Sheffield, E, & Sharpe, J.M. (2010). Problem ferns: their impact and management. Pp. 255–322 In: Mehltreter K., Walker L. R., & Sharpe, J. M. (eds.). Fern Ecology. Cambridge University Press, New York	"the clumping, colonial habit of <i>Dicksonia squarrosa</i> arises from its ability to reproduce vegetatively by runners arising from subterranean adventitious buds."

607	Minimum generative time (years)	
	Source(s)	Notes
	T.E.R:R.A.I.N. (2019). Rough Tree Fern ( <i>Dicksonia squarrosa</i> ). <a href="http://www.terrain.net.nz/">http://www.terrain.net.nz/</a> . [Accessed 11 Sep 2019]	"It has a fast growth rate of up to 10 cm (5 in) a year, growing up to 6 m tall. " [Time to maturity unspecified]
	Brock, J. M., Perry, G. L., Lee, W. G., & Burns, B. R. (2016). Tree fern ecology in New Zealand: A model for southern temperate rainforests. <i>Forest Ecology and Management</i> , 375, 112-126	"Table 2.4 Growth rates (cm yr <sup>-1</sup> ) of tree fern species from demographic studies, North Island of New Zealand." [ <i>Dicksonia squarrosa</i> - 4.8 (4.3–5.4) cm yr <sup>-1</sup> to 18.5 ± 2.9 cm yr <sup>-1</sup> in Podocarp broadleaved forest]

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	Source(s)	Notes
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. Flora of New Zealand — Ferns and Lycophytes. Fascicle 11. Manaaki Whenua Press, Lincoln	[Unknown, but small spores could possibly be moved by human activity in soil] "Occurs under mānuka, tawa, pōhutukawa, podocarp, beech and broadleaved forest, or in second-growth forest, open scrub, on forest margins, and occasionally in dune hollows or open pasture. It often grows along creek banks, or on poorly-drained or swampy soil."

702	Propagules dispersed intentionally by people	y
-----	--	---

Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"Dicksonia L'Heritier is a genus of about 25 species from temperate South Pacific and tropical America." ... "At least five species are grown in Hawai'i," [Includes <i>Dicksonia squarrosa</i> ]
	Dave's Garden. (2019). <i>Dicksonia</i> Species, Harsh Tree Fern, Rough Tree Fern, Wheki - <i>Dicksonia squarrosa</i> . <a href="https://davesgarden.com/guides/pf/go/58592/">https://davesgarden.com/guides/pf/go/58592/</a> . [Accessed 11 Sep 2019]	"This plant has been said to grow in the following regions: Eureka, California Mckinleyville, California Thousand Oaks, California Portland, Oregon"
	New Zealand Plant Conservation Network. (2014). Flora Details - <i>Dicksonia squarrosa</i> . <a href="http://nzpcn.org.nz/flora_details.aspx?ID=1791">http://nzpcn.org.nz/flora_details.aspx?ID=1791</a> . [Accessed 10 Sep 2019]	"Where To Buy - Commonly available from mainstream and specialist native plant nurseries."
	Bezona, N., Rauch, F. D., & Iwata, R. Y. 1994. Tree ferns for Hawai'i gardens. Research Extension Series 144. CTAHR,, University of Hawaii, Honolulu, HI	[Promoted for cultivation in the Hawaiian Islands] "This is a medium-sized tree fern, growing up to 20 feet high, with a slender, black trunk clothed with leaf bases. The crown has fronds which are nearly horizontal, growing to 8 feet long, and are dull, dark green in color. They are stiff, leathery, and harsh to the touch. The fronds are on black-brown stalks which are clothed by long, brown, stiff hairs when young. This fern prefers cool, moist conditions with filtered shade."

703	Propagules likely to disperse as a produce contaminant	
	<b>Source(s)</b>	<b>Notes</b>
	WRA Specialist. (2019). Personal Communication	Unknown, but it may be possible that spores become contaminants of pots or other planting media

704	Propagules adapted to wind dispersal	y
	<b>Source(s)</b>	<b>Notes</b>
	Brock, J. M., Perry, G. L., Lee, W. G., & Burns, B. R. (2016). Tree fern ecology in New Zealand: A model for southern temperate rainforests. <i>Forest Ecology and Management</i> , 375, 112-126	"Tree fern sporophytes produce abundant small spores that are readily wind dispersed"

705	Propagules water dispersed	y
	<b>Source(s)</b>	<b>Notes</b>
	Brownsey, P. J. & Perrie, L. R. (2015). Dicksoniaceae. In: Breitwieser, I.; Heenan, P. B.; Wilton, A. D. <i>Flora of New Zealand — Ferns and Lycophytes</i> . Fascicle 11. Manaaki Whenua Press, Lincoln	"It often grows along creek banks, or on poorly-drained or swampy soil." [Presence along creek banks suggests that water, in addition to wind, is likely responsible for dispersal of spores]

Qsn #	Question	Answer
706	<b>Propagules bird dispersed</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	Brock, J. M., Perry, G. L., Lee, W. G., & Burns, B. R. (2016). Tree fern ecology in New Zealand: A model for southern temperate rainforests. <i>Forest Ecology and Management</i> , 375, 112-126	"Tree fern sporophytes produce abundant small spores that are readily wind dispersed" [Although spores may potentially adhere to bird feet or feathers, the primary vector of dispersal is wind]

707	<b>Propagules dispersed by other animals (externally)</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	Brock, J. M., Perry, G. L., Lee, W. G., & Burns, B. R. (2016). Tree fern ecology in New Zealand: A model for southern temperate rainforests. <i>Forest Ecology and Management</i> , 375, 112-126	"Tree fern sporophytes produce abundant small spores that are readily wind dispersed" [Possibly, but unlikely. Although spores may potentially adhere to animal fur or feet, the primary vector of dispersal is wind]

708	<b>Propagules survive passage through the gut</b>	
	<b>Source(s)</b>	<b>Notes</b>
	WRA Specialist. (2019). Personal Communication	Unknown if consumption of fern fronds results in passage of viable spores

801	<b>Prolific seed production (&gt;1000/m2)</b>	y
	<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. <i>Plant Protection Quarterly</i> , 25(2): 56-74	"Assume 'yes' for fern taxa unless contradictory evidence exists."

802	<b>Evidence that a persistent propagule bank is formed (&gt;1 yr)</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Overdyck, E., & Clarkson, B. D. (2012). Seed rain and soil seed banks limit native regeneration within urban forest restoration plantings in Hamilton City, New Zealand. <i>New Zealand Journal of Ecology</i> , 36(2): 177-190	"Appendix 2. Species classified as persistent in soil seed banks for urban (planted and natural, n = 13) or rural (natural, n = 4) forest types: closed circle (●) persistent >10 seeds difference in soil seed bank than annual seed rain, at one or more sites;" [ <i>Dicksonia squarrosa</i> classified as persistent in urban and rural spore bank. Longevity unspecified]

803	<b>Well controlled by herbicides</b>	
	<b>Source(s)</b>	<b>Notes</b>
	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	[Methods to control <i>Sphaeropteris cooperi</i> may be effective on <i>D. squarrosa</i> ] "Australian tree fern was susceptible to sprays of concentrates of dicamba and of 2,4-D directly on the stem terminals. Triclopyr was not as effective(50)."

Qsn #	Question	Answer
	Arosa, M. L., Ceia, R. S., Quintanilla, L. G., & Ramos, J. A. 2012. The tree fern <i>Dicksonia antarctica</i> invades two habitats of European conservation priority in São Miguel Island, Azores. <i>Biological Invasions</i> , 14(7): 1317-1323	[Unknown, but chemical methods used on other tree fern species may be effective] "As far as we know our study is the first to report invasive <i>D. antarctica</i> and therefore control methods have not been tested. Next step could be to test on this species the physical and chemical methods successfully used for <i>S. cooperi</i> (Motooka et al. 2003), another Australian tree fern."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	Ogden, J., Braggins, J., Stretton, K., & Anderson, S. (1997). Plant species richness under <i>Pinus radiata</i> stands on the central North Island volcanic plateau, New Zealand. <i>New Zealand Journal of Ecology</i> , 21(1), 17-29	[May resprout after clearing for pine plantations] "Seedlings and juveniles of <i>Dicksonia squarrosa</i> were present in the youngest stand (6 years). The juveniles were probably derived vegetatively from trunks not killed by the logging and silvicultural treatments, but the seedlings were probably mostly derived from gametophytes."
	Brock, J. M., Perry, G. L., Lee, W. G., & Burns, B. R. (2016). Tree fern ecology in New Zealand: A model for southern temperate rainforests. <i>Forest Ecology and Management</i> , 375, 112-126	[Resprouts after damage] " <i>C. colensoi</i> and <i>D. squarrosa</i> are susceptible to browsing by ungulates, and where these herbivores are abundant, tree ferns may die off (Veblen and Stewart, 1980; Mark et al., 1991; Wardle, 1991). However, <i>D. squarrosa</i> can resprout after disturbance (Martin and Ogden, 2006; Smale et al., 2008), which provides it with an advantage over the other tree fern species."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. (2019). Personal Communication	Unknown



**Summary of Risk Traits:**

High Risk / Undesirable Traits

- Able to grow, and potentially invade, regions with cool, subtropical climates
- Naturalizing in Volcano, Hawaii (Hawaiian Islands)
- Reported to be aggressive in gardens, needing room to spread
- A native pasture weed in New Zealand
- Other *Dicksonia* species are invasive
- Potentially allelopathic
- Reported to be highly flammable; may increase fire risk in drier areas
- Shade tolerant (can establish under intact forest)
- Tolerates many soil types
- Forms dense stands and excludes other vegetation in native range
- Reproduces by spores and apogamous gametophytes (requiring no fertilization)
- Spreads vegetatively by underground runners
- Seeds dispersed by wind, water, and intentional cultivation
- Prolific spore production
- May form a persistent spore bank
- Tolerates and will resprout after cutting or browsing damage

Low Risk Traits

- May primarily threaten cooler, higher elevations of the Hawaiian Islands and other tropical island ecosystems
- Unarmed (no spines, thorns, or burrs)
- Palatable to ungulates and other browsing animals
- Non-toxic