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FERNS AND LYCOPHYTES

GLEICHENIACEAE



L.R. PERRIE & P.J. BROWNSEY

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Cover image: *Sticherus cunninghamii*. Frond, showing β costae with costal segments.

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Introduction

The family Gleicheniaceae is represented in New Zealand by three native genera (*Dicranopteris*, *Gleichenia*, and *Sticherus*) with collectively nine species, of which two are endemic. These genera have a distinctive morphology with pinnae that branch pseudodichotomously and which may extend indeterminately from buds between the pseudodichotomies. They are also all terrestrial plants with creeping rhizomes and exindusiate sori with few (2–20) sporangia. These genera can be distinguished from one another by their frond architecture, the number of sori per segment, the number of sporangia per sorus, venation patterns, and indumentum, which can be scaly or hairy. The single species of *Dicranopteris* in New Zealand is restricted to geothermal areas in the central North Island. The four species of *Gleichenia* are widespread, albeit less frequent in the east, and the endemic *G. inclusisora* is less common than the others. In *Sticherus*, the endemic *S. cunninghamii* is widespread and common, but more so in the west. Of the other *Sticherus* species in New Zealand, *S. flabellatus* is restricted to the northern North Island, and the other two are very uncommon in the western South Island. All of the non-endemic New Zealand species also occur in Australia, and several extend further afield. Of these, *D. linearis* and *G. dicarpa* are in particular need of taxonomic revision.

Gleicheniaceae C.Presl, *Reliq. Haenk.* 1, 70 (1825)

Terrestrial ferns. Rhizomes creeping, scaly or hairy. Fronds monomorphic, not articulated to rhizome, of determinate (not NZ) or indeterminate growth (NZ) in adults. Stipes scaly or hairy, but often glabrescent. Rachis with pinnate lamina (not NZ), or absent with a single pair of pinnae (not NZ), or reduced to a bud at the apex of the stipe with a single pair of pinnae (NZ); rachis buds sometimes extending to produce another tier comprising a rachis terminating in another rachis bud and pair of pinnae. Pinnae unforked or forking pseudodichotomously 1-several times; buds at bifurcations sometimes extending 1-several times. Veins free. Sporangia in sori; exindusiate. Sporangia with oblique annulus and \pm defined stomium; maturing \pm simultaneously; 128–1000 spores per sporangium. Homosporous; spores monolete or trilete, plain or rugulate, sometimes perforate or rarely reticulate, lacking chlorophyll.

Taxonomy: A family of six genera and about 140 species.

Allan (1961) placed New Zealand plants now attributed to *Dicranopteris*, *Gleichenia*, and *Sticherus* into a broadly-circumscribed *Gleichenia*. Recent treatments generally accept six genera in the Gleicheniaceae, encompassing the New Caledonian endemic *Stromatopteris* and segregating the neotropical *Gleichenella* from *Dicranopteris* (Smith et al. 2006; Christenhusz et al. 2011).

Stromatopteris is apparently most closely related to *Gleichenia* and *Sticherus* (Schuettpehl & Pryer 2007), rendering untenable the recognition of *Stromatopteris* as one of two subfamilies (Kramer 1990).

- 1 Ultimate segments <3 mm long, bearing no more than one sorus each; ultimate leaflets arranged pinnately on β costae *Gleichenia*
Ultimate segments >4 mm long, bearing >2 sori each; ultimate leaflets branched pseudodichotomously from β costae 2
- 2 Axes subtending the pseudodichotomously-branched ultimate leaflets (i.e., the β costae) lacking costal segments; 7–12 sporangia per sorus; ultimate segments with veins between midvein and margin branched more than once; scales absent from lamina and rhizome *Dicranopteris*
Axes subtending the pseudodichotomously-branched ultimate leaflets (i.e., the β costae) bearing costal segments; 3–5 sporangia per sorus; ultimate segments with veins between midvein and margin branched only once; scales present, always evident on rhizome, but sometimes hair-like on lamina *Sticherus*

Distribution: Distributed throughout tropical and subtropical regions, extending also into southern temperate regions. Three genera and at least nine species in New Zealand; two species endemic.

Biostatus: Indigenous (Non-endemic).

Table 1: Number of species and named hybrids in New Zealand within *Gleicheniaceae* C.Presl

Category	Number
Indigenous (Endemic)	2
Indigenous (Non-endemic)	8
Total	10

Recognition: The frond architecture of Gleicheniaceae is strikingly different to all other fern families. Most Gleicheniaceae have a rachis of indeterminate growth (often confined, at least initially, to a resting bud) and pinnae that branch pseudodichotomously and which may extend indeterminately from buds between the pseudodichotomies. *Stromatopteris* is a notable exception to these characters, while *Diplopterygium* lacks the pseudodichotomous branching of the pinnae. The family is also characterised by exindusiate sori of few (2–20) sporangia.

Notes: The terminology of Shaw & Ranker (2011) is used to describe the often pseudodichotomously-branching and indeterminate frond architecture in the Gleicheniaceae; the most pertinent terms for characterising the New Zealand taxa are described below (also see Figs. 2, 4, 6).

The distal, or outer-most, axes of the frond are termed α costae; moving progressively inwards towards the stipe are β costae, γ costae, δ costae, etc. We have used *proximal-most costa* to refer to the axis that connects each pinna to the central stipe/rachis axis; the proximal-most costa may be an α , β , γ , δ , etc. costa, depending on how divided the pinna is.

The smallest units of the lamina are termed *ultimate segments* (on α costae) or *costal segments* (on other costae). The ultimate segments of *Gleichenia* measure c. 1–2 mm long, 1–2 mm wide, whereas

those of *Dicranopteris* and *Sticherus* are larger, 5–55 mm long, 1–4.5 mm wide, and distinctly oblong or linear. Ultimate segments are borne pinnatisectly on an α costa; an α costa with its ultimate segments comprises an *ultimate leaflet*. *Gleichenia* differs significantly in its frond architecture from the other genera in New Zealand in that its ultimate leaflets are arranged pinnately on a β costa (or a γ costa etc.); in *Dicranopteris* and *Sticherus*, the ultimate leaflets branch pseudodichotomously from the distal end of a β costa. *Costal segments* are like ultimate segments but borne on axes other than an α costa. Costal segments are absent from *Dicranopteris* (except those subtending a rachis or pinna bud) and *Gleichenia*, but are borne pinnatisectly on β costae, γ costae, etc. in *Sticherus*.

In many species of Gleicheniaceae the rachis initially comprises only a bud, situated at the apex of the stipe and flanked by a pair of pinnae. This *rachis bud* may be subtended by *pseudostipules* and/or *accessory leaflets*. A pseudostipule resembles an ultimate segment. An accessory leaflet resembles an ultimate leaflet, or can be even more divided. In New Zealand, *Gleichenia* may have accessory leaflets that are often proximally branched, *Sticherus* may have pseudostipules that may be proximally branched or lobed, and *Dicranopteris* has an accessory leaflet paired with a costal segment.



Fig. 1: *Dicranopteris linearis*. In *Dicranopteris* the β costae lack costal segments.

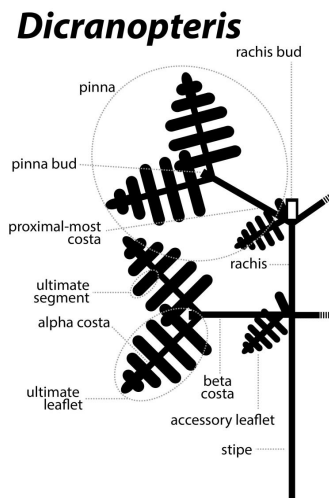


Fig. 2: Terminology of Gleicheniaceae frond architecture: *Dicranopteris*.



Fig. 3: *Gleichenia microphylla*. In *Gleichenia* the ultimate segments are small, and the ultimate leaflets are arranged pinnately on β costae.

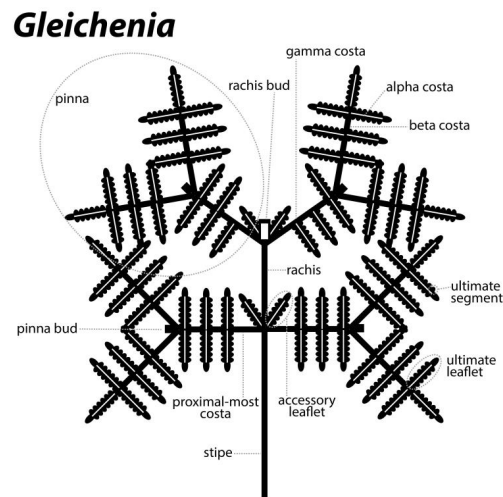


Fig. 4: Terminology of Gleicheniaceae frond architecture: *Gleichenia*.



Fig. 5: *Sticherus cunninghamii*. In *Sticherus* the β costae bear costal segments.

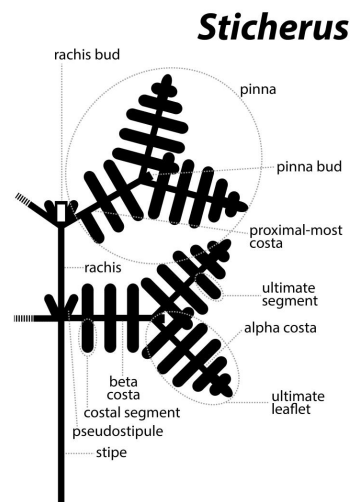


Fig. 6: Terminology of Gleicheniaceae frond architecture: *Sticherus*.

***Dicranopteris* Bernh., Neues J. Bot. 1(2): 38 (1805)**

= *Mertensia* Willd., Kongl. Vetensk. Acad. Nya Handl. 25: 165 (1804) nom. illeg. non *Mertensia* Roth 1797

Type taxon: *Dicranopteris dichotoma* (Thunb.) Bernh. = *Dicranopteris linearis* (Burm.f.) Underw.

Etymology: From the Greek *dikranos* (two-branched), and *pterus* (a fern), a reference to the dichotomous branching pattern.

Terrestrial ferns. Rhizomes long-creeping, hairy. Stipes hairy or glabrescent. Rachis reduced to a bud at the apex of the stipe with a single pair of pinnae; rachis buds sometimes extending to produce another tier comprising a rachis terminating in another rachis bud and pair of pinnae. Pinnae unforked, being equivalent to a single ultimate leaflet (rarely NZ), or forking pseudodichotomously 1–2 times; buds at bifurcations sometimes extending once. Laminae, axes, and rachis and pinna buds hairy, these hairs sometimes branched, scales absent. β costae lacking costal segments. α costae of the ultimate leaflets arising pseudodichotomously from distal end of β costae. Ultimate segments on α costa >10 mm long, oblong, entire, with veins branching two or more times between midvein and margin. Sori superficial, 6–20 either side of midvein, each with 7–12 sporangia. Spores trilete, radially symmetrical, plain or shallowly rugulate.

Taxonomy: A genus of 10–20 species. Species limits are poorly defined, with the widespread *Dicranopteris linearis* particularly problematic.

Allan (1961) included *Dicranopteris* in a broadly-circumscribed *Gleichenia*. The nomenclatural history of *Dicranopteris* was detailed by Pichi Sermolli (1972). *Dicranopteris* Bernh. is a replacement name for *Mertensia* Willd., a later homonym of *Mertensia* Roth (Boraginaceae). Bernhardt (1805) lectotypified *Mertensia* Willd. (and *Dicranopteris* by extension) by including in his new genus only one of the species from Willdenow's genus, *M. dichotoma* (Thunb.) Willd. (\equiv *Polypodium dichotomum* Thunb. \equiv *D. dichotoma* (Thunb.) Bernh.).

Distribution: Ten to twenty species distributed throughout the tropics and subtropics, extending to southern temperate Australia and New Zealand; about three to five species in each of America (Mickel & Smith 2004), Africa and neighbouring islands (Roux 2009), India (Fraser-Jenkins 2009), China and Japan (Xiaofeng et al. 2013), Malesia (Holttum 1959), and the Pacific (Minagawa & Kuratsuji 2008), with one in Australia (Chinnock & Bell 1998). One non-endemic species in New Zealand.

Biostatus: Indigenous (Non-endemic).

Table 2: Number of species in New Zealand within *Dicranopteris* Bernh.

Category	Number
Indigenous (Non-endemic)	1
Total	1

Recognition: *Dicranopteris* can be distinguished from the superficially-similar *Sticherus* by the absence of lamina on the axes subtending the pseudodichotomously-paired ultimate leaflets; that is,

Dicranopteris has no costal segments on the β costae, whereas *Sticherus* does. The ultimate segments of *Dicranopteris* are at least 11 mm in length, in contrast to *Gleichenia*, which has ultimate segments less than 3 mm long. In New Zealand, *Dicranopteris* is only found in geothermal areas of the central North Island.

Cytology: The base chromosome number in *Dicranopteris* is $x = 39$ (Kramer 1990).

Notes: Holttum (1957, p.170) pointed out that the hairs of *Dicranopteris* are often branched, particularly at the base, which may be “rather massive, not hair like”. Nevertheless, the ‘hairs’ of *Dicranopteris* are markedly different from the scales and other indumentum found in *Gleichenia* and *Sticherus*, and this terminological convention is widely followed.

***Dicranopteris linearis* (Burm.f.) Underw., *Bull. Torrey Bot. Club* 34: 250 (1907)**

≡ *Polypodium lineare* Burm.f., *Fl. Indica*, 235, t. 67, f. 2 (1768)

≡ *Gleichenia linearis* (Burm.f.) C.B. Clarke, *Trans. Linn. Soc. London, Bot. Series* 2, 1: 428 (1880)

≡ *Mertensia linearis* (Burm.f.) Fritsch, *Bull. Herb. Boissier* Série 2, 1: 1092 (1901)

Holotype (?): Java, *H. van Santen s.n.*, Herb. Delessert, G 00360111 (image!)

= *Polypodium dichotomum* Thunb. in Murray, *Syst. Veg.*, ed. 14, 938 (1784)

≡ *Mertensia dichotoma* (Thunb.) Willd., *Kongl. Vetensk. Acad. Nya Handl.* 25: 167 (1804)

≡ *Dicranopteris dichotoma* (Thunb.) Bernh., *Neues J. Bot.* 1(2): 38 (1805)

≡ *Gleichenia dichotoma* (Thunb.) Hook., *Sp. Fil.* 1, 12 (1844)

Holotype (?): Sida San, [Kosida Mts, near Nagasaki,] Japan, *C.P. Thunberg s.n.*, UPS Thunb. 25245 (online!)

= *Gleichenia hermannii* R.Br., *Prodr. Fl. Nov. Holland.*, 161 (1810) — as *G. hermannii*

≡ *Mertensia hermannii* (R.Br.) Poir., *Encycl. Suppl.* 3, 670 (1814)

≡ *Dicranopteris hermannii* (R.Br.) Nakai, *Bull. Natl. Sci. Mus.* 29: 60 (1950)

Lectotype (designated by Perrie & Brownsey 2015): Shoalwater Bay passage, [Queensland,] *R. Brown Iter Austral.* 111, BM 001038294!

Etymology: From the Latin *linearis* (narrow and parallel-sided), a reference to the shape of the ultimate segments.

Rhizomes long-creeping, 1.5–3.5 mm diameter; rhizome hairs red-brown, often clustered only around apices and stipe bases or occasionally densely clothing rhizome. Fronds 140–1220 mm long. Stipes 55–960 mm long, glabrous. Laminae 90–660 mm long, 110–380 mm wide, adaxially green, abaxially usually glaucous (rarely \pm green), herbaceous, hairy. Rachis bud sometimes extending once (rarely twice), hairy; rachis bud hairs red-brown, 1.2–2.5 mm long; pseudostipulate with each flanking branch bearing an accessory leaflet. Pinnae 100–350 mm long, 45–320 mm wide; with 1 (occasionally 2, with penultimate fork then pseudostipulate like the rachis bud, rarely 0) pseudodichotomous fork (excluding growth from pinna buds); pinna buds not extending or rarely extending once. Proximal-most (primary) costae 10–60 mm long, to 105 mm long in pinnae with 2 pseudodichotomous forks, lacking costal segments (excluding pseudostipules). Ultimate leaflets narrowly ovate, rarely narrowly elliptic, 90–300 mm long, 22–75 mm wide, usually angustate, rarely caudate; with 25–54 pairs of ultimate segments. Abaxial surface of α costae with red-brown branched hairs proximally, otherwise glabrous. Ultimate segments narrowly oblong, 11–42 mm long, 2–4.5 mm wide, arising at 80–85° from α costae, entire, emarginate; abaxial surface with red-brown branched hairs usually restricted to proximal part of midvein, otherwise glabrous; red-brown glands present on veins, 15–40 μ m long. Sori 6–20 either side of midvein, with 7–12 sporangia each. Spores 25–27 μ m long, c. 27–35 μ m wide (2 samples).

Distribution: North Island: Volcanic Plateau.

Altitudinal range: 20–500 m.

Dicranopteris linearis is confined in New Zealand to geothermal areas, largely between Lake Taupō and the Rotorua lakes, but with a few populations also between Kawerau and Whakatāne. It extends from about 20 m above sea level near Whakatāne to near 500 m between Rotorua and Taupō. It has not been recorded from the Kermadec Islands.

Also tropical Africa, tropical Asia, New Guinea, Australia (Western Australia, Northern Territory, Queensland, New South Wales), Solomon Islands, Vanuatu, New Caledonia, Fiji, Samoa, Tonga, Cook Islands, French Polynesia, Pitcairn Island, Hawaiian Islands.

Biostatus: Indigenous (Non-endemic).

Habitat: *Dicranopteris linearis* is confined in New Zealand to geothermal areas, often around active vents. It often occurs amongst *Kunzea* scrub, with *Nephrolepis flexuosa*, *Christella dentata*, and/or *Gleichenia* spp. It can be locally common.

Recognition: *Dicranopteris linearis* is the only species of *Dicranopteris* in New Zealand. Species of *Sticherus* are superficially similar but are distinguished by the presence of costal segments on the β costae; *Dicranopteris* has none.

Cytology: $2n = c. 160$ (de Lange et al. 2004). This is consistent with tetraploid counts of *Dicranopteris linearis* from India, Sri Lanka and New Guinea; diploid counts have also been obtained from these other areas (see Löve et al. 1977).

Notes: Numerous varieties of *Dicranopteris linearis* have been recognised elsewhere; 13 in Malaysia (Holttum 1959), three in Australia (Chinnock & Bell 1998).

The minute glands noted by Chinnock & Bell (1998) on the abaxial surface of the laminae of Australian plants they called *Dicranopteris linearis* var. *linearis* also occur in New Zealand plants, as well as material from New Guinea, Solomon Islands, Vanuatu, New Caledonia, Fiji, Tonga, Cook Islands, French Polynesia, Pitcairn Island, and Hawaiian Islands.

In contrast, the Australian lectotype of *Gleichenia hermannii* R.Br. (= *Dicranopteris linearis*) has very few red-brown glands on the abaxial surface of the laminae. Furthermore, the protologue of Brown (1810) states "...pinnis linearibus integerrimis obtusis,...". The apices of the ultimate segments of the lectotype are a mixture of obtuse and emarginate, whereas New Zealand material is much more regularly emarginate.

WELT P005357 (Rotomahana, *E. Craig* s.n.) is unusual in that hairs are abundant over the abaxial surface of the lamina and the minute glands are absent or obscured. It thus resembles other taxa, such as *D. caudata* (Copel.) H.St.John from Fiji.

Satisfactory measurements of spore size could not be obtained from New Zealand material in AK, CHR, or WELT; normal spore development may be uncommon in New Zealand. However, the few spores observed are considerably smaller than those of *Gleichenia*, consistent with the findings of Large & Braggins (1991).

Bartholomew et al. (1997) pointed out that Carl Thunberg's names in Johan Murray's *Systema vegetabilium* of 1784 should be attributed to Thunberg. The correct author citation for *Polypodium dichotomum* is therefore "Thunb." and not "Thunb. ex Murray".

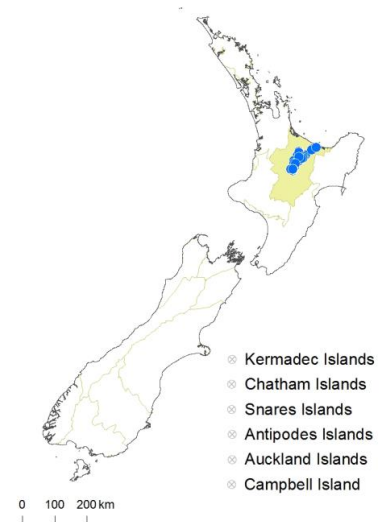


Fig. 7: *Dicranopteris linearis* distribution map based on databased records at AK, CHR and WELT.



Fig. 8: *Dicranopteris linearis*. Frond showing β costae lacking costal segments, and with pseudostipules and accessory leaflets around the rachis bud.



Fig. 9: *Dicranopteris linearis*. Frond showing β costae lacking costal segments.



Fig. 10: *Dicranopteris linearis*. Young, unfurling frond with pinnae each with two successive pseudodichotomous forks, showing β and γ costae lacking costal segments.



Fig. 11: *Dicranopteris linearis*. Frond with pinnae each with two successive pseudodichotomous forks.



Fig. 12: *Dicranopteris linearis*. Habit.



Fig. 13: *Dicranopteris linearis*. Open geothermal habitat.



Fig. 14: *Dicranopteris linearis*. Habit, and habitat under geothermal scrub.



Fig. 15: *Dicranopteris linearis*. Unfurling rachis.

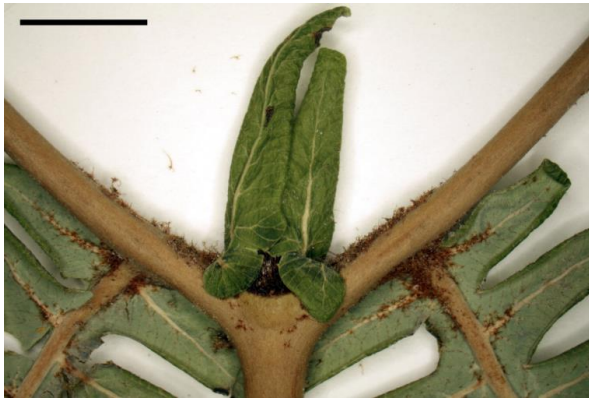


Fig. 16: *Dicranopteris linearis*. Rachis bud with pseudostipules and bases of accessory leaflets. WELT P020860. Scale bar = 5 mm.



Fig. 17: *Dicranopteris linearis*. Pinna bud with indumentum of hairs. WELT P020860. Scale bar = 2 mm.



Fig. 18: *Dicranopteris linearis*. Ultimate segments, showing colour difference between abaxial and adaxial surfaces, sori, forked venation, and emarginate apices.

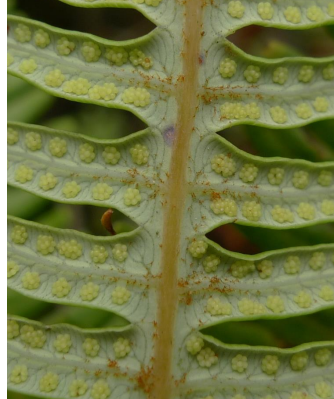


Fig. 19: *Dicranopteris linearis*. Abaxial surface of ultimate segments, with sori, and red hairs on proximal part of midvein.



Fig. 20: *Dicranopteris linearis*. Red-brown branched hairs on proximal part of midvein of ultimate segment. WELT P020860. Scale bar = 1 mm.



Fig. 21: *Dicranopteris linearis*. Veins of ultimate segments branching at least twice between midvein and margin, and bearing red-brown glands. WELT P020860. Scale bar = 0.5 mm.

***Gleichenia* Sm., *Mém. Acad. Roy. Sci. (Turin)* 5: 419, t. 9, fig. 10 (1793), nom. cons.**

= *Calymella* C.Presl, *Tent. Pterid.*, 48, t. 1(3) (1836)

= *Gleicheniastrum* C.Presl, *Gefässbündel Farn*, 30 (1847)

Type taxon: *Gleichenia polypodioides* (L.) Sm.

Etymology: Named in honour of F.W. Gleichen (1717-83), German amateur naturalist.

Vernacular name: tangle fern

Terrestrial ferns. Rhizomes long-creeping, scaly. Stipes scaly or glabrescent. Rachis with pinnate lamina (not NZ), or absent with a single pair of pinnae (not NZ), or reduced to a bud at the apex of the stipe with a single pair of pinnae (NZ); rachis buds sometimes extending to produce another tier comprising a rachis terminating in another rachis bud and pair of pinnae. Pinnae unforked, comprising a β costa with ultimate leaflets (occasionally NZ), or forking pseudodichotomously 1 to several times (NZ); buds at bifurcations sometimes extending 1-several times. Laminae, axes, and rachis and pinna buds bearing scales, sometimes hair-like. β costae bearing ultimate leaflets. α costae of the ultimate leaflets arranged pinnately on β costae. Ultimate segments on α costa <3 mm long, \pm square or ovate, entire, with simple (and obscured) veins between midvein and margin. Sori superficial or embedded in lamina, one on each ultimate segment, each with 2–5 sporangia. Spores trilete, radially symmetrical, plain or shallowly rugulate.

Taxonomy: A genus of at least 12 species.

Allan (1961) included species now attributed to *Dicranopteris* and *Sticherus* in a broadly-circumscribed *Gleichenia*. Recent treatments generally accept *Dicranopteris* and *Sticherus* as separate genera and a narrowly-circumscribed *Gleichenia* (Smith et al. 2006; Christenhusz et al. 2011). The nomenclatural history of *Gleichenia* was detailed by Pichi Sermolli (1972).

- 1 Sori embedded to more than half their height in conspicuous pits within abaxial surface of laminae; scales on abaxial surface of laminae \pm orbicular *inclusisora*
- Sori \pm superficial on abaxial surface of laminae; scales on abaxial side of laminae ovate or stellate (with hair-like branches) but not orbicular 2

-
- 2 Scales on abaxial surface of α costae not percurrent (i.e., not extending to its apex); abaxial surface of ultimate segments glabrous 3
 Scales on abaxial surface of α costae percurrent (i.e., extending to its apex); abaxial surface of ultimate segments usually with minute, branched, hair-like scales 4
- 3 Ultimate segments green on abaxial surface, complanate or recurved but not pouched, with at least some apices cuspidate (\pm triangular); most sori with >2 sporangia; indumentum of abaxial surface of β costae dominated by stellate scales with stiffly patent branches, along with some ovate scales *microphylla*
 Ultimate segments white or glaucous on abaxial surface, recurved or pouched, with rounded apices; most or all sori with 2 sporangia; indumentum of abaxial surface of β costae comprising an intergrading mix of ovate scales and stellate scales with patent or curled branches *dicarpa*
 Not with either of the above combinations of character states (e.g., ultimate segments with glaucous abaxial surfaces and \pm complanate; ultimate segments pouched and indumentum of abaxial surface of β costae dominated by stellate scales with stiffly patent branches) *xpunctulata*
- 4 β costae lacking stellate scales with patent branches, 11–73 mm long, with 4–14 pairs of ultimate leaflets; adaxial surface of ultimate segments strongly convex; pinna buds usually extending, often more than once; pinnae with 0–1 (rarely 2) pseudodichotomous forks (excluding growth from pinna buds) *alpina*
 β costae bearing stellate scales with patent branches on abaxial and/or adaxial surfaces (branches curled in Chatham Islands' plants), 29–230 mm long, with 7–50 pairs of ultimate leaflets; adaxial surface of ultimate segments complanate or weakly convex; pinna buds occasionally extending but rarely more than once; pinnae with 1–4 (rarely 0 or 5) pseudodichotomous forks (excluding growth from pinna buds) *dicarpa*

Distribution: At least 12 species distributed in the Old World tropics and temperate regions, extending from southern Africa, through south-east Asia to Australia, New Zealand and New Caledonia (Perrie et al. 2012); three species in Africa and islands of the western Indian Ocean, four in south-east Asia, six in Australia, one in Solomon Islands, and one in New Caledonia. Four species in New Zealand; one endemic.

Biostatus: Indigenous (Non-endemic).

Table 3: Number of species and named hybrids in New Zealand within *Gleichenia* Sm.

Category	Number
Indigenous (Endemic)	1
Indigenous (Non-endemic)	4
Total	5

Recognition: In New Zealand, the ultimate segments less than 3 mm in length distinguish *Gleichenia* from *Dicranopteris* and *Sticherus* which have ultimate segments at least 5 mm long.

Cytology: The base chromosome number in *Gleichenia* is $x = 20$ or 22 (Kramer 1990).

Notes: In relation to the measurements reported here for the trilete spores of *Gleichenia*, “length” is the longest of the three distances between the (three visible) corners and the midpoint of their respective opposite face, and “width” is the length of that face.

Morphological intermediates occur amongst New Zealand's *Gleichenia*, combining character states that would otherwise characterise different species and/or exhibiting intermediate character states. Such plants do not appear to have the abnormally-formed spores that characterise many (but not all) fern hybrids. Nevertheless, these morphologically intermediate plants are treated here as putative hybrids, and they are particularly common between *G. dicarpa* and *G. microphylla* (see *G. xpunctulata*).



Fig. 22: Abaxial surfaces of ultimate leaflets (with α costae). *Gleichenia alpina* (WELT P026753) at left; *G. dicarpa* (WELT P026797) at right. Scale bar = 2 mm.

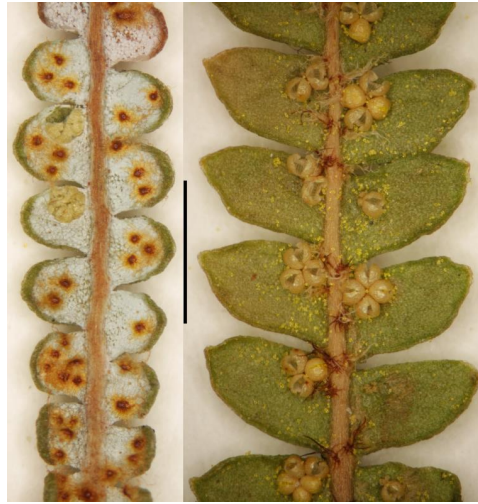


Fig. 23: Abaxial surfaces of ultimate leaflets (with α costae). *Gleichenia inclusisora* (WELT P023659) at left; *G. microphylla* (WELT P026729) at right. Scale bar = 2 mm.

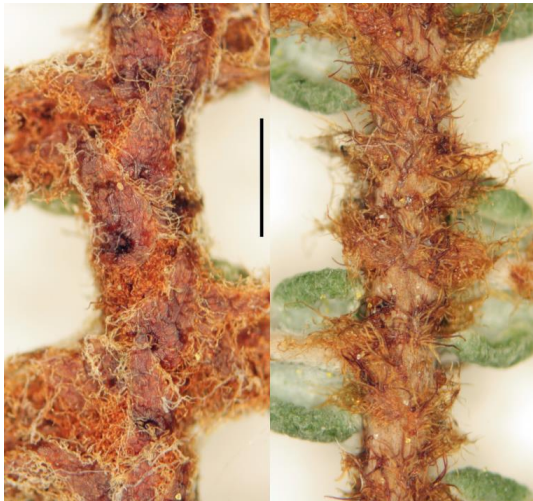


Fig. 24: Indumentum on the abaxial surface of the α costa. *Gleichenia alpina* (WELT P026744) at left; *G. dicarpa* (WELT P026797) at right. Scale bar = 1 mm.

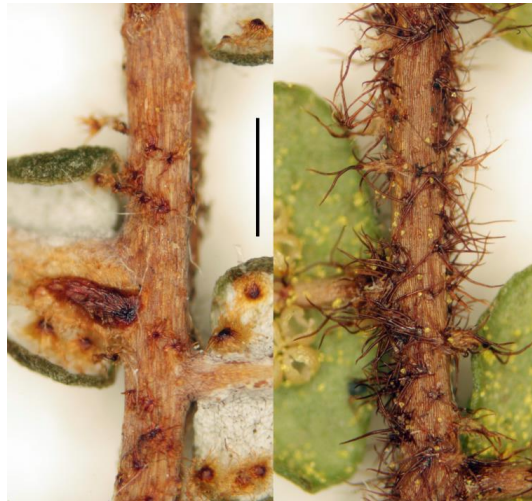


Fig. 25: Indumentum on the abaxial surface of the β costa. *Gleichenia inclusisora* (WELT P023656) at left; *G. microphylla* (WELT P026729) at right. Scale bar = 1 mm.

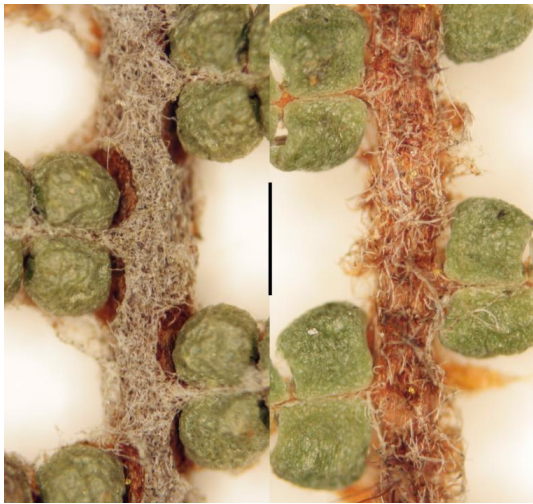


Fig. 26: Indumentum on the adaxial surface of the β costa. *Gleichenia alpina* (WELT P026744) at left; *G. dicarpa* (WELT P026797) at right. Scale bar = 1 mm.

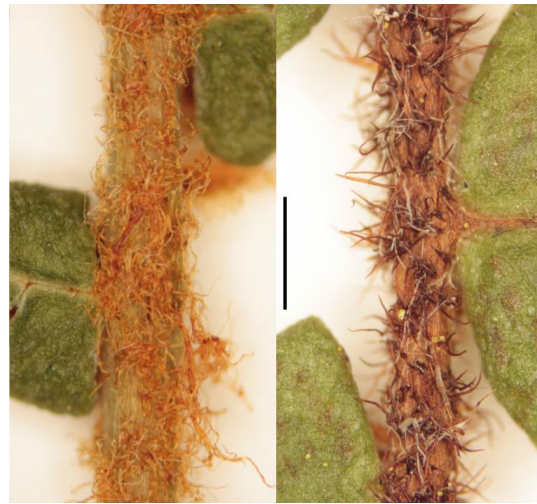


Fig. 27: Indumentum on the adaxial surface of the β costa. *Gleichenia inclusisora* (WELT P023651) at left; *G. microphylla* (WELT P026730) at right. Scale bar = 1 mm.



Fig. 28: Fronds of *Gleichenia microphylla* (left) and *G. dicarpa* (right).

***Gleichenia alpina* R.Br., *Prodr. Fl. Nov. Holland.*, 161 (1810)**

≡ *Mertensia alpina* (R.Br.) Poir., *Encycl. Suppl.* 3, 670 (1814)

≡ *Platyzoma alpinum* (R.Br.) Desv., *Mém. Soc. Linn. Paris* 6: 199 (1827)

≡ *Calymella alpina* (R.Br.) C.Presl, *Tent. Pterid.*, 49 (1836)

≡ *Gleichenia dicarpa* var. *alpina* (R.Br.) Hook.f., *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II*, 5 (1854)

≡ *Gleichenia circinnata* var. *alpina* (R.Br.) Dobbie, *New Zealand Ferns* ed. 4, 44 (1951) — as *G. circinnata* var. *alpina*

Lectotype (designated by Perrie & Brownsey 2015): summit of Table Mountain [Mt Wellington], Derwent, [Tasmania], *R. Brown Iter Austral.* 105, BM 001038247!

= *Pteris platyzoma* Christenh. in Christenhusz et al., *Phytotaxa* 19: 22 (2011) nom. nov. pro *Gleichenia dicarpa* R.Br. 1810 (non *Pteris alpina* Field 1890)

Etymology: From the Latin *alpinus* (alpine), a reference to the habitat of this species.

Vernacular name: alpine tangle fern

Rhizomes long-creeping, 1–2.5 mm diameter; rhizome scales ovate or orbicular, 0.6–1.9 mm long, 0.4–1.1 mm wide, brown, shortly-setose. Fronds 85–1250 mm long. Stipes 60–660 mm long, distally scaly. Laminae 40–1100 mm long, 40–220 mm wide. Rachis buds usually extending 1–3 (rarely 0 or 4–9) times; rachis bud scales ovate, 1.0–2.7 mm long, 0.5–1 mm wide, brown, ciliate. Rachis buds without accessory leaflets. Pinnae 25–230 mm long, 15–120 mm wide; with 0–1 (rarely 2) pseudodichotomous forks (excluding growth from pinna buds); pinna buds (in pinnae with at least 1 fork) usually extending 1–5 (rarely 8) times. Proximal-most costae 4–22 mm long, scaly but

glabrescent in old fronds. γ costae (where not proximal-most costa) 5–17 mm long, with 0–2 pairs of costal leaflets. β costae 11–73 mm long, with 4–14 pairs of ultimate leaflets; adaxially with brown or pale branched-scales with curly branches that form a lanate mass; abaxially with dark-brown or orange-brown, ovate, ciliate scales, 680–1300 μm long, 340–780 μm wide, lacking stiffly stellate scales. Longest ultimate leaflets 8–41 mm long, with 11–48 pairs of ultimate segments. α costae adaxially with pale, branched hair-like scales percurrent; abaxially with ovate, dark-brown to orange-brown, ciliate scales, 340–960 μm long, 250–520 μm wide, percurrent. Ultimate segments 0.5–0.9 mm long, 0.6–1.0 mm wide, \pm square, abaxially pouched, apices rounded; adaxially green, \pm glabrous, strongly convex; abaxially \pm obscured by scales of α costa, but white, with small branched pale scales or \pm glabrous. Sori superficial but obscured by the strongly pouched ultimate segments and scales of α costae, each with 2 sporangia. Spores 36.4–45.4 μm long, 41.7–50.0 μm wide (6 populations).

Distribution: North Island: Volcanic Plateau, Gisborne, Taranaki, Southern North Island.

South Island: Western Nelson, Westland, Canterbury, Otago, Fiordland, Southland.

Stewart Island.

Altitudinal range: 0–1380 m.

Gleichenia alpina occurs from the central North Island through to the South Island and Stewart Island. It grows between 680 and 1380 m above sea level in the North Island, descending to 570 m in the northern South Island and reaching near sea level in southern Westland and further south. It is absent from east of the axial ranges in the South Island except for occasional populations in Otago. It has not been recorded from Mount Taranaki.

Also Australia (Tasmania).

Biostatus: Indigenous (Non-endemic).

Habitat: *Gleichenia alpina* occurs in subalpine bogs and scrub, and other cold, open habitats. It usually grows in the open, often growing through other vegetation, and rarely extends into forest. It favours wet ground, and is often found with *Empodisma*.

Recognition: *Gleichenia alpina* is characterised by comparatively short frond axes and the dense orange-brown (becoming pale) scales that obscure the abaxial surface of the lamina. Its strongly pouched ultimate segments mean it can be confused only with *G. dicarpa*. From that species, *G. alpina* can be distinguished by: the absence of stellate scales with patent branches on the β costae; the strongly convex adaxial surface of the ultimate segments; only 0–1 (rarely 2) pseudodichotomous forks in the pinnae (excluding growth from pinna buds); the absence of accessory leaflets around the rachis bud; and pinna buds that usually extend, often more than once. In contrast, *G. dicarpa* has: stellate scales with patent branches (curled in Chatham Islands' plants) on the abaxial and/or adaxial surfaces of the β costae; complanate or weakly convex adaxial surface of the ultimate segments; 1–4 (rarely 0 or 5) pseudodichotomous forks in the pinnae (excluding growth from pinna buds); usually accessory leaflets around the rachis bud; and pinna buds that extend only occasionally and rarely more than once.

Cytology: No count has been made from New Zealand material of *Gleichenia alpina*, but $n = 20$ has been reported for Australian material (Tindale & Roy 2002).

Hybridisation: Infrequent morphological intermediates between *Gleichenia alpina* and *G. dicarpa* suggest this pair may hybridise (e.g., near Blackball, L.R. Perrie 6376 & L.D. Shepherd, WELT P026765; near Jackson Bay, L.R. Perrie 6758 et al., WELT P026768).

A single collection (Denniston, *F. Overmars* A17, WELT P026702, P026703) indicates that *Gleichenia alpina* hybridises rarely with *G. inclusisora*. Although there are few sori, they are embedded, and there are obvious scales on the abaxial surface of the ultimate segments, reflecting the involvement of *G. inclusisora*. However, these scales are larger, more ovate, and less-distinctly bicolorous than *G. inclusisora*, and the ultimate segments are abaxially more pouched, indicating the involvement of *G. alpina* or *G. dicarpa*. The large size of the scales suggests the other parent is more likely *G. alpina* than *G. dicarpa*; this is borne out by the hybrid's chloroplast DNA sequence, which matches *G. alpina* (L.D. Shepherd unpub.).

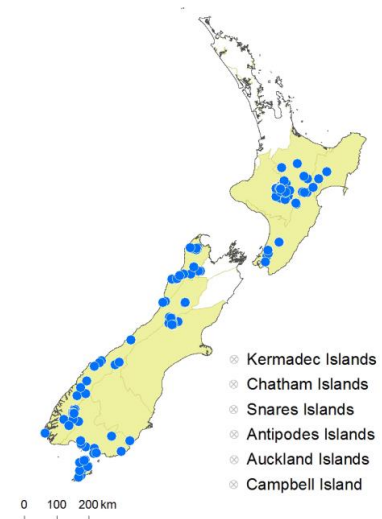


Fig. 29: *Gleichenia alpina* distribution map based on databased records at AK, CHR and WELT, and supplemented with selected OTA records.

Notes: The status of *Gleichenia alpina* in New Zealand has long been uncertain (Allan 1961; Brownsey et al. 1985). It was treated as a Tasmanian endemic by Chinnock & Bell (1998). However, New Zealand material matches Tasmanian material both in morphology and genetics (Perrie et al. 2007, 2012).



Fig. 30: *Gleichenia alpina*. Fronds.



Fig. 31: *Gleichenia alpina*. Fronds.



Fig. 32: *Gleichenia alpina*. Fronds with young axes.



Fig. 33: *Gleichenia alpina*. Scales on bud and subtending axes.



Fig. 34: *Gleichenia alpina*. Scales on α costae forming indumentum that obscures abaxial surface of ultimate leaflets.



Fig. 35: *Gleichenia alpina*. Habitat.



Fig. 36: *Gleichenia alpina*. Scale indumentum on abaxial surface of ultimate leaflet. WELT P026753. Scale bar = 1 mm.



Fig. 37: *Gleichenia alpina*. Adaxial surface of ultimate leaflet, with strongly convex ultimate segments and percurrent, pale scales on the α costa. WELT P026753. Scale bar = 1 mm.



Fig. 38: *Gleichenia alpina*. Scales on the abaxial surface of a β costa. WELT P026744. Scale bar = 1 mm.



Fig. 39: *Gleichenia alpina*. Branched scales forming a lanate mass on adaxial surface of a β costa. WELT P026753. Scale bar = 1 mm.

***Gleichenia dicarpa* R.Br., *Prodr. Fl. Nov. Holland.*, 161 (1810)**

≡ *Mertensia dicarpa* (R.Br.) Poir., *Encycl. Suppl.* 3, 670 (1814)

≡ *Platyzoma dicarpum* (R.Br.) Desv., *Mém. Soc. Linn. Paris* 6: 199 (1827)

≡ *Calymella dicarpa* (R.Br.) C.Presl, *Gefässbündel Farn*, 30 (1847)

≡ *Pteris dicarpa* (R.Br.) Christenh. in Christenhusz et al., *Phytotaxa* 19: 22 (2011)

Lectotype (designated by Perrie & Brownsey 2015): P[ort] Dalrymple, [Tasmania,] *R. Brown Iter. Austral.* 108, BM 001038251!

= *Gleichenia hecistophylla* A.Cunn., *Companion Bot. Mag.* 2: 361 (1837)

≡ *Gleichenia semivestita* var. *hecistophylla* (A.Cunn.) Hook.f., *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II*, 5 (1854)

≡ *Gleichenia circinnata* var. *hecistophylla* (A.Cunn.) Hook.f., *Handb. New Zealand Fl.*, 348 (1864)

≡ *Gleichenia dicarpa* var. *hecistophylla* (A.Cunn.) G.Schneid., *Book Choice Ferns* 2, 219 (1893)

≡ *Gleicheniastrum hecistophyllum* (A.Cunn.) Nakai, *Bull. Natl. Sci. Mus.* 29: 44 (1950)

Lectotype (designated by Perrie & Brownsey 2015): New Zealand, Herb. A. Cunningham, K 00974378! (The precise collection details are ambiguous; see Perrie & Brownsey 2015.)

- = *Gleichenia dicarpa* var. *major* T.Moore, *Index Fil.*, 375 (1862)
 ≡ *Gleicheniastrium hecistophyllum* var. *majus* (T.Moore) Nakai, *Bull. Natl. Sci. Mus.* 29: 44 (1950)
 Type: not located (see Perrie & Brownsey 2015).
 = *Calymella major* Nakai, *Bull. Natl. Sci. Mus.* 29: 41 (1950)
 Holotype: Tasmania, *Dr Milligan 389* [presumably the larger frond, on the left, under which Nakai has his label], BM 001038250!
 = *Gleichenia dicarpa* var. *longipinnata* T.Moore ex G.Schneid., *Book Choice Ferns* 2, 220 (1893)
 Type: not located (see Perrie & Brownsey 2015).

Etymology: From the Greek *di-* (two), and *carpos* (fruit), a reference to the paired sporangia in each sorus.

Vernacular names: matua-rarauhe; spider fern; swamp umbrella fern; tangle fern; waewae-kākā

Rhizomes long creeping, 1–3.5 mm diameter; rhizome scales lanceate or ovate, 0.7–2.7 mm long, 0.2–1.1 mm wide, brown, setose and/or ciliate, usually also with smaller stellate scales. Fronds 80–1460+ mm long. Stipes 50–1100 mm long, usually distally scaly, rarely glabrous. Laminae 30–730+ mm long, 30–540+ mm wide. Rachis buds not extending or extending 1–3 (rarely 4) times; rachis bud scales lanceate or ovate, 0.7–4.0 mm long, 0.3–1.0 mm wide, brown, ciliate, sometimes apically setose. Rachis buds usually with single or paired accessory leaflets near base of each proximal-most costa, or rarely without accessory leaflets; accessory leaflets where present usually proximally bunched. Pinnae 35–500+ mm long, 15–420 mm wide; with 1–4 (rarely 0 or 5) successive pseudodichotomous forks (excluding growth from pinna buds); pinna buds occasionally extending once (rarely 2–3 times). Proximal-most costae 11–120 mm long, persistently scaly but glabrescent in old fronds. γ costae (where not proximal-most costa) 10–105 mm long, with 2–15 (rarely 0) pairs of costal leaflets (excluding accessory leaflets around bud). β costae 29–250 mm long, with 7–50 pairs of ultimate leaflets; adaxially usually with brown or pale branched scales with curly branches that form a lanate mass, or rarely with dark-brown or pale stellate scales with \pm patent branches; abaxially with a mix of ovate or lanceate, brown or pale, ciliate and/or setose scales, 420–1400 μ m long, 150–450 μ m wide, and dark brown, red-brown or pale stellate scales with \pm patent or curled branches, 150–500 μ m long. Longest ultimate leaflets 13–90 mm long, with 17–80 pairs of ultimate leaflets. α costae adaxially with pale, branched, hair-like scales, either glabrescent and not percurrent, or persistent and percurrent; abaxially with lanceate to ovate, brown or pale (and then usually with darker attachment) ciliate scales, 400–900 μ m long, 150–520 μ m wide, often restricted to proximal half of α costae, or occasionally percurrent. Ultimate segments 0.4–1.6 mm long, 0.6–1.6 mm wide, \pm square, abaxially pouched or recurved, apices rounded; adaxially green, glabrous, usually \pm complanate (rarely \pm convex); abaxially white or glaucous, glabrous or with small branched brown-centred scales. Sori \pm superficial, each with 2 (rarely 3) sporangia. Spores 34.8–45.1 μ m long, 39.3–48.1 μ m wide (20 populations).

Distribution: North Island: Northland, Auckland, Volcanic Plateau, Gisborne, Taranaki, Southern North Island.

South Island: Western Nelson, Sounds-Nelson, Marlborough, Westland, Canterbury, Otago, Fiordland, Southland.

Stewart Island, Chatham Islands.

Altitudinal range: 0–1350 m.

Gleichenia dicarpa is widespread from the far north of the North Island to Stewart Island, but it is uncommon to the east of the axial ranges of the North and South Islands, and apparently absent from much of the Fiordland coastline. It is the only *Gleichenia* on the Chatham Islands. It occurs from near sea level to 850 m above sea level in the North Island and most of the South Island, extending to 1000 m in Western Nelson Ecological Province and 1350 m in Canterbury Ecological Province.

Also Australia (Queensland, New South Wales, Victoria, Tasmania) and New Caledonia. The attribution of plants outside Australasia (e.g., Malesia) to *Gleichenia dicarpa* requires re-examination (see Notes).

Biostatus: Indigenous (Non-endemic).

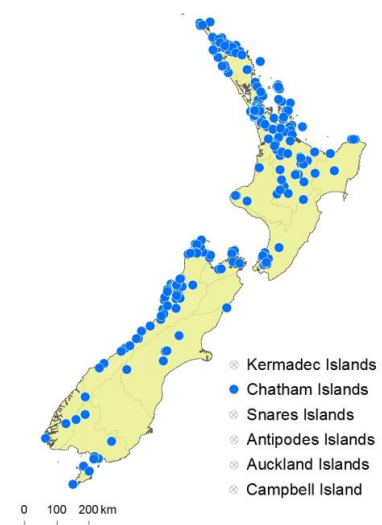


Fig. 40: *Gleichenia dicarpa* distribution map based on databased records at AK, CHR and WELT.

Habitat: *Gleichenia dicarpa* usually occurs in *Leptospermum/Kunzea* and other scrub and low forest, or swamps and other open habitats with wet ground, such as pakihi (wet, infertile heaths). It is often on road and track sides, and on poor substrates (e.g., clay, ultrabasic). It infrequently extends into forest (kauri, beech), and to drier ground. *Gleichenia dicarpa* tends to grow in more open and wetter sites than *G. microphylla*, but they often co-occur.

Recognition: The pouched or recurved ultimate segments with rounded apices and white or glaucous abaxial surfaces, sori mostly with 2 sporangia, and the intergrading mix of ovate and stellate scales on the abaxial surface of the β costae distinguish *Gleichenia dicarpa* from *G. microphylla*; the latter has complanate or recurved ultimate segments, with green abaxial surfaces and at least some apices cuspidate, sori mostly with >2 sporangia, and stellate scales with stiffly patent branches dominating the abaxial surface of the β costae. However, putative hybrids combining the character states of both species and/or with intermediate character states are widespread and fairly common.

The larger size of the fronds, pinnae with more than 2 pseudodichotomous forks, and accessory leaflets subtending the rachis buds distinguish most plants of *Gleichenia dicarpa* from *G. alpina*; definitively, *G. dicarpa* has stellate scales with patent branches (curled in Chatham Islands' plants) on the β costae whereas *G. alpina* does not.

The superficial sori and mixture of ovate and stellate scales on the abaxial surface of the laminae separates *Gleichenia dicarpa* from *G. inclusisora*, which has sori embedded within pits in the lamina and \pm orbicular scales.

Cytology: $n = 20$ (Brownlie 1958, as *Gleichenia circinata* [sic])

Hybridisation: Morphological intermediates between *Gleichenia dicarpa* and *G. microphylla* are common (e.g., plants with \pm complanate ultimate segments that are glaucous on their abaxial surface). These are potentially hybrids and that is how they are treated here (see *Gleichenia xpunctulata*).

Most putative hybrids with *Gleichenia microphylla* involve the morphological form of *G. dicarpa* that lacks both percurrent scales on the abaxial surface of the α costae and scales on the abaxial surface of the ultimate segments (see Notes below). But plants of *G. dicarpa* with percurrent scales on the abaxial surface of the α costae and scales on the abaxial surface of the ultimate segments from the northern North Island (see Notes) also seem to hybridise with *G. microphylla* (e.g., Kawerua, A.E. Wright s.n., AK 223063; Opuia, L.R. Perrie 4814, WELT P022337).

Infrequent morphological intermediates between *Gleichenia dicarpa* and *G. alpina* suggest that this pair may also hybridise (e.g., near Blackball, L.R. Perrie 6376 & L.D. Shepherd, WELT P026765; near Haast, L.R. Perrie 6753 et al., WELT P026768).

Notes: As circumscribed here, *Gleichenia dicarpa* in New Zealand is morphologically and genetically variable. At least four groups can be recognised amongst New Zealand plants, but their distinctiveness needs further examination, and it is unclear which might be treated as separate taxa.

A) Plants with percurrent scales on the abaxial surface of the α costae and scales on the abaxial surface of the ultimate segments (e.g., Mount Somers, L.R. Perrie 3941 & L.D. Shepherd, WELT P021161; Pukerau, L.R. Perrie et al. 6296, WELT P026809; Key Summit, L.R. Perrie 5496 & L.D. Shepherd, WELT P026810). Groups C and D share these characteristics, but plants of group A are distinguished by the prominent, patently-branched stellate scales on the abaxial and adaxial surfaces of the β costae. Plants of group A have chloroplast DNA sequences closely related to plants of *G. dicarpa* from Australia and New Caledonia (D.J. Ohlsen et al. unpub.). Group A plants occur definitely in (southern) Westland, Canterbury, and Southland Ecological Provinces, possibly Stewart Island and in the eastern North Island (e.g., Kaweka Ranges, L.R. Perrie et al. 2983, WELT P020672), and perhaps sporadically elsewhere. Group A plants match the morphology of some plants of *G. dicarpa* in Australia and, given the close genetic relationship, are probably conspecific. However, Australian *G. dicarpa* might include more than one species as it is morphologically variable. For instance, the ultimate segments of some (but not all) Australian plants, including the lectotype of *G. dicarpa*, are strongly pouched with a pronounced lamina flange alongside the abaxial surface of the α costae. This feature does not occur in *G. dicarpa* from New Zealand, but is uniformly present in New Caledonia. The lectotype is otherwise similar to group A, except only in the smallest of three frond pieces are the stellate scales on the abaxial surface of the β costae darkly coloured with patent branches; in the two larger frond pieces, the corresponding indumentum is paler brown with twisted branches. The significance of this variation in Australia is unclear.

B) Plants with scales on the abaxial surface of the α costae that are not percurrent and ultimate segments with a glabrous abaxial surface (e.g., Heaphy Track, L.R. Perrie 4495, WELT P026785; Atarau, L.R. Perrie 6373 & L.D. Shepherd, WELT P026787). Plants of group B have chloroplast DNA

sequences closely related to *G. microphylla* (Perrie et al. 2012) and *G. mendellii* (G.Schneid.) S.B.Andrews (D.J. Ohlsen et al. unpub.). Group B plants occur from the north of the North Island to Stewart Island; they are the most widespread and common *G. dicarpa* group in New Zealand, and the only form of *G. dicarpa* found in large parts of the country. The relationship of group B plants to *G. mendellii* from Australia requires investigation. *Gleichenia mendellii* shares the scale characteristics described above for group B plants, along with ultimate segments that are glaucous on their abaxial surface and relatively weakly pouched. However, the epitype of *G. mendellii* (Queensland, Russell Is., P.R. Sharpe 3130, BRI AQ0370733) differs in having a higher frequency of sori with more than two sporangia and sparser indumentum on the abaxial surface of the β costae. Based on their morphology, other Australian plants outside the currently accepted distribution of *G. mendellii* (south-eastern Queensland and north-eastern New South Wales; Chinnock & Bell 1998), and attributed to *G. dicarpa*, also need re-examination (e.g., Tasmania, Gordon River, A.T. Dobson 77029, CHR 313699).

C) Plants from the Chatham Islands (e.g., Chatham Island, P.J. de Lange CH919 & P.B. Heenan, AK 300719; Chatham Island, C.H. Hay s.n., 23 June 2007, WELT P026814). This is the only *Gleichenia* recorded from the Chatham Islands. Like those of group A, plants of group C have percurrent scales on the abaxial surface of the α costae and scales on the abaxial surface of the ultimate segments. Group C plants differ in that the stellate scales on the abaxial surface of the β costae have curled or twisted rather than stiffly patent branches. Chloroplast DNA sequences of group C plants are more closely related to group B plants (and *G. microphylla*) than to group A plants and Australian *G. dicarpa* (D.J. Ohlsen et al. unpub.).

D) Plants with percurrent scales on the abaxial surface of the α costae and scales on the abaxial surface of the ultimate segments (e.g., Karikari Peninsula, L.R. Perrie 4193, WELT P021155; near Taipa, L.R. Perrie et al. 6405, WELT P026777). The scales on the abaxial surface of the α costae have bodies usually less than 300 μm wide, such that they appear as a mass of tangled hairs (actually their cilia). This usually distinguishes them from groups A and C, whose wider scales on the abaxial surface of the α costae are quite evident. Additionally, group D plants have prominent, branched accessory leaflets around their rachis buds (like group B plants), but these are often lacking in group A and C plants (and are unbranched when present). Chloroplast DNA sequences of group D plants match those of group B plants (D.J. Ohlsen et al. unpub.). Plants of group D dominate *G. dicarpa* populations in Northland, are common in Auckland (together with group B plants), and appear to infrequently extend south to Taranaki and Volcanic Plateau Ecological Provinces.

In addition to its morphological and genetic variation, the taxonomy of *Gleichenia dicarpa* is further complicated by its nomenclature, particularly the long-confused *G. circinnata* Sw. (Christensen 1910; Holttum 1959; Brownsey et al. 1985). This was described by Swartz (1801), but only later said to be from Australia (Swartz 1806). It has been variously confused with both *G. dicarpa* and *G. microphylla*, both also described from Australian material, and both post-dating *G. circinnata*. The putative type material of *G. circinnata*, S P4151 and P4153 (online!), is fragmentary, but is clearly not *G. microphylla*. Holttum (1959), noting conflict with the protologue, argued that it was also not equivalent to *G. dicarpa*, but this requires re-evaluation in the context of a detailed review of the morphological variation in Australasian *G. dicarpa*. This should be done before making substantive nomenclatural changes, particularly given that *G. dicarpa* as currently circumscribed may comprise a complex of species in Australasia; in that context, *G. circinnata* and *G. dicarpa* may or may not be synonymous.

Gleichenia dicarpa has been attributed to New Caledonia and Philippines (e.g., Holttum 1959). However, the relationship of plants outside Australasia to Australian material representative of the type, and to the Malesian *G. vulcanica* Blume, requires re-evaluation.

The lectotype of *Gleichenia hecistophylla* A.Cunn. appears to belong to group B of *G. dicarpa*, but the other syntype belongs to group D (Perrie & Brownsey 2015).

The Tasmanian holotype of *Calymella major* Nakai has a morphology not found in New Zealand.



Fig. 41: *Gleichenia dicarpa*. Group B. Habit.



Fig. 42: *Gleichenia dicarpa*. Group B. Frond.



Fig. 43: *Gleichenia dicarpa*. Abaxial surface of the ultimate leaflet (with α costa): group A (WELT P026809) at left; group B (WELT P026797) at right. Scale bar = 2 mm.

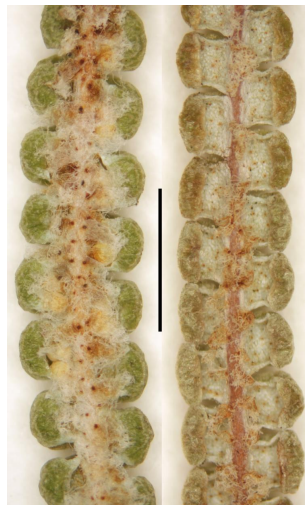


Fig. 44: *Gleichenia dicarpa*. Abaxial surface of the ultimate leaflet (with α costa): group C (WELT P026817) at left; group D (WELT P021155) at right. Scale bar = 2 mm.

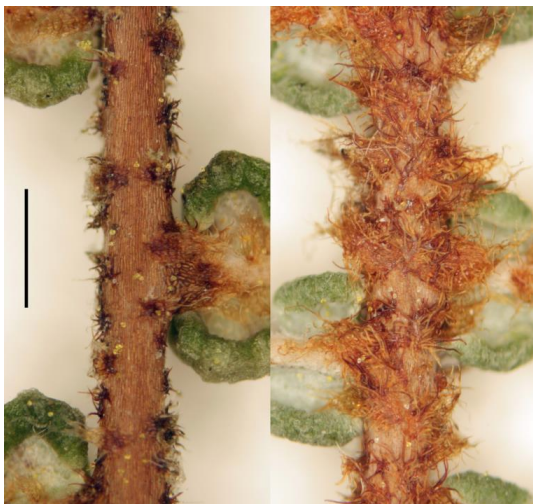


Fig. 45: *Gleichenia dicarpa*. Indumentum on the abaxial surface of the β costa: group A (WELT P026809) at left; group B (WELT P026797) at right. Scale bar = 1 mm.

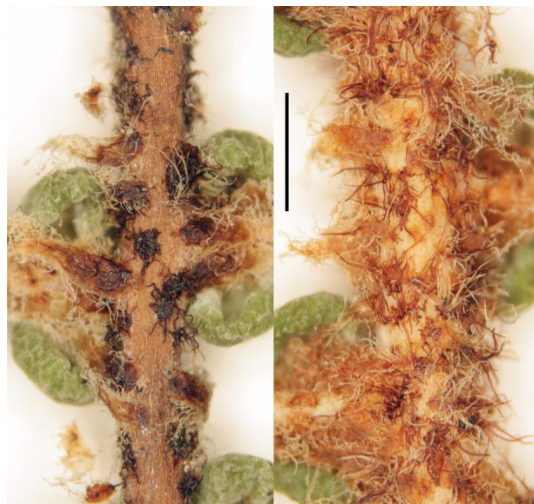


Fig. 46: *Gleichenia dicarpa*. Indumentum on the abaxial surface of the β costa: group C (WELT P026817) at left; group D (WELT P021155) at right. Scale bar = 1 mm.

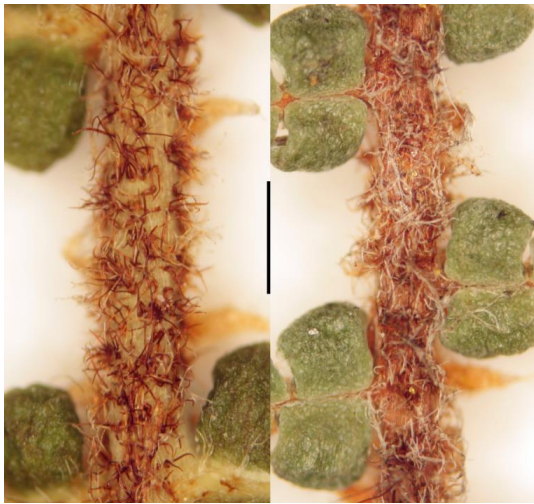


Fig. 47: *Gleichenia dicarpa*. Indumentum on the adaxial surface of the β costa: group A (WELT P026809) at left; group B (WELT P026797) at right. Scale bar = 1 mm.

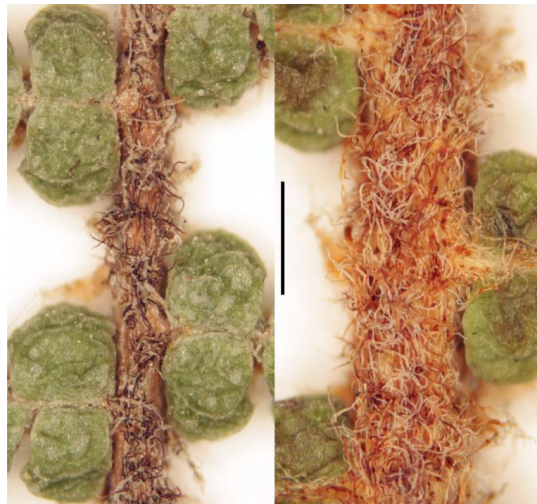


Fig. 48: *Gleichenia dicarpa*. Indumentum on the adaxial surface of the β costa: group C (WELT P026814) at left; group D (WELT P021155) at right. Scale bar = 1 mm.



Fig. 49: *Gleichenia dicarpa*. Group B. Indumentum on stipe and proximal-most axes, and rachis bud with accessory leaflets.



Fig. 50: *Gleichenia dicarpa*. Group B. Proximally-branched accessory leaflets around rachis bud.



Fig. 51: *Gleichenia dicarpa*. Group B. Abaxial surface of α and β costae.

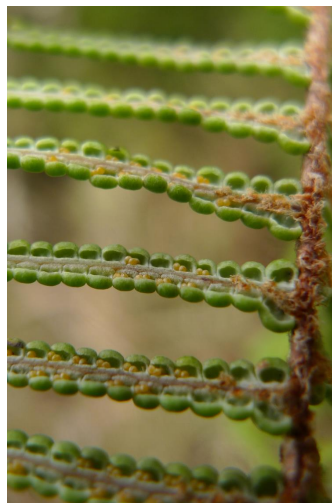


Fig. 52: *Gleichenia dicarpa*. Group B. Sori, each with two sporangia.



Fig. 53: *Gleichenia dicarpa*. Group A. Frond.



Fig. 54: *Gleichenia dicarpa*. Group A. Rachis bud without accessory leaflets.

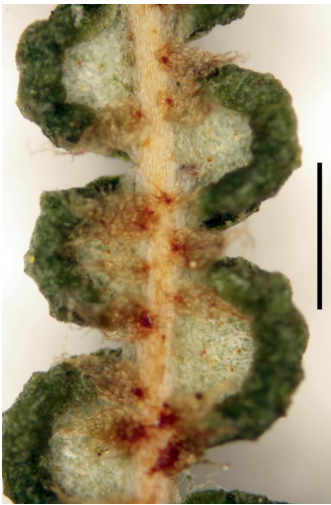


Fig. 55: *Gleichenia dicarpa*. Group A. Abaxial surface of ultimate leaflet. The brown-centres of the branched scales on the glaucous surface of the ultimate segments are visible as dots. WELT P026809. Scale bar = 1 mm.



Fig. 56: *Gleichenia dicarpa*. Group C. Curled or twisted branches of the stellate scales on the abaxial surface of the β costae characterise group C plants. WELT P026814. Scale bar = 0.5 mm.



Fig. 57: *Gleichenia dicarpa*. Group D. Frond.



Fig. 58: *Gleichenia dicarpa*. Group D. Abaxial surface of β costa and ultimate leaflets.



Fig. 59: *Gleichenia dicarpa*. Group D. Habitat.



Fig. 60: *Gleichenia dicarpa*. Group D. Abaxial surface of ultimate leaflets. The brown-centres of the branched scales on the glaucous surface of the ultimate segments are visible as dots. WELT P021155. Scale bar = 0.5 mm.

***Gleichenia inclusisora* Perrie, L.D.Sheph. & Brownsey, New Zealand
J. Bot. 50: 406 (2012)**

Holotype: New Zealand, South Island, between Blackball and Atarau, *L.R. Perrie* 6374 & *L.D. Shepherd*, 14 Dec. 2010, WELT P023647/A-F!; isotype: CHR!

Etymology: From the Latin *inclusus* (meaning enclosed), a reference to the sori being embedded within the lamina. While this feature is not unique in *Gleichenia*, it is diagnostic amongst the species in Australasia.

Rhizomes long-creeping, 1–3 mm diameter; rhizome scales ovate or orbicular, 0.5–1.2 mm long, 0.5–0.8 mm wide, brown, peltate, bullate, ± entire. Fronds 130–1230+ mm long. Stipes 40–860 mm long, ± glabrous. Laminae 90–600+ mm long, 100–400+ mm wide. Rachis bud not extending or extending 1–2 times; rachis bud scales ovate, 1.5–2.5 mm long, 1–1.5 mm, dark brown with paler margins, ciliate or erose. Rachis bud without accessory leaflets. Pinnae 50–950+ mm long, 50–300 mm wide; with 1–4 (rarely 0) successive pseudodichotomous forks (excluding growth from pinna buds); pinna buds sometimes extending 1–2 times. Proximal-most costae 10–150 mm long, quickly glabrescent. γ costae (where not proximal-most costa) 10–40 mm long, with 0–4 pairs of costal leaflets. β costae 25–135 mm long, with 5–26 pairs of ultimate leaflets; adaxially with orange-brown or white branched scales with curly branches that form a lanate mass; abaxially with a mix of scales like those of the pinna buds and ultimate segments, glabrescent. Longest ultimate leaflets 13–59 mm long, with 15–47 pairs of ultimate segments. α costae adaxially ± glabrous; abaxially with scattered scales like those of the ultimate segments or glabrous. Ultimate segments 0.7–1.4 mm long, 0.9–1.4 mm, ovate, complanate or recurved, apices rounded; adaxially green, glabrous, complanate; abaxially white or glaucous, with orbicular to ovate scales, 0.3–0.8 mm long, 0.3–0.6 mm wide, dark brown with paler margins, long-ciliate, peltate, bullate. Sori c. $\frac{3}{4}$ embedded in lamina pit, each with 3 (rarely 4) sporangia. Spores 38.1–41.1 μm long, 42.7–45.5 μm wide (3 populations).

Distribution: North Island: Auckland.

South Island: Western Nelson, Westland.

Altitudinal range: 5–840 m.

Gleichenia inclusisora has a stronghold in the Westport-Greymouth area, with populations scattered along the west coast of the South Island to about Haast. In the South Island, it occurs from near sea level to about 660 m above sea level. In the North Island, there is a single population in the northern Coromandel Peninsula, at about 840 m above sea level. An old collection (1920s or earlier) that is labelled as Ōpepe (*herb. Eric Craig?*, AK 115752), presumably near Taupō, is not mapped because this species has not been reported from the region subsequently; the locality is regarded as doubtful.

Biostatus: Indigenous (Endemic).

Habitat: *Gleichenia inclusisora* occurs in pakihi (wet, infertile heaths) and open shrubland/treeland. It regularly occurs with other *Gleichenia* species, particularly *G. dicarpa*. *Gleichenia inclusisora* tends to be in rockier sites than *G. dicarpa*.

Recognition: *Gleichenia inclusisora* is recognised by the sori being embedded within lamina pits, and by the comparatively large, bicolorous, ± orbicular scales on the abaxial surface of the laminae.

Hybridisation: A single collection (Denniston, *F. Overmars* A17, WELT P026702, P026703) indicates that *Gleichenia inclusisora* hybridises rarely with *G. alpina*. Although there are few sori, they are embedded, and there are obvious scales on the abaxial surface of the ultimate segments, reflecting the involvement of *G. inclusisora*. However, these scales are larger, more ovate, and less-distinctly bicolorous than *G. inclusisora*, and the ultimate segments are abaxially more pouched, indicating the involvement of *G. alpina* or *G. dicarpa*. The large size of the scales suggests the other parent is more likely *G. alpina* than *G. dicarpa*; this is borne out by the hybrid's chloroplast DNA sequence, which matches *G. alpina* (L.D. Shepherd unpub.).

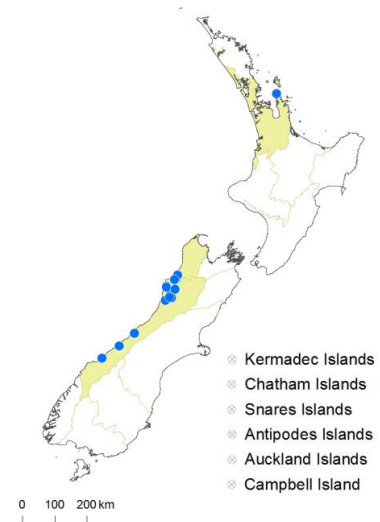


Fig. 61: *Gleichenia inclusisora* distribution map based on databased records at AK, CHR and WELT.



Fig. 62: *Gleichenia inclusisora*. Frond.



Fig. 63: *Gleichenia inclusisora*. Near-glabrous stipes.

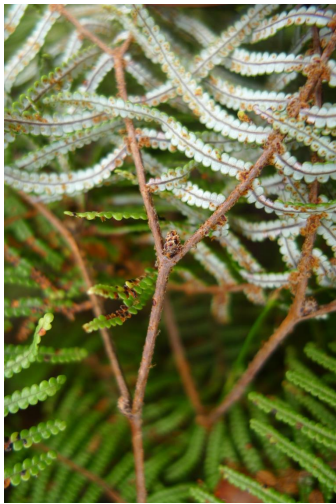


Fig. 64: *Gleichenia inclusisora*. Indumentum of pinna bud and proximal axes.



Fig. 65: *Gleichenia inclusisora*. Abaxial surface of α and β costae.



Fig. 66: *Gleichenia inclusisora*. Abaxial surface of ultimate leaflets, with embedded sori, including some 'pits' where the sporangia have fallen out.

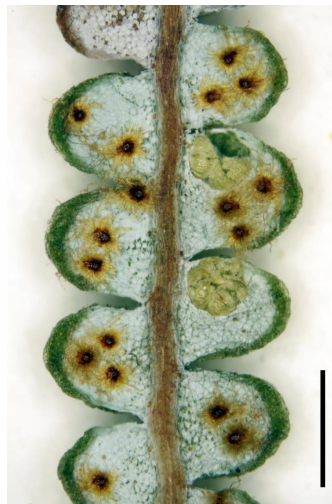


Fig. 67: *Gleichenia inclusisora*. Abaxial surface of ultimate segments, with \pm orbicular scales and sori embedded in lamina pits. WELT P023659. Scale bar = 1 mm.



Fig. 68: *Gleichenia inclusisora*. Scales on the abaxial surface of ultimate segments. WELT P023659. Scale bar = 0.5 mm.



Fig. 69: *Gleichenia inclusisora*. Habitat, amongst low shrubs.



Fig. 70: *Gleichenia inclusisora*. Habitat, climbing at margin of forest clearing.



Fig. 71: The adaxial surfaces of the fronds of *Gleichenia dicarpa* (left) are usually duller than *G. inclusisora* (right).

***Gleichenia microphylla* R.Br., *Prodr. Fl. Nov. Holland.*, 161 (1810)**

- ≡ *Mertensia microphylla* (R.Br.) Kaulf., *Enum. Filic.*, 41 (1824)
- ≡ *Platyzoma recurvum* Desv., *Mém. Soc. Linn. Paris* 6: 199 (1827) nom. nov. pro *Gleichenia microphylla* R.Br. 1810 (non *Platyzoma microphyllum* R.Br. 1810)
- ≡ *Calymella microphylla* (R.Br.) C.Presl, *Tent. Pterid.*, 49 (1836)
- ≡ *Gleicheniastrum microphyllum* (R.Br.) C.Presl, *Gefässbündel Farn*, 30 (1847)
- ≡ *Gleichenia circinnata* var. *microphylla* (R.Br.) Maiden & Betche, *Census N.S.W. Pl.*, 6 (1916)
Lectotype (designated by Perrie & Brownsey 2015): [King's Island, Tasmania,] *R. Brown Iter. Austral.* 107, BM 001038257!
- = *Gleichenia semivestita* Labill., *Sert. Austro-Caledon.*, 8, t. 11 (1824)
- ≡ *Gleicheniastrum semivestitum* (Labill.) C.Presl, *Gefässbündel Farn*, 30 (1847)
- ≡ *Gleichenia circinnata* var. *semivestita* (Labill.) T.Moore, *Index Fil.*, 374 (1862)
- ≡ *Gleichenia microphylla* var. *semivestita* (Labill.) Alderw., *Malayan Ferns Fern Allies*, 80 (1917)
- ≡ *Calymella semivestita* (Labill.) Ching, *Sunyatsenia* 5: 288 (1940)
- ≡ *Gleicheniastrum microphyllum* var. *semivestitum* (Labill.) Nakai, *Bull. Natl. Sci. Mus.* 29: 45 (1950)
Lectotype (designated by Perrie & Brownsey 2015): Austro-Caledonia [New Caledonia], ex Herb. Labillardière, Herb. Webbianum 215568, FI 004180 (online!)
- = *Gleichenia patens* Colenso, *Trans. & Proc. New Zealand Inst.* 20: 212 (1888)
- ≡ *Gleichenia circinnata* var. *patens* (Colenso) Domin, *Biblioth. Bot.* 20 (85): 202 (1913)
Lectotype (designated by Perrie & Brownsey 2015): Wairakei, Taupo, *C.J. Norton s.n.*, Herb. Colenso, WELT P003354/A-B!
- = *Gleichenia circinnata* var. *concolor* Domin, *Biblioth. Bot.* 20 (85): 202 (1913)
Type: not located (see Perrie & Brownsey 2015).

Etymology: From the Greek *micro-* (small), and *phyllus* (small-leaved), a reference to the small ultimate segments in the context of earlier circumscriptions of *Gleichenia* that included species with larger ultimate segments now accepted in other genera such as *Sticherus*.

Vernacular names: carrier tangle fern; parasol fern; waewae-kākā; waewae-kōtuku; waewae-matuku

Rhizomes long-creeping, 1.5–3 mm diameter; rhizome scales lanceate or ovate, 1.2–2.6 mm long, 0.5–1.0 mm wide, brown, setose, mixed with stellate scales. Fronds 110–1600 mm long. Stipes 65–1100 (rarely 25) mm long, distally scaly. Laminae 100–520+ (rarely 35) mm long, 80–520+ (rarely 30) mm wide. Rachis buds not extending or extending 1–2 (rarely 3) times; rachis bud scales acicular or lanceate, 0.8–2.6 mm long, 0.2–0.6 mm wide, brown, ciliate and apically setose. Rachis buds usually with single or paired accessory leaflets near base of each proximal-most costae; these accessory leaflets often proximally branched. Pinnae 40–370 mm long, 30–290 mm wide; with 1–3 (rarely 0 or 4) successive pseudodichotomous forks (excluding growth from pinna buds); pinna buds occasionally extending once (rarely 2–3 times). Proximal-most costae 14–70 mm long, persistently scaly. γ costae (where not proximal-most costa) 25–75 mm long, with 2–11 pairs of costal leaflets (excluding accessory leaflets around bud). β costae 30–390 (rarely 12) mm long, with 5–38 pairs of ultimate leaflets; adaxially with dense dark-brown or red-brown stellate scales with patent or divergent branches; abaxially with red-brown stellate scales with branches 400–1000 μ m long, mixed with

lanceate, red-brown or pale, ciliate and/or setose scales, 260–1200 µm long, 80–260 µm wide. Longest ultimate leaflets 20–110 (rarely 8) mm long, with 18–62 (rarely 9) pairs of ultimate segments. α costae adaxially glabrous or with scattered, pale, branched, hair-like scales; abaxially with pale, curly, branched, hair-like scales, proximal only or scattered if percurrent. Ultimate segments 1.3–2.7 mm long, 0.8–2.0 mm wide, ovate or deltate, complanate or recurved, at least some apices cuspidate (otherwise obtuse); adaxially green, glabrous, complanate; abaxially green, glabrous. Sori superficial, each with 2–4 (rarely 5) sporangia. Spores 37.7–41.4 µm long, 41.1–45.7 µm wide (6 populations).

Distribution: North Island: Northland, Auckland, Volcanic Plateau, Taranaki, Southern North Island.

South Island: Western Nelson, Sounds-Nelson, Marlborough, Westland, Fiordland, Southland .

Stewart Island.

Altitudinal range: 5–760 m.

Gleichenia microphylla is widespread from the far north of the North Island to Stewart Island, but is largely confined to areas west of the axial ranges of the North and South Islands. It occurs from near sea level to 600 m above sea level, reaching 760 m on Stewart Island.

Also Australia (New South Wales, South Australia, Victoria, Tasmania). Some authors (e.g. Chinnock & Bell 1998) have attributed *Gleichenia microphylla* to New Caledonia, but this is not supported by recent collections (see Notes). The attribution of plants outside Australasia (e.g., Malesia) to *G. microphylla* requires examination (see Notes).

Biostatus: Indigenous (Non-endemic).

Habitat: *Gleichenia microphylla* frequently occurs in *Leptospermum*/*Kunzea* and other scrub, as well as open situations within other forest types (kauri, podocarp, beech, broadleaved, and/or plantation), particularly along natural or human-induced margins (e.g., along roads and tracks). It occurs in or around swamps and other wet ground, but extends to ridges, and to rocky and poor substrates (e.g., clay, ultrabasic). *Gleichenia microphylla* tends to occupy more shaded and drier sites than *G. dicarpa*, but they often co-occur.

Recognition: *Gleichenia microphylla* has complanate or recurved ultimate segments with green abaxial surfaces, and at least some of them have cuspidate (± triangular) apices. The indumentum on the abaxial surface of the β costae is dominated by stellate scales with stiffly patent branches. Most sori have more than 2 sporangia. It thus differs substantially from *G. dicarpa*, which has pouched or recurved ultimate segments with white or glaucous abaxial surfaces and rounded apices, an indumentum on the abaxial surface of the β costae comprising an intergrading mix of ciliate ovate scales and stellate scales, and sori mostly with 2 sporangia. However, putative hybrids combining the character states of both species and/or with intermediate character states are widespread and fairly common.

Cytology: n = 20 (Brownlie 1961)

Hybridisation: Morphological intermediates between *Gleichenia microphylla* and *G. dicarpa* are common (e.g., plants with ± complanate ultimate segments that are glaucous on their abaxial surface). These are potentially hybrids and that is how they are treated here (see *Gleichenia ×punctulata*).

Notes: One of the syntypes of *Gleichenia patens* Colenso, WELT P002911, has pinna buds that extend to an unusual degree. This is likely the basis of Cheeseman's opinion (1925, p.85) that *Gleichenia patens* is "an excessively proliferous state".

Gleichenia semivestita Labill. is a synonym of *G. microphylla* (Perrie & Brownsey 2015). The former was described from New Caledonia. This may be the source of the attribution of *G. microphylla* to New Caledonia. However, Brownlie (1969) did not record it, and modern collections do not support the presence of *G. microphylla* in New Caledonia. Labillardière (1824) may have mistakenly attributed Australian material of *G. microphylla* to New Caledonia.

Malesian plants have also been attributed to *Gleichenia microphylla* (Holtum 1959). However, this needs re-examination because at least some of these plants differ from Australian and New Zealand

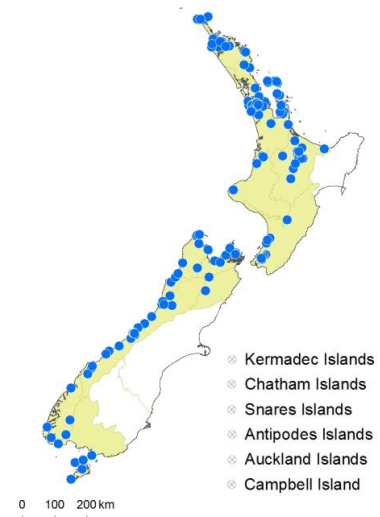


Fig. 72: *Gleichenia microphylla* distribution map based on databased records at AK, CHR and WELT, and supplemented with selected OTA records.

material in having patently-branched stellate scales \pm percurrent on the β costae (Malaysia, Mount Ophir, *Shah 3604 & Ahmad*, CHR 304103), and in having glaucous abaxial surfaces on the ultimate segments (Piggot 1988).



Fig. 73: *Gleichenia microphylla*. Habit.



Fig. 74: *Gleichenia microphylla*. Frond.



Fig. 75: *Gleichenia microphylla*. Adaxial surface of ultimate leaflets.



Fig. 76: *Gleichenia microphylla*. Abaxial surface of young frond, with immature sori.



Fig. 77: *Gleichenia microphylla*. Abaxial surface of frond, with mature sori of 2–4 sporangia.



Fig. 78: *Gleichenia microphylla*. Abaxial surface of ultimate leaflet, with sori, showing complanate and cuspidate ultimate segments. WELT P026730. Scale bar = 1 mm.



Fig. 79: *Gleichenia microphylla*. Indumentum on adaxial surface of β costa. WELT P026730. Scale bar = 1 mm.



Fig. 80: *Gleichenia microphylla*. Indumentum on abaxial surface of β costa showing stellate scales. WELT P026729. Scale bar = 1 mm.



Fig. 81: *Gleichenia microphylla*. Habitat.



Fig. 82: *Gleichenia microphylla*, growing intermixed with *G. inclusora*. They appear similar from above, but some fronds of *G. inclusora* are showing the white abaxial surfaces.

***Gleichenia* ×*punctulata* Colenso, *Trans. & Proc. New Zealand Inst.* 16: 344 (1884) pro sp.**

Lectotype (designated by Perrie & Brownsey 2015): Great Barrier Island, *C.P. Winkelmann s.n.*, WELT P003355/A-B!, but excluding the piece at lower-left on sheet P003355/B.

Etymology: From the Latin *punctulatus* (minutely dotted), a reference by Colenso to the “shining dots”, of unknown origin, that produce the glaucous or white colour on the abaxial surface of the lamina of *Gleichenia dicarpa* and its hybrids. These dots can coalesce to give a uniform covering.

Distribution: Putative hybrids between *Gleichenia dicarpa* and *G. microphylla* are found throughout the broad area of overlapping distributions of the parental species, from the northern North Island to Stewart Island.

Biostatus: Indigenous (Non-endemic).

The presence of *Gleichenia* ×*punctulata* in Australia is likely but requires confirmation.

Habitat: The putative hybrids are found in the same habitats as *G. dicarpa* and *G. microphylla*, and usually grow with one or both of the parental species.

Recognition: Morphologically intermediate between *Gleichenia dicarpa* and *G. microphylla*, combining character states found in the putative parents and/or with intermediate character states: e.g., plants with ± complanate ultimate segments that are glaucous on their abaxial surface, or plants

with pouched ultimate segments but indumentum on the costae dominated by stellate scales with stiffly patent branches. The name *G. ×punctulata* applies to this hybrid combination.

Notes: Morphological intermediates between *Gleichenia dicarpa* and *G. microphylla* are common. These are potentially hybrids and, while substantiating evidence is lacking (e.g., from spore morphology or genetics), that is how they are treated here. Their spores appear to be normally formed. While abnormally-formed spores provide strong evidence of hybridity in ferns, spores that appear normal do not rule out the plants being hybrids.

Most putative hybrids with *Gleichenia microphylla* involve the *G. dicarpa* morphological variant lacking both percurrent scales on the abaxial surface of the α costae and scales on the abaxial surface of the ultimate segments (group B; see Notes under *G. dicarpa*). But plants of *G. dicarpa* with percurrent scales on the abaxial surface of the α costae and scales on the abaxial surface of the ultimate segments from the northern North Island (group D; see Notes under *G. dicarpa*) also putatively hybridise with *G. microphylla* (e.g., Kawerua, A.E. Wright s.n., 13 May 1974, AK 223063; Opuia, L.R. Perrie 4814, WELT P022337), although these are not included in the *Gleichenia* key.

Perrie & Brownsey (2015) noted that most of the syntype material of *Gleichenia punctulata* appears to be the hybrid between *G. dicarpa* and *G. microphylla*. The single exception is the piece at lower-left of WELT P003355/B, which belongs to group D of *G. dicarpa* (see Notes under *G. dicarpa*). Furthermore, Colenso's protologue relates to both taxa (Perrie & Brownsey 2015). The lectotype was therefore selected to attach Colenso's name to the bulk of the syntype material.

It is not clear which group of *Gleichenia dicarpa* is involved in the hybrid combination represented by the lectotype. While it was evidently collected with a specimen of group D, the lectotype lacks both percurrent scales on the abaxial surface of the α costae and scales on the abaxial surface of the ultimate segments, consistent with group B rather than group D. However, it is uncertain how these characters are expressed in hybrids of group D with *G. microphylla*, although at least some such putative hybrids have scales on the abaxial surface of the ultimate segments (see above).

Given the taxonomy adopted here, the binomial *Gleichenia ×punctulata* can be used for hybrids between *G. dicarpa* and *G. microphylla*. We note, however, that if segregates are formally recognised within what we here treat as *G. dicarpa*, the name *G. ×punctulata* may be difficult to apply. This is because of the uncertain parentage of the lectotype, discussed above.

***Sticherus* C.Presl, Tent. Pterid., 51 (1836)**

Type taxon: *Sticherus laevigatus* (Willd.) C.Presl

Etymology: From the Greek *stichos* (in a row or line), possibly a reference to the ordered rows of elongate ultimate segments.

Vernacular name: umbrella ferns

Terrestrial ferns. Rhizomes long-creeping, scaly. Stipes scaly or glabrescent. Rachis with pinnate laminae (not NZ), or reduced to a bud at the apex of the stipe with a single pair of pinnae (NZ); rachis buds sometimes extending to produce another tier comprising a rachis terminating in another rachis bud and pair of pinnae (NZ). Pinnae unforked, being equivalent to an ultimate segment (not NZ) or to an ultimate leaflet (rarely NZ), or forking pseudodichotomously 1 to several times (NZ); buds at bifurcations sometimes extending 1-several times. Laminae, axes, and rachis and pinna buds bearing scales, sometimes hair-like. β costae bearing costal segments. α costae of the ultimate leaflets arising pseudodichotomously from distal end of β costae. Ultimate segments on α costa >4 mm long, oblong or linear, entire or crenulate, with once-branched veins between midvein and margin. Sori superficial, 3–18 either side of midvein, each with 3–5 sporangia. Spores monolete, rugulate and perforate.

Taxonomy: A genus of about 95 species (Gonzales & Kessler 2011).

Allan (1961) included *Sticherus* in a broadly-circumscribed *Gleichenia*. The nomenclatural history of *Sticherus* was detailed by Pichi Sermolli (1972). The New Zealand species of *Sticherus* were reviewed by Brownsey et al. (2013).

- 1 Proximal-most costae with 3–8 pairs of costal segments; ultimate segments arising at 70–85° from α costae *tener*
Proximal-most costae usually with 0–2 pairs of costal segments (excluding pseudostipules), rarely 3–4; ultimate segments arising at 40–70° from α costae 2

- 2 Scales on abaxial surface of α costae ovate, >250 μ m wide; ultimate segments abaxially glaucous, 5–20 mm long *cunninghamii*
 Scales on abaxial surface of α costae acicular or hair-like, <200 μ m wide; ultimate segments abaxially green, 8–55 mm long 3
- 3 α costae >10 times longer than proximal-most costae; ultimate segments crenulate, crenulations extending along length of margin; angle between pairs of ultimate leaflets in centre of laminae usually 20–40°; confined to northern North Island *flabellatus*
 α costae usually <10 times longer than proximal-most costae; ultimate segments entire or crenulate, crenulations often restricted to apex; angle between pairs of ultimate leaflets in centre of laminae often 40–60°; confined to South Island *urceolatus*

Distribution: Widespread in tropical and southern temperate regions, although very few species in Africa; 54 species occur in the Neotropics (Gonzales & Kessler 2011), about 16 in Malesia (Holtum 1959) and nine in the tropical Pacific; in the southern temperate zone there are five species in both Chile (Marticorena & Rodríguez 1995) and Australia (Chinnock & Bell 1998). Four species in New Zealand; one endemic.

Biostatus: Indigenous (Non-endemic).

Table 4: Number of species in New Zealand within *Sticherus* C.Presl

Category	Number
Indigenous (Endemic)	1
Indigenous (Non-endemic)	3
Total	4

Recognition: *Sticherus* can be distinguished from the superficially-similar *Dicranopteris* by the presence of laminae on the axes subtending the pseudodichotomously-paired ultimate leaflets; that is, *Sticherus* has costal segments on the β costae, and *Dicranopteris* does not. In New Zealand, the ultimate segments of at least 5 mm in length distinguish *Sticherus* from *Gleichenia*, which has ultimate segments <3 mm long.

Cytology: The base chromosome number in *Sticherus* is $x = 34$ (Kramer 1990).



Fig. 83: *Sticherus cunninghamii*. Ultimate segments with numerous sori, each with 3-5 sporangia.

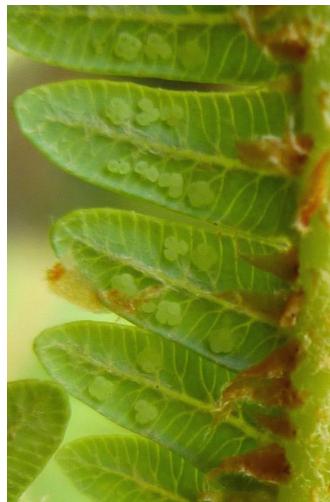


Fig. 84: *Sticherus cunninghamii*. Veins branching only once between midvein and margin.

***Sticherus cunninghamii* (Heward ex Hook.) Ching, *Sunyatsenia* 5: 283 (1940)**

≡ *Gleichenia cunninghamii* Heward ex Hook., *Sp. Fil.* 1, 6, t. 6b (1844) — as *G. cunninghami* Lectotype (designated by Perrie & Brownsey 2015): New Zealand, *Edgerley s.n.*, herb. Hook., K! (photo WELT E471/10)

= *Gleichenia ciliata* Colenso, *Trans. & Proc. New Zealand Inst.* 29: 414 (1897)

≡ *Sticherus ciliatus* (Colenso) Nakai, *Bull. Natl. Sci. Mus.* 29: 15 (1950)

Lectotype (designated by Perrie & Brownsey 2015): Ruahine Range, *Andrews s.n.*, WELT P003358!

= *Gleichenia cunninghamii* var. *montanum* Dobbie, *New Zealand Ferns ed. 3*, 399 (1931)

Lectotype (designated by Perrie & Brownsey 2015): Fig. 142a in Dobbie, *New Zealand Ferns ed. 3*, 399 (1931).

Etymology: Named in honour of Allan Cunningham (1791-1839), a plant collector for Kew and colonial botanist in New South Wales.

Vernacular names: rarauheriki; tapuwae kōtuku; umbrella fern; waekura

Rhizomes long-creeping, 2–5 mm diameter; rhizome scales lanceate, 2.5–7.0 mm long, 0.5–1.0 mm wide, brown, shortly ciliate. Fronds 140–980 mm long. Stipes 65–730 mm long, scaly particularly distally, or glabrous. Laminae 70–450 mm long, 130–490 mm wide, adaxially green, abaxially usually glaucous (rarely ± green), coriaceous or herbaceous, scaly. Rachis buds not extending or extending once (rarely twice), scaly; usually pseudostipulate, with one usually lobed costal segment near base of each flanking branch. Rachis bud scales lanceate or ovate, 0.8–5.0 mm long, 0.2–1.6 mm wide, brown, ciliate. Pinnae 120–280 mm long, 75–400 mm wide; with 3 (rarely 2 or 4) successive pseudodichotomous forks (excluding growth from pinna buds); pinna buds not extending or rarely extending once or twice, sometimes absent. Proximal-most (primary) costae 5–20 mm long, with usually 0–2 (rarely 3) pairs of costal segments (excluding pseudostipules). β costae 8–80 (rarely to 120) mm long, with 3–20 (rarely to 39) pairs of costal segments. Ultimate leaflets narrowly ovate, 80–270 mm long, 9–34 mm wide, usually angustate (rarely caudate), usually mostly falcate; with 30–66 pairs of ultimate segments; pairs in centre of lamina diverging 30–55°. Abaxial surface of α costae scaly; scales lanceate or ovate, 1350–4000 μm long, 280–850 μm wide, brown, ciliate, persistent. Ultimate segments narrowly oblong, 5–20 mm long, 1–2.5 mm wide, arising at 55–70° from α costae, entire, acute; abaxial surface with persistent pale stellate scales that resemble branched hairs. Sori 3–17 either side of midvein, usually with 3–5 sporangia each. Spores 29–31 μm long, 14–15 μm wide (4 populations).

Distribution: North Island: Northland, Auckland, Volcanic Plateau, Gisborne, Taranaki, Southern North Island.

South Island: Western Nelson, Sounds-Nelson, Westland, Canterbury, Otago, Fiordland, Southland.

Stewart Island, Auckland Islands.

Altitudinal range: 5–1370 m.

Sticherus cunninghamii is widespread from near Kaitiāia in the North Island through to Stewart Island, and also occurs on the Auckland Islands. It occurs from near sea level to 1250 m above sea level in the North Island, 1370 m in north-west Nelson, and just over 1000 m elsewhere in the South Island. It is absent from large areas east of the axial ranges in both the North and South Islands.

Biostatus: Indigenous (Endemic).

Habitat: *Sticherus cunninghamii* occurs in all major forest types, as well as in scrub. It extends rarely to subalpine grassland. It grows in the open or in shade, and while often found in drier sites like ridges and banks, it can also occur on wet ground.

Recognition: The abaxially glaucous ultimate segments and prominent scales on the abaxial surface of the α costae distinguish *Sticherus cunninghamii* from the other *Sticherus* species in New Zealand.

Cytology: $n = 34$ (Brownlie 1958).

Hybridisation: *Sticherus cunninghamii* hybridises infrequently with all of the other *Sticherus* species in New Zealand. Hybrids can usually be recognised by their intermediate frond and scale characteristics and abnormally formed spores. Hybrids with *S. tener* and *S. urceolatus* were documented by Brownsey et al. (2013). Based on morphological intermediacy, hybrids between *S. cunninghamii* and *S. flabellatus* also occur, albeit infrequently (e.g., abaxially glaucous, but with

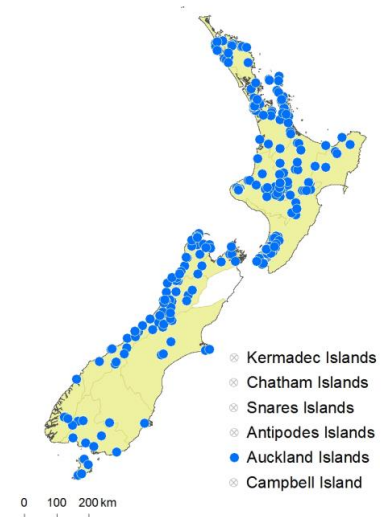


Fig. 85: *Sticherus cunninghamii* distribution map based on databased records at AK, CHR and WELT, and supplemented with selected OTA records.

caudate leaflets, and scales on the abaxial surface of the α costae of intermediate width); unlocalised, *Colenso s.n.*, WELT P002888, P002890, P002891, P002897, P002905; Whangarei, *A.J. Dakin s.n.*, AK 213848; Great Barrier Island, *A.E. Wright s.n.*, AK 220418. The spores of WELT P002891 include a high proportion of irregular shapes, supporting the inference of hybridity.



Fig. 86: *Sticherus cunninghamii*. Habit.



Fig. 87: *Sticherus cunninghamii*. Frond, showing β costae with costal segments.



Fig. 88: *Sticherus cunninghamii*. Rachis extending to produce a second tier of pinnae.



Fig. 89: *Sticherus cunninghamii*. Abaxial (left) and adaxial (right) surfaces of ultimate leaflets, showing the glaucous undersurface.



Fig. 90: *Sticherus cunninghamii*. Indumentum on stipe and proximal-most costae; rachis bud pseudostipulate.

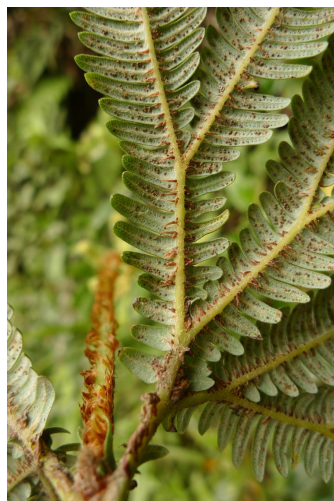


Fig. 91: *Sticherus cunninghamii*. Indumentum on abaxial surface of costae.



Fig. 92: *Sticherus cunninghamii*. Indumentum on abaxial surface of costae, in young frond.



Fig. 93: *Sticherus cunninghamii*. Sori, each with 3–5 sporangia.

Sticherus flabellatus* (R.Br.) H.St.John, *Occas. Pap. B. P. Bishop Mus. 17: 81 (1942)

≡ *Gleichenia flabellata* R.Br., *Prodr. Fl. Nov. Holland.*, 161 (1810)

≡ *Mertensia flabellata* (R.Br.) Poir., *Encycl. Suppl.* 3, 670 (1814)

Lectotype (designated by Perrie & Brownsey 2015): Port Jackson, [New South Wales,] *R. Brown Iter. Austral.* 109, BM 001038249!

= *Gleichenia littoralis* Colenso, *Trans. & Proc. New Zealand Inst.* 16: 344 (1884)

Lectotype (designated by Allan 1961): Great Barrier Island, *C.P. Winkelmann s.n.*, WELT P003359!

Etymology: From the latin *flabellatus* (fan-shaped), a reference to the shape of the frond.

Rhizomes long-creeping, 2.5–6 mm diameter; rhizome scales lanceate or ovate, 1.3–2.6 mm long, 0.3–0.8 mm wide, brown, ciliate, sometimes only shortly so. Fronds 180–1490 mm long. Stipes 55–1100 mm long, scaly proximally or glabrous. Laminae 90–770 mm long, 100–450 mm wide, green on both surfaces, herbaceous, scaly. Rachis buds not extending or extending once (rarely 2–3 times), scaly; not pseudostipulate. Rachis bud scales lanceate or ovate, 1.2–2.6 mm long, 0.2–0.7 mm wide, brown, ciliate. Pinnae 95–400 mm long, 120–260 mm wide; with 2–3 (rarely 1) successive pseudodichotomous forks (excluding growth from pinna buds); pinna buds not extending or rarely extending once or twice. Proximal-most (primary) costae 6–20 mm long, with 0–1 pairs of costal segments. β costae 13–75 mm long, with 3–23 pairs of costal segments. Ultimate leaflets narrowly ovate or narrowly elliptic, 100–280 mm long, 20–80 mm wide, usually at least some caudate (otherwise angustate), usually mostly straight; with 24–52 pairs of ultimate segments; pairs in centre of lamina diverging 20–40° (rarely 45°). Abaxial surface of α costae scaly; scales acicular or hair-like, 500–1600 μ m long, 30–90 μ m wide, pale, ciliate, glabrescent. Ultimate segments narrowly oblong or linear, 14–55 mm long, 1.5–2.5 mm wide, arising at 40–65° from α costae, crenulate, acute; abaxial surface with pale stellate scales that resemble branched hairs, glabrescent. Sori 7–18 either side of midvein, usually with 4–5 sporangia each. Spores 32–35 μ m long, 17–19 μ m wide (4 populations).

Distribution: North Island: Northland, Auckland.

Altitudinal range: 0–370 m.

Sticherus flabellatus occurs from North Cape to near Waihi in the North Island. The highest recorded altitude of c. 370 m above sea level occurs in Puketi Forest. Collections from further south are discounted because they are probably incorrectly labelled or from cultivated plants (Ōpōtiki, *Baxter s.n.*, WELT P018468; Ōpepe, collector unknown, WELT P005416; Mt. Freeth, Picton, *McMahon s.n.*, WELT P010704). The South Island records from near Tākaka and Stockton discussed by Given (1982) are misidentifications of other *Sticherus* species (Brownsey et al. 2013).

Also New Guinea, Australia (Northern Territory, Queensland, New South Wales, Victoria), New Caledonia.

Biostatus: Indigenous (Non-endemic).

Habitat: *Sticherus flabellatus* frequently occurs alongside waterways, roads, and tracks, but also on bluffs, and in swamps, gumlands, and other habitats associated with high light levels. It is usually associated with scrub or low, open forest, principally *Leptospermum* and/or *Kunzea*, but it can occur in gaps within *Agathis australis*, podocarp, and/or broadleaved (e.g., *Weinmannia*, *Beilschmiedia*) forest.

Recognition: The crenulate and abaxially green ultimate segments, usually caudate leaflets, acicular or hair-like scales on the abaxial surface of the α costae, and the ultimate segments arising at $\leq 70^\circ$ from the α costae distinguish *Sticherus flabellatus* from *S. cunninghamii* and *S. tener*. *Sticherus flabellatus* is very similar to *S. urceolatus*, but the former usually has longer α costae relative to the proximal-most costae, and more pronounced serrations of the ultimate segments. The difference in ploidy is reflected in the smaller spore size of *S. flabellatus* (32–35 μm long, 17–19 μm wide cf. 38–43 μm long, 19–23 μm wide for *S. urceolatus*). In New Zealand, *S. flabellatus* (northern North Island) and *S. urceolatus* (northern and western South Island) are allopatric.

Cytology: $n = 34$ (Brownlie 1961)

Hybridisation: *Sticherus flabellatus* hybridises, albeit infrequently, with *S. cunninghamii*, based on morphological intermediacy (e.g., abaxially glaucous, but with caudate leaflets, and scales on the abaxial surface of the α costae of intermediate width): unlocalised, *Colenso s.n.*, WELT P002888, P002890, P002891, P002897, P002905; Whangarei, *A.J. Dakin s.n.*, AK 213848; Great Barrier Island, *A.E. Wright s.n.*, AK 220418. The spores of WELT P002891 include a high proportion of irregular shapes, supporting the inference of hybridity. Furthermore, *S. flabellatus* may be a diploid progenitor, together with *S. tener*, of the tetraploid and putatively allopolyploid *S. urceolatus* (Brownsey et al. 2013).

Notes: Chinnock & Bell (1998) accepted two varieties in Australia, distinguished by segment and sporangia size. The typical variety was attributed to New Zealand. The other variety, *var. compactus* (C.T.White & Goy) D.A.Sm., is endemic to northern Australia.

In relation to *Gleichenia littoralis* Colenso, the statement by Allan (1961, p.21) that “Colenso based his description on the Great Barrier specimens; the type specimen, at W [WELT]...” constitutes lectotypification because there is only one collection in WELT from Great Barrier Island (WELT P003359). It comprises three fronds. The other syntypes are: New Zealand, *W. Colenso s.n.*, com. Dec. 1885, K! (photo WELT E471/9); Whangaruru Harbour, *W. Colenso s.n.*, WELT P002907!

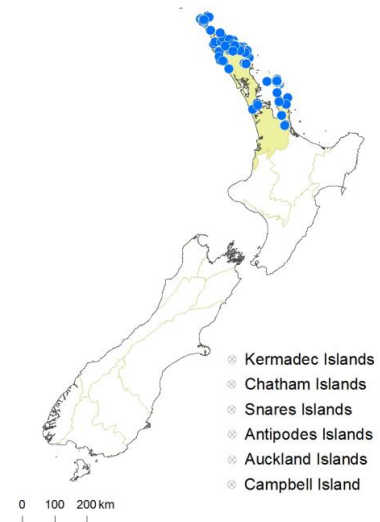


Fig. 94: *Sticherus flabellatus* distribution map based on databased records at AK, CHR and WELT.



Fig. 95: *Sticherus flabellatus*. Habit.



Fig. 96: *Sticherus flabellatus*. Frond.



Fig. 97: *Sticherus flabellatus*. Rachis bud, without pseudostipules.



Fig. 98: *Sticherus flabellatus*. Ultimate segments, with crenulate margin.

***Sticherus tener* (R.Br.) Ching, *Sunyatsenia* 5: 285 (1940)**

as "tenerus"

≡ *Gleichenia tenera* R.Br., *Prodr. Fl. Nov. Holland.*, 161 (1810)

≡ *Mertensia tenera* (R.Br.) Poir., *Encycl. Suppl.* 3, 670 (1814)

≡ *Gleichenia flabellata* var. *tenera* (R.Br.) Hook.f., *Bot. Antarct. Voy. III. (Fl. Tasman.) Part II*, 131 (1858)

Lectotype (designated by Perrie & Brownsey 2015): Mons Tabul [Mons Tabularis = Table Mt = Mt Wellington], Tasmania, *R. Brown Iter Austral.* 110, BM 001038245!

Etymology: From the latin *tener* (soft, delicate), a reference to the texture of the frond.

Rhizomes long-creeping, 1.5–3 mm diameter; rhizome scales lanceate, 1.3–3.5 mm long, 0.2–0.7 mm wide, brown, ciliate, sometimes only shortly so, rarely ± entire. Fronds 200–630 mm long. Stipes 80–380 mm long, scaly proximally and/or distally or glabrous. Laminae 90–330 mm long, 90–340 mm wide, green on both surfaces, herbaceous, scaly. Rachis buds often not extending or occasionally extending once (rarely twice), scaly; sometimes pseudostipulate, with one or two costal segments on stipe below or level with rachis bud, rarely with additional costal segments near base of each flanking branch. Rachis bud scales lanceate, 1.3–2.7 mm long, 0.2–0.6 mm wide, brown, ciliate. Pinnae 90–190 mm long, 45–260 mm wide; with 1 (occasionally 2, rarely 0) pseudodichotomous fork (excluding growth from pinna buds); pinna buds not extending or rarely extending once. Proximal-most (primary) costae 12–34 mm long, with 3–8 pairs of costal segments. β costae (where not proximal-most costae) 22–55 mm long, with 6–13 pairs of costal segments. Ultimate leaflets narrowly ovate, 75–180 mm long, 16–40 mm wide, usually angustate, rarely caudate, falcate or straight; with 21–43

pairs of ultimate segments; pairs in centre of lamina diverging 40–70°. Abaxial surface of α costae scaly; scales lanceate, 1200–2450 μm long, 80–300 μm wide, brown, ciliate, persistent. Ultimate segments narrowly oblong, 10–22 mm long, 1.5–3 mm wide, arising at 70–85° from α costae, usually entire or rarely crenulate, acute; abaxial surface with pale stellate scales that resemble branched hairs, sometimes glabrescent. Sori 3–11 either side of midvein, usually with 3–4 sporangia each. Spores 33–37 μm long, 17–18 μm wide (5 samples, 2 populations).

Distribution: South Island: Western Nelson, Fiordland.

Altitudinal range: 50–690 m

Sticherus tener has two disjunct occurrences: near Westport, on and between the Stockton and Denniston Plateaus, at 450–690 m above sea level; and on Resolution and Anchor Islands and Mt. Hodges in Fiordland, at 50–600 m above sea level. Plants of *S. tener* have not been collected from Stewart Island, but there are putative hybrids between *S. tener* and *S. cunninghamii* from there (Mt. Anglem, M.A. Ritchie s.n., CHR 372808; south side of The Paps, H.D. Wilson 798.227, CHR 404108).

Also Australia (Victoria, Tasmania).

Biostatus: Indigenous (Non-endemic).

Sticherus tener was ranked by de Lange et al. (2013) as Nationally Critical within the New Zealand Threat Classification System.

Habitat: The *Sticherus tener* populations near Westport occur within sandstone overhangs and on steep banks, amongst low woody vegetation. The Fiordland populations occur on poor soils under scrub or low, mixed forest, but extend into taller beech/podocarp forest.

Recognition: The near right angle (70–85°) at which the ultimate segments arise from the α costae, and the 3–8 pairs of costal segments on the proximal-most costae distinguish *Sticherus tener* from the other *Sticherus* species in New Zealand.

Cytology: No count has been made from New Zealand material of *Sticherus tener*, but $n = 34$ has been reported for Australian material (Garrett et al. 1998).

Hybridisation: *Sticherus tener* hybridises with *S. cunninghamii* (Brownsey et al. 2013). Hybrids can usually be recognised by their intermediate frond and scale characteristics and abnormally formed spores. Additionally, *S. tener* may be a diploid progenitor, together with *S. flabellatus*, of the tetraploid and putatively allopolyploid *S. urceolatus* (Brownsey et al. 2013).

Notes: New Zealand material is not known to reach the frond size, the number of tiers of pinnae, or extent of pinna forking recorded for Australia (Garrett et al. 1998).

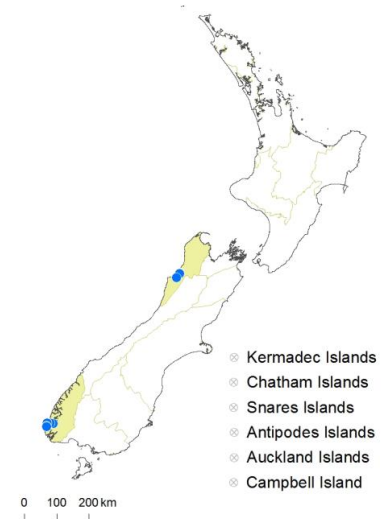


Fig. 99: *Sticherus tener* distribution map based on databased records at AK, CHR and WELT, and supplemented with selected OTA records.



Fig. 100: *Sticherus tener*. Habit.



Fig. 101: *Sticherus tener*. Frond.



Fig. 102: *Sticherus tener*. Small frond, still showing ultimate segments arising at close to 90° from α costae.



Fig. 103: *Sticherus tener*. Pseudostipules, below rachis bud (which has extended).



Fig. 104: *Sticherus tener*. Abaxial surface of ultimate leaflet, showing sori with 3–4 sporangia.



Fig. 105: *Sticherus tener*. Rhizome.

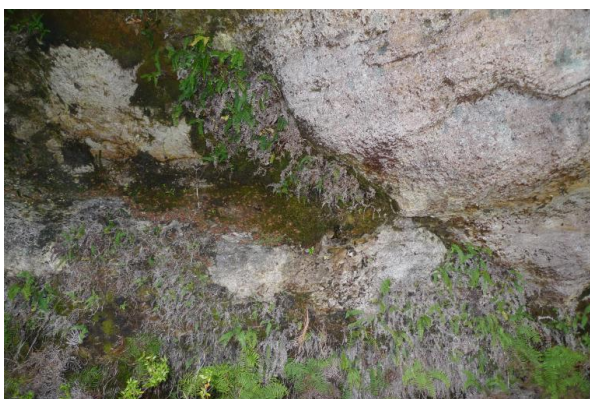


Fig. 106: *Sticherus tener*. Habitat, on walls of rock overhang.



Fig. 107: *Sticherus tener*. Habitat, in colluvium under rock overhang.

Sticherus urceolatus M. Garrett & Kantvilas in Garrett et al., *Muelleria* 11: 103 (1998)

Holotype: Graham Creek, 2 km S of Wineglass Bay, Freycinet Peninsula, Tasmania, *M. Garrett s.n.*, 10 Aug. 1997, HO (image!); isotypes BM 001038241, CHR 522859, MEL 2279261, NSW 487544.

Etymology: From the latin *urceolatus* (urn-shaped), a reference to the vase-shaped habit of the pinnae when growing in an exposed position.

Rhizomes long-creeping, 2–5 mm diameter; rhizome scales lanceate or ovate, 1.7–4.2 mm long, 0.5–0.8 mm wide, brown, ciliate. Fronds 120–930 mm long. Stipes 40–600 mm long, scaly proximally or glabrous. Laminae 65–390 mm long, 75–390 mm wide, green on both surfaces, herbaceous, scaly. Rachis buds not extending or sometimes extending once (rarely twice), scaly; sometimes pseudostipulate, with a single, usually lobed costal segment near base of each flanking branch. Rachis bud scales lanceate, rarely ovate, 1.7–3.5 mm long, 0.3–0.7 mm wide, brown, ciliate. Pinnae 70–390 mm long, 30–180 mm wide; with 2 (occasionally 0, 1 or 3) successive pseudodichotomous forks (excluding growth from pinna buds); pinna buds not extending or rarely extending once. Proximal-most (primary) costae 11–32 mm long, with 0–4 pairs of costal segments (excluding pseudostipules). β costae 26–65 mm long, with 5–13 pairs of costal segments. Ultimate leaflets narrowly ovate or narrowly elliptic, 60–280 (rarely 310) mm long, 15–54 (rarely 90) mm wide, angustate or caudate, usually mostly straight; with 21–58 pairs of ultimate segments; pairs in centre of lamina diverging 40–60° (occasionally 30°). Abaxial surface of α costae scaly; scales acicular, 1000–2100 μ m long, 80–180 μ m wide, brown, ciliate, glabrescent. Ultimate segments narrowly oblong (rarely linear), 8–30 (rarely 52) mm long, 1.5–3 (rarely 4) mm wide, arising at 60–70° from α costae, usually crenulate or rarely entire, acute; abaxial surface with pale stellate scales that resemble branched hairs, glabrescent. Sori 3–16 either side of midvein, usually with 3–5 sporangia each. Spores 38–43 μ m long, 19–23 μ m wide (5 samples, 2 populations).

Distribution: South Island: Western Nelson.

Altitudinal range: 0–900 m

Sticherus urceolatus occurs in Golden Bay near the coast, and near Westport, on and between the Stockton and Denniston Plateaus, at 310–900 m above sea level. A putative hybrid between *S. urceolatus* and *S. cunninghamii* has been collected from Indian Island in Fiordland, at about 130 m above sea level; no definite specimens of *S. urceolatus* from Fiordland were known to Brownsey et al. (2013).

Also Australia (New South Wales, Victoria, Tasmania).

Biostatus: Indigenous (Non-endemic).

Sticherus urceolatus was ranked by de Lange et al. (2013) as Nationally Critical within the New Zealand Threat Classification System.

Habitat: The *Sticherus urceolatus* populations near Westport occur on steep, north-facing cliffs, and along streamsides, track cuttings and roadsides amongst low, woody vegetation, and in more open areas on sloping river banks. The population in Golden Bay occurs on shoreline bluffs including coal measures amongst low, woody vegetation. A nearby site with *S. cunninghamii* \times *S. urceolatus* comprises sandy granite soil beside a river, under a light forest canopy.

Recognition: The crenulate and abaxially green ultimate segments, acicular or hair-like scales on the abaxial surface of the α costae, and the ultimate segments arising at $\leq 70^\circ$ from the α costae distinguish *Sticherus urceolatus* from *S. cunninghamii* and *S. tener*. *Sticherus urceolatus* is very similar to *S. flabellatus*, but the former usually has shorter α costae relative to the proximal-most costae, and less pronounced serrations on the ultimate segments. The difference in ploidy is reflected in the larger spore size of *S. urceolatus* (38–43 μ m long, 19–23 μ m wide cf. 32–35 μ m long, 17–19 μ m wide for *S. flabellatus*). In New Zealand, *S. urceolatus* (northern and western South Island) and *S. flabellatus* (northern North Island) are allopatric.

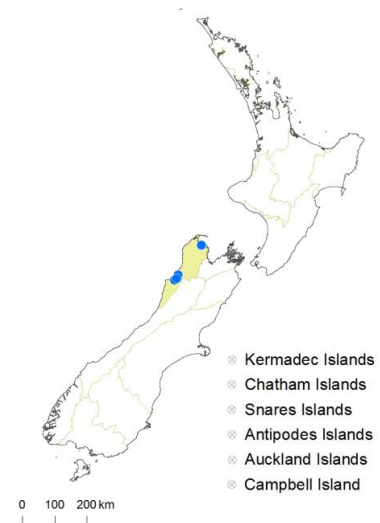


Fig. 108: *Sticherus urceolatus* distribution map based on databased records at AK, CHR and WELT.

Cytology: No count has been made from New Zealand material of *Sticherus urceolatus*, but $n = 68$ has been reported for Australian material (Garrett et al. 1998).

Hybridisation: *Sticherus urceolatus* hybridises with *S. cunninghamii*, although the hybrids can be difficult to distinguish (see Brownsey et al. 2013). The hybrid population in Golden Bay has abnormally formed spores. However, the material of putative hybrids from Fiordland available to Brownsey et al. (2013) was not sufficiently mature to check for the expected presence of abnormally formed spores.

Notes: New Zealand material is not known to reach the frond size or the number of tiers of pinnae recorded for Australia (Garrett et al. 1998).



Fig. 109: *Sticherus urceolatus*. Frond.



Fig. 110: *Sticherus urceolatus*. Frond.



Fig. 111: *Sticherus urceolatus*. Abaxial surface of ultimate leaflet showing slightly crenulate margins and sori with 3–5 sporangia.

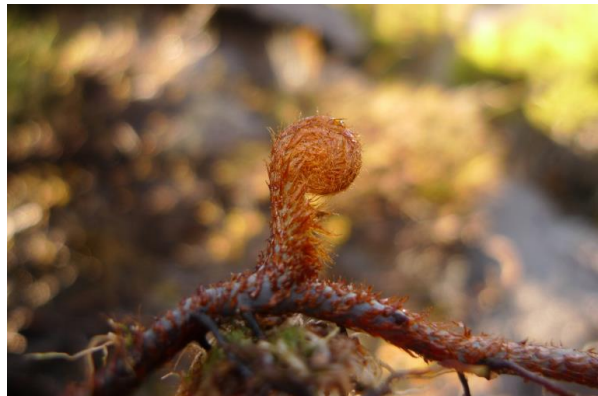


Fig. 112: *Sticherus urceolatus*. Frond newly emerging from rhizome.



Fig. 113: *Sticherus urceolatus*. Habitat.



Fig. 114: *Sticherus urceolatus*. Habitat, within rock overhang.

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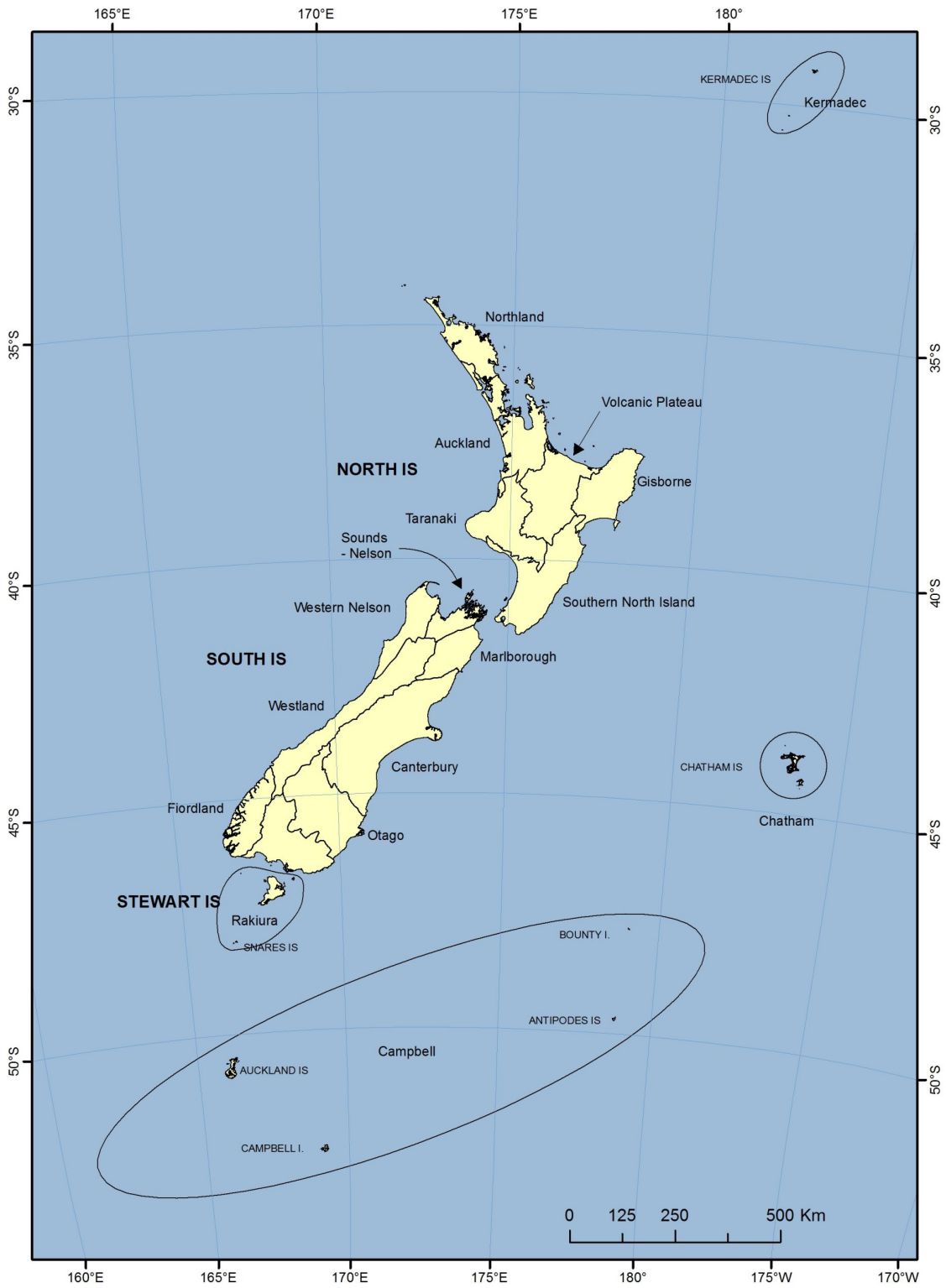
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L.R. Perrie and P.J. Brownsey

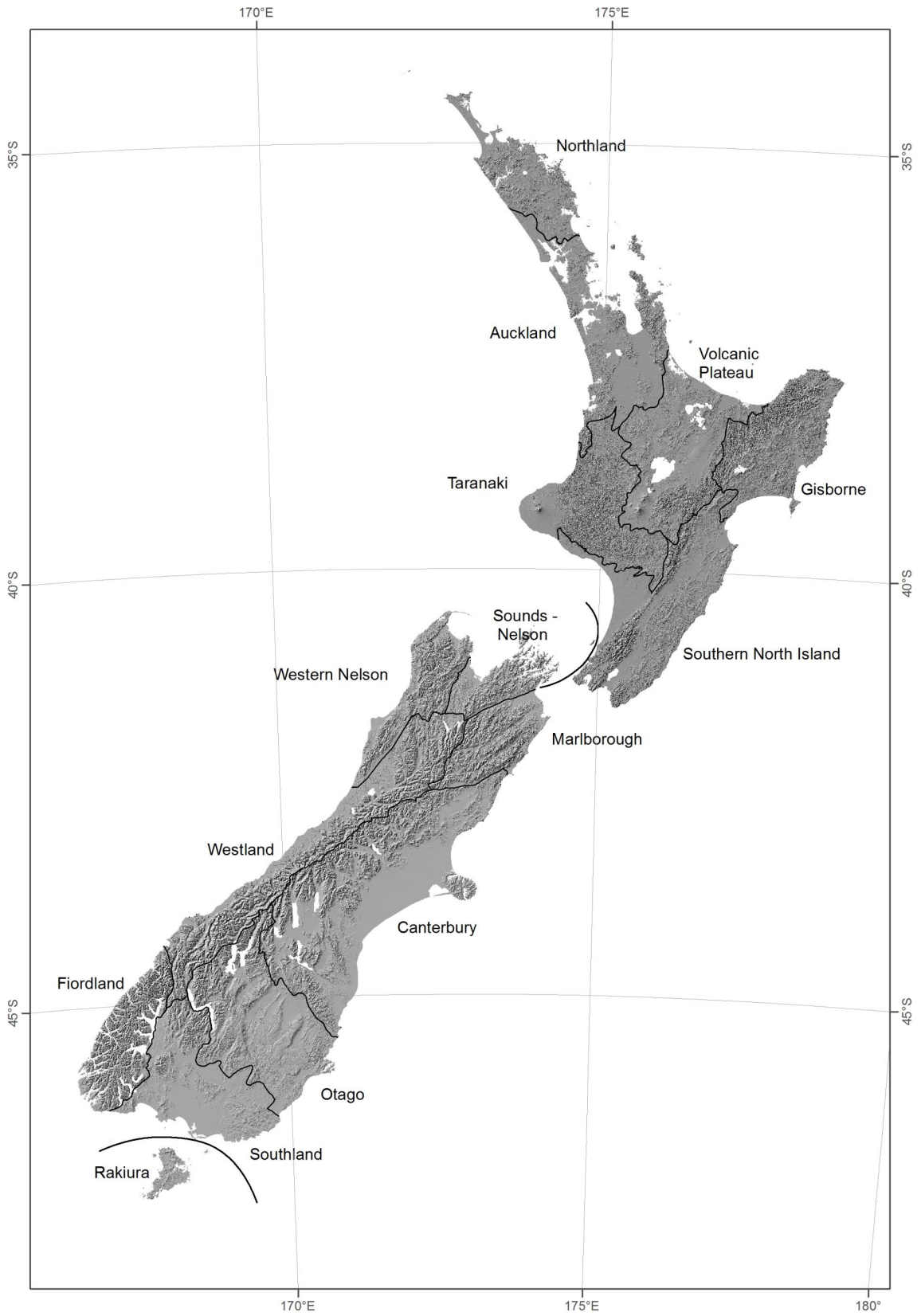
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Map 1: Map of New Zealand and offshore islands showing Ecological Provinces



Map 2: Map of New Zealand showing Ecological Provinces

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