



FLORA OF NEW ZEALAND
FERNS AND LYCOPHYTES

THELYPTERIDACEAE



P.J. BROWNSEY & L.R. PERRIE

Fascicle 16 – AUGUST 2016

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CATALOGUING IN PUBLICATION

Brownsey, P.J. (Patrick John), 1948-

Flora of New Zealand [electronic resource] : ferns and lycophytes. Fascicle 16, Thelypteridaceae / P.J. Brownsey and L.R. Perrie. -- Lincoln, N.Z. : Manaaki Whenua Press, 2016.

1 online resource

ISBN 978-0-478-34786-9 (pdf)

ISBN 978-0-478-34761-6 (set)

1.Ferns -- New Zealand - Identification. I. Perrie, L.R. (Leon Richard). II. Title. III. Manaaki Whenua-Landcare Research New Zealand Ltd.

UDC 582.394.742(931)

DC 587.30993

DOI: 10.7931/B1G59H

This work should be cited as:

Brownsey, P.J. & Perrie, L.R. 2016: Thelypteridaceae. *In*: Breitwieser, I.; Wilton, A.D. *Flora of New Zealand - Ferns and Lycophytes*. Fascicle 16. Manaaki Whenua Press, Lincoln.
<http://dx.doi.org/10.7931/B1G59H>

Cover image: *Pneumatopteris pennigera*. Frond of mature plant.

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Introduction

The large family Thelypteridaceae is represented in New Zealand by just five genera (*Christella*, *Cyclosorus*, *Macrothelypteris*, *Pneumatopteris* and *Thelypteris*) with five non-endemic species. Four species have rather localised distributions confined to the northern part of the North Island, with two extending also to the Kermadec Islands. The fifth species, *Pneumatopteris pennigera*, is widely distributed throughout the North Island, much of the South Island and on the Chatham Islands. All members of the family in New Zealand are terrestrial ferns with pinnate to pinnate-pinnatifid fronds (except for *Macrothelypteris*, which is more divided), and they bear a variety of hairs, glands and scales. The veins are mostly free, except that the basal veins of the pinna lobes often unite below the sinus in a characteristic pattern, and the sori are round and protected by reniform indusia, except in *Pneumatopteris pennigera*, which is exindusiate.

***Thelypteridaceae* Pic.Serm., *Webbia* 24: 709 (1970)**

Type taxon: *Thelypteris* Schmidel

Terrestrial (NZ) or rarely epiphytic (not NZ) ferns. Rhizomes short- to long-creeping, erect or forming a short arborescent trunk, scaly. Fronds monomorphic or rarely dimorphic, not articulated to rhizome. Laminae undivided (not NZ) or 1-pinnate to 3-pinnate-pinnatifid (NZ), catadromous, herbaceous or coriaceous, usually hairy, sometimes bearing glands, rarely also scaly, often with aerophores in two lines on stipe and rachis and on abaxial surfaces at bases of pinnae. Veins free (NZ), or with one or more basal veins from adjacent pinna lobes uniting below the sinus (NZ), or rarely reticulate (not NZ). Sori round (NZ) or slightly elongate (not NZ), superficial, borne on abaxial surface away from margins; paraphyses usually absent or rarely present; indusia reniform, irregularly shaped or absent; sporangial maturation mixed. Sporangia with vertical annulus, usually 64 spores per sporangium. Homosporous; spores monolete (NZ) or rarely trilete (not NZ), lacking chlorophyll; perispores reticulate, winged, echinate or tuberculate.

Taxonomy: A family of 5–25 genera depending on authority, and almost 1000 species.

Taxonomic classification of the family remains uncertain with many different treatments having been proposed. At one extreme, Christenhusz & Chase (2014) suggest that the Thelypteridaceae should be subsumed within a greatly expanded Aspleniaceae. However, that would create a very large family that is difficult to define morphologically, and the concept is not accepted here. Most recent authorities, including Smith et al. (2006), recognise Thelypteridaceae as a clearly defined, monophyletic family, but subdivision of the family is more contentious. Smith et al. (2006) recognise only *Cyclosorus*, *Macrothelypteris*, *Phegopteris*, *Pseudophegopteris* and *Thelypteris*, which Christenhusz & Chase (2014) would reduce further to just three genera, whereas Holttum (1971a, 1977, 1982) grouped the Old World species into 25 genera. Holttum's treatment has been criticised for needing combinations of characters to define genera, and because generic boundaries are blurred by possible hybridisation and transitional species (Smith 1990). Smith (1971) and Smith et al. (2006) included *Christella* within a more broadly circumscribed *Cyclosorus*. Molecular evidence is still preliminary and not yet conclusive, especially with respect to the clade that includes *Christella*, *Cyclosorus* and *Pneumatopteris* (Smith & Cranfill 2002; He & Zhang 2012). The most recent work suggests that *Christella* is polyphyletic, with most Palearctic species, including *C. dentata*, not congeneric with Neotropical species (Almeida et al. 2016). Until there is greater clarity in the circumscription of these genera, we follow Holttum's long-standing treatment of the family in the Pacific and Australasia (Holttum 1977) to provide consistency and comparability with listings for Australia (Bostock 1998), Fiji (Brownsey & Perrie 2011) and the south-west Pacific (Nakamura 2008).

On the basis of Holttum's classification, the family is represented in New Zealand by five indigenous genera – *Christella*, *Cyclosorus*, *Macrothelypteris*, *Pneumatopteris* and *Thelypteris*. In stark contrast to the diversity in Australia and the Pacific, each of these genera is monotypic in New Zealand, and the five representatives are easily distinguished. Previously, they were all included in a broadly construed *Thelypteris* by Allan (1961).

- 1 Fertile laminae at least 2-pinnate-pinnatifid; lamina hairs up to 2 mm long;
indusia 0.2–0.4 mm wide *Macrothelypteris*
Fertile laminae 1-pinnate or 1-pinnate-pinnatifid, but not more divided;
lamina hairs up to 1 mm long; indusia absent or, if present, 0.4–1.2 mm wide 2
- 2 All veins free; indusia bearing capitate hairs *Thelypteris*
At least the basal pair of veins in each pinna segment uniting with those from
adjacent segments; indusia absent, glabrous or bearing acicular hairs 3
- 3 Rhizomes erect; sori lacking indusia *Pneumatopteris*
Rhizomes erect or creeping; sori with well-developed indusia 4
- 4 Basal pair of pinnae much shorter than those at mid-lamina *Christella*
Basal pair of pinnae about as long as those at mid-lamina *Cyclosorus*

Distribution: Widespread in tropical and sub-tropical regions, with a few species extending into temperate zones. The greatest diversity is found in Malesia, with 440 species (Holttum 1982), and the Neotropics, with another 300 species (Smith 1990). There are about 100 species in the Pacific region (Holttum 1977) and 23 in Australia (Bostock 1998). Five non-endemic genera with five species in New Zealand; none endemic.

Biostatus: Indigenous (Non-endemic).

Table 1: Number of species in New Zealand within *Thelypteridaceae* Pic.Serm.

Category	Number
Indigenous (Non-endemic)	5
Total	5

Recognition: The Thelypteridaceae comprise mostly terrestrial ferns with undivided to almost 4-pinnate fronds, which bear hairs and sometimes also glands and scales. Characteristically the stipes, rachises and pinna bases have aerophores, and the veins are mostly free, except that the basal veins of the pinna lobes often unite below the sinus. The sori are usually round, away from the margin, and either exindusiate or protected by reniform indusia. The sporangia have a vertical annulus, and almost always produce monolete spores.

***Christella* H.Lév., *Fl. Kouy-Tcheou*, 472 (1915)**

Type taxon: *Christella parasitica* (L.) H.Lév.

Etymology: Named in honour of K.H.H. Christ (1833–1933), Swiss pteridologist and Professor of Botany at Basel

Terrestrial ferns. Rhizomes erect to short- or long-creeping, scaly. Rhizome scales narrowly ovate, setiferous. Fronds monomorphic. Stipes hairy. Laminae 1-pinnate-pinnatifid, herbaceous, usually with 1–5 pairs of lower pinnae gradually reduced in size to c. 20 mm long; basal pinnae auricled acroscopically; aerophores at base of pinnae not swollen; abaxial surface of laminae lacking scales, usually bearing erect acicular hairs, often bearing short capitate hairs, and sometimes bearing thick red or orange glandular hairs (not NZ), lacking sessile spherical glands. Veins free (not NZ) or one or more basal veins from adjacent pinna lobes uniting below the sinus (NZ). Sori round, indusiate; paraphyses absent. Indusia reniform, bearing acicular hairs. Sporangia lacking glands or hairs near annulus, but bearing an elongate, unicellular, glandular hair on the stalk. Spores monolete, tuberculate or ridged.

Taxonomy: Allan (1961) included all New Zealand species of Thelypteridaceae within a broadly construed *Thelypteris*. Holttum (1976) recognised *Christella* as a distinct genus of Thelypteridaceae with about 50 species, mostly in the Old World tropics, and one species in New Zealand. He distinguished the genus principally by the presence of an elongate, unicellular, thick, blunt hair on the stalks of the sporangia (Holttum 1971a). In addition, the lower pinnae are gradually reduced, the aerophores at the base of the pinnae are not swollen, acicular hairs are usually present on both surfaces of the lamina, short capitate hairs are often present, thick red or orange glandular hairs are sometimes present (but not in New Zealand), sessile spherical glands are absent, the basal veins from adjacent pinnules usually join, and the sori are indusiate (Holttum 1977). Smith et al. (2006) included *Christella* within a broadly circumscribed *Cyclosorus*, but Holttum's classification is followed here for consistency (see Taxonomy under Thelypteridaceae).

Distribution: A genus of c. 50 species distributed in the tropics and subtropics of the Old World and one extending to tropical America (Holttum 1976); five species in Australia (Bostock 1998) and 18 in the Pacific (Holttum 1977). *Christella dentata* is naturalised in the New World (Smith 1971; Holttum 1976) and Hawai'i (Palmer 2003). One species in New Zealand; not endemic.

Biostatus: Indigenous (Non-endemic).

Table 2: Number of species in New Zealand within *Christella* H.Lév.

Category	Number
Indigenous (Non-endemic)	1
Total	1

Cytology: The base chromosome number in *Christella* is $x = 36$ (Holttum 1977; Smith 1990).

Notes: Holttum (1971b) accepted Lévillé's earlier name, *Christella*, for a genus that he was then in the process of recognising. He selected *C. parasitica* (L.) H.Lév. as the type of the genus and redefined some of the characters.

Davison (1995) investigated *Christella* in New Zealand for an M.Sc. at the University of Auckland, but the results of her work have never been published.

***Christella dentata* (Forssk.) Brownsey & Jermy, *Brit. Fern Gaz.* 10: 338 (1973)**

- ≡ *Polypodium dentatum* Forssk., *Fl. Aegypt.-Arab.*, 185 (1775)
- ≡ *Dryopteris dentata* (Forssk.) C.Chr., *Kongel. Danske Vidensk. Selsk. Naturvidensk. Math. Afh.* 6: 24 (1920)
- ≡ *Thelypteris dentata* (Forssk.) E.P.St.John, *Amer. Fern J.* 26: 44 (1936)
- ≡ *Cyclosorus dentatus* (Forssk.) Ching, *Bull. Fan Mem. Inst. Biol.* 8: 206 (1938)
Holotype: Yemen, Bolghose, *P. Forsskål* 809, C 10002814 (!online)
- = *Polypodium nymphale* G.Forst., *Fl. Ins. Austr.*, 81 (1786)
- ≡ *Aspidium nymphale* (G.Forst.) Schkuhr, *24 Kl. Linn. Pfl.-Syst.* 1, 36, t. 34 (1804)
- ≡ *Nephrodium nymphale* (G.Forst.) Desv., *Mém. Soc. Linn. Paris* 6: 258 (1827)
- ≡ *Dryopteris nymphalis* (G.Forst.) Copel., *Bernice P. Bishop Mus. Bull.* 59: 46 (1929)
- ≡ *Cyclosorus nymphalis* (G.Forst.) Ching, *Bull. Fan Mem. Inst. Biol.* 10: 247 (1941)
- ≡ *Thelypteris nymphalis* (G.Forst.) C.F.Reed, *Phytologia* 17: 297 (1968)
Lectotype (chosen by Holttum 1976): *G. Forster Herbarium* 279, BM 000036001! (said by Forster and Holttum to be from New Zealand, but the sheet is annotated "type Tahiti")
- = *Polypodium molle* Jacq., *Collectanea* 3, 188 (1791) nom. illeg. non *Polypodium molle* Schreb. 1771
- ≡ *Aspidium molle* Sw., *J. Bot. (Schrader)* 1800(2): 34 (1801) nom. nov. pro *Polypodium molle* Jacq. 1791
- ≡ *Nephrodium molle* (Sw.) R.Br., *Prodr. Fl. Nov. Holland.*, 149 (1810)
- ≡ *Dryopteris molle* (Sw.) Hieron., *Hedwigia* 46: 348 (1907)
Holotype: cult. in Vienna, *Jacquin s.n.*, W 0052625 (!online)
- = *Nephrodium remotum* Heward, *London J. Bot.* 1: 121 (1842)
Holotype: Norfolk Island, *A. Cunningham* 21, 1830, K 000951645 (!online)
- = *Christella dentata* var. *caespitosa* Holttum, *Kew Bull.* 41: 518 (1986)
Holotype: Australia, Queensland, 19 km S of Russell River bridge, on Innisfail-Cairns road, *R.J Chinnock* 5802 & *P.J. Brownsey*, AD 98304157!

Etymology: From the Latin *dentatus* (toothed), a reference to the incised pinnae.

Vernacular name: soft fern

Rhizomes either creeping, up to 150 mm long (in herbarium specimens, but recorded up to 1000 mm in wild populations) with stipes arising 1–10 mm apart in tufts at or near the apex, 2.5–4 mm diameter, or erect and up to 70 mm tall, or very rarely up to 1000 mm tall; bearing scattered scales. Rhizome scales narrowly ovate, 3.5–14 mm long, 0.5–1.2 mm wide, pale or chestnut-brown, entire, with numerous superficial hairs. Fronds 340–1195 mm long, arching upwards. Stipes 45–350 mm long, pale or yellow-brown (or sometimes purple), hairy throughout, scaly proximally. Laminae 1-pinnate to 1-pinnate-pinnatifid, elliptic, narrowed to a pinnatifid apex, 200–945 mm long, 68–350 mm wide, pale to dark green on both surfaces, herbaceous. Scales absent on lamina surfaces; colourless acicular hairs up to 1 mm long abundant on both surfaces and margins; tiny colourless to yellow capitate hairs on abaxial surface. Primary pinnae in 8–30 pairs below pinnatifid apex, widely spaced especially proximally, narrowly ovate or narrowly oblong; the longest at about the middle, sessile, 36–255 mm long, 10–31 mm wide; the basal pair 5–89 mm long, auricled acroscopically. Primary pinnae divided $\frac{1}{2}$ to $\frac{3}{4}$ to the midrib; ultimate segments 5–16 mm long, 3–6 mm wide; apices obtuse to truncate, margins entire and inrolled; sometimes the basal acroscopic segment extended and lobed up to 22 mm long and 11 mm wide. Basal veins on adjacent pinna segments joining, unbranched in each ultimate pinna segment. Sori round, in one row either side of midrib away from pinna margins; indusia reniform, 0.6–1.2 mm diameter, bearing acicular hairs.

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

Kermadec Islands.

Altitudinal range: 0–400 m.

Christella dentata has been recorded in lowland sites on the Kermadec Islands (Raoul, Macauley and Cheeseman Islands), from Te Pahi (Spirits Bay, Te Huka Bay, Akura Stream, Waitangi Stream), a few localities near Awanui north of Kaitaia, and in thermal regions from Rotorua to Tokaanu. It extends from near sea level to about 300 m on Raoul Island and 400 m near Taupō. It has also been collected from near Kāwhia Harbour, and from Paemako near Piopio, where the status of the populations as indigenous or naturalised is uncertain; neither population is extant. There are populations which are naturalised in a few sites in Auckland and Hamilton, and these may have originated from indigenous plants brought into cultivation at various sites nearby (e.g. AK 305923, Auckland). Others may have originated from cultivated plants with an overseas origin (see below). There is also a specimen in the Armstrong Herbarium (CHR 633413) supposedly collected from Heathcote, Christchurch by J.F. Armstrong in 1863 that might have come from a naturalised plant, although such a record is unlikely at this locality.

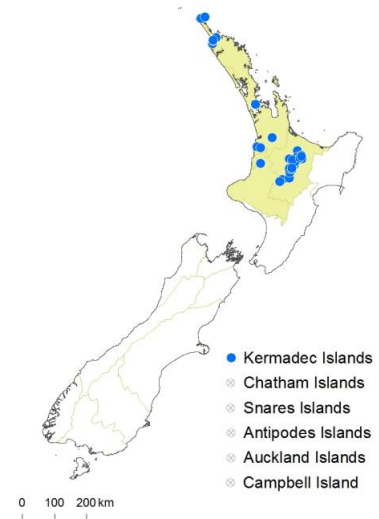


Fig. 1: *Christella dentata* distribution map based on databased records at AK, CHR and WELT.

Widely distributed in the tropics and subtropics of the Old World from Africa to India, Asia, Australia and most of the islands in the Pacific; extends north to the Azores, Madeira and Crete (Brownsey & Jermy 1973). Naturalised in the Americas (Smith 1971; Holtum 1976) and Hawai'i (Palmer 2003); Strother & Smith (1970) noted that although common in greenhouses and botanical gardens, it was collected in the New World only twice before 1930, but has since spread very rapidly. Plants in the Neotropics and in Hawai'i have distinctive purple stipes similar to some naturalised plants in New Zealand (e.g. AK 305922, Auckland) and some plants of uncertain status (e.g. AK 212348, Kāwhia).

Biostatus: Indigenous (Non-endemic).

Indigenous: non-endemic (but naturalised in Auckland and Hamilton and possibly western Waikato).

The species was given a conservation status of 'At Risk / Naturally Uncommon' by de Lange et al. (2013).

Habitat: On the Kermadec Islands *Christella dentata* grows in *Metrosideros* forest, clearings, scrub, open grassland, pumice banks, under overhanging cliffs, disturbed areas, in swampy sites and at the entrance to petrel burrows with *Hypolepis dicksonioides*. Around Kaitaia and Te Pahi it occurs very locally in disturbed and cattle-trampled sites in coastal wetland, on river banks, in streambeds, along roadsides, in drains, under rawiri (*Kunzea linearis*) forest and in alluvial podocarp forest. In geothermal areas on Raoul Island and the Rotorua/Taupō district it occurs on heated soil, beside hot streams and mud pools, often under mānuka and kānuka in sheltered places or in weedy vegetation. In the western Waikato it was recorded from kahikatea forest. Naturalised plants grow under willows and in disturbed or urban environments.

Recognition: *Christella dentata* is recognised by its herbaceous fronds, primary pinnae divided $\frac{1}{3}$ to $\frac{3}{4}$ to the midrib with obtuse to truncate segments, basal pair of pinnae reduced, veins in adjacent segments joining, indumentum on the abaxial surfaces comprising acicular hairs and tiny capitate hairs but lacking scales, and indusia bearing acicular hairs. The rhizomes are creeping (up to 1 m long recorded in wild populations, de Lange, NatureWatchNZ #1463496) to erect (up to 1 m tall, recorded by de Lange, AK 314009), and the fronds arise in tufts at or near the apices, with very short distances between adjacent stipes. This contrasts with the longer-creeping rhizomes with more widely spaced fronds in *Cyclosorus interruptus* and *Thelypteris confluens*.

Cytology: $n = 72$ (Brownlie 1961, as *Cyclosorus nymphalis*, Taupō); $2n = 144$ (de Lange et al. 2004, Foley's Bush, Awanui).

Notes: Allan (1961) recognised only a single species of *Christella* in New Zealand (as *Thelypteris dentata*). Given (1981) suggested that plants from thermal areas might be different to those from around Kaitaia, which he related to "*C. dentata* of the tropics", but did not elaborate on how they could be distinguished. Brownsey et al. (1985) listed two taxa, *C. dentata* and *C. sp.*, stating that "two species of *Christella* may occur in New Zealand, one in thermal areas and the Kermadec Islands, and

one in north Auckland”. Brownsey & Smith-Dodsworth (1989) distinguished the thermal plant by its shorter rhizome and smaller frond compared to Northland plants but noted that “its taxonomic status and affinities are not yet determined”. De Lange et al. (2010) stated that “populations of *Christella* from geothermally active parts of the North Island and from the crater region of Raoul Island lack the long, creeping rhizome typical of northern New Zealand and most Raoul Island *C. dentata*, instead producing over time a small, erect trunk. These plants also have narrower, hairier fronds.” They concluded that “these plants are not the same as *C. dentata*, and appear to represent another possibly unnamed variant” but cautioned that further research was still needed.

The taxonomic status of the two forms of *C. dentata* has been re-evaluated by Brownsey & Perrie (2016a). From an analysis of the frond and rhizome morphology, spore size and cytology they found that the only difference between them was the nature of the rhizome and that, in contradiction to Brownsey & Smith-Dodsworth (1989), there were no quantitative frond measurements that could be used to distinguish two taxa. The available evidence strongly suggested that populations in New Zealand are uniformly tetraploid and no DNA sequence differences were found between the two forms. Furthermore, they found that the rhizomes, whether creeping or erect, were fundamentally similar in producing tufts of fronds near the apex, rather than fronds that are widely spread along the rhizome (as in families with long-creeping rhizomes such as Dennstaedtiaceae, Hymenophyllaceae or Polypodiaceae). They suggested that the nature of the rhizome may not be of great taxonomic significance, and simply a reflection of different habitats in which the plants are found. Plants in Australia show similar variation. Brownsey & Perrie (2016a) concluded that “there is only one rather variable species indigenous to New Zealand, similar to that in Australia, which is correctly identified as *Christella dentata*.”

The picture is complicated by the presence of plants in New Zealand with distinctive purple stripes that are very similar to plants that are naturalised in Hawai’i and the Neotropics. It is likely that they have naturalised in New Zealand as escapes from cultivated plants originally introduced from overseas. The earliest record is a plant grown from spore collected near Kāwhia in 1987 (AK 212348), but several others have been collected since 1991. Given its history in the Americas, the plant could spread in New Zealand unless carefully controlled.



Fig. 2: *Christella dentata*. Mature plant growing at Te Huka Bay, Northland.



Fig. 3: *Christella dentata*. Mature plant growing on Raoul Island.



Fig. 4: *Christella dentata*. Young plant showing greatly reduced basal pinnae.



Fig. 5: *Christella dentata*. Underground, short-creeping rhizome giving rise to tufts of fronds at apex.

***Cyclosorus* Link, Hort. Reg. Bot. Berol. 2, 128 (1833)**

Type taxon: *Cyclosorus gongylodes* (Schkuhr) Link

Etymology: From the Greek *kuklos* (a circle), a reference to the shape of the sorus.

Terrestrial ferns. Rhizomes long-creeping, scaly. Rhizome scales narrowly to broadly ovate, setiferous (not NZ) or entire (NZ). Fronds monomorphic. Stipes scaly, minutely hairy or glabrous. Laminae 1-pinnate, coriaceous, lower pinnae not reduced in size; basal pinnae not conspicuously auricled; aerophores lacking; abaxial surface of laminae bearing scales on costae, bearing acicular and short capitate hairs on the lamina surfaces or glabrous, and bearing spherical red or orange glands on the costae. One or more basal veins from adjacent pinna lobes always uniting below the sinus. Sori round, indusiate; paraphyses absent. Indusia reniform, bearing acicular hairs. Sporangia lacking glands or hairs near the annulus, but bearing a multicellular hair with a terminal spherical red or orange gland on the stalk. Spores monoletate, finely and irregularly spinulose.

Taxonomy: Allan (1961) included all New Zealand species of Thelypteridaceae within a broadly construed *Thelypteris*. Holttum (1971a) distinguished *Cyclosorus* as a genus with long-creeping rhizomes, the basal pinnae not reduced, thin flat scales present on the lower surface of the costae, and spherical glands present on the lower surface of the veins and at the ends of multicellular hairs on the stalks of the sporangia. Smith et al. (2006) interpreted *Cyclosorus* much more broadly to include many of Holttum's genera, including *Christella* and *Pneumatopteris*, but Holttum's classification is followed here for consistency (see Taxonomy under Thelypteridaceae).

Distribution: A pantropical genus of possibly 2–4 poorly distinguished species (Smith 1990). One species in Australia (Bostock 1998) and the Pacific (Holttum 1977). One species in New Zealand; none endemic.

Biostatus: Indigenous (Non-endemic).

Table 3: Number of species in New Zealand within *Cyclosorus* Link

Category	Number
Indigenous (Non-endemic)	1
Total	1

Cytology: The base chromosome number in *Cyclosorus* is $x = 36$ (Holttum 1971a; Smith 1990).

Cyclosorus interruptus (Willd.) H.Itô, *Bot. Mag. (Tokyo)* 51: 714, f. 9 (1937)

≡ *Pteris interrupta* Willd., *Phytographia*, 13, t. 10, f. 1 (1794)

≡ *Thelypteris interrupta* (Willd.) K.Iwats., *J. Jap. Bot.* 38: 314 (1963)

Lectotype (selected by Mazumdar 2016): Plate 1, fig. 1 in Willdenow, *Phytographia* (1794).

Epiptotype (selected by Mazumdar 2016): India, Tamil Nadu [Madras], Aug. 1794, Rottler ex Klein s.n., Herb. Willd. no. 19770011, B (!online), isoeptotype Herb. Willd. no. 19770012, B (!online).

= *Nephrodium propinquum* R.Br., *Prodr. Fl. Nov. Holland.*, 148 (1810)

Lectotype (selected by Brownsey & Perrie 2016): New Holland [Australia], Nova Cambria australis [now Queensland] prope [near] Endeavour River, *J. Banks & D. Solander s.n.*, 1770, BM 001044504!

= *Nephrodium inaequilaterum* Colenso, *Trans. & Proc. New Zealand Inst.* 20: 229 (1888)

Lectotype (chosen by Allan 1961): Taupo, *C.J. Norton*, Herb. W. Colenso, WELT P003345!

Etymology: From the Latin *interruptus* (interrupted).

Rhizomes long-creeping, up to 115 mm long (in herbarium specimens) with stipes arising 5–30 mm apart, 1.5–4 mm diameter, bearing scattered scales. Rhizome scales ovate to broadly ovate, 1–3 mm long, 0.5–1.5 mm wide, pale to dark brown, entire. Fronds 225–1450 mm long, held stiffly upright. Stipes 120–970 mm long, yellow-brown to chestnut-brown, almost black at base, glabrous or scaly near base, slightly polished. Laminae 1-pinnate, usually elliptic or ovate, sometimes narrowly, rarely broadly so, abruptly narrowed to a pinnatifid apex, 115–580 mm long, 35–215 mm wide, dull green on both surfaces or sometimes lighter on abaxial surface, coriaceous. Ovate or broadly ovate, pale brown scales with hairy margins on abaxial surface of pinna midribs and costae; colourless, acicular hairs up to 0.4 mm long on both surfaces of the costae and veins; spherical orange glands variably present on abaxial surfaces of costae and veins. Primary pinnae in 6–18 pairs below the pinnatifid apex, widely spaced especially proximally, narrowly elliptic; the longest at or below the middle, short-stalked, 42–150 mm long, 6–18 mm wide; the basal pair not or scarcely reduced in length. Primary pinnae divided $\frac{1}{3}$ to $\frac{1}{2}$ to the midrib; ultimate segments 3–10 mm long, 2.5–6 mm wide; apices acute and bluntly apiculate, margins entire. Basal veins on adjacent pinna segments joining, unbranched in each ultimate pinna segment. Sori round, in one row either side of midrib away from pinna margins; indusia reniform, 0.5–0.9 mm diameter, bearing acicular or rarely capitate hairs or almost glabrous.

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

Altitudinal range: 0–600 m.

Cyclosorus interruptus occurs in coastal and lowland areas of the North Island from Te Pahi to Kāwhia and the Bay of Plenty, and throughout the geothermal region from Whakatāne to Tokaanu where it extends locally into montane areas. It grows from sea level to about 600 m near Wairakei.

Also widespread in the tropics and subtropics of the Americas, Africa, India, Asia, Australia and most of the islands of the Pacific, including Hawai'i.

Biostatus: Indigenous (Non-endemic).

The species was given a conservation status of 'At Risk / Declining' by de Lange et al. (2013).

Leach (2005) suggested that *Cyclosorus interruptus* might have been introduced to New Zealand by early Polynesian settlers, because it grows in abandoned taro pondfields in the Pacific Islands and could have been introduced with taro. Against this is the likelihood of self-dispersal, given the large number of fern species that are indigenous to New Zealand and shared with Australia and/or the Pacific Islands.

Habitat: Occurs in swamps, on peaty soils and lake margins in the northern part of its distribution, and on heated soil near hot springs and streams, or in swamps, in geothermal regions, sometimes under mānuka, and kānuka. In the Waikato it is also found under willows (*Salix cinerea* and *S. fragilis*). It is often associated with *Typha orientalis*, *Phormium tenax*, *Isachne globosa*, *Machaerina juncea*, *Carex*

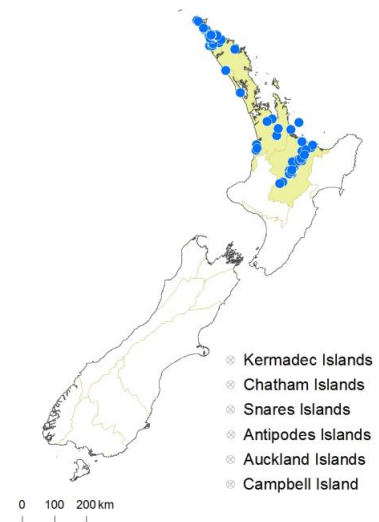


Fig. 6: *Cyclosorus interruptus* distribution map based on databased records at AK, CHR and WELT.

spp., *Juncus* spp., *Schoenus brevifolius*, *Thelypteris confluens* and *Blechnum minus*, and with *Christella dentata*, *Lycopodiella cernua* and *Nephrolepis flexuosa* in thermal areas.

Recognition: *Cyclosorus interruptus* is recognised by its long-creeping rhizomes, erect and leathery fronds, primary pinnae divided one-third to halfway to the midrib with acute segments, basal pair of pinnae not reduced, veins in adjacent segments joining, indumentum on the abaxial lamina surfaces comprising broad scales, acicular hairs and spherical orange glands, and indusia usually bearing acicular hairs or sometimes glabrous. Plants vary considerably in size; the largest, with greatly extended stipes (longer than the laminae), occur in swamps in the Far North, whilst stunted plants are found on thermal soils in the central North Island with much smaller fronds and shorter rhizomes.

Cytology: n = 36 (Brownlie 1961, as *Cyclosorus gongylodes*).

Notes: The names *Polypodium unitum* L. and *Aspidium gongylodes* Schkuhr, and combinations based on them used in earlier Flora treatments (notably *Nephrodium unitum*, *Cyclosorus gongylodes*, *Dryopteris gongylodes* and *Thelypteris gongylodes*) are misidentifications of *Cyclosorus interruptus* (see Holttum 1977; Bostock 1998).



Fig. 7: *Cyclosorus interruptus*. Large population of mature plants growing in wetland.



Fig. 8: *Cyclosorus interruptus*. Mature plant growing in wetland.



Fig. 9: *Cyclosorus interruptus*. Mature frond showing erect habit and un-reduced basal pinnae.



Fig. 10: *Cyclosorus interruptus*. Mature frond showing erect habit and un-reduced basal pinnae.



Fig. 11: *Cyclosorus interruptus*. Abaxial surface of primary pinna showing segments divided less than halfway to the costa, basal pair of veins in adjacent segments joining, and ovate scales and short acicular hairs on the veins and costae.



Fig. 12: *Cyclosorus interruptus*. Abaxial surface of primary pinna showing acicular hairs on costae and veins, and reniform indusia protecting the sori.



Fig. 13: *Cyclosorus interruptus*. Abaxial surface of primary pinna showing basal pair of veins on adjacent segments joining, and reniform indusia protecting sori.



Fig. 14: *Cyclosorus interruptus*. Abaxial surface of primary pinna showing mature indusia and sori.

***Macrothelypteris* (H.Itô) Ching, *Acta Phytotax. Sin.* 8: 308 (1963)**

Type taxon: *Macrothelypteris oligophlebia* (Baker) Ching

Etymology: From the Greek *makros* (large), and *thelypteris* (the name of a fern), a reference to the large fronds in this genus.

Terrestrial ferns. Rhizomes short-creeping or suberect, scaly. Rhizome scales narrowly ovate, thickened at their bases, with marginal and superficial acicular or capitate hairs. Fronds monomorphic. Stipes scaly and hairy. Laminae 2-pinnate to 3-pinnate-pinnatifid, herbaceous, lower pinnae not reduced in size; aerophores lacking; abaxial surface of laminae bearing scales and/or hairs; scales pallid, narrow and with or without ciliate margins, or absent; hairs multicellular and acicular, or unicellular and acicular or capitate; glandular hairs and sessile spherical glands absent. Veins free, branched in the pinnules and not reaching the margins. Sori small, often irregularly shaped, indusiate (NZ) or exindusiate (not NZ); paraphyses absent. Indusia tiny, bearing short capitate hairs. Sporangia bearing capitate hairs near the annulus, lacking hairs on the stalk. Spores monoletate, minutely reticulate and with slight wings.

Taxonomy: Allan (1961) included all New Zealand species of Thelypteridaceae within a broadly construed *Thelypteris*. However, *Macrothelypteris* is now widely recognised as a distinct genus of about nine species in the Old World tropics and subtropics and the Pacific (Holttum 1969, 1971a; Smith et al. 2006). It is characterised by a short-creeping rhizome, rhizome scales which are narrow and thickened at their bases, often with acicular or capitate marginal hairs, at least bipinnate laminae, veins in the pinnules which are branched and do not reach the margins, small sori with very small indusia, and sporangia that bear capitate hairs near the annulus.

Distribution: A genus of about nine species distributed in Madagascar, subtropical and tropical Asia and Malesia, Australia and the Pacific islands (Holttum 1969); two species in Australia (Bostock 1998) and three in the Pacific (Holttum 1977). *Macrothelypteris torresiana* is naturalised in the American tropics and subtropics (Holttum 1969), and in southern Africa (Crouch et al. 2011). One species in New Zealand; none endemic.

Biostatus: Indigenous (Non-endemic).

Table 4: Number of species in New Zealand within *Macrothelypteris* (H.Itô) Ching

Category	Number
Indigenous (Non-endemic)	1
Total	1

Cytology: The base chromosome number in *Macrothelypteris* is $x = 31$ (Holttum 1971a; Smith 1990).

***Macrothelypteris torresiana* (Gaudich.) Ching, *Acta Phytotax. Sin.* 8: 310 (1963)**

≡ *Polystichum torresianum* Gaudich. in Freycinet, *Voy. Uranie, Bot.*, 333 (1828)

≡ *Lastrea torresiana* (Gaudich.) T.Moore, *Index Fil.*, 106 (1858)

≡ *Thelypteris torresiana* (Gaudich.) Alston, *Lilloa* 30: 111 (1960)

Holotype: Mariana Islands, C. Gaudichaud-Beaupré, P; isotype G (*n.v.*; see Holttum 1977)

= *Aspidium uliginosum* Kunze, *Linnaea* 20: 6 (1847)

≡ *Dryopteris uliginosa* (Kunze) C.Chr., *Index Filic. Suppl.* 3, 100 (1934)

≡ *Thelypteris uliginosa* (Kunze) Ching, *Bull. Fan Mem. Inst. Biol.* 6: 342 (1936)

Lectotype (chosen by Morton 1973): cult. Hort. Bot. Leipzig, originally from Java, BR (*n.v.*)

Etymology: Named in honour of Luís Vaz de Torres (b. 1565), a Spanish pilot on de Queirós's expedition to the Pacific (1605–1607), after whom Torres Strait is named.

Rhizomes short-creeping to erect, 3–5 mm diameter, scaly. Rhizome scales narrowly ovate, 6–10 mm long, 0.5–1 mm wide, pale to dark brown, with numerous marginal and superficial hairs. Fronds 235–1200 mm long, rarely up to 2000 mm, arching upwards. Stipes 90–750 mm long, glaucous when fresh, yellow-brown when dry, swollen and with scales and hairs near base especially when young, slightly rough proximally but smooth and glabrous distally. Laminae deeply 2-pinnate-pinnatifid to 3-pinnate-pinnatifid, ovate, gradually tapering to the apex, 145–1000 mm long, 95–700 mm wide, light green on both surfaces, herbaceous. Scales virtually absent; colourless, acicular hairs up to 0.6 mm long on adaxial costa surfaces, and multicellular hairs up to 2 mm long on the abaxial costae and vein surfaces; short capitate hairs up to c. 0.1 mm long on all lamina surfaces. Primary pinnae in 15–25 pairs, widely spaced especially proximally, narrowly ovate to ovate; the longest near the base, short-stalked, 60–450 mm long, 25–200 mm wide, reducing gradually in length to the apex; the basal pair often not much reduced in length. Secondary pinnae narrowly ovate, 16–120 mm long, 5–40 mm wide, midribs narrowly winged, apices acuminate, bases decurrent. Tertiary pinnae (when present) oblong, 8–24 mm long, 1–6 mm wide, apices obtuse, margins serrate to divided more than halfway to midrib, bases decurrent forming a wing on the secondary pinna midribs. Veins all free, branching in ultimate pinna segments, not reaching the margins. Sori round, on veins of ultimate segments, away from pinna margins; indusia reniform, 0.2–0.4 mm diameter, bearing capitate hairs or almost glabrous.

Distribution: North Island: Northland
Kermadec Islands

Altitudinal range: 30–120 m.

In New Zealand *Macrothelypteris torresiana* occurs regularly only on the Kermadec Islands (recorded from Raoul and Macauley Islands). On Raoul Island it was reported as a "generally uncommon species" by Sykes (1977) but 20 years later was said to be increasing in abundance (de Lange & Crowcroft 1997), following cyclone disturbance which had enabled it to expand its range. It has been collected from 30–120 m. A vagrant occurrence at Surville Cliffs, North Cape was reported by de Lange & Crowcroft (1997) but has not been relocated since. This record is the southernmost occurrence of the species in the Pacific region.

Also in tropical and subtropical regions from Madagascar to India, China, Japan, south-east Asia, Australia and the Pacific islands as far as Pitcairn Island. Naturalised in the American tropics and subtropics (Holttum 1969, 1977), southern Africa (Crouch et al. 2011) and Hawai'i (Palmer 2003).

Biostatus: Indigenous (Non-endemic).

The species was given a conservation status of 'At Risk / Naturally Uncommon' by de Lange et al. (2013).

Habitat: *Macrothelypteris torresiana* has been recorded on Raoul Island from disturbed habitats and slip faces in open sunny areas, on banks, in swamps and on Macauley Island from the base of canyon walls growing with sparse *Hypolepis dicksonioides*. At North Cape, on Surville Cliffs, it was found on open ultramafic rock scree (de Lange & Crowcroft 1997).

Recognition: *Macrothelypteris torresiana* is recognised by its large fronds, glaucous stipes, 2-pinnate-pinnatifid or more divided laminae, free veins, indumentum of long, multicellular, acicular hairs on the abaxial surfaces and much shorter capitate hairs, absence of scales and glands on the laminae, and tiny indusia.

Cytology: $2n = 124$ (de Lange et al. 2004).

Notes: Names used in earlier Floras based on *Cheilanthes setigera* Blume (notably *Nephrodium setigerum* and *Dryopteris setigera*) are misidentifications. *Macrothelypteris setigera* is a Malesian species which has been much confused with *M. torresiana* (Holttum 1977).

It was reported by de Lange & Crowcroft (1997) that occasional cultivated specimens of *M. torresiana* have set viable spores, and given rise to sporelings in the vicinity of the adult plants (e.g. the experimental glasshouses at the University of Auckland, AK 231884, 231951). This location is a long way south of the southernmost known wild population at Surville Cliffs. However, de Lange & Crowcroft noted that such occurrences are uncommon and that few sporelings survive, even in the mild Auckland winters.

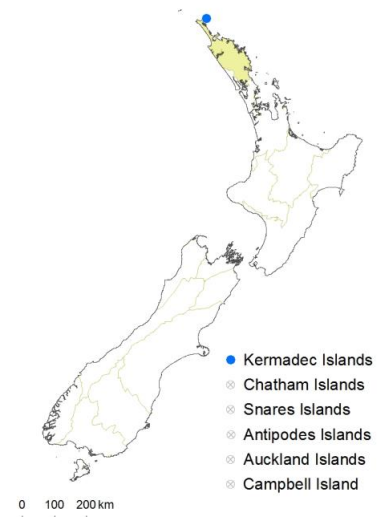


Fig. 15: *Macrothelypteris torresiana* distribution map based on databased records at AK, CHR and WELT.



Fig. 16: *Macrothelypteris torresiana*. Mature plant growing from a short-creeping rhizome.



Fig. 17: *Macrothelypteris torresiana*. Mature plant with 3-pinnate fronds.



Fig. 18: *Macrothelypteris torresiana*. Mature 3-pinnate frond.



Fig. 19: *Macrothelypteris torresiana*. Abaxial surface of fertile pinna showing small sori.

***Pneumatopteris* Nakai, *Bot. Mag. (Tokyo)* 47: 179 (1933)**

Type taxon: *Pneumatopteris callosa* (Blume) Nakai

Etymology: From the Greek *pneuma* (air, wind or breath), and *pterus* (a fern), a reference to the aerophores in some species.

Terrestrial ferns. Rhizomes usually erect or suberect (NZ), rarely long-creeping (not NZ), scaly. Rhizome scales ovate, thin, appressed, often with marginal hairs (not NZ) or entire (NZ). Fronds monomorphic. Stipes scaly, sometimes spiny (not NZ). Laminae 1-pinnate to 2-pinnate-pinnatifid, herbaceous, several pairs of lower pinnae gradually or abruptly reduced in size; basal pinnae auricled acroscopically; aerophores at base of pinnae white and swollen in young living fronds; abaxial surface of laminae bearing a few ovate scales (NZ) or lacking scales (not NZ); abaxial surface bearing short acicular hairs, and sometimes a few capitate or glandular hairs, or glabrous; sessile spherical glands absent. One or more basal veins from adjacent pinna lobes uniting below the sinus (NZ) or rarely veins free (not NZ). Sori round, indusiate (not NZ) or exindusiate (NZ); paraphyses absent. Indusia (when present) reniform, glabrous or bearing acicular hairs. Sporangia usually bearing short capitate hairs near the annulus, and a multicellular hair with a swollen apical cell on the stalk (not NZ) or both such hairs absent (NZ). Spores monoete, with many wings.

Taxonomy: Allan (1961) included all New Zealand species of Thelypteridaceae within a broadly construed *Thelypteris*. Holttum (1971a, 1973) recognised *Pneumatopteris* as a genus characterised by a usually erect rhizome, stipes bearing broad scales often with hairs on the margins, at least one pair

of greatly reduced basal pinnae, aerophores white and more or less swollen in fresh material, basal veins on adjacent pinnules usually anastomosing, lower lamina surface usually pustular when dry, lacking glands and never densely hairy, sori usually indusiate, sporangia usually bearing short capitate hairs near the annulus and multi-cellular hairs with swollen apical cells on the sporangial stalks. Smith et al. (2006) included *Pneumatopteris* within a broadly circumscribed *Cyclosorus*. Holttum's classification is followed here (see Taxonomy under Thelypteridaceae), although the sole New Zealand representative of *Pneumatopteris* is an atypical member of the genus as construed by him (see Notes under *P. pennigera*).

Distribution: A genus of c. 80 species distributed from tropical Africa, Asia, Malesia, Australia and the Pacific islands to Hawai'i in the north and New Zealand in the south (Smith 1990); three species in Australia (Bostock 1998) and 17 in the Pacific (Holttum 1977). One species in New Zealand; none endemic.

Biostatus: Indigenous (Non-endemic).

Table 5: Number of species in New Zealand within *Pneumatopteris* Nakai

Category	Number
Indigenous (Non-endemic)	1
Total	1

Cytology: The base chromosome number in *Pneumatopteris* is $x = 36$ (Holttum 1971a; Smith 1990).

***Pneumatopteris pennigera* (G.Forst.) Holttum, *Blumea* 21: 305 (1973)**

- ≡ *Polypodium pennigerum* G.Forst., *Fl. Ins. Austr.*, 82 (1786)
- ≡ *Aspidium pennigerum* (G.Forst.) Sw., *J. Bot. (Schrader)* 1800(2): 34 (1801)
- ≡ *Nephrodium pennigerum* (G.Forst.) C.Presl, *Reliq. Haenk.* 1, 35 (1825)
- ≡ *Polystichum pennigerum* (G.Forst.) Gaudich. in Freycinet, *Voy. Uranie, Bot.*, 328 (1828)
- ≡ *Lastrea pennigera* (G.Forst.) C.Presl, *Tent. Pterid.*, 76 (1836)
- ≡ *Goniopteris pennigera* (G.Forst.) J.Sm., *J. Bot. (Hooker)* 4: 54 (1841)
- ≡ *Goniopteris forsteri* T.Moore, *Index Fil.*, 99 (1858) nom. nov. pro *Aspidium pennigerum* (G.Forst.) Sw. 1801
- ≡ *Dryopteris pennigera* (G.Forst.) C.Chr., *Index Filic.*, 283 (1905)
- ≡ *Cyclosorus pennigerus* (G.Forst.) Ching, *Bull. Fan Mem. Inst. Biol.* 10: 247 (1941)
- ≡ *Thelypteris pennigera* (G.Forst.) Allan, *Fl. New Zealand* 1, 51 (1961)
Lectotype (chosen by Nicolson & Fosberg 2003): no locality, *Forster*, UPS-T 24698 (*n.v.*)
- = *Phegopteris cunninghamii* Mett., *Fil. Hort. Bot. Lips.*, 84 (1856)
Holotype: Cult. Leipzig ex New Zealand (*n.v.*, see Holttum 1977)
- = *Aspidium novae-zeelandiae* Ettingsh., *Denkschr. Kaiserl. Akad. Wiss., Wien. Math.-Naturwiss. Kl.* 23: 103 (1864)
Lectotype (selected by Brownsey & Perrie 2016): Nova Zeelandia [New Zealand], *Hügel s.n.*, s.d., W 0052715 (!online)
- = *Polypodium pennigerum* var. *giganteum* Colenso, *Trans. & Proc. New Zealand Inst.* 14: 339 (1882)
Lectotype (selected by Brownsey & Perrie 2016): New Zealand, Manawatu River, W. Colenso s.n., s.d., AK 142518! (two pinnae only)
- = *Polypodium pennigerum* var. *hamiltonii* Colenso, *Trans. & Proc. New Zealand Inst.* 14: 338 (1882)
- ≡ *Dryopteris pennigera* var. *hamiltoni* (Colenso) Cheeseman, *Man. New Zealand Fl.*, ed. 2, 36 (1925)
- ≡ *Cyclosorus pennigerus* var. *hamiltoni* (Colenso) Crookes in Dobbie, *New Zealand Ferns* ed. 4, 262 (1951)
Lectotype (chosen by Allan 1961): Kereru, A. *Hamilton*, Herb. W. Colenso, WELT P003350! (isolectotypes? AK 142511, 221795!)
- = *Polypodium subsimilis* Colenso, *Trans. & Proc. New Zealand Inst.* 20: 233 (1888)
Lectotype (chosen by Allan 1961): 70 mile Bush, Herb. W. Colenso, WELT P003349!

Etymology: From the Latin *pennigerus* (with feathery leaves), a reference to the dissection of the fronds.

Vernacular names: feather fern; gully fern; piupiu; pākauroharoha

Rhizomes prostrate or erect, often forming short arborescent trunks up to 1 m tall, bearing scales at the apex. Rhizome scales ovate to narrowly ovate, 3–8 mm long, 1–4 mm wide, chestnut-brown,

entire. Fronds 340–2070 mm long, rarely only 200 mm long at high elevations, arching upwards. Stipes 40–430, rarely up to 770 mm long, pale brown, scaly to almost glabrous. Laminae 1-pinnate to 2-pinnate-pinnatifid, narrowly elliptic or elliptic, gradually tapering to a pinnatifid apex, 270–1390, rarely up to 1500 mm long, 80–400 mm wide, rarely only 160 mm long and 50 mm wide at high elevations, mid-green on both surfaces, thin and herbaceous. Ovate or broadly ovate, pale brown scales on abaxial surface of costae; colourless or pale brown acicular hairs up to 0.2 mm long on both costa surfaces; colourless capitate hairs <0.1 mm long on abaxial surfaces of costae. Primary pinnae in 8–35 pairs below pinnatifid apex, widely spaced especially proximally, narrowly oblong to narrowly ovate; the longest at or near the middle, sessile or short-stalked, the longest 44–220 mm long, rarely only 27 mm long at high elevations, 11–34 mm wide; the basal pair greatly reduced, 10–70 mm long, auricled acroscopically. Primary pinnae divided $\frac{1}{3}$ to $\frac{1}{2}$, or rarely $\frac{2}{3}$, to the midrib; ultimate segments (excluding proximal pair) 5–17 mm long, 3.5–7 mm wide, apices obtuse or rounded, margins entire or minutely serrate; the proximal pair of ultimate segments often longer than the others with the basal acroscopic segment occasionally divided to the costa and greatly extended and deeply lobed, up to 53 mm long and 24 mm wide. Basal veins in adjacent pinna segments joining, unbranched in each ultimate pinna segment. Sori round, in one row either side of midrib away from pinna margins; indusia absent.

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

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

Three Kings Islands, Chatham Islands

Altitudinal range: 0–700 m.

Pneumatopteris pennigera occurs in lowland areas, extending locally to montane sites, throughout the North Island, growing from near sea level to about 700 m on Mt Maungatautari in the Waikato region. In the South Island it is largely confined to lowland areas in the northern half of the island, although it extends locally to Fiordland, Southland and the Otago Peninsula, and from near sea level to about 600 m on Banks Peninsula.

Also Australia (Queensland, Victoria, Tasmania).

Biostatus: Indigenous (Non-endemic).

Habitat: A terrestrial fern that occurs under kauri, podocarp, broadleaved and beech forest, under mānuka, kānuka and *Salix* spp., and in *Carex secta* swamps. It grows on the forest floor, in gullies, on banks, streamsides and alluvial terraces, usually in heavy shade and damp sites, but sometimes in more open areas.

Recognition: *Pneumatopteris pennigera* is recognised by its erect rhizome, primary pinnae divided $\frac{1}{3}$ to $\frac{2}{3}$ to the midrib with rounded segments, greatly reduced basal pinnae, veins in adjacent segments joining, indumentum on the abaxial surfaces comprising ovate scales and acicular and capitate hairs but lacking glands, and sori lacking indusia. The network of dark veins on the thin green fronds distinguishes *Pneumatopteris pennigera* from other common forest ferns.

Cytology: n = 72 (Brownlie 1954, as *Cyclosorus pennigerus*).

Notes: *Pneumatopteris pennigera* is an atypical member of the genus in that it has ovate scales on the abaxial surface of the costae when young, the abaxial surface of the lamina is not pustular when dry, indusia are lacking, and there are no glands or hairs on the sporangia (Holttum 1977). Bostock (1998) noted that it (and *P. costata*) needed further study in relation to their generic placement.

Kunze (1850) evidently believed that Cunningham's (1837) concept of *Aspidium pennigerum* differed from that of Swartz (1801) and he created a *nomen novum* for it – *Aspidium cunninghamii* Kunze, *Linnaea* 23: 225 (1850). However, neither Kunze (1850), nor Cunningham (1837), provided a description and the name is therefore a *nomen nudum*. In any case, Kunze's name is illegitimate, being a later homonym of *Aspidium cunninghamii* Colenso (1843).

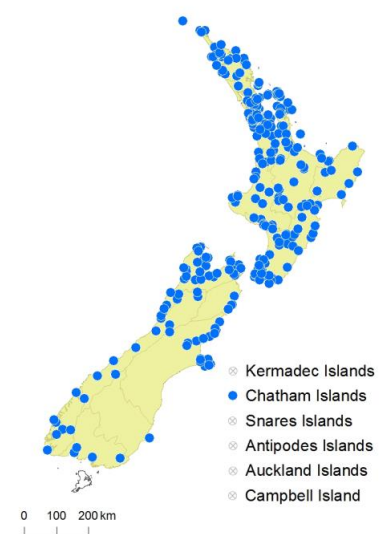


Fig. 20: *Pneumatopteris pennigera* distribution map based on databased records at AK, CHR and WELT.



Fig. 21: *Pneumatopteris pennigera*. Mature plant growing on a steep stream bank.



Fig. 22: *Pneumatopteris pennigera*. Apical portion of mature frond showing primary pinnae divided more than halfway to costa.



Fig. 23: *Pneumatopteris pennigera*. Plant with a short aerial trunk.



Fig. 24: *Pneumatopteris pennigera*. Mature plants with erect trunks.



Fig. 25: *Pneumatopteris pennigera*. Fronds arising from an erect rhizome. The basal pinnae are greatly reduced in length, but the basal acroscopic secondary segments are longer and more divided than the other segments.



Fig. 26: *Pneumatopteris pennigera*. Ovate, pale brown stipe scales.



Fig. 27: *Pneumatopteris pennigera*. Young crozier.



Fig. 28: *Pneumatopteris pennigera*. Abaxial surface of primary pinna showing basal pair of veins from adjacent segments joining and immature sori lacking indusia.



Fig. 29: *Pneumatopteris pennigera*. Abaxial surface of primary pinna showing mature sori lacking indusia.



Fig. 30: *Pneumatopteris pennigera*. Abaxial surface of primary pinna with segments divided about halfway to costa, bearing mature sori lacking indusia.

Thelypteris* Schmidel, *Icon. Pl., Ed. Keller, 3, 45, t. 11, 13 (1763), nom. cons.

Type taxon: *Thelypteris palustris* Schott

Etymology: From the Greek *thelys* (female), and *pterus* (a fern), a name used by Theophrastus.

Terrestrial ferns. Rhizomes long-creeping, scaly. Rhizome scales ovate, entire. Fronds monomorphic or slightly dimorphic. Stipes scaly. Laminae 1-pinnate-pinnatifid to 1-pinnate-pinnatisect, herbaceous to coriaceous, the lower pinnae not or little reduced in size; basal pinnae not conspicuously auricled acroscopically; aerophores lacking; abaxial surface of laminae bearing flat thin scales, erect acicular and short capitate hairs, but lacking glandular hairs and sessile spherical glands. Veins free, sometimes forked in the pinnules and reaching the margins. Sori round, indusiate; paraphyses absent. Indusia reniform, bearing capitate hairs. Sporangia bearing capitate hairs near annulus, but lacking hairs on the stalk. Spores monolete, irregularly and minutely spinulose.

Taxonomy: Allan (1961) included all New Zealand species of Thelypteridaceae within a broadly construed *Thelypteris*. Holttum (1971a) redefined the genus globally to include just two species characterised by a long-creeping rhizome, unreduced basal pinnae, free veins that are often forked in the pinnules and reach the margins, scales on the lower surface of the costae, acicular and capitate hairs on the lower surface of the lamina, no sessile glands, indusiate sori, and sporangia that bear capitate hairs. Smith et al. (2006) had a much broader interpretation of *Thelypteris*, including also *Amauropelta*, *Coryphopteris*, *Lastrea*, *Metathelypteris* and *Parathelypteris*, but Holttum's classification is followed here for consistency (see Taxonomy under Thelypteridaceae).

Distribution: A genus of two species with one in temperate Europe and Asia and the other in tropical and subtropical regions of the southern hemisphere in South America, Africa, India, Malesia and Australasia (Holttum 1977; Smith 1990). One species in New Zealand; none endemic.

Biostatus: Indigenous (Non-endemic).

Table 6: Number of species in New Zealand within *Thelypteris* Schmidel

Category	Number
Indigenous (Non-endemic)	1
Total	1

Cytology: The base chromosome number in *Thelypteris* is $x = 35$ (Holttum 1971a; Smith 1990).

***Thelypteris confluens* (Thunb.) C.V.Morton, *Contr. U.S. Natl. Herb.*
38: 71 (1967)**

≡ *Pteris confluens* Thunb., *Prodr. Pl. Cap.*, 171 (1800)

Holotype: e Cap b. Spei [Cape of Good Hope, South Africa], *C.P.Thunberg s.n.*, UPS-T 24904 (*n.v.*, see Roux 2009)

= *Aspidium thelypteris* var. *squamigerum* Schltld., *Adumbr. Fil.*, 23, t. 11 (1825)

≡ *Aspidium squamigerum* (Schltld.) Fée, *Mém. Foug.*, 8. *lc. Esp. Nouv.*, 104 (1857)

≡ *Thelypteris palustris* var. *squamigera* (Schltld.) Weath. in Johnston, *Contr. Gray Herb.* 73: 40 (1924)

≡ *Thelypteris squamigera* (Schltld.) Ching, *Bull. Fan Mem. Inst. Biol.* 6: 329 (1936) — as *squamulosa*

Holotype: atque in Promontorio bonae spei ad Hexriver [Hex River, Cape of Good Hope, South Africa], *J.L.L.Mund et L. Maire, C.H. Bergius s.n.*, P 00482788 (online)

= *Nephrodium squamulosum* Hook.f., *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II*, 39 (1854)

≡ *Nephrodium thelypteris* var. *squamulosum* (Hook.f.) Hook., *Sp. Fil.* 4, 88 (1862)

≡ *Dryopteris thelypteris* var. *squamulosum* (Hook.f.) Cheeseman, *Man. New Zealand Fl.*, ed. 2, 33 (1925)

Lectotype (chosen by Holttum 1977): New Zealand, *Colenso*, K! (photo WELT E471/13)

= *Lastrea invisa* J.B.Armstr., *Trans. & Proc. New Zealand Inst.* 13: 359 (1881)

Holotype: Waikato, Herb. Armstrong, CHR 633400!

Etymology: From the Latin *confluens* (running together).

Vernacular names: marsh fern; swamp fern; swamp lady fern

Rhizomes long-creeping, up to 175 mm long (in herbarium specimens) with stipes arising 8–37 mm apart, 1.5–3 mm diameter, bearing scattered scales. Rhizome scales ovate to broadly ovate, 1–3 mm long, 0.5–1.5 mm wide, pale brown, entire. Fronds 380–1150 mm long, held stiffly upright. Stipes 180–670 mm long, yellow-brown to chestnut-brown and often almost black at the base, glabrous or scaly near base, slightly polished. Laminae sometimes appearing slightly dimorphic with fertile pinna segments inrolled and a little narrower than the sterile, deeply 1-pinnate-pinnatifid to 1-pinnate-pinnatisect, narrowly elliptic to elliptic, or rarely narrowly obovate, usually narrowed to a short pinnatifid apex, 150–540 mm long, 40–145 mm wide, mid-green on both surfaces, herbaceous to coriaceous. Broadly ovate or broadly elliptic or almost orbicular pale brown scales on abaxial surface of pinna midribs and costae; colourless, acicular and capitate hairs up to 1 mm long on both surfaces of costae and veins. Primary pinnae in 14–27 pairs below pinnatifid apex, widely spaced especially proximally, narrowly elliptic or narrowly ovate to almost oblong; the longest at about mid-lamina, short-stalked, 25–80 mm long, 6–18 mm wide; the basal pair not or scarcely reduced in length. Primary pinnae divided almost, or rarely completely, to the midrib; ultimate segments oblong, 3–10 mm long, 1.5–3 mm wide, apices acute to obtuse, margins usually inrolled, bases adnate to decurrent. Veins all free, forking in sterile pinna segments, undivided in fertile segments. Sori round, in one row either side of midrib away from pinna margins; indusia reniform, 0.4–0.6 mm diameter, bearing capitate hairs.

Distribution: North Island: Northland, Auckland, Volcanic Plateau

Altitudinal range: 0–300 m.

Thelypteris confluens occurs in lowland areas of the northern North Island from near North Cape to the Bay of Plenty and Rotorua district, with an outlying population at Lake Rotokawa near Taupō. It mostly grows close to sea level but extends to 300 m at Lake Rotoehu, near Rotorua.

Also tropical and subtropical regions from Argentina (Zuloaga et al. 2008) to Africa, Madagascar, India, south-east Asia, Malesia and Australia (Queensland, Victoria).

Biostatus: Indigenous (Non-endemic).

The species was given a conservation status of 'At Risk / Naturally Uncommon' by de Lange et al. (2013).

Habitat: Confined to lake, swamp and marsh vegetation, or on peat in raised bogs; mostly found within dune slacks and their associated wetlands, sometimes found under mānuka, willows or pines, or rarely on old *Carex* mounds in open sunny sites; often associated with *Typha orientalis*, *Machaerina juncea*, *Eleocharis acuta*, *Isachne globosa*, *Isolepis prolifera*, *Apodasmia similis*, *Cyclosorus interruptus* and *Blechnum minus*. It is largely confined to coastal areas, but extends inland in wetlands on geothermally heated soils in the southern part of its range.

Recognition: *Thelypteris confluens* is recognised by its long-creeping rhizomes, rigidly erect fronds, deeply 1-pinnate-pinnatifid to 1-pinnate-pinnatisect laminae, pinnae divided almost to the midribs, basal pair of pinnae not reduced in length, free veins, indumentum on the abaxial surfaces comprising broad scales, acicular hairs and capitate hairs, but lacking glands, and indusia bearing capitate hairs.

Cytology: $2n = 70$ (de Lange et al. 2004).

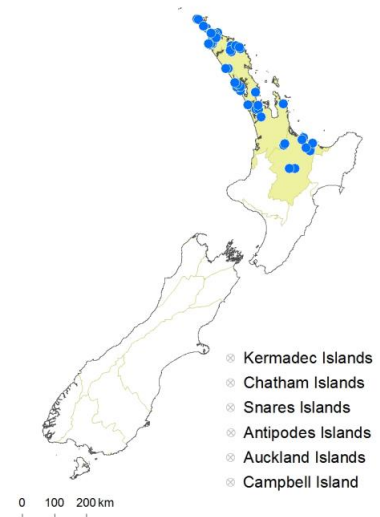


Fig. 31: *Thelypteris confluens* distribution map based on databased records at AK, CHR and WELT.



Fig. 32: *Thelypteris confluens*. Mature frond with unreduced basal pinnae growing in wetland.



Fig. 33: *Thelypteris confluens*. Apical portion of mature frond growing in wetland.



Fig. 34: *Thelypteris confluens*. Abaxial surface of primary pinna with segments divided almost to the costa, and the basal veins of adjacent segments not joining.



Fig. 35: *Thelypteris confluens*. Abaxial surface of primary pinnae showing ovate, pale brown scales on the costae.

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Acknowledgements

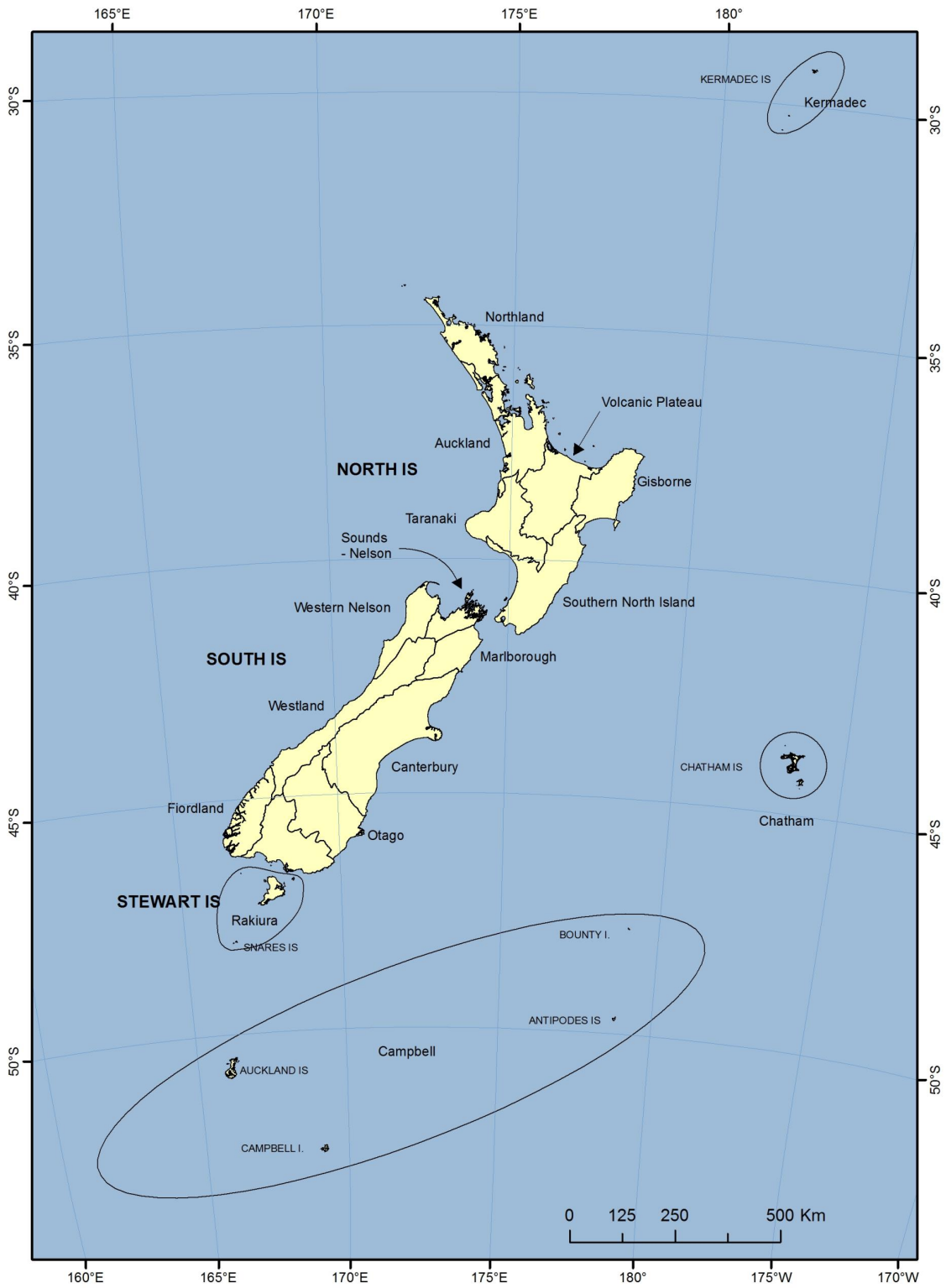
We thank the staff at AK, CHR and WELT for loans of specimens and for databasing and providing spreadsheets of collection data. We are grateful to staff at CHR for the preparation of maps and for assistance in editing and formatting the text, and to Peter de Lange for reviewing the manuscript. We are especially grateful to Peter de Lange and Jeremy Rolfe for supplying material and observational data relating to *Christella dentata*, and for use of photographs of this and other species.

P.J. Brownsey and L.R. Perrie

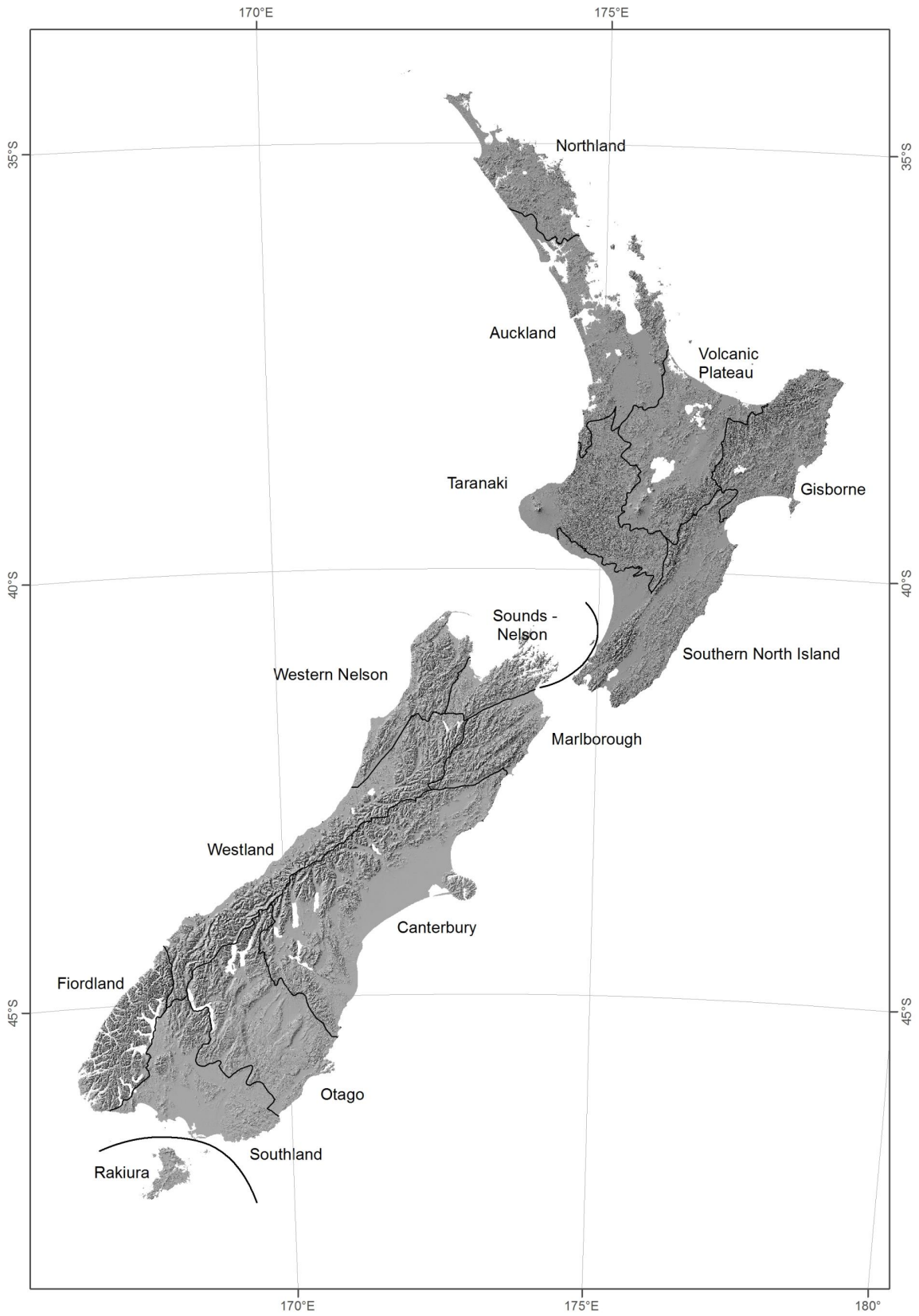
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PatB@tepapa.govt.nz

LeonP@tepapa.govt.nz



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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The electronic Flora of New Zealand (**eFloraNZ**) project provides dynamic, continually updated, online taxonomic information about the New Zealand flora. Collaborators in the project are Landcare Research, the Museum of New Zealand Te Papa Tongarewa, and the National Institute of Water and Atmospheric Research (NIWA).

The eFloraNZ presents new systematic research and brings together information from the Landcare Research network of databases and online resources. New taxonomic treatments are published as fascicles in PDF format and provide the basis for other eFloraNZ products, including the web profiles.

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ISBN 978-0-478-34786-9



9 780478 347869