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Cover image: *Cyathea medullaris*. Mature plant.

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Contents

Introduction

The family Cyatheaceae is represented in New Zealand by one genus (*Cyathea*) with seven indigenous species, five of which are endemic, and one naturalised species. *Cyathea smithii* is widespread throughout both main islands and extends to the Auckland Islands, the southernmost limit for any tree fern in the world. *Cyathea colensoi* is widespread in the South Island but extends only to Coromandel in the North Island. *Cyathea dealbata* and *C. medullaris* are both widespread in the North Island, but in the South Island they are common only on the east and west coasts, respectively. *Cyathea cunninghamii* is largely confined to the wetter western parts of both main islands. Two species, *C. kermadecensis* and *C. milnei*, are confined to the Kermadec Islands. *Cyathea cooperi* is naturalised in the Auckland area but is cultivated in other centres and has the potential to spread. Most species of *Cyathea* are tree ferns with arborescent trunks, but *C. colensoi* is distinguished by the lack of an upright trunk. All New Zealand species of *Cyathea* have highly divided fronds that bear scales and hairs, the scale characters being particularly important diagnostically. The sori occur away from the margin and are protected by a variety of different shaped indusia, or lack indusia altogether. DNA sequence data indicates that there are four major groups within the Cyatheaceae and alternative classifications recognise these at the generic or subgeneric level; only one genus is recognised in this treatment.

Cyatheaceae Kaulf., *Wesen Farrenkr.,* [119] (1827)

Type taxon: *Cyathea* Sm.

Terrestrial ferns. Rhizomes rarely prostrate and creeping, or usually forming an arborescent trunk covered in adventitious roots and either persistent stipe bases or stipe scars; bearing scales at the apex. Fronds monomorphic (NZ), or sometimes slightly dimorphic (not NZ), not articulated to rhizome, sometimes with aphlebiae at the base (not NZ). Laminae rarely entire or 1-pinnate (not NZ), usually 2–4-pinnate (NZ), catadromous, herbaceous to coriaceous, bearing scales and hairs. Veins free. Sori round, borne on abaxial surface away from margins; paraphyses present; indusia either absent, forming a saucer-like structure at the base of the receptacle, forming a cup- or hood-shaped structure around the sorus, or completely enclosing the sorus and rupturing irregularly at maturity; receptacles slightly to strongly elevated, sporangia maturing in gradate sequence. Sporangia with slightly oblique annulus, 64 or 16 spores per sporangium. Homosporous; spores trilete; exospores sometimes pitted; perispores granulate, with coarse echinae or slender rodlets, ridged, or sometimes very thin; spores lacking chlorophyll.

Taxonomy: A family of one genus, with about 500 species.

The phylogenetic relationships of the scaly tree ferns (Cyatheaceae), based on DNA sequence data from five plastid regions, were investigated by Korall et al. (2007). They recognised four major groups. *Sphaeropteris*, characterised by conform scales often bearing dark setae on the margins, and spores with an echinate perine, was shown to be sister to the rest of the scaly tree ferns, which comprised an unresolved trichotomy of three well-supported clades. Of the latter, *Cyathea sensu stricto* has marginate scales without an apical seta, and spores that have a pitted exine. However, the other two groups, *Alsophila sensu stricto* and *Gymnosphaera*, are less clearly separated morphologically. Both groups have marginate scales with an apical seta, and spores with a ridged perine, but *Gymnosphaera* has 64 spores per sporangium compared to 16 in *Alsophila*. Species of *Gymnosphaera* also often have slightly dimorphic fronds with reduced fertile pinnules, skeletonised pinnae (aphlebiae) at the base of the frond, and scales with pale, fragile margins.

Korall et al. (2007) discussed three possible options for classifying the taxa: i) four separate genera; ii) two separate genera (*Sphaeropteris* and *Cyathea*) with *Cyathea* divided into three subgenera; or iii) a single genus (*Cyathea*) divided into two or four subgenera. Smith et al. (2006) recognised four genera – *Alsophila*, *Cyathea*, *Gymnosphaera* and *Sphaeropteris*. However, the affinities of species in the *Alsophila* and *Gymnosphaera* groups have not all been investigated or determined, particularly in the Pacific region. Until species in this region are better understood, we prefer to accept a single genus, *Cyathea*.

Distribution: Throughout the tropics and south temperate regions; richest in cool montane rain forests of the wet tropics (Conant et al. 1995) and generally absent from dry areas and much of the north temperate zone (Kramer 1990). One genus and eight species in New Zealand.

Biostatus: Indigenous (Non-endemic).

Table 1: Number of species in New Zealand within *Cyatheaceae* Kaulf.

Category	**Number**
Indigenous (Endemic)	5
Indigenous (Non-endemic)	2
Exotic: Casual	1
Total	**8**

Recognition: The Cyatheaceae comprises terrestrial ferns that have arborescent trunks, or sometimes creeping or decumbent rhizomes, usually with large 2–4-pinnate fronds bearing scales and hairs. The sori are positioned away from the margin and vary from being unprotected to completely covered by an indusium at maturity. The sporangia have an oblique annulus and release trilete spores. The spores of all indigenous New Zealand species of Cyatheaceae have been described and illustrated by Large & Braggins (1991).

Notes: Tree ferns play a diverse role in New Zealand forests. They are an important host for epiphytic vascular plants, providing an ideal substrate for their juvenile growth (Pope 1924, 1926). Ogle et al. (2000) found that even dead tree fern trunks provided microhabitat for a significant number of epiphytes and vines, and were an integral part of the forest. Page & Brownsey (1986) suggested that skirts of dead fronds on many tree ferns may provide a defence against epiphytes and climbing plants, whilst Gillman & Ogden (2005) showed that shedding fronds from tree ferns, or producing a skirt of fronds, are alternative strategies that can reduce competition from terrestrial and epiphytic seedlings,

respectively. Beever (1984) investigated the frequency and cover of moss species on tree fern trunks and showed that there was significant variation in the communities that occurred on different species of tree fern.

Cyathea Sm., *Mém. Acad. Roy. Sci. (Turin)* 5: 416 (1793)

= *Sphaeropteris* Bernh., *J. Bot. (Schrader)* 1800(2): 122, t. 1(1) (1801)

= *Alsophila* R.Br., *Prodr. Fl. Nov. Holland.,* 158 (1810)

= *Hemitelia* R.Br., *Prodr. Fl. Nov. Holland.,* 158 (1810)

Type taxon: *Cyathea arborea* (L.) Sm.

Etymology: From the Greek *kyathos* (a cup), a reference to the shape of the indusium in some species.

Terrestrial ferns. Rhizomes usually forming an arborescent trunk covered in adventitious roots and either persistent stipe bases or stipe scars, or rarely prostrate and creeping; bearing scales at the apex. Rhizome scales conform or marginate, either bearing a single dark-coloured apical seta, or bearing setae along the scale margins or on the scale surfaces, or lacking dark-coloured setae. Fronds monomorphic. Stipes bearing scales, either directly on the stipe surface or on low to prominent tubercles, sometimes also hairy. Laminae 2-pinnate to 3-pinnate-pinnatifid (NZ) or rarely entire or 1-pinnate- (not NZ), catadromous, herbaceous to coriaceous, bearing scales similar to those of the rhizome, and usually also multi-cellular hairs. Sori round, borne on abaxial surface away from margins; paraphyses present; indusia either absent, forming a saucer-like structure at the base of the receptacle, forming a cup or hood-shaped structure around the sorus, or completely enclosing the sorus and rupturing irregularly at maturity; receptacles slightly to strongly elevated, sporangia maturing in gradate sequence. Spores trilete, radially symmetrical; exospores sometimes pitted; perispores granulate, with coarse echinae or slender rodlets, or sometimes very thin.

Taxonomy: A genus of about 500 species. The Australasian and Pacific species of *Cyathea sensu lato* were revised by Holttum (1964) and his treatment is largely followed here. Allan (1961) was uncertain about *C. cunninghamii* in New Zealand, suggesting that some specimens might be hybrids between *C. medullaris* and *C. smithii*. However, Brownsey (1979) confirmed the presence of *C. cunninghamii* in New Zealand and illustrated the distinguishing features of all three species. No hybrids involving *C. medullaris* are accepted. The status of the two Raoul Island endemics, *C. kermadecensis* and *C. milnei*, has been discussed by Brownsey & Perrie (2015a).

1	Stipe and lamina scales with dark-coloured spines at the apices and on the margins; trunks bearing hexagonal or oval stipe scars	2
	Stipe and lamina scales lacking dark-coloured spines, or spines confined to the apices, or borne on the scale surface; trunks occasionally absent, or when present, usually bearing projecting remnants of stipe bases	3
2	Stipes black; indusia completely covering the sori when young, splitting irregularly at maturity; hairs in sorus inconspicuous, shorter than or equalling the sporangia	*medullaris*
	Stipes pale brown; indusia absent; hairs in sorus conspicuous, equalling or longer than the sporangia	*cooperi*
3	Indusia absent; hairs in sorus conspicuous, longer than sporangia; trunks prostrate, or less than 1m tall at maturity	*colensoi*
	Indusia present; hairs in sorus inconspicuous, shorter than sporangia; trunks several metres tall at maturity	4
4	Abaxial surface of lamina bearing abundant curly hairs; indusia covering sori when young, opening to form a deep cup at maturity	5
	Abaxial surface of lamina lacking obvious curly hairs; indusia covering sori when young, opening to a hood-shape or saucer-shape at maturity	6

5	Abaxial surface of lamina white, blue-green or grey-green; scales very scattered or absent on abaxial surface of costae; stipe bases rough; plants of main islands	*dealbata*
	Abaxial surface of lamina green; scales abundant on abaxial surface of costae; stipe bases conspicuously tuberculate; plants confined to Kermadec Islands	*milnei*
6	Stipes and rachises of dead fronds forming a persistent skirt around trunk on mature plants; indusia saucer-shaped, forming less than half a sphere at maturity	*smithii*
	Stipes and rachises not persistent on mature plants; indusia hood-shaped, forming more than half a sphere at maturity	7
7	Tertiary pinnae deeply divided; abaxial surface of lamina bearing red or white acaroid scales, usually lacking irregularly curled acicular hairs; plants of main islands	*cunninghamii*
	Tertiary pinnae crenate or almost undivided; abaxial surface of lamina bearing only white acaroid scales and irregularly curled acicular hairs; plants confined to Kermadec Islands	*kermadecensis*

Distribution: Throughout the tropics and south temperate regions. Of the groups identified by Korall et al. (2007), *Sphaeropteris* extends from India through south-east Asia to Australia, New Zealand and the tropical Pacific, with about eight species also in Central and South America; *Cyathea sensu stricto* occurs predominantly in Central and South America, but also occurs from New Guinea and Queensland through the tropical Pacific to the Austral Islands. The delimitation of *Alsophila* and *Gymnosphaera* is not clear, but *Alsophila* apparently extends through tropical and southern Africa, India, China, south-east Asia, Australia, New Zealand, the tropical Pacific, Central and South America, while *Gymnosphaera* occurs from Madagascar through India, south-east Asia to Australia and presumably into the Pacific, with a single species also in Mexico (Conant et al. 1995; Large & Braggins 2004; Korall et al. 2007). Five endemic, two indigenous and one species casual in New Zealand.

Biostatus: Indigenous (Non-endemic).

Table 2: Number of species in New Zealand within *Cyathea* Sm.

Category	**Number**
Indigenous (Endemic)	5
Indigenous (Non-endemic)	2
Exotic: Casual	1
Total	**8**

Cytology: The base chromosome number in *Cyathea* is n = 69 Kramer (1990).

Cyathea colensoi (Hook.f.) Domin, *Pteridophyta,* 262 (1929)

≡ *Alsophila colensoi* Hook.f., *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II,* 8, t. 73 (1854)

Lectotype (selected by Brownsey & Perrie 2015b): New Zealand, *W. Colenso No. 1673*, 1849, K (on two sheets)! (photo WELT E466/13, E466/24).

Etymology: Named in honour of William Colenso (1811-99), a printer, missionary, politician and botanist in New Zealand.

Vernacular names: creeping tree fern; mountain tree fern

Rhizomes prostrate, ascending at apex, very rarely forming a short woody trunk up to 1 m tall and 80 mm diameter, covered in stipe bases; bearing scales near the apex. Rhizome scales marginate, acicular, lacking dark-coloured setae, very pale brown. Fronds 460–1500 mm long, held upright; dead fronds falling. Stipes 90–700 mm long, 4–20 mm wide, 4–5 mm deep, red-brown proximally, often yellow-brown distally, finely tuberculate or smooth, bearing hairs and scales; hairs fine, acicular, colourless or pale brown, up to 1 mm long; scales acicular, pale brown or with pale margins and dark centres, lacking dark-coloured setae, densely covering base of stipe, up to 40 mm long and 3 mm wide, becoming more scattered distally, interspersed with dense red acaroid scales c. 0.1 mm in diameter. Laminae deeply 2-pinnate-pinnatifid to 2-pinnate-pinnatisect, elliptic or ovate to broadly ovate, 370–1150 mm long, 190–740 mm wide, dark green on both surfaces, herbaceous; adaxial surfaces of rachis, pinna midribs, costae and laminae abundantly covered in fine, acicular, colourless or pale brown hairs up to 1 mm long; abaxial surfaces bearing pale scales with bullate or flattened

bases and attenuate apices, up to 2 mm long and 0.5 mm wide, and red acaroid scales c. 0.1 mm in diameter, occasionally with a small flattened pale brown base; rachis red-brown or yellow-brown, becoming yellow-brown distally, smooth or finely tuberculate. Primary pinnae in 20–25 pairs, narrowly ovate or narrowly triangular; the longest at or below the middle, 130–400 mm long, 45–120 mm wide, short-stalked. Secondary pinnae narrowly ovate or narrowly triangular, the longest 23–65 mm long, 7–15 mm wide, short-stalked or sessile. Longest tertiary segments 3–7 mm long, 1.5–2.5 mm wide, adnate; apices acute; margins entire to crenate. Sori 0.5–0.8 mm in diameter; paraphyses longer than sporangia; indusia absent.

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

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

Stewart Island.

Altitudinal range: 60–1150 m.

Cyathea colensoi is a fern of montane forest in the North Island, occurring from Table Mountain, Te Aroha, Mt Pirongia and the Honokāwā Range south through the Urewera Ranges, Volcanic Plateau, Mt Taranaki, Ruahine and Tararua Ranges, occupying a zone from c. 400 m to 1100 m. However, there are early collections by Harry Carse from Mt Maungataniwha and from Tākou, Whangaroa by H.B. Matthews which are well north of the currently known distribution. The presence of *C. colensoi* in Northland needs confirmation. In the South Island *C. colensoi* is widely distributed as a fern of montane forest, reaching 1150 m on Mt Owen, but descending to 60 m at the Pororari River, Westland and to 80 m in coastal regions of north-west Nelson. It is absent from Marlborough and much of inland Otago.

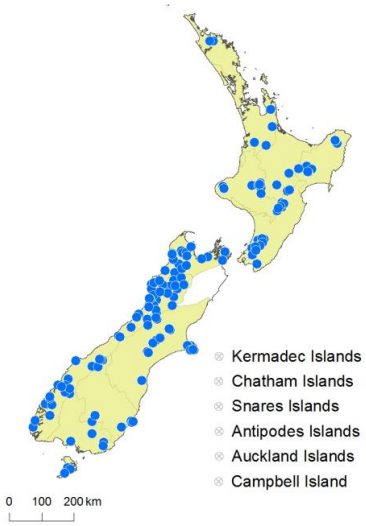

Fig. 1: *Cyathea colensoi* distribution map based on databased records at AK, CHR, OTA and WELT.

Biostatus: Indigenous (Endemic).

Habitat: *Cyathea colensoi* occurs most frequently under beech forest, but also under podocarp, *Weinmannia*, *Metrosideros umbellata* and *Libocedrus* forest, and occasionally on road cuttings or under scrub.

Recognition: *Cyathea colensoi* is the only species of the genus in New Zealand that produces fertile fronds from a prostrate rhizome. Very rarely plants with a short trunk no more than 1 m high have been observed but these cases are exceptional. *Cyathea colensoi* is also the only native species that lacks an indusium. It has conspicuous hairs in the sorus which are longer than the sporangia. It is often mistaken in the field for young plants of *C. smithii*, but the latter species never produces fertile fronds until it has developed a trunk.

Cytology: n = 69 (Brownlie 1958).

Notes: There are two collections in the Hookers' Herbarium at K, numbered 1673 and 1673α. Colenso's collections were sent to W.J. Hooker in a letter dated 21 January 1848. In the letter, Colenso stated "1673. *Polypodium ruahinensis*, W.C., a beautiful species - never arborescent, fronds 4–5 feet long, woods, ascent to Ruahine, ½-way up. It has hairs under its sori, and had it been arborescent, I should have called it an *Alsophila*". The specimens themselves are labelled "*Polypodium ruahinense*" (St George 2009). *Colenso 1673* was chosen as the lectotype by Brownsey & Perrie (2015b).

Fig. 2: *Cyathea colensoi*. Mature plant lacking a trunk growing on the forest floor.

Fig. 3: *Cyathea colensoi*. Apex of prostrate rhizome and stipe bases bearing acicular, pale brown scales.

Fig. 4: *Cyathea colensoi*. Young frond showing the characteristic form of the uncoiling crozier (at top right).

Fig. 5: *Cyathea colensoi*. Mature frond with longest primary pinnae at mid-lamina.

Fig. 6: *Cyathea colensoi*. Acicular pale brown scales with dark centres at junction of stipe and rachis.

Fig. 7: *Cyathea colensoi*. Acicular pale brown scales interspersed with tiny red acaroid scales at junction of rachis and primary pinna.

Fig. 8: *Cyathea colensoi*. Acicular pale brown scales interspersed with tiny red acaroid scales at junction of primary pinna and secondary pinnae.

Fig. 9: *Cyathea colensoi*. Sori lacking indusia but with emergent paraphyses amongst the sporangia. Red acaroid and pale brown ovate scales visible on midribs.

Cyathea cooperi (Hook. ex F.Muell.) Domin, *Pteridophyta,* 262 (1929)

≡ *Alsophila cooperi* Hook. ex F.Muell., *Fragm. (Mueller),* 117 (1866)
≡ *Sphaeropteris cooperi* (Hook. ex F.Muell.) R.M.Tryon, *Contr. Gray Herb.* 200: 24 (1970)
Lectotype (selected by Tindale 1956): Woollongong, New South Wales, *W.W. Woolls*, MEL 1061262. Isolectotype MEL1061257.

Etymology: Named in honour of Sir Daniel Cooper (1817?-42), a British botanist.

Distribution: North Island: Auckland.

Known as a naturalised plant, with a trunk 500 mm high, only from Captain Springs Reserve, Auckland, but the species is cultivated in several places including the Bay of Islands, Auckland and Wellington.

Occurs naturally in Australia (eastern Queensland and New South Wales). It is naturalised in south-west Western Australia, and possibly in southern Victoria (Bostock 1998), and is a serious weed of rainforests in Hawai'i (Palmer 2003).

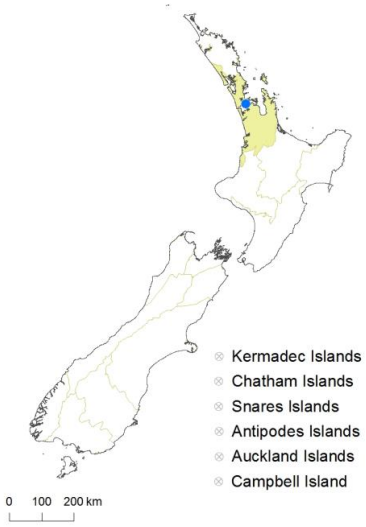

Fig. 10: *Cyathea cooperi* distribution map based on databased records at AK, CHR, OTA and WELT.

Biostatus: Exotic; casual.

Habitat: Recorded from near water, under willow trees, probably as an escape from cultivation.

First record: Gardner (1994). Voucher: AK 218773; CHR 484311, 1993.

Recognition: *Cyathea cooperi* is similar to *C. medullaris* in having stipe scars on the trunk, and stipe scales with dark red, marginal setae that are lacking in all other New Zealand species of *Cyathea*. It differs in having pale or mid-brown stipes bearing pale brown scales, rather than the markedly black stipes and blackish-brown scales of *C. medullaris*. The tertiary pinnae of *C. cooperi* have more or less entire margins and rounded apices, compared to those in *C. medullaris* which are serrate and acute. The scales on the abaxial lamina surfaces are linear or acicular in outline, in contrast to the ovate scales of *C. medullaris*, although both species have scales with marginal setae. The sori of *C. cooperi* are distinctive in lacking indusia, but having setiferous scales around the base, quite unlike the indusia of *C. medullaris* that completely enclose the sori before maturity and then break open irregularly.

Notes: A specimen collected by Mossman in 1850 from Wairoa, North Auckland (WELT P015834) belongs to this species. However, there must be some doubt as to whether it originated from a wild plant in New Zealand, or was a collection from Australia (where Mossman also visited) whose label was subsequently transposed. The species has been in cultivation in Auckland since about 1980 (Gardner 1994), and in Wellington since before 2006 (WELT P021977). Sporelings are known to have

established in a nursery near Kerikeri, and the species has the potential to spread in Northland (Heenan et al. 1998).

Fig. 11: *Cyathea cooperi*. Plant growing in cultivation.

Fig. 12: *Cyathea cooperi*. Trunk and stipe bases covered in pale brown scales .

Cyathea cunninghamii Hook.f. in Hooker, *Icon. Pl. 10,* t. 985 (1854)

≡ *Alsophila cunninghamii* (Hook.f.) R.M.Tryon, *Contr. Gray Herb.* 200: 36 (1970)

Lectotype (selected by Tindale 1956): New Zealand, *W. Colenso No. 1780*, labelled "Cyathea pulcherrima W.C.", K! (photo WELT B13599).

Etymology: Named in honour of Allan Cunningham (1791–1839), a plant collector for Kew and colonial botanist in New South Wales, who visited New Zealand in 1826.

Vernacular names: gully tree fern; pūnui; slender tree fern

Rhizomes erect, forming a woody trunk up to c. 20 m tall, 50–200 mm in diameter or rarely up to 280 mm in well-grown plants, covered in dark brown to black appressed stipe bases in the upper part of the trunk, and stipe scars in the lower part; bearing scales near the apex. Rhizome scales marginate, narrowly ovate, lacking dark-coloured setae, pale brown. Fronds 1500–3000 mm long, held horizontally; dead fronds usually falling, but often persistent in immature plants. Stipes 80–450 mm long, 12–45 mm wide and 7–35 mm deep at the base, black proximally, becoming black-brown or red-brown distally, tuberculate and rough, bearing hairs and scales; hairs fine, acicular, colourless or pale brown, up to 1 mm long; scales narrowly ovate, pale brown throughout or with dark brown centres, densely covering base of stipe, up to 50 mm long and 1–2 mm wide, becoming more scattered distally, interspersed with dense red acaroid scales c. 0.1 mm in diameter, sometimes with small expanded bases. Laminae deeply 2-pinnate-pinnatifid to 3-pinnate-pinnatifid, ovate or elliptic or obovate, 1400–2750 mm long, 420–1000 mm wide, dark green above, paler below, herbaceous or coriaceous; adaxial surfaces of rachis, pinna midribs, costae and rarely the laminae abundantly covered in fine, acicular, colourless or pale brown hairs up to 1 mm long, and scattered, narrowly ovate, pale brown scales; abaxial surfaces very rarely bearing scattered curled acicular hairs, but bearing abundant pale scales with bullate bases and attenuate apices sometimes with a red apical seta, up to 5 mm long and 1 mm wide, and abundant colourless or red acaroid scales, 0.1–0.2 mm long, sometimes with a small expanded base c. 1 mm long; rachis red-brown, becoming yellow-brown distally, finely tuberculate. Primary pinnae in 20–30 pairs, narrowly ovate or narrowly triangular or narrowly elliptic; the longest at or above the middle, 270–600 mm long, 80–210 mm wide, short-stalked; the lowermost pair often greatly reduced and distant from the next pair up. Secondary pinnae narrowly ovate or narrowly triangular, the longest 43–110 mm long, 9–28 mm wide, short-stalked or sessile. Longest tertiary pinnae 5–15 mm long, 1.5–3 mm wide, adnate; apices acute; margins entire, crenate or divided up to ⅔ to the midrib. Sori 0.5–0.9 mm in diameter; paraphyses shorter than sporangia, or absent; indusia open on side away from costa before maturity, hood-shaped at maturity and forming more than a hemisphere, splitting on upper surface with age.

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

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

Chatham Islands.

Altitudinal range: 0–950 m.

Cyathea cunninghamii occurs throughout coastal and lowland areas in the damper western part of the North Island, extending locally to montane regions of southern Coromandel, and the Kaimai, Ruahine and Tararua Ranges. It is largely absent from the drier east coast. It occurs from sea level up to 800 m on Mt Pirongia, and 950 m on Mt Te Aroha. In the South Island it is confined to coastal and lowland areas in the Marlborough Sounds, north-west Nelson and Westland as far south as Poison Bay in northern Fiordland, with an isolated record on the east coast from Half Way Bush, Dunedin. It occurs from sea level up to about 200 m, and has also been collected from the Chatham Islands.

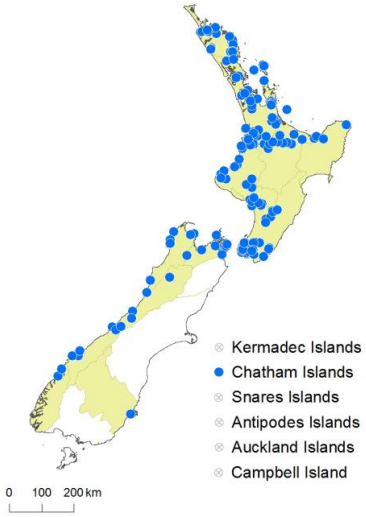

Fig. 13: *Cyathea cunninghamii* distribution map based on databased records at AK, CHR, OTA and WELT.

Also occurs in Australia (Queensland, New South Wales, Victoria, Tasmania). It is known from single populations in south-east Queensland and south-east New South Wales, and is largely confined to Victoria and Tasmania. It hybridises with *C. australis*, and the hybrid is known as *C. ×marcescens* (Peacock et al. 2013).

Biostatus: Indigenous (Non-endemic).

Habitat: Brownsey (1979) noted that *Cyathea cunninghamii* "…appears to favour damp gullies or river banks in lowland forested areas, particularly where there are fresh soils or there is frequent deposition of detritus and silt". It is a tall, emergent species recorded from podocarp and broadleaved forest, kānuka forest, wetland forest, and occasionally from silver beech forest, or under *Pinus radiata*. It also occurs in coastal forest and sometimes with nikau in the South Island. It is susceptible to drought (Brownsey 1979) and is rare in the eastern parts of both main islands. It is locally common in damper areas of the North Island, such as along the Whanganui River.

Recognition: On the main islands of New Zealand *Cyathea cunninghamii* is most easily confused with *C. medullaris*. It is distinguished by its slender trunk covered in appressed stipe bases rather than hexagonal scars, shorter (up to 3 m long cf. up to 5 m long) and rather lacy fronds, thinner and rougher stipes (up to 45 mm wide and 35 mm deep cf. up to 90 mm wide and 60 mm deep), stipe scales that lack marginal setae, and hood-shaped rather than irregularly splitting indusia. *Cyathea cunninghamii* differs from *C. smithii* in lacking a skirt of persistent dead fronds when mature, and having hood-shaped rather than saucer-shaped indusia. These three species can also be distinguished by the form of their lamina scales (Brownsey 1979).

Cyathea cunninghamii is morphologically very similar to *C. kermadecensis*. The two taxa share indusia which open at maturity to form a hood-shape, and a diverse array of very similar hairs and scales on the abaxial surface of the laminae. No other taxa in New Zealand or Australia have indusia of this type or such a diversity of scales and hairs. However, *C. kermadecensis* has a greater abundance of large pale brown scales on the abaxial surfaces of the costae than *C. cunninghamii*, and scattered, irregularly curled, acicular hairs on the abaxial costae, which are usually absent in *C. cunninghamii*. *C. kermadecensis* also lacks the red acaroid scales of *C. cunninghamii*, producing only colourless acaroid scales with slightly longer branches. The tertiary pinnae of *C. cunninghamii* are slightly more divided, and the stipe bases of *C. kermadecensis* are red-brown rather than black as in *C. cunninghamii*. The status of the two species has been discussed by Brownsey & Perrie (2015a). They are very closely related but are retained here as species in the absence of any definitive evidence to the contrary.

Cytology: 2n = 138 (Murray & de Lange 2013).

Notes: Colenso's No. 1780, chosen as the lectotype of *Cyathea cunninghamii* by Tindale (1956), was sent to W.J. Hooker in a letter initially dated 29 September 1848 and closed on 20 October. In the letter, Colenso stated "1780. Incipient fronds sprouting from a prostrate (felled) caudex, side of road. Caudex 9 feet long. *Cyathea pulcherissima*, W.C." (St. George 2009).

Fig. 14: *Cyathea cunninghamii*. Mature plant with emergent crown of lacy fronds with narrow stipes.

Fig. 15: *Cyathea cunninghamii*. Mature plant with tall trunk and narrow stipes.

Fig. 16: *Cyathea cunninghamii*. Young plant with a few dead fronds persistent on the trunk.

Fig. 17: *Cyathea cunninghamii*. Mature plant showing the lack of persistent dead fronds, the remnant stipe bases on the trunk, and the narrow, black stipes.

Fig. 18: *Cyathea cunninghamii*. Mature plant with pale brown scales on the trunk and stipe bases.

Fig. 19: *Cyathea cunninghamii*. Tuberculate stipe bases with acicular pale brown scales.

Fig. 20: *Cyathea cunninghamii*. Secondary pinna bearing deeply divided tertiary pinnae.

Fig. 21: *Cyathea cunninghamii*. Sori protected by hood-shaped indusia.

Cyathea dealbata (G.Forst.) Sw., *J. Bot. (Schrader)* 1800(2): 94 (1801)

≡ *Polypodium dealbatum* G.Forst., *Fl. Ins. Austr.,* 83 (1786)
Lectotype (selected by Nicolson & Fosberg 2003): New Zealand, *Forster*, No. 293, K (*n.v.*)

= *Cyathea tricolor* Colenso, *Trans. & Proc. New Zealand Inst.* 15: 304 (1883)
≡ *Cyathea dealbata* var. *tricolor* (Colenso) Domin, *Biblioth. Bot.* 20 (85): 27 (1913)
≡ *Alsophila tricolor* (Colenso) R.M.Tryon, *Contr. Gray Herb.* 200: 37 (1970)
Lectotype (selected by Brownsey & Perrie 2015b): New Zealand, com. W. Colenso, Sept.1883, K! (photo WELT E466/15–16).

= *Hemitelia falciloba* Colenso, *Trans. & Proc. New Zealand Inst.* 24: 394 (1892)
≡ *Cyathea falciloba* (Colenso) Domin, *Pteridophyta,* 264 (1929)
Lectotype (selected by Allan 1961): Dannevirke, H[awkes] B[ay], Herb. Colenso, WELT P003305 (on two sheets)!

Etymology: From the Latin *dealbatus* (covered with a white powder), a reference to the distinctive white undersides of the fronds.

Vernacular names: kātote; ponga; silver fern

Rhizomes very rarely prostrate, usually erect, forming a woody trunk up to c. 12 m tall, 160–450 mm in diameter, covered in light brown or white projecting stipe bases; bearing scales near the apex. Rhizome scales marginate, acicular, lacking dark-coloured setae, chestnut-brown, shining. Fronds 2000–4000 mm long, held horizontally; dead fronds often persistent in immature plants, rarely so in mature plants. Stipes 30–900 mm long, 15–40 mm wide and 15–40 mm deep at the base, pale brown

or whitish, tuberculate and slightly to moderately rough; scales at base of stipe chestnut-brown, shining, twisted, up to 70 mm long and 3 mm wide, becoming more scattered distally. Laminae deeply 2-pinnate-pinnatifid to 2-pinnate-pinnatisect, ovate or elliptic or obovate, 1500–3350 mm long, 600–1150 mm wide, herbaceous or coriaceous; adaxial surface dark green and slightly glossy; abaxial surface often green in young plants but becoming white or glaucous or occasionally grey- or blue-green in older plants; adaxial surfaces of rachis and pinna midribs sparsely covered with colourless or pale brown curly hairs up to c. 1 mm long, but the lamina more or less glabrous; abaxial surfaces bearing abundant curly hairs; abaxial surface of costae bearing occasional pale brown ovate scales with a dark terminal seta c. 1 mm long; junctions of the pinnae with the rachis sometimes bearing larger ovate scales up to c. 3 mm long and 1 mm wide with dark terminal and lateral setae arising from the surface of the scales; rachis pale brown or whitish. Primary pinnae in 20–30 pairs, either ovate, narrowly ovate, narrowly triangular or narrowly elliptic; the longest at or above the middle, 290–650 mm long, 135–240 mm wide, short-stalked, gradually decreasing proximally to a much reduced basal pair. Secondary pinnae narrowly ovate or narrowly triangular or narrowly elliptic, the longest 70–145 mm long, 13–30 mm wide, short-stalked or sessile, either deeply divided almost to the base, or completely divided into tertiary segments. Longest tertiary segments 7–18 mm long, 2–4 mm wide, adnate or decurrent; apices acute; margins entire or shallowly serrate. Sori 0.5–0.8 mm in diameter; paraphyses shorter than sporangia; indusia covering sori before maturity, opening to form a deep cup with a smooth rim at maturity, often later breaking apart.

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

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

Three Kings Islands, Chatham Islands.

Altitudinal range: 0–900 m.

Cyathea dealbata occurs on the Three Kings Islands and throughout coastal and lowland areas of the North Island. In the South Island it occurs in coastal and lowland areas from Nelson and Marlborough south to Punakaiki on the west coast, and to just south of Dunedin on the east coast. It is also present on the Chatham Islands. In the North Island it grows from near sea-level to about 650 m in the Kaweka Ranges and 800 m on the Waimarino Plains. In the South Island it is mostly found in coastal and lowland areas but extends locally into montane forest, reaching 900 m at Jordan Stream in the Inland Kaikoura Ranges.

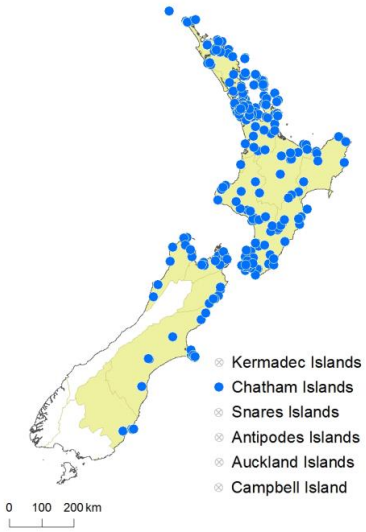

Fig. 22: *Cyathea dealbata* distribution map based on databased records at AK, CHR, OTA and WELT.

Biostatus: Indigenous (Endemic).

Habitat: *Cyathea dealbata* occurs as a sub-canopy species under kauri, podocarp, beech and broadleaved forest, and in kānuka and mānuka scrub, usually in drier areas. It is occasionally found on bush margins and in more open areas, and has been recorded from amongst rushes in a dune slack.

Recognition: *Cyathea dealbata* is usually immediately recognisable by the white colour of the undersurface of the fronds. Aberrant specimens, and very young plants, with grey-green, blue-green or green undersurfaces can be identified by the abundant curly hairs. The indusia are also distinctive at maturity when they form a deep cup-shape, but are best seen at senescence when the sporangia have been shed.

Cyathea dealbata is morphologically very similar to *C. milnei*. The two taxa are characterised by abundant crisped or curled hairs on both surfaces of the laminae, and by indusia which open at maturity to form a deep cup that later breaks apart or spreads out to form a bowl shape. No other species in New Zealand have indusia of this type or such a preponderance of curled hairs. *Cyathea milnei* is distinguished by the green colour of the abaxial lamina surface compared to the distinctive white colour of most populations of *C. dealbata*, although there are several populations in northern New Zealand that have grey- or blue-green abaxial surfaces. *Cyathea milnei* also tends to have more persistent dead fronds on the trunks of mature plants, pale brown rather than white stipes and rachises, more conspicuously tuberculate stipe bases, proportionally fewer hairs and more scales on the abaxial costae, slightly larger sori (0.6–0.8 mm, cf. c. 0.5 mm wide), and more fragile indusia that break up easily. The status of the two species has been discussed by Brownsey & Perrie (2015a). They are very closely related, but are retained here as species in the absence of any definitive evidence to the contrary.

Cytology: n = 69 (Brownlie 1958).

Notes: There are three syntype specimens of *Hemitelia falciloba* Colenso in WELT (P002483–4, P003305), and two more at AK (136265, 136267). Allan (1961, p. 41) lectotypified one of the specimens in WELT (P003305) by describing uniquely the material (now on two sheets) as comprising "four partial pinnae (2 sterile, 2 fertile)".

Allan (1961, p. 40) also lectotypified *Cyathea tricolor* Colenso but the specimen in WELT is now missing, presumed lost, and a replacement lectotype at K was selected from syntypes in AK, K and WELT by Brownsey & Perrie (2015b).

Rawlings (1969) reported an unusual form of *Cyathea dealbata* from Warawara Forest with prostrate rhizomes. Similar plants were reported by Bryony Macmillan from Warkworth (CHR 199046) and by Peter de Lange from Te Paki at Unuwhao Bush (AK 223017–9, 222931), near North Cape (AK 322831–3) and Radar Bush (WELT P027464). The fronds collected by Rawlings were said to be sterile and less white than usual in this species, and as "dirty-grey to glaucescent" by de Lange. Some other populations in northern New Zealand, from Raglan, Kāwhia and Waihi to North Cape, and from Coppermine Island, Rabbit Island, Goat Island and the Three Kings Islands, have blue-grey, grey-green or almost green abaxial surfaces but do not appear to differ in any other character from populations with white undersurfaces. Colenso's *C. tricolor*, described from the Seventy Mile Bush between Norsewood and Dannevirke, was also noted for its "bluish tint", as well as for its "shining dark green upper foliage" and "general and regular drooping appearance". These plants appear to be at one end of clinal variation in *C. dealbata* and are not recognised taxonomically here.

Kirk (1873) recorded a specimen of *C. dealbata* with a branching trunk and double crown, but suggested that it might have arisen as a result of damage to the growing point. He noted three other examples that he had seen with similar branching trunks.

Fig. 23: *Cyathea dealbata*. Mature plants with fronds held horizontally.

Fig. 24: *Cyathea dealbata*. Mature plants, some lacking dead fronds and one with an unusual skirt of dead fronds.

Fig. 25: *Cyathea dealbata*. Young plant showing a few persistent dead fronds and whitish stipes to the living fronds.

Fig. 26: *Cyathea dealbata*. Trunk of a mature plant showing the lack of persistent dead fronds but projecting stipe bases around the trunk.

Fig. 27: *Cyathea dealbata*. Young crozier protected by scales.

Fig. 28: *Cyathea dealbata*. Chestnut-brown scales on stipe bases.

Fig. 29: *Cyathea dealbata*. Underside of young frond showing the white colour developing on the margins.

Fig. 30: *Cyathea dealbata*. Underside of fertile frond showing the characteristic white colour.

Fig. 31: *Cyathea dealbata*. Tuberculate, silver-coloured stipe bearing acicular chestnut-brown scales.

Fig. 32: *Cyathea dealbata*. Underside of fertile frond from the Far North showing glaucous coloration rather than the more usual white colour.

Fig. 33: *Cyathea dealbata*. Underside of fertile frond showing dense curly hairs on the midribs, and mature sori.

Fig. 34: *Cyathea dealbata*. Underside of fertile frond showing mature sori. Some indusia have lost their sporangia to reveal a deep cup.

Cyathea kermadecensis W.R.B.Oliv., *Trans. & Proc. New Zealand Inst.* 42: 158 (1910)

≡ *Alsophila kermadecensis* (W.R.B.Oliv.) R.M.Tryon, *Contr. Gray Herb.* 200: 37 (1970)

Lectotype (selected by Brownsey & Perrie 2015b): Sunday Island [Raoul Island, Kermadec Islands], *W.R.B.Oliver s.n.*, 12 Oct. 1908, K 000974328!

Etymology: *kermadecensis* (Latin) – from the Kermadec Islands, north of New Zealand.

Rhizomes erect, forming a woody trunk up to c. 20 m tall, 140–200 mm in diameter, covered in red-brown appressed stipe bases in the upper part of the trunk and stipe scars in the lower part; bearing scales near the apex. Rhizome scales marginate, narrowly ovate, lacking dark-coloured setae, pale brown or red-brown. Fronds 2050–4000 mm long, arching up from the crown; dead fronds often falling to leave clean scars but sometimes a few persisting on the trunks. Stipes 70–320 mm long, 10–33 mm wide and 10–30 mm deep at the base, pale brown to red-brown becoming black at the very base, tuberculate and rough, bearing hairs and scales; hairs fine, acicular, colourless or pale brown, up to 1 mm long; larger scales narrowly ovate, pale or red-brown, up to 35 mm long and 1 mm wide, densely covering base of stipe, becoming more scattered distally; smaller scales acaroid, colourless, 0.1–0.2 mm long, sometimes forming a dense appressed tomentum on young stipes. Laminae 2-pinnate-pinnatifid to 2-pinnate-pinnatisect, elliptic or obovate, 1750–2100 mm long, 700–900 mm wide, adaxial surface dark shining green, abaxial surface dull green, coriaceous to herbaceous; adaxial surfaces of rachis, pinna midribs and costae abundantly covered in fine, acicular, colourless or pale brown hairs up to 1 mm long; abaxial surfaces bearing hairs and scales; hairs acicular, scattered, irregularly curled, up to 1.5 mm long; larger scales abundant, narrowly ovate, pale brown, up to 5 mm long and 1 mm wide, usually lacking a terminal red seta; smaller scales acaroid, colourless, 0.1–0.2 mm long, sometimes with expanded bases, often appressed to costa surface; rachis yellow-brown or pale brown, finely tuberculate. Primary pinnae in 18–30 pairs, narrowly ovate or narrowly

elliptic or elliptic; the longest above the middle, 325–610 mm long, 110–195 mm wide, short-stalked; the lowest pair often greatly reduced. Secondary pinnae narrowly ovate or narrowly triangular, the longest 65–115 mm long, 14–35 mm wide, short-stalked or sessile. Longest tertiary segments 8–22 mm long, 2–2.5 mm wide, adnate; apices acute; margins crenate. Sori 0.6–0.9 mm in diameter; paraphyses shorter than sporangia, or absent; indusia open on side away from costa before maturity, hood-shaped at maturity and forming more than a hemisphere, splitting on upper surface with age.

Distribution: Kermadec Islands.

Altitudinal range: 15–465 m.

Endemic to Raoul Island.

Biostatus: Indigenous (Endemic).

Cyathea kermadecensis was given a conservation status of Naturally Uncommon by de Lange et al. (2013).

Habitat: *Cyathea kermadecensis* grows in *Metrosideros*, *Ascarina* and *Rhopalostylis* forest in ravines, gullies and on cliffs, mostly in the higher and wetter parts of Raoul Island but also at lower elevations and drier sites. It is apparently less common than *C. milnei* (Sykes 1977).

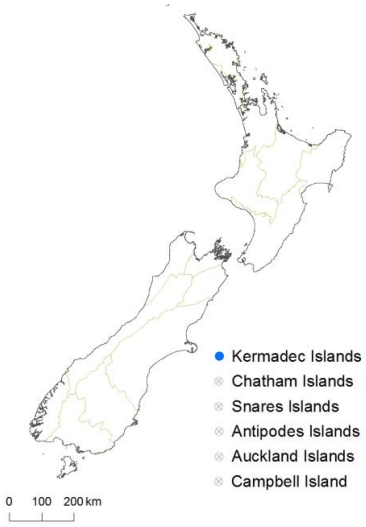

Fig. 35: *Cyathea kermadecensis* distribution map based on databased records at AK, CHR, OTA and WELT.

Recognition: *Cyathea kermadecensis* is morphologically very similar to *C. cunninghamii*. The two taxa share indusia which open at maturity to form a hood-shape, and a diverse array of very similar hairs and scales on the abaxial surface of the laminae. No other taxa in New Zealand or Australia have indusia of this type or such a diversity of scales and hairs. However, *C. kermadecensis* has a greater abundance of large pale brown scales on the abaxial surfaces of the costae than *C. cunninghamii*, and scattered, irregularly curled, acicular hairs on the abaxial costae which are usually absent in *C. cunninghamii*. *C. kermadecensis* also lacks the red acaroid scales of *C. cunninghamii*, producing only colourless acaroid scales with slightly longer branches. The tertiary segments of *C. cunninghamii* are slightly more divided, and the stipe bases of *C. kermadecensis* are red-brown rather than black as in *C. cunninghamii*. The status of the two species has been discussed by Brownsey & Perrie (2015a). They are very closely related, but are retained here as species in the absence of any definitive evidence to the contrary.

Cytology: 2n = 138 (Murray & de Lange 2013).

Notes: *Cyathea kermadecensis* was first lectotypified by Holttum (1964). However his choice included two specimens and was further narrowed to a single specimen by Brownsey & Perrie (2015b).

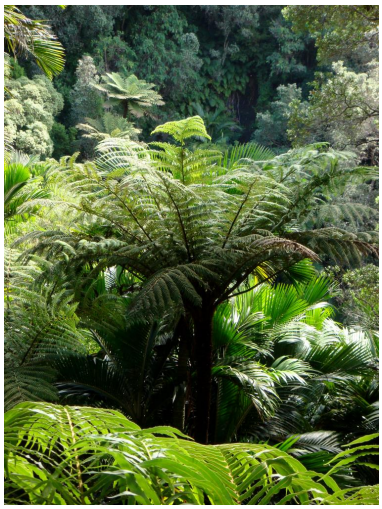

Fig. 36: *Cyathea kermadecensis*. Mature plants growing on Raoul Island showing the lack of persistent dead fronds.

Fig. 37: *Cyathea kermadecensis*. Crown of mature plant on Raoul Island.

Fig. 38: *Cyathea kermadecensis*. Crown of cultivated plant showing the red-brown colour of the stipe bases and trunk.

Fig. 39: *Cyathea kermadecensis*. Crozier on a cultivated plant protected by red-brown scales.

Fig. 40: *Cyathea kermadecensis*. Crown of plant growing on Raoul Island showing red-brown scales densely covering the stipe bases and trunk.

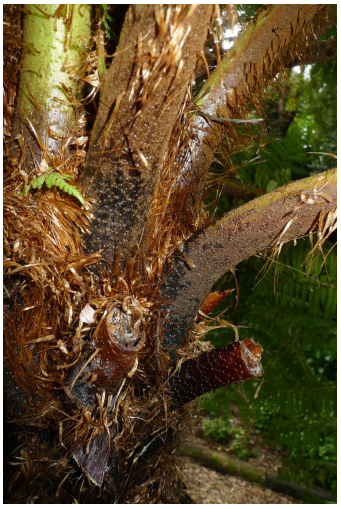

Fig. 41: *Cyathea kermadecensis*. Tuberculate stipe bases with acicular pale and red-brown scales.

Fig. 42: *Cyathea kermadecensis*. Underside of fertile frond showing crenate tertiary segments.

Fig. 43: *Cyathea kermadecensis*. Underside of fertile frond showing mature sori protected by hood-shaped indusia.

Cyathea medullaris (G.Forst.) Sw., *J. Bot. (Schrader)* 1800(2): 94 (1801)

≡ *Polypodium medullare* G.Forst., *Pl. Esc.,* 74 (1786)
≡ *Sphaeropteris medullaris* (G.Forst.) Bernh., *J. Bot. (Schrader)* 1800(2): 122 (1801)
Lectotype (selected by Nicolson & Fosberg 2003): Nova Zelandia [New Zealand], Herb. G. Forster No. 287, BM 001048422!

= *Cyathea medullaris* var. *integra* Hook., *Sp. Fil. 1,* 27 (1844)
Type: New Zealand, W. Colenso (not located).

= *Cyathea polyneuron* Colenso, *Trans. & Proc. New Zealand Inst.* 11: 429 (1879)
≡ *Cyathea medullaris* var. *polyneuron* (Colenso) C.Chr., *Index Filic.,* 194 (1905)
Lectotype (selected by Allan 1961): Napier, Herb. Colenso, WELT P003306 (on two sheets)!

Etymology: From the Latin *medullaris* (pithy), a reference to the pith of this species that was baked and eaten by Māori.

Vernacular names: black tree fern; katātā; kōrau; mamaku; pītau

Rhizomes erect, forming a woody trunk up to c. 20 m tall, 150–300 mm in diameter, covered in black, hexagonal stipe scars; bearing scales near the apex. Rhizome scales conform, acicular, bearing dark-coloured setae on margins, blackish-brown, shining. Fronds 3000–5000 mm long, arching upwards from the crown; dead fronds usually falling, but up to 5 occasionally persistent. Stipes 160–1650 mm long, 40–95 mm wide and 40–60 mm deep at the base, black, sometimes becoming dark brown distally, weakly tuberculate and slightly rough; blackish-brown or dark brown scales with dark-coloured setae on margins densely covering base of stipe, up to 50 mm long and 2 mm wide, becoming pale brown, smaller and more scattered distally. Laminae deeply 2-pinnate-pinnatifid to 3-pinnate-pinnatifid, elliptic or obovate, 3000–4000 mm long, 600–2000 mm wide, dark green on adaxial surface, pale green on abaxial surface, coriaceous; adaxial surfaces of rachis and primary pinna midribs abundantly covered in fine, acicular, colourless or pale brown hairs up to 1 mm long, more scattered on secondary pinna midribs and tertiary pinnae; abaxial surfaces bearing ovate scales with attenuate apices and dark red marginal and apical setae, up to 2 mm long and 1 mm wide on the pinna midribs, and acicular scales up to 5 mm long and 0.5 mm wide on the rachis; rachis blackish-brown on abaxial surface, becoming yellow-brown or pale brown distally, often yellow-brown or yellow-green or green on adaxial surface especially when young, tuberculate. Primary pinnae in 20–25 pairs, ovate, narrowly ovate or narrowly triangular; the longest at or above the middle, 350–950 mm long, 125–300 mm wide, short to long-stalked, abaxial surfaces of costae tuberculate. Secondary pinnae narrowly ovate or narrowly triangular, the longest 65–185 mm long, 12–37 mm wide, short-stalked or sessile. Longest tertiary pinnae 7–20 mm long, 2–4 mm wide, adnate to decurrent; apices acute; margins serrate or divided up to half way to costa. Sori 0.7–1.1 mm in diameter; paraphyses as long as sporangia; indusia completely covering sori before maturity, splitting irregularly at maturity.

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

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

Three Kings Islands, Chatham Islands, Stewart Island.

Altitudinal range: 0–650 m.

Cyathea medullaris occurs primarily in coastal and lowland forest throughout much of the North Island, extending locally into montane forest. It ranges from sea level to 550 m near Taihape, and to 650 m in the Raukūmara and Kaweka Ranges. In the South Island it occurs in coastal and lowland districts of north-west Nelson and the Marlborough Sounds, extending sporadically on the west coast to Fiordland and Southland, and on the east coast to Banks Peninsula. It is absent from Otago and inland areas of Canterbury and Marlborough. It reaches 400 m on Banks Peninsula and 450 m at Blue Duck Reserve in the Seaward Kaikoura Range. It occurs also on the Three Kings Islands and Chatham Islands. There is a 19th century collection from Stewart Island (WELT P005625), but Wilson (1982) states it is “rare and local, as far south as Port Adventure”.

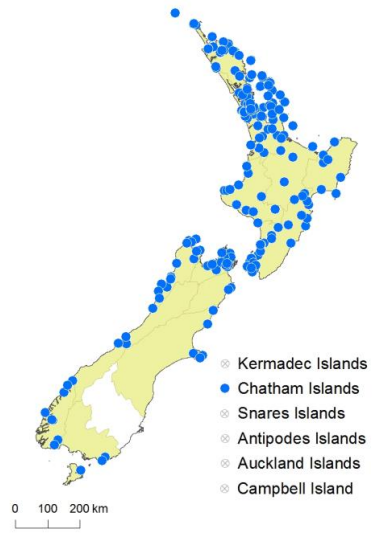

Fig. 44: *Cyathea medullaris* distribution map based on databased records at AK, CHR, OTA and WELT.

Also occurs in Fiji, Samoa, Tahiti, Marquesas Islands, Austral Islands and Pitcairn Island (Holttum 1964). Whether the Pacific Islands' populations are genuinely conspecific with those in New Zealand requires investigation.

The species is reported to be naturalised in the Azores (Lehnert, pers. comm. 2011).

Biostatus: Indigenous (Non-endemic).

Habitat: *Cyathea medullaris* is a tall emergent species that occurs mostly in broadleaved forest, but also in podocarp, beech and kānuka forest and under introduced conifers and *Salix* species. It can be abundant in the initial forest formed on slips and other disturbed sites undergoing regeneration. It is a frost-tender species, and prefers damp habitats.

Recognition: In the field *Cyathea medullaris* is readily distinguished by its tall trunk with black hexagonal stipe scars, and large arching fronds with thick black stipes. The lamina and stipe scales have dark red setae along both margins, which distinguishes this species from all other native species. Even very young plants of *C. medullaris* can be positively identified by this character. The naturalised *C. cooperi* has similar scales but is distinguished by its pale brown stipes and exindusiate sori. Plants of *C. cunninghamii* are superficially similar to *C. medullaris* but have more slender trunks covered in appressed stipe bases, shorter and more lacy fronds, and thinner stipes. *C. cunninghamii* also has scales that lack the marginal setae, and indusia that open to form a hood-shape, rather than splitting open irregularly.

Cytology: n = 69 (Brownlie 1961).

Notes: *Cyathea polyneuron* was described by Colenso (1879) from a plant he originally collected on Scinde Island, Napier. There are specimens in the Colenso Herbarium at WELT (P003306), in the Cheeseman Herbarium (AK 143439), and on two sheets at K. However, Allan (1961, p. 41) lectotypified the specimen at WELT, stating "the type in WELT consists of three portions of a rachis bearing in all 20 secondary pinnae…", a description which accurately relates to WELT P003306 (now on two sheets).

Cyathea medullaris var. *integra* was described by Hooker (1844–1846) from specimens collected by Colenso in New Zealand, but no material has been located at AK, K or WELT, which hold most of Colenso's collections, and the type has been left undesignated (Brownsey & Perrie 2015b).

Fig. 45: *Cyathea medullaris*. Plants growing abundantly on a disturbed hillside.

Fig. 46: *Cyathea medullaris*. Mature plants emerging above the surrounding forest.

Fig. 47: *Cyathea medullaris*. Young plant with dead fronds persistent on the trunk.

Fig. 48: *Cyathea medullaris*. Mature plant with emergent crown, lacking dead fronds and with large fronds and thick black stipes.

Fig. 49: *Cyathea medullaris*. Crozier covered in acicular dark brown scales.

Fig. 50: *Cyathea medullaris*. Crown of immature plant with thick black stipe bases covered in dark brown scales.

Fig. 51: *Cyathea medullaris*. Crown of mature plant with thick black stipe bases covered in dark brown scales.

Fig. 52: *Cyathea medullaris*. Crown and trunk of mature plant showing thick black stipe bases, and trunks with hexagonal stipe scars.

Fig. 53: *Cyathea medullaris*. Large, obovate frond on mature plant.

Fig. 54: *Cyathea medullaris*. Underside of sterile lamina covered in pale, ovate scales with dark-coloured setae on margins.

Fig. 55: *Cyathea medullaris*. Underside of fertile lamina showing indusia completely enclosing immature sori.

Fig. 56: *Cyathea medullaris*. Underside of fertile lamina showing mature sori, mostly still enclosed within the indusia, but a few in which the indusia have broken open irregularly.

Cyathea milnei Hook. ex Hook.f., *Handb. New Zealand Fl.,* 349 (1864)

≡ *Alsophila milnei* (Hook. ex Hook.f.) R.M.Tryon, *Contr. Gray Herb.* 200: 37 (1970)

Holotype: Kermadec Isles, Raoul Is., *J. MacGillivray*, Voyage of HMS *Herald*, Bot. No. 942, July 1854, K! (photo WELT E466/17).

Etymology: Named in honour of W.G. Milne (?–1886), collector on the voyage of HMS *Herald* to the Pacific 1852–61.

Rhizomes erect, forming a woody trunk up to c. 8 m tall, 50–280 mm in diameter, covered in light brown projecting stipe bases; bearing scales near the apex. Rhizome scales marginate, acicular, lacking dark-coloured setae, chestnut-brown, shining. Fronds 1500–4000 mm long, held horizontally; dead fronds persistent. Stipes 70–400 mm long, 15–35 mm wide and 10–26 mm deep, green or pale brown throughout, strongly tuberculate and rough; scales at base of stipe chestnut-brown, up to 50 mm long and 3 mm wide, twisted, becoming more scattered distally. Laminae deeply 2-pinnate-pinnatifid to 2-pinnate-pinnatisect, elliptic or obovate, 1200–2800 mm long, 700–1200 mm wide, coriaceous; adaxial surface dark glossy green, abaxial surface dull green; adaxial surfaces of rachis and pinna midribs covered with colourless or pale brown curly hairs up to c. 1 mm long, but the lamina more or less glabrous; abaxial surfaces of primary pinna costae bearing abundant curly hairs, but those of the secondary pinna costae less hairy; abaxial surfaces of costae bearing abundant pale brown ovate scales, sometimes with a dark terminal seta, up to c. 4 mm long and 1 mm wide, the scales often occurring in irregular clusters along the costae; rachis pale brown or yellow-brown or green. Primary pinnae in 20–30 pairs, ovate or elliptic; the longest at or above the middle,

350–700 mm long, 150–260 mm wide, short-stalked. Secondary pinnae narrowly obovate, narrowly ovate or narrowly triangular, the longest 85–145 mm long, 15–33 mm wide, short-stalked or sessile, either deeply divided almost to the base, or completely divided into tertiary segments. Longest tertiary segments 8–15 mm long, 2.5–4 mm wide, adnate or decurrent; apices acute; margins shallowly to deeply serrate. Sori 0.7–1.0 mm in diameter; paraphyses shorter than sporangia; indusia covering sori before maturity, opening to form a deep cup with a smooth rim at maturity, usually quickly breaking apart.

Distribution: Kermadec Islands.

Altitudinal range: 25–500 m.

Endemic to Raoul Island.

Biostatus: Indigenous (Endemic).

Cyathea milnei was given a conservation status of Naturally Uncommon by de Lange et al. (2013).

Habitat: *Cyathea milnei* grows more commonly in drier *Metrosideros* forest at low altitudes on Raoul Island, but a few plants extend into the higher and wetter forest. It is apparently more common than *C. kermadecensis* (Sykes 1977).

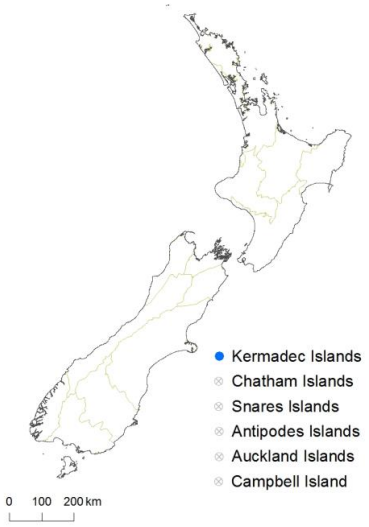

Fig. 57: *Cyathea milnei* distribution map based on databased records at AK, CHR, OTA and WELT.

Recognition: *Cyathea milnei* is morphologically very similar to *C. dealbata*. The two taxa are characterised by abundant crisped or curled hairs on both surfaces of the laminae, and by indusia which open at maturity to form a deep cup that later breaks apart or spreads out to form a bowl shape. No other species in New Zealand have indusia of this type or such a preponderance of curled hairs. *Cyathea milnei* is distinguished by the green colour of the abaxial lamina surface compared to the distinctive white colour of most populations of *C. dealbata*, although there are several populations in northern New Zealand that have grey- or blue-green abaxial surfaces. *Cyathea milnei* also tends to have more persistent dead fronds on the trunks of mature plants, pale brown rather than white stipes and rachises, more conspicuously tuberculate stipe bases, proportionally fewer hairs and more scales on the abaxial costae, slightly larger sori (0.6–0.8 mm, cf. c. 0.5 mm wide), and more fragile indusia that break up easily. The status of the two species has been discussed by Brownsey & Perrie (2015a). They are very closely related but are retained here as species in the absence of any definitive evidence to the contrary.

Notes: *Cyathea milnei* was described by Hooker (1864), but attributed to a manuscript description by William Hooker, based on specimens collected from the Kermadec Islands by John MacGillivray. In the Hookers' Herbarium at K there are three sheets of material collected from the Kermadec Islands during the voyage of the Herald. Two were collected by W.G. Milne in 1855, and one by John MacGillivray in 1854. However, only the latter accords with Hooker's protologue and is therefore the holotype.

Fig. 58: *Cyathea milnei*. Crown of mature plant on Raoul Island showing the thick trunk bearing projecting stipe bases.

Fig. 59: *Cyathea milnei*. Crown of mature plant on Raoul Island showing the pale brown and green stipes.

Fig. 60: *Cyathea milnei*. Plant in cultivation (at left) growing alongside a plant of *C. dealbata*, showing the very similar habit of both species.

Fig. 61: *Cyathea milnei*. Crozier on a plant in cultivation, protected by acicular chestnut-brown scales.

Fig. 62: *Cyathea milnei*. Crown of a plant in cultivation showing trunk with projecting stipe bases, giving rise to green, tuberculate stipes.

Fig. 63: *Cyathea milnei*. Cultivated plant with very rough stipe bases.

Fig. 64: *Cyathea milnei*. Frond on a plant in cultivation showing the glossy green upper surface.

Fig. 65: *Cyathea milnei*. Underside of young fertile frond showing curly hairs and ovate pale brown scales on the primary costae, but only scales on the secondary costae.

Fig. 66: *Cyathea milnei*. Underside of mature fertile frond showing curly hairs and scales on the primary costae, but only scales and a few hairs on the secondary costae.

Fig. 67: *Cyathea milnei*. Underside of mature fertile frond showing sori surrounded by deep cup-shaped indusia.

Cyathea smithii Hook.f., *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II,* 8, t. 72 (1854)

≡ *Hemitelia smithii* (Hook.f.) Hook. ex Hook. & Baker, *Syn. Fil.,* 31 (1865)
≡ *Alsophila smithii* (Hook.f.) R.M.Tryon, *Contr. Gray Herb.* 200: 37 (1970)
Lectotype (selected by Brownsey & Perrie 2015b): New Zealand, *W. Colenso No. 770*, K! (photo WELT E466/7).

= *Hemitelia stellulata* Colenso, *Trans. & Proc. New Zealand Inst.* 18: 222 (1886)
Lectotype (selected by Allan 1961): Norsewood, Herb. W. Colenso, 1884, WELT P003307!

= *Hemitelia microphylla* Colenso, *Trans. & Proc. New Zealand Inst.* 27: 399 (1895)
≡ *Hemitelia smithii* var. *microphylla* (Colenso) Cheeseman, *Man. New Zealand Fl.,* 951 (1906)
≡ *Cyathea novae-zelandiae* Domin, *Pteridophyta,* 264 (1929) nom. nov. pro *Hemitelia microphylla* Colenso 1895
Lectotype (selected by Brownsey & Perrie 2015b): Dannevirke, Herb. W. Colenso, WELT P002512!

Etymology: Named in honour of John Smith (1798–1888), curator of the Royal Botanic Gardens, Kew.

Vernacular names: Smith's tree fern; kātote; soft tree fern

Rhizomes erect, forming a woody trunk up to c. 8 m tall, 120–320 mm in diameter, covered in dark brown appressed stipe bases; bearing scales near the apex. Rhizome scales marginate, acicular, lacking dark-coloured setae, dark brown, shining. Fronds 1650–3000 mm long, held horizontally; midribs of dead fronds persistent as a skirt around trunk. Stipes 80–450 mm long, 15–30 mm wide and 10–20 mm deep at the base, dark brown proximally, becoming chestnut or yellow-brown distally, weakly tuberculate and slightly rough, bearing hairs and scales; hairs fine, acicular, colourless or pale brown, up to 1 mm long; scales densely covering base of stipe, acicular, dark brown or chestnut-brown, shining, up to 60 mm long and 3 mm wide, becoming narrowly ovate, pale brown, and more scattered distally, interspersed with dense red acaroid scales c. 0.1 mm in diameter. Laminae 2-pinnate-pinnatisect to 3-pinnate-pinnatifid, ovate or elliptic or obovate, 1000–2000 mm long, 450–750 mm wide, dark green on adaxial surface, pale green on abaxial surface, herbaceous; adaxial surfaces of rachis and costae of primary pinnae abundantly covered in fine, acicular, colourless or pale brown hairs up to 1 mm long, becoming scattered on costae of secondary pinnae; abaxial surfaces bearing very scattered colourless acicular hairs, narrowly ovate or acicular pale brown scales lacking dark setae and up to 3 mm long and 0.5 mm wide, and colourless scales with ciliate margins or red acaroid scales c. 0.1 mm in diameter; rachis chestnut-brown, becoming yellow-brown distally. Primary pinnae in 20–30 pairs, narrowly ovate or narrowly triangular; the longest at or above the middle, 230–500 mm long, 60–130 mm wide, short-stalked, reducing proximally to a basal pair less than half the length of the longest pair. Secondary pinnae narrowly ovate or narrowly triangular, the longest 30–65 mm long, 7–16 mm wide, sessile. Longest tertiary pinnae 4–9 mm long, 1.5–2.5 mm wide, adnate or decurrent; apices acute; margins serrate or divided up to halfway to the costa. Sori 0.5–0.9 mm in diameter; paraphyses shorter than sporangia; indusia open on side away from costa before maturity, saucer-shaped at maturity and forming less than a hemisphere, not splitting with age.

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

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

Chatham Islands, Stewart Island, Auckland Islands.

Altitudinal range: 0–1100 m.

Cyathea smithii occurs from near Kaitaia throughout the North Island, primarily in montane forest but extending locally into lowland areas. It ranges from 30 m in the Hunua Ranges up to 900 m in the Tararua Ranges, and 1100 m on Mt Taranaki. In the South Island, it occurs in lowland and montane forest, mostly west of the main divide, but also sporadically on the drier east coast. It extends from near sea-level to about 900 m on Avalanche Peak, Waimakariri, and 1100 m in north-west Nelson. It occurs also on the Chatham Islands, Stewart Island and on the Auckland Islands, the southernmost limit for tree ferns anywhere in the world.

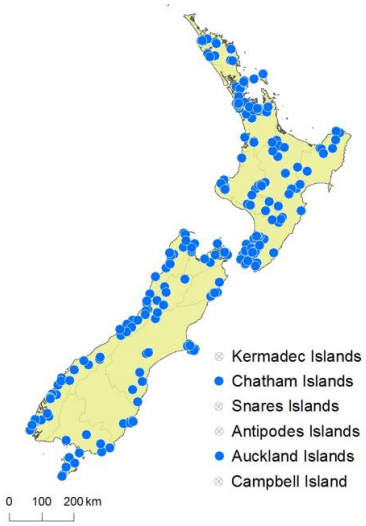

Fig. 68: *Cyathea smithii* distribution map based on databased records at AK, CHR, OTA and WELT.

Biostatus: Indigenous (Endemic).

Habitat: *Cyathea smithii* is a hardy, subcanopy species which favours colder, wetter conditions, and is the dominant tree at higher altitudes and in the far south of the country. It occurs under podocarp, beech, kānuka and broadleaved forest.

Recognition: *Cyathea smithii* is readily recognised in the field by its persistent dead stipes and rachises with abraded pinnae, which appear like a grass skirt around the trunk. The only other mainland New Zealand tree fern that regularly forms a skirt is *Dicksonia fibrosa*, where entire dead fronds are retained. Young immature plants of *C. smithii* are sometimes confused with *C. colensoi*, but fertile fronds are only produced on *C. smithii* when plants have developed trunks more than 1 m tall and can no longer be mistaken for *C. colensoi*.

Cyathea smithii can be distinguished from *C. cunninghamii* by its saucer-shaped, rather than hood-shaped indusia. The pale brown lamina scales are also distinctive in lacking dark setae at the apex (Brownsey 1979), and the acaroid scales never have an expanded pale brown base, as is sometimes the case in *C. cunninghamii*.

One collection of *C. smithii* from the Chatham Islands (WELT P021516) has larger pinnae than any mainland collection, with primary pinnae up to 600 mm long and 145 mm wide, secondary pinnae up

to 80 mm long and 20 mm wide, and tertiary pinnae up to 14 mm long and 4 mm wide. It is unclear whether plants are generally bigger on the Chatham Islands.

Cytology: n = 69 (Brownlie 1958).

Notes: There are six syntype specimens of *Hemitelia stellulata* Colenso in WELT (P002506-10, P003307), another at AK (143440), and two at K. Allan (1961, p. 43) lectotypified one of the specimens in WELT (P003307) by describing uniquely the material on the sheet ("a portion of a rachis with 8 pinnae").

Buchanan (1887) recorded a specimen of *C. smithii* from Dunedin which branched to form several heads.

Fig. 69: *Cyathea smithii*. Mature plant (at left) with a persistent skirt of dead stipes and rachises growing alongside a plant of *Dicksonia fibrosa* (at right) with a skirt of complete dead fronds.

Fig. 70: *Cyathea smithii*. Mature plant with a persistent skirt of dead stipes and rachises.

Fig. 71: *Cyathea smithii*. Young plant developing a persistent skirt of dead stipes and rachises.

Fig. 72: *Cyathea smithii*. Crown of mature plant with scales on trunk and stipes.

Fig. 73: *Cyathea smithii*. Crozier on a mature plant protected by dark brown scales.

Fig. 74: *Cyathea smithii*. Chestnut- brown scales on stipes of a young plant.

Fig. 75: *Cyathea smithii*. Underside of fertile frond showing ovate pale brown scales and (barely visible) minute red acaroid scales on the midribs.

Fig. 76: *Cyathea smithii*. Underside of fertile frond showing ovate pale brown scales and red acaroid scales on the midribs.

Fig. 77: *Cyathea smithii*. Underside of fertile pinnae with sori obscuring the shallow saucer-shaped indusia.

Fig. 78: *Cyathea smithii*. Underside of over-mature fertile pinnae. Most indusia have lost the sporangia to reveal their shallow saucer shape.

References

Allan, H.H. 1961: *Flora of New Zealand. Vol. I. Indigenous Tracheophyta: Psilopsida, Lycopsida, Filicopsida, Gymnospermae, Dicotyledones.* Government Printer, Wellington.

Beever, J.E. 1984: Moss epiphytes of tree-ferns in a warm-temperate forest, New Zealand. *Journal of the Hattori Botanical Laboratory 56*: 89–95.

Bernhardi, J.J. 1801: Tentamen alterum filices in genera redigenda. *Journal für die Botanik (Schrader) 1800(2)*: 121–136.

Bostock, P.D. 1998: Cyatheaceae. *In*: *Flora of Australia.* Vol. 48. 193–205.

Brown, R. 1810: *Prodromus Florae Novae Hollandiae et Insulae Van-Diemen.* Johnson, London.

Brownlie, G. 1958: Chromosome numbers in New Zealand ferns. *Transactions of the Royal Society of New Zealand 85*: 213–216.

Brownlie, G. 1961: Additional chromosome numbers – New Zealand Ferns. *Transactions of the Royal Society of New Zealand. Botany 1*: 1–4.

Brownsey, P.J. 1979: *Cyathea cunninghamii* in New Zealand. *New Zealand Journal of Botany 17*: 97–107.

Brownsey, P.J.; Perrie, L.R. 2015a: Re-evaluation of the taxonomic status of *Cyathea kermadecensis* and *C. milnei* (Cyatheaceae) supports their continued recognition. *Tuhinga 26*: 51–62.

Brownsey, P.J.; Perrie, L.R. 2015b: Taxonomic notes on the New Zealand flora: types in the fern families Cyatheaceae, Dicksoniaceae and Loxsomataceae. *New Zealand Journal of Botany 53(2)*: 124–128.

Buchanan, J. 1887: On a remarkable branching specimen of *Hemitelia smithii*. *Transactions and Proceedings of the New Zealand Institute 14*: 356–357.

Cheeseman, T. F. 1906: *Manual of the New Zealand Flora.* Government Printer, Wellington, N.Z.

Christensen, C. 1905–1906: *Index Filicum.* Hagerup, Copenhagen.

Colenso, W. 1879: A description of two New Zealand ferns, believed to be new to science. *Transactions and Proceedings of the New Zealand Institute 11*: 429–433.

Colenso, W. 1883: A description of four new ferns from our New Zealand forests. *Transactions and Proceedings of the New Zealand Institute 15*: 304–310.

Colenso, W. 1886: A description of some newly-discovered cryptogamic plants; being a further contribution towards the making known the botany of New Zealand. *Transactions and Proceedings of the New Zealand Institute 18*: 219–255.

Colenso, W. 1892: Description of three species of newly discovered New Zealand ferns. *Transactions and Proceedings of the New Zealand Institute 24*: 394–398.

Colenso, W. 1895: A description of two new ferns and one new *Lycopodium*, lately detected in our New Zealand forests. *Transactions and Proceedings of the New Zealand Institute 27*: 399–401.

Conant, D.S.; Raubeson, L.A.; Attwood, D.K.; Stein, D.B. 1995: The relationships of Papuasian Cyatheaceae to New World tree ferns. *American Fern Journal 85*: 328–340.

de Lange, P.J.; Rolfe, J.R.; Champion, P.D.; Courtney, S.P.; Heenan, P.B.; Barkla, J.W.; Cameron, E.K.; Norton, D.A.; Hitchmough, R.A. 2013: *Conservation status of New Zealand indigenous vascular plants, 2012. New Zealand Threat Classification Series 3.* Department of Conservation, Wellington.

Domin, K. 1913: Beiträge zur Flora und Pflanzengeographie Australiens. *Bibliotheca Botanica 20 (85)*: 1–239.

Domin, K. 1929: *Pteridophyta. Soustavný přehled žijících i vyhynulých kaprodorostů.* Nákladem České Akademie, Prague.

Forster, J.G.A. 1786a: *De Plantis Esculentis Insularum Oceani Australis Commentatio Botanica.* Haude & Spener, Berlin.

Forster, J.G.A. 1786b: *Florulae Insularum Australium Prodromus.* Dietrich, Göttingen.

Gardner, R.O. 1994: *Cyathea cooperi* naturalised in Auckland. *Auckland Botanical Society Journal 49*: 43–44.

Gillman, L.N.; Ogden, J. 2005: Microsite heterogeneity in litterfall risk to seedlings. *Austral Ecology 30*: 497–504.

Heenan, P.B.; Breitwieser, I.; Glenny, D.S.; de Lange, P.J.; Brownsey, P.J. 1998: Checklist of dicotyledons and pteridophytes naturalised or casual in New Zealand: additional records 1994-1996. *New Zealand Journal of Botany 36(2)*: 155–162.

Holttum, R.E. 1964: The tree ferns of the genus *Cyathea* in Australasia and the Pacific. *Blumea 12*: 241–274.

Hooker, J.D. 1854–1855: *The Botany of the Antarctic Voyage of H.M. Discovery Ships Erebus and Terror, in the years 1839–1843, under the command of Captain Sir James Clark Ross.* II. Flora Novae-Zelandiae. Part II. Flowerless plants. Lovell Reeve, London.

Hooker, J.D. 1864: *Handbook of the New Zealand Flora: a systematic description of the native plants of New Zealand and the Chatham, Kermadec's, Lord Auckland's, Campbell's and Macquarie's Islands.* Part I. Reeve, London.

Hooker, W.J. 1844–1846: *Species filicum.* Vol. 1. Pamplin, London.

Hooker, W.J. 1854: *Icones Plantarum.* Vol. 10. Pamplin, London.

Hooker, W.J.; Baker, J.G. 1865: *Synopsis filicum.* Part 1. Hardwicke, London.

Kaulfuss, G.F. 1827: *Das Wesen der Farrenkräuter.* Cnobloch, Leipzig.

Kirk, T. 1873: Notice of a remarkable arborescent fern on Ngongotaha. *Transactions and Proceedings of the New Zealand Institute 5*: 347–348.

Korall, P.; Conant, D.S.; Metzgar, J.S.; Schneider, H.; Pryer, K.M. 2007: A molecular phylogeny of scaly tree ferns (Cyatheaceae). *American Journal of Botany 94*: 873–886.

Kramer, K.U. 1990: Cyatheaceae. *In*: Kramer, K.U.; Green, P.S. *Pteridophytes and gymnosperms.* Vol. 1. *In*: Kubitzki, K. (ed.) *The Families and Genera of Vascular Plants.* Springer-Verlag, Berlin.

Large, M.F.; Braggins, J.E. 1991: *Spore atlas of New Zealand ferns and fern allies.* SIR Publishing, Wellington.

Large, M.F.; Braggins, J.E. 2004: *Tree ferns.* CSIRO Publishing, Melbourne.

Mueller, F.J.H. von 1865-1866: *Fragmenta Phytographiae Australiae.* Vol. 5. Government Printer, Melbourne.

Murray, B.G.; de Lange, P.J. 2013: Contributions to a chromosome atlas of the New Zealand flora – 40. Miscellaneous counts for 36 families. *New Zealand Journal of Botany 51*: 31–60.

Nicolson, D.H.; Fosberg, F.R. 2003: The Forsters and the Botany of the Second Cook Expedition (1772–1775). *Regnum Vegetabile 139*: 1–760.

Ogle, C.; La Cock, G.; Halsey, B. 2000: What use are dead tree ferns?. *Ecological Management 8*: 95–103.

Oliver, W.R.B. 1910: The vegetation of the Kermadec Islands. *Transactions and Proceedings of the New Zealand Institute 42*: 118–175.

Page, C.N.; Brownsey, P.J. 1986: Tree fern skirts: a defence against climbers and large epiphytes. *Journal of Ecology 74*: 787–796.

Palmer, D.D. 2003: *Hawai'i's ferns and fern allies.* University of Hawai'i Press, Honolulu.

Peacock, R.J.; Downing, A.; Brownsey, P.; Cameron, D. 2013: Distribution, habitat preferences and population sizes of two threatened tree ferns, *Cyathea cunninghamii* and *Cyathea* x *marcescens*, in south-eastern Australia. *Cunninghamia 13*: 1–24.

Pope, A. 1924: The role of the tree fern in the New Zealand bush. Part I. *New Zealand Journal of Science and Technology 7*: 52–61.

Pope, A. 1926: The role of the tree fern in the New Zealand bush. Part II. *New Zealand Journal of Science and Technology 8*: 85–98.

Rawlings, G.B. 1969: Fern records from Warawara Forest. *New Zealand Journal of Botany 7*: 100–102.

Smith, A.R.; Pryer, K.M.; Schuettpelz, E.; Korall, P.; Schneider, H.; Wolf, P.G. 2006: A classification for extant ferns. *Taxon 55(3)*: 705–731.

Smith, J.E. 1793: Tentamen botanicum de filicum generibus dorsiferarum. *Mémoires de l'Académie Royale des Sciences de Turin 5*: 401–422.

St. George, I. 2009: *Colenso's collections.* New Zealand Native Orchid Group, Wellington.

Swartz, O.P. 1801: Genera et species filicum ordine systematico redactarum. *Journal für die Botanik (Schrader) 1800(2)*: 1–120.

Sykes, W. R. 1977: Kermadec Islands Flora: An annotated check list. *New Zealand Department of Scientific and Industrial Research Bulletin 219*: [1]–216.

Tindale, M.D. 1956: The Cyatheaceae of Australia. *Contributions from the New South Wales National Herbarium 2*: 327–361.

Tryon, R.M. 1970: The classification of the Cyatheaceae. *Contributions from the Gray Herbarium of Harvard University 200*: 4–53.

Wilson, H.D. 1982: *Field Guide: Stewart Island Plants.* Field Guide Publications, Christchurch.

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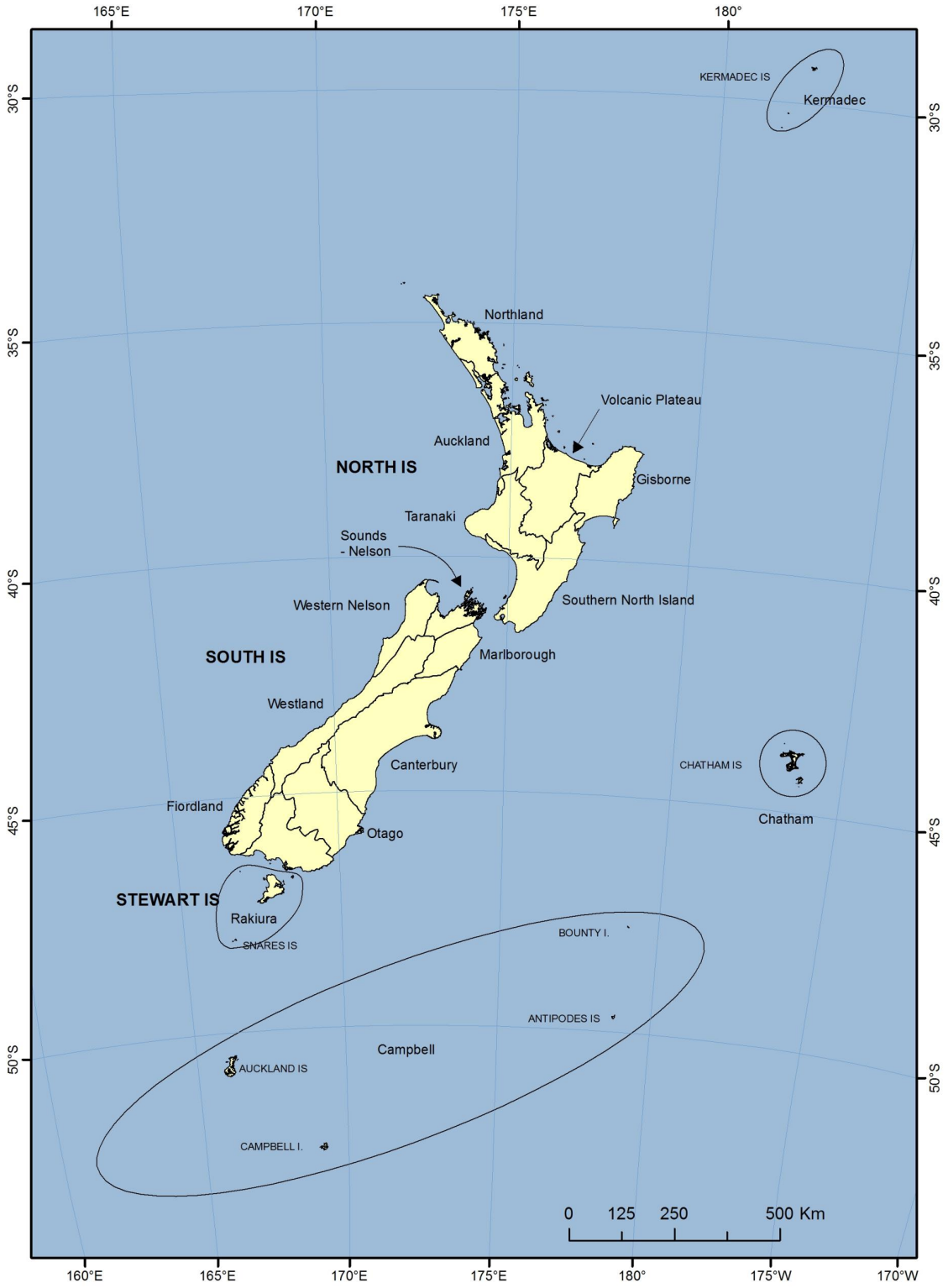
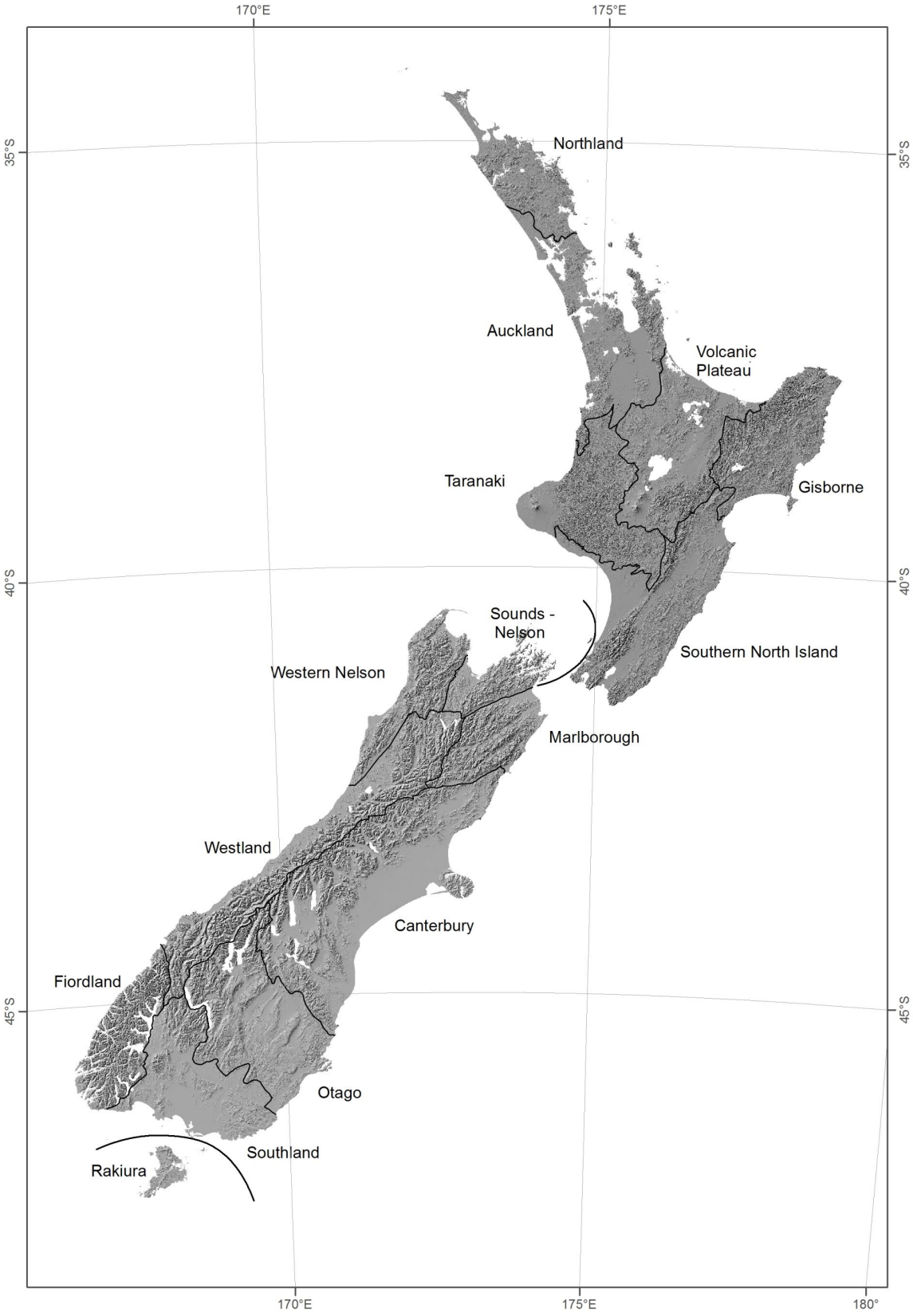


Map 1: Map of New Zealand and offshore islands showing Ecological Provinces



Map 2: Map of New Zealand showing Ecological Provinces

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