



# **FLORA OF NEW ZEALAND**

## **FERNS AND LYCOPHYTES**

### **SCHIZAEACEAE**



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**P.J. BROWNSEY & L.R. PERRIE**

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Cover image: *Schizaea australis*, mature fronds showing infolded fertile branches on fertile portions.

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## Introduction

The family Schizaeaceae is represented in New Zealand by one genus with four non-endemic species. One species is confined to the northern part of the North Island, two have disjunct distributions in the north of both Islands, and one has a predominantly southern or montane/subalpine distribution. All species of *Schizaea* have a highly characteristic growth form with a long, sometimes dichotomously branched, sterile, stem-like portion, and very short, pinnately branched, infolded fertile portions. Species of *Schizaea* are commonly known as comb ferns because of their distinctive appearance.

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## Schizaeaceae Kaulf., Wesen Farrenkr., [119] (1827)

**Type taxon:** *Schizaea* Sm.

Terrestrial ferns. Rhizomes erect or creeping, bearing septate hairs. Fronds monomorphic, not articulated to rhizome, divided into proximal sterile portions and much shorter distal fertile portions. Sterile portions of the frond very narrow, undivided or branching dichotomously, glabrous or hairy or scabrid. Veins free. Fertile portions of the frond highly reduced and modified, divided pinnately (NZ) or pseudodigitately (not NZ). Sporangia borne in one row either side of midrib on abaxial surface of each fertile branch, not in sori, ovoid or ellipsoid, attached basally, with a horizontal annulus around the upward-pointing apex, dehiscing by a vertical longitudinal slit, maturing  $\pm$ simultaneously; 128–256 spores per sporangium. Homosporous; spores monolete, variously papillate or scabrate or granulate, lacking chlorophyll.

**Taxonomy:** A family of two genera and about 30 species (Smith et al. 2006). Earlier classifications have varied in their treatment of the Schizaeales. Allan (1961) and Kramer (1990) included the Lygodiaceae and Anemiaceae in the Schizaeaceae, whereas Pichi Sermolli (1977) maintained all three as separate families. Three families are now generally recognised within the Schizaeales (Smith et al. 2006; Christenhusz et al. 2011).

**Distribution:** Widely distributed in tropical and south temperate regions, with one species also in North America. One genus with four species in New Zealand; none endemic.

**Biostatus:** Indigenous (Non-endemic).

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

Category	Number
Indigenous (Non-endemic)	4
<b>Total</b>	<b>4</b>

**Recognition:** The Schizaeaceae are terrestrial ferns recognised by their creeping rhizomes bearing septate hairs, linear or fan-shaped fronds, free veins, very short fertile portions of the frond borne distally on much longer unbranched or dichotomously branching sterile portions, sporangia not in sori, and base chromosome numbers of 77, 94 and 103.

### *Schizaea* Sm., *Mém. Acad. Roy. Sci. (Turin)* 5: 419 (1793) nom. cons.

= *Microschizaea* C.F.Reed, *Bol. Soc. Brot. Ser. 2* 21: 133 (1948)

= *Ripidium* Bernh., *J. Bot. (Schrader)* 1800(2): 127 (1801)

**Type taxon:** *Schizaea dichotoma* (L.) Sm.

**Etymology:** From the Greek *schizo* (split, cut), a reference to the incised, dichotomously-divided frond segments.

As for the family, except: sterile portions of the frond terete or flattened; modified fertile portions, at the distal end of the undivided or dichotomously branching sterile portions, pinnately branched; branches of the fertile portions short and infolded.

**Taxonomy:** A genus of c. 15 species (when distinguished from *Actinostachys*).

- |   |  |                  |
|---|--|------------------|
| 1 | Sterile portion of the frond dichotomously branching 1–7 times .....   | 2                |
|   | Sterile portion of the frond undivided .....   | 3                |
| 2 | Sterile portion of the frond flattened, glossy and smooth, dividing 3–7 times;<br>fertile portions of the frond 2–8 mm long .....                      | <i>dichotoma</i> |
|   | Sterile portion of the frond $\pm$ terete, dull and often scabrid, dividing 1–2 or<br>rarely 3 times; fertile portions of the frond 5–24 mm long ..... | <i>bifida</i>    |
| 3 | Sterile portion of the frond often scabrid; branches of fertile portions 3–13<br>mm long; hairs present amongst the sporangia .....                    | <i>bifida</i>    |
|   | Sterile portion of the frond smooth; branches of fertile portions 2–7 mm long;<br>hairs absent between the sporangia .....                             | 4                |

- 
- 4 Sterile portion of the frond 15–345 mm long; fertile portion of the frond 3–17 mm long; branches of fertile portions in 4–13 pairs; stomata on sterile portion of frond 81–114  $\mu\text{m}$  long; plants of montane or southern and subantarctic areas ..... *australis*
- Sterile portion of the frond 100–550 mm long; fertile portion of the frond 9–38 mm long; branches of fertile portions in 7–30 pairs; stomata on sterile portion of frond 126–180  $\mu\text{m}$  long; plants of lowland areas ..... *fistulosa*

**Distribution:** Widespread in tropical and southern temperate regions; one species in temperate North America, four to six in tropical America, one in South America, three in Africa, one in India and Sri Lanka, four in south-east Asia, five in Australia, and five in the Pacific. Four species in New Zealand; none endemic.

**Biostatus:** Indigenous (Non-endemic).

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

Category	Number
Indigenous (Non-endemic)	4
<b>Total</b>	<b>4</b>

**Recognition:** *Schizaea* has very characteristic fronds with very short, pinnately branched fertile portions at the distal end of long, undivided or dichotomously branched, sterile portions. The fertile branches are infolded in the form of a comb, and the sori are borne individually in marginal rows either side of the midrib.

**Cytology:**  $n = c. 72, 77, 94, 96, 103$  and approximate numbers up to  $c. 540$  (Kramer 1990). These numbers defy interpretation and no base number for the genus has yet been clearly identified.

### ***Schizaea australis* Gaudich., Ann. Sci. Nat. (Paris) 5: 98 (1825)**

≡ *Schizaea fistulosa* var. *australis* (Gaudich.) Hook.f., *Handb. N. Zeal. Fl.*, 749 (1867)

≡ *Microschizaea australis* (Gaudich.) C.F.Reed, *Bol. Soc. Brot. Ser. 2* 21: 134 (1948)

Lectotype (selected by Brownsey & Perrie 2013): Iles Malouines [Falkland Islands], C. Gaudichaud s.n., P 00523210 (image!)

= *Schizaea palmata* Hombr., *Voy. Pôle Sud, Bot.*, t. 4z (1843)

Holotype: Iles Auckland [Auckland Islands], *Voyage de l'Astrolabe et de la Zélée 1838-1840*, Hombron, 1841, P 00523211!

**Etymology:** From the Latin *australis* (southern), a reference to the southern hemisphere distribution of this plant

**Vernacular name:** southern comb fern

Rhizomes short-creeping; bearing glossy, chestnut-brown, septate hairs, 1–3 mm long. Fronds 20–250 mm long, rarely to 350 mm long in sheltered lowland areas, 2–5 mm wide. Sterile portion of frond undivided, erect, 15–245 mm long, rarely to 345 mm long in sheltered lowland areas,  $\pm$ terete, furrowed on one side, 0.25–0.5 mm diameter, green or pale brown, glabrous or with scattered hairs; stomata on sterile portion of frond 81–114  $\mu\text{m}$  long. Fertile portion of frond pinnately divided, 3–12 mm long, rarely to 17 mm long, 1–4 mm wide; fertile branches infolded, in 4–13 pairs, 1–5 mm long, with fimbriate margins. Sporangia borne in one row either side of midrib of fertile branches, 4–8 per branch; hairs absent amongst sporangia.

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

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

Chatham Islands, Stewart Island, Auckland Islands, Campbell Island.

Altitudinal range: 0–1400 m.

*Schizaea australis* is found locally in montane and subalpine areas of the North Island from c. 450 m on Great Barrier Island to 1400 m on Ruapehu and in the Raukūmara Ranges. It has been collected from Great Barrier Island, Coromandel Peninsula, Urewera and Raukūmara Ranges, the Volcanic Plateau, the Herangi Range, Egmont National Park, and Tararua and Rimutaka ranges. In the South Island it occurs west of the Main Divide, most commonly in north-west Nelson and north Westland, but also at Arthur's Pass, in south Westland, Fiordland and Southland as far east as Awarua Bay, Invercargill. It generally occurs above 300 m, but descends to coastal regions on pakihi soils on the West Coast and in north-west Nelson. It is common on Stewart Island and extends to the subantarctic islands. It ranges from almost coastal areas in the subantarctic to subalpine areas up to 1400 m in north-west Nelson. It has also been recorded for the Chatham Islands (de Lange et al. 2011, confirmed by WELT P026986, but not AK 888 which is *S. fistulosa*).

Also southern Chile, Falkland Islands, and probably Australia (Tasmania) where its distribution requires further investigation.

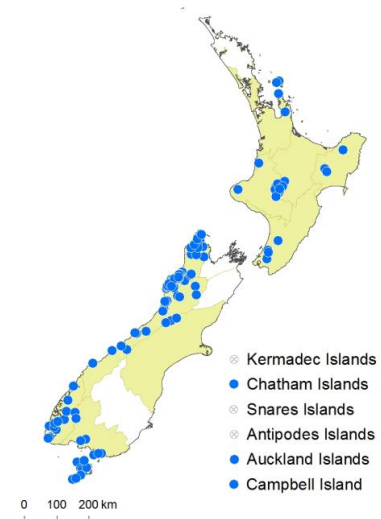
**Biostatus:** Indigenous (Non-endemic).

**Habitat:** Normally a terrestrial fern that occurs from lowland to subalpine areas, favouring boggy ground in tussock, short grassland, herbfield, *Gleichenia* fernland, turf vegetation or open scrub and podocarp forest, but also in seepages and at the side of tarns. It can also occur on near vertical mossy banks and rock faces. On Table Mountain, Coromandel and Mt Hobson, Great Barrier Island, it is epiphytic on *Metrosideros* and *Agathis* in open forest in extremely boggy areas. At lower elevations it is found on pakihi soils.

**Recognition:** *Schizaea australis* is closely related to *S. fistulosa* but differs in its shorter fronds (20–350 mm cf. 115–570 mm long), shorter fertile portions of the frond (3–17 mm cf. 9–38 mm long), fewer pairs of fertile branches (4–13 cf. 7–30 pairs), its montane and more southerly distribution, and its generally more slender habit and twisted sterile portions of the frond. The distributions of the two species overlap on Great Barrier Island, Mt Moehau, and in north-west Nelson, but only in north-west Nelson are populations frequently found in the same altitudinal range. *S. fistulosa* is distinct from *S. australis* in having twice as many chromosomes ( $n = c.190$  cf.  $n = 94$ ). This ploidy difference is reflected in the size of the guard cells of the stomata, which are arranged in long vertical lines on the sterile portions of the frond and are visible under a dissecting microscope. The guard cells are 126–180  $\mu\text{m}$  long in *S. fistulosa* compared with 81–114  $\mu\text{m}$  long in *S. australis* (Brownsey & Perrie 2013).

**Cytology:**  $n = 94$  (Brownlie 1965; Lash 1966).

**Hybridisation:** There is some cytological evidence for hybridisation between *S. australis* and *S. fistulosa* (Brownsey et al. 1985). Lash (1966) reported  $n = 94$  for several populations of *S. australis* from north-west Nelson, and  $n = c.150$  for other populations from the same area with generally larger plants. Reinterpretation of Lash's illustrated cell suggested the presence of at least some univalents (Brownsey et al. 1985), and the possibility of hybridisation causing failure of pairing. A chromosome count of  $n = c.190$  has been reported for *S. fistulosa* from Auckland (Brownsey et al. 1985; Dawson et al. 2000). Lash's count of  $c.150$  is consistent with the possibility of hybridisation between *S. fistulosa* and *S. australis* in north-west Nelson where both species are known to occur.



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





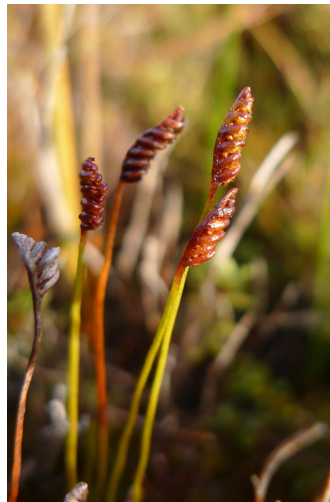
**Fig. 2:** *Schizaea australis*: mature plant growing on wet, pākihi soil.



**Fig. 3:** *Schizaea australis*: mature plant growing amongst taller vegetation, showing undivided sterile portions.



**Fig. 4:** *Schizaea australis*: mature fronds showing infolded fertile branches on fertile portions.



**Fig. 5:** *Schizaea australis*: mature fronds showing infolded fertile branches on fertile portions.

***Schizaea bifida* Willd., *Abh. Kurfürstl.-Mainz. Akad. Nützl. Wiss. Erfurt.* 2(5): 30, t. 3, fig. 3 (1802)**

≡ *Acrostichum bifidum* (Willd.) Poir., *Encyc. Suppl.* 1, 126 (1810)

Holotype: Nova Hollandia [Australia], leg. F.W.H.A. von Humboldt, Herb. Willdenow, B (W 19489-01 0, image!)

= *Schizaea asperula* N.A.Wakef., *Victoria Naturalist* 59: 89 (1942)

Lectotype (selected by Wakefield 1953): Betka River Head, Victoria, Australia, N.A. Wakefield 13, 3 Feb. 1941, MEL 1511492 (image!)

**Etymology:** From the Latin *bifidus* (bifid), a reference to the dichotomously branching frond segments.

**Vernacular name:** forked comb fern

Rhizomes short-creeping; bearing glossy, chestnut-brown, septate hairs, 1.5–5 mm long. Fronds 50–500 mm long, rarely to 650 mm long in sheltered situations, 5–65 mm wide. Sterile portion of frond undivided or dichotomously divided 1–2, or rarely 3 times, erect, 40–500 mm long, or rarely to 630 mm long, ±terete or flattened, furrowed, 0.5–1.0 mm in diameter, green or pale brown, bearing scattered hairs proximally, often scabrid distally. Fertile portions of frond pinnately divided, 5–24 mm long, 3–10 mm wide; fertile branches infolded, in 4–18 pairs, 3–13 mm long, undivided or dichotomously

branched 1–2 times, with fimbriate margins. Sporangia borne in one row either side of midrib of fertile branches, 10–30 per branch; long hairs present amongst sporangia.

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

South Island: Western Nelson, Sounds-Nelson.

Three Kings Islands.

Altitudinal range: 0–900 m.

*Schizaea bifida* occurs locally throughout Northland, Auckland and the Waikato/King Country, extending to the East Cape Region and south to the Rotorua/Taupō thermal region, with an outlying population near Ohakune (CHR 35196). It grows from near sea level to about 600 m in the Kauaeranga Forest Park and 900 m on Mt Pirongia. It also occurs up to 120 m in north-west Nelson, from Golden Bay south to Charleston and east to Richmond.

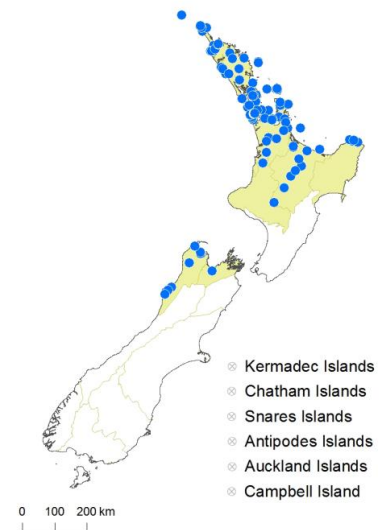
Also New Caledonia and Australia (Queensland, NSW, South Australia, Victoria, Tasmania).

**Biostatus:** Indigenous (Non-endemic).

**Habitat:** A terrestrial fern found on poor clay and pākihi soils, thermally heated ground, or occasionally in peat swamp. The species is mostly confined to lowland areas, usually under mānuka or kānuka scrub, or occasionally under kauri and low pōhutukawa forest, often in moss carpet. It is hard to find, even where abundant, because of its inconspicuous frond, and is becoming scarcer as its scrub habitats are cleared for farming or forestry.

**Recognition:** When well-grown, *Schizaea bifida* is easily recognised by its dichotomously branching sterile frond portions, which are distinguished from those of *S. dichotoma* by being terete rather than flattened. Plants with undivided sterile portions of the frond are similar to *S. fistulosa* but can be distinguished by their scabrid rather than smooth texture, by the longer fertile branches (3–13 mm cf. 2–5 mm long), and by the presence of hairs amongst the sporangia.

**Cytology:** n = 77 (Lovis 1958).



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



**Fig. 7:** *Schizaea bifida*: mature frond with undivided sterile portion growing on a mossy hummock.



**Fig. 8:** *Schizaea bifida*: fertile portions of fronds.



**Fig. 9:** *Schizaea bifida*: fertile portion of frond showing infolded fertile branches, one of which is branching dichotomously.

***Schizaea dichotoma* (L.) Sm., *Mém. Acad. Roy. Sci. (Turin)* 5: 422, t. 9, fig. 9 (1793)**

≡ *Acrostichum dichotomum* L., *Sp. Pl.*, 1068 (1753)

≡ *Osmunda dichotoma* (L.) Spreng., *J. Bot. (Schrader)* 1799(2): 268 (1800)

≡ *Ripidium dichotomum* (L.) Bernh., *J. Bot. (Schrader)* 1800(2): 127, t. 2, fig. 3 (1801)

Lectotype (selected by Holttum 1959): Drawing of "Cochine branched Comb Fern" in Petiver, *Gazophyl. Nat.* t. 70, f. 12 (1702–1709), (*n.v.*)

= *Schizaea forsteri* Spreng., *Anleit. Kenntn. Gew.* 3, 157 (1804)

≡ *Schizaea dichotoma* var. *forsteri* (Spreng.) Domin, *Biblioth. Bot.* 20 (85): 207 (1915)

Type: New Caledonia, *Forster* (according to the Australian Plant Name Index); not located, and possibly no longer extant (Stafleu & Cowan 1985, p. 806).

**Etymology:** From the Latin *dichotomus* (splitting in two), a reference to the dichotomously branching frond segments.

**Vernacular name:** fan fern

Rhizomes short-creeping; bearing glossy, chestnut-brown, septate hairs, 1.5–3.5 mm long. Fronds 60–460 mm long, 20–140 mm wide, fan-shaped. Sterile portion of frond dichotomously divided 3–7 times, erect, 55–450 mm long, flattened, margins entire, 1.0–1.5 mm wide, brown proximally, shiny green distally, occasionally red when young, bearing scattered hairs. Fertile portions of frond pinnately divided, 2–8 mm long, 1–6 mm wide; fertile branches infolded, in 4–8 pairs, 2–7 mm long, undivided or sometimes dichotomously branched, with fimbriate margins. Sporangia borne in one row either side of midrib of fertile branches, 10–15 per branch; long hairs present amongst sporangia.



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

Kermadec Islands.

Altitudinal range: 0–500 m.

*Schizaea dichotoma* occurs on the Kermadec Islands and from Kaitiaki, through Northland and Auckland, to Kāwhia, extending to East Cape and south to Rotorua and Lake Taupō. It grows from near sea level on some offshore islands to c. 500 m on Little Barrier Island, the Paeroa Range, and Rainbow Mountain, near Rotorua.

Also widespread in the tropics and subtropics; East Africa, Madagascar, Mascarene Islands, southern India, Sri Lanka, south-east Asia, Australia (northern Western Australia, Northern Territory, Queensland, NSW) and throughout the Pacific from New Caledonia to the Marquesas Islands.

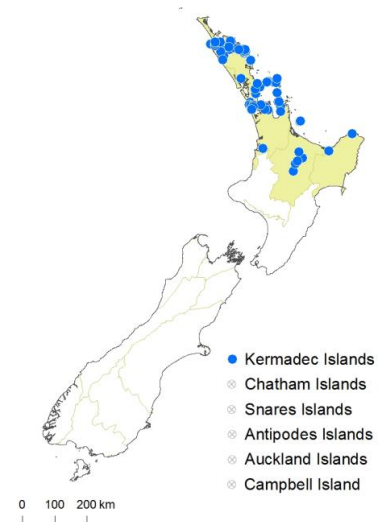
**Biostatus:** Indigenous (Non-endemic).

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

**Habitat:** A terrestrial fern usually found under lowland kauri forest; also under mānuka scrub, around thermal sites in the Rotorua/Taupō area, or occasionally under pōhutukawa, tawa or pūriri forest and on sandstone banks.

**Recognition:** *Schizaea dichotoma* is easily recognised by its fan-shaped fronds with shiny green, flattened, dichotomously branched sterile laminal segments. The short fertile segments are confined to the tips of the sterile segments.

**Cytology:**  $n = 77$  (Lovis in Holttum 1959);  $n = c.540$  (Brownlie 1961). The latter count may have been an erroneous count from a tapetal cell.



**Fig. 10:** *Schizaea dichotoma* distribution map based on databased records at AK, CHR, NZFRI and WELT.



**Fig. 11:** *Schizaea dichotoma*: mature frond showing flattened, dichotomously branched sterile portion, bearing short, fertile portions with infolded fertile branches at the end of each sterile branch.

## ***Schizaea fistulosa* Labill., Nov. Holl. Pl. 2, 103, t. 250, fig. 3 (1807)**

≡ *Acrostichum fistulosum* (Labill.) Poir., *Encyc. Suppl.* 1, 125 (1810)

≡ *Microschizaea fistulosa* (Labill.) C.F.Reed, *Bol. Soc. Brot. Ser. 2* 21: 134 (1948)

Lectotype (selected by Brownsey & Perrie 2013): Nova Hollandia et Terra Diemen [Australia and Tasmania], *Labillardière* s.n., FI 219617 (barcode FI 004236) - 2 plants at left of sheet (image!).

= *Schizaea propinqua* A.Cunn., *Companion Bot. Mag.* 2: 362 (1837)

≡ *Schizaea fistulosa* var. *propinqua* (A.Cunn.) Bonap., *Notes ptérid.* 13, 289 (1921)

Holotype: Between Keri Keri and Waimate stations, New Zealand, *R. Cunningham*, 1834, K! (photo WELT E469/15)

**Etymology:** From the Latin *fistulosus* (tubular), a reference to the long, terete, sterile frond segments.

**Vernacular name:** comb fern

Rhizomes short-creeping; bearing glossy, chestnut-brown, septate hairs, 1.5–3.5 mm long. Fronds 115–570 mm long, 2–5 mm wide. Sterile portion of frond undivided, erect, 100–550 mm long, ±terete, furrowed on one side, 0.5–1.0 mm in diameter, green or pale brown, glabrous or with scattered hairs; stomata on sterile portion of frond 126–180 µm long. Fertile portion of frond pinnately divided, 9–30 mm long, rarely to 38 mm long, 2–5 mm wide; ultimate branches infolded, in 7–30 pairs, 2–5 mm long, with fimbriate margins. Sporangia borne in one row either side of midrib of ultimate fertile branches, 5–12 per branch; hairs absent amongst sporangia.

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

South Island: Western Nelson, Sounds Nelson.

Chatham Islands.

Altitudinal range: 0–700 m.

*Schizaea fistulosa* occurs throughout Northland and Auckland, in the King Country, around Rotorua, on heated ground at Tokaanu, in a few localities in northern South Island from Whanganui Inlet to Croisilles Harbour, and on the Chatham Islands. In the North Island it extends from sea level to about 360 m on Great Barrier Island and 700 m on Mt Moehau. In the South Island it is confined to lowland sites.

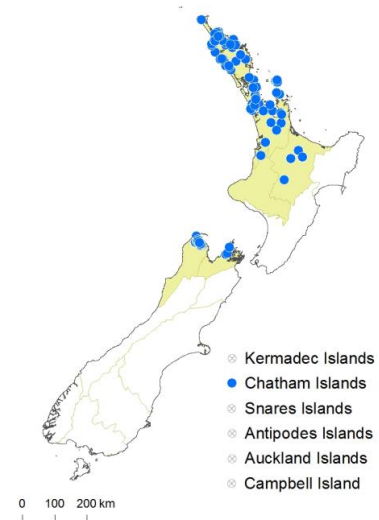
Also Peninsular Malaysia, Borneo, New Guinea, Australia (Western Australia, South Australia, NSW, Victoria, Tasmania), New Caledonia, Fiji, Society Islands, Marquesas Islands.

**Biostatus:** Indigenous (Non-endemic).

**Habitat:** A terrestrial fern that grows in lowland areas on gumland and poor clay or sandy soils, pākihi, or sometimes on hummocks in *Sphagnum* bog, either in the open, under light mānuka, kānuka or *Hakea* scrub, or in open kauri forest. It sometimes grows in moss cushions under scrub, and on heated ground in the Rotorua/Taupō region.

**Recognition:** *Schizaea fistulosa* is closely related to *S. australis* but differs in its longer fronds (115–570 mm cf. 20–350 mm long), longer fertile portions of the frond (9–38 mm cf. 3–17 mm long), more pairs of fertile branches (7–30 cf. 4–13 pairs), its generally lowland and more northerly distribution, and its habit of producing relatively robust, straight, tall fronds, often amongst other vegetation. The distributions of the two species overlap on Great Barrier Island, Mt Moehau, and in north-west Nelson, but only in north-west Nelson are populations frequently found in the same altitudinal range. *S. fistulosa* is distinct from *S. australis* in having twice as many chromosomes ( $n = c.190$  cf.  $n = 94$ ). This ploidy difference is reflected in the size of the guard cells of the stomata, which are arranged in long vertical lines on the sterile laminal segments and visible under a dissecting microscope. The guard cells are 126–180 µm long in *S. fistulosa* compared with 81–114 µm long in *S. australis* (Brownsey & Perrie 2013).

**Cytology:**  $n = c.190$  (Brownsey et al. 1985; Dawson et al. 2000);  $n = c.270$  (Brownlie 1965). The latter count may have been an erroneous count from a tapetal cell (see Brownsey et al. 1985).



**Fig. 12:** *Schizaea fistulosa* distribution map based on databased records at AK, CHR and WELT.

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**Hybridisation:** There is some cytological evidence for hybridisation between *S. australis* and *S. fistulosa* (Brownsey et al. 1985). Lash (1966) reported  $n = 94$  for several populations of *S. australis* from north-west Nelson, and  $n = c.150$  for other populations from the same area with generally larger plants. Reinterpretation of Lash's illustrated cell suggested the presence of at least some univalents (Brownsey et al. 1985), and the possibility of hybridisation causing failure of pairing. Lash's count of c.150 is consistent with hybridisation between *S. fistulosa* and *S. australis* in north-west Nelson where both species are known to occur.



**Fig. 13:** *Schizaea fistulosa*: mature plant.



**Fig. 14:** *Schizaea fistulosa*: fully mature fertile portion of frond.



**Fig. 15:** *Schizaea fistulosa*: fully mature fertile portion of frond showing the sporangia.



**Fig. 16:** *Schizaea fistulosa*: plant with developing and fully mature fronds.

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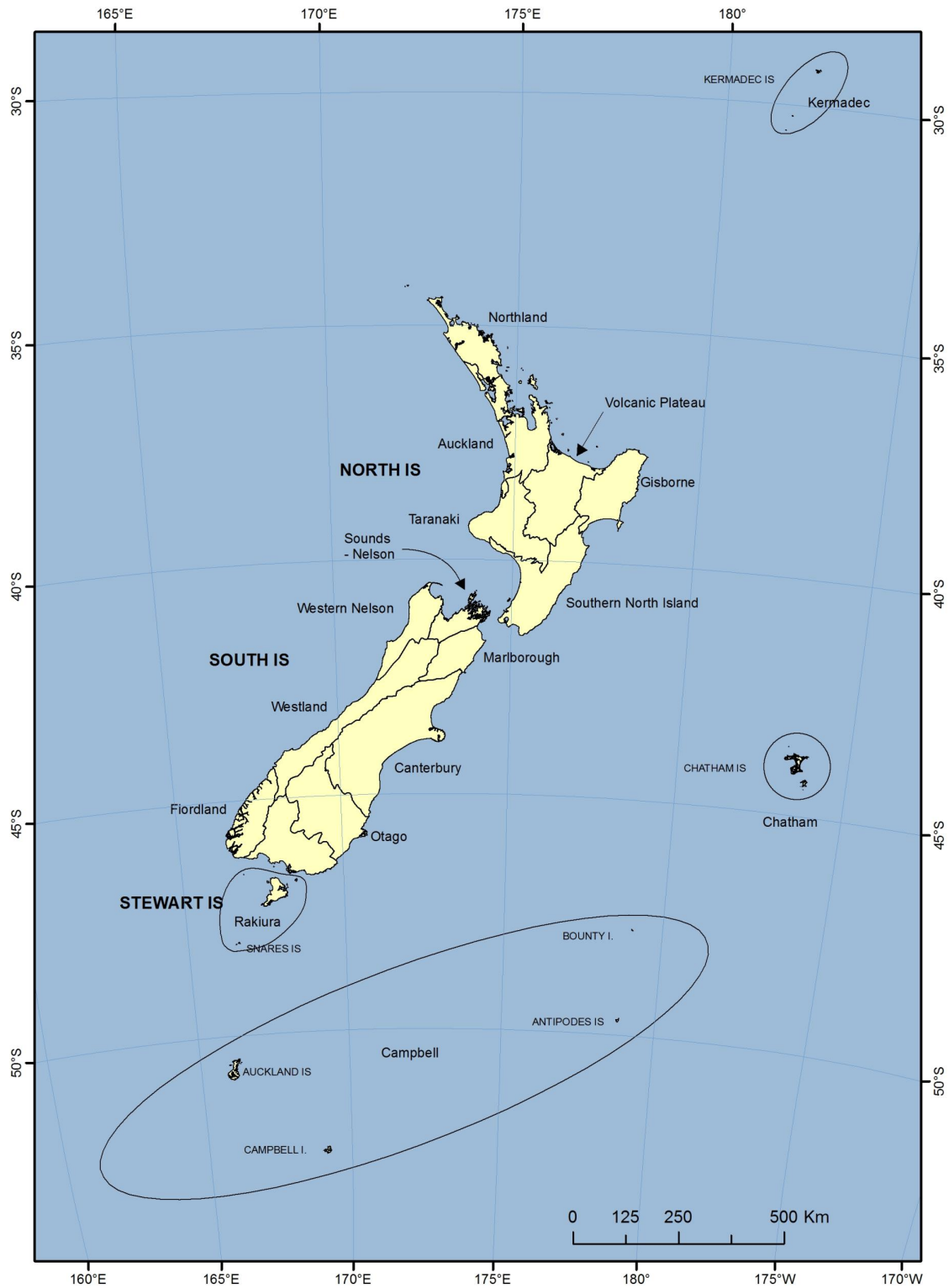
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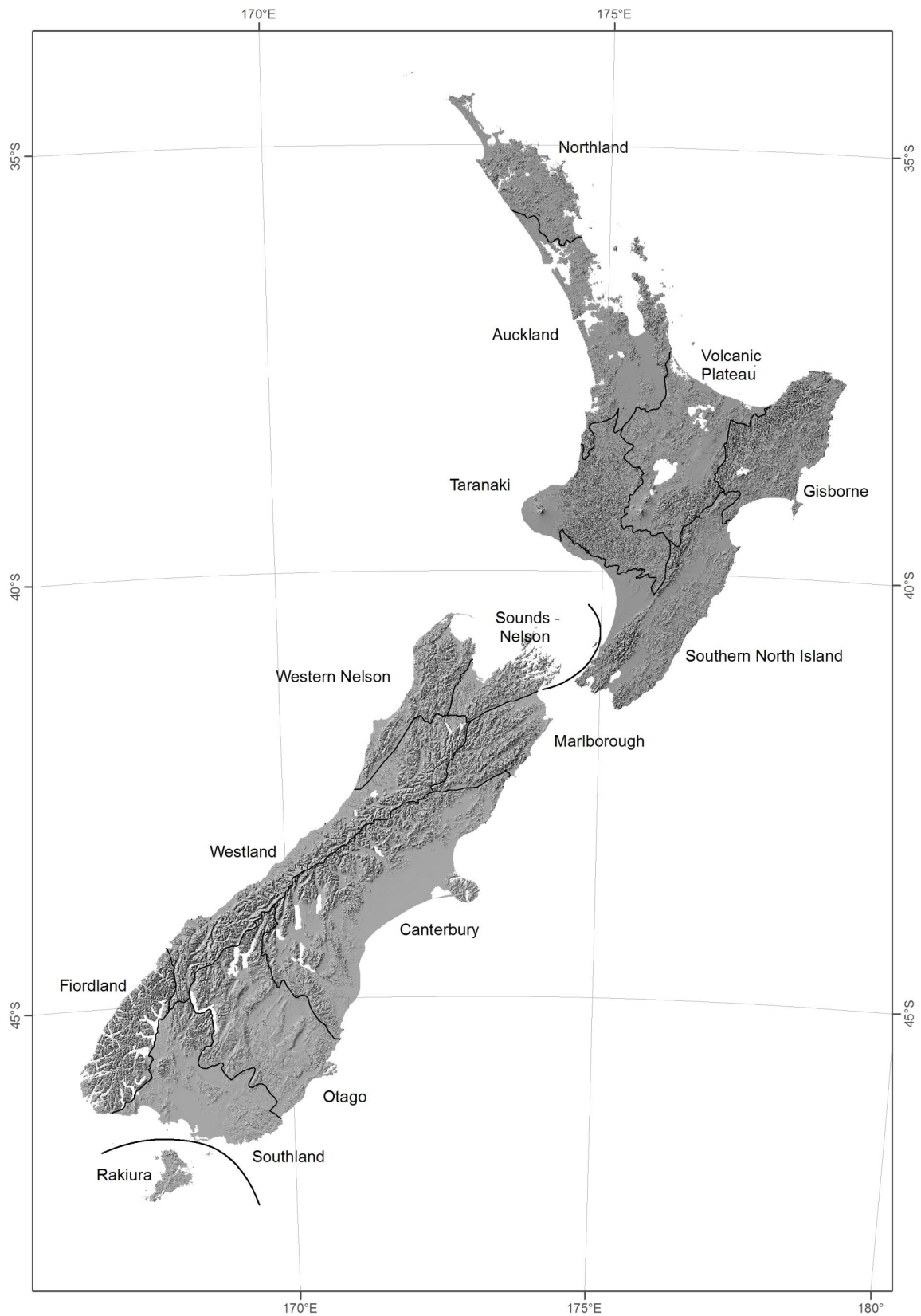
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**Map 1:** Map of New Zealand and offshore islands showing Ecological Provinces



**Map 2:** Map of New Zealand showing Ecological Provinces

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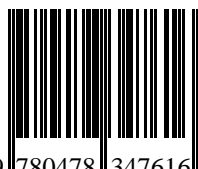
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