

# FLORA OF NEW ZEALAND

## FERNS AND LYCOPHYTES

### CYSTOPTERIDACEAE



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Fascicle 23 – OCTOBER 2018

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#### CATALOGUING IN PUBLICATION

Brownsey, P. J. (Patrick John), 1948–

Flora of New Zealand : ferns and lycophytes. Fascicle 23, Cystopteridaceae / P.J. Brownsey and L.R. Perrie. -- Lincoln, N.Z.: Manaaki Whenua Press, 2018.

1 online resource

ISBN 978-0-9 47525-45-3 (pdf)

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

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

UDC 582.394.742(931)

DC 587.30993

DOI: 10.7931/B1263V

This work should be cited as:

Brownsey, P.J. & Perrie, L.R. 2018: Cystopteridaceae. *In*: Breitwieser, I.; Wilton, A.D. *Flora of New Zealand – Ferns and Lycophytes*. Fascicle 23. Manaaki Whenua Press, Lincoln.  
<http://dx.doi.org/10.7931/B1263V>

Cover image: *Cystopteris tasmanica*. Mature plant growing on moss-covered limestone rock.

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## Introduction

Cystopteridaceae is a small, mainly temperate family occurring in both the northern and southern hemispheres. It is represented in New Zealand by one indigenous and one naturalised species. *Cystopteris tasmanica* is an indigenous species which occurs in montane and alpine areas of both islands, frequently on limestone or marble but also on greywacke and granite. It is widespread in the South Island, but confined to central parts of the North Island. It is also found in eastern Australia from New South Wales to Tasmania. *Cystopteris fragilis* is a naturalised species occurring mostly in urban areas from Auckland to Invercargill, and it has been in New Zealand since the late 19th century. Species of *Cystopteris* can be recognised by their herbaceous, usually glabrous, pinnate to 3-pinnate laminae, by their hood-like indusia protecting the sori, and by their echinate spores.

*Cystopteris* has previously been included in Dryopteridaceae, Athyriaceae or Woodsiaceae, but on the basis of molecular evidence is now separated into a much smaller Cystopteridaceae.

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## **Cystopteridaceae (Payer) Shmakov, *Turczaninowia* 4: 60 (2001)**

**Type taxon:** *Cystopteris* Bernh.

Terrestrial ferns. Rhizomes short-creeping (NZ) or long-creeping or rarely erect (not NZ), scaly. Fronds monomorphic, not articulated to rhizome. Laminae 1–3-pinnate (NZ) or rarely 3-pinnate-pinnatifid (not NZ), anadromous or catadromous, herbaceous, glabrous or scaly or hairy. Veins free, terminating at the leaf margin. Sori round or slightly elongate on veins, borne on abaxial surface away from margins; receptacles raised and hardened (NZ) or flat (not NZ); paraphyses absent; indusia present (NZ) or absent (not NZ), attached at base, inflated and curving hood-like over the sporangia; sporangial maturation mixed. Sporangia with vertical annulus, usually 64 spores per sporangium. Homosporous; spores monolete, lacking chlorophyll; perispores echinate (NZ) or tuberculate or with broad folds and sometimes perforate (not NZ).

**Taxonomy:** A family of 3 genera and about 37 species (PPG 1 2016).

Rothfels et al. (2012) undertook a family-level classification for the eupolypod II clade of leptosporangiate ferns, one of two major clades within the eupolypod ferns. The latter, together with Lindsaeaceae, Saccolomataceae, Dennstaedtiaceae, and Pteridaceae, makes up the Polypodiales. Rothfels et al. (2012) argued that the eupolypod II clade was still poorly understood at the time of the classification proposed by Smith et al. (2006), and they therefore presented a new classification derived largely from published molecular studies.

The relationships of the genera they included within Cystopteridaceae had previously been subject to very different interpretations. Kramer (1990) included them within subfamily Athyrioideae in a very broadly construed Dryopteridaceae. Smith et al. (2006) placed them within the athyroid ferns (Woodsiaceae), which they separated from the dryopteroid ferns (Dryopteridaceae). Pichi Sermolli (1977) and Wang et al. (2004) included them in Athyriaceae, from which *Woodsia* and its segregates were removed into a much-reduced Woodsiaceae. Rothfels et al. (2012) went a step further and subdivided Athyriaceae into five further families, separating off four small groups from the much larger Athyriaceae. These included Cystopteridaceae, Diplaziopsidaceae, Rhacidosoraceae, and Hemidictyaceae, with the latter three in many respects somewhat closer to Aspleniaceae. Cystopteridaceae includes three main genera, *Acystopteris*, *Cystopteris*, and *Gymnocarpium*, with a few other small segregates sometimes recognised. Only *Cystopteris* occurs in New Zealand.

**Distribution:** A family found primarily in temperate regions, often in montane habitats. *Cystopteris* and *Gymnocarpium* are common ferns of north temperate regions, while *Cystopteris* also occurs in the southern temperate zone, and *Acystopteris* in tropical east Asia. One non-endemic genus with two species in New Zealand; none endemic.

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

**Table 1:** Number of species in New Zealand within Cystopteridaceae (Payer) Shmakov

<b>Category</b>	<b>Number</b>
Indigenous (Non-endemic)	1
Exotic: Fully Naturalised	1
<b>Total</b>	<b>2</b>

**Recognition:** The family Cystopteridaceae comprises terrestrial ferns with short- to long-creeping scaly rhizomes, veins that terminate at the leaf margin. Indusia, when present, are hood-like, attached at the base and arching over the sporangia.

## ***Cystopteris* Bernh., *Neues J. Bot.* 1(2): 5, 26 (1805), nom. cons.**

**Type taxon:** *Cystopteris fragilis* (L.) Bernh.

**Etymology:** From the Greek *kustos* (bladder) and *pterus* (fern), a reference to the inflated base of the indusium in these ferns.

Terrestrial ferns. Rhizomes short-creeping (NZ) or rarely erect (not NZ), scaly. Rhizome scales non-clathrate, narrowly ovate. Stipes adaxially sulcate, glabrous or scaly. Laminae 1–3-pinnate (NZ) or 3-pinnate-pinnatifid (not NZ), herbaceous, glabrous or scaly or occasionally bearing minute glandular hairs, rarely bulbiferous (not NZ). Sori round; receptacles raised and hardened. Indusia attached at base, inflated and curving hood-like over the sporangia. Spores monolete, perispores echinate (NZ) or verrucate (not NZ).

**Taxonomy:** A genus of c. 26 species (PPG 1 2016).

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Within Cystopteridaceae *Cystopteris* and *Acystopteris* are sister genera, and in turn are sister to *Gymnocarpium* (Rothfels et al. 2012). *Cystopteris* is distinguished from *Gymnocarpium* by its lack of articulate pinnae, the presence of indusia, a raised and hardened soral receptacle, and a base chromosome number of  $x = 42$ . By contrast *Gymnocarpium* has articulate pinnae, is exindusiate, has a flat receptacle, and has a chromosome number of  $x = 40$ . *Acystopteris* is distinguished by its multiseptate hairs on the lamina and densely verrucose spores.

Allan (1961) treated *Cystopteris* in Athyriaceae, which he said included “a few genera of rather uncertain delimitation”. *Cystopteris* was monographed by Blasdell (1963), but he failed to make any mention of the Australasian species *C. tasmanica*. His work has therefore been largely ignored in the southern hemisphere, and this has contributed to a poor understanding of the genus in New Zealand until relatively recently.

*Cystopteris tasmanica* was first described by Hooker (1844–1846) from Tasmania, and then reduced to a variety of *C. fragilis* by Hooker (1858–1859). However, the taxon was not detected in New Zealand until Hooker (1867) included it in his Handbook as *C. fragilis*. This treatment was followed by Cheeseman (1906, 1925), who added *C. tasmanica*, *C. novae-zealandiae* J.B.Armstr., and *C. laciniatus* Colenso to the synonymy. Allan (1961) also referred New Zealand material to *C. fragilis*, but suggested that some forms approached *C. tasmanica*. Blasdell (1963) apparently overlooked *C. tasmanica* and referred South American and Australasian material to *C. fragilis* var. *apiiformis* (Gand.) C.Chr., based on *C. apiiformis* Gand. from the Falkland Islands. Whether or not South American and Australasian material is identical remains to be determined, but the names *C. tasmanica* and *C. fragilis* var. *tasmanica* have priority over *C. apiiformis* and *C. fragilis* var. *apiiformis* when applied to Australasian material. Lovis (1959) was the first to recognise that both Australian and New Zealand material was sufficiently distinct to warrant species status using the name *C. tasmanica*.

An adventive plant is now well established in New Zealand. This is referable to the European *C. fragilis* (Brownsey in Webb et al. 1988), and the presence of both species in New Zealand emphasises their distinctiveness. Colenso's *C. laciniatus* is based on the European plant, indicating that it has been here for well over a hundred years.

- 1 Laminae usually 1–2-pinnate, 20–245 mm long, 8–88 mm wide; fertile and sterile fronds slightly dimorphic; primary pinnae 4–45 mm long, 4–24 mm wide; apices of primary and secondary pinnae obtuse or round-ended..... *tasmanica*
- Laminae 2–3-pinnate, 75–280 mm long, 26–175 mm wide; fertile and sterile fronds monomorphic; primary pinnae 16–95 mm long, 9–50 mm wide; apices of primary and secondary pinnae acute or acuminate..... *fragilis*

**Distribution:** *Cystopteris* occurs mostly in temperate regions and often in montane habitats (Rothfels et al. 2012); the majority of species are in the northern hemisphere, with two in South America (Zuloaga et al. 2008) and South Africa (Roux 2009), one endemic to Hawai'i (Palmer 2003) and one in Australia (Jones 1998). Two species in New Zealand; one native and one naturalised.

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

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

Category	Number
Indigenous (Non-endemic)	1
Exotic: Fully Naturalised	1
<b>Total</b>	<b>2</b>

**Recognition:** In New Zealand, species of *Cystopteris* can be distinguished by their herbaceous and usually glabrous 1–3-pinnate laminae, characteristically hood-like indusia which enclose the sori, and echinate spores (Large & Braggins 1991).

**Cytology:** The base chromosome number in *Cystopteris* is  $x = 42$  (Kramer 1990).

### ***Cystopteris fragilis* (L.) Bernh., Neues J. Bot. 1(2): 27 (1805)**

≡ *Polypodium fragile* L., Sp. Pl. 1091 (1753) – as *Polypodium filix-fragile*

Lectotype (selected by Copeland 1929): *J. Amman* 52, Herb. Linn. 1251.51, LINN (online; see Jarvis 2007)

= *Cystopteris laciniatus* Colenso, *Trans. & Proc. New Zealand Inst.* 31: 265 (1899)  
Holotype: Canterbury, cultivated by W. Colenso, Herb Cheeseman, AK 135924!

**Etymology:** From the Latin *fragilis* (brittle), a reference to the nature of the frond in this species.

Rhizomes short-creeping, up to 40 mm long (in herbarium specimens), 1.5–2.5 mm in diameter, with stipes arising 5–10 mm apart; bearing scales. Rhizome scales narrowly ovate, 2.0–3.5 mm long, 0.4–0.8 mm wide, golden brown. Fronds 110–475 mm long. Stipes 25–200 mm long, pale brown or yellow-brown; bearing scattered narrowly ovate, pale brown scales with filiform apices, up to 4 mm long, 0.5 mm wide. Rachises pale brown, becoming green distally, winged distally, sulcate, bearing scattered hair-like scales up to 1.5 mm long. Laminae 2–3-pinnate, ovate to narrowly ovate, tapering to a pinnatifid apex, 75–280 mm long, 26–175 mm wide, yellow-green on both surfaces, herbaceous, glabrous. Primary pinnae in 10–20 pairs, narrowly spaced or slightly overlapping distally, winged throughout, ovate; the longest at or below the middle, short-stalked, 16–95 mm long, 9–50 mm wide, apices acute to acuminate. Secondary pinnae winged throughout, gradually decreasing in length along each primary pinna to the distal end; the longest secondary pinnae ovate, 6–30 mm long, 4–13 mm wide, apices acute or acuminate, bases shortly stalked, margins partly or completely divided to the midrib; the distal secondary pinnae narrowly ovate to oblong, apices acute, bases adnate. Tertiary segments 3–8 mm long, 1–4 mm wide, margins incised. Sori round, on veins; indusia ovate to broader than long, 0.6–1 mm long.

**Distribution:** North Island: Northland, Auckland, Gisborne, Southern North Island.

South Island: Canterbury, Otago, Southland.

Chatham Islands.

Altitudinal range: 0–240 m.

A widespread northern temperate species first recorded by Colenso (1899) as *C. laciniatus*. It is naturalised in Auckland city, around Hamilton and parts of the Waikato, in Wellington and Christchurch, on Banks Peninsula, and in Dunedin, Invercargill, and on the Chatham Islands. It occurs mostly in lowland areas but reaches 240 m on Banks Peninsula, and probably higher in inland Canterbury.

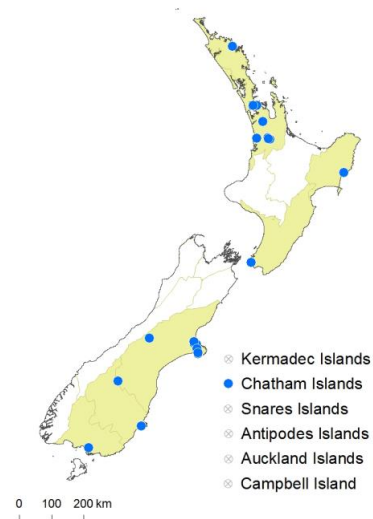
**Biostatus:** Exotic; fully naturalised.

**Habitat:** *Cystopteris fragilis* occurs most frequently in or near urban areas, where it grows along shaded streams and road banks, and in roadside ditches, often under *Salix* species or broadleaved forest.

**First record:** Colenso (1899, p. 265). Voucher AK 135924, 1898. A specimen in the Armstrong Herbarium (CHR 633386) labelled “*Cystopteris fragilis*, naturalised, Christchurch, JBA” probably represents an even earlier record, but is undated.

**Recognition:** *Cystopteris fragilis* is a naturalised plant confined largely to lowland areas, usually near urban centres. It is distinguished morphologically from the indigenous *C. tasmanica* by its generally larger and more divided laminae (2–3-pinnate cf. 1–2-pinnate), by its longer and wider primary pinnae (16–95 mm long, 9–50 mm wide cf. 6–42 mm long, 4–24 mm wide), and by the apices of its primary and secondary pinnae, which are acute to acuminate rather than obtuse or rounded.

**Notes:** *Cystopteris laciniatus* was described by Colenso (1899) from a plant collected in North Canterbury by T. Keir in 1898. The only extant specimen (AK 135924) consists of two fronds taken by Colenso from a living plant in cultivation, originally from Canterbury, and labelled “*Cystopteris laciniatus* sp. nov.” in his own hand-writing. There are no specimens at K or WELT, and in the absence of other authentic material, the AK specimen is assumed to be the holotype. The specimens are clearly identifiable as the naturalised *C. fragilis*.



**Fig. 1:** *Cystopteris fragilis* distribution map based on databased records at AK, CHR & WELT.





**Fig. 2:** *Cystopteris fragilis*. Herbarium specimen, WELT P018045/B, showing mature, fertile, 2-pinnate-pinnatifid frond with acute or acuminate pinna apices.



**Fig. 3:** *Cystopteris fragilis*. Close up of WELT P016370 showing round sori protected by hood-like indusia.

### ***Cystopteris tasmanica* Hook., *Sp. Fil.* 1, 199 (1846)**

≡ *Cystopteris fragilis* var. *tasmanica* (Hook.) Hook.f., *Bot. Antarct. Voy. III. (Fl. Tasman.) Part II*, 136, t. 166 (1858)

Holotype: Van Diemen's Land [Tasmania], *R.C. Gunn* 32, 1838, K 001089192!

= *Cystopteris novae-zealandiae* J.B.Armstr., *Trans. & Proc. New Zealand Inst.* 13: 360 (1881)

Lectotype (selected by Brownsey & Perrie 2017): Mt Armstrong, *J.B. Armstrong*, 1867, CHR 633385! (collection at top left).

**Etymology:** *tasmanicus* (Latin) – from Tasmania.

**Vernacular name:** bladder fern

Rhizomes short-creeping, up to 60 mm long (in herbarium specimens), 1.5–3 mm in diameter, with stipes arising 2–10 mm apart; bearing scales. Rhizome scales narrowly ovate, 2.5–4 mm long, 0.3–1.0 mm wide, golden brown. Fronds 25–400 mm long, or rarely to 470 mm long. Stipes 10–225 mm long, rarely to 250 mm long, pale brown to yellow-brown or rarely red-brown proximally, bearing scattered narrowly ovate pale brown scales with filiform apices, up to 4 mm long, 0.5 mm wide. Rachises pale brown, becoming green distally, narrowly winged distally, sulcate, bearing scattered hair-like scales up to 1 mm long. Laminae 1–2-pinnate or rarely 1–2-pinnate-pinnatifid, ovate or narrowly ovate or narrowly elliptic, tapering to a pinnatifid apex, 18–245 mm long, 5–75 mm or rarely to 88 mm wide, yellow-green on both surfaces, herbaceous; mature fronds glabrous or with a few scattered hair-like scales on costae, young fronds sometimes abundantly covered in minute glandular hairs (apparently lost with age and with drying). Primary pinnae in 4–14 pairs, widely spaced, winged throughout, ovate to oblong; the longest at or below the middle, short-stalked, 3–45 mm long, 3–24 mm wide, apices acute or obtuse or rounded; those on pinnate fronds divided into rounded lobes, those on more divided fronds partly or completely divided into secondary pinnae. Secondary pinnae decreasing slightly in length along each primary pinna to the distal end; the longest secondary pinnae elliptic or ovate, 2–13 mm long, 1–11 mm wide, apices obtuse or rounded, margins crenate to deeply divided, bases shortly stalked or adnate. Sori round, on veins; indusia ovate to broadly ovate, 0.6–1 mm long.

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

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

Altitudinal range: 300–1900 m.

*Cystopteris tasmanica* is an uncommon plant in the North Island, being found from 1000–1900 m on Mt Taranaki, Mt Ruapehu, and from the Gisborne to Tararua Ranges. In the South Island it occurs in montane to alpine areas in north-west Nelson and along, and to the east of, the main divide. It ranges from 300 m in the Rakaia Gorge to over 1750 m on Mt Owen in north-west Nelson.

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

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

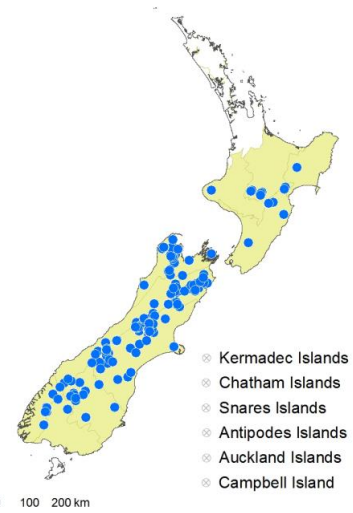
**Habitat:** *Cystopteris tasmanica* grows most frequently on limestone or marble, but sometimes also on greywacke and granite. It occurs under rocks and boulders, in sink-holes, in rock crevices and on wet rock faces, in caves, on stable scree, and on track and river banks, either in shaded rocky areas, subalpine grassland or under scrub, beech or podocarp forest.

**Recognition:** *Cystopteris tasmanica* is an indigenous species, largely confined to limestone in montane to alpine areas. It is distinguished morphologically from the naturalised *C. fragilis* by its generally smaller and less divided laminae (1–2-pinnate cf. 2–3-pinnate), by its shorter and narrower primary pinnae (6–42 mm long, 4–24 mm wide cf. 16–95 mm long, 9–50 mm wide), and by the apices of its primary and secondary pinnae, which are obtuse or rounded rather than acute to acuminate.

**Cytology:** n = 84 (Brownlie 1958, as *Cystopteris fragilis*).

**Notes:** New Zealand plants were misidentified as the European *C. fragilis* in most earlier New Zealand Floras (e.g. Hooker 1867; Cheeseman 1906, 1925; Allan 1961; Crookes 1963). They were referred to the South American *C. fragilis* var. *apiiformis* (Gand.) C.Chr. by Blasdell (1963). Whether or not Australasian material is identical to South American material remains to be determined, but in any event the name *C. tasmanica* (at species or varietal rank) has priority.

Blasdell (1963) noted that minute glandular hairs are present on fronds of several species of *Cystopteris*. They have occasionally been observed on young living fronds of *C. tasmanica*, but they are apparently lost with maturity, and with drying, and have not been observed on herbarium material.



**Fig. 4:** *Cystopteris tasmanica* distribution map based on databased records at AK, CHR & WELT.



**Fig. 5:** *Cystopteris tasmanica*. Mature plants growing amongst limestone rock.



**Fig. 6:** *Cystopteris tasmanica*. Mature 1-pinnate-pinnatifid fronds.



**Fig. 7:** *Cystopteris tasmanica*. Mature plant growing on moss-covered limestone rock.



**Fig. 8:** *Cystopteris tasmanica*. Mature 1-pinnate-pinnatifid frond with round or obtuse pinna apices.



**Fig. 9:** *Cystopteris tasmanica*. Mature 1-pinnate-pinnatifid frond with round or obtuse pinna apices.



**Fig. 10:** *Cystopteris tasmanica*. Abaxial surface of fertile frond showing mature sori away from the lamina margin.



**Fig. 11:** *Cystopteris tasmanica*. Abaxial surface of fertile frond showing minute glandular hairs, and round sori protected by hood-like indusia.



**Fig. 12:** *Cystopteris tasmanica*. Abaxial surface of fertile frond showing mature sori from which the indusia have been shed.

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## Acknowledgements

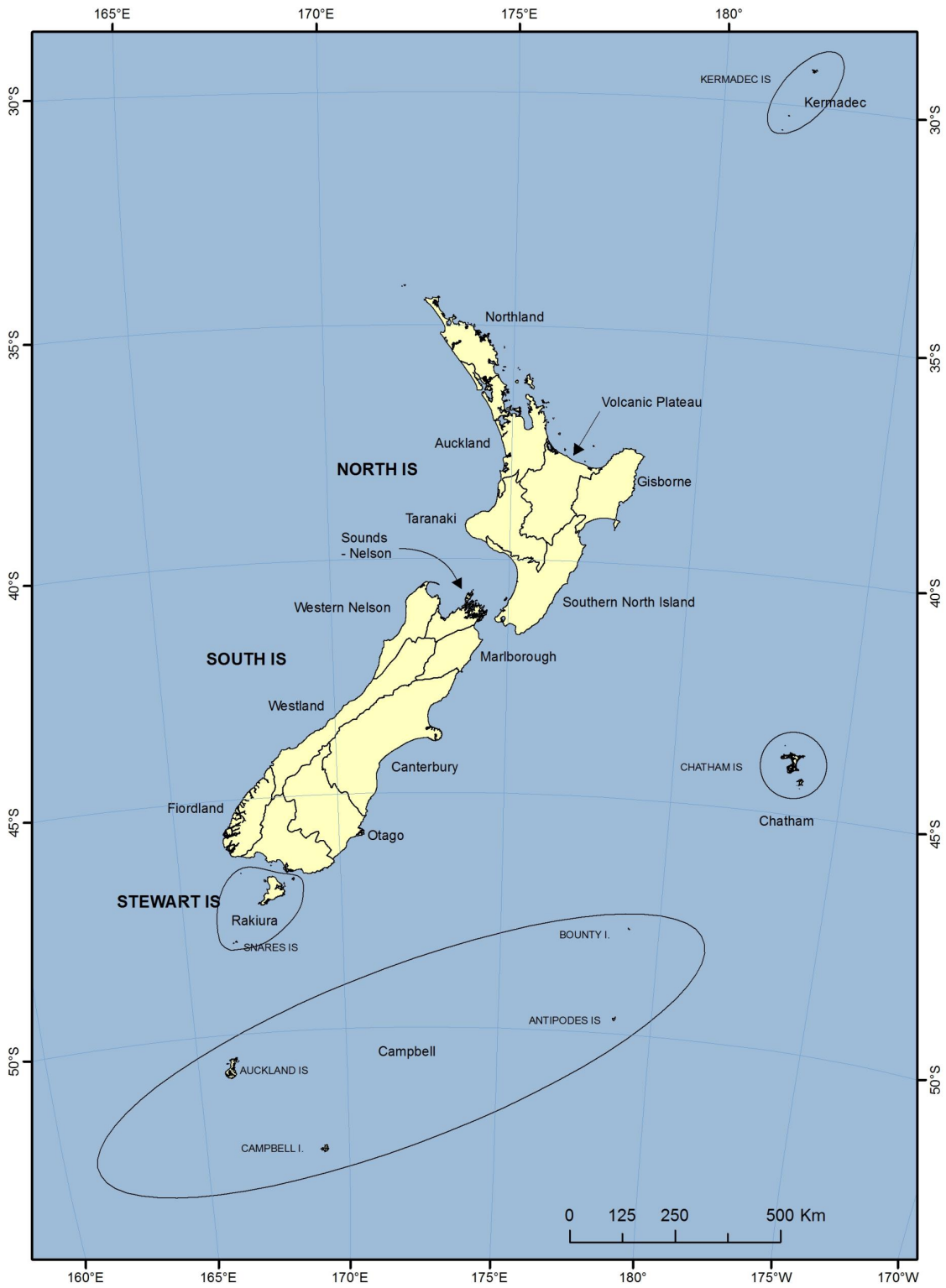
We thank the staff at AK, CHR, and WELT for loans of specimens and for databasing and providing spreadsheets of collection data. We are grateful to staff at CHR for the preparation of maps and for assistance in editing and formatting the text, and to Barbara Parris for reviewing the manuscript.

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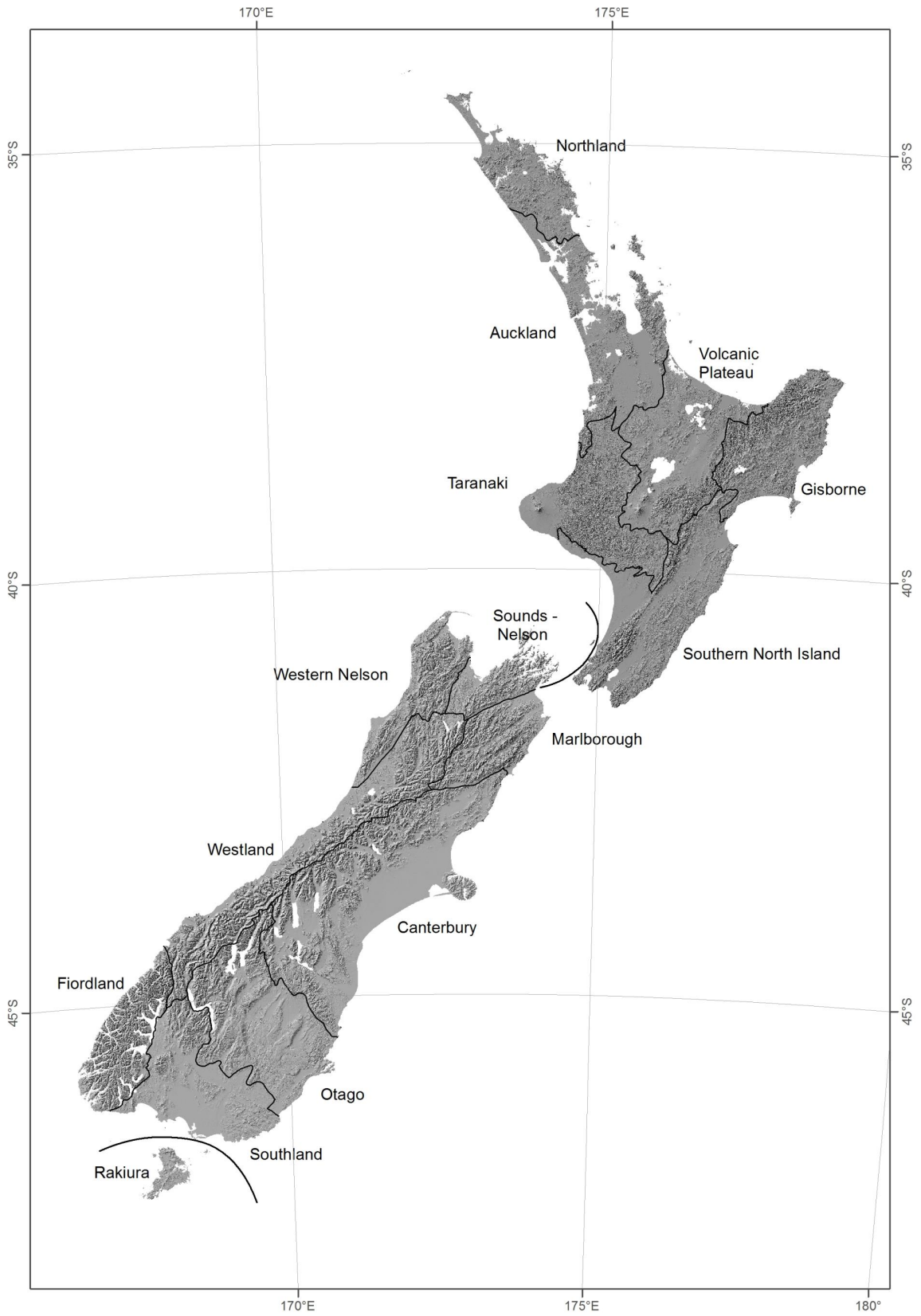
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**Map 1:** Map of New Zealand and offshore islands showing Ecological Provinces



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



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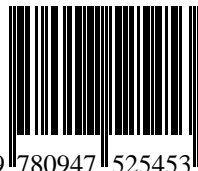
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ISBN 978-0-9 47525-45-3



9 780947 525453