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Cover image: *Centrolepis ciliata*, habit of cushion (near Lake Te Anau).

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Contents

Introduction

A family of about 34 species in three genera, *Aphelia*, *Centrolepis* and *Gaimardia*; two genera are represented in New Zealand: *Centrolepis* (4 indigenous and 1 introduced species) and *Gaimardia* (1 indigenous species). Generally they inhabit infertile and poorly drained soils - in New Zealand they are commonly found in bogs, wet heathland or along the edge of tarns and lakes.

The majority of species occur in Australia (30 species). *Aphelia* has six species endemic to Australia. In *Centrolepis*, 21 species are recorded from Australia of which some of 4 species also extend to New Zealand, Malesia, South East Asia and Hainan (China). Outside of Australia endemic species of *Centrolepis* occur in New Zealand (2) and Malesia (1). In *Gaimardia*, three species occur in Tasmania and one of those, *G. setacea*, is also found in New Zealand and New Guinea. A fourth species, *G. australis*, is endemic to southern South America (Tierra del Fuego and Falkland Islands).

Centrolepidaceae Endl., *Gen. Pl. 2,* 119 (1836)

Type taxon: *Centrolepis* Labill.

Perennial or annual, leafy, moss-like cushions or small solitary tufts. Stems branching or condensed without discernible internodes; producing axillary adventitious roots. Leaves grass-like with open sheaths. Flowering stem a scape. Inflorescence a terminal spike with opposing or alternating sheathing bracts subtending female and/or bisexual reproductive units, or a solitary bisexual flower. Androecium 1 or 2 stamens; anthers dorsifixed, versatile, bisporangiate unilocular, dehiscing by a slit; pollen grains 1-porate. Gynoecium a multilocular ovary of superposed carpels in 1 or 2 rows, or a single carpel, or a collateral bilocular ovary; ovules solitary; styles as many as carpels; stigmatic region papillate. Flowers wind pollinated or selfed. Fruit a capsule. Seeds dehiscent.

Taxonomy: Analyses using chloroplast DNA data are conflicted as to whether the centrolepids should remain as a separate family or be placed in the Restionaceae (Briggs B.G.; Linder H.P. 2009; Briggs et al. 2010). Traditionally the family has been separated from the Restionaceae on the basis of leafiness, monoecism (vs dioecism), the sometimes presence of an annual habit, and the unusual reduced floral structures that have either been interpreted as pseudanthia (Eichler 1875; Moore & Edgar 1970; Cooke 1988) or as bisexual flowers (Hieronymus 1873; Cheeseman 1925; Sokoloff et al. 2009).

1 Inflorescence a spike with 2–3 alternate bracts; reproductive unit (a true flower) with 2 collateral carpels, stamens 2 ..... *Gaimardia*

2 Inflorescence a spike with 2 opposing bracts; Reproductive units with 1 carpel or 2-many superposed carpels, stamens 1 or absent ..... *Centrolepis*

Biostatus:

Table 1: Number of species in New Zealand within *Centrolepidaceae* Endl.

Category	**Number**
Indigenous (Endemic)	2
Indigenous (Non-endemic)	3
Exotic: Casual	1
Total	**6**

Centrolepis Labill., *Nov. Holl. Pl. 1,* 7, t. 1 (1804)

= *Alepyrum* R.Br., *Prodr. Fl. Nov. Holland.,* 253 (1810)

= *Devauxia* R.Br., *Prodr. Fl. Nov. Holland.,* 252 (1810)

= *Pseudalepyrum* Dandy, *J. Bot.* 70: 330 (1932) *nom. nov.*

Type taxon: *Centrolepis fascicularis* Labill.

Perennial or annual, moss-like cushions or small solitary tufts. Monoecious. Leaves cauline and densely distichous along short-branching stems or leaves radical. Leaf-sheaths membranous to scarious; apex of sheath sometimes auricled; mouth aligular, or minutely ligular, or pilose; leaf-lamina papillate. Inflorescence a terminal spike of 2 opposite or sub-opposite unequal sheathing bracts, each subtending 1 to numerous reproductive units, which are female and/or bisexual, with or without subtending secondary hyaline scales. Androecium, stamens 1, free. Gynoecium a single ovary with 1 carpel or a multiloculate ovary of superposed connate carpels in 1 or 2 rows along an axis; each carpel with a single style; styles united to above the ovary then free; styles stigmatic above the ovary, with papillae, crimson. Fruit a capsule, simple with 1 seed or multiloculate. Seeds dehiscing via a longitudinal line of weakness (dorsal slit).

Taxonomy: The bisexual reproductive unit of *Centrolepis* is interpreted here as a male flower reduced to a single stamen and a female flower with one to many carpels (Hieronymus 1873, Prakash 1969, Sokoloff et al. 2009). The anatomical evidence provided by Sokoloff et al. (2009) supports the unusual vertical stack of carpels being an elaboration of the gynoecium (a single multilocular ovary) rather than an aggregation of separate flowers (Eichler 1875, Hamann 1962, Moore & Edgar 1970), however it is still unclear whether the androecium belongs to the same flower or is a separate unisexual flower reduced to a single stamen.

1 Leaves glabrous 2

Leaves hairy; only the leaf-sheath or both leaf-sheath and lamina 3

2	Cushion habit, leaves cauline, perennial	*C. pallida*
	Tufted habit, leaves radical, annual (semi-aquatic)	*C. glabra*
3	Floral bracts glabrous	*C. ciliata*
	Floral bracts hairy	4
4	Leaves hairy, flowering stems with retrorse pilose hairs	*C. strigosa*
	Leaves hairy on the leaf-sheath, but mostly glabrous on the lamina, flowering stems glabrous	*C. fascicularis*

Distribution: New Zealand, Australia, New Guinea, Sumatra and Sulawesi (Indonesia), Borneo (Malaysia), Philippines, Cambodia, Thailand, Vietnam and Hainan (China).

Biostatus: Indigenous (Non-endemic).

Table 2: Number of species in New Zealand within *Centrolepis* Labill.

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

Centrolepis ciliata (Hook.f.) Druce, *Bot. Soc. Exch. Club Brit. Isles* 4 Suppl.: 614 (1917 [1916])

≡ *Gaimardia ciliata* Hook.f., *Bot. Antarct. Voy. I. (Fl. Antarct.) Vol. I,* 85 (1844)
≡ *Alepyrum ciliatum* (Hook.f.) Hieron. in Engler et al., *Nat. Pflanzenfam.,* 14 (1888)
≡ *Pseudalepyrum ciliatum* (Hook.f.) Dandy, *J. Bot.* 70: 331 (1932)
Lectotype: (selected by E. Edgar 1970) Ld Auckland Isld., *J.D. Hooker s.n.*, Nov. 1840, K 843388!, isolectotype AK 2910!

= *Centrolepis viridis* (Kirk) Kirk, *Trans. New Zealand Inst.* 23: 441 (1891)
Type: Arthur's Pass, 3000 ft, Kirk 653, Jan. 1876, WELT 16337!

= *Centrolepis viridis* var. *ligulata* Kirk, *Trans. New Zealand Inst.* 23: 442 (1891)
≡ *Gaimardia ciliata* var. *ligulata* (Kirk) Cheeseman, *Man. New Zealand Fl., ed. 2,* 289 (1925)
≡ *Pseudalepyrum ciliatum* var. *ligulatum* (Kirk) Dandy, *J. Bot.* 70: 331 (1932)
Type: Frazer Peaks, Stewart Id, T. Kirk 965, Jan 1887, WELT 16335!; K.

Etymology: From Latin *cilium* (a short eye-lash-like hair), a reference to hairs on the leaf-sheath

Perennial cushion, 5–100 mm high. Stems ascending, branching. Leaves crowded, obscurely distichous, cauline and imbricate, weakly spreading to erect. Leaf-sheath 2.5–6 mm long, scarious, with multicellular hispid hairs. Leaf-sheath auricles lobed or absent; ligulate, sometimes minute or occasionally pilose. Leaf-lamina 2.5–23 × 0.4–0.7 mm, subulate, with an acute or acicular apex, terete to faintly channelled, glabrous or with pilose hairs below. Uppermost leaf, leaf-like or reduced to a membranous cataphyll. Flowering stems 3.5–20 mm long, glabrous. Inflorescence a compressed ellipsoid to oblong spike, 2.6–5 × 1–1.5 mm. Outer primary floral bract 2.6–5 mm long, elliptic and contracting to an incurved or straight foliar point; papillate. Inner floral bract, 2–4 mm long, elliptic to oblong contracting to an incurved or straight foliar point; papillate. Primary bracts separated by an internode 0.2–0.8 mm long. Secondary hyaline scales present, 1/reproductive unit. Reproductive units/spike 2–3(–5) all bisexual or 1–2 bisexual the rest female. Androecium 1 stamen; filament capillary, 3–7 mm long; anthers fusiform, 0.96–1.6 mm long. Gynoecium, 1–2–(3) connate, superposed carpels. Styles stigmatic with branched papillae, crimson. Seeds 0.75–1 × 0.3–0.5 mm, ellipsoid, yellow to yellow-brown or brown, striated.

Distribution: North Island: South Auckland (Hauhungaroa Range, Raukūmara Range, Kaimanawa, Tongariro, National Park, Urewera National Park), Taranaki, Volcanic Plateau, Wellington (Ruahine and Tararua ranges).

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

Stewart Island, Auckland Islands, Campbell Island.

Biostatus: Indigenous (Endemic).

Habitat: Montane to alpine bogs, flushes, turfs, tarn edges, pakihi and wet heathlands to 1600 m a.s.l., descending to sea-level in the south and west of the South Island in lowland pakihi, peat bogs and oligotrophic swamps.

Recognition: Distinguished from the two other cushion bog centrolepids with which it can occur, *Centrolepis pallida* and *Gaimardia setacea*, by hairy leaf-sheaths, both primary inflorescence bracts contracted to mucronate foliar points, and the presence of secondary hyaline scales within the primary floral bracts.

Phenology: Flowering: Nov.-Jan.

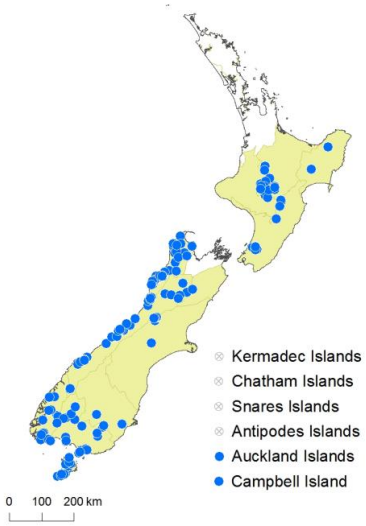

Fig. 1 *Centrolepis ciliata* distribution map based on databased records at AK, CHR and WELT.

Notes: Plants on the New Zealand mainland have inflorescence bracts with distinctive incurved foliar points whereas plants from the Auckland and Campbell islands have foliar points more-or-less straight.

Fig. 2: *Centrolepis ciliata*, flowering shoots with adventitious roots and hispid hairs on leaf-sheaths.

Fig. 3: *Centrolepis ciliata*, flowering plants on the edge of a cushion showing spikes with extruding stamens.

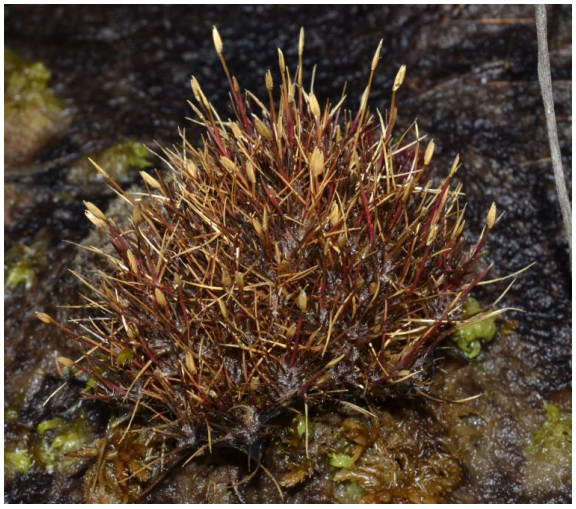

Fig. 4: *Centrolepis ciliata*, habit of cushion (near Lake Te Anau).

Fig. 5: *Centrolepis ciliata*, two cushions flowering in an alpine bog at Arthurs Pass.

Fig. 6: *Centrolepis ciliata*, cushion with disintegrating inflorescences (primary floral bracts) at the end of summer.

Fig. 7: *Centrolepis ciliata*, spikes showing primary bracts with incurved apices and hyaline scales just visible.

Fig. 8: *Centrolepis ciliata*, cushions in sand (Denniston Plateau, Westland).

Centrolepis fascicularis Labill., *Nov. Holl. Pl. 1,* 7-8. tab 1 (1805)

Holotype: in capite Van Diemen [Tas.], 1792, Labillardiere, FI n.v., isotypes B n.v., microfiche AD

= *Devauxia billardieri* R.Br., *Prodr. Fl. Nov. Holland.,* 252 (1810) *pro parte*
Lectotype: in paludosis prope Sydney, N.S.W., R. Brown, BM fide D. Cooke, op. cit. 38. isolectotypes MEL 535282, MEL 536057

= *Centrolepis cuspidigera* Rudge, *Trans. Linn. Soc. London* 10: 283 (1811) *nom. illeg.*
Type: fig. 1, t.12

= *Devauxia longifolia* Gaudich., *Voy. Uranie, Bot.,* 419 (1829)

≡ *Centrolepis longifolia* (Gaudich.) Kunth, *Enum. Pl. 3,* 489 (1841)
Holotype: in Novae Hollandieae ora orientali, N.S.W, Gaudichaud, P

Etymology: From Latin *fascicul* (bundle) a reference to the habit.

Perennial cushion, 15–70 mm high. Stem internodes condensed and not discernible. Leaves spiral, appearing radical, spreading. Leaf-sheath 2–4 mm long, hyaline, with multicellular hispid hairs. Leaf-sheath auricles absent; aligulate. Leaf-lamina 8–20 × 0.3–0.5 mm, filiform, with an acicular apex, terete, a few multicellular hairs below, glabrous above. Uppermost leaf reduced to a membranous cataphyll. Flowering stems 8–65 mm long, glabrous. Inflorescence an ovoid spike, 3.5–5 × 2–3.5 mm. Outer primary floral bract 3.5–5 mm long, ovate and contracting to a spreading, glabrous foliar point; covered with multicellular hispid hairs, hyaline margins ciliate. Inner floral bract, 2.5–4 mm long, ovate and contracting to a spreading, glabrous foliar point, covered with multicellular hispid hairs; hyaline margins ciliate. Primary bracts separated by an internode 0.5–1 mm long. Secondary hyaline scales present, 2/reproductive unit. Reproductive units/spike 7–9, all bisexual. Androecium 1 stamen; filament capillary, 2–4 mm long; anthers ellipsoid, 0.48–0.8 mm long. Gynoecium (2)–3–4 connate, superposed carpels. Styles stigmatic with simple papillae, crimson. Seeds 0.5–0.6 × 0.23–0.3 mm, oblong-ovoid, yellow-brown, striated.

Distribution: North Island: North Auckland, Waitakere Ranges, Swanson Stream Catchment, Watercare Filter Station “Floc Pond”.

Indigenous to Australia, occurring in six states: South Australia, Victoria, Tasmania, New South Wales, Queensland, and Western Australia (possibly introduced) (Cooke 1992).

Biostatus: Exotic; casual.

Habitat: Heathland, bogs; infertile soils

Recognition: Distinguished from all other centrolepids in New Zealand, except for *C. strigosa*, by the presence of hairs on the primary floral bracts. Distinguished from *C. strigosa* by a glabrous flowering stem and a more or less glabrous leaf-lamina with just a few hairs on the lower lamina. Also, *C. fascicularis* has fewer RUs/spike compared with *C. strigosa*.

Phenology: Flowering: Nov.-Feb.

Notes: Known from one locality growing in open *Leptospermum scoparium* heathland on the edge of an artificial flocculation pond at a water treatment facility.

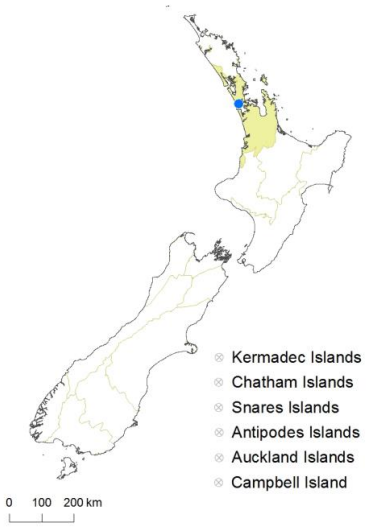

Fig. 9 *Centrolepis fascicularis* distribution map based on databased records at AK, CHR and WELT.

Fig. 10: *Centrolepis fascicularis*, habit of flowering plant.

Fig. 11: *Centrolepis fascicularis*, inflorescences showing hispid spikes and glabrous flowering stems.

Fig. 12: *Centrolepis fascicularis*, spike showing multicellular hispid hairs and relatively long foliar points.

Centrolepis glabra (F.Muell. ex Sond.) Hieron., *Abh. Naturf. Ges. Halle* 12: 209-210 (1873)

≡ *Devauxia glabra* F.Muell. ex Sond., *Linnaea* 28: 226 (1856)
Holotype: Mount Emu Creek [Victoria], *Mueller s.n.*, MEL 536058!

= *Alepyrum muelleri* Hook.f., *Bot. Antarct. Voy. III. (Fl. Tasman.) Vol. II,* 78 (1858)
Holotype: Macquarie River [Tasmania], ex herb. *R.C. Gunn s.n.*, K

= *Centrolepis platychlamys* Reader, *Vict. Naturalist* 23: 23 (1906)
Little Desert, Lowan [Victoria], *F. Reader s.n.*, Nov 1900, MEL

Annual tuft, 4–30 mm high. Stem internodes condensed and not discernible. Leaves spiral, appearing radical, spreading. Leaf-sheath 1–3.5 mm long, hyaline, glabrous. Leaf-sheath auricles absent; aligulate. Leaf-lamina 2.5–24 × 0.4–0.5 mm, subulate, with an acuminate apex, terete to faintly compressed, glabrous. Uppermost leaf reduced to a membranous cataphyll. Flowering stems 1.5–14 mm long, glabrous. Inflorescence an ovoid spike, 3–4 × 0.8–1.4 mm. Outer primary floral bract 3.0–4 mm long, ovate and narrowing to a foliar point; papillate. Inner floral bract, 1.6–2.5 long mm, ovate; papillate. Internode between primary bracts absent. Secondary hyaline scales absent. Reproductive units/spike 3–6, 2 or 3 bisexual, the others female. Androecium 1 stamen; filament capillary, 2–4 mm long; anthers ellipsoid, 0.6–1 mm long. Gynoecium (2)–3–6 connate, superposed carpels. Styles

stigmatic with simple papillae, crimson. Seeds, 0.5–0.6 × 0.24–0.3 mm, obovoid, yellow to yellow-brown or red-brown, faintly striated.

Distribution: South Island: Spider Lakes in mid Canterbury, Ahuriri River near Snowy Gorge Creek junction in south Canterbury, Lakes Te Anau and Manapouri in Southland.

In Australia, occurring in five states: Western Australia, South Australia, New South Wales, Victoria and Tasmania (Cooke 1992).

Biostatus: Indigenous (Non-endemic).

Habitat: Associated with fluctuations of shorelines of kettlehole tarns and lakes in the montane to upper montane zone from 200 to 800 m a.s.l. Initially growing below the waterline in silt or sand, or in a sandy matrix of gravel and rock, then flowering and fruiting above the receding waterline during late summer and autumn.

Recognition: Distinguished from *C. pallida*, which is also glabrous, by a tufted habit with leaves appearing radical, whereas *C. pallida* forms tight cushions and has a distinctly distichous eaf arrangement. Also, *C. glabra* has a membranous cataphyll subtending the flowering stem, whereas in *C. pallida* a normal leaf subtends the flowering stem.

Phenology: Flowering: Mar.-May

Notes: New Zealand plants have slightly larger seeds and longer anthers than recorded from Australian plants (Cooke 1992).

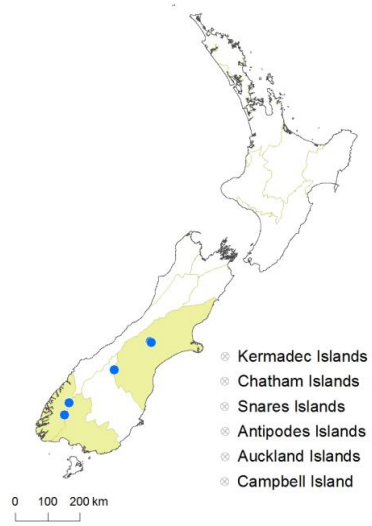

Fig. 13 *Centrolepis glabra* distribution map based on databased records at AK, CHR and WELT.

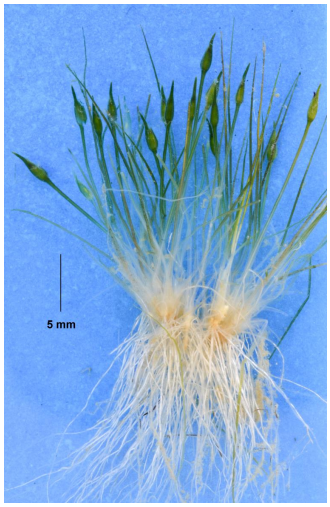

Fig. 14: *Centrolepis glabra*, the lax tuft of a submerged plant from a kettlehole tarn (Spider Lakes, Canterbury).

Fig. 15: *Centrolepis glabra*, tuft of a plant that was growing in gravel above the waterline of a kettlehole tarn (Ahuriri Valley, Canterbury).

Fig. 16: *Centrolepis glabra*, showing membraneous cataphylls clasping the flowering stem.

Fig. 17: *Centrolepis glabra*, habit of flowering plants exposed on the shore of a kettlehole tarn (Ahuriri Valley, Canterbury).

Fig. 18: *Centrolepis glabra*, terrestrial tufts growing in silt and gravel.

Fig. 19: *Centrolepis glabra*, population of plants on the shore of a kettlehole tarn (Ahuriri Valley, Canterbury).

Centrolepis pallida (Hook.f.) Cheeseman, *Man. New Zealand Fl.,* 757 (1906)

≡ *Gaimardia pallida* Hook.f., *Bot. Antarct. Voy. I. (Fl. Antarct.) Vol. I,* 86 (1844)
≡ *Alepyrum pallidum* (Hook.f.) Hook.f., *Bot. Antarct. Voy. II. (Fl. Nov.-Zel.) Vol. II,* 268, t. 62 C (1853)
≡ *Pseudalepyrum pallidum* (Hook.f.) Dandy, *J. Bot.* 70: 331 (1932)
Lectotype: (selected by E. Edgar 1970) Campbell Isld., *J.D. Hooker 1622*, K 340075!
= *Centrolepis minima* Kirk, *Trans. New Zealand Inst.* 23: 441 (1891)
≡ *Pseudalepyrum minimum* (Kirk) Dandy, *J. Bot.* 70: 331 (1932)
Lectotype: (selected by E. Edgar 1970) Lake Brunner, *T. Kirk s.n.*, Mar 1885, WELT 16318!, isolectotypes AK 2892! K 843390!

Etymology: From Latin *pallidus* (pale), a reference to the pale coloured tufts.

Perennial cushion, 8–45 mm high. Stems ascending, branching. Leaves distichous, cauline and imbricate, weakly spreading to erect. Leaf-sheath 2.8–6.5 mm long, scariose, glabrous. Leaf-sheath auricles absent; aligulate. Leaf-lamina 1.5–5.5 × 0.3–0.8 mm, ensiform to subulate, with an acute or acuminate apex, terete to compressed, glabrous. Uppermost leaf normal. Flowering stems 2–11 mm long, glabrous. Inflorescence an ovoid spike, 3.2–6 × 0.8–1.5 mm. Outer primary floral bract 3.3–6.0 mm long, ovate and often narrowing to a short foliar point; papillate. Inner floral bract, 2.4–4.7 mm long, ovate occasionally mucronate; papillate. Internode between primary bracts absent. Secondary hyaline scales absent. Reproductive units/spike (1)- 2–(4), one bisexual (occ. 2) the other(s) female. Androecium 1–(2) stamen; filament capillary, 2–15 mm long; anthers ellipsoid, 1.4–2.4 mm long. Gynoecium 2–4–(5) connate, superposed carpels. Styles stigmatic with simple papillae, crimson. Seeds 0.56–0.7 × 0.32–0.4 mm, obovoid, red-brown, smooth.

Distribution: North Island: Volcanic Plateau, northern Ruahine Range.

South Island: West Nelson, Westland, Canterbury, Otago, Southland, Fiordland (rare in Westland and Canterbury).

Stewart Island, Auckland Islands, Campbell Island.

Biostatus: Indigenous (Endemic).

Habitat: Subalpine to alpine bogs, flushes, turfs, tarns and stream margins to 1890 m a.s.l., often on the flat tops of hills in bogs, but common on the sandy and rocky shores of the southern South Island glacial lakes (sometimes submerged below the waterline); descending to sea level in the southern South Island (Sandy Point) and Stewart Island (Masons Bay).

Recognition: Distinguished from *C. glabra* by a cushion habit and a distinctly distichous arrangement of leaves, whereas *C. glabra* forms singular tufts and the leaf arrangement appears radical. Also, a normal leaf subtends the flowering stem in *C. pallida*, not a membranous cataphyll as in *C. glabra*. Distinguished from *C.ciliata* by being completely glabrous and the absence of secondary yaline scales within the primary floral bracts.

Phenology: Flowering: Dec.-Jan.

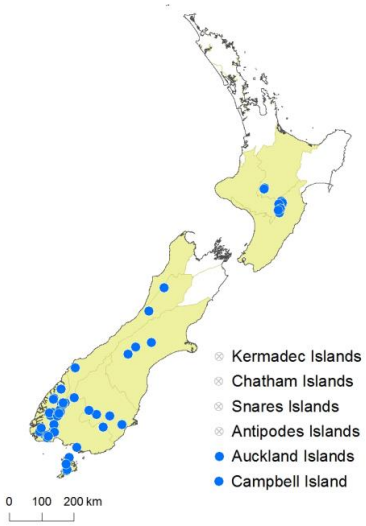

Fig. 20 *Centrolepis pallida* distribution map based on databased records at AK, CHR and WELT.

Notes: Some populations of predominantly aquatic cushions are often reddish green, have longer subulate leaves and more reproductive units/spike, 3 rather than 2. Such populations have been recorded in Southland in Lakes Manapouri and Te Anau, and in Green Lake.

Fig. 21: *Centrolepis pallida*, habit - flowering shoots, each spike showing stigmata and a single extruding anther.

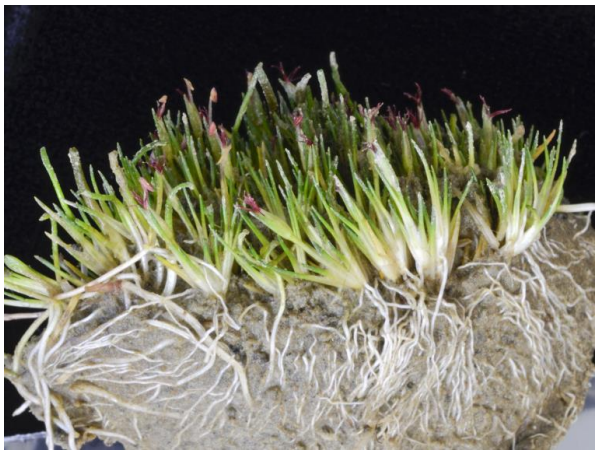

Fig. 22: *Centrolepis pallida*, flowering plants.

Fig. 23: *Centrolepis pallida*, habit of cushion on rocky shore (Lake Hauroko).

Fig. 24: *Centrolepis pallida*, young plants forming a mat in fine gravel on the shore of Lake Hauroko.

Fig. 25: *Centrolepis pallida*, flowering head showing the unequal length of the floral bracts.

Fig. 26: *Centrolepis pallida*, cushions on the rocky shores of Lake Hauroko.

Fig. 27: *Centrolepis pallida*, established population with large cushions and developing mats of young plants (in the foreground) on the shores of Lake Hauroko.

Fig. 28: *Centrolepis pallida*, wet turf in fine sand in Surprise Bay, Lake Manapouri.

Fig. 29: *Centrolepis pallida*, cushions establishing along shore of Lake Te Anau at Henry Creek (a line of dead turf just captured in the top right of the photograph).

Centrolepis strigosa (R.Br.) Roem. & Schult., *Syst. Veg. ed. 15, 1,* 43 (1817)

≡ *Devauxia strigosa* R.Br., *Prodr. Fl. Nov. Holland.,* 252 (1810)

Lectotype: (selected by D.A. Cooke 1992) saxes prope Bald Head, King Georges Sound [Western Australia], *R. Brown No. 5831*, 1801, BM; isolectotype CANB 67855!

Etymology: From Latin *strigosus* (bristles), a reference to the notable bristliness of this species.

Annual tuft, 15–80 mm high. Stem internodes condensed and not discernible. Leaves spiral, appearing radical, spreading. Leaf-sheath 1.6–5.5 mm long, hyaline, with multicellular hispid hairs. Leaf-sheath auricles absent; aligulate. Leaf-lamina 5–25 × 0.2–0.48 mm, filiform, with an acicular apex, terete, with multicellular hispid hairs. Uppermost leaf reduced to a membranous cataphyll. Flowering stems 10–65 mm long, surface retrorsely pilose. Inflorescence an ovoid spike, 3–4 × 1.5–5 mm. Outer primary floral bract 2.6–4 mm long, ovate and contracting to a short, spreading, glabrous foliar point, covered with multicellular hispid hairs; hyaline margins ciliate. Inner floral bract, 2.5–3.6 mm long, ovate and contracting to a short, spreading, glabrous foliar point, covered with multicellular hispid hairs; hyaline margins ciliate. Primary bracts separated by an internode 0.5–1.2 mm long. Secondary hyaline scales present, 2 or 3/reproductive unit. Reproductive units/spike (4)–13–(15), all bisexual. Androecium 1 stamen; filament capillary, 2–3 mm long; anthers ellipsoid, 0.5–1 mm long. Gynoecium 3–9 connate, superposed carpels. Styles stigmatic with simple papillae, crimson. Seeds 0.4–0.6 × 0.23–0.3 mm, obovoid, yellow-brown or red-brown, smooth to faintly striated.

Distribution: North Island: North Auckland, Kai Iwi Lakes: Kai Iwi, Taharoa and Waikere, inland from Baylys Beach near Dargaville, Lake Ototoa, South Head, Kaipara Harbour.

South Island: Southland, The Bluff/Motupōhue summit and Sandy Point at the New River Estuary, Invercargill.

Indigenous to Australia, occurring in six states: Western Australia, South Australia, Queensland, New South Wales, Victoria and Tasmania (Cooke 1992).

Biostatus: Indigenous (Non-endemic).

Habitat: Wet coastal sand, sandy-peat, shores of dune lakes, open coastal heathland; infertile soils, from sea level to 260 m a.s.l.

Recognition: Distinguished from all other centrolepids in New Zealand by a complete covering of hairs over the leaves, flowering stem and inflorescence bracts. *Centrolepis strigosa* is most similar to *C. fascicularis*, but that species does not have the retrorse pilose hairs on the flowering stem and the leaf-lamina is mostly glabrous with just a few hairs on the lower lamina.

Phenology: Flowering: Nov.-Feb.

Notes: There are three subspecies of *C. strigosa* indigenous to Australia; populations in New Zealand are referable to *C. strigosa* subsp. *strigosa*.

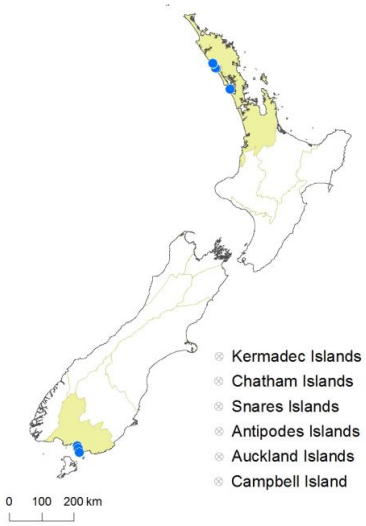

Fig. 30 *Centrolepis strigosa* distribution map based on databased records at AK, CHR and WELT.

In New Zealand *C. strigosa* has been treated as both indigenous (Cheeseman 1925; Moore & Edgar 1970) and naturalised (Healy & Edgar 1980). Healy & Edgar (1980) changed its biostatus to naturalised on the basis of a wide disjunction in distribution following a discovery in late 1970 (*Mason & Esler*, 1970) from heathland near Dargaville - the other populations being at Bluff (*Kirk*, 1890) and 15 km away at Sandy Point near Invercargill (*Poole*, 1940). Subsequently over the last four decades it has been collected north of Dargaville at the Kai Iwi Lakes and south of Dargaville at Lake Ototoa on the South Kaipara Peninsula.

The arrival of *C. strigosa* in New Zealand is likely to have been recent and a hypothesis of arrival from Australia associated with human activity cannot easily be discarded. It has a limited presence here and its lack of discovery from unmodified habitats and away from areas of settlement, suggests either direct human introduction or establishment via trans-Tasman bird migration into human-modified habitats. Both the Southland and North Auckland populations are in areas of early European settlement and disturbance: in Southland, a major port and town (Bluff and Invercargill) and in the Dargaville area associated with gum-diggings in coastal heathlands. However, these places are also obvious ports-of-call for trans-Tasman birds, e.g. dune-lakes, a promontory and an estuary sand-spit. An interpretation of *C. strigosa* as part of an ‘indigenous vagrant flora’ is favoured here although human activity has probably assisted its establishment. Arrival into New Zealand coastal habitats via oceanic bird transport from south-eastern Australian populations is a likely scenario given its minute seeds and habitat preferences.

Although the known distribution of *C. strigosa* in North Auckland has widened to c. 90 km of the west coast, the South Island populations at The Bluff/Motupōhue and Sandy Point, the former dating back to 1890, appear to have remained localised.

Fig. 31: *Centrolepis strigosa*, a flowering tuft with hispid hairs on the leaves and inflorescence bracts, and retrorse pilose hairs on the flowering stem.

Fig. 32: *Centrolepis strigosa*, habit of flowering plant in roadside gravel on Bluff Hill (Southland).

Fig. 33: *Centrolepis strigosa*, young plant in sand (shore of Lake Taharoa, Northland).

Fig. 34: *Centrolepis strigosa*, close up of spike showing retrorse pilose hairs on the flowering stem.

Fig. 35: *Centrolepis strigosa*, a mature spike spreading and exposing secondary hyaline scales with fruits within.

Fig. 36: *Centrolepis strigosa*, inflorescences with mature fruit.

Fig. 37: *Centrolepis strigosa*, release of seed from capsules and from within the folds of the papery secondary bracts.

Fig. 38: *Centrolepis strigosa*, habit of plants growing in sand on the shore of Lake Taharoa (Northland).

Gaimardia Gaudich., *Ann. Sci. Nat. (Paris)* 5: 100 (1825)

Type taxon: *Gaimardia australis* Gaudich.

Perennial, moss-like cushions. Leaves cauline, densely distichous along branching stems. Hermaphrodite. Leaf-sheaths scarious, auricles absent, ligulate. Leaf-lamina terete to channelled, surface papillate. Inflorescence a terminal spike of 2–3 alternating convolute, appressed bracts. Secondary hyaline floral scales, absent. Flowers 1 or 2/spike, bisexual. Androecium, stamens 2. Gynoecium a collateral bilocular ovary; styles 2. Fruit a bilocular capsule, each locule containing 1 seed. Seed dehiscing longitudinally via a line of weakness (dorsal slit).

Taxonomy: Moore & Edgar (1970) followed Eichler (1875) and Hamann (1962) in interpreting the reproductive structure of *Gaimardia* as a partial inflorescence composed of an aggregation of reduced male and female flowers (a pseudanthial hypothesis). However Sokoloff et al. (2009) provide compelling anatomical evidence of an euanthial interpretation, a perfect flower with a bilocular ovary and two stamens.

Distribution: New Zealand, Tasmania (Australia), New Guinea, Tierra del Fuego and Falkland Islands.

Biostatus: Indigenous (Non-endemic).

Table 3: Number of species in New Zealand within *Gaimardia* Gaudich.

Category	**Number**
Indigenous (Non-endemic)	1
Total	**1**

Gaimardia setacea Hook.f., *Bot. Antarct. Voy. II. (Fl. Nov.-Zel.) Vol. II,* 267 (1853)

Lectotype: (selected by E. Edgar 1970) Port Preservation, New Zealand, *Lyall s.n.*, K 843384!

Etymology: From Latin *seta* (a stiff hair), in reference to the bristle-like leaf-lamina.

Perennial cushion, 15–80 mm high. Stems ascending, much branched towards the base. Leaves densely distichous, imbricate, weakly spreading to erect. Leaf-sheath, 3.2–6 mm long, scarious, glabrous, shiny red-brown, auricles absent, long ligulate with an acute apex. Leaf-lamina 4–8 × 0.3–0.5 mm, setaceous with a long hyaline acicular tip, terete to faintly channelled, glabrous. Uppermost leaf normal. Flowering stems 8–20 mm long, glabrous. Inflorescence a narrow ovoid spike, 2.8–5.0 × 0.7–1.0 mm, with 2–3 alternate bracts. Inflorescence bracts separated by a flattened internode, 1.5–2.0 mm long. The lowermost bract, 2.0–3.0 mm long, ovate with an acuminate or mucronate apex, occasionally emarginate, always subtending a bisexual flower, the smaller second bract subtending a bisexual flower or sterile, the third bract if present sterile. Androecium, stamens 2, free; filament capillary, 1.5–2.8 mm long; anthers 0.5–0.8 mm long, ellipsoid. Gynoecium a collateral bilocular ovary; styles 2, free; apical stigmatic part of style crowded with branched papillae, white. Seeds 0.8–1 × 0.28–0.4 mm, oblong-ovoid, yellow-brown or red-brown, faintly striated.

Distribution: South Island: Nelson, Canterbury, Otago, Westland, Southland, Fiordland, Stewart Island.

Also recorded from Tasmania and New Guinea.

Biostatus: Indigenous (Non-endemic).

Habitat: Subalpine to alpine bogs, peat and sphagnum bogs, turfs, wet open heathland from 400 to 1500 m.

Recognition: Distinguished from the two bog species of *Centrolepis* (*C. ciliata* and *C. pallida*), by 2–3 distinctly alternate inflorescence bracts, shiny red-brown or brown leaf-sheaths and the laminae with long hyaline needle-tips. Often found in close proximity with *C. ciliata*, but easily distinguished from that species, which has hairy leaf-sheaths, whereas *Gaimardia setacea* is completely glabrous.

Phenology: Flowering: Nov.–Jan.

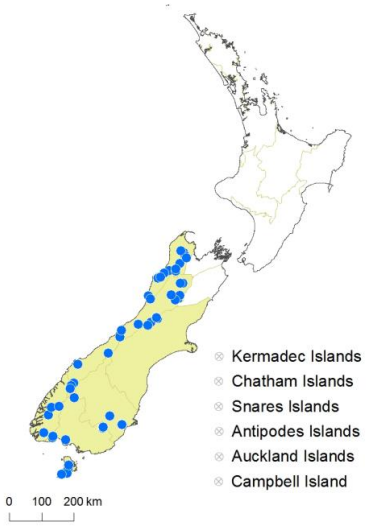

Fig. 39 *Gaimardia setacea* distribution map based on databased records at AK, CHR and WELT.

Fig. 40: *Gaimardia setacea*, flowering cushion (Arthurs Pass).

Fig. 41: *Gaimardia setacea*, shortly branching shoots.

Fig. 42: *Gaimardia setacea*, flowering shoots.

Fig. 43: *Gaimardia setacea*, a flowering shoot showing distichous phyllotaxy and shiny red-brown leaf-sheaths.

Fig. 44: *Gaimardia setacea*, a shoot and leaf showing acicular hyaline leaf-tips and a spike wtih three alternate bracts - the lower two bracts each subtend a single flower.

Fig. 45: *Gaimardia setacea*, close-up of spikes, each showing two alternate bracts.

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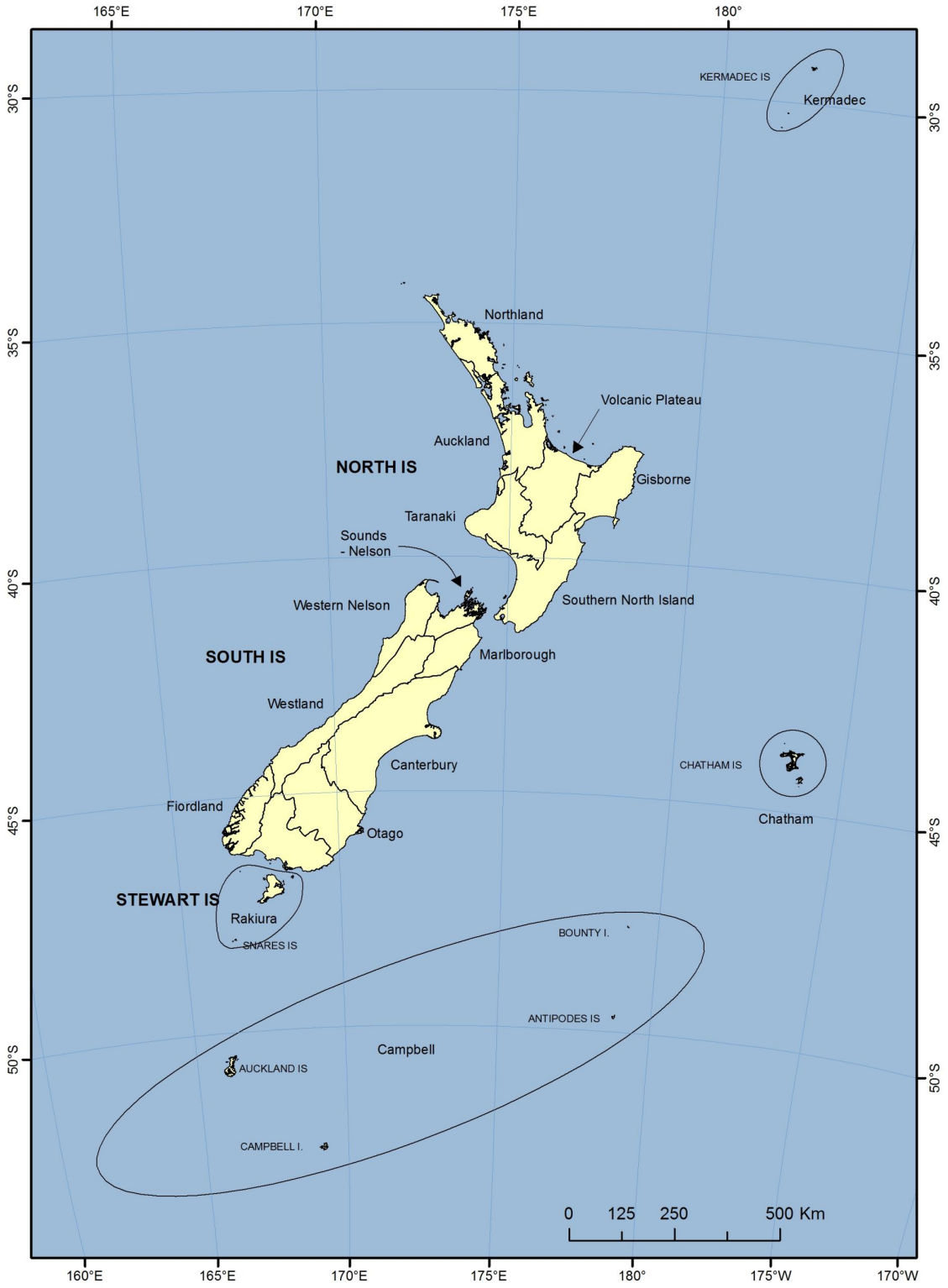
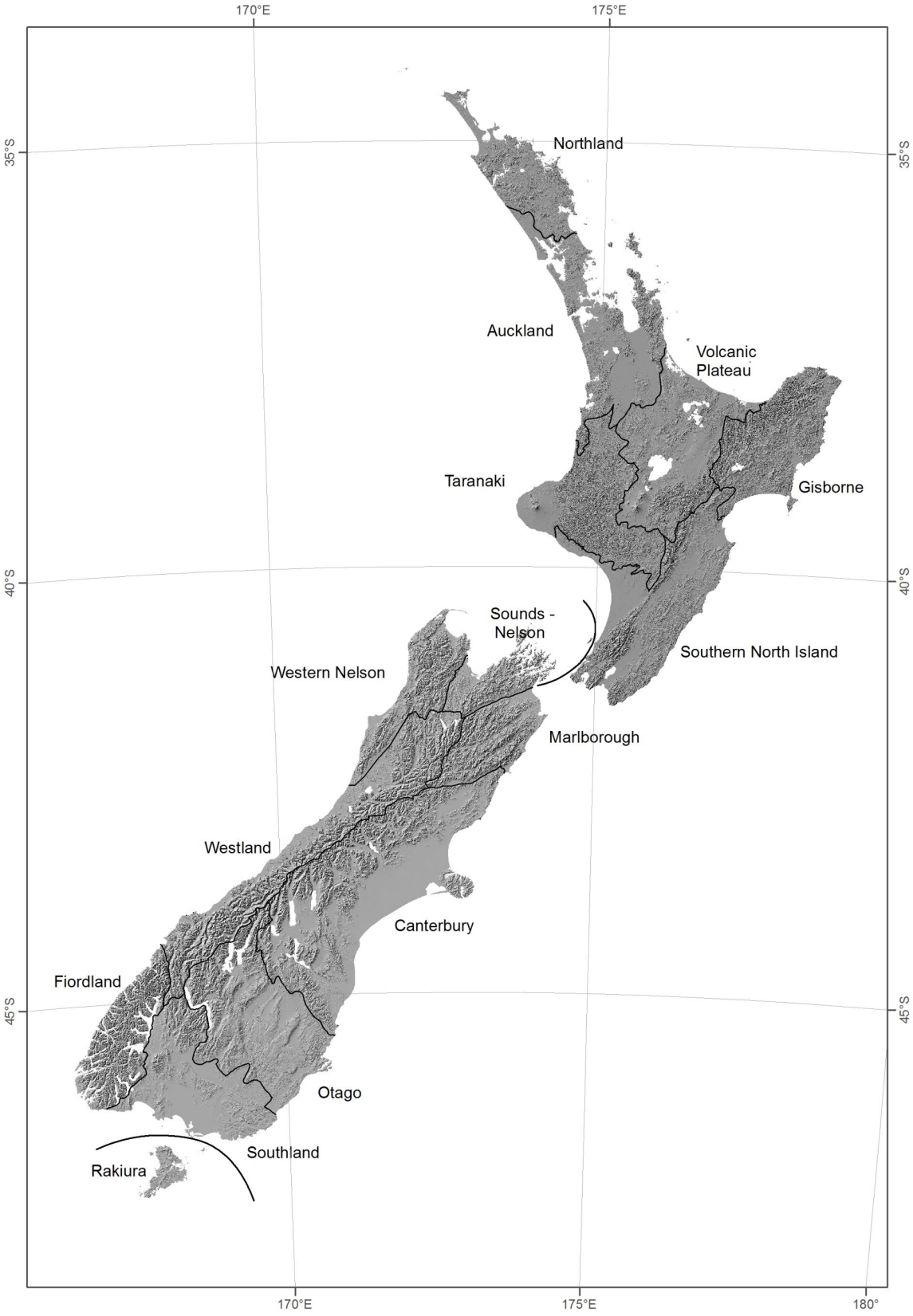


Map 1: Map of New Zealand and offshore islands showing Ecological Provinces



Map 2: Map of New Zealand showing Ecological Provinces

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