FLORA OF NEW ZEALAND

FERNS AND LYCOPHYTES

EQUISETACEAE

P.J. BROWNSEY & L.R. PERRIE

Fascicle 6 – MARCH 2015

nzflora

CATALOGUING IN PUBLICATION

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

Flora of New Zealand [electronic resource] : ferns and lycophytes. Fascicle 6, Equisetaceae / P.J. Brownsey and L.R. Perrie. -- Lincoln, N.Z. : Manaaki Whenua Press, 2015.

1 online resource

ISBN 978-0-478-34775-3 (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 582.374.2(931)DC 587.20993

DOI: 10.7931/B1159G

This work should be cited as:
Brownsey, P.J. & Perrie, L.R. 2015: Equisetaceae. *In*: Breitwieser, I.; Heenan, P.B.; Wilton, A.D. *Flora of New Zealand — Ferns and Lycophytes*. Fascicle 6. Manaaki Whenua Press, Lincoln. http://dx.doi.org/10.7931/B1159G

Cover image: *Equisetum arvense*, sterile stems with lateral branches arising in whorls at nodes.

Manaaki Whenua PRESS

Contents

Introduction

The family Equisetaceae is represented in New Zealand by one genus with three introduced species; all are classified as Unwanted Organisms. *Equisetum arvense* was first recorded in Wanganui in 1922 and has since spread aggressively along river banks throughout much of the southern North Island, and northern South Island. *Equisetum hyemale* is less invasive, occurring in mostly urban areas from Whangarei to Invercargill, whilst *E. fluviatile* is known from just one collection near Huntly. All species of *Equisetum* have a characteristic growth form with erect aerial stems that are usually hollow, jointed and longitudinally grooved, produce whorls of branches and leaves, and bear conspicuous terminal strobili which themselves comprise whorls of peltate sporangiophores. Species of *Equisetum* are commonly known as horsetails because of their distinctive appearance, or as scouring rushes because of their high silica content.

Equisetaceae Michx. ex DC., *Essai Propr. Méd. Pl.,* 49 (1804)

Type taxon: *Equisetum* L.

Terrestrial ferns. Underground stems long-creeping, freely branching, bearing wiry roots. Aerial stems green, erect, branching in whorls or unbranched, usually with a central hollow surrounded by two rings of smaller alternating cavities, jointed, longitudinally grooved, siliceous, glabrous, bearing leaves in sheathing whorls at the nodes. Leaves united laterally into a sheath, toothed at the apices, equalling the number of stem grooves. Veins undivided in each leaf. Strobili terminal on main aerial stems, or sometimes on lateral stems, or on specialised shoots lacking chlorophyll, bearing stalked peltate sporangiophores arranged in whorls. Several sporangia pendent from adaxial surface of heads of sporangiophores; each sporangium sessile, lacking an annulus and dehiscing by a longitudinal slit, containing 1000s of spores and elaters. Homosporous; spores alete, spherical, attached to four coiled elaters, granulate to smooth, chlorophyllous.

Taxonomy: A family of one genus and 15 species (Hauke 1990). The Equisetaceae is a very distinctive family of terrestrial ferns with erect aerial stems that are usually hollow, jointed and longitudinally grooved, produce whorls of branches and leaves, bear conspicuous terminal strobili comprising whorls of peltate sporangiophores, and have a base chromosome number of 108.

Traditionally the Equisetaceae has been included within the fern allies, and is clearly related to early groups of fossil plants in the Sphenophyllales and Calamitales. However, molecular evidence now indicates that the family is part of the ferns, albeit distantly related and its exact placement remains uncertain. Pryer et al. (2004) and Smith et al. (2006) treated Equisetaceae as sister to Marattiaceae, but Rai & Graham (2010) suggested that the group is sister to the rest of the ferns. Christenhusz et al. (2011) considered the latter position to be more consistent with the fossil record but continued to include Equisetaceae within the ferns.

Distribution: Virtually cosmopolitan except for Australia and New Zealand. Three naturalised species occur in New Zealand.

Biostatus: Exotic; fully naturalised.

Table 1: Number of species in New Zealand within *Equisetaceae* Michx. ex DC.

Category	**Number**
Exotic: Fully Naturalised	2
Exotic: Casual	1
Total	**3**

Equisetum L., *Sp. Pl.,* 1061 (1753)

Type taxon: *Equisetum arvense* L.

Etymology: From the Latin *equus* (horse), and *seta* (bristle), a reference to the resemblance of the vegetative stem to a horse's tail.

Vernacular names: horsetail; scouring rush

Terrestrial ferns. Underground stems long-creeping, freely branching, bearing wiry roots. Aerial stems green, erect, branching in whorls or unbranched, usually with a central hollow surrounded by two rings of smaller alternating cavities, jointed, longitudinally grooved, siliceous, glabrous, bearing leaves in sheathing whorls at the nodes. Leaves united laterally into a sheath, toothed at the apices, equalling the number of stem grooves. Veins undivided in each leaf. Strobili terminal on main aerial stems, or sometimes on lateral stems, or on specialised shoots lacking chlorophyll, bearing stalked peltate sporangiophores arranged in whorls. Several sporangia pendent from adaxial surface of heads of sporangiophores; each sporangium sessile, lacking an annulus and dehiscing by a longitudinal slit, containing 1000s of spores and elaters. Homosporous; spores alete, spherical, attached to four coiled elaters, granulate to smooth, chlorophyllous.

Taxonomy: A genus of 15 species. *Equisetum* comprises two well-marked subgenera, *Equisetum* and *Hippochaete* (Hauke 1990). Subgenus *Equisetum* is distinguished by its superficial stomata, which are usually scattered or in bands of two or more stomata wide, by its non-apiculate strobili, and its annual, regularly branched, aerial stems. Subgenus *Hippochaete* has sunken stomata in single lines, apiculate strobili, and usually perennial, often unbranched, aerial stems. Of the species occurring in New Zealand, *E. hyemale* belongs to subgenus *Hippochaete*, and *E. arvense* and *E. fluviatile* to subgenus *Equisetum*.

1	Fertile and sterile stems dimorphic; sterile stems with abundant whorls of branches	*arvense*
	Fertile and sterile stems monomorphic; sterile stems unbranched, or only sparsely branched	2
2	Sterile stems 400–600 mm tall, sparsely branched; ridges on aerial stems smooth; apices of strobili obtuse	*fluviatile*
	Sterile stems 1000–2000 mm tall, usually unbranched; ridges on aerial stems with two rows of tubercles; apices of strobili apiculate	*hyemale*

Distribution: Virtually cosmopolitan except for Australia and New Zealand. Two species fully naturalised, and one casual, in New Zealand.

Biostatus: Exotic; fully naturalised.

Table 2: Number of species in New Zealand within *Equisetum* L.

Category	**Number**
Exotic: Fully Naturalised	2
Exotic: Casual	1
Total	**3**

Cytology: n = 108 (Hauke 1990).

Notes: *Equisetum* was possibly first introduced to New Zealand in 1900 by Leonard Cockayne who obtained four species from Karl Goebel in Munich and grew them in his garden at New Brighton. He quickly regretted his choice of plants and shortly after had to eradicate them before they became firmly established (Thomson 1979, pp. 390–391).

Equisetum arvense L., *Sp. Pl.,* 1061 (1753)

Lectotype (selected by Jonsell & Jarvis 1994): *Clayton 341*, BM 000062951

Etymology: From the Latin *arvensis* (pertaining to cultivated fields), a reference to its native habitat in Europe.

Vernacular name: field horsetail

Aerial stems dimorphic. Sterile stems erect, 100–800 mm high, 1–5 mm in diameter, green, usually regularly branched, with undivided lateral branches arising in whorls; main stem occasionally producing terminal strobili in mid-summer; stem ridges nearly smooth; grooves 4–14; central hollow <half the diameter of the stem; leaf sheaths green with brown tips, 4–10 mm long. Fertile stems 95–275 mm high, 1–3 mm in diameter, pale brown, lacking chlorophyll, unbranched; normally appearing in spring before the sterile stems, and dying after shedding spores; leaf sheaths pale green or brown with darker teeth, 9–22 mm long. Strobili 4–40 mm long, 5–10 mm in diameter, apices obtuse.

Distribution: North Island: Auckland, Gisborne, Taranaki, Southern North Island.

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

Altitudinal range: 0–670 m.

A widespread northern temperate species now extensively naturalised in the Manawatu and Rangitīkei catchments of the North Island, and the Mokihinui and Matiri catchments in the South Island. It is also naturalised in Auckland, Kāwhia, New Plymouth, Gisborne, Hawke's Bay, eastern and southern Wairarapa, parts of Marlborough, Christchurch, Ashburton and Otago Peninsula. It occurs most frequently in lowland sites along river banks, but has been recorded up to 560 m at Mataroa, near Taihape, and 670 m in the Marino Mts, Nelson.

It was first recorded in the wild from Wanganui and was believed to have been introduced with iris rhizomes from Japan (Atkinson 1922). It has spread from there throughout the Manawatu and Rangitīkei catchments as far as Taihape and Palmerston North. It is dispersed easily in river shingle and sand, while in urban areas it has spread with other garden plants, or sometimes been misguidedly cultivated. It now occurs in a substantial part of central New Zealand and will inevitably spread further.

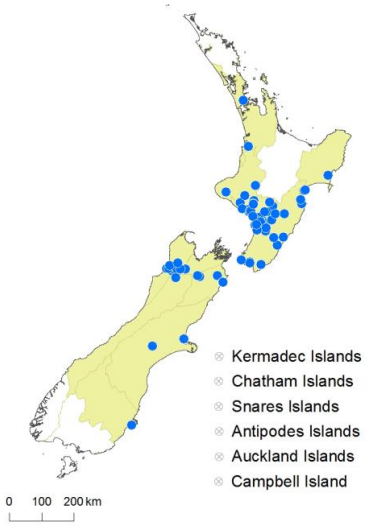

Fig. 1: *Equisetum arvense* distribution map based on databased records at AK, CHR and WELT.

Biostatus: Exotic; fully naturalised.

Habitat: *Equisetum arvense* occurs most frequently along muddy banks of lakes and rivers, in river shingle and sand, along drains and the edges of swamps, in damp grass, in wet dune hollows, around shingle piles, and as a weed of cultivation in urban areas. It is an aggressive weed in sandy and muddy soils because of its extensive underground rhizomes, and frequently excludes other vegetation. It is almost impossible to eradicate once established, and is not readily susceptible to chemical control (James & Rahman 2010). In urban areas, stems are capable of pushing up through tar seal.

First record: Atkinson (1922, p. 290). Voucher: AK 110803, 1922

Recognition: *Equisetum arvense* is recognised by its dimorphic fertile and sterile stems, its abundantly branching vegetative stems that have uniformly green leaf sheaths with 4–14 grooves, and its obtuse strobilus. It is easily the most common of the species in New Zealand, frequently dominating river-banks and other sites where it has become established.

Notes: *Equisetum arvense* in the Northern Hemisphere has been documented by Hauke (1967), and its coning behaviour in New Zealand described by Brownsey et al. (1985). In New Zealand *E. arvense* is an Unwanted Organism.

Fig. 2: *Equisetum arvense*: brown unbranched fertile stem with terminal strobilus, and green sterile stems with branches arising in whorls.

Fig. 3: *Equisetum arvense*: unbranched fertile stem, lacking chlorophyll, bearing a terminal strobilus; branched, green, sterile stems in the background.

Fig. 4: *Equisetum arvense*: close up of strobilus showing sporangia pendent from the adaxial surface of sporangiophores.

Fig. 5: *Equisetum arvense*: sterile stems with lateral branches arising in whorls at nodes.

Equisetum fluviatile L., *Sp. Pl.,* 1062 (1753)

Lectotype (selected by Hauke 1978): Herb. Linn. No 1241.6, LINN.

Etymology: From the Latin *fluviatilis* (pertaining to running water), a reference to its native habitat in Europe.

Vernacular name: water horsetail

Aerial stems monomorphic. Stems erect, 400–600 mm high, 2.5–5 mm in diameter, green, sparsely branched with undivided lateral branches arising in whorls; stem ridges nearly smooth; grooves 12–16; central hollow c. 4/5 the diameter of the stem; leaf sheaths pale brown or green with black teeth, 5–8 mm long. Strobili terminal on green stems, 6–10 mm long, 4–5 mm in diameter, apices obtuse.

Distribution: North Island: Auckland.

Altitudinal range: c. 40 m.

A widespread northern temperate species (Hauke 1978); known only from one collection near Huntly.

Biostatus: Exotic; casual.

Habitat: Muddy pools on a stream margin. Plants occupied an area of 2 m² resulting from a deliberate planting in a nearby fishpond, but the colony was subsequently eradicated.

First record: de Lange (1988) – as *Equisetum palustre*; Webb et al. (1995). Voucher: AK 185311, 1988.

Recognition: *Equisetum fluviatile* is recognised by its monomorphic and sparsely branched stems, black-tippped leaf sheaths with 12-16 grooves, and its obtuse strobilus. It is the rarest species of *Equisetum* in New Zealand.

Notes: A cultivated population of this plant has been recorded from Eskdale, Napier where it was deliberately planted by the owner of the land who sold aquatic plants for ornamental purposes (de Lange 1988). In New Zealand *E. fluviatile* is an Unwanted Organism.

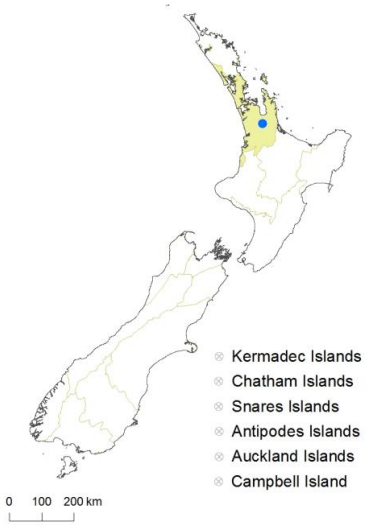

Fig. 6: *Equisetum fluviatile* distribution map based on databased records at AK, CHR and WELT.

Equisetum hyemale L., *Sp. Pl.,* 1062 (1753)

Type: not designated (see Jarvis 2007)

Etymology: From the Latin *hyemalis* (pertaining to winter).

Vernacular names: Dutch rush; rough horsetail; scouring rush

Aerial stems monomorphic. Stems erect, 1000–2000 mm high, 5–15 mm in diameter, green, unbranched or with very occasional undivided lateral branches arising in whorls; stem ridges with two rows of tubercles; grooves 22–45; central hollow c. ⅔ the diameter of the stem; leaf sheaths pale green or white with black teeth and sometimes a second black band near the base of the sheath, 11–22 mm long. Strobili terminal on green stems, 8–16 mm long, 4–8 mm in diameter, apices apiculate.

Distribution: North Island: Northland, Auckland, Taranaki, Southern North Island.

South Island: Canterbury, Southland.

Altitudinal range: 5–40 m.

A widespread northern temperate species now known from localities at Whangārei Heads, Auckland City, New Plymouth, Levin, Christchurch, Otatara and Invercargill. Most of these records are of plants in gardens (sometimes derelict) where they are well established or spreading, and for which there is no direct evidence of deliberate cultivation. Only the populations in Taranaki and Levin are clearly adventive. The species has also been reported from Motueka, Greymouth, and Fox River (Clayson Howell pers. comm.) but without supporting herbarium specimens.

Biostatus: Exotic; fully naturalised.

Habitat: In most of the known localities *Equisetum hyemale* appears to have been an escape from cultivation, or to have been occupying bare sections or derelict gardens. Many of the populations have now been eradicated. However, at the Levin site, plants have escaped from a rural property and occupy a large patch at the side of SH1.

First record: Healy (1994). Voucher: CHR 402611, 1993.

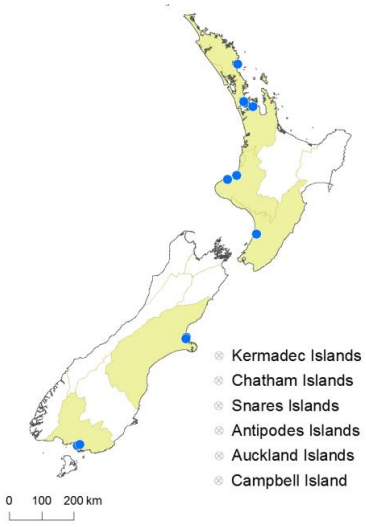

Fig. 7: *Equisetum hyemale* distribution map based on databased records at AK, CHR and WELT.

Recognition: *Equisetum hyemale* is recognised by its monomorphic stems, its usually unbranched stems, black-tipped leaf sheaths with 22–45 grooves, and its apiculate strobilus. It is the tallest species in New Zealand.

Notes: *Equisetum hyemale* in the northern hemisphere has been documented by Hauke (1963). In New Zealand, it is an Unwanted Organism.

Fig. 8: *Equisetum hyemale*: unbranched fertile and sterile stems.

Fig. 9: *Equisetum hyemale*: unbranched, green, sterile stem with leaf sheaths at nodes.

Fig. 10: *Equisetum hyemale*: close up of sterile stem showing leaf sheaths at nodes, and ridges on the internodes.

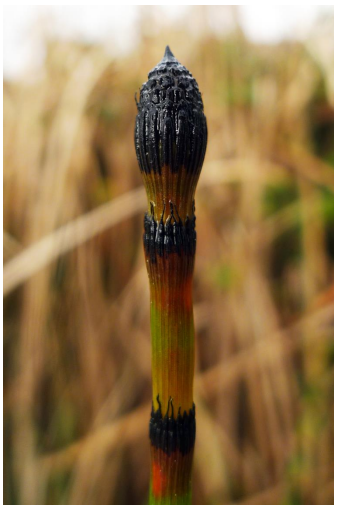

Fig. 11: *Equisetum hyemale*: unbranched, fertile stem with apiculate strobilus at apex.

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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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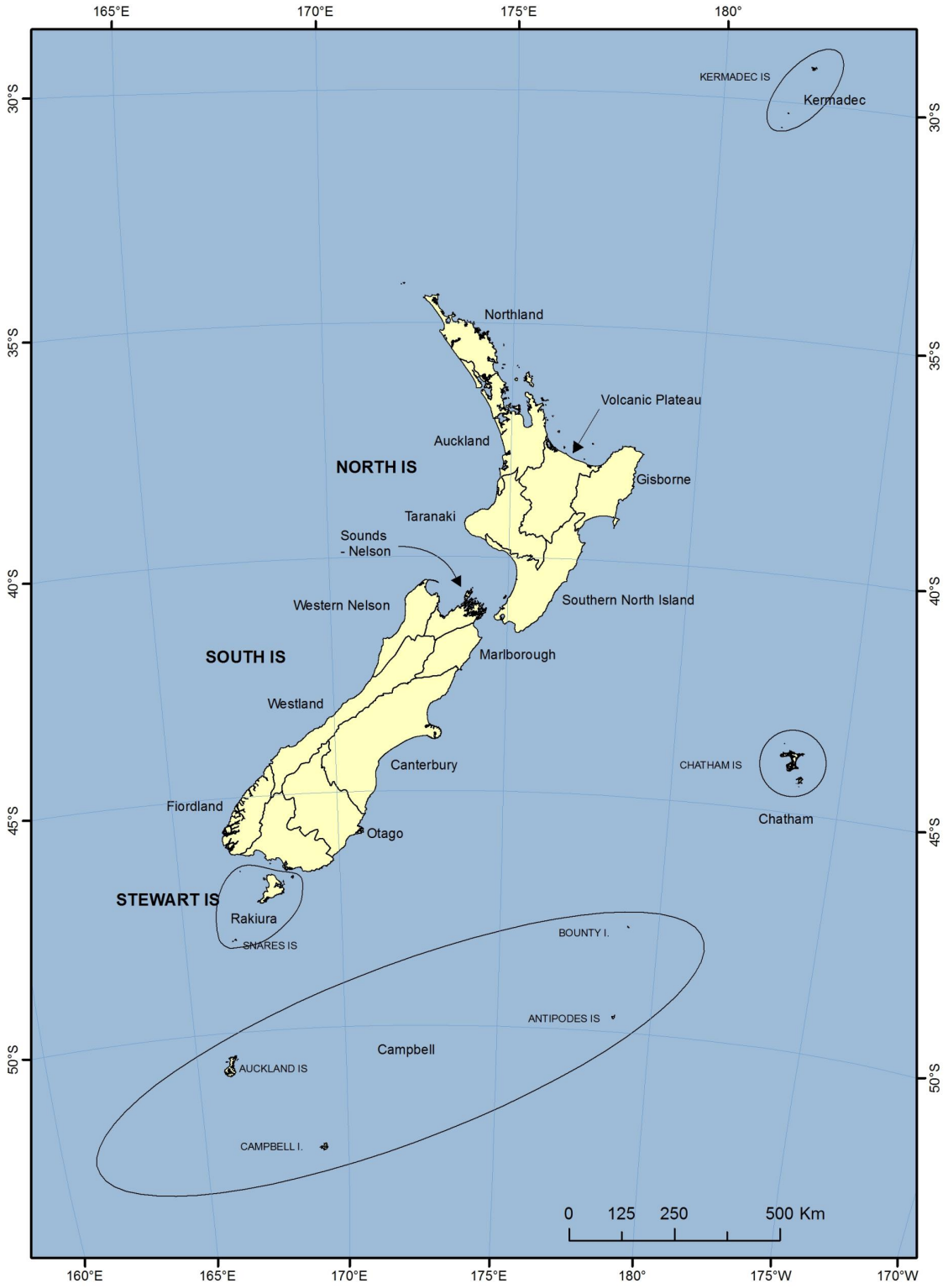
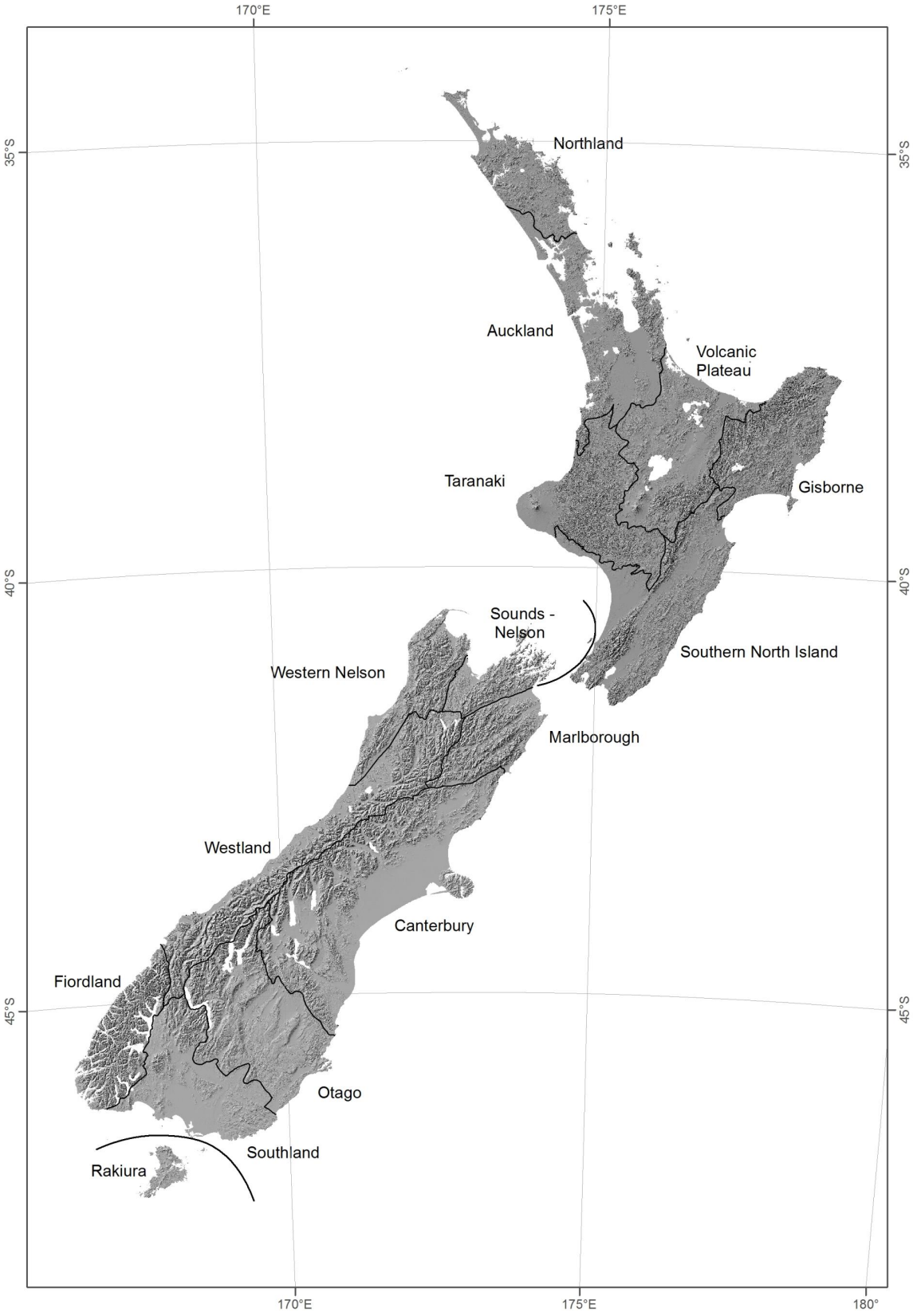


Map 1: Map of New Zealand and offshore islands showing Ecological Provinces



Map 2: Map of New Zealand showing Ecological Provinces

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