

The Lichen genus *Peltigera* (Peltigerales: Ascomycota) in New Zealand

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ABSTRACT: Sixteen species of the lichen genus *Peltigera* Willd., are recognised in the New Zealand mycobiota, viz. *P. canina*, *P. degenii*, *P. didactyla*, *P. dolichorbiza*, *P. hymenina*, *P. lepidophora*, *P. malacea*, *P. membranacea*, *P. nana*, *P. neckeri*, *P. neopolydactyla*, *P. polydactylon*, *P. praetextata*, *P. rufescens*, *P. subhorizontalis*, and *P. ulcerata*. A key to species, descriptions of all taxa, biogeographic affinities and distribution maps are presented. *Peltigera degenii*, *P. hymenina*, *P. neckeri*, and *P. neopolydactyla* are recorded for the first time from New Zealand.

KEYWORDS: lichens; New Zealand lichens; *Peltigera*; nutrient-cycling; biogeography

Introduction

Species of *Peltigera* are foliose, commonly broad-lobed lichens, having a cyanobacterial photobiont (and in some Northern Hemisphere taxa a green chlorococcacean photobiont), a corticate upper surface, and a decorticate lower surface with prominent veins and rhizines. It is the generitype of the family Peltigeraceae in the suborder Peltigerineae of the order Lecanorales (Tehler 1996). *Peltigera* is a widespread cosmopolitan genus with 45 species known worldwide (Hawksworth *et al.* 1995), of which 16 are here recorded from New Zealand. Species are fast growing and often occur in disturbed habitats where their life span is short. Being potential diazotrophs (nitrogen-fixers), they undoubtedly make a positive contribution to the cycling of nitrogen in the biomes in which they occur.

The earliest records of *Peltigera* from New Zealand are J.D. Hooker's made during the Antarctic Voyage of 1839–43 when he collected *Peltigera polydactylon* from the Auckland and Campbell Islands (Hooker & Taylor 1844; Hooker 1847; Taylor & Hooker

1847) and *P. polydactylon*, *P. canina* var. *pusilla* [= *P. didactyla*], and *P. rufescens* from northern New Zealand (Babington 1855). Nylander (1860) described *P. polydactyla* var. *dolichorbiza* from several tropical areas, as well as New Zealand, raising it to specific rank as *P. dolichorbiza* in his later account of New Zealand lichens (Nylander 1888). Müller Argoviensis (1894) noted the following taxa of *Peltigera* from New Zealand: *P. rufescens* and var. *spuria* [= *P. didactyla*], *P. polydactyla* and var. *dolichorbiza* [= *P. dolichorbiza*] and f. *minor* [? = *P. polydactylon*], and *P. pusilla* [= *P. didactyla*]. Hellbom (1896), in recording the New Zealand lichens collected by the Swedish botanist Sven Berggren in 1874–75, listed *P. malacea*, *P. rufescens*, *P. polydactylon*, *P. dolichorbiza*, and *P. horizontalis* [= *P. subhorizontalis*].

In the 20th century, the study of New Zealand lichens was given a renewed impetus and direction by the visit of the Swedish lichenologists G. Einar and Greta Du Rietz who collected widely from North Auckland to the Subantarctic islands during a stay of several months

in 1926–27. Einar Du Rietz encouraged H.H. Allan to collect New Zealand lichens from a wide range of habitats (Galloway 1976) and send them to the leading European lichenologists of the day for identification. In turn, H.H. Allan enlisted the enthusiastic interest and practical support of the Dunedin-based botanist and businessman J.S. Thomson (Godley 1996) to collect lichens from coastal, inland, and high-alpine sites in the South Island. Alexander Zahlbruckner (1860–1938) in Vienna was Allan's major lichenological contact in Europe and he sent the specimens of *Peltigera* which arrived from Allan to V.K. Gyelnik in Budapest for determination. Gyelnik (1906–45) the authority on *Peltigera* (see for example Gyelnik 1928, 1929, 1933), was an erratic and compulsive taxonomist who published a large number of new names in the genus, many of which were later synonymised or rejected (Sjödín 1954; Hale 1990). Gyelnik (1928) described *Peltigera tereziana* and *P. pellucida* f. *dilacerata* from New Zealand material held in the herbarium in Vienna, but both taxa are referable to *P. degenii*, and his taxon *P. nigripunctata* f. *farinosa* (Gyelnik 1931: 168) from a New Zealand collection of Sven Berggren, is referable to *P. subhorizontalis*. Gyelnik also provided the names for *Peltigera* in Zahlbruckner's posthumous work on New Zealand lichens (Zahlbruckner 1941: 293–4) viz., *P. scutata* [= *P. polydactylon*], *P. tereziana* Gyeln. [= *P. degenii*], *P. nana*, and f. *ventosa* Gyeln. (a *nomen nudum*, since a description was not provided), *P. pusilla* [= *P. neckeri*], *P. virescens* and var. *tasmanica* Gyeln. [= *P. degenii*], *P. dolichorbiza* and f. *javanica* Gyeln. [= *P. neckeri*], and *P. pellucida* f. *dilacerata* [= *P. degenii*].

James Murray published an account of *Peltigera*, based mainly on South Island collections made by William Martin, Jack Scott Thomson, David Scott, his own collections from 1954–59, supplemented with specimens from CHR, including both New Zealand and European material identified by Gyelnik (Murray 1960). Murray recognised 9 species with 6 varieties: viz. *P. nigripunctata*, *P. scutata*, *P. virescens* [= *P. degenii*], *P. horizontalis* var. *muscorum* [= *P. subhorizontalis*], *P. horizontalis* var. *muscorum* f. *albido-pruinatum* J.S. Murray [= *P. subhorizontalis*], *P. polydactyla* [= *P. polydactylon*], *P. polydactyla* var. *magyarica* (Gyeln.) J.S. Murray [= *P. neopolydactyla*], *P. polydactyla* var. *polydactyloides*, *P. dolichorbiza*, *P. dolichorbiza* var. *nana*, *P. malacea*, *P. canina*, *P. canina* var. *rufescens*

[= *P. rufescens*], *P. canina* var. *spuria* [= *P. didactyla*], *P. canina* var. *spuria* f. *sorediata* [= *P. didactyla*], and *P. praetextata*.

The New Zealand lichen flora account of *Peltigera* (Galloway 1985: 362–6) discusses *P. dolichorbiza*, *P. lepidophora*, *P. membranacea*, *P. nana*, *P. spuria* [= *P. didactyla*], *P. subhorizontalis*, and *P. ulcerata*; however, it is a rather conservative and limited treatment based primarily on herbarium specimens examined in BM and CHR.

Recently, Northern Hemisphere studies on *Peltigera* (Purvis & James 1992; Holtan-Hartwig 1993; Vitikainen 1994; Goffinet & Hastings 1994; Goward *et al.* 1995; Martinez *et al.* 1997) have considerably clarified the limits of taxa, and a more precise evaluation of chemical and morphological characters has led to a much clearer and more rigorous definition of species than was hitherto applied. In the light of this recent work on the taxonomy and distribution of *Peltigera* in the Northern Hemisphere, a reappraisal of *Peltigera* in New Zealand is timely, since it is now recognised that this genus is a potentially important nitrogen-fixer in both forest and grassland biomes. A survey of all *Peltigera* collections from New Zealand made over the past 60 years was therefore undertaken, together with field studies in southern New Zealand, and disclosed 16 taxa which are discussed below.

Materials and Methods

Type and other material (800 specimens) was obtained from, or examined in, the following herbaria: AK, BM, CHR, OTA, WELT. Thin-layer chromatography of acetone extracts was carried out according to standardised methods (Culberson 1972; White & James 1985).

Morphology and Anatomy

Taxa in *Peltigera* are identified by morphological, anatomical, and chemical characters which are discussed in detail in several recent studies (Holtan-Hartwig 1993; Goffinet & Hastings 1994; Vitikainen 1994; Goward *et al.* 1995) and are briefly summarised here.

Thallus: All species are heteromerous, the photobiont in New Zealand populations being *Nostoc*, a potential diazotroph (nitrogen-fixer), and have lobed thalli with a corticate upper surface and a decorticate lower

surface. Thallus size varies greatly depending on several environmental factors (see Vitikainen 1994) but in general, species with small thalli (i.e. less than 4 cm diam.) include *P. didactyla*, *P. lepidophora*, *P. subhorizontalis* and *P. ulcerata*; while species with much larger thalli [i.e. (6–)10–15(–20) cm diam.] include *P. canina*, *P. degenii*, *P. dolichorbiza*, *P. hymenina*, *P. malacea*, *P. membranacea*, *P. nana*, *P. neckeri*, *P. neopolydactyla*, *P. polydactylon*, *P. praetextata*, and *P. rufescens*.

Cortex: The upper cortex in most species of *Peltigera* occurring in New Zealand is glabrous, glossy or matt, smooth, wrinkled, dimpled, bullate or billowed (see illustrations in Goward *et al.* 1995: 93), or plane. Lobe tips can be plane, ascending, inrolled, or downturned. Thallus colour varies with exposure to direct sunlight. Specimens growing in shaded habitats are generally dark blue-grey or blue-black when wet and grey or blue-grey when dry, while specimens from more exposed, dry, and sunny habitats are brownish tan to red-brown. The presence of surface pruina in *P. neckeri* imparts a distinctive celadon-green to grey-green colour to moist specimens.

Tomentum: The presence of tomentum or cortical hairs is characteristic of the *P. canina* group. The following taxa have surface tomentum (use x 10 lens — often best seen at lobe margins or at base of apothecia): *P. canina* (tomentose over whole of upper surface), *P. degenii* (tomentum thin and scattered at lobe apices only), *P. didactyla*, *P. lepidophora*, *P. membranacea*, *P. praetextata*, and *P. rufescens* (tomentose mainly at or near lobe tips).

Pruina: Two species have aggregations of glistening white crystals or pruina (use x 10 lens) on the upper surface: *P. neckeri* has often quite thick patches of pruina in older parts of the thallus, while some specimens of *P. subhorizontalis* have a slight frosting of pruina at lobe margins and on marginal phyllidia or lobules.

Soredia: Two species have soredia: *P. didactyla* (with scattered tomentum at lobe apices and margins) and *P. ulcerata* (with a glabrous upper cortex). The small, juvenile, sorediate phase of *P. didactyla* is very similar to *P. ulcerata* with both taxa having orbicular soralia generally developing in erose patches at the

lobe margins. Soredia are greyish-blue, coarse, and granular, and react C+ red (gyrophoric acid). The fertile phase of *P. didactyla* has lobes that are larger than in the more or less cochleate juvenile phase, and the soredia become reduced to non-sorediate scars and eventually disappear (Purvis & James 1992: 445).

Isidia: These structures are present in only one species, *P. lepidophora*. The isidia are laminal, terete to more or less lobate, uniformly corticate, and often crowded centrally.

Phyllidia: These are small, flattened, dorsiventral structures, usually constricted at the base, simple, expanded at tips, to subcoralloid or peltate. They have a distinct, corticate upper surface with photobiont layer and a pale ecorticate, lower surface as in the parent thallus. Phyllidia occur at the lobe margins and also along cracks or tears in the upper cortex in *P. praetextata*, *P. polydactylon*, *P. rufescens*, and *P. subhorizontalis* (where they may be white-pruinose or “frosted”).

Venation: The venation of the lower surface is an important taxonomic character in *Peltigera* (see Vitikainen 1994; Goward *et al.* 1995: 93 for illustrations). Veins may be (1) indistinct or lacking altogether and then replaced by a more or less uniform, dense felt of tomentum (in *P. hymenina*, *P. lepidophora*, and *P. malacea*); (2) broad, 1–2.5(–4) mm (in *P. didactyla*, *P. nana*, *P. neopolydactyla*, *P. ulcerata*); (3) narrow, 0.2–0.5(–1) mm (in *P. canina*, *P. degenii*, *P. dolichorbiza*, *P. membranacea*, *P. neckeri*, *P. polydactylon*, *P. praetextata*, *P. rufescens*, *P. subhorizontalis*). The relief of the veins is described as flat or raised. Veins are generally smooth, but in two species (*P. canina* and *P. membranacea*) they are erect-tomentose (use x 10 lens). Veins may be whitish or pale pinkish or yellowish-buff at the margins and darker to greyish brown or brown-black centrally, or they may be uniformly dark from margins to centre. The spaces separating the veins (interstices) may be polygonal, lenticular, or oval (see Goward *et al.* 1995: 93), and are generally paler in colour than the veins, frequently white and rather fibrous (use x 10 lens). These characters are best looked for in sterile lobes.

Rhizines: These are extensions of medullary hyphae projecting from the surface of the veins, serving to

anchor the thallus to the substratum. They may be pale whitish, or buff to dark brown or black, concolorous with, or contrasting with, the veins. In outline, rhizines are classified as simple, fasciculate, penicillate, or flocculent (see Goward *et al.* 1995: 93), but there is considerable intergrading between these categories and some species may have more than one kind of rhizine. In *P. canina* and *P. membranacea*, the rhizines have short, erect hyphae projecting at right angles to the main axis of the rhizine and are designated erect-tomentose (use $\times 10$ lens). Rhizines may be discrete and widely scattered, to closely crowded or confluent.

Apothecia: Apothecial initials are present in some species as small, brownish or red-brown, fuzzy, marginal protuberances. Apothecia have rather limited taxonomic value; however, the flat, horizontal discs of *P. subhorizontalis* contrast with the generally erect, round to involute or saddle-shaped discs of the other fertile species occurring in New Zealand. Apothecia are hemiangiocarpic (see Vitikainen (1994: 16) for appropriate references); the ascus tip has an amyloid tube structure in the thallus (Rambold & Triebel 1992); hymenial characters are generally similar in all fertile species (Vitikainen 1994); ascospores are more or less fusiform or acicular, colourless or pale straw-coloured or pale brownish, 3–7(–9)-septate, 30–95 \times 2.5–5 μm .

Chemistry

Species of *Peltigera* are either deficient in secondary chemistry, or else produce compounds from the acetate-polymalonate pathway (tridepsides such as tenuiorin, methyl gyrophorate and gyrophoric acid) and/or the mevalonic acid pathway [hopane triterpenoids such as zeorin (hopan-6 α , 22-diol), dolichorrhizin (15 α -acetoxyhopan-22-ol) and peltidactylin (7 β -acetoxyhopan-22-ol)]. These are best detected by thin-layer chromatographic techniques. For a fuller discussion of chemical characters in *Peltigera* see Holtan-Hartwig (1993) and Vitikainen (1994).

Lichenicolous fungi

It is a remarkable fact that *Peltigera*, with only about 45 species worldwide, supports at least 45 obligate lichenicolous fungi, of which 39 are only known from

Peltigera, and six of these constitute monospecific genera (Hawksworth 1980a). This exceptionally high number of lichenicolous fungi restricted to species of *Peltigera* is now accepted as partial and compelling evidence for the ancient ascomycete lineage of *Peltigera* (Hawksworth 1982a, 1988a, 1988b; Galloway 1991; Vitikainen 1994). The tomentose and secondary-product-deficient species of *Peltigera* are more commonly infected by lichenicolous fungi than are species having a glabrous upper cortex and containing secondary compounds in the medulla. The following genera of lichenicolous fungi are known from *Peltigera*: *Actinopeltis*, *Arthonia*, *Bacidia*, *Corticifraga*, *Dacampia*, *Dacampiosphaeria*, *Diplodina*, *Fusarium*, *Hemigrapha*, *Herpotrichiella*, *Illosporium*, *Karsteniomyces*, *Lasiosphaeriopsis*, *Leptosphaeria*, *Leptosphaerulina*, *Libertella*, *Metasphaeria*, *Nanostictis*, *Nectria*, *Nectriella*, *Neonorrlinia*, *Ompbalina*, *Paranectria*, *Pezizella*, *Phacopsis*, *Phaeospora*, *Pboma*, *Polycoccum*, *Ramularia*, *Refractobilum*, *Rbagadostoma*, *Scutula*, *Stigmatidium*, *Thelocarpon*, *Trichoconis*, *Trichosphaeria*, and *Wentomyces* (Hawksworth 1980a, 1980b, 1981, 1982b, 1986, 1989; Hawksworth & Diederich 1988; Hawksworth & Santesson 1990; Santesson 1984). The pinkish-orange spots of *Illosporium carneum* are particularly noticeable in many populations of the juvenile, soreddiate phase of *Peltigera didactyla*.

Peltigera and nutrient cycling in New Zealand ecosystems

Lichens having cyanobacteria as primary photobionts or as cephalodia can fix substantial amounts of atmospheric nitrogen into combined organic nitrogen using heterocyst nitrogenase (Rai 1990). Green *et al.* (1980) reported a possible nitrogen contribution between 1 and 10 kg N per hectare per year from large foliose lichens (*Pseudocyphellaria* and *Stictia*) in temperate rainforest in the Urewera. The contribution of species of *Peltigera* to the nitrogen budgets of forest and grassland biomes in New Zealand is undoubtedly substantial, since many of the taxa have rapid growth, produce a large biomass, and appear to be strongly competitive. It is becoming clear that the ability of lichens to contribute to the nitrogen budgets of forest and grassland ecosystems on nitrogen-limited soils is

Key to New Zealand species of *Peltigera*

- 1 Upper surface of thallus tomentose or pruinose 2
 Upper surface of thallus glabrous 10
- 2 Upper surface pruinose 3
 Upper surface tomentose 4
- 3 Pruina in glistening, laminal patches; apothecia erect **P. neckeri**
 Pruina restricted to lobe apices; apothecia horizontal **P. subhorizontalis**
- 4 Thallus sorediate, isidiate or phyllidiate 5
 Thallus without soredia, phyllidia or isidia 7
- 5 Thallus isidiate or phyllidiate 6
 Thallus sorediate (soredia may be lost in mature specimens); commonly infested with brightly coloured (orange to pinkish) lichenicolous fungi **P. didactyla**
- 6 Thallus isidiate **P. lepidophora**
 Thallus phyllidiate **P. practextata**
- 7 Tomentum more or less confined to lobe margins and apices 8
 Tomentum more or less uniform **P. canina**
- 8 Veins and rhizines pale 9
 Veins and rhizines dark **P. rufescens**
- 9 Veins smooth; rhizines simple, smooth **P. degenii**
 Veins and rhizines with erect tomentum (appearing fuzzy) **P. membranacea**
- 10 Thallus without soredia 11
 Thallus sorediate **P. ulcerata**
- 11 Veins more or less indistinct, diffuse below 12
 Veins distinct, with more or less well-defined interstices developed between veins 13
- 12 Tomentum below pale buff or whitish **P. hymenina**
 Tomentum below dark grey-brown to blackened **P. malacea**
- 13 Thallus thick, coriaceous 14
 Thallus thin, papery; lobes broad, rounded; veins pale buff or reddish brown **P. nana**
- 14 Rhizines short or tufted, 2–5(–7–10) mm long 15
 Rhizines long, slender, black, 5–10(–15) mm long **P. dolichorhiza**
- 15 Veins dark, 1.5–3(–4) mm wide, flat; spores 62.5–95 x 2.5–3 µm **P. neopolydactyla**
 Veins pale to brown, 0.5–1.5 mm wide, more or less raised; spores (48–)50–60(–64) x 2.5–4 µm
 **P. polydactylon**

a major ecological role for these symbiotic diazotrophs (Galloway 1995). Quantification of the contribution that species of *Peltigera* make to nitrogen budgets in New Zealand biomes is, without question, a field for exciting future research.

Taxonomy

Peltigera Willd., *Fl. Berol. Prodr.*: 347 (1787) *nom. cons.*

Type species: *P. canina* (L.) Willd. (*Lichen caninus* L.)

Thallus foliose, heteromerous, dorsiventral, lobate, in rosettes or irregularly spreading, 1–20 cm diam. Lobes usually elongate, radial, contiguous or overlapping, blue-grey, olivaceous, grey-green, grey-brown or reddish brown when dry. Margins entire, isidiate, phyllidiate or sorediate, or with small, fuzzy, brown apothecial initials. Upper surface smooth, to dimpled or more or less bullate, matt or shining, scabrid, arachnoid or tomentose, sometimes pruinose or maculate. Medulla white, paraplectenchymatous, hyphae loosely woven. Lower surface ecorticate, densely arachnoid-tomentose and dark-pigmented especially at the centre or with anastomosing pale or dark veins; rhizines numerous, solitary or confluent. Photobiont cyanobacterial, *Nostoc* and/or green chlorococcoid (*Coccomyxa*). Ascromata apothecia, hemiangiocarpous, marginal, saddle-shaped, tubular or flat, discs oval or rounded, red-brown to black, often with reflexed or crenulate margins, on horizontal or vertically ascending lobes. Hymenium colourless, 80–100 µm tall. Asci cylindrical-clavate, 75–85 x 10–13 µm, with an amyloid tube structure in the tholus (Rambold & Triebel 1992: 58, Fig. 19g). Ascospores fusiform-acicular, colourless to pale yellowish or brownish, 3–7(–9)-septate, 25–100 x 2.5–5 µm. Conidiomata pycnidial, immersed to sessile. Conidia acrogenous, fusiform to sub-bifusiform, 6–11 x 2–5(–8) µm. Chemistry: tridepsides or hopane triterpenoids present, or, commonly, without demonstrable chemistry. Terricolous, muscicolous, rarely epiphytic or saxicolous.

The Species

1. *Peltigera canina* (L.) Willd., *Fl. Berol. Prodr.*: 347 (1787). *Lichen caninus* L., *Sp. Pl.*: 1149 (1753). For typification and additional synonymy see Jørgensen *et al.* (1994: 285–6) and Vitikainen (1994: 29–30).

Illustrations: Moberg & Holmäsén (1982: 172); Olech & Alstrup (1988: 177, fig. 2); Hale & Cole (1988: pl. 8a); Vitt *et al.* (1988: 230); Goffinet & Hastings (1994: 14, fig. 20, 15, figs 21, 22); Vitikainen (1994: 29, fig. 75); Jørgensen *et al.* (1994: 286, fig. 12); McCune & Geiser (1997: 205).

Description: Thallus forming broadly radiating patches 4–8(–10) cm diam. Lobes 1–2 cm wide, 3–6 cm long. Margins entire to very shallowly scalloped or incised, slightly thickened below, noticeably downturned at apices. Upper surface dark livid grey-brown to reddish-grey-brown when wet, pale grey-brown when dry, densely and uniformly tomentose, unevenly wrinkled to more or less bullate in central parts. Lower surface whitish or pale whitish buff at margins, darkening centrally. Veins conspicuous, raised, narrow, anastomosing, pale buff at margins, darkening to grey-brown centrally, interstices lenticular (x 10 lens). Rhizines penicillate to flocculent, discrete to more or less confluent at base, pale buff or whitish at margins, grey-brown centrally, 1–4 mm long. Apothecia not seen.

Chemistry: TLC — nil.

Distribution (Fig. 1): At present known in New Zealand only from subalpine grassland habitats in Canterbury (Mt Cook) and Otago (Forgotten River) both east and west of the Main Divide, and from a lawn in South Otago (Waitahuna). *Peltigera canina* is a cosmopolitan species, widespread, arctic to temperate in the Northern Hemisphere (North America, Britain, Scandinavia, Europe, Asia, Africa) and South America and Australia in the Southern Hemisphere, where it appears to be scattered and rare (Vitikainen 1994).

Habitat ecology: In New Zealand *Peltigera canina* is so far known from subalpine and lowland situations in both adventive and native grasslands. It has been only rarely collected to date from New Zealand, but is an extremely distinctive species and should be looked for more widely in open, grassland habitats.

Distinguishing features: *Peltigera canina* is characterised by its large, rounded lobes with inflexed margins and evenly tomentose upper surface; the pale lower surface with distinct, raised, whitish veins; and richly branched rhizines having confluent bases. It is distinct from *P. membranacea*, which has a thinner

thallus, a coarser venation, more slender rhizines that have a distinctive erect tomentum (use x 10 lens).

Specimens examined: **Canterbury**: Mount Cook National Park, in large circular patches, disturbed adventive grassland near Survey cottage, 275 m, 16.x.1972, *H.D. Wilson 3040* (CHR 260715). **Otago**: Forgotten River Flats, in tussock grassland, 800 m, xi. 1966, *D.J. Galloway s.n.* (CHR 490617); Waitahuna, C. Howley's garden, on mown lawn below large conifer, 8.x.1997, *D.J. Galloway 0373* (OTA). Material cited as *P. canina* var. *canina* by Murray (1960: 395) is referable to *P. membranacea*.

2. *Peltigera degenii* Gyeln., *Magyar Bot. Lapok* 225: 253 (1927).

?= *Peltigera tereziiana* Gyeln., *Österr. Bot. Z.* 77: 220 (1928). Type: New Zealand. *Sine loco* [? near Greymouth], *R. Helms 218*, W — not seen.

?= *Peltigera pellucida* f. *dilacerata* Gyeln., *Österr. Bot. Z.* 77: 224 (1928). Type: New Zealand. Auckland, *Jeltnek 46*, W — not seen.

= *Peltigera virescens* auct.

Illustration: Vitikainen (1994: 35, fig. 79).

Description: Thallus orbicular to broadly spreading, 2–10(–15) cm diam. Lobes linear-elongate to subirregular, 1–3(–5) cm long, 4–10(–12) mm wide. Margins entire to occasionally shallowly notched or crenulate, sometimes phyllidiate, apices sometimes more or less downturned, not noticeably thickened below, sometimes suffused red-brown, here and there thinly tomentose. Upper surface dark slatey blue-black when wet, pale bluish grey when dry, smooth to shallowly wrinkled, dimpled or undulate, matt or shining, thinly tomentose at or near margins and apices and close to apothecial discs; tomentum, ragged, whitish or pale buff, not thickly developed as in *P. canina*. Lower surface white in a broad marginal zone, darkening slightly to pale buff towards centre, or white from margins to centre. Veins narrow, 0.2–0.5 mm diam., pale buff or yellowish, to brown-black or black centrally, raised, anastomosing, surface smooth; interstices broadly polygonal or lenticular, white, fibrous or roughened, often rather thin and appearing somewhat greyish through exposure of cyanobacterial

layer. Rhizines discrete, pale, concolorous with veins, darkening to brownish or brown-black at centre, slender, simple, smooth-surfaced, 3–8(–10) mm long. Apothecia erect, on short to elongated marginal stalks; discs flat to more or less inrolled and saddle-shaped, 3–6 mm diam., matt, epruinose, pale to dark red-brown; margins pale buff, corrugate-scabrid, soon excluded by disc, buff-tomentose and more or less ridged below. Ascospores colourless, acicular, 3–7-septate, (38–)45–60(–70) x 2–3.5 µm.

Chemistry: TLC — nil.

Distribution (Fig. 2): Occurs from latitude 35°21'S (Panguru) to latitude 47°S (Glory Cove, Stewart Island), sea level to 1000 m. A possibly bipolar species, widespread in temperate to boreal regions of the Northern Hemisphere, including North America, Great Britain, Scandinavia, Europe, Asia (Vitikainen 1994). Previously recorded from New Zealand as *P. virescens*, *P. virescens* var. *tasmaniae*, and as *P. canina* var. *leucorbiza* (Zahlbruckner 1941; Murray 1960).

Habitat ecology: *Peltigera degenii* grows on damp soil and litter, and amongst mosses, on rotting logs and on rocks in shaded situations, in scrub, open forest, on roadside banks, and in grassland from sea level to 1000 m.

Distinguishing features: *Peltigera degenii* is characterised by its narrow, whitish or buff veins; long, simple, slender, smooth-surfaced, pale rhizines; no secondary metabolites; and thin, scattered, patches of tomentum at the apices of lobes and sometimes near young apothecia. It is distinguished from *P. nana* by the colour and morphology of the veins and rhizines, and the presence of scattered tomentum on lobe margins.

Specimens examined: **North Auckland**: Panguru, on bark, 10.v.1984, *B.W. Hayward s.n.* (AK 206695).

Auckland: Hunua Ranges, Wairoa Valley track, on damp leaf litter, 20.ix.1997, *D.B. Rogan 90* (AK 234347).

South Auckland: Te Aroha, *J.K. Bartlett s.n.* (AK 192194 pr.p.); Waimiha Stream, *J.K. Bartlett s.n.* (AK 192206 pr.p.); Pirongia, *H.H. Allan s.n.* (CHR 160950); Tree Trunk Gorge Road, on mosses on soil beneath regenerating kanuka/beech forest, 23.v.1990, *A.E. Wright 10182* (AK 194549). **Taranaki**: New Plymouth, *L.B. Moore s.n.* (CHR 487914) [recorded by Murray (1960: 395) as *P. canina* var. *canina* f. *membranacea*].

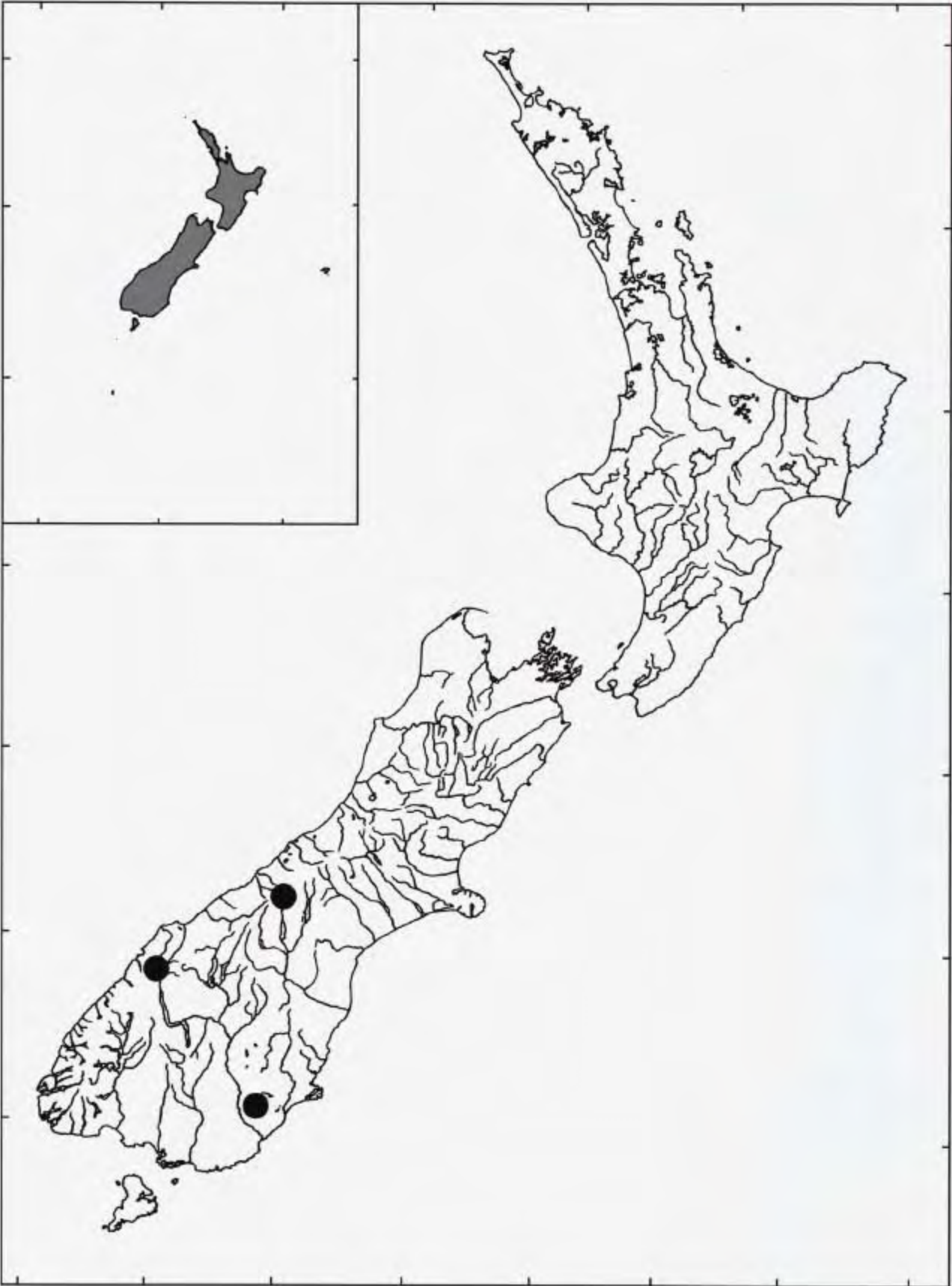


Fig. 1: Distribution of *Peltigera canina* in New Zealand

Wellington: Erua, *J.K. Bartlett s.n.* (AK 192196); Chateau Tongariro, on rotting log, i.1975, *B.W. & G.C. Hayward H112.65* (AK 154454; CHR 4900660); Akitio, vi.1972, *D.J. Galloway s.n.* (CHR 490598); Pahiatua Track, northern Tararua Range, iii.1970, *D.J. Galloway s.n.* (CHR 490586 pr.p.); Pohangina Bridge, *H.H. Allan s.n.* (CHR 490591); Tiritea Stream near Palmerston North, 27.viii.1933, *E. Chamberlain s.n.* (CHR 490571, 490577); Wai-iti Creek, Tararua Range, 22.i.1944, *H.H. Allan s.n.* (CHR 160931, 160932); Ohau River, 1.iii.1936, *E. Chamberlain s.n.* (CHR 490572); Haywards, The Hutt, on Mossy Hill, 18.viii.1943, *D. Cairns s.n.* (CHR 490509); Orongorongo Range, wet bank 14.vii.1941, *H.H. Allan s.n.* (CHR 487956 pr.p.). **Nelson:** Lake Rotoroa, rotting log, 17.xi.1997, *D.J. Galloway s.n.* (CHR 266605); Matakaitaki Valley, S of Murchison, amongst moss on wet ground, 3.vi.1968, *D.H. Smith s.n.* (CHR 160941, 160942). **Marlborough:** Mt Stokes, ii.1920, *J.H. McMabon s.n.* (WELT L1492); Wairau Valley, on earth, 6.ix.1959, *W. Martin 1934* (CHR 490605 pr.p.); Onamalutu, fallen log, ix.1956, *W. Martin 4214* (OTA 048718); Hundalee, between Conway Bridge and Oaro, moss covered decayed log in beech forest, 6.iii.1954, *W. Martin 1301* (OTA 048439); Dillon's Hill, Waihopai Valley, in grass on hillside in shade of manuka, 24.ix.1956, *W. Martin 4211* (OTA 048650). **Westland:** Alec's Knob Track, Franz Josef Glacier, on exposed tree roots, 11.iii.1964, *W. Martin s.n.* (CHR 490578); Haast Pass W side, on schist debris, iv.1957, *J. Murray 1182* (OTA 048744 pr.p.); Near Ngatau Hut, among bryophytes and debris on fallen logs in wet places, 11.v.1973, *P. Child 1750* (CHR 445372). **Canterbury:** Banks Peninsula, Toi Clearing, West Track, Hinewai Reserve, under kanuka, amongst moss, at edge of track through regenerating bush, 21.vii.1998, *H.D. Wilson s.n.* (OTA); **Craigieburn** Range, North Canterbury Ski Club Huts, on soil beneath tall, open *Nothofagus solandri* var. *cliffortioides* forest, 4.xi.1989, *A.E. Wright 9274* (AK 187346); Mid Godley Valley, subalpine scrub on S aspect, 25.xi.1958, *D. Scott 285* (OTA 048747); Mt Cook National Park, Governor's Bush, 24.i.1972, *D.J. Galloway 2134* (CHR 260722); Black Birch Stream, on mossy rock in totara/broadleaf forest, 9.iv.1972, *H.D. Wilson 2708* (CHR 260725); Waihi Gorge, xii.1958, *Mason 512* (OTA 048669, 048749); Mt Nething, rocks in fellfield/grassland

mosaic, 21.iii.1980, *D.R. Given 12434* (CHR 498205). **Otago:** Glendhu Bluff, Lake Wanaka, amongst moss overlying rock, 2.i.1965, *W. Martin s.n.* (CHR 490584); Manuka Gorge, on humus on rock wall, 9.v.1970, *P. Child 183* (CHR 445370); Waipori Gorge, roadside in beech forest, 18.iv.1970, *J. Child 375* (CHR 390183); Outram Glen, mossy trees, forest margin, i.1961, *W. Martin A115* (OTA 048719); Maungatua, iii.1954, *J. Murray 0392* (OTA 048640); Wakari, Dunedin, iv.1958, *J. Murray 1935* (OTA 048634); Flagstaff Hill, Dunedin, on rotten log, *J.S. Thomson T1071* (CHR 490576); Mihiwaka, on earth, 29.viii.1957, *W. Martin 706* (OTA 048707); Mt Cargill, mossy bank at side of track from Bethune's Gully, 16.iv.1995, *D.J. Galloway 0380* (OTA); Fraser Gully, Dunedin, on vertical sandcliff, 20.x.1970, *P. Child 839* (CHR 445381); Morrison's Creek, on rotten rock, *J.S. Thomson T 732* (CHR 490573; OTA 047797); Leith Valley, moss on rock, *J.S. Thomson T 2324* (CHR 487907, 487909, 487910; OTA 047398); Dunedin Botanic Gardens, on clay bank, vi.1958, *J. Murray 1973* (OTA 048635); Taieri Mouth, on sloping ground in open forest, 10.ii.1965, *W. Martin s.n.* (CHR 490 580); Coult's Gully Road, Taieri Beach, damp rock face, i.1958, *J. Murray 1423* (OTA 048743). **Southland:** McKinnon Pass, on moss, beech forest, *J.S. Thomson T 2900 pr.p.* (CHR 160935); Hollyford-Eglinton Divide, 10.i.1970, *D.J. Galloway s.n.* (CHR 490643); Eglinton Valley, *Rawlings s.n.* (CHR 487911); Forest Hill, on mosses, i.1954, *J. Murray 0392* (OTA 048683 pr.p.); Waihopai [Reserve], Invercargill, on prostrate log in shade, forest margin, 14.x.1967, *W. Martin s.n.* (OTA 048716); Te Wae Wae Bay, on coastal track between Bluecliffs and Port Craig, on ground, 24-6.x.1998, *A. Knight s.n.* (OTA). **Stewart Island:** Glory Cove, 15.ii.1967, *D.J. Galloway s.n.* (CHR 490666).

3. *Peltigera didactyla* (With.) J.R. Laundon, *Lichenologist* 16: 217 (1984). *Lichen didactylus* With., *Bot. Arr. Veg. Gr. Brit.* 1, 2: 718 (1776); type: Dillenius, *Historia Muscorum*: Tab. XXVIII, Fig. 108 (1742) — holotype; OXF — epitype (typotype); see Laundon (1984: 217). For detailed synonymy see Vitikainen (1994: 37-8).

Illustrations: Moberg & Holmäsén (1982: 178); Wirth (1987: 341); Vitt *et al.* (1988: 231); Goffinet & Hastings (1994: 20, fig. 29); Vitikainen (1994: 38, fig. 81); McCune & Geiser (1997: 208).

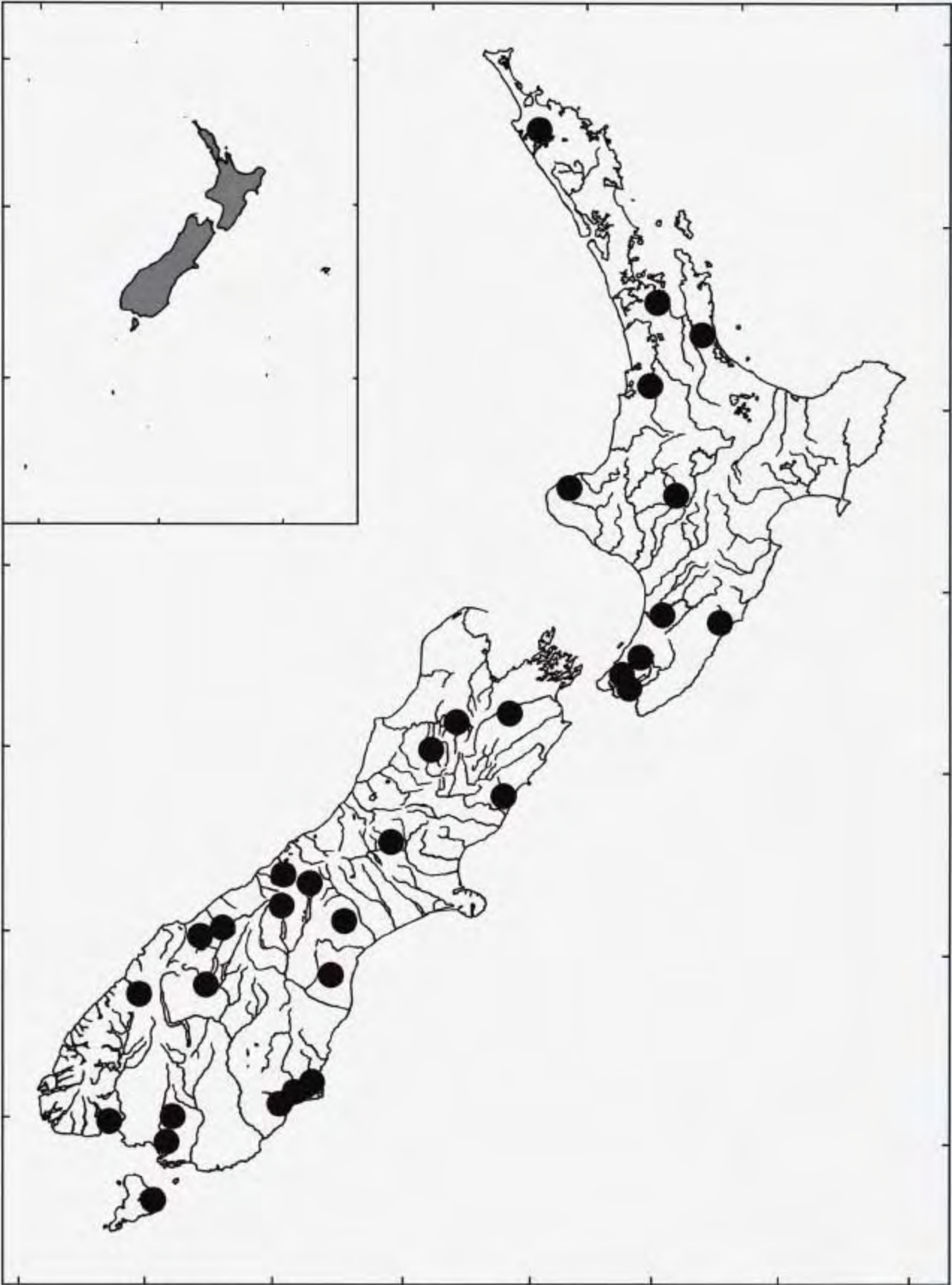


Fig. 2: Distribution of *Peltigera degenii* in New Zealand

Description: Thallus orbicular, small, often cochleate, 0.5–2(–3) cm diam. Lobes 1–2 (rarely 3–5) cm long, 0.5–1(–2) cm wide, plane to ascending, 100–200 µm thick. Margins entire, often incurled. Upper surface coriaceous, dark slate blue-black, suffused dark red-brown when wet, brownish grey or pale greyish green, suffused red-brown when dry, tomentose; tomentum most apparent in sterile, sorediate lobes, thinly arachnoid, continuous or discontinuous in scattered, rather tattered patches at margins and centrally; sorediate. Soralia marginal and laminal in rounded to oblong, erose spots or patches, disappearing in older, usually fertile specimens; soredia coarse, granular, grey-blue to red-brown. Lower surface pale whitish or brownish pink. Veins distinct, raised, 0.5–1 mm wide, whitish to pale buff, darkening centrally, interstitial spaces conspicuous, white, fibrous. Rhizines simple at first, soon becoming fasciculate, more or less penicillate at maturity, to 2.5 mm long, rather sparse at margins, common at centre. Apothecia on ascending, revolute lobes, 2–4 mm diam., rounded to irregular-elongate, disc red-brown to brown-black, matt, epruinose, margins pale buff, crenulate-corrugate. Ascospores elongate-fusiform, 5–7-septate, 55–70 x 3–4 µm.

Chemistry: medulla TLC nil; soredia C± pink-red (fading rapidly) containing gyrophoric acid [corresponding to the chemodeme *P. didactyla* var. *extenuata* (Nyl. ex Vain.) Goffinet & Hastings (Goffinet & Hastings 1994, 1995)].

Distribution (Fig. 3): From latitude 38°S (South Kawhia) to latitude 46°33'S (Greenhills, near Bluff). A widespread, cosmopolitan lichen known from North America, Europe, Asia, South America, Africa, and Australasia.

Habitat ecology: *Peltigera didactyla* grows on damp, often bare soil or amongst mosses, or in subalpine turf, commonly at roadside verges amongst moss and pebbles at edge of bitumen, or at edges of gravel paths in gardens, sea level to 1500 m. It is normally a rather ephemeral, short-lived, pioneer species in disturbed habitats, commonly attacked by lichenicolous fungi such as the orange-pink *Illosporium carneum*, and by *Corticifraga fuckelii* and *C. peltigerae* (Hawksworth & Santesson 1990; Vitikainen 1994).

Distinguishing features: *Peltigera didactyla* is characterised by the presence of laminal, orbicular soralia

(frequently reacting C+ pink), and a more or less tomentose upper surface on small, cochleate lobes which are also often attacked by white to orange or pinkish lichenicolous fungi. The juvenile, sorediate phase is eventually superseded by a fertile, non-sorediate phase. It is distinguished from *P. ulcerata* by the thinner, more or less tomentose lobes.

Specimens from high-alpine habitats (e.g. Dunstan Mountains) have very thick, more or less upright lobes and develop a thick, white, fibrous tomentum at the margins (often more or less loosely attached and sloughing off), and copious white, penicillate rhizines below; the laminal soralia are often poorly developed. A particularly robust form from Doubtful Sound, Fiordland [Murray 3946 and identified by James Murray as *P. canina* var. *canina* (Murray 1960: 396)] has broad, more or less rounded lobes (1–2 cm broad and 3–5 cm long) which are uniformly tomentose and with more or less scabrid-areolate patches at margins and occasionally centrally. It has scattered submarginal (rarely central) soralia, containing coarse, granular, blue-grey soredia (C+ pink), and characteristic flocculent-entangled, short rhizines associated with narrow, raised veins on the lower surface, the rhizines often projecting as a fringe at lobe margins.

The Fiordland and high-alpine specimens, although much larger than the typical, small, cochleate forms from disturbed habitats in rural and urban areas, are here maintained in *P. didactyla* pending further study of the variation of this species in New Zealand.

Specimens examined: **South Auckland:** South Kawhia, W of Awaroa Road, growing on vertical clay cutting beside farm track through rough pasture, 28.x.1989, A.E. Wright 9093 (AK 187081); Napier-Taupo Road, on soil beside stream, under damp bank, 27.viii.1979, J.K. Bartlett s.n. (AK 192200). **Nelson:** Nelson Lakes National Park, St Arnaud Range, beech forest, 1.i.1959, M.J.A. Simpson 290 (CHR 306340); Travers Range, second basin, bushline gorge, more or less sunny ledge kept damp by seepage, 24.iv.1962, L.B. Moore s.n. (CHR 160784). Reefton, river side, J.K. Bartlett s.n. (AK 231097). **Canterbury:** Rangitata River Mouth, xi.1958, Mason 404 (OTA 048660); The Wolds Station Lake Tekapo, x.1958, Mason 10 (OTA 048658); Mt Hay Station, Lake Tekapo, xi.1958, Mason (OTA 048659);

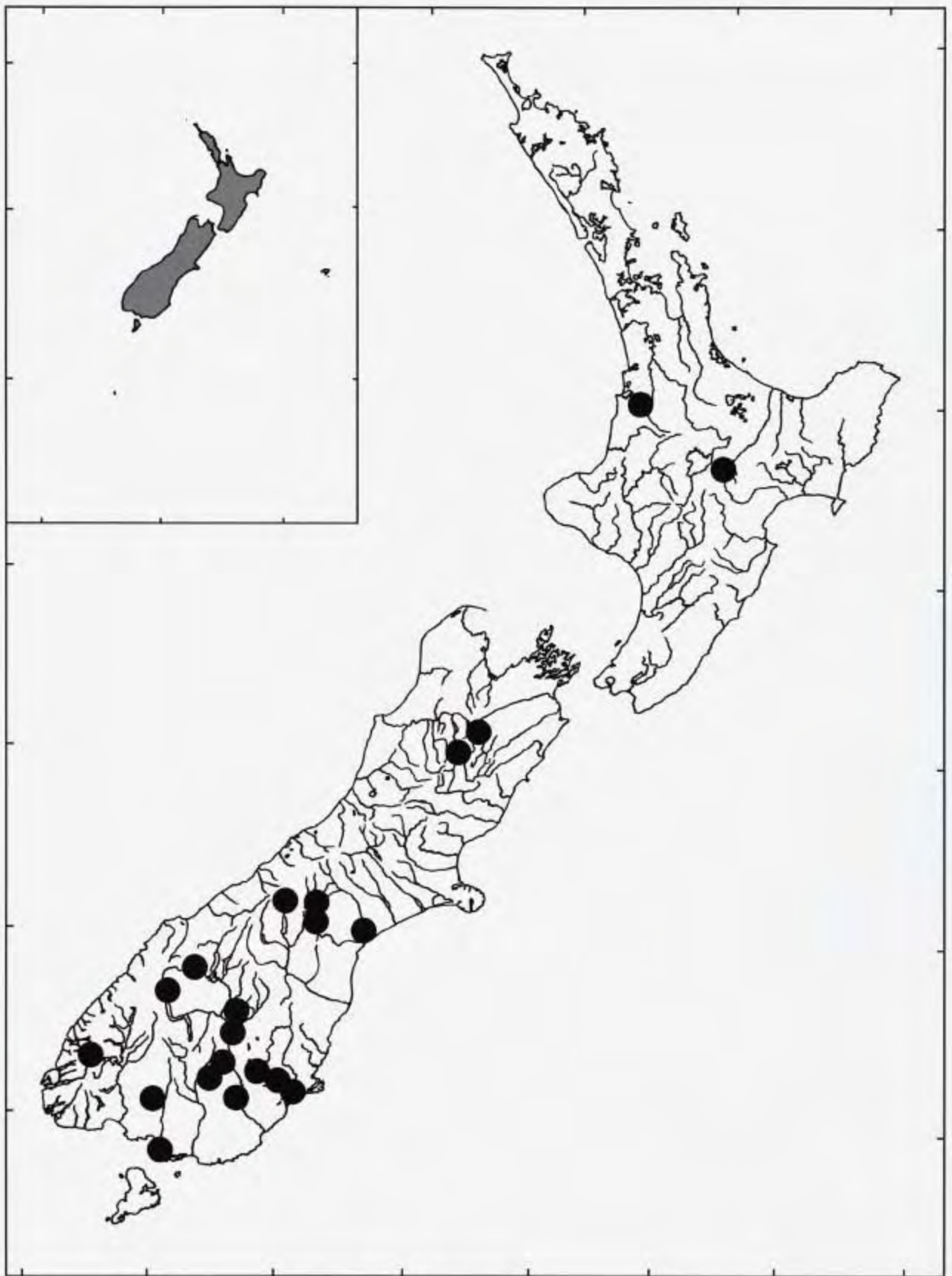


Fig. 3: Distribution of *Peltigera didactyla* in New Zealand

Mt Cook National Park, disturbed adventive grassland on ground near Survey Cottage, 16.x.1972, *H.D. Wilson* 3041 (CHR 260714); Mt Sebastopol, 22.i.1972, *D.J. Galloway* 2169, 2213 (CHR 260716, 260717); Sebastopol track, under snow totara in open scrub, 6.viii.1972, *H.D. Wilson* 2961 (CHR 260913); Glencoe Stream, in moss on stones and silt in open stream bed, 11.x.1972, *H.D. Wilson* 3039 (CHR 260915). **Otago:** Mt Misery, on damp ground, 17.vii.1970, *J. Child* 946 (CHR 390212); West Matukituki Valley, 10.ix.1967, *D.J. Galloway* s.n. (CHR 490626); Matukituki River bridge, among moss on rocky face, 24.v.1970, *P. Child* 358 (CHR 445379); Dunstan Mountains, small fragments scattered among mosses in subalpine bog near stream, 19.ii.1986, *P. Child* 2697 (CHR 445389); Dunstan Mountains, N of Fairfax Spur, mossy herb bog in bed of upland stream, 26.i.1998, *P.N. Johnson* 3284 (CHR); Pigeon Island, Lake Wakatipu, on hillside schist slab amongst other lichens, 19.iv.1998, *A. Knight* s.n. (OTA); Gem Lake, Whitecomb Range, in damp soil at base of grasses, snowbank below cirque lip, 17.iii.1997, *D.J. Galloway* 1071 (OTA); Mt Bengier, in summit grassland, among moss turf between tussocks, 27.i.1997, *D.J. Galloway* 1430 (OTA); Alexandra pine forest, scattered on dampish sandy soil among thyme on W margin, 7.ix.1985, *P. Child* 2481 (CHR 445387); Lake Onslow, in moss and soil at side of track near fishing huts, 30.vii.1998, *D.J. Galloway* 0337 (OTA); Beaumont State Forest, Ross Road off Grindstone Road, small fragments among mosses on wet clayish road verge, 14.ix.1985, *P. Child* 2519 (CHR 445386); Henley, at roadside near Taieri River, 16.vii.1998, *D.J. Galloway* 0370 (OTA); Lammerlaw Range, Deep Stream, mossy rock on hillside above DCC pipeline intake, 13.ii.1998, *D.J. Galloway* 0157 (OTA); South of Taieri Mouth, iv.1958, in bush, *J. Murray* 1671 (OTA 048663). **Southland:** Argyle Burn, Brigham's Leap, on roadside bank in grasses and mosses, 24.vii.1998, *D.J. Galloway* 0384 (OTA); Oreti Plains, Woods Road, Jenny Woods's garden, on margins of brick path and herb garden 19.x.1997, *D.J. Galloway* 0379 (OTA); Doubtful Sound, on track ii.1959, *J. Murray* 3946 (OTA 048636); Greenhills, ii.1952, *W. Martin* s.n. (CHR 487962).

4. *Peltigera dolichorbiza* (Nyl.) Nyl., *Lich. N.Z.*: 43 (1888). *Peltigera polydactyla* var. *dolichorbiza* Nyl.,

Syn. Meth. Lich. 1 (2): 327 (1860). Type: Nova Granata [Colombia], *sine loco, sine collectoribus*, H-NYL 33203! *fide* Galloway (1985: 364).

Illustration: Malcolm & Galloway (1997: 117, pl. 14b).

Description: Thallus orbicular to spreading, 2–10(–20) cm diam. Lobes more or less detached, 0.5–1.5 cm wide and 3–8 cm long, rather brittle, thin. Margins sinuous, sometimes more or less inrolled, often ascending, slightly thickened below, entire to notched, incised or torn, occasionally with fuzzy brown tomentose apothecial initials, or with small, regenerating lobules. Upper surface glabrous, dark slaty blue-black, suffused red-brown in parts when wet, pale grey, suffused brownish to olivaceous brown to buff or chestnut when dry, glossy, smooth to slightly wrinkled to more or less bullate, or shallowly dimpled. Lower surface tomentose, white to brown. Veins pale pinkish, buff or brownish at margins (and there often forming a closed, continuous network), anastomosing, darkening to brownish or brown-black centrally, slightly raised, smooth, 0.2–1(–1.5) mm wide, interstices conspicuous, whitish or pale, polygonal to oval. Rhizines discrete to more or less entangled, scattered to crowded, simple at first, then fasciculate, slender, pale buff at margins, soon brown-black, tapering towards apices 5–10(–15) mm long. Apothecia erect, round to saddle-shaped, 2–5 mm diam., often more or less reflexed on narrow, elevated lobules; disc red-brown, matt; margins thin, corrugate-scabrid, pale pinkish buff. Ascospores (3–)5–7(–9)-septate, 50–80 x 3–4 μ m.

Chemistry: \pm Tenuiorin, \pm methyl gyrophorate, peltidactylin, dolichorrhizin, zeorin, hopane-7 β , 22-diol.

Distribution (Fig. 4): From the Three Kings Islands (latitude 34°10'S) to Stewart Island. A pantropical and oceanic species widely distributed in the Pacific from Hawaii (Magnusson & Zahlbruckner 1943: 96) and Java (Zahlbruckner & Mattick 1956: 446) to Australia (Filson 1996) and New Zealand (Galloway 1985), also in Africa (Swinscow & Krog 1988) and in South and Central America.

Habitat ecology: *Peltigera dolichorbiza* grows on damp soil, amongst bryophytes, on the mossy bases of forest trees and treeferns, on rotting logs in partial to deep shade; on clay banks, in gravel paths, in subalpine bogs, subalpine to high-alpine grasslands; and on mangroves in northern, coastal sites. It has an

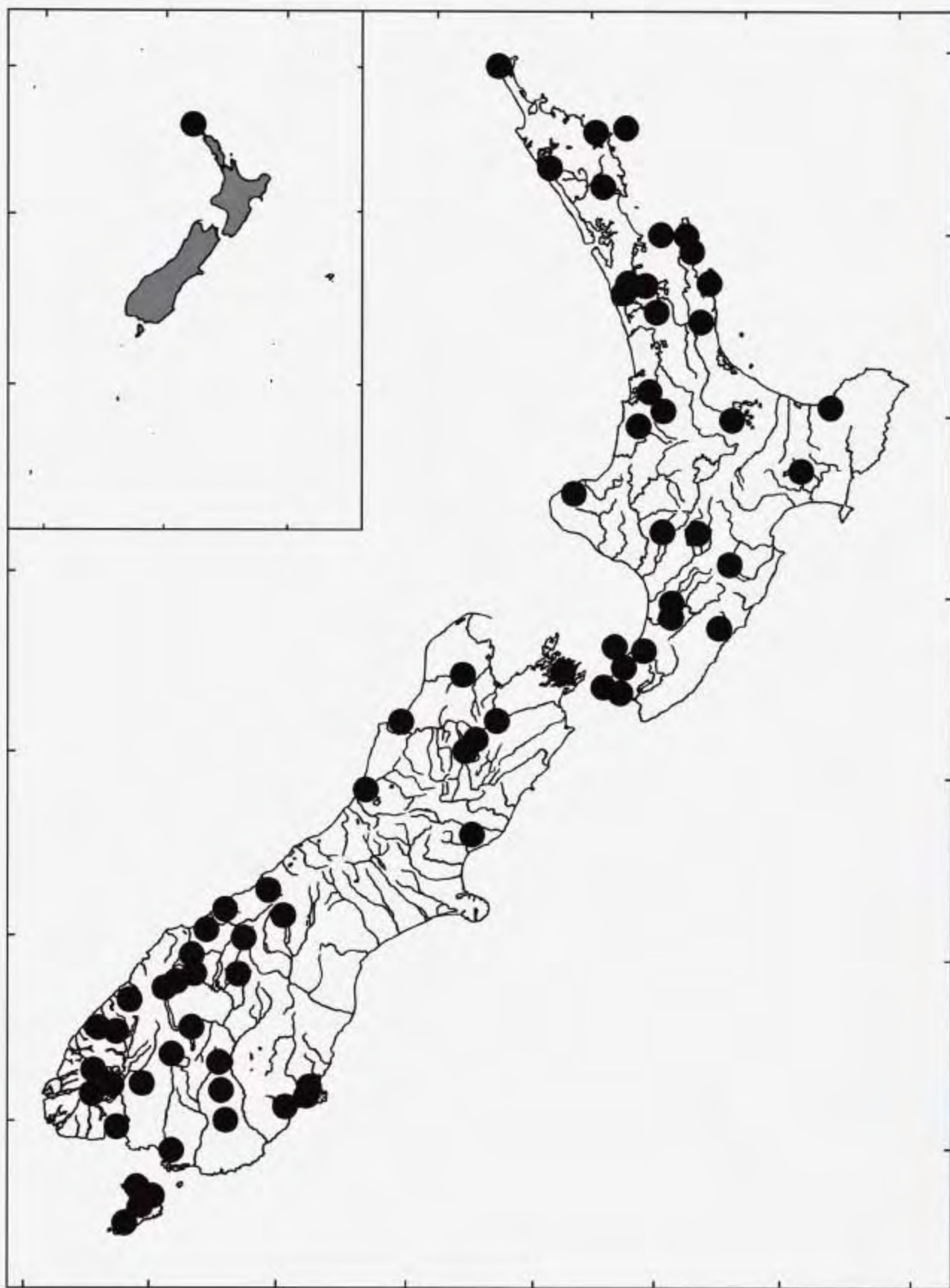


Fig. 4: Distribution of *Peltigera dolichorbiza* in New Zealand

altitudinal range from sea level to 1600 m. In alpine grasslands it is found at the base of tussocks, where shade and humidity are high.

Distinguishing features: *Peltigera dolichorbiza* is characterised by a glabrous, glossy upper surface, often wrinkled or dimpled; linear-elongate to rather irregular lobes, with crisped, ascending margins without phyllidia; pale to dark, narrow to broad, slightly raised veins below; with scattered, long, slender, simple to fasciculate, pale buff to dark-brown or black rhizines. It has a complex chemistry dominated by hopane triterpenoids. It is distinguished from *P. polydactylon* by the longer, more slender rhizines and the absence of marginal phyllidia or lobules; and from *P. nana* by its thicker, more glossy, coriaceous thallus, narrower lobes, and narrower, raised veins and longer rhizines.

Representative specimens: **North Auckland:** Three Kings Islands, Great Island, Tasman Valley, 13.xi.1970, *D.J. Galloway s.n.* (CHR 451391); Radar Bush, *J.K. Bartlett s.n.* (AK 192204); Puketi, *J.K. Bartlett s.n.* (AK 199168); Kawerua, on moss covered log beneath kauri, v.1973, *B.W. & G.C. Hayward s.n.* (AK 182522); Titamoe, Kaihu State Forest, on soil, xii.1985, *B.W. Hayward s.n.* (AK 175361); Waiwhapuka Island, beneath manuka on steep moss covered bank, 11.i.1980, *A.E. Wright s.n.* (AK 165921); Headwaters of Te Rereatuoro Stream, 26.i.1985, *A.E. Wright 7043* (AK 168400); Wekaweka Road, growing on mosses at base of tree trunks, 18.ii.1988, *A.E. Wright 8000* (AK 178755); Poor Knights Islands, Aorangi, eastern ridge to Oneho Hill, on damp ground, viii.1984, *B.W. Hayward s.n.* (AK 172448); Whangarei, i.1936, *W.A. Given s.n.* (CHR 160949); Little Barrier Island, top of Mt Hauturu, on subalpine soil, 8.v.1990, *B.W. Hayward s.n.* (AK 203729); Thumb Track, 22.viii.1981, *A.E. Wright 4128* (AK 160391); Great Barrier Island, Wairahi Stream, on damp soil beside stream, i.1984, *B.W. Hayward s.n.* (AK 172280); Cuvier Island, Lookout Point, 25.v.1980, *A.E. Wright s.n.* (AK 154169, 154151). **Auckland:** Huia, Georges Creek, on bank of stream, 9.iv.1950, *T.C. Chambers s.n.* (AK 58419); Swanson, end of Tram Valley Road, on ground amongst *Dicranoloma* and *Cladina confusa* beneath regenerating kauri forest, 22.iii.1986, *A.E. Wright 7531* (AK 173546); Waitakere ranges, Karamatura Stream, on boulders, xi.1973, *B.W. Hayward H41.7* (CHR 378971); Waitakeres, Nihotupu

Stream, on clay at trackside, 15.viii.1992, *A.E. Wright 12160* (AK 213455); Rangitoto Island, on mangrove, *H.H. Allan s.n.* (CHR 487960). **South Auckland:** Milnes Creek, Hunua Ranges, xii.1972, *I.G. Barton s.n.* (CHR 487983); Mt Kohukohunui Track, 2.v.1974, *A. Dakin s.n.* (CHR 487982); Maungatawhiri, *L.B. Moore G20* (CHR 487931); Kauaeranga River, *J.K. Bartlett s.n.* (AK 192202); Mt Pirongia, on decayed white pine, *H.H. Allan W12* (CHR 487949, 487951; OTA 048677); Whakarewarewa State Forest, near Blue Lake, at base of tree fern in densely shady place, 5.xii.1985, *G. Taylor s.n.* (AK 178587); Kaingaroa Plains, on earth in fern land, iv.1936, *K.W. Allison L 246* (CHR 487947); Stubb's Farm, 22 km W of Otorohanga, on base of *Dicksonia squarrosa* stump on margin of pasture and forest, 29.x.1989, *A.E. Wright 9152* (AK 185806); Mangaotaki Stream, King Country, vi.1972, *D.J. Galloway s.n.* (CHR 490597). **Gisborne:** Motu, *J.K. Bartlett s.n.* (AK 197500); Urewera National Park, Aniwanuiwa, 18.iii.1970, *P.J. Edwards 66* (CHR 487935). **Hawke's Bay:** Waikamaka, 26–30.viii.1941, *N.L. Elder 216/29* (CHR 241664). **Taranaki:** New Plymouth, *L.B. Moore s.n.* (CHR 487958); Mt Egmont, iii.1969, *J. Rowley 68482* (CHR 487943). **Wellington:** Kaimanawa Range, Waipakahi Valley, iv.1972, *D.J. Galloway s.n.* (CHR 490602); Near Whakapapa Village, on dead standing wood amongst mosses, 23.v.1988, *A.E. Wright 8066* (AK 179879); Ohakune, x.1932, *W. Attwood s.n.* (CHR 160948, 487948, 490596); Manawatu Gorge, *H.H. Allan s.n.* (CHR 160945, 160946, 160947); Pongaroa, vi.1972, *D.J. Galloway s.n.* (CHR 490599); Totara Reserve, Pohangina Valley, 1.x.1972, *D.J. Galloway s.n.* (CHR 490593); Tiritia Stream, near Palmerston North, 27.viii.1933, *E. Chamberlain G1* (CHR 487924, 487930); Waiopahu, Tararua Range, iv.1969, *D.J. Galloway 68474* (CHR 490600); Wai-iti Creek, Tararua Range, 22.i.1944, *H.H. Allan s.n.* (CHR 160933, 160934); Kapiti Island, on soil in mossy clearing, kanuka forest, 11.iv.1982, *B.W. Hayward KL8* (AK 167945); Waikanae, Reikorangi, v.1963, *A.E. Wade 47* (AK 192197); Wilton's Bush, in mosses on bank, 7.ix.1956, *W. Martin 5425* (OTA 048684); Wainuiomata, *H.H. Allan 5252* (CHR 487934); Eastbourne, Butterfly Creek, on soil, 1980, *B.W. Hayward s.n.* (AK 175364). **Nelson:** Cobb Ridge, *J.K. Bartlett s.n.* (AK 192210); Korere, mossy floor of beech forest, 10.i.1925, *H.H. Allan s.n.* (CHR 487989); Nelson Lakes National Park, Whisky Falls, Lake Rotoiti, 3.i.1959, *M.J.A.*

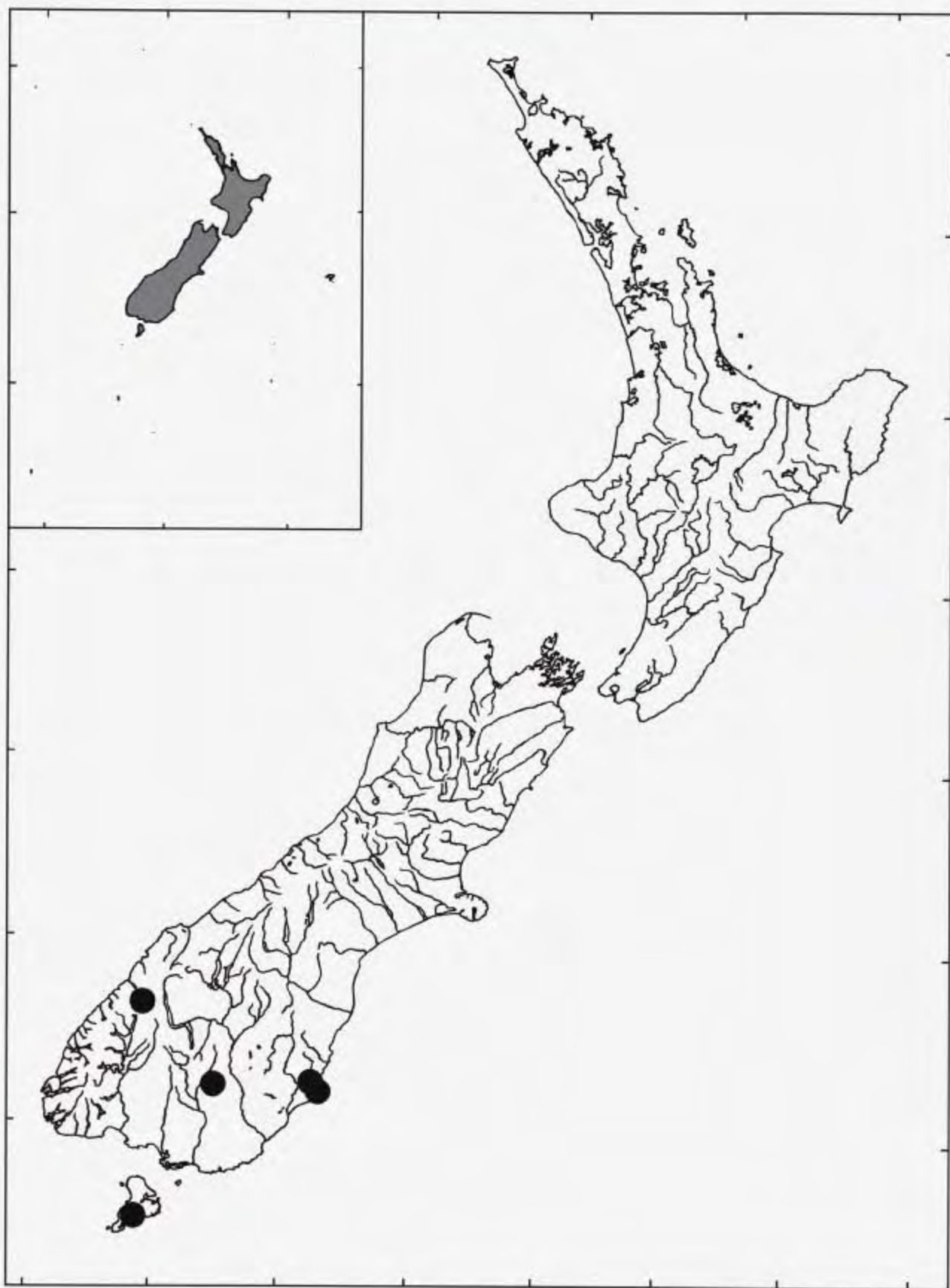


Fig. 5: Distribution of *Peltigera hymenina* in New Zealand

Simpson 447 (CHR 306365); Head of D'Urville River, iii.1965, *M.J.A. Simpson 4311* (CHR 306363); 10 km N of Westport, on debris in moist, forested gully, 26.ii.1980, *J.A. Elix 7183* (CHR 348136). **Marlborough:** Okoha Saddle, along track up Mt Stokes, on bark in beech forest, 5.i.1992, *B.W. Hayward s.n.* (AK 205429); Wairau Valley, 2.ix.1959, *W. Martin 7965* (OTA 048436). **Westland:** Aorangi Forest Reserve, Greymouth, on prostrate tree fern, 10.x.1958, *W. Martin 6882* (OTA 048704); Moonlight Creek, on old gold tailings at sluice site, 31.xii.1977, *D.R. Given 10950* (CHR 498208); Franz Josef Glacier on log in forest, 11.iii.1966, *W. Martin s.n.* (CHR 490583); Lake Paringa, 22.viii.1970, *J. Child 1969*, (CHR 388567); Haast Pass, W side, iv.1957, *R. Smith 0937, 0954* (OTA 048665, 048678); Quartz Hill, near Haast, roadside bank, among mosses, 19.v.1971, *P. Child 1452* (CHR 445392); Near Ngatau Hut, on wet debris and bryophytes on fallen logs, 11.v.1973, *P. Child 1752* (CHR 445362); Near Lichen Creek, Waitototo, on damp bryophytes in beech forest, 17.v.1985, *P. Child 2368* (CHR 445363). **Canterbury:** S of Mt Palm, Lowry Peaks Range, on mossy rocks, 24.i.1980, *J.A. Elix 6910* (CHR 267129); Mount Cook National Park, White Horse Hill, among moss on floor of subalpine scrub on steep bank, 13.viii.1971, *H.D. Wilson 2089* (CHR260724). **Otago:** Mt Brewster, iii.1968, *D.J. Galloway s.n.* (CHR 490640); Kidd's Bush, Lake Hawea, among bryophytes, 2.viii.1985, *P. Child 2430* (CHR 445364); West Matukituki Valley, Aspiring Hut, 10.ix.1967, *D.J. Galloway s.n.* (CHR 490633); Jordan River, Paradise, damp, mossy bark, 27.i.1970, *J. Child 322* (CHR 390179); Invincible Creek, Rees Valley, among moss on boulder, 26.viii.1970, *P. Child 773* (CHR 445391); Remarkables, Rastus Burn, in damp hollow, on debris, moss etc, under clump of *Cbionochloa macra*, 27.i.1986, *P. Child 2192* (CHR 445365); Mt Bengier, head of Timber Creek, grassland bordering bog, 27.i.1997, *D.J. Galloway 0374* (OTA); Black Gully, Blue Mountains, bark of beech, 14.xi.1970, *P. Child 1102* (CHR 445356); Mt Cargill, near beech trees, on earth, ii.1950, *W. Martin 5509* (CHR 490657); Graham's Bush, on ground at side of track, 15.ii.1998, *J.M. Bannister s.n.* (OTA 049067); Wakari, iv.1958, *J. Murray 1936* (OTA 048731); Botanic Gardens, Dunedin, among small stones at edge of gravel path with *Leptogium crispatellum*, 2.vi.1998, *D.J. Galloway 0257* (OTA); South of Taieri Mouth, on trees in dense bush, iv.1958, *J. Murray 1670, 1674* (OTA 048681, 048686);

W side Lake Waihola, on a damp, shady bank, 5.vii.1970, *P. Child 471* (CHR 445390); Woodside Glen, wet bank and rock, 21.ix.1997, *J.M. Bannister s.n.* (OTA). **Southland:** West Dome, W side moist, mossy disturbed gravel, partly ultramafic, beside gravel road in manuka scrub, 25.i.1998, *P.N. Johnson 3285* (CHR); Takitimu Forest, Princhester Hut, 12.ix.1998, *A. Knight* (OTA); Pukerau, *Festuca rubra* bog, v.1967, *D.J. Galloway s.n.* (CHR 490631); Waihopai Scenic Reserve, Invercargill, dead log in forest, 3.iv.1954, *W. Martin 1304* (OTA 048441); McKinnon's Pass, on moss, beech forest, *J.S. Thomson T2900 pr.p.* (CHR 160937); Head of Caswell Sound, on ground, 8.i.1998, *J.M. Bannister s.n.* (OTA 048818); Doubtful Sound, *J.S. Thomson T2879, T2885* (OTA 047830, 047856); *Ibid.*, *J.S. Thomson & G. Simpson* (CHR 487972, 490637); Western shore of Lake Thomson north of stream draining from Lake Wade, on slip face, 22.v.1986, *A.J. Fife 7683* (CHR176891); Spey River, 13.ii.1959, *M.J.A. Simpson 1114* (CHR 490636); Lake Virginia near Lake Manapouri, 22.ii.1959, *M.J.A. Simpson 1508* (CHR 490647); Borland Bog, 29.ii.1996, *J. Steel s.n.* (OTA 048062); Lake Hauroko Hut, 23.xii.1997, *A. Knight s.n.* (OTA); Alton Valley, v.1962, *D.J. Galloway s.n.* (CHR490639); Section 2, Waikoau River, Te Wae Wae Bay, v.1962, *D.J. Galloway s.n.* (CHR 490627); Rowallan Burn, on fern log, *J.S. Thomson T 2504* (CHR 487974). **Stewart Island:** Mt Anglem, west ridge grassland, ii.1966, *D.J. Galloway s.n.* (CHR 487966); Maori Beach, v.1964, *D.J. Galloway s.n.* (OTA); Oban, on trees and on ground, 16.ii. 1947, *W. Martin 78* (OTA 048705); Moturau Moana, Butterfields beach, on rock retaining wall, on *Cordyline australis*, on ponga fence, 6.vi.1998, *D.J. Galloway 478, 453, 534* (OTA); Glory Cove, 15.ii.1967, *D.J. Galloway s.n.* (CHR 487976); Freshwater Valley, *J.S. Thomson 3055* (CHR 490616); Port Pegasus, Disappointment Cove, 29.xi.1969, *D.J. Galloway s.n.* (CHR 490665); Bald Cone, mossy bank, 7.iv.1978, *H.D. Wilson 278* (CHR 265395).

5. *Peltigera hymenina* (Ach.) Delise in Duby, *Bot. Gall.* 2: 597 (1830). *Peltidea hymenina* Ach., *Meth. Lich.*: 284 (1803). For typification and synonymy see Vitikainen (1994: 47).

Illustrations: Wirth (1987: 343 — as *P. lactucifolia*); Holtan-Hartwig (1993: 47, figs 52, 53 — as *P. lactucifolia*); Vitikainen (1994: 48, fig. 90).

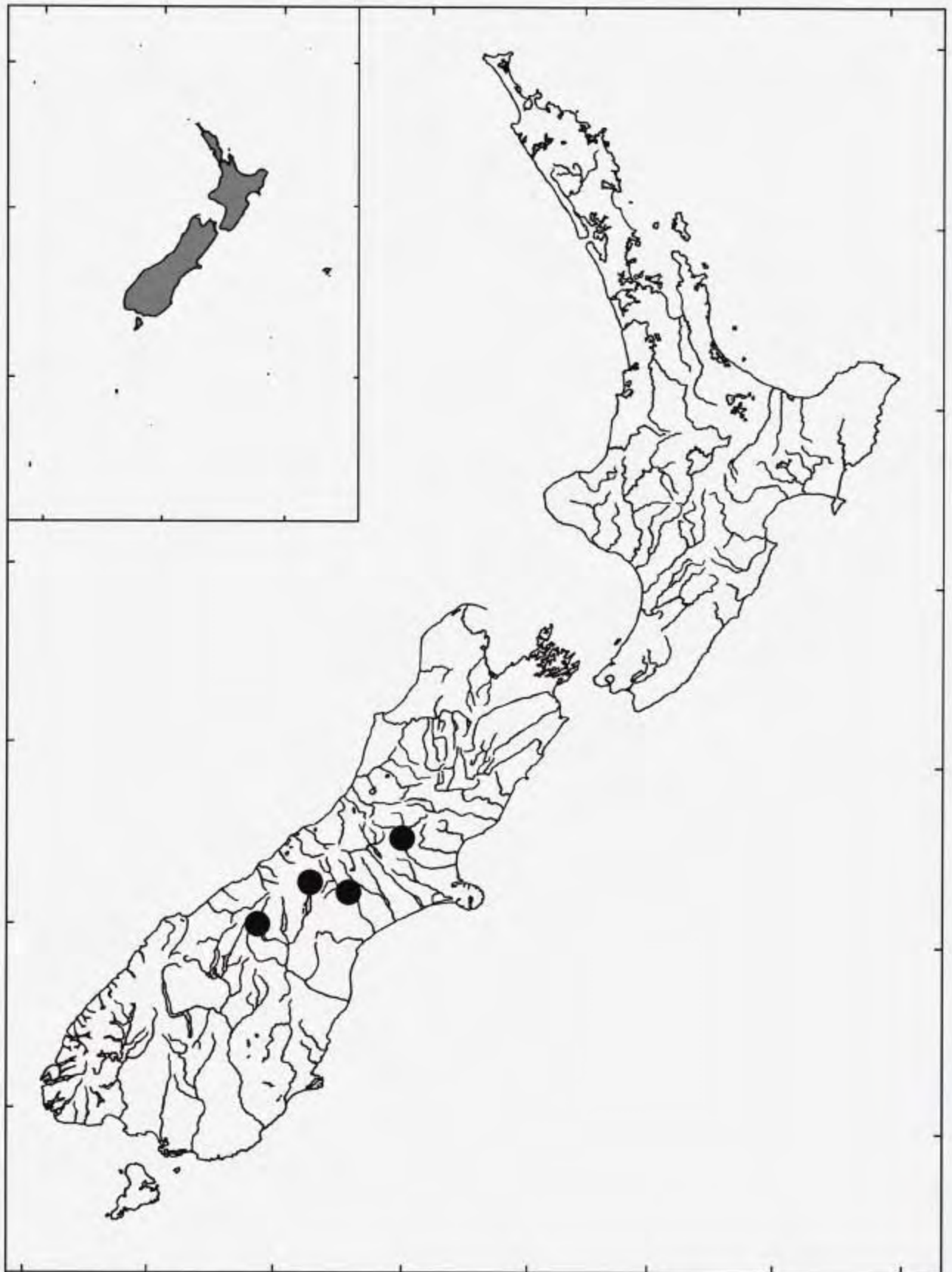


Fig. 6: Distribution of *Peltigera lepidophora* in New Zealand

Description: Thallus rosette-forming to irregularly spreading, 3–8(–14) cm diam. Lobes linear, imbricate, 0.5–1.2(–2) cm diam., 2–6 cm long, rather thin, 200–300 µm thick. Margins entire or shallowly notched, wavy, more or less inrolled in parts. Upper surface slatey blue-grey to brown-grey, suffused red-brown at apices when wet, olive-green to brownish green to pale grey when dry, matt, minutely maculate (x 10 lens, best seen when wet), without isidia, phylidia, or soredia. Lower surface without veins or, when present, veins flat, broad, indistinct, more or less evenly felted-tomentose from centre to margins, or occasionally with small, scattered, whitish interstitial areas apparent at margins between veins (x 10 lens), pale yellowish buff in a broad, marginal zone darkening centrally. Rhizines thin, scattered, simple to fasciculate, pale yellow-buff to dark-brown, generally rather short, 2–4 mm long. Apothecia rather rare, 3–5 mm long, saddle-shaped, on short marginal stalks, disc red-brown, epruinose, margins corrugate-roughened, pale buff, tomentose below. Ascospores fusiform, 3–5-septate, 50–70(–80) x 3–4 µm.

Chemistry: Tenuiorin, methyl gyrophorate, gyrophoric acid, peltidactylin, dolichorrhizin, zeorin (tr.), hopane-7β,22-diol, unidentified triterpenoid (tr.).

Distribution (Fig. 5): From the east coast of South Island from Dunedin to Pukerua, and from Fiordland (Homer) and southern Stewart Island (Tin Range). Recorded for the first time from New Zealand, but still much in need of collection as it is very poorly collected and imperfectly known here. Apparently bipolar, known from the Northern Hemisphere from North America, Western Europe, the British Isles, Macaronesia, and Africa (Purvis & James 1992; Vitikainen 1994), but not elsewhere in the Southern Hemisphere.

Habitat ecology: *Peltigera hymenina* grows amongst mosses and bryophytes often with other lichens (especially *Cladia aggregata*, *C. sullivanii*) in subalpine grassland, or on soil or rocks, sea level to 700 m.

Distinguishing features: *Peltigera hymenina* differs from other taxa in the *P. polydactylon* aggregate by its mainly pale buff-brown lower surface, with more or less continuous felted tomentum and rather diffuse venation, the somewhat maculate and less shiny

upper surface, and the thin, pale, simple to fasciculate short rhizines.

Specimens examined: **Otago:** Leith Valley, Dunedin, 300 m, ix.1958, *J. Murray* 3543 (OTA 048697) [Cited by Murray (1960: 392) as *P. polydactyla* var. *polydactyloides*]; Nichols Creek, Flagstaff, on mossy ground under ferns, 19.vii.1998, *A. Knight* s.n. (OTA); Mt Cargill, east side, on earth and on rock, *W. Martin* 6964 (CHR 490611); Ravensbourne, xi.1956, *J. Murray* 1181 (OTA 048693) [Cited by Murray (1960: 392) as *P. polydactyla* var. *polydactyloides*]; Lake Onslow, scrambling through grass in moss and grasses at base of rock in grassland, near fishing huts, 30.vii.1998, *D.J. Galloway* 0339 (OTA). **Southland:** Brigham's Leap, Argyle Burn, amongst grass on roadside bank, 24.vii.1998, *D.J. Galloway* 0382 (OTA); Fiordland, Homer Huts, v.1967, *D.J. Galloway* s.n. (CHR 490630). **Stewart Island:** Tin Range, 25.xi.1969, *D.J. Galloway* s.n. (CHR 487936).

6. *Peltigera lepidophora* (Vain.) Bitter, *Ber. Deutsch. Bot. Ges.* 22: 251 (1904). *Peltigera cantina* var. *lepidophora* Vain., *Meddel. Soc. Fauna Fl. Fennica* 2: 49 (1878). For typification and additional synonymy see Vitikainen (1994: 51).

Illustrations: Yoshimura (1973: 536, fig. 1); Moberg & Holmäsén (1982: 175); Goffinet & Hastings (1994: 29, fig. 46); Vitikainen (1994: 52, fig. 94).

Description: Thallus small, (0.5–)1–2(–4) cm diam., rounded, level with or slightly sunken into substratum. Lobes concave, often crowded, more or less cochleate, rarely more or less plane, 2–6(–8) mm diam. Margins entire, sinuous, ascending, more or less inrolled. Upper surface dark slate blue-black to brownish when wet, olive-brownish to red-brown when dry, coriaceous, thinly white-tomentose in parts, or more or less glabrous centrally and tomentose only at margins; isidiate. Isidia small, 0.2–0.5(–1) mm tall, rounded, corticate, button-like at first, becoming lobed with age, pale to dark red-brown, scattered to densely crowded. Lower surface pale yellow-buff to greyish or brownish, roughly tomentose. Veins indistinct. Rhizines scattered, simple to more or less fasciculate, pale buff to brown, 1–2 mm long. Apothecia not seen.

Chemistry: TLC — nil.

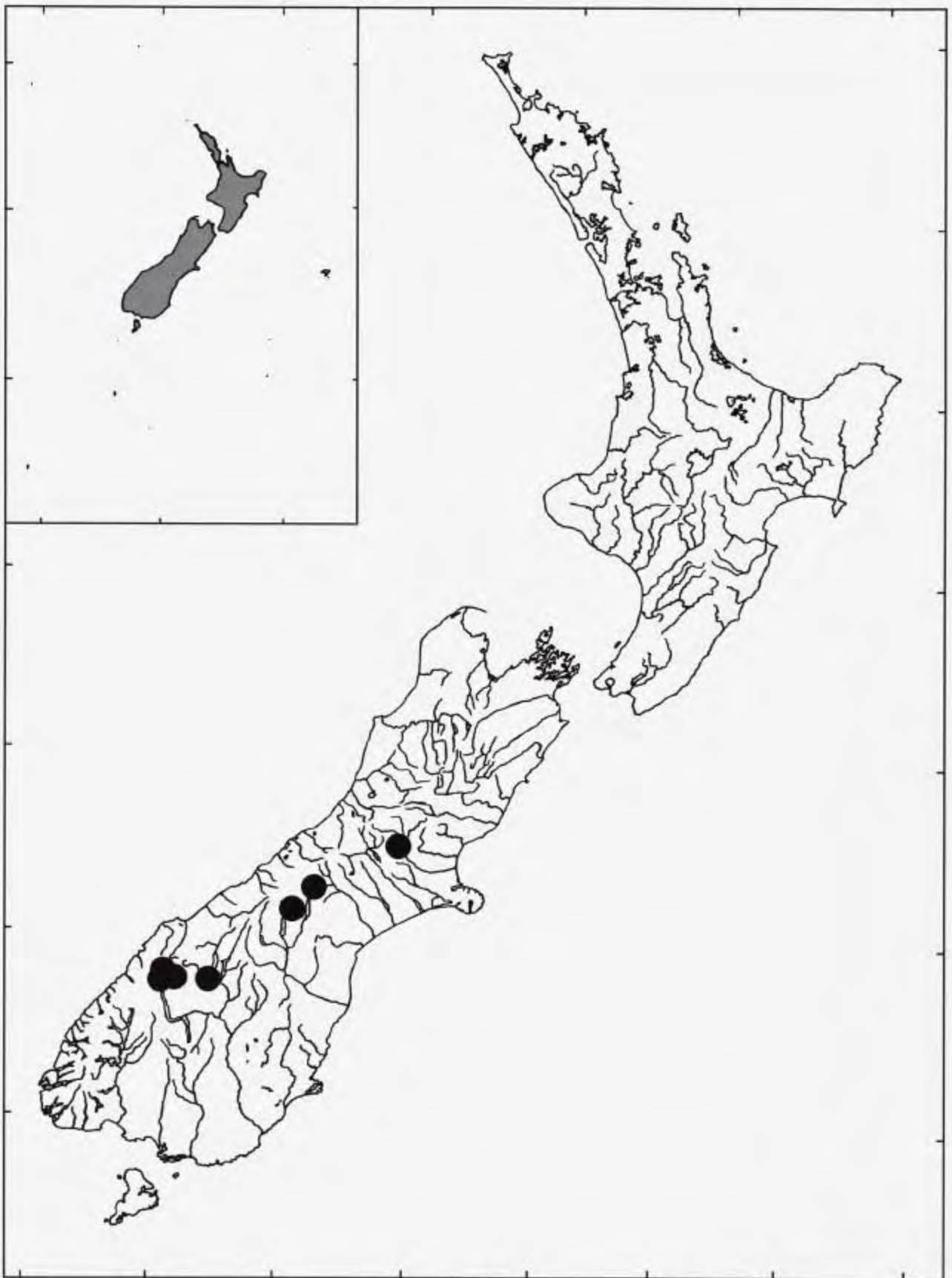


Fig. 7: Distribution of *Peltigera malacea* in New Zealand

Distribution (Fig. 6): Nelson (Mt Arthur) to Canterbury (Castle Hill, upper Ashburton River, Rangitata Gorge, lower Godley Valley, Maitland Valley, Lake Ohau). Circumpolar in the Northern Hemisphere (North America, Europe, Asia), also in Hawaii [as *P. spuria* (Magnusson & Zahlbruckner 1943: 96)] and South America (Vitikainen 1994).

Habitat ecology: *Peltigera lepidophora* grows on sandy, often calcareous, exposed soils, in upland to alpine habitats, to 2000 m. Associating with: *Arthrobarbaphis citrinella*, *Candelariella vitellina*, *Cladia aggregata*, species of *Cladonia*, *Lecanora epibryon* ssp. *broccha*, *Lecidella wulfenii*, and *Rinodina olivaceobrunnea*. Moribund thalli sometimes colonised by *Candelariella vitellina*, *Lecidella wulfenii*, and *Rinodina olivaceobrunnea*. Still very poorly known in New Zealand.

Distinguishing features: *Peltigera lepidophora* is characterised by the small, more or less cochleate lobes growing directly on soil, and with a tomentose upper surface and scattered to crowded, laminal isidia. It is similar in gross morphology to the juvenile, soreciate phase of *P. didactyla*, but is distinguished from it by the presence of isidia and an absence of soredia.

Specimens examined: **Canterbury**: Castle Hill, not common, xii.1962, *D.J. Galloway s.n.* (CHR 487912); upper Ashburton River, 5 km W of Hakatere, near Spider Lakes, in open, depleted grassland on exposed soil, 15.iii.1999, *D.J. Galloway 0923* (OTA); Rangitata Gorge, east end, on soil, 31.viii.1977, *D.J. Galloway s.n.* (CHR 490506); Lower Godley Valley, on broken rock, 30.xii.1957, *D. Scott 156* (OTA 048668) [Cited by Murray (1960: 397) as *P. canina* var. *spuria*]; Maitland Valley, Lake Ohau, on soil, dry bank, v.1958, *J. Murray 1734* (OTA 048661) [comprising also *P. didactyla* and *P. neckeri* — cited by Murray (1960: 397) as *P. canina* var. *spuria* f. *sorediata*].

7. *Peltigera malacea* (Ach.) Funck, *Crypt. Gewächse* 33: 5 (1827). *Peltidea malacea* Ach., *Syn. Lich.*: 240 (1814). For typification and additional synonymy see Vitikainen (1994: 57–8).

Illustrations: Moberg & Holmäsén (1982: 176); Wirth (1987: 345); Holtan-Hartwig (1993: 51, figs 58, 59); Vitikainen (1994: 59, fig. 100); McCune & Geiser (1997: 211).

Description: Thallus rosette-forming to irregularly spreading, 2–5(–8) cm diam. Lobes broadly rounded 1–2(–3) cm wide and 4–6 cm long, and 1–1.5 mm thick. Margins entire, slightly thickened below, plane to wavy, inrolled, more or less subascending, without soredia or phyllidia, often with a rim of erect, compact tomentum (x 10 lens). Upper surface glabrous, coriaceous, matt or shining, olive brownish or greenish brown centrally, suffused dark red-brown towards margins, without soredia or phyllidia, undulate, shallowly wrinkled, here and there with longitudinal cracks or tears. Lower surface without veins, more or less continuously felted-tomentose (rarely with a few scattered, white interstitial areas close to margins), pale creamish buff at margins (greyish white in exposed alpine forms), soon becoming greyish to brownish black or more or less blackened centrally. Rhizines sparse, widely scattered, short, bushy-tufted, densely fasciculate 1–3 mm long, black or brown-black to greyish. Apothecia not seen.

Chemistry: Gyrophoric acid, methyl gyrophorate, tenuiorin, zeorin, dolichorrhizin, and several unidentified triterpenoids. Holtan-Hartwig (1993) distinguished 4 chemodemes.

Distribution (Fig. 7): Mountain areas east of the Main Divide from Canterbury (Torlesse Ra.) to Otago (Maungatua). Still rather poorly known and collected in New Zealand. First recorded in New Zealand from the Bealey River by Hellbom (1896: 28) from a collection made in 1874 by the Swedish Botanist Sven Berggren, but not seen by Murray (1960: 394–395) or by me. Now confirmed for New Zealand by a range of South Island collections (see below). A bipolar species (Galloway & Aptroot 1995), circumpolar in the Northern Hemisphere in boreal and arctic zones, less common in temperate lowlands, rare or lacking in oceanic areas of North America, Europe, and Asia (Vitikainen 1994: 60). It is not known from Australia (Filson 1996).

Habitat ecology: *Peltigera malacea* occurs in subalpine to high-alpine grassland and fellfield, among mosses and debris in damp sites, 300–2300 m.

Distinguishing features: *Peltigera malacea* is characterised by its broad, very thick lobes, indistinct veins of the lower surface, forming a more or less continu-

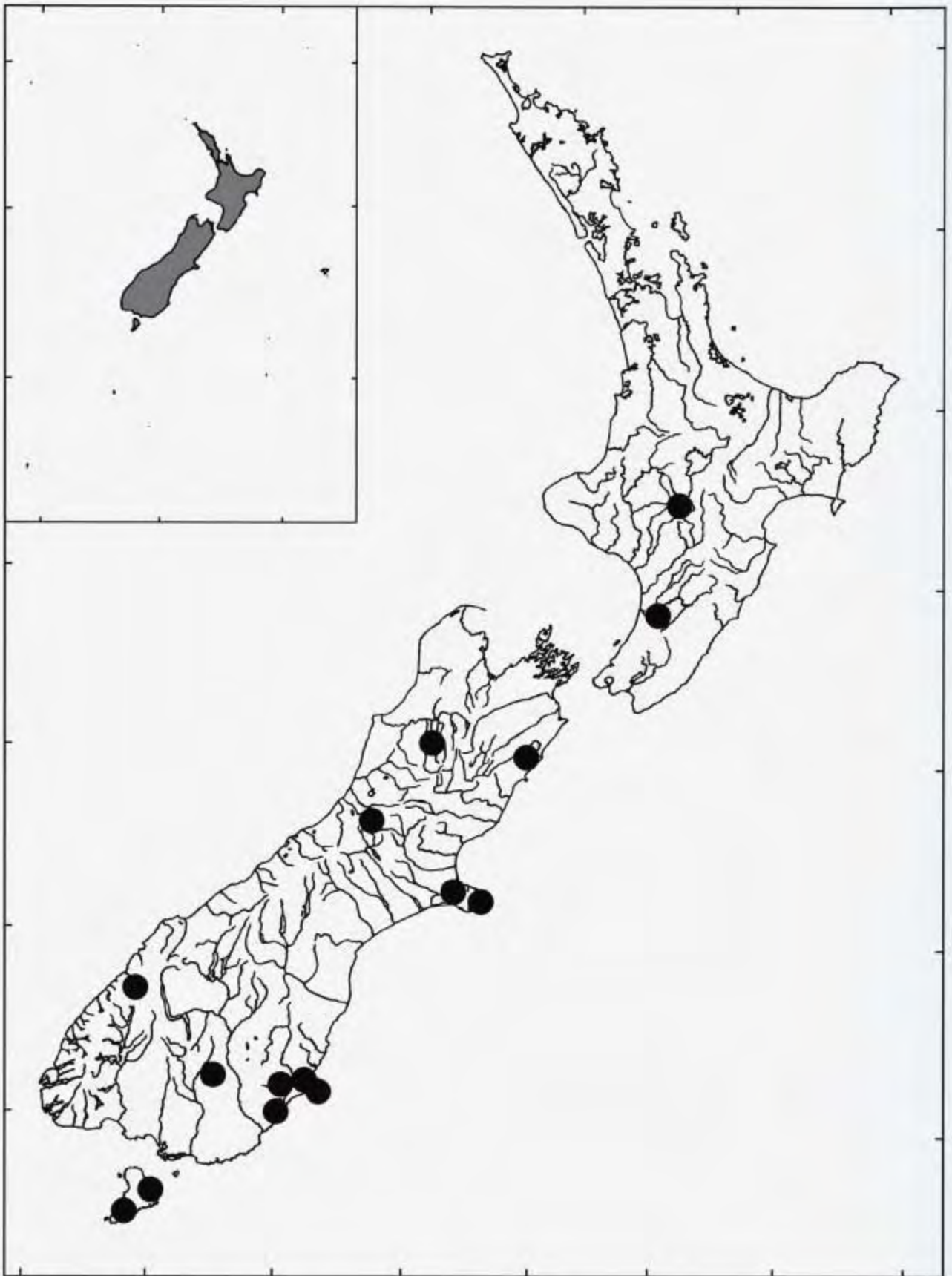


Fig. 8: Distribution of *Peltigera membranacea* in New Zealand

ous greyish to blackish or brown-black, felty layer which projects at the margins as an erect, brownish fringe.

Specimens examined: **Canterbury:** Torlesse Range, Foggy Peak, on scree, xi.1972, *D.J. Galloway s.n.* (CHR 487967); Lower Godley Valley, litter in grassland, 29.xii.1957, *D. Scott 158* (OTA 048735); Mount Cook National Park, Cooper's Mate, 2300 m, slopes above Aida Glacier, Murchison, nival zone rock face, mostly firm and red but with some rubble, 5.ii.1972, *H.D. Wilson 2244* (CHR 260713). **Otago:** Matukituki River Mouth, on damp rock ledges beside the lake, 27.vi.1970, *P. Child 409* (CHR 445354); Lake Wanaka, among grass in damp area, 26.vi.1970, *P. Child 845* (CHR 390304); West Hunter Valley, among mosses and debris on damp, subalpine boulders, 21.i.1971, *P. Child 1330* (CHR 445383); Bedford Valley, 26.xii.1970, *D.J. Galloway s.n.* (CHR 487973); Earnslaw, 27.i.1970, *J. Child 334* (CHR 390187; OTA 048720); Paradise, damp, shady bank, among moss, 28.i.1970, *J. Child 324* (CHR 390182); Maungatua, on mosses and tussocks overlying earth, ii.1956, *W. Martin 5602* (CHR 487977).

8. *Peltigera membranacea* (Ach.) Nyl., *Bull. Soc. linn. Normandie, sér. 4*, 1: 74 (1887). *Peltigera canina* *γ**membranacea* Ach., *Lich. Univ.*: 518 (1810).

Illustrations: Olech & Alstrup (1988: 177, fig. 1); Goffinet & Hastings (1994: 33, figs 57, 58); Vitikainen (1994: 62, fig. 103); McCune & Geiser (1997: 212).

Description: Thallus spreading, large, 2–8(–12) cm diam. Lobes 0.5–2 cm wide, 1–3(–6) cm long. Margins entire or shallowly scalloped or incised, downturned at apices and usually more or less tomentose. Upper surface dark grey-black or bluish black, suffused red-brown when wet, pale greyish, olivaceous to dark reddish brown when dry, more or less conspicuously longitudinally wrinkled or bullate, more or less maculate, especially at apices (use x 10 lens), tomentose. Tomentum, thin, white or pale greyish, generally confined to margins and apices, or sometimes spreading more widely over the upper surface, central parts more or less glabrous. Lower surface white, tomentose. Veins conspicuous, raised 0.5–1 mm wide, anastomosing, rather widely separated, erect-tomentose (use x 10 lens) appearing fluffy, white, to

pale buff at margins, to dark brown centrally; interstices broadly polygonal. Rhizines scattered to crowded, discrete, simple, slender, white to pale buff or brownish, rarely dark-brown or blackened, conspicuously erect-tomentose (use x 10 lens), often with a squarrose terminal tuft, 5–7(–12) mm long. Apothecia rounded to saddle-shaped, 2–5(–7) mm diam., disc concave, matt, red-brown, epruinose; margins pale, ragged-lacerate or roughened, pale buff-tomentose below, when young the apothecium incurved, the disc obscured by pale buff exciple. Ascospores colourless, 3–5-septate, (40–)45–68(–75) x 2.5–4 μ m.

Chemistry: TLC — nil.

Distribution (Fig. 8): From Wellington (Ruapehu) to Stewart Island. A cosmopolitan species known also from North America, western Europe (including Macaronesia, Great Britain, and Scandinavia), Asia (Vitikainen 1994), and Tasmania (Kantvilas 1994; Filson 1996).

Habitat ecology: *Peltigera membranacea* grows on damp soil, on rotting wood, stumps, amongst grasses, and on damp rocks in rather open situations rather than in closed forest sites. It is still rather poorly collected and understood in New Zealand.

Distinguishing features: *Peltigera membranacea* is characterised by broad lobes with tomentose, down-rolled margins and scattered tomentum on the upper surface; raised, anastomosing veins which are covered with an erect tomentum (x 10 lens), the inter-vein interstices broadly polygonal, and discrete, long, slender, simple rhizines covered with erect tomentum (bottle-brush-like). It has a thinner thallus than *P. canina* and is also separated from this species by the above characters and the slightly longer spores. Vitikainen (1994: 63) opines that Southern Hemisphere collections named as *P. membranacea* "probably represent other species"; however, New Zealand collections conform with material seen from Great Britain, Europe, and Scandinavia. Colour morphs of *P. malacea*, *P. membranacea*, and some other taxa are known (Holtan-Hartwig 1993; Goward *et al.* 1997). A recent study of British Columbia populations of *P. membranacea* has suggested a relationship between thallus colour and genetic variability in the *Nostoc* photobionts (Miao *et al.* 1997).

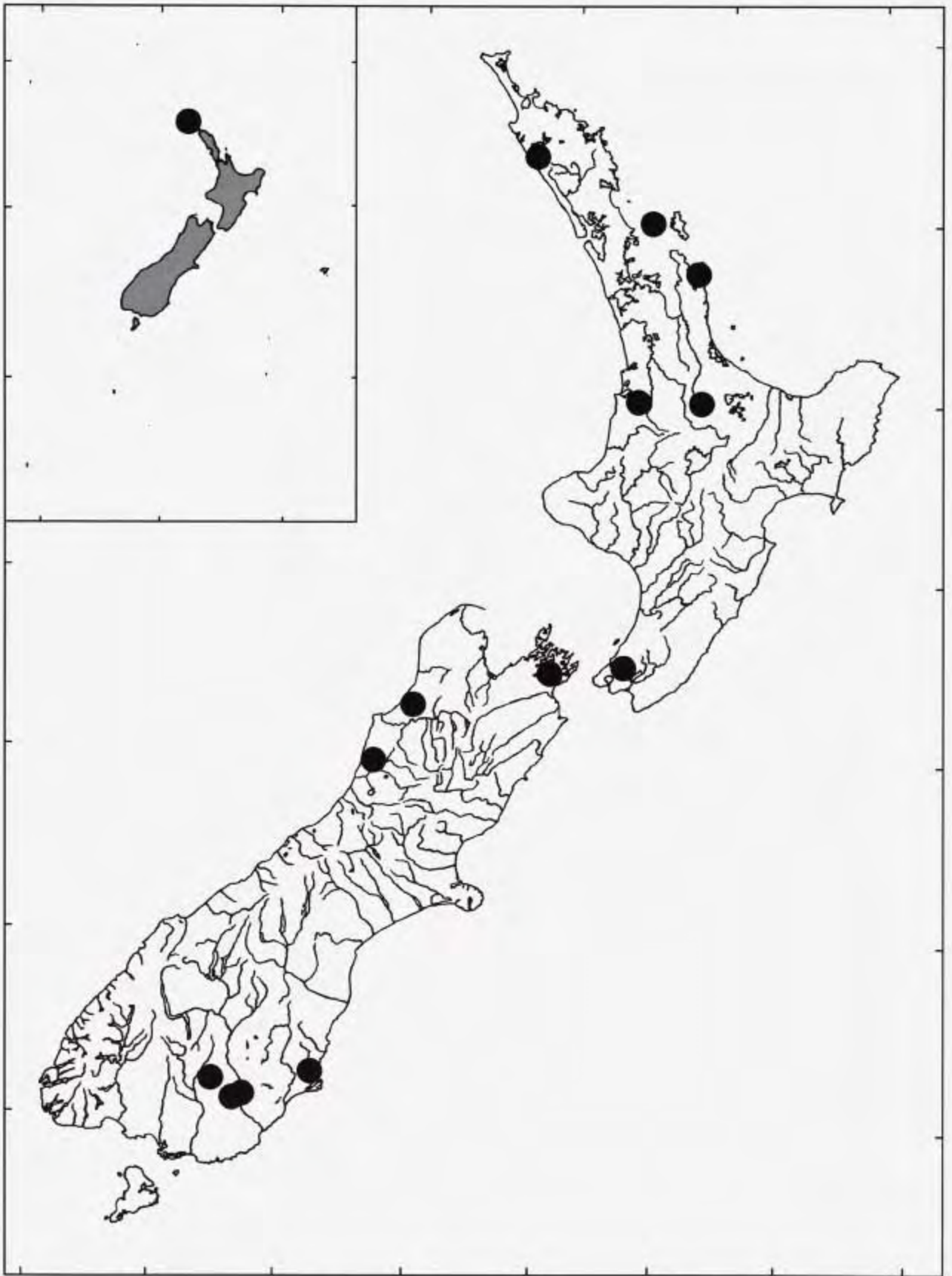


Fig. 9: Distribution of *Peltigera nana* in New Zealand

Specimens examined: **Wellington:** Ruapehu, Silica Rapids Track, soil, 28.xi.1992, *D. Glenney 4177* (WELT L5042); Tiritia near Palmerston North, *E. Chamberlain s.n.* (CHR 160955). **Nelson:** Matakita Valley, 2 miles S of Murchison, amongst moss on wet ground, 3.vi.1968, *D.H. Smith s.n.* (CHR 160940). **Marlborough:** Seaward Valley Road near Blue Duck Scientific Reserve, on rotting wood in rough pasture, 1.xi.1993 *A.E. Wright 12320* (AK 215431). **Canterbury:** Arthur's Pass National Park, Upper Bealey Track to Margaret's Tarn, on forest floor, 5.xi.1989, *W.A. Nelson s.n.* (WELT L2584); Port Hills, Summit Road, Ahuriri Scenic Reserve, on rocks in grassland adjacent to forest, 25.v.1996, *A.E. Wright 12654* (AK 231781); Banks Peninsula, Toi Clearing, West Track, Hinewai Reserve, under kanuka on edge of track through regenerating bush, 21.vii.1998, *H.D. Wilson s.n.* (OTA); Mt Cook National Park, Glencoe Fan near Youth Hostel, scratched up by birds in adventive grassland, 28.x.1971, *H.D. Wilson 1901* (CHR 260723). **Otago:** Deep Stream, 6.viii.1969, *J. Child 92* (CHR 390186); Sandymount, Otago Peninsula, side of track, 12.x.1997, *J.M. Bannister s.n.* (OTA); Mt Cargill, on ground, vi.1961, *D.J. Galloway s.n.* (CHR 490607); Flagstaff, E side, on stump, ix.1959, *J. Murray 4571* (OTA 048654); Leith Valley, on ground, *J.S. Thomson T1740* (CHR 487971); Fraser Gulley, among mosses on boulders, 20.x.1970, *P. Child 837, 838* (CHR 445371, 445380); Black Gully Dam, 23.xi.1997, *J.M. Bannister s.n.* (OTA); Sullivan's Dam, Leith Valley, 2.xi.1997, *J.M. Bannister s.n.* (OTA); Tomahawk, on rocks, xi.1953, *J. Murray 038* (OTA 048646); Coult's Gully, Taieri Beach, damp soil, i.1958, *J. Murray 1424* (OTA 048645). **Southland:** Fiordland, Milford, on ground, 9.i.1998, *J.M. Bannister s.n.* (OTA 048813); Argyle Burn, Brigham's Leap, on roadside bank amongst grass and mosses, 24.viii.1998, *D.J. Galloway 0387* (OTA); Invercargill, Waihopai Forest Reserve, *W. Martin s.n.* (CHR 490512). **Stewart Island:** Ulva Island, on earth at forest margin, iii.1946, *W. Martin s.n.* (CHR 490648); Waituna Bay, sandy ground in open bayhead shrubland, plot 282, 27.ii.1979, *H.D. Wilson 789-739* (CHR 265394).

9. *Peltigera nana* Vain., *Philipp. J. Sci. sect. C*, 8: 114 (1913). *P. dolichorbiza* var. *nana* (Vain.) J.S. Murray, *Trans. Roy. Soc. N.Z.* 88: 394 (1960). Typification is discussed in Gyelnik (1936: 132).

Illustrations: Malcolm & Galloway (1997: 178, fig. 270).

Description: Thallus rather large, orbicular to spreading 5–10(–15) cm diam. Lobes broadly rounded, 1–2(–2.5) cm wide, 2–6(–8) cm long, papery, much thinner in texture (100–200 µm thick) than *P. dolichorbiza* and *P. polydactylon*. Margins wavy-undulate, here and there more or less inrolled, entire to minutely scalloped, occasionally with small, fuzzy-brown tomentose apothecial initials. Upper surface glabrous, dark blue-black when wet, pale greyish or olivaceous to dark-brown when dry, matt, somewhat coriaceous, papery, smooth to undulate-crumpled, more or less bullate or longitudinally ridged. Lower surface tomentose, pale. Veins flattened, diffuse, rather broad, 0.5–2.5 mm wide, more or less coalescing and continuous at margins, anastomosing towards centre, pale buff to reddish brown, smooth; interstices white, fibrous, oval to elongate. Rhizines discrete, widely scattered, slender, simple to fasciculate, pale buff to dark-brown or black, 3–8(–12) mm long. Apothecia rather small, more or less erect, occasional to rare, 3–5 mm diam., saddle-shaped, more or less strongly inrolled, on marginal lobules; disc red-brown to dark-brown, matt, epruinose; margins pale buff or pinkish, verrucose-roughened, more or less obscured by disc. Ascospores straight or curved, acicular, colourless 5–7-septate, (40–)45–55(–60) x 2.5–4 µm.

Chemistry: Tenuiorin, dolichorrhizin, peltidactylin and zeorin (tr.).

Distribution (fig. 9): From the Three Kings Islands (latitude 34°10'S) to northern Southland (latitude 45°45'S). Known also from the Philippines (Murray 1960).

Habitat ecology: *Peltigera nana* grows in moist, though fairly open, more or less disturbed habitats, on rocks, rotting logs, tree bases, on soil, amongst mosses and grasses at forest margins, or on roadside banks, where it often occurs with other species of *Peltigera* and with other lichens such as *Cladia aggregata* and *Stereocaulon ramulosum*.

Distinguishing features: *Peltigera nana* is characterised by broadly rounded, thin, papery lobes to 100–200 µm thick, about half the thickness of *P. dolichorbiza* at 220–400 µm thick; a glabrous upper surface, a pale lower surface with broad, flat, diffuse

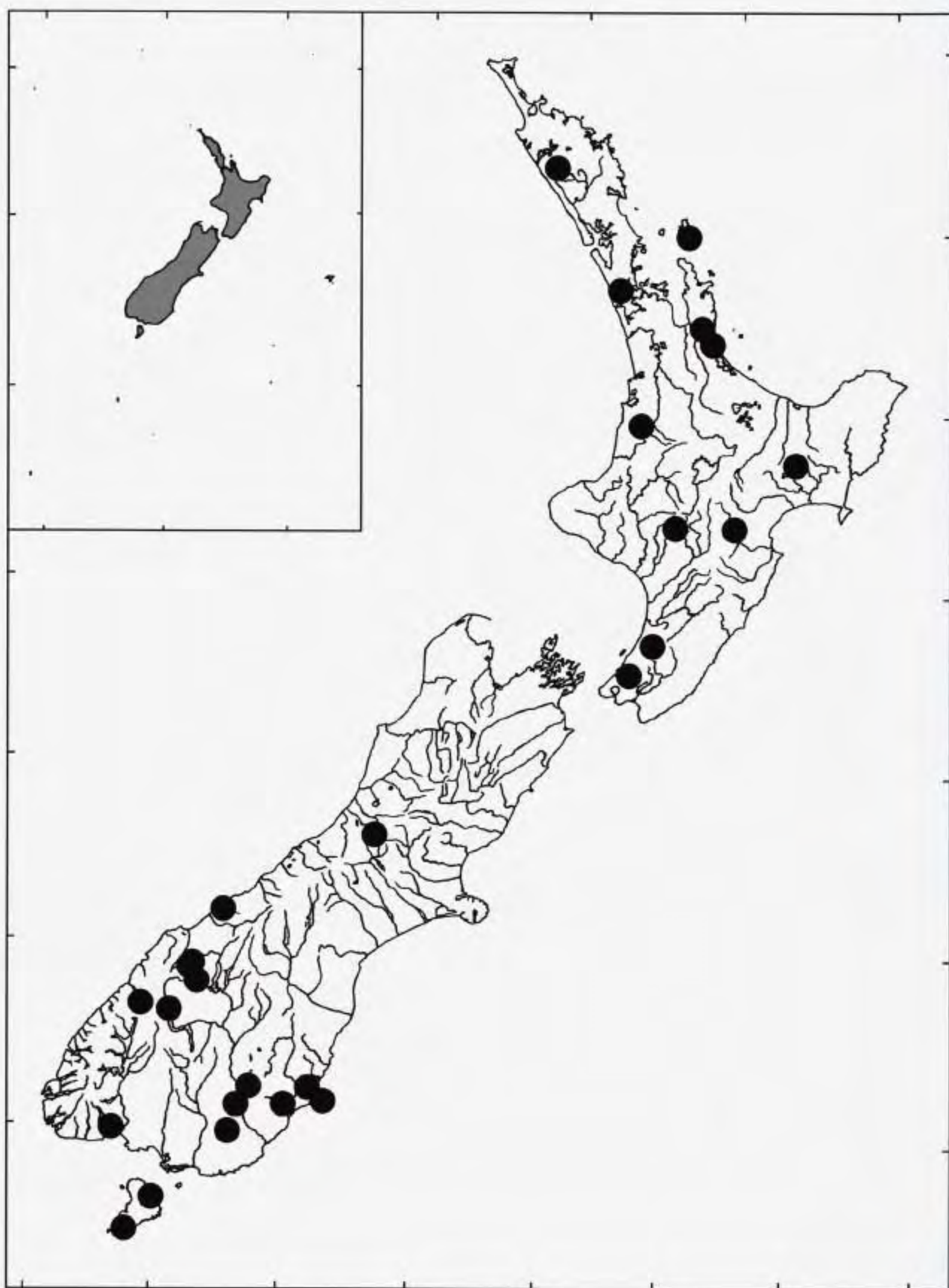


Fig. 10: Distribution of *Peltigera neckert* in New Zealand

pale buff to reddish brown veins, and discrete, scattered pale to dark, simple to fasciculate rhizines [3–8(–12) mm long], and a medullary chemistry of tenuiorin and three tripterpenoids.

Specimens examined: **North Auckland:** Three Kings Islands, Great Island, Tasman Valley, 15.xi.1970, *D.J. Galloway s.n.* (CHR 451394); 5.5 km SE of Opononi, at roadcut, 5.ii.1993, *A.E. Wright 19706* (AK 210904); Little Barrier Island, *W.M. Hamilton G 52* (CHR 487952) [isotype of *Peltigera nana* f. *ventosa* Gyeln. *nom. nud.* (Zahlbruckner 1941: 293)]. **South Auckland:** Mt Maungatawhiri, on rocks in open canopied bush, viii.1974, *B.W. & G.C. Hayward H44.100* (AK 154452); South Kawhia, W of Awaroa Road, Lake Koraha, on rotting log, and on trunk of old *Carex secta*, 28.x.1989, *A.E. Wright 9107, 9101* (AK 184793, 185787); Perimeter Road near Tokoroa, on lower trunk of *Pseudopanax crassifolius* in open shrubland vegetation, 16.iii.1990, *A.E. Wright 10220* (AK 202666). **Wellington:** Wai-iti Stream, Tararua Range, 22.i.1944, *H.H. Allan s.n.* (CHR 160930). **Marlborough:** Anakiwa, Queen Charlotte Sound, *H.H. Allan s.n.* (CHR 160959, 160960, 487987). **Westland:** Mokihinui Bluff, Buller, by streamside, 4.iii.1941, *H.H. Allan s.n.* (CHR 487985); Runanga, on mosses, x.1958, *W. Martin s.n.* (CHR 487978); Marsden Road, Greymouth, on soil at bush margin, ix.1956, *W. Martin 5430* (OTA 048713); Lake Kaniere, on dead tree, 4.iii.1954, *W. Martin 1349* (OTA 048637). **Otago:** Waitati, on ground in manuka scrub, *J.S. Thomson T 1893* (CHR 487969; OTA 047285); Leith-Waitati Saddle, moss on *Fuchsia excorticata*, *J.S. Thomson T 2168* (CHR 490609); Birch Island, Clutha River below Beaumont, on damp fallen log among mosses, 22.ii.1986, *P. Child 2709* (CHR 445378); Kaka Point, 7.ii.1967, *D.J. Galloway s.n.* (CHR 490618). **Southland:** Argyle Burn, Brigham's Leap, on roadside bank amongst grass and moss, 24.vii.1998, *D.J. Galloway 0385* (OTA).

10. *Peltigera neckeri* Hepp ex Müll.Arg., *Mem. Soc. Phys., Hist. Nat. Genève* 16: 370 (1862). For typification and additional synonymy see Vitikainen (1994: 65).

Illustrations: Olech & Alstrup (1988: fig. 4); Holtan-Hartwig (1993: 57, figs 66, 67); Goffinet & Hastings (1994: 35, figs. 61, 62); Vitikainen (1994: 65, fig. 106).

Description: Thallus in rosettes to irregularly spreading, 2–6(–8) cm diam. Lobes irregular, 0.5–1.5 cm wide, 1–3(–4) cm long. Margins irregularly scalloped or incised, slightly ascending, suffused red-brown, sometimes white-pruinose, sometimes ragged-eroded and regenerating small, irregular lobules or phyllidia. Upper surface celadon-green to steely grey when wet, pale greyish green to more or less olivaceous, tinged red-brownish when dry, matt or shining, more or less maculate at margins and apices (use x 10 lens), with small to large patches of glistening, transparent to white pruina (use x 10 lens) developing mainly centrally. Lower surface pale, tomentose between veins. Veins, 0.5–1 mm wide, flat to more or less raised, conspicuous at margins, anastomosing, pale buff at margins to dark-brown or black centrally or more or less uniformly black from margins to centre; interstices oval or lenticular, white or pale buff. Rhizines fasciculate, dark-brown to black, 2–4(–6) mm long, rather sparse at margins, more common centrally. Apothecia erect, saddle-shaped to more or less cylindrical or finger-like, 4–8 mm long, on short (3–5 mm), involute marginal lobes; disc dark red-brown to brown-black, epruinose; margins very thin, pale, often obscured by inrolled disc, dark-brown-tomentose below. Ascospores 3–7-septate, elongate-fusiform, colourless, (35–)45–62(–70) x 2.5–5 µm.

Chemistry: Tenuiorin, methyl gyrophorate, gyrophoric acid, dolichorrhizin, zeorin, and several unidentified triterpenoids (Holtan-Hartwig 1988, 1993).

Distribution (Fig. 10): From North Auckland (latitude 35°39'S) to southern Stewart Island (latitude 47°14'S). *P. neckeri* is a bipolar species which is widely distributed in temperate to boreal habitats of the Northern Hemisphere (Purvis & James 1992; Vitikainen 1994). It is not known from Australia (Filson 1996), Africa (Swinscow & Krog 1988), or southern South America (Galloway & Quilhot 1999).

Habitat ecology: *Peltigera neckeri* grows on sandy soil, amongst mosses in humid sites, often at streamsides or river banks (where it is occasionally more or less inundated), or alongside shaded paths and on damp, mossy roadside banks.

Distinguishing features: *Peltigera neckeri* is readily distinguished by the presence of white, glistening,

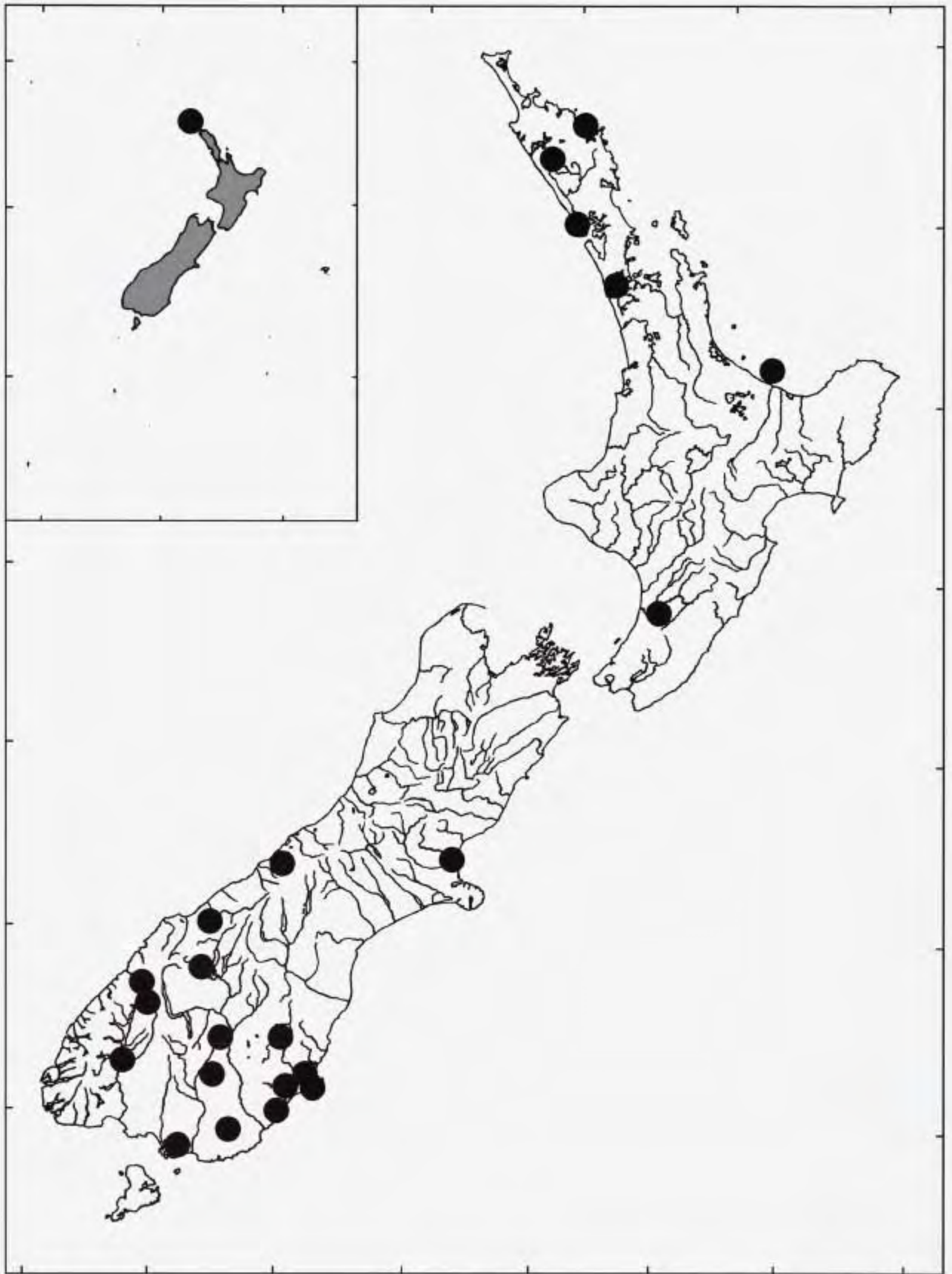


Fig. 11: Distribution of *Peltigera neopolydactyla* in New Zealand

irregular patches of laminal pruina (use x 10 lens) which give thalli a pale celadon-green colour when wet. The only other species having white pruina on the lobes is *P. subhorizontalis*, but this is much less densely pruinose, the pruina being mainly confined to the lobe margins and marginal phyllidia, it also has horizontal, round apothecia which are quite different to the erect, saddle-shaped to more or less cylindrical apothecia of *P. neckeri*.

Specimens examined: **North Auckland:** Waipoua Forest, damp rocks of quarry, 28.x.1934, *L.B. Moore s.n.* (CHR 487946) [cited by Zahlbruckner (1941: 294) as *P. dolichorbiza* f. *javanica* Gyeln. — identified by Gyelnik]; Great Barrier Island, Tryphena, on roadside clay bank, i.1984, *B.W. & G.C. Hayward s.n.* (AK 169008); Great Barrier Island, 0.5 km N of Windy Canyon Track to Mt Hobson, roadside on rock in ditch, 5.x.1995, *B. Polly s.n.* (WELT L5222). **Auckland:** Anawhata Stream, Waitakere, on stream boulders, xii.1973, *B.W. & G.C. Hayward H 41.4* (AK 154 389; CHR 378970). **South Auckland:** Te Aroha, *J.K. Bartlett s.n.* (AK 1922208); Tangitu, Kaimai Range, *J.K. Bartlett s.n.* (AK 192209); Mangaotaki Valley near Pio Pio, x.1971, *D.J. Galloway s.n.* (CHR 490601). **Gisborne:** Lake Waikaremoana, Korotipa Bay, among mosses on rocky headland on lake shore, 16.x.1997, *P.N. Johnson 3279* (CHR). **Hawke's Bay:** Puketitiri, *J.K. Bartlett s.n.* (AK 192205). **Wellington:** Ohakune, *J.E. Attwood s.n.* (CHR 487981); Pahiatua Track, northern Tararua Range, iii.1970, *D.J. Galloway s.n.* (CHR 48798); Wai-iti Stream, Tararua Range, on moss covered soil, 22.i.1944, *H.H. Allan s.n.* (CHR 160928); Ohau Valley, Tararua Range, 8.iii.1969, *D.J. Galloway 68590* (CHR 487933). **Canterbury:** Arthur's Pass, on earth, 2.vi.1962, *W. Martin s.n.* (CHR 490514); Mount Cook National Park, Wakefield track near Hooker roadbridge, earthy bank, 17.ii.1972, *H.D. Wilson 2295* (CHR 260719). **Westland:** Near Moeraki, among bryophytes on damp soil on fallen tree base, uncommon, 18.iii.1973, *P. Child 1746* (CHR 445367); Near Lichen Creek, Waitototo River, on bryophytes in shady bank beside river, 17.v.1985, *P. Child 2369* (CHR 445395). **Otago:** West Matukituki Valley, 10.ix.1967, *D.J. Galloway s.n.* (CHR 490641); Rob Roy Stream, Matukituki Valley, on mosses at edge of silver beech forest, 4.iv.1971, *P. Child 1393 pr.p.* (CHR 445384); Pigeon Island, Lake Wakatipu, track to trig, 18.iv.1998, *A. Knight s.n.* (OTA); Swampy Sum-

mit, Dunedin, iv.1963, *D.J. Galloway s.n.* (CHR 487908); S face of Flagstaff, shaded rocks, 29.i.1954, *W. Martin 1152* (OTA 048438) [cited as *P. praetextata* by Murray (1960: 397)]; Graham's Bush, on ground at side of track, 15.ii.1998, *J. Bannister s.n.* (OTA 049066); Sandymount near Dunedin, on sand, *J.S. Thomson 1773*, ZA 528 (CHR 490551) [cited as *P. pusilla* by Zahlbruckner (1941: 293), and as *P. polydactyla* var. *polydactyloides* by Murray (1960: 392)]; Maungatua, summit bog, iv.1966, *D.J. Galloway s.n.* (CHR 487942); Craig Flat Road, S of Millers Flat, on soil overlying roadside rock face, 7.ix.1997, *D.J. Galloway 0191* (OTA); Rigney, on soil veneer over rocks on banks of Clutha River, 30.iii.1998, *D.J. Galloway 1431* (OTA); Beaumont State Forest, Road 21 off Grindstone Road, on clay soil on wet road verge, 14.ix.1985, *P. Child 2518* (CHR 445373); Conical Hills, [*G.B. Rawlings s.n.* (CHR 487964)]. **Southland:** Fiordland National Park, Milford Sound, on ground, 9.i.1998, *J. Bannister s.n.* (OTA 048815); Te Wae Wae Bay, on coastal track between Bluecliffs and Port Craig, on ground, 24–6.x.1998, *A. Knight s.n.* (OTA). **Stewart Island:** Near Moturau Moana, mossy bank at roadside above Butterfield's Beach, on damp rocks close to gravel surface of road verge, 6.vi.1998, *D.J. Galloway 480* (OTA); Wilson Bay, 29.xi.1969, *D.J. Galloway s.n.* (CHR 487965).

11. *Peltigera neopolydactyla* (Gyeln.) Gyeln., *Rev. Bryol. Lichénol.* 5: 71 (1933). *Peltigera polydactylon* var. *neopolydactyla* Gyeln., *Magyar Bot. Lapok.* 31: 46 (1932). For typification and additional synonymy see Vitikainen (1994: 67).

Illustrations: Holtan-Hartwig (1993: 58, figs. 68, 69); Goffinet & Hastings (1994: 37, figs. 64, 65, 66); Vitikainen (1994: 67, figs. 108, 109).

Description: Thallus large, orbicular to spreading, 3–8(–15) cm diam. Lobes linear to irregular 0.5–1.5 cm wide, 2–6 cm long. Margins entire, wavy, to minutely and irregularly notched or torn, slightly thickened below, without phyllidia or tomentum, rarely with tomentose apothecial initials. Upper surface glabrous, dark blue-black or slatey grey-black when wet, pale grey to chestnut brown or red-brown when dry, glossy or matt, smooth, undulate to more or less billowed or bullate towards centre. Lower surface

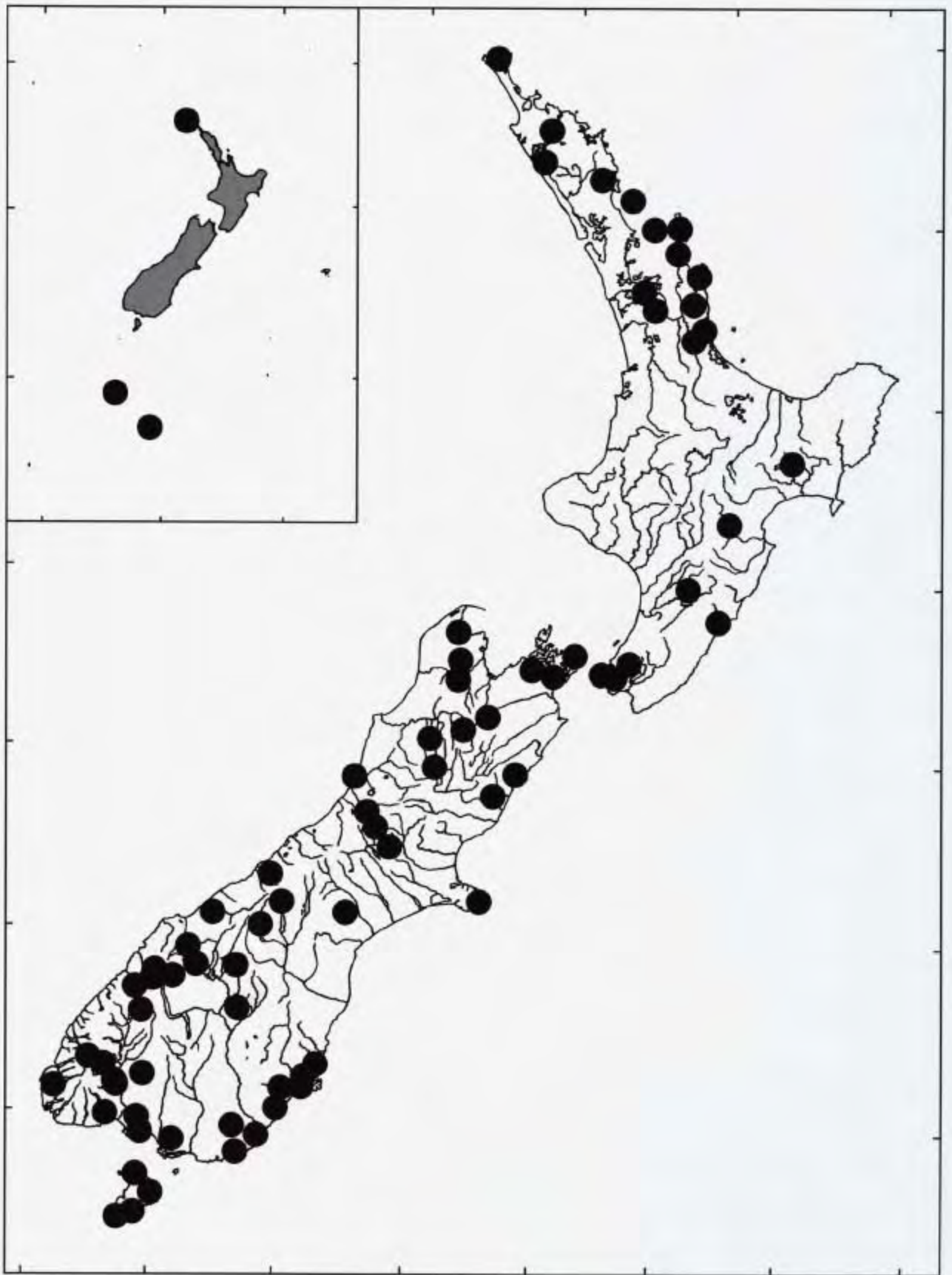


Fig. 12: Distribution of *Peltigera polydactylon* in New Zealand

tomentose, whitish or buff at margins, soon becoming greyish, brown or blackened centrally. Veins broad, flattened to slightly raised, 1.5–3(–4) mm wide, greyish or grey-brown at margins, black or brown-black centrally, anastomosing; interstices white, lenticular to oval. Rhizines brown to black, simple to fasciculate, 3–7(–10) mm long. Apothecia common, erect, saddle-shaped; disc red-brown, matt, epruinose, inrolled; margins pale buff, roughened, warted, soon disappearing, pale buff, ridged, tomentose below. Ascospores colourless, acicular, 3–7-septate, (62.5–)70–90(–95) x 2.5–3 µm.

Chemistry: Tenuiorin, methyl gyrophorate, peltidactylin, dolichorrhizin, zeorin, and unidentified triterpenoids (minor).

Distribution (Fig. 11): Three Kings Islands (latitude 34°10'S) to Awarua Bay (latitude 46°34'S). A possibly bipolar species. It is circumpolar, boreal to arctic in the Northern Hemisphere where it occurs in North America, Europe, and Asia (Holtan-Hartwig 1993; Goffinet & Hastings 1994; Vitikainen 1994; Goward et al. 1995). New Zealand records are the first for the Southern Hemisphere.

Habitat ecology: *Peltigera neopolydactyla* grows on damp, often peaty soils, amongst mosses and debris or on rotting logs below forest trees, or in scrub associations; on damp rocks and amongst grass on roadside banks; amongst *Sphagnum* in bogs from sea level to 1300 m.

Distinguishing features: *Peltigera neopolydactyla* is characterised by large, glabrous lobes with a more or less billowed or bullate upper surface (best seen towards centre), entire margins; buff to dark-brown or black, weakly raised veins below [1.5–3(–4) mm wide], black or brown-black, simple to fasciculate rhizines [3–7(–10) mm long], and long, acicular spores (62.5–95 x 2.5–3 µm). It is distinguished from *P. polydactylon* by the wider, flatter veins and the longer spores.

Specimens examined: **North Auckland:** Three Kings Islands, Great Island, North East Peninsula, xi.1970, *D.J. Galloway s.n.* (CHR 451392); Bald Hill, on soil in kanuka, xii.1982, *B.W. & G.C. Hayward s.n.* (AK 161482); Tasman Valley, beneath kanuka, xii.1983, *B.W. Hayward s.n.* (AK 169836); Bay of Islands, Moturua Island, on earth, i.1980, *B.W. & G.C.*

Hayward s.n. (AK 165920); Waipoua State Forest, mixed forest on river bank, i.1987, *B.W. Hayward s.n.* (AK 182463); Tapu Bush, North Kaipara Barrier, on ground, 22.v.1991, *B.W. Hayward s.n.* (AK 202558).

Auckland: Huia Stream, Waitakere Range, 22.i.1961, *E.E. Chamberlain* (CHR 487954). **South Auckland:** Motuhora (Whale) Island, Upper Camp Valley, on rocks beneath pohutukawa, i.1986, *B.W. Hayward s.n.* (AK 172072); Ridge above aviary, on moss bank below teatree, i.1986, *B.W. Hayward s.n.* (AK 172071).

Wellington: Tiritea near Palmerston North, *E. Chamberlain s.n.* (CHR 160956). **Westland:** Fox Glacier, xii.1954, *G.L. Longbottom s.n.* (OTA 048672); Near Ngatau Hut, among bryophytes and debris on boles of silver beech and fallen logs in wet places, 11.v.1973, *P. Child 1751* (CHR 445361); McArthur Flats, Arawata River, xi.1966, *D.J. Galloway s.n.* (CHR 490638). **Canterbury:** Woodend Beech, growing on moss in boggy ground under *Pinus* plantation, 12.x.1963, *I. Fryer s.n.* (CHR 490515, 490603); Lottery Bush, Waiiau, mixed beech-podocarp forest on old terraces and low rolling hill country, 7.xii.1982, *M.J.A. Simpson 8437 & M. Stolp* (CHR 414437). **Otago:** West Matukituki Valley, 10.ix.1967, *D.J. Galloway s.n.* (CHR487925); Symes Road. Old Man Range, frequent in wet, subalpine bush, 8.iii.1997, *J. Steel s.n.* (OTA 048024); Rock & Pillar Range, below Leaning Lodge, *Sphagnum* bog, 21.x.1977, *J. Child 1785* (CHR 388390); Maungatua, in grass beside track through manuka, 15.i.1954, *W. Martin 925* (OTA 048685); Mopanui, on damp rock under manuka, 30.vii.1970, *J. Child 1031* (CHR 390196); Swampy Summit, Dunedin, on soil, 19.iii.1966, *D.J. Galloway s.n.* (OTA 046888); Leith Saddle, amongst mosses on log in open forest, 8.xi.1969, *W. Martin s.n.* (CHR 490606); Wakari, Dunedin, iv.1958, *J. Murray 1934* (OTA 048695); Ravensbourne, shaded branch, vii.1958, *J. Murray 1976* (OTA 048694); Outram Glen, on mossy tree bases, 1.1961, *W. Martin A115* (CHR 487979); Waipori Gorge, on forest floor, vii.1969, *J. Child 44* (CHR 390178); S of Taieri Mouth, in bush, iv.1958, *J. Murray 1667, 1673* (OTA 048699, 048696); Akatore Bridge, i.1958, *J. Murray 1555* (OTA 048675). **Southland:** Milford Sound, on ground, 9.i.1998, *J.M. Bannister s.n.* (OTA 048814); Lake Gunn, vii.1962, *J. Taylor s.n.* (CHR 160770); Manapouri, on debris, beech forest, 1954, *D. Hamilton s.n.* (OTA 048676); Argyle Burn,

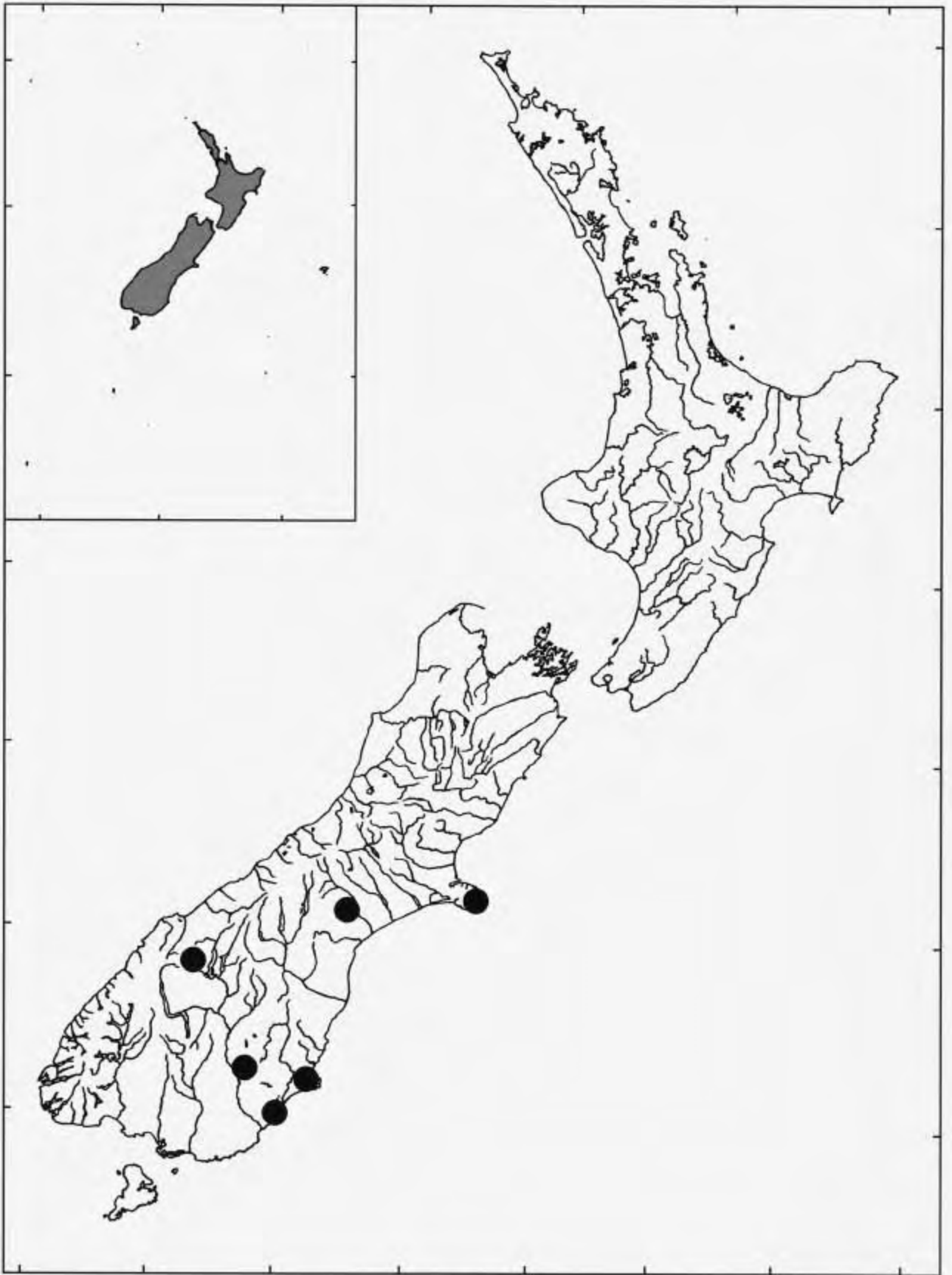


Fig. 13: Distribution of *Peltigera praetextata* in New Zealand

Brigham's Leap, on roadside bank amongst moss and grass beneath *Cytisus scoparius*, 24.vii.1998, *D.J. Galloway* 0381 (OTA); Pukerau, *Festuca rubra* bog, v.1967, *D.J. Galloway* s.n. (CHR 490635); Awarua Bog, near Awarua Bay, on peaty earth amongst manuka, 27.xii.1958, *W. Martin* 5786 (CHR 490510); Awarua Bay, on detritus under pines, *W. Martin* s.n. (CHR 487963); Near Awarua Bay, on relatively wet peat soil, 20.v.1959, *G.C. Martin* s.n. (CHR 487980).

12. *Peltigera polydactylon* (Neck.) Hoffm., *Descr. Adumbr. Lich.* 1: 19 (1790). *Lichen polydactylon* Neck., *Metb. Musc.*; 85 (1771). For typification and additional synonymy see Vitikainen (1994: 69).

Illustrations: Moberg & Holmäsén (1982: 176); Olech & Alstrup (1988: 177, fig. 5); Holtan-Hartwig (1993: 63, figs 76, 77); Goffinet & Hastings (1994: 38, fig. 68, 39, figs 69, 70); Vitikainen (1994: 69, fig. 111).

Description: Thallus orbicular to irregularly spreading, 2–8(–15) cm diam. Lobes irregular, linear-laciniate, more or less discrete at apices, overlapping centrally, 0.5–1.5 cm wide, 1.5–3(–4) cm long. Margins entire, wavy, slightly thickened below, more or less ascendent, often lacerate-incised to more or less phyllidiate, or here and there with small, fuzzy, brownish apothecial initials. Upper surface glabrous, dark leaden-grey to blue-black when wet, pale blue-grey to somewhat brownish when dry, minutely maculate close to margins (use x 10 lens), glossy to matt, undulate, wrinkled, dimpled or more or less bullate in parts, often irregularly longitudinally or laterally cracked with small phyllidia occasionally regenerating from margins of cracks. Lower surface tomentose, pale or whitish at margins, to buff or dark brown centrally. Veins rather flattened to raised, 0.5–1.5 mm diam., pale buff to dark brown at margins, brown-black to black centrally, confluent to more or less continuous at margins, soon anastomosing, and with more or less oval to rounded, pale or whitish interstices. Rhizines simple to fasciculate, pale buff to dark brown or blackened, in rows or with more or less confluent bases near apices, more widely scattered centrally, rather short, 2–4 mm long. Apothecia erect, round to saddle-shaped, 2–5 mm diam., on more or less involute marginal stalks; disc pale to dark red-brown, epruinose; margins thin, crenate, pale buff.

Ascospores colourless, 3–5-septate, acicular, (48–)50–60(–64) x 2.5–4 µm.

Chemistry: Peltidactylin, dolichorrhizin, zeorin.

Distribution (Fig. 12): From the Three Kings Islands (latitude 34°10'S) to southern Stewart Island (latitude 47°14'S) and the Subantarctic islands. *Peltigera polydactylon* is a cosmopolitan species widespread in the Northern Hemisphere, South America, and Australia (Vitikainen 1994).

Habitat ecology: *Peltigera polydactylon* grows in moderate shade to high-light habitats on soil, amongst mosses and litter and rotting logs on the forest floor; on rocks, roadside banks, subalpine bogs, and scrub; from sea level to 1800 m.

Distinguishing features: *Peltigera polydactylon* is characterised by linear-elongate lobes with wavy, ascendent margins which are often phyllidiate; it has a glabrous, glossy upper surface; more or less erect apothecia on involute stalks; simple to fasciculate, rather short rhizines which are often in rows or with more or less confluent bases at the margins; and with hopane triterpenoids in the medulla. It is distinguished from *P. dolichorbiza* by the wavy, ascendent margins and the presence of marginal phyllidia, and the rather shorter rhizines.

Specimens examined: **North Auckland**: Three Kings Islands, Great Island, North-East Peninsula, xi.1970, *D.J. Galloway* s.n. (CHR 451393); Pandora, *J.K. Bartlett* s.n. (AK 192192); Radar Bush, *J.K. Bartlett* s.n. (AK 192207); Warawara State Forest, *J.K. Bartlett* s.n. (AK 192193); Mangamuka, roadside in kauri forest, 21.vi.1941, *H.H. Allan* s.n. (CHR 487957); Tutukaka, on soil in forest inland, ix.1980, *B.W. Hayward* s.n. (AK 164502); Kawerua, on decaying log beneath bush in forest, v.973, *B.W. & G.C. Hayward* s.n. (AK 182531); Waipoua, Yakas Track, base of *Dicksonia squarrosa* on track, 8.i.1990, *C.J. West* s.n. (WELT L4548); Hugh Crawford Reserve, forest litter, *C. Fosters* s.n. (AK 222534); Onerahi, Whangarei, roadside manuka, 11.xii.1996, *D.J. Galloway* W32 (CHR); Hen Island, Moran's Look-out, on side of rock, viii.1977, *B.W. & G.C. Hayward* s.n. (AK 161874); Little Barrier Island, on soil beneath manuka, viii.1981, *B.W. Hayward* s.n. (AK 175362); Rakitu Island, on soil beneath kanuka, 1980, *B.W. Hayward* s.n. (AK 166166); Great Barrier Island,

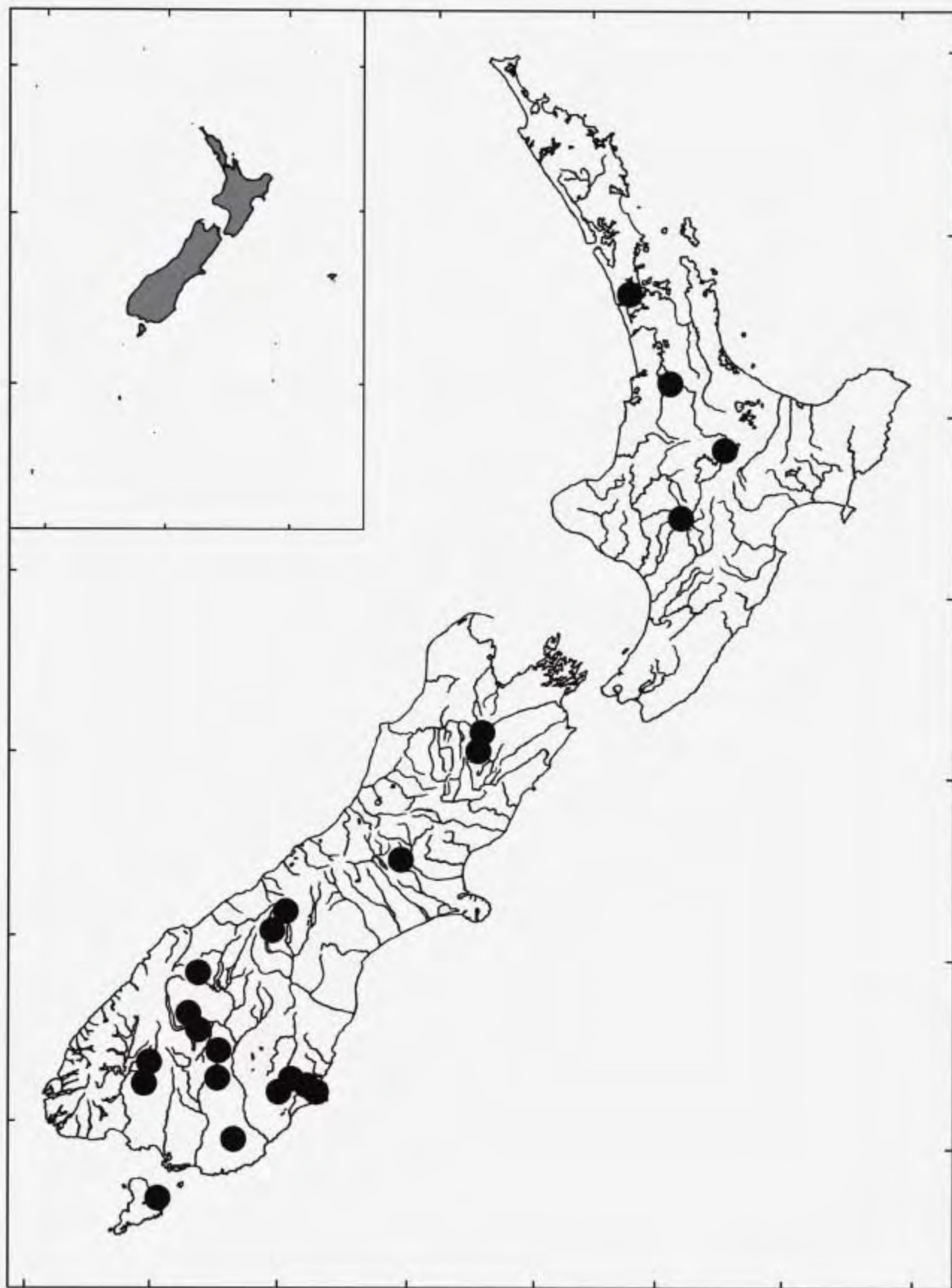


Fig. 14: Distribution of *Peltigera rufescens* in New Zealand

- x.1972, *B.W. Hayward H30.12* (CHR 378969). **Auckland:** Kauri Glen Reserve, Northcote, on base of manuka trunk 6 cm above ground on bush margin, 28.iv.1974, *A.E. Wright 12355* (AK 232988). **South Auckland:** Moehau, *J.K. Bartlett s.n.* (AK 196142); Mt Maungatawhiri, on earth in broken-in grassland on slopes, viii.1974, *B.W. Hayward H44.99* (AK 154479); Kauaeranga Valley, Tarawaere Track, on rotting log, 1977, *G.C. & B.W. Hayward s.n.* (AK 165919); Hunua Gorge, on ground, open forest floor, thin litter layer, 6.vi.1976, *A.J. Dakin s.n.* (AK 208317); Te Aroha, *J.K. Bartlett s.n.* (AK 192203); Kaimai Tunnel, *J.K. Bartlett s.n.* (AK 192195); Te Maika, *J.K. Bartlett s.n.* (AK 198344); Hatepe Valley, i.1975, *G.C. Martin s.n.* (OTA 048434); **Gisborne:** Urewera National Park, Aniwanawa, 19.iii.1970, *P.J. Edwards 53* (CHR 490655). **Hawke's Bay:** Puketitiri, xii.1958, *M. Clark 4298* (OTA 148689). **Wellington:** Whariti, Ruahine Range, on bryophytes overlying rotten log, 2.xii.1967, *W. Martin s.n.* (CHR490658); Akitio, vi.1972, *D.J. Galloway s.n.* (CHR 487961); Otaki River, Tararua Range, iv.1969, *D.J. Galloway 79140* (CHR 490585); Tauherenikau, Wairarapa, viii.1941, *V.D. Zotov s.n.* (CHR 490592); Masterton, xi.1873, *J. Buchanan s.n.* (WELT L3001); Wilton's Bush, 15.vii.1969, *J. Child 75* (CHR 390295); Wainuiomata, *H.H. Allan s.n.* (CHR 490589); Orongorongo Range, 14.vii.1941, *H.H. Allan s.n.* (CHR 487927). **Nelson:** Kaituna Gorge, moss on trees, *J.S. Thomson T 1955* (OTA 047380); S flank of Mt Mytton, Cobb Valley, on rotten stump, 11.ii.1988, *A.J. Fife 8679 & B.H. Macmillan* (CHR 460795); Mt Arthur, *J.K. Bartlett s.n.* (AK 197104); Whisky Creek on Flora Saddle Track, amongst shattered rock at trackside crossing open scree slope, 13.iv.1991, *B.W. Hayward & A.E. Wright 11185* (AK 204381); Ridge above Mole Tops, Nelson Lakes National Park, rocks, 14.ii.1968, *M.J.A. Simpson 5366* (CHR 306358); Lake Rotorua, beech-podocarp forest, 17.xi.1977, *D.J. Galloway s.n.* (CHR 266643); Pelorus Bridge Forest Reserve, on moss-covered earth, 1.x.1956, *W. Martin 4168* (OTA 048710); Lake Rotoiti, 13.i.1960, *D. Scott 377* (OTA 048690); Matakaitaki Valley S of Murchison, amongst moss on wet ground, 3.vi.1968, *D.H. Smith s.n.* (CHR 160939); Maruia Springs, on old log, 6.i.1971, *P. Child s.n.* (CHR 445357). **Marlborough:** Motuara Island, on bark in mixed teatree forest, 4.i.1992, *G.C. Hayward s.n.* (AK 205509); Anakiwa, *H.H. Allan s.n.* (CHR 487986); Track between Resolution Bay and Ship Cove, 1.i.1992, *B.W. Hayward s.n.* (AK 205325); Wairau Valley, on moist soil amongst tall manuka, 2.ix.1959, *W. Martin 7962* (OTA 048709); Lake Rotorua, near Kaikoura, on very wet bank along track, 1.vi.1968, *N.C. Lambrechtsen s.n.* (CHR 160925). **Westland:** Kelly's Creek, on bark of *Olearia acicennifolia* over small side stream, 17.ii.1991, *A.E. Wright, 11120* (AK 201978); Cobden Bank, Greymouth, on Mahoe, 24.ii.1954, *W. Martin 5422* (OTA 048708); Upper Waihao Valley, grassy flats by ice-scoured hillocks, 30.x.1967, *I. Fryer s.n.* (CHR 160841); Quartz Hill near Haast, among moss on rotten log, 19.v.1971, *P. Child 1453* (CHR 445358); Lower Haast Valley, on fallen tree trunk, 25.x.1964, *W. Martin 6200* (CHR 490649); Drake Flats, Waiatoto, on trunk of old fallen silver beech, 16.v.1985, *P. Child 2357* (CHR 445375). **Canterbury:** Upper Bealey River, Arthur's Pass, among mosses on bank in stunted, open mountain beech forest near treeline, 17.xii.1997, *P.N. Johnson 3283* (CHR); Arthur's Pass, in detritus, margin of beech forest, 2.vi.1962, *W. Martin 5266* (CHR 490513); Mt Wall, Craigieburn Range, iii.1959, *A.F. Mark s.n.* (OTA 048435); Hundalee, on earth (floor of beech forest), 6.iii.1954, *W. Martin 1306* (OTA 048457); Banks Peninsula, Toi Clearing, West Track, Hinewai Reserve, edge of grassy track under fringe of kanuka, 21.vii.1998, *H.D. Wilson s.n.* (OTA); Mt Cook National Park, Sealy Lakes Track, in moss on side of large rock in low subalpine scrub, 11.iv.1972, *H.D. Wilson 2722* (CHR 260905); Rata Stream, Peel Forest, overarching branch in stream-bed, 6.x.1977, *B.P.J. Molloy s.n.* (CHR 240915); Huxley Gorge, Lake Ohau, v.1958, *J. Murray 1848* (OTA 048692). **Otago:** West Matukituki Valley, Aspiring Hut, 10.ix.1967, *D.J. Galloway s.n.* (CHR 490642); Kidd's Bush, Lake Hawea, common on ground among bryophytes in damp, manuka heath, 3.vi.1973, *P. Child 1787* (CHR 445394); Rees Valley, Mt Earnslaw, iv.1972, *A.A. Deans s.n.* (CHR 487932); Hidden Falls Stream, 19.ii.1968, *D.J. Galloway s.n.* (CHR 490628); Beans Burn, Dart Valley, on damp riverbank, 23.viii.1972, *P. Child 1725* (CHR 445360); Upper Routeburn, v.1968, *A.F. Mark s.n.* (OTA 021599); Survey Flat, Dart Valley, xii.1967, *D.J. Galloway s.n.* (CHR 490629); Earnslaw, among scrub, 27.i.1970, *J. Child 330* (CHR 390180); Dunstan Mountains, scattered among mosses, subalpine bog

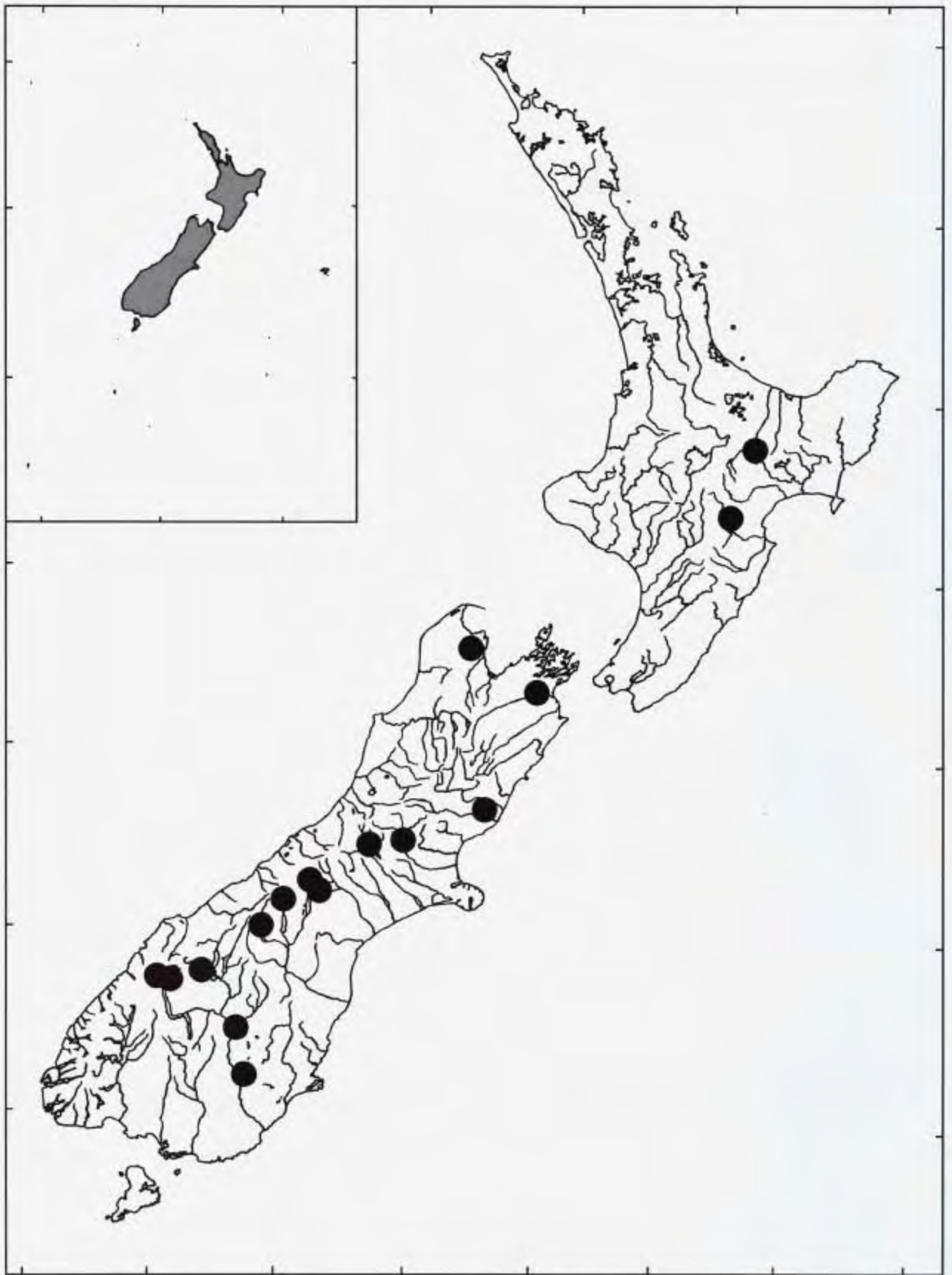


Fig. 15: Distribution of *Peltigera subhorizontalis* in New Zealand

near stream, 19.ii.1986, *P. Child* 2698 (CHR 445366); Merton, damp grass, i.1959, *J. Murray* 3899 (OTA 048437); Mopanui, 30.vii.1970, *J. Child* 1021 (CHR 390215); Whare Flat, on forest floor track, 17.iv.1960 *W. Martin* s.n. (CHR 490582); Flagstaff, among grass on edge of shady bank, 2.viii.1969, *J. Child* 85 (CHR 383354); Leith Saddle, on decaying wood on forest floor, 16.iii.1966, *W. Martin* s.n. (OTA 048717); Morrison's Creek, iii.1963, *D.J. Galloway* s.n. (CHR 490608); Abbotts Hill, rotten log, 2.ix.1933, *J.S. Thomson* T 929 (OTA 025595); O'Brien's Creek, Taieri Mouth, mossy bank, xi.1957, *J. Murray* 1261 (OTA 048701); S of Taieri Mouth, iv.1958, *J. Murray* 1672 (OTA 048698); Berwick, on old log, 17.viii.1969, *J. Child* 100 (CHR 383356); Waipori Gorge, beech forest floor, vii.1969, *J. Child* s.n. (OTA 048433); Akatore River, old tree trunk, 26.x.1997, *J.M. Bannister* s.n. (OTA); Tuapeka West, beech-kanuka forest, 26.x.1996, *A. Knight* s.n. (OTA); Kaka Point, 7.ii.1967, *D.J. Galloway* s.n. (CHR 490632); Tautuku Beach, Catlins, on *Metrosideros*, i.1957, *J. Murray* 1025 (OTA 048673); **Southland:** Milford, on ground, 9.i.1998, *J.M. Bannister* s.n. (OTA 048813 pr.p.); McKinnon's Pass, on moss, beech forest, *J.S. Thomson* T 2900 pr.p. (CHR 160936); Doubtful Sound, *J.S. Thomson* T 2883 (OTA 047888); Cook Stream, Pickersgill Harbour, Dusky Sound, 18.ii.1969, *D.J. Galloway* s.n. (CHR 490622); South Arm, Lake Manapouri, on rotting log, 16.xi.1990, *A.E. Wright* 10588 (AK 205647); Lake Monowai, on bark of *Nothofagus solandri* var. *cliffortioides*, along margin of lake, 19.xi.1990, *A.E. Wright* 10791 (AK 200674); Cascade Creek, Eglington Valley, on forest floor amongst detritus, 27.ii.1972, *W. Martin* s.n. (CHR 490511); Takitimu Forst, Beckett's Hut, 13.ix.1998, *A. Knight* (OTA); Kuriwao, on peaty area, iii.1958, *W. Martin* 5763 (CHR 497913); Waihopai [Reserve], Invercargill, on decaying log in shade, forest margin, 14.x.1967, *W. Martin* s.n. (CHR 490646); Seaward Bush, Invercargill, moss-covered log on forest floor, 3.i.1966, *W. Martin* s.n. (CHR 490645); Riverton Bush, rotten log, *J.S. Thomson* T 797 (OTA 047729); Longwood Range, on moist earth, 25.i.1957, *W. Martin* 6949 (CHR 490644); Te Wae Wae Bay, on coastal track between Bluecliffs and Port Craig, on ground, 24–6.x.1998, *A. Knight* s.n. (OTA). **Stewart Island:** Mt Anglem, 23.v.1964, *G.A.M. Scott* 70 (OTA 007795); Glory Cove, 15.ii.1967, *D.J. Galloway* s.n. (CHR

490670, 490671); Ocean Beach, creeping over mosses on tree trunk, 11.ii.1947, *W. Martin* 60 (CHR 490653); Islet Cove, Port Pegasus, in coastal forest, 3.ii.1989, *B.W. Hayward* s.n. (AK 208182); Port Pegasus, on dead tree, 5.i.1998, *J.M. Bannister* s.n. (OTA 048817); Anchorage Island, Port Pegasus, ii.1967, *D.J. Galloway* s.n. (OTA); Anchorage Island, i.xii.1969, *D.J. Galloway* s.n. (CHR 490668); Wilson Bay, Port Pegasus, 29.xi.1969, *D.J. Galloway* s.n. (CHR 490667).

13. *Peltigera praetextata* (Flörke ex Sommerf.) Zopf, *Ann. Chem.* 364: 299 (1909). *Peltidea ulorbiza* β *praetextata* Flörke ex Sommerf., *Suppl. Fl. Lappon.*: 123 (1826). For typification and additional synonymy see Vitikainen (1994: 74).

?= *Peltigera nitens* f. *zeelandica* Gyeln., *Magy. Bot. Lapok.* 28: 60 (1929). Type: New Zealand, *sine loco*, *S. Berggren* (S — not seen) [see Murray 1960: 397–8].

Illustrations: Moberg & Holmäsén (1982: 12, fig. 12, 177); Wirth (1987: 347); Goffinet & Hastings (1994: 41, figs 75, 76); Vitikainen (1994: 74, fig. 115); McCune & Geiser (1997: 217).

Description: Thallus rounded to irregular, 3–10(–12) cm diam., closely attached centrally, margins more or less ascending. Lobes 0.5–1.5(–2) cm wide and 2–4 cm long. Margins slightly thickened below, inrolled or downrolled, entire, wavy or notched, more or less phyllidiate. Upper surface dark slatey blue-black, suffused red-brown at margins when wet, red-brown to grey-brown when dry, thinly tomentose at margins, glabrous centrally, wrinkled to more or less bullate, more or less phyllidiate. Phyllidia marginal or developing from cracks and tears in upper surface, simple at first, becoming more or less coralloid branched, 0.2–1 mm tall, concolorous with upper surface or darker, etomentose, scattered to more or less densely crowded. Lower surface whitish to pale buff at margins, darkening to more or less brownish centrally. Veins conspicuous (use x 10 lens), raised, 0.2–0.8 mm wide, whitish or pale yellow-brown at margins to brownish or more or less blackened centrally; interstices lenticular, whitish. Rhizines discrete, simple, pale to brown, 2–5 mm long. Apothecia occasional, on involute, marginal lobes, more or less rounded, 5–6 mm diam.; disc matt, dark red-brown, epruinose; margins pale buff to red-brown, coarsely corrugate-

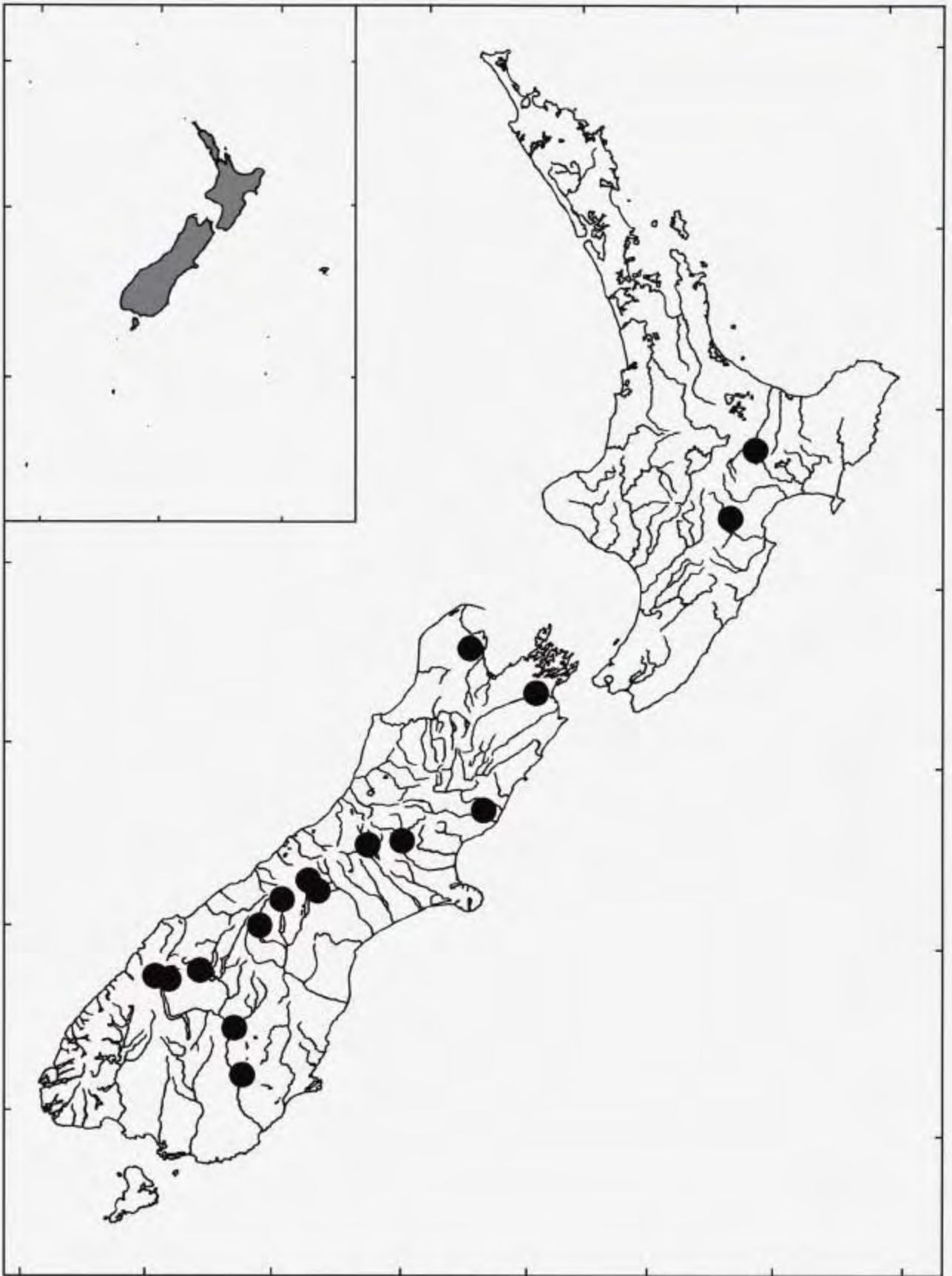


Fig. 16: Distribution of *Peltigera ulcerata* in New Zealand

scabrid to minutely phyllidiate, pale buff, tomentose, and more or less ridged below. Ascospores acicular, hyaline to pale straw, 3–5-septate, 45–70 × 3–4 µm.

Chemistry: TLC — nil.

Distribution (Fig. 13): Known in New Zealand from mainly lowland habitats in Canterbury (Peel Forest) and Otago from coastal (Dunedin, Akatore) and inland (Millers Flat, West Matukituki) sites. *Peltigera praetextata* is a cosmopolitan species widespread in the Northern Hemisphere (Purvis & James 1992; Vitikainen 1994; Goward et al. 1995; Swinscow & Krog 1988). In the Southern Hemisphere it is known at present only from New Zealand.

Habitat ecology: *Peltigera praetextata* occurs on shaded mossy rocks alongside streams and rivers, on damp rocks of roadside cuttings. It is still poorly known and collected in New Zealand.

Distinguishing features: *Peltigera praetextata* is distinguished from both *P. canina* and *P. membranacea* by the presence of marginal and occasionally also laminal phyllidia, a tomentose upper surface (the tomentum commonly only present at the margins), the flattened, smooth brown veins, and slender, simple rhizines which are not fused together at their base.

Specimens examined: **Canterbury**: Banks Peninsula, Hinewai Reserve, West Track near Quiet Stream, on side of track through second-growth hardwood forest, 10.ix.1998, *H.D. Wilson s.n.* (OTA); Peel Forest, at base of old tree stump, *P. Child 1209* (CHR 445374). **Otago**: Dunedin, Wakari, mossy rock by stream, xi.1957, *J. Murray 1213* (OTA 048648); Akatore Bridge, i.1958, *J. Murray 1556* (OTA 048649); Craig Flat Road, 6.6 km W of Millers Flat, on W-facing damp rocks and rock faces at side of road, 10.xi.1997, *D.J. Galloway 1058, 1059* (OTA); Cascade Stream, West Matukituki, 10.x.1967, *D.J. Galloway s.n.* (CHR 490620).

14. *Peltigera rufescens* (Weiss) Humb., *Fl. Friberg.*: 2 (1793). *Lichen caninus* [var.] *rufescens* Weiss, *Pl. Crypt. Fl. Goett.*: 79 (1770). For typification and additional synonymy see Vitikainen (1994: 77–8).

Illustrations: Martin & Child (1972: 115, pl. 27); Moberg & Holmäsén (1982: 177); Wirth (1987: 348); Vitt et al. (1988: 230); Goffinet & Hastings (1994: 44, fig. 82, 45,

fig. 83); Vitikainen (1994: 78, fig. 118); McCune & Geiser (1997: 218).

Description: Thallus rosette-forming to irregularly spreading 3–12(–30) cm diam. Lobes irregular, linear to rounded, 0.5–1.2 cm wide and 0.5–2.5(–3) cm long. Margins undulate-wavy, crisped, ascendent, often lobulate or phyllidiate, commonly tomentose, or scabrid, whitened, sometimes with small, fuzzy, brown-tomentose apothecial initials. Upper surface brownish or reddish brown, paler to more or less whitish at margins and apices (in alpine forms often conspicuously eroded-white or greyish), tomentose at or near margins, glabrous centrally, matt or shining, smooth to undulate or more or less bullate in parts, sometimes maculate at or near margins (x 10 lens), rarely with small patches of glistening pruina towards centre. Lower surface tomentose, pale buff or whitish at margins, dark brown to blackening centrally. Veins 0.5–1 mm wide, rather flat, brown to dark-brown or black, anastomosing; interstices pale or whitish, lenticular. Rhizines simple at margins, soon becoming entangled-confluent, in more or less dense lines along veins, pale brownish or buff at margins, soon dark-brown to black towards centre, 2–5 mm long. Apothecia saddle-shaped 3–5 mm long, on short, marginal lobes; disc matt, epruinose dark red-brown to brown-black. Ascospores colourless, elongate-fusiform, 5–7-septate, (45–)50–60(–65) × 2.5–5 µm.

Chemistry: TLC — nil.

Distribution (Fig. 14): From Auckland (Waitakere Ra.) to Stewart Island (Paterson Inlet). A cosmopolitan species widespread in both Northern and Southern Hemispheres (Purvis & James 1992; Vitikainen 1994).

Habitat ecology: *Peltigera rufescens* grows on soil or amongst mosses, on roadside verges and banks, on old sand dunes, on stumps and decorticated wood, on rocks, and in alpine turf, generally in rather open situations from sea level to 2000 m. Commonly associating with other cyanobacterial lichens such as *Coccocarpia palmicola*, *Peltigera didactyla*, and *Massalongia carnosa*.

Distinguishing features: *Peltigera rufescens* is characterised by a tomentose upper surface (often only at margins), upturned lobe margins and apices, frequently with phyllidia (in lowland forms especially),

blackish confluent rhizines in more or less dense lines, and veins darkening abruptly from margins to centre. Exposed alpine forms are smaller and more caespitose than lowland forms, and have thicker more leathery lobes which are much more closely and complexly folded-crowded, with conspicuously grey-white margins and apices, possibly the result of erosion by wind-blown soil or stones.

Specimens examined: **Auckland:** Waitakere, on banks, viii.1958, *J. Murray 3456* (OTA 048652). **South Auckland:** Ruakura Junction, i.1936, *H.H. Allan s.n.* (CHR 160904, 160944); Waikato River near Huka Falls, on bank of roadway under scrub, 16.xi.1964, *A.J. Healy 64/418* (CHR 487915). **Wellington:** Tongariro National Park, in forest, 21.iv.1960, *D. Scott 484* (OTA 048666). **Nelson:** Mangarakau, sandy bank, *J.S. Thomson T 2639* (OTA 047267); Nelson Lakes National Park, St Arnaud, Lake Rotoiti, amongst moss under manuka, 15.xi.1977, *D.J. Galloway s.n.* (CHR 266745). **Westland:** *Sine loco*, on soil, 22.viii.1970, *J. Child 1122* (CHR 390211). **Marlborough:** Upper Wairau Valley, in shade of manuka, 2.ix.1959, *W. Martin 1831* (CHR 490604). **Canterbury:** Arthur's Pass National Park, Andrews River, amongst moss on rock at forest margin, 16.ii.1991, *W.A. Nelson s.n.* (WELT L2805); Craigieburn Range, Porter Heights Ski Field, western side, on soil on edge of tussock, 15.i.1998, *D.B. Rogan 142* (AK 235187); Mount Cook National Park, Mt Sebastopol, 22.i.1972, *D.J. Galloway 2212* (CHR 260721); Mt St Mary, *J.S. Thomson 2560* (CHR 490516; OTA 030028). **Otago:** Rob Roy Stream, Matukituki Valley, luxuriant patches to 30+ cm, on mosses at edge of S beech forest, 4.iv.1971, *P. Child 1393 pr.p.* (CHR 445384); Coronet Peak, iii.1961, *A.F. Mark 5727* (OTA 048752); Remarkables, on *Polytrichum* beside tarn E of Lake Alta, 27.i.1972, *J. Child 1415* (CHR 388458); Old Man Range, Potters, on soil between tussocks on old gold workings, 26.ii.1998, *D.J. Galloway 0240* (OTA); Gem Lake Cirque, Whitecomb Range, in damp soil at base of grasses in snowbank, 17.iii.1997, *D.J. Galloway 1072* (OTA); Lake Onslow, in moss on rock in grassland near fishing huts, 30.vii.1998, *D.J. Galloway 0338* (OTA); Lammerlaw Range, Deep Stream, mossy rock on hillside above DCC pipeline intake, 13.ii.1998, *D.J. Galloway 0156* (OTA); Lee Stream-Hindon Road, xi.1956, *J. Murray*

0695a (OTA 048691); Sandymount, on sand, *J.S. Thomson T1773* (OTA 047720); Mount Cargill, on dry soil, 1.1959, *J. Murray 3782, 3783* (OTA 048657, 048656); Flagstaff, E side, on damp rocks, ix.1959, *J. Murray 4570, 4572* (OTA 048655, 048653); Flagstaff, 29.i.1954, *W. Martin 1137* (OTA 048423); Wakari, Dunedin, iv.1958, *J. Murray 1903* (OTA 048647); 34 Lynwood Avenue, Dunedin, on wooden sleeper in garden, 30.x.1997, *J.M. Bannister s.n.* (OTA); Ravensbourne, clay banks, vii.1958, *J. Murray 1977* (OTA 048644); Tomahawk, on moss etc., xi.1953, *J. Murray 0391* (OTA 048643). **Southland:** Kaiwera, on swampy ground, iv.1958, *W. Martin s.n.* (CHR 490659); South Mavora Lake, 4.ix.1998, *J.M. Bannister s.n.* (OTA); Takitimu Forest, Beckett's Hut, 13.ix.1998, *A. Knight* (OTA). **Stewart Island:** Near Moturau Moana above Butterfield's Beach, on roadside bank, 6.vi.1998, *D.J. Galloway 481* (OTA); Moturau Moana Gardens, on ponga fence, 6.vi.1998, *D.J. Galloway 532* (OTA); Golden Bay, soil on shaded vertical face above jetty, 8.vi.1998, *D.J. Galloway 546* (OTA).

15. *Peltigera subhorizontalis* Gyeln., *Annls Cryptog. Exot.* 5: 39 (1932). Type: Australia. **Victoria:** On rock by Moranding Creek, Kilmore, April 1890, *F.R.M. Wilson 1118* (NSW L2902 — not seen — holotype, *vide* Filson 1986: 220).

= *Peltigera nigripunctata* f. *farinosa* Gyeln., *Annls Cryptog. Exot.* 4: 168 (1931). Type: New Zealand, 1874–5, *S. Berggren*, sub *39 Peltigera venosa* (UPS — not seen).

= *Peltigera horizontalis* var. *muscorum* f. *albido-pruinosa* *J.S. Murray, Trans Roy. Soc. N.Z.* 88: 391 (1960). Type: New Zealand. **Otago:** Matukituki Valley, 4000 ft, on soil among scree, *D. Scott 4389* (OTA! — holotype).

Description: Thallus in neat rosettes or irregularly spreading to 1–3(–6) cm diam. Lobes 0.2–0.5(–1) cm wide and 0.5–2 cm long. Margins entire, incised-lacerate to crenulate-lobulate or phyllidiate, weakly to noticeably white-pruinose (use x 10 lens) appearing frosted. Upper surface olive-green or yellowish olive-brown to greyish blue, tinged brownish to red-brown, matt, glossy in parts, rarely delicately white-pruinose in parts imparting a frosted appearance to lobes. Lower surface pale whitish buff to dark brown. Veins flat, to somewhat raised, anastomosing, 0.2–0.8 mm wide, pale to

dark-brown; interstices pale, oval to irregular. Rhizines pale to dark-brown, simple to densely fasciculate, short, to 2 mm long. Apothecia flat, horizontal, 2–3(–5) mm diam., distinctly raised above thalline margin; disc red-brown to brown-black, epruinose; margins pale buff, corrugate to minutely lobulate, exciple below scabrid-tomentose. Ascospores uniformly 3-septate, colourless to pale brownish, elongate-fusiform, 26–32(–38) x 5–8 μm .

Chemistry: TLC — nil.

Distribution (Fig. 15): From latitude 38°35'S (Te Whaiti) to latitude 45°40'S (S of Millers Flat). Known also from Victoria, and cited as from New South Wales by Filson (1996: 97).

Habitat ecology: On soil (both acid and calcareous), often amongst mosses on rocks or on damp, shady rocky banks or under forest trees, or in short tussock grassland, 30–1400 m.

Distinguishing features: *Peltigera subhorizontalis* is characterised by the white-pruinose margins which are entire to more or less phyllidiate, and the characteristic, horizontal apothecia. Murray (1960: 390) cited a number of South Island collections (recorded above) as *P. horizontalis* var. *muscorum*, and referred white-pruinose forms to f. *albido-pruinosa* (Murray 1960: 391) noting a similarity to *P. frigida* R. Sant. from southern Chile (Santesson 1944: 11–12). However, this latter species has much smaller thalli (to 2 cm diam.), lacks marginal phyllidia and pruina, has raised, non-anastomosing veins, and longer, narrower spores (40–44 x 3.5–6 μm).

Specimens examined: **South Auckland**: Te Whaiti, *J.K. Bartlett s.n.* (AK 192582). **Hawke's Bay**: Puketitiri, *J.K. Bartlett s.n.* (AK 4499001). **Nelson**: Takaka Hill, on rocky bank, ii.1953, *W. Martin s.n.* (CHR 487993). **Marlborough**: Avon Valley, 29.ii.1956, *W. Martin* 4245 (OTA 048712); Waihopai, *J.K. Bartlett s.n.* (AK 184042). **Canterbury**: Waiwera, Limestone Range, i.1941, *H.H. Allan s.n.* (CHR 490549; OTA 048738); Saddle between Cass Hill and Sugarloaf, on soil in *Notobofagus solandri* var. *cliffortioides* forest remnant, 18.ii.1991, *A.E. Wright* 11128 (AK 201485); Moa Creek, 17.ii.1979, *J. Brown s.n.* (CHR 490548); Mount Cook National Park, Kea Point track, on damp moss, old moraine, 24.xii.1970, *P. Child* 1199 (CHR 445369); mid

Godley River Valley, damp shady rock, 19.viii.1958, *D. Scott* 203 (OTA 048740); lower Godley River Valley, in short tussock grassland, 26.ii.1958, *D. Scott* 202 (OTA 048741); Mary Hill Station, Lake Tekapo, x.1958, *Mason* 43, 54 (OTA 048736, 048739, 048742); Glen Lyon Station, Lake Ohau, x.1958, *Mason* 177a (OTA 048737). **Otago**: Matukituki River bridge, on mossy rock, 24.v.1970, *P. Child* 357 (CHR 445368); Routeburn Valley, upper montane *Notobofagus fusca* forest at track above Routeburn Hut, on mossy boulders and rocks, 15.ii.1927, *G. Einar & Greta Du Rietz* 1792 (OTA 048748); Paradise, on shady bank, 28.i.1970, *J. Child* 783 (CHR 390203); Alexandra, on earth overlying schist rocks, 24.xii.1963, *W. Martin* 6265 (CHR 487992); Craig Flat Road, 6.6 km S of Millers Flat, damp rock faces at roadside, 10.xi.1997, *D.J. Galloway* 1052 (OTA).

16. *Peltigera ulcerata* Müll. Arg., *Flora* 63: 261 (1880).

Illustration: Swinscow & Krog (1988: pl. 12b).

Description: Thallus orbicular, small, 1–5 cm diam. Lobes, crowded, concave, more or less cochleate, 2–5(–10) mm diam., 5–25 mm long, to 250 μm thick. Margins entire, sinuous, to more or less ascending, slightly thickened below, often downrolled, more or less sorediate, occasionally lobulate, tinged brownish or brown-black. Upper surface glabrous, matt or glossy, pale greyish-green to olive-brown when wet, cinnamon-brown or yellowish, suffused brownish at margins when dry, sometimes more or less red-brown, sorediate. Soralia laminal and marginal, at first rounded, 1–2(–5) mm diam., forming in breaks in upper cortex, eroding and becoming confluent-ulcerose; soredia coarse, granular, blue-grey at first becoming red-brown when mature, often totally eroding and exposing patches of pale medulla. Lower surface pale buff or whitish, more or less uniformly buff-tomentose at margins. Veins flat, broad to confluent, indistinct at margins, with small, white, oval to irregular fibrous, white; interstices, pale pinkish brown at margins darkening centrally. Rhizines fasciculate, penicillate, solitary or in lines to more or less clustered, 1–3 mm long, pale buff at margins, darkening to brown-black centrally. Apothecia not seen.

Chemistry: Medulla TLC — nil; soralia C+ red; containing methyl gyrophorate more or less gyrophoric acid.

Distribution (Fig. 16): From latitude 36°48'S (Rangitoto Island) to latitude 44°50'S (Cluden Hill near Tarras). A widespread pantropical and pantemperate species (Vitikainen 1992, 1996), originally described from Brazil (Müller Argoviensis 1880, 1881). It is not yet recorded from Australia (Filson 1996).

Habitat ecology: *Peltigera ulcerata* is still rather infrequently collected in New Zealand, being known from sea level to subalpine habitats at 1500 m. It grows on soil, amongst moss, or on tree trunks near the ground, in rather open well-lit situations.

Distinguishing features: *Peltigera ulcerata* is characterised by the small, crowded, cochleate lobes having a glabrous, rather coriaceous upper surface and with prominent, marginal and laminal, ulcerose soralia containing coarse, granular grey-blue to red-brown soredia which are C+ red (gyrophoric acid). It is distinguished from *P. didactyla* by its smaller, thicker lobes and glabrous upper surface and the buff brown lower surface, and the morphology of the rhizines. The relationship of the pantropical *P. ulcerata* to the boreal taxon *P. leptoderma* Nyl. (Nylander 1860: 325) is discussed by Vitikainen (1994: 39).

Specimens examined: **Auckland:** Rangitoto Island, on *Metrosideros excelsa*, 9.xi.1982, *J.K. Bartlett* 20565 (AK 192198). **South Auckland:** Karangahake Gorge, 20.vi.1980, *J.K. Bartlett s.n.* (AK 204792); Te Kauri Park Scenic Reserve, along margin of forest and pasture; on base of fallen tree fern, 30.x.1989, *A.E. Wright* 9183 (AK 187103); Waihaha, *J.K. Bartlett s.n.* (AK 192199). **Marlborough:** Seaward Valley near Blue Duck Scientific Reserve, growing on moss on rotting wood in rough pasture, 1.xi.1993, *A.E. Wright* 12319 (AK 215430). **Canterbury:** Arthur's Pass National Park, Mt Cassidy, on soil, 18.xii.1980, *J.K. Bartlett s.n.* (CHR 490552); Saddle between Cass Hill and Sugarloaf, occasional on moss on soil beneath *Nothofagus solandri* var. *cliffortioides* forest, 18.ii.1991, *A.E. Wright* 11132 (AK 201489); Moa Creek, 17.ii.1979, *I. Brown s.n.* (CHR 490547); Mount Cook National Park, Mt Sebastopol, 20.i.1972, *D.J. Galloways s.n.* (CHR 490550); Sebastopol track, bank under snow totara in open scrub, 6.viii.1972, *H.D. Wilson* 2964 (CHR 260914); Black Birch Fan, damp bank under broadleaf etc. in litter on edge of bush, 16.x.1972, *H.D. Wilson* 3043

(CHR 260916). **Otago:** Cluden Hill, Tarras, among moss, on rock, 1.i.1970, *J. Child* 515 (CHR 384614).

Biogeographical notes

The 16 species of *Peltigera* found in New Zealand show a number of biogeographical affinities (see Galloway 1996 for explanation of terms) These are:

(1) *Cosmopolitan or azonal taxa:* Seven species (44% of the total) are widespread, cosmopolitan species and include *P. canina*, *P. didactyla*, *P. lepidophora*, *P. membranacea*, *P. polydactylon*, *P. praetextata*, and *P. rufescens*.

(2) *Bipolar taxa:* Five species (31% of the total) are bipolar and include *P. degenii*, *P. bymenina*, *P. malacea*, *P. neckeri*, and *P. neopolydactyla*.

(3) *Pantropical-southern temperate taxa:* Two species (12.5% of the total) are widespread in tropical areas and also reach New Zealand, viz. *P. dolichorbiza* and *P. ulcerata*.

(4) *Palaeotropical-southern temperate taxa:* One species (6.25% of the total), viz. *P. nana*, has a scattered distribution in the Pacific region.

(5) *Australasian taxa:* One species (6.25% of the total), viz. *P. subhorizontalis*, is shared between Australia and New Zealand, though it is more widespread in New Zealand than it is in Australia. No taxa are as yet considered endemic to New Zealand.

The high proportion of widespread and Northern Hemisphere taxa in the New Zealand *Peltigera* mycobiota (75% of the total) is a reflection of the presumed antiquity and slow rates of evolution of the genus, a viewpoint which is supported by several lines of evidence including ascus structure, the diversity of lichenicolous taxa associated with *Peltigera*, the presence of both obligatory and facultative cyanobacterial photobionts, and the diversity of hopane triterpenoids (Hawksworth 1980a, 1982a, 1988a, 1988b; Galloway 1991; Vitikainen 1994).

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