

The lichen genus *Physcia* (Schreb.) Michx (*Physciaceae*: *Ascomycota*) in New Zealand

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ABSTRACT: Fourteen species of the lichen genus *Physcia* (Schreb.) Michx are recognised in the New Zealand mycobiota, viz: *P. adscendens*, *P. albata*, *P. atrostriata*, *P. caesia*, *P. crispa*, *P. dubia*, *P. erumpens*, *P. integrata*, *P. jackii*, *P. nubila*, *P. poncinsii*, *P. tribacia*, *P. tribacoides*, and *P. undulata*. Descriptions of each taxon are given, together with a key and details of biogeography, chemistry, distribution, and ecology. *Physcia tenuisecta* Zahlbr., is synonymised with *Hyperphyscia adglutinata*, and *Physcia stellaris* auct. is deleted from the New Zealand mycobiota. *Physcia atrostriata*, *P. dubia*, *P. integrata*, and *P. nubila* are recorded from New Zealand for the first time. A list of excluded taxa is appended.

KEYWORDS: lichens, New Zealand lichens, *Physcia*, atmospheric pollution, biogeography.

Introduction

Species of *Physcia* (Schreb.) Michx, are foliose, lobate, loosely to closely appressed lichens, with a whitish, pale greenish, green-grey to dark-grey upper surface (not darkening, or colour only little changed, when moistened). In New Zealand they occur most commonly on coastal and inland (rarely high-alpine) rocks, on a variety of human-made substrata (especially concrete), on living bark of trees and shrubs, mainly of planted and ornamental trees (especially fruit trees) in urban and agricultural areas, and more occasionally on native trees and shrubs in forest and scrub communities. Several species survive in areas of moderate to high pollution, and it is possible that some taxa are introductions to the New Zealand lichen mycobiota, since European settlement.

Physcia is the generitype of the family *Physciaceae* *nom. cons.* in the suborder *Lecanorineae* of the order *Lecanorales* (Tehler 1996; Helms *et al.* 2003; Eriksson *et al.* 2004; Pennycook & Galloway 2004). The family comprises 25

genera with c. 860 species presently known (Kirk *et al.* 2001), and was recently emended to include taxa having: *Lecanora*-type asci; a hyaline hypothecium; and ascospores with distinct wall thickenings or of *Rinodella*-type (Helms *et al.* 2003). *Physcia* is a widespread, cosmopolitan genus with c. 57 species known worldwide (Moberg 1977, 1986, 1990, 1994, 1997, 2001, 2002, 2004) having asci of *Lecanora*-type and ascospores of *Physcia*- and *Pachysporaria*-types (Rambold *et al.* 1994; Helms *et al.* 2003). Recent molecular studies (Wedin *et al.* 2002; Helms *et al.* 2003) have shown that the taxa *Caliciaceae* Chevall. (1826) and *Physciaceae* Zahlbr. (1898) are confamilial and, accordingly, Wedin & Grube (2002) propose that *Physciaceae* *nom. cons.*, be conserved against the older *Caliciaceae*.

The earliest record of *Physcia* from New Zealand is of *Parmelia stellaris* (= *Physcia jackii*), collected by William Colenso and recorded by Babington (1855). This taxon is widespread in New Zealand, and in Australia and has only recently been shown to be an independent species not at all related to *Physcia stellaris* from the Northern Hemisphere

(Moberg 2001: 298–301). Nylander (1866) listed *Physcia stellaris* f. *radiata*, and *P. plinthiza* (= *Hyperphyscia plinthiza*) from Lauder Lindsay's 1861 Otago collections, to which Lindsay (1866c, 1868) added *P. caesia*. These same taxa were later listed by Hooker (1867), Müller Argoviensis (1894), and Hellbom (1896). Nylander (1888: 46) described *Physcia obscuriuscula* Nyl. [= *Parmelia* s. lat.] from a Knight collection, on rock.

In the twentieth 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 extensively from Northland (Trousons Park) to the subantarctic islands during a stay of several months in 1926–27 (Galloway 2004b). Einar Du Rietz encouraged H. H. Allan to collect New Zealand lichens from a wide range of habitats (Galloway 1976) and send them to leading European lichenologists of the day for identification. In turn, H. H. Allan enlisted the enthusiastic interest and support of the Dunedin businessman and botanist Jack Scott Thomson (Godley 1996; Bannister 2000) to collect lichens from coastal, inland, and high-alpine sites in South Island. Alexander Zahlbruckner (1860–1938) in Vienna was Allan's major lichen contact in Europe, and he identified New Zealand specimens of *Physcia* collected by H. H. Allan, K. W. Allison, L. B. Moore, and J. S. Thomson. In an account of foliicolous lichens from Kitchener Park, Feilding, Zahlbruckner recorded *P. crispa* Nyl., and described *P. tremens* Zahlbr., from sterile material (Zahlbruckner *et al.* 1928). In his posthumous work on New Zealand lichens, Zahlbruckner (1941) listed: *P. caesia*, *P. integrata* and *P. integrata* var. *sorediosa* (= *P. poncinsii*), *P. stellaris* var. *radiata* (= *P. poncinsii*) and var. *rosulata* (= *P. erumpens* and *P. jackii*), *P. adscendens*, *P. crispa*, *P. tremens*, and *P. plinthiza* (= *Hyperphyscia plinthiza*), and he described *P. tenuisecta* Zahlbr. (= *Hyperphyscia adglutinata*) and *P. regalis* Zahlbr. (= *Pannaria allorbiza*).

The account of *Physcia* in *Flora of New Zealand Lichens* (Galloway 1985: 391–395) records *P. adscendens*, *P. aipolia*, *P. albata*, *P. caesia*, *P. callosa* (= *P. tribacia*), *P. stellaris* (= *P. jackii*), *P. tenuisecta* (= *Hyperphyscia adglutinata*) and *P. tribacoides* [sic] (= *P. poncinsii*). This, however, was a rather limited treatment based mainly on herbarium specimens from BM, CHR and OTA. *Physcia erumpens* Moberg and *P. poncinsii* Hue were recorded from New Zealand collections by Scutari (1995). Fieldwork undertaken since 1994 in connection with a study of lichens as

monitors of atmospheric pollution in New Zealand (Johnson *et al.* 1998) disclosed the presence of *P. poncinsii* and of *P. undulata* Moberg widely throughout New Zealand (see also Malcolm & Galloway 1997), and collections were also made of *P. albata* and *P. dubia* and of a prominent coastal saxicolous, sorediate taxon referable to *P. nubila* (Moberg 1990, 2001). The second author (RM) and Björn Owe-Larsson visited New Zealand in 1992, and their collections of *Physcia* (UPS) are included in this study. A survey of all *Physcia* collections from New Zealand made over the past 60 years, together with field studies from Northland to Stewart Island, has disclosed 14 taxa, four of which are here recorded from New Zealand for the first time. These are discussed below.

Materials and methods

Type and other material (500 specimens) was obtained from, or examined in, the following herbaria: AK, ASU, BM, BRI, CANU, CBG, CHR, GZU, OTA, S, UPS, W, WELT, herb. W. Malcolm. Thin-layer chromatography of acetone extracts was carried out according to standardised methods (Culberson 1972; White & James 1985).

Morphology and anatomy

The main features of thallus morphology and anatomy in *Physcia* are discussed in Thomson (1963) and in detail by Moberg (1977, 1983, 1986, 1990, 1997, 2001), and are mentioned in connection with species delimitation only briefly here.

UPPER SURFACE AND UPPER CORTEX: Several species have a distinctive 'frosted' appearance resulting from a fine, white surface pruina (x10 lens), that is a constant feature of *P. atrostriata* and *P. undulata*. The upper cortex in *Physcia* is always paraplectenchymatous, whereas species of *Heterodermia* have a prosoplectenchymatous upper cortex.

LOWER SURFACE AND LOWER CORTEX: The colour of the lower surface is a useful character in distinguishing taxa of similar morphology. While most New Zealand taxa have a pale, whitish lower surface that may darken to greyish to pale buff centrally, two species, *P. erumpens* and *P. integrata*, have a paraplectenchymatous, black or dark-brown lower surface from margins to centre. The lower surface of *P. atrostriata* is characteristically prosoplectenchymatous, brown-black and striate, unlike that found in any other species.

SORALIA: The position and form of soralia are useful characters in delimiting taxa in *Physcia*. In agreement with Moberg (1986, 1990) the following kinds of soralia are recognised in New Zealand species:

- i) Species with eumarginal soralia: *P. atrostriata*, *P. crispa*, *P. nubila*, *P. undulata*.
- ii) Species with terminal-labiate soralia: *P. dubia*, *P. tribacia*.
- iii) Species with helmet-shaped (forniciform) soralia: *P. adscendens*.
- iv) Species with marginal-capitate soralia: *P. caesia*.
- v) Species with laminal, maculiform soralia: *P. albata*.
- vi) Species with laminal, crateriform soralia: *P. erumpens*, *P. poncinsii*.
- vii) Species with laminal, capitate soralia: *P. caesia*, *P. poncinsii*.

APOTHECIA: In the fertile species recorded from New Zealand – *P. adscendens* (rare), *P. caesia* (very rare), *P. erumpens*, *P. jackii*, *P. nubila*, *P. poncinsii*, and *P. tribacoides* (rare) – apothecia are fairly uniform in shape and size, being sessile, rounded, 0.5–1.5(–2) mm in diameter, with some apothecia in *P. poncinsii* reaching 3 mm in diameter. Discs are plane, matt, brown-black to black, with or without a fine, grey-white pruina. The thalline exciple (concolorous with thallus) becomes sorediate in *P. erumpens*, *P. nubila*, and *P. poncinsii*. Ascospore size is only of minor importance in delimiting species (Moberg 1983, 1990).

CONIDIOMATA: Pycnidia seem to be rarely developed in taxa recorded from New Zealand. They are most conspicuous in collections of *P. caesia*, where they occur as scattered, immersed black dots on the upper surface of the lobes. Conidia are colourless, subcylindrical. Pycnidia in *Physciaceae* are discussed in detail by Moberg (1977: 11–15).

LICHENICOLOUS FUNGI: The fungal parasite *Polycoccum pulvinatum* (Eitler) R. Sant. infects specimens of *Physcia caesia* from maritime habitats (Northland to Stewart Island), but appears to be absent from inland localities (Galloway *et al.* 1999).

Chemistry

Atranorin is present in all species (cortex K⁺ yellow, and occasionally the medulla is also K⁺ yellow). In addition, the triterpenoid zeorin is found in the following species: *P. albata*, *P. atrostriata*, *P. caesia*, *P. erumpens*, *P. integrata*,

P. jackii, *P. nubila*, *P. poncinsii*, *P. tribacoides*, and *P. undulata*, while *P. adscendens*, *P. crispa*, *P. dubia*, and *P. tribacia* have atranorin alone. Occasionally leucotylin and other triterpenoids are present.

Biogeographical notes

The 14 species of *Physcia* occurring in New Zealand show a number of biogeographical affinities (see Galloway 1996 for explanation of terms).

- (1) *Cosmopolitan (azonal) taxa*: Five species (36% of the total) are widespread, cosmopolitan species and include *P. adscendens*, *P. caesia*, *P. dubia*, *P. tribacia*, and *P. tribacoides*.
- (2) *Palaeotropical taxa*: Eight species (57% of the total) have a scattered, Pacific Basin distribution (from East Africa to the western coasts of North and South America) and include *P. albata*, *P. atrostriata*, *P. crispa*, *P. erumpens*, *P. integrata*, *P. nubila*, *P. poncinsii*, and *P. undulata*.
- (3) *Australasian taxa*: One species (7% of the total), viz. *P. jackii*, is shared between New Zealand and Australia. No taxa are endemic to New Zealand.

The high proportion of palaeotropical and cosmopolitan taxa in the New Zealand *Physcia* mycobiota (together, 93% of the total) is noteworthy and is undoubtedly a reflection of the fact that 78% of the *Physcia* mycobiota of New Zealand is composed of sorediate, readily dispersed taxa, a phenomenon recognised in other foliose genera of the *Physciaceae* (Moberg 1994).

Key to species of *Physcia* in New Zealand

- 1 Lobes without marginal cilia 2
Lobes with marginal cilia *P. adscendens*
- 2 Without soralia, usually with well-developed apothecia 3
With soralia; with or without apothecia 4
- 3 Lower surface pale *P. jackii*
Lower surface black (except at tips) *P. integrata*
- 4 Medulla K⁻ 5
Medulla K⁺ 7
- 5 Soralia not developing from marginal lobules or isidia 6
Soralia developing from marginal lobules or isidia *P. crispa*

- 6 Lobes very narrow, 0.1–0.5(–1) mm wide; upper surface pale grey, not darkening towards apices; soralia coralloid on lower surface of lobe apices and margins, not labriform; lower cortex paraplectenchymatous *P. tribacia*
 Lobes wider, 0.4–0.8 (–1.2) mm wide; upper surface grey-white centrally, darkening to somewhat blackened at apices; soralia conspicuously labriform, marginal; lower cortex prosoplectenchymatous *P. dubia*
- 7 Lower surface white to brownish or ash-grey 8
 Lower surface black *P. erumpens*
- 8 Soralia distinctly laminal 9
 Soralia marginal or marginal-capitate 11
- 9 Soralia capitate or spreading in laminal patches, not crateriform 10
 Soralia crateriform, rarely capitate *P. poncinsii*
- 10 Thalli broad-lobed; soralia spreading in laminal patches; corticolous; lower cortex paraplectenchymatous *P. albata*
 Thalli narrow-lobed; soralia capitate; saxicolous; lower cortex prosoplectenchymatous *P. caesia*
- 11 Corticolous 12
 Saxicolous *P. nubila*
- 12 Lower surface not distinctly brown-black-striate 13
 Lower surface distinctly brown-black-striate *P. atrostriata*
- 13 Upper surface white-pruinose, ‘frosted’; soralia not capitate or callus-like *P. undulata*
 Upper surface not white-pruinose, not ‘frosted’; soralia capitate, callus-like *P. tribacooides*

Taxonomy

Physcia (Schreb.) Michx, *Fl. Bor.-Ameri.* 2: 326 (1803). ≡ *Lichen* sect. *Physcia* Schreb., *Gen. Pl.* 2: 768 (1791).

TYPE SPECIES: *P. tenella* (Scop.) DC. *nom. cons.* (*Lichen tenellus* Scop.)

Thallus foliose, lobate with discrete or overlapping lobes, somewhat closely adnate to substratum, greyish (not changing colour, or colour only little changed, when moistened), with or without maculae, marginal cilia, pruina (appearing ‘frosted’) or soredia, upper cortex paraplec-

tenchymatous, lower cortex prosoplectenchymatous or paraplectenchymatous, with simple rhizines. Photobiont green, *Trebouxia*. Medulla white. Ascomata apothecia, lecanorine, laminal, sessile, or subpedicellate, with a brown to black matt disc, with or without a whitish pruina. Asci cylindrical, 8-spored. Ascospores brown, 1-septate, of *Physcia*- or *Pachysporaria*-type. Hamathecium of paraphyses, branched, thickened and brown at apices. Conidiomata pycnidia, immersed, except for darkened, apical ostiole. Conidia subcylindrical, 4–6 µm long. Chemistry: atranorin constantly present, sometimes with zeorin or other triterpenoids.

CHARACTERISTIC FEATURES: Greyish colour (not changing, or only little changed, when moistened); paraplectenchymatous upper cortex with K⁺ yellow reaction (atranorin); and brown, 1-septate ascospores of *Physcia*- or *Pachysporaria*-type.

Species account

1. *Physcia adscendens* H. Olivier, *Fl. Lich. Orne* 1: 79 (1882) *nom. cons.* For nomenclatural discussion of this name see Laundon (1995: 246–247). Type: Sweden, *sine loco*, E. Acharius, H-ACH 1428 – *type cons.* (Gams 1998: 446).

ILLUSTRATIONS: Filson (1974: 5 pl. 2A–D); Moberg & Holmåsén (1982: 199); Vitt *et al.* (1988: 238); Hale & Cole (1988: 97, fig. 41A); Dobson (1992: 263); Goward *et al.* (1994: 110, fig. 4A); Hansen (1995: 53); McCune & Geiser (1997: 227); Barron (1999: 9, pl. 3, fig. 18); St Clair (1999: 144); Brodo *et al.* (2001: 550, fig. 658); Moberg (2002: 97).

DESCRIPTION: Thallus orbicular or confluent, 1–5(–8) cm in diameter, sometimes (e.g. on vertical gravestones) spreading in more extensive swards, or cushion-forming; somewhat loosely attached. Lobes variable, plane to convex, sometimes long and narrow, sometimes shorter and broader (0.5–1(–2) mm wide, 1–4(–8) mm long); apices swollen-globose, inflated, 2–3 mm wide, ciliate. Cilia conspicuous; marginal and apical, rarely also laminal; simple to furcate or 1–3-branched at apices; pale whitish; apices often brown-black; 0.5–1.5(–2) mm long. Upper surface whitish or greyish to grey-green, pale green or somewhat greyish blue; minutely roughened-papillate or knobby to coarsely areolate-roughened in parts (x10 lens); usually conspicuously white-maculate (x10 lens). Lower surface white, smooth to delicately longitudinally striate or

ribbed (x10 lens), often subcanaliculate; margins slightly thickened, rhizinate, sorediate. Rhizines scattered, concolourous with lower surface or darker, simple, up to 1–2 mm long. Lower cortex prosoplectenchymatous. Soralia helmet-shaped, on expanded underside of inflated lobe apices. Soralia soredia coarse, granular greyish or greenish white. Apothecia rare; often only very sparingly developed, but sometimes quite common and well-developed; laminal; pedicellate (pedicel narrow, 0.2–0.4 mm in diameter); sometimes with projecting cilia. Thalline exciple concolourous with thallus, smooth, sparsely to densely maculate, crenate to distinctly toothed or lobed, projecting over margins of disc, rarely with projecting cilia. Disc up to (0.5–)1–3 mm in diameter, round, subconcave to undulate, matt, brown-black, epruinose to thinly white-pruinose. Epithecium brown, 7.5–10 μm thick. Hymenium colourless 75–90 μm tall, Hypothecium opaque, colourless. Ascospores of *Physcia*-type, brown, 15–18.5 x 6.8–8.5 μm . CHEMISTRY: Upper cortex K⁺ yellow; medulla K⁻; containing atranorin.

DISTRIBUTION (Fig. 1): From Whangarei to Southland and the Chatham Islands. Known also from Great Britain, Europe, Scandinavia, the Arctic, Israel, Turkey, the Ukraine, Asia, North and East Africa, South Africa, North and South America, Hawaii, Australia (Thomson 1963; Moberg 1977, 1986, 1990, 1997, 2001, 2002, 2004; Swinscow & Krog 1988; Coppins 1992, 2002; Santesson 1993; Nimis 1993; Hansen 1995; Esslinger & Egan 1995; Egea 1996, Galun & Mukhtar 1996; John 1996; Kondratyuk *et al.* 1996; Seaward 1996; Elix & McCarthy 1998; Galloway & Quilhot 1999; Diederich & Sérusiaux 2000; Scholz 2000; Calvelo & Liberatore 2001; Hafellner & Türk 2001; Llimona & Hladun 2001; Elvebakk & Moberg 2002; McCarthy 2003; Santesson *et al.* 2004).

HABITAT ECOLOGY: *Physcia adscendens* is very widely distributed in New Zealand on both native and introduced trees and shrubs, but is especially common on fruit trees and ornamental trees in gardens and along roadsides, and on both basic (limestone) and acidic (basalt, greywacke, schist) rocks, on concrete asbestos sheeting, shade cloth, bitumen of footpaths and little-used roads, gravestones (often very well developed on both horizontal and vertical surfaces, and on surrounding concrete coping), iron railings, sawn treated wood (fence posts, railings, gates, etc.), and on old painted surfaces. It is one of the most catholic and widespread of lichens in New Zealand, and is able to withstand moderate to heavy amounts of atmospheric

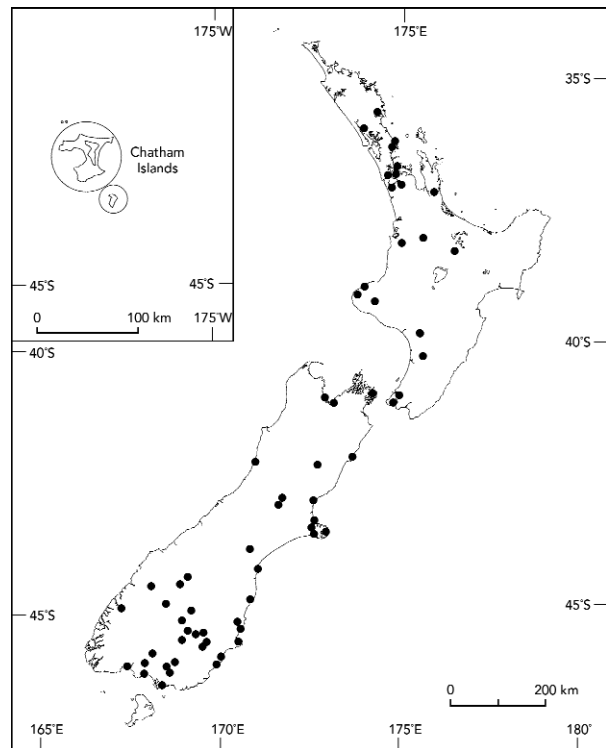


Fig. 1 Distribution of *Physcia adscendens* in New Zealand

pollution (Johnson *et al.* 1998). It colonises the following phorophytes: *Avicennia marina* var. *resinifera*, *Betula pendula*, *Carmichaelia* spp., *Coprosma propinqua*, *Cordyline australis*, *Crataegus monogyna*, *Cytisus scoparius*, *Discaria toumatou*, *Fraxinus excelsior*, *Leptospermum scoparium*, *Metrosideros excelsa*, *Myoporum laetum*, *Olearia odorata*, *Pimelea aridula*, *Pittosporum crassifolium*, *Plagianthus divaricatus*, *Podocarpus hallii*, *Populus nigra*, *Prunus avium*, *Salix pendula*, *Teloepa* spp., *Ulmus procera*.

It associates with the following lichens: *Amandinea punctata*, *Bacidia laurocerasi*, *Buellia griseovirens*, *Candelaria concolor*, *Candelariella reflexa*, *Caloplaca* spp., *Dirinaria applanata*, *Fellhanera bouteillei*, *Heterodermia japonica*, *H. obscurata*, *H. speciosa*, *Hyperphyscia adglutinata*, *Lecanora intumescens*, *L. flavopallida*, *Parmotrema chinensis*, *Phaeophyscia hispidula*, *Physcia caesia*, *P. dubia*, *P. jackii*, *P. poncinsii*, *P. undulata*, *Ramalina celastri*, *Rimelia reticulata*, *Rinodina* spp., *Sporopodium* sp., *Teloschistes chrysophthalmus*, *T. velifer*, *T. xanthoroides*, *Xanthomendoza novozelandica*, *Xanthoria candelaria*, *X. parietina*, and *X. polycarpa*.

DISTINGUISHING FEATURES: *Physcia adscendens* is a cosmopolitan species, characterised by: long, white cilia on the

lobe margins; and terminal, inflated lobe apices with helmet-shaped soralia.

SELECTED SPECIMENS EXAMINED: **Northland:** Whangarei, on mangrove in culvert near FERNZ, s. l. 9.xii.1996, *D. J. Galloway 5011* (OTA); Warkworth, L. B. Moore Memorial Park, on pohutukawa, 12.xii.1996, *D. J. Galloway 5010* (OTA); Tokotoka, 13.iii.1981, *J. K. Bartlett s. n.* (AK 204851); Leigh, pohutukawa trees, 12.xii.1996, *D. J. Galloway 5009* (CHR); The Noises, Otata Island, on *Pittosporum crassifolium*, 20.iii.1993, *A. E. Wright 12234* (AK 209683). **Auckland:** Milford, on concrete fence posts, viii.1982, *B. W. Hayward s. n.* (AK 204671). **South Auckland:** Glenbrook Steel Works, on bottlebrush close to Central Stores, 13.xii.1996, *D. J. Galloway 5012* (OTA); Mt Te Aroha near TV station, on rocks, 16.iii.1982, *J. K. Bartlett s. n.* (AK 192276); Waiorongomai Stream, Te Aroha, on rocks, 26.ii.1976, *D. J. Galloway s. n.* (CHR 240439); Pio Pio, L. K. Wilson's farm, on wooden railings, 11.vi.1978, *D. J. Galloway s. n.* (CHR 348246); east of Taupo, amongst moss on base of mānuka, 18.xii.1933, *K. W. Allison L260* (CHR 241906); east of Waiotapu, on *Carmichaelia*, *Olearia*, and mānuka, viii.1936, *K. W. Allison L330* (CHR 241895). **Taranaki:** Motunui, Methanex Plant, twigs of ngaio in planted shrubbery, 40 m, 26.x.1993, *P. N. Johnson 849* (CHR); Stratford Power, Stratford, on concrete walls and fence posts, 16.xii.1996, *D. J. Galloway 5014* (OTA); Near Eltham, 28.xi.1998, *J. M. Bannister s. n.* (OTA 049834). **Wellington:** Whangaehu, on hawthorn, 27.xi.1998, *J. M. Bannister s. n.* (OTA 049831); Rangitikei Valley, 5 km south of Rata, on willow, 20.v.1984, *B. W. Hayward s. n.* (AK 206777); Hutt Valley, Fraser Park, trunk of pohutukawa, 9.xi.1995, *P. N. Johnson 1642* (CHR). **Marlborough:** Ship Cove, Queen Charlotte Sound, on driftwood logs, 1.i.1992, *A. E. Wright 11728* (AK 204913); Kaikoura Peninsula, Point Kean, 3.ii.1981, *L. Tibell 10648* (UPS). **Westland:** Greymouth Cemetery, on gravestones, 12.iii.1999, *D. J. Galloway 2108* (OTA). **Canterbury:** Waimakariri River flats between Mt White Bridge and the Hawdon shelter, on boulders under matagouri, 16.ii.1991, *A. E. Wright 11077* (AK 201457); Castle Hill, *J. K. Bartlett s. n.* (AK 198404); Whiterock, Rangitata Gorge Road, on limestone, 17.i.1985, *C. D. Meurk* (CHR); Hororata River, on *Cytisus scoparius*, 16.x.1964, *A. J. Healy 64/326* (CHR 347888); Amberley, on *Cytisus scoparius*, 7.v.1964, *A. J. Healy 64/71B* (CHR 241933); Christchurch, Beckenham Park, east end, on alder, 5.viii.1993, *P. N. Johnson 801*

(CHR); North Brighton, on sycamore, 26.x.1995, *P. N. Johnson 1540* (CHR); South Hagley Park, on sycamore, 5.x.1993, *P. N. Johnson & A. J. Fife JF58* (CHR); Avonside, Woodham Park on *Ulmus procera* in urban park, 4.x.1993, *P. N. Johnson & A. J. Fife JF22* (CHR); Banks Peninsula, Kaituna Valley, on *Sophora microphylla*, 10.x.1980, *L. Tibell 9105* (UPS); Kaitorete Spit, on decorticated branches in sand dunes, 29.xi.1980, *L. Tibell 9786* (UPS); Lincoln College grounds, tree bark, 12.ii.1970, *T. W. Rawson s. n.* (CHR 162641); Lincoln, DSIR garden, on kowhai, 6.vi.1991, *P. N. Johnson 236* (CHR); Pleasant Point, on *Pseudotsuga* spp., 29.ii.1964, *A. J. Healy 64/40* (CHR 241911). **Otago:** Timaru Creek, Lake Hawea, on *Discaria toumatou*, 3.x.1970, *P. Child 800* (CHR 445470); Bold Peak above Kinloch, on stumps and logs of *Nothofagus*, 18.ii.1927, *G. Einar & Greta Du Rietz 1856:1* (UPS); Queenstown Gardens, on silver birch, 330 m, 21.xi.1993, *P. N. Johnson 933* (CHR); Strath-Clyde Road, Springvale near radio mast, on *Pimelea aridula* in xeric communities of old dry terraces, 22.iv.1985, *P. Child 2296* (CHR 445472); Alexandra, trunks of willow and cherry at edge of town near river, 29.viii.1993, *P. N. Johnson 812* (CHR); Upper Pomahaka River, above Jordan ford, north-facing slopes, on mature *Olearia odorata* in grassland, 700 m, *D. J. Galloway 5008* (OTA); Teviot Valley, Teviot Road on *Cytisus scoparius*, 21.viii.1997, *D. J. Galloway* (OTA); Gabriels Gully, on dead broom, 17.i.1999, *J. M. Bannister 1189* (OTA); Horse Range Road below Trotters Gorge, on willows, 8.vii.1970, *P. Child 479* (CHR 445463); Shag Point, iron cattle grid, *J. M. Bannister 11* (OTA); Mt Misery, on schist rock, 11.vii.1970, *J. Child 1247* (CHR 384977); Cornish Head, Waikouaiti, on sandstone boulder in steep grassland on exposed south aspect of headland, 10 m, 27.vi.1993, *P. N. Johnson 755* (CHR); Dunedin, Claremont Street, basalt rock in stone wall, 8.iii.1997, *J. M. Bannister 235* (OTA); Dunedin, Wallace Street, on top of postbox, 7.v.1996, *J. M. Bannister 36* (OTA); Dunedin, the North Ground, on ash tree in city park, 7.iii.1994, *P. N. Johnson 1085* (CHR); Dunedin, Forth Street Bridge over Leith Stream, on top and sides of concrete piers, amongst moss, 17.x.1996, *D. J. Galloway s. n.* (OTA); Flagstaff, on rocks, 12.iii.1961, *D. J. Galloway s. n.* (CHR 347885); Otago Peninsula, Broad Bay, on poplar tree, 25.v.1991, *P. N. Johnson 222* (CHR); Lake Waiholo, south-west shore, *Coprosma propinqua* twigs in swamp, 26.ix.1991, *P. N. Johnson 312* (CHR); Taieri Mouth Track, on bark, 16.ii.1997, *J. M. Bannister 191* (OTA); Akatore

Stream, on divaricating shrubs, 4.xii.1994, *D. J. Galloway* 08 (OTA); Crystals Beach, old gate, ii. 1996, *J. M. Bannister* 35 (OTA); Toko Mouth, on concrete fencepost, 4.iv.1999, *D. J. Galloway* 1344 (OTA); Wangaloa Hill, on dead broom, 5.vii.1970, *P. Child* 439 (CHR 44546); Inch Clutha, on willows, 5.vii.1970, *P. Child* 453 (CHR 445462); Black Gully, Blue Mountains, on concrete power pole, 15.vii.1999, *D. J. Galloway* 0662 (OTA). **Southland:** Dollimore Park, Hokonui Hills near Gore, 17.ix.1997, *D. J. Galloway* (OTA); Gore–Te Tipua Road, bridge over Waimumu Stream, on concrete sides of bridge, 19.x.1997, *D. J. Galloway* 5013 (OTA); Matura, Kath Falconer's garden, on leaves of *Telopea*, 17.ix.1997, *D. J. Galloway* s. n. (OTA); Castle Rock near Dipton, limestone rocks, 30.viii.1999, *D. J. Galloway* (OTA); Southfert Fertiliser Works, on radiata pine tree, 19.xi.1996, *P. N. Johnson* 3160 (CHR); Tiwai Point, on twigs of *Coprosma propinqua* and stems of *Podocarpus hallii* in shrubland beside estuary, 10 m, 20.xi.1996, *P. N. Johnson* 3235 (CHR); Otautau, Holst Park, on *Alnus glutinosa*, 4.xi.1997, *D. J. Galloway* 0265 (OTA); South coast, Bluecliffs to Sandhill Point, on coastal rocks, 25.x.1998, *A. Knight* s. n. (OTA 049650); Mt Donald between Lake Te Anau and Caswell Sound, 17.v.1941, *G. Simpson* s. n. (CHR 241914). **Chatham Islands:** Chatham Island, Big Bush, on loose bryozoan limestone outcrops near quarry, ii.1985, *B. P. J. Molloy* s. n. (CHR 413831).

2. *Physcia albata* (F. Wilson) Hale, *Bryologist* 66: 73 (1963).

≡ *Parmelia albata* F. Wilson, *Vict. Nat.* 6: 69 (1889). Type: Australia. Victoria, Mt William, near Ararat, November 1888, *F. R. M. Wilson*, MEL – lectotype (*vide* Moberg 1986: 851).

ILLUSTRATIONS: Moberg (1986: 852, fig. 10); Scutari (1995: 220, fig. 4A).

DESCRIPTION: Thallus orbicular to irregularly spreading, 1–3(–4.5) cm in diameter, closely attached from margins to centre, or with margins free and subscentent. Lobes broadly rounded, 3–5(–7) mm wide, 5–7(–10) mm long, discrete, adjacent to subimbricate at margins, imbricate centrally; margins entire, sinuous, here and there very shallowly notched or incised, slightly thickened, with a thin, raised rim below (x10 lens) that becomes thicker and coriaceous in specimens from exposed sites. Upper surface pale greenish grey in specimens in shaded habitats, to grey-white or whitish in those from exposed sites, greyish black

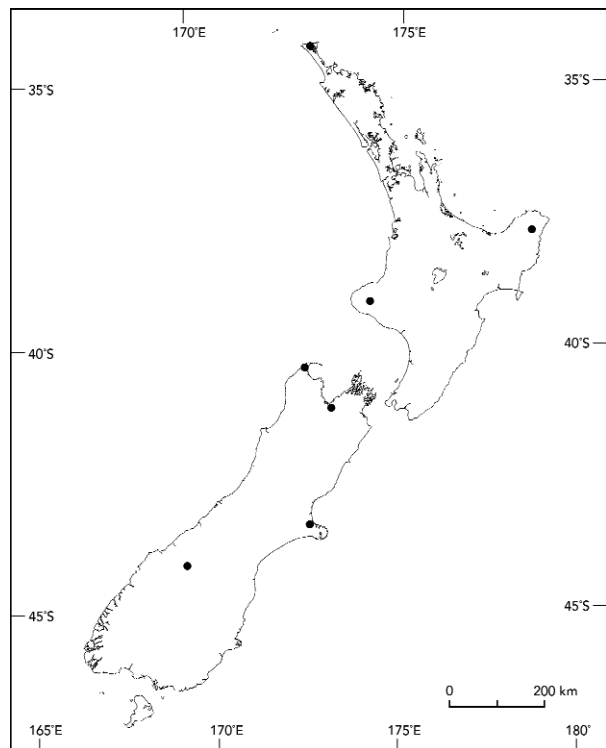


Fig. 2 Distribution of *Physcia albata* in New Zealand

and sometimes areolate-scabrid (x10 lens) towards apices in exposed specimens, matt, epruinose, smooth or shallowly undulate, occasionally dimpled or crumpled towards centre, minutely white-maculate (x10 lens; maculae best seen in fresh, moist material), sorediate. Soralia laminal, developing towards centre of lobes (rarely at margins), arising from the eroded apices of minute to verrucose papillae or pustules that had coalesced to form somewhat circular to irregular patches 0.1–1(–5) mm in diameter, sometimes areas of white medulla exposed. Soralia soredia farinose to granular, concolorous with upper surface or paler. Lower surface matt to slightly glistening, smooth, white at margins darkening to greyish or brownish centrally, rhizinate. Rhizines widely scattered at margins to densely entangled centrally, simple to subsquarrose, white or pale greyish at margins, darkening to grey-brown centrally, 0.5–1(–1.5) mm long. Lower cortex paraplectenchymatous. Apothecia and pycnidia not seen in New Zealand material.

CHEMISTRY: Cortex and medulla K⁺ yellow; containing atranorin and zeorin.

DISTRIBUTION (Fig. 2): From near North Cape in Northland to near the Haast Pass (Makarora) in Otago. Known

also from East and South Africa (Moberg 1986, 2004; Swinscow & Krog 1988), South America where it appears to be rare (Moberg 1990; Scutari 1995; Galloway & Quilhot 1999; Calvelo & Liberatore 2001), Hawaii (Hale 1963; Elix & McCarthy 1998) and Australia (Moberg 2001; McCarthy 2003).

HABITAT ECOLOGY: Known in New Zealand from the bark of sycamore (*Acer pseudoplatanus*) bordering a shaded stream, and from scrub and from exposed serpentine rock. The material from sycamore bark (Taranaki) grew luxuriantly amongst mosses on the shaded, humid side of the trunks, associating with *Normandina pulchella* and *Parmelia erumpens*. Material from Radar Bush (Northland) was gathered with *Heterodermia* spp., *Parmotrema chinense*, and *Physcia caesia*. It is still very poorly collected in New Zealand and its precise ecological requirements here are still to be determined.

DISTINGUISHING FEATURES: *Physcia albata* is a palaeotropical species, characterised by: broad, rounded lobes with entire margins; a smooth, matt, epuriose upper surface; soralia in spreading patches, arising from eroding pustules or papillae, and spreading more widely over lamina, often exposing areas of white medulla beneath; and a paraplectenchymatous lower cortex.

SPECIMENS EXAMINED: **Northland:** Radar Bush, *J. K. Bartlett 23886* (AK 192282). **Gisborne:** Mount Taitai, 29.xii.1982, 1.i.1983, *J. K. Bartlett 21544, 22708, 22752* (AK 203525, 197476, 192314, 197503). **Taranaki:** Monmouth Road, Stratford, common on humid, shaded trunks of sycamore, 17.xii.1997, *D. J. Galloway 5007* (OTA). **Nelson:** Kaihoka, *J. K. Bartlett 22619* (AK 192272); Roding River Valley, on very exposed serpentine rock, 275 m, 27.viii.1981, *J. K. Bartlett 20795* (AK 192320). **Canterbury:** Banks Peninsula, Mitchells Track, Port Hills, on mossy volcanic rocks in remnant forest, 17.iv.1980, *J. A. Elix 7817* (CANB). **Otago:** North of Hawea near Makarora Bridge, on scrub, 3.ix.1981, *J. K. Bartlett 20796, 20797* (AK 192323, 192322).

3. *Physcia atrostriata* Moberg, *Nord. J. Bot.* 6 (6): 853 (1986). Type: Tanzania. Tanga Province, Usumbara Mts, Amani, in the surroundings of Forestry House, 5°07'S, 38°38'E, altitude c. 900 m, on *Spatodea* sp. on a grassy south-east-exposed slope, 1971. *R. Moberg 1495a*, UPS – holotype.

ILLUSTRATIONS: Moberg (1986: 853, fig. 12); Aptroot (1987: 36, pl. 8); Swinscow & Krog (1988: 224, fig. 108);

Scutari (1995: 220, fig. 4B); Brodo *et al.* (2001: 551, fig. 661).

DESCRIPTION: Thallus rosette-forming to irregularly spreading, closely attached, 1–3 cm in diameter, often confluent with neighbouring thalli and forming irregular patches 5–8 cm in diameter. Lobes irregularly branching, 0.5–1(–1.2) mm wide, 2–6(–8) mm long, discrete at margins, soon imbricate to complex-imbricate centrally, plane to subconvex. Margins rarely entire, to variously notched, incised to minutely lobulate; slightly thickened and ridged below; generally paler than upper surface (especially at lobe apices); commonly obscured at centre by generous development of confluent soredia; non-sorediate areas generally white-pruinose. Upper surface smooth to shallowly undulate; matt; glabrous centrally; commonly white-pruinose and appearing 'frosted' towards and at apices; pale green when moist but off-white, grey-white, pale olivaceous-buff to pinkish in parts when dry; sorediate. Soralia marginal, labriform-undulate, developing towards inner parts of lobes and around sinuses between lobes, eroding extensive areas of both lower and upper surfaces. Soralia soredia delicate, farinose, greenish when moist, olivaceous to greenish white or off-white when dry and on storage. Lower surface ecorticate; white at margins; pale tan or brownish centrally, with conspicuous red-brown to brown-black, ribbed or nerve-like longitudinal striations (prosoplectenchymatous); rhizinate. Rhizines conspicuous, frequent, simple, occasionally with a short squarrose tuft at apices, slender (0.02–0.05 mm wide), 0.5–1.2(–1.5) mm long, brown or black. Apothecia and pycnidia not seen in New Zealand collections.

CHEMISTRY: Cortex and medulla K⁺ yellow; containing atranorin, zeorin and several unidentified triterpenoids.

DISTRIBUTION (Fig. 3): In Northland between latitudes 35°S and 36°22'S. Still very poorly known in New Zealand. A pantropical species known also from East and South Africa (Moberg 1986, 2004; Swinscow & Krog 1988), Florida (Harris 1990; Esslinger & Egan 1995; Brodo *et al.* 2001), the Guyanas (Aptroot 1987), Hong Kong (Aptroot & Seaward 1999), the Philippines (Aptroot & Sipman 1989), South America (Moberg 1990; Scutari 1995; Marcano *et al.* 1996; Calvelo & Liberatore 2001), Portugal and the Azores (Moberg 1989), South Africa (Scutari 1995), and Australia (Moberg 2001; McCarthy 2003).

HABITAT ECOLOGY: Collected from the bark of *Avicennia marina* var. *resinifera* (mangrove), *Cordyline australis*, and

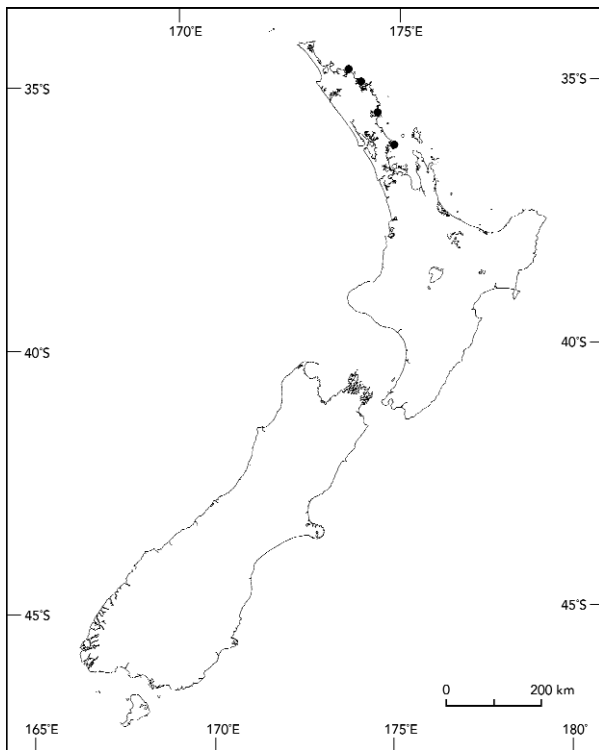


Fig. 3 Distribution of *Physcia atrostriata* in New Zealand

Pittosporum umbellatum, but the very few collections seen give scant indication of the ecological requirements of this species in New Zealand. In the specimens seen it associates with the lichens *Heterodermia japonica* and *Normandina pulchella*. Elsewhere in its range it is known from tree trunks in rather open situations.

DISTINGUISHING FEATURES: *Physcia atrostriata* is a palaeotropical species, characterised by: a pale grey-white upper surface that is delicately white-pruinose, appearing 'frosted'; marginal soredia best developed in the sinuses between lobes; and brown-black striations on the lower surface.

SPECIMENS EXAMINED: **Northland:** *J. K. Bartlett* 23993 (AK 192283); Ririwha (Stephenson) Island, Puriri Valley, on bark in bush, 28.viii.1982, *A. E. Wright* 5129 (AK 162095); Onerahi, near Whangarei, on mangrove, 21.vii.1981, *J. K. Bartlett s. n.* (AK 192279); Tawharanui Peninsula, 3.5 km west of Tokatu Point, on bark of *Pittosporum umbellatum*, 25.v.1981, *L. Tibell* 13236 (UPS L-021121); Kerikeri Inlet, on mangrove, 11.iv.1992, *R. Moberg & B. Owe-Larsson* NZ 16:3 (UPS); Hauparua Inlet, 9 km east of Kerikeri, on seashore rocks, 11.iv.1992, *R. Moberg & B. Owe-Larsson* NZ 19:7 (UPS).

4. *Physcia caesia* (Hoffm.) Fűrnr., *Fl. Ratisbon* 2: 250 (1839).

≡ *Lichen caesius* Hoffm., *Enum. lich. eur.*: 65 (1784). Type: Austria, Steinach, 1957, *M. Steiner, Krypt. exs. Vind.* No 4139, UPS – neotype (*vide* Moberg 1977: 64).

ILLUSTRATIONS: Martin & Child (1972: 125, pl. 35); Kashiwadani (1975: pl. 3:2); Moberg & Holmåsén (1982: 200); Redon (1985: pl. 17, fig. 75); Hale & Cole (1988: 97, fig. 41D); Dobson (1992: 264); Goward *et al.* (1994: 110, fig. 8B); Hansen (1995: 54); McCune & Geiser (1997: 230); Barron (1999: 10, pl. 4, fig. 19); St Clair (1999: 147); Brodo *et al.* (2001: 553, fig. 663); Moberg (2002: 98).

DESCRIPTION: Thallus orbicular to spreading, closely attached from margins to centre or with margins somewhat free and subscentent, 1–4(–6) cm in diameter. Lobes (0.2–)0.5–2 mm wide, 4–10(–12) mm long, irregularly or pinnately branched, more or less convex, often densely imbricate to discrete and widely separated; margins entire, apices rounded to shallowly notched or incised, often slightly rolled under. Upper surface grey or whitish grey, sometimes bluish grey to somewhat blackened centrally with paler apices, or pale grey at centre with somewhat blackened apices; matt to roughened, noticeably coarsely areolate-scabrid at apices (x10 lens); distinctively white-maculate, with somewhat raised maculae (x10 lens); sorediate. Soralia laminal or marginal; on short, terminal lobes; capitate and somewhat hemispherical; 0.5–1(–1.2) mm in diameter, often coalescing and covering whole lobe. Soralia soredia coarsely granular, greenish when moist, whitish to blackened when dry, often eroded to expose medulla or lower cortex, rarely soralia lacking. Lower surface whitish to pale buff at margins, brownish or somewhat blackened centrally, smooth, matt, rhizinate. Lower cortex prosoplectenchymatous. Rhizines simple, stout (0.01–0.02 mm in diameter), 0.4–0.8(–1) mm long, irregularly scattered at apices to densely crowded-entangled centrally, often projecting slightly at apices, pale whitish or grey to red-brown or black. Apothecia commonly absent to very rare or occasional, sessile, 0.2–0.8(–1) mm in diameter; margins entire, prominent, persistent, smooth, concolorous with thallus; disc plane, matt, black, epruinose or occasionally with a fine, grey-white pruina. Epithecium brown to dark-brown, 15–20 µm thick. Hymenium colourless, 85–100 µm tall. Asci clavate, 65–75 x 15–18 µm. Ascospores brown, broadly ellipsoid, 18–21.5(–23) x 8–10 µm. Pycnidia common to

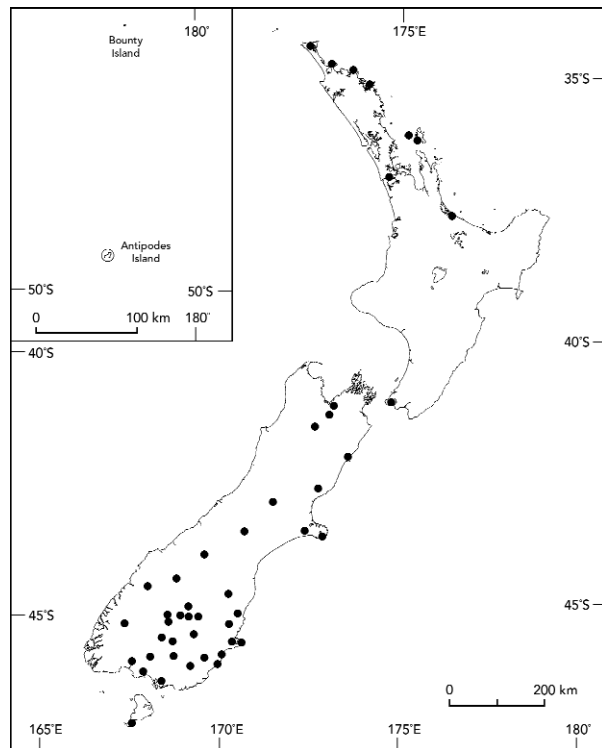


Fig. 4 Distribution of *Physcia caesia* in New Zealand

sparse, immersed, black, up to 0.2 mm in diameter. Conidia 4–5 x 1 μ m.

CHEMISTRY: Upper cortex and medulla K⁺ yellow; containing atranorin and zeorin.

DISTRIBUTION (Fig. 4): From Northland (Radar Bush) to Stewart Island (Port Pegasus) and the Antipodes. Known from all major landmasses including Antarctica (Awasthi 1960; Thomson 1963; Filson 1974; Moberg 1977, 1986, 1990, 1997, 2001, 2002, 2004; Redon 1985; Swinscow & Krog 1988; Coppins 1992, 2002; Nimis 1993; Santesson 1993; Esslinger & Egan 1995; Hansen 1995; Egea 1996; John 1996; Kondratyuk *et al.* 1996; Seaward 1996; Elvebakk & Hertel 1997; Elix & McCarthy 1998; Galloway & Quilhot 1999; Diederich & Sérusiaux 2000; Scholz 2000; Calvelo & Liberatore 2001; Hafellner & Türk 2001; Llimona & Hladun 2001; Øvstedal & Lewis Smith 2001; Elvebakk & Moberg 2002; Kurokawa 2003; McCarthy 2003; Santesson *et al.* 2004).

HABITAT ECOLOGY: *Physcia caesia* is a widespread lichen in New Zealand on both natural and human-made substrata, generally in sites exposed to full sunlight, though it also grows in moss polsters in crevices and ledges of dry overhangs in high-alpine sites. It colonises both basic (lime-

stone) and slightly acid rocks (schist, greywacke, basalt that may be affected by dust, manuring from birds or sea spray, etc.) from sea level to 2200 m (high-alpine specimens are usually very small and narrow-lobed and somewhat reminiscent of *P. tribacia*). *Physcia caesia* is one of the most commonly seen saxicolous macrolichens in Central Otago, often covering large areas of schist, making outcrops appear grey-white from a distance. It commonly grows on concrete (fence posts, copings and headstones of graves in cemeteries, piers and parapets of bridges, dam walls, picnic tables, etc.) and on bitumen pavement of footpaths and little-used roads. On bleached, weathered sheep bones scattered on the summit plateau of the Old Man Range in Central Otago (1650 m), *P. caesia* is the dominant colonising lichen. It associates with the following lichens in these varied habitats: *Acarospora* spp., *Caloplaca rubelliana*, *Candelariella coralliza*, *C. vitellina*, *Megalania chalybeia*, *Diploschistes scruposus*, *Flavoparmelia haysomii*, *Lecanora dispersa*, *L. polytropa*, *Lecidea fuscoatricula*, *L. lapicida*, *Lecidella stigmatea*, *Peltula* sp., *Phaeophyscia endococcinoides*, *P. hispidula*, *Physcia adscendens*, *P. dubia*, *P. poncinsii*, *P. tribacia*, *Placopsis perrugosa*, *Pseudocyphellaria crocata*, *Punctelia subrudecta*, *Umbilicaria grisea*, *Xanthoparmelia mougeotina*, and *Xanthoria elegans*.

DISTINGUISHING FEATURES: *Physcia caesia* is a cosmopolitan species, characterised by: rather narrow convex lobes; maculae on the upper surface (x10 lens) imparting a distinctive spotted or marbled appearance; marginal capitate soralia; and thick, blackish, simple rhizines often projecting from the lower surface at lobe apices. It may sometimes be confused with *P. poncinsii*, but the distinctly crateriform soralia of the latter species are characteristic. Specimens from coastal habitats from Northland (Karikari Peninsula) to southern Stewart Island (Port Pegasus) are sometimes parasitised by the lichenicolous fungus *Polycoccum pulvinatum* (Eitner) R. Sant. (Galloway *et al.* 1999, as *Polycoccum galligenum*), which is characterised by its distinctive laminal, erumpent galls on the upper surface of *P. caesia*, and its brown, 1-septate ascospores (16–)17–20(–21) x 7–9 μ m, the upper cell being larger.

SPECIMENS EXAMINED: **Northland:** Radar Bush, *J. K. Bartlett* 23886 (AK 192282); Puheke, Karikari Peninsula, 132 m, rocks in grassland, 9.iii.2000, *D. J. Galloway & S. Hammer* (CHR) [parasitised by *Polycoccum pulvinatum*]; Ririwha (Stephenson) Island, Charles Bay, on coastal rock faces just above high water, 29.viii.1982, *A. E. Wright* 5149 (AK 162115); Russell, Bay of Islands, on maritime rocks,

- 9.iii.1966, *A. E. Wade s. n.* (AK 192285); Great Barrier Island, Rangiahua Island, Camp Bay, on maritime rocks, i.1985, *G. C. Hayward s. n.* (AK 206678); Little Barrier Island, Pohutukawa Flat, on damp maritime rocks in shade, 6.v.1990, *B. W. Hayward s. n.* (AK 203662). **Auckland:** Green Bay, concrete retaining wall above beach, *s. l.*, 17.i.1996, *D. J. Galloway 1011* (CHR). **South Auckland:** Mt Maunganui, on coastal rocks, 24–26.v.1966, *A. E. Wade s. n.* (AK 192301) [parasitised by *Polycoccum pulvinatum*]. **Wellington:** Wellington, Botanic Gardens, on rocky banks of paths, 22.viii.1966, *W. Martin s. n.* (CHR 493611). **Nelson:** Kerr Bay, north-west corner of Lake Rotoiti, on exposed boulder on lake margin, 14.iv.1991, *A. E. Wright 1127* (AK 204471); Red Hill, Waiau Valley, 17.xii.1980, *J. K. Bartlett 19386* (AK 197080); Ruby Lake, on rock beside lake edge, 24.xii.1982, *J. K. Bartlett s. n.* (AK 192273); Hackett River Valley, *D. Glenney* (WELT L 003750). **Marlborough:** South of Black Miller Stream, north Kaikoura coast, 24.xii.1998, *A. Knight s. n.* (OTA) [parasitised by *Polycoccum pulvinatum*]. **Canterbury:** Lowry Peaks Range, 1 km south of Mt Palm, on exposed rocks in pasture, 24.i.1980, *J. A. Elix 6894* (CHR 266048); Castle Hill Basin, Flock Hill, on crest of small limestone outcrop in hillside 'flock' of limestone tors, 16.xii.1997, *P. N. Johnson 3281* (CHR); Port Hills, Christchurch, Devils Gap, on shady rock, 19.i.1985, *C. D. Meurk & H. D. Wilson s. n.* (CHR); Banks Peninsula, Kaituna Valley, on boulders in pasture, 10.x.1980, *L. Tibell 9112a* (UPS); Banks Peninsula, Lighthouse Road, 2 km south of Akaroa, on stones and rocks, 27.x.1980, *L. Tibell 9326* (UPS); Lake Ellesmere, on rocky outcrop, 16.viii.1970, *J. Child 1047* (CHR 388394); Rangitata Gorge, east end, on rocks, 31.viii.1977, *D. J. Galloway s. n.* (CHR 375633, 240488, 493544); Rangitata Valley, Coal Creek, on limestone, 17.i.1985, *H. Mayrhofer, H. Hertel, C. D. Meurk & B. P. J. Molloy* (UPS); Upper Godley Valley, 22.viii.1958, *D. Scott 206* (OTA 047129); Mt Sebastopol, 22.i.1972, *D. J. Galloway 2157, 2208* (CHR 260740, 260738); Tasman Valley, Blue Stream, on crests of greywacke rocks above water level in small stream at hill base beside lateral moraine, 800 m, 19.xii.1993, *P. N. Johnson 951* (CHR); Maitland Valley, Lake Ohau, v.1959, *J. Murray 1742* (OTA 047180); above Ben More Dam, iii.1961, *J. Murray 5751* (OTA 047135). **Otago:** Matukituki River mouth, on rocks, 27.vi.1970, *P. Child 153* (CHR 4455476); Damper Bay, Lake Wanaka, on lake-edge rocks, 19.v.1970, *P. Child 295* (CHR 445477); Bold Peak above Kinloch, on boulders in *Nothofagus* forest, 18.ii.1927, *G. Einar & Greta Du Rietz 1859* (UPS); Invincible Creek, Rees Valley, on rock, 1210 m, 8.i.1980, *C. D. Meurk* (OTA); Lake Wakatipu, on rock outcrops on lake shore, 310 m, 16.x.1994, *P. N. Johnson 1293* (CHR); Waikerikeri Valley, Clyde, on schist outcrops, 19.iv.1970, *P. Child 501* (CHR 445475); South Hector Mountains, on rock, 1490, m, *C. D. Meurk* (CHR); Garvie Mountains, Roaring Lion Creek, on crest of schist or in valley, 1260 m, 9.i.1996, *P. N. Johnson 1997* (CHR); Old Man Range, Hyde Rock, 30.iii.1997, *D. J. Galloway s. n.* (OTA); Alexandra, on schist rocks, 24.xii.1963, *W. Martin 5754* (CHR 402939); Lake Roxburgh, south-east end, Cave Creek, on upward face of big schist slab in creek bed in open, 22.i.1994, *P. N. Johnson 976* (CHR); Poolburn Reservoir, on concrete retaining wall, 10.v.1999, *D. J. Galloway 0676* (OTA); Serpentine Gully, Rough Ridge, on schist outcrop in grassland, 25.ii.1999, *D. J. Galloway 1338, 1385* (OTA); Kyeburn Diggings, on rock, 17.vi.1997, *J. M. Bannister 474* (OTA); Pomahaka River below Crown Rock yards, on rock outcrop near river, 13.iv.1998, *D. J. Galloway 0500* (OTA); Sutton Salt Lake, on schist, 15.iv.1995, *J. M. Bannister 28* (OTA); Trotters Gorge Scenic Reserve, on greywacke breccia-conglomerate boulder at bush edge, picnic site, 40 m, 12.xii.1998, *D. J. Galloway 5003* (OTA); Horse Range, Translator Road, on greywacke breccia-conglomerate, 290 m, 12.xii.1998, *D. J. Galloway 5002* (OTA); Lamb Hill, on schistose rock, 14.vi.1933, *J. S. Thomson T 264, ZA 99 pr.p.* (CHR 162681); Macraes Road, iv.1997, *J. M. Bannister 542* (OTA); Port Chalmers, on rotten rock, 27.vii.1933, *J. S. Thomson T 709* (CHR 160299); Dunedin, Wallace Street, on pavement, 6.x.1996, *J. M. Bannister 67* (OTA); Dunedin, Forth Street Bridge over Leith Stream, on tops and sides of concrete piers, amongst moss, 17.ix.1996, *D. J. Galloway s. n.* (OTA); Signal Hill microwave station, on concrete, 27.iv.1997, *J. M. Bannister 553* (OTA); Otago Peninsula, Broad Bay, on large rock outcrop among hillside pasture, 13.iv.1993, *P. N. Johnson 630, 631* (CHR); Mt Charles, Otago Peninsula, ix.1958, *J. Murray 3520* (OTA 047130); Highcliff, on volcanic lava, 1966, *W. Martin s. n.* (CHR 493621); Harbour Cone, on volcanic rocks, i.1965, *W. Martin 7333* (CHR 493620); Maungatua, v.1958, *J. Murray 1963* (OTA 047183); Domain, Taieri Mouth, on rotten rock, 10.ii.1965, *W. Martin s. n.* (CHR 402965); Akatore River mouth, on coastal rocks, 26.xii.1995, *P. N. Johnson 1901* (CHR)

[parasitised by *Polycoccum pulvinatum*]; Crystals Beach, on rock, 26.ii.1996, *J. M. Bannister* 27 (OTA); Waipahi River near Clinton, on concrete rural gate post, 3.ii.1995, *P. N. Johnson* 1316 (CHR); Rongahere, on old concrete fence posts, 13.vii.1985, *P. Child* 2412 (CHR 445484). **Southland:** Castle Rock near Dipton, on limestone rocks, 30.viii.1999, *D. J. Galloway* (OTA); Gore–Te Tipua Road, concrete bridge over Waimumu Stream, common and abundant on upper surface of western side of bridge, 19.x.1997, *D. J. Galloway* 5004 (OTA); Invercargill, Eastern Cemetery, headstone, on upward facing surface of fine masonry, 2.ii.1995, *P. N. Johnson* 1311 (CHR); Invercargill, Swinton Street, on asphalt footpath, 14.iv.1979, *D. J. Galloway s. n.* (CHR 266049); Southfert Fertiliser Works near Invercargill, on large steel pipe lying alongside Fertiliser Works buildings, 5 m, 19.xi.1996, *P. N. Johnson* 3140 (CHR); Pourakino Valley, on concrete picnic table, 4.xi.1997, *D. J. Galloway* 0193 (OTA); Clifden, on limestone, *J. S. Thomson* T 2265 (CHR 347890, OTA 047791, 047778); Lake Te Anau, S. Fiord, west of Driftwood Cove, on lake shore rock, 10.iii.1993, *P. N. Johnson* 515 (CHR); South coast, Bluecliffs to Sandhill Point, 25.x.1998, *A. Knight s. n.* (OTA 049695). **Stewart Island:** Port Pegasus, Islet Cove, on maritime rocks, 3.ii.1989, *B. W. Hayward s. n.* (AK 204606) [parasitised with *Polycoccum pulvinatum*]; Ibid. Cooks Arm, on maritime rocks, 25.i.1989, *B. W. Hayward s. n.* (AK 208239). **Antipodes Island:** Penguin Landing, on steep rock above main penguin colony, 4.iv.1927, *G. Einar Du Rietz* 2623:1 (UPS).

5. *Physcia crispa* Nyl., *Syn. meth. lich.* 1 (2): 423 (1860). Type: Ile Marquises, Noukahiva, Vallée de Tai-ha, *D. Jardin*, H-NYL 32199 – lectotype (*vide* Moberg 1986: 854).

ILLUSTRATION: Moberg (1986: 854, fig. 14).

DESCRIPTION: Thallus irregularly spreading, loosely attached, 1–2 cm in diameter. Lobes thin, rather fragile, 1–2 mm wide, 2–3 mm long, crowded-imbricate. Margins irregularly notched or incised to crenulate, ascending, sinuous, slightly thickened-ridged below, minutely lobulate-isidiate becoming sorediate. Upper surface pale olivaceous green when moist, creamish green to very pale buff-green when dry, smooth to shallowly undulate, matt, sorediate, without maculae or pruina. Soralia developing from minute marginal lobules or isidia (x10 lens), soon becoming sorediate and eroded in conspicuous areas of margins and lower surface, in places somewhat labriform, most conspicuous on inner parts of lobes and around

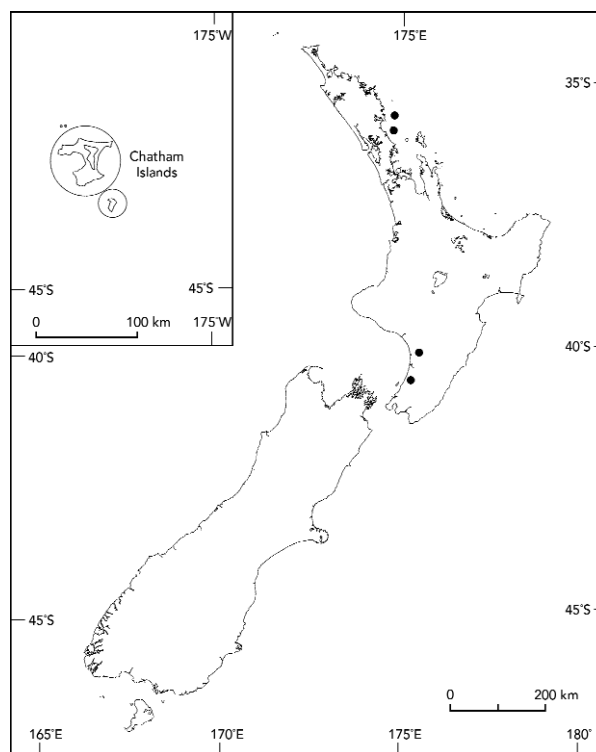


Fig. 5 Distribution of *Physcia crispa* in New Zealand

sinuses separating lobes. Soredia coarsely granular, olivaceous white. Lower surface corticate, white to ivory, darkening to pale tan centrally, smooth to minutely wrinkled or pitted, rhizinate. Lower cortex paraplectenchymatous. Rhizines widely scattered, rather sparse, concolorous with lower surface, simple, with an apical squarrose tuft, 0.5–1 mm long. Apothecia and pycnidia not seen.

CHEMISTRY: Cortex K⁺ yellow; medulla K⁻; containing atranorin.

DISTRIBUTION (Fig. 5): At present known only from: collections made on the northern offshore islands (Cavalli Islands, the Poor Knights Islands, and the Hen and Chickens Islands) between latitudes 35°S and 36°S (Hayward & Hayward 1978, 1979, 1984, as *Physcia albicans*; Hayward & Wright 1991, as *Physcia tribacoides*); a reference to a foliicolous collection from Kitchener Park near Feilding, where it was collected from the leaves of *Beilschmiedia tawa* and *Prumnopitys taxifolius* (Zahlbruckner *et al.* 1928); a collection from a Levin street; and from Taia Reserve on Chatham Island. *Physcia crispa* is a palaeotropical species known also from East Africa (Moberg 1986; Swinscow & Krog 1988), North America

(Harris 1990, 1995; Esslinger & Egan 1995; Brodo *et al.* 2001), South America (Aptroot 1989b; Moberg 1990; Scutari 1995; Marcano *et al.* 1996; Calvelo & Liberatore 2001), Hong Kong (Aptroot & Seaward 1999), the Pacific Islands (Elix & McCarthy 1998, as *Physcia albicans*), and Australia (Moberg 2001; McCarthy 2003).

HABITAT ECOLOGY: The specimens seen in this study were collected from bark in northern coastal forest and from bushes in a Levin street. Elsewhere in its range it is known from tree trunks in both shaded and open situations (Moberg 1990), and as an epiphyte of leaves in lowland forest (see above).

DISTINGUISHING FEATURES: *Physcia crispata* is a palaeotropical species, characterised by: thin, fragile, undulate lobes; marginal soralia developing from minutely lobules or isidia; and a K⁻ reaction of the medulla (zeorin absent). Nomenclature of this species is discussed in Moberg (1986: 855).

SPECIMEN EXAMINED: **North Auckland:** Poor Knights Islands, Aorangi Island, top of Tatua Peak, on bark, viii.1984, *B. W. Hayward s. n.* (AK 172344) [Recorded in Hayward & Wright (1991: 43 as *Physcia cf. tribacoides* Nyl.).] **Wellington:** Levin, Queen Street East, on branches of a bush, 16.v.1962, *A. E. Wade 86* (AK 192318). **Chatham Islands:** Taia Reserve, on tree trunk bases in partly open forest, 3.viii.2000, *P. N. Johnson 3563* (CHR).

6. *Physcia dubia* (Hoffm.) Lettau, *Hedwigia* 52: 254 (1912).

≡ *Lobaria dubia* Hoffm., *Dtschl. Fl.*: 156 (1796). Type: Germany, Ehingen, 1897, *Rieber, Arnold, Lich. ex.* No. 1724, UPS – neotype (*vide* Moberg 1977: 76).

ILLUSTRATIONS: Kashiwadani (1975: pl. 3:4); Moberg (1977: 8, fig. 5E; 76, fig. 34); Moberg & Holmåsén (1982: 201); Moberg & Hansen (1986: 10, fig. 11); Wirth (1987: 369); Hale & Cole (1988: 99, fig. 42B); Dobson (1992: 264); Goward *et al.* (1994: 110, fig. 8A); Hansen (1995: 54); St Clair (1999: 148); Brodo *et al.* (2001: 554, fig. 665); Moberg (2002: 98).

DESCRIPTION: Thallus loosely to closely attached centrally, apices free and ascending, spreading in small rosettes (0.5–) 1–3(–6) cm in diameter. Lobes narrow (0.4–0.8(–1.2) mm wide), rather short (1–3 mm long), crowded-congested centrally, discrete at periphery, apices bifurcate to irregularly and minutely divided (x10 lens). Margins slightly thickened and in places somewhat inrolled. Upper surface pale mineral grey to grey-white, darkening to somewhat

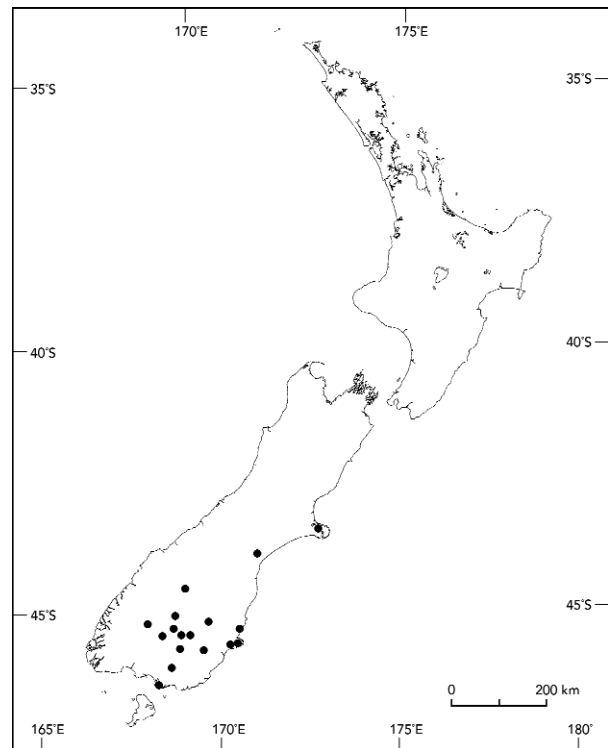


Fig. 6 Distribution of *Physcia dubia* in New Zealand

blackened at apices; matt; minutely lumpy to papillate to sporadically coarsely areolate-scabrid (x10 lens). Soralia marginal, often on small secondary lobes, distinctively labriform, with soredia greenish (in shaded specimens), grey-white to somewhat blackened, and coarse, granular. Lower surface corticate, whitish to pale buff-pink, darkening slightly towards centre. Rhizines scattered, whitish to brownish or somewhat blackened, simple, 0.5–1(–1.2) mm long. Lower cortex prosoplectenchymatous. Apothecia and pycnidia not seen in New Zealand material.

CHEMISTRY: Cortex K⁺ yellow; medulla K⁻; containing atranorin.

DISTRIBUTION (Fig. 6): Presently known in New Zealand from Canterbury (Port Hills) to Southland where it appears to be quite widespread in both coastal and inland sites, and from natural and human-made substrata, from sea level to 1708 m. Being a rather small, delicate species it is probably frequently overlooked and no doubt is more widely distributed in New Zealand than present records show. A widespread, cosmopolitan species common in the Northern Hemisphere (Thomson 1963; Moberg 1977; Moberg & Hansen 1986; Coppins 1992, 2002; Nimis 1993; Santesson 1993; Esslinger & Egan 1995; Hansen

1995; Egea 1996; Kondratyuk *et al.* 1996; Elvebakk & Hertel 1997; Scholz 2000; Brodo *et al.* 2001; Hafellner & Türk 2001; Llimona & Hladun 2001; Kurokawa 2003; Santesson *et al.* 2004), East Africa (Moberg 1986; Swinscow & Krog 1988), southern South America (Moberg 1990; Galloway & Quilhot 1999; Calvelo & Liberatore 2001; Elvebakk & Moberg 2002), and Antarctica (Øvstedal & Lewis Smith 2001).

HABITAT ECOLOGY: On both basalt and schist rocks where it is known from tops of nutrient-enriched bird-perch rocks; tops and from vertical faces of schist outcrops in sunny, exposed sites as well as from dry underhangs. It is also collected, rarely, from dust-impregnated bark. The species also colonises a variety of human-made substrata including: concrete posts; walls, gravestones; and dust-impregnated old wooden painted window frames and old painted iron machinery. It has a preference for basic and nutrient-enriched habitats where it associates with other high light- and/or nutrient-loving lichens including: *Caloplaca* spp., *Candelariella coralliza*, *C. vitellina*, *Flavoparmelia haysomii*, *Lecanora dispersa*, *L. polytropha*, *Parmelina labrosa*, *Physcia adscendens*, *P. caesia*, *P. poncinsii*, *Punctelia subrudecta*, *Teloschistes velifer*, *Umbilicaria grisea*, *Xanthoparmelia scabrosa*, *Xanthoria elegans*, and *X. parietina*.

DISTINGUISHING FEATURES: *Physcia dubia* is a cosmopolitan species characterised by: narrow lobes rarely exceeding 1 mm in diameter; marginal, labriform soralia most commonly produced at lobe tips; mineral-grey, matt, epruinose upper surface, noticeably darker (to brownish or blackish) at apices; K– medulla (zeorin absent); and a prosoplectenchymatous lower cortex. It is distinct from *P. tribacia*, which has a shiny upper surface and a paraplectenchymatous lower cortex.

SPECIMENS EXAMINED: **Canterbury:** Christchurch, Port Hills, Devils Gap, East Peak, on basalt rock, 19.i.1985, *C. D. Meurk s. n.* (CHR); Temuka, on dusty bark, xi.1958, *Mason 263, 272* (OTA 048015). **Otago:** Pisa Range, Lake McKay, on top surface of schist outcrops, 15.ii.1986, *P. Child 2677* (CHR 445486); Nevis Valley, on trunk of old apple tree at old sluicing site within upland grassy valley, 800 m, 11.i.1995, *P. N. Johnson 1917* (CHR); Garvie Mountains, Roaring Lion Creek, 1260 m, on crest of schist tor in valley, 9.i.1996, *P. N. Johnson 2055* (CHR); Poolburn Reservoir, on top of concrete handrail and retaining wall, 10.v.1999, *D. J. Galloway 06777* (OTA); Serpentine Gully, Rough Ridge, on top of schist outcrop in

grassland near old gold diggings, 1000 m, 25.ii.1999, *D. J. Galloway 1385* (OTA); Umbrella Mountains, Gem Lake, on the top surfaces of lakeside boulders, 9.iii.1986, *P. Child 2838* (CHR 445487); Old Man Range, Hyde Rock, on schist rocks and ledges of bluffs at the head of Gorge Creek, 30.iii.1997, *D. J. Galloway 2508* (OTA); Roxburgh, War memorial, on sunny schist outcrops, 30.x.1997, *D. J. Galloway s. n.* (OTA); Mt Bengier, head of Black Jacks Creek, on dry underhangs of schist tors, 27.i.1997, *D. J. Galloway 2510* (OTA); Black Gully, Blue Mountains, on concrete power pole at playground, 15.vii.1999, *D. J. Galloway 0661* (OTA); Hammonds Hill, Merton, on dry rocks, ix.1959, *J. Murray 4664* (OTA 047173); Dunedin, Forth Street Bridge, on top and sides of concrete piers amongst moss, 17.x.1996, *D. J. Galloway s. n.* (OTA); Abbots Hill, i.1958, *J. Murray 1604* (OTA 047138). **Southland:** Lumsden, on old flaking paint on cast-iron winch outside Information Centre, 150 m, 11.vii.2000, *D. J. Galloway* (CHR); Waikaia Cemetery, on headstone, 25.vii.1998, *D. J. Galloway 2511* (OTA); Mataura, Kath Falconer's garden, on old painted window sill of derelict house, 40 m, 17.ix.1997, *D. J. Galloway 5006* (OTA); Invercargill, Eastern Cemetery, headstone, on vertical face of polished granite, 2.ii.1995, *P. N. Johnson 1308* (CHR); South Mavora Lake at north end, on top of bird-perch rock at roadside, 520 m, 25.1.2001, *D. J. Galloway 5510* (CHR 533949).

7. *Physcia erumpens* Moberg, *Nord. J. Bot.* 6 (6): 856 (1986). Type: Kenya, Aberdare National Park, c. 5 km west of Ruhuruini Park Gate, 0°22'S, 36° 47'E, altitude c. 2550 m, on the trunk of *Neoboutonia macrocalyx* along the road. 1979. *R. Moberg 4419a*, UPS – holotype.

ILLUSTRATIONS: Moberg (1986: 857, fig. 16); Swinscow & Krog (1988: 227, fig. 110); Scutari (1995: 220, fig. 4C).

DESCRIPTION: Thallus orbicular to irregularly spreading, 1–3(–5) cm in diameter, closely attached from margins to centre. Lobes rather narrow (0.5–1.5(–2) mm wide), 2–3(–10) mm long, subdichotomously to irregularly branched, discrete, adjacent to subimbricate at apices, complex-imbricate centrally, plane to convex or somewhat crumpled. Margins entire, shallowly notched or incised to somewhat wavy, or with small secondary lobules; apices rounded to irregularly scalloped or incised; slightly thickened-ridged below. Upper surface pale greenish white when moist, off-white to white when dry, matt, smooth, minutely white-maculate (x10 lens) in older parts,

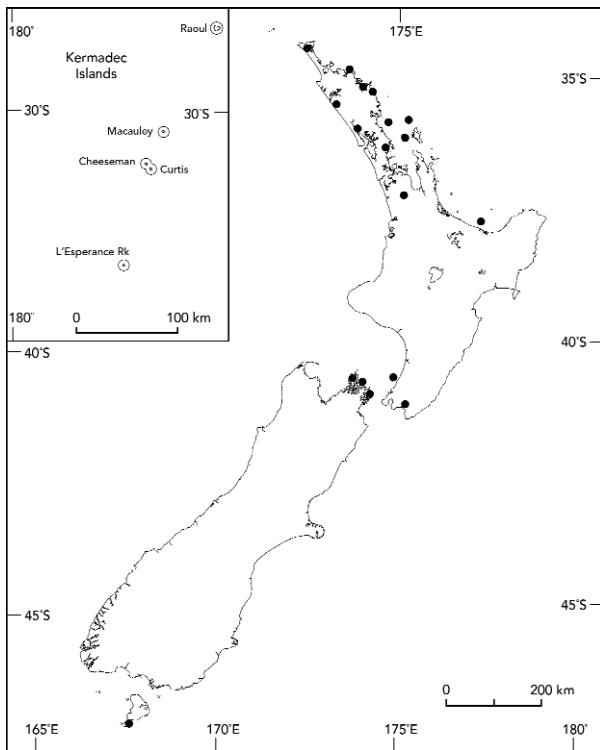


Fig. 7 Distribution of *Physcia erumpens* in New Zealand

epruinose, sorediate. Soralia laminal, rounded to irregular, (0.2–)0.5–1(–1.5) mm in diameter, often confluent and eroding to large areas and exposing white medulla, distinctively crateriform, margins often conspicuous and flaring back from exposed medulla and accumulated soredia. Sorelia soredia coarsely granular, pale greenish to white. Lower surface smooth, matt to slightly glossy in parts, greyish to red-brown to black, rhizinate. Lower cortex paraplectenchymatous. Rhizines sparse to numerous, simple, with a squarrose tuft at tip, 0.2–0.5(–0.8) mm long, grey to brown-black. Apothecia sparse to occasional, solitary to 2 or 3 together, sessile, constricted at base, rounded, 0.5–1(–2) mm in diameter; thalline exciple prominent, persistent, swollen, smooth to crenulate-striate, dissolving here and there into soredia in older fruits, concolorous with thallus. Disc subconcave to plane, pale to dark red-brown to somewhat blackened, with or without pruina. Epithecium olive-brown to dark brown, 10–12.5 μm thick. Hymenium 85–100 μm tall, colourless. Hypothecium opaque, densely interwoven, pale yellowish or brownish. Ascospores brown, broadly ellipsoid, *Pachysporaria*-type, (20–)22–25(–28) \times 7.5–10 μm .
CHEMISTRY: Upper cortex and medulla K⁺ yellow;

containing atranorin and zeorin and several unidentified triterpenoids.

DISTRIBUTION (Fig. 7): Most frequently collected from northern, coastal habitats but ranging southwards to Kapiti Island and the Marlborough islands of Cook Strait, a disjunction shown also by *Physcia integrata* and *Teloschistes flavicans*. Also recorded from Port Pegasus at the south of Stewart Island. First described from East Africa (Moberg 1986), it was subsequently recorded from Madagascar (Aptroot 1988), the Philippines (Aptroot & Sipman 1989), South America (Moberg 1990; Scutari 1995; Marcano *et al.* 1996; Galloway & Quilhot 1999; Calvelo & Liberatore 2001), Portugal, the Azores, Macaronesia and Italy (Moberg 1989; Nimis 1993), the Sonoran Desert and Baja Californian North America (Moberg 1997), and from South Africa (Moberg 2004).

HABITAT ECOLOGY: On coastal vegetation (maritime scrub, mangroves, trees in coastal forest) and rocks (both maritime and in coastal grasslands) and in parks and on farmland on introduced trees. It is known from the following phorophytes: *Araucaria araucana*, *Avicennia marina* var. *resinifera*, *Cordyline australis*, *Corynocarpus laevigatus*, *Cupressus macrocarpa*, *Dacrydium intermedium*, *Leptospermum scoparium*, *Myoporum laetum*, *Pittosporum tenuifolium*, *Solanum linnaeanum*.

It associates with the following lichens: *Megalaria melanotropa*, *Heterodermia obscurata*, *H. speciosa*, *Normandina pulchella*, *Pannaria elixii*, *Parmelia sulcata*, *Physcia integrata*, *P. undulata*, *Pseudocyphellaria aurata*, and *Pyxine subcinerea*.

DISTINGUISHING FEATURES: *Physcia erumpens* is a palaeotropical species, characterised by: convex lobes; a black lower surface, with a paraplectenchymatous lower cortex; and crateriform to capitate laminal soralia. The black lower surface distinguishes it from *P. poncinsii*.

SPECIMENS EXAMINED: **Kermadec Islands:** Raoul Island, Denham Bay, behind dunes, on ngaio, 22.xi.1994, *B. W. Hayward s. n.* (AK 224408). **Northland:** Waitiki Stream, *J. K. Bartlett s. n.* (AK 192278 pr.p.); Tapotopotu Bay, on mangroves, v.1984, *B. W. Hayward s. n.* (AK 172704); Ririwha (Stephenson) Island, behind Charles Bay, on rock outcrops in steep pasture, 29.viii.1982, *A. E. Wright 5133* (AK 162099); Bay of Islands, Urukupuka Island, on Sodom's apple, i.1980, *B. W. & G. C. Hayward* (AK 155031); Opuia, on mangrove, 20.xi.1933, *L. B. Moore & L. M. Cranwell* (CHR 493564); Whangaruru Harbour, Teal Bay, on mangroves, i.1987, *B. W. Hayward s. n.* (AK

204686); Kawerua, on macrocarpa, 2.i.1987, *B. W. Hayward s. n.* (AK 181599); Lady Alice Island, on bark, kohekohe–karaka forest, i.1982, *B. W. Hayward L6* (AK 167821); Fanal Island, maritime rocks, 26.v.1979, *A. E. Wright* (AK 154062); Hen Island, Lighthouse Point, on bark in dark forest, viii.1977, *B. W. & G. C. Hayward* (AK 165924); Tokatoka, *J. K. Bartlett 24163* (AK 191974); Little Barrier Island, 1 km south of Hingaia Point, on exposed andesite cliffs amongst low coastal scrub, 6.v.1990, *A. E. Wright 9920, 9924* (AK 193373, 1933377); Mahurangi River, on *Avicennia resinifera*, 3.ix.1933, *L. B. Moore* (AK 18994); Lucy B. Moore Park, Warkworth, on *Araucaria araucana* bark, 12.xii.1996, *D. J. Galloway 96157* (OTA). **South Auckland:** Meremere, 7.vii.1980, *J. K. Bartlett s. n.* (AK 196287); Motuhora (Whale) Island, east of McEwens Bay, 40 m, on mature cabbage tree in stand of fern, 1.i.1986, *G. C. Hayward s. n.* (AK 175383). **Wellington:** Kapiti Island, on rocks in clearing in maritime scrub, 11.iv.1982, *B. W. Hayward KL5* (AK 167948); Tahoramourea (Browns) Island off Kapiti Island, on maritime rocks, iv.1982, *B. W. Hayward s. n.* (AK 172187); Western Lake Road along shores of Lake Wairarapa, on fence, 27.vi.1992, *B. Polly s. n.* (WELT L3412). **Marlborough:** D'Urville Island, south-west side of Kupe Bay, on maritime rocks, 0–5 m, 6.i.1988, *B. W. Hayward s. n.* (AK 181580); *Ibid.* south and west slopes of Mt Maud, on rocks in damp, shaded, mixed forest gully, 25–300 m, 3.i.1988, *B. W. & G. C. Hayward* (AK 181259, 181361); Chetwode Islands, the Haystack, on petrel scrub, 25 m, iii.1984, *B. W. Hayward s. n.* (AK 175386); Queen Charlotte Sound, Ship Cove, on bark of karaka on grassland immediately behind beach, 1.i.1992, *A. E. Wright 11733* (AK 204918); *Ibid.*, Resolution Bay, Schoolhouse Bay, on bark in mixed tea tree forest, 5–20 m, 6.i.1992, *B. W. Hayward s. n.* (AK 205618); *Ibid.*, Long Island, main ridge track, on bark of *Pittosporum tenuifolium* in regenerating forest on summit, 80 m, 3.i.1992, *A. E. Wright 11826* (AK 205050). **Stewart Island:** Port Pegasus, Islet Cove, on bark of *Dacrydium intermedium*, 25.i.1989, 2 m, *B. W. Hayward s. n.* (AK 204046).

8. *Physcia integrata* Nyl., *Syn. meth. lich.* 1 (2): 424 (1860). Type: Mexico. Orizaba, *F. Müller*, H-NYL 32211 – holotype (*vide* Moberg 1986: 858).

ILLUSTRATIONS: Awasthi (1960: pl. 1, fig. 2); Moberg (1986: 858, fig. 18); Aptroot (1987: 40, pl. 10); Swinscow & Krog (1988: 229, fig. 112).

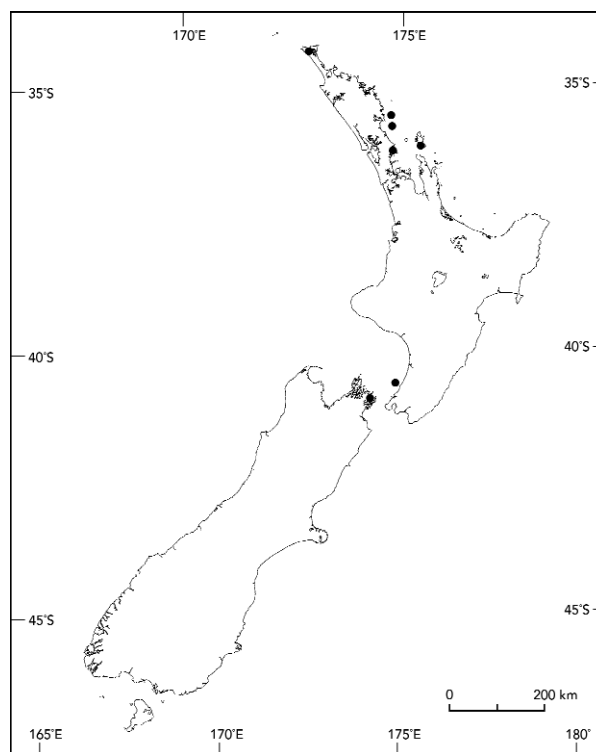


Fig. 8 Distribution of *Physcia integrata* in New Zealand

DESCRIPTION: Thallus orbicular to irregularly spreading, (1–)2–3(–4) cm in diameter, closely attached from margins to centre. Lobes narrow (0.5–1 mm wide), 2–10(–15) mm long, subdichotomously to irregularly branching, discrete from apices to centre, to somewhat adjacent to interlaced, complex-imbricate centrally, flat to convex. Margins entire, to delicately notched or incised or irregularly secondarily lobulate, without isidia or soralia. Upper surface very pale greenish white when moist, more or less white to ivory-white when dry, smooth or patchily minutely lumpy, glossy to matt, epruinose, minutely white maculate (x10 lens), maculae best seen at or towards apices of lobes, without isidia or soredia. Lower surface smooth, matt to slightly glossy, dark-brown to black, sometimes with a narrow, pale marginal zone, rhizinate. Lower cortex paraplectenchymatous. Rhizines numerous, entangled, squarrosely branched, brown to black, 0.4–0.8(–1) mm long. Apothecia and pycnidia not seen in New Zealand collections.

CHEMISTRY: Cortex and medulla K⁺ yellow; containing atranorin and zeorin.

DISTRIBUTION (Fig. 8): Known in New Zealand at present from northern, offshore islands between latitudes 35°30'S

and 36°S, and from Kapiti Island, and Motuara Island in the Marlborough Sounds. Known also from India (Awasthi 1960), East and South Africa (Moberg 1986, 2004, Swinscow & Krog 1988), Hong Kong (Aptroot & Seaward 1999), Central and South America (Aptroot 1987; Moberg 1990; Marciano *et al.* 1996), the Pacific (Elix & McCarthy 1998), and Australia (Moberg 2001; McCarthy 2003).

HABITAT ECOLOGY: On bark of *Avicennia marina* var. *resinifera* and *Kunzea ericoides* and possibly on the bark of other lowland and coastal forest trees. The particular ecological requirements of this species in New Zealand remain to be determined. Specimens examined are associated with the following lichens: *Megalania melanotropia*, *Pannaria elixii*, *Physcia erumpens*, *P. jackii*, *Pseudocyphellaria aurata*, *Pyrenula* sp., *Rimelia austrocratrata*. Elsewhere in its range it grows on tree trunks (rarely on rocks) in rather open, lowland situations (Moberg 1986, 1990, 2001).

DISTINGUISHING FEATURES: *Physcia integrata* is a palaeotropical species, characterised by: a smooth, sometimes glossy, upper surface, without isidia, soralia, or pruina; a black, distinctly paraplectenchymatous lower surface (often paler at or near the margins); brown to black rhizines; and atranorin and zeorin as secondary metabolites.

SPECIMENS EXAMINED: **Northland:** Waitiki Stream, *J. K. Bartlett s. n.* (AK 192278 pr.p); Lady Alice Island, on bark in kanuka–*Myrsine* forest, i.1982, *B. W. Hayward L23* (AK 167825); Poor Knights Islands, Aorangi Island, on western cliff, on bark in semi-dark forest, ix.1980, *B. W. Hayward s. n.* (AK 172703); Great Barrier Island, Whangaparapara, on mangroves, i.1984, *B. W. Hayward s. n.* (AK 171833); Mahurangi River, on mangrove, 3.ix.1933, *L. B. Moore s. n.* (AK 18995). **Wellington:** Kapiti Island, on kanuka, 11.iv.1982, *B. W. Hayward KA2* (AK 167781). **Marlborough:** Motuara Island, on track up to Cook's Cairn, 100 m, on bark in mixed tea tree forest, x.1992, *G. C. Hayward s. n.* (AK 205512).

9. *Physcia jackii* Moberg, *Bibliotheca Lichenol.* 78: 298 (2001). Type: Australia, Australian Capital Territory, Uriarra Crossing, Murrumbidgee River (17 km north-west of Capital Hill, Canberra), 35°15'S, 148°57'E, altitude 400 m, on river bank with *Casuarina cunningghamii* forest and open rocky outcrops, on fallen *Casuarina*, 12.iii.1992, *R. Moberg & B. Owe-Larsson A67:1*, CANB – holotype; BM, CANL, GZU, H, HMAS, LD, M, MIN, O, TNS, UPS, US, Herb. K. Kalb, Herb. A. Vezda – isotypes (Moberg, *Lich. Sel. Exs.* No. 328).

= *Physcia stellaris* auct. non (L.) Nyl. sensu Galloway (1985: 394).

ILLUSTRATIONS: Martin & Child (1972: 110, pl. 22, as *Physcia stellaris*); Malcolm & Galloway (1997: 135, 143, as *Physcia stellaris*); Moberg (2001: 299, fig. 1).

DESCRIPTION: Thallus orbicular, rosette-forming to irregularly spreading (encircling twigs), closely attached from margins to centre, 1–2(–7) cm in diameter. Lobes plane to convex, 0.5–2(–3) mm wide, 3–5(–8) mm long, adjacent to loosely imbricate at apices, densely and complexly imbricate centrally, often also secondarily lobulate or hummocky centrally. Margins entire, shallowly notched, incised or scalloped, not noticeably thickened below. Upper surface pale greenish grey or blue-grey when moist, grey-white to creamish when dry, smooth to minutely granular-crystalline (x10 lens), occasionally minutely maculate centrally (x10 lens), epruinose, esorediate. Lower surface whitish at margins to pale buff or creamish centrally, smooth, rhizinate. Lower cortex prosoplectenchymatous, with the lowermost part of isodiametric cells (paraplectenchymatous). Rhizines sparse to frequent, simple to squarrose-branched (especially at apices), white to pale tan, 0.4–1 mm long. Apothecia laminal, at centre of thallus, frequent, crowded-congested, sessile, constricted at base, rounded or contorted through mutual pressure, (0.2–)0.5–1(–2) mm in diameter; thalline exciple persistent, concolorous with thallus, entire, smooth to crenulate-striate. Disc plane, matt, dark brown-black, with or without a fine, grey-white, delicately farinose pruina. Epithecium yellow-brown to chestnut-brown, 12.5–18 µm thick. Hymenium colourless 100–112.5 µm tall. Hypothecium pale yellow-brown, opaque, of densely interwoven hyphae. Ascospores grey-brown, *Physcia*-type, (20–)22–25(–27.5) x 7.5–10 µm. Pycnidia sparse or absent, to numerous when present.

CHEMISTRY: Cortex K+ yellow; medulla K+ yellow; containing atranorin and zeorin.

DISTRIBUTION (Fig. 9): From South Auckland (Raglan) to Stewart Island. Known also from Australia (Moberg 2001: 300, fig.2) and South Africa (Moberg 2004).

HABITAT ECOLOGY: Widespread on introduced trees and shrubs in parks, gardens and along roadsides and wasteland, also on native trees and shrubs at forest margins, streamsides, etc. It colonises the following phorophytes: *Abies* sp., *Acer pseudoplatanus*, *Aristotelia serrata*, *Berberis* sp., *Carmichaelia* sp., *Coprosma propinqua*, *C. repens*, *Cordyline australis*, *Crataegus monogyna*, *Cupressus*

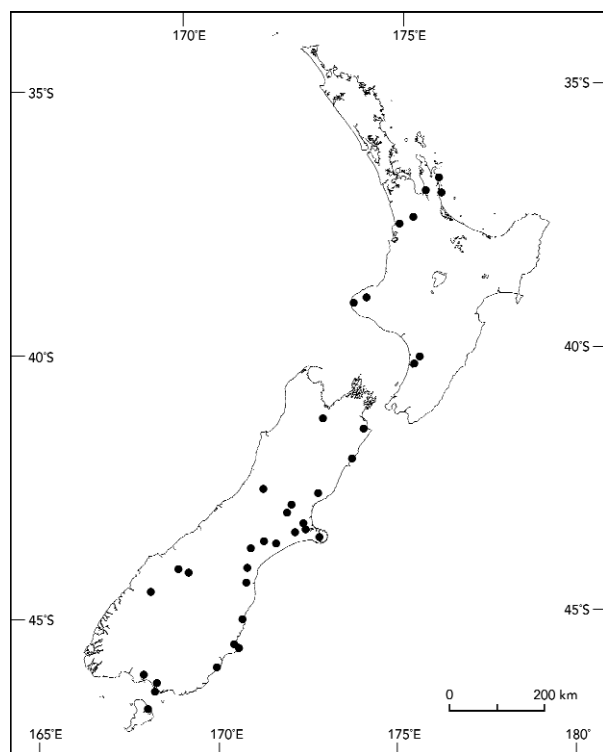


Fig. 9 Distribution of *Physcia jackii* in New Zealand

macrocarpa, *Cytisus scoparius*, *Discaria toumatou*, *Fraxinus excelsior*, *Lycium ferocissimum*, *Malus* spp., *Melicope simplex*, *Muehlenbeckia australis*, *Olearia odorata*, *Plagianthus betulinus*, *Populus nigra*, *Prunus* spp., *Salix* spp., *Sambucus nigra*, *Sophora microphylla*, *S. prostrata*, *S. tetraptera*, *Sorbus aucuparia*, *Ulmus campestris*.

It associates with the following lichens: *Buellia griseovirens*, *Haematomma babingtonii*, *Lecanora carpinea*, *Physcia adscendens*, *P. poncinsii*, *P. undulata*, *Ramalina celastri*, *R. glaucescens*, *R. inflexa*, *Teloschistes chrysophthalmus*, *T. velifer*, *Usnea* spp., *Xanthomendoza novozelandica*, *Xanthoria candelaria*, *X. parietina*, and *X. polycarpa*.

DISTINGUISHING FEATURES: *Physcia jackii* is an Australasian species characterised by: a neat, rosette-forming thallus; abundant, central apothecia; the K+ yellow medulla (atranorin); a chemistry comprising atranorin (cortex and medulla) and zeorin (medulla); and the corticolous habit. New Zealand material is very uniform chemically and also morphologically. The rather smooth, emaculate upper cortex and the crowded, central apothecia have led to the New Zealand material formerly being identified as *P. stellaris*. However, true *P. stellaris* [Riesengebirge: Brückenberg, c. 850 m, 15.viii.1938, *J. Hillmann!* (CHR 493534)] lacks

zeorin in the medulla, and no New Zealand specimen formerly identified as *P. stellaris* has atranorin alone in acetone extracts. Earlier references in the literature to *Physcia stellaris* (e.g. Zahlbruckner 1941, Martin & Child 1972, Galloway 1985, 1992, Malcolm & Galloway 1997) are referable to *P. jackii*.

SELECTED SPECIMENS EXAMINED: **South Auckland:** Kauaeranga River estuary, Thames, on mangrove in tidal swamp, 8.i.1982, *J. A. Elix 9931* (CANB); South end of Onemana Beach, on *Coprosma*, 13.xi.1992, *L. Tibell 19522* (AK); Coromandel Peninsula, Hot Water Beach, on seashore rocks, 10.iv.1992, *R. Moberg & B. Owe-Larsson NZ11:3* (UPS); Hamilton, xi.1959, *J. Murray 4743* (CHR 493573). **Taranaki:** Mt Taranaki, east side, Mountain Road, on stems of barberry in roadside hedge, 17.ii.1994, *P. N. Johnson 1124* (CHR); Manu Stream, coastal scarp, on *Coprosma repens*, 28.x.1993, *P. N. Johnson 895* (CHR); Coast near Rahotu, on boxthorn shrubs in dune, 15.ii.1994, *P. N. Johnson 1106* (CHR); Waipapa, on boxthorn hedge, 27.x.1993, *P. N. Johnson 870* (CHR). **Wellington:** Rangitikei, *J. K. Bartlett 21442* (AK 192316); Kitchener Park, Feilding, *H. H. Allan s. n.* (CHR 347900); Feilding, on plum tree, 25.v.1962, *A. J. Healy 62/231* (CHR 241891); Between Lake Alice and Marton, on bark of *Cordyline australis*, 18.vii.1961, *A. J. Healy 61/264* (CHR 241901). **Nelson:** Foxhill, on roadside *Crataegus monogyna*, 26.vii.1964, *A. J. Healy 54/110* (CHR 347899). **Marlborough:** Seddon, south-east bank Awatere road/rail bridge, on *Muehlenbeckia astonii*, 60 m, 25.v.1993, *P. J. de Lange s. n.* (AK 215061); 'Glentui', Hapuku River, Kaikoura, lowland forest on *Sophora*, 14.vi.1964, *A. J. Healy 64/100* (CHR 241920). **Westland:** Otira Gorge, pre-alpine *Dracophyllum* forest, on trunks of *Hoheria glabrata*, 15.iv.1927, *G. Einar & Greta Du Rietz 2658:1* (UPS). **Canterbury:** Waikari, on *Cupressus* sp., 10.x.1962, *A. J. Healy 62/345* (CHR 347906); Omihiri State Forest, on *Carmichaelia* sp., 11.vii.1963, *A. J. Healy 63/293* (CHR 347905); Spotswood, 10.vii.1958, *A. J. Healy 58/477* (CHR 241750); Lowry Peaks Range, 1.5 km south-west of Mt Palm, on matagouri in pasture, 24.i.1980, *J. A. Elix 6852* (CHR 347915); Ashley Gorge Reserve, on sycamore, 31.xii.1994, *D. J. Galloway & C. J. Evans* (OTA); Waimakariri River near Hakett, on *Sophora prostrata*, 16.x.1964, *A. J. Healy 64/310* (CHR 241917); West of Yaldhurst, on dead twigs of *Sophora prostrata*, 13.iv.1958, *R. Mason 5741* (CHR 489371, 489493); Banks Peninsula, Mitchells Track, Port Hills, on kowhai in remnant forest,

17.iv.1980, 17.iv.1980, *J. A. Elix* 7815 (CANB); Banks Peninsula, Kaituna Valley, on trunk of *Sophora microphylla*, 10.x.1980, *L. Tibell* 9098 (UPS); Dunsandel, on *Sambucus nigra*, 11.ix.1963, *A. J. Healy* 63/177 & *I. Fryer* (CHR 160409); Lincoln, Landcare Research, kowhai grove, 2.viii.1993, *P. N. Johnson* 783 (CHR); South side Rakaia River, on *Cytisus scoparius*, 11.ix.1963, *A. J. Healy* 63/187 & *I. Fryer* (CHR 160400); Mt Somers, on *Cytisus scoparius* along irrigation channel, 7.ix.1962, *A. J. Healy* 62/262 (CHR 160465); Ashburton River east of Tinwald, on poplar, 29.i.1962, *A. J. Healy* 62/119 (CHR 241896, 241921); Peel Forest, on *Melicope simplex*, 13.v.1964, *A. J. Healy* 64/94 (CHR 347904); Kakahu Bush, on *Coprosma* in native forest, 25.ii.1964, *A. J. Healy* 64/20 (CHR 347912); He-Hae-Te Moana Road near Gapes Gully, on *Discaria toumatou*, 25.ii.1964, *A. J. Healy* 64/21 (CHR 241916); Three Mile Bush Road, on *Coprosma* at foot of limestone outcrop, 8.ix.1964, *A. J. Healy* 64/188 (CHR 241915); Pleasant Point, on *Ulmus campestris*, 12.xii.1965, *A. J. Healy* 65/227 (CHR 241905); Kelseys Bush near Waimate, 21.x.1963, *R. Mason* 10243 (CHR 347911); Waihao Downs, on dead *Coprosma* sp., 26.xii.1961, *R. Mason* 8931, 8932, 8940 (CHR 347909, 347907, 347908, respectively). **Otago:** Makarora River mouth, on willows, 23.v.1970, *P. Child* 339 (CHR 445488); Glenorchy, Department of Conservation ranger's garden, on *Sorbus*, 10.xi.1998, *D. J. Galloway* 2503 (OTA); West of Weston, on *Olearia odorata*, 7.v.1992, *P. N. Johnson* 347 (CHR); Kakanui, on bark, 31.xii.1998, *J. M. Bannister s. n.* (OTA 049909); Lower Waianakarua Valley, on sycamore, 20.xii.1993, *P. N. Johnson* 960 (CHR); Red Hut, Breakneck Road, Herbert, 7.vii.1970, *J. Child* 883 (CHR 384969); Evansdale Glen, on willow trees, 13.i.1996, *P. N. Johnson* 2037 (CHR); Broad Bay, Otago Peninsula, on twigs of *Coprosma propinqua*, 22.xii.1996, *P. N. Johnson* 3255 (CHR); Whare Flat, Taieri, on bark by forest track, 17.iv.1965, *W. Martin s. n.* (CHR 347898); Wai Rongoa, Dunedin, on *Populus nigra*, vii.1935, *J. S. Thomson* [T 2191] W50 (CHR 241838); Woodside Glen, on hawthorn twigs, 22.ix.1997, *J. M. Bannister* 587 (OTA); Henley Road, on dead broom, 18.vii.1970, *P. Child* 551 (CHR 445489); Akatore Creek near bridge, at bases of divaricating shrubs, 4.xii.1994, *D. J. Galloway* 04 (OTA). **Southland:** Otautau, Holt Park, on fir tree, 4.xi.1997, *D. J. Galloway* 282 (OTA); Queen's Park Invercargill, on *Prunus* sp., v.1961, *D. J. Galloway s. n.* (CHR 493598); Southfert Fertiliser Works, on *Cupressus* tree by Colyer Road,

21.xi.1996, *P. N. Johnson* 3167 (CHR). **Stewart Island:** Oban, opposite Traill Park, on roadside *Hoheria*, 7.vi.1998, *D. J. Galloway* 5027 (OTA); Butterfields Beach, Moturau Moana, on *Aristotelia serrata*, 6.vi.1998, *D. J. Galloway* 469 (OTA).

10. *Physcia nubila* Moberg, *Nordic J. Bot.* 10: 335 (1990). Type: Peru, c. 150 km north of Lima, coastal desert at Huacho, 200 m, on small rocks in the mist zone, 1979, *K. Kalb* & *G. Plöbst*, Herb. K. Kalb – holotype; UPS, K. Kalb, *Lich. Neotrop. Exs.* No. 324 – isotypes.

ILLUSTRATION: Moberg (1990: 335, fig. 12).

DESCRIPTION: Thallus rosette-forming to irregularly spreading, 1–3(–4) cm in diameter, closely attached from margins to centre. Lobes variable, thin to thick, (0.5–)1–2(–3) mm wide, 5–10(–20) mm long, convex, flabellate, imbricate from margins to centre, branching irregular. Margins delicately scalloped, notched or incised, to minutely lobulate; apices slightly curled under, thickened (x10 lens); erose-sorediate towards inner parts. Upper surface white, creamish to grey-white, sometimes suffused grey-black at apices; areolate-scabrid (x10 lens) at or near apices; matt or minutely roughened-fibrous (x10 lens) elsewhere, sometimes white-pruinose and/or maculate at or close to margins. Soralia marginal, sometimes along the entire length of the lobe; and laminal, towards inner parts of lobes; erumpent-erose, sometimes coalescing and forming extensive sorediate patches centrally. Soralia soredia coarsely granular, white or grey-white. Lower surface corticate; creamish white to pale buff with a narrow, darker, marginal zone; smooth; rhizinate. Lower cortex prosoplectenchymatous. Rhizines scattered, rather sparse at margins, more numerous centrally, concolorous with lower surface, simple, with an apical squarrose tuft, 0.5–0.8 mm long. Apothecia rare, generally absent (when present often abundantly developed), sessile, constricted at base, rounded, 0.5–1(–1.5) mm in diameter. Thalline exciple persistent, thick, swollen, entire to somewhat scalloped, concolorous with thallus, not becoming sorediate in older fruits. Disc concave to plane, matt, dark brownish to black, epruinose. Epithecium chestnut-brown 15–18 µm thick. Hymenium colourless, 65–85(–90) µm tall. Hypothecium colourless, opaque, intricately interwoven. Ascospores grey-brown, *Pachysporaria*-type, broadly ellipsoid, apices obtuse, (16.5–)20–23 x 8–10.5 µm. Pycnidia occasional to common, laminal, immersed, black, punctiform, minute (x10 lens).

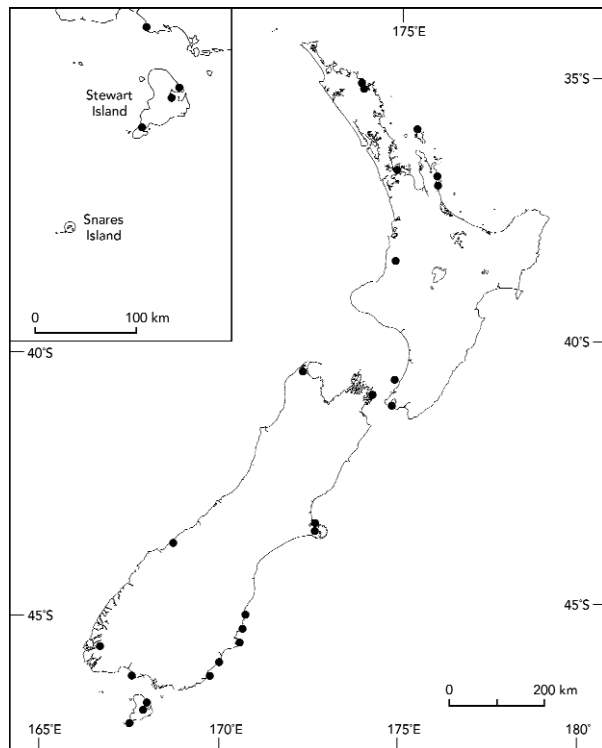


Fig. 10 Distribution of *Physcia nubila* in New Zealand

CHEMISTRY: Cortex K⁺ yellow; medulla K⁺ yellow; containing atranorin and zeorin.

DISTRIBUTION (Fig. 10): Widely distributed from Great Barrier Island (36°17'S) to southern Stewart Island and the Snares (48°07'S), but still rather poorly collected in New Zealand. Known also from South America (Peru), South Africa and south-eastern Australia (Moberg 1990, 2001, 2004; McCarthy 2003).

HABITAT ECOLOGY: On coastal rocks close to high tide mark. Associating with the lichens *Caloplaca cribrosa*, *C. subglobulata*, *Dirina neozelandica*, *Lecanora austrooceanica*, *Opegrapha diaphoriza*, *Pertusaria* spp., *Verrucaria durietzii*, *V. striatula*, *Xanthoparmelia scabrosa*, and *Xanthoria ligulata*. Rarely also on iron railings with *Physcia adscendens* and *Xanthoria parietina*. Elsewhere in its range it is known from rocks and trees in open situations (Moberg 1990, 2001).

DISTINGUISHING FEATURES: *Physcia nubila* is a palaeotropical, rather variable species characterised by: marginal (also laminal towards centre of thallus) often prominent soralia that are either confined to the lobe sinuses or develop along the whole lobe margin. It differs from *P. undulata*, which has more irregular lobes (undulating), a thinner thallus, and different triterpenoids (Moberg 2001: 302).

SPECIMENS EXAMINED: **Northland:** Kerikeri Inlet, Okura River, on mangrove, 11.iv.1992, *R. Moberg & B. Owe-Larsson NZ16:2* (UPS); 2.5 km south-west of Russell, on mangrove, 1.v.1927, *G. Einar & Greta Du Rietz 2742:12* (UPS); Needles, Great Barrier Island, on rocks in open, 4–10.i.1984, *B. W. Hayward s. n.* (AK 182638). **Auckland:** Rangitoto Island, 9.xi.1982, *J. K. Bartlett 20516* (AK 192292). **South Auckland:** Coromandel Peninsula, Waikawau Beach, bush remnant near beach, 29.x.1982, *J. K. Bartlett 20365* (UPS); Hot Water Beach, on seashore rocks, 10.iv.1992, *R. Moberg & B. Owe-Larsson NZ11:1* (UPS); South end of Onemana Beach, on volcanic rocks at seashore, 13.xi.1992, *L. Tibell 19534* (AK). **Taranaki:** 14 km north of Mapiu, on stones close to a creek, 7.iv.1992, *R. Moberg & B. Owe-Larsson NZ1:11* (UPS). **Wellington:** Kapiti Island, on maritime rocks, iv.1982, *B. W. Hayward KL14* (AK 230747); Wellington, on rock, xi.1995, *J. M. Bannister 34* (OTA). **Nelson:** Kaihoka, *J. K. Bartlett* (AK 195795). **Marlborough:** Queen Charlotte Sound, Hippah Island off Motuara Island, on maritime rock faces, 6.i.1992, *A. E. Wright 11960* (AK 205179). **Westland:** Ship Creek, north of Haast, on coastal rocks, 18.v.1971, *P. Child 1406* (CHR 445483). **Canterbury:** Taylors Mistake, on volcanic rocks along foreshore, 15.iii.1980, *J. A. Elix 7610* (CANB); Banks Peninsula, Kaituna Valley, on *Sophora microphylla*, 10.x.1980, *L. Tibell 9091, 9097* (UPS); Banks Peninsula, 5 km south-east of Charteris Bay, on forest tree in remnant bushland, 19.i.1980, *J. A. Elix 6825* (CANB). **Otago:** Shag Point, on iron cattle grid, *J. M. Bannister 11* (OTA); Matanaka, on coastal rocks, 2.xi.1935, *J. S. Thomson [T 2334] ZA62* (CHR 241890); Otago Heads, on rock, 12.ix.1933, *J. S. Thomson [T 1008] ZA3600* (CHR 241893); Pipikaretu Beach, on volcanic tuff at shore, 19.iv.1980, *J. A. Elix 7830* (CANB); Port Chalmers, 24.x.1933, *J. S. Thomson [T 1260] ZA451* (CHR 241904); Allens Beach, on rock, *J. M. Bannister 977* (OTA); Goat Island, on coastal rock, 15.ix.1933, *J. S. Thomson [T 1039] ZA29* (CHR 241899); Ibid., on rock, 25.xi.1995, *J. M. Bannister 75* (OTA); Quarantine Island, Otago Harbour, on coastal rocks, 9.xii.1995, *P. N. Johnson 1719* (CHR); Akatore River mouth, on coastal rock-mudstone, 26.xii.1995, *P. N. Johnson 1900* (CHR); Ibid. 31.x.1970, *P. Child 880* (CHR 445481); Kaka Point, on rocks at high tide mark, 4.iv.1999, *D. J. Galloway 1401* (OTA); Nugget Point Peninsula, on exposed coastal rocks, 6.ii.1967, *D. J. Galloway s. n.* (CHR 347 893, 347917). **Southland:** Dusky Sound, Supper Cove, around Supper

Cove Hut, 29.xii.1997, *Allison Knight s. n.* (OTA 048878); Pahia Point, on coastal rocks, *J. S. Thomson T 2257* (CHR 347891). **Stewart Island:** Bathing Beach, Halfmoon Bay, on littoral rock, 5.ii.1980, *C. D. Meurk B111* (CHR); Small island near Freds Camp [Paterson Inlet], on littoral rock, 19.ii.1980, *C. D. Meurk B45* (CHR); Port Pegasus, Cooks Arm, on maritime rocks, 25.i.1989, *B. W. Hayward s. n.* (AK 208239); Port Pegasus, Disappointment Cove, on coastal rock of small island, 1.ix.1998, *D. J. Galloway 0779* (OTA); Port Pegasus, Broad Bay, on rock on beach, west end, 2.ix.1998, *D. J. Galloway 2534* (OTA 054015). **Snares Islands:** South-west Promontory, near penguin rookery, 1961, *B. A. Fineran 91* (CANU).

11. *Physcia poncinsii* Hue, *Bull. Soc. Bot. Fr.* 63, Mém. 28: 10 (1917). Type: Kenya. Central Province, Fort Hall District, 'voisinage de la rivière Tika (Thika)', altitude c. 1500 m, 1912, *Poncins*, PC – lectotype (*vide* Moberg 1986: 859). ILLUSTRATIONS: Swinscow & Krog (1988: 227, fig. 113); Scutari (1990a: 265, fig. 1; 269, fig. 4); Scutari (1995: 220, fig. 4D)

DESCRIPTION: Thallus orbicular to irregularly spreading, 1–4(–8) cm in diameter, closely to loosely attached. Lobes very variable, 0.5–1(–2) mm wide, 2–5(–15) mm long, discrete, adjacent to complex-imbricate, subdichotomously to irregularly branched, convex to somewhat plane; apices rounded, scalloped to somewhat truncate, often slightly inrolled. Margins entire or delicately notched, incised or scalloped, slightly thickened below, not sorediate. Upper surface green to green-white when moist, white to creamish or greyish when dry, sometimes distinctly maculate (x10 lens), with or without white pruina, apices sometimes areolate-scabrid (x10 lens), sorediate. Soralia laminal, erupting from breaks in upper surface, the margins flaring and somewhat rolled back, appearing distinctively crateriform to capitate, orbicular, 0.1–1(–15) mm in diameter, often becoming confluent; soredia granular to coarsely granular, green-white to white. Lower surface white at or near margins, darkening centrally to pale yellow-buff or pale greyish; smooth; matt; rhizinate. Lower cortex prosoplectenchymatous, with the lowermost part often short-celled and thick-walled. Rhizines scattered at margins to numerous and more or less entangled centrally, simple to squarrose-branched, white to tan or brown or greyish, 0.5–1 mm long. Apothecia sparse to numerous, sessile, constricted at base, round to irregular, 0.5–2(–3) mm in diameter; thalline exciple concolorous

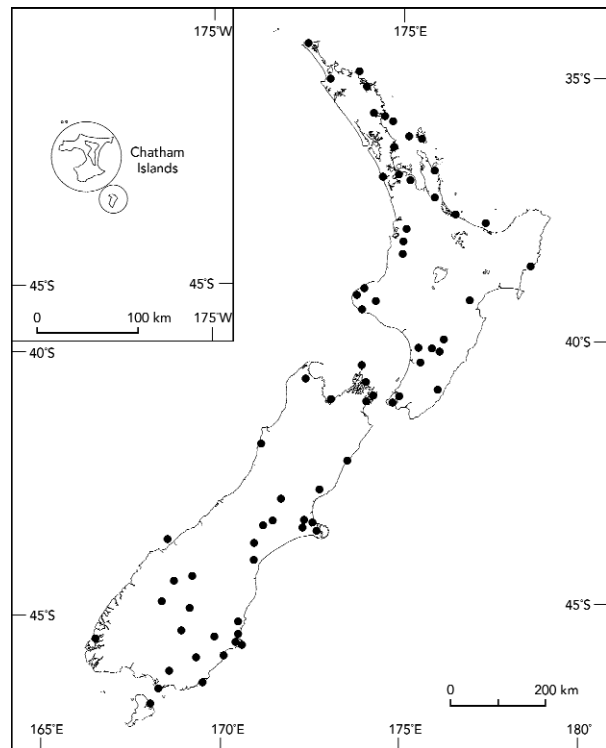


Fig. 11 Distribution of *Physcia poncinsii* in New Zealand

with thallus, persistent, entire to crenulate or delicately scalloped, sometimes sorediate in patches; disc concave at first, soon becoming plane to undulate or convoluted, matt, brown-black with or without a fine, grey-white pruina. Epithecium pale to mid chestnut-brown, 12.5–22 μ m. Hymenium colourless, 60–75 μ m tall. Hypothecium dilute yellow-brown, opaque, of densely interwoven hyphae. Ascospores grey-brown, broadly ellipsoid with rounded or pointed apices, *Pachysporaria*-type, (17.5–)20–22.5 x 7.5–10 μ m.

CHEMISTRY: Cortex and medulla K+ yellow; containing atranorin and zeorin.

DISTRIBUTION (Fig. 11): Widely distributed in New Zealand from Northland to Stewart Island, mainly coastal but also inland. Known also from: East and South Africa (Moberg 1986, 2004; Swinscow & Krog 1988); South America (Moberg 1990; Scutari 1995; Marciano *et al.* 1996; Galloway & Quilhot 1999; Calvelo & Liberatore 2001); Florida and the Sonoran Desert in Baja California and Mexico (Harris 1995; Moberg 1997); and Australia (Moberg 2001; McCarthy 2003).

HABITAT ECOLOGY: On a range of substrata, being especially common on the bark of both native and introduced

trees and shrubs, as well as occurring on concrete, tombstones, and rocks in open grassland (coastal and inland), sea level to 1000 m. It is known from the following trees and shrubs (phorophytes): *Acer pseudoplatanus*, *Aristotelia serrata*, *Beilschmiedia tarairi*, *Carpodetus serratus*, *Coprosma crassifolia*, *C. repens*, *Cordyline australis*, *Corynocarpus laevigatus*, *Cupressus macrocarpa*, *C. sempervirens*, *Dacrycarpus dacrydioides*, *Discaria toumatou*, *Dysoxylum spectabile*, *Fagus cuprea*, *F. sylvatica*, *Fraxinus excelsior*, *Hebe elliptica*, *Kunzea ericoides*, *Leptospermum scoparium*, *Lycium ferocissimum*, *Melicytus ramiflorus*, *Metasequoia glyptostroboides*, *Metrosideros excelsa*, *Muehlenbeckia complexa*, *Olearia odorata*, *Pinus radiata*, *Pittosporum eugenioides*, *Plagianthus* spp., *Podocarpus totara*, *Populus nigra*, *Prumnopitys ferruginea*, *Rubus schmidelioides*, *Salix* spp., *Sophora microphylla*, *Streblus banksii*. It also forms large swards on introduced and wayside trees such as hawthorn, willow, poplar, *Pinus radiata*, etc. It associates with the following lichens: *Amandinea punctata*, *Caloplaca homologa*, *Candelariella reflexa*, *Chrysothrix candelaris*, *Coccocarpia palmicola*, *Dirinaria applanata*, *Heterodermia speciosa*, *Hyperphyscia adglutinata*, *Lecanora flavopallida*, *Melanelia glabruloides*, *Normandina pulchella*, *Parmotrema grayanum*, *Phaeophyscia hispidula*, *Physcia adscendens*, *P. albata*, *P. caesia*, *P. jackii*, *Porina exocha*, *Pseudocyphellaria crocata*, *P. episticta*, *Punctelia borreri*, *Pyxine subcinerea*, *Sticta fuliginosa*, *Teloschistes chrysophthalmus*, *Usnea* spp., and *Xanthoria parietina*.

DISTINGUISHING FEATURES: *Physcia poncinsii* is a palaeotropical species, characterised by: convex lobes with truncate apices; distinctive crateriform soralia; a white lower surface. In earlier accounts of New Zealand lichens, this species was recorded as: *P. integrata*, *P. integrata* var. *sorediosa*, *P. stellaris*, *P. stellaris* var. *radiata*, and *P. stellaris* var. *rosulata* (Zahlbruckner 1941: 378), and as *P. tribacioides* [sic] (Galloway 1985: 384–395, Galloway 1992: 28, Malcolm & Galloway 1997: 33). It is a widespread and rather variable species, corticolous specimens having thinner and flatter lobes than saxicolous specimens, which generally have thick, convex, maculate lobes.

SPECIMENS EXAMINED: **Northland:** Radar Bush, xii.1978, *J. K. Bartlett s. n.* (AK 192281); Cavalli Islands, Motukawa-nui Island, coastal forest, i.1979, *B. W. & G. C. Hayward s. n.* (AK 161876); Kaitaia, one mile north of Orowhano Hill, 24.v.1964, *R. C. Lloyd 47* (AK 165286); Waipoua State Forest, Kawerua Hotel, on pohutukawa bark, 31.xii. 1986, *B. W. Hayward s. n.* (AK 181603); Bay

of Islands, Te Pahi Islands, Turtle Island, 22.i.1990, *A. E. Wright 9730* (AK 193847); Kerikeri Inlet, on mangrove at bridge across Okura River, 11.iv.1992, *R. Moberg & B. Owe-Larsson NZ 16:1* (UPS); Bay of Islands, Urupukapuka Island, i.1980, on cabbage trees, *B. W. & G. C. Hayward s. n.* (AK 165925); Lady Alice Island, on maritime rocks, i.1982, *B. W. Hayward s. n.* (AK 167920); Poor Knights Islands, on bark of *Avicennia resinifera*, *L. B. Moore s. n.* (CHR 160745); Hen Island, on open rock, viii.1977, *B. W. & G. C. Hayward s. n.* (AK 161877); Whangarei Heads, mixed forest, viii.1980, *B. W. Hayward s. n.* (AK 175402); Whangarei, FERNZ fertiliser works, on pohutukawa, 10.xii.1996, *D. J. Galloway 5019* (CHR); Mahurangi River, on *Avicennia resinifera*, 3.ix.1933, *L. B. Moore ZA 124* (CHR 342836); Warkworth, L. B. Moore Memorial Park, on *Melicytus ramiflorus* and pohutukawa, 12.xii.1996, *D. J. Galloway 5016, 5017* (CHR); Great Barrier Island, on kanuka, i.1983, *B. W. Hayward s. n.* (AK 169785); Little Barrier Island, on maritime rocks, viii.1981, *B. W. Hayward s. n.* (AK 175380). **Auckland:** Piha, rainforest, 6.ii.1949, *O. Selling* (S); Rangitoto Island, on *Avicennia resinifera*, *H. H. Allan Z 48* (CHR 241880); Point Chevalier, on mangrove, 19.i.1979, *G. N. Stevens 2801* (BRI); Hunua Domain, on matai, 8.ii.1976, *A. J. Dakin s. n.* (AK 233073). **South Auckland:** Coromandel Peninsula, Port Jackson, on steep seashore rocks, 13.xi.1992, *L. Tibell 19566* (AK); Mount Te Aroha, *J. K. Bartlett s. n.* (AK 192297); Penguin Island, on rocks beneath pohutukawa, viii.1973, *B. W. & G. C. Hayward H49.106* (AK 157384); Wharekaho Beach, Whitianga, viii.1974, *B. W. Hayward H44.79* (CHR 493594); Watchman Rock, on *Coprosma* sp., upper maritime zone, viii.1973, *B. W. & G. C. Hayward H49.61* (AK 132934); Mount Maunganui, coastal rocks, 24.v.1966, *A. E. Wade s. n.* (AK 192300); North-west Rurima Island, on maritime rocks, 1984, *B. W. Hayward s. n.* (AK 175385); Motuhora Island, summit of main peak, on rocks in semi-open mahoe–pohutukawa forest, 2.i.1986, *G. C. Hayward s. n.* (AK 175381); Huntly, Waikato River, opposite power station, on willow, 7.ii.1994, *P. N. Johnson 1052* (CHR); Stubb's farm, 22 km west of Otorohanga, on vertical limestone face on margin of pasture and forest, 29.x.1989, *A. E. Wright 9148* (AK 1870910); South Kawhia, near Lake Kohara, on *Prumnopitys ferruginea* in ridge-top forest, 28.x.1989, *A. E. Wright 9115* (AK 187085); Pio Pio, L. K. Wilson's farm, x.1971, *D. J. Galloway s. n.* (CHR 493582). **Gisborne:** Te Puia, north of Gisborne, on *Cordyline*

australis, *H. H. Allan s. n.* (CHR 241981); Grays Bush Scenic Reserve, 12 km west of Gisborne, on twigs and bark in mixed podocarp forest, 14.i.1982, *J. A. Elix 10092, 10096* (CANB); Wainui Beach, on pine trees along foreshore, 14.i.1982, *J. A. Elix 10090b* (CANB). **Hawke's Bay:** Puketitiri, *J. K. Bartlett s. n.* (AK 204735); 10 km north of Tiniroto, on totara in open woodland, 15.i.1982, *J. A. Elix 10106* (CANB). **Taranaki:** Motunui, Methanex Fuels Plant, on ngaio stem in planted shrubbery, 26.x.1993, *P. N. Johnson 854* (CHR); Manu Stream, coastal scarp crest, on stems of dead boxthorn shrub in open, 28.x.1993, *P. N. Johnson 892* (CHR); New Plymouth, East End, on coastal pohutukawa, 11.xii.1995, *P. N. Johnson 1720, 1745 & D. J. Galloway* (CHR); St Mary's Churchyard, on copper beech and *Cupressus sempervirens*, 13.xii.1995, *P. N. Johnson 1792, 1806 & D. J. Galloway* (CHR); 14 km north of Mapiu, on stones and *Melicytus ramiflorus*, 7.iv.1992, *R. Moberg & B. Owe-Larsson NZ1:10, 13* (UPS); Opunake, on base of macrocarpa in full light, 15.iii.1994, *P. N. Johnson 1108* (CHR); Stratford, Stratford Power, on sycamore, *Rubus schmidelioides*, and mahoe beside stream, 16.xii.1996, *D. J. Galloway 5022-5025* (CHR); Monmouth Road near Stratford, on sycamore, 17.xii.1996, *D. J. Galloway 5020, 5021* (CHR). **Wellington:** Woodville Domain, on trees at forest margin, 5.v.1980, *J. A. Elix 7906, 7913* (CANB); Palmerston North, Massey University, on *Fraxinus excelsior*, 21.iii.1970, *G. Degelius NZ-158* (UPS); Pongaroa, east coast, vi. 1972, *D. J. Galloway s. n.* (CHR 493563); Whariti Peak, Ruahine Range, iv.1970, *D. J. Galloway s. n.* (CHR 493581); Merry Hill, Feilding, on *Hoheria sextylosa*, *H. H. Allan ZA 453* (CHR 241834); Hutt Valley Ludlam Park, on pohutukawa, totara, and *Pittosporum eugenioides* in park, 9.xi.1995, *P. N. Johnson 1605, 1610, 1612, 1614* (CHR); Lower Hutt, Mitchell Park, trunk of *Metasequoia glyptostroboides* in park, 9.xi.1995, *P. N. Johnson 1628* (CHR); Wellington Botanical Gardens, 22.viii.1966, *W. Martin* (CHR 493605); Somes Island, *B. Polly* (WELT). **Nelson:** Golden Bay, Mt Burnett, on limestone outcrops, *H. Mayrhofer 12356, N. & W. Malcolm* (GZU); Boulder Bank, on low *Muehlenbeckia complexa* thicket, 15.iv.1991, *B. W. Hayward & A. E. Wright 11347* (AK 204541); Botanical Hill Reserve, on rocks and exotic trees in parkland, 6.iv.1980, *J. A. Elix 7763, 7764, 7766* (CANB). **Westland:** Punakaiki Blowholes, on limestone rocks and *Cordyline australis* at roadside, 16.i.1927, *G. Einar & Greta Du Rietz 1618:2, 1618:3, 1622b:1* (UPS); Taumaka, Open Bay Islands, on bark of *Hebe elliptica*, just above sea cliffs, 18.viii.1970, *C. J. Horning NZ 321/A* (CHR 162657). **Marlborough:** Stephens Island, on ngaio bark, 14.iv.1970, *I. A. E. Atkinson s. n.* (CHR 493597); Chetwode Islands, Nukuwaiata Island, on petrel scrub. iii.1984, *B. W. Hayward s. n.* (AK 169804); D'Urville Island, Owhai Bay, on koekoe, 5.i.1988, *G. C. & B. W. Hayward s. n.* (AK 181579); Queen Charlotte Sound, Resolution Island, on *Corynocarpus laevigatus*, 7.i.1992, *A. E. Wright 11989* (AK 205201); Shakespeare Bay near Picton, on dead karaka, 22.xii.1998, *J. M. Bannister* (OTA 049913); Puhipuhi Forest Reserve, near bridge over Hapuku River, 13.ix.1956, *W. Martin 4194* (CHR 493613), Goose Bay near Kaikoura, on stones on steep hillside in forest, 13.ix.1956, *W. Martin 4193* (CHR 493615). **Canterbury:** Cass, above Biological Station, on twigs of *Discaria toumatou*, 8.i.1927, *G. Einar & Greta Du Rietz 1457:3* (UPS); Lowry Peaks Range, 1.6 km south of Mt Palm, on greywacke rocks in pasture land, 180 m, 24.i.1980, *J. A. Elix 6851* (CHR 347916); Christchurch, Yaldhurst Road, on ash trunk, 8.x.1993, *P. N. Johnson & A. J. Fife JF45* (CHR); Burnside Domain off Memorial Avenue, on sycamore, 8.x.1993, *P. N. Johnson & A. J. Fife JF 102* (CHR); South Hagley Park, on sycamore, 6.x.1993, *P. N. Johnson & A. J. Fife JF66* (CHR); Banks Peninsula, Kaituna Valley, on boulders in semi-open pasture, 10.x.1980, *L. Tibell 9112b* (UPS); Lake Forsyth, Banks Peninsula, on *Coprosma crassifolia*, *F. Allen* (CHR 341907); Governors Bay, on tombstones, vi.1970, *P. Hogan* (CHR 388410); Lincoln, Landcare Research, kowhai grove, 2.viii.1993, *P. N. Johnson 787* (CHR); Rakaia Gorge, on rock ledges facing sun, 20.vi.1991, *P. N. Johnson 265* (CHR); Mt Somers, limestone soil, amongst mosses on weathered limestone rocks, 6.xi.1977, *D. J. Galloway s. n.* (CHR 240987); Peel Forest, i.1971, *D. J. Galloway s. n.* (CHR 493580); Orari River near Washdyke, on sycamore, 15.vi.1991, *P. N. Johnson 243A* (CHR). **Otago:** Timaru Creek, Lake Hawea, on matagouri, 3.x.1970, *P. Child 801* (CHR 445480); Matukituki River mouth, on schist rocks, 27.vi.1970, *P. Child 153* (CHR 445476); Queenstown Gardens, on ash, sycamore, and kowhai, 21.xi.1993, *P. N. Johnson 925* (CHR); Cromwell Gorge, on sunny rocks, 21.vi.1970, *P. Child 378* (CHR 445478); Great Moss Swamp, just below Loganburn Dam, on dry wall of rock face, 24.i.1994, *P. N. Johnson 1016* (CHR); Trotters Gorge Scenic Reserve, on kanuka in shade, 12.xii.1998, *D. J. Galloway 5028* (OTA); Goodwood, on bark, 17.iii.1996,

J. M. Bannister 14 (OTA); Warrington Sand Spit, on *Pinus radiata*, 2.vi.1996, *J. M. Bannister 30* (OTA); Guilds Hill, amongst moss on *Plagianthus* sp., 4.v.1997, *J. M. Bannister 493* (OTA); Ross Creek Reservoir, Dunedin, on bark, 29.x.1995, *J. M. Bannister 70* (OTA); Dunedin Northern Cemetery, on claret ash, 11.i.1995, *P. N. Johnson 1261* (CHR); Boulder Beach, Otago Peninsula, on rock outcrops, 13.vi.1992, *P. N. Johnson 350* (CHR); Waipori, on moss on fallen trunk, 18.v.1997, *J. M. Bannister 374* (OTA); Boyds Bush near Dunedin, on rock, *J. S. Thomson T495, ZA57* (CHR 241881); Otakou Bush, on rotten logs, 22.vii.1933, *J. S. Thomson T598* (CHR 241926); Taieri Mouth, on rock, 16.ii.1997, *J. M. Bannister 204* (OTA); Waikaro behind Measly Beach, on dead twigs, 14.xi.1997, *J. M. Bannister 660* (OTA); Rongahere on ornamental trees, 13.viii.1985, *P. Child 2413* (CHR 445491); Pomahaka River, above Jordan River ford, on *Olearia odorata* in grassland, 17.iii.1997, *D. J. Galloway 5015* (OTA); Nugget Point Peninsula, 6.ii.1967, *D. J. Galloway s. n.* (CHR 493575); Pounaweia, on coastal shrubs in saltmarsh close to estuary, 4.iv.1999, *D. J. Galloway 1412* (OTA). **Southland:** Edendale, on twigs, 13.iii.1997, *J. M. Bannister 360* (OTA); Grove Bush, Invercargill, on tree bark in forest remnant, *W. Martin A 569* (CHR 493617); Invercargill, Eastern Cemetery, headstone on upward-facing surface of fine masonry, 2.ii.1995, *P. N. Johnson 1310* (CHR); Waihopai Scenic Reserve, Invercargill, on podocarp bark (*Dacrycarpus dacrydioides*), iii.1954, 24.xii.1965, *W. Martin* (CHR 493602, 493603, 493606); Greenhills, on podocarp bark, 3.i.1966, *W. Martin s. n.* (CHR 493607); Tiwai Point, on *Cupressus macrocarpa*, 20.xi.1996, *P. N. Johnson 3180* (CHR); Breaksea Sound, Wairaki Island, on *Hebe elliptica*, ii.1991, *P. N. Johnson 96* (CHR). **Stewart Island:** Butterfields Beach, Moturau Moana, on *Aristotelia serrata*, 6.vi.1998, *D. J. Galloway 460* (OTA); Oban, opposite Traill Park, on *Hoheria* sp., 7.vi.1998, *D. J. Galloway 5026* (OTA). **Chatham Island:** 2.5 km south-west of Waitangi, on coastal rock, 29.iii.2000, *P. N. Johnson 3495* (CHR); Near Lake Kairae, open and well-lit forest remnant behind coastal dunes on live bark at base of *Corynocarpus* trees, 3.viii.2000, *P. N. Johnson 3450, 3543, 3544, 3545, 3549, 3550* (CHR).

12. *Physcia tribacia* (Ach.) Nyl., *Flora* 57: 307 (1874).

≡ *Lecanora tribacia* Ach., *Lich. Univ.*: 415 (1810).

Type: Anglia, *sine loco, sine collectoribus*, H-ACH 1115 –

lectotype (*fide* Moberg 1986: 860).

= *Physcia callosa* auct. non. Nyl., sensu Galloway (1985: 393).

ILLUSTRATIONS: Kashiwadani (1975: pl. 4:1); Moberg (1986: 850, fig. 9; 861, fig. 21); Scutari (1990b: 453, fig. 1; 455, fig. 2; 456, fig. 3; 457, fig. 4; 458 figs 5, 6; 459, fig. 7); Dobson (1992: 265); Scutari (1990b: 453, fig. 1; 455, fig. 2; 456, fig. 3; 457, fig. 4; 458, figs 6, 7; 459, fig. 7; 1995: 221, fig. 5B).

DESCRIPTION: Thallus orbicular, stellate-radiating, thalli often confluent, (0.5–)1–2(–4) cm in diameter, closely attached centrally, more loosely attached to somewhat ascending at margins. Lobes very narrow (0.1–0.5(–1) mm wide), 1–2(–4) mm long, dichotomously to irregularly branched, densely imbricate centrally, shallowly convex; margins crenate, apices crenulate-incised, noticeably curled under. Upper surface pale grey to grey-white, matt to minutely crystalline and patchily glistening and minutely white-maculate (x10 lens). Lower surface corticate, whitish to pale brownish, rhizinate, sorediate. Lower cortex paraplectenchymatous. Rhizines common to sparse, mainly at margins, white to pale buff, simple, up to 1 mm long. Soralia mainly apical, also marginal, irregular, coarsely granular or coralloid, eroding on lower surface of lobe apices ('sorediogenous parasidia' of Scutari (1990b)). Soredia granular grey-white to greenish. Apothecia and pycnidia not seen in New Zealand material.

CHEMISTRY: Cortex K+ yellow; medulla K–; containing atranorin.

DISTRIBUTION (Fig. 12): It has a rather scattered distribution in New Zealand, from Gisborne in the North Island, and from Canterbury to Southland in the South Island. Known also from Great Britain, Scandinavia, Europe, North and South America, North and East Africa, Turkey, the Ukraine, South Africa, India, Asia, Japan, the Pacific and Australia (Awasthi 1960; Thomson 1963; Poelt 1974; Kashiwadani 1975; Moberg 1986, 1990, 1997, 2001, 2002, 2004; Scutari 1990b, 1995; Coppins 1992, 2002; Nimis 1993; Elix & Kantvilas 1995; Esslinger & Egan 1995; Egea 1996; John 1996; Kondratyuk *et al.* 1996; Marcano *et al.* 1996; Elix & McCarthy 1998; Galloway & Quilhot 1999; Diederich & Sérusiaux 2000; Scholz 2000; Calvelo & Liberatore 2001; Hafellner & Türk 2001; Llimona & Hladun 2001; Kurokawa 2003; McCarthy 2003; Santesson *et al.* 2004).

HABITAT ECOLOGY: Occurring on tops and vertical sides of sunny rocks (schist and greywacke), in dry rock overhangs,

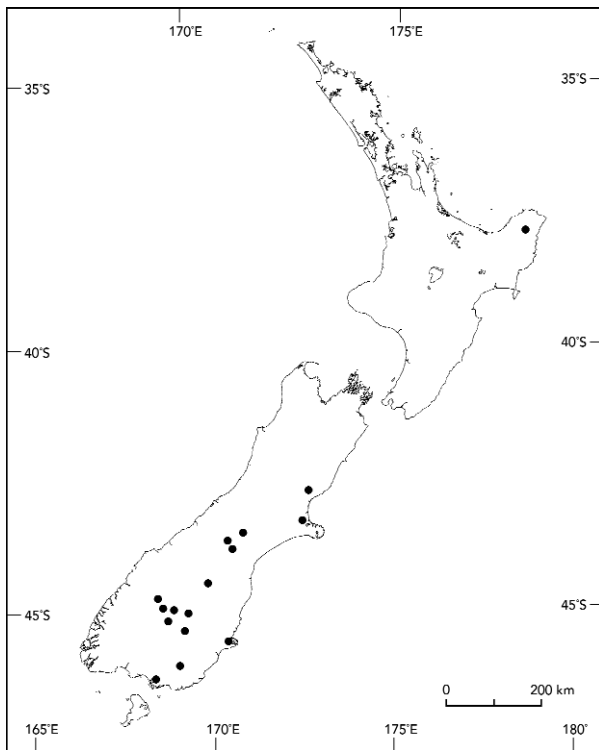


Fig. 12 Distribution of *Physcia tribacia* in New Zealand

on bird-perch rocks, occasionally growing near sea level on bitumen footpaths, and on concrete posts, and collected once from a polished granite gravestone. Found from sea level to 1825 m. Associates with the following lichens: *Acarospora* spp., *Caloplaca rubelliana*, *Flavoparmelia haysomii*, *Lecanora polytropa*, *Physcia caesia*, *Punctelia subrudecta*, *Teloschistes velifer*. The small size of this lichen makes it easily overlooked and consequently collections of it are still rather few. It should be looked for more widely in New Zealand.

DISTINGUISHING FEATURES: *Physcia tribacia* is a cosmopolitan species, characterised by: narrow lobes; crenulate lobe apices, and margins that are noticeably curled over and granular sorediate on the lower surface; and a paraplectenchymatous lower surface. Material earlier determined as *Physcia callosa sensu* J. W. Thomson (1963) *non* Nyl., from New Zealand (Galloway 1985: 393, 1992: 28; Malcolm & Galloway 1997: 33) refers to *P. tribacia*, whereas *P. callosa* Nyl. *sens str.* refers to a Californian taxon now subsumed in the synonymy of *Physcia phaea* (Tuck.) J. W. Thomson (Moberg 1997:177). *Physcia tribacia* may be confused with *P. dubia* but is distinguished from it by:

the narrower lobes; the character of the lower cortex; and the morphology of the soralia.

SPECIMENS EXAMINED: **Gisborne:** Mount Taitai, 850 m, J. K. Bartlett 21544 (AK 192315). **Canterbury:** Lowry Peaks Range, 1 km south-west of Mt Palm, on rocks, 200 m, 24.i.1980, J. A. Elix 6885 (CHR 267120); Rangitata Gorge (east end), on rocks on river bank, 31.viii.1977, D. J. Galloway *s. n.* (CHR 493583); Burkes Pass, under dry rocks, 28.viii.1981, J. K. Bartlett *s. n.* (AK 192274); Christchurch, junction of Opawa and Centaurus Roads, on dry exposed basalt in open scrub on steep slope, 5.viii.1993, A. J. Fife JF118, P. N. Johnson, C. D. Meurk, L. Burrows (CHR); Tekapo, west slope of Mt Hay, 1000 m, xi.1958, Mason 227 (OTA 047156). **Otago:** Hawkdun Range, on rock in crevice in outcrop, 1542 m, 25.x.1976, J. Child *s. n.* (CHR 388402); Arrowtown, on underside of dry rock face, 2.ix.1981, J. K. Bartlett *s. n.* (AK 192275); Remarkables, south-east of South Cone, on a surface ledge, schist outcrop, 1829 m, 27.i.1972, P. Child 1687 (CHR 445460); Garvie Mountains, Roaring Lion Creek, on crest of schist tor in valley, 1260 m, 9.i.1996, P. N. Johnson 1997, 2055 (CHR); Carrick Range, on rock tor in grassland, Nevis Road, 800–900 m, 15.iii.1997, D. J. Galloway 2533 (OTA); Alexandra Lookout, on rock, 10.x.1964, W. Martin 5691 (CHR 493616); Summit Road, Alexandra to Little Valley, on sloping and vertical rock surfaces, 31.xii.1964, W. Martin *s. n.* (CHR 493619); Roxburgh War Memorial, on sloping schist rocks, 30.x.1997, D. J. Galloway 2509, 2532 (OTA), Dunedin, Heriot Row, on pavement, 6.x.1996, J. M. Bannister 66 (OTA); Mt Cargill, north-facing slopes, on rocks below summit, 2.vi.1999, M. E. Thomas *s. n.* (OTA); Waipahi River near Clinton, on concrete rural gate post, 3.ii.1995, P. N. Johnson 1316 (CHR). **Southland:** Invercargill, Eastern Cemetery, headstone, on vertical face of polished granite, 2.ii.1995, P. N. Johnson 1308 (CHR).

13. *Physcia tribacoides* Nyl., *Flora* 57: 307 (1874). Type: France: St Sauveur le Vicomte, *Lenormand*, H-NYL 32197 – lectotype (*vide* Kashiwadani 1975: 38).

ILLUSTRATIONS: Kashiwadani (1975: 38, fig. 7; pl. 4, fig. 2); Moberg (1986: 849, fig. 8D; 861, fig. 22).

DESCRIPTION: Thallus rosette-forming, 1–3(–4) cm in diameter, closely attached from margins to centre. Lobes thin, 0.5–1.2(–2) mm wide, 1–5(–8) mm long, shallowly convex, discrete or adjacent at apices to somewhat imbricate centrally, apices crenulate. Margins entire, irregularly

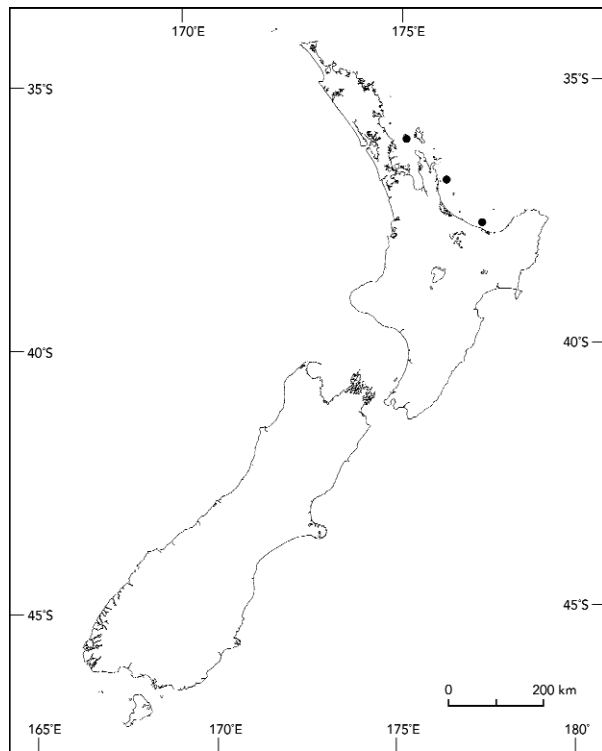


Fig. 13 Distribution of *Physcia tribacoides* in New Zealand

lobulate, crenate or shallowly incised; with scattered projecting rhizines from lower surface; somewhat imbricate centrally, not noticeably thickened below; sorediate. Upper surface whitish, creamish to pale grey; smooth to shallowly undulate, here and there punctate-impressed; matt; white-maculate in older parts (x10 lens); epruinose. Soralia marginal, rather sparse, developed at inner parts of thallus, rounded, 0.5–1.2 mm in diameter, capitate, callus-like; soredia densely crowded, farinose, white. Lower surface whitish at or near margins, darkening centrally to pale greyish or brownish, matt or slightly glossy in parts, smooth, rhizinate. Lower cortex paraplectenchymatous. Rhizines scattered, simple to squarrose-branched, whitish to grey or brownish, slender, 0.5–0.8 mm long, sometimes projecting from margins. Apothecia rare, immature, up to 0.3 mm in diameter; thalline exciple swollen, persistent, concolorous with thallus; disc plane, matt, brown, epruinose. Ascospores not seen [of *Pachysporaria*-type, 20–23 x 9–12 μm (Moberg 1986: 861)].

CHEMISTRY: Cortex and medulla K⁺ yellow; containing atranorin and zeorin.

DISTRIBUTION (Fig. 13): Rarely collected from offshore islands in northern New Zealand (Hayward *et al.* 1986;

Hayward & Hayward 1990). Most earlier records of *P. t. tribacoides* from New Zealand (Galloway 1985: 395) refer to *P. poncinsii* (q.v.). Also known from Great Britain, southern and western Europe (Coppins 1992, 2002; Nimis 1993; Llimona & Hladun 2001), the Azores (Aptroot 1989a), East and South Africa (Moberg 1986, 2004; Swinscow & Krog 1988), Japan (Kashiwadani 1975), the Philippines (Aptroot & Sipman 1989), Argentina (Calvelo & Liberatore 2001), and Australia (Moberg 2001; McCarthy 2003).

HABITAT ECOLOGY: On exposed rock faces at sea level and on bark of mahoe (*Melicytus ramiflorus*) in coastal forest.

DISTINGUISHING FEATURES: *Physcia tribacoides* is characterised by: callus-like, capitate, marginal soralia; crenate lobes; a paraplectenchymatous lower cortex with thick-walled cells; and atranorin and zeorin (cortex and medulla K⁺ yellow).

SPECIMENS EXAMINED: **Northland:** Little Barrier Island, beach halfway between Te Hue Pa and Ngorengore Point, on exposed rocks at back of boulder beach, 10.v.1990, *A. E. Wright 10050* (AK 193505). **South Auckland:** Motuhora (Whale) Island, top of Pa Hill, on mahoe bark, 30.xii.1985, *B. W. Hayward s. n.* (AK 175384); Rabbit Island, on *Melicytus* in pohutukawa–*Melicytus* forest, viii.1973, *B. W. & G. C. Hayward H49.65* (AK 155045).

14. *Physcia undulata* Moberg, *Nord. J. Bot.* 6 (6): 861 (1986). Type: Kenya. Rifta Valley Province, Kajiado District, Ngong Hills, south of the highest part, 1°26'–27'S 36°39'E, altitude c. 2170 m, on shrubs, 1971, *R. Moberg 1406c*, UPS – holotype.

ILLUSTRATIONS: Moberg (1986: 862, fig. 23); Scutari (1995: 225, fig. 6A, 6B).

DESCRIPTION: Thallus rosette-forming to irregularly spreading, 0.5–2(–3) cm in diameter, closely to loosely attached to substratum, rather small and fragile. Lobes convex to plane, rather narrow ((0.2–)0.5–1(–1.5) mm wide), 2–8 mm long, discrete from margins to centre or imbricate both at margins and centrally, apices rounded to truncate to irregularly notched or incised. Margins entire to notched, incised or crenulate; slightly to markedly raised; conspicuously sorediate, especially towards centre of thallus at base of lobes and around sinuses separating lobes, generally free of soredia at apices. Soralia marginal, linear, undulate, eroding at margins and extending to lower surface, at times appearing somewhat labriform; soredia coarsely granular, greenish when moist, white

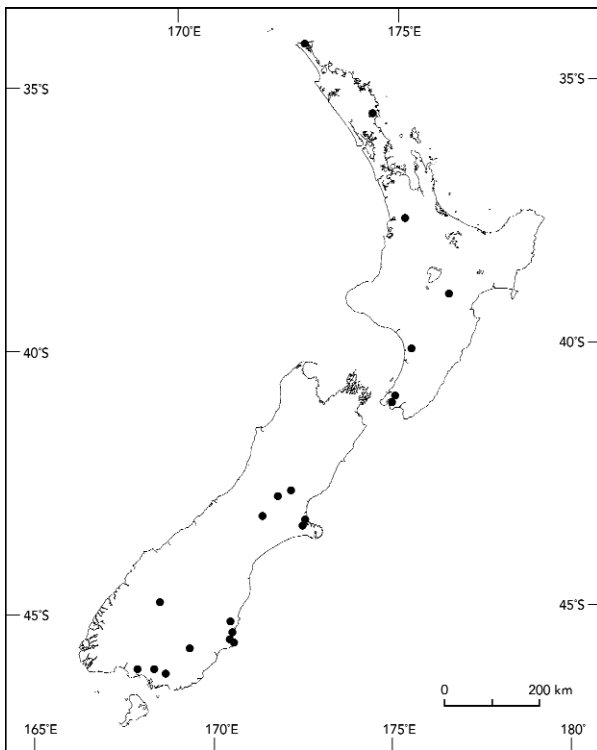


Fig. 14 Distribution of *Physcia undulata* in New Zealand

when dry and on prolonged storage. Upper surface matt, smooth to shallowly undulate, pale lettuce-green when moist, on drying soon becoming pale green-white to clean grey-white, delicately white-pruinose and appearing 'frosted' especially at apices (x10 lens), sometimes white-maculate centrally (x10 lens). Lower surface whitish to greyish at margins, pale buff-brown centrally, never brown-black-striate; rhizinate. Lower cortex of an indistinct, prosoplectenchymatous to paraplectenchymatous type. Rhizines somewhat prominent at margins, more sparse and scattered centrally, simple with a squarrose tuft at tip, stout (0.1–0.2 mm wide, 0.4–0.8 mm long), whitish to grey-black or brownish. Apothecia and pycnidia not seen in New Zealand collections.

CHEMISTRY: Upper cortex and medulla K+ yellow; containing atranorin, zeorin and several unidentified triterpenoids.

DISTRIBUTION (Fig. 14): Occurring in New Zealand from Northland to Southland. Known also from Portugal and Spain (Moberg 1989; Llimona & Hladun 2001), the Azores (Aptroot 1989a), East and South Africa (Moberg 1986, 2004; Swinscow & Krog 1988), the Sudan (Scutari 1995: 225), South America (Moberg 1990; Scutari 1995;

Galloway & Quilhot 1999; Calvelo & Liberatore 2001), Florida and the south-eastern Sonoran Desert in North America (Harris 1995, Moberg 1997), and in Australia (material seen from South Australia [CHR 266649] and New South Wales [CHR 489491, as *Physcia caesia*. W. A. Weber: *Lichenes Exsiccati* No. 269. Australia. New South Wales, Bungonia Caves, 7 miles east of Bungonia, on rim of gorge above Shoalhaven River; on limestone outcrops of sink-hole, over mosses, 10 April 1968, W. A. Weber & D. McVean] – Moberg 2001; McCarthy 2003).

HABITAT ECOLOGY: Primarily a lowland corticolous species growing directly on living bark (especially twigs) or amongst mosses on bark, it also colonises old and dead bracken, moist rocks beside streams and rivers, mossy concrete on paths and steps, tile roofs, old painted wooden surfaces, and occasionally on stony banks periodically wetted by rain flow off hillsides above. It is not known from coastal rocks. It colonises the following phorophytes: *Acer pseudoplatanus*, *Carpodetus serratus*, *Crataegus monogyna*, *Discaria toumatou*, *Fagussylvatica*, *Fraxinus excelsior*, *Melicytus ramiflorus*, *Myoporum laetum*, *Platanus x acerifolia*, *Quercus robur*, *Populus* spp., *Sophora microphylla*, *Ulmus x hollandica*.

Physcia undulata associates with the following lichens: *Amandinea punctata*, *Caloplaca inclinans*, *Candelariella reflexa*, *Dirinaria applanata*, *Haematomma babingtonii*, *Heterodermia speciosa*, *Hyperphyscia adglutinata*, *Lecanora carpinea*, *Parmelina labrosa*, *Physcia adscendens*, *P. jackii*, *P. poncinsii*, *Punctelia subrudecta*, *Ramalina celastri*, *R. inflexa*, *Teloschistes chrysophthalmus*, *T. velifer*, *Xanthomendoza novozelandica*, *Xanthoria parietina*, and *X. polycarpa*.

DISTINGUISHING FEATURES: *Physcia undulata* is a palaeotropical species, characterised by: rather small, fragile rosette-forming, to at times somewhat straggling, thalli; marginal, somewhat undulate soralia; a delicately white-pruinose upper surface (especially at the lobe apices) giving a 'frosted' appearance to the upper surface (x10 lens); a pale whitish to buff lower surface without any trace of brown-black striation; and atranorin and zeorin (cortex and medulla K+ yellow). It may be confused with the widespread saxicolous species *P. nubila*, but is distinguished from it by the more irregular, undulating lobes, a thinner thallus, and different triterpenoids (Moberg 2001: 302). *Physcia atrostriata* is similar in a number of aspects of its morphology but is distinguished from *P. undulata* by its distinctive brown-black striations on the lower surface.

SPECIMENS EXAMINED: **Northland:** Radar Bush, xii.1978,

J. K. Bartlett s. n. (AK 192282); Waitiki Stream, *J. K. Bartlett s. n.* (AK 192278 pr.p.); Onerahi, on mangrove, 21.vii.1981, *J. K. Bartlett s. n.* (AK 194666, 194668). **South Auckland:** Ruakura, on plane tree bark, 6.vi.1978, *D. J. Galloway s. n.* (CHR 493574). **Hawke's Bay:** Kuripapango, xii.1958, *M. Clark 4317* (OTA 047175). **Wellington:** Whangaehu, on roadside twigs, 27.xi.1998, *J. M. Bannister* (OTA 049828). Greatford near Marton, on bark, *H. H. Allan* (CHR 241900); Lower Hutt, Mitchell Park, on *Fagus* sp., 9.xi.1995, *P. N. Johnson 1623* (CHR); Mokopuna Island, on coastal rocks in the upper zone, 2.vi.1993, *P. N. Johnson 700 & C. J. West* (CHR); Somes Island, Wellington Harbour, southern area beyond gun emplacements, *B. Polly* (WELT L 005574). **Canterbury:** Waimakariri River flats between Mt White Bridge and the Hawdon shelter, on old matagouri on river flats, 16.ii.1991, *A. E. Wright 11073* (AK 201453); North branch of Waipara River, west of Hawarden, on face of stony bank, 30.i.1962, *R. Mason 8977* (CHR 241835); Burnside Park, Christchurch, on oak trunk, 8.x.1993, *P. N. Johnson & A. J. Fife JF102* (CHR); Avonside, trunk of sycamore in churchyard, 5.x.1993, *P. N. Johnson & A. J. Fife JF49* (CHR); Riccarton House Christchurch, on trunk of *Quercus robur* in urban park, 6.x.1993, *P. N. Johnson & A. J. Fife JF69* (CHR); South Hagley Park, Christchurch, on trunk of sycamore in urban park, 6.x.1993, *P. N. Johnson & A. J. Fife JF39* (CHR); Southey Street, on tile roof of house, 17.x.1991, *P. N. Johnson 313* (CHR); Cashmere, on ash trunk in urban park, 5.viii.1993, *P. N. Johnson & A. J. Fife JF109* (CHR); Lincoln, Landcare Research, on tree trunk in kowhai grove, 2.viii.1983, *P. N. Johnson 781, 782* (CHR); Rakaia Gorge, on veneer of wind-deposited silt on conglomerate rock face in gorge, 20.vi.1991, *P. N. Johnson 267* (CHR). **Otago:** Queenstown Gardens, on kowhai trunk, 21.xi.1993, *P. N. Johnson 926* (CHR); Trotters Gorge, on dry mossy ledge on conglomerate rock-face in part shade of low kanuka forest, 6.iii.1993, *P. N. Johnson 459* (CHR); Ibid., on *Carpodetus serratus* bordering picnic area, 12.xii.1998, *D. J. Galloway 5030* (OTA); Warrington Sand Spit, on bracken, 2.vi.1996, *J. M. Bannister 7* (OTA); Harbour Cone, Portobello, on volcanic rocks by roadside, 13.ii.1966, *W. Martin s. n.* (CHR 493540); Dunedin, Anzac Avenue (urban avenue), on trunk of elm tree, 28.iii.1996, *D. J. Galloway 0116, 0138 & Beatrice Lee* (CHR); Forth Street Bridge over Leith Stream, on top and sides of concrete pier, 17.xi.1996, *D. J. Galloway s. n.* (OTA); Woodside Glen, on

hawthorn, 22.ix.1997, *J. M. Bannister 556* (OTA); Beaumont, on rock, low hillside east of river, 13.x.1968, *J. Child 19* (CHR 3894965). **Southland:** Otautau, Holt Park, on concrete steps, 4.xi.1997, *D. J. Galloway 0261* (OTA); Mataura, Kath Falconer's garden, on old painted windowsill of derelict farmhouse, 17.ix.1997, *D. J. Galloway s. n.* (OTA); Forest Hill, on limestone, iv.1961, *J. Murray 5835* (OTA 047189).

Excluded taxa

Physcia adscandens [sic](Th.Fr.) Olivier. Recorded in Martin (1966: 150). This is referable to *P. adscandens* H. Olivier.

Physcia adglutinata (Ach.) Nyl. Recorded in Knight (1884: 401), Martin (1966: 150). This is referable to *Hyperphyscia adglutinata* (Flörke) H. Mayrhofer & Poelt.

Physcia adglutinata var. *minor* Müll.Arg. Recorded in Müller Argoviensis (1894: 41), Hellbom (1896: 50). This is referable to *Hyperphyscia adglutinata* (Flörke) H. Mayrhofer & Poelt.

Physcia aipolia (Ehrenb. Ex Humb.) Fűrnr. Recorded in Galloway (1985: 392–393, 1992: 28, Malcolm & Galloway 1997: 33). This is referable to *P. jackii* Moberg.

Physcia albicans (Pers.) Thomson. Recorded in Martin (1966: 150). This is referable to *Heterodermia* sp.

Physcia callosa Nyl. Recorded in Galloway (1985: 393; 1992: 28) and Malcolm & Galloway (1997: 33). This is referable to *P. tribacia* Nyl.

Physcia chrysophthalma (L.) DC. Recorded in Nylander (1866: 249; 1888: 45), Lindsay (1866 a: 353, 1866c: 518). This is referable to *Teloschistes chrysophthalmus*.

Physcia ciliata (Hoffm.) DR. Recorded in Martin (1968: 205), and Martin & Child (1972: 108). This is referable to *Phaeophyscia orbicularis* (Neck.) Moberg.

Physcia crispa (Pers.) Nyl. Recorded in Fineran (1969: 250). This is referable to *Physcia nubila* Moberg (Galloway 2004a).

Physcia elaeina (Sm.) A. L. Sm. Recorded in Martin (1968: 205), and Martin & Child (1972: 108). This is referable to *Hyperphyscia adglutinata* (Flörke) H. Mayrhofer & Poelt.

Physcia flavicans (Sw.) DC. Recorded in Lindsay (1866c: 519), Nylander (1888: 44). This is referable to *Teloschistes flavicans* (Sw.) Norman.

Physcia hypoleuca Tuck. Recorded in Nylander (1888),

- Hellbom (1896: 49), and Martin (1970: 249). This is referable to *Heterodermia speciosa* (Wulf.) Trevis.
- Physcia incavata* Stirt. Recorded in Stirton (1900), Zahlbruckner (1941: 371), Murray (1960: 202), and Martin (1966: 150). This is referable to *Xanthoria incavata* (Stirt.) Zahlbr. (Kondratyuk & Galloway 1996).
- Physcia integrata* Nyl. Recorded in Zahlbruckner (1941: 378), Martin (1966: 150), and Martin (1970: 249). This is referable to *P. poncinsii* Hue.
- Physcia integrata* var. *sorediosa* Vain. Recorded in Zahlbruckner (1941: 378), Martin (1966: 150), and Martin (1970: 249). This is referable to *P. nubila* Moberg.
- Physcia leucomela* (L.) Michx. Recorded in Nylander (1888: 45), Hellbom (1896: 49). This is referable to *Heterodermia leucomela* (L.) Poelt.
- Physcia ligulata* Körb. Recorded in Nylander (1888: 45). This is referable to *Xanthoria ligulata* (Körb.) P. James.
- Physcia mougeotii* Schaer. Recorded in Martin (1966: 150). This is referable to *Xanthoparmelia mougeotina* (Nyl.) D. J. Galloway (Galloway 1980: 538-539).
- Physcia obscura* Nyl. Recorded in Müller Argoviensis (1894: 41), Hellbom (1896: 50). This is referable to *Phaeophyscia orbicularis* (Neck.) Moberg.
- Physcia obscura* var. *ciliata* (Hoffm.) Tuck. Recorded in Martin (1966: 150). This is referable to *Phaeophyscia orbicularis* (Neck.) Moberg.
- Physcia obscuriuscula* Nyl. Recorded in Nylander (1888: 46), Müller Argoviensis (1894: 41), and Martin (1966: 150). This is referable to *Parmelia sens. lat.*
- Physcia orbicularis* (Neck.) Thomson. Recorded in Martin (1966: 150), Martin & Child (1972: 108). This is referable to *Phaeophyscia orbicularis* (Neck.) Moberg.
- Physcia parietina* (L.) De Not. Recorded in Nylander (1866: 249; 1888: 45), Lindsay (1866a: 353, 1866c: 518). This is referable to *Xanthoria parietina* (L.) Th.Fr.
- Physcia picta* (Sw.) Nyl. Recorded in Nylander (1888: 46), Müller Argoviensis (1894: 41), Martin (1966: 150). This is referable to *Dirinaria picta* (Sw.) Clem. & Shear.
- Physcia picta* var. *sorediata* Nyl. Recorded in Hellbom (1896: 49). This is referable to *Dirinaria applanata* (Fée) Awasthi.
- Physcia plinthiza* Nyl. Recorded in Nylander (1866: 249; 1888: 46), Lindsay (1866a: 353, 1866b: 419), Knight (1880:369), Hellbom (1896: 50), and Martin (1966: 150). This is referable to *Hyperphyscia plinthiza* (Nyl.) Müll.Arg.
- Physcia pulverulenta* (Schreb.) Nyl. Recorded in Müller Argoviensis (1894: 40), Martin (1966: 150), and Martin & Child (1972: 108). This is referable to *Dirinaria picta* (Sw.) Clem. & Shear.
- Physcia pulverulenta* var. *venusta* (Ach.) Nyl. Recorded in Martin (1966: 150). This is referable to *Dirinaria picta* (Sw.) Clem. & Shear.
- Physcia regalis* Zahlbr., *Denkschr. Akad. Wiss. Wien. math.-naturwiss. Kl.* 104: 379 (1941). Type: New Zealand. Holotype: New Zealand. Auckland, Rangitoto Island, on *Metrosideros tomentosa* in light forest, *H. H. Allan A105*, W! – holotype: isotype CHR 379831! This is referable to *Pannaria allobiza* (Nyl.) Elvebakk & D. J. Galloway (Elvebakk & Galloway 2003: 5).
- Physcia semipinnata* (J.F. Gmel.) Moberg. Recorded in Malcolm & Malcolm (2001: 40, 51). Material collected from Nelson by Dr W. M. Malcolm has a prosoplectenchymatous upper cortex and is therefore referable to *Heterodermia*, and cannot be *Physcia leptalea* (Ach.) DC., which is the correct name for *P. semipinnata* (see Laundon 1995; Gams 1998). This ciliate, fertile species of *Heterodermia* needs further investigation in New Zealand.
- Physcia speciosa* (Wulf.) Nyl. Recorded in Hellbom (1896: 48). This is referable to *Heterodermia speciosa* (Wulf.) Trevis.
- Physcia stellaris* auct non. (L.) Nyl. All material seen identified as *P. stellaris* from New Zealand (over 100 collections) contains zeorin in the medulla, as verified by thin-layer chromatography. The K+ yellow medulla spot test result (due to atranorin) is not always conclusive and a number of collections tested K–; however, acetone extracts of all specimens examined were found to contain zeorin. Accordingly, *P. stellaris* must be excluded from the New Zealand mycobiota. All earlier records of *P. stellaris* refer to *P. jackii* Moberg (see above).
- Physcia stellaris* var. *radiata* (Ach.) Nyl. Recorded in Nylander (1866: 249, 1888: 46), Lindsay (1866a: 353; 1866c: 519), Müller Argoviensis (1894: 41), Zahlbruckner (1941: 378), and Martin (1970: 249). This is referable to *Physcia poncinsii* Hue.
- Physcia stellaris* var. *rosulata* (Ach.) Hue. Recorded in Nylander (1888: 46), Müller Argoviensis (1894: 41), Zahlbruckner (1941: 378), and Martin (1966: 150). This is referable to *Physcia erumpens* Moberg and *P. poncinsii* Hue (North Island collections) and to *P. jackii* Moberg (South Island collections).

Physcia stellaris var. *venusta* (Ach.) Nyl. Recorded in Martin (1966: 150). This is referable to *P. jackii* Moberg.

Physcia synthalea C. Knight. Recorded in Knight (1884: 401), Hellbom (1896: 50), and Martin (1966: 150). This is referable to *Hyperphyscia plinthiza* (Nyl.) Müll.Arg.

Physcia tenella (Scop.) DC. Recorded in Martin (1968: 205). This is referable to *P. adscendens* H. Olivier.

Physcia tenuisecta Zahlbr., *Denkschr. Akad. Wiss. Wien. math.-naturwiss. Kl.* 104: 378 (1941). Type: New Zealand. Northland, Mahurangi River on *Avicennia*, L. B. Moore ZA 3580, W! – holotype: CHR 241833! – isotype. This material is referable to *Hyperphyscia adglutinata* (Flörke) H. Mayrhofer & Poelt. Recorded in Martin (1966: 150), Galloway (1985: 394; 1992: 28), and Malcolm & Galloway (1997:33).

Physcia tremens Zahlbr. in A. Zahlbruckner, K. Keissler, and H. H. Allan, *Trans. N. Z. Inst.* 59: 312 (1928). Type: New Zealand. Wellington: Kitchener Park, Feilding, on leaves of *Alectryon excelsus* and *Podocarpus spicatus* [= *Prumnopitys taxifolia*], 5.xi.1926, H. H. Allan (W – not seen). Recorded in Zahlbruckner *et al.* (1928: 312–313), Zahlbruckner (1941: 379), and Martin (1966: 150). From the description, obviously not a species of *Physcia* at all (cortex K–), and possibly a young thallus of *Pannaria sphinctrina*, which is often found as a facultative foliicole on leaves of lowland forest trees, and when poorly developed may be very like *Physcia*.

Physcia tribacia (Ach.) Nyl. Recorded in Martin (1966: 150). This is referable to *Physcia poncinsii* Hue.

Physcia tribacioides [*sic*] sensu D. J. Galloway non Nyl. Recorded in Galloway (1985: 394; 1992: 28), Malcolm & Galloway (1997: 33). This is referable to *P. poncinsii* Hue.

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References

- Aptroot, A. (1987). Pyxinaceae (Lichens). *In: Görts-van Rijn, A.R.A. (ed.) Flora of the Guianas. Series E: fungi and lichens.* Pp.1–53. Koenigstein: Koeltz Scientific Books.
- Aptroot, A. (1988). Lichens of Madagascar: the Pyxinaceae (syn. Physciaceae). *Cryptogamie, Bryologie, Lichénologie* 9(2): 141–147.
- Aptroot, A. (1989a). Contribution to the Azores lichen flora. *Lichenologist* 21(1): 59–65.
- Aptroot, A. (1989b). Studies on Colombian cryptogams. XL. The family Pyxinaceae. *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen, Series C*, 92: 269–280.
- Aptroot, A. and Seaward, M.R.D. (1999). Annotated checklist of Hongkong lichens. *Tropical Bryology* 17: 57–101.
- Aptroot, A. and Sipman, H. (1989). New lichen records from the Philippines. *Acta Bryolichenologica Asiatica* 1(1,2): 31–41.
- Awasthi, D.D. (1960). Contributions to the lichen flora of India and Nepal I. The genus *Physcia* (Ach.) Vain. *Journal of the Indian Botanical Society* 39 (1): 1–21.
- Babington, C. (1855). Lichenes. *In: Hooker, J.D. (ed.) The Botany of the Antarctic Voyage of H. M. Discovery Ships Erebus and Terror in the years 1839–1843, under the command of Captain Sir James Clark Ross. II. Flora Novae Zelandiae. Part II. Flowerless Plants*, pp. 266–311. London: Lovell Reeve.
- Bannister, J. (2000). Profile of a botanist. John Scott Thomson and Thomson's lichen collection at OTA. *Botanical Society of Otago Newsletter* 16: 9–12.
- Barron, G. (1999). *Understanding Lichens*. Slough: Richmond Publishing Co. Ltd. iii + 92 pp.
- Brodo, I.M., Sharnoff, S.D. and Sharnoff, S. (2001) *Lichens of North America*. New Haven and London: Yale University Press. 795 pp.
- Calvelo, S. and Liberatore, S. (2001). Checklist of Argentinean lichens (Version 2). http://www.biologie.uni-hamburg.de/checklists/argentina_1.htm (viewed 07 March 2005).
- Coppins, B.J. (1992). *Physcia*. *In: Purvis, O.W., Coppins, B.J., Hawksworth, D.L., James, P.W., and D.M. Moore (eds.) The Lichen Flora of Great Britain and Ireland.* Pp. 467–470. London: The Natural History Museum.
- Coppins, B. J. (2002). *Checklist of Lichens of Great Britain and Ireland*. Huddersfield: British Lichen Society. 87 pp.
- Culbertson, C.F. (1972). Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method. *Journal of Chromatography* 72: 113–125.

- Diederich, P. and Sérusiaux, E. (2000). *The Lichens and Lichenicolous Fungi of Belgium and Luxembourg. An annotated checklist*. Luxembourg: Musée National d'Histoire Naturelle. 207 pp.
- Dobson, F.S. (1992). *Lichens. An illustrated Guide to the British and Irish Species*. Third edition. Slough: The Richmond Publishing Co. Ltd. 376 pp.
- Dobson, F.S. (2000). *Lichens. An illustrated Guide to the British and Irish Species*. Fourth edition. Slough: The Richmond Publishing Co. Ltd. 431 pp.
- Egea, J.M. (1996). Catalogue of lichenized and lichenicolous fungi of Morocco. *Bocconea* 6: 19–114.
- Elix, J.A. and Kantvilas, G. (1995). New taxa and new records from the Tasmanian lichen flora. *Papers and Proceedings of the Royal Society of Tasmania* 129: 63–68.
- Elix, J.A. and McCarthy, P.M. (1998). Catalogue of the lichens of the smaller Pacific islands. *Bibliotheca Lichenologica* 70: 1–361.
- Elix, J.A., Whitton, A.A., and Jones, A.J. (1982). Triterpenes from the lichen genus *Physcia*. *Australian Journal of Chemistry* 35: 641–647.
- Elvebakk, A. and Galloway, D.J. (2003). Notes on the heterogeneous genus *Psoroma* s. lat. in New Zealand. *Australasian Lichenology* 53: 4–9.
- Elvebakk, A. and Hertel, H. (1997) ['1996']. A catalogue of Svalbard plants, fungi, algae, and cyanobacteria. Part 6. Lichens. *Norsk Polarinstitutt Skrifter* 198: 271–359.
- Elvebakk, A. and Moberg, R. (2002). Foliose and placodioid species of the lichen family *Physciaceae* in southernmost Chile. *Lichenologist* 34 (4): 311–320.
- Eriksson, O.E., Baral, H.-O., Currah, R.S., Hansen, K., Kurtzman, C.P., Rambold, G., and Laessøe, T. (2004). Outline of Ascomycota - 2004. *Myconet* 10: 1–99.
- Esslinger, T.L. and Egan, R.S. (1995). A sixth checklist of the lichen-forming, lichenicolous, and allied fungi of the continental United States and Canada. *Bryologist* 98 (4): 467–549.
- Filson, R.B. (1974). Studies in Antarctic lichens I: notes on *Caloplaca citrina* (Hoffm.) Th.Fr. and *Physcia caesia* (Hoffm.) Hampe. *Muelleria* 3: 1–8.
- Fineran, B.A. (1969). The flora of the Snares Islands, New Zealand. *Transactions of the Royal Society of New Zealand, Botany* 3 (17): 237–270.
- Galloway, D.J. (1976). H.H. Allan's early collections of New Zealand lichens. *New Zealand Journal of Botany* 14: 225–230.
- Galloway, D.J. (1980). *Xanthoparmelia* and *Chondropsis* (Lichenes) in New Zealand. *New Zealand Journal of Botany* 18: 525–552.
- Galloway, D.J. (1985). *Physcia*. In: *Flora of New Zealand Lichens*. Pp. 391–395. Wellington: P.D. Hasselberg, New Zealand Government Printer.
- Galloway, D.J. (1992). Checklist of New Zealand lichens. *DSIR Land Resources Scientific Report* 26: 1–58.
- Galloway, D.J. (1996). Lichen biogeography. In: Nash III, T.H. (ed.) *Lichen Biology*. Pp. 199–216. Cambridge: Cambridge University Press.
- Galloway, D.J. (2004a). Notes on some lichen names recorded from the Snares Islands, southern New Zealand. *Australasian Lichenology* 55: 21–25.
- Galloway, D.J. (2004b). The Swedish connection in New Zealand lichenology. *Symbolae Botanicae Upsalienses* 34(1): 63–85.
- Galloway, D.J. and Hayward, B.W. (1987). Lichens from the Three Kings Islands, northern New Zealand. *Records of the Auckland Institute and Museum* 24: 197–213.
- Galloway, D.J., Knight, A., Johnson, P.N., and Hayward, B.W. (1999). Additional lichen records from New Zealand 30. *Polycoccum galligenum*, new to New Zealand and the Southern Hemisphere. *Australasian Lichenology* 45: 8–9.
- Galloway, D.J. and Quilhot, W. (1999) ['1998']. Checklist of Chilean lichen-forming and lichenicolous fungi. *Gayana (Botanica)* 55 (2): 111–185.
- Galun, M. and Mukhtar, A. (1996). Checklist of the lichens of Israel. *Bocconea* 6: 149–171.
- Gams, W. (1998). Report of the Committee for Fungi: 7. *Taxon* 47 (2): 445–447.
- Godley, E.J. (1996). Biographical notes (23): John Scott Thomson FLS, FCS, Hon. FRNZIH (1882–1943). *New Zealand Botanical Society Newsletter* 45: 11–14.
- Goward, T., McCune, B., and Meidinger, D. (1994). *The Lichens of British Columbia. Illustrated Keys. Part 1: foliose and squamulose species*. Victoria: Ministry of Forests Research Program. v + 181 pp.
- Hafellner, J. and Türk, R. (2001). Die lichenisierten Pilze Österreichs – eine Checkliste der bisher nachgewiesenen Arten mit Verbreitungsangaben. *Stappia* 76: 3–167.
- Hale Jr., M.E. (1963). The systematic position of *Parmelia albata* Wils. *Bryologist* 66: 72–74.
- Hale Jr., M.E. and Cole, M. (1988). *Lichens of California. California Natural History Guides* 54: 1–254. Berkeley: University of California Press.
- Hansen, E.S. (1995). *Greenland Lichens*. Atuagkat: Rhodos International Science and Art Publishers. 124 pp.
- Harris, R.C. (1990). *Some Florida Lichens*. New York: R.C. Harris, The New York Botanical Garden, Bronx, New York. 109 pp.
- Harris, R.C. (1995). *More Florida Lichens including the 10¢ tour of the Pyrenolichens*. New York: R.C. Harris, The New York Botanical Garden, Bronx, New York. 192 pp.
- Hayward, B.W. and Hayward, G.C. (1979). Lichens of the Cavalli Islands, northern New Zealand. *Tane* 25: 109–118.
- Hayward, B.W. and Hayward, G.C. (1984). Lichens of the Chickens Islands, northern New Zealand. *Tane* 30: 43–51.
- Hayward, B.W. and Hayward, G.C. (1990). Lichens of Whale (Motuhora) and Rurima Islands, Bay of Plenty, New Zealand. *Tane* 32: 61–71.

- Hayward, B.W., Hayward, G.C., and Galloway, D.J. (1986). Lichens of Great Barrier and adjacent islands, northern New Zealand. *Journal of the Royal Society of New Zealand* 16 (2): 121–137.
- Hayward, B.W. and Wright, A.E. (1991). Lichens from the Poor Knights Islands, northern New Zealand: additions and an updated species list. *Tane* 33: 39–48.
- Hayward, G.C. and Hayward, B.W. (1978). Lichens of Hen Island, northern New Zealand. *Tane* 24: 119–130.
- Hellbom, P.J. (1896). Lichenaea Neo-Zeelandica seu lichenes novae zelandiae a Sv. Berggren annis 1874–1875 collecti. *Bihang till Kongliga Svenska Vetenskaps-Akademiens Handlingar* 21 (3/13): 1–150.
- Helms, G., Friedl, T., and Rambold, G. (2003). Phylogenetic relationships of the Physciaceae inferred from rDNA sequence data and selected phenotypic characters. *Mycologia* 95 (6): 1078–1099.
- Hooker, J.D. (1867). *Handbook of the New Zealand Flora*. Part II. Pp. 550–594. London: Lovell Reeve.
- Howe Jr., R.H. (1912). The lichens of the Linnean Herbarium with remarks on Acharian material. *Bulletin of the Torrey Botanical Club* 39: 199–203.
- John, V. (1996). Preliminary catalogue of lichenized and lichenicolous fungi of Mediterranean Turkey. *Bocconea* 6: 173–216.
- Johnson, P.N., Burrows, L.E., and Galloway, D.J. (1998). Lichens as air pollution monitors. *Landcare Research Contract Report*, LC9899/04.
- Kashiwadani, H. (1975). The genera *Physcia*, *Physconia*, and *Dirinaria* (Lichens) of Japan. *Gingkoana* 3: 1–77.
- Kirk, P.M., Cannon, P.F., David, J.C., Stalpers, J.A. (eds). (2001). *Ainsworth and Bisby's Dictionary of the Fungi*. Ninth edition. Wallingford: CABI Bioscience. CABI International. xi + 655 pp.
- Knight, C. (1880). Contribution to the Lichenographia of New Zealand. *Transactions and Proceedings of the New Zealand Institute* 12: 367–379.
- Knight, C. (1884). On the Lichenographia of New Zealand. *Transactions and Proceedings of the New Zealand Institute* 16: 400–408
- Kondratyuk, S.Y. and Galloway, D.J. (1996). Notes on *Xanthoria* Th.Fr. I. The identity of *Xanthoria incavata* (Stirton) Zahlbruckner. *Lichenologist* 28 (2): 189–193.
- Kondratyuk, S., Navrotskaya, I., Khodosovtsev, A., and Solonina, O. (1996). Checklist of Ukrainian lichens. *Bocconea* 6: 217–294.
- Kurokawa, S. (2003). *Checklist of Japanese lichens*. Tokyo: National Science Museum. 128 pp.
- Laundon, J.R. (1995). The ciliate species of *Physcia* (lichenized *Ascomycotina: Lecanorales*), with two conservation and two rejection proposals (1162–1165). *Taxon* 44: 246–248.
- Lindsay, W.L. (1866a). List of lichens collected in Otago, New Zealand. *Transactions of the Botanical Society of Edinburgh* 8: 349–358.
- Lindsay, W.L. (1866b). Observations on new lichens and fungi collected in Otago, New Zealand. *Transactions of the Royal Society of Edinburgh* 24 (2): 407–456.
- Lindsay, W.L. (1866c). Observations on New Zealand lichens. *Transactions of the Linnean Society* 25 (3): 493–560.
- Lindsay, W.L. (1868). *Contributions to New Zealand Botany*. London and Edinburgh: Williams and Norgate. 102 pp.
- Llimona, X. and Hladun, N.L. (2001). Checklist of the lichens and lichenicolous fungi of the Iberian Peninsula and the Balearic Islands. *Bocconea* 14: 1–581.
- McCarthy, P.M. (2003). Catalogue of Australian Lichens. *Flora of Australia Supplementary Series* 19: 1–237.
- McCune, B. and Geiser, L. (1997). *Macrolichens of the Pacific Northwest*. Corvallis: Oregon State University Press. xiv + 386 pp.
- Malcolm, W.M. and Galloway, D.J. (1997). *New Zealand Lichens. Checklist, key, and glossary*. Wellington: Museum of New Zealand Te Papa Tongarewa, Wellington. vi + 192 pp.
- Malcolm, W.M. and Malcolm, N. (2001). *New Zealand's leaf-dwelling lichens*. Nelson: Micro-Optics Press. vi + 73 pp.
- Marcano, V., Méndez, A.M., Sipman, H., and Calderon, L. (1996). A first checklist of the lichen-forming fungi of the Venezuelan Andes. *Tropical Bryology* 12: 193–235.
- Martin, W. (1966). Census catalogue of the lichen flora of New Zealand. *Transactions of the Royal Society of New Zealand, Botany* 3 (8): 139–159.
- Martin, W. (1968). Supplement to census catalogue of New Zealand lichens. *Transactions of the Royal Society of New Zealand, Botany* 3 (13): 203–208.
- Martin, W. (1970). The lichen flora of the Dunedin botanical subdistrict. *Transactions of the Royal Society of New Zealand, Botany* 11 (19): 243–255.
- Martin, W. and Child, J. (1972). *Lichens of New Zealand*. Wellington: A. H. and A. W. Reed. 193 pp.
- Moberg, R. (1977). The lichen genus *Physcia* and allied genera in Fennoscandia. *Symbolae Botanicae Upsalienses* 22 (1): 1–108.
- Moberg, R. (1983). The genus *Phaeophyscia* in East Africa. *Nordic Journal of Botany* 3: 509–516.
- Moberg, R. (1986). The genus *Physcia* in East Africa. *Nordic Journal of Botany* 6: 843–864.
- Moberg, R. (1989). Studies on *Physcia* – III. Three *Physcia* species new to Europe and the Azores. *Herzogia* 8: 249–253.
- Moberg, R. (1990). The lichen genus *Physcia* in Central and South America. *Nordic Journal of Botany* 10: 319–342.
- Moberg, R. (1994). Is the Pacific an area of speciation for some foliose genera of the lichen family Physciaceae? *Journal of the Hattori Botanical Laboratory* 76: 173–181.
- Moberg, R. (1997). The lichen genus *Physcia* in the Sonoran Desert and adjacent areas. *Symbolae Botanicae Upsalienses* 32(1): 163–186.
- Moberg, R. (2001). The lichen genus *Physcia* in Australia. *Bibliotheca Lichenologica* 78: 289–311.

- Moberg, R. (2002). *Physcia*. *Nordic Lichen Flora* 2: 33–38.
- Moberg, R. (2004). Notes on foliose species of the lichen family Physciaceae in southern Africa. *Symbolae Botanicae Upsalienses* 34 (1): 257–288.
- Moberg, R. and Hansen, E.S. (1986) The lichen genus *Physcia* and allied genera in Greenland. *Meddelelser om Grønland Bioscience* 22: 1–32.
- Moberg, R. and Holmåsén, I. (1982). *Lavar. En fälthandbok*. Stockholm: Interpublishing. 237 pp.
- Müller Argoviensis, J. (1894). Conspectus sytematicus lichenum Novae Zelandiae. *Bulletin de l'Herbier Boissier* 2, Appendix 1: 1–114.
- Murray, J. (1960). Studies of New Zealand lichens. II. The Teloschistaceae. *Transactions of the Royal Society of New Zealand* 88: 197–210.
- Nimis, P.L. (1993). *The Lichens of Italy. An annotated catalogue*. Monografie XII. Torino: Museo Regionale di Scienze Naturali. 897 pp.
- Nylander, W. (1866). Lichenes Novae Zelandiae, quos ibi legit anno 1861 Dr Lauder Lindsay. *Botanical Journal of the Linnean Society* 9: 244–259.
- Nylander, W. (1888). *Lichenes Novae Zelandiae*. Paris: P. Schmidt. 156 pp.
- Øvstedal, D.O. and Lewis Smith, R.I. (2001). *Lichens of Antarctica and South Georgia*. Cambridge: Cambridge University Press. xii + 411 pp.
- Pennycook, S.R., and Galloway, D.J. (2004). Checklist of New Zealand 'fungi'. In: McKenzie, E.H.C. (ed.). Introduction to Fungi of New Zealand. *Fungi of New Zealand/Ngā Harore o Aotearoa 1*. Fungal Diversity Research Series 14: 401–488.
- Poelt, J. (1974). Die Gattungen *Physcia*, *Physciopsis* und *Physconia* (Lichenes, Physciaceae) (Flechten des Himalaya 6). *Ergebnisse des Forschungsunternehmens Nepal Himalaya Khumbu Himal* 6(2): 57–100.
- Rambold, G., Mayrhofer, H., and Matzer, M. (1994). On the ascus types in the Physciaceae (Lecanorales). *Plant Systematics and Evolution* 192: 31–40.
- Redon, J. (1985). *Liquenes Antarticos*. Santiago: Instituto Antartico Chileno. 123 pp.
- Santesson, R. (1993). *The lichens and lichenicolous fungi of Sweden and Norway*. Lund: SBT-förlaget. 240 pp.
- Santesson, R., Moberg, R., Nordin, A., Tønsberg, T., and Vitikainen, O. (2004). *Lichen-forming and lichenicolous fungi of Fenoscandia*. Uppsala: Museum of Evolution, Uppsala University. 359 pp.
- Scholz, P. (2000). Katalog der Flechten und flechtenbewohnenden Pilze Deutschlands. *Schriftenreihe für Vegetationskunde* 31: 1–298.
- Scutari, N.C. (1990a). Studies on foliose Pyxinaceae (Lecanorales, Ascomycotina) from Argentina, I: new records from South America. *Nova Hedwigia* 50(1–2): 261–274.
- Scutari, N.C. (1990b). Studies on foliose Pyxinaceae (Lecanorales, Ascomycotina) from Argentina, II: anatomical-ontogenetic studies in *Physcia tribacia* (Ach.) Nyl. *Nova Hedwigia* 50(3–4): 451–461.
- Scutari, N.C. (1992). Estudios sobre Pyxinaceae foliosas (Lecanorales, Ascomycotina) de la Argentina, IV: claves de los generos y las especies de la Provincia de Buenos Aires. *Boletin de la Sociedad de Argentina de Botanica* 28(1–4): 169–173.
- Scutari, N.C. (1995). Los macrolíquenes de Buenos Aires, II: *Phaeophyscia*, *Physcia* y *Pyxine* (Physciaceae, Ascomycotina). *Darwiniana* 33(1–4): 211–231.
- Seaward, M.R.D. (1996). Checklist of Tunisian lichens. *Bocconea* 6: 115–148.
- Swinscow, T.D.V. and Krog, H. (1988). *Macrolichens of East Africa*. London: British Museum (Natural History). 390 pp.
- St. Clair, L.L. (1999). *A color guidebook to common Rocky Mountain lichens*. Provo, Utah: The M.L. Bean Life Science Museum, Brigham Young University. 242 pp.
- Stirton, J. (1900). On new lichens from Australia and New Zealand. *Transaction and Proceedings of the New Zealand Institute* 32: 70–82.
- Tehler, A. (1996). Systematics, phylogeny and classification. In: Nash III, T.H. (ed.) *Lichen Biology*. Pp. 217–239. Cambridge: Cambridge University Press.
- Thomson, J.W. (1963). The lichen genus *Physcia* in North America. *Beihefte zur Nova Hedwigia* 7: 1–172.
- Vitt, D.H., Marsh, J.E., and Bovey, R.B. (1988) *Mosses Lichens and Ferns of Northwest North America*. Edmonton: Lone Pine Publishing. 296 pp.
- Wedin, M., Baloch, E., and Grube, M. (2002). Parsimony analyses of mtSSU and nITS rDNA sequences reveal the natural relationships of the lichen families Physciaceae and Caliciaceae. *Taxon* 51 (4): 655–660.
- Wedin, M. and Grube, M. (2002). Proposal to conserve *Physciaceae* nom cons. against an additional name *Caliciaceae* (Lecanorales, Ascomycota). *Taxon* 51 (4): 802.
- White, F.J. and James, P.W. (1985). A new guide to microchemical techniques for the identification of lichen substances. *Bulletin of the British Lichen Society* 47 (Supplement): 1–41.
- Wirth, V. (1987). *Die Flechten Baden-Württembergs Verbreitungsatlas*. Stuttgart:Verlag Eugen Ulmer. 528 pp.
- Wright, A.E., Hayward, B.W., and Hayward, G.C. (1980). Lichens from Fanal Island, Mokohinau Group, northern New Zealand. *Tane* 26: 45–52.
- Zahlbruckner, A. (1941). Lichenes Novae Zelandiae a cl. H.H. Allan eiusque collaboratoribus lecti. *Denkschriften der Akademie der Wissenschaften Wien Mathematisch-Naturwissenschaftliche Klasse* 104: 249–380.
- Zahlbruckner, A., Keissler, K., and Allan, H.H. (1928). The epiphyllous lichens of Kitchener Park, Feilding, New Zealand. *Transactions of the New Zealand Institute* 59: 304–314.