



<https://doi.org/10.15407/ukrbotj81.02.145>

RESEARCH ARTICLE

## New Zealand *Lithothelium* (*Pyrenulaceae*) — description of a new species *Lithothelium kiritea* sp. nov., with notes on *L. australe*

Andrew J. MARSHALL<sup>1</sup> , André APTROOT<sup>2</sup> ,  
Dan J. BLANCHON<sup>3</sup> , Campbell J. JAMES<sup>1</sup> , Peter J. de LANGE<sup>1\*</sup> 

<sup>1</sup> Applied Molecular Solutions Research Group, School of Environmental and Animal Sciences, Unitec Institute of Technology, Private Bag 92025, Victoria Street West, Auckland 1142, New Zealand

<sup>2</sup> Laboratório de Botânica / Liquenologia, Instituto de Biociências, Bairro Universitário, Campo Grande, Mato Grosso do Sul, Brazil

<sup>3</sup> Auckland War Memorial Museum Tāmaki Paenga Hira, Private Bag 92018, Victoria Street West, Auckland, New Zealand

\* Author for correspondence: [pdelange@unitec.ac.nz](mailto:pdelange@unitec.ac.nz)

**Abstract.** *Lithothelium kiritea* A.J. Marshall, Aptroot, de Lange & Blanchon sp. nov. (*Pyrenulaceae*) is described from Aotearoa / New Zealand. The new species has a mainly coastal and mostly westerly distribution in Aotearoa / New Zealand and is thus far known only from the bark of living *Cordyline australis* (*Asparagaceae*). The new species is separated from *Lithothelium australe* (treated here as endemic to the Chatham Islands), by its corticolous, rather than saxicolous habit, white to pale buff (when fresh) thallus and large ascospores (measuring 32–40 × 12–15 µm). *Lithothelium kiritea* is easily recognised and usually abundant in the locations where it has been found, yet it seems to have not been collected until 1973 when it was sampled once and then not collected again until 2018. Currently, specimens matching *L. kiritea* have not been reported from Australia, so we recommend it be searched for there. Within Aotearoa / New Zealand, we propose that the species be assessed as ‘Not Threatened’ using the New Zealand Threat Classification System.

**Keywords:** lichen taxonomy, lichenized mycobiota, *Lithothelium*, *Lithothelium kiritea* sp. nov., New Zealand

### Introduction

The genus *Lithothelium* Müll. Arg. contains mostly lichenized ascomycetes in the *Pyrenulaceae*. Worldwide, 28 species are currently accepted, which are all keyed out in Aptroot (2022). Hitherto, it was represented in the greater Aotearoa / New

Zealand archipelago by a single species, *L. australe* Aptroot & H. Mayrhofer, described from collections made from Rēkohu / Wharekauri / Chatham Island (Aptroot, Mayrhofer, 1991), the largest island in the Chatham Islands group located c. 800 km east of the main islands of Aotearoa / New Zealand.

ARTICLE HISTORY. Submitted 26 March 2024. Revised 17 April 2024. Published 28 April 2024

CITATION. Marshall A.J., Aptroot A., Blanchon D.J., James C.J., de Lange P.J. 2024. New Zealand *Lithothelium* (*Pyrenulaceae*) — description of a new species *Lithothelium kiritea* sp. nov., with notes on *L. australe*. *Ukrainian Botanical Journal*, 81(2): 145–154. <https://doi.org/10.15407/ukrbotj81.02.145>

© M.G. Kholodny Institute of Botany, NAS of Ukraine, 2024

© Publisher PH "Akademperiodyka" of the NAS of Ukraine, 2024

This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>)



**Fig. 1.** *Lithothelium kiritea* on *Cordyline australis*, Nile River, Charleston, Te Waipounamu / South Island, Aotearoa / New Zealand (image: P.J. de Lange)

During fieldwork in the Auckland Region of the North Island of Aotearoa / New Zealand, the senior author noted a conspicuous white crustose lichen covering the usually exposed trunks of *Cordyline australis* (G. Forst.) Endl. (*Asparagaceae*



**Fig. 2.** Habitat of *Lithothelium kiritea* at the type locality (image: A.J. Marshall)

Juss. subfam. *Lomandroideae* Thorne & Reveal; earlier sometimes treated in segregate families *Laxmanniaceae* Bubani or *Lomandraceae* Lotsy) (Figs 1, 2). Despite its local abundance, this lichen seems to have only been collected once before (collection B.W. Hayward H18.1256, AK186257), from an Auckland University field site at Kawerua, Te Tai Tokerau / Northland (35°38'9.18 S, 173°26'29.73 E). The phorophyte was misidentified as taraire (*Beilschmiedia tarairi* (A. Cunn.) Benth. & Hook. f. ex Kirk, family *Lauraceae* Juss.), whereas the substrate is indisputably *Cordyline australis* and the specimen had been placed in the herbarium as a species of *Pyrenula* Ach. Subsequent investigation of specimens collected by the senior author in 2018 suggested that the lichen was a species of *Lithothelium*, and following receipt of specimens one of us (A. Aptroot) with a worldwide knowledge of the genus concluded that they represented a new species, warranting formal recognition.

In this paper we describe the new species, provide an account of its distribution and ecology, and present a conservation assessment using the New Zealand Threat Classification System (Townsend et al., 2008). We also provide an update on the distribution, ecology and conservation status of *Lithothelium australe*.

## Materials and Methods

Specimens were examined using standard microscopic techniques, using hand-cut sections mounted

in water or stained using lactophenol cotton blue after pretreatment with KOH to observe ascus structures (Orange et al., 2010). Thin-layer chromatography was used to check for chemical constituents, but the results were inconclusive.

We searched AK, CHR, OTA, UNITEC and WELT herbaria for collections of *Lithothelium* in their holdings of *Pyrenulaceae* and undetermined pyrenulaceous crustose collections (for herbarium acronyms see Thiers, 2008—onward).

## Taxonomy

*Lithothelium* Müll. Arg., Bot. Jahrb. Syst. 6: 386 (1885).

Type species: *Lithothelium cubanum* Müll. Arg., Bot. Jahrb. Syst. 6: 386 (1885).

*Lithothelium kiritea* A.J. Marshall, Aptroot, de Lange & Blanchon, sp. nov.

**Type:** —NEW ZEALAND. North Island, Waitākere Ranges, Whatipu, 37°2′34.7 S, 174°30′24.13 E, A.J. Marshall (AJM91), 24 Mar 2024. On bark of *Cordyline australis*, 4 m, (holotype UNITEC 14328, isotypes, AK, B).

**Diagnosis:** Distinguished from *Lithothelium australe* by the corticolous rather than saxicolous growth habit, white to pale buff, appearing whiter with age (grey to dark grey with green tinge in *L. australe*) thallus, and larger spores, 32–40 × 12–15 µm (20–26 × 6–8 µm in *L. australe*).

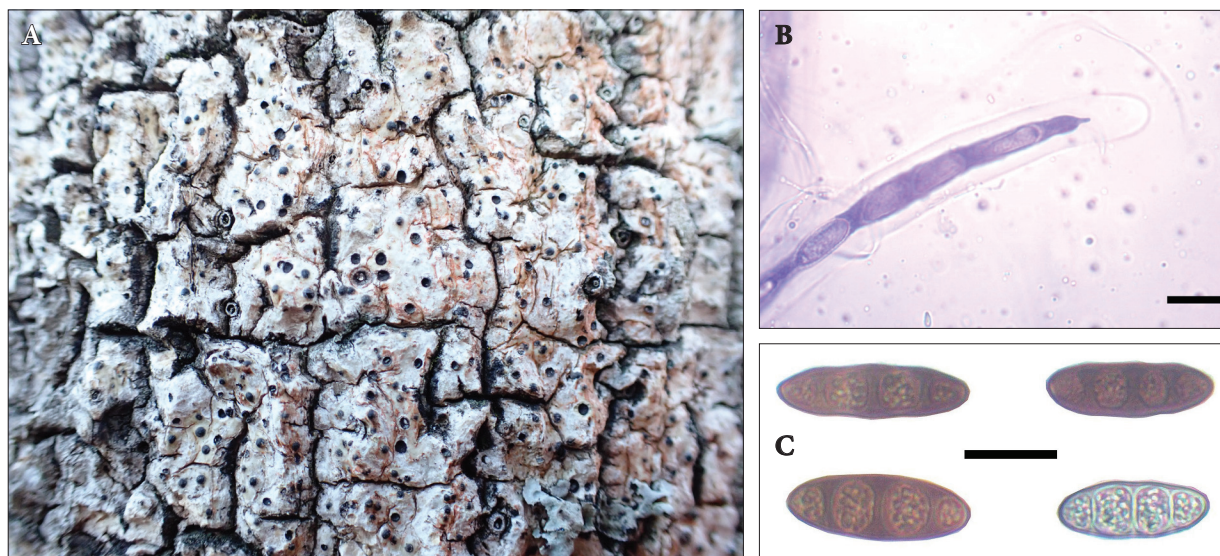
Mycobank accession number: MB#852916

**Thallus** (Figs 3A–C) — white to pale buff, appearing whiter with age, darker when fresh and often appearing darker around perithecia, without marginal prothallus. Angular crystals present throughout, fleck-like, 60–150 × 30–60 µm. **Photobiont** — green (genus not evident, probably *Trentepohlia*). **Perithecia** — simple, without pseudostromatic tissues. Conical to globose, usually erumpent from substratum but very occasionally partially covered, 0.8–1.0 mm diam., 0.5–0.8 mm tall, usually 0.15–0.30 mm emergent from thallus. Ascocarp wall completely carbonised, without distinct clypeus, 35–50 µm thick. Ostiole black, rimmed, rim paler than ascocarp, 150–350 µm diam., usually apical but occasionally skewed. **Hamathecium** — interspersed with oil droplets, IKI–, paraphyses simple, not branched at tips, approx. 1 µm thick. **Asci** — fissitunicate with rounded ocular chamber, tending to slightly sagittiform at maturity, 160–225 × 20–25 µm. **Ascospores** — 4–8/ascus, uniseriate,

colourless at first but becoming red-brown with age. Lumina tending towards angular with rounded corners, 3-septate, central two lumina larger than the terminal lumina, 32–40 × 12–15 µm. Spore wall smooth, without granules. **Pycnidia** — not always present, 240–450 µm diam., black, wall completely carbonised; spermatia acrogenous, filiform, colourless, curved 15–20 × 0.25–0.50 µm.

**Chemistry.** UV negative, no substances detected with TLC.

**Representative Specimens:** AOTEAROA / NEW ZEALAND, TE IKA A MAUI / NORTH ISLAND: Doubtless Bay, Taipa, Paranui Wildlife Reserve, M. Ford MR2250, 25 Apr 2023, UNITEC 14207; Waipoua, Kawerua, B.W. Hayward H18.156, May 1973, AK 186257; Okahukura, Taporā, A.J. Marshall & E. Ashby s.n., 1 Mar 2022, UNITEC 13412; Aranga, Aranga Settlement, P.J. de Lange 15618 & S.J. Wells, 17 Jan 2024, UNITEC 14265; Pouto, Punahaere Creek Conservation Area, M. Ford MF2249, 3 Feb 2023, UNITEC 14206; Kaipara Heads, Waionui Inlet, A.J. Marshall s.n., 16 Jun 2022, UNITEC 13411; Mataia, Mataia QEII Covenant, M. Watson MW61, 20 May 2016, UNITEC 8978; Mataia, Mataia QEII Covenant, P.J. de Lange 15414 & M. Baling, 18 Mar 2022 UNITEC 13364; Hauraki Gulf / Tikapa Moana, Kawau Island, Mansion House Bay, A.J. Marshall AJM86, 16 Nov 2023, UNITEC 14233; Kaukapakapa, Haruru Road, A.J. Marshall AJM27 & C. Kilgour, 21 March 2018, UNITEC 14041; Whangaparāoa, Shakespeare Regional Park, P.J. de Lange 15604 & C. James, 20 Oct 2023, UNITEC 14205; Hauraki Gulf / Tikapa Moana, Tiritirimatangi, A.J. Marshall AJM83, 25 Feb 2023, UNITEC 14185; Waitākere, Te Henga (Bethells Beach), A.J. Marshall AJM62, 24 Jul 2022, UNITEC 14042; Waitākere, Wigmore Bay, A.J. Marshall & C. Kilgour, 3 Jun 2021, UNITEC 12869; Waitākere, above Wigmore Bay, A.J. Marshall AJM64 & C. Kilgour, 13 Dec 2021, UNITEC 14044; Waitākere, Anawhata, A.J. Marshall s.n., 2 Feb 2022, UNITEC 13413; Waitākere, Anawhata, A.J. Marshall AJM65 & E. Marshall, 2 Jan 2023, UNITEC 14043; Waitākere, Whatipu, A.J. Marshall AJM63, 15 Mar 2022, UNITEC 14045; Waitākere, Whatipu, A.J. Marshall s.n., 26 Oct 2021, UNITEC 13414. TE WAI POUNAMU / SOUTH ISLAND: North Westland, Kohaihai River, P.J. de Lange 15616 & G.M. Crowcroft, 6 Jan 2024, UNITEC 14261; North Westland, Karamu, P.J. de Lange 15615 & G.M. Crowcroft, 6



**Fig. 3.** *Lithothelium kiritea*. A: thallus at the type locality (image: A.J. Marshall); B: ascus showing rounded ocular chamber (image: A.J. Marshall). Scale bar: 20 µm; C: a selection of ascospores. Spores are red/brown at maturity and hyaline when immature (image: A.J. Marshall). Scale bar: 20 µm

Jan 2024, UNITEC 14260; North Westland, Hector Beach, P.J. de Lange 15614 & G.M. Crowcroft, 6 Jan 2024, UNITEC 14259; North Westland, Westport, Orowaiti Lagoon, P.J. de Lange 15613 & G.M. Crowcroft, 6 Jan 2024, UNITEC 14258; North Westland, Tauranga Bay, P.J. de Lange 15612 & G.M. Crowcroft, 5 Jan 2024, UNITEC 14257; North Westland, Nile River, P.J. de Lange 15611 & G.M. Crowcroft, 6 Jan 2024, UNITEC 14256; North Westland, Charleston, Constant Bay, P.J. de Lange 15610 & G.M. Crowcroft, 5 Jan 2024, UNITEC 14255. CHATHAM ISLANDS: Rēkohu / Wharekauri / Chatham Island, Wharekauri, Chudleigh Reserve, 30 Sep 2023, P.J. de Lange CH4444, UNITEC 14186.

**Recognition:** In Aotearoa / New Zealand, prior to this paper only one species of *Lithothelium* was known, *L. australe*. That species, considered endemic to the Chatham Islands group (c.f. Galloway, 2007), is saxicolous and thus far only known to inhabit limestone (de Lange, Schmid, 2023). For differences between that species and *L. kiritea* see under *L. australe* below. As the Aotearoa / New Zealand lichenized mycobiota is biogeographically strongly linked to Australia (Galloway, 2007), we examined *Lithothelium* there. Currently, seven species of *Lithothelium* are recognised in Australia and its neighbouring islands (Aptroot, 2009; McCarthy, 1996, 2001, 2015). From all these, *L.*

*kiritea* is distinguished by its consistently white or pale buff thallus and larger spores (32–40 × 12–15 µm). Of the Australian species, *L. austropacificum* P.M. McCarthy from Lord Howe Island is grey-green to yellow-green with spores (18–)22.5(–28) × (8–)11(–14) µm, *L. decumbens* (Müll. Arg.) Aptroot is grey-green with spores 15–20 × 7–10 µm, *L. hieroglyphicum* (Müll. Arg.) Aptroot is brownish and oily in appearance with spores 17–19(–22) × (6–)7–8 µm, *L. kantvilasii* P.M. McCarthy is white-grey with spores 12–18 × 4–6 µm, *L. nanosporum* (C. Knight) Aptroot is yellow-olive green or slate grey with spores 14–23 × 5.5–9.0 µm, *L. obtectum* (Müll. Arg.) Aptroot is brown-green or grey with spores 10–18 × 4.0–7.5 µm and *L. quiescens* P.M. McCarthy from Christmas Island is pale grey to greenish brown with spores (18–)25(–31) × (10–)14(–20) µm. However, as noted below, we have reasons to suspect that dedicated searching on that continent will eventually find *L. kiritea* to be present there.

**Distribution** (Fig. 4): Endemic to Aotearoa / New Zealand where so far it is known from regions including and north of Tamaki Makaurau / Auckland (with a mostly westerly distribution), Te Ika a Maui / North Island; from North Westland, Te Waipounamu / South Island and from one location on Rēkohu / Wharekauri / Chatham Island. Despite contacting interested amateurs and posting

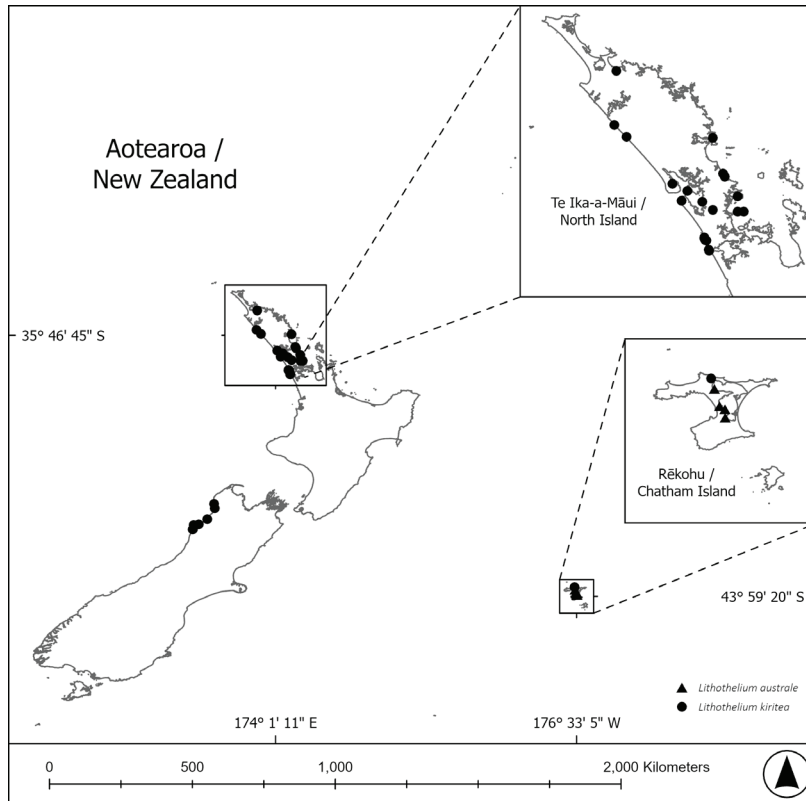


Fig. 4. Distribution of both species of *Lithothelium* based on herbarium specimens

images of the new species through social media and an article (de Lange et al., 2023) with the exception of some specimens collected from Te Tai Tokerau / Northland the authors received no specimens from locations outside those noted here.

**Ecology:** *Lithothelium kiritea* has so far only been collected from a single phorophyte, *Cordyline australis* (Figs 1, 2), on which it is often the only species of lichen inhabiting the bark, at least until host trees reach a level of maturity where other species of lichen begin to colonise and displace it, at which point it can be sometimes still seen on smaller canopy branches. It seems to be a mainly lowland, narrowly coastal species (Fig. 4), rarely extending inland for more than a few kilometres; currently the highest altitude so far recorded is 266 m a.s.l. near Anawhata, Waitākere Ranges, West Auckland (36°55'38.8 S, 174°28'21.65 E), and the furthest distance from the coast approximately 10 km from a gully wetland near Haruru Road, Rodney (36°35'3.98 S, 174°32'35.99 E). The species seems to be photophilous, eschewing shaded sites, very much a feature of the lichen mycobiota of its chosen phorophyte

growing in exposed situations. As *Cordyline australis* can persist in a range of open situations, like dune fields, reverting shrubland and pasture, wetlands, as well as farmland and urban habitats, there is an abundant and frequent phorophyte at least within the known range of *Lithothelium kiritea*. Although first collected by the authors in 2018 near Haruru Road, Rodney, it has since been found to be particularly abundant on Auckland's west coast, with the largest population seen to date being in the coastal Whatipu wetland. This is of particular note as the wetland here is relatively young (the area where the type specimen was collected would have been under sea water as recently as 1940 (Esler, 1974; Cameron, 2013)), and *Lithothelium* appears to be locally one of the most common lichens.

In most of the sites where *Lithothelium kiritea* has been found it is not only conspicuous but often extremely common. Yet the species seems to have been missed by lichenologists collecting from large parts of its known range between the 1950s–1990s, and especially, seemingly absent from collections made from its only known phorophyte tī kōuka /

cabbage tree (*Cordyline australis*) during that time. This is important because *Cordyline australis* and its associated biota were then of major interest due to that species' widespread decline and death over much of its range due to a phenomenon termed 'sudden decline of cabbage tree' (Beever et al., 1996). The absence of early collections coupled with a predominantly westerly distribution and apparent absence over large parts of the Aotearoa / New Zealand archipelago strongly suggests *Lithothelium kiritea* is a recent arrival to the islands. In a pattern similar to that described for rust fungi by McKenzie (1998) and in flowering plant genera such as *Senecio* (see below), we suspect that *Lithothelium kiritea* is present but as yet unrecognised in Australia (see 'Recognition' section above) and that it has reached Aotearoa / New Zealand from there. Consider, for example and comparison, the cases of *Senecio diaschides* D.G. Drury and *S. esleri* C.J. Webb, species first described from Aotearoa / New Zealand (Drury, 1974; Webb, 1989) and subsequently discovered in Australia, described there as *S. cahillii* Belcher (Belcher, 1983) and *S. brevitubulus* I. Thomps. (Thompson, 2006), respectively, before their synonymy was realised. If we are correct, then the species should be looked for in New South Wales and Victoria, locations from which a range of readily wind-dispersed flowering plants and ferns occur which share their distributions with northern and western Aotearoa / New Zealand (de Lange, Molloy, 1996; de Lange, Norton, 1998).

**Conservation Status:** *Lithothelium kiritea* is usually an abundant, at times locally dominant lichen of the trunks of *Cordyline australis* in coastal locations. At this stage, we can see no active threats to the species, which, within its known haunts — with the notable exception of the Chatham Islands — is not only abundant but common in secure (i.e. protected/reserved) land. As there are no major threats known to the lichen, and its phorophyte is both common and seemingly recovering from the 'sudden decline of cabbage tree' syndrome (Beever et al., 1996) through regeneration, we recommend that *Lithothelium kiritea* be listed as 'Not Threatened' using the New Zealand Threat Classification System (Townsend et al., 2008). However, we still lack exact population sizes and trends, so we recommend that this assessment be qualified 'DPS' [Data Poor Population Size] and 'DPT' [Data Poor Trend] as per the revisions of Rolfe et al. (2019).

**Etymology:** The epithet 'kiritea' is based on te reo Māori [Māori language] meaning 'white skinned' and refers to the white covering the species applies to the bark of its host phorophyte. This name was bestowed, following consultation, by the iwi [tribe] Te Kawerau ā Maki who exercise mana whenua [custodianship] over the area where the authors first recognised this species.

***Lithothelium australe*** Aptroot & H. Mayrhofer, *Mycotaxon* 41(1): 219 (1991) (see Aptroot, Mayrhofer, 1991).

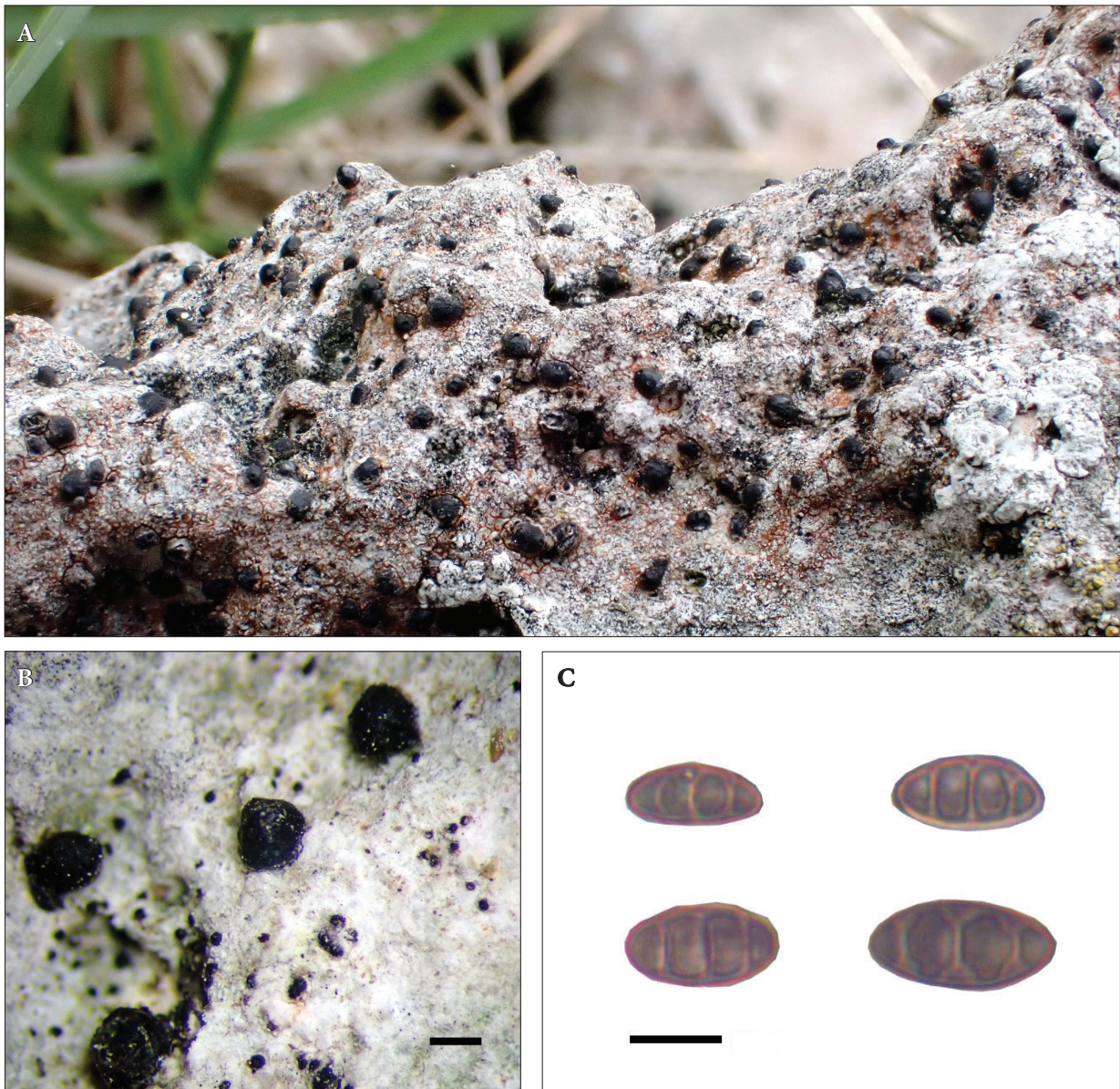
Mycobank accession number: MB#127986

**Type:** —NEW ZEALAND. Chatham Islands, Rēkohu / Wharekauri / Chatham Island, "Big Bush," B.P.J. Molloy s.n., Feb 1985. On loose bryozoan limestone outcrops, 40 m (*holotype* CHR449435!, *isotypes*, BM, CHR, GZU).

**Thallus** (Figs 5A–C) — endolithic, grey to dark grey with green tinge when fresh, drying white, fading to pale buff over time in storage, without marginal prothallus. **Photobiont** — green (genus not evident, probably *Trentepohlia*). **Perithecia** — simple, numerous or with fused ostioles and fused walls (astrothelloid), without pseudostromatic tissues and crystals, conical, erumpent from the substrate, exposed, 0.5–0.7 × 0.3–0.5 mm; ascocarp wall completely carbonised, without distinct clypeus, up to 150 µm thick; ostiole brown, obconical, skewed, 100–200 µm diam. **Hamathecium** — not inspersioned, IKI–; interthecial hyphae true paraphyses, branched only at the tips; paraphyses absent. **Asci** — fissitunicate, with sagittiform ocular chamber, 80–110 × 12–15 µm. **Ascospores** — 8/ascus, uniseriate, mature red-brown, fusiform with attenuated ends, 20–26 × 6–8 µm, symmetrically septate, not constricted at the septa, septa consisting of 3 distosepta, endospore thickened in immature spores, but thickenings slightly reduced in mature ones; spore wall smooth, without gelatinous sheet. **Pycnidia** — numerous, 100–200 µm diam., black, wall completely carbonised, up to 40 µm thick; spermatia acrogenous, colourless, filiform, 6–10 × 0.2–0.4 µm.

**Chemistry.** No substances detected by TLC.

**Representative Specimens:** AOTEAROA / NEW ZEALAND, CHATHAM ISLANDS: Rēkohu / Wharekauri / Chatham Island, Te Whanga, Motuhinahina, P.J. de Lange CH4325, 12 Feb 2023, UNITEC 13983; Rēkohu / Wharekauri / Chatham Island, Te Whanga, Motuhinahina, P.J. de Lange CH4511 & H. Tuanui-Chisholm, 18 Apr 2023,



**Fig. 5.** *Lithothelium australe*. A: habit; Motuhinahina, Te Whanga, Rēkohu / Wharekauri / Chatham Island, Aotearoa / New Zealand (image: P.J. de Lange); B: thallus showing perithecia and pycnidia; Te Matarae, Te Whanga, Rēkohu / Wharekauri / Chatham Island, Aotearoa / New Zealand (image: P.J. de Lange). Scale bar: 2 mm; C: a selection of ascospores (image: A.J. Marshall). Scale bar: 10  $\mu$ m

UNITEC 14060; Rēkohu / Wharekauri / Chatham Island, Te Matarae Road, Te Matarae, Kamo Property, P.J. de Lange CH4167 & L.M.H. Schmid, 10 May 2022, UNITEC 13375.

**Recognition:** Despite being treated by Galloway (2007), *Lithothelium* was not included in his keys to the lichenized mycobiota of his *Lichen Flora of New Zealand*, so we provide below a key to enable the

genus to be distinguished from superficially similar genera found in Aotearoa / New Zealand. When they described *Lithothelium australe*, Aptroot and Mayrhofer (1991) noted that it was the only saxicolous species in the genus with brown ascospores, which set it apart from other morphologically similar taxa of *Lithothelium*. From *Lithothelium kiritea*, *L. australe* is easily distinguished by its basicolous, saxicolous

(rather than strictly corticolous) habit, grey to dark grey green-tinged (Fig. 5A) rather than white (Fig. 3A) to pale buff thallus when fresh, and ascospores measuring  $20\text{--}26 \times 6\text{--}8 \mu\text{m}$  (Fig. 5C) rather than  $32\text{--}40 \times 12\text{--}15 \mu\text{m}$  (Fig. 3C).

**Distribution** (Fig. 4): *Lithothelium australe* at the time of its formal recognition was reported only from one location (“Big Bush”) from Rēkohu / Wharekauri / Chatham Island, the largest island of the Chatham Islands group from where the species was collected in 1985 (Aptroot, Mayrhofer, 1991). Galloway (2007) also reported the species from Bullock Creek, North Westland, South Island, which remains the only record of this species outside the Chatham Islands in the greater New Zealand archipelago (de Lange, Schmid, 2023). However, the specimen on which that record was based, *B. Polly s.n.*, WELT L006418! on examination is *Thelidium papulare* (Fr.) Arnold, thus rendering *Lithothelium australe* endemic, for now, to the Chatham Islands. In 2022, there were no further collections of *L. australe* on the islands until populations were found at three locations on Rēkohu / Wharekauri / Chatham Island (de Lange, Schmid, 2023).

**Ecology:** *Lithothelium australe* appears to be a strict calcicole with the four known collections made from limestone along the western shoreline and islands of Te Whanga, Rēkohu / Wharekauri / Chatham Island. At the three Rēkohu / Wharekauri / Chatham Island locations described by de Lange and Schmid (2023) *Lithothelium* was considered scarce on the shoreline of Te Whanga and initially also on Motuhinahina (de Lange, Schmid, 2023). At these locations it was noted growing on east-facing limestone outcrops, often in partially sheltered sites, within pits, crevices or flags. Though it still remains scarce on the shoreline of Te Whanga, *Lithothelium* is now known to be abundant on Motuhinahina, a 0.454 ha, 3 m a.s.l., karst island located 0.56 km offshore in Te Whanga. The species was initially described as scarce there (de Lange, Schmid, 2023) during observations made during a visit at the end of a protracted drought. A subsequent visit to the island during April (a wetter time of the year), targeting lichenized mycobiota, found *L. australe* widespread and abundant in a range of situations from deeply shaded to extremely exposed limestone (the species is easier to see on wet rather than dry rock). No one has as yet confirmed the species is still present at ‘Big Bush’ a privately owned forest that can be difficult to access. Why the species is so scarce on the adjacent shoreline

of Te Whanga is unclear (see Conservation Status below). On the shoreline of Te Whanga, *Lithothelium australe* associates with *Buellia albula* (Nyl.) Müll. Arg., *Caloplaca* spp., *Opegrapha rupestris* Pers. and *Physcia adscendens* H. Olivier. On Motuhinahina, common associates include the mosses *Tortella flavovirens* (Bruch) Broth., *Syntrichia antarctica* (Hampe) R.H. Zander, *Zygodon menziesii* (Schwägr.) Arn., and the lichens *Buellia albula*, *Caloplaca* c.f. *johnwhinrayi* S.Y. Kondr. & Kärnefelt, other *Caloplaca* spp., *Chrysothrix candelaris* (L.) J.R. Laundon, *Diploicia canescens* subsp. *australasica* Elix & Lumbsch, *Dufourea ligulata* (Körber) Frödén, Arup & Søchting, *Hydropunctaria maura* (Wahlenb.) C. Keller, Gueidan & Thüs and *Opegrapha rupestris*.

**Conservation Status:** *Lithothelium australe* was assessed as ‘Data Deficient’ by the New Zealand Indigenous Lichen Threat Assessment Panel (de Lange et al., 2018). Recently de Lange and Schmid (2022) reviewed the status of the species following its rediscovery on Rēkohu / Wharekauri / Chatham Island. Although they reported the species from three new locations (they were unable to visit the type locality on that island), they concluded that there was still insufficient data to change the threat status of this species. Subsequent opportunistic surveys of suitable habitat on that island have failed to locate further populations. More dedicated survey is needed to resolve this species’ conservation status.

**Etymology:** An explanation of the decision to furnish this *Lithothelium* with the species epithet ‘*australe*’ was not provided by Aptroot and Mayrhofer (1991). However, it is probably based on the ‘southerly’ location of the species, which was at that time the only *Lithothelium* known from Aotearoa / New Zealand.

## Keys

Although Galloway (2007) admitted *Lithothelium australe* into the Aotearoa / New Zealand lichenized mycobiota, he did not provide a key to the genus. Therefore, we provide one here for the genus and the species.

### Key to *Lithothelium* in Aotearoa / New Zealand (adapted from Aptroot, 2009)

1. Ascospores red-brown, with rounded lumina; asci with a rounded or sagittiform ocular chamber, 3-septate . . . . . *Lithothelium*



– Ascospores brown, with mostly angular lumina; asci without an ocular chamber, 3–7-septate . . .  
 . . . . . *Pyrenula*

### Key to Aotearoa / New Zealand *Lithothelium* species

1. Saxicolous on calcareous rocks, thallus when fresh grey to dark grey green-tinged, ascospores 20–26 × 6–8 µm . . . . . *Lithothelium australe*
  - Corticolous on *Cordyline australis*, thallus when fresh white to pale buff, ascospores 32–40 × 12–15 µm . . . . . *Lithothelium kiritea*

### Acknowledgements

We thank Edward Ashby (Te Kawerau ā Maki) for permission to collect specimens and for the suggestion of the species epithet. In Auckland Andrew Marshall wishes to thank Cameron Kilgour, Heloise Le Gros, Erica Marshall and Harriet Marshall for assistance with collecting specimens, Vicky Bethell for assistance with access to Wigmore Bay where one of the first specimens was collected, and Yumiko Baba and Ella Rawcliffe (Auckland Museum) for access to specimens. For help collecting specimens from North Westland, Peter de Lange wishes to

thank Gillian Crowcroft. Similarly, on Rēkohu, Peter de Lange wishes to thank John and Judy Kamo (access to Te Mataarae), Hamish Tuanui-Chisholm (access to Motuhinahina) for permission to access land and collect specimens, and for field assistance Luzie Schmid (then a student at the School of Environmental & Animal Sciences, Unitec Institute of Technology) and Tom Hitchon and Denise Fastier (both from the Department of Conservation). The authors also thank Marley Ford for sending specimens from Te Tai Tokerau / Northland, and Mike Lusk and Lara Shepherd for undertaking searches for *Lithothelium kiritea* in Te Matau a Maui / Hawkes Bay and southern portion of Te Ika a Maui / North Island.

### ETHICS DECLARATION

The authors declare no conflict of interest.

### ORCID

- A.J. Marshall:  <https://orcid.org/0000-0002-8603-9461>  
 A. Aptroot:  <https://orcid.org/0000-0001-7949-2594>  
 D.J. Blanchon:  <https://orcid.org/0000-0002-7931-5499>  
 C.J. James:  <https://orcid.org/0009-0008-0637-7139>  
 P.J. de Lange:  <https://orcid.org/0000-0001-6699-7083>

### REFERENCES

- Aptroot A. 2009. *Pyrenulaceae*. In: McCarthy P.M., Kuchlmayr B. (eds.), *Flora of Australia*, vol. 57 (*Lichens* 5). Canberra; Melbourne: Australian Biological Resources Study (ABRS) / CSIRO Publishing, pp. 449–480.
- Aptroot A. 2022. World key to the species of *Pyrenulaceae* and *Trypetheliaceae*. *Archive for Lichenology*, 29: 1–90. Available at: <https://d-nb.info/1253929890/34>
- Aptroot A., Mayrhofer H. 1991. *Lithothelium australe* spec. nova, a new lichen from New Zealand. *Mycotaxon*, 41: 219–222.
- Belcher R.O. 1983. New Australian species of ercchthitoid *Senecio* (*Asteraceae*). *Muelleria*, 5: 119–122.
- Beever R.E., Forster R.L.S., Rees-George J., Robertson G.I., Wood G.A., Winks C.J. 1996. Sudden decline of cabbage tree (*Cordyline australis*): Search for the cause. *New Zealand Journal of Ecology*, 20: 53–68. <https://newzealandecology.org/nzje/1989.pdf>
- Cameron E.K. 2013. A visit to the Whatipu Sands, West Auckland. *Auckland Botanical Society Journal*, 68(1): 43–47. Available at: [https://bts.nzpcn.org.nz/site/assets/files/24023/ak\\_bot\\_soc\\_journal\\_68\\_1\\_jun\\_2013\\_43-47.pdf](https://bts.nzpcn.org.nz/site/assets/files/24023/ak_bot_soc_journal_68_1_jun_2013_43-47.pdf)
- de Lange P.J., Molloy B.P.J. 1996. Vagrancy within New Zealand threatened orchids: what are our conservation priorities? *New Zealand Botanical Society Newsletter*, 40: 13–14. Available at: <https://www.nzbotanicalsociety.org.nz/newsletter/NZBot-Soc-1995-40.pdf>
- de Lange P.J., Norton D.A. 1998. Revisiting rarity: a botanical perspective on the meanings of rarity and the classification of New Zealand's uncommon plants. *Royal Society of New Zealand Miscellaneous Series*, 48: 145–160.
- de Lange P.J., Schmid L.M.H. 2023. *Lithothelium australe* Aptroot & H. Mayrhofer (*Pyrenulaceae*) rediscovered on the Chatham Islands. *Trilepidea*, 227: 6–9. Available at: [https://www.nzpcn.org.nz/site/assets/files/0/72/902/trilepidea\\_march\\_2023\\_final.pdf](https://www.nzpcn.org.nz/site/assets/files/0/72/902/trilepidea_march_2023_final.pdf)
- de Lange P.J., Marshall A.J., Blanchon D.J. 2023. Can you help our research on a new species of lichen? *Trilepidea*, 234: 12. Available at: [https://www.nzpcn.org.nz/site/assets/files/0/75/143/trilepidea\\_october\\_2023\\_final.pdf](https://www.nzpcn.org.nz/site/assets/files/0/75/143/trilepidea_october_2023_final.pdf)
- de Lange P.J., Blanchon D., Knight A., Elix J., Lücking R., Frogley K., Harris A., Cooper J., Rolfe J. 2018. Conservation status of New Zealand indigenous lichens and lichenicolous fungi, 2018. *New Zealand Threat Classification Series*, 27. Wellington: Department of Conservation, 64 pp. Available at: <https://www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs27entire.pdf>

- Drury D.G. 1974. Illustrated and annotated key to the erectitoid Senecios in New Zealand (*Senecioneae* – *Compositae*) with a description of *Senecio diaschides*. *New Zealand Journal of Botany*, 12: 513–540. <https://doi.org/10.1080/0028825X.1974.10428637>
- Esler A.E. 1974. Vegetation of the sand country bordering the Waitakere Range, Auckland: the southern beaches. *Proceedings of the New Zealand Ecological Society*, 21: 72–77. Available at: [https://bts.nzpcn.org.nz/site/assets/files/24023/ak\\_bot\\_soc\\_journal\\_68\\_1\\_jun\\_2013\\_43-47.pdf](https://bts.nzpcn.org.nz/site/assets/files/24023/ak_bot_soc_journal_68_1_jun_2013_43-47.pdf)
- Galloway D.J. 2007. *Flora of New Zealand Lichens*, 2<sup>nd</sup> ed. Lincoln: Manaaki Whenua Press, 2397 pp.
- McCarthy P.M. 1996. *Lithothelium austropacificum* sp. nov. (*Pyrenulaceae*) from Lord Howe Island, Australia. *Lichenologist*, 28: 290–294.
- McCarthy P.M. 2001. The genus *Lithothelium* (*Pyrenulaceae*) in Christmas Island, Indian Ocean. *Australasian Lichenology*, 49: 7–9.
- McCarthy P.M. 2015. A new species of *Lithothelium* (lichenized *Ascomycota*, *Pyrenulaceae*) from the Tarkine region, north-western Tasmania. *Telopea*, 18: 167–170.
- McKenzie E.H.C. 1998. Rust fungi of New Zealand — An introduction, and list of recorded species. *New Zealand Journal of Botany*, 36: 233–271. <https://doi.org/10.1080/0028825X.1998.9512564>
- Orange A., James P.W., White F.J. 2010. *Microchemical methods for the identification of lichens*. London: British Lichen Society, 101 pp.
- Rolfe J.R., Makan T., Tait A. 2019. Supplement to the New Zealand Threat Classification System manual — new qualifiers and amendments to qualifier definitions. Available at: <https://nztns.org.nz> (Accessed 12 March 2023).
- Townsend A., de Lange P.J., Duffy C., Miskelly C., Molloy B.P.J., Norton D.A. 2008. *New Zealand Threat Classification System manual*. Wellington, 30 pp. Available from: <https://www.doc.govt.nz/Documents/science-and-technical/sap244.pdf>
- Thompson I.R. 2006. A taxonomic treatment of tribe *Senecioneae* (*Asteraceae*) in Australia. *Muelleria*, 24: 51–110.
- Webb C.J. 1989. *Senecio esleri* (*Asteraceae*), a new fireweed. *New Zealand Journal of Botany*, 27: 565–567.

#### Рід *Lithothelium* (*Pyrenulaceae*) у Новій Зеландії:

#### опис нового виду *Lithothelium kiritea* sp. nov. і нотатки щодо *L. australe*

А.Дж. МАРШАЛЛ<sup>1</sup>, А. АПТРУТ<sup>2</sup>,

Д.Дж. БЛАНЧОН<sup>3</sup>, К.Дж. ДЖЕЙМС<sup>1</sup>, П.Дж. де ЛАНГЕ<sup>1</sup>

<sup>1</sup> Технічний університет УніТек, Окленд, Нова Зеландія

<sup>2</sup> Інститут біологічних наук, Кампу-Гранді, Бразилія

<sup>3</sup> Оклендський військово-історичний музей, Окленд, Нова Зеландія

**Реферат.** Описано новий вид *Lithothelium kiritea* A.J. Marshall, Aptroot, de Lange & Blanchon sp. nov. (*Pyrenulaceae*) з Аотеароа / Нової Зеландії. Він поширений виключно у прибережній зоні переважно західної частини Нової Зеландії і наразі відомий лише на корі живих дерев *Cordyline australis* (*Asparagaceae*). Новоописаний вид виділено з *Lithothelium australe* (який розглядається тут як ендемічний вид архіпелагу Чатем), оскільки він є епіфітом на корі дерев, а не епілітом, має талом білого до світло-жовтуватого кольору і великі за розміром спори (32–40 × 12–15 мкм). *Lithothelium kiritea* є легко впізнаваним видом, який зазвичай трапляється у великій кількості, проте, ймовірно, його перший зразок було зібрано лише у 1973 році і цей збір лишався єдиним аж до 2018 року. Можливі знахідки *L. kiritea* для Австралії дотепер не наводилися, але ми рекомендуємо провести там пошук цього виду. Згідно з класифікацією загроз, прийнятою у Новій Зеландії, пропонуємо оцінити цей вид як такий, для існування якого немає загроз.

**Ключові слова:** *Lithothelium*, *Lithothelium kiritea* sp. nov., ліхенізована мікобіота, Нова Зеландія, таксономія лишайників