

# Ecological communities of Aotearoa / New Zealand species threatened by myrtle rust (*Austropuccinia psidii* (G. Winter) Beenken): The flora and mycobiota of the endemic genus *Lophomyrtus* Burret

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# Ecological communities of Aotearoa / New Zealand species threatened by myrtle rust (*Austropuccinia psidii* (G. Winter) Beenken): The flora and mycobiota of the endemic genus *Lophomyrtus* Burret

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## Abstract

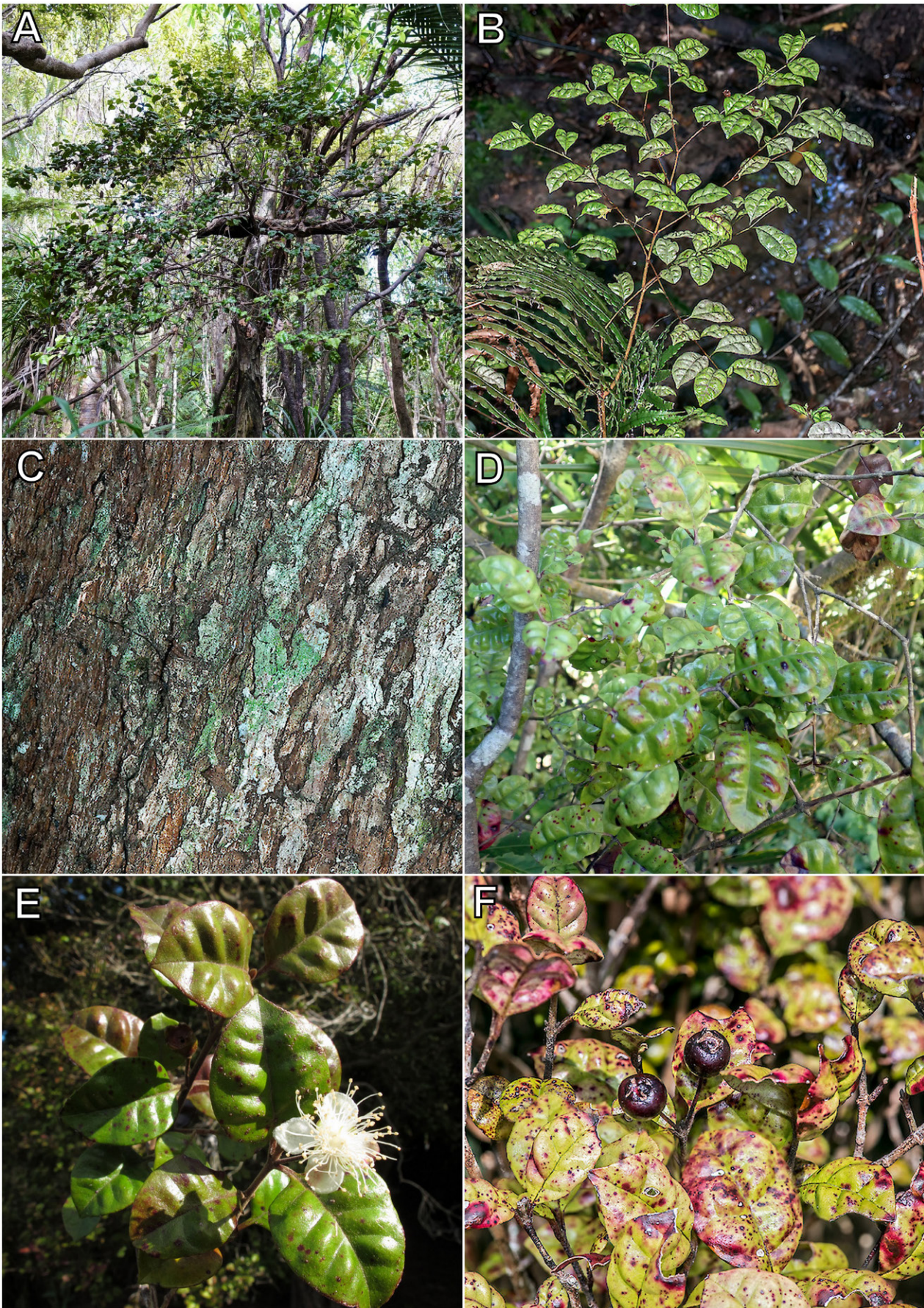
The invasive rust *Austropuccinia psidii*, responsible for myrtle rust disease, poses a serious threat to the New Zealand Myrtaceae. Since the 2017 detection of *Austropuccinia psidii* in Aotearoa / New Zealand, the rust has spread rapidly, resulting in the decline and death of a range of indigenous Myrtaceae, most notably the two species of the endemic genus *Lophomyrtus*, ramarama (*L. bullata*) and rōhutu (*L. obcordata*). While the threat *Austropuccinia psidii* poses to *Lophomyrtus* is now widely recognised, the indirect impact the rust has on the associated biota is poorly understood. Very little has been documented about the biota found in association with *Lophomyrtus*. To rectify this, we undertook a survey of the specimens held in three of the key Aotearoa / New Zealand herbaria that had been collected from *Lophomyrtus*. This was supplemented by field work in eight sites in western Te Ika a Maui / North Island, and north-western Te Wai Pounamu / South Island of Aotearoa / New Zealand. Although the herbarium searches located few specimens, and field work was limited to a few sample points within the range of *Lophomyrtus*, we found 221 taxa associated with *Lophomyrtus*, 176 taxa on ramarama, 81 on rōhutu and one on the naturally occurring hybrid between these two species *Lophomyrtus* × *ralphii*. Of the 176 taxa found on ramarama, 59 are bryophytes (one hornwort, 33 liverworts and 25 mosses), five pteridophytes, 16 spermatophytes and 96 are lichenised mycobiota. Rōhutu supported 81 taxa: comprising one cyanobacterium, one alga, twenty-nine bryophytes (17 liverworts and 12 mosses), four pteridophytes, two spermatophytes and 44 lichenised mycobiota. Wild populations of *Lophomyrtus* × *ralphii*

were not investigated, and herbarium searches only disclosed one plant, the mistletoe *Korthalsella lindsayi*, associated with it. Several lichens and liverworts collected from *Lophomyrtus* represent potentially new species, and *Lepra erythrella* is a new addition to the lichenised mycobiota of Aotearoa / New Zealand. None of the putative new species are endemic to *Lophomyrtus*.

## Introduction

Aotearoa / New Zealand has 29 indigenous Myrtaceae in five genera (de Lange & Schmid 2021; de Lange & Rolfe 2010; de Lange 2014; Schönberger et al. 2021); all are endemic, with the possible exception of *Leptospermum scoparium* J.R.Forst. et G.Forst., which, as currently circumscribed (Thompson 1989; Sykes 2016), extends to Australia and Rarotonga (Cook Islands), though de Lange & Schmid (2021), on the basis of genetic analyses published by Buys et al. (2019), treated it as endemic to Aotearoa / New Zealand. Of the five indigenous genera, two, *Lophomyrtus* Burret and *Neomyrtus* Burret in tribe Myrteae, are endemic to Aotearoa / New Zealand (de Lange & Rolfe 2010).

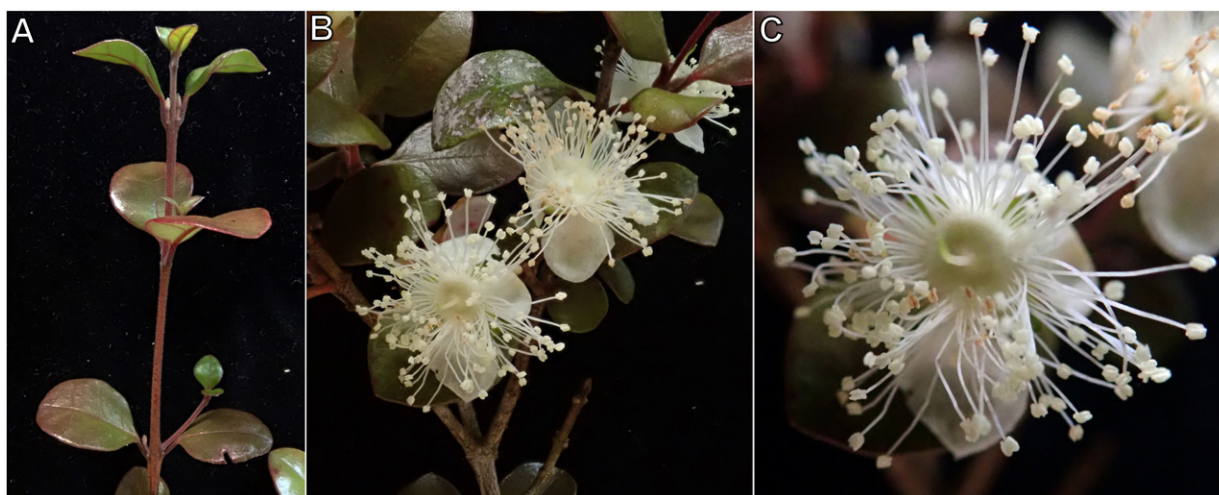
*Lophomyrtus* is a genus of two species, ramarama (*Lophomyrtus bullata* Burret) (Figure 1) and rōhutu (*Lophomyrtus obcordata* (Raoul) Burret) (Figure 2). These two species were originally described as either species of *Myrtus* L. or *Eugenia* L., *L. bullata* as *Myrtus bullata* Sol. ex A.Cunn. nom. illeg. (Cunningham 1839), and *L. obcordata* as *Eugenia obcordata* Raoul (Raoul 1844). *Eugenia obcordata* was transferred to *Myrtus* nine years after Raoul placed it in *Eugenia* as *M. obcordata* (Raoul) Hook.f. by Hooker (1853). Both species were then transferred by Burret (1941) to his new genus *Lophomyrtus*, where they have remained, as one of the few endemic genera left in the Aotearoa / New Zealand flowering plant flora (Govaerts et al. 2010; Garnock-Jones 2014; Schönberger et al. 2021). A third species, *Lophomyrtus ralphii* (Hook.f.) Burret, described by Hooker (1855) as *Myrtus ralphii* Hook.f., following the conclusions of Leonard Cockayne (Cockayne 1918)



**Figure 1.** *Ramarama* (*Lophomyrtus bullata*). **(A)** Growth habit, Waitākere Ranges. Photo: J. Knight. **(B)** Sapling, Stokes Valley. Photo: J.R. Rolfe. **(C)** Bark, Boulder Hill, Lower Hutt. Photo: J.R. Rolfe. **(D)** Branchlet and foliage, Awaroa Scenic Reserve, South Kawhia. Photo: P.J. de Lange. **(E)** Flowers, ex cultivated Dunedin Botanic Garden. Photo: J.W. Barkla. **(F)** Fruits, Western Hutt Hills. Photo: J.R. Rolfe.



**Figure 2.** Rōhutu (*Lophomyrtus obcordata*). **(A)** Growth habit, Southland. Photo: J. Bythell. **(B)** Bark, Upper Hutt. Photo: J.R. Rolfe. **(C)** Branchlets and fruits, Broad Bay, Otago Peninsula. Photo: C. Knox. **(D)** Flowers, Aorere Delta. Photo: S. Walls. **(E)** Flowers, Stevenson's Island, Lake Wanaka. Photo: J.W. Barkla. **(F)** Fruits, Taita. Photo: J.R. Rolfe.



**Figure 3.** *Lophomyrtus xralphii*, a widespread, polymorphic hybrid plant found wherever the ranges of ramarama and rōhutu overlap. Selections of it with darkly pigmented leaves are popular in cultivation. (A) Branchlet. (B) Flowering branchlet. (C) Flowers, ex cultivated Unitec Institute of Technology, Mt Albert, Tāmaki Makaurau / Auckland. Photos: P.J. de Lange.

is now treated as the nothotaxon *Lophomyrtus xralphii* (Figure 3).

Ramarama occurs throughout Te Ika a Maui / North Island, where it is found in coastal, lowland to lower montane indigenous forest and associated shrubland (de Lange 2022a). In Te Wai Pounamu / South Island it is confined to the northern portion of that island to as far south as Greymouth in the west and north Canterbury in the east (de Lange 2022a). Rōhutu is more wide-ranging, occurring through both Te Ika a Maui / North Island and Te Wai Pounamu / South Island, though it is often regionally scarce particularly in the northern portion of Te Ika a Maui / North Island (de Lange 2022b).

The rust, *Austropuccinia psidii* (G. Winter) Beenken, which causes myrtle rust disease, was first reported from Aotearoa / New Zealand in May 2017. Following its detection, it has spread rapidly throughout Te Ika a Maui / North Island and the northern portion of Te Wai Pounamu / South Island (Galbraith & Large 2017; Beresford et al. 2018) reaching Rēkohu / Chatham Islands in April 2022 (see <https://inaturalist.nz/observations/109933128>). Although the full impact of myrtle rust on Aotearoa / New Zealand Myrtaceae is still unknown, based on the Australian experience it may be a decade or more before the full impact of this novel pathogen becomes evident (Carnegie et al. 2015; Carnegie & Pegg 2018; Fensham et al. 2020).

Since its 2017 detection in Aotearoa / New Zealand *Austropuccinia* Beenken has been frequently recorded infecting ramarama, rōhutu, white rata (*Metrosideros diffusa* Sol. ex Gaertn), pōhutukawa (*Metrosideros excelsa* Sol. ex Gaertn.) and maire tawake (*Syzygium maire* (A.Cunn.) Sykes et Garn.-Jones (Toome-Heller et al. 2020; Schmid et al. 2021). Of these species,

*Austropuccinia* will cause the death of maire tawake, ramarama and rōhutu both in cultivation and in natural habitats (Beyond Myrtle Rust 2020; authors' pers. obs.), and in some parts of the northern range of these hosts it is now uncommon to find specimens not infected by this rust. These observations support the current threat assessment of 'Threatened / Nationally Critical', which had been given as a precautionary measure to these three species by de Lange et al. (2018a) on the advice of Australian experts researching the impact of *Austropuccinia* on their indigenous Myrtaceae.

The arrival of myrtle rust has prompted the urgent need to better understand the ecological communities of our indigenous Myrtaceae (Blanchon et al. 2020; Jo et al. 2022). At present, information on the associates of Aotearoa / New Zealand Myrtaceae is limited, and skewed toward vascular plants (Blanchon et al. 2020). For example, Bylsma et al. (2014), noted 16 fern and flowering plant taxa epiphytic on pōhutukawa. McKenzie et al. (1999) also published an annotated list of non-lichenised fungi known from *Metrosideros* Banks et Gaertn, and an account of the non-lichenised fungi of *Kunzea* Richb. and *Leptospermum* J.R.Forst. et G.Forst. (McKenzie et al. 2006).

To help rectify that apparent knowledge gap, we provide here a preliminary contribution to that need by listing the flora and mycobiota that utilise *Lophomyrtus* as a phorophyte. This contribution is not intended to be comprehensive, as we have only examined herbarium holdings in four Aotearoa / New Zealand herbaria, AK, CHR, UNITEC and WELT (Thiers 2020–onwards) and examined eight locations supporting *Lophomyrtus* (see below); nevertheless, this paper constitutes the first freely available compendium of the associates of

*Lophomyrtus* formally published for this genus. It is to be hoped that this contribution stimulates further investigation into the flora and mycobiota that utilise *Lophomyrtus*.

## Methods

### Herbarium searches

Records mentioning either *Lophomyrtus bullata*, *L. obcordata* or the hybrid *L. ×ralphii* (Hook.f.) Burret as the phorophyte / 'host' were collated in a spreadsheet from the herbarium databases of the herbaria AK, CHR, UNITEC and WELT. The records were arranged by their taxonomic groups and their threat status according to the New Zealand Threat Classification System (Townsend et al. 2008) noted.

### Study sites

In addition to herbarium specimens, we undertook field work at eight locations in Te Ika a Maui North Island and Te Wai Pounamu / South Island (Figure 4). Field collection was mostly opportunistic, in part being hindered by access to locations due to concerns over the spread of *Austropuccinia*. However, in a few Waikato locations, Department of Conservation assistance from Dr C. Beard enabled more comprehensive sampling. The sample sites are as follows:

#### ***Lophomyrtus bullata* sites sampled (Figure 4)**

*Te Ika a Maui / North Island, South Auckland, Waikato, South Kawhia, Awaroa Scenic Reserve*

Vegetation Association: Riparian, lowland kahikatea (*Dacrycarpus dacrydioides* (A.Rich.) de Laub.) Forest. Understorey dominated by *Lophomyrtus bullata*.

Latitude: -38.147495°S, Longitude: 174.938993°E.

*Te Ika a Maui / North Island, South Auckland, Waikato, Te Anga, Mangapohue Natural Bridge Scenic Reserve*

Vegetation Association: Riparian vegetation developed along margins of limestone canyon. *Lophomyrtus bullata* uncommon component of understorey vegetation.

Latitude: -38.259607°S, Longitude: 174.900449°E.

*Te Ika a Maui / North Island, Taranaki, North Taranaki, Waitaanga*

Vegetation Association: Silver beech (*Lophozonia menziesii* (Hook.f.) Heenan et Smissen) forest. *Lophomyrtus bullata* occasional component of forest understorey.

Latitude: -38.841526°S, Longitude: 174.822548°E.

#### ***Lophomyrtus obcordata* sites sampled (Figure 4)**

*Te Ika a Maui / North Island, South Auckland, Āwhitu Peninsula, Lighthouse Bush*

Vegetation Association: *Lophomyrtus obcordata* / *Leptospermum* aff. *scoparium* (a) shrubland.

Latitude: -37.052617°S, Longitude: 174.545833°E.

*Te Ika a Maui / North Island, South Auckland, Āwhitu Peninsula, Signal Station Bush*

Vegetation Association: Mixed coastal forest of tawa (*Beilschmiedia tawa* (A.Cunn.) Benth. et Hook. ex Kirk) with porokaiwhiri (*Hedycarya arborea* J.R.Forst. et G.Forst.), and rewarewa (*Knightia excelsa* R.Br.). *Lophomyrtus obcordata* occasional as small trees and shrubs within understorey.

Latitude: -37.051440°S, Longitude: 174.552683°E.

*Te Wai Pounamu / South Island Nelson, Motueka, Riuwaka Valley Road*

Vegetation Association: Matai (*Prumnopitys taxifolia* (Sol. ex D.Don) de Laub.) / kahikatea (*Dacrycarpus dacrydioides*) forest. *Lophomyrtus obcordata* common understorey tree.

Latitude: -41.047754°S, Longitude: 172.924232°E.

*Te Wai Pounamu / South Island, Nelson, Brooklyn, Brooklyn Reserve*

Vegetation Association: Totara (*Podocarpus totara* D.Don var. *totara*) forest remnant. *Lophomyrtus obcordata* occasional understorey tree.

Latitude: -41.0548°S, Longitude: 172.5732°E.

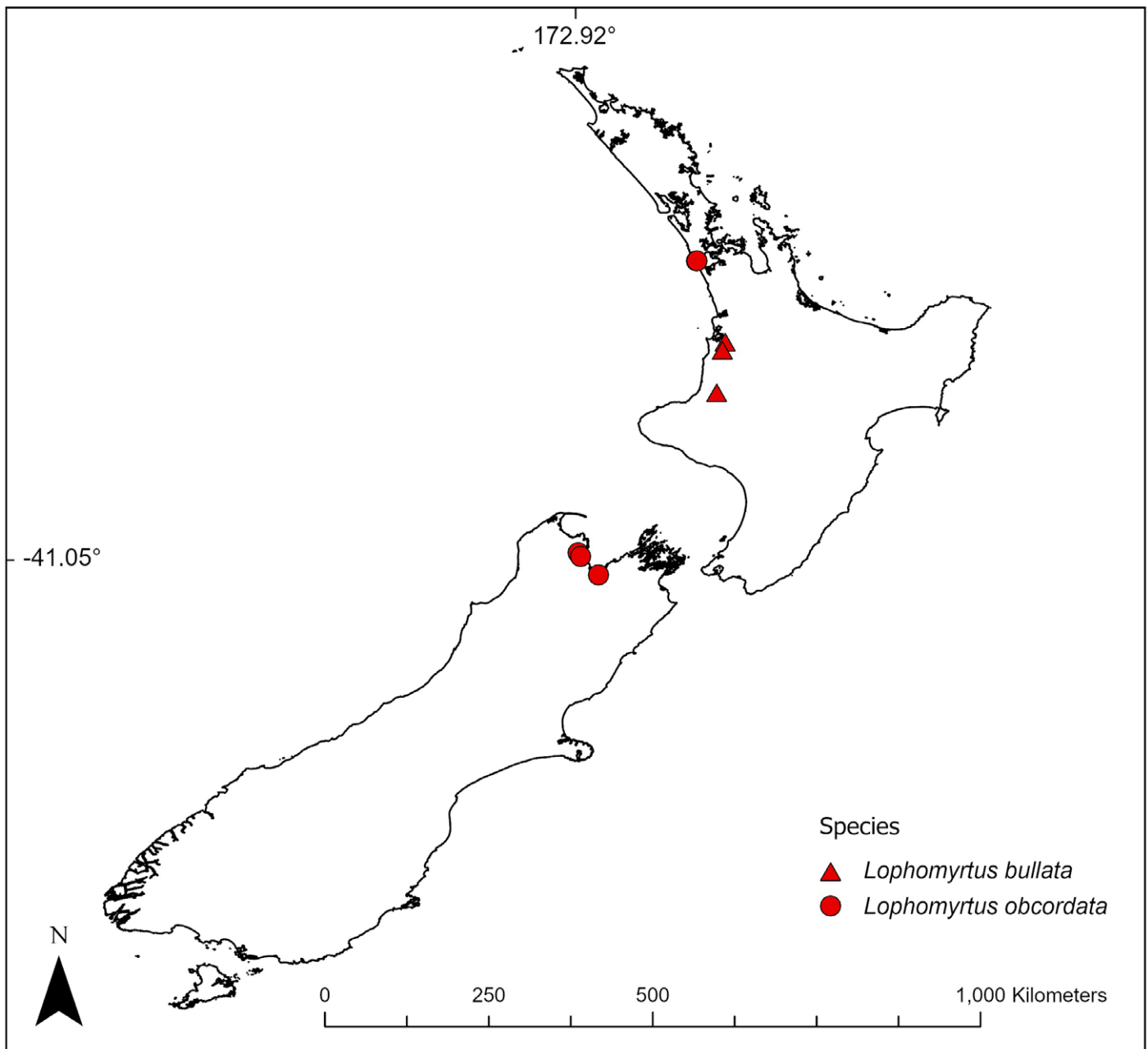
*Te Wai Pounamu / South Island, Nelson, Barnicoat Range, Richmond, Easby Reserve*

Vegetation Association: Scattered *Lophomyrtus obcordata* in reverting manouea (*Kunzea ericoides* (A.Rich.) Joy. Thomps.) forest.

Latitude: -41.2010°S, Longitude: 173.1510°E.

## Results and discussion

Collectively we found 221 taxa associated with *Lophomyrtus*, 176 taxa on ramarama, 81 on rōhutu and one on *Lophomyrtus ×ralphii* (authorities for these taxa are given in Appendix 1). Thirty-six taxa were common to the two *Lophomyrtus* species. Our figures, with the exception of lichenised mycobiota, excluded mycobiota as we lacked the expertise to undertake family or lower-rank determinations. However, when possible, specimens were sent to PDD where it is to be hoped they will be identified in due course. The following summarises the associates by broad taxonomic group.



**Figure 4.** Locations from where *Lophomyrtus* species were sampled. Triangles – ramarama (*Lophomyrtus bullata*), circles – rōhutu (*Lophomyrtus obcordata*).

### **Lophomyrtus**

Both species of *Lophomyrtus* and their hybrid form shrubs to small trees 6 (–7) m tall (de Lange 2022a, 2022b). Branching is well developed in specimens growing in exposed sites but those within shaded locations such as growing under a dense forest canopy are often sparingly branched. The bark of *Lophomyrtus* decorticates in larger flakes, that of rōhutu especially shedding, such that the trunks are often bare of epiphytic growth. However, ramarama, which attains a greater stature and breadth than rōhutu usually does, may have portions of decorticated trunk – often in sites where a former branch had been, leaving holes or crevices – and it is in these sites that fungi, bryophytes and other

plants often establish.

The micro-niches of *Lophomyrtus* are notably less than those documented for pōhutukawa (Blanchon et al. 2020). However, the branch and branchlet forks of *Lophomyrtus* and the bullate leaves of ramarama provide a range of habitats suitable for colonisation, while the greater altitudinal range and habitat tolerances of the genus are less limiting than the strict coastal / lakeside often seral habitat favoured by pōhutukawa. A direct comparison is not possible for any taxonomic groups other than the lichenised mycobiota, however, as Blanchon et al. (2020) only reported on this group, finding 187 taxa utilising pōhutukawa, whereas this study found 95 lichenised mycobionts on ramarama and

44 on rōhutu. The greater number of lichens reported from pōhutukawa is not surprising, especially as this phorophyte, as a much larger tree, offers a greater range of microniches (see Blanchon et al. 2020). It is also likely that the iconic status of pōhutukawa has ensured that it is better studied and collected than *Lophomyrtus* (Bylsma et al. 2014; Simpson 2005).

### Ramarama (*Lophomyrtus bullata*)

Ramarama had the greatest diversity of associates, most of which are corticolous taxa. Whilst the bark of ramarama sheds readily, the branches and branchlets, notably the forks, provide a suitable habitat for colonisation. Also, the trunk base, especially in older specimens where fallen bark has accumulated, provides a secure site for the establishment of a range of plants and lichens



**Figure 5.** Bryophyte and Lichen growth on the lower trunk and branches of ramarama (*Lophomyrtus bullata*), Awaroa Scenic Reserve, South Kawhia. The dominant species visible in this image are the mosses *Leptostomum macrocarpon*, *Macromitrium longipes* and *Papillaria flavolimbata*; liverworts *Lepidolaena taylorii*, *Porella elegantula*; and the lichens *Cladonia darwinii*, *Dictyonema*, *Pannaria araneosa*, and *Pannaria delicata*. Photo: P.J. de Lange.

which over time will grow up the trunk (Figure 5). The coriaceous bullate and presumably long-lived leaves of ramarama (Figure 1D–F) also provide a suitable habitat for foliicolous liverworts, notably *Cololejeunea laevigata* and *Siphonolejeunea nudipes* var. *nudipes*, to colonise.

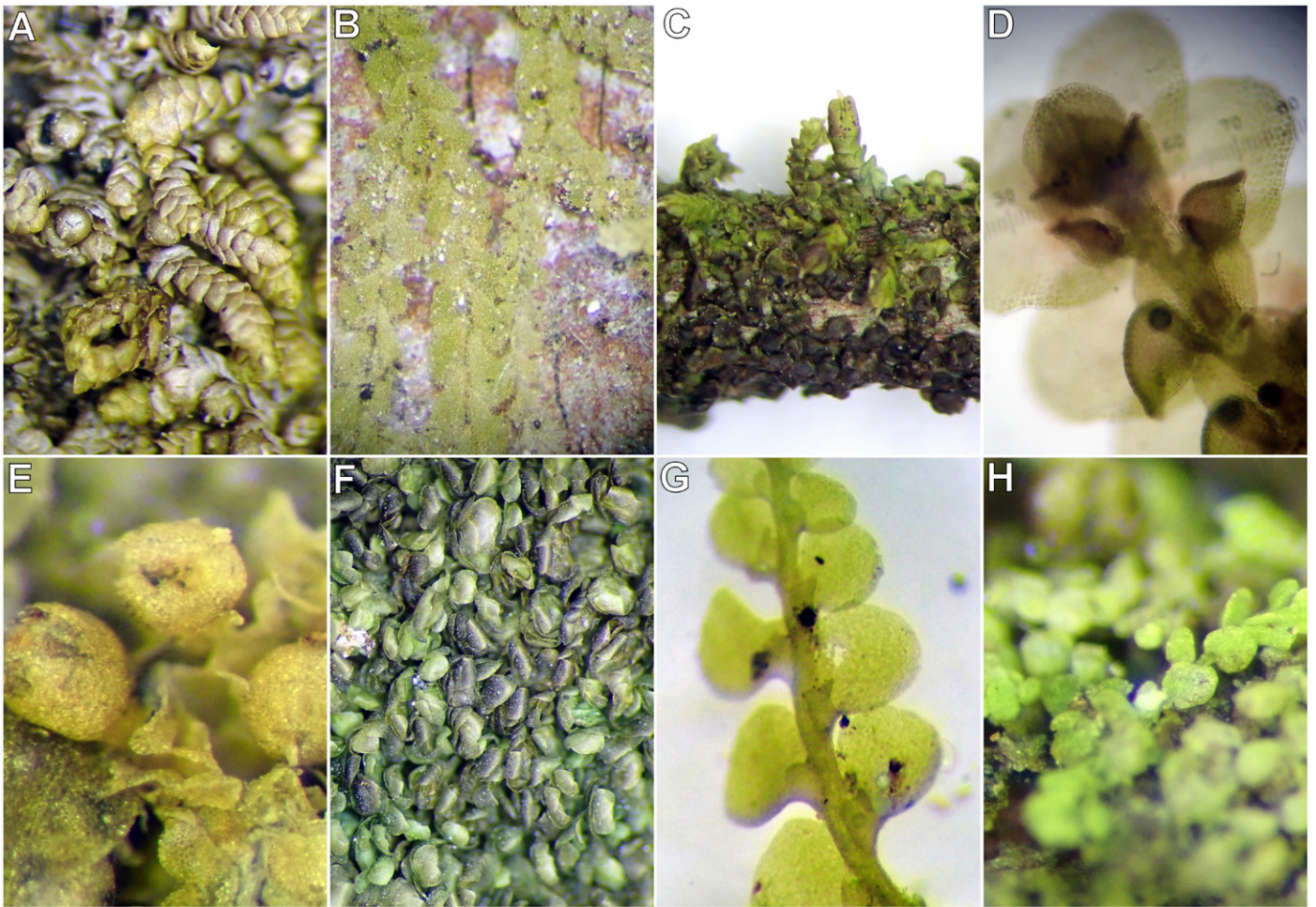
Our study found 176 taxa on ramarama. These taxa are broken down by taxonomic group as follows: 59 bryophytes (one hornwort, 33 liverworts and 25 mosses), five pteridophytes, 16 spermatophytes and 96 lichenised mycobiota.

Of the liverworts (see Figure 6 for examples), the Lejeuneaceae Rostovzev were the dominant family found on ramarama, with 12 species from seven genera noted. None of those found are listed as threatened (de Lange et al. 2020) though one, *Lopholejeunea* (a), treated as an unnamed species by de Lange et al. (2020), requires formal taxonomic assessment. Five species of *Radula* Dumort. (Radulaceae) were also recorded from ramarama; of these, one, *Radula marginata*, is listed as 'At Risk / Declining' due to indiscriminate harvesting of plants for their hallucinogenic properties (Toyota et al. 2003; de Lange et al. 2020).

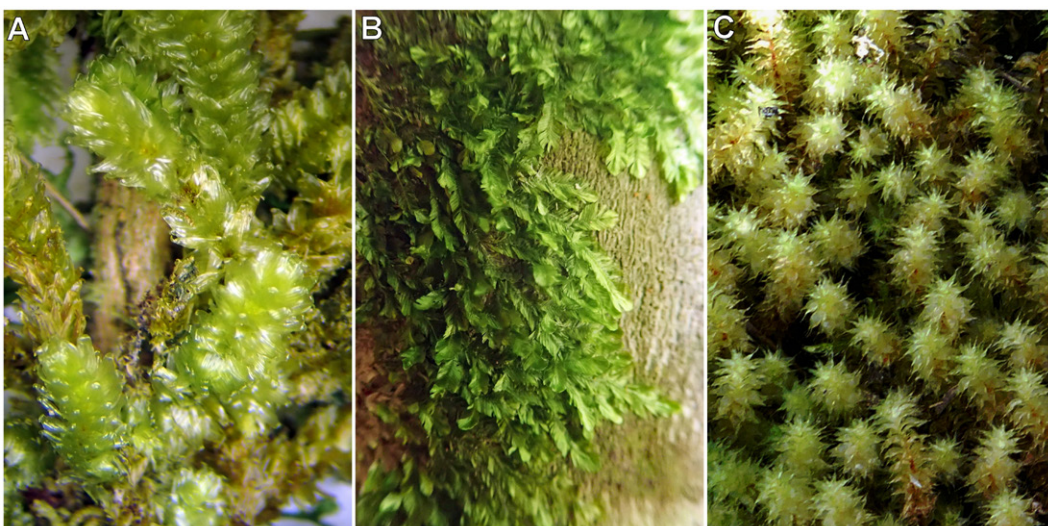
Of the 25 mosses recorded from ramarama (see Figure 7 for examples), mosses from the Orthotrichaceae Arn. (3 genera, 3 species) and Ptychomniaceae M.Fleisch. (3 genera, 3 species) were the most commonly noted. None of these are listed as threatened by Rolfe et al. (2016). In some situations, notably in the upper branches and branchlets of ramarama, copious growths of *Papillaria crocea* and *P. flavolimbata* may be found, while the branch forks are a favoured habitat for *Cryphaea dilatatus* and *C. tenella*, pin cushion moss (*Leptostomum macrocarpon*) and species of *Macromitrium* Brid. Otherwise, the trunk base and damaged portions of trunk were often colonised by *Cladomnion* Hook. f. et Wilson (Figure 7A), *Ptychomnion aciculare* (Figure 7C) and *Rosulabryum* J.R. Spence. Despite the tendency of ramarama bark to shed, growths of the *Orthorrhynchium elegans* (Figure 7B) were often found in this habitat; presumably this moss can rapidly recolonise portions of trunk from which it has been shed.

Of the six pteridophytes recorded from ramarama, the most commonly encountered family was the Polypodiaceae J.Presl et C.Presl with *Pyrrosia elaeagnifolia* found in three ramarama field sites investigated, and *Zealandia pustulata* subsp. *pustulata* at two. In both species, growth had commenced on the forest floor, with the ferns managing to retain partial purchase on the flaking trunk bark, so reaching the branches and branchlets where a firmer attachment

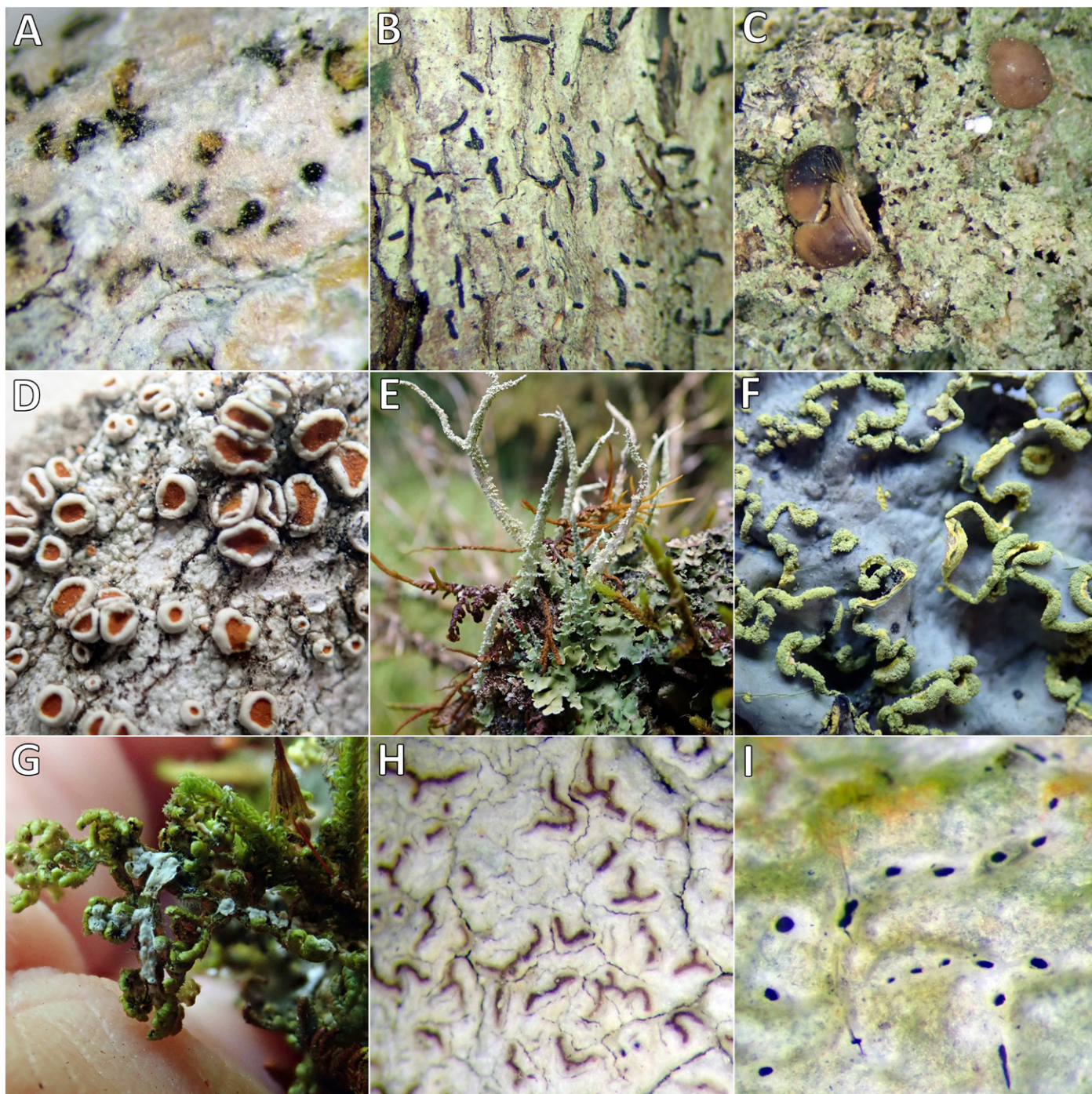




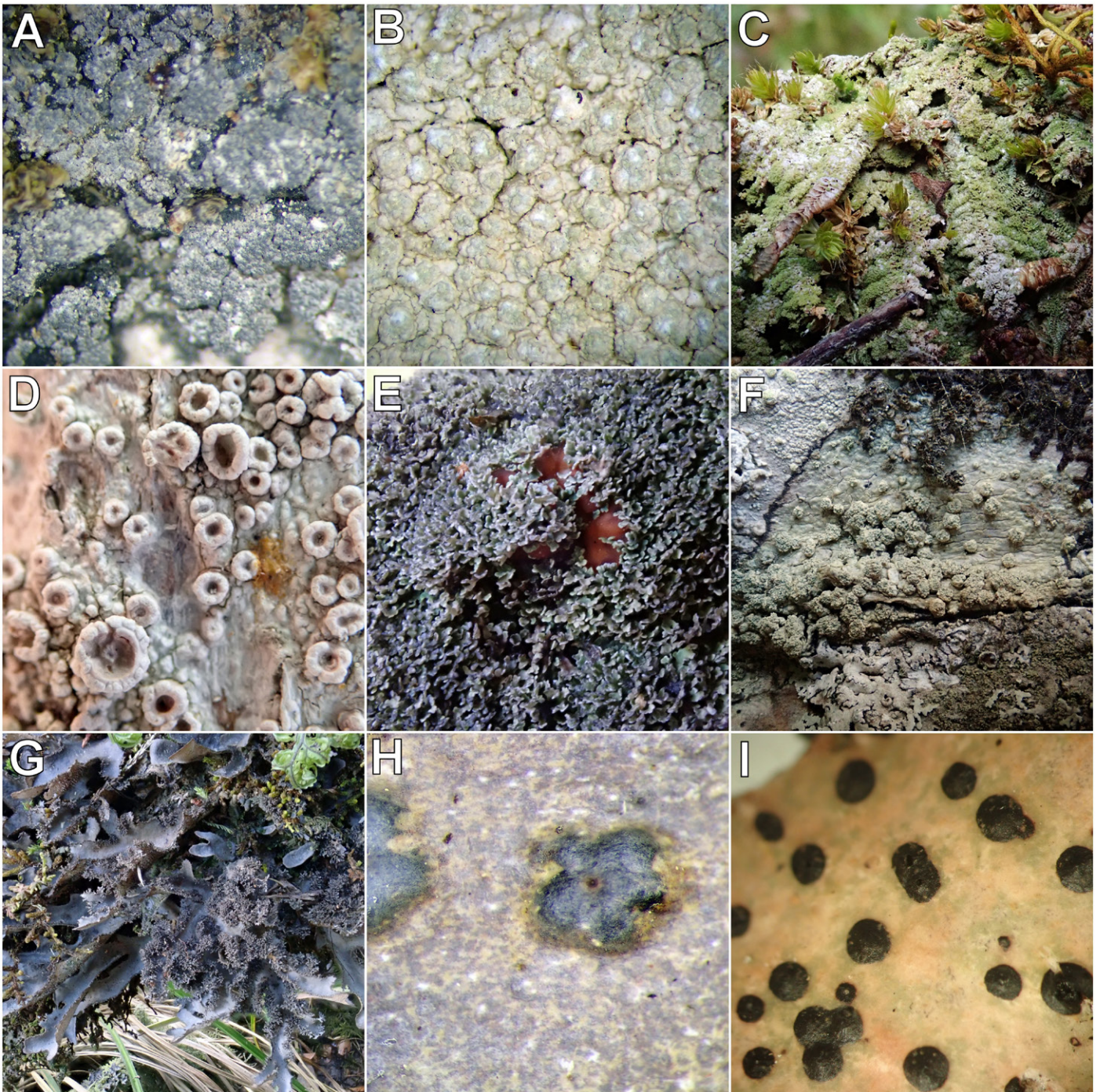
**Figure 6.** Liverworts associated with ramarama (*Lophomyrtus bullata*). (A) *Cheilolejeunea comittans*, Awaroa Scenic Reserve, South Kawhia. (B) *Chiloscypus muricatus*, Awaroa Scenic Reserve, South Kawhia. (C) *Frullania incumbens*, Awaroa Scenic Reserve, South Kawhia. (D) *Frullania pycnantha*, Awaroa Scenic Reserve, South Kawhia. (E) *Lejeunea oracola*, Awaroa Scenic Reserve, South Kawhia. (F) *Lopholejeunea*, Awaroa Scenic Reserve, South Kawhia. (G) *Radula strangulata*, Awaroa Scenic Reserve, South Kawhia. (H) *Siphonolejeunea nudipes* var. *nudipes*, Awaroa Scenic Reserve, South Kawhia. Photos: P.J. de Lange.



**Figure 7.** Mosses associated with ramarama (*Lophomyrtus bullata*). (A) *Cladomnion ericoides*, Mangapohue Natural Bridge Scenic Reserve, Te Anga. (B) *Orthorrhynchium elegans*, Awaroa Scenic Reserve, South Kawhia. (C) *Ptychomnion aciculare*, Awaroa Scenic Reserve, South Kawhia. Photos: P.J. de Lange.



**Figure 8.** Lichenised mycobiota associated with ramarama (*Lophomyrtus bullata*). **(A)** *Arthonia indistincta*, Awaroa Scenic Reserve, South Kawhia. **(B)** *Arthonia epiodes*, Awaroa Scenic Reserve, South Kawhia. **(C)** *Bapulmia buchananii*, Awaroa Scenic Reserve, South Kawhia. **(D)** *Brigantiaea chrysosticta*, Awaroa Scenic Reserve, South Kawhia. **(E)** *Cladonia darwinii*, Awaroa Scenic Reserve, South Kawhia. **(F)** *Crocodia aurata*, Awaroa Scenic Reserve, South Kawhia. **(G)** *Dictyonema*, Awaroa Scenic Reserve, South Kawhia. **(H)** *Enterographa pallidella*, Awaroa Scenic Reserve, South Kawhia. **(I)** *Fissurina*, Mangapohue Natural Bridge Scenic Reserve, Te Angra. Photos: P.J. de Lange.



**Figure 9.** Lichenised mycobiota associated with ramarama (*Lophomyrtus bullata*). **(A)** *Fuscopannaria granulans*, Awaroa Scenic Reserve, South Kawhia. **(B)** *Lepra erythrella*, Awaroa Scenic Reserve, South Kawhia. **(C)** *Megalania* aff. *orokonuiana*, Awaroa Scenic Reserve, South Kawhia. **(D)** *Orcholechia pallescens*, Awaroa Scenic Reserve, South Kawhia. **(E)** *Pannaria delicata*, Awaroa Scenic Reserve, South Kawhia. **(F)** *Pertusaria puffina*, Awaroa Scenic Reserve, South Kawhia. **(G)** *Pseudocyphellaria dissimilis*, Awaroa Scenic Reserve, South Kawhia. **(H)** *Pyrenula leucostoma*, Awaroa Scenic Reserve, South Kawhia. **(I)** *Pyrenula nitidula*, Mangapohue Natural Bridge Scenic Reserve, Te Angra. Photos: **A–H**, P.J. de Lange; **I**, A.J. Marshall.

could be made. This was also the way *Icarus filiformis*, another climbing fern, appears to have succeeded in establishing on ramarama. The other pteridophytes noted, *Asplenium flaccidum* and *Hymenophyllum sanguinolentum*, were noted growing at the trunk base, within decorticated rotted portions of trunk or, more commonly, within the branch forks.

Fifteen spermatophytes were noted on ramarama; these included two naturalised species, cocksfoot (*Dactylis glomerata*) and *Sison amomum*, which had colonised ramarama growing on a forest margin abutting rough pasture. At Awaroa Scenic Reserve, the upper branch forks were often colonised by *Astelia hastata* and *Earina mucronata*. One occurrence of a seedling *Ripogonum scandens* was also noted, in this case a plant that germinated within a pin cushion moss growing on ramarama. Of the indigenous species, seven are lianes, which had grown through ramarama in the same way the lianoid ferns had; two, the hemiparasitic *Korthalsella clavata*, and *K. lindsayi*, are listed as 'At Risk / Declining' (de Lange et al. 2018a). While *Korthalsella lindsayi* has been reported for ramarama by Sultan et al. (2018), *K. clavata* has not, so this is a new record for this host association. Two species, the rata vines (*Metrosideros diffusa* and *M. fulgens*) are listed as 'Threatened / Nationally Vulnerable' because of the risk posed by *Austropuccinia psidii*, which infects them (de Lange et al. 2018a; authors' pers. obs.).

The most diverse group of ramarama associates are lichenised mycobiota (see Figures 8 and 9 for examples); we report here 96 species, of which the Peltigeraceae Willd. (21 species from 4 genera) were the main contributing family, followed by the Pannariaceae Tuck., Parmeliaceae Zenker and Ramalinaceae C.Agardh, which each contributed 9 species, followed by the Collemataceae Zenker (8 species from two genera). Eleven of the lichens recorded are listed as 'At Risk' or 'Data Deficient' (de Lange et al. 2018b) and 14 lichens are either unresolved to species level (e.g., *Dictyonema* C.Agardh ex Kunth, Figure 8G), require taxonomic assessment (e.g., *Megalania* aff. *orokonuiana* (Figure 9C), and a potentially new species of *Fissurina* Feé (Figure 8I), or are new additions to the lichenised mycobiota of Aotearoa / New Zealand so have no conservation listing yet, e.g., *Lepra erythrella* (Figure 9B) and *Pyrenula leucostoma* (Figure 9H), the latter discussed by Marshall et al. (2020). No clear patterns are evident in the lichen assemblages collected, beyond that where ramarama grew on forest margins it supported more lichen diversity, of photophilous species, and

when growing in shaded sites less diversity of shade-tolerant taxa, e.g., *Bacidia* De Not. spp., *Collema* Weber ex F.H.Wigg. spp., *Coenogonium luteum* and *Leptogium* (Ach.) Gray spp., than we had anticipated. Eleven lichens have been listed as 'Data Deficient' by de Lange et al. (2018b); their discovery on ramarama therefore adds to our scant knowledge of them and will help improve our knowledge for further threat assessments.

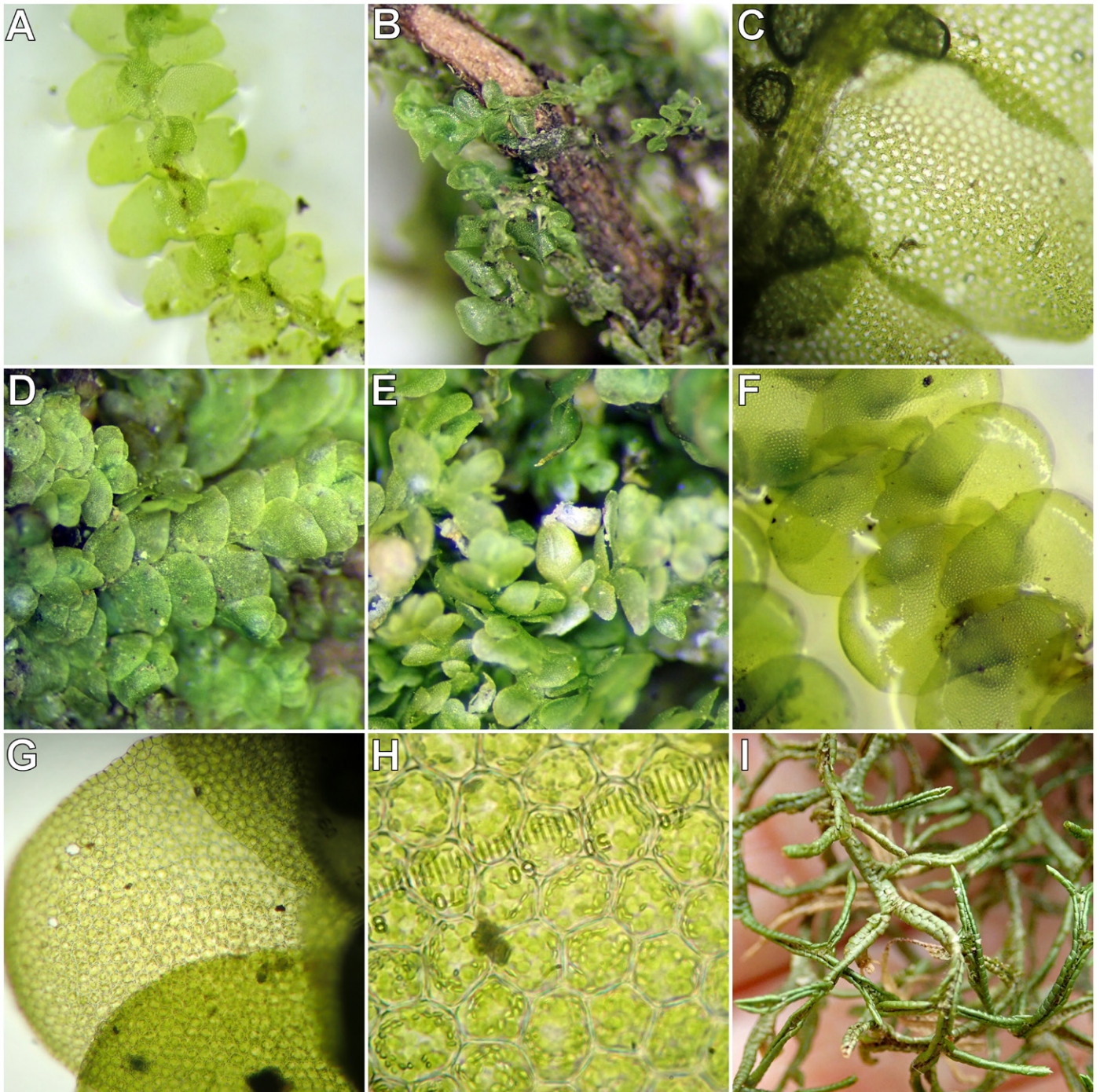
### **Rōhutu (*Lophomyrtus obcordata*)**

Rōhutu, the wider ranging of the two *Lophomyrtus* species, based on our admittedly limited sampling, seems to support fewer associates than ramarama. This may be because rōhutu bark sheds more readily than ramarama (Figure 2B). In this species, co-associates were mostly confined to branch forks, especially in those forks where shed bark had accumulated. The leaves, though non-bullate and smaller than ramarama, supported a range of cyanobacterial growths not noted in ramarama. While we were unable to identify the majority of these, based on the diversity of shape and form, further investigation of them may prove rewarding.

Our study found 81 taxa on rōhutu, comprising of one cyanobacterium, one alga, twenty-nine bryophytes (17 liverworts and 12 mosses), four pteridophytes and two spermatophytes. As with ramarama, lichenised mycobiota were the most prolific (44 species).

Cyanobacteria and algae are common on the leaves and branchlets of rōhutu. One of the cyanobacteria we found on the leaves of rōhutu plants sampled at Āwhitu (Figure 3) has been provisionally identified as a species of *Tolypothrix* Kützing ex Bornet et Flahault, *T. c.f. pseudodoxia* by Dr P. Novis of Landcare Research (pers comm, 20 July 2020). Aside from cyanobacteria, *Trentepohlia* was also commonly seen in shaded or humid habitats, growing on leaves, petioles and especially the upper branchlets. We were unable to obtain species-level determinations but on the basis of growth habit we suspect that there is more than one species present on rōhutu. Further investigation is needed.

Of the 17 liverworts recorded (see Figure 10 for examples), 15 are listed as 'Not Threatened' (de Lange et al. 2020) and two, a suspected undescribed species belonging to the *Porella elegantula* complex (Figures 10G, 10H) and the newly described *Lejeunea demissa* (Figures 10A–C; Renner et al. 2021), have yet to receive a formal conservation assessment (note, though that *Lejeunea demissa* was awarded a provisional status of 'Not Threatened' by Renner et al. 2021). Aside from species of *Frullania* Raddi, *Metzgeria furcata* and *Siphonolejeunea*



**Figure 10.** Liverworts associated with rōhutu (*Lophomyrtus obcordata*). (A–C) *Lejeunea demissa*, Riuwaka Valley Road, Motueka. (D) *Lejeunea hodgsoniana*, Signal Station Bush, Āwhitu Peninsula. (E) *Lejeunea oracula*, Signal Station Bush, Āwhitu Peninsula. (G, H) *Porella*, Riuwaka Valley Road, Motueka. (I) *Porella elegantula*, Riuwaka Valley Road, Motueka. Photos: P.J. de Lange.

*nudipes* var. *nudipes*, none of the liverworts recorded were common on rōhutu. With respect to liverwort families, the Lejeuneaceae was, as was also the case with ramarama, the largest contributing family to the liverwort assemblage on rōhutu with nine species from five genera, and with *Lejeunea* (four species) the most commonly encountered genus of that family. Members of the Lejeuneaceae were most commonly found on the branchlets just above the forks, in which places they often grew interdigitated with species of *Frullania*. In high light situations, *Frullania pycnantha* and *F. fugax* were the most common of the 17 liverworts reported, and easily the most conspicuous on account of their darkly pigmented foliage – often appearing black in the field. In shaded sites, *Metzgeria* sp. (possibly *M. howeana* Steph., previously attributed to a *M. furcata* (L.) Corda, a species now thought to not occur in Aotearoa / New Zealand – see Bechteler et al. [2021]) was often well developed, with large specimens mostly noted at the trunk base, where bark shedding is less of an issue.

We found 12 species of mosses on rōhutu (Appendix 1). At Lighthouse Bush, Āwhitu, where rōhutu grows in an exposed coastal shrubland, mosses were uncommon; there were two species of *Syntrichia* Brid., *S. laevipilia* and *S. papillosa*, while over the ridge at Signal Station Bush, where rōhutu grows within a mature coastal forest remnant, pin cushion moss was the most commonly encountered species. However, in shaded, humid habitats, such as those sites sampled within the riparian forest on the sides of the Riuwaka River, the upper branchlets of rōhutu were typically festooned in *Weymouthia cochlearifolia*, *W. mollis*, *Papillaria crocea* from the Lembophyllaceae Broth., and *Alleniella hymenodonta* from the Neckeraceae Schimp.

Pteridophyte associates of rōhutu were not evident in our herbarium searches, and our limited sampling only found four species from three families (Appendix 1). At Āwhitu, *Arthropteris tenella*, *Pyrrosia elaeagnifolia* and *Zealandia pustulata* subsp. *pustulata* were locally common at Signal Station Bush, growing on the taller rōhutu trees exposed along the western side of a coastal forest remnant.

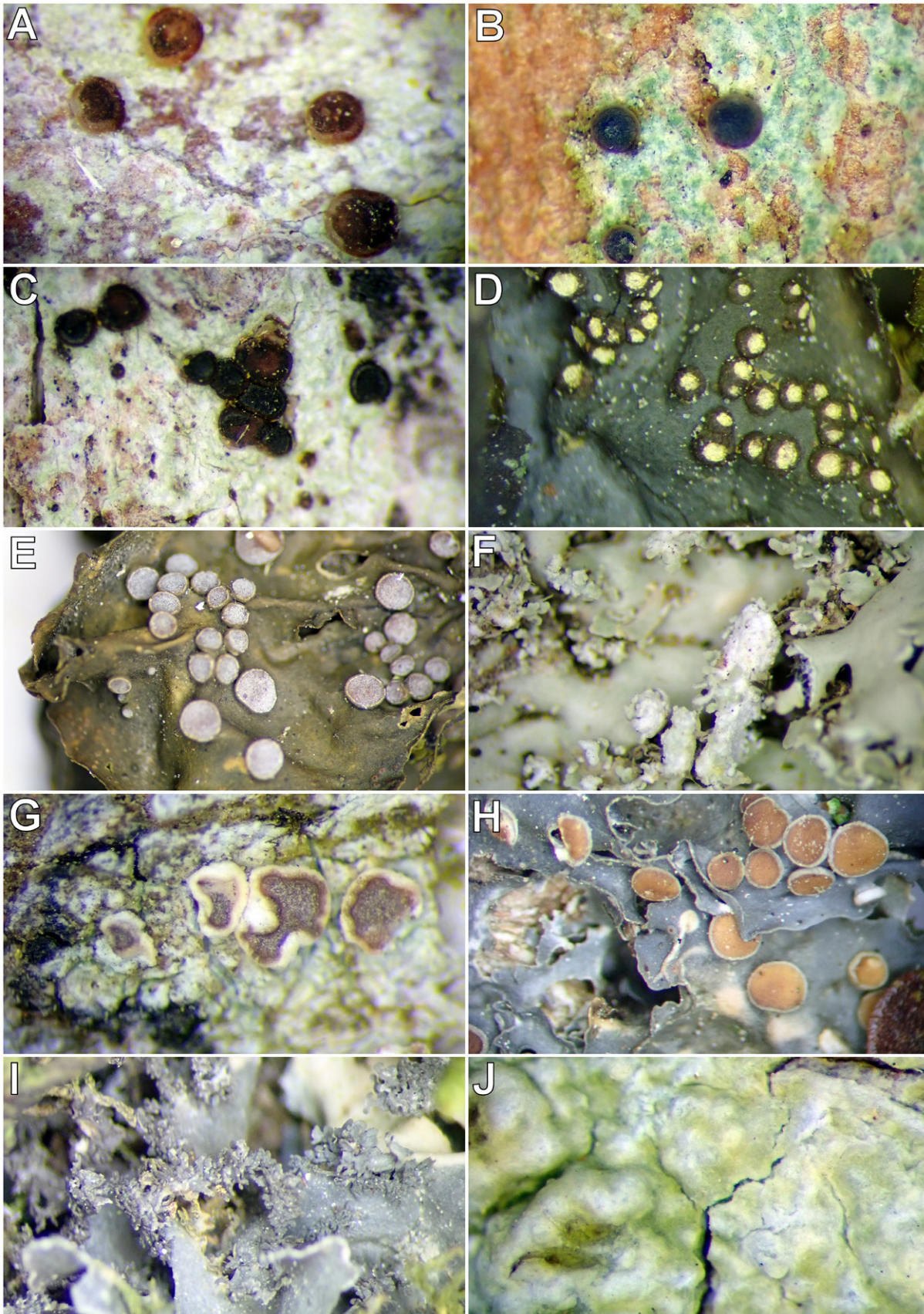
Herbarium searches and field sampling only recorded two spermatophytes from rōhutu, the orchid *Drymoanthus adversus*, commonly seen on the upper trunk and branches of rōhutu at Signal Station Bush, and the hemiparasitic dwarf mistletoe *Korthalsella lindsayi*. Sultan et al. (2018) noted that rōhutu is an important secondary host for *Korthalsella lindsayi* (Figure 11).

As with ramarama, the greatest diversity of co-



**Figure 11.** The dwarf mistletoe *Korthalsella lindsayi* parasitic on rōhutu (*Lophomyrtus obcordata*), High Bare Peak, Little River, Horomaka Banks Peninsula. Photo: Alice Shanks.

associates were lichenised mycobiota (see Figure 12 for some examples), with our herbarium searches and field sampling recording 44 taxa, 42 determined to species level and two (*Calicium* Pers., *Pyrenula* Ach.) to genus level. The largest contributing lichen families on rōhutu are the Parmeliaceae (six species from four genera), Ramalinaceae (six species from two genera) and the Collemataceae (six species from one genus, *Leptogium*). Of the 44 lichenised mycobiota documented here (Appendix 1) six are listed as ‘At Risk / Naturally Uncommon’, four as ‘Data Deficient’ and three are not assessed either because we were unable to obtain a species rank determination, or, as is the case for *Usnea dasaea*, it is a new addition to the lichenised mycobiota of Aotearoa / New Zealand (Bannister et al. 2020) and so does not as yet have a formal conservation assessment (c.f. de Lange et al. 2018b). As with the ‘Data Deficient’ lichens found on ramarama, the discovery of four ‘Data Deficient’ lichens found on rōhutu is an improvement on our poor knowledge of them, and their documentation here will help clarify their status in future



**Figure 12.** Lichenised mycobiota associated with rōhutu (*Lophomyrtus obcordata*). (A) *Bacidia laurocerasi*, Lighthouse Bush, Āwhitu Peninsula. (B) *Bacidia leucocarpi*, Riuwaka Valley Road, Motueka. (C) *Bacidia wellingtonii*, Lighthouse Bush, Āwhitu Peninsula. (D) *Collema laeve*, Riuwaka Valley Road, Motueka. (E) *Collema leucocarpum*, Waitaanga, North Taranaki. (F) *Heterodermia spathulifera*, Signal Station Bush, Āwhitu Peninsula. (G) *Lecanora flavopallida*, Signal Station Bush, Āwhitu Peninsula. (H) *Leptogium aucklandicum*, Riuwaka Valley Road, Motueka. (I) *Leptogium oceanianum*, Riuwaka Valley Road, Motueka. (J) *Pertusaria thiospoda*, Signal Station Bush, Āwhitu Peninsula. Photos: P.J. de Lange.

threat assessments. The most commonly encountered lichens on rōhutu were crustose species of the following genera: *Arthonia* Ach., *Arthopyrenia* A.Massal, *Bacidia*, *Coenogonium* Ehrenb. (*C. luteum* only) and *Pertusaria*. A species of *Calicium*, unfortunately only seen as sterile specimens, was extremely common in the windswept rōhutu growing at Lighthouse Bush, Āwhitu.

One *Pertusaria* DC., *P. puffina*, first recognised for Aotearoa / New Zealand by Er et al. (2015) from specimens collected off the trunks of manawa / mangrove (*Avicennia marina* subsp. *australasica* (Walp.) J.Everett) at Mataia, near Glorit, Kaipara Harbour, we found on rōhutu at the two sites sampled on the Āwhitu Peninsula. *Pertusaria puffina* was also recorded on ramarama sampled at the Awaroa Scenic Reserve, South Kawhia. This species, though much more widespread than initially believed, probably still merits the current threat listing of 'At Risk / Naturally Uncommon' as it remains biological sparse and occurrences are widely scattered.

### ***Lophomyrtus* × *ralphii***

This hybrid is widespread wherever the ranges of ramarama and rōhutu overlap. For our study we were unable to sample a hybrid swarm. Herbarium searches located only one associate, the dwarf mistletoe *Korthalsella lindsayi*.

## **Conclusion**

Although the decline of *Lophomyrtus* as a consequence of the spread of *Austropuccinia psidii* was predicted (de Lange et al. 2018a), ramarama and rōhutu as widespread species have suffered the fate common to many abundant species suddenly tipped into serious decline – ignorance. When de Lange et al. (2018a) listed ramarama and rōhutu as 'Threatened / Nationally Critical' they did so as a precautionary measure in response to the detection of *Austropuccinia* in Aotearoa / New Zealand. It was hoped that that listing would prove unwarranted. At the time of writing (April 2022), some four years later it is evident that this high listing was warranted; ramarama is now in serious decline throughout its range. Regional extinctions are now being witnessed, notably in Tairāwhiti / East Cape and the western Waikato (G. Atkins, pers. comm, 6 November 2021; authors' pers. obs.). Rōhutu, being more widespread, is so far less threatened, though the species is declining over a large part of its northern range (authors' pers. obs.).

With these declines there is an urgent need to find effective conservation-management strategies to ensure

the survival of both species. With that need comes the realisation of how little we know about the autecology and microbiome of ramarama and rōhutu.

This study, therefore, is an attempt to start the process of documenting the microbiome of ramarama and rōhutu. While our study is still preliminary, and we stress that a much wider sampling of both species, including their associated fungi and encompassing their full altitudinal and latitudinal spread, is needed, we found that *Lophomyrtus* support a diverse array of plants and lichenised mycobiota. In this paper we report on 221 taxa found from a sampling of eight *Lophomyrtus* populations (three *L. bullata*, five *L. obcordata*). While none of the taxa we found are confirmed as endemic to ramarama and rōhutu, the discovery of 15 lichens listed as 'Data Deficient' by de Lange et al. (2018b) highlights how the deliberate targeting of a phorophyte for lichens can help resolve the status of poorly known taxa. This was also noted by Blanchon et al. (2020), who reported similar results from their investigation of pōhutukawa. Further, at least one lichen, a *Fissurina*, has yet to be determined to species rank but a preliminary investigation and consultation with experts (A. Aptroot, R. Lücking, pers. comm. 28 January 2022) suggests it may be a new species, or a new record for Aotearoa / New Zealand.

As with Blanchon et al. (2020), we urge that more comprehensive sampling of *Lophomyrtus*, especially of non-lichenised mycobiota and cyanobacteria, is undertaken. We see this as high priority, considering the rapid decline, especially of ramarama, due to the ongoing spread of *Austropuccinia*.



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**Appendix 1.** List of flora and lichenised mycobiota found in association with *Lophomyrtus bullata*, *L. obcordata*, and *L. xralphii*

### ***Lophomyrtus bullata***

Taxon	Family	Threat Status	Voucher
Bryophytes (59)			
Hornworts (1)			
<i>Dendroceros validus</i> Steph.	Dendrocerotaceae	Not Threatened	CHR 633103
Liverworts (33)			
<i>Chandonanthus squarrosus</i> (Hook.) Schiffn.	Anastrophyllaceae	Not Threatened	UNITEC 13071
<i>Hymenophyton leptopodium</i> (Hook.f. et Taylor) Steph.	Hymenophytaceae	Not Threatened	CHR 657705
<i>Frullania incumbens</i> Mitt.	Frullaniaceae	Not Threatened	UNITEC 13167
<i>Frullania patula</i> Mitt.	Frullaniaceae	Not Threatened	UNITEC 13161
<i>Frullania pycnantha</i> (Hook.f. et Taylor) Taylor	Frullaniaceae	Not Threatened	UNITEC 13189
<i>Frullania rostellata</i> Mitt.	Frullaniaceae	Not Threatened	UNITEC 13163
<i>Cheilolejeunea comitans</i> (Hook.f. et Taylor). R.M.Schust.	Lejeuneaceae	Not Threatened	AK 291330
<i>Cheilolejeunea mimosa</i> (Hook.f. et Taylor). R.M.Schust.	Lejeuneaceae	Not Threatened	UNITEC 13159
<i>Cheilolejeunea</i> sp.	Lejeuneaceae	Not Assessed	UNITEC 13187
<i>Cololejeunea laevigata</i> (Mitt.) R.M.Schust.	Lejeuneaceae	Not Threatened	UNITEC 13178

<i>Lejeunea colensoana</i> (Steph.) M.A.M. Renner	Lejeuneaceae	Not Threatened	UNITEC 13171
<i>Lejeunea flava</i> (Sw.) Nees	Lejeuneaceae	Not Threatened	AK 291373
<i>Lejeunea oracula</i> M.A.M. Renner	Lejeuneaceae	Not Threatened	UNITEC 13183
<i>Lopholejeunea</i> (a) (AK 327822; New Zealand ( <i>Lopholejeunea plicatiscypha</i> of Hamlin 1972)	Lejeuneaceae	Not Threatened	UNITEC 13186
<i>Lopholejeunea colensoi</i> Steph.	Lejeuneaceae	Not Threatened	CHR 620593
<i>Thysananthus anguiformis</i> (Hook.f. et Taylor) Taylor ex Gottsche, Lindenb. et Nees	Lejeuneaceae	Not Threatened	UNITEC 13182
<i>Siphonolejeunea nudipes</i> (Hook.f. et Taylor) Herzog var. <i>nudipes</i>	Lejeuneaceae	Not Threatened	UNITEC 13169
<i>Spruceanthus olivaceus</i> (Hook.f. et Taylor) X.Q.Shi, R.L.Zhu et Gradst.	Lejeuneaceae	Not Threatened	UNITEC 13190
<i>Lepidolaena clavigera</i> (Hook.) Trevis.	Lepidolaenaceae	Not Threatened	UNITEC 13158
<i>Lepidolaena taylorii</i> (Gottsche) Trevis.	Lepidolaenaceae	Not Threatened	UNITEC 13179
<i>Chiloscyphus muricatus</i> (Lehm.) J.J.Engel et R.M.Schust.	Lophocoleaceae	Not Threatened	UNITEC 13176
<i>Dendromastigophora flagellifera</i> (Hook.f.) R.M.Schust.	Mastigophoraceae	Not Threatened	UNITEC 11549
<i>Metzgeria</i> sp. (possibly <i>M. howeana</i> Steph.)	Metzgeriaceae	Not Threatened	UNITEC 13108
<i>Plagiochila trispicata</i> Colenso	Plagiochilaceae	Not Threatened	AK 316878
<i>Plagiochila banksiana</i> Gottsche	Plagiochilaceae	Not Threatened	UNITEC 13088
<i>Porella amoena</i> (Colenso) Martin	Porellaceae	Not Threatened	UNITEC 13105
<i>Porella elegantula</i> (Mont.) E.A.Hodgs.	Porellaceae	Not Threatened	UNITEC 11747

<i>Radula allisonii</i> Castle	Radulaceae	Not Threatened	UNITEC 13170
<i>Radula demissa</i> M.A.M.Renner	Radulaceae	Not Threatened	AK 315585
<i>Radula grandis</i> Steph.	Radulaceae	Not Threatened	AK 312086
<i>Radula marginata</i> Taylor ex Gottsche, Lindenb. et Nees	Radulaceae	At Risk – Declining	UNITEC 13177
<i>Radula strangulata</i> Hook.f. et Taylor	Radulaceae	Not Threatened	AK 360278
<i>Leiomitra lanata</i> (Hook.) R.M.Schust.	Trichocoleaceae	Not Threatened	UNITEC 13157
<b>Mosses (25)</b>			
<i>Cratoneuropsis relaxa</i> (Hook.f. et Wilson) M.Fleisch.	Amblystegiaceae	Not Threatened	UNITEC 13110
<i>Braithwaitea sulcata</i> (Hook.) A.Jaeger	Braithwaiteaceae	Not Threatened	UNITEC 11746
<i>Rosulabryum subtomentosum</i> (Hampe) J.R.Spence	Bryaceae	Not Threatened	UNITEC 13112
<i>Cryphaea dilatatus</i> (Hook.f. et Wilson) Paris et Schimp	Cryphaeaceae	Not Threatened	UNITEC 13090
<i>Cryphaea tenella</i> (Schwägr) Müll.Hal.	Cryphaeaceae	Not Threatened	UNITEC 13091
<i>Holomitrium perichaetiale</i> (Hook.) Brid.	Dicranaceae	Not Threatened	UNITEC 13185
<i>Lopidium concinnum</i> (Hook.) Hook.f. et Wilson	Hypopterygiaceae	Not Threatened	UNITEC 13122
<i>Weymouthia mollis</i> (Hedw.) Broth.	Lembophyllaceae	Not Threatened	UNITEC 13099
<i>Weymouthia cochlearifolia</i> (Schwägr.) Dixon	Lembophyllaceae	Not Threatened	UNITEC 13047
<i>Leptostomum macrocarpon</i> (Hedw.) Bach.Pyl.	Leptostomataceae	Not Threatened	UNITEC 13049

<i>Papillaria crocea</i> (Hampe) A.Jaeger	Meteoriaceae	Not Threatened	AK 315250
<i>Papillaria flavolimbata</i> (Müll.Hal. et Hampe) A. Jaeger	Meteoriaceae	Not Threatened	UNITEC 13095
<i>Alleniella hymenodonta</i> (Müll.Hal.) S.Olsson, Enroth et D.Quandt	Neckeraceae	Not Threatened	UNITEC 13093
<i>Leptodon smithii</i> (Hedw.) F.Weber et D.Mohr	Neckeraceae	Not Threatened	AK 289421
<i>Macromitrium gracile</i> (Hook.) Schwägr.	Orthotrichaceae	Not Threatened	CHR 461640
<i>Macromitrium helmsii</i> Paris	Orthotrichaceae	Not Threatened	CHR 104379
<i>Macromitrium longipes</i> (Hook.) Schwägr.	Orthotrichaceae	Not Threatened	UNITEC 13145
<i>Orthorrhynchium elegans</i> (Hook.f. et Wilson) Reichardt	Orthorrhynchiaceae	Not Threatened	UNITEC 11748
<i>Sciadocladus menziesii</i> (Hook.) Broth.	Pterobryellaceae	Not Threatened	UNITEC 13089
<i>Cladomnion ericoides</i> (Hook.) Hook. f. et Wilson	Ptychomniaceae	Not Threatened	UNITEC 13097
<i>Ptychomnion aciculare</i> (Brid.) Mitt.	Ptychomniaceae	Not Threatened	UNITEC 13098
<i>Tetraphidopsis pusilla</i> (Hook.f. et Dixon) Wilson	Ptychomniaceae	Not Threatened	AK 317733
<i>Wijkia extenuata</i> (Brid.) H.A.Crum var. <i>extenuata</i>	Sematophyllaceae	Not Threatened	UNITEC 13180
<i>Wijkia extenuata</i> var. <i>caudata</i> Fife	Sematophyllaceae	Not Threatened	UNITEC 13141
<i>Trachyloma diversinerve</i> Hampe	Trachylomataceae	Not Threatened	UNITEC 13096
<b>Pteridophytes (6)</b>			
<i>Asplenium flaccidum</i> G.Forst.	Aspleniaceae	Not Threatened	UNITEC 11705

<i>Icarus filiformis</i> (A.Cunn.) Gasper et Salino	Blechnaceae	Not Threatened	UNITEC 11569
<i>Hymenophyllum sanguinolentum</i> (G.Forst) Sw.	Hymenophyllaceae	Not Threatened	UNITEC 11732
<i>Pyrrhosia elaeagnifolia</i> (Bory) Hovenkamp	Polypodiaceae	Not Threatened	UNITEC 11709
<i>Zealandia pustulata</i> (G.Forst.) Testo et A.R.Field subsp. <i>pustulata</i>	Polypodiaceae	Not Threatened	UNITEC 11708
<b>Spermatophytes (16)</b>			
<b>Monocots I (3)</b>			
<i>Astelia hastata</i> Colenso	Asteliaceae	Not Threatened	UNITEC 12648
<i>Earina mucronata</i> Lindl.	Orchidaceae	Not Threatened	UNITEC 11704
<i>Ripogonum scandens</i> J.R.Forst. et G.Forst.	Ripogonaceae	Not Threatened	UNITEC 13084
<b>Monocot II – Commelinids (1)</b>			
* <i>Dactylis glomerata</i> L.	Poaceae	Naturalised	UNITEC 11710
<b>Core Eudicots (12)</b>			
* <i>Sison amomum</i> L.	Apiaceae	Naturalised	UNITEC 11731
<i>Parsonsia heterophylla</i> A.Cunn.	Apocynaceae	Not Threatened	UNITEC 11706
<i>Griselinia lucida</i> (J.R.Forst et G.Forst.) G.Forst.	Griselinaceae	Not Threatened	UNITEC 13168
<i>Metrosideros diffusa</i> (G.Forst.) Sm.	Myrtaceae	Nationally Vulnerable	UNITEC 11702



<i>Metrosideros fulgens</i> Sol. ex Gaertn	Myrtaceae	Nationally Vulnerable	UNITEC 11733
<i>Fuchsia perscandens</i> Cockayne et Allan	Onagraceae	Not Threatened	UNITEC 11568
<i>Passiflora tetrandra</i> Banks ex DC.	Passifloraceae	Not Threatened	UNITEC 11735
<i>Pittosporum cornifolium</i> A.Cunn.	Pittosporaceae	Not Threatened	CHR 33664
<i>Muehlenbeckia complexa</i> var. <i>grandifolia</i> Carse	Polygonaceae	Not Threatened	UNITEC 11707
<i>Korthalsella clavata</i> (Kirk) Cheeseman	Santalaceae	At Risk / Declining	CHR 33525
<i>Korthalsella lindsayi</i> (Oliv. ex Hook.f.) Engl.	Santalaceae	At Risk / Declining	CHR 33925
<i>Urtica sykesii</i> Grose-Veldman et Weigend	Urticaceae	Not Threatened	UNITEC 13083
<b>Lichenised Mycobiota (96)</b>			
<i>Arthonia epiodes</i> Nyl.	Arthoniaceae	Data deficient	UNITEC 13073
<i>Arthonia indistincta</i> C. Knight et Mitt.	Arthoniaceae	Data deficient	UNITEC 13087
<i>Brigantiaea chrysosticta</i> (Hook.f. et Taylor) Hafellner et Bellem.	Brigantiaeaceae	Not Threatened	UNITEC 13031
<i>Brigantiaea phaeomma</i> (Nyl.) Hafellner	Brigantiaeaceae	Not Threatened	UNITEC 13032
<i>Cladonia darwinii</i> S.Hammer	Cladoniaceae	Not Threatened	UNITEC 13059
<i>Coccocarpia erythroxyli</i> (Spreng.) Swinscow et Krog.	Coccocarpiaceae	Not Threatened	UNITEC 13021
<i>Coccocarpia palmicola</i> (Spreng.) Arv. et D.J. Galloway	Coccocarpiaceae	Not Threatened	UNITEC 12151
<i>Coenogonium luteum</i> (Dicks.) Kalb et Lücking	Coenogoniaceae	Not Threatened	UNITEC 13181

<i>Collema leucocarpum</i> Hook.f. et Taylor	Collemataceae	Not Threatened	UNITEC 13154
<i>Collema subconveniens</i> Nyl.	Collemataceae	Not Threatened	UNITEC 13147
<i>Collema subflaccidum</i> Degel.	Collemataceae	Naturally Uncommon	UNITEC 13149
<i>Leptogium aucklandicum</i> Zahlbr.	Collemataceae	Not Threatened	UNITEC 13220
<i>Leptogium coralloideum</i> (Meyen et Flot.) Vain.	Collemataceae	Naturally Uncommon	UNITEC 13103
<i>Leptogium crispatellum</i> Nyl.	Collemataceae	Not Threatened	UNITEC 12152
<i>Leptogium cyanescens</i> (Rabenh.) Körb.	Collemataceae	Not Threatened	UNITEC 13023
<i>Leptogium oceanium</i> Kitaura et Marcelli	Collemataceae	Not Threatened	UNITEC 13079
<i>Fissurina</i> Fée	Graphidaceae	Not Assessed	UNITEC 13121
<i>Thelotrema lepadinum</i> (Ach.) Ach.	Graphidaceae	Not Threatened	UNITEC 13082
<i>Haematomma hilare</i> Zahlbr.	Haematommaceae	Not Threatened	CHR 626799
<i>Lecidea fuscocincta</i> Stirt.	Lecideaceae	Data Deficient	UNITEC 13025
<i>Dictyonema</i> C. Agardh ex Kunth	Lichenomphalloideae	Not Assessed	UNITEC 13080
<i>Megalospora gompholoma</i> (Müll.Arg.) C.W.Dodge subsp. <i>gompholoma</i>	Megalosporaceae	Not Threatened	UNITEC 13027
<i>Ochrolechia pallescens</i> (L.) A.Massal.	Ochrolechiaceae	Not Threatened	UNITEC 13028
<i>Erioderma leylandii</i> (Taylor) Müll. Arg.	Pannariaceae	Naturally Uncommon	UNITEC 13070
<i>Fuscopannaria granulans</i> P.M.Jørg.	Pannariaceae	Data Deficient	UNITEC 13360

<i>Leioderma solediatum</i> D.J.Galloway et P.M. Jørg.	Pannariaceae	Not Threatened	UNITEC 13362
<i>Pannaria araneosa</i> (C. Babington) Hue	Pannariaceae	Not Threatened	UNITEC 11771
<i>Pannaria delicata</i> P.M. Jørg. et D.J.Galloway	Pannariaceae	Not Threatened	UNITEC 13358
<i>Pannaria immixta</i> Nyl.	Pannariaceae	Not Threatened	UNITEC 13359
<i>Pannaria</i> aff. <i>minutiphylla</i>	Pannariaceae	Not Assessed	UNITEC 11772
<i>Parmeliella nigrocincta</i> (Mont.) Müll.Arg.	Pannariaceae	Not Threatened	UNITEC 13357
<i>Psoroma allorhizum</i> (Nyl.) Hue	Pannariaceae	Not Threatened	UNITEC 13361
<i>Parmotrema crinitum</i> (Ach.) M.Choisy	Parmeliaceae	Not Threatened	UNITEC 13119
<i>Parmotrema perlatum</i> (Huds.) M.Choisy	Parmeliaceae	Not Threatened	UNITEC 13033
<i>Parmotrema robustum</i> (Degel.) Hale	Parmeliaceae	Naturally Uncommon	UNITEC 13078
<i>Tuckermannopsis chlorophylla</i> (Willd.) Hale	Parmeliaceae	Data Deficient	UNITEC 13072
<i>Usnea angulata</i> Ach.	Parmeliaceae	Not Threatened	UNITEC 13060
<i>Usnea baileyi</i> (Stirt.) Zahlbr.	Parmeliaceae	Data Deficient	UNITEC 13215
<i>Usnea dasaea</i> Stirt.	Parmeliaceae	Not Assessed	UNITEC 13076
<i>Usnea rubicunda</i> Stirt.	Parmeliaceae	Not Threatened	UNITEC 12149
<i>Usnea</i> aff. <i>baileyi</i>	Parmeliaceae	Not Assessed	UNITEC 13233
<i>Crocodia aurata</i> (Acharius) Link	Peltigeraceae	Not Threatened	UNITEC 12146

<i>Crocodia poculifera</i> (Müller Arg.) D.J. Galloway et Elix	Peltigeraceae	Naturally Uncommon	UNITEC 12150
<i>Crocodia rubella</i> (Hook.f. et Taylor) Trevis.	Peltigeraceae	Not Threatened	UNITEC 13153
<i>Podostictina pickeringii</i> (Tuck.) Moncada et Lücking	Peltigeraceae	Not Threatened	UNITEC 13036
<i>Pseudocyphellaria billardierei</i> (Delise) Räsänen	Peltigeraceae	Not Threatened	UNITEC 13151
<i>Pseudocyphellaria carpoloma</i> (Delise) Vain.	Peltigeraceae	Not Threatened	UNITEC 13164
<i>Pseudocyphellaria coriacea</i> (Hook.f. et Taylor) D.J. Galloway et P. James	Peltigeraceae	Not Threatened	UNITEC 13129
<i>Pseudocyphellaria chloroleuca</i> (Hook.f. et Taylor) Du Rietz	Peltigeraceae	Not Threatened	UNITEC 13063
<i>Pseudocyphellaria crocata</i> (L.) Vain.	Peltigeraceae	Not Threatened	UNITEC 7123
<i>Pseudocyphellaria dissimilis</i> (Nyl.) D.J.Galloway et P.James	Peltigeraceae	Not Threatened	UNITEC 13065
<i>Pseudocyphellaria faveolata</i> (Delise) Malme	Peltigeraceae	Not Threatened	UNITEC 13086
<i>Pseudocyphellaria glabra</i> (Hook.f. et Taylor) C.W. Dodge	Peltigeraceae	Not Threatened	UNITEC 13085
<i>Pseudocyphellaria haywardiorum</i> D.J. Galloway	Peltigeraceae	Naturally Uncommon	UNITEC 13077
<i>Pseudocyphellaria intricata</i> (Delise) Vain.	Peltigeraceae	Naturally Uncommon	UNITEC 13043
<i>Pseudocyphellaria montagnei</i> (C.Bab.) D.J. Galloway et P. James	Peltigeraceae	Not Threatened	UNITEC 13165
<i>Pseudocyphellaria multifida</i> (Laurer) D.J. Galloway et P. James	Peltigeraceae	Not Threatened	UNITEC 13101
<i>Pseudocyphellaria rufovirescens</i> (C.Bab.) D.J. Galloway	Peltigeraceae	Not Threatened	UNITEC 13104
<i>Sticta fuliginosa</i> (Dicks.) Ach.	Peltigeraceae	Not Threatened	UNITEC 9627

<i>Sticta latifrons</i> A. Rich.	Peltigeraceae	Not Threatened	UNITEC 12147
<i>Sticta limbata</i> (Sm.) Ach.	Peltigeraceae	Not Threatened	UNITEC 13155
<i>Sticta martini</i> D.J.Galloway	Peltigeraceae	Not Threatened	UNITEC 13044
<i>Lepra erythrella</i> (Müll.Arg.) I.Schmitt, B.G.Hodk. et Lumbsch	Pertusariaceae	Not Assessed	UNITEC 13356
<i>Lepra psoromica</i> (A.W.Archer et Elix) A.W.Archer et Elix	Pertusariaceae	Not Threatened	UNITEC 13022
<i>Pertusaria alboatra</i> Zahlbr.	Pertusariaceae	Naturally Uncommon	UNITEC 13120
<i>Pertusaria puffina</i> A.W.Archer et Elix	Pertusariaceae	Naturally Uncommon	UNITEC 13034
<i>Pertusaria sorodes</i> Stirt.	Pertusariaceae	Not Threatened	UNITEC 13062
<i>Pertusaria thiospoda</i> C.Knight	Pertusariaceae	Not Threatened	UNITEC 13045
<i>Leucodermia leucomelos</i> (L.) Kalb	Physciaceae	Not Threatened	UNITEC 13024
<i>Physcia albata</i> (F. Wilson) Hale	Physciaceae	Not Threatened	UNITEC 13235
<i>Physcia jackii</i> Moberg	Physciaceae	Not Threatened	UNITEC 13156
<i>Polyblastidium casarettianum</i> (A.Massal.) Kalb	Physicaceae	Naturally Uncommon	UNITEC 13066
<i>Phlyctis uncinata</i> Stirt.	Phlyctidaceae	Not Threatened	UNITEC 13061
<i>Phlyctis subuncinata</i> Stirt.	Phlyctidaceae	Not Threatened	UNITEC 13209
<i>Bapalmuia buchananii</i> (Stirt.) Kalb et Lücking	Pilocarpaceae	Not Threatened	UNITEC 13058
<i>Calopadia subcoerulescens</i> (Zahlbr.) Vězda	Pilocarpaceae	Not Threatened	UNITEC 13188

<i>Porina exocha</i> (Nyl.) P.M.McCarthy	Porinaceae	Not Threatened	UNITEC 13042
<i>Porina</i> "green soresiate"	Porinaceae	Not Assessed	UNITEC 13232
<i>Pyrenula leucostoma</i> Ach.	Pyrenulaceae	Not Assessed	UNITEC 13056
<i>Pyrenula nitidula</i> (Bres.) R.C.Harris	Pyrenulaceae	Not Threatened	UNITEC 13057
<i>Bacidia laurocerasi</i> (Delise ex Duby) Vain.	Ramalinaceae	Not Threatened	UNITEC 13029
<i>Bacidia leucothalamia</i> (Nyl.) Hellb.	Ramalinaceae	Data Deficient	UNITEC 13204
<i>Bacidia minutissima</i> C.Knight	Ramalinaceae	Data Deficient	UNITEC 13126
<i>Bacidia superula</i> (Nyl.) Hellb.	Ramalinaceae	Data Deficient	UNITEC 13207
<i>Megalaria grossa</i> (Pers. ex Nyl.) Hafellner	Ramalinaceae	Not Threatened	UNITEC 13206
<i>Megalaria melanotropa</i> (Nyl.) D.J.Galloway	Ramalinaceae	Not Threatened	UNITEC 13068
<i>Megalaria</i> aff. <i>orokonuiana</i> Fryday et A.Knight	Ramalinaceae	Not Assessed	UNITEC 13064
<i>Phyllopsora furfuracea</i> (Pers.) Zahlbr.	Ramalinaceae	Data Deficient	UNITEC 13035
<i>Ramalina geniculata</i> Hooker f. et Taylor	Ramalinaceae	At Risk / Declining	UNITEC 12148
<i>Enterographa pallidiella</i> (Nyl.) Redinger	Roccellaceae	Not Threatened	UNITEC 13074
<i>Bunodophoron murrayi</i> (Ohlsson ex Tibell) Wedin	Sphaerophoraceae	Not Threatened	AK 309531
<i>Lepraria</i> Ach.	Stereocaulaceae	Not Assessed	UNITEC 13038
<i>Lepraria ulrikii</i> Grewe, Barcenás-Peña, Díaz et Lumbsch	Stereocaulaceae	Not Assessed	UNITEC 13039

<i>Arthopyrenia peltigerella</i> Zahlbr.	Trypethellaceae	Data Deficient	UNITEC 13213
<i>Arthopyrenia</i> sp.	Trypethellaceae	Not Assessed	UNITEC 13115
<i>Normandina pulchella</i> (Borrer) Nyl.	Verrucariaceae	Not Threatened	UNITEC 11744

### **Lophomyrtus obcordata**

Taxon	Family	Threat Status	Voucher
Cyanophyceae (1)			
<i>Tolypothrix</i> c.f. <i>pseudodoxia</i>	Microchaetaceae	Not Assessed	CHR PdL 14668
Chlorophyta (1)			
<i>Trentepohlia</i> Mart.	Trentepohliaceae	Not Assessed	UNITEC 11495
Bryophytes (29)			
Liverworts (17)			
<i>Frullania fugax</i> (Hook.f. et Taylor) Taylor	Frullaniaceae	Not Threatened	UNITEC 11461
<i>Frullania pycnantha</i> (Hook.f. et Taylor) Gottsche, Lindenb. et Nees	Frullaniaceae	Not Threatened	UNITEC 13214
<i>Frullania rostellata</i> Mitt.	Frullaniaceae	Not Threatened	AK357971
<i>Frullania squarrosula</i> (Hook.f. et Taylor) Taylor	Frullaniaceae	Not Threatened	UNITEC 11460
<i>Acrolejeunea mollis</i> (Hook.f. et Taylor) Schiffn.	Lejeuneaceae	Naturally Uncommon	UNITEC 11529
<i>Lejeunea demissa</i> M.A.M. Renner	Lejeuneaceae	Not Assessed	UNITEC 13226

<i>Lejeunea gracilipes</i> (Taylor) Spruce	Lejeuneaceae	Not Threatened	UNITEC 11531
<i>Lejeunea hodgsoniana</i> Grolle ex R.J.Lewington, P.Beveridge et M.A.M.Renner	Lejeuneaceae	Not Threatened	UNITEC 11438
<i>Lejeunea oracula</i> M.A.M.Renner	Lejeuneaceae	Not Threatened	UNITEC 11444
<i>Myriocoleopsis minutissima</i> (Sm.) R.L.Zhu, Y.Yu et Pócs	Lejeuneaceae	Not Threatened	UNITEC 11440
<i>Siphonolejeunea hamata</i> (Grolle) M.A.M.Renner	Lejeuneaceae	Not Threatened	UNITEC 11441
<i>Siphonolejeunea nudipes</i> var. <i>nudipes</i> (Hook.f. et Taylor) Herzog	Lejeuneaceae	Not Threatened	UNITEC 13192
<i>Spruceanthus olivaceus</i> (Hook.f. et Taylor) X.Q.Shi, R.L.Zhu et Gradst.	Lejeuneaceae	Not Threatened	UNITEC 11445
<i>Metzgeria</i> sp. (possibly <i>M. howeana</i> Steph.)	Metzgeriaceae	Not Threatened	UNITEC 11436
<i>Metzgeria bartlettii</i> Kuwah.	Metzgeriaceae	Not Threatened	UNITEC 13191
<i>Porella elegantula</i> (Mont.) E.A.Hodgs.	Porellaceae	Not Threatened	UNITEC 13223
<i>Porella</i> sp. (a)	Porellaceae	Not Assessed	UNITEC 13224
<b>Mosses (12)</b>			
<i>Campochaete arbuscula</i> (Sm.) Reichardt	Lembophyllaceae	Not Threatened	CHR 512948
<i>Weymouthia cochlearifolia</i> (Schwägr.) Dixon	Lembophyllaceae	Not Threatened	UNITEC 13200
<i>Weymouthia mollis</i> (Hedw.) Broth.	Lembophyllaceae	Not Threatened	UNITEC 13201
<i>Leptostomum macrocarpon</i> (Hedw.) Bach.Pyl.	Leptostomataceae	Not Threatened	UNITEC 11530
<i>Papillaria crocea</i> (Hampe) A.Jaeger	Meteoriaceae	Not Threatened	UNITEC 13199



<i>Alleniella hymenodonta</i> (Müll.Hal.) S.Olsson, Enroth et D.Quandt	Neckeraceae	Not Threatened	UNITEC 13193
<i>Neckera laevigata</i> Hook.f. et Wils.	Neckeraceae	Not Threatened	CHR 438747
<i>Macrocoma tenue</i> (Hook. et Grev.) Vitt	Orthotrichaceae	Not Threatened	UNITEC 11527
<i>Orthotrichum tasmanicum</i> Hook.f. et Wilson	Orthotrichaceae	Not Threatened	UNITEC 13222
<i>Syntrichia laevipila</i> Brid.	Pottiaceae	Not Threatened	UNITEC 11526
<i>Syntrichia papillosa</i> (Wilson) Jur.	Pottiaceae	Not Threatened	UNITEC 11528
<i>Rhaphidorrhynchium amoenum</i> (Hedw.) M.Fleisch.	Sematophyllaceae	Not Threatened	UNITEC 11525
<b>Pteridophytes (4)</b>			
<i>Arthropteris tenella</i> (G.Forst.) J.Sm. ex Hook.f.	Tectariaceae	Not Threatened	UNITEC 11552
<i>Asplenium flaccidum</i> G.Forst.	Aspleniaceae	Not Threatened	UNITEC 11553
<i>Pyrosia eleagnifolia</i> (Bory) Hovenkamp	Polypodiaceae	Not Threatened	UNITEC 11555
<i>Zealandia pustulata</i> (G.Forst.) Testo et A.R.Field	Polypodiaceae	Not Threatened	UNITEC 11554
<b>Spermatophytes (2)</b>			
<b>Monocots I (1)</b>			
<i>Drymoanthus adversus</i> (Hook.f.) Dockrill	Orchidaceae	Not Threatened	UNITEC 11556
<b>Core Eudicots (1)</b>			
<i>Korthalsella lindsayi</i> (Oliv. ex Hook.f.) Engl.	Santalaceae	Not Threatened	CHR 507984

<b>Lichenised Mycobiota (44)</b>			
<i>Arthonia atra</i> (Pers.) A.Schneid.	Arthoniaceae	Naturally Uncommon	UNITEC 11427
<i>Arthonia radiata</i> (Pers.) Ach.	Arthoniaceae	Not Threatened	UNITEC 11442
<i>Bactrospora arthonioides</i> Egea et Torrente	Arthoniales incertae sedis	Data Deficient	UNITEC 11374
<i>Dirinaria applanata</i> (Fée) D.D. Awasthi	Caliciaceae	Not Threatened	UNITEC 11512
<i>Calicium</i> Pers.	Caliciaceae	Not Assessed	UNITEC 11523
<i>Coenogonium luteum</i> (Dicks.) Kalb et Lücking	Coenogoniaceae	Not Threatened	UNITEC 11428
<i>Collema laeve</i> Hook.f. et Taylor	Collemataceae	Not Threatened	UNITEC 13234
<i>Leptogium aucklandicum</i> Zahlbr.	Collemataceae	Not Threatened	UNITEC 13198
<i>Leptogium cyanescens</i> (Ach.) Körb.	Collemataceae	Not Threatened	UNITEC 11456
<i>Leptogium coralloideum</i> (Meyen et Flot.) Vain.	Collemataceae	Naturally Uncommon	UNITEC 11457
<i>Leptogium crispatellum</i> Nyl.	Collemataceae	Not Threatened	UNITEC 13203
<i>Leptogium oceanium</i> Kitaura et Marcelli	Collemataceae	Not Threatened	UNITEC 13231
<i>Halegrapha mucronata</i> (Stirt.) Lücking	Graphidaceae	Not Threatened	UNITEC 11382
<i>Thalloлома subvelata</i> (Stirt.) D.J. Galloway	Graphidaceae	Not Threatened	UNITEC 11375
<i>Lecanora flavopallida</i> Stirt.	Lecanoraceae	Not Threatened	UNITEC 11492
<i>Opegrapha agelaeoides</i> Nyl.	Opegraphaceae	Not Threatened	UNITEC 11522

<i>Parmotrema crinitum</i> (Ach.) M.Choisy	Parmeliaceae	Not Threatened	UNITEC 11453
<i>Parmotrema perlatum</i> (Huds.) M.Choisy	Parmeliaceae	Not Threatened	UNITEC 11431
<i>Parmotrema reticulatum</i> (Taylor) M.Choisy	Parmeliaceae	Not Threatened	UNITEC 11430
<i>Usnea dasaea</i> Stirt.	Parmeliaceae	Not Assessed	UNITEC 11435
<i>Usnea rubicunda</i> Stirt.	Parmeliaceae	Not Threatened	UNITEC 11429
<i>Punctelia borreri</i> (Sm.) Krog	Parmeliaceae	Not Threatened	UNITEC 11448
<i>Sticta fuliginosa</i> (Hoffm.) Ach.	Peltigeraceae	Not Threatened	UNITEC 13194
<i>Pseudocyphellaria</i> aff. <i>crocata</i> (a) (UNITEC 7123; Wairarapa)	Peltigeraceae	Naturally Uncommon	UNITEC 13196
<i>Pertusaria puffina</i> A.W. Archer et Elix	Pertusariaceae	Naturally Uncommon	UNITEC 11377
<i>Pertusaria sorodes</i> Stirt.	Pertusariaceae	Not Threatened	UNITEC 13228
<i>Pertusaria thiospoda</i> C. Knight	Pertusariaceae	Not Threatened	UNITEC 11511
<i>Heterodermia spathulifera</i> Moberg et Purvis	Physciaceae	Data Deficient	UNITEC 11449
<i>Physcia adscendens</i> (Fr.) H. Olivier	Physciaceae	Not Threatened	UNITEC 11458
<i>Physcia poncinsii</i> Hue	Physciaceae	Not Threatened	UNITEC 11379
<i>Physcia jackii</i> Moberg	Physciaceae	Not Threatened	UNITEC 11380
<i>Polyblastidium casarettianum</i> (A.Massal.) Kalb	Physciaceae	Naturally Uncommon	UNITEC 13219
<i>Pyrenula</i> Ach.	Pyrenulaceae	Not Assessed	UNITEC 11433

<i>Ramalina celastri</i> (Spreng.) Krog & Swinscow	Ramalinaceae	Not Threatened	UNITEC 11434
<i>Ramalina peruviana</i> Ach.	Ramalinaceae	Not Threatened	UNITEC 11455
<i>Bacidia laurocerasi</i> (Del. ex Duby) Vain.	Ramalinaceae	Not Threatened	UNITEC 11493
<i>Bacidia leucocarpa</i> C. Knight	Ramalinaceae	Data Deficient	UNITEC 13227
<i>Bacidia leucothalamia</i> (Nyl.) Hellb.	Ramalinaceae	Data Deficient	UNITEC 13205
<i>Bacidia wellingtonii</i> (Stirt.) D.J.Galloway	Ramalinaceae	Not Threatened	UNITEC 11494
<i>Teloschistes sieberianus</i> (Laurer) Hillmann	Teloschistaceae	Naturally Uncommon	UNITEC 11381
<i>Teloschistes chrysophthalmus</i> (L.) Th.Fr.	Teloschistaceae	Not Threatened	UNITEC 11443
<i>Xanthoria parietina</i> (L.) Th.Fr.	Teloschistaceae	Not Threatened	UNITEC 11454
<i>Arthopyrenia minutella</i> (C. Knight) Müll. Arg.	Trypethellaceae	Not Threatened	UNITEC 11514
<i>Normandina pulchella</i> (Borrer) Nyl.	Verrucariaceae	Not Threatened	UNITEC 11452

### ***Lophomyrtus xralphii***

Taxon	Family	Threat Status	Voucher
Spermatophytes (1)			
Core Eudicots (1)			
<i>Korthalsella lindsayi</i> (Oliv. ex Hook.f.) Engl.	Santalaceae	Not Threatened	

## Authors

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