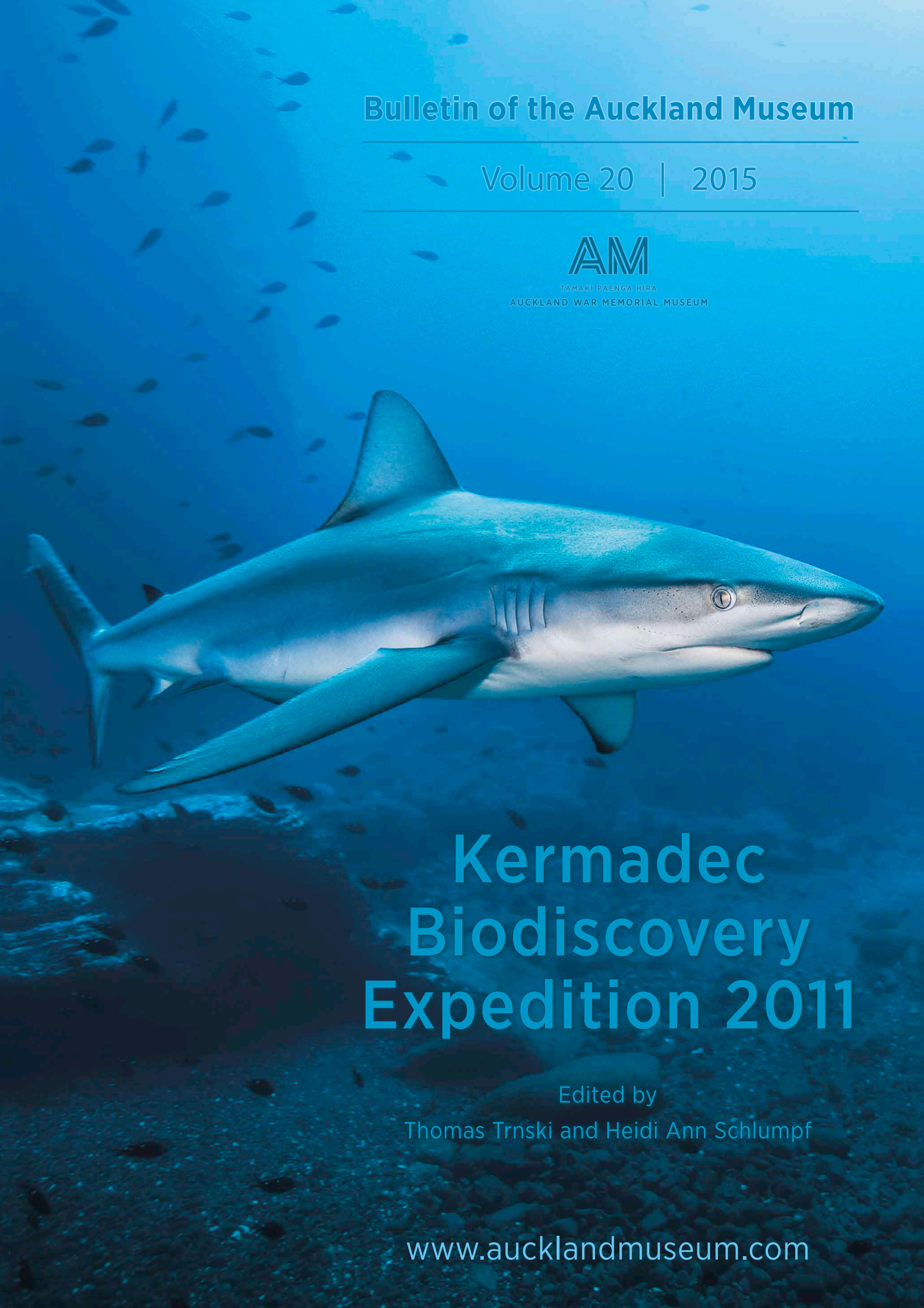




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Lichen notes from the Kermadec Islands.

II. *Ramalina*

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Abstract

Eleven species of *Ramalina* (*R. australiensis*, *R. canariensis*, *R. celastri*, *R. exiguella*, *R. geniculata*, *R. leiodea*, *R. luciae*, *R. meridionalis*, *R. microspora*, *R. pacifica* and *R. peruviana*) are accepted for the Kermadec Islands. The northern Kermadec Islands had the greatest diversity of species (eleven species) while the southern Kermadec Islands had collectively five species. These were distributed as follows (islands arranged from north to south): northern Kermadec Islands (the Herald Islets (six species), the Meyer Islands group (two species), Raoul Island (nine species)); southern Kermadec Islands (Macauley Island (six species), Curtis Island (one species), Cheeseman Island (one species), L'Esperance (two species)). *Ramalina leiodea* is a new addition to the mycobiota of the New Zealand Botanical Region and *R. canariensis* and *R. meridionalis* are new records for the Kermadec Islands, and a significant easterly extension for *R. meridionalis*.

Keywords

Kermadec Islands; Ramalinaceae; *Ramalina*; *R. australiensis*; *R. canariensis*; *R. celastri*; *R. exiguella*; *R. geniculata*; *R. leiodea*; *R. luciae*; *R. meridionalis*; *R. microspora*; *R. pacifica*; *R. peruviana*; biogeography; New Zealand botanical region.

INTRODUCTION

The first apparent collections of *Ramalina* from the Kermadec Islands (Fig. 1) were made by W.R.B. Oliver in 1908. Those collections, along with all of Oliver's other lichen specimens, were identified by A.D. Cotton at Kew and the results were then published by Oliver (1912). In that paper Oliver reported two species, *Ramalina fastigiata* Ach. and *R. farinacea* Ach. from "Sunday Island" (Raoul Island). However, subsequent examination of Oliver's specimens in New Zealand herbaria, indicate that they are referable to *R. microspora* Kremp. (WELT L04263), *R. pacifica* Asahina (AK 202677, WELT L04265) and *R. peruviana* Ach. (AK 33480).

Lichen collections were also made by R.C. Cooper from Raoul Island in 1956, and they, along with Oliver's 1908 collections and the more extensive ones made by W.R. Sykes, were examined by T.W. Rawson, who did all the lichen determinations listed for the islands published by Sykes (1977) in his Flora of the Kermadec Islands (see de Lange & Galloway 2015). Sykes (1977) listed six species for the northern Kermadec Islands and one for the southern Kermadec Islands. The species listed by Sykes (1977) were: *Ramalina allanii* B. de Lesd. (= *R. australiensis* Nyl.), *R. farinacea* (specimens are *R. pacifica* (WELT L4265) or *R. peruviana* (AK 304651)), *R. fastigiata* (specimen (WELT L4263)

is *R. microspora*), *R. intermediella* Vain. (specimen (CHR 385510) is *R. luciae* Molho, Bodo, W.L.Culb. et C.F.Culb.), *R. microspora* and *R. pacifica*.

Blanchon *et al.* (1996) listed six species for the Kermadec Islands (*R. australiensis*, *R. exiguella* Stirt., *R. geniculata* Hook.f. et Taylor, *R. luciae*, *R. pacifica* and *R. peruviana*), based on the original W.R.B. Oliver, R.C. Cooper and W.R. Sykes collections noted above and also unaccessioned Raoul Island material collected by C.J. West (from a ten-week trip she made there in 1993).

Elix and McCarthy (1998) subsequently listed eight species for the Kermadec Islands, largely following Blanchon *et al.* (1996), recognising *R. australiensis*, *R. exiguella*, *R. luciae*, *R. pacifica* and *R. peruviana* but omitting *R. geniculata*. They also accepted without comment *R. farinacea*, *R. fastigiata* and *R. microspora* from Sykes (1977).

Bannister and Blanchon (2003), examining W.R.B. Oliver, R.C. Cooper and W.R. Sykes' Kermadec Islands *Ramalina* material, and also unaccessioned material collected by B.W. Hayward and A.E. Wright from Raoul Island in 1994, accepted eight species: *Ramalina australiensis*, *R. exiguella*, *R. geniculata*, *R. luciae*, *R. microspora* (as *R. cf. microspora*), *R. pacifica*, and *R. peruviana* for the islands, and they added *R. celastri* (Spreng.) Krog et Swinscow. They identified a specimen (AK 202677) collected by W.R.B. Oliver in 1908 and

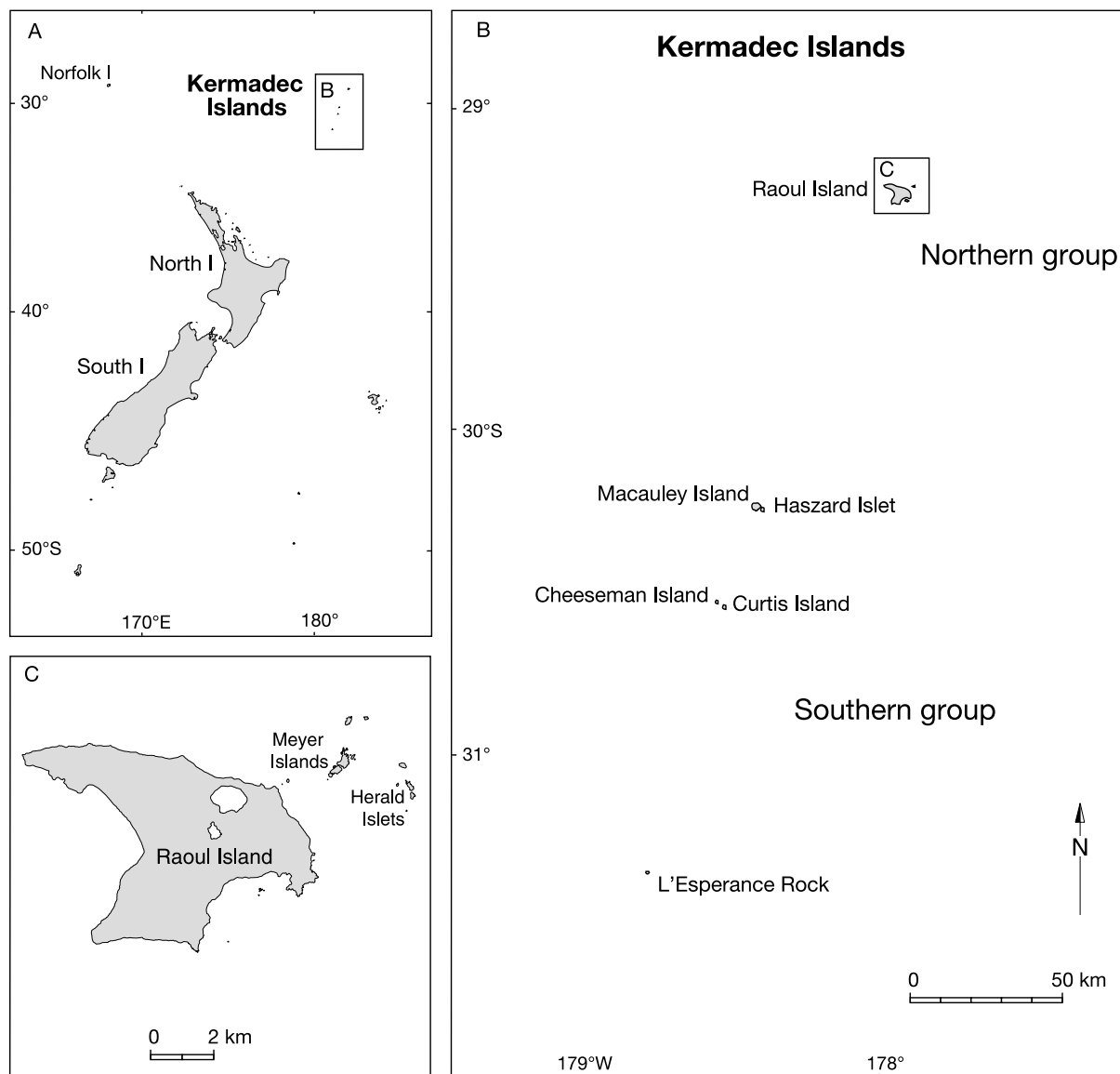


Figure 1. The Kermadec Islands. A. Location of the Kermadec Islands in relation to the continental islands of New Zealand. B. Spatial relationship between the northern and southern islands of the Kermadec Islands. C. Raoul Island, the Meyer and Herald Islets – collectively the northern Kermadec Islands. Map by Jeremy R. Rolfe

originally determined as *R. farinacea* as *R. pacifica*, and further noted that another specimen collected by Oliver and labelled as *R. fastigiata*, contained divaricatic acid and could belong to *R. cf. microspora* (Bannister & Blanchon 2003).

The most recent lichen flora treatment for New Zealand (Galloway 2007) recognised seven species of *Ramalina* for the Kermadec Islands, listing *R. australiensis*, *R. celastri*, *R. exiguella*, *R. luciae*, *R. pacifica* and *R. peruviana* from Raoul Island, and *R. geniculata* from the Kermadec Islands in general. Notably, Galloway (2007) did not accept *Ramalina microspora* for the islands, noting (Pp. 1506) that “a fertile, non-sorediate taxon (cf. *R. microspora* Kremp.) is also known from coastal lava outcrops in scrub from Raoul Island in the Kermadec Islands (Bannister & Blanchon 2003). But its exact status is still in doubt and it is not included here”. During May

2011, the senior author visited the Kermadec Islands and collected specimens of *Ramalina* from Raoul Island, the Meyer Islands and Herald Islets, Macauley Island, Curtis Island, Cheeseman Island and L'Esperance Rock (Fig. 1). From those collections Blanchon *et al.* (2012) have now confirmed the presence of *Ramalina microspora* on the Kermadec Islands.

Eleven species are now known from the Kermadec Islands. Three species, *R. canariensis* Steiner, *R. leiodea* (Nyl.) Nyl. and *R. meridionalis* Blanchon et Bannister, are new to the Islands. *Ramalina leiodea* is also a new addition to the New Zealand Botanical Region (*sensu* Allan 1961, de Lange & Rolfe 2010) mycobiota. Because the other *Ramalina* collections significantly expand the known range of the genus on the Kermadec Islands, we provide here a full treatment and key to the genus *Ramalina* for the islands.

ARTIFICIAL KEY TO SPECIES OF *RAMALINA* ON THE KERMADEC ISLANDS

- | | |
|---|------------------------------------|
| 1. Thallus sorediate | 2. |
| Thallus not sorediate | 6. |
| 2. Soredia erupting through lower surface and apices | <i>R. canariensis</i> |
| Soredia in well-defined soralia | 3. |
| 3. Soralia ellipsoidal or round; marginal | 4. |
| Soralia punctiform; marginal and apical on elongate branches | <i>R. peruviana</i> |
| 4. Medulla K+ pink or red; branches long and narrow | 5. |
| Medulla K–; branching short and thallus deformed | <i>R. pacifica</i> (broad form) |
| 5. Medulla K+ red; branches short between dichotomies | <i>R. pacifica</i> |
| Medulla K+ pink; branches long between dichotomies | <i>R. luciae</i> |
| 6. Branches terete to subterete | 7. |
| Branches flattened to canaliculate | 11. |
| 7. Apothecia numerous; terminal or subterminal | 8. |
| Apothecia marginal or absent | 10. |
| 8. Branches solid and not perforated | 9. |
| Branches hollow; perforate | <i>R. geniculata</i> |
| 9. Saxicolous, branching dense and entangled; pseudocyphellae absent; divaricatic acid..... | <i>R. microspora</i> (narrow form) |
| Corticolous; branching mainly from base; pseudocyphellae linear; divaricatic acid absent | <i>R. exiguella</i> |
| 10. Branching denser at apices than at base; K– | <i>R. australiensis</i> |
| Branching denser at base than apices; K+ red | <i>R. meridionalis</i> |
| 11. Thallus caespitose; saxicolous; apothecia terminal; divaricatic acid present | <i>R. microspora</i> (broad form) |
| Thallus erect to pendulous; corticolous or saxicolous; apothecia laminal or marginal; divaricatic acid absent | 12. |
| 12. Branches canaliculate; apothecia concave to plane; boninic acid present | <i>R. leiodea</i> |
| Branches flattened; apothecia plane to convex; boninic acid absent | <i>R. celastri</i> |

THE SPECIES

Ramalina australiensis Nyl.

Description (Fig. 2) Thallus corticolous or saxicolous, yellow-green, green to grey-green, erect to pendulous, 30–150 mm long, rarely to 250 mm; branching sparse in basal region to dense and irregular towards the apices where small branchlets emerge at right angles to the primary branch; branch width 0.1–1.5(–2.0) mm, primary branches subterete and fine or flattened and coarse, fine secondary branches often occur at right angles to



Figure 2. *Ramalina australiensis*, Raoul Island, Green Lake (B.W. Hayward KE5, AK 224398). Scale Bar 20 mm.
Photo: Dan Blanchon

main branch, apices curled or hooked; surface matt, longitudinally grooved near base; linear pseudocyphellae often present; holdfast delimited; soralia absent. Apothecia uncommon, sessile, lateral, +/- basal, plane to convex, disc 0.5–1.0(–1.3) mm diam., margin entire, pale pink-orange; ascospores ellipsoid, straight, 12–16 × 4.0–6.0 µm. **Chemistry:** Usnic acid only. Medulla K–. Description based on Blanchon *et al.* (1996).

Northern Kermadec Islands: Raoul Island: Five specimens seen: Hutchinson Bluff, W.R. Sykes 412/K, 5 Dec 1966, CHR 352164; East of Coral Bay, B.W. Hayward KE36, 26 Nov 1994, AK 224388; Boat Cove, A.E. Wright 12486, 26 Nov 1994, AK 224392; Green Lake, B.W. Hayward KE5, 21 Nov 1994, AK 224398; Near bottom of Sunshine Valley, B.W. Hayward KE29, 24 Nov 1994, AK 224402. **Herald Islets:** One specimen seen: Dayrell Island, P.J. de Lange K1279, 18 May 2011, UNITEC 6953. **Southern Kermadec Islands: Macauley Island: One specimen seen:** “Homalanthus Bush”, P. J. de Lange K1200, 21 May 2011, UNITEC 5912.

Comments *Ramalina australiensis* has been collected from Raoul and Dayrell Islands in the northern Kermadec Islands, and from Macauley Island in the Southern Kermadec Islands. In the Northern Kermadec Islands, specimens were collected from Kermadec pohutukawa (*Metrosideros kermadecensis*) and from Macauley Island, on Kermadec popular (*Homalanthus populifolius*).

Corticolous specimens tend to have long, fine branches, and can be confused with fine specimens of *R. peruviana* or *R. geniculata*. However, *R. peruviana* is sorediate and has a chemistry of the sekikaic acid aggregate, whereas *R. geniculata* is hollow and perforate. Saxicolous specimens can resemble *R. meridionalis* but that species branches mainly from the base and has norstictic acid in its medulla (K+ red), whereas *R. australiensis* has denser branching of fine side branches towards the apices and is K–.

***Ramalina canariensis* Steiner**

Description (Fig. 3) Thallus corticolous, pale-green to yellow-green, erect, 8–35 mm long; branching palmate or irregular; branch width 1.0–3.5 mm, branches flat, apices blunt, usually split; surface matt, smooth to rugose; holdfast delimited; soralia marginal and apical, often developing with the separation of upper and lower surfaces. Apothecia not seen in Kermadec or New Zealand material. Chemistry: Usnic acid and divaricatic acid. Medulla K–.

Description based on Blanchon *et al.* (1996).



Figure 3. *Ramalina canariensis*, Raoul Island, Sunshine Valley (P. J. de Lange K1206, UNITEC 5967). Scale Bar 20 mm. Photo: Dan Blanchon

Northern Kermadec Islands: Raoul Island: One specimen seen: Sunshine Valley, P. J. de Lange K1206, 16 May 2011, UNITEC 5967.

Comments *Ramalina canariensis* is a mainly maritime species, with Stevens (1987) recording it from parts of Australia with a Mediterranean type of climate, and also from the Mediterranean region, Canary Islands, South Africa and South America. In New Zealand the species has been referred to as having a subtropical maritime distribution (Blanchon *et al.* 1996), but Bannister *et al.* (2004) noted that specimens had been found in inland sites in New Zealand at 260 m in altitude. In New Zealand the species is not commonly seen, resulting in its current listing as ‘Naturally Uncommon’ by the New Zealand Lichen Threat Listing Panel (de Lange *et al.* 2012).

***Ramalina celastri* (Spreng.) Krog et Swinscow**

Description (Fig. 4) Thallus corticolous or saxicolous, pale green to grey-green, occasionally blue-grey, erect or pendulous, 10–120(–150) mm long; branching trichotomous, subdichotomous or irregular, small branches at right angles to the main branch sometimes present; branch width (1–)3–10 mm, occasionally to 20 mm, branches range from narrow and canaliculate with fine apices to broad and flat with blunt or tattered tips; surface matt, smooth to ridged or rugose, thin to coarse and thick, often torn or fenestrate in older thalli, sometimes producing small lobules from torn areas; pseudocyphellae common, short linear to punctiform; holdfast delimited; soralia absent. Apothecia numerous, marginal on narrow branches, marginal and laminal on broader branches; disc 0.3–2.0(–4.0) mm in diam., plane to convex; margin narrow, entire, smooth or incised, often occluded with age; ascospores oval, ellipsoid, straight, 9.5–15.5(–17.5) × 4.0–6.0 µm. Chemistry: Usnic acid and two unknowns (trace). Medulla K–.

Description based on Blanchon *et al.* (1996).



Figure 4. *Ramalina celastri*, Raoul Island, Green Lake (B.W. Hayward KE5, AK 224397). Scale Bar 20 mm. Photo: Dan Blanchon

Northern Kermadec Islands: Raoul Island: Two specimens seen: Green Lake, B.W. Hayward KE5, 21 Nov 1994, AK 224397; Denham Bay Track, Orange Grove Track, P.J. de Lange K749, 18 May 2011, AK 330764. **Herald Islets:** One specimen seen: Dayrell Island, P.J. de Lange K1278, 18 May 2011, UNITEC 6955.

Comments *Ramalina celastri*, a widespread, pan-subtropical species (Stevens 1987, Blanchon *et al.* 1996), has been recorded only from Raoul and Dayrell Islands. This photophilous species is evidently very uncommon on Raoul Island. Its absence from historical lichen collections made from Raoul Island, at a time when the island’s forest was much degraded through goat browse, and as a result frequented by photophilous lichen species such as *Ramalina pacifica* and *Crocodia aurata* (Ach.) Link (de Lange & Galloway 2015), suggests that *R. celastri* could even be a recent arrival to Raoul.

On Raoul Island the species appears to be exclusively corticolous, although in New Zealand it is routinely either saxicolous or corticolous (Blanchon *et al.* 1996, Hayward *et al.* 2014). The only species *R. celastri* is likely to be confused with is *R. leiodea* but that species is usually canaliculate, has concave or plane apothecia, and has a boninic acid chemistry, whereas *R. celastri* has plane to convex apothecia and no medullary chemistry.

***Ramalina exiguella* Stirton**

Description (Fig. 5) Thallus corticolous, grey-green to yellow-green, erect, rigid, 8–15(–20) mm long; branching mainly basal but with short, lateral branches appearing in some specimens; branch width 0.2–0.6 mm, branches subterete to terete, narrow, apices fine; surface shiny or matt, regularly grooved to cause a string-like appearance; pseudocyphellae common, linear; holdfast delimited; soralia absent. Apothecia common, few to many, marginal and subterminal causing branch tips to become geniculate; disc 0.3–1.7 mm diam., plane to convex; margin entire; ascospores ellipsoid, bent or rarely straight, occasionally reniform, $11.5\text{--}15.5 \times 5.0\text{--}7.0 \mu\text{m}$. **Chemistry:** Usnic acid only. Medulla K–
Description based on Blanchon *et al.* (1996).



Figure 5. *Ramalina exiguella*, Herald Islets, Dayrell Island (P.J. de Lange K553 AK 330754). Scale Bar 20 mm.

Photo: Dan Blanchon

Northern Kermadec Islands: Raoul Island: Five specimens seen: Green Lake, B.W. Hayward KE5, 21 Nov 1994, AK 224387; Green Lake, B.W. Hayward KE5, 21 Nov 1994, AK 224396; Lava Point, A.E. Wright 12446, 23 Nov 1994, AK 224395; Green Crater, C.J. West s.n., 1 Jul 1993, WELT L04403; Sunshine Coast, Near Boat Cove, 21 May 2012, P.J. de Lange K1160, AK 330765; **Herald Islets: One specimen seen:** Dayrell Island, P.J. de Lange K553, 18 May 2011, AK 330754.

Comments *Ramalina exiguella*, a typically corticolous, photophilous species from East Africa, Australia and New Zealand (Blanchon *et al.* 1996), is known in the Kermadec Islands only from the northern Kermadec Islands, where it has only been recorded from Raoul

and Dayrell Islands. With one exception, the saxicolous gathering of P.J. de Lange K1160, the Kermadec collections were all corticolous, being collected from the exposed twigs and branchlets of Kermadec pōhutukawa. On the Kermadec Islands this species is likely to be confused with only *R. geniculata* but it is not hollow and perforate, and it does not have any medullary chemistry.

***Ramalina geniculata* Hook.f. et Taylor**

Description (Fig. 6) Thallus corticolous and saxicolous, green to yellow-green, erect to subpendulous, 20–40(–50) mm high; branching dichotomous to subdichotomous; branch width 0.5–2.0(–4.0) mm, branches hollow, perforate, perforations oval; surface matt to shiny, smooth to rugose; pseudocyphellae rare, pustulate; holdfast delimited; soralia absent. Apothecia common, terminal or subterminal, usually geniculate (spurred); disc 0.5–3.0(–3.5) mm diam., plane or convex; margin entire but occluded at maturity; ascospores ellipsoid, straight or slightly curved, $(8.5\text{--})9.5\text{--}13.5 \times 4.0\text{--}7.0 \mu\text{m}$. **Chemistry:** Usnic acid, sekikaic acid (major) +/- divaricatic acid (minor), or divaricatic acid (major) +/- sekikaic acid. K+ pink.

Description based on Blanchon *et al.* (1996).



Figure 6. *Ramalina geniculata*, Raoul Island, Sunshine Valley (B.W. Hayward KE29 AK 224401). Scale Bar 20 mm.

Photo: Dan Blanchon

Northern Kermadec Islands: Raoul Island: Nine specimens seen: Bell's Terrace, C.J. West s.n., Jul 1993, WELT L04405; Green Lake, B.W. Hayward KE5, 21 Nov 1994, AK 224387; Northeast end of Denham Bay, B.W. Hayward KE12, 22 Nov 1994, AK 224390; near bottom of Sunshine Valley, B.W. Hayward KE29, 24 Nov 1994, AK 224401; Mouth of Sunshine Valley, B.W. Hayward KE30, 24 Nov 1994, AK 224389; Sunshine Valley, A.E. Wright 12473, 24 Nov 1994, AK 224391; North Terraces, B.W. Hayward KE34, 25 Nov 1994, AK 224399; Lava Point, A.E. Wright 12490, 26 Nov 1994, AK 224393; Bluff near Boat Cove, P.J. de Lange K547, 16 May 2011, AK 330747. **Southern Kermadec Islands: Macauley Island: Two specimens seen:** Western slopes of Mt Haszard, W.R. Sykes 1054/K,

18 Nov 1970, CHR 211875; Mt Haszard, *P.J. de Lange K556*, 21 May 2011, AK 330757.

Comments *Ramalina geniculata* is a corticolous and saxicolous species also found in New Zealand (Blanchon *et al.* 1996). Fine forms such as *P.J. de Lange K547* (AK 330747) approach the morphology of *R. australiensis*, *R. exiguella* or *R. peruviana*, and more robust forms like those collected from Macauley Island can resemble *R. microspora*. The hollow and perforate nature of *R. geniculata* easily distinguishes it from those other species. In the northern Kermadec Islands, *R. geniculata* was collected only from Raoul Island, mostly from open, coastal sites and from boulders lying in rank pasture. Despite the abundance of this habitat on the nearby Meyer Islands and the Herald Islets, the species was not seen there during the 2011 survey. On Macauley Island, *R. geniculata* seems to be uncommon, though there it grew with the superficially similar *R. microspora* and as such it might have been confused with that species in the field.

***Ramalina leiodea* (Nyl.) Nyl.**

Description (Fig. 7) Thallus corticolous, grey-green, erect or subpendulous, 40–80(–90) mm long; branching subdichotomous, sparse to moderate; branch width (0.5–)2.0–4.0 mm, branches compressed, flat or distinctly canaliculate when narrow, apices attenuate; surface matt, smooth to rugose, short linear pseudocyphellae sometimes present; holdfast delimited; soralia absent. Apothecia common, marginal and subterminal, rarely laminal, small thalli produce subterminal apothecia subtended by a spur; disc 1–3 mm in diam., concave to plane; margin entire or

incised at maturity; ascospores oval, ellipsoid, straight, or slightly curved, 9.5–15.5(–17.5) x 4.0–6.0 µm. **Chemistry:** Boninic acid (major), 2-*O*-methylsekikaic acid (minor), 2,4'-di-*O*-methylnorsekikaic acid (minor), 4'-*O*-methylpaludosic acid (minor), 4,4'-di-*O*-methylcryptochlorophaic acid (minor), and usnic acid. Medulla K–.

Description based on Stevens (1987).

Northern Kermadec Islands: Herald Islets: Two specimens seen: North Chanter, South summit, *P.J. de Lange K620*, 16 May 2011, AK 330761; Dayrell Island, *P.J. de Lange K1289*, 18 May 2011, UNITEC 6954. **Southern Kermadec Islands: Macauley Island: One specimen seen:** Mt Haszard, western seaward cliffs, *P.J. de Lange K557*, 21 May 2011, AK 330758.

Comments *Ramalina leiodea* is recorded from islands in the Indian and Pacific Oceans, Australia, New Caledonia, Norfolk Island and Lord Howe Island (Stevens 1987). Its presence therefore on the Kermadec Islands is to be expected, and it is indeed surprising it has not been recorded from there before. The current distribution may in part explain this, as neither Dayrell, North Chanter nor Macauley Island are often visited, and then rarely so by botanists. Interestingly, Sykes (1977) collected the saxicolous *R. microspora* from Macauley Island and it is tempting to speculate that had *R. leiodea* been present then, because it is a conspicuous species, he would almost certainly have gathered it too. However, the type of habitat in which it was collected on Macauley Island, Kermadec ngaio (*Myoporum rapense* subsp. *kermadecense* (Sykes) Chinnock) treeland was



Figure 7. *Ramalina leiodea*, Macauley Island, Mt Haszard (seaward cliffs) (*P.J. de Lange K557*, AK 330758). Scale Bar 20 mm. Photo: Dan Blanchon



Figure 8. *Ramalina luciae*, Raoul Island, road to Ravine 8 (*W.R. Sykes 679/K*, CHR 385510). Scale Bar 20 mm. Photo: Dan Blanchon

scarce during Syke's visits due to goat browse. Had it been present, then it is likely that it probably grew in cliff refugia on shrubs and trees, virtually inaccessible to humans. The only species likely to be confused with *R. leiodea* is *R. celastri* but that species lacks boninic acid and tends to have convex apothecia. An earlier Raoul Island collection (*A. E. Wright* 12490, (AK 284975)) could also be *R. leiodea*; the specimen is very fragmentary but boninic acid was detected with thin layer chromatography (J. Bannister pers. comm.).

Ramalina luciae Molho, Bodo, Culb. et C.Culb.

Description (Fig. 8) Thallus corticolous, pale green or green-yellow, subpendulous to pendulous, 44–120(–190) mm long; branching dichotomous, elongation between branching; branch width 0.5–3.0 mm, branches flattened at base and subterete at apices, growth form tangled due to fusion of branches; cortex matt; pseudocyphellae present, linear, inconspicuous; soralia marginal and laminal, round to ellipsoid. Apothecia not seen in New Zealand material. **Chemistry:** Usnic acid, sekikaic acid (major), 4'-*O*-demethylsekikaic acid (minor), 4'-*O*-methylnorsekikaic acid (minor) and ramalinolic acid (trace). Medulla K+ pink.

Description based on Blanchon *et al.* (1996).

Raoul Island: Five specimens seen: Between Meteorological Station, Boat Cove and Fishing Rock, *R.C. Cooper* 44209, 44289, Jun 1956, AK 310856, AK 310857; Above farm, *W.R. Sykes* 679/K, 3 Jan 1967, CHR 385510; Beside road to Ravine 8, Bell's Flat, *C.J. West s.n.*, 7 Jul 1993, WELT L04404, Bell's Flat, *C.J. West s.n.*, n.d. WELT L04402.

Comments Stevens (1987) records *Ramalina luciae* from Africa, Sri Lanka, Indonesia, Australia and across the Pacific to Fiji, Cook Islands and Tahiti. In the Kermadec Islands, *R. luciae* has only been collected from trees on Raoul Island – it seems to be absent from the same types of habitats on the nearby Meyer Islands and Herald Islets, where it is to be replaced by *R. pacifica*. Morphologically, *R. luciae* is very similar to *R. pacifica*, with both species having long dichotomous branches and large round to ellipsoid soralia. Chemistry easily separates the species, with *R. luciae* having the sekikaic acid aggregate (K+ pink) and *R. pacifica* having salazinic acid in the medulla (K+ red). *Ramalina luciae* tends to have longer branches between dichotomies (branching points). Stevens (1987) notes that apothecia in Australia are uncommon; they are described as lateral, with the disc 2 mm diam. and concave. The spores of *R. luciae* are ellipsoid to fusiform, straight or rarely curved (10–)12–16(–18) × 4–5(–6) µm.

Ramalina meridionalis Blanchon et Bannister

Description (Fig. 9.) Thallus corticolous or saxicolous (in New Zealand rarely corticolous), grey-green to yellow-green, suberect to pendulous, 3–12(–200) mm long, sparse to densely branched; branching mainly dichotomous, often with narrow lateral branches, usually more densely branched at the base where the holdfast



Figure 9. *Ramalina meridionalis*, Macauley Island, Mt Haszard (seaward cliffs) (P.J. de Lange K1159, AK 330766). Scale Bar 20 mm. Photo: Dan Blanchon

can produce several branches; branch width 1.0–2.0 mm, basal branches rigid angular-terete to slightly flattened, apical branches terete-subterete, twisted and somewhat nodulose, attenuate with fine apices which often break, leaving a blunt tip; surface matt, pseudocyphellae always present, numerous, linear, long, often giving a striate or striate-nervose appearance; holdfast delimited; soredia absent. Outer cortex indistinct or absent, chondroid strands present in medulla. Pycnidia present. Apothecia not seen in material from the Kermadec Islands. **Chemistry:** Usnic acid (major), norstictic acid (major) and ± connorstictic acid (minor). Medulla K+ red, C–. Description based on Blanchon and Bannister (2002).

Northern Kermadec Islands: Herald Islets: One specimen seen: Nugent Island, *P.J. de Lange* K1162, 18 May 2012, AK 330752. **Southern Kermadec Islands: Macauley Island: One specimen seen:** Mt Haszard, north-western seaward cliffs, *P.J. de Lange* K1159, 21 May 2012, AK 330766.

Comments: This species has been recorded from New Zealand, Lord Howe Island and Norfolk Island (Bannister & Blanchon 2003) so its presence on the Kermadec Islands was not unexpected. It is evidently scarce on the Kermadec Islands, though it is possible that it has been overlooked through confusion with the superficially similar *R. australiensis*. *Ramalina meridionalis* is most reliably distinguished from *R. australiensis* by the presence of norstictic acid (K+ red) and the lack of extensive secondary branching towards the apices.

***Ramalina microspora* Kremp.**

Description (Fig. 10) Thallus saxicolous, orange-brown, caespitose, 10.0–17.5 mm high. Branching dense, entangled, with many small side branches, anastomoses visible between adjacent branches; branches solid, narrow, terete, subterete to flattened (particularly at base), minor branch tips curled and slightly attenuate; branch width 0.1–2.0 mm, surface pitted and uneven; no pseudocyphellae seen; holdfasts delimited, multiple, some blackened. Apothecia common, subterminal, marginal, laminal and some geniculate, disc 0.2–2.5 mm in diam., concave to plane when very young with thick thalline margin, plane to convex and occluded when mature, obscuring margin. Ascospores 8 per ascus, elliptical, 1-septate, $10\text{--}14 \times 3\text{--}4 \mu\text{m}$. *Chemistry*: Divaricatic acid. Medulla K–.

Description based on Blanchon *et al.* (2012).

Northern Kermadec Islands: Raoul Island: One specimen seen: *W.R.B. Oliver s.n.*, 1908, *n.d.*, WELT L04263. **Herald Islets: Two specimens seen:** Dayrell Island, *P.J. de Lange K552*, 18 May 2011, AK 330753; Dayrell Island, *P.J. de Lange K1282*, 18 May 2011, UNITEC 6953. **Southern Kermadec Islands: Macauley Island: Five specimens seen:** Southern edge of plateau, *W.R. Sykes 1029/K*, 22 Nov 1970, CHR 162670; Crater Walls (Mt Haszard), *P.J. de Lange K554*, 21 May 2011, AK 330755; Mt Haszard, north-western seaward cliffs, *P.J. de Lange K555*, 21 May 2011, AK 330756; western seaward cliffs, *P.J. de Lange K559*, 21 May 2011, AK 330760; Mt Haszard, western seaward cliffs, *P.J. de Lange K571*, 21 May 2011, AK 330767. **Curtis Island: Four specimens seen:** West side of island, *W.R. Sykes 1038/K*, 28 Nov 1970 CHR 162672; Around fumaroles near summit, *G.A. Taylor s.n.*, 10 Nov

1989, AK 257905; AK 257906; Chasm, Foodtown Bay, *G.A. Taylor s.n.*, 10 Nov 1989, AK 257914. **Cheeseman Island: One specimen seen:** Summit rock outcrops, southern side of island, *P.J. de Lange K560*, 24 May 2011, AK 325084. **L'Esperance Rock: One specimen seen:** *P.J. de Lange K1158*, 26 May 2011, AK 330763.

Comments Blanchon *et al.* (2012) confirmed *Ramalina microspora* as present on Curtis, Cheeseman and Macauley Islands; the main islands of the southern Kermadec Islands. Subsequent examination of specimens for this paper, extends the Kermadec range south to L'Esperance Rock, and also confirms the species as present in the northern Kermadec Islands (cf. Sykes 1977), where it is known from Raoul Island and from Dayrell Island in the Herald Islets chain. This is supposedly a Hawaiian Islands endemic whose range was recently extended to Rarotonga in the Cook Islands (Blanchon & de Lange 2011). Its presence on Rarotonga and the Kermadec Islands follows a pattern already noted by Renner and de Lange (2011) for *Lejeunea hawaikiana* M.A.M. Renner et de Lange and *L. schusteri* Grolle, minute, corticolous liverworts, originally described as New Zealand endemics and subsequently recorded from Raoul Island and Rarotonga. A note of an epiphyllous gathering of it reported by Sykes (1977: 48, CHR 211875) is actually *R. geniculata*, and *Ramalina microspora* appears to be an exclusively saxicolous lichen (see Blanchon *et al.* 2012), characterized by its densely branched caespitose thallus which is studded with subterminal and marginal apothecia and a secondary chemistry of divaricatic acid. Two other species recorded from the Kermadec Islands, *Ramalina geniculata* and *R. exiguella*, could be mistaken for *R. microspora*. However, *Ramalina geniculata* is inflated and perforate, whereas *R. exiguella* lacks perforations and medullary secondary chemistry.



Figure 10. *Ramalina microspora*, Curtis Island, near summit (*G.A. Taylor s.n.*, AK 257906). Scale Bar 20 mm. Photo: Dan Blanchon

***Ramalina pacifica* Asah.**

Description (Fig. 11A, B) Thallus corticolous rarely saxicolous, grey-green to yellow-green, erect or subpendulous to pendulous, 20–110 mm long; branching dichotomous, sparse to dense and intricate; branch width 0.5–2.5 mm, branches flat, some marginal and apical splitting; broad basally, narrowing towards apices; apices attenuate and forked; surface matt or shiny, smooth, often with linear pseudocyphellae; holdfast delimited; soralia marginal and laminal, round to ellipsoid, margins prominent. Apothecia not seen. *Chemistry*: Usnic acid, salazinic acid (major), +/- protocetraric acid (minor/trace). Medulla K+ red.

Description based on Blanchon *et al.* (1996)

Northern Kermadec Islands: Raoul Island: Five specimens seen: *W.R.B. Oliver s.n.*, 1908, AK 202677; *W.R.B. Oliver s.n.*, 1908, WELT L04265; Lava Point, *A.E. Wright 12491*, 26 Nov 1994, AK 224394; North Terraces, *B.W. Hayward KE34*, 25 Nov 1994, AK 224400; near Boat Cove, *P.J. de Lange K546*, 16 May 2011, AK 330746. **Meyer Islands: Three specimens seen:** North Meyer, *W.R. Sykes 675/K*, 6 Dec 1966, CHR 161137; North Meyer, *P.J. de Lange K542*, 12 May 2011, AK 330742;



Figure 11. *Ramalina pacifica*. A. Raoul Island, Lava Point, narrow form (A. E. Wright 12491, AK 224394). B. Herald Islets, North Chanter, broad form (P. J. de Lange K548, AK 330748). Scale Bar 20 mm. Photo: Dan Blanchon

North Meyer, *P.J. de Lange K1157*, 12 May 2011, AK 330768; South Meyer, *P.J. de Lange K544*, 13 May 2011, AK 330744. **Herald Islets: Two specimens seen:** North Chanter, North Summit, *P.J. de Lange K548*, 16 May 2011 AK 330748; Dayrell Island, *P.J. de Lange K1283*, 18 May 2011, UNITEC 6957. **Southern Kermadec Islands: Macauley Island: One specimen seen:** Mt Haszard, western seaward cliffs, *P.J. de Lange K558*, 21 May 2011, AK 330759. **L'Esperance Rock: One specimen seen:** Summit, *P.J. de Lange K561*, 26 May 2011, AK 330762.

Comments *Ramalina pacifica* is a mainly subtropical-warm temperate species, found from South Africa through Southeast Asia, Australia, New Zealand and the Cook Islands (Stevens 1987, Blanchon *et al.* 1996). On the continental islands of New Zealand it is now in decline, resulting in its current listing as Threatened by the New Zealand Lichen Threat Listing Panel (de Lange *et al.* 2012). However, on the Kermadec Islands it is one of the more common *Ramalina* species, though it is now mostly seen there in the northern Kermadec Island group on the less densely vegetated Meyer Islands and Herald Islets. It now seems less common on Raoul Island (cf. Oliver 1912, Sykes 1977), possibly because the forest cover there has increased in density following the eradication of goats from that island in 1983, thus providing conditions that do not favour this photophilous species (de Lange & Galloway 2015). In the southern Kermadec Islands, *Ramalina pacifica* was collected from Macauley Island and L'Esperance Rock, and these seem to be the first records of the species from the southern Kermadec Islands.

Some saxicolous specimens, e.g. L'Esperance Rock (*de Lange K561*, AK 330762), have stunted and deformed morphology and only traces of salazinic acid in TLC. On the islands, *Ramalina pacifica* can be mistaken for broad forms of *R. peruviana* but that species has denser irregular branching and the sekikaic acid aggregate, whereas *R. pacifica* has dichotomous branching and salazinic acid. The species can be sympatric with *R. luciae* but they are easily distinguished by their chemistry. Apothecia are unknown in New Zealand and Stevens (1987) reports them as uncommon in Australian material. They are described by Stevens (1987) as marginal, disc 1–3 mm diam., concave, plane or convex, edges sometimes incised; spores fusiform or ellipsoid, straight or slightly curved, $12\text{--}16\text{--}(20) \times 4\text{--}6\text{ }\mu\text{m}$.

Ramalina peruviana Ach.

Description (Fig. 12) Thallus corticolous, rarely saxicolous, grey-green to yellow green, tufted, erect to subpendulous, 20–60 mm long; branching subdichotomous to irregular, intricate; branch width 0.15–1.3 mm, branches flat to subterete or terete, branches can be slightly twisted, apices sharp; surface matt or shiny, smooth or rugose, pseudocyphellae sometimes present; holdfast delimited or diffuse in dense colonies; soralia punctiform, numerous, laminal, marginal or apical, small fibrils often produced from soralia. Apothecia rare, marginal, lateral; disc 0.4–2.7 mm diam., concave to plane, often incised; ascospores narrow, fusiform, straight or rarely curved, $(9.5\text{--})14.5\text{--}17.0\text{--}(23.0) \times 3.0\text{--}6.0\text{ }\mu\text{m}$. **Chemistry:** Usnic acid, homosekikaic acid (major), sekikaic acid (major),



Figure 12. *Ramalina peruviana*, Herald Islets, Napier Island (P. J. de Lange K550, AK 330750). Scale Bar 20 mm.
Photo: Dan Blanchon

ramalinolic acid (minor/trace), 4'-*O*-demethylsekikaic acid (minor/trace), 4'-*O*-methylnorsekikaic acid (minor/trace), +/- 4'-*O*-methylnorhomosekikaic acid (trace). Medulla K+ pink.

Description based on Blanchon *et al.* (1996)

Northern Kermadec Islands: Raoul Island: Five specimens seen: *W.R.B. Oliver s.n.*, 1908, AK 33480; Between Meteorological Station, Boat Cove and Fishing Rock, *R.C. Cooper 44128*, Jun 1956, AK 304651; Above farm, *W.R. Sykes 679/K*, 3 Jan 1967, CHR385511; Old orchard behind Met Station, *B.W. Hayward KE31*, 25 Nov 1994, AK 224386; Sunshine Valley, *P.J. de Lange K545*, 16 May 2012, AK 330745. **Meyer Islands: Two specimens seen:** North Meyer, *P.J. de Lange K541*, 12 May 2011, AK 330741; South Meyer, *P.J. de Lange K543*, 13 May 2011, AK 330743. **Herald Islets: Three specimens seen:** North Chanter, North Summit, *P.J. de Lange K549*, 16 May 2011, AK 330749; Napier, *P.J. de Lange K550*, 17 May 2011, AK 330750; Nugent, *P.J. de Lange K551*, 18 May 2011, AK 330751.

Comments: *Ramalina peruviana* is a widely distributed species. Stevens (1987) lists it from Africa, Australia, New Zealand, South America and several Pacific islands. In New Zealand, it is widespread in the North and northern South Islands, also the Chatham and Three Kings Islands (Bannister *et al.* 2004), and in the North Island; next to *R. celastri* probably the most commonly encountered species in the genus. On the Kermadec Islands, it seems to be restricted to the northern Kermadec Islands where it grows on rocks and bark. On the Kermadec Islands *Ramalina peruviana* could be mistaken for *R. australiensis* or *R. pacifica* but *R. australiensis* lacks soralia and has no medullary chemistry, and *R. pacifica* has simple dichotomous branching and salazinic acid in the medulla rather than the sekikaic acid aggregate.

Incertae sedis

We were unable to identify one *W.R.B. Oliver* specimen from Raoul Island (WELT L04264) to species level due to its fragmentary nature and poor state of preservation. Additionally, we were unable to locate two other specimens held at AK, AK 227550 and AK 310551, both from Raoul Island.

DISCUSSION

This paper accepts eleven *Ramalina* species for the Kermadec Islands, an increase of four (*R. canariensis*, *R. leiodea*, *R. meridionalis* and *R. microspora*) on those accepted earlier for the islands by Bannister and Blanchon (2003), and Galloway (2007). Of the species recorded here, only *R. leiodea* is new to the mycobiota of the New Zealand Botanical Region, *R. microspora* having been finally confirmed as present in the New Zealand Botanical Region (*sensu* Allan 1961) by Blanchon *et al.* (2012). The discovery of *Ramalina meridionalis* on the Kermadec Islands represents an anticipated easterly range extension of this species, which had hitherto been recorded from the northern North Island of New Zealand, Lord Howe and Norfolk Islands (Blanchon & Bannister 2002). The number of species recorded for the Kermadec Group (eleven) compares favourably with that of mainland New Zealand (15, Galloway 2007) or nearby Norfolk Island (eight, <http://www.anbg.gov.au/abrs/lichenlist/IS_NORFOLK.html>, viewed 14 May 2012) and Lord Howe Island (five, McCarthy 2012). In contrast the seeming low diversity of *Ramalina* on Lord Howe Island is unusual. This may reflect the more closely forested condition of that island, which would limit the range of habitats for photophilous *Ramalina*, or the possibility that the lichen mycobiota of that island has yet to be thoroughly explored.

In a pattern that reflects island size, relief, habitat and vegetation recovery, *Ramalina* is best represented only on the islands of the northern Kermadec Islands. With the exception of *R. microspora*, none of the *Ramalina* species recorded from the southern Kermadec Islands (*R. geniculata* and *R. pacifica*) are widespread, though on Macauley Island, *R. pacifica* is locally common in a small area. Nevertheless, aside from the Meyer Islands and Herald Islets, *Ramalina* is not especially conspicuous on Raoul Island either, quite a departure from the comments made by Sykes (1977) of *R. pacifica*: 'The long grey fronds of this species are common on *Rhopalostylis* trunks on the Terraces of Raoul' which was not the case in 2011. Indeed, aside from a few selected microhabitats, such as boulder beaches, cliff faces and on the exposed branches of trees, in the high canopy, or along ridgelines, none of the *Ramalina* recorded from the northern Kermadec Islands were common. While some, such as *Ramalina celastri*, are inexplicably scarce. We suspect that the changes in abundance of some *Ramalina* species recorded by Oliver (1912) and Sykes (1977) from Raoul Island, and the scarcity of others, reflects the ongoing recovery of that island's vegetation following the removal of goats (by 1983), and, by 2002, cats and rats (see de Lange & Havell 2009). The forest on Raoul Island has greatly changed in its structure since the first lichen collections were made, with a general thickening up of the understorey. *Ramalina* species are generally photophilous, and it seems probable that the past abundance of species such as *R. pacifica* (Sykes 1977) can be attributed to the then open forested conditions created over much of the island by feral goats. Now, 29 years after the last goat was eradicated, such habitats exist only where local

conditions have kept the vegetation open (e.g. coastal shrubland at Coral Bay, on the exposed ridgelines and cliff faces of Hutchison, and Smiths Bluff, and at Boat Cove and Denham Bay), within the caldera where volcanic activity has kept the vegetation cover open, or in places where human activity has kept the forest open, such as along the Airstrip of the Terraces.

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