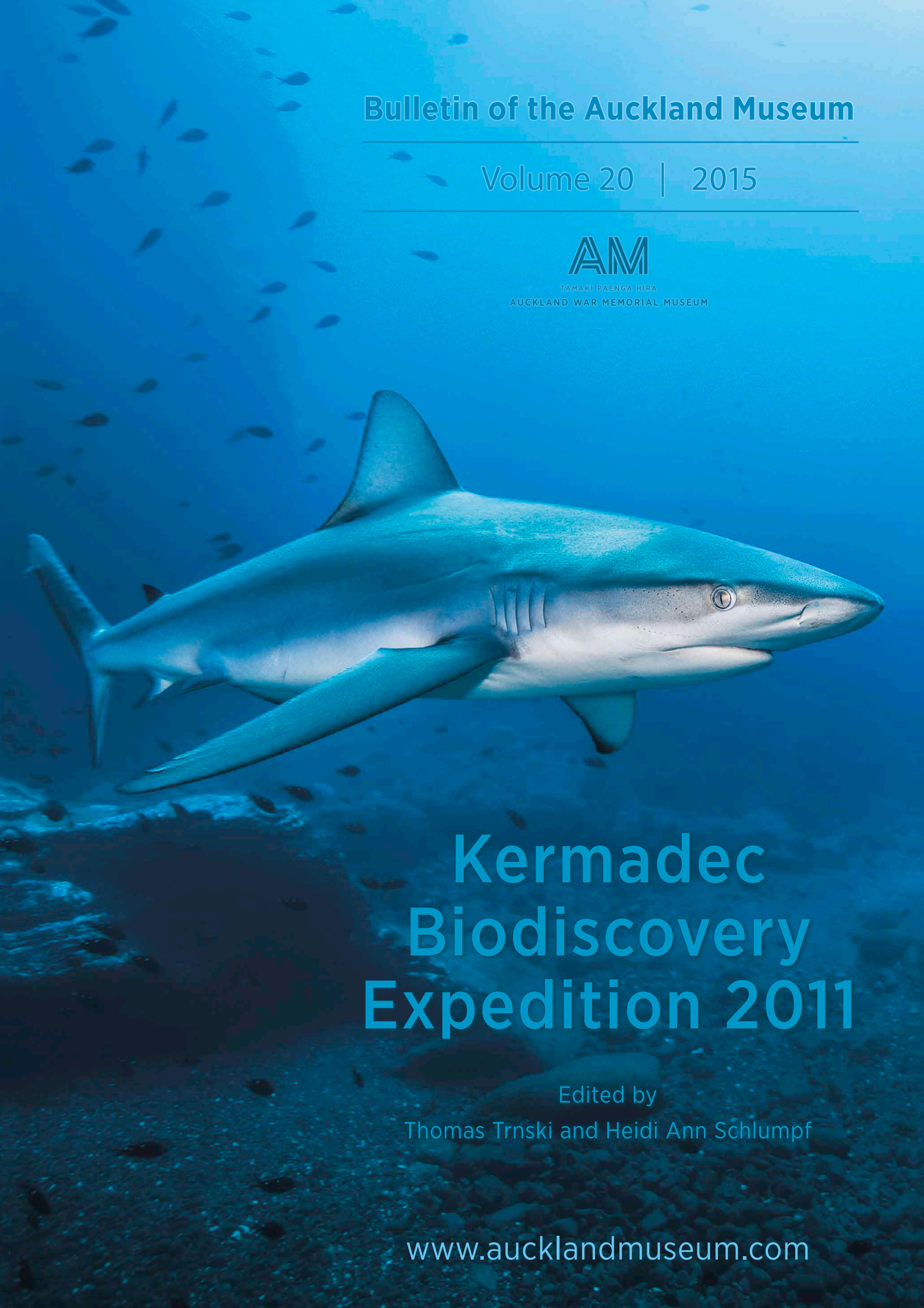




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The flora and vegetation of L'Esperance Rock, southern Kermadec Islands

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Abstract

The flora and vegetation of L'Esperance Rock, Kermadec Islands, is described. L'Esperance has a flora of twelve plants (one pteridophyte, nine angiosperms, one liverwort, one moss). Fifteen lichens (14 identified to species level, one to genus level) are also reported here. The grass, *Lachnagrostis billardierei* subsp. *billardierei*, and the herbs, *Lepidium oleraceum*, *Spergularia tasmanica*, and *Solanum nodiflorum*, are additions to the vascular flora of L'Esperance Rock, and, aside from the *Lepidium* and *Solanum*, the others are also additions to the known flora of the Kermadec Islands. Ten lichens are additions to recorded mycobiota for L'Esperance Rock, and of these, seven are also new records for the Kermadec Islands. Three empirically derived plant associations are recognised: bare rock and cliff faces, lichen field and *Disphyma* turf. The impact of Cyclone Bune (which struck L'Esperance Rock at the 28 March 2011) on the vegetation of the Rock is discussed, and the role that cyclones may have in the turnover of island flora is briefly explored. The conservation status of the L'Esperance Rock endemic *Senecio lautus* subsp. *esperensis* is reviewed.

Keywords

Kermadec Islands; southern Kermadec Islands; L'Esperance Rock; flora; lichens; bryophytes; pteridophytes; angiosperms; plant associations; cyclone damage; island biogeography; *Senecio lautus* subsp. *esperensis*

INTRODUCTION

L'Esperance Rock (4.86 ha, 70 m a.s.l., 31° 25' 52.03" S, 178° 53' 56.12" W; Fig. 1, 2) is the most southerly and isolated of the southern Kermadec Islands. The geology is subaerially deposited feldspar-rich basaltic andesites and andesitic scoria (Brothers & Hawke 1981, but see Latter *et al* 1992 for an alternative view). The elevation of the Rock is confused. Initially Sykes (1971) stated that this was 60.96 m a.s.l., and then, in his *Kermadec Bulletin*, he gave it as 45.72 m (Sykes 1977), whereas the actual rock reaches an elevation of 70 m a.s.l. (see de Lange 2012 and NZ Kermadec Islands Topo25 maps (<http://data.linz.govt.nz/#/layer/864-nz-kermadec-is-raster-image-topo25/> accessed 15 August 2013)).

L'Esperance Rock is a narrow, north–south aligned, jagged volcanic crag that rises steeply to a narrow saddle area of deeply furrowed and pitted, dark red, scoriaceous lava, at the southern end of which is the highest point. On either side of the ‘summit saddle’ are two large circular pits that have been called ‘craters’ by landing parties, though whether they are the result of volcanic activity or erosion is unclear. The northern end of the Rock is almost separated from the southern two thirds by a steep-sided, more or less east–west-running saddle the base of which lies at an estimated 20 m a.s.l. Along the southern and south-western side of the Rock are a series

of rock platforms and wave-washed rock outcrops. Vascular plant vegetation is confined to the upper two thirds of the Rock, and is mostly concentrated along the summit saddle, and fringing the ‘craters’.

The first flora of L'Esperance Rock was compiled by T.F. Cheeseman based on collections made by Captain J. Fairchild from the island in August 1888 (in Cheeseman's unpublished notebook of the 1887 Kermadec expedition; Auckland War Memorial Museum, Ref. MS 58, Box 20, Item 1). This consisted of four vascular plants: *Agrostis* L. sp. (= *Lachnagrostis* Trin. sp.), *Asplenium obtusatum* G.Forst. (= *A. northlandicum* (Brownsey) Ogle), *Mesembryanthemum australe* Sol. ex G.Forst. (= *Disphyma australe* subsp. *stricticaule* Chinnock), *Senecio lautus* Willd. (= *Senecio lautus* subsp. *esperensis* (Sykes) de Lange)). These collections however, seem to have been lost (Sykes 1971). W.R.B. Oliver visited the Rock in 1908 and recorded the same four species and added one further plant, *Parietaria debilis* G.Forst. (Oliver 1910). He considered that the Rock was scarcely able to support a vascular plant flora because it is almost wholly subjected to salt spray. Sykes (1971, 1977) visited the Rock twice, on day trips in July 1969 and November 1970, and during these visits he added only one further vascular plant record to Oliver's list, *Rhagodia triandra* (G.Forst.) Aellen (= *Chenopodium trigonon* subsp. *trigonon* Schult.). He also

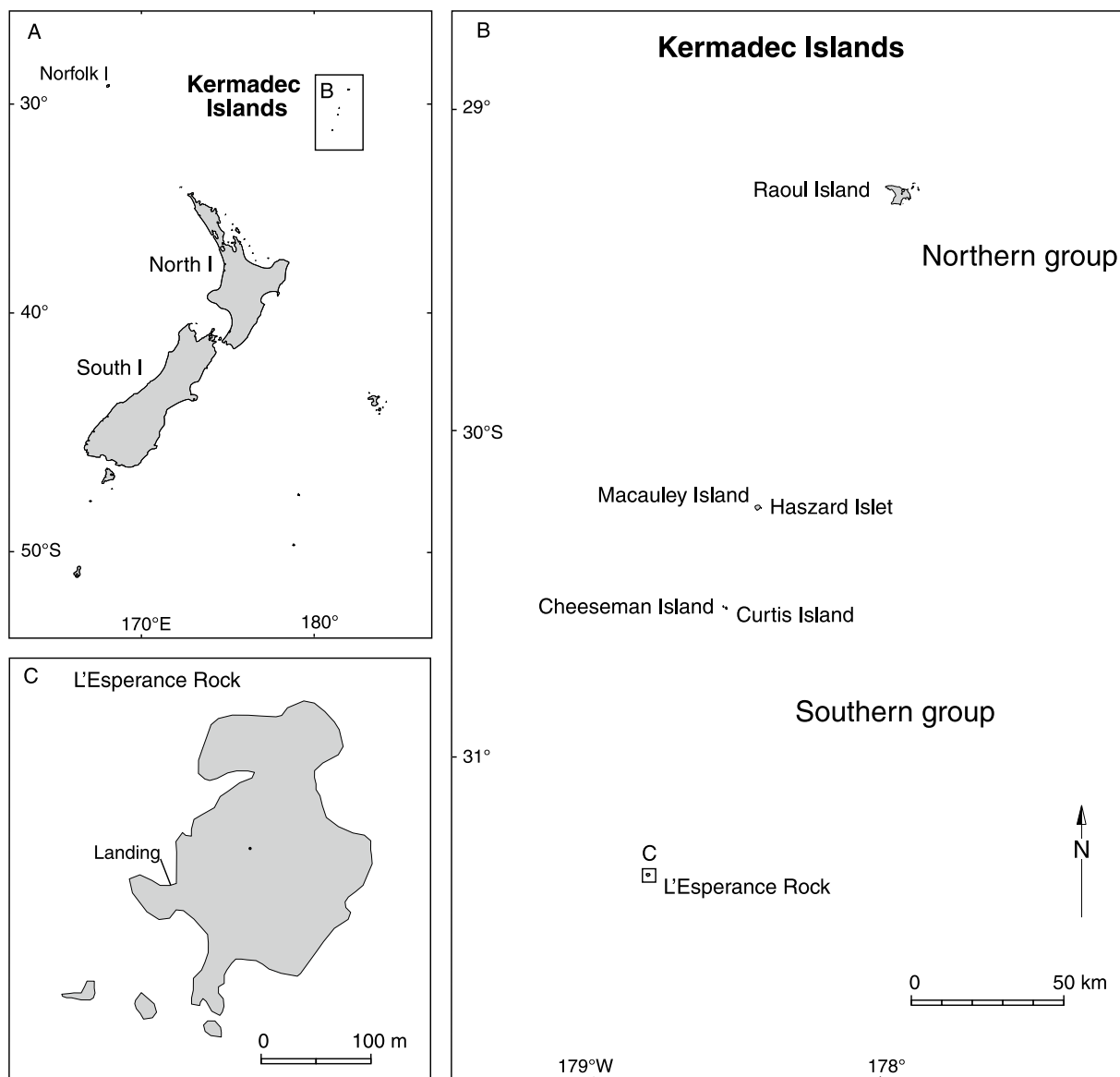


Figure 1. Location of the Kermadec Islands showing **A**, the position of the Kermadec islands in relation to Norfolk Is. and the main New Zealand islands, **B**, location of the northern and southern Kermadec Islands, and **C**, L'Esperance Rock showing landing site used during May 2011.



Figure 2. L'Esperance Rock, 26 May 2011 as seen from western side at low tide. Visible is the western 'crater', summit saddle aligned north to south, and at the southern termination of the saddle also the highest point on the Rock.

described a new, endemic variety of *Senecio lautus* from the Rock, *S. lautus* var. *esperensis* Sykes (Sykes 1971), since elevated to subspecies rank (de Lange *et al.* 2010) though it probably merits species rank (de Lange 2012).

Visits to L'Esperance Rock are infrequent because it is the most remote of the Kermadec Islands (lying 96.56 km SSW of Curtis Island, its nearest neighbour in the chain) (Fig. 1), and it lies out of the main shipping route to Raoul Island. Department of Conservation entomologist Warren Chinn and I visited it for five hours on 26 May 2011 during the 2011 Kermadec Biodiscovery Expedition. Landing on that day was possible only on the western side of the rock, in a narrow gut which afforded excellent access up to the summit saddle. During my visit I examined all of the accessible vegetated parts of the island, collected plants

and lichens, examined the conservation status of *Senecio lautus* subsp. *esperensis*, and procured live material of some plants (*Lachnagrostis* *Parietaria* and *Senecio*) for further study back in Auckland, New Zealand. I also made empirical observations on the plant associations.

Here I report on: the collections made during that visit, the conservation status of *Senecio lautus* subsp. *esperensis* and using my field observations describe the plant associations of the Rock.

METHODS

During my visit to L'Esperance I traversed most of the Rock (estimated 90% coverage) during which time I undertook a full survey of the bryophytes and vascular flora, collected some of the more obvious lichens and made notes on the birds (for bird observations see de Lange 2012). I described the plant associations using the non-quantitative method of Atkinson (1985).

Herbarium specimens collected were treated as follows: bryophytes and lichens were collected into packets and air dried in transit to New Zealand, while vascular plants were collected into a solution of three parts concentrated ethanol to one part concentrated acetic acid. Back in New Zealand the vascular plants were then sorted, cleaned and dried at AK.¹

Live seedlings of *Lachnagrostis littoralis*, *Parietaria debilis* and *Senecio lautus* subsp. *esperensis* were uplifted from the Rock and cultivated in Auckland, New Zealand, until they reached the flowering or fruiting stage. In this way taxonomically informative herbarium specimens of these three species were obtained. Herbarium specimens of vascular plants and bryophytes were lodged at AK with duplicates sent to CHR, F, and WELT, and most lichen collections were lodged at UNITEC.

Authorities for all lichens and plants seen on L'Esperance Rock are either provided in Appendix 1, or within the main body of this paper. Nomenclature and families for the sole moss and liverwort seen follows de Lange & Beever (2015), and Ngā Tipū o Aotearoa – New Zealand Plants Database (<http://nzflora.landcareresearch.co.nz/> – accessed 15 August 2013) and Stotler & Long (2009). Authorities for lichen families and taxa follow Elix (2011), de Lange *et al.* (2012) and Blanchon *et al.* (2012). Angiosperms are arranged phylogenetically according to APG III (2009), and then alphabetically by family as per de Lange & Rolfe (2010) with authorities derived from the International Plant Names Index (<http://www.ipni.org/index.html> – accessed 15 August 2013). Lichens and bryophytes are also arranged alphabetically by family.

RESULTS

Flora and Mycobiota of L'Esperance Rock

I accept 10 vascular plants (one pteridophyte, nine angiosperms) and two bryophytes for L'Esperance Rock (Appendix 1). Of these, four angiosperms, the liverwort

and the moss, are additions to previous accounts of the flora of L'Esperance Rock.

Two angiosperm species, *Lachnagrostis billardiarei* subsp. *billardiarei* and *Spergularia tasmanica* are also additions to the flora of the Kermadec Islands (Sykes 1977; Sykes & West 1996; de Lange *et al.* 2013a). The liverwort and moss are also the first records of bryophytes on L'Esperance Rock.

Bryophytes

One liverwort, the foliose *Frullania pentapleura*, and one moss *Bryum argenteum* were collected from the Rock (Appendix 1).

Although I have assigned the L'Esperance *Frullania* to *F. pentapleura* (here including the morphologically similar New Zealand endemic *F. solanderiana* Colenso), this species is part of a variable Australasian species complex that is being investigated (M.J. von Konrat *pers. comm.*).

Vascular Plants

Eleven vascular plant collections were made from L'Esperance Rock (Appendix 1). In addition, three specimens were collected as live plants during my visit there, and these were cultivated back in Auckland until flowering, with specimens collected from them lodged in AK. All six vascular plant species previously recorded from L'Esperance Rock by Sykes (1977) were seen during my visit, and a further four taxa collected are additions to the flora of the Rock: *Lachnagrostis billardiarei* subsp. *billardiarei*, *Lepidium oleraceum*, *Spergularia tasmanica* and *Solanum nodiflorum*. These finds represent a 60% gain in the vascular flora of L'Esperance Rock since the last listing for the Rock by Sykes (1971, 1977) and Sykes & West (1996).

Because of cyclone damage, and possibly also because of the time of the year, the annuals *Lachnagrostis littoralis* subsp. *littoralis*, *Parietaria*, and *Senecio* were only noted as seedlings. The fern *Asplenium northlandicum* was locally common, particularly in the western 'crater' and on the south-western-facing ledges near the southern (and main) summit. Though still the dominant plant of the island, most plants of *Disphyma* were tattered, dying and/or dead adults because of recent storm damage (Fig. 3). Nevertheless, *Disphyma* seedlings, mostly still at the cotyledon stage, were abundant. A very few adult plants were also flowering, albeit sparingly, and in all cases the flowers noted were pink rather than white (cf. Sykes 1977).

Parietaria debilis was the next most common vascular plant: seedlings up 100 mm tall were frequent, particularly where the deeply fissured scoriaceous summit saddle lava provided some shelter from the wind, and also around the rotting corpses of black winged petrels (*Pterodroma nigripennis*) (Fig. 4). *Senecio lautus* subsp. *esperensis*, the sole endemic of the Rock and a plant adjudged as 'Threatened / Nationally Critical' (see

1. Herbarium acronyms follow Thiers (2013)



Figure 3. *Disphyma* turf on the summit saddle of L'Esperance Rock showing cyclone-inflicted die back and resprouting. In this image patches of *Parietaria* and *Senecio* seedlings are also present.



Figure 4. An area of dead *Disphyma* turf supporting *Parietaria debilis* and *Senecio lautus* subsp. *esperensis* seedlings that have germinated around a black winged petrel (*Pterodroma nigripennis*) corpse.



Figure 5. *Senecio lautus* subsp. *esperensis* seedlings seen here growing with scattered *Parietaria debilis* amongst the deeply fissured, scoriaceous summit saddle lava. Note the dead *Disphyma* (killed by Cyclone Bune) and scattered feathers and wing of a dismembered black winged petrel.



Figure 6. Summit Saddle of L'Esperance Rock (straddling the 'western' and 'eastern' craters) showing the deeply fissured and pitted scoriaceous lava field which during the May 2011 visit was sporting large expanses of bare ground and dead *Disphyma* due to the passage of Cyclone Bune 56 days prior to the date this image was taken. Already patches of resprouting *Disphyma* can be seen reclaiming this area.



Figure 7. Regenerating *Disphyma* turf on the summit saddle. While most of the *Disphyma* is dead some of it has resprouted and the bare ground between dead plants supported numerous seedlings (cotyledon stage). Also to be noted are patches of *Parietaria* and *Senecio* that formed distinctive mixed 'patches' on the margins of dead or resprouting *Disphyma*.

de Lange *et al.* 2010; de Lange *et al.* 2013b), was almost as common, though again it was mostly observed as seedlings (< 30 mm tall) (Fig. 5). Seasonally this plant must be very common and, to judge by measurements made of *in-situ*, dried-off plants, commonly attain heights of nearly 1 m (see AK 326043).

Chenopodium trigonon subsp. *trigonon* was very uncommon, again due to storm damage. Most plants were seedlings (some up to 50 mm long) but a few storm-battered, resprouting specimens were noted near the southern end of the summit saddle.

Seedlings of *Lachnagrostis littoralis* subsp. *littoralis* were common in the fissured and cracked lava of the main saddle area. Several of these were taken back to New Zealand and cultivated until reproductive. Previously Sykes (1977), based on comments made by then DSIR Botany Division agrostologist V. Zotov, had placed L'Esperance specimens of this grass in *L. richardii* Zotov, a species later synonymised with *L. pilosa* (Buchanan) Edgar subsp. *pilosa* by Edgar (1995). Subsequently Edgar (1995) placed the L'Esperance *Lachnagrostis* within her concept of *L. littoralis* subsp. *littoralis*, a subspecies she accepted as also present on all the other main islands of the Kermadec Islands. Nevertheless, L'Esperance Rock seedlings cultivated back in New Zealand are more robust than typical *L. littoralis*, with much broader leaves than the size range given for *L. littoralis* in New Zealand and Kermadec Islands specimens (Edgar 1995). Chromosome counts I obtained from one of the L'Esperance Rock plants had $2n = 98$ rather than $2n = 56$ (the only number so far recorded for both subspecies of *L. littoralis* (de Lange & Murray 2002; Murray *et al.* 2005)). In New Zealand two numbers have been obtained for *L. pilosa* subsp. *pilosa*, $2n = 56$ and $2n = 98$ (de Lange & Murray 2002; Murray *et al.* 2005), the plants with $2n = 98$ being the more common and widely distributed (Murray *et al.* 2005). However, with respect to other critical characters, particularly those of the lemma and rachilla, the L'Esperance Rock *Lachnagrostis* fits within *L. littoralis* subsp. *littoralis* (R.O. Gardner *pers. comm.*) thus matching the circumscription offered by Edgar (1995). Nevertheless, while I retain L'Esperance Rock plants in *L. littoralis* subsp. *littoralis*, they would repay further critical study, in the opinion of Australian *Lachnagrostis* expert A.J. Brown (*pers. comm.*).

Lichens

While Sykes (1977) noted that lichenized fungi are a conspicuous part of the vegetation of L'Esperance Rock, they have hitherto been poorly collected from the Rock. I mostly collected the more obvious and/or dominant lichens and probably overlooked many of the smaller, less conspicuous crustose lichens. From the collections, fourteen taxa (eight crustose, three fruticose, three foliose) were identified to species level (Appendix 1). Of the species, two taxa, *Buellia stellulata* and *Dufourea ligulata* had been recorded previously from L'Esperance Rock by Sykes (1977), while the others are new records for the Rock and, except for *Ramalina microspora* and *R. pacifica*, are also new records for the Kermadec

Islands. Two species of *Caloplaca*, *C. acheila* and *C. rubentior* are species previously regarded as endemic to the North Auckland coastline of the North Island, New Zealand (Galloway 2007). A further species of *Caloplaca*, with a leprose, green-yellow thallus, was also collected but being sterile could not be determined to species level. Of those *Caloplaca* species treated by Galloway (2007) it approaches *C. lutea* (J.R. Laundon) D.J. Galloway in most respects except colour. *Caloplaca lutea* is a montane to alpine species of the main axial ranges of the North and South Islands (Galloway 2007). The *Heterodermia pseudospeciosa* is also apparently new to the mycobiota of the New Zealand Botanical Region (de Lange *et al.* 2012), because Elix (2011) though recording it from New Zealand, does not cite specimens. A second *Heterodermia*, keys to *H. japonica* following Elix (2011) but differs from other Kermadec and New Zealand examples of this species by the thallus undersides with are white rather than usual violet-purple – the sole condition ascribed to it by Galloway (2007).

CYCLONE DAMAGE

As with the rest of the Kermadec Islands visited (de Lange 2011a, 2011b, 2011c, 2012, de Lange 2015a, 2015b) the vegetation of L'Esperance Rock was still recovering from the passage of Cyclone Bune, which had struck the Kermadec Islands on the 28 March 2011 (de Lange 2012). The most obvious impact of the cyclone on the Rock was the reduction in the cover of *Disphyma* (Fig. 6, 7). The destruction of the emergency fuel dump and associated platform used by rescue helicopters also attested to the ferocity of the storm. The platform and fuel dump comprising 10 or more 44-gallon drums of aviation fuel, and built at c.60 m a.s.l., had been present one month prior to the passage of the cyclone (M. Jolly *pers. comm.*). It seems that the cyclone had simply blown the structure and its associated fuel off the Rock.

Despite the destruction, which included a summit littered with rotting black-winged petrel corpses, many of which had been scavenged by a raptor of some kind (possibly Australasian harrier (*Circus approximans*) (G.A. Taylor *pers. comm.*)) (Fig. 8), numerous *Disphyma*, *Parietaria*, *Lachnagrostis littoralis* subsp. *littoralis* and *Senecio* seedlings were seen (Fig. 4, 7). While the cyclone had severely impacted on the scrambling perennials *Disphyma* and *Chenopodium*, no serious damage was noted in the fern *Asplenium northlandicum* (Fig. 9), even in those areas where the surrounding *Disphyma* turf was completely dead.

Plant Associations

Three plant associations were distinguished during my visit. A generalised map showing their distribution is provided (Fig. 10). The vegetation associations are arranged in an approximate altitudinal sequence.

1. Bare Rock and Cliff Faces

Bare rock occupied an estimated 40% of the Rock. As defined here 'Bare Rock' was free of obvious vegetation with a lichen cover visually estimated at 5% or less.



Figure 8. Black-winged petrel corpse probably scavenged by harrier hawk (*Circus approximans*).



Figure 9. *Asplenium northlandicum* – this was the only vascular plant that appeared to have suffered no Cyclone damage, specimens appearing in the devastated *Disphyma* landscape as dark green tufts that were even visible from at sea.

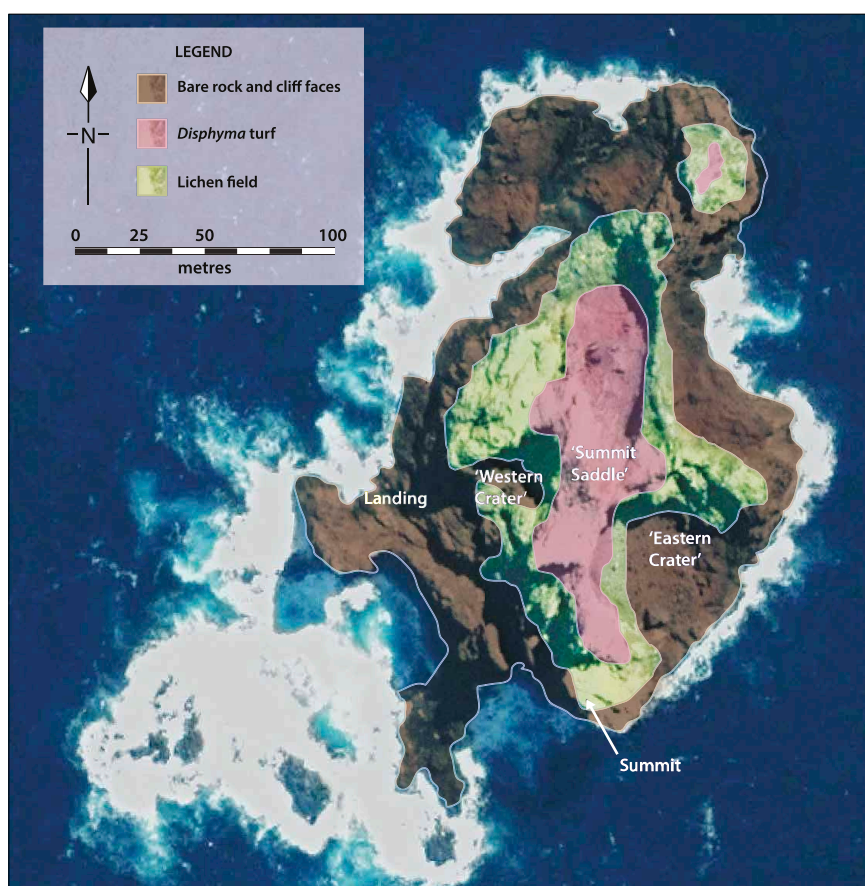


Figure 10. L'Esperance Rock (photographed 25 May 2008). Here the approximate distribution of plant associations prior to Cyclone Bune is shown. Also noted is the landing site used during the May 2011 visit, and those informal names used for this paper. Image courtesy of Department of Conservation

Bare rock surfaces though most common in those areas subjected to frequent wave wash and salt spray, continued as cliff faces almost right to the Rock summit (Fig. 11). Aside from the obvious effect of wave wash, there was no pattern in the distribution of bare rock with respect to aspect, elevation or orientation.

The few lichens present in these bare rock areas were *Buellia stellulata* and *Caloplaca* spp., whose merging into the lichen field proper was visually delineated by a sudden, marked dominance of dark yellow *Dufourea ligulata*, *Caloplaca sublobulata* and pinkish-white *Roccellina exspectata* colonies.

2. Lichen field

Lichen field was defined as those areas free of (or virtually so) vascular plants where lichen cover exceeded 5%. Lichen field occupied an estimated 20% of the Rock. However, during my visit to the Rock, lichens visually dominated the landscape, though this dominance may not be the usual condition, as it was undoubtedly enhanced by the cyclone damage to the otherwise normally dense *Disphyma* turf. This near death of *Disphyma* left large expanses of bare rock through which the mosaic of lichen field appeared rather more conspicuous than it would normally be when surrounded by masses of green *Disphyma* turf (Fig. 12). Of those lichens seen, the most conspicuous lichen was *Dufourea ligulata*, whose dark yellow crust-like thalli formed a colourful band (Fig. 12) that could even be seen while at sea during our initial circumnavigation of the Rock by the *RV Braveheart* on 10 May 2011 (see de Lange 2011d). Visually at least, *Dufourea* was noted as especially common lining the walls of the 'craters' and on the summit saddle scoriaceous lava where it grew admixed with pinkish-white crusts of *Roccellina exspectata* (Fig. 13). This abundance, at least as observed in the field is probably an overestimate because on closer inspection of *Dufourea* specimens later in New Zealand they were found to be admixed with numerous, dark orange and greenish-yellow species of *Caloplaca* – most especially *C. sublobulata*. Another common associate of *Dufourea* was the bluish-grey *Buellia stellulata* (Fig. 14), which because of its colour was not easily seen in the field, growing as it does on the bluish-grey and reddish-black basalt of L'Esperance Rock. Also in one place just below the Rock summit, in a very sheltered, eastern-facing ledge, the perceived dominance of *Dufourea* was broken by a dense growth of stunted specimens of the fruiticose *Ramalina microspora* and *R. pacifica* (see de Lange & Blanchon 2015).

3. *Disphyma* turf

Disphyma turf (along with its variants which are discussed below) (Fig. 3, 7) is the dominant vegetation of L'Esperance Rock. It occurs from almost the spray zone to the summit. However, at the time of my visit, cyclone damage had so severely impacted the *Disphyma* turf cover of the rock that it was not only difficult to determine its normal percentage cover, but also the usual abundance of other associated vascular plants, many of which were noted only as seedlings or dead

specimens. Nevertheless, based on photographs that I have seen, e.g., de Lange *et al.* (2010), *Disphyma* turf may normally occupy as much as 40% of the rock, being absent only from the most exposed cliff faces and boulder slopes. However, in May 2011 due to cyclone damage this coverage had been reduced to about 10% with the remainder sporting dead plants (Fig. 3), though in these areas numerous *Disphyma* seedlings (cotyledon stage) were seen.

While *Disphyma* formed a monospecific association in the most exposed places of the Rock, in sheltered areas such as the 'crater' walls and floor, on ledges and along the summit saddle, the monotony of the turf is broken by the seasonal presence (and possibly seasonal co-dominance) of annual shrubby herbs such as *Parietaria debilis* and *Senecio lautus* subsp. *esperensis* (Fig. 3, 7) and the grass *Lachnagrostis littoralis* subsp. *littoralis*. All of these associates were seen in May 2011 as seedlings and/or *in-situ* dried off plants. Further, in some places, such as the southern end of the Rock, in and around a grey ternlet (*Procelsterna cerulea albivitta*) nesting ground, at least as judged from the masses of dead *in situ* stems, it would seem that *Senecio lautus* subsp. *esperensis* may even form a monospecific association. On the summit saddle and in a few places near the southern summit the scrambling herb *Chenopodium trigonon* subsp. *trigonon* was also present within the *Disphyma* turf, and this too may usually be more common.

In the saddle area, solitary occurrences of *Lachnagrostis billardiarei* subsp. *billardiarei*, *Lepidium oleraceum*, *Solanum nodiflorum* and *Spergularia media* were noted. These taxa, all new records for L'Esperance Rock (see Sykes 1977; Sykes & West 1996), may be recent arrivals, or perhaps have a seasonal presence resulting in their being overlooked during past visits to the Rock, most of which have been in the much drier conditions of mid to late summer.

One final variant within the *Disphyma* turf occurs mostly along the inner 'crater' walls, and within the least exposed and more sheltered overhangs and ledges of the summit area. In these places *Asplenium northlandicum* may be secondarily dominant to *Disphyma*. In these areas abundant seedlings of *Lachnagrostis* were also noted, so perhaps this annual grass may have a greater prominence in late winter and spring.

Conservation Status of *Senecio lautus* subsp. *esperensis*

Senecio lautus subsp. *esperensis*, the sole endemic of L'Esperance Rock received its first conservation listing of 'Rare' in 1981, when Given (1981) stated "...its inclusion in the threatened plants list is due not to the influence of man so much as the exceedingly small area of land which it occupies". Subsequent listings by the New Zealand Threatened Plant Committee (Cameron *et al.* 1993, 1995) either listed it as 'Rare' or 'Local' before a final listing of 'Range Restricted' (de Lange *et al.* 1999), using a different threat classification scheme then under development (de Lange & Norton 1998). Subsequent listings, using the New Zealand Threat Classification System (NZTCS) (Townsend *et al.* 2008) elevated the conservation status

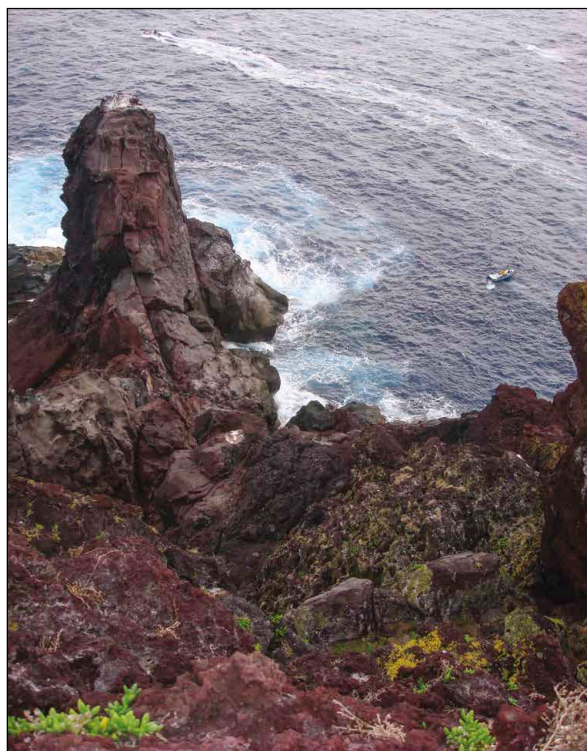


Figure 11. Bare rock covered during the May 2011 visit an estimated 60% of the Rock. In this image an expanse of nearly bare rock leads from the western landing to just below the summit saddle. In the foreground are stunted, resprouting *Disphyma* plants and a few *Asplenium northlandicum*, whilst the dominant lichens here include *Buellia stellulata*, *Dufourea ligulata* and a greenish yellow, leprose species of *Caloplaca*.



Figure 15. *Senecio lautus* subsp. *esperensis* in flower (8 October 2011) in Auckland, New Zealand.

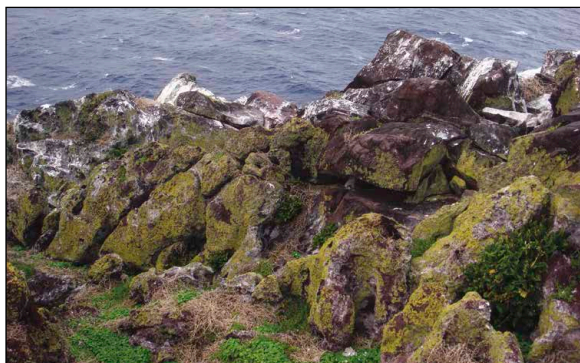


Figure 12. Lichen field dominated by golden yellow *Dufourea ligulata* and *Caloplaca sublobulata*. Note the seemingly 'storm resistant' *Asplenium northlandicum* tufts, and in the small 'gut' the expanse of mostly dead *Disphyma* and abundance of *Parietaria* seedlings.



Figure 13. *Physcia poncinsii* and *Roccellina expectata* (centre) surrounded by the dominant, though smaller colonies of *Dufourea ligulata*. In this image can also be seen the crustose *Buellia stellulata* surrounding the *Physcia* and *Roccellina*, and, also a few small tufts of the fruiticose *Ramalina pacifica*.



Figure 14. A portion of scoriaceous lava virtually dominated by *Buellia stellulata*. *Buellia* though not as obvious as the golden yellow *Dufourea ligulata* is very common on L'Esperance Rock.

of this plant to 'Threatened / National Critical' (see de Lange *et al.* 2009; de Lange *et al.* 2013b). Despite the major shift in threat status, the basis for the first listing by Given (1981) was still applicable, that of area of occupancy, which under the NZTCS meant that any taxon naturally occupying an area of <1 ha automatically qualifies as 'Threatened / National Critical'. However, these later threat listings also introduced an element of uncertainty, qualifying the assessments as 'DP' ('Data Poor') because nothing definite was known about the *Senecio* beyond the observation that it was still present in the wild in 1988 and at that time said to be possibly threatened by leakage from an emergency fuel dump that had been erected on the Rock for use by rescue helicopters (de Lange *et al.* 2010).

Therefore the May 2011 landing on L'Esperance Rock provided a valuable opportunity to revisit the conservation status of the plant. As noted above, the *Senecio* was the third most abundant vascular plant seen on the Rock during my visit. While no adults were found numerous seedlings of this plant were seen from the western 'crater' rim right along the summit saddle. No plants were seen outside this area, an area which corresponds roughly to the location mentioned for it by Sykes (1971). As previously mentioned, the possible threat from the fuel dump had also been eliminated, as that structure and its contents had vanished – a presumed casualty of Cyclone Bune. Despite these findings, the *Senecio* still qualifies as 'Threatened / Nationally Critical' because of the small area (≤ 1 ha) it naturally occupies. The only change recommended to the threat listing of this plant was to drop the qualifier 'DP', a decision ratified by the New Zealand Indigenous Vascular Plant Threat Listing Panel (de Lange *et al.* 2013).

As a further conservation measure, live plants (seedlings between 5 and 15 mm tall) were bought back to Auckland, New Zealand for cultivation. The intention was to obtain seed for storage in the New Zealand Indigenous Flora Seedbank (see www.nzpcn.org.nz) as a safeguard, and also to procure better herbarium material of the plant.

In cultivation plants grew rapidly, reaching dimensions comparable to that indicated by the *in-situ*, standing, dead material seen on the Rock in May 2011 (see AK 326043, AK 328000). However, within weeks of their first flowering (October 2011) (Fig. 15) plants started to exhibit symptoms suggestive of a *Phytophthora* infection, and within a few weeks all plants had died. This vulnerability to a water mould type of infection was also seen in another Kermadec (Raoul Island) endemic *Senecio*, *S. kermadecensis* Belcher, whose cultivation for procuring seed had been attempted in Auckland during 2009. Although confirmation of the disease in both instances was not made, that a species of *Phytophthora* was a likely candidate for their demise is probable (P. Johnston *pers. comm.*). From a conservation perspective it means that more rigorous biosecurity measures are needed for visits to the island habitats of these endemic *Senecio*, but most especially *S. lautus* subsp. *esperensis*, which unlike *S. kermadecensis* is only known from the single wild population.

DISCUSSION

L'Esperance Rock has the most depauperate flora of the southern Kermadec Islands, comparable with Haszard Islet, (see de Lange 2015b, Table 1). Nevertheless, this paper reports four additions to the vascular flora, and documents the first records of bryophytes of the Rock. On face value these finds suggest that L'Esperance Rock, whose flora has been remarkably stable over the last 123 years of documented botanical visits (see Oliver 1910; Sykes 1971, 1977), is now in an active expansion phase. The problem is determining whether this 'expansion' stems from genuine recent long distance seed dispersal, or is part of a seasonal presence of these species that has been missed during past visits, or results from seed-banks freshly exposed by Cyclone Bune in March 2011.

Deriving a satisfactory answer to these questions would require further carefully timed visits to document changes in flora composition and vegetation recovery after disturbance caused by cyclones. The role of cyclones in the periodic destruction and rejuvenation of the vegetation of the Kermadec Islands as a whole merits further investigation. Cyclones influence the composition and structure of vegetation of many Pacific islands (Mueller-Dombois and Fosberg 1998, Webb *et al.* 2011) but their influence on northern New Zealand offshore islands has had little attention (Cameron 1990; de Lange 2015b). As with the other islands of the southern Kermadec Islands, it is likely that the normally dense turf of *Disphyma* of L'Esperance presents a major barrier to colonisation by other species. The mass mortality and damage to these turfs caused by cyclones such as Cyclone Bune may create opportunities for local colonisation by other plant species, from seed banks or by the arrival of seed from neighbouring islands. This disturbance may also account for the increase in the flora of L'Esperance Rock, and if this is correct, then the size of the flora should decline the longer the island is undisturbed by cyclones (Connell 1978).

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APPENDIX 1: Flora and mycobiota of L'Esperance Rock, southern Kermadec Islands.

† denotes addition to Kermadec Island flora, ‡ denotes addition to flora or mycobiota of L'Esperance Rock.

Taxon	Family	Voucher	Abundance
Bryophytes (2)			
Liverworts (1)			
‡ <i>Frullania pentapleura</i> Taylor	Frullaniaceae	AK 325245	scarce
Mosses (1)			
‡ <i>Bryum argenteum</i> Hedw.	Bryaceae	AK 325243	scarce
Pteridophytes (1)			
<i>Asplenium northlandicum</i> (Brownsey) Ogle	Aspleniaceae	AK 326031	common
Angiosperms (9)			
Monocots II (2)			
†‡ <i>Lachnagrostis billardiarei</i> (R.Br.) Trin. Subsp. <i>billardiarei</i>	Poaceae	AK 326053	scarce
<i>Lachnagrostis littoralis</i> (Hack.) Edgar subsp. <i>littoralis</i>	Poaceae	AK 329744	Locally common
Core Eudicots (7)			
<i>Disphyma australe</i> subsp. <i>stricticaule</i> Chinnock	Aizoaceae	AK 326036	dominant
<i>Chenopodium trigonon</i> (Schult.) subsp. <i>trigonon</i>	Amaranthaceae	AK 326037	scarce
<i>Senecio lautus</i> subsp. <i>esperensis</i> (Sykes) de Lange	Asteraceae	AK 326033, AK 328000	common
†‡ <i>Spergularia tasmanica</i> (Kindb.) L.G.Adams	Caryophyllaceae	AK 326041	scarce

Taxon	Family	Voucher	Abundance
‡ <i>Lepidium oleraceum</i> G.Forst. ex Sparrm.	Brassicaceae	AK 326039	scarce
‡ <i>Solanum nodiflorum</i> Jacq.	Solanaceae	AK 326046	scarce
<i>Parietaria debilis</i> G.Forst	Urticaceae	AK 326045, AK 328001	common
Lichens (15)			
<i>Buellia stellulata</i> (Taylor) Mudd	Physciaceae	UNITEC 5895	common
†‡ <i>Caloplaca acheila</i> Zahlbr.	Teloschistaceae	UNITEC 5893	scarce
†‡ <i>Caloplaca rubentior</i> (Zahlbr.) D.J.Galloway	Teloschistaceae	UNITEC 5890	scarce
†‡ <i>Caloplaca sublobulata</i> (Myl.) Zahlbr.	Teloschistaceae	UNITEC 5892	common
†‡ <i>Caloplaca</i> sp.	Teloschistaceae	UNITEC 5891	common
<i>Dufourea ligulata</i> (Körb.) Frödén, Arup et Sochting	Teloschistaceae	UNITEC 5898	dominant
†‡ <i>Haematomma fenizianum</i> A.Massal.	Haematommaceae	CHR 630888	scarce
†‡ <i>Heterodermia japonica</i>	Physciaceae	UNITEC 5905	scarce
†‡ <i>Heterodermia pseudojaponica</i> (Kurok.) W.L.Culb.	Physciaceae	UNITEC 5904	scarce
†‡ <i>Lecanora cenisioides</i> Lumbsch	Lecanoraceae	UNITEC 5897	scarce
†‡ <i>Physcia poncinsii</i> Hue	Physciaceae	UNITEC 5906	scarce
‡ <i>Ramalina microspora</i> Kremp.	Ramalinaceae	AK 330763	scarce
‡ <i>Ramalina pacifica</i> Asahina	Ramalinaceae	AK 330762	scarce
†‡ <i>Roccellina exspectata</i> Tehler	Roccellaceae	UNITEC 5894	common
†‡ <i>Stereocaulon vesuvianum</i> Pers.	Stereocaulaceae	UNITEC 5896	scarce