

LICHENS FROM THE THREE KINGS ISLANDS, NORTHERN NEW ZEALAND

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Abstract. One hundred and sixty nine lichen taxa in 81 genera are recorded from the Three Kings Islands, northern New Zealand. Although most records are from Great Island, the list also includes collections from North East Island, South West Island and West Island. More than half of the lichens recorded are cosmopolitan (35%) species or New Zealand endemics (20%), with the remainder showing the following affinities: australasian (17%), pantropical (13%), austral (7%), palaeotropical (5%) and Western Pacific (3%). A distinctive perlatolic acid-containing strain of *Neofuscelia pulla* appears to be confined to the Three Kings Islands. Great Island is the type locality for *Erioderma soledatium*. *Endocarpon* cf. *adscendens*, *Phyllopsora* cf. *haemophaea* and *Pyxine cocoes* are additions to the New Zealand lichen flora, and an undescribed species of *Trapeliopsis* occurs on *Metrosideros excelsa* bark.

The Three Kings Islands consist of one large island (Great I), three smaller ones (North East I, South West I and West I) and a chain of bare or scrub-covered rocks (Princes Is) in the southern Pacific Ocean (Lat. c. 34° 6'S: Long. 172° 20'E) some 53 km northwest of Cape Maria van Diemen, northern New Zealand (Fig. 1). The islands range in size from less than 20 hectares to 3500 hectares, and Great I attains an altitude of 283 m. The islands are affected by a warm current so that climate is humid, with much mist or fog conducive to a dense plant cover in some areas (Cranwell 1962). Rainfall is probably rather similar to that for the far north of New Zealand with extended dry periods in the summer. Frequent coastal fog keeps epiphytic vegetation moist for reasonable periods, though nowhere is there a luxuriant epiphytic plant cover characteristic of areas of warm temperatures and high rainfall such as are common in very many parts of New Zealand. Separation from the New Zealand mainland has been effective for a long time, perhaps from the Lower Tertiary (Cranwell 1962).

As a result of Cheeseman's discovery of several local endemic taxa (Cheeseman 1888, 1891) [*Alectryon grandis*, *Coprosma macrocarpa*, *Davallia tasmanii*, *Hebe insularis*, *Paratrophis smithii* (= *Streblus smithii*), *Pittosporum fairchildii*], Cockayne (1921) proposed a separate Three Kings botanical district as part of the North Auckland Botanical Province. The vascular flora comprises nearly 180 species with 13 of these locally endemic, a surprising number for such a small geographical area and probably representing "... a portion of the Pleistocene survivors which never regained mainland habitats" (Wardle 1963). Although much interest has focussed on the Three Kings flora and on the processes of regeneration following the extermination of a large population of goats in 1946 (Baylis 1948; Oliver 1948; Turbott 1948; Baylis

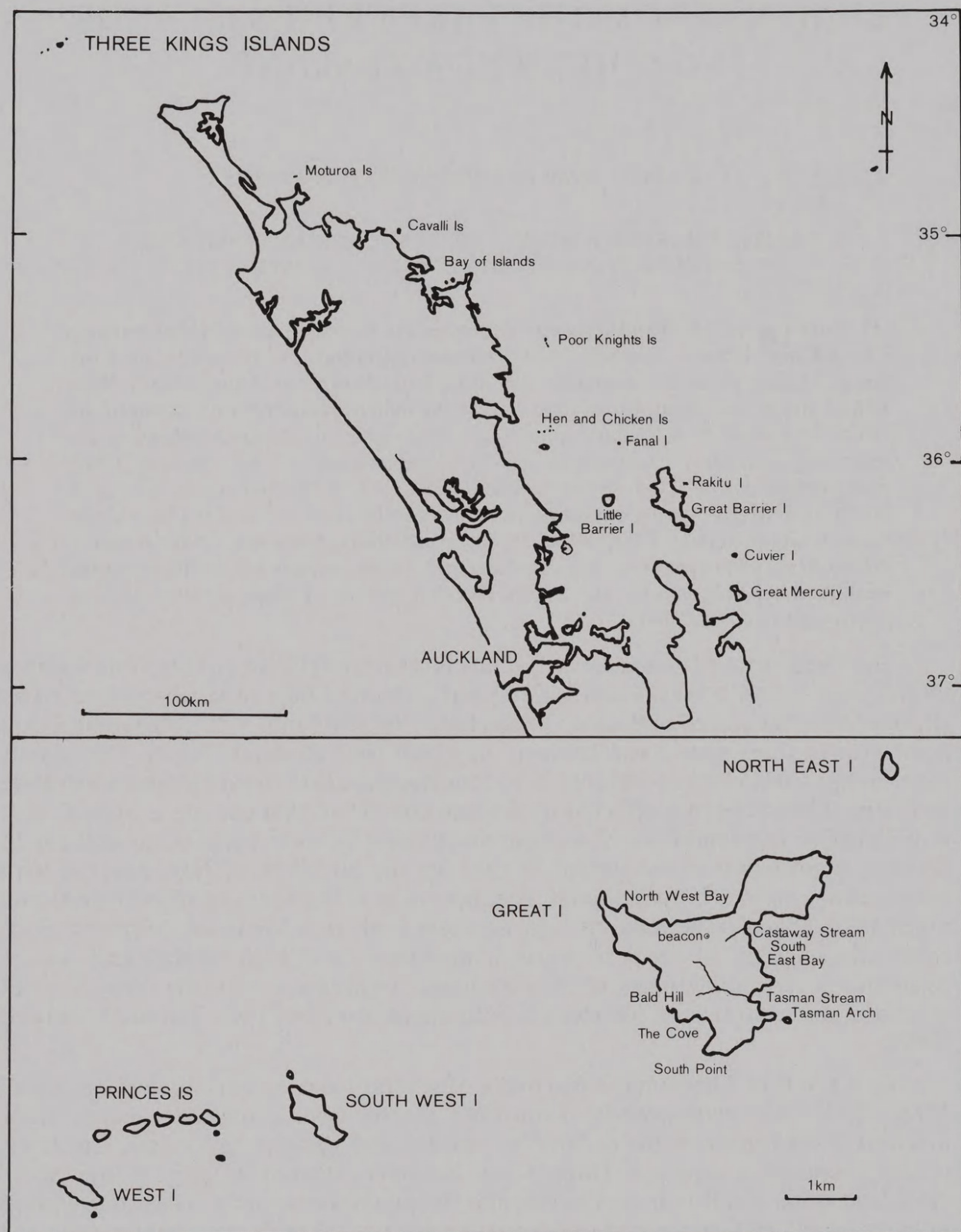


Fig. 1. Location of northern off-shore islands and map of Three Kings Islands.

1951a, 1951b; Holdsworth 1951; Baylis 1958; Cranwell 1962; Turbott 1963; Holdsworth & Baylis 1967; Wright 1983), at present little is known of the lichens to be found there apart from occasional references in particular generic accounts, based on collections made by one of us (D.J.G.) in 1970. These include *Erioderma sorediatum* (Galloway & Jørgensen 1975), *Parmelia pulla*, *P. verrucella* (Esslinger 1977; Culberson, Culberson & Esslinger 1977), *Opegrapha agelaeoides*, *Phaeographis australiensis* (Hayward 1977), *Parmeliella pycnophora* (Keuck 1977), *Coccocarpia erythroxyli*, *C. palmicola*, *C. pellita* (Arvidsson & Galloway 1979; Arvidsson 1983), *Stereocaulon corticatum*, *S. ramulosum* (Galloway 1980), *Xanthoparmelia australasica*, *X. conspersa*, *X. furcata*, *X. mexicana*, *X. scabrosa*, *X. tinctina* (Galloway 1981), *Porpidia albocaerulescens* (Hertel & Knoph 1984), *Xanthoparmelia streimannii*, *X. tasmanica* (Elix et al. 1986), and *Haematomma saxicola* (Rogers & Bartlett 1986).

The present study records the macrolichens and a number of microlichens collected on the Three Kings Is in 1970, 1982 and 1983. In November 1970 D.J.G. spent one month on Great I (including a day on South West I), during an expedition organised by Entomology Division, D.S.I.R. (Ramsay 1971). B.W.H. visited the Three Kings Is in December 1982 and December 1983, spending a total of 12 days on Great I and making landings on West, North East and South West Is. Lichens collected on these visits are discussed below. Studies on the microlichens collected are still incomplete and will be reported at a later date. Voucher specimens of lichens collected on the Three Kings Is are held in the herbarium of the Auckland Institute and Museum (B.W.H. and some of D.J.G.), and in the herbaria of Botany Division, D.S.I.R., Lincoln (D.J.G.), and the British Museum (Natural History), London (D.J.G.).

Lichens are arranged alphabetically by species and genus. Except where otherwise stated, nomenclature follows Galloway (1985). Islands are abbreviated as follows: Great I (G), South West Is (SW), West I (W), North East I (NE).

Species list

Habitat:

- 1 maritime
- 2 cliff ridges and faces
- 3 cliff tops
- 4 coastal forest
- 5 *Leptospermum* forest
- 6 regenerating forest (including *Meryta sinclairii*, *Coprosma macrocarpa* etc.)
- 7 inland outcrops and clearings, Tasman Stream bed
- 8 pohutukawa
- 9 exposed scrub (Bald Hill, south side of Tasman Valley, South Point)
- 10 original forest remnants (*Pennantia baylisiana*, *Vitex lucens* etc.)

Substrate:

- r = rock
- b = bark
- s = soil
- w = decorticated wood
- l = leaves

LIST OF LICHENS OF THREE KINGS ISLANDS

<i>Arthonia knightii</i>	4b, 6b (G)
<i>Bacidia albidoplumbea</i>	5w (G)
<i>B.buchananii</i>	4bs, 10b (G)
<i>Brigantiaea chrysosticta</i>	2r (G)
<i>Buellia stellulata</i>	2r (G)
<i>Caloplaca cribrrosa</i>	1r (G), 3r (NE)
<i>C.inclinans</i>	4b, 6b (G)
<i>C.mooreae</i>	4b (SW)
<i>C.sublobulata</i>	1r (G)
<i>Candelaria concolor</i>	2r (G)
<i>Candelariella xanthostigma</i>	5b (G)
<i>Catillaria melanotropa</i>	4b, 5b (G)
<i>Chrysothrix candelaris</i>	4b, 5b, 6b, 8b (G), 4b (SW)
<i>Cladia aggregata</i>	3s, 4s, 5s, 6s, 7rs, 8bs, 9rs (G)
<i>Cladina confusa</i> (R.Sant.) Follm. & Ahti (Ahti 1984)	5s, 9s (G)
<i>Cladonia capitellata</i>	5s, 7r, 8s, 9s (G)
<i>C.carassensis</i>	3s (G)
<i>C.cervicornis</i>	3s, 5s, 9s (G)
<i>C.cervicornis</i> ssp. <i>verticillata</i>	5s (G)
<i>C.corniculata</i> Ahti & Kashiwadani (Ahti & Kashiwadani 1984)	9s (G)
<i>C.cornuta</i>	5s (G)
<i>C.enantia</i>	2s, 8s, 9s (G)
<i>C.fimbriata</i>	5s, 9s (G)
<i>C.floerkeana</i>	5sw, 9s (G)
<i>C.gracilis</i> ssp. <i>tenerrima</i>	5s (G)
<i>C.krempelhuberi</i>	9s (G)
<i>C.macilenta</i>	5s (G)
<i>C.neozelandica</i>	3s (G)
<i>C.ochrochlora</i>	2s, 3s, 5w, 9s (G)
<i>C.polycarpoides</i>	3s, 5s, 7r, 8b, 9s (G)
<i>C.ramulosa</i> (With.) Laundon (Laundon 1984)	3s, 5s (G)
<i>C. cf rigida</i>	3s (G)
<i>C.scabriuscula</i>	5s, 9s (G)
<i>C.squamosula</i>	3s (G)
<i>C.wilsonii</i> Archer (Archer 1984)	5s, 9s (G)
<i>Clathroporina exocha</i>	4b, 10br (G)
<i>Coccocarpia erythroxyli</i>	5b, 6b (G)
<i>C.palmicola</i>	5br, 7r, 8b (G)
<i>C.pellita</i>	7r, 8b (G)
<i>Coccotrema porinopsis</i>	8b (G)
<i>Coenogonium implexum</i>	10b (G)
<i>Collema coccophorum</i>	2r (G)
<i>C.glaucophthalmum</i>	4b (SW)
<i>C.laeve</i>	4b, 5b, 6b (G), 4b (SW)
<i>Dictyonema moorei</i>	5b (G)
<i>Diplotomma alboatrum</i>	2r (G)
<i>Dirinaria applanata</i>	4b (SW)
<i>D.picta</i>	4b, 8b (G)
<i>Endocarpon</i> cf. <i>adscendens</i> (Anzi) Müll.Arg.	2r (G)
<i>Erioderma sorediatum</i>	5b, 8b, 9b (G)

<i>Flavoparmelia euplecta</i> (Stirton) Hale (Hale 1986)	7r (G)
<i>Graphina subvelata</i>	4b (G)
<i>Gymnoderma melacarpum</i>	8b (G)
<i>Haematomma saxicola</i> R.W. Rogers (Rogers & Bartlett 1986)	2r, 3r (G), 3r (SW)
<i>Heterodermia japonica</i>	2r, 3s, 9s (G)
<i>H.leucomelos</i> ssp. <i>boryi</i>	3s, 4b, 5b (G)
<i>H.obscurata</i>	5b (G), 4b (SW)
<i>H.speciosa</i>	3s, 5b (G)
<i>Hyperphyscia adglutinata</i>	5b (G)
<i>Hypotrachyna formosana</i>	3r, 5r, 7r (G)
<i>Lecanactis redingeri</i>	5b (G)
<i>Lecanora atra</i>	2r, 3r, 7r, 9r (G)
<i>L.campestris</i>	2r, 3rs (G)
<i>L.dispersa</i>	1r (G)
<i>L.flavopallida</i>	3b, 5bw (G)
<i>Lecidea cerinocarpa</i>	4b (SW)
<i>L.conisalea</i>	4b, 6b (G)
<i>L.fuscocincta</i>	4bs, 5b (G)
<i>Lecidella schistiseda</i>	2r, 7r (G)
<i>Leioderma pycnophorum</i>	5b, 6b, 9b (G)
<i>Lepraria incana</i>	7rs (G)
<i>Leprocaulon arbuscula</i>	7r (G)
<i>Leptogium azureum</i>	3b, 4b, 5b (G), 4b (SW)
<i>L.brebissonii</i>	5b (G)
<i>L.crispatellum</i>	3bs, 4s, 5b (G)
<i>L.cyanescens</i>	4bs, 7r, 10b (G), 4b (SW)
<i>Megalospora gompholoma</i>	5bw (G)
<i>Melaspilea subeffigurans</i>	4b (G)
<i>Miltidea ceroplasta</i> (Church.Bab.) D. Galloway & Hafellner (Hafellner 1984)	5b (G)
<i>Neofuscelia pulla</i>	2r, 5r (G)
<i>N.verrucella</i>	2r, 3r, 7r (G)
<i>Normandina pulchella</i>	8b, 10b (G)
<i>Ochrolechia parella</i>	2r, 9r (G)
<i>O. cf thelotremoides</i>	4b, 6b (G)
<i>Opegrapha agelaeoides</i>	4b (G)
<i>O.intertexta</i>	4b, 6b (G), 4b (SW), 4b (W)
<i>O.spodopolia</i>	5r (G)
<i>Pannaria elatior</i>	4b, 5b, 6b (G)
<i>P.fulvescens</i>	5b, 9b (G)
<i>P.subimmixta</i>	2r (G)
<i>Paraparmelia scotophylla</i> (Kurok.) Elix & Johnston (Elix, Johnston & Verdon 1986)	1r (G)
<i>Parmeliella mucorina</i>	4b (G)
<i>P.nigrocincta</i>	5b (G)
<i>Parmotrema cetratum</i>	2r, 3r, 7r, 8b, pr (G), 2r (SW)
<i>P.chinense</i> (Osbeck) Hale & Ahti (Hale & Ahti 1986)	2r, 5b (G), 3b (W)
<i>P.crininum</i>	2r, 4b, 5b (G), 4b (SW)
<i>P.cristiferum</i>	5b (G)
<i>P.grayanum</i>	2r, 3r (G)
<i>P.mellissii</i>	5b (G)
<i>P.reticulatum</i>	2r, 3r, 5rw, 7r, 8br, 9r (G), 4b (SW)

<i>P.subtinctorium</i>	9r (G), 4b (SW), 4b (W)
<i>P.tinctorum</i>	3r, 4b, 5br, 8b, 9r (G), 4b (SW)
<i>Peltigera dolichorhiza</i>	5s (G)
<i>P.nana</i>	5s, 6s (G)
<i>Peltula euploca</i>	2rs (G)
<i>Pertusaria lavata</i>	7r (G)
<i>P.melaleucoides</i>	5b (G)
<i>P.novaezelandiae</i>	5b, 8b, 9b (G)
<i>P.sorodes</i>	5b, 8b (G)
<i>P.superba</i>	7r (G)
<i>Phaeographis australiensis</i>	6b (G), 6b (SW)
<i>Phaeophyscia orbicularis</i>	2r, 5b (G)
<i>Phlyctella uncinata</i>	4b (G), 9b (NE), 4b (SW)
<i>Phyllopsora</i> cf. <i>haemophaea</i> (Nyl.) Müll.Arg	5b (G)
<i>P.microdactyla</i>	4b, 10b (G)
<i>Physcia tenuisecta</i>	5b, 8b (G)
<i>P.tribacioides</i>	5b, 10b (G)
<i>Physconia grisea</i>	3rs, 5b (G)
<i>Placopsis parellina</i> f. <i>argillacea</i>	2s (G)
<i>Poeltiaria turgescens</i> (Koerber) Hertel (Hertel 1984)	1r, 2r (G)
<i>Porpidia albocaerulescens</i> (Wulfen) Hertel & Knoph (Hertel & Knoph 1984)	2r, 5r, 7r, 9r (G)
<i>Pseudocyphellaria aurata</i>	4b, 5b, 7r, 9b (G), 6b (SW)
<i>P.carpoloma</i>	5b (G)
<i>P.chloroleuca</i> (Galloway 1986)	2r, 4b, 5b, 6b, 8b (G)
<i>P.crocata</i>	2r, 5s, 7r (G)
<i>P.episticta</i>	4b, 5b, 7s, 8b, 10b (G)
<i>P.flavicans</i>	2r, 5b (G)
<i>P.montagnei</i>	5b, 6b (G)
<i>P.poculifera</i>	2r, 3r, 4b, 5b, 6b, 7b, 8b (G)
<i>Pseudoparmelia pseudosorediosa</i>	2r, 5br, 7b, 9b (G)
<i>Psoroma allorhizum</i>	3r, 5b (G)
<i>P.araneosum</i>	2r, 3r, 4b, 5b (G)
<i>P.pholiodotoides</i>	4b, 5b (G)
<i>Punctelia borreri</i>	4b (SW)
<i>Pyrenothrix nigra</i>	5b (G)
<i>Pyrenula crassescens</i>	4b, 6b (G)
<i>P.</i> cf. <i>moniliformis</i>	4b (G)
<i>Pyxine cocoes</i> (Sw.) Nyl.	4b (SW)
<i>Ramalea cochleata</i>	7s (G)
<i>Ramalina australiensis</i> Nyl. (Stevens 1987)	1r, 2r, 3b, 5b, 8b, 9b (G), 4r (NE)
<i>R.celastri</i>	1r, 2r, 3r, 7r (G), 4b (SW), 4r (NE)
<i>R.pacifica</i>	2r, 3r, 4b, 5b (G)
<i>R.peruviana</i>	5b (G)
<i>Rhizocarpon viridiatrum</i>	2r (G)
<i>Rinodina thiomela</i>	1r, 2r (G)
<i>Sphinctrina tubiformis</i>	2r (G)
<i>Stereocaulon corticatulum</i>	9rs (G)
<i>S.ramulosum</i>	2r, 3r, 5s, 7r, 8s, 9rs (G)
<i>Sticta latifrons</i>	3b, 4b, 5b, 6b, 10b (G)

<i>S.squamata</i>	4b, 5b, 6b, 8b, 9b (G)
<i>Strigula elegans</i>	4l (W)
<i>Teloschistes flavicans</i>	2r, 3br, 4b, 5b, 8b, 9b (G), 4r (NE), 3r, 4b (SW), 3b, 4b (W)
<i>Thelotrema lepadinum</i>	5b (G)
<i>Trapeliopsis granulosa</i> (Hoffm.) H.T. Lumbsch (Coppins & James 1984)	5bs (G)
<i>Trapeliopsis</i> sp.	8b (G)
<i>Usnea arida</i>	2b, 3b, 5b, 8b, 9b (G), 4b (SW)
<i>U.oncodes</i>	9b (G)
<i>U.rubicunda</i>	2b, 3b, 5b, 7r (G)
<i>U.societatis</i>	2r, 3br, 5b, 6b, 7r, 8b, 9b (G)
<i>Verrucaria maura</i>	1r (G), 1r (SW)
<i>Xanthoparmelia australasica</i>	2r, 3r, 9r (G), 3r (NE)
<i>X.furcata</i>	2r, 3r, 9r (G)
<i>X.mexicana</i>	2r, 3r (G)
<i>X.scabrosa</i>	2r (G)
<i>X.streimannii</i> (Elix & P.Armstr.) Elix & Jen Johnston (Elix & Armstrong 1983; Elix, Johnston & Armstrong 1986)	2r, 3r, 9r (G)
<i>X.tasmanica</i>	9r (G)
<i>X. tinctina</i>	7r (G)
<i>Xanthoria ligulata</i>	1r, 2r (G), 3r (NE)
<i>X.parietina</i>	1r (G), 1r, 4b (SW), 3r (NE)

FLORISTIC DIVERSITY

In this paper we record 169 lichen taxa in 81 genera from the Three Kings Is. These numbers are compared with those from other northern offshore islands (Fig.1) in Table 1.

Table 1. Numbers of lichen species and genera from northern offshore islands.

Islands	Species	Genera	Source
Three Kings Is	169	81	This work
Motorua Is	21	15	G.C. Hayward & Wright 1977
Cavalli Is	85	39	B.W. Hayward & Hayward 1979
Eastern Bay of Islands	111	43	B.W. Hayward & Hayward 1980
Poor Knights Is	132	52	unpublished — see also B.W. Hayward & Hayward 1982a
Hen and Chicken Is	156	58	G.C. Hayward & Hayward 1978 B.W. Hayward & Hayward 1984
Fanal I	58	31	Wright et al. 1980
Little Barrier I	170	67	unpublished
Rakitu I	124	50	B.W. Hayward & Hayward 1982b
Great Barrier I	252	79	Dakin & Galloway 1980 B.W. Hayward et al. 1986
Cuvier I	49	28	B.W. Hayward et al. 1981
Great Mercury I	104	41	G.C. Hayward et al. 1976

The lichen flora of the Three Kings Is appears to be more diverse than that of any other island or island group north of Lat 36° S. This is probably best explained by the large number of different habitats available for colonisation, and reasonably extensive areas of successional vegetation in adequate light where lichens are always fairly richly developed. The length of time spent in intensive search would also account for some, but not all, of the apparent greater diversity on the Three Kings Islands. In time, with the re-establishment of the mixed coastal forest and the consequent reduction of light resulting from a more or less closed canopy, a reduction in both numbers and diversity of the lichens present can be expected.

LICHEN COMMUNITIES AND HABITATS

Maritime

The only maritime habitats visited were the landing places at North West Bay and South East Bay on Great I and the landing platform in the small harbour at the north end of South West I. Here *Verrucaria maura* occurs intertidally and several yellow-orange lichens dominate the rocks above high tide; species of *Caloplaca* (*C. cribrosa*, *C. sublobulata*) and *Xanthoria* (*X. ligulata*, *X. parietina*), with the orange-red, narrow-lobed *X. ligulata* being most common. Tufts of *Lichina confinis*, normally found intertidally with *V. maura*, were not observed.

Cliff face and ridges

Great I is surrounded by high cliffs, several of which on their upper slopes have exposed, traversable areas of rocks or soil. This zone which extends from high water mark to coastal scrub or forest, is very rich in lichens, especially small saxicolous and terricolous species, most of which will be the subject of a later paper. Most conspicuous lichens in this zone are the large, grey, foliose species of *Parmotrema*, the yellow foliose or subfruticose thalli of *Xanthoparmelia*, the orange-red straggling tufts of *Teloschistes flavicans* and the green-grey or yellowish tufts of *Ramalina* and *Usnea*. On rocks towards the top of the North West landing slope, the scarlet apothecia of the crustose *Haematomma saxicola* are locally noteworthy. Important lichens in this zone include: *Candelaria concolor*, *Collema coccophorum*, *Diplotomma alboatrum*, *Endocarpon* cf. *adscendens*, *Heterodermia japonica*, *Lecanora atra*, *L. campestris*, *Lecidella schistiseda*, *Neofuscelia pulla*, *N. verrucella*, *Ochrolechia parella*, *Pannaria subimmixta*, *Parmotrema cetratum*, *P. chinense*, *P. crinitum*, *P. grayanum*, *P. reticulatum*, *Peltula euploca*, *Phaeophyscia orbicularis*, *Placopsis parellina* f. *argillacea*, *Poeltiaria turgescens*, *Porpidia albocaerulescens*, *Pseudocyphellaria crocata*, *P. poculifera*, *Psoroma araneosum*, *Ramalina celastri*, *R. pacifica*, *R. australiensis*, *Rinodina thiomela*, *Stereocaulon ramulosum*, *Usnea societatis*, *Xanthoparmelia furcata*, *X. mexicana*, *X. scabrosa* and *Xanthoria ligulata*.

Open cliff tops

Pohutukawa (*Metrosideros excelsa*) and kanuka (*Leptospermum ericoides*) are common trees on the cliff tops surrounding Great I, though in many places open, rocky clearings occur where trees give way to stunted shrubs. In such situations where light is

plentiful a characteristic lichen vegetation is met with. On trees the most noticeable lichens are the orange-red *Teloschistes flavicans* and the yellow-green, pendulous *Ramalina australiensis*. Associated bark lichens included: *Lecanora flavopallida*, *Leptogium azureum*, *L. crispatellum*, *Sticta latifrons*, *Usnea arida*, *U. rubicunda* and *U. societatis*. On rock the main lichens are: *Hypotrachyna formosana*, *Neofuscelia verrucella*, *Parmotrema cetratum*, *P. reticulatum*, *P. tinctorum*, *Physconia grisea*, *Pseudocyphellaria poculifera*, *Psoroma allorhizum*, *P. araneosum*, *Ramalina celastri*, *Teloschistes flavicans*, *Usnea societatis*, *Xanthoparmelia furcata*, *Xanthoria ligulata* and *X. parietina*.

Coastal forest

Here are included forest trees and understory shrubs that occur on Great I at, or near cliff tops around the coast, and along the Tasman Stream, and also on South West I. Major phorophytes include: *Coprosma macrocarpa*, *C. rhamnoides*, *Cordyline kaspar*, *Litsea calicaris*, *Melicytus ramiflorus*, *Metrosideros excelsa*, *Meryta sinclairii*, *Cyathea medullaris*. The extensive areas of *Leptospermum* (especially in Castaway Valley, the Tasman Valley and the north-east peninsula) and the stands of pohutukawa on Great I are dealt with separately, as are the scattered remnants of the original forest of the island.

In the canopy of coastal forest where high light conditions prevail, the fruticose taxa *Ramalina australiensis*, *Teloschistes flavicans* and *Usnea* species (*U. arida*, *U. rubicunda*, *U. societatis*) are most common. Bark species include: *Caloplaca inclinans*, *C. mooreae*, *Catillaria melanotropa*, *Chrysothrix candelaris*, *Clathroporina exocha*, *Collema glaucophthalma*, *C. laeve*, *Dirinaria applanta*, *D. picta*, *Lecidea cerinocarpa*, *L. fuscocincta*, *L. conisalea*, *Leptogium crispatellum*, *L. cyanescens*, *Pannaria elatior*, *Parmeliella mucorina*, *Phlyctella uncinata*, *Phyllopsora microdactyla*, *Pseudocyphellaria aurata*, *P. episticta*, *P. poculifera*, *P. chloroleuca*, *Psoroma araneosum*, *P. pholidotoides*, *Pyxine cocoes* (on *Meryta*, South West I), *Sticta latifrons* and *Xanthoria parietina*.

On the ground there is normally severe competition from grasses, sedges and mosses and there are generally few lichens. Those present include: *Cladia aggregata*, *Bacidia buchananii*, *Leptogium crispatellum*, *Peltigera dolichorhiza* and *Stereocaulon ramulosum*.

Coprosma macrocarpa is nearly always completely devoid of lichens although the inconspicuous crustose *Melaspilea subeffigurans* was only found on its bark. *Cyathea medullaris* is poorly colonised except for *Bacidia buchananii*, *Lepraria* and occasional colonies of *Pseudocyphellaria episticta*. *Cordyline kaspar* in favourable sites (especially in the lower courses of eastern tributaries of the Tasman stream) supports a number of lichens, mainly *Sticta latifrons*, *Pseudocyphellaria chloroleuca* and species of *Parmotrema*, though occasionally large colonies of *Catillaria melanotropa* occur on this substrate. Rarely, colonies of *Pseudocyphellaria carpoloma* and *P. montagnei* grow on the bark of this tree.

Leptospermum forest

This covers wide areas of Castaway Valley, Tasman Valley and most of the north-eastern part of Great I (Baylis 1951b, Holdsworth & Baylis 1967). *Leptospermum ericoides* is the present climax tree cover and older trees are more heavily colonised with lichens than are young trees whose canopies tend to be too dense to allow sufficient light to penetrate to primary branches where lichens tend to grow. In open situations and at lower levels the dominant lichens of *Leptospermum* bark are (in order of importance): *Pseudocyphellaria poculifera*, *P.episticta*, *P.flavicans*, *P.chloroleuca*, *Sticta latifrons*, *S.squamata*, *Parmotrema cetratum*, *P.crinatum*, *P.reticulatum*, *P.tinctorum*, *Psoroma allorhizum*, *P.pholidotoides*, *Megalospora gompholoma*. More rarely are found: *Coccocarpia palmicola*, *Leioderma pycnophorum*, *Leptogium azureum*, *L.brebissonii*, *L.crispatellum*, *L.cyanescens*, *Pannaria elatior*, *Pertusaria sorodes*, *Pyrenothrix nigra* and *Thelotrema lepadinum*. At the highest elevations on Great I and especially near cliff tops, pendulous, fruticose species of *Ramalina*, and *Usnea* are common (dead species of *Leptospermum* also tend to be well covered by species of these two genera regardless of where they occur) often in association with *Teloschistes flavicans*. This last species is a brilliant yellow-, or orange-red in well lit sites, becoming pale yellow in shade. Above about 180 m, the major epiphyte of trunks of *Leptospermum* is *Sticta latifrons* and, to a lesser extent, *Pseudocyphellaria chloroleuca*, both of these species persisting on old trunks in quite low-light situations where few other lichens are present. *Heterodermia leucomelos* ssp. *boryi* was collected only rarely from *Leptospermum* near the summit of Great I, although it occurs in coastal scrub south of the Tasman Arch. On the ground under *Leptospermum* where light is sufficient several lichens occur, most notably *Cladia aggregata*, *Cladina confusa* (especially in the north-east peninsula), *Stereocaulon ramulosum* and several species of *Cladonia* (*C.capitellata*, *C.cervicornis*, *C.cornuta*, *C.fimbriata*, *C.macilenta*, *C.polycarpoides*). In some places terricolous or muscicolous communities are quite well developed and include species of *Leptogium*, *Parmotrema*, *Psoroma* and *Pseudocyphellaria*, obviously derived from the nearby corticolous communities on *Leptospermum*.

Regenerating forest

This includes tree species and understorey shrubs other than *Leptospermum* or *Metrosideros*, and comprises most trees found in habitat 4 (above) including: *Brachyglottis arborescens*, *Coprosma macrocarpa*, *C.rhamnoides*, *Corynocarpus laevigatus*, *Cordyline kaspar*, *Meryta sinclairii*, *Melicytus ramiflorus*, *Litsea calicaris*, and *Pittosporum fairchildii*.

Meryta (puka) is at present the dominant tree in this habitat (especially on Great, South West and North East Is) and supports a small but exceedingly interesting lichen community on its smooth bark. Crustose lichens tend to be more common on this phorophyte than foliose or fruticose ones as the crown of large glossy leaves greatly reduces the light available to foliose and fruticose epiphytes. In large trees (such as those on South West I) a number of macrolichens occur on *Meryta* including: *Parmotrema subtinctorium*, *P.tinctorum*, *Pseudocyphellaria aurata*, *P.poculifera*, *Punctelia borreri*, *Ramalina celastri*, *R.pacifica*, *Usnea arida* and *U.societatis*. The

foliose tropical lichen *Pyxine cocolae* also occurs on this phorophyte on South West I but not yet apparently on Great I. Microlichens from *Meryta* include: *Caloplaca inclinans*, *Arthonia knightii*, *Chrysothrix candelaris*, *Graphina subvelata*, *Lecidea conisalea*, *Opegrapha intertexta*, *Phaeographis australiensis*, *Phlyctella uncinata* and *Pyrenula crassescens*.

Inland outcrops and clearings including Tasman stream bed

These include prominent rock outcrops above the Castaway Depot site in Castaway Valley on the ridges leading to the lighthouse beacon, and several small outcrops in the Tasman Valley, and the bed of the Tasman stream. On soil in these areas the dominant lichens in all sites are *Cladia aggregata*, several species of *Cladonia*, and *Stereocaulon ramulosum*. A number of species of *Parmotrema* are encountered (mainly *P. reticulatum*) and in some sheltered sites saxicolous *Usnea societatis* may develop. Most of the lichen cover of these areas is contributed by saxicolous microlichens which will be reported upon in a subsequent paper.

Metrosideros excelsa trees

The pohutukawa grove below Bald Hill in Tasman Valley, and the patch below the cliff top on the north-west coast in the vicinity of the sole surviving tree of *Pennantia baylisiana* were visited, as well as clumps south of Tasman Arch and at South Point. Pendulous species of *Ramalina* and *Usnea* are strikingly developed on pohutukawa, draping the trunks from canopy to the ground. Dominant species are *Ramalina australiensis* and *Usnea societatis*, with *Teloschistes flavicans* developed on trunks exposed to high light and salt-laden winds. Besides the dominant pendulous lichens mentioned, the bark of pohutukawa supports a diverse lichen flora, notable taxa including: *Coccocarpia palmicola*, *C. pellita*, *Coccotrema porinopsis*, *Erioderma solediatum*, *Normandina pulchella*, *Pertusaria novaezelandiae*, *Physcia tenuisecta* and a distinctive, undescribed species of *Trapeliopsis*.

Exposed scrub

Areas of exposed scrub (including *Hebe insularis*, stunted *Leptospermum* and *Metrosideros*) and $\pm$ bare patches of soil occur most notably on Bald Hill, the south side of Tasman Valley and at South Point above The Cove. On soil, *Cladia aggregata*, and *Stereocaulon* are dominant lichens, with *S. ramulosum* being represented (sometimes in swards) in all localities, and the sorediate *S. corticatulum* much less commonly developed. Species of *Cladonia* (the red-fruited *C. floerkeana* is locally common on Bald Hill) are frequently encountered as well as species of *Heterodermia*, *Ramalina*, *Parmotrema* and *Xanthoparmelia* growing on stones and rocks. Prostrate kanuka and *Coprosma rhamnoides* support several lichens the most common of which are *Coccocarpia erythroxyli*, *Erioderma solediatum* [the type locality for this species is *Leptospermum* scrub on the south side of Tasman Valley (Galloway & Jørgensen 1975)], *Leioderma pycnophorum*, *Pannaria fulvescens*, *Pseudocyphellaria aurata* and *P. poculifera*.

Original forest remnants

Under this heading we include *Alectryon grandis*, *Brachyglottis arborescens*, *Pennantia baylisiana*, *Nestegis apetala*, *Heimerliodendron brunonianum*, *Pittosporum fairchildii*, *Streblus smithii* and *Vitex lucens*. All of these species are broad-leaved trees growing in $\pm$ dense shade. *Pennantia baylisiana* is an exception to this, the solitary surviving specimens (as seen in 1970) growing on a reasonably open rock scree. The site has now "... regenerated almost beyond recognition with a thick cover of ferns and herbs, and the base of the *Pennantia* is now obscured by a dense growth of its own shoots" (Wright 1983:181). The dominant corticolous lichen on *P. baylisiana* is *Clathroporina exocha* (in 1970 this lichen covered 15-20% of the bark surface) and this species also colonises rocks close to the roots of the tree. Significantly it is also developed on the other phorophytes mentioned but is not found elsewhere. Other lichens growing in the rather shaded conditions offered by these phorophytes include *Bacidia buchananii*, *Coenogonium implexum*, *Leptogium cyanescens*, *Normandina pulchella*, *Phyllopsora microdactyla*, *Physcia tribacioides*, *Pseudocyphellaria episticta* and *Sticta latifrons*. This last lichen is found on only the oldest trees of *Brachyglottis* and *Pittosporum fairchildii*. Young saplings of this latter plant tend to have a bark entirely free of lichens and it is only on the oldest specimens that *Sticta latifrons*, *Leptogium cyanescens* and *Clathroporina exocha* were seen. Such an association of lichens is common in northern coastal and lowland forest on the New mainland, especially where *Beilschmiedia tawa* is common. The most common lichen lowland forest interiors in northern New Zealand, *Pseudocyphellaria dissimilis*, is altogether from the Three Kings flora.

DISCUSSION

Of the 169 lichens recorded in this paper, 35% are widespread cosmopolitan species of a temperate or "oceanic" character (biogeographical terminology follows Galloway 1979, 1985), many producing readily dispersed diaspores such as soredia or isidia [e.g., *Candelaria concolor*, *Heterodermia leucomelos* ssp. *boryi*, *H. speciosa*, *Normandina pulchella*, *Pseudocyphellaria aurata*, *Teloschistes flavicans*], while others are consistently fertile and lack vegetative diaspores [e.g., *Lecanora atra*, *L. campestris* (see Brodo 1984), *Leptogium azureum*, *Thelotrema lepadium*]. Species endemic to the New Zealand region account for 20% of the lichens recorded, and a similar proportion (17%), including most of the species of *Xanthoparmelia*, have an Australasian affinity.

Pantropical taxa comprise c. 13% of the Three Kings lichens, prominent members of this element being *Coccocarpia palmicola*, *Hypotrachyna formosana*, *Pannaria fulvescens* and several species of *Parmotrema*, including the pantropical weedy species *P. cristiferum* and *P. tinctorum* (Hale 1965, Krog & Swinscow 1981). Many taxa in this element produce vegetative diaspores and are only rarely fertile.

Austral species in the Three Kings flora (7%), demonstrating a southern, circum-polar distribution (see Galloway 1979, 1985; Jørgensen 1983) include *Brigantiaea chrysosticta* (saxicolous in the Three Kings), *Cladonia capitellata*, *Leioderma pycnophorum* and *Stereocaulon corticatulum*, and ally the Three Kings lichens with

other southern Pacific lichen floras as well as with those of cool-temperate South America, and the islands Juan Fernandez (Zahlbruckner 1924, 1926) and Tristan da Cunha (Jørgensen 1977, 1979, 1983). Palaeotropical taxa, which include *Peltigera dolichorhiza*, *Cladina confusa*, *Pseudocyphellaria poculifera* and *Ramalina celastri*, comprise 5% of the Three Kings lichen flora and show distinct relationships with the lichen floras of north-eastern Australia, Lord Howe Island and New Caledonia (Smith 1922). *Erioderma sorediatum*, a presumed palaeotropical lichen first described from the Three Kings (Galloway & Jørgensen 1975), is now known from the Phillipines, India, Central America, the Caribbean and, very rarely, from North America (Maass 1983). A small number of species (3%) are part of the Western Pacific element and include *Heterodermia japonica* and *Peltigera nana*.

Because of the relative dryness of the island's climate, truly permanently humid habitats are lacking and hence a large number of genera and species common on the New Zealand mainland are absent from the Three Kings flora, especially taxa in such southern genera as *Nephroma*, *Menegazzia*, *Pannoparmelia*, *Pseudocyphellaria*, *Siphula* and *Sphaerophorus*. Genera not found on the Three Kings include: *Anzia* (the tropical *A. madagascarensis* is known from sites close by in Northland), *Baeomyces*, *Cetrelia*, *Chiodecton*, *Dendroscocaulon*, *Glyphis*, *Heterodea*, *Hypogymnia*, *Laurera*, *Lobaria*, *Lopadium*, *Ocellularia*, *Parmelina*, *Physma*, *Porina*, *Sarcographa*, *Thysanothecium* and *Trypethelium*, many of which have pantropical, palaeotropical or Western Pacific species reaching into New Zealand including several northern off-shore islands south of the Three Kings.

The characteristic local endemic component of the phanerogamic flora is not matched in the lichen flora to any extent, though of the Three Kings collections of *Neofuscelia pulla* Esslinger (1977) noted "... eight specimens collected from various localities on Three Kings belong to the stenosporic acid race but none contained the usual trace of divaricatic acid. Instead, each specimen contained a small or trace amount of perlatolic acid, with the stenosporic acid. These were the only specimens of *Parmelia pulla* found to contain perlatolic acid. The Three Kings race is apparently very localised. It is interesting to note that although this localised range is undoubtedly monophyletic, it exhibits much of the total range of morphological variation of *P. pulla* as a whole". Possibly the microlichens yet to be fully determined may disclose some taxa endemic to the Three Kings, but on present evidence the degree of endemism (at the species level) is of the order of 1% or less.

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