

The vegetation, flora, mycobiota and vertebrate fauna of Motuhinahina, a limestone island in Te Whanga, Rēkohu / Wharekauri / Chatham Island

Peter J. de Lange, Rowan K. Scott, Campbell J. James, Dayna J. M. McKenzie, Marleen Baling, Rachel R. Klein, Karla Butcher, Amelia Tapp, Sophie Rear, Andrew J. Marshall, Rob Chappell, Hamish Tuanui-Chisholm

<https://doi.org/10.55457/pibdiv.004104>

The vegetation, flora, mycobiota and vertebrate fauna of Motuhinahina, a limestone island in Te Whanga, Rēkohu / Wharekauri / Chatham Island by Peter J. de Lange, Rowan K. Scott, Campbell J. James, Dayna J. M. McKenzie, Marleen Baling, Rachel R. Klein, Karla Butcher, Amelia Tapp, Sophie Rear, Andrew J. Marshall, Rob Chappell and Hamish Tuanui-Chisholm is licensed under a Creative Commons Attribution-NonCommercial 4.0 International Licence.

This publication may be cited as:

de Lange, P. J., Scott, R. K., James, C. J., McKenzie, D. J. M., Baling, M., Klein, R. R., Butcher, K., Tapp, A., Rear, S., Marshall, A. J., Chappell, R., Hamish Tuanui-Chisholm. (2026). The vegetation, flora, mycobiota and vertebrate fauna of Motuhinahina, a limestone island in Te Whanga, Rēkohu / Wharekauri / Chatham Island. *Perspectives in Biodiversity*, 4(1): 31–59.

Contact:

www.unitec.ac.nz/epress

ePress

Manukau Institute of Technology and Unitec

Private Bag 92025, Victoria Street West

Tāmaki Makaurau Auckland 1142

Aotearoa New Zealand



ISSN 3021-114X

The vegetation, flora, mycobiota and vertebrate fauna of Motuhinahina, a limestone island in Te Whanga, Rēkohu / Wharekauri / Chatham Island

Peter J. de Lange^{1*} , Rowan K. Scott², Campbell J. James¹ , Dayna J. M. McKenzie¹, Marleen Baling¹ , Rachel R. Klein¹ , Karla Butcher³, Amelia Tapp¹, Sophie Rear¹, Andrew J. Marshall¹ , Rob Chappell⁴, Hamish Tuanui-Chisholm⁵

Affiliations:

1. Applied Molecular Solutions Research Group, School of Environmental and Animal Sciences, Manukau Institute of Technology and Unitec, Private Bag 92025, Victoria Street West, Auckland 1142, New Zealand
2. Northland Regional Council, Private Bag 9021, Te Mai, Whangārei 0143, New Zealand
3. School of Biological Sciences, University of Auckland, Thomas Building, 44 Symonds Street, Grafton, Auckland 1010, New Zealand
4. 200 Mannion Road, Wyuna Bay, Coromandel 3581, New Zealand
5. 1007 Waitangi–Tuku Road, Chatham Islands 8016, New Zealand

* Corresponding author: pdelange@unitec.ac.nz

Associate Editor: Lilith Fisher

Article type: Research paper

Abstract

Motuhinahina (0.454 ha, 3 m a.s.l., -43.896777 [45°53'47.01" W] -176.488079 [176°29'17.02" S]) is the largest of the 21 limestone islands and rock stacks present along the western side of Te Whanga, Rēkohu / Wharekauri / Chatham Island. The island is an example of a very uncommon terrestrial ecosystem on Chatham's karst islands, islets and rock stacks. The island is notable for its role as a safe refuge and nesting site for papua / Chatham Island shag (*Leucocarbo onslowi*) and kawau o Rangihau / Pitt Island shag (*Phalacrocorax featherstoni*), and for having a key population of waiū-atua / shore spurge (*Euphorbia glauca*), a seriously threatened species on the Chatham Islands, and in decline on the main islands of Aotearoa / New Zealand. In this paper, we document some of the biota of Motuhinahina. For the flora and mycobiota we report 136 taxa present from 78 families (one chromist [brown seaweed], four algal, 12 bryophyte, six pteridophyte [Polypodiopsida], 38 Angiosperm [flowering plant], seven fungal and ten lichenised mycobiota) and 126 genera (one chromist [brown seaweed], four algal, 14 bryophyte, seven pteridophyte, 77 flowering plants, eight fungal and 15 lichenised mycobiont). Fourteen bird species (11 indigenous / endemic and three naturalised) are also reported. Puhina / kekeno / New Zealand fur seals (*Arctocephalus forsteri*) are reported to be increasing in numbers and breeding on the island. Six vegetation associations and landforms are described and mapped using the field-based method described by Atkinson in 1985. One fern, *Asplenium appendiculatum* subsp. *appendiculatum*, two flowering plants, *Centipeda minima* subsp. *minima* and *Lachnagrostis pilosa* subsp. *nubifera*, and one lichen, *Flavoplaca mereschkowskiana*, are either new records for the Chatham Islands or Aotearoa as a whole. Motuhinahina has huge potential as a secure site to establish several Chatham Islands ornithophilous endemics.

Keywords

Chatham Islands, Te Whanga, limestone, karst islands, biota, vegetation associations

Introduction

Te Whanga lagoon, at 160 km², is the largest water body within the Chatham Islands group (part of greater Aotearoa / New Zealand [hereafter Aotearoa]) and dominates the landscape of Rēkohu / Wharekauri / Chatham Island (hereafter Rēkohu). While most of Te Whanga comprises open water, scattered along the eastern portion, abutting Taia, is a series of low-relief sand islands and islets, and along the western side, 21 small (mostly ≤ 0.01 ha) limestone islands and rock stacks are present. These represent c. 1.584 ha (c. 0.0018%) of the land area of Rēkohu, so are arguably one of the most uncommon terrestrial ecosystems in the Chatham Islands. While most of these islands and rock stacks are scarcely vegetated, a few support shrubland, and the largest island, Motuhinahina (0.454 ha, 3 m a.s.l., -43.896777 [45°53'47.01" W], -176.488079 [176°29'17.02" S]) (Figures 1 and 2), has a low forest cover. Motuhinahina, at c. 0.56 km from the adjacent shoreline of Rēkohu, is also the most isolated of these ecosystems. Prior to this paper, the island's flora and fauna had only been documented once, in a file note made by Rob Chappell, who, in his then role as Department of Lands and Survey Ranger, visited the island on 16 December 1986. That file note, made

accessible by the New Zealand Plant Conservation Network (see: <https://www.nzpcn.org.nz/publications/plant-lists/lists/plant-checklist-for-motuhinahina-island-chatham-island/>), provided succinct summaries of the island's physiography and vegetation (especially forest cover and height), and notes of avifauna and flora. Chappell recorded 25 indigenous vascular plants and five species of birds, one of which was a naturalised species, dunnoek (*Prunella modularis* (Linnaeus, 1758)). The other four indigenous species were noted as nesting. Chappell also noted the arid conditions of the island.

Aside from this visit, the island has remained a popular site for islanders to visit during the summer. On account of its role in the conservation of the two endemic shags, papua / Chatham Island shag (*Leucocarbo onslowi* (Forbes, 1893)) and kawau o Rangihau / Pitt Island shag (*Phalacrocorax featherstoni* Buller, 1873), the island is frequently visited by the Bell brothers, Mike and David (M. Bell, pers. comm., 2 October 2023). Motuhinahina is also well known for a viable population of the nationally declining waiū-atua / shore spurge (*Euphorbia glauca* G.Forst.) (de Lange et al., 2024) (Figure 3), one of the largest and most secure in the Chatham group.

Motuhinahina and the other limestone islands, as well as the islets and rock stacks of Te Whanga, as karst systems, are also notable, as this ecosystem is

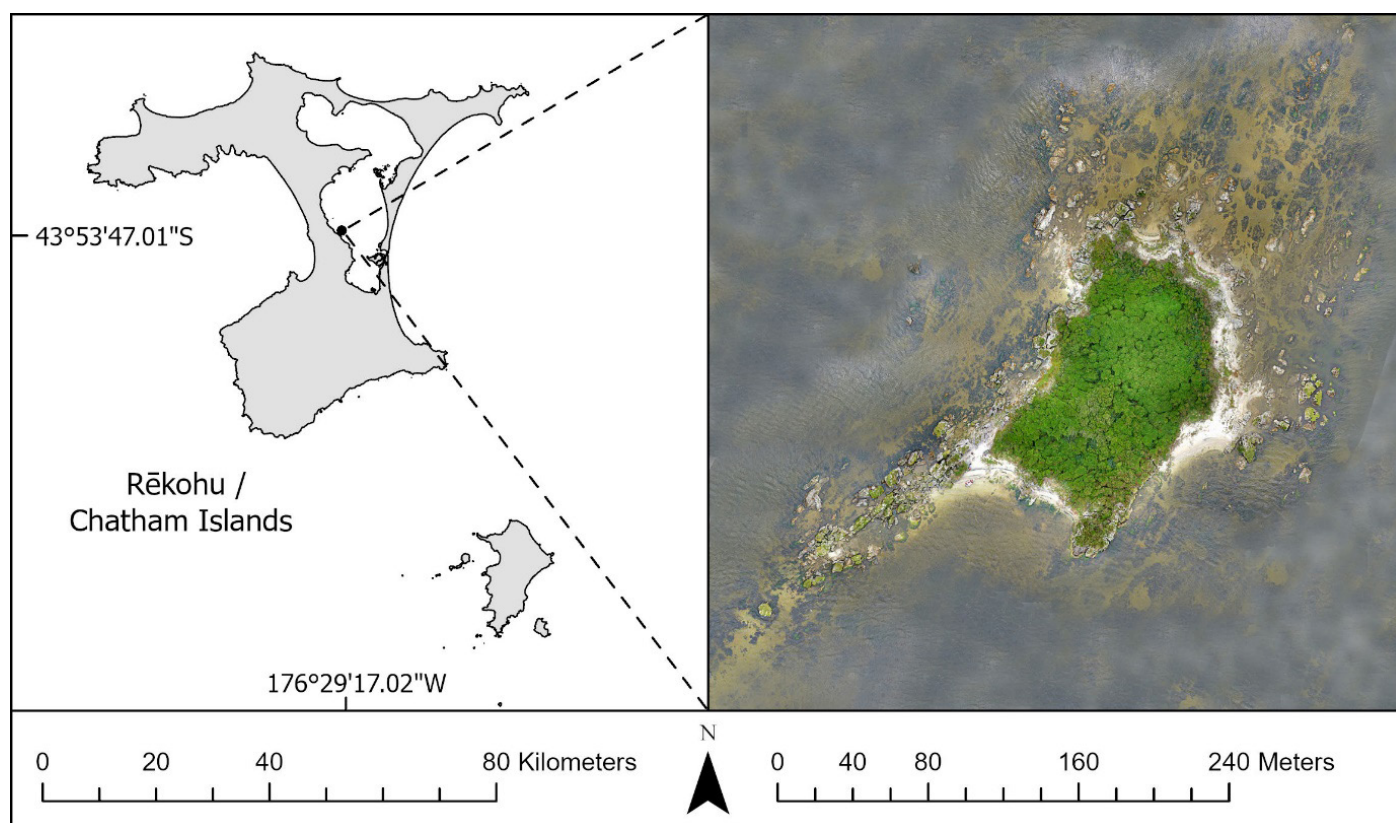


Figure 1. Motuhinahina, located within Te Whanga, Rēkohu / Wharekauri / Chatham Island.

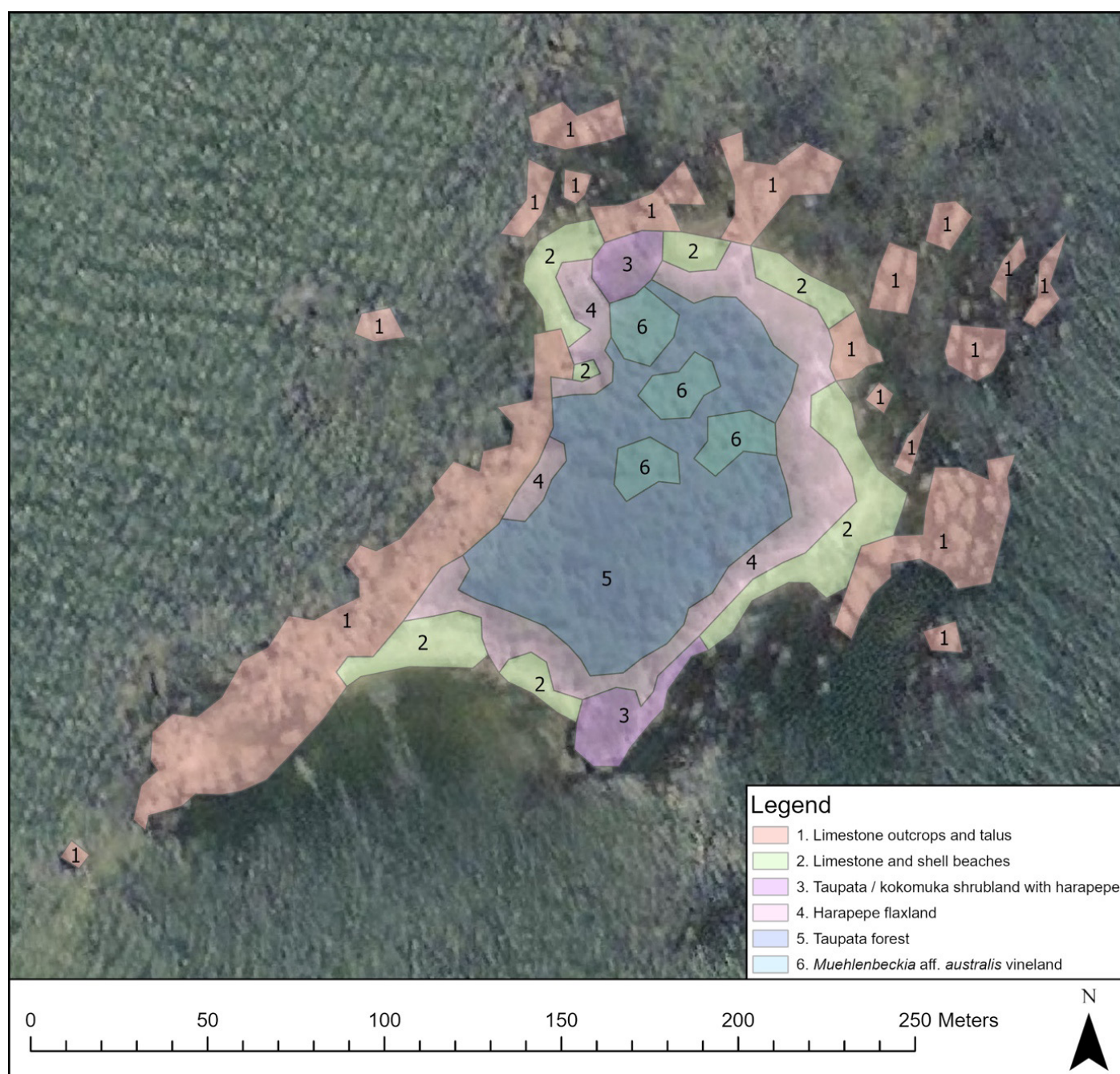


Figure 2. The vegetation associations and landforms of Motuhinahina island.

uncommon in the islands. Yet despite their scarcity and importance as intact examples of an otherwise severely degraded ecosystem on the main island (de Lange et al. 2026 in sub.), there has been little documentation of their biota and vegetation associations. Since 15 February 2023, we have made three visits to Motuhinahina – in April 2023, mid-February 2024 and mid-February 2025. This paper documents the results from those visits.

Geology and Physiography

Motuhinahina is low lying, roughly east–west aligned and rectangular in outline (Figures 1 and 2). The shoreline is mainly comprised of outcrops, rock stacks, tors, rubble and talus that extend up to 90 m offshore from the main island in the western, northern and eastern portions (Figure 4). The island is formed from an exposure of heavily weathered limestone that had been mapped as ‘Te Whanga Limestone’ of early Eocene to Oligocene age (Hay et al. 1970; James et al. 2011). There are, however, two distinct lithologies within Te Whanga Limestone



Figure 3. Waiū-atua / shore spurge (*Euphorbia glauca*), a seriously threatened species on the Chatham Islands and in decline in the main islands of Aotearoa, has a large population on Motuhinahina. Currently, this is the most secure population of this species known from the Chatham Islands. In this image, *Euphorbia* is growing with purei (*Carex trifida*), *Ficinia nodosa*, harapepe (*Phormium tenax*) and *Haloragis erecta* subsp. *erecta*.

(Campbell et al. 1988; James et al. 2011). Those authors observed that these lithologies, while well defined by dates obtained from their micropaleontological assemblages, were hard to separate in the field due to their discontinuous bedding and inconsistent lithification (grading from soft and easily weathered to local hard, sparry-textured outcrops). Their solution was to recognise a ‘Te Whanga Limestone’ with two members, Matanginui and Te One limestone, and for those sites where these lithologies gave way to an extremely hard, coarsely textured biosparite, an ‘Undifferentiated Te Whanga Limestone’ (Campbell et al. 1988). It is this variant of limestone that forms Motuhinahina.

The limestone of Motuhinahina has formed a karst landscape (Figure 4) of hogsbacks, grykes, karrenfields, razorbacks, rock stacks, towers and near-shore tors that in places extend up to 200 m offshore as emergent features protruding from a shallow encircling reef (covered by 1–2 m of water depending on lagoon water-levels). This karst landscape is a conspicuous feature of the island’s shoreline, and in places forms a maze of outcrops up to 2 m tall and 3 m wide. The geomorphology of some limestone outcrops suggests an origin in the collapse of small caves or rock arches. The sides of these outcrops and tors are typically deeply pitted, in places weakly flagged, and then usually weathered razor sharp. Between these outcrops is limestone talus and rubble, or small beaches (Figure



Figure 4. The northern shoreline of Motuhinahina looking west over Te Whanga to the coastline between Ohuru and Plum Tree. This island portion is delineated by numerous limestone outcrops, tors and karren fields whose tops are usually weathered razor-sharp.



Figure 5. One of five small beaches on Motuhinahina. In this image, the upper portion of the beach is densely vegetated by *Atriplex australasica*, *A. prostrata*, Chatham Islands celery (*Apium prostratum* subsp. *denticulatum*), purei (*Carex trifida*), *Ficinia nodosa* and kōkōmuka (*Veronica dieffenbachii*). This image was taken on 12 February 2023 (our first visit to the island). This beach and its associated vegetation were almost completely destroyed following the passage of Cyclone Gabrielle, which reached the Chatham Islands on 14 February 2023. By 2025 it had regained its former spread, but remained sparingly vegetated.

5) comprised of limestone chip and sand, and shells. The karst topography, rubble and talus collectively allow for a highly free-draining landscape, which, as Chappell noted in 1986, is very dry. There are no natural streams, ponds or seepages, and on our February and April visits, a visage of drought-stricken vegetation seemed to be the usual condition. The central densely vegetated portion of the island rises to an estimated 3 m a.s.l. Here, limestone outcrops are less prominent and narrower, taking the form of razorbacks rising to 1 m above the soil surface and often less than 0.2 m wide. It seems likely that the central portion of the island was also formed through the accumulation of limestone rubble, chip, sand and shell eroded from the outcrops, and from the sediment and shells washed in by the lagoon. Whatever the exact origin, the surface of this substrate is now covered in a 0.5–1 m deep friable black soil strewn with limestone lithics and shell fragments. Similar, though shallower, skeletal soils have developed in suitable sites on the exposed limestone outcrops described above. Without soil testing, this soil is probably best classified as a typic rendzic melanic soil *sensu* Hewitt (2010) and Hewitt et al. (2021).

Methods

Motuhinahina was visited for four hours on 12 February 2023, two hours on 18 April 2023, three hours on 10 February 2024 and three hours on 2 February 2025. During these visits, observations of the geology, vegetation, fauna, flora, fungi and lichenised mycobiota were made, and that data was collated and tabulated. Methods for fauna observations are also described in Baling et al. (2023) and Klein et al. (2025). Collections of plant, lichenised and non-lichenised mycobiota were made and lodged in AK and UNITEC herbaria (Herbarium codes follow Thiers from 2008 onward). Taxa observed are arranged taxonomically by family as follows: chromista and alga (Nelson 2020), Avifauna (Miskelly 2022), bryophytes (Söderström et al. 2016), pteridophytes and flowering plants (APG 2003, 2009, 2016; PPG 2016), fungi (Mycobank, <https://www.mycobank.org>), lichenised mycobiota (Kraichak et al. 2018). Authorities for those taxa seen on Motuhinahina are provided in Appendices 1 and 2. Vegetation associations were distinguished in the field using the empirical field-based vegetation classification system of Atkinson (1985). Aerial images were obtained during the February 2025 visit. They were recorded using a

DJI Mavic Pro 2 (Shenzhen, China) drone and mapping software Site Scan LE set at an altitude of 40 m and an 80% overlap. The final image of the island was curated using WebODM (OpenDroneMap, <https://opendronemap.org/webodm/>). Names for biota are those that were currently in use in Aotearoa in November 2025.

Results

Flora and mycobiota

A total of 136 taxa from 78 families (one chromist [brown seaweed], four algal, 12 bryophyte, six pteridophyte [Polypodiopsida], 38 angiosperm [flowering plant], seven fungal and ten lichenised mycobiota) and 126 genera (one chromist [brown seaweed], four algal, 14 bryophyte, seven pteridophyte, 77 flowering plant, eight fungal and 15 lichenised mycobiont) were recorded from Motuhinahina (Appendix 1). Nine of the families and 28 of the genera present on the island are also only represented by naturalised taxa. Four taxa, three mosses (*Campylopus* Brid., *Racomitrium* P.Beauv. and *Trichostomopsis* Cardot) and a fungus, (*Chlorophyllum*) listed here are not substantiated by voucher specimens, though the fungus and a moss, *Trichostomopsis australasiae*, are supported by an iNaturalist NZ observation (<https://inaturalist.nz/observations/199639468>, <https://inaturalist.nz/observations/157449851> respectively).

Algae

Although algae were not specifically a focus of the survey, four species, four green (one terrestrial [*Rosenvingiella*], three marine [*Codium* (1 sp.), *Ulva* (2 sp.)]) and a red seaweed (*Gracilaria chilensis*) were collected. *Codium*, *Ulva* and *Gracilaria* were commonly seen festooning the submerged limestone reefs fringing the island. These algae are also a significant component of the organic matter scattered along the strandline of the island's beaches. These seaweeds are abundant in the shallow water of Te Whanga. The *Rosenvingiella*, most likely *R. tasmanica* (S. Heesh, pers. comm., May 2023), was common on shaded, damp, guano-splattered limestone outcrops below shag roosts and nesting sites along parts of the northern coastline of the island. During the 12 February 2024 visit, a single brown seaweed, *Halopteris funicularis* (Ochrophyta (Chromista)), was also collected from partially submerged limestone. Although it is not technically an algae, we include it here for reference's sake.



Figure 6. *Pulchrinodus inflatus*, an uncommon moss on the Chatham Islands, grows at the back of the north-western beach on Motuhinahina in the shelter of purei (*Carex trifida*) amongst coarse limestone chips and broken shells.

Bryophytes

We collected 14 taxa, two liverworts and 12 mosses. The two liverworts, *Chiloscyphus semiteres* var. *semiteres* and *Frullania pentapleura*, were noted on limestone outcrops, associated rubble and soils. Only the *Frullania* was considered common. Of the 12 mosses recorded, one, *Eurhynchium praelongum*, is naturalised to the Chatham Islands (Fife 2020), and another, *Pulchrinodus inflatus*, is noteworthy. *Pulchrinodus* (Figure 6) is a large and conspicuous species most commonly seen in the northern portion of Te Ika-a-Māui / North Island. On the Chatham Islands, it has hitherto been collected twice (Fife 2017a), once in peaty windswept turf at Ohira Bay, Rēkohu, and once from open peaty ground under *Dracophyllum* Labill. on Rangihau / Rangiauria / Pitt Island. On Motuhinahina, *Pulchrinodus* was noted in scattered locations growing in sandy soil, admixed with limestone fragments at the back of a small beach. It was associated with *Ficinia nodosa*, purei (*Carex trifida*), *Lachnagrostis billardierei* subsp. *billardierei* and *Plantago coronopus*. On the limestone rock stacks and outcrops, another moss, conspicuous on account of its forming of small blackish-brown balls on the otherwise light-grey, greyish-white limestone rock, is *Zygodon menziesii*. This species, seemingly salt-tolerant according to Fife (2017b), is commonly seen on those more exposed, 'Undifferentiated Te Whanga Limestone' outcrops along the western shoreline of Te Whanga.

Otherwise, on margins of the tops of those limestone outcrops supporting a low shrubland, especially in crevices or exposed situations, *Tortella flavovirens* can be locally common, the *Tortella* turves often providing a habitat for *Colobanthus muelleri*, and in spring and early summer, *Aira caryophyllea* subsp. *caryophyllea*.

Polypodiophyta

Thirteen indigenous species of fern and one hybrid were recorded during our visit. Of these, only three, *Asplenium chathamense*, *A. lyallii* and *Pteridium esculentum*, are common on the island, probably because they are hardy species, tolerant of open habitats, such as limestone outcrops, and drought. *Asplenium chathamense* is a generalist species on the Chatham Islands, favouring open, coastal habitats, exposed or sheltered rock outcrops and the ground layer of open forest that has developed on the better-draining soils – it is only uncommon in those forests developed over peaty ground, and it is absent from wetlands. Similarly, *Asplenium lyallii* is a common species on rocky outcrops of basalt and limestone in forested or non-forested sites throughout the islands. However, that species is, like *A. chathamense*, a scarce terrestrial fern in forests developed over peaty ground. Where the ranges of both species overlap, hybrids between them can be common. On Motuhinahina, both species grow on exposed and semi-sheltered limestone outcrops, with hybrids between them occasionally present (Figure 7), especially on the island's northern side. Along the margins of the central



Figure 7. The hybrid *Asplenium chathamense* × *A. lyallii* is a conspicuous, though uncommon, component of the shaded and sheltered limestone outcrops along the north-eastern side of Motuhinahina.

forested area, at the back of beaches and on the tops of some of the larger vegetated limestone outcrops, *Pteridium* is also locally common.

Other ferns were uncommon, with species such as *Adiantum cunninghamii*, *Asplenium oblongifolium* and *A. scleroprium* occurring as single individuals. Epiphytic species were represented solely by *Pyrrosia eleagnifolia*, which was noted growing on rock. The *Asplenium scleroprium* record is now the third and northernmost observation of this species from the Chatham Islands. It is also the northernmost for this species in greater Aotearoa (see Brownsey & Perrie 2018).

The *Doodia* record is significant. This species was hitherto only known from the Chatham Islands from a single 2015 collection (P.J. de Lange CH2567, AK 358186) from Hokoreoro / Rangatira / South East Island (Brownsey & Perrie 2021, as *Blechnum parrisiae* Christenh.). On Motuhinahina, it grew on limestone outcrops within dense *Muehlenbeckia* aff. *australis* vineland. This conspicuous fern has not yet been found elsewhere on the Chatham Islands. As it is not known from cultivation on the islands, it may be that these occurrences are the result of recent establishment via long-distance dispersal from Aotearoa, where this fern is ubiquitous (Brownsey & Perrie 2021).

Angiosperms

Angiosperms are the dominant floral component of the island's ecosystem, with 99 taxa recorded during our visits. Despite their dominance, the impact of the survey conditions and the timing of surveys (late summer and autumn) may explain the underrepresentation of spring annuals. During the February visits, eight grasses were mainly identified from dead, dried-off plants with no live specimens seen. Similarly, *Senecio radiolatus* must be seasonally abundant on the island, as judged from the numerous dried-off plants seen in the February visits and numerous seedlings in April. During the February visits, *Atriplex australasica*, *Oxybasis ambigua* and *Tetragonia tetragonioides* were common to abundant, and yet scarcely evident during the April visit. This can be explained easily given that these are short-lived, often annual species; however, the perennial *Goodenia radicans*, noted as abundant in February, and then nearly absent in April, is less easily explained. Overall, 14 species were considered abundant, 45 common, and seven were noted as single plants, leaving 33 taxa considered uncommon.

Seven abundant taxa are halophytic, drought-tolerant species found on the limestone rock stacks, outcrops



Figure 8. *Muehlenbeckia* aff. *australis* vineland. This vine, an unnamed species, is also found locally in the two main islands of Aotearoa. It is abundant on Motuhinahina, where it suppresses, smothers and often kills the surrounding canopy species. In this image, the *Muehlenbeckia* is smothering kawakawa (*Piper excelsum* subsp. *excelsum*), hakapiri (*Olearia traversiorum*), taupata (*Coprosma repens*) and harapepe (*Phormium tenax*).

and beaches, e.g., *Disphyma papillatum* and *Salicornia quinqueflora* subsp. *quinqueflora*. Four naturalised species, *Coprosma repens*, *Medicago lupulina*, *Plantago coronopus* and *Solanum chenopodioides*, are common weedy species throughout the islands. Their presence on Motuhinahina reflects their abundance along the shoreline of Te Whanga and their ease of seed dispersal via water and birds. The dominance of *Muehlenbeckia* aff. *australis* (Figure 8) throughout the island was first noted in 1986, and islanders (John and Judy Kamo, pers. comm., February 2023) believe this vine is increasing its 'hold' on the central portion of the island. The Chatham Islands race of *Muehlenbeckia* has thicker leaves than any of its Aotearoa counterparts (P. J. de Lange, unpubl. data) and is surprisingly drought tolerant. This may partly explain its ability to thrive in the dry soils, limestone rubble and outcrops of Motuhinahina. The hybrid swarm *Veronica chathamica* × *V. dieffenbachii* (Figure 9), though noted as abundant on the tops of the larger limestone outcrops and at the backs of beaches, was starting to wilt in the February 2023 and 2024 visits, but had recovered from this by the February 2025 visit. This hybrid, a feature of disturbed vegetation throughout the coastal and lowland portions of the main islands of the Chathams group, appears to be more drought tolerant than either of its parents. Of the two species, pure examples of *Veronica dieffenbachii* are uncommon on the island, and those

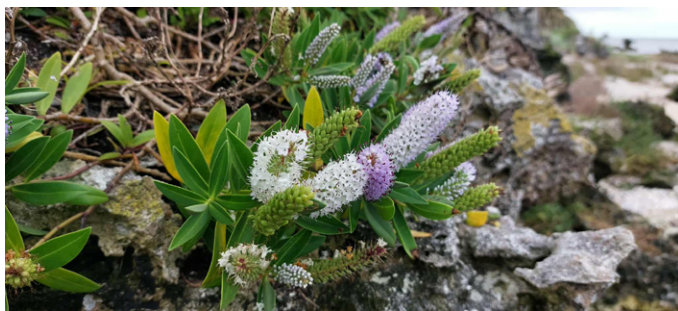


Figure 9. *Veronica chathamica* × *V. dieffenbachii* is the most common *Veronica* on Motuhinahina, where it can be found primarily on shrubland on the tops of the larger limestone outcrops.

seen were suffering severe drought damage in February 2023, and had nearly all died out by February 2025, while the other, *V. chathamica*, in a pure state, was only common on limestone rubble and amongst *Disphyma*.

Fungi

Eight fungi were seen during the four visits made to Motuhinahina. This is undoubtedly an underrepresentation, partly caused by the dry conditions during the February visits and time constraints for their survey during the April visit. Of those fungi seen, *Auricularia cornea*, though conspicuous, was noted once on a standing damaged kōpī / karaka (*Corynocarpus*

laevigatus), with the same tree also supporting a few *Pleurotus* fruiting bodies during the April visit. In April 2023 the naturalised *Favolaschia claudopus* was noted as uncommon on decorticated hakapiri (*Olearia traversiorum*). During the February 2024 visit, a robust species of *Chlorophyllum* (Figure 10) was noted as locally common in one site, growing in well-rotted *Coprosma repens* / *Muehlenbeckia* aff. *australis* leaf litter under a dense canopy of those plants (see: <https://inaturalist.nz/observations/199639468>). More widespread on the island were rust and mildew fungi; for example, almost all *Epilobium billardioreanum* plants seen in the February visits were infected with the naturalised willowherb mildew (*Podosphaera epilobii*). Similarly, the leaves of *Apium prostratum* subsp. *denticulatum* were commonly infected with another presumed naturalised fungus, *Septoria apiicola*. During the April visit, *Lobelia anceps* plants were commonly infected with *Puccinia aucta*. On all of the visits, most *Sonchus oleraceus* seen were infected, sometimes heavily, by the naturalised rust *Peristemma pseudosphaeria*. At the north-eastern end of the island, where purei (*Carex trifida*) is locally common at the back of a small shell and limestone chip and sand beach, *Puccinia chathamica* was locally common on the leaves of that sedge. Previously, this rust had been recorded from *Carex chathamica* Petrie and *C. trifida* (McKenzie 1991; McKenzie 2008, as *Uredo*

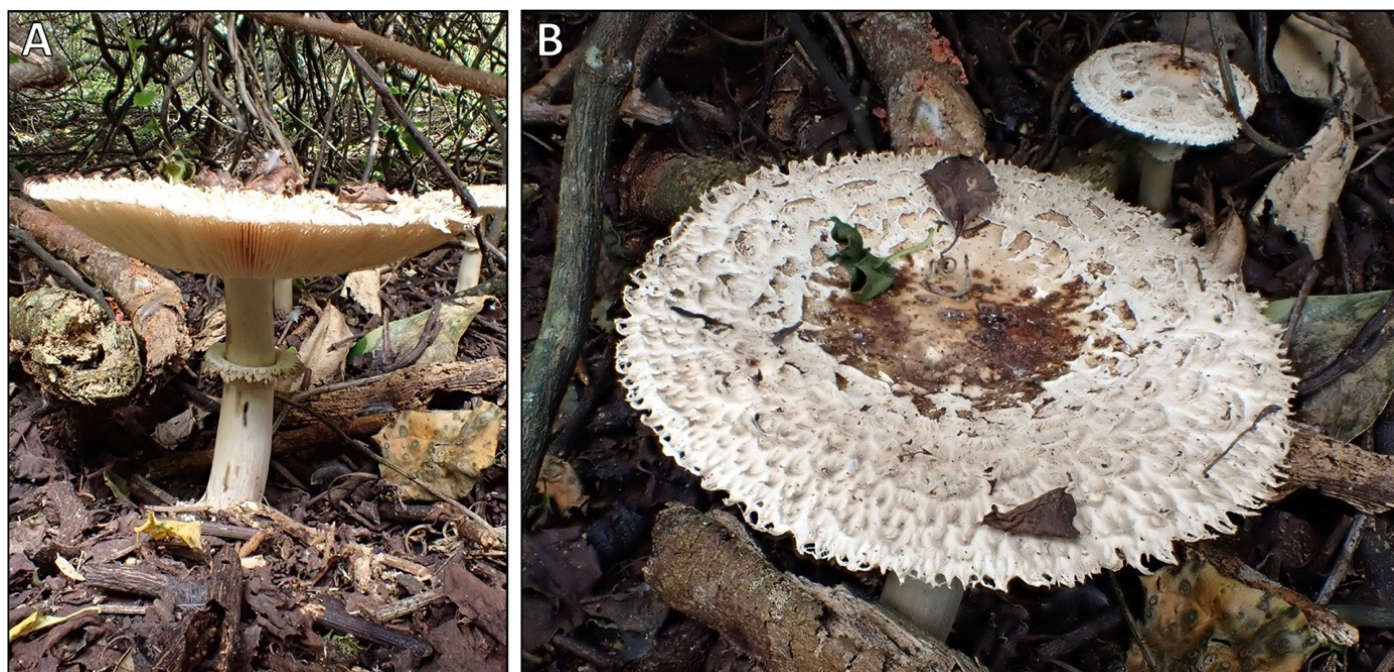


Figure 10. A species of *Chlorophyllum* was noted in one site during the 10 February 2024 visit to Motuhinahina. **A.** Side view of fruiting body showing stipe, volva, gills and pileus. **B.** Top view of pileus. Six fruiting bodies were noted emergent from an area of moderately well-rotted taupata (*Coprosma repens*), *Muehlenbeckia* and hakapiri (*Olearia traversiorum*) wood and leaves. The largest fruiting body stood 100 mm tall with the pileus 140 mm in diameter.

chathamica McKenzie and *Puccinia chathamica*). Based on McKenzie (1991) and these recent observations, *Puccinia chathamica* is now known from nine locations on the Chatham Islands, seven from Rēkohu, one from Rangihau and one from Hokoreoro.

Lichenised mycobiota

Due to time constraints, lichenised mycobiota, especially saxicolous taxa, were poorly sampled. The island's vegetation offers few suitable phorophytes and microhabitats for corticolous and foliicolous lichens. A single inihina (*Melicytus chathamicus*) was sampled and found to support seven lichens. The main lichen diversity on the island occurs within the saxicolous crustose taxa colonising limestone – of the 18 taxa we collected from the island, 10 are exclusively saxicolous crusts. The most common are *Diplotomma alboatrum* and *Opegrapha rupestris*, occurring on most limestone rocks in the area. *Hydropunctaria maura* is restricted to shaded locations exposed or close to the water of the lagoon, but is still common. Obvious yet less common is *Diploicia canescens* subsp. *australasica*, mostly found on northern-facing rocks exposed to the lagoon. On the limestone outcrops to the south-east of the island, *Caloplaca johnwhinrayi* is locally common. On the western side of these outcrops, we found *Flavoplaca mereschkowskiana*, another new record for the lichenised mycobiota of Aotearoa as a whole, growing in association with *Porina corrugata*.

Avifauna

As already noted, Motuhinahina is important in that it is one of the known refuges and breeding grounds for the Threatened / Nationally Vulnerable kawau o Rangihau / Pitt Island shag (*Phalacrocorax featherstoni*) and papua / Chatham Island shag (*Leucocarbo onslowi*). In addition to these birds, our four visits to the island have recorded a further 15 species, giving a total of 17 species, seen over a combined total of 16 hours on the island (Appendix 2). Of these, 13 are indigenous / endemic and four are naturalised to the Chatham Islands. The most commonly observed birds between 2023 and 2025 were karoro / southern black-backed gulls (*Larus dominicanus*) (15–31 individuals, nests present) and kawau o Rangihau / Pitt Island shags (*Phalacrocorax featherstoni*) (2–22 individuals seen, nests present). Starlings were not observed, but there was evidence of roosting by this species at Motuhinahina (Baling et al. 2023), with large flocks noted settling on the island at dusk (P. Smith, pers. comm., April 2023). The larger trees and shrubs



Figure 11. Puhina / kekeno / New Zealand fur seal (*Arctocephalus forsteri*) adult female suckling pup (2 February 2025). On that visit to Motuhinahina, ten adults and two pups were seen – the most significant number noted since our first visit to the island in February 2023.

on the island are covered in their guano and discarded feathers, and we suspect they are a significant vector of bird-dispersed indigenous and pest plant species. We also noted weka (*Gallirallus australis hectori*) every year, with three adults and three chicks in 2023, and a family with two fledglings and one bird in 2025. Weka have previously been eradicated and reported swimming to the island (Klein et al. 2025; M. Bell, pers. comm., October 2023).

Seals

Puhina / kekeno / New Zealand fur seals (*Arctocephalus forsteri* Lesson 1828) have been observed on all visits to Motuhinahina, with three adults and two pups seen in 2023 and the most significant number seen during the February 2025 visit, which was 10 adults and two suckling pups (see <https://inaturalist.nz/observations/261085353>, Figure 11). Kekenos are regularly reported from the island. However, evidence of breeding is considered 'recent' (M. Bell, pers. comm., October 2023).

Vegetation associations

Six vegetation associations and landforms were mapped on Motuhinahina (Figure 2):

Limestone outcrops and talus

Numerous tors and outcrops form the margins of Motuhinahina (Figures 2, 4). However, tors and outcrops interconnected by talus and rockfield are especially prominent along the island's northern shoreline, extending westward in a gradually narrowing lobe for some 200 m. A similar extensive series of tors and outcrops is also located at the north-eastern side of the island and the south-eastern and south-western margins. The limestone rock is heavily weathered, the surfaces presenting as jagged, in places razor-sharp, flags, interpreted here as following bedding within the limestone. Pitting and solution holes are common along the flags. Deep rubble-strewn depressions between the larger outcrops are common, probably the result of the collapse of former caves or archways.

The vegetation of this portion of the island is a complex mosaic of coastal turf covering the talus slopes, areas of limestone chip and sand beach developed between outcrops, and on the small cliff faces and summits of the most exposed outcrops. The larger outcrops, notably those located more toward the central portion of the island, support a taller vegetation of shrubs and harapepe (*Phormium tenax*) described below. Although exposed rock faces generally lack vascular plants, they may support pockets of *Asplenium chathamense*, *A. lyallii* (and hybrids between them), *Apium prostratum* subsp. *denticulatum*, *Geranium traversii*, *Salicornia quinqueflora* subsp. *quinqueflora* and *Samolus repens* var. *repens*.

Due to time constraints, mapping this vegetation was beyond our abilities, so the landform and its associated vegetation are described here collectively. However, we distinguished three key vegetation associations from this landform, which are described below.

Disphyma turf

Disphyma papillatum is the dominant, in places sole, plant of the outer exposed limestone tors and outcrops, and in those sites used as haul-outs and nurseries for puhina / kekeno / seal. In these locations, suitable slopes, outcrops, tor summits, and where soil has accumulated, *Disphyma* forms a thick, interlaced turf (Figure 12). This turf is only broken in sites where birds roost and/or nest. Within these places are late-winter and spring annuals, and other short-lived plants such as *Aira caryophyllea*, *Hordeum murinum* subsp. *murinum*, *Lachnagrostis littoralis* subsp. *littoralis*, *Puccinellia chathamica*, *Senecio radiolatus* and *S. lautus* appear to have a strong seasonal presence (based on observation



Figure 12. *Disphyma* turf, north-western side of Motuhinahina.

of dried-off specimens and sporadic live plants). On the talus slopes and at their bases, *Goodenia radicans*, *Plantago coronopus*, *Salicornia* and *Samolus* may be locally dominant, and, in places, *Crassula moschata* – though at the time of our visits, this was mostly seen as dead or drought-stricken dying plants. In a few sites, occasional 0.1–0.4 m-tall *Atriplex australasica* were also noted, often growing out of deeply pitted limestone in soil pockets. *Disphyma* has a less compact, interlacing growth in the more shaded sites, and in these places, *Tetragonia tetragonioides*, *T. trigyna* and *Salicornia* can be co-dominant.

Coastal turf

Between the outcrops, small areas of beach developed from accumulated limestone sand, chip, rubble and shells support a compact turf of interwoven *Apium*, *Isolepis cernua* var. *cernua*, *Goodenia*, *Leptinella potentillina*, *Plantago coronopus*, *Ranunculus acaulis*, *Samolus*, *Schoenus nitens* and *Triglochin striata*, through which there is often a seasonal presence of *Lachnagrostis filiformis*, *Epilobium billardereanum* and *Medicago lupulina* (Figure 13). Though mostly of limited extent, these turfs may occupy areas of 2–3 m² along portions of the northern and eastern shoreline where the distance between the limestone outcrops is greater. Their larger size affords some shelter from coastal erosion. Coastal turf was observed as best developed on the 12 February 2023 visit, days prior to the passage of Cyclone Gabrielle and subsequent storm-generated swells. Much of this association was seriously eroded in the storm (Figure 14) and has yet to return to its former dominance.



Figure 13. Coastal turf is best developed along the northern shoreline of Motuhinahina. Here, a summer presence of *Epilobium billardereanum* and *Lachnagrostis filiformis* is showing through the patches of turf (12 February 2023).



Figure 14. Coastal turf in much the same location as the previous image (Figure 13). Here, the impact of Cyclone Gabrielle, which passed through the Chatham Islands on 14 February 2023, and subsequent localised storms, resulted in significant coastal erosion around Te Whanga. On Motuhinahina, the main impact was the loss of beaches and coastal turf, though in this image there can be seen the major salt-burn of harapepe (*Phormium tenax*), taupata (*Coprosma repens*) and *Muehlenbeckia* aff. *australis*, all of which had still not recovered nearly a year later (10 February 2024).

Talus

Depending on the degree of exposure, the talus may be devoid of plant growth or smothered in *Disphyma* turf. However, in some places, especially between the larger outcrops where there is some shelter, dense swards of *Atriplex prostrata*, *Lepidium didymum*, *Oxybasis ambigua*, *Puccinellia chathamica*, *Salicornia*, *Tetragonia tetragonioides*, *T. trigyna* and *Urtica australis*, and, less commonly, tufts of *Asplenium chathamense*, *Lachnagrostis billardierei* subsp. *billardierei* and *Ficinia nodosa* can be present. At the south-western portion of Motuhinahina, a significant rubble-filled depression (possibly a collapsed cave), sheltered from the lagoon waters and prevailing winds by encircling rock walls, supported masses of *Muehlenbeckia* aff. *australis*, through which grew purei (*Carex trifida*), *Urtica australis*, poroporo (*Solanum laciniatum*), and taupata (*Coprosma repens*) saplings. At this site on shaded rock, free from *Muehlenbeckia*, the Chatham Islands race of *Parietaria debilis* was locally common.

Limestone and shell beaches

A series of small beaches (Figure 5) comprised of coarse limestone sand and chip and intact or broken shells – mostly cockles (*Austrovenus stutchburyi* (Wood, 1828)), blue mussel (*Mytilus galloprovincialis* Lamarck, 1819) and mud whelk (*Cominella glandiformis* (Reeve, 1847)) – have developed along those parts of Motuhinahina free from limestone outcrops and rubble. The most extensive beaches occur on the island's south-western, eastern and south-eastern portions. The beach profiles tend to be steeply shelving, dipping at 15–20°, with an abruptly eroded face at the low-tide mark. The strandline of these beaches is sparingly to at times locally well vegetated, usually with *Lepidium didymum*, *Oxybasis ambigua*, *Tetragonia tetragonioides*, *Apium prostratum* subsp. *denticulatum*, *Atriplex australasica*, *A. prostrata*, *Puccinellia*, *Pseudognaphalium lanatum*, *Senecio elegans*, *S. lautus* and *Sonchus oleraceus*.

Beyond the strandline, the typically flattened portion of the beaches supports *Salicornia*, masses of *Hordeum*, and in places sedgelands of either purei (*Carex trifida*) or *Ficinia nodosa*. Scattered through this vegetation, *Solanum chenopodioides* is often common, though other associates usually include seedling and sapling taupata, poroporo and kōkōmuka hybrids (*Veronica chathamica* × *V. dieffenbachii*) (Figure 9) and small harapepe. *Euphorbia glauca* (Figure 3) is locally common in two locations, often growing with *Ficinia nodosa* and harapepe patches. Along the eastern side, 1.5–2 m tall



Figure 15. Taupata (*Coprosma repens*) / kōkōmuka (*Veronica* hybrid) shrubland with harapepe (*Phormium tenax*) – a variable vegetation association that fringes the tops of those limestone outcrops with deeper soil. Taupata and *Veronica chathamica* × *V. dieffenbachii* are usually the main woody plants present, and harapepe (*Phormium tenax*) may be locally dominant.

shrubs of kōkōmuka (*Veronica dieffenbachii*) are present. On the landward side of this vegetation, there is usually a sharply delineated line of either taupata shrubland merging into forest or harapepe flaxland.

Taupata (Coprosma repens) / kōkōmuka (Veronica hybrids) shrubland with harapepe (Phormium tenax)

On the tops of the most extensive limestone outcrops, especially those with a broad, flattened aspect, and in sites where soil has accumulated to depths of 0.1–0.2 m, a diverse shrub / flaxland is present (Figure 15). The two most common shrubs within this association are taupata and harapepe, though on occasion the kōkōmuka hybrid *Veronica chathamica* × *V. dieffenbachii*, hokotaka (*Corokia macrocarpa*) and hokopēke puapiki (*Leucopogon parviflorus*) can be locally common. Other prominent vegetation plants may include *Asplenium chathamense*, *A. lyallii*, *Ficinia nodosa*, tangles of *Muehlenbeckia* aff. *australis*, *Tetragonia trigyna*, and less commonly the procumbent kōkōmuka Rēkohu (*Veronica chathamica*)

Harapepe (Phormium tenax) flaxland

Harapepe forms a fringing, patchy vegetation association (Figure 16) at the back of the beaches, and in the gaps and on exposed ground between the limestone outcrops that form the outer rim of the island. Where it is best developed, it is several metres wide and often without associates, though *Euphorbia glauca* may grow through it in some places. Mostly, though, it appears to be in the process of being smothered by *Muehlenbeckia*. Some large harapepe supported taupata saplings growing from their centres, sprouting from the humus that has formed from accumulated dead harapepe leaves and remnants of the inflorescences.



Figure 16. Harapepe (*Phormium tenax*) flaxland often grows between the island's interior taupata (*Coprosma repens*) forest and *Muehlenbeckia* aff. *australis* vineland.

Taupata (Coprosma repens) forest

Dominating most of the island is a dense, windswept vegetation, which due to its height (up to 3 m tall) and closed canopy we elected to call 'forest' (Figure 17). This vegetation has developed on a 0.5–1.0 m-deep layer of soil derived from limestone chip, broken shell and humus that has accumulated between a series of limestone razorbacks, which in places is up to 1 m tall. The soil appears to have once been extensively bird-burrowed, though during our visit we saw no evidence of recent occupation. Except for a few multi-trunked / coppiced kōpī and kawakawa (*Piper excelsum* subsp.



Figure 17. Looking across the southern shoreline of Motuhinahina to the central taupata (*Coprosma repens*) forest and portions covered in *Muehlenbeckia* vineland, with scant associated inihina (*Melicytus chathamicus*) and hakaipiri (*Shawia traversiorum*).

excelsum), the canopy of this vegetation is dominated (95% or more) by taupata that is 2–3 m tall and up to 0.1 m in trunk diameter, through which is usually threaded *Muehlenbeckia*. *Muehlenbeckia* stems typically form an almost impenetrable layer within the understorey, making other associated plants mostly absent. However, drought-stricken 0.2–0.6 m-tall poroporo saplings were common in a few places during the February 2023 visit, and less stressed examples were locally common in the understorey on the February 2025 visit. Other sparse associates included saplings of inihina and kōpī. The forest floor was either devoid of plant growth or thickly covered in *Muehlenbeckia* seedlings of 40–50 mm in height, and in places black elderberry (*Sambucus nigra*). Near the coastline, the dense taupata canopy is broken by mostly senescent hakapiri (*Olearia traversiorum*), inihina, mataira (*Myrsine chathamica*) and singletons of karamū hioa (*Coprosma chathamica*), hoho (*Pseudopanax chathamicus*) and ngaio (*Myoporum semotum*). Many of these tree species are in ill-thrift, partly because of the smothering tangles of *Muehlenbeckia*, but also because they seem to have sustained considerable canopy damage, possibly from past storms and drought. For example, most hakapiri seen had been toppled to the north and north-west. Similarly, all kōpī seen were multi-trunked, resulting from extensive coppicing, and these specimens had dead and/or severed central trunks (often split at about 2 m above ground). The forest is used as an evening starling (*Sturnus vulgaris vulgaris*) roost, evident from feathers on the ground, and the faecal-splattered kawakawa, poroporo, kōpī and taupata leaves. Starlings are probably responsible for black elderberry on Motuhinahina, which remains a relatively uncommon naturalised species on Rēkohu. On our visit, we only saw seedlings up to 0.1 m tall, and these were aggregated around the bases of kōpī and taller taupata. All that was seen was removed, as elderberry could become a serious weed species on Motuhinahina and elsewhere on the Chatham Islands.

Muehlenbeckia aff. *australis* vineland

Muehlenbeckia vineland (Figures 8, 18), based on the observations of Chatham Islanders familiar with Motuhinahina, seems to be increasing in its extent on the island (J. Kamo, pers. comm., February 2023, and Hamish Tuanui-Chisholm, author, pers. obs.). Currently, two main concentrations of vineland are located at the eastern and south-eastern portions of the taupata forest. *Muehlenbeckia* has 100% cover in these locations, forming impenetrable tangles up to 3 m in height. Along



Figure 18. *Muehlenbeckia* vineland – in this association, *Muehlenbeckia* may have 100% cover, forming impenetrable tangles up to 3 m in height, passing through which usually necessitates crawling. Sparse associates can include taupata (*Coprosma repens*), kawakawa (*Piper excelsum* subsp. *excelsum*), hakapiri (*Shawia traversiorum*), kōpī (*Corynocarpus laevigatus*) and inihina (*Melicytus chathamicus*).

the margins of this vegetation, its vines thread through and in places smother and topple taupata, kawakawa, hakapiri, kōpī and inihina.

If, as we surmise, the island's interior vegetation has been subjected to frequent storm damage, it is likely that the *Muehlenbeckia* has taken hold following one of those disturbance events and is still expanding its coverage.

Discussion

Flora

During the December 1986 visit to Motuhinahina, one of the authors (Rob Chappell) recorded five species we could not find: *Veronica barkeri* Cockayne (as *Hebe barkeri* (Cockayne) Cockayne), nau / Cook's scurvy grass

(*Lepidium oleraceum* Sparrm. ex G.Forst.), *Myrsine coxii* Cockayne, *Solanum aviculare* G.Forst. (by which Chappell means *S. aviculare* G.Forst. var. *aviculare*) and sea rush (*Juncus kraussii* subsp. *australiensis* (Buchenau) Snogerup (as *J. maritimus* var. *australiensis* Buchenau)). Of these, we consider the *Veronica*, *Myrsine* and *Solanum* records as misidentifications of *Veronica dieffenbachii*, *Myrsine chathamica* and *Solanum laciniatum*, which are present on Motuhinahina. There is no suitable habitat on Motuhinahina for *Veronica barkeri* and *Myrsine coxii*. *Solanum aviculare* is unlikely, as this species is extremely uncommon on the Chatham Islands, whereas *S. laciniatum* is not only abundant on Motuhinahina, but it is the most common indigenous *Solanum* on all of the islands. Further, people often confuse *S. laciniatum* for *S. aviculare*. Sea rush is locally present around Te Whanga, and though we did not see it on Motuhinahina during our visits, it is reasonable to assume it has been present there in the past.

The 1986 record of *Lepidium oleraceum*, while unlikely to be that species, almost certainly refers to one of the *Lepidia* segregated from that species by de Lange et al. (2013). In 1986, when the observation was made, it was believed that all Chatham Islands *Lepidia* were *L. oleraceum*. Later, de Lange et al. (2013) revised and segregated what was known as Chatham Islands *L. oleraceum* into four species: three endemic, and one, *L. oligodontum* de Lange & Heenan, shared with the Antipodes. These species are seriously at risk of extinction (de Lange et al. 2024). Although *Lepidium oleraceum* s.s. is known from the Chatham Islands, that record is of a single 2006 collection from Maung'Re / Mangere Island, and it has not been seen since. It now seems likely that this occurrence either stemmed from accidental spread of seed by ornithologists who had, prior to visiting Maung're been working on islands supporting *L. oleraceum*, in the northern Tīkapa Moana / Hauraki Gulf, Te Ika-a-Māui, or perhaps stemmed from seed dispersed by sea birds moving between Aotearoa and the Chatham Islands. Either of these explanations is plausible. Dale et al. (2017) showed that mucilage produced by wetted seed of *L. oleraceum* can stick to surfaces for longer than 24 months and retain viability. Of the 2013 segregates, two species, *Lepidium oligodontum* de Lange & Heenan and *L. rekohuense* de Lange & Heenan, are the most likely contenders for the plants seen in 1986. There is plenty of habitat for these taxa on the island, and both species are still present on Rēkohu. Of the two, we suspect that *Lepidium oligodontum*, which is the more common, was the more

likely to have been observed, as it is often associated with puhina / kekeno / seal haul-outs (de Lange et al. 2013), and these mammals are present on Motuhinahina. However, as no specimens or images were taken, this remains speculative. The four surveys of Motuhinahina found no plants, and it looks like *Lepidium* has been extirpated from the island.

New Records

One fern, *Asplenium appendiculatum* subsp. *appendiculatum*, and two flowering plants, sneezeweed (*Centipeda minima* subsp. *minima*) and *Lachnagrostis pilosa* subsp. *nubifera*, are new records for the vascular plant flora of the Chatham Islands (de Lange et al. 2011). The fern is widespread and common over the main islands of Aotearoa, whereas both the *Centipeda* and the *Lachnagrostis* are listed as 'At Risk / Naturally Uncommon' (de Lange et al. 2024).

Several plants of *Asplenium appendiculatum* subsp. *appendiculatum* were noted growing on a heavily shaded limestone outcrop during the April 2023 visit. In February 2025 these had died, possibly due to drought. However, it is likely this fern occurs elsewhere on the island, as yet unrecognised, due to its superficial resemblance to *A. chathamense*, and hybrids between that species and *A. flaccidium*. Irrespective, this record is not only a new record for the Chatham Islands (de Lange et al. 2011), but it is also now the eastern-most occurrence of this fern in Australasia (Brownsey & Perrie 2018).

The genus *Centipeda* was previously known from the islands from specimens of *C. aotearoana* N.G. Walsh collected at the Hāpūpū Ponds south of Kaingaroa, and on the shoreline at Pana / Blind Jim's, Te Whanga. Since de Lange et al. (2011) was published, the Hāpūpū Ponds have virtually dried up, rarely filling with water, and are mostly vegetated by pasture grasses. *Centipeda aotearoana* has not been seen there since 2014, and at Pana / Blind Jim's, fencing of the shoreline to exclude stock has also eliminated the open habitat that the species requires. Sneezeweed is less robust than *C. aotearoana*, though in Aotearoa it occupies a broader range of habitats, often found in damp, cattle-pugged or vehicle-tracked pathways through swamps, indigenous forest and partially shaded, closely cropped pasture. Sneezeweed seems more tolerant of shade than the other *Centipeda* species recorded from Aotearoa (Walsh 2001). Its discovery on Motuhinahina, though unexpected, follows this pattern, with plants noted in

shaded sites under etiolated stems of *Euphorbia glauca*, and between purei (*Carex trifida*), growing on compacted soil with *Leptinella squalida* s.l. At the time of our visit, it was locally common. While sneezeweed could be a new arrival to the Chatham Islands, because it is a small, short-lived plant, we think it is more likely that it has been overlooked. The habitats occupied by sneezeweed are similar to those occupied by the endemic *Callitriche chathamensis*, so we suggest that sneezeweed should be looked for where that plant grows.

The second addition, *Lachnagrostis pilosa* subsp. *nubifera*, is a subspecies of wind grass hitherto treated as endemic to the Antipodes and Auckland Islands (Edgar 1995). On Motuhinahina, a single dried-off plant grew on soil lodged in a depression on the top of an exposed limestone outcrop. That collection (UNITEC 13904, <https://inaturalist.nz/observations/152089826>) was identified as *L. pilosa* and this subspecies based on lemma size, investiture, awn position and length, as the branching pattern of the culm (seemingly intravaginal) was poorly preserved in the dried-off material seen. Further collections of better material are needed to confirm the record fully – but to date we have not seen further plants on our visits to the island. Nevertheless, the evenly and shortly hairy 1.5–2.0 mm-long lemma, furnished with a short (0.6–1.2 mm long) straight to very slightly curved awn positioned in the upper third or quarter of the lemma, is diagnostic of this subspecies. The occurrence of this grass on the Chathams is not wholly unexpected, either; there are other plants shared with the Antipodes (e.g., *Lepidium oligodontum* (de Lange et al. 2013)) and Auckland Islands (e.g., *Leptinella potentillina* (Lloyd 1972 as *Cotula potentillina*)), and on those islands these taxa cohabit with the *Lachnagrostis*.

Lichenised mycobionts

Of those lichens with a corticolous habit, we noted that the most productive phorophyte on the island is inihina, from which seven species were recovered from the trunk and lower branches of that species. Two of these, *Arthonia atra* and *Lecanora kohu*, are currently listed as 'At Risk / Naturally Uncommon' and 'Data Deficient' by de Lange et al. (2018). However, *Arthonia atra* is now known to be widespread in Aotearoa and seems to be common on the Chatham Islands.

Lecanora kohu, currently assumed to be endemic to the Chatham Islands, had been assessed as 'Data Deficient' by de Lange et al. (2018), because at the time of its formal recognition it was known only from two collections from Hokoreore (Printzen et al. 2017).



Figure 19. *Lithothelium australe*, an apparently Chatham Islands-endemic lichen, is a saxicolous species on limestone rock, which is common on Motuhinahina.

Subsequent opportunistic collecting between 2018 and 2021 has found *Lecanora kohu* to be locally common and widespread on Rēkohu, and it has also been collected from Rangihau and Wharekaikite / Rabbit Island. Based on these findings, de Lange (2021) suggested that the species warranted listing as 'Threatened / Nationally Endangered' not because it was uncommon, but rather that most populations were found on exposed trees in ill-thrift, or in unfenced forest remnants experiencing canopy collapse. Since then, numerous populations have been found in various secure sites and habitats, suggesting that the species might be better assessed as 'At Risk / Naturally Uncommon.' On Motuhinahina, *Lecanora kohu* is locally common on inihina, hakapiri and taupata.

The saxicolous limestone-inhabiting *Lithothelium australe* (Figure 19) is assumed to be endemic to the islands (Marshall et al. 2024). It is a more common species found on exposed and shaded limestone outcrops around Motuhinahina. Described in 1991 by Aptroot & Mayrhofer (1991) from a single collection made from Big Bush on Rēkohu, the species was not seen again on the Chatham Islands until May 2022, when it was collected from limestone outcrops on Te Mātārae Road (de Lange & Schmid 2023; Marshall et al. 2024). On Motuhinahina, the *Lithothelium* is locally common.

Topelia rosea (Figure 20), currently assessed as 'Data Deficient' (de Lange et al. 2018), is abundant on Motuhinahina, where it forms pink or beige mamillated growths over shaded or partially shaded limestone along the southern side of the island. Outside the Chatham Islands, within the Aotearoa archipelago, this species is known only from collections made from limestone outcrops near Kaihoka Lakes, north-west Kahurangi National Park (Galloway 2007).



Figure 20. *Topelia rosea*, a poorly known saxicolous lichen of calcareous substrates, proved to be locally common on shaded rock on Motuhinahina.



Figure 21. *Chrysothrix candelaris* – seemingly a very uncommon lichen in Aotearoa. Most records of this species from the main islands of Aotearoa are referable to *C. granulosa* G.Thor and *C. xanthina* (Vain.) Kalb. On Motuhinahina, *C. candelaris* is common on limestone, where it occurs in the driest sites, such as at the back and undersides of deeply cut limestone flags.

The discovery of *Chrysothrix candelaris* (Figure 21) is notable. Currently assessed as ‘Not Threatened’ by de Lange et al. (2018), it is now known that the majority of Aotearoa collections referred to this species by Galloway (1985, 2007) are *C. xanthina* (Vain.) Kalb and *C. granulosa* G.Thor. Indeed, an unpublished study of Aotearoa *Chrysothrix* (P. J. de Lange, unpubl. data) failed to find specimens of *C. candelaris* s.s. Thus, the Motuhinahina *C. candelaris* appears to be the first *bona fide* record of this species from the greater Aotearoa archipelago. For now, treating this species as ‘Data Deficient’ seems advisable. On Motuhinahina,

Chrysothrix was commonly seen on sheltered limestone outcrops, colonising the undersides of flags or the weathered solution runnels between these. In these situations, it is often associated with *Diploicia canescens* subsp. *australasica*, *Lithothelium australe* and *Caloplaca* species.

Despite the still-limited collections of saxicolous Chatham Islands lichens, the limestone communities of Motuhinahina are now reasonably well investigated. The novelty of *Caloplaca johnwhinrayi*, a hitherto Australian endemic recently recognised for Aotearoa, was documented by de Lange and Blanchon (2025) from a single collection from Motuhinahina. However, we now know it is locally common on the exposed limestone of the island’s southern side. Furthermore, associated with the *Caloplaca* is a new lichen record for Aotearoa, *Flavoplaca mereschkowskiana*. This species was also collected from Pana / Blind Jim’s and Te Mātārae Road limestone outcrops. The *Caloplaca* and *Flavoplaca* are species often found in association with *Porina corrugata* in limestone habitats of Southern Australia and Tasmania (Kantvilas 2016; Kantvilas 2019). *Porina corrugata* has been collected from limestone at Kaikōura (Te Waipounamu / South Island), suggesting that the *Caloplaca* and *Flavoplaca* are likely present in Te Waipounamu. Indeed, outside the Chatham Islands, we suggest that further collections and study of Aotearoa-wide limestone habitats should also focus on *Caloplaca*, a genus in need of a comprehensive revision (see comments by Galloway 2007; Sparkes et al. 2014; de Lange & Blanchon 2025).

Pest Species

Flora

The most serious threat to the vegetation of Motuhinahina is taupata. Not indigenous to the islands (de Lange et al. 2011), it was probably introduced there as an ornamental and windbreak as it can tolerate extreme wind, salt blast and some drought. As taupata has bird-dispersed fruits (Thorsen et al. 2009), it has established from these plantings and is now widespread across the islands, often dominating coastal vegetation and associated rock outcrops. On Motuhinahina, it is the most common of the woody plants and in places dominates the vegetation almost to the exclusion of other indigenous shrubs and trees. Removal of taupata, if followed by restoration plantings of inihina, Chatham Island ngaio and mataira, could be considered. However, this would

be a long-term project as Motuhinahina is subjected to a constant ‘seed rain’ from roosting starlings, which undoubtedly contribute fresh input of taupata seed from fruits eaten from adjacent shoreline sources. Successful long-term eradication would require this species to be removed from large swathes of the adjacent coastline and farmland, which realistically is unlikely, considering the value bestowed on this species as a shelterbelt (J. Kamo, pers. comm., to P. J. de Lange, April 2023), also how widespread it is in a range of habitats and locations, and its ease of seed dispersal.

We only found seedling elderberries up to 100 mm tall (Figure 22). This species is likely derived from bird-dispersed seed from the adjacent shoreline, where elderberry is locally present. Comparable to taupata, elderberry also poses a serious long-term threat to the islands’ woody vegetation, especially the forested interior. We removed all seedlings during our visits and encourage other visitors to continue this practice. As elderberry is still uncommon on the Chatham Islands, removing specimens from the adjacent shoreline and across the island could be considered part of a broader ecological restoration goal. This would require collaboration between the Chatham Islands council, Environment Canterbury and landowners.

Two other woody species need careful consideration. Kōpī, though not indigenous to the Chatham Islands, has cultural significance. It is uncommon on Motuhinahina, therefore its eradication from there is feasible, especially as there are no suitable avian vectors likely to disperse it to the island, at least for now – if the local aims of predator-free 2050 are realised, then *parea* (*Hemiphaga chathamensis* (Rothschild, 1891)) could establish on the adjacent coastline and disperse kōpī fruit. However, eradication would need to be considered in the context of the cultural landscape it occupies. Consultation with imi, iwi and Chatham Islanders would be necessary. The other, *Muehlenbeckia* aff. *australis* (Figures 8, 17) is a significant threat to the island’s woody vegetation. Again, this vine has bird-dispersed fruits, and its removal from the island would be difficult in terms of labour and ongoing maintenance; removal may also threaten the interior vegetation if done too quickly. Nevertheless, locals have commented on how the vine has increased its dominance on the island (J. Kamo, pers. comm., to P. J. de Lange, April 2023) in recent years. While it provides a key habitat for invertebrates, and food and shelter for birds, our observations suggest it impacts the trees and shrubs known to occur historically on the island. At the very least, partial control would be necessary if any



Figure 22. Elderberry (*Sambucus nigra*) seedling growing on the forest floor of Motuhinahina. This species, a major invasive pest on the main islands of Aotearoa, has yet to achieve the same notoriety on the Chatham Islands. However, the incidence of mature, fruiting adult trees is increasing, and due to birds avidly eating the fruits, it can be anticipated to establish throughout even the more remote forested islands. On Motuhinahina, it was locally present under trees used as night roosts for starlings (*Sturnus vulgaris vulgaris*).

plantings were to be considered.

Fauna

On our visits, we saw no mammalian predators, but we assume that rats (*Rattus* spp.) are present, most likely black rat (*R. rattus* (Linnaeus, 1758)), though brown rat (*R. norvegicus* (Berkenhout, 1769)) and possibly kiore (*R. exulans* (Peale, 1848)) may also be present. The island is within swimming distance of all three (Russell et al. 2008), and black and brown rats are abundant on the adjacent shoreline and hinterland. Mice (*Mus musculus* Linnaeus, 1758) may also be present. Eradication of all is feasible, though reinvasion from the adjacent shoreline would remain a constant threat. Similarly, buff weka (*Gallirallus australis hectori*) threaten any ground-nesting

birds and larger invertebrates. However, weka are culturally significant to the islanders, so any control plan for Motuhinahina must be based on careful consultation.

Restoration potential

Even if plant and animal pest control were not undertaken, Motuhinahina offers a potentially secure place for a range of threatened plants, notably *Lepidium flexicaule* Kirk, *L. panniforme*, *L. rekohuense*, *Leptinella featherstonii* F.Muell (all species that thrive in the open, guano-enriched habitats present on the island), kopakopa (*Myosotidium hortensia* (Decne.) Baill) and embergeria (*Sonchus grandifolius* Kirk). For the *Lepidia*, secure habitats are urgently needed for *Lepidium panniforme* and *L. rekohuense* – both now known from one or two natural populations in extremely vulnerable habitats (de Lange et al. 2013) where they teeter on the brink of extinction. Their reintroduction would require further surveys at different seasons, first to ascertain if the *Lepidium* seen in 1986 has died out. *Leptinella featherstonii*, though secure on the outer predator-free, ornithocoprophilous islands, islets and rock stacks (de Lange 2019), persists on Rēkohu at one site, Kaingaroa Point, where plants are maintained through regular applications of fertiliser.

The beaches, rock stacks and coastal turf provide numerous locations suitable for establishing kopakopa and embergeria. Aside from providing a further secure habitat for these plants, their addition to the island flora would enhance its appeal to island visitors.

If plant and animal pest control were undertaken, replanting the island interior with tree species sourced from there and the adjacent shore, such as karamū hioa, hoho, inihina, hakaipiri and ngaio, would be recommended. These species are already on the island, where their persistence is usually compromised by taupata and *Muehlenbeckia* aff. *australis*.

Acknowledgements

We would like to thank Mike and Dave Bell for the use of their boats to access Motuhinahina. Our gratitude goes to Eileen and Gary Cameron for allowing access across their land at Ohuru, and to Pat Smith for access across his land at Te Mātārae. We thank John and Judy Kamo and Susan Thorpe for their comments on Motuhinahina. David Lowe gave guidance on the soils of Motuhinahina, and Cam Nelson and Hamish Campbell on limestone geology. Jessica Beever assisted with moss determinations, and Dan Blanchon helped with

some lichen identifications. We would also like to thank Alan Fryday and Robert Lücking for their assistance in determining some of the more difficult lichen collections. As always, we acknowledge Jocelyn Powell and the late David Johnston (11 October 1966–19 January 2025) for allowing us to use Whareweka / Science House, Te One, as our research base and home away from home while staying on Rēkohu. Lastly, our gratitude goes to those students who participated in the NSCI 7108 Field Trip to the Chatham Islands between 2023 and 2024, all of whom visited Motuhinahina and helped make our survey work that much more meaningful. Finally, we thank the two anonymous reviewers for their thoughtful and constructive evaluations of our paper.

Data Accessibility Statement

No additional database.

Author Contributions

Peter J. de Lange: Field work (lead); conceptualisation (lead); data curation (lead); validation (lead); visualisation (lead); provision of images (lead); writing – original draft (lead); writing – review and editing (lead).

Rowan K. Scott: Field work (equal); data curation (supporting); writing – review and editing (supporting).

Campbell J. James: Field work (equal); data curation (supporting); provision of images (supporting); writing – original draft (supporting); writing – review and editing (supporting).

Dayna J. M. McKenzie: Field work, review and editing (supporting).

Marleen Baling: Field work (equal); data curation (equal); validation (equal); visualisation (equal); writing – original draft (supporting); writing – review and editing (equal).

Rachel R. Klein: Field work; validation (equal); writing – review and editing (equal).

Karla Butcher: Field work (supporting); writing – review and editing (supporting).

Amelia Tapp: Field work; writing – review and editing.

Sophie Rear: Field work; writing – review and editing.

Andrew J. Marshall: Provision of figures; writing – review and editing.

Rob Chappell: Writing – review and editing.

Hamish Tuanui-Chisholm: Transport (lead); field work (lead); writing – review and editing.

References

- Angiosperm Phylogeny Group [APG] (2003). An update of the Angiosperm Phylogeny Group Classification for the orders and families of flowering plants: APG II. *Botanical Journal of the Linnean Society*, 141(4): 399–436. <https://doi.org/10.1046/j.1095-8339.2003.t01-1-00158.x>
- Angiosperm Phylogeny Group [APG] (2009). An update of the Angiosperm Phylogeny Group Classification for the orders and families of flowering plants: APG III. *Botanical Journal of the Linnean Society*, 161(2): 105–121. <https://doi.org/10.1111/j.1095-8339.2009.00996.x>
- Angiosperm Phylogeny Group [APG] (2016). An update of the Angiosperm Phylogeny Group Classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnean Society*, 181(1): 1–20. <https://doi.org/10.1111/boj.12385>
- Aptroot, A., Mayrhofer, H. (1991). *Lithothelium australe* spec. nova, a new lichen from New Zealand. *Mycotaxon*, 41: 219–222.
- Atkinson, I. A. E. (1985). Derivation of vegetation mapping units for an ecological survey of Tongariro National Park, North Island, New Zealand. *New Zealand Journal of Botany*, 23(3): 361–378. <https://doi.org/10.1080/0028825X.1985.10425343>
- Baling, M., McKenzie, D. J. M., Scott, R. K., van Vugt, L. H., Tuanui-Chisholm, H., de Lange, P. J. (2023). Observations of avifauna on Rēkohu / Wharekauri / Chatham Island, Chatham Islands group, in February 2023. *Perspectives in Biodiversity*, 1(1): 1–24. <https://doi.org/10.34074/pibdiv.001102>
- Brownsey, P. J., Perrie, L. R. (2021). Blechnaceae. In: Breitwieser, I. (ed.), *Flora of New Zealand – Ferns and lycophytes*. Fascicle 29. Lincoln: Manaaki Whenua Press. <https://doi.org/10.7931/c37p-g050>
- Brownsey, P. J., & Perrie, L. R. (2018). Aspleniaceae. In: Breitwieser, I., Wilton, A. D. (eds.), *Flora of New Zealand – Ferns and lycophytes*. Fascicle 18. Lincoln: Manaaki Whenua Press. <https://doi.org/10.7931/B1562D>
- Campbell, H. J., Andrews, P. B., Beu, A. G., Edwards, A. R., Hornibrook, N. deB., Laird, M. G., Maxwell, P. A., Watters, W. A. (1988). Cretaceous–Cenozoic lithostratigraphy of the Chatham Islands. *Journal of the Royal Society of New Zealand*, 18(3): 285–308. <https://doi.org/10.1080/03036758.1988.10426471>
- Dale, E., de Lange, P. J., Burns, B. (2017). Seed dispersal but not seed germination facilitated by seabirds: Seed ecology of Cook’s scurvy grass. *New Zealand Journal of Ecology*, 41(2): 226–233. <https://doi.org/10.20417/nzjecol.41.27>
- de Lange, P. J. (2019). Chatham oddities – the anomalous Chatham Island button daisy. *Chatham Islands, New Zealand*. <https://web.archive.org/web/20220203073157/https://chathams.co.nz/chatham-oddities-the-anomalous-chatham-island-button-daisy/>
- de Lange, P. J. (2021). An update on *Lecanora kohu* (Lecanoraceae) – new locations and a review of its conservation status. *Trilepidea*, 209: 5–9. https://www.nzpcn.org.nz/site/assets/files/0/65/811/trilepidea_july_2021_final.pdf
- de Lange, P. J., Blanchon, D. J., Knight, A., Elix, J., Lücking, R., Frogley, K., Harris, A., Cooper, J., Rolfe, J. R. (2018). *Conservation status of New Zealand indigenous lichens and lichenicolous fungi, 2018*. New Zealand Threat Classification Series 27. Wellington: Department of Conservation. 64 pp. <https://www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs27entire.pdf>
- de Lange, P. J., Blanchon, D. J. (2025). *Caloplaca johnwhinrayi* S.Y.Kondr. & Kärnefelt (Teloschistaceae) on the Chatham Islands – a new record for Aotearoa / New Zealand. *Perspectives in Biodiversity*, 3: 38–43. <https://doi.org/10.34074/pibdiv.003104>
- de Lange, P. J., Gosden, J., Courtney, S. P., Fergus, A. J., Barkla, J. W., Beadel, S. M., Champion, P. D., Hindmarsh-Walls, R., Makan, T., Michel, P. (2024). *Conservation status of vascular plants in Aotearoa New Zealand, 2023*. New Zealand Threat Classification Series 43. Wellington: Department of Conservation. 105 pp. <https://www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs43entire.pdf>
- de Lange, P. J., Heath, C. D., James, C. J., Marshall, A. J., Tuanui-Chisholm, H. (2026). The vegetation and biota of Rangimata / Shag Rock, Te Whanga, Rēkohu / Wharekauri / Chatham Island. *Perspectives in Biodiversity*, 4(1): 60–74. <https://doi.org/10.55457/pibdiv.004105>
- de Lange, P. J., Heenan, P. B., Rolfe, J. R. (2011). *Checklist of vascular plants recorded from the Chatham Islands*. Wellington: Department of Conservation. 57 pp. <https://www.nzpcn.org.nz/publications/plant-lists/lists/checklist-of-indigenous-vascular-plant-species-recorded-from-the-chatham-islands/>
- de Lange, P. J., Heenan, P. B., Houliston, G. J., Rolfe, J. R., Mitchell, A. D. (2013). New *Lepidium* (Brassicaceae) from New Zealand. *PhytoKeys*, 24: 1–147. <https://doi.org/10.3897/phytokeys.24.4375>

- de Lange, P. J., Schmid, L. M. H. (2023). *Lithothelium australe* Aptroot et H. Mayrhofer (Pyrenulaceae) rediscovered on the Chatham Islands. *Trilepidea*, 227: 6–9. https://www.nzpcn.org.nz/site/assets/files/0/72/902/trilepidea_march_2023_final.pdf
- Edgar, E. (1995). New Zealand species of *Deyeuxia* P. Beauv. and *Lachnagrostis* Trin. (Gramineae: Aveneae). *New Zealand Journal of Botany*, 33(1): 1–33. <https://doi.org/10.1080/0028825X.1995.10412940>
- Fife, A. J. (2017). Pulchrinodaceae. In: Breitwieser, I., Wilton, A. D. (eds.), *Flora of New Zealand – Mosses*. Fascicle 32. Lincoln: Manaaki Whenua Press. 16 pp. <https://doi.org/10.7931/B13S31>
- Fife, A. J. (2017b). Orthotrichaceae. In: Breitwieser, I., Wilton, A. D. (eds.), *Flora of New Zealand – Mosses*. Fascicle 31. Lincoln: Manaaki Whenua Press. 116 pp. <https://doi.org/10.7931/B1J01C>
- Fife, A. J. (2020). Brachytheciaceae. In: Smitsen, R., Wilton, A. D. (eds.), *Flora of New Zealand – Mosses*. Fascicle 46. Lincoln: Manaaki Whenua Press. 66 pp. <http://doi.org/10.7931/w15y-gz43>
- Galloway, D. J. (1985). *Flora of New Zealand lichens*. Wellington: New Zealand Government Printer. 662 pp.
- Galloway, D. J. (2007). *Flora of New Zealand Lichens*, 2nd edition. Lincoln: Manaaki Whenua Press. 2397 pp.
- Hay, R. F., Mutch, A. R., Watters, W. A. (1970). Geology of the Chatham Islands. *New Zealand Geological Survey Bulletin*, 83: 1–86.
- Hewitt, A. E. (2010). *New Zealand soil classification*, 3rd edition. Landcare Research Science Series 1. Lincoln: Manaaki Whenua Press. 136 pp.
- Hewitt, A. E., Balks, M. R., Lowe, D. J. (2021). *The soils of Aotearoa New Zealand*, 1st edition. Berlin and Heidelberg: Springer. 332 pp. <https://doi.org/10.1007/978-3-030-64763-6>
- James, N. P., Jones, B., Nelson, C. S., Campbell, H. J., Titjen, J. (2011). Cenozoic temperate and sub-tropical carbonate sedimentation on an oceanic volcano – Chatham Islands, New Zealand. *Sedimentology*, 58(4): 1007–1029. <https://doi.org/10.1111/j.1365-3091.2010.01193.x>
- Kantvilas, G. (2016). A synopsis and key for the lichen genus *Caloplaca* (Teloschistaceae) on Kangaroo Island, with the description of two new species. *Journal of the Adelaide Botanic Gardens*, 29: 53–69. https://data.environment.sa.gov.au/Content/Publications/JABG29P053_Kantvilas.pdf
- Kantvilas, G. (2019). An annotated catalogue of the lichens of Kangaroo Island, South Australia. *Swainsona*, 32: 1–97. https://data.environment.sa.gov.au/Content/Publications/JABG32P001_Kantvilas.pdf
- Klein, R. R., Coyle, H., Flower, R., Heath, C. D., James, C., Mae, S., Rear, S., O'Brien, S., Tapp, A., Thia, D., Tuanui-Chisholm, H., de Lange, P. J., Baling, M. (2025). Observations of avifauna on Rēkohu / Wharekauri / Chatham Island, Chatham Islands group, in February 2024. *Perspectives in Biodiversity*, 3(1): 1–14. <https://doi.org/10.34074/pibdiv.003101>
- Kraichak, E., Huang, J. P., Nelsen, M. P., Leavitt S. D., Lumbsch, H. T. (2018). A revised classification of orders and families in the two major subclasses of Lecanoromycetes (Ascomycota) based on a temporal approach. *Botanical Journal of the Linnean Society*, 188(3): 233–249. <https://doi.org/10.1093/botlinnean/boy060>
- Lloyd, D. G. (1972). A revision of the New Zealand, Subantarctic, and South American species of *Cotula*, section *Leptinella*. *New Zealand Journal of Botany*, 10(2): 277–372. <https://doi.org/10.1080/0028825X.1972.10429156>
- Marshall, A. J., Aptroot, A., Blanchon, D. J., James, C. J., de Lange, P. J. (2024). New Zealand *Lithothelium* (Pyrenulaceae) – description of a new species *Lithothelium kiritea* sp. nov., with notes on *L. australe*. *Ukrainian Botanical Journal*, 81(2): 145–154. <https://doi.org/10.15407/ukrbotj81.02.145>
- McKenzie, E. H. C. (1991). *Puccinia tetragoniae* var. *novae-zelandiae* var. nov. and *Uredo chathamica* sp. nov. from Chatham Islands, New Zealand. *Mycotaxon*, 41: 307–310. <https://www.biodiversitylibrary.org/page/64530895#page/311/mode/1up>
- McKenzie, E. H. C. (2008). Rust fungi in the subantarctic islands of New Zealand. *Mycoscience*, 49: 1–10. <https://doi.org/10.1007/s10267-007-0385-1>
- Miskelly, C. M. (2022). *Checklist of the birds of New Zealand*, 5th edition. Nelson: Ornithological Society of New Zealand. 336 pp. <https://www.birdsnz.org.nz/society-publications/checklist/>

- Nelson, W. (2020). *New Zealand seaweeds: An illustrated guide*, 2nd edition. Wellington: Te Papa Press. 352 pp.
- Printzen, C., Blanchon, D. J., Fryday, A. M., de Lange, P. J., Houston, D. M., Rolfe, J. R. (2017). *Lecanora kohu*, a new species of *Lecanora* (Lichenized Ascomycota: Lecanoraceae) from the Chatham Islands, New Zealand. *New Zealand Journal of Botany*, 55(4): 439–451. <https://doi.org/10.1080/0028825X.2017.1364274>
- Pteridophyte Phylogeny Group [PPG] (2016). A community-derived classification for extant lycophytes and ferns. *Journal of Systematics and Evolution*, 54(6): 563–603. <https://doi.org/10.1111/jse.12229>
- Russell, J. C., Towns, D. R., Clout, M. N. (2008). *Review of rat invasion biology: Implications for island biosecurity*. Science for Conservation 286. Wellington: Department of Conservation. 54 pp. <https://www.doc.govt.nz/documents/science-and-technical/sfc286entire.pdf>
- Söderström, L., Hagborg, A., von Konrat, M. J., Bartholomew-Began, D., Bell, D., Briscoe, L., Brown, E. A., Cargill, C., Costa, D. P., Crandall-Stotler, B. J., Cooper, E. D., Dauphin, G., Engel, J. J., Feldberg, K., Glenny, D. S., Gradstein, S. R., He, X. L., Heinrichs, J., Hentschel, Ilkiu-Borges, A. L., Katagiri, T., Konstantinova, N. A., Larraín, J., Long, D. G., Nebel, M., Pócs, T., Puche, F., Reiner-Drehwald, E., Renner, M. A. M., Sass-Gyarmati, A., Schäfer-Verwimp, A., Moragues, J. G. S., Stotler, R. E., Sukkharak, P., Thiers, B. M., Uribe, J., Váňa, J., Villar-Real, J. C., Wigginton, M., Zhang, L., Zhu, R-L. (2016). World checklist of hornworts and liverworts. *PhytoKeys*, 59: 1–828. <https://doi.org/10.3897/phytokeys.59.6261>
- Sparkes, J. H., de Lange, P. J., Blanchon, D. J. (2014). Notes on *Caloplaca allanii* Zahlbr. (Teloschistaceae) a poorly known West Auckland, North Island, New Zealand endemic. *New Zealand Journal of Botany*, 52(3): 304–309. <https://doi.org/10.1080/0028825X.2014.891240>
- Thiers, B. (2008 onward). *Index Herbariorum: A global directory of public herbaria and associated staff*. New York Botanical Garden. Available online: <http://sweetgum.nybg.org/science/ih> [Accessed: 30 October 2021]
- Thorsen, M. J., Dickinson, K. J. M., Seddon, P. J. (2009). Seed dispersal systems in the New Zealand flora. *Perspectives in Plant Ecology, Evolution and Systematics*, 11: 285–309. https://www.researchgate.net/publication/223100978_Seed_dispersal_systems_in_the_New_Zealand_flora
- Walsh, N. G. (2001). A revision of *Centipeda* (Asteraceae). *Muelleria*, 15: 33–64. <https://doi.org/10.5962/p.237630>

Appendix 1: Flora and Mycobiota of Motuhinahina, Te Whanga, Rēkohu / Wharekauri / Chatham Island

* – taxa naturalised to the Chatham Islands

I – 'Indigenous' biostatus

N – 'Naturalised' biostatus

H – hybrid

Taxon	Family	Voucher	Abundance
Ochrophyta (1) (I:1)			
<i>Halopteris funicularis</i> (Mont.) Sauv.	Stypocaulaceae	UNITEC 14978	uncommon
Chlorophyta (4) (I:4)			
<i>Codium fragile</i> subsp. <i>novae-zelandiae</i> (J.Agardh) P.C.Silva	Codiaceae	UNITEC 14100	abundant
<i>Rosenvingiella</i> cf. <i>tasmanica</i> M.B.J.Moniz, Rindi & Guiry	Prasiolaceae	UNITEC 14030	common
<i>Ulva compressa</i> L.	Ulvaceae	UNITEC 14976	common
<i>Ulva intestinalis</i> L.	Ulvaceae	UNITEC 14977	common
Rhodophyta (1) (I:1)			
<i>Gracilaria chilensis</i> C.J.Bird, McLachlan & E.C.Oliveira	Gracilariaceae	UNITEC 14106	common
Bryophytes (14)			
Liverworts (2) (I:2)			
<i>Chiloscyphus semiteres</i> (Lehm.) Lehm. & Lindenb. var. <i>semiteres</i>	Lophocoleaceae	UNITEC 13881	uncommon
<i>Frullania pentapleura</i> Taylor	Frullaniaceae	UNITEC 13882	common
Mosses (12) (I:11 N:1)			
<i>Campylopus introflexus</i> (Hedw.) Brid.	Dicranaceae		uncommon
* <i>Eurhynchium praelongum</i> (Hedw.) Schimp.	Brachytheciaceae	UNITEC 13883	common
<i>Fissidens leptocladus</i> Müll.Hal. ex Rodway	Fissidentaceae	UNITEC 14109	uncommon
<i>Ptychomitrium australe</i> (Hampe) A.Jaeger	Ptychomitriaceae	UNITEC 13884	common
<i>Pulchrinodus inflatus</i> (Hook.f. & Wilson) B.H.Allen	Pulchrinodaceae	UNITEC 13885	uncommon
<i>Racopilum convolutaceum</i> (Müll.Hal.) Reichardt	Racopilaceae		common
<i>Syntrichia antarctica</i> (Hampe) R.H.Zander	Pottiaceae	UNITEC 13981	uncommon
<i>Tortella flavovirens</i> (Bruch) Broth.	Pottiaceae	UNITEC 14096	common
<i>Tortula muralis</i> Hedw.	Pottiaceae	UNITEC 13982	uncommon
<i>Trichostomopsis australasiae</i> (Hook. & Grev.) H.Rob.	Pottiaceae		uncommon
<i>Wijkia extenuata</i> (Brid.) H.A.Crum var. <i>extenuata</i>	Sematophyllaceae	UNITEC 14098	uncommon
<i>Zygodon menziesii</i> (Schwägr.) Arn.	Orthotrichaceae	UNITEC 14097	common
Polypodiophyta (14) (I:13 H:1)			
<i>Asplenium appendiculatum</i> (Labill.) C.Presl subsp. <i>appendiculatum</i>	Aspleniaceae	UNITEC 14212	uncommon
<i>Asplenium chathamense</i> Brownsey	Aspleniaceae	UNITEC 13886	common

<i>Asplenium lyallii</i> (Hook.f.) T.Moore	Aspleniaceae	UNITEC 13887	common
<i>Asplenium oblongifolium</i> Colenso	Aspleniaceae	UNITEC 13888	one seen
<i>Asplenium polyodon</i> G.Forst.	Aspleniaceae	UNITEC 13889	one seen
<i>Asplenium scleroprium</i> Hombr.	Aspleniaceae	UNITEC 14058	one seen
<i>Asplenium chathamense</i> Brownsey × <i>A. lyallii</i> (Hook.f.) T.Moore	Aspleniaceae	UNITEC 13890	uncommon
<i>Pteridium esculentum</i> (G.Forst.) Cockayne	Dennstaedtiaceae	UNITEC 13892	common
<i>Adiantum cunninghamii</i> Hook.	Pteridaceae	UNITEC 14126	one seen
<i>Austroblechnum lanceolatum</i> (R.Br.) Gasper et V.A.O.Dittrich	Blechnaceae	UNITEC 14218	uncommon
<i>Doodia australis</i> (Parris) Parris	Blechnaceae	UNITEC 14252	one seen
<i>Pellaea rotundifolia</i> (G.Forst.) Hook.	Pteridaceae	UNITEC 13893	uncommon
<i>Pteris tremula</i> R.Br.	Pteridaceae	UNITEC 13891	uncommon
<i>Pyrrosia eleagnifolia</i> (Bory) Hovenkamp	Polypodiaceae	UNITEC 13894	uncommon

Spermatophytina (99)

Angiosperms (99)

Magnoliids (1) (I:1)

<i>Piper excelsum</i> G.Forst. subsp. <i>excelsum</i>	Piperaceae	UNITEC 13895	common
---	------------	--------------	--------

Monocots I (2) (I:2)

<i>Phormium tenax</i> J.R.Forst. & G.Forst.	Asphodelaceae	UNITEC 14082	common
<i>Triglochin striata</i> Ruiz et Pav.	Juncaginaceae	UNITEC 14031	common

Monocots II – Commelinids (23) (I:13 N:10)

<i>Carex trifida</i> Cav.	Cyperaceae	UNITEC 13896	common
<i>Carex ventosa</i> C.B.Clarke	Cyperaceae	UNITEC 14085	one seen
<i>Ficinia nodosa</i> (Rottb.) Goetgh., Muasya & D.A.Simpson	Cyperaceae	UNITEC 13897	common
<i>Isolepis cernua</i> (Vahl) Roem. & Schult. var. <i>cernua</i>	Cyperaceae	UNITEC 13898	common
<i>Schoenoplectus pungens</i> (Vahl) Palla	Cyperaceae	UNITEC 14034	uncommon
<i>Schoenus nitens</i> (R.Br.) Roem. & Schult.	Cyperaceae	UNITEC 14035	uncommon
* <i>Aira caryophyllea</i> L. subsp. <i>caryophyllea</i>	Poaceae	UNITEC 14311	common
* <i>Bromus hordeaceus</i> L.	Poaceae	UNITEC 15171	uncommon
* <i>Calamagrostis arenaria</i> (L.) Roth	Poaceae	UNITEC 13899	common
* <i>Holcus lanatus</i> L.	Poaceae	UNITEC 14081	common
* <i>Hordeum murinum</i> L. subsp. <i>murinum</i>	Poaceae	UNITEC 13900	common
<i>Lachnagrostis billardiarei</i> (R.Br.) Trin. subsp. <i>billardiarei</i>	Poaceae	UNITEC 13901	uncommon
<i>Lachnagrostis filiformis</i> (G.Forst.) Trin.	Poaceae	UNITEC 13902	uncommon
<i>Lachnagrostis littoralis</i> (Hack.) Edgar subsp. <i>littoralis</i>	Poaceae	UNITEC 13903	uncommon
<i>Lachnagrostis pilosa</i> subsp. <i>nubifera</i> Edgar	Poaceae	UNITEC 13904	uncommon
* <i>Lagurus ovatus</i> L.	Poaceae	UNITEC 14137	common
* <i>Lolium perenne</i> L.	Poaceae	UNITEC 14215	uncommon

* <i>Poa annua</i> L.	Poaceae	UNITEC 13905	common
<i>Poa chathamica</i> Petrie	Poaceae	UNITEC 13906	common
* <i>Poa pratensis</i> L.	Poaceae	UNITEC 14020	common
* <i>Poa trivialis</i> L.	Poaceae	UNITEC 14095	common
<i>Puccinellia chathamica</i> (Cheeseman) Allan & Jansen	Poaceae	UNITEC 13907	common
<i>Apodasmia similis</i> (Edgar) B.G.Briggs & L.A.S.Johnson	Restionaceae	UNITEC 14087	uncommon
Eudicots (1) (I:1)			
<i>Ranunculus acaulis</i> Banks & Sol. ex DC.	Ranunculaceae	UNITEC 13908	common
Core Eudicots (72) (I:48 N:23 H:1)			
* <i>Sambucus nigra</i> L.	Adoxaceae	UNITEC 13938	uncommon
<i>Atriplex australasica</i> Moq.	Amaranthaceae	UNITEC 13941	common
* <i>Atriplex prostrata</i> Boucher ex DC.	Amaranthaceae	UNITEC 13942	abundant
<i>Oxybasis ambigua</i> (R.Br.) de Lange & Mosyakin	Amaranthaceae	UNITEC 14094	abundant
<i>Salicornia quinqueflora</i> (Bunge ex Ung.-Sternb.) A.J.Scott subsp. <i>quinqueflora</i>	Amaranthaceae	UNITEC 13943	abundant
<i>Disphyma papillatum</i> Chinnock	Aizoaceae	UNITEC 14037	abundant
<i>Tetragonia tetragonioides</i> (Pall.) Kuntze	Aizoaceae	UNITEC 13939	common
<i>Tetragonia trigyna</i> Banks & Sol. ex Hook.f.	Aizoaceae	UNITEC 13940	common
<i>Apium prostratum</i> subsp. <i>denticulatum</i> P.S.Short	Apiaceae	UNITEC 13944	common
<i>Lilaeopsis novae-zelandiae</i> (Gand.) A.W.Hill	Apiaceae	UNITEC 14032	uncommon
<i>Pseudopanax chathamicus</i> Kirk	Araliaceae	UNITEC 13945	one seen
<i>Corokia macrocarpa</i> Kirk	Argophyllaceae	UNITEC 13947	uncommon
<i>Centipeda minima</i> (L.) A.Braun & Asch. subsp. <i>minima</i>	Asteraceae	UNITEC 13979	uncommon
* <i>Cirsium vulgare</i> (Savi) Ten.	Asteraceae	UNITEC 14038	common
<i>Cotula coronopifolia</i> L.	Asteraceae	UNITEC 14088	common
* <i>Erigeron sumatrensis</i> Retz.	Asteraceae	UNITEC 13948	uncommon
* <i>Hypochaeris radicata</i> L.	Asteraceae	UNITEC 13949	uncommon
* <i>Leontodon saxatilis</i> Lam.	Asteraceae	UNITEC 13950	uncommon
<i>Leptinella potentillina</i> F.Muell.	Asteraceae	UNITEC 13946	common
<i>Leptinella squalida</i> Hook.f. s.l.	Asteraceae	UNITEC 13980	uncommon
<i>Olearia traversiorum</i> (F.Muell.) Hook.f.	Asteraceae	UNITEC 13951	uncommon
<i>Pseudognaphalium lanatum</i> (G.Forst.) Smitsen, Breitw. & de Lange	Asteraceae	UNITEC 13952	common
* <i>Senecio elegans</i> L.	Asteraceae	UNITEC 13953	common
<i>Senecio lautus</i> Willd.	Asteraceae	UNITEC 13954	common
<i>Senecio radiolatus</i> F.Muell.	Asteraceae	UNITEC 14079	common
<i>Senecio</i> aff. <i>glomeratus</i> Poir.	Asteraceae	UNITEC 13955	common
* <i>Sonchus asper</i> (L.) Hill	Asteraceae	UNITEC 13956	uncommon
* <i>Sonchus oleraceus</i> L.	Asteraceae	UNITEC 13957	common

* <i>Taraxacum</i> F.H.Wigg sect. <i>Taraxacum</i>	Asteraceae	UNITEC 13958	uncommon
* <i>Lepidium didymum</i> L.	Brassicaceae	UNITEC 13959	common
<i>Lobelia anceps</i> L.f.	Campanulaceae	UNITEC 13960	common
<i>Lobelia arenaria</i> (Hook.f.) Heenan & de Lange	Campanulaceae	UNITEC 14036	common
* <i>Cerastium glomeratum</i> Thuill.	Caryophyllaceae	UNITEC 13961	common
<i>Colobanthus muelleri</i> Kirk	Caryophyllaceae	UNITEC 13962	uncommon
* <i>Sagina procumbens</i> L.	Caryophyllaceae	UNITEC 13963	common
* <i>Stellaria media</i> (L.) Vill. subsp. <i>media</i>	Caryophyllaceae	UNITEC 14086	common
* <i>Corynocarpus laevigatus</i> J.R.Forst. & G.Forst.	Corynocarpaceae	UNITEC 13964	uncommon
<i>Crassula moschata</i> G.Forst.	Crassulaceae	UNITEC 14310	uncommon
<i>Dichondra</i> aff. <i>brevifolia</i> Buchanan	Convolvulaceae	UNITEC 14084	common
<i>Leptecophylla robusta</i> (Hook.f.) C.M.Weiller	Ericaceae	UNITEC 13909	one seen
<i>Leucopogon parviflorus</i> (Andrews) Lindl.	Ericaceae	UNITEC 13910	common
<i>Euphorbia glauca</i> G.Forst.	Euphorbiaceae	UNITEC 13911	common
* <i>Medicago lupulina</i> L.	Fabaceae	UNITEC 13912	abundant
<i>Geranium traversii</i> Hook.f.	Geraniaceae	UNITEC 13913	common
<i>Goodenia radicans</i> (Cav.) Pers.	Goodeniaceae	UNITEC 14309	abundant
<i>Haloragis erecta</i> (Murray) Oken subsp. <i>erecta</i>	Haloragaceae	UNITEC 13914	one seen
<i>Linum monogynum</i> var. <i>chathamium</i> Cockayne	Linaceae	UNITEC 13915	uncommon
<i>Epilobium billardioreanum</i> DC.	Onagraceae	UNITEC 13916	abundant
* <i>Bellardia viscosa</i> (L.) Fisch. & C.A.Mey.	Orobanchaceae	UNITEC 15170	uncommon
* <i>Plantago coronopus</i> L.	Plantaginaceae	UNITEC 13917	abundant
<i>Veronica chathamica</i> Buchanan	Plantaginaceae	UNITEC 13918	common
<i>Veronica dieffenbachii</i> Benth.	Plantaginaceae	UNITEC 13919	uncommon
<i>Veronica chathamica</i> Buchanan × <i>V. dieffenbachii</i> Benth.	Plantaginaceae	UNITEC 13920	abundant
<i>Muehlenbeckia</i> aff. <i>australis</i> (G.Forst.) Meisn.	Polygonaceae	UNITEC 13921	abundant
* <i>Rumex obtusifolius</i> L.	Polygonaceae	UNITEC 13922	uncommon
* <i>Lysimachia arvensis</i> (L.) U.Manns. & Anderb.	Primulaceae	UNITEC 13923	common
<i>Myrsine chathamica</i> F.Muell.	Primulaceae	UNITEC 13924	uncommon
<i>Samolus repens</i> (J.R.Forst. & G.Forst.) Pers. var. <i>repens</i>	Primulaceae	UNITEC 13925	abundant
<i>Coprosma chathamica</i> Cockayne	Rubiaceae	UNITEC 13926	uncommon
<i>Coprosma propinqua</i> var. <i>martinii</i> W.R.B.Oliv.	Rubiaceae	UNITEC 13927	one seen
* <i>Coprosma repens</i> A.Rich.	Rubiaceae	UNITEC 13928	abundant
<i>Limosella australis</i> R.Br.	Scrophulariaceae	UNITEC 14033	uncommon
<i>Myoporum semotum</i> de Lange & Heenan	Scrophulariaceae	UNITEC 13929	one seen
* <i>Solanum chenopodioides</i> Lam.	Solanaceae	UNITEC 13930	abundant
<i>Solanum laciniatum</i> Aiton	Solanaceae	UNITEC 13931	abundant
* <i>Solanum nigrum</i> L.	Solanaceae	UNITEC 13932	common
<i>Solanum opacum</i> A.Braun & C.D.Bouché	Solanaceae	UNITEC 13933	uncommon

<i>Pimelea villosa</i> Sol. ex Sm.	Thymelaeaceae	UNITEC 13934	one seen
<i>Parietaria</i> aff. <i>debilis</i> G.Forst.	Urticaceae	UNITEC 13935	common
<i>Urtica australis</i> Hook.f.	Urticaceae	UNITEC 13936	common
<i>Urtica urens</i> L.	Urticaceae	UNITEC 14083	uncommon
<i>Melicytus chathamicus</i> (F.Muell.) Garn.-Jones	Violaceae	UNITEC 13937	uncommon

Mycobiota (26)

Ascomycota (2) (I: N: 2)

* <i>Podosphaera epilobii</i> (Wallr.) de Bary	Erysiphaceae	UNITEC 13974	common
* <i>Septoria apiicola</i> Sacc.	Mycosphaerellaceae	UNITEC 13978	uncommon

Basidiomycota (6) (I: 4 N: 2)

<i>Auricularia cornea</i> Ehrenb.	Auriculariaceae	UNITEC 14090	uncommon
<i>Chlorophyllum</i> Massee	Agaricaceae		
* <i>Favolaschia claudopus</i> (Singer) Q.Y.Zhang & Y.C.Dai	Mycenaceae	UNITEC 14040	uncommon
<i>Pleurotus</i> (Fr.) P.Kumm.	Pleurotaceae	UNITEC 14091	uncommon
* <i>Peristemma pseudosphaeria</i>	Pucciniaceae	UNITEC 14177	common
<i>Puccinia chathamica</i> McKenzie	Pucciniaceae	UNITEC 13977	common

Lichenised Mycobiota (18)

<i>Arthonia atra</i> (Pers.) A.Schneid.	Arthoniaceae	UNITEC 13965	uncommon
<i>Arthonia peraffinis</i> Nyl.	Arthoniaceae	UNITEC 13966	uncommon
<i>Bacidia</i> De Not.	Ramalinaceae	UNITEC 13967	uncommon
<i>Buellia albula</i> (Nyl.) Müll.Arg.	Caliciaceae	UNITEC 13968	abundant
<i>Caloplaca</i> Th.Fr.	Teloschistaceae	UNITEC 13969	uncommon
<i>Caloplaca johnwhinrayi</i> S.Y.Kondr. & Kärnefelt	Teloschistaceae	UNITEC 14946	common
<i>Diplotomma alboatrum</i> (Hoffm.) Flot.	Caliciaceae	UNITEC 13970	abundant
<i>Diploicia canescens</i> subsp. <i>australasica</i>	Caliciaceae	UNITEC 14945	uncommon
<i>Dirinaria applanata</i> (Fée) Awasthi	Caliciaceae	UNITEC 13971	uncommon
<i>Flavoplaca mereschkowskiana</i> (S.Y.Kondr. & Kärnefelt) Arup, Fröden & Söchting	Teloschistaceae	UNITEC 14932	uncommon
<i>Hydropunctaria maura</i> (Wahlenb.) C.Keller, Gueidan & Thüs	Verrucariaceae	UNITEC 14930	common
<i>Lecanora kohu</i> Printzen, Blanchon, Fryday & de Lange	Lecanoraceae	UNITEC 13972	uncommon
<i>Lithothelium australe</i> Aptroot & H.Mayrhofer	Pyrenulaceae	UNITEC 13983	uncommon
<i>Opegrapha rupestris</i> Pers.	Opegraphaceae	UNITEC 13973	common
<i>Physcia adscendens</i> (Fr.) H.Oliver	Physciaceae	UNITEC 14942	uncommon
<i>Physcia poncinsii</i> Hue	Physciaceae	UNITEC 13974	uncommon
<i>Porina corrugata</i> Müll.Arg.	Trichotheliaceae	UNITEC 14940	uncommon
<i>Xanthoria parietina</i> (L.) Th.Fr.	Teloschistaceae	UNITEC 13975	uncommon

APPENDIX 2: Avifauna recorded from Motuhinahina (February 2023, April 2023, February 2024, 2025 observations)

* – taxa naturalised to Chatham Islands

Scientific Name	Family	Abundance		
		2023 ¹	2024 ²	2025
<i>Circus approximans</i> Peale, 1848	Accipitridae	–	–	1
<i>Cygnus atratus</i> Latham, 1790	Anatidae	1 (egg in a nest)	–	–
<i>Egretta novaehollandiae</i> (Latham, 1790)	Ardeidae	–	3	–
<i>Hirundo neoxena</i> Gould, 1842	Hirundinidae	2	–	–
<i>Leucocarbo onslowi</i> (Forbes, 1893)	Phalacrocoracidae	1	–	–
<i>Phalacrocorax carbo</i> (Linnaeus, 1758)	Phalacrocoracidae	(feathers)	–	10
<i>Phalacrocorax featherstoni</i> Buller, 1873	Phalacrocoracidae	22 (nests also seen)	12	2
<i>Chroicocephalus novaehollandiae scopulinus</i> (J.R.Forster, 1843)	Laridae	–	–	–
<i>Larus dominicanus</i> Lichtenstein, 1823	Laridae	15	19	31
<i>Anthus novaezealandiae chathamensis</i> Lorenz-Liburnau, 1902	Motacillidae	6	–	–
* <i>Passer domesticus</i> (Linnaeus, 1758)	Passeridae	–	–	1
* <i>Prunella modularis</i> (Linnaeus, 1758)	Prunellidae	1 (calls)	–	–
* <i>Gallirallus australis hectori</i> (Hutton, 1873)	Rallidae	6 (including 3 chicks)	2	3 (including 2 fledglings)
<i>Rhipidura fuliginosa penita</i> Bangs, 1911	Rhipiduridae	–	–	2
<i>Eudyptula minor minor</i> (J.R.Forster, 1781)	Spheniscidae	1	–	–
* <i>Sturnus vulgaris vulgaris</i> Linnaeus, 1758	Sturnidae	(feathers)		
<i>Zosterops lateralis</i> (Latham, 1802)	Zosteropidae	–	1 (nest)	–

1. Also see: Baling, M., McKenzie, D. J. M., Scott, R. K., van Vugt, L. H., Tuanui-Chisholm, H., de Lange, P. J. (2023). Observations of avifauna on Rēkohu / Wharekauri / Chatham Island, Chatham Islands group, in February 2023. *Perspectives in Biodiversity*, 1(1): 1–24. <https://doi.org/10.34074/pibdiv.001102>

2. Also see: Klein, R. R., Coyle, H., Flower, R., Heath, C. D., James, C., Mae, S., Rear, S., O'Brien, S., Tapp, A., Thia, D., Tuanui-Chisholm, H., de Lange, P. J., Baling, M. (2025). Observations of avifauna on Rēkohu / Wharekauri / Chatham Island, Chatham Islands group, in February 2024. *Perspectives in Biodiversity*, 3(1): 1–14. <https://doi.org/10.34074/pibdiv.003101>