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Vegetation, vascular flora, and fauna of Motueka and Poikeke Islands, Eastern Coromandel Peninsula, Northeast New Zealand

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Abstract
The vascular flora, vegetation and fauna of Motueka and Poikeke Islands, eastern Coromandel Peninsula, northeast New Zealand, are described based on five visits to the islands during 1989, 2004–2008. Their combined flora totals 107 vascular species (76% indigenous) and 6 bryophytes. Seven vegetation associations are described. The islands lie 0.9 km off the coast and possess a rich indigenous vascular flora including both typical mainland and island species. The vegetation is in an advanced stage of succession after past disturbances, although there were recent rockslides on Motueka. Twenty-six naturalised vascular species are present, but only four of these are considered environmental weeds. Twenty-four species of birds, Norway rat, one possible historic reptile observation and brief observations on invertebrates are reported. A kōrero on the cultural origin of the islands is included.

Keywords
Motueka; Poikeke; islands; eastern Coromandel; vegetation; vascular flora; weeds; seabirds; Norway rat.

INTRODUCTION

New Zealand's offshore islands are important habitats for endemic flora and fauna, supporting some relict populations (Towns & Ballantine 1993; Gibbs 2016). Conservation biology has focused on islands because some ecological processes are less altered on them and because they can be restored by reducing or eliminating pressures on them, especially from invasive plants and animals (Towns *et al.* 1997). Islands in northern New Zealand have also been important for Māori as sites of permanent settlement or seasonally occupied and managed for crops and harvests of resources such as seabirds (Bellingham *et al.* 2010). Therefore, restoring islands needs an information base of understanding the islands' histories and biogeography. It is important to document islands' floras and faunas since they are likely to be dynamic as successions occur on them (Wilmshurst *et al*. 2014) and since distributions of many species are poorly understood (Chapple & Hitchmough 2016; Gibbs 2016).

In this study we document the flora and fauna of two northern New Zealand islands for which there is little published information, and which have some floristic features that are unexpected, often thought more typical of islands further from the mainland. Motueka and Poikeke are islands that lie 0.9 km off Cathedral Cove on the eastern coast of the Coromandel Peninsula, 2.0 km north of Hahei, at 36° 49′ S, 175° 48′ E (Fig. 1). The smaller island, Poikeke, is 150 m southwest of Motueka and is joined by a rocky reef exposed at low tide (Fig. 2). Motueka covers 6.0 ha (Taylor 1989) and measures approximately 500 m × 180 m (long axis roughly west–east), highest point 66 m ASL. Poikeke (1.0 ha), is roughly oval, 150 m long × 70 m across, and 22 m ASL and is marked as a pā site on the topographic map (NZ Topo50 BA35-Whitianga). The islands lie within the 900 ha Te Whanganui-A-Hei (Cathedral Cove) Marine Reserve which was gazetted in 1992. Both islands are eroded remnants of a rhyolite dome that erupted during the Miocene, 7–8 Ma, and are composed entirely of

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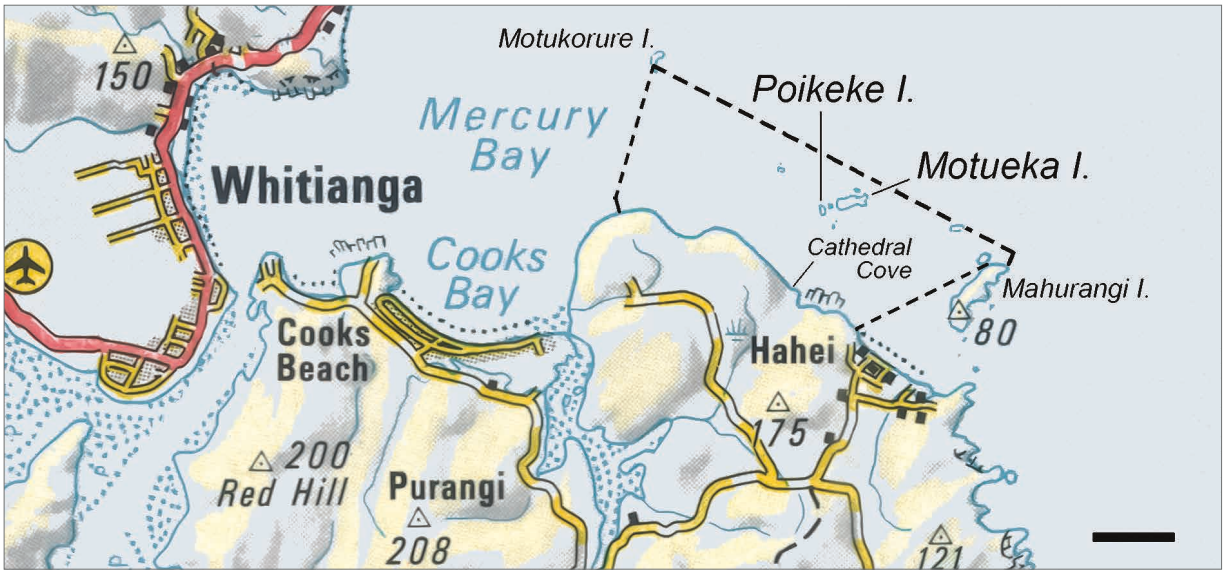

Figure 1. Location of Motueka and Poikeke Islands and boundary of the Te Whanganui-A-Hei (Cathedral Cove) Marine Reserve off Cathedral Cove (marked by - - -), eastern Coromandel Peninsula. Topo map (1:250000) modified by Joshua Salter. Scale bar = 1 km

Figure 2. Poikeke viewed from Motueka at low tide showing the exposed connecting intertidal reef. Photo: 21 Mar 2008. Unless otherwise stated all photos are by EKC.

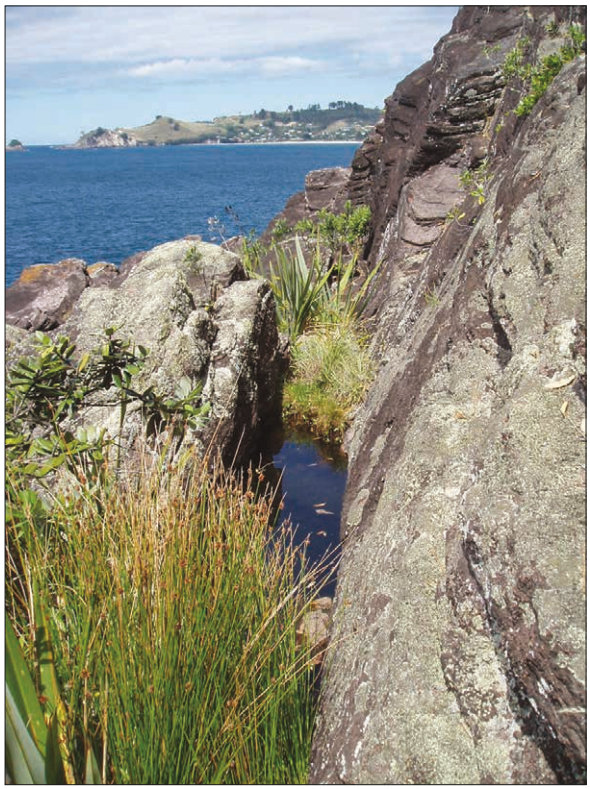

Figure 3. A few brackish rock pools with associated vegetation of *Ficinia nodosa*, stunted pōhutukawa, *Isolepis cernua* and harakeke at the eastern end of Motueka just above the high tide level was the only free water observed. Photo: 1 Mar 2005.

Figure 4. EKC and PJB being rowed by David Towns from the boat to the northern rocky shore of Motueka. The lack of beaches made landing challenging at times but their absence has helped to protect both islands from human visitors. Photo by M.S. Durrett: 17 Apr 2004.

flow-banded rhyolite (Moore 1976, Phil Moore pers. comm., 2006). Much of the islands is steep and quite eroded with many loose rocks, making it difficult to traverse the steeper slopes. Rockfalls appear to be frequent. Except for a few brackish rock pools just above the spring high tide level at the east end of Motueka (Fig. 3), no other sources of water (e.g., small streams, seeps) were seen during our summer-autumn visits. The rocky islands' coastline is devoid of beaches (Fig. 4).

Motueka and Poikeke are places of spiritual, cultural, customary, ancestral and historical significance to Ngāti Hei, who have mana whenua over these motu, and which are administered by the Ngāti Hei Trust.

> Tu ana i te takere nui o te waka Te Arawa ee
> Ko wai – ko wai
> I te taumata tanga a Tangaroa ee
> Ki uta ngā manu, tohorā ki tai
> Ka poua, poua, poua te toko
> Hei, Waitaha,Tuhukea nei
> Ko wai ko wai
> Ngā uri a Pūhaorangi nei
> Kia ita, kia ita, kia ita ee hii!

In ancient times, Motueka was commonly known as Te Kuraetanga o taku Ihu, named by Hei, a rangatira (chief). It was common for highborn rangatira to proclaim islands and everything in proximity by comparing or likening such landmarks to the tapu of their own physical attributes: in the case of Motueka to the tā-moko radiating from the bridge of his nose (the kōrero is further detailed in Appendix 1).

Lieutenant James Cook landed on Poikeke, without the botanists Joseph Banks and Daniel Solander, on 15 November 1769 when it was an occupied island pā and commented on its occupation (Beaglehole 1955, Moore 1976, see Appendix 2). When Joseph Banks passed near Motueka, the name he recorded was Motu Iki (Beaglehole 1955: p.201 footnote); it has also been referred to subsequently as Pigeon Island (see Moore 1976 for a discussion about names for the island). Ngāti Hei prefers Motueka as its current name.

METHODS

Motueka and Poikeke Islands were visited by four of the authors on five occasions during 1989, 2004–2006. GAT and AJDT participated in an informal three-day survey of several of the islands off Cathedral Cove in March 1989, including Motueka (3 hrs on 4–5 March) and Poikeke (1 hr 15 mins on 3–4 March), recording vascular plants, birds and trapping for rodents. EKC and PJB were part of a group of 4–7 people that visited Motueka on 17 April 2004 (5 hrs), 1 March 2005 (6 hrs),

Motueka and Poikeke on 2 March 2006 (6 hrs), and NW Motueka 21 Feb 2008 (1 hr). The main purpose of the latter visits was to set up and record data from four 10 ×10 m forest plots on Motueka as part of a Marsden Fund project 'Impacts of alien organisms on ecosystem function' (Fukami *et al.* 2006), while one of us (EKC) searched the islands widely in an attempt to record the vascular flora, different vegetation types, avifauna and miscellaneous biota. Sixty-six vascular plant and bryophyte vouchers collected by the authors are housed in the Auckland Museum herbarium (AK). Additional observations were made in October 2021 by Department of Conservation staff (Claire Wooldridge and Marie Everth pers. comm. 2021) on Motueka of a vascular plant, rat and nesting seabirds.

Plant names largely follow Ngā Tipu o Aotearoa – New Zealand Plants (https: nzflora.landcareresearch.co.nz, accessed 10 October 2021), and bird names largely follow the Checklist of the Birds of New Zealand (Gill *et al*. 2010).

Previous published biological records and collections

Little has been previously published on the flora or fauna of Motueka or Poikeke Islands apart from a brief forest canopy description, three species of seabird bones and a rat bone all recorded on Poikeke, and a possible historical tuatara (*Sphenodon punctatus*) observation on Motueka (Moore 1976). Based on GAT and AJDT's visit, Waugh *et al*. (2013) recorded the breeding of tītī/sooty shearwater (*Ardenna grisea*) on Poikeke, and Miskelly *et al*. (2019) recorded hundreds of ōi/grey-faced petrel burrows (*Pterodroma gouldi*) on Motueka and Poikeke and Norway rat (*Rattus norvegicus*) on Poikeke. The only previous collection of any kind located were land snails (*Rhytida greenwoodi*) collected on Motueka in 1947 held in Museum of New Zealand Te Papa Tongarewa.

Our observations and collections are combined and presented below, including the previous records and collections.

RESULTS

Vegetation of Motueka

Both islands are steeply cliffed with little vegetation on their north, east and west sides, apart from one steep forested valley on the NW side of Motueka (Fig. 5). However, the southern sides and the summit ridges of both islands are generally well-forested almost to sea level (Fig. 6). Seven vegetation communities on Motueka and a general account of Poikeke are described below. The two broadleaf forest areas on Motueka and the summit forest of Poikeke are more advanced in their succession than the rest of the islands' vegetation. Past disturbances would include pre-European clearing by Māori, fire, windthrow, slumping and general erosion. The 1944 aerial photograph (966/51, NZ Aerial Mapping Ltd) is poor quality because of shadowing; however, it does indicate a similar amount of forest cover as the period of our surveys.

The islands are prone to summer–autumn droughts as witnessed during our April 2004 and February 2008 visits with some woody species exhibiting wilting and

Figure 5. Oblique aerial view looking SSW over Motueka Island (foreground) with Poikeke to the right (near high tide); Hahei Beach behind, Coromandel Peninsula. Photo: Lloyd Homer, GNS Science # 64289, Feb 1976. Reproduced with permission.

Figure 6. Motueka and Poikeke Islands near high tide, showing their well-forested southern sides, looking due north, from Cathedral Cove carpark road. Photo: 18 Jan 2015.

leaf loss, e.g., hangehange (*Geniostoma ligustrifolium*), māhoe (*Melicytus ramiflorus*) and rangiora (*Brachyglottis repanda*). Also, the six dead tree fern (mamaku *Cyathea medullaris*) bases were probably a result of a previous drought. A similar die-off of tree ferns on Te Haupa/Saddle Island (Hauraki Gulf) was blamed on droughts, and it was speculated that these species may be unable to persist on islands that lack permanent freshwater (Tennyson & Taylor 1999).

Broadleaf forest south-facing slope

The canopy of the south-facing forest on a rocky slope (c. 30º) was 6–8 (–10) m tall, containing kohekohe (*Didymocheton spectabilis*), karaka (*Corynocarpus laevigatus*), māhoe, whārangi (*Melicope ternata*), tawāpou (*Planchonella costata*), pūriri (*Vitex lucens*) and parapara (*Ceodes brunoniana*). The rocks piled up to 1m high on the uphill side of the largest tree found, a pūriri c.1m in diameter (Fig. 7), indicated the instability of these slopes. The main understorey shrubs were kawakawa (*Piper excelsum*), hangehange, coastal karamū (*Coprosma macrocarpa*), rangiora and houpara (*Pseudopanax lessonii*) – the latter three species more common in forest gaps. Forest composition and structure in two, subjectively placed 100 m^2 plots in this forest type is detailed in Appendix 3. The main ground plant amongst the rocks was huruhuruwhenua/shining spleenwort (*Asplenium oblongifolium*) and less commonly *Pteris carsei*. Seedlings of most of the canopy species were present except pūriri. Taupata (*Coprosma repens*) and karo (*Pittosporum crassifolium*) c. 4 m tall dominated the coastal fringe.

Figure 7. Rocks piled up on the uphill side of the largest pūriri seen (c.1 m DBH), lower-mid slope, south side of Motueka. Photo: 1 Mar 2005

Broadleaf forest north-facing slope

Between tall pōhutukawa (*Metrosideros excelsa*) (c.16 m tall) there was an even canopy c.10 m tall on a steep face of kohekohe, parapara, māhoe and locally tūrepo/large-leaved milk tree (*Streblus banksii*); with a shrub layer of kawakawa, coastal māhoe (*Melicytus novae-zelandiae*), houpara and rangiora; and ground cover of huruhuruwhenua, houpara seedlings and, very locally, *Pteris carsei*. Seabird burrows were locally common. Forest composition and structure in two subjectively placed 100 m^2 plots in this forest type is detailed in Appendix 3.

Pōhutukawa forest

The tallest vegetation on the summit plateau east of the middle of the island was pōhutukawa 8–14 m tall, with some trees reaching c. 22 m tall, with individual stems 25–50 cm diameter and one with a basal diameter of 1.5 m. All pōhutukawa were branched from near the base, indicating that they had established in the open. On the western margin of this pōhutukawa canopy and sloping down to the south was a pure stand of karo c. 8 m tall. Below this pōhutukawa and karo canopy was a gap (Fig. 8) down to a dense shrub layer 1–2 m tall. This layer was dominated by coastal karamū, with coastal mahoe, rangiora, houpara, hangehange, and sapling kohekohe, māhoe and karaka. Kōwharawhara (*Astelia banksii*), huruhuruwhenua, rengarenga (*Arthropodium cirratum*) and harakeke/flax (*Phormium tenax*) were the main groundcover species. Because the karo stems in the subcanopy were even-sized they could be a cohort that germinated and grew beneath the pōhutukawa canopy, possibly in response to a disturbance event that opened the canopy, e.g., a wind storm, after which the canopy has since regrown. The karo cohort is probably <30 years old, based on stem size and likely growth rates.

Exotic pines

At the eastern end of the island a stand of naturalised maritime pines (*Pinus pinaster*) was present, estimated to number 30 trees 1.5–10 m tall, on a rocky clifftop down to sea level. The larger trees were on the upper slopes (Fig. 9). Tiny seedlings were frequent, mainly on the lower open slopes. The understorey was open with occasional shrubs of karo, houpara and pōhutukawa. Pine needles and bare rock dominated the ground, with a scattering of danthonia species (*Rytidosperma* spp.) and *Asplenium haurakiense*. Away from this locality only one other pine was seen on the island – a seedling near the middle of the summit plateau.

Cliff scrub

The eroding north-facing steep (c. 60º) slopes supported a variety of shrubs and herbaceous species. The two main shrubs were pōhutukawa (to 6 m tall) and karo (1–2 m tall); houpara (Fig. 10), coastal māhoe and coastal karamū were also present. The main smaller species, often on narrow ledges, included ferns (huruhuruwhenua, *Asplenium haurakiense*), grasses (cocksfoot *Dactylis glomerata*, danthonia species); native spinach

Figure 8. A 6 m-vegetation gap between 8 m-tall karo canopy with a dense shrub layer < 2 m tall dominated by coastal karamū. Mid-Motueka, upper S-facing slope. Photo: 1 Mar 2005.

Figure 9. Invasive maritime pines to 10 m tall and with cones, eastern end of Motueka among pōhutukawa. Photo: 1 Mar 2005.

Figure 10. Houpara, one of the commonest woody plants, with young fruit. Photo: 1 Mar 2005.

(*Tetragonia trigyna*), *Peperomia urvilleana*, knobby clubrush (*Ficinia nodosa*), herbaceous daisies (*Senecio hispidulus*, *Hypochaeris radicata*), and low shrubs of koromiko (*Hebe pubescens*) near the clifftops.

Summit scrub

On the western side of the summit on level land was a shrubland, 1.5–2.5 m tall, measuring c.8 × 5 m, dominated by mingimingi (*Leucopogon fasciculatus*) and rārahu/bracken (*Pteridium esculentum*), with occasional māpou (*Myrsine australis*), houpara, kōwharawhara and a tawāpou. A few other ferns (huruhuruwhenua and *Asplenium haurakiense*) were present. The shrubland margin was dominated by taller pōhutukawa and whārangi. It is interesting that there is no tea tree (*Leptospermum* or *Kunzea* spp.) present and mingimingi appears to be locally filling that ecological gap. The low stature of the vegetation and the presence of rārahu indicates some type of recent disturbance, possibly a local fire or a storm uprooting vegetation.

Disturbed site from a recent rockslide

At the foot of tall cliffs by the western end (north side, Fig. 11) was a disturbed site from a rockslide through a coastal fringe forest c. 6 m tall on a talus slope 6–10 m across. Several paths c. 4 m across had been flattened through the forest (Fig. 12), which included pōhutukawa, karo, houpara, taupata, parapara and a low ngaio (*Myoporum laetum*). Judging by the vegetation, the disturbance was perhaps 2–4 years before our visit in 2004. The rocky disturbed area was dominated by pōporo/small-flowered nightshade (*Solanum americanum*) (Fig. 13), *Senecio hispidulus*, and fleabane (*Erigeron sumatrensis*); with occasional lush plants of inkweed (*Phytolacca octandra*), catsear (*Hypochaeris radicata*), native grasses (*Anthosachne kingiana* and *Dichelachne crinita*), harebell (*Wahlenbergia vernicosa*), mats of native spinach, a few clumps of island cutty grass (*Cyperus insularis*) and a single young plant of poroporo (*Solanum aviculare*).

Vegetation of Poikeke

Unlike Motueka, Poikeke is a flat-topped island (probably levelled by Māori – see Appendix 2), and gently slopes down to the south side, but is otherwise steeply cliffed. The plateau forest canopy is dominated by tawāpou with abundant houpara usually of less stature than the tawāpou (Fig. 14), the former with many broken heads, reaching c. 12 m-tall and stems to 40 cm DBH, and houpara to 8 m and 30 cm DBH. Coastal karamū, māhoe, and hangehange are also present. Karo 4–5 m tall was common near clifftops along with smaller plants of coastal māhoe and emergent pōhutukawa 10(-12) m tall. Huruhuruwhenua is the dominant ground fern among the abundant petrel burrows. A single maritime pine was noted. Moore (1976) recorded a mixed forest 5–10 m tall, including karaka, pōhutukawa and five-finger (as *Neopanax arboreus* (= *Pseudopanax arboreus*) – not seen by us, more likely to be *Pseudopanax lessonii*, the commonest woody plant present).

Observations on islet on east side of Poikeke

The narrow islet c. 4 m asl and 12 m long (Fig. 15), lying 10 m off the east side of Poikeke was briefly surveyed on 2 March 2006. Ten vascular species were recorded (listed in Appendix 4), all were indigenous and included native sea spurrey (*Spergularia tasmanica*). Prostrate taupata and karo to 1.5 m tall were the only woody species present. All these species are reasonably tolerant of saltwater. Two old gull nests were observed, most likely karoro/black-backed gull (*Larus dominicanus*), and the abundance of guano suggested the islet was a popular seabird roost.

Flora

Vascular flora of Motueka and Poikeke

The combined vascular flora of both islands is 107 species (76% are native species), Motueka has 105 species (75% native), and Poikeke 61 species (84% native) (see Table 1 and Appendix 4). Forty percent of

Figure 11. Recent rockslides were evident through the fringe forest on the talus slope at the foot of the summit cliffs by the western end of Motueka. Photo looking SE: 1 Mar 2005.

Figure 12. Recent rockslide, involving boulders to c. 1 m across, breaking and flattening branches through the coastal forest fringe of pōhutukawa, karo, houpara, taupata, parapara and ngaio on the talus slope below the cliffs. East end of Motueka, north side. Photo: 2 Mar 2006.

the species records are supported by herbarium vouchers held in the Auckland Museum (AK, and listed in Appendix 4). Unsurprisingly the larger island supports the larger flora, in fact 46 species (43%) were only on Motueka, 59 species (54%) were present on both islands. One species (*Adiantum cunninghamii*) was found only on Poikeke and another (*Spergularia tasmanica*) only on the islet on the eastern side of Poikeke.

The 'island' element of the flora

The flora of Motueka and Poikeke has two different northern New Zealand elements to it. The occurrence of unnamed large-leaved forms on northern offshore islands of common mainland 'normal-leaved' forms of shrubs and trees has been commented on by Hamilton and Atkinson (1961), Beever (1986), Taylor (1986) and Cameron and Young (2019). Three species, rangiora,

Figure 13. The path of the rockslide was dominated by herbaceous species, especially pōporo/small-flowered nightshade and fleabane. Note – poroporo bottom left. East end Motueka north side. Photo: 2 Mar 2006.

Figure 14. Tawāpou and houpara dominated forest on the flat summit of Poikeke. Photo: 2 Mar 2006.

Figure 15. Narrow islet on east side of Poikeke at around mid-tide, supported a vascular flora of 10 species, all indigenous, including native sea spurrey which was not recorded on the two main islands. Photo: from Poikeke with Motueka in the background: 2 Mar 2006.

Table 1. Vascular flora totals of Motueka and Poikeke Islands according to plant groupings and native or naturalised status.

Plant group	Motueka	Poikeke and Poikeke islet	Combined
Native ferns	9	6	10
Native dicot trees and shrubs	26	16	26
Native dicot herbs	16	12	17
Native climbers and related trailers	5	3	5
Native monocots (except sedges & grasses)	8	3	8
Native sedges	7	5	7
Native grasses	8	6	8
Naturalised conifers	1	1	1
Naturalised dicot trees and shrubs	3	-	3
Naturalised dicot herbs	13	8	13
Naturalised monocots: grasses	9	1	9
Totals (% native)	105 (77)	61 (79)	107 (76)

taurepo (*Rhabdothamnus solandri*) and kawakawa in northern New Zealand frequently have larger leaves on these islands than occur on their mainland counterparts. Sapling rangiora had leaves to 422 × 306 mm in length and width, with a petiole to 140 mm. This is shorter but wider than large leaves recorded from Tuhua/Mayor Island in the outer Bay of Plenty by Taylor (1986) where the leaf lamina measured 545 × 265 mm. Kawakawa with overlapping leaf bases and generally larger and shinier leaves on Motueka and Poikeke than the mainland plants is the undescribed 'Hauraki Gulf form' of Gardner (1997) that occurs from the Hauraki Gulf south to Tuhua/Mayor Island (Gardner 1997; Rhys Gardner, pers. comm. 2008). Taurepo all had rather orbicular leaf blades to 60 × 46 mm, which are comparable to the leaf size from Taranga and Hauturu Islands, the largest leaves recorded (cf. Beever 1986, fig. 1).

There is another group of northern 'island' species that are now mainly restricted to offshore islands because of their subtropical nature and/or because rodent browsing has all but eliminated them from the adjacent mainland coast. On Motueka and Poikeke these include coastal māhoe, tūrepo/large-leaved milk tree, parapara (Fig. 16) and tawāpou. The attractive ground fern *Pteris carsei* could also be included here because it is most common and most luxuriant on the islands of northeast New Zealand. However, it also occurs less commonly on the mainland generally as far south as Awhitu on the west coast and southern Coromandel Ranges/Bay of Plenty on the east coast (Brownsey *et al.* 2020) where the plants are generally smaller and hybridisation with *P. saxatilis* can be frequent (EKC pers. obs.).

Figure 16. Parapara with large leaves and green fruit (centre), tawāpou behind and pōhutukawa foreground. Forest, west end Motueka on north side. Photo: 21 Feb 2008.

Bryophytes

Five mosses and a liverwort were collected from Motueka during our visits. These were later identified as: *Fissidens curvatus* var. *curvatus* (AK 287913), *Frullania solanderiana* (AK 286204), *Macromitrium brevicaule* (AK 290053), ?*Rhynchostegium tenuifolium* (AK 286207, 301800), *Sematophyllum homomallum* (AK 290052) and *Thuidiopsis furfurosa* (AK 288305). This list will be far from complete.

Vertebrate Fauna, Miscellaneous Invertebrates and a Fungus

Rats

Based on field work in 1971–72, Moore (1976) recorded a pelvic bone of a rat (*Rattus* sp.) on Poikeke. GAT & AJDT trapped an adult female and an immature female Norway rat (*Rattus norvegicus*) on Poikeke, and they also had mouse and rat traps sprung without catching any rodents on Motueka in March 1989. Evidence of rats was present on both islands during our 2004–08 visits: droppings (matched the size typical of Norway rats), ground husking stations of chewed karo and houpara fruit, and tips of fleshy horokaka /native ice plant (*Disphyma australe*) leaves appeared to be chewed by rats (Fig. 17). Department of Conservation staff (Marie Everth pers. comm. 2021) noted evidence of rats still being present on Motueka in October 2021.

Figure 17. The damaged tips of fleshy horokaka/native ice plant suspected to have been chewed by Norway rats. Lichen-encrusted coastal rocks Poikeke, 2 Mar 2006.

Birds

A total of 24 bird species were recorded on or next to Motueka and Poikeke Islands; 20 are native and four are exotic species (see Appendix 5). In 1971–72 Moore collected bones of kuaka/common diving petrel (*Pelecanoides urinatrix*), ōi/grey-faced petrel and probable kawau tikitiki/spotted shag (*Stictocarbo punctatus*) on Poikeke (Moore 1976). Department of Conservation staff (Marie Everth pers. comm. 2021) observed an ōi/grey-faced petrel egg (rat-chewed) and adult ōi feathers on Motueka in October 2021. All other observations were made during our combined visits.

Reptiles

Reptiles were not seen during our visits, but Moore (1976) reported on an apparent sighting of tuatara (*Sphenodon punctatus*) on Motueka by Mr H. Harsant in the 1910s–1920s. JJD is unaware of tuatara ever being on Motueka.

Miscellaneous invertebrates

The land snail, *Rhytida greenwoodi* was collected by F.G. Thomson & K. Thomson (A.C. O'Connor collection), March 1947, Motueka, 4 vouchers, Te Papa M.115512. Occasional shells of this indigenous snail in NW-facing forested slopes on Motueka were found eroding out of a talus slope at the western end of the island (April 2004).

Kutukutu/antlion lacewing (*Weeleus acutus*) larval traps in soft dry soil were locally common on the south end of Poikeke (March 2006).

The white butterfly (*Pieris rapae*) was seen in a shrubby area, clifftop near summit, Motueka (March 2005), perhaps attracted to the wild turnip (*Brassica rapa* subsp. *sylvestris*).

The honeybee (*Apis mellifera*) was seen in a shrubby area, clifftop near summit, Motueka (March 2005).

The German wasp (*Vespula germanica*) was seen in a shrubby area, clifftop near summit, Motueka (March 2005).

Salt pool mosquitos (*Opifex fuscus*) were present in the brackish rock pools at the east end of Motueka (March 2005).

Fungus

Orange pore fungi (*Favolaschia calocera*) were present on wood in forest, Motueka (March 2005).

DISCUSSION

Flora

Environmental weeds

Of the 26 naturalised exotic species recorded on the island only four would qualify as environmental weeds warranting control: maritime pine, needlebush (*Hakea sericea*), boxthorn (*Lycium ferrosissimum*) and loquat (*Rhaphiolepis bibas*). Apart from loquat the other three species require open sites, and because of the eroding nature of the steep faces Motueka will permanently have open sites and be prone to invasion of such weed species from the adjacent mainland. Being closer to the mainland, Poikeke has the potential to act as a stepping-stone for some weed species. However, the distribution of the four environmental weeds, which were all confined to Motueka except for a single maritime pine, suggests this was not the case for these four species.

Maritime pines were common on the adjacent mainland cliffs, and they are the most likely source of wind-blown seed. They have established on the most distant end of Motueka from the mainland, which presumably is related to that end being more open than the rest of this island and Poikeke, and therefore more prone to pine invasion. They are presumed to be a recent arrival because they were not observed in 1989. The presence of these pines increases the island's fire risk (Perry *et al*. 2014; Wyse *et al*. 2018).

Needlebush was locally common along the north side of the rather open ridge east of the summit and a single plant grew near the east end. Its seeds are wind-blown. All plants in the 2000s were <1 m tall. The species was also recorded in 1989 as 'several shrubs on steep open site'. It was not recorded on Poikeke. Needlebush also increases the fire risk (Perry *et al*. 2014; Wyse *et al*. 2018).

Boxthorn was present as a single group of c. 8 unhealthy looking plants to 3 m tall at the east end of Motueka Island. The species was also recorded in 1989 as a 'local patch'. It was not recorded on Poikeke. Boxthorn is usually spread by frugivorous birds eating the small fleshy fruit – tūī, blackbird, starling, silvereye and kererū were all recorded on these islands.

Loquat was recorded after our visits as a single well-established seedling in the mid-forested slope on the south side of Motueka and uprooted by Department of Conservation staff (Claire Wooldridge pers. comm. 2021) in October 2021. Kererū are the most likely seed vector and they were observed both times when the southern forest of Motueka was visited by EKC & PJB (April 2004, March 2005).

Because of their proximity to the mainland Motueka and Poikeke are biologically connected to the mainland. They are well within the reach of wind-blown seeds, birds with seed ingested or attached externally, or floating seeds on inshore currents. Environmental weeds present on the adjacent mainland coast which pose a threat to Motueka/Poikeke (EKC pers. obs., Jan 2015) include: coastal banksia (*Banksia integrifolia*), cotoneaster (*Cotoneaster glaucophyllus*), Chinese privet (*Ligustrum sinense*), polygala (*Polygala myrtifolia*), blackberry (*Rubus fruiticosus* agg.), veldt grass (*Ehrharta erecta*), and pampas grasses (*Cortaderia jubata*, *C. selloana*). The nearby town of Hahei, only 2 km distant, has a resident population of c. 300 people and a large pool of garden plant species, including the phoenix palm (*Phoenix canariensis*). Sullivan *et al*. (2005) showed that there is a correlation between the numbers of weeds in native forest fragments in northern New Zealand and the distance to the nearest large town. Loquat recently reaching Motueka shows this danger – could phoenix palm be next? Phoenix palm is known to naturalise on small northern islands in the Hauraki Gulf (Cameron 2010: fig. 18, Cameron 2021) and has locally established on the coast east of Whitianga (Fig. 18).

Indigenous flora

Just as Motueka is subject to arrivals from the adjacent mainland of exotic species (see above), native species are also likely to be arriving. Porokaiwhiri /pigeonwood (*Hedycarya arborea*) is suspected to be a recent arrival because no adults were seen on the island and it is absent from Poikeke. Māpou could possibly be a recent arrival on Motueka as no adults were observed; however, adults were present on Poikeke which is the likely seed source for Motueka. Conversely, only two juvenile plants of parapara were seen on Poikeke and adults were present on Motueka.

Figure 18. Naturalised spiny phoenix palms along the coast east of the outer Whitianga Harbour mouth, c. 8 km west of Motueka Island. Photo: 2 Mar 2006.

Comparison of the indigenous vascular floras with eight nearby small undisturbed islands

Taylor *et al*. (1990) compared the indigenous vascular floras of 12 small undisturbed northern New Zealand islands. Eight of these are from the Mercury Islands and Ruamāhua /Aldermen Islands which lie within 30 km of Motueka/Poikeke and with a similar eastern aspect: Atiu/ Middle 13 ha (Cameron 1990); Green 2.3 ha (Atkinson 1964); stack west of Green 0.1 ha (Taylor *et al*. 1990); Black Rocks 2.0 ha (Taylor *et al*. 1990); Old Man Rock 0.7 ha (Atkinson 1962); Hongiora/Flat 3.3 ha (Taylor *et al*. 1990); Nga Horo/Hernia 3.4 ha (Court *et al*. 1973); and Half 1.6 ha (Court *et al*. 1973). Compared with these eight islands, Motueka/Poikeke are unusual in containing many indigenous species not normally associated with small northern New Zealand islands They include four ferns (*Adiantum cunninghamii, Blechnum filiforme, Cyathea medullaris, Pteris carsei*), four dicotyledons (*Ceodes brunoniana, Haloragis erecta, Rhabdothamnus solandri, Vitex lucens*) and two monocotyledons (*Earina mucronata, Rhopalostylis sapida*). The distance from the mainland of the eight islands varies from 2.5 to 19.5 km. The reason for the presence of these species on Motueka and Poikeke appears to be their proximity to the mainland and therefore receiving a higher 'rain' of mainland seed.

Considering that parts of the vegetation are quite young, indicating fairly recent disturbance, it is surprising on islands so close to the mainland that both mānuka (*Leptospermum scoparium*) and kānuka (*Kunzea robusta*) are absent, even though both are common on the adjacent mainland. Atkinson (2004) proposed models for forest succession on northern New Zealand islands, in which either pōhutukawa or kānuka (both small-seeded, wind-dispersed Myrtaceae) dominates as the initial coloniser and noted that it is rare for both species to be equally common. Successions on Motueka and Poikeke (in which pōhutukawa apparently dominated) lend support to Atkinson's model. The mechanisms by which pōhutukawa or kānuka dominates in early succession, often to exclude the other, may be related to any or all of substrate type, soil compaction, timing of dispersal, and proximity of seed sources, and require detailed investigations. Atkinson (2004) considered that successions on islands in which pōhutukawa dominated were often poor in woody species. That is not the case on either Motueka or Poikeke. On Motueka, the distinct tree communities developing under pōhutukawa may be determined by aspect, slope stability, soil depth, and potentially moisture availability. Moreover, ground ferns such as *Polystichum* spp. and *Adiantum* spp., which are often common on such islands, are absent or nearly absent. Perhaps the rocky slopes are too mobile for some terrestrial fern species.

Other 'island' species that might be expected on Motueka/Poikeke include Cook's scurvy grass (*Lepidium oleraceum*) which is present on four of the eight islands of the Mercury and Aldermen Islands noted above, and *Parietaria debilis* which is present on three of them. Both these species were also present on Motukorure (Centre) Island (Fig. 1), only 3.3 km northwest of Motueka (GAT pers. obs., March 1989).

Impact of Norway rats

Norway rats may affect successional processes, by preying on burrowing seabirds and limiting their disturbance regime and nutrient input (Fukami *et al*. 2006) and potentially through seed and leaf predation. For example, kiore (*Rattus exulans*) ate seeds of various tree species, including tūrepo and karo, reducing their recruitment on northern New Zealand islands (Campbell & Atkinson 2002). Tūrepo was locally present as established trees on Motueka but we did not observe seedlings. If Norway rats have been long present on Motueka then it is unlikely that they have depressed recruitment of karo (Fig. 8, cf. Campbell & Atkinson 2002). However, Norway rats prey on tree seeds in other countries in which they have been introduced (e.g., Shepherd & Ditgen 2013), and studies are needed to determine whether Norway rats depress seedling recruitment of New Zealand trees, including tūrepo and karo (Grant-Hoffman *et al.* 2010). The suspected chewing of horokaka/native ice plant leaves by rats on Motueka/Poikeke backs the theory that this plant may be suppressed by Norway rats, which probably eat it for moisture (Tennyson & Taylor 1999). Could the reason that the fleshy-leaved native sea spurrey that was only recorded on an islet adjacent to Poikeke be because of rat browsing? Two of the authors (EKC & GAT) have frequently observed sea spurrey occurring on islets too small to support rats, or only on larger islands without freshwater where it is confined to ledges inaccessible to rats. Palaeoecological and new surveys of Motueka and Poikeke could also reveal whether kiore were present on these islands in the past, potentially affecting the successions on the islands.

Threatened and At-risk Species

This follows the New Zealand Threat Classification System of Townsend *et al*. (2008).

Vascular plants

Following the ranking of de Lange *et al*. (2018) there are two 'Nationally Vulnerable' species (pōhutukawa, poroporo); three 'At-risk – Declining' (rauhuia *Linum monogynum*, island cutty grass *Cyperus insularis*, blue wheatgrass *Anthosachne kingiana*); and two 'At-risk – Relict' (parapara, tūrepo/large-leaved milktree). Although pōhutukawa is one of the commonest trees on the islands and adjacent mainland, it is considered Threatened because of the arrival the invasive fungus, myrtle rust (*Austropuccinia psidii*) to New Zealand. Primarily an island sedge of northern New Zealand, *Cyperus insularis* was recorded on Motueka along with a possible hybrid which "has the right head shape for *C. insularis*, but the dark blotch of *C. ustulatus*" (Peter de Lange pers. comm. 2006). The 'dark blotch' is present on the distal ends of the culm of *C. ustulatus*, whereas *C. insularis* is green, or rarely pale brown in this area (Heenan & de Lange 2005: table 1). Hybridisation was unrecorded in their paper.

Birds

Following the ranking of Robertson *et al*. (2021), seven of the bird species reported from Motueka/Poikeke are considered Threatened or At-risk: two 'Nationally Vulnerable' (kawau tikitiki/spotted shag, taranui/Caspian tern *Hydroprogne caspia*); four 'At-risk – Declining' (tītī/sooty shearwater, kororā/blue penguin *Eudyptula minor*, tarāpunga/red-billed gull *Larus novaehollandiae*, tara/white-fronted tern *Sterna striata*); and one 'At-risk – Relict' (kuaka/common diving petrel). The Poikeke population of tītī/sooty shearwaters is notable because, while this species is widespread, it is scarce and declining at northern New Zealand colonies (Waugh *et al*. 2013). Kuaka/common diving petrel bones found on two separate trips suggest that this species may be attempting to nest on Poikeke, however, the species is unlikely to succeed while Norway rats are present. A probable kawau tikitiki/spotted shag bone identified in 1976 (Moore 1976) possibly indicates the former presence of this species on Poikeke. This species has declined in northern New Zealand and was locally extinct as a breeding species on the entire Coromandel coast by the 2000s (Rawlence *et al*. 2019).

Fauna

Motueka and Poikeke Islands have birds typical of the Coromandel coast. However, islands such as these act as refuges for nesting petrels. Despite the presence of Norway rats, these islands support a population of hundreds of nesting ōi/grey-faced petrels. While this petrel is common in northern New Zealand, the Motueka/Poikeke population is important because it no longer survives on the eastern Coromandel mainland (nesting on the adjacent mainland has not been reported for decades) (Miskelly *et al.* 2019). Other seabirds nest here (tītī/sooty shearwater, kororā/blue penguin, karoro/black-backed gull) or potentially nest here (kuaka/common diving petrel, shags, terns and tarāpunga/red-billed gull). With restoration (including eradication of rats), these islands would likely become significantly more important for seabirds.

We did not detect any reptiles on the islands, presumably because of the presence of Norway rats, however a systematic search for lizards is needed. The historic record of tuatara is tantalising and quite likely correct. Tuatara are on several other islands in the region (e.g., Crook 1973) but they have not survived anywhere with Norway rats (Newman 1986; Towns & Dougherty 1994).

CONCLUSIONS

For such small, steep islands it was surprising to find such diverse broadleaf forest of good stature on the steep central slopes on both the north and south sides of Motueka Island and the summit of Poikeke. The flora contains a good range of 'island' species and plant forms (large leaf size) more commonly found on more

Figure 19. Favoured roost trees in 2008 of kāruhiruhi/pied shags in pōhutukawa above a sea tunnel on the west side of Poikeke. Photo looking east: 21 Feb 2008.

remote islands, which was unexpected given the islands' close proximity to the mainland. Most plant species are regenerating well except for a few of the 'island' species. Naturalised plants are generally present in low numbers and only four species are recommended for management, two of which increase the flammability of the islands. The proximity of the islands to areas with large seasonal tourist numbers poses risks through introductions of predators (rodents, and rainbow skink, *Lampropholis delicata*) and through igniting accidental or deliberate fires that could reset successions, potentially favouring colonisation by pyrogenic weeds such as pampas grasses and pines from the adjacent mainland. Of the petrels, at least ōi/grey-faced petrels are still attempting to nest on Motueka and Poikeke. The eradication of Norway rats would assist both their breeding success and provide opportunities for smaller species like common diving petrels to nest. This would restore indigenous ecosystem processes on the islands. Source colonies of petrels are abundant on the islands both to the north of Mercury Bay (such as the Mercury Islands) and to the south (such as the Aldermen Islands) (Taylor *et al*. 1990; Taylor 2000a, 2000b). The effects of Norway rats on the flora remain unclear. However, Norway rats are very likely to impact on the intertidal biota – part of the marine reserve. Taylor & Thomas (1993) found that 70% of 20 Norway rat stomach remains analysed from Breaksea Island in Fiordland contained marine fauna (35% shellfish and 40% fish). Navarrete & Castilla (1993) found in the central Chile coast that Norway rats preyed on 40 different intertidal species, including both mobile (crabs) and sessile species (limpets); and on the Aleutian Islands in Alaska, Kurle *et. al.* (2008) compared islands with and without Norway rats and demonstrated that the invasive rats directly reduced bird (glaucous-winged gull *Larus glaucescens* and black oystercatcher *Haematopus bachmani*) densities through predation, indirectly causing invertebrates to significantly increase and fleshy algal cover to reduce.

Eradication of Norway rats would have significant benefits to these islands by helping to restore the seabird-driven ecosystem processes that are present on other mammal-free islands in the region and should be a management priority in the near future.

Because of its proximity to the mainland, we recommend monitoring of the island every two years checking for establishment of new exotic plant and animal species. A spring survey could be beneficial in recording biota previously over-looked during our summer-autumn surveys.

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APPENDIX 1: Kōrero on the origin of Motueka

The korero begins with the famous basalt (karā) mountain Maunga Tāhanga (Tā – to strike, hanga – to build or make). In Ngāti Hei lore the karā of Tāhanga was so valued and famous that the legendary taniwha of greenstone, Poutini, had heard of this mountain and came to claim Tāhanga as his own. Poutini wanted to put Tāhanga under his spell and turn Tāhanga into his precious pounamu so that the maunga would exalt his mana all over the North Island. This angered the goddess Hine-Tua-Hōanga as she proclaimed her mana was more powerful than that of Poutini because it was sandstone that was used as the grinding stones (hōanga) to shape pounamu into its smooth lines further justifying that her power was even greater than that of the mischievous taniwha Poutini so she set about driving the intruding Poutini far from her kāinga.

Hine-Tua-Hōanga did not want the greenstone people residing in her rohe, for her people were of the sandstone – the sandstone people. So, she ordered her two pet sharks Ruamanowai and Aninihi to attack Poutini and drive him from Tāhanga so they chased him around to Raupuha (Matapaua Bay) then to Puhiwai then on to Waitaia. Poutini then fled south toward Tuhua (Mayor Island) to seek refuge from the infuriated Hine-Tua-Hōanga. Poutini thought then perhaps Tuhua would fall under his spell which of course was famous as the source of the best Tūhua (obsidian) in all of Aotearoa. The fins of the two pet sharks of Hine-Tua-Hōanga can be clearly seen today and are known as Motu Mango (The Twins) between Waitaia and Matapaua Bays.

Relentless in her pursuit of Poutini, Hine-tua-Hōanga gave chase. As she sped toward Tuhua she ordered her pet sharks to guard Tāhanga. The memory of her pursuit can be seen by the trail of island sentinels she left behind in her wake while heading for Tuhua: the Mercury Island group, Ohinau Island group including Motueka, and the Ruamāhua Island group. All these groups of islands were more customarily known to Ngāti Hei as Nga Tapuwae O Hine-Tua Hōanga (the footsteps of Hine) to ensure that Poutini would not circle back to cast his magic on Tāhanga should she be distracted. The islands and towering rocks (teka) from Aotea (Great Barrier) to Tuhua were her sentinels and the descendants of Hei have carried the spiritual mana of the deity of Hine-Tua-Hōanga through the ages as kaitiaki and ahi kā to this day.

Ngāti Hei were the proprietors of Tāhanga. Hine-Tua-Hōanga was the personified form relative to Maunga Tāhanga. Ngāti Hei were people of stone. They were experts in fashioning adzes, drills and taonga of all sizes and shapes and were known for building stone structures and stairways that guarded their gardens and pā that can still be seen to the trained eye.

APPENDIX 2: From Lieutenant James Cook's journal (Beaglehole 1955: 201–202) in 15 November 1769

"The Island [Poikeke] we landed upon was very small, yet there were upon it a Village the inhabitants of which received us very friendly. This little Village was laid out in small Oblong squares, and each pallisaded round. The Island afforded no fresh Water and was only accessible on one side: from this I concluded that it was not choose for any Conveniency it could afford them, but for its Natural Strength."

APPENDIX 3: Forest composition in four 100 m^2 plots established on Motueka in 2004 (N-facing) and 2006 (S-facing)

Two on the north-facing slopes and two on the south-facing slopes (all living stems ≥2.5 cm diameter at 1.35 m height measured). Tree species are listed in each plot in descending order of basal area (a proxy for biomass) and by their stem density (mean values calculated across the two plots in each forest type). The plots were subjectively located in forested areas not dominated by pōhutukawa.

	Basal area (m^2 ha^{-1})	Stem density ha^{-1}
South-facing plots (mean aspect = 118°, slope = 18°)		
Corynocarpus laevigatus	17.84	400
Didymocheton spectabilis	9.16	3500
Coprosma macrocarpa	5.63	2400
Melicope ternata	1.14	500
Pseudopanax lessonii	0.97	700
Melicytus ramiflorus	0.87	200
Ceodes brunoniana	0.74	250
Piper excelsum	0.21	200
Brachyglottis repanda	0.18	100
Geniostoma ligustrifolium	0.15	150
Undetermined	0.05	50
Total	36.94 (range 25.46 – 48.41)	8450 (range 7600 – 9300)
North-facing plots (mean aspect = 298°, slope = 32°)		
Didymocheton spectabilis	9.69	800
Ceodes brunoniana	8.44	700
Melicytus ramiflorus	6.06	500
Coprosma macrocarpa	3.27	1400
Planchonella costata	2.07	150
Streblus banksii	1.83	50
Piper excelsum	1.00	650
Brachyglottis repanda	0.61	250
Pseudopanax lessonii	0.18	100
Corynocarpus laevigatus	0.10	50
Geniostoma ligustrifolium	0.07	50
Melicope ternata	0.07	50
Total	33.41 (range 26.30 – 40.51)	4750 (range 3500 – 6000)

APPENDIX 4: Vascular flora of Motueka and Poikeke Islands and their status if Nationally Threatened or At-Risk

Abundance generally is noted by a five-tiered scale for each taxon. Records are also given for Poikeke islet by registering Pi in a separate column, together with herbarium sheet numbers where voucher specimens exist. Voucher specimens are lodged in the Auckland Museum (AK).

Key:

a = abundant ***c*** = common ***o*** = occasional

l = local ***s*** = scarce (< 5 plants seen) * = naturalised species

M = Motueka P = Poikeke Pi = islet on east side of Poikeke

Plants groups	M 1989	M 2004-08	P 1989	P 2006	Pi 2006	Comments from 2004-08 observations (unless otherwise stated). Herbarium vouchers (AK)
Ferns (10 + 0) (= native + naturalised)						
Adiantum cunninghamii			P			huruhuru
Asplenium haurakiense	M	M	P	P		***lc***, mainly rocky partly open areas. AK 290812. A single collection from clifftops under pohutukawa canopy on Motueka may be *Asplenium flaccidum*, AK 290754.
Asplenium oblongifolium	M	M	P	P		huruhuruwhenua/shining spleenwort. ***o***–***a***, terrestrial in forest
Blechnum filiforme		M				pānako, thread fern. 2 terrestrial patches (10 x 1 m & 0.3 x 0.2 m), upper S-facing forest
Cyathea dealbata		M				ponga. ***l*** plant with 2 m trunk, upper S-facing forest, W end
Cyathea medullaris		M				mamaku. 2 live plants with trunks to 1 m tall, and 6 dead bases; upper S-facing forest slope
Lecanopteris pustulatum	M	M	P	P		kōwaowao/hound's tongue. ***o***, terrestrial, partly open forest
Pteridium esculentum	M	M	P	P		rārahu/bracken. ***lc***, in patches, open areas, bush margins
Pteris carsei	M	M				coastal brake. ***l***, mainly S-facing forested slopes. AK 290800
Pyrrosia elaeagnifolia		M	P	P		leather-leaf fern. ***o***, terrestrial, rupestral and epiphytic.
Conifers (0 + 1)						
*Pinus pinaster**		M		P		maritime pine. M: ***l***, c.30 trees 1.5–10 m tall, open E end, seedlings common by adults; also, single seedling halfway along summit ridge. P: single 1.5 m tall tree with cones, basal diameter 13 cm, exposed N ridge. AK 290716 & 290828
Dicot Trees & Shrubs (26 + 3)						
Brachyglottis repanda	M	M				rangiora. ***lc***; canopy gaps, to 5 m tall, leaf blades of all plants rather large and shiny above; sapling leaves to 422 x 306 mm. AK 290776 & 290840
Carmichaelia australis	M	M	P	P		mākaka, North Island broom. M: ***o***, to 4 m tall, semi-open sites, upper forest margins. P: 3 plants to 2 m tall. AK 290819

Plants groups	M 1989	M 2004-08	P 1989	P 2006	Pi 2006	Comments from 2004-08 observations (unless otherwise stated). Herbarium vouchers (AK)
Ceodes brunoniana At-risk – Relict	M	M	P	P		parapara. M: ***lc***, forest, especially S and NW sides, canopy trees to 8 m tall, with stems to 50 cm diameter. Fruiting adults present but no seedlings. P: 2 juveniles only, 0.5 & 2.0 m tall. AK 289750.
Coprosma macrocarpa subsp. *minor*	M	M	P	P		coastal karamū. ***o–la***, forest understorey. AK 290815
Coprosma repens	M	M	P	P	Pi	taupata. ***o–lc***, low plants in exposed sites to erect canopy trees to 4 m tall fringe of S boulder beach of M
Corynocarpus laevigatus	M	M	P	P		karaka. M: ***c***, S-side in forest, seedlings to canopy trees; l at NW end coastal slope. P: 6 saplings (no adults) close together c.1 m tall, in forest
Didymocheton spectabilis	M	M				kohekohe. ***c***, as canopy trees; ***la*** as seedlings carpeting in places
Geniostoma ligustrifolium	M	M	P	P		hangehange. ***o***, forest understorey; leaves rather fleshy on plants close to the coast. AK 290810, 290835 & 295198
Hakea sericea *	M	M				needlebush. ***lc***, low plants (<1 m tall) on open summit ridge, mainly near W end. AK 286263
Hebe pubescens subsp. *pubescens*	M	M				koromiko. ***o***, upper open slopes. AK 286150 & 290705
Hedycarya arborea		M				porokaiwhiri/pigeonwood. ***o***, seedlings and saplings in forest (no adults seen)
Leucopogon fasciculatus	M	M				mingimingi. ***lc***, upper open sites
*Lycium ferrocissimum**	M	M				boxthorn. ***l***, ***c***. 8 plants to 3 m tall, all unhealthy, E open slope over c.10 m x 10 m. Recorded as 'local patch' in Apr 1989. AK 290748
Melicope ternata	M	M	P	P		whārangi. M: ***lc***, mainly upper slopes as small canopy trees on S-side and summit ridge; ***o*** throughout. P: ***s***, in forest. AK 290838
Melicytus novae-zelandiae	M	M	P	P		coastal māhoe. ***o***, mainly close to coast, as low shrubs to small trees 4 m tall. AK 290822
Melicytus ramiflorus	M	M	P	P		māhoe. ***o–lc***, canopy trees throughout
Metrosideros excelsa Nationally Vulnerable	M	M	P	P		pōhutukawa. ***a***, commonest and tallest trees, to 22 m tall with branches to 50 cm diameter on summit ridge.
Myoporum laetum		M				ngaio. ***l***, prostrate shrubs in exposed sites to canopy trees, coastal, NW side
Myrsine australis	M	M	P	P		māpou. M: ***o–lc***, seedlings and saplings, upper forest slopes and W end coastal slope – 3 m tree tallest seen. P: ***lc***, especially on W end, to 6 m tall
Pimelea urvilleana		M				pinatoro. ***s***, E end only, coastal rocks in open
Piper excelsum subsp. *excelsum* "Hauraki Gulf form"	M	M	P	P		kawakawa. ***c***, in forest; an undescribed form with over-lapping leaf bases and large shiny leaf blades "Hauraki Gulf form" (see Gardner 1997: 301); the petioles were either green or reddish. AK 290794, 290797, 290799 & 292312

Plants groups	M 1989	M 2004-08	P 1989	P 2006	Pi 2006	Comments from 2004-08 observations (unless otherwise stated). Herbarium vouchers (AK)
Pittosporum crassifolium	M	M	P	P	Pi	karo. ***c***, coastal fringe and rocky outcrops, seedlings scarce
Planchonella costata	M	M	P	P		tawāpou. M: ***o–lc***, all size classes, including canopy trees. P: ***c***, plateau forest, trees to 12 m tall, 40 cm DBH
Pseudopanax lessonii	M	M	P	P		houpara. ***o–lc***, mainly as canopy trees on steep coastal slopes; seedlings ***la***. AK 290782
Rhabdothamnus solandri	M	M				taurepo. ***l***, understorey shrubs to 1 m tall, upper S forest, rocky slopes at foot of bluffs; leaf blades orbicular (to 60 x 46 mm) and flowers the normal red-orange. AK 290769 & 290826
Rhaphiolepis bibas *						loquat. M: a single well-established seedling (uprooted), mid-forested slope on south side (observation by DoC, Oct 2021)
Solanum aviculare Nationally Vulnerable		M	P			poroporo. M: single young plant, rock fall site, NW coast. AK 295173.
Streblus banksii At-risk – Relict		M				tūrepo/large-leaved milktree. ***s***, 7 m canopy tree and a few saplings, forest, N-side only; ripe seed on a 2 m bush. AK 290842.
Vitex lucens	M	M				pūriri. ***s***, a few canopy trees on S-side only, to 16 m tall and 1 m DBH; no seedlings
Dicot Herbs (17 + 13)						
Brassica rapa subsp. *sylvestris* *	M	M	?P			wild turnip. M: ***l***, semi-open steep shrubby slope, N-side below summit. AK 286149 & 290806
Centaurium erythraea *	M	M				centaury. ***l***, E open slopes
Chenopodium trigonon subsp. *trigonon*	M	M	P	P		pig weed. ***o***, open coast. AK 295200
Cirsium vulgare *	M	M	P			Scotch thistle. M: ***s***, canopy gap
Crepis capillaris *	M	M	P			hawkesbeard. M: ***s***, open site
Dichondra repens	M	M	P	P		creeping dichondra. ***o***, semi-open sites
Erigeron sumatrensis *	M	M	P	P		fleabane. ***o***, open sites
Euchiton sphaericus		M		P		star cudweed. ***l***, open sites. AK 290744 & 290833
Haloragis erecta	M	M	P	P		toatoa/shrubby haloragis. ***l***, forest gaps and margins
Hypochaeris radicata *	M	M	P	P		catsear. ***o***, open and disturbed sites. AK 290660 & 290702
Leontodon saxatilis *		M	P			hawkbit. M: ***l***, open sites
Linum monogynum At-Risk – Declining		M				rauhuia. ***o***, lower open coastal slopes.
Lobelia anceps		M	P	P		punakuru, shore lobelia. ***l–lc***, coastal fringe, especially at E end by rock pools on M

Plants groups	M 1989	M 2004-08	P 1989	P 2006	Pi 2006	Comments from 2004-08 observations (unless otherwise stated). Herbarium vouchers (AK)
Lysimachia arvensis s.l. *		M				pimpernel. ***l***, flower colour not seen, E open slopes
*Medicago nigra**		M				bur medick. 3 seedlings, margin of rock pool, upper splash zone at E end
Orobanche minor *	M	M	P			broomrape. ***o***, open sites
Oxalis rubens	M	M				dune oxalis. ***l***, open slopes
Peperomia urvilleana	M	M	P	P		***o–la***, rocky, mainly shaded forest steep slopes. AK 290802
Phytolacca octandra *	M	M				inkweed. ***l***, lower open forest slopes, N-side. AK 301854
Polycarpon tetraphyllum *	M	M				allseed. ***o***, open slopes
Pseudognaphalium luteoabum	M	M				pukatea, Jersey cudweed. ***s***, single open site, NW coast. AK 295174
Samolus repens	M	M	P	P	Pi	mākoako/sea primrose. ***l***, mainly coastal rocks E end, and also on N coast
Salicornia quinqueflora	M	M	P	P	Pi	ureure/glasswort. ***l***, N and S coastal rocks (splash zone)
Senecio diaschides		M				fireweed. ***1***, semi-open, shrubby ridgetop; AK 290830
Senecio hispidulus	M	M	P	P		fireweed. ***o–lc***, open sites. AK 290706 & 290791
Senecio lautus	M	M	P	P	Pi	shore groundsel. ***o***, coastal rocks. AK 295172
Solanum americanum	M	M	P	P		pōporo/small-flowered nightshade. ***o***, open sites. AK 290753
Sonchus oleraceus *	M	M	P	P		pūhā, sow thistle. ***o***, open sites
Spergularia tasmanica					Pi	native sea spurrey. ***lc***, only seen on small rocky islet on E side of Poikeke. AK 295199
Wahlenbergia vernicosa		M				coastal harebell. ***o***, open slopes, rocky slip site, flowers mauve. AK 290714
Dicot Climbers and related Trailers (5 + 0)						
Calystegia soldanella	M	M				panahi, shore bindweed. Single patch 3 m long, on coast at W end of island
Clematis paniculata	M					puawānanga/white clematis
Disphyma australe	M	M		P	Pi	horokaka/native ice plant. ***o***, coastal fringes and exposed summit ridge on M
Muehlenbeckia complexa	M	M	P	P		pōhuehue/wire vine. ***o***, small patches, open and partial shade, upper slopes
Tetragonia trigyna	M	M	P	P		kokihi/climbing native spinach. M: ***lc***, open sites. P: ***s***, clifftop. AK 290673

Plants groups	M 1989	M 2004-08	P 1989	P 2006	Pi 2006	Comments from 2004-08 observations (unless otherwise stated). Herbarium vouchers (AK)
Monocots (except Sedges & Grasses) (8 + 0)						
Arthropodium cirratum	M	M	P	P		rengarenga. ***c***, open and semi-open rocky sites. AK 290774
Astelia banksii	M	M	P	P		kōwharawhara. ***c***, open and semi-open rocky sites
Astelia hastata		M				kahakaha. single large terrestrial clump, upper rocky bluffs, S-facing
Dianella nigra		M				tūrutu. ***o***, semi-open rocky sites; AK 290703-04
Earina mucronata		M				peka-a-waka. 3 large terrestrial clumps on rocky bluffs, S side of western highpoint; stems to 70 cm long. AK 290771
Phormium tenax	M	M	P	P		harakeke/NZ flax. ***o***, open rocky sites and understorey where light is high
Rhopalostylis sapida		M				nikau. 3 trunkless plants, largest with leaves to 1.5 m long, S forest
Thelymitra longifolia		M				māikuku/white sun orchid. ***l***, semi-open sites, summit ridge. AK 289510
Monocots: Sedges (7 + 0)						
Carex flagellifera	M	M	P	P		mānaia/Glen Murray tussock. M: ***l***, S and W coast. P: ***o***, forest margin. AK 290761
Carex testacea		M		P		speckled sedge. M: ***l***, upper forest slope, S-side. P: ***lc***, plateau forest margins. AK 290825 & 295196
Cyperus insularis At-risk - Declining	?M	M	?P			island cutty grass. 2 patches, open sites at E end. AK 290648.
Cyperus insularis × *C. ustulatus*		M				***l***, NW end, rockslide site. "Has the right head shape for *C. insularis*, but the large dark blotch of *C. ustulatus*" PJ de Lange (pers. comm. 2006). AK 295176
Ficinia nodosa	M	M	P	P	Pi	wīwī/knobby clubrush. ***lc***, open sites, coast and upper rocky sites
Gahnia lacera		M				tarangārara/bamboo sedge. 2 clumps, both in upper S-facing shrubby slopes near summit ridge. AK 290756
Isolepis cernua		M	P	P	Pi	slender clubrush. ***l***, E end, especially by rock pools. AK 290715
Monocots: Grasses (8 + 9)						
Aira caryophyllea *		M				silvery hair grass. ***lc***, open summit ridge. AK 290824
Anthosachne kingiana subsp. *multiflora* At-risk – Declining	M	M				blue wheatgrass. ***l***, N-facing slopes, sunny open sites, plants glaucous. AK 290671.
Anthoxanthum odoratum *	M	M	P			sweet vernal. M: ***s***, open rocky site, N side
Avena barbata *		M				slender oat. ***l***, open sites E end

Plants groups	M 1989	M 2004-08	P 1989	P 2006	Pi 2006	Comments from 2004-08 observations (unless otherwise stated). Herbarium vouchers (AK)
Bromus catharticus *		M		P		prairie grass. ***l***, semi-open sites
Dactylis glomerata *	M	M				cocksfoot. ***lc***, sunny, open slopes
Dichelachne crinita	M	M	P	P		long-hair plume grass. ***o***, open sites
*Holcus lanatus**		M				Yorkshire fog. ***s***, open site
Lachnagrostis billardierei		M				sand wind grass. ***o***, open rocky sites
Lachnagrostis littoralis subsp. *littoralis*	?M	M		P	Pi	***l***, S coast, bare rocks, splash zone. P; ***lc***, coastal rocks. AK 290767
Lolium arundinaceum *		M				tall fescue. ***l***, open and semi-open rocky slopes
Oplismenus hirtellus	M	M	P	P		panic grass. ***o***, shaded sites. AK 295195
Poa anceps	M	M	P	P		broad-leaved poa. ***c***, sward-forming in open sites, plants glaucous. AK 290655
Rytidosperma biannulare	M	M				danthonia. ***c–la***, open sites. Recorded in 1989 as *Rytidosperma* sp. AK 290658
Rytidosperma unarede		M	P	P		danthonia. M: ***o***, open sites. P: ***lc*** clifftops. Recorded in 1989 as *Rytidosperma* sp. AK 295197
Sporobolus africanus *		M				ratstail. ***s***, open coastal cliffs at west end of island
Vulpia bromoides *	M	M				vulpia hair grass. ***lc***, open summit ridge and steep coastal slopes

APPENDIX 5: Birds recorded on Motueka and Poikeke Islands and their status if Nationally Threatened or At-Risk

Key: * = naturalised species

Name	Motueka	Poikeke
tītī/sooty shearwater (*Ardenna grisea*) At-risk – Declining	Colour of feathers and recent droppings suggested that some of the burrows were probably this species; x 1 tibiotarsus bone (Mar 1989)	x 1 half-grown chick in burrow; x 3 humeri (Mar 1989)
kuaka/common diving petrel (*Pelecanoides urinatrix*) At-risk – Relict		Humeri and tibiotarsi (Moore 1976); tibiotarsus bone (Mar 1989)
ōi/grey-faced petrels (*Pterodroma gouldi*)	x 2 large broken eggs, 100s of burrows – most were probably this sp. (Mar 1989); burrows locally common, especially NW forest slope, adult in burrow (Apr 2004); rat-chewed egg (Oct 2021)	6 bones + eggshells (Moore 1976); 100s of large burrows, most, probably this sp.; x 4 humeri and 5 other bones (Mar 1989); burrows throughout forest, probably this sp. (Mar 2006)
kororā/blue penguin (*Eudyptula minor*) At-risk – Declining	Burrow, 20 m ASL, NW side (Feb 2008)	

Name	Motueka	Poikeke
tākapu /Australasian gannet (*Morus serrator*)	x 1 just offshore (Mar 1989)	
kāruhiruhi/pied shags (*Phalacrocorax varius*)	x 1 on coastal rock, E end (Mar 2004); x 6 on intertidal rocks between Poikeke (Feb 2008)	x 10 on rocky outcrop (Mar 1989); c.12 in a roost pōhutukawa tree on W cliff, by a sea tunnel, Fig. 19 (Mar 2006 and Feb 2008)
kawau paka/little shag (*Phalacrocorax melanoleucos*)		x 1 on adjacent rock outcrop (Mar 1989)
kawau tikitiki/spotted shag (*Stictocarbo punctatus*) Nationally Vulnerable		Probable juv. humerus (Moore 1976)
kāhu/swamp harrier (*Circus approximans*)	Overhead, NW coast (Feb 2008)	
karoro/black-backed gull (*Larus dominicanus*)	x 1 flying (Mar 1989); x 1 coastal rocks (Mar 2005)	x 1 shoreline (Mar1989); pair on N ridge; x 2 old nests on islet on E side of Poikeke, presumed to be this sp. (Mar 2006)
tarāpunga/red-billed gull (*Larus novaehollandiae*) At-risk – Declining	x 1 (Mar 1989)	x 1 (Mar 2006)
taranui/Caspian tern (*Hydroprogne caspia*) Nationally Vulnerable	x 1 flying offshore (Mar 1989)	x 1 shoreline (Mar 1989)
tara/white-fronted tern (*Sterna striata*) At-risk – Declining	Flying close to island (Mar 2005)	fishing close by in small groups and roosting on Poikeke (Mar 2006)
kererū/native pigeon (*Hemiphaga novaeseelandiae*)	x 1 S forest (Apr 2004); x 2 S forest, feeding on kawakawa and karaka fruit (Mar 2005)	Femur (Mar 1989)
kōtare/sacred kingfisher (*Todiramphus sanctus*)	x 1 (Mar 1989)	
warou/welcome swallow (*Hirundo neoxena*)	x 1 (Mar 1989); present (Apr 2004)	x 1 (Mar 1989)
tauhou/silvereye (*Zosterops lateralis*)	Present (Mar 1989, Apr 2004, Mar 2005)	x 2 (Mar 1989)
riroriro/grey warbler (*Gerygone igata*)	Few (Mar 1989); present (Apr 2004, Feb 2008)	x 2 (Mar 1989); present (Mar 2006)
blackbird (*Turdus merula*) *	x 2 heard (Mar 1989); present (Apr 2004)	
pīwakawaka/fantail (*Rhipidura fuliginosa*)	Present (Apr 2004)	
tūī (*Prosthemadera novaeseelandiae*)	Present (Apr 2004, Mar 2006)	
house sparrow (*Passer domesticus*) *	Heard (?) (Mar 1989)	
chaffinch (*Fringilla coelebs*) *	Heard (?) (Mar 1989)	
starling (*Sturnus vulgaris*) *	Heard (Mar 1989)	