FLORA AND FAUNA OF MOTUKOKAKO (PIERCY ISLAND), CAPE BRETT, NORTHERN NEW ZEALAND

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SUMMARY

Motukokako lacks recent modification and is rat-free. Although small, in terms of conservation it is probably the most important island in the Bay of Islands. It contains a small forest which is dominated by tawapou (*Planchonella costata*). Ninety-nine vascular plant species and five lower plants are recorded in an annotated species list and the flora is compared with two forest areas close by. The island's vegetation and conservation values are discussed. Two petrels (*Pterodroma macroptera* and *P. nigripennis*), two lizards (*Leiolopisma smithi* and *Hoplodactylus pacificus*) and a medium-sized land snail (*Rhytida dunniae*) were also recorded.

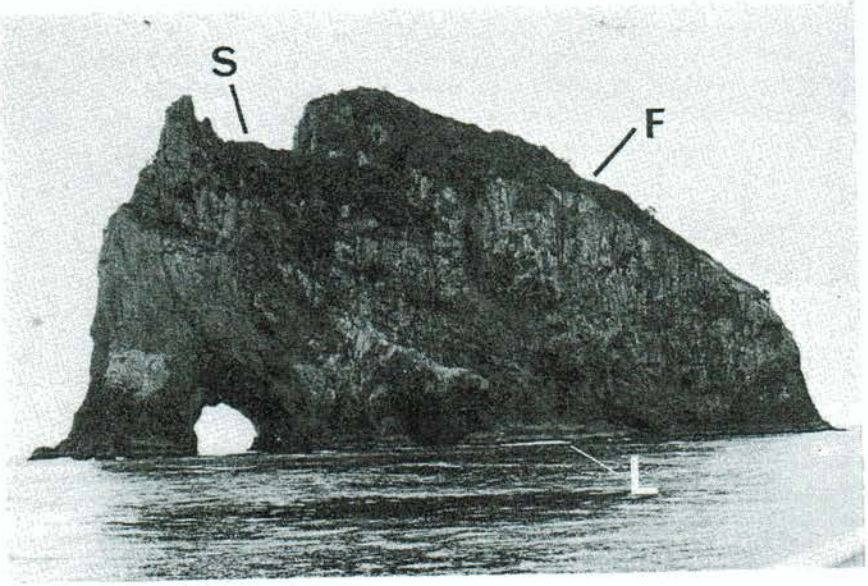

Fig. 1 Eastern side of Motukokako; S = Saddle Ridge, F = northern forest, L = Landing Ledge (informal names). November 1983.

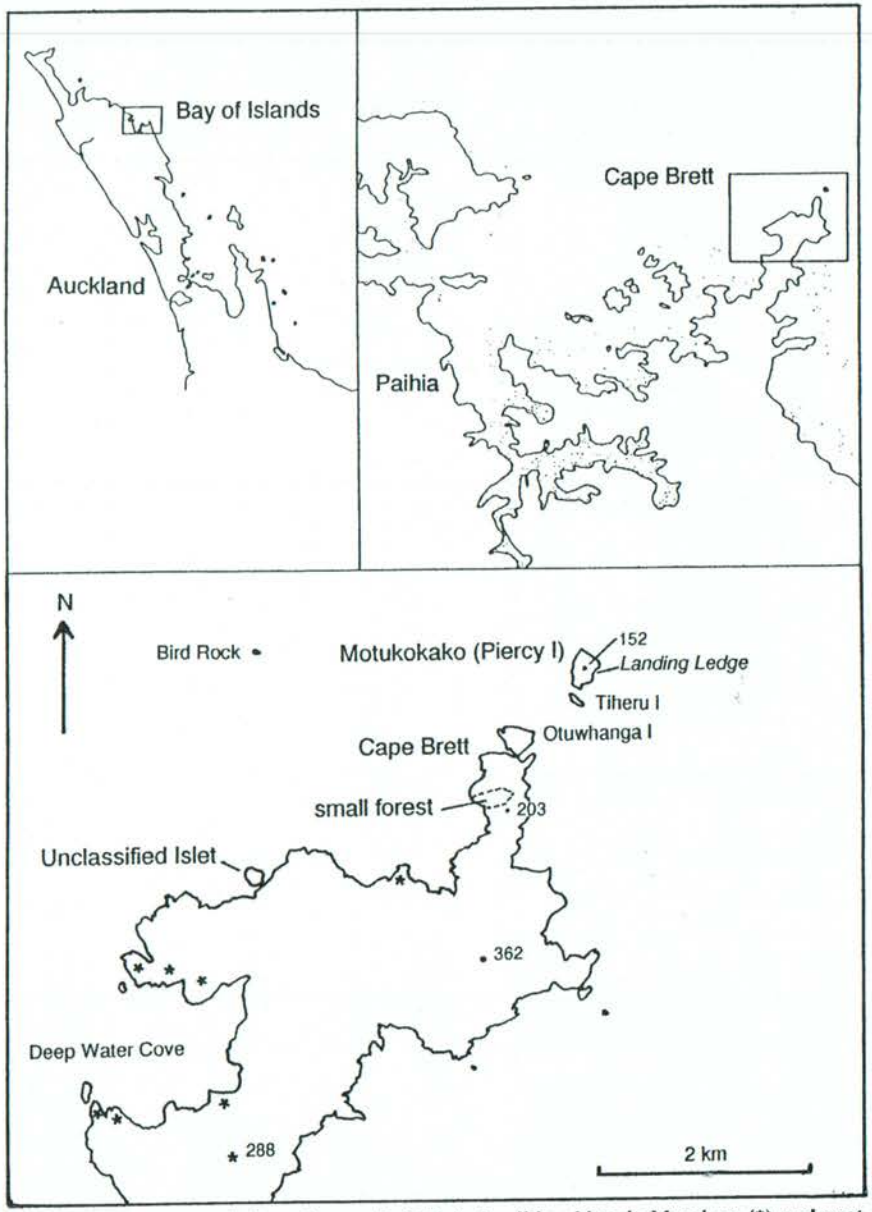

Fig. 2 **Place names (informal name in italics), localities, historic Maori pa (*) and spot heights (m) for Motukokako and the adjacent Cape Brett Peninsula. Insets show location with respect to northern New Zealand.**

INTRODUCTION

Motukokako (Piercy, or "Hole in the rock" Island) is a well known New Zealand tourist attraction (Fig. 1). The island lies 850m north-east off Cape Brett, Bay of Islands, north-east New Zealand (Lat. 35° 10'S, Long. 174° 20'E), grid reference 260 Q05 329697, highest point 152m ASL (Fig. 2). Motukokako is 6.9 ha in size and measures approximately 400 x 200m. The tribe which has the mana whenua over this motu is Ngai Tawake ki te moana or Patu Keha (P.P. Ahitapu pers. comm., 1991). It is administered by the Motukokako Trust.

The island is composed of Waipapa greywacke and argillite of Permian-Jurassic age, unconformably overlain by (?)Oligocene Whangarei Limestone and cut by series of quartz veins (Braithwaite *et al.* 1990); also at the northern end of Motukokako, the limestone is altered to Zn-Pb mineralised calc-silicate skarns.

Rather bare cliffs encircle the lower 50-100m of the island, but much of the upper slopes are more gentle and well forested. The extreme, exposed position of the island has kept the vegetation well moulded to the island's contours. No free or standing water was seen during our visit. Even coastal seepages appeared absent. Motukokako is the largest island in the Bay of Islands which lacks recent disturbance and introduced animals and consequently has outstanding conservation values.

We are unaware of any publications concerning the flora and fauna of Motukokako. In this paper we record what we observed and also compare the flora with part of the adjacent Cape Brett Scenic Reserve and a smaller islet close by.

Although unskilled in recognising archaeological evidence, we did notice a few old marine mollusc shells on the surface (a midden?), under and between loose rocks just north-east of the summit. Mussel and white rock shells were evident. The fortress-like shape of the island would have made a natural island pa.

The origin of the name Motukokako is said to have originated through the practice in ancient times of the chiefs using the feathers of kokako (*Callaeas cinerea*) for their own personal use as a hair adornment (P.P. Ahitapu pers. comm., 1991). Lieutenant, later Captain, James Cook named Cape Brett and Piercy Island in honour of Admiral Sir Peircy Brett, thus creating a pun for the perforated island (Reynolds 1988).

We visited Motukokako on 30 November 1987, accompanied by Robin and Webber Booth, and R. Witehira, a trustee for the island from Rawhiti. We ascended the island from the eastern side using a rope. The rope was useful in terms of safety but it also lessened the damage to the steep areas. Almost 5

hours were spent on the island from 1200-1645 hrs.

VEGETATION

Forest

Although the island is encircled by cliffs there is good forest on the upper northern part of the island. It is on a moderate to steep slope ($\leq 30^{o}$), is roughly 150m long by up to 120m wide, covers 1.3 ha and has a north-east aspect. This forest is 6-8m tall, with about 80% canopy cover and is dominated by tawapou (*Planchonella costata*). On the lower slopes where the soil is deeper, puriri (*Vitex lucens*) is a common associate. Other frequent canopy trees are coastal maire (*Nestegis apetala*) and large-leaved milk tree (*Streblus banksii*). Parapara (*Pisonia brunoniana*), kohekohe (*Dysoxylum spectabile*), karaka (*Corynocarpus laevigatus*) and mapou (*Myrsine australis*) are occasionally present and pohutukawa (*Metrosideros excelsa*) is restricted mainly to the margins. Most forest trees were branched low down; the largest diameter was a puriri at 78cm dbh (diameter at breast height = 1.4m).

The forest shrub layer is generally sparse and is represented by coastal karamu (*Coprosma macrocarpa*), rangiora (*Brachyglottis repanda*), parapara, mahoe (*Melicytus ramiflorus*) and mapou. Under the forest the ground is generally rocky but there are areas of deep soil. Ground cover is also sparse but clumps of *Gahnia lacera* and patches of the creeping fern *Arthropteris tenella* are locally common. Clumps of the sedge *Carex spinirostris*, open patches of the grass *Oplismenus hirtellus* and kohekohe seedlings are all frequent. The following ferns have a scattered distribution on the ground: shining spleenwort (*Asplenium oblongifolium*), hound's tongue (*Phymatosorus diversifolius*) and *Polystichum richardii*. Akakiore (*Parsonsia capsularis*) is a common liane and the smaller liane, *Calystegia tuguriorum* is present. The two main epiphytes are ferns: leather-leaf fern (*Pyrrosia eleagnifolia*) and hound's tongue. Adventive species are absent except in forest openings where sow thistle (*Sonchus oleraceus*), ripgut brome (*Bromus diandrus*) and slender oat (*Avena barbata*) are occasionally present with the native shrub, whau (*Entelea arborescens*).

Forest margins

Forest margins are extremely exposed with prostrate, wind-shorn, woody shrubs amongst herbaceous species and rocky outcrops. The frequent low woody shrubs observed on the northern and eastern clifftops are coastal mahoe (*Melicytus novae-zelandiae*), *Pittosporum umbellatum*, pohutukawa and kowhai (*Sophora microphylla*). Occasional shrubs are ngaio (*Myoporum laetum*) and

titoki (*Alectryon excelsus*). Locally common is wire vine (*Muehlenbeckia complexa*) as hummocks or climbing through shrubs. Common native herbs and grasses in these open areas include; New Zealand harebell (*Wahlenbergia gracilis*), coastal snow tussock (*Chionochloa bromoides*), *Tetragonia trigyna*, small-flowered nightshade (*Solanum americanum*) and *Astelia banksii*. Common herbaceous weeds include allseed (*Polycarpon tetraphyllum*), slender oat, ripgut brome and vulpia hair grass (*Vulpia bromoides*). Occasional native herbs include rengarenga (*Arthropodium cirratum*), cloak fern (*Cheilanthes sieberi*), kahakaha (*Collospermum hastatum*), danthonia (*Rytidosperma unarede*) and shore groundsel (*Senecio lautus*). Occasional herbaceous weeds include sow thistle and broad-leaved fleabane (*Conyza albida*).

Cliffs

The bare eastern cliffs were the only ones we saw close up. Here on the cliffs and narrow ledges are occasional large clumps of coastal snow tussock, *Astelia banksii* and New Zealand flax (*Phormium tenax*). Some ledges support small woody plants of karo (*Pittosporum crassifolium*), pohutukawa, taupata (*Coprosma repens*) and coastal mahoe. Occasional herbs include New Zealand ice plant (*Disphyma australe*), glasswort (*Sarcocornia quinqueflora*) and ripgut brome. Saxicolous lichens are common. Low down by Landing Ledge, various grasses are present: "Lachnagrostis littoralis", paspalum (*Paspalum dilatatum*), ratstail, long-hair plume grass (*Dichelachne crinita*) and *Lolium rigidum*.

FLORA

The vascular flora of Motukokako numbers 99 taxa (Table 1) of which 82% are native. All the introduced species are herbaceous and are a very minor part of the vegetation. No aggressive weed species are present. The eight adventive monocotyledons are all grasses.

As expected the flora contains good numbers of woody species typical of northern New Zealand offshore islands: tawapou, coastal maire, coastal mahoe, parapara, tawaroa (*Beilschmiedia tawaroa*) and large-leaved milk tree. The first four are also native to the more tropical Norfolk Island (only at species level for coastal mahoe) and parapara extends further to New South Wales, Kermadecs and then a large gap until to Hawaii (Sykes 1987). The shrub-like herb, koru (*Pratia physaloides*), is a northern North Island threatened endemic species of "vulnerable" status (Wilson and Given 1989). Another large threatened endemic herb is *Rorippa divaricata* which has its stronghold on the northern New Zealand offshore islands and a status of "rare" (Given *et al.* 1987). The third threatened native species also of "rare" status is parapara (Given *et al.* 1987),

a small tree which in New Zealand has its stronghold on the northern New Zealand offshore islands. The large hanging grass, coastal snow tussock, is a showy endemic of many northern North Island coastal cliffs and offshore islands.

The small moss, *Macromitrium brevicaule* and the orange fruticose lichen, *Teloschistes flavicans* are tropical elements in the New Zealand lower plant flora. The moss is only known in New Zealand from the north-east coast and offshore islands of the northern North Island (J.E. Beever pers. comm., 1991). *T. flavicans* reaches as far south as Nelson but is unknown in the North Island south of Auckland (Galloway 1985).

An annotated species list is presented below which includes all the vascular plant taxa seen, four bryophytes and one lichen (these last two groups were not searched for). Abundance is generally noted by a five-tiered scale for each taxon: common, frequent, occasional, local and rare. Where a voucher exists to support the record, the herbarium sheet is listed. Voucher specimens are lodged in the Botany Department herbarium, University of Auckland (AKU). An asterisk (*) denotes an adventive species.

Nomenclature of the ferns generally follows Brownsey *et al.* (1985), and of the angiosperms Allan (1961), Moore and Edgar (1970), Webb *et al.* (1988), Connor and Edgar (1987) for native grasses and Healy (1984) for exotic grasses. Many nomenclature changes relating to native angiosperms reviewed by Connor and Edgar (1987) are followed.

FERNS

Arthropteris tenella — Locally abundant forming patches under forest, occasionally climbing trees.

Asplenium haurakiense — Occasional, open and shaded sites.

A. oblongifolium — shining spleenwort Frequent in forest and rarely epiphytic.

Cheilanthes sieberi — cloak fern Occasional, open northern ledges.

Doodia media subsp. *australis* — Single colony, northern forest margins.

Phymatosorus diversifolius — hound's tongue Locally frequent, terrestrial and epiphytic in forest.

Polystichum richardii — Frequent throughout in shaded sites.

Pteris comans — Local, upper eastern forest slope.

Pyrrosia eleagnifolia — leather-leaf fern Frequent, mainly epiphytic in forest.

DICOTYLEDONS

Alectryon excelsus — titoki Frequent as seedlings in forest and occasional as small trees up to 5m tall. Some leaflets quite large with lamina up to 11 x 4cm and as few as 4 pairs of leaflets per leaf. AKU 20472.

Anagallis arvensis var. *arvensis** — scarlet pimpernel Local, Landing Ledge.

Beilschmiedia tarairi — taraire Single tree *c.*4m tall x *c.*3m wide, mid eastern slope.

B. tawaroa — tawaroa Single tree *c.*9m tall, 43.5cm diameter at 20cm, upper eastern slope.

Brachyglottis repanda — rangiora Occasional forest shrub.

Calystegia tuguriorum — Frequent as small liane in forest.

Carmichaelia aligera — N.Z. broom Common as seedlings under forest and frequent as forest margin shrubs.

*Centaurium erythraea** — centaury Local, Landing Ledge.

*Cirsium vulgare** — Scotch thistle Rare, forest margin.

*Conyza albida** — broad-leaved fleabane Occasional, coastal ledges.

Coprosma macrocarpa — coastal karamu Frequent as small and tall shrubs in forest and forest margins.

C. repens — taupata Occasional, cliffs and forest margins.

Corynocarpus laevigatus — karaka Frequent as seedlings to small trees in forest.

Crassula sieberiana — Occasional on exposed coastal rock.

Dichondra repens — Locally common in the open and in forest.

Disphyma australe — N.Z. ice plant Occasional in the open, mainly on cliffs.

Dysoxylum spectabile — kohekohe Locally common as seedlings/saplings (*c.*1m tall) to trees, largest in a chasm, north side of saddle *c.*7m tall and 31.2cm diameter at 1m.

Einadia trigonos subsp. *trigonos* — Local, coastal ledges. AKU 20474.

Entelea arborescens — whau Occasional as shrubs in forest gaps.

Gnaphalium gymnocephalum — Local, high coastal ledges.

Haloragis erecta — shrubby haloragis Occasional, open places.

Hoheria populnea — houhere Rare, small trees in forest.

Hydrocotyle elongata — Locally common, forming patches in shaded sites. Mainly steep shrubby areas. Leaves unusually large for the species, with petioles up to 11cm and lamina to 44mm diameter. Peduncles up to 15cm. AKU 20470.

*Hypochoeris radicata** — catsear Occasional, open coastal sites.

Lobelia anceps — shore lobelia Occasional, coastal crevices.

Melicope ternata — wharangi Rare, tall shrubs, Saddle Ridge.

Melicytus novae-zelandiae subsp. *novae-zelandiae* — coastal mahoe Common as shrubs in exposed sites.

M. ramiflorus subsp. *ramiflorus* — mahoe Frequent as seedlings and occasional as shrubs in forest areas; no trees seen.

Metrosideros excelsa — pohutukawa Frequent as shrubs up to the tallest trees on the island at *c.*12m tall, in exposed sites.

Muehlenbeckia complexa — wire vine Locally common on cliffs, forming small hummocks on open ledges and climbing through shrubs on forest margins.

Myoporum laetum var. *laetum* — ngaio Occasional shrubs, forest margins.

Myrsine australis — mapou Locally frequent as understory shrubs and small trees in main forest area.

Nestegis apetala — coastal maire Frequent as canopy trees. Largest *c.*6m tall with 25.7cm diameter at 1m, on northern side of Saddle Ridge.

Oxalis exilis	Rare, in forest. AKU 20471.
Parietaria debilis	Occasional, open coastal slopes.
Parsonsia capsularis	akakiore Common liane in forest and shrubby slopes, flowers orange.
Peperomia urvilleana	Occasional, on rock outcrops in the open and in scrub and forest.
Pisonia brunoniana	parapara Frequent in forest and shrubby areas mainly as seedlings or shrubs; occasional as canopy trees.
Pittosporum crassifolium	karo Frequent on cliff ledges and forest margins.
P. umbellatum	Common shrub on forest margins.
Planchonella costata	tawapou Commonest tree on the island; the largest was on the eastern side of the north facing slope and was *c*.9m tall and 34.6cm dbh.
*Polycarpon tetraphyllum**	allseed Common on open coastal ledges.
Pratia physaloides	koru Two small patches near summit in rocky forested site.
Pseudognaphalium luteoalbum	Jersey cudweed Occasional, open coastal ledges.
Pseudopanax lessonii	houpara Frequent shrub on forest margin.
Rhabdothamnus solandri	taurepo Several shrubs near summit, in rocky forested site, all with pale yellow flowers.
Rorippa divaricata	Occasional in open forest and shrub areas. AKU 20544.
Samolus repens	Occasional, coastal rocks.
Sarcocornia quinqueflora subsp. *quinqueflora*	glasswort Occasional, coastal rocks and cliffs.
Senecio lautus subsp. *lautus*	shore groundsel Occasional, open coastal sites.
*Silene gallica**	catchfly Occasional, open coastal sites.
Solanum americanum	small-flowered nightshade Frequent, open sites.
*Sonchus asper**	prickly sow thistle Single plant on ledge, bush margin.
*S. oleraceus**	sow thistle Occasional, open sites.
Sophora microphylla	kowhai Local, low spreading plants on forest margin.
Streblus banksii	large-leaved milk tree Frequent as canopy trees. Largest *c*.7m tall, 26.0cm dbh, on northern side of Saddle Ridge.
Tetragonia trigyna	Frequent, coastal slopes.
*Trifolium dubium**	suckling clover Local, Landing Ledge. AKU 20469.
Vitex lucens	puriri Frequent, many quite sizeable in the northern slope forest. The largest was *c*.9m tall and 78.0cm dbh.
Wahlenbergia gracilis	N.Z. harebell Locally common, open sites, flowers white. AKU 20466.

MONOCOTYLEDONS

Arthropodium cirratum	rengarenga Occasional on cliffs and under forest.
Astelia banksii	Frequent as large tussocks on coastal ledges, locally common in forest and occasional as epiphytes.
*Avena barbata**	slender oat Common, open sites.
*Briza minor**	shivery grass Local, coastal ledges.
*Bromus diandrus**	ripgut brome Common, open sites.
Carex spinirostris	Common, in forest.
C. testacea	Occasional, forest margins.

Chionochloa bromoides	coastal snow tussock Common, coastal cliffs.
Collospermum hastatum	kahakaha Occasional, forest and open ridges.
Cordyline australis	cabbage tree Three seen, up to 5m tall, in forest.
Cyperus ustulatus	Occasional, coastal ledges.
Deyeuxia billardierei	sand wind grass Occasional, open sites and forest margin.
Dianella nigra	turutu Local, in forest.
Dichelachne crinita	long-hair plume grass Local, coastal ledges.
Gahnia lacera	Locally common in forest.
Isolepis cernua	Local, Landing Ledge.
I. nodosa	Local, Landing Ledge.
Lachnagrostis filiformis s.s.	N.Z. wind grass Local, coastal ledges. AKU 20465.
"L. littoralis"	Occasional, bare coastal rocks. AKU 20467.
*Lolium rigidum**	Local, Landing Ledge. AKU 20476.
Microlaena polynoda	Locally common, on steep bushy slopes. AKU 20475.
Oplismenus hirtellus subsp. *imbecillis*	Common in forest.
*Paspalum dilatatum**	paspalum Local, Landing Ledge.
*P. vaginatum**	saltwater paspalum Local, Landing Ledge.
Phormium tenax	N.Z. flax Frequent, coastal cliffs.
Poa anceps subsp. *anceps*	Occasional, steep bushy slopes.
Rhopalostylis sapida	nikau Locally abundant on mid-eastern slope, stems up to 3m to the narrow leaf bowl. Stemless plants locally common over a much larger area.
Rytidosperma unarede	danthonia Occasional, coastal ledges. AKU 20473.
*Sporobolus africanus**	ratstail Local, Landing Ledge.
*Vulpia bromoides**	vulpia hair grass Locally common, coastal ledges. AKU 20468.

BRYOPHYTES

Frullania sp.	On puriri bark in forest. AKU 71447.
F. falciloba	On open rocky ledges. AKU 71450.
Macromitrium brevicaule	On coastal rocks and puriri bark. AKU 71448 and 71451.
Porella elegantula	On roots and rocks in forest. AKU 71449.

LICHENS

Teloschistes flavicans	Locally common on small exposed rocky outcrop, east facing, by Saddle Ridge amongst other lichen species, leather-leaf fern, *Asplenium haurakiense* and *Peperomia urvilleana*. AKU 81589.

Table 1. Vascular flora of Motukokako.

Plant group	Indigenous	Adventive	Totals
Ferns	9	-	9
Dicotyledons	50	10	60
Monocotyledons	22	8	30
TOTALS	81	18	99

Seabirds

Grey-faced petrel (*Pterodroma macroptera*); about 12 medium to large burrows were checked during the visit. These all contained nearly fully grown chicks (down still present on body) that would be ready to fledge within 1-3 weeks. Burrows were sparsely distributed over the island with small concentrations of 10-30 burrows on steep slopes above the cliffs and on spurs, and in pockets of deep soil under fairly tall coastal forest on the moderate to steep north-east face. However, there were large areas with no burrows present.

We consider that we surveyed about 50% of the potential burrow areas on the island. Only 100-120 burrows were counted during this survey. Overall, we estimated that there were fewer than 500 burrows present on Motukokako and a probable breeding population of about 200-300 pairs of grey-faced petrels.

According to the island Trustees, muttonbirding continued on Motukokako until about 1970. The grey-faced petrel population observed during our visit was small compared with colonies on other northern offshore islands. Nevertheless, it is probably one of the larger populations remaining in the Bay of Islands.

Black-winged petrel *(P. nigripennis)*; locating a previously unknown colony of this mainly tropical species was the major find of the trip. Eight small-medium size burrows were found in a group on the summit plateau, *c.*10m from the cliff-top and under 4-5m tall coastal forest. The burrows were in well drained fibrous soil amongst numerous tree roots and rocky ground. All burrows were fairly shallow (15-30cm below the surface) and most had short (30-40cm) tunnels often ending in rocks. Some of these burrows may have been abandoned as the ground was very rocky. Three of the burrows had fresh soil and excreta at the entrance indicating recent activity. Only one burrow (1.2m long and straight) was occupied. This contained a pair of adult black-winged petrels (Fig. 3). The bill of one bird measured 24x10mm (length x width). Soon after putting these birds back in the burrow, one was seen walking across the ground to a sea cliff where it climbed onto a rock outcrop then flew off eastwards, soaring high.

These petrels appear to be new colonists on the island judging by the size and location of the colony; no other petrel burrows were located on the summit plateau. Other new colonies of this predominately subtropical petrel have established on islands around northern New Zealand in recent years in what appears to be a southward expansion of the species range. The nearest known breeding grounds of these small birds are on Simmonds Islands off Houhora, Motuopao Island off Cape Maria van Dieman and the Three Kings Islands (Tennyson 1991). However, during Easter 1983, P.J. Bellingham (pers. comm., 1990) saw at least 50 and possibly 100 black-winged petrels prospecting Otuwhanga Island off the end of Cape Brett.

Other burrowing petrels; a few dark grey petrel feathers were scattered through flax, coastal snow tussock and coastal herbs on the lower slopes above the landing. There were several tunnel-like runs through this vegetation but no burrows were present as soil was lacking. One desiccated downy petrel chick was found under the vegetation. It seemed to be too large for a diving petrel (*Pelecanoides urinatrix*) and could have been a 2-3 week old grey-faced petrel chick that had fallen from the slope above. The identity of the feathers was not determined but they could have come from diving petrels, black-winged petrels or perhaps fluttering shearwaters (*Puffinus gavia*). No small petrel burrows were observed on Motukokako.

At sea, about 300m off the island, was a huge mixed flock of seabirds. These included 3000-5000 fairy prions (*Pachyptila turtur*), hundreds of red-billed gulls (*Larus novaehollandiae*) and white-fronted terns (*Sterna striata*), several hundred fluttering shearwaters, up to 50 gannets (*Morus serrator*), 25-50 Buller's shearwaters (*Puffinus bulleri*) and sooty shearwaters (*P. griseus*), *c.*20 flesh-footed shearwaters (*P. carneipes*) and one diving petrel. The seabirds were feeding over a huge school of trevally (*Pseudocaranx dentex*) and kingfish (*Seriola lalandi*).

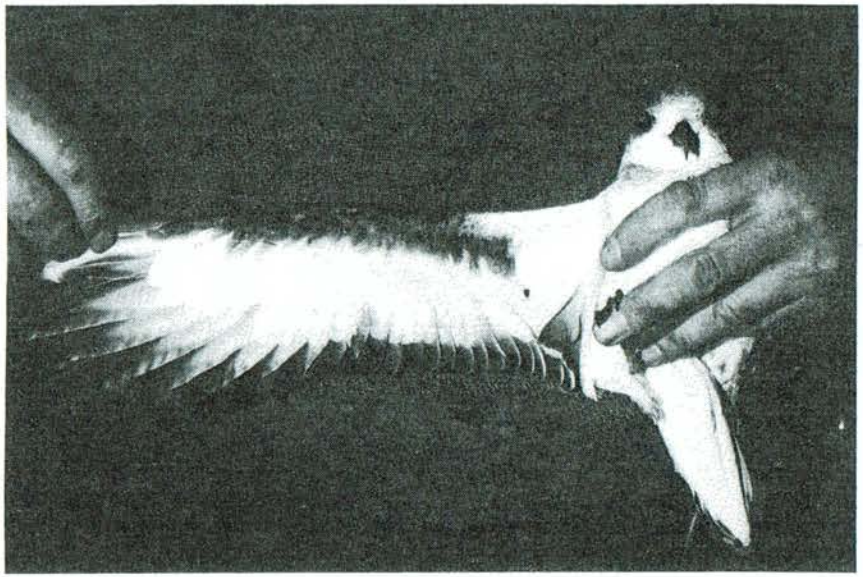

Fig. 3 **Black-winged petrel (*Pterodroma nigripennis*), Motukokako. November 1987.**

Landbirds

New Zealand pigeon (*Hemiphaga novaeseelandiae*); one seen.

Red-crowned parakeet (*Cyanoramphus novaezelandiae*); one or two seen.

Welcome swallow (*Hirundo neoxena*); one or two seen.

Hedge sparrow (*Prunella modularis*); one or two seen.

Grey warbler (*Gerygone igata*); several heard.

Fantail (*Rhipidura fuliginosa*); one seen.

Blackbird (*Turdus merula*); one seen.

Silvereye (*Zosterops lateralis*); one or two seen.

Starling (*Sturnus vulgaris*); several seen.

Myna (*Acridotheres tristis*); one or two seen.

Reptiles

Two species of lizard were seen during our visit. One skink (brown, pointed nose and no medium stripe) was found under a rock and was identified as a common skink (*Leiolopisma smithi*). Several other skinks were found under dead nikau fronds. About 10 common geckos (*Hoplodactylus pacificus*) were found under litter or hiding inside petrel burrows on the summit. The geckos were dark grey/brown in appearance with a faint pattern on the dorsum, had long toes and the nostril was connected to the rostrum.

The island looks suitable as habitat for several other species of lizards but these would need to be looked for at night or caught in pit-fall traps. In particular, *Cyclodina allani* or *C. magregori* potentially could be present. The Maori Trustee mentioned to us that he had heard that one group of muttonbirders had pulled out of a burrow what they thought was a tuatara (*Sphenodon punctatus*). The reptile may have been this species or could have been a large *Hoplodactylus duvauceli* which can appear like a small tuatara. A night visit is needed to adequately survey the reptiles on this island.

Invertebrates

Small beetles were common under rocks. These included species in the families Tenebrionidae (*Mimopaeus* and an unidentified smaller species), and Carabidae. Several large centipedes (*Cormocephalus rubriceps*) were found under rotting logs near the summit. A medium sized native snail species was common in the deep litter of the coastal forest. This was identified by F.J. Brook (pers. comm., 1988) as an undescribed subspecies or race of *Rhytida dunniae*.

Introduced mammals

We found no evidence that rodents, possums (*Trichosurus vulpecula*) or other introduced pests were present on the island. The abundance of lizards, invertebrates and several native trees seldom common where rats (*Rattus* spp.) are present, e.g. large-leaved milk-tree, karo, provides further support for this observation.

DISCUSSION

Flora

The orange flowers of the akakiore are the same colour as those on northern Great Barrier Island (cf. Wright and Cameron 1985) and similar to the yellow-orange akakiore flowers on Fanal Island, Mokohinau Islands (AKU 16122). Flower colour for this species varies from white (usual colour) to yellow to rose to dark red (Allan 1961). We wonder how widespread this orange flower colour is?

The large leaflets of the titoki on Motukokako make an interesting comparison with the Three Kings titoki (*Alectryon excelsus* var. *grandis*), accepted by many botanists as a separate species, *A. grandis*. Allan (1961) records the leaflet lamina of *A. excelsus* as 5-10 x 2-5cm in 4-6 pairs; and *A. grandis* as 10-18 x 5-9cm in 2-3 pairs. A cultivated 2.5m tall Three Kings titoki in the Auckland University grounds has leaves with as few as (1)-2 pairs of leaflets and individual laminas up to 15.7 x 6.8cm. But the same plant has many leaves with 4 pairs of leaflets with their largest leaflets only 10.5 x 4.4cm (a size similar to the large leaflets on the Motukokako titoki). The titoki on the Poor Knights Islands is considered by some botanists to be the same as the Three Kings titoki (Beever 1983). A full morphological comparison is required to learn the appropriate status for titoki from Three Kings, Poor Knights and other northern offshore islands.

Comparison of Motukokako flora

It is interesting to compare the vascular flora of Motukokako with two smaller adjacent forest areas (Appendix 1). These include an unclassified islet less than 2.5km south-west of Cape Brett and a small forest area of Cape Brett Scenic Reserve which includes the coastal area by Cape Brett itself (Fig. 2). Both areas were surveyed by one of us (EKC) in June 1980 and a vascular plant list for the unclassified islet was published (Cameron 1982). Kohekohe was wrongly omitted from the unclassified islet species list but it was commented on next to the karaka entry by mistake (cf. Cameron 1982). Karaka was common in the shrub canopy on the south-western side of the islet. The taxonomy of the 1982 list has been brought up to date in Appendix 1. The *Rhagodia triandra* record is presumed to be *Einadia trigonos*.

The three areas vary in size from Motukokako (6.9 ha), Cape Brett forest (almost 4 ha), to unclassified islet (2.1 ha). Cape Brett forest was on a 25° slope with a south-west aspect. The continuous forest canopy was 6-8m tall and mainly consisting of coastal maire, kohekohe and tawaroa. It was heavily eaten out by feral goats (*Capra hircus*) in 1980.

The unclassified islet was crowned with forest 5-6m tall with coastal maire, kohekohe, mapou and tawaroa all common. Pohutukawa and kanuka (*Kunzea ericoides*) were emergent to 12m tall. The presence of tall kanuka indicates disturbance, probably early this century. Possums and rats were thought to be present (Cameron 1982).

The three areas have a total of 130 species and one hybrid. They have 34 species in common; 26 species only in Cape Brett forest, 23 species only on Motukokako; 13 only on the unclassified islet; 14 common to Motukokako and unclassified islet, 12 common to Motukokako and Cape Brett forest and eight common to Cape Brett forest and the unclassified islet. The absence of large-leaved milk tree and karo from Cape Brett forest and the absence of large-leaved milk tree from the unclassified islet is possibly related to rat predation on the seed of these species (cf. Atkinson 1972, 1986).

Many vascular plant species present in the forest flora of Cape Brett and/or the unclassified islet are rather surprising absentees from Motukokako, e.g. *Adiantum hispidulum*, *Pteris tremula*, koromiko (*Hebe stricta*) and akepiro (*Olearia furfuracea*) which all grow in rather open sites. The absence of the more shade tolerant shrubs like *Coprosma rhamnoides*, hangehange (*Geniostoma rupestre*) and kawakawa (*Macropiper excelsum*) may be related to past forest disturbances and they have yet to return. If the island has suffered a major disturbance then the absence of species that usually proliferate after fire or disturbance, e.g. bracken (*Pteridium esculentum*), kanuka, manuka (*Leptospermum scoparium*) can possibly be explained by two scenarios: the

island's relative remoteness and that they have failed to establish so far; or they established but were displaced by the rapid succession of canopy species on the island. This latter scenario is unlikely because some should have persisted on the forest margins or cliff ledges.

Forest age

The small diameters of the Motukokako trees (largest 78cm dbh; refer annotated species list), the low branching and their general youthfulness indicate that they are not ancient. Judging from the archaeological evidence, historical Maori use of the Cape Brett Peninsula area was extremely high (see Fig. 2 for location of eight historic Maori pa on the Peninsula). Hayward (1986) claims that the archaeology of many of the small islands close to the coast of northern New Zealand indicates that they were cleared of forest, terraced and used as small defended pa. Also, that the more distant small islands have evidence of temporary visits by pre-historic mutton-birding or fishing parties and most appear to have had their forest fired. It is very likely that steep-sided Motukokako would have been used for such activities by local Maori and its vegetation may have been fired. However, we found no obvious evidence of charcoal (though it was not searched for).

No large trees were seen, even as decaying trunks on the ground. The youthful looking trees probably indicate a massive disturbance to the island's vegetation, perhaps mid to late last century. It would be useful to core some trees for actual ages and search fully for charcoal to aid this dating. (The age of the oldest trees does not necessarily indicate the age of forest establishment, but the overall apparent youth of the forest supports the view that this is the case). Although a forest on such an exposed island would be susceptible to storm damage, it is unlikely that a storm would flatten and kill every tree on the island at any one time. Therefore it appears that Motukokako was clear of forest last century either by fire(s), or (maintained) Maori clearing. The paucity of breeding petrels on such a suitable island supports this theory.

The local presence of *Astelia banksii* and flax under a canopy of pohutukawa, kohekohe, and karaka on the mid-east forest slope supports the youthfulness of the forest. With time these *Astelia banksii* and flax will be shaded out. Also some species appear to have established recently on Motukokako, e.g. there are few adults and numerous seedlings of nikau (*Rhopalostylis sapida*), titoki and mahoe.

Fauna

The poor diversity of breeding petrels on this rodent-free island was rather

unexpected. Similar inaccessible rodent-free sites usually have large breeding concentrations of fluttering shearwaters and diving petrels and often one or more species of large shearwater. It seems unlikely that intensive muttonbirding could have caused the local extinction of these species as the more favoured grey-faced petrel is still present in reasonable numbers. The absence of these species may be related to a past disturbance where the habitat of the island was unsuited to these species. Some northern offshore islands, e.g. Middle Island in Mercury group, have retained large breeding populations of petrels even though they were formerly heavily modified (Cameron 1990, pers. obs.). On Middle Island, the steep slopes are covered with taupata shrubs and these sites may have supported a remnant population of seabirds and reptiles. However, on Motukokako, the cliffs which surround the summit would have provided few refuges for any breeding petrels or reptiles once the summit vegetation was lost or heavily modified.

A careful survey to establish the status of reptiles on the island may help reveal the past vegetation cover on this island. Forest dwelling species, e.g. *Cyclodina* skinks would not have survived a period of severe deforestation. Currently conditions on the island appear suitable for some of these species but if the forest was absent last century, the ground may have lacked sufficient damp soil and cover to support these species.

Birds like blackbird, starling and myna probably nest on the island and may be responsible for introducing the exotic grasses amongst nest material carried from Cape Brett area.

Conservation values

Motukokako has many outstanding conservation values. It is the largest island in the Bay of Islands that lacks recent disturbance and contrasts with the adjacent Cape Brett Peninsula biota which has been highly modified by goats, possums, rodents and mustelids (*Mustela* spp.). No introduced animals appeared to be present. Three threatened species of native vascular plants are present on Motukokako and the island supports a unique forest type (tawapou dominant forest). Motukokako has the characteristic tropical element present in the flora of many northern New Zealand offshore islands. This includes many plant species with a restricted northern New Zealand distribution. The island's vegetation provides a valuable insight from which we can interpret the more modified vegetation of other islands and coastal areas of the Bay of Islands. Motukokako also lacks any problem weed species that could have a high impact on the native vegetation. Two species of petrel breed there, at least two lizards are present and a medium-sized land snail is common. The small colony of black-winged petrels appears to be newly established.

We recommend that no plant or animal species be introduced to Motukokako as it is one of the few islands in the Bay of Islands remaining in a natural state. The fortress-like cliffs and exposed location protect the island from most inquisitive humans. However, we recommend that visits to the top of the island be kept to a minimum (as they currently are) as the soil is fragile and increased erosion would spoil the scenic appeal of the island and lessen the conservation values.

ACKNOWLEDGEMENTS

We thank the Motukokako Trust for allowing us to visit the island, especially Trust Secretary Peti Pukepuke Ahitapu for providing us with information about the island and Ringa Witehira for accompanying us on the day. The three Booth brothers (Chris, Robin and Webber) organised the trip and Robin and Webber provided transport to the island; Elizabeth Edgar identified the *Lolium*, Fred Brook identified the *Rhytida*, Peter Bellingham for his black-winged petrel observation, Jessica Beever and John Braggins identified the bryophytes and Bill Sykes commented on the draft manuscript; we thank them all.

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APPENDIX 1. Comparison of native vascular flora on Motukokako, Unclassified islet near Cape Brett (Cameron 1982) and part of Cape Brett Scenic Reserve (Cameron 1980, unpublished).

Species	Locality		
	Motukokako	Unnamed stack	Cape Brett SR
FERNS (20)			
Adiantum hispidulum	-	+	+
A. cunninghamii	-	+	-
Arthropteris tenella	+	-	-
Asplenium flaccidum s.s.	-	-	+
A. haurakiense	+	+	-
A. northlandicum	-	-	+
A. oblongifolium	+	+	+
Blechnum sp. 1	-	-	+
Cheilanthes distans	-	+	-
C. sieberi	+	+	-
Cyathea dealbata	-	-	+
C. medullaris	-	-	+
Doodia media	+	+	+
Pellaea rotundifolia	-	+	-
Phymatosorus diversifolius	+	+	-
Polystichum richardii	+	+	+
Pteridium esculentum	-	-	+
Pteris comans	+	-	-
P. tremula	-	-	+
Pyrrosia eleagnifolia	+	+	+
DICOTYLEDONS (81)			
Alectryon excelsus	+	-	-
Apium prostratum	-	-	+

Beilschmiedia tarairi	+	-	+
B. tawaroa	+	+	+
Brachyglottis kirkii s.s.	-	+	-
B. repanda	+	+	+
Callitriche muelleri	-	+	-
Calystegia tuguriorum	+	-	-
Carmichaelia aligera	+	-	+
Clematis cunninghamii	-	+	+
Coprosma arborea	-	+	-
C. lucida	-	-	+
C. macrocarpa	+	+	+
C. repens	+	+	+
C. rhamnoides	-	-	+
Corynocarpus laevigatus	+	+	+
Crassula sieberiana	+	-	-
Cyathodes juniperina	-	+	+
Dichondra repens	+	+	+
Disphyma australe	+	+	+
Dysoxylum spectabile	+	+	+
Einadia trigonos	+	+	-
Entelea arborescens	+	-	-
Geniostoma rupestre	-	+	-
Gnaphalium audax	-	+	-
G. gymnocephalum	+	-	-
Gonocarpus incanus	-	-	+
Griselinia lucida	-	-	+
Haloragis erecta	+	-	+
Hebe stricta	-	-	+
Hebe sp. "m"	-	-	+
Hoheria populnea	+	+	+
Hydrocotyle elongata	+	-	+
Knightia excelsa	-	+	+
Kunzea ericoides	-	+	+
Leptospermum scoparium	-	-	+
Leucopogon fasciculatus	-	-	+
Litsea calicaris	-	-	+
Lobelia anceps	+	+	+
Macropiper excelsum	-	-	+
Melicope ternata	+	-	-
Melicytus novae-zelandiae	+	+	+
M. ramiflorus	+	+	+
Metrosideros excelsa	+	+	+
M. perforata	-	+	-
Muehlenbeckia australis	-	+	-
M. complexa	+	+	+
Myoporum laetum	+	+	-
Myrsine australis	+	+	+
Nestegis apetala	+	+	+

N. lanceolata	-	+	+
Olearia furfuracea	-	+	+
Oxalis exilis	+	-	-
Parietaria debilis	+	-	-
Parsonsia capsularis	+	?	?
Peperomia urvilleana	+	+	+
Pimelea prostrata	-	-	+
Pisonia brunoniana	+	-	-
Pittosporum crassifolium	+	+	-
P. umbellatum	+	+	+
Planchonella costata	+	+	+
Pomaderris phylicifolia	-	-	+
Pratia physaloides	+	-	-
Pseudognaphalium luteoalbum	+	-	-
Pseudopanax arboreus	-	+	+
P. crassifolius x *P. lessonii*	-	+	+
P. lessonii	+	+	-
Ranunculus reflexus	-	-	+
Rhabdothamnus solandri	+	+	+
Rorippa divaricata	+	-	-
Rubus cissoides	-	-	+
Samolus repens	+	+	+
Sarcocornia quinqueflora	+	+	-
Senecio lautus s.s.	+	+	-
Solanum americanum	+	-	-
Sophora microphylla	+	+	+
Spergularia media	-	-	+
Streblus banksii	+	-	-
Tetragonia trigyna	+	+	+
Vitex lucens	+	-	+
Wahlenbergia gracilis	+	-	-

MONOCOTYLEDONS (30)

Acianthus sinclairii	-	+	-
Arthropodium cirratum	+	+	+
Astelia banksii	+	+	-
Carex breviculmis	-	+	-
C. lambertiana	-	+	-
C. spinirostris	+	-	+
C. testacea	+	-	-
Chionochloa bromoides	+	+	-
Collospermum hastatum	+	+	-
Cordyline australis	+	-	+
Cyperus ustulatus	+	-	+
Deyeuxia billardierei	+	-	-
Dianella nigra	+	-	+
Dichelachne crinita	+	+	-
Echinopogon ovatus	-	-	+

Freycinetia baueriana	-	-	+
Gahnia lacera	+	+	+
Isolepis cernua	+	-	+
I. nodosa	+	+	+
Lachnagrostis filiformis s.s.	+	-	-
"L. littoralis"	+	-	-
Leptocarpus similis	-	-	+
Libertia grandiflora/ixioides	-	-	+
Microlaena polynoda	+	-	+
M. stipoides	-	-	+
Oplismenus hirtellus	+	+	+
Phormium tenax	+	+	+
Poa anceps s.s.	+	+	+
Rhopalostylis sapida	+	-	-
Rytidosperma unarede	+	?	-