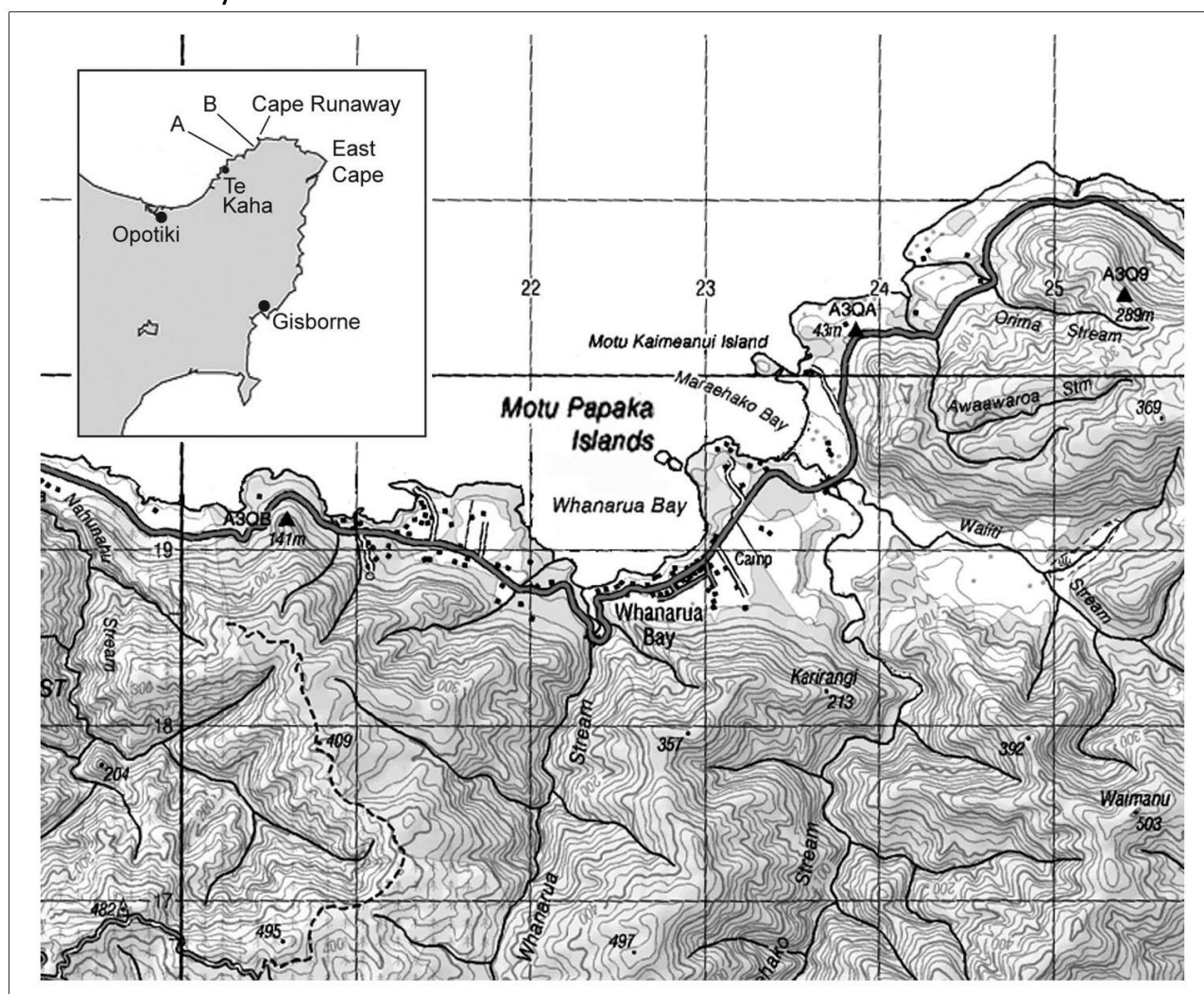


# Vascular plants of Whanarua Bay, eastern Bay of Plenty, including flora and fauna of Motu Papaka Islands, north-eastern Whanarua Bay

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## Introduction

During two family, spring holidays (25 Sep–2 Oct 1999; 25–29 Sep 2000) based at Whanarua Bay, East Cape, the author explored some of the local area, including the coastline of the Bay and two adjacent islands, Motu Papaka Islands (formerly wrongly spelt “Papaku” on topographical maps), which together with the reef that they are on, form the north-eastern boundary of Whanarua Bay (Fig. 1). All observations relate to the two visits during 1999–2000 and the observations are weighted firstly to the Motu Papaka Islands, secondly the eastern side of Whanarua Bay (east of Whanau River), and lastly on a single visit to the western side of the Bay.



**Fig. 1.** Inset: location of Whanarua Bay (A) and an unnamed stack off the south end of Whangaparaoa Beach (B), eastern Bay of Plenty. The enlarged main map shows the location of Whanarua Bay and Motu Papaka Islands in detail. From topo map (1: 1250000) modified by Joshua Salter. Scale: squares are 1 km apart.

Whanarua Bay and Papaka Islands are composed of bedded greywacke sandstone and well-rounded pebble conglomerate of the Pakau Terrane. These sedimentary rocks were deposited in the sea during the Early Cretaceous about 100–120 million years ago (Bruce Hayward pers. comm.). The Papaka Islands are greywacke and the extensive intertidal reefs in the Bay are conglomerates. Sandy/pebble beaches were few and there was a small dune system by the mouth of the Whanarua Stream in the centre of the Bay, otherwise the coast was mainly rocky.

### **Whanarua Bay coast (excluding Papaka Islands)**

The coastal vegetation is a mix of regenerating native bush with scattered pōhutukawa (*Metrosideros excelsa*) trees, shrubby vegetation on steep faces, and rock outcrops (Figs. 2, 3). Open areas modified for baches occupy nearly 20% of the Whanarua Bay coastline. Much of the coastal vegetation does not continue back beyond the cliffs. The author attempted to record along the coastal fringe all the wild plants and a few cultivated species that were likely to become naturalised (Appendix 1).



**Fig. 2.** West side of Whanarua Bay, showing the rocky coast at a lowish tide, scattered pōhutukawa on cliffs, pine trees (centre left on skyline) and mainly shrubby vegetation on the left. Photo from SE part of the Bay, 2 Oct 1999. All photos by the author.

On the coastal slopes of the east side of the Bay the largest and commonest trees were pōhutukawa. Also in the canopy were: tītoki (*Alectryon excelsus*), tawa (*Beilschmiedia tawa* s.str.), taupata (*Coprosma repens*), tutu (*Coriaria arborea*),

karaka (*Corynocarpus laevigatus*), kohekohe (*Didymocheton spectabilis*), whau (*Entelea arborescens*), houhere (*Hoheria populnea* agg.), rewarewa (*Knightia excelsa*), kānuka (*Kunzea robusta*), pukatea (*Laurelia novae-zendiae*), mānuka (*Leptospermum scoparium*), wharangi (*Melicope ternata*), māhoe (*Melicytus ramiflorus*), ngaio (*Myoporum laetum*), karo (*Pittosporum crassifolium*), whauwhaupaku (*Pseudopanax arboreus*), houpapa (*Pseudopanax lessonii*) and kōwhai (*Sophora tetraptera*) in varying degrees of abundance. The understorey or ground cover included: *Coprosma rhamnoides*, karamū (*Coprosma robusta*), *Cordyline banksii*, ponga (*Cyathea dealbata*), mamaku (*Cyathea medullaris*), *Cyperus ustulatus*, akeake (*Dodonaea viscosa*), mingimingi (*Leucopogon fascicularis*), akepiro (*Olearia furfuracea*), *Olearia paniculata*, *Ozothamnus leptophyllus*, harakeke (*Phormium tenax*), kawakawa (*Piper excelsum*); vines of kareao/supplejack (*Ripogonum scandens*) and *Calystegia tuguriorum*; ground ferns of *Asplenium flaccidum*, *Polystichum wawranum*, *Pteris tremula*; and epiphytes of *Earina mucronata* and *Phlegmariurus billardierei*.



**Fig. 3.** Southeast Whanarua Bay with the most eastern baches in the Bay among large pōhutukawa trees, erect rewarewa trees behind the baches, and sandy/gravel beach (near low tide), 2 Oct 1999.

See Table 1 for the flora totals recorded in broad plant groups, and Appendix 1 for the full list. Of the 64 naturalised species recorded for the Bay (Appendix 1), many stand out as potentially aggressive environmental weeds, including: patches of tuber ladder fern (*Nephrolepis cordifolia*), loquat (*Rhaphiolepis bibas*), boxthorn

(*Lycium ferrocissimum*), brush wattle (*Paraserianthes lophantha*), blue morning glory (*Ipomoea indica*), Kahili ginger (*Hedychium gardnerianum*), tradescantia (*Tradescantia fluminensis*), kikuyu (*Cenchrus clandestinus*), pampas grass (*Cortaderia selloana*), veldt grass (*Ehrharta erecta*), *Carex divulsa*, agapanthus (*Agapanthus praecox*) and montbretia (*Crocasmia ×crocosmiiflora*).

Note – on 3 Oct 2010 the Rotorua Botanical Society visited Whanarua Bay Scenic Reserve (148 ha) situated on the south side of State Highway 35. It is only 140 m from the Whanarua Bay coast at its closest point (see [https://ontheair.nz/assets/ZLP\\_BP-0096](https://ontheair.nz/assets/ZLP_BP-0096)), and includes the lower eastern tributary of the Whanarua Stream. They recorded the Scenic Reserve habitat as coastal and semi-coastal forest (Cashmore 2011) and listed 132 indigenous and 49 naturalised species (Hobbs et al. 2011a), 73% being indigenous.

### **Motu Papaka Islands**

“Motu Papaka” translates to “island of crabs” – the inner island is Motu Papakanui (0.2 ha) and the outer Motu Papakaiti (0.28 ha, from Taylor 1989), information from Stewart Nyman (pers. comm., Oct 2022). The islands were defensive fighting pā and are wāhi tapu – permission must be sought from local iwi before accessing them.



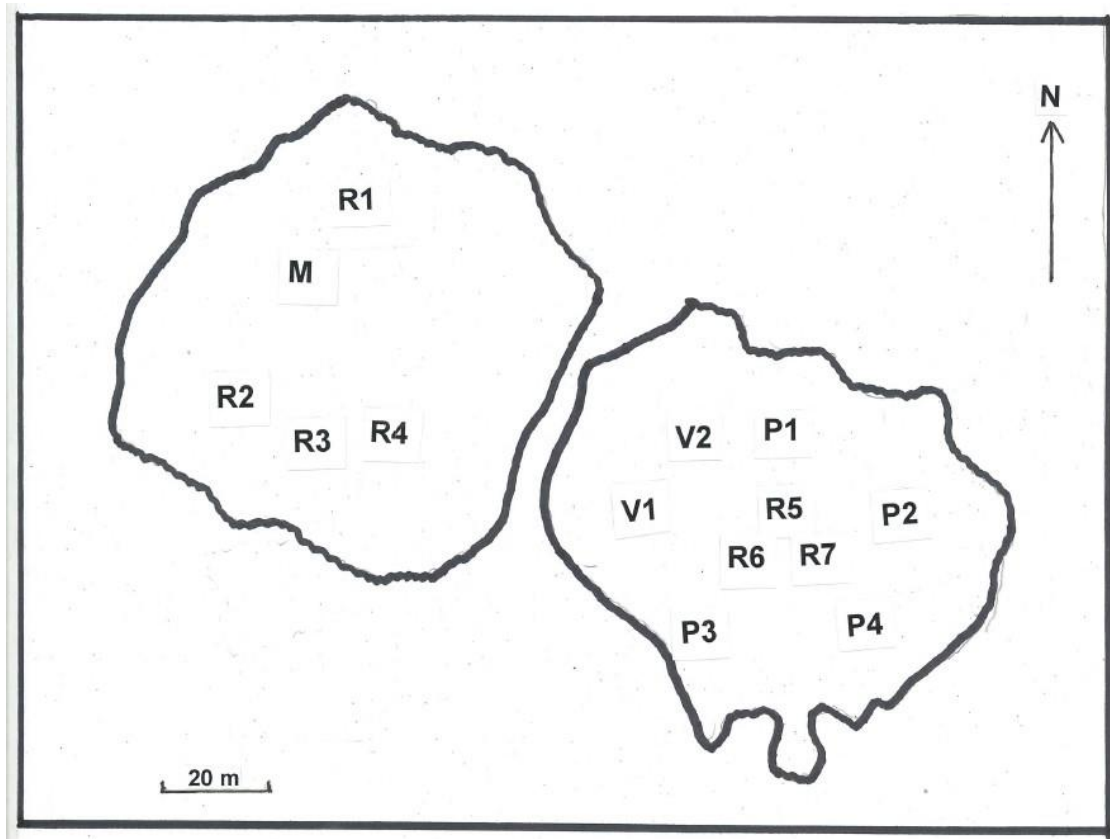
**Fig. 4.** Motu Papaka Islands appearing as one island, mainland coast on right, NE Whanarua Bay; looking due north from Whanarua Bay near low tide. Note – the emergent trees, particularly on the outer island, of pōhutukawa, rewarewa and the large mangleo standout. 1 Oct 1999.

The Papaka Islands (central point: 37° 40' 26.8" S, 177° 47' 34.7" E) abut each other (Fig. 4) and only around high tide are they separated by the sea. From the mainland they are separated by a 4 m-wide gut, wadable near low water at the northern end (perhaps dry during low spring tides?). Intertidal sea caves are present on the north and west side of the inner island. The remains of a boat haul-out can be seen on the mainland side by the inner island. The islands are forested, flat-topped (natural?), the inner one c.10 m asl and the outer c.12 m asl. Both islands are steeply cliffed with little erosion, and only in a few places is there easy access to their forested plateaus. The author visited both islands during each holiday and the observations are recorded in Appendices 2 and 3.

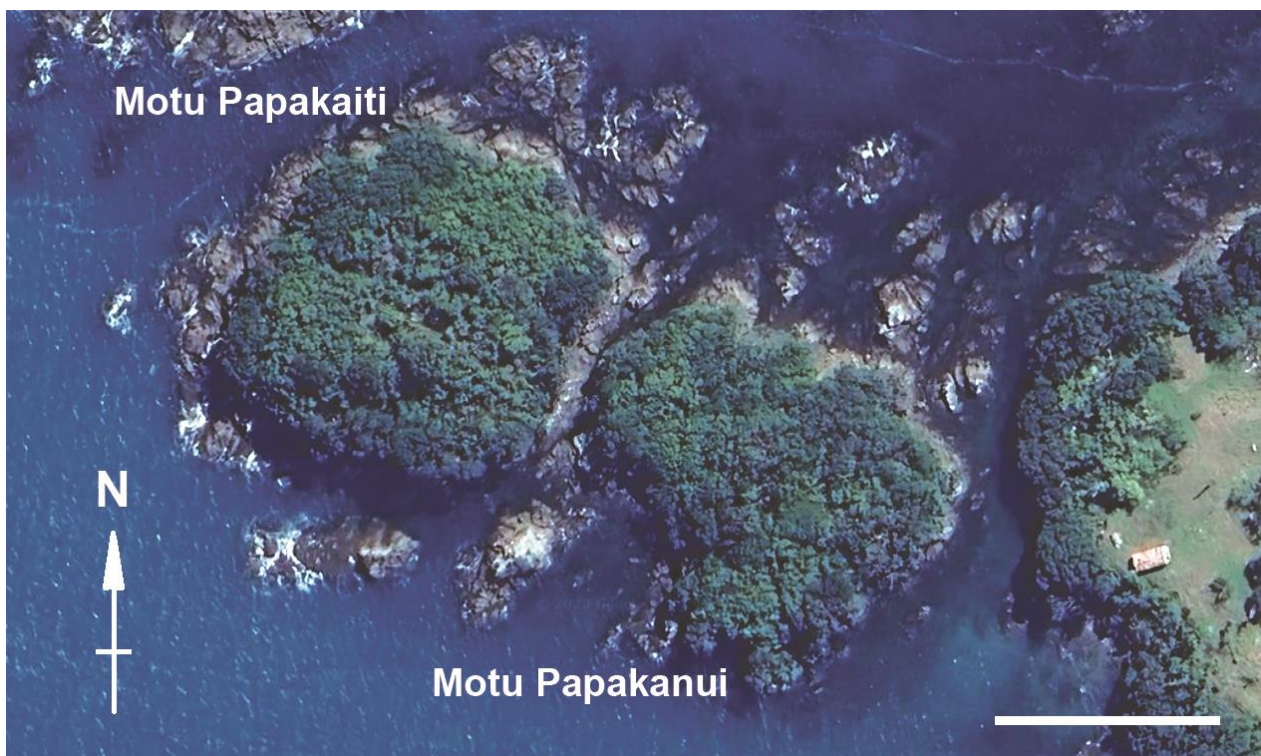
### Vascular plant flora and vegetation

Nothing has been planted on the islands (Stewart Nyman pers. comm., and pers. obs.). Rocky cliffs form much of the perimeter of both islands and a forest canopy clothes most of the upper parts with some trees emergent through the canopy (Fig. 4).

- a. Canopy: houpara, 5-6 m tall, forms the main canopy, occasionally with kohuhu (*Pittosporum tenuifolium*) and by the outer margin, karo. On the inner island the canopy is locally overtopped by pōhutukawa, 10-14 m tall; emergent rewarewa are present on both islands; also, māpou, pūriri (*Vitex lucens*), porokaiwhiri / pigeonwood and mangeao locally reach the canopy or are emergent through it, the largest mangeao tree being 12 m tall. The canopy of the outer island appeared to be older and was more variable in species diversity than the inner island. The pōhutukawa was confined to the margins of the outer island, whereas it was central and marginal on the inner island. Most of the pōhutukawa canopies were thin – the result of brushtail possum browsing? The diameter at breast height (dbh) of the largest trees were measured, see Table 2 and for their locations Figs. 5 and 6. When observed a year later (28 Sep 2000) the largest mangeao was leaning over towards the NW, c. 35° from vertical, and the bark was split but the canopy appeared to still be healthy – perhaps the result of a recent storm event. The undermining of roots by seabird burrows, may have contributed.
- b. Shrub and ground cover: the main shrubs were hangehange (*Geniostoma ligustrifolium*), kawakawa and clumps of bamboo sedge (*Gahnia lacera*); ground cover commonly contained *Asplenium oblongifolium*, *Lecanopteris pustulata*, *Carex banksiana*, *Libertia grandiflora*, *Pterostylis banksii* and seedlings of porokaiwhiri. Much of the shrub and ground cover was denser on the outer island.



**Fig. 5.** Approximate locations of the larger trees on Motu Papaka Islands in Sep 1999. See Table 2 for their diameters and key to the coded initials.



**Fig. 6.** Motu Papaka Islands: Papakaiti (outer island on left); Papakanui (inner island, centre) and mainland (right). Showing the complete forest cover of the islands, associated reefs and sea channels. From Google Maps (image 16 Oct 2022) modified by Joshua Salter. Scale bar: 50 m.

- c. Naturalised species occurred here as well, including *Festuca bromoides*, *Trifolium dubium*, ratstail (*Sporobolus africanus*) and scarlet pimpernel (*Lysimachia arvensis*). Locally in the shady, damp coastal guts grew the natives *Isolepis cernua*, *Lobelia anceps* and *Apium prostratum*.
- d. Climbers: the only climber to reach the canopy was kareao/supplejack; one other climber, *Clematis cunninghamii*, was represented by a few low juvenile vines.
- e. Vascular plant epiphytes were few: *Astelia hastata*, with locally a few young clubmosses (*Phlegmariurus billardierei*) on a horizontal branch of pōhutukawa, leather fern (*Pyrrosia elaeagnifolia*) also on pōhutukawa branches, and the orchid, *Bulbophyllum pygmaeum*, on the trunks of rewarewa.

The vascular flora totals for the individual Motu Papaka Islands were: 70 (inner) and 51 (outer) species, 89% and 84% indigenous respectively and their combined flora totalled 97 vascular species, 14% being naturalised species (see Table 1, Appendix 2).

### Fauna

- a. Mammals: pest bait stations (either empty or with old bait) and tracking tunnels were common on both islands. Apart from the thin pōhutukawa canopies, there was no obvious sign of rat or possum browsing. However, a brushtail possum skeleton was present on the outer island – presumably a result of an earlier baiting. Their past presence is perhaps a sign that the channel between the islands and the mainland does become dry during extreme low tides – or perhaps possums just swam the short distance. However, there is evidence that possums are reluctant swimmers and crossers of water bodies (e.g., Zero Invasion Predators 2020).
- b. Birds: there were at least 20 burrows on the outer island under forest and two burrows on the inner island, their openings measuring c. 15 cm tall x 20 cm wide. They were all open and appeared to be active (entrance open and ground around them fairly clear). An unbroken egg found on the surface of the outer island on 26 Sep 1999 measured 74 x 43 mm, and another one on 28 Sep 2000: 75 x 44 mm (the same egg?). Ōi / grey-faced petrel seems the most likely contender for burrows and egg(s) of that size (Graeme Taylor, pers. comm.). Also, an intact egg on the ground is an indicator of no rats or mustelids present, especially by September as ōi eggs are laid June to late July and one would expect any mammalian predators to have found and eaten it by September (Graeme Taylor, pers. comm.). See Appendix 3 for a full list of birds observed.

- c. Reptiles: no lizards observed.
- d. Miscellaneous Invertebrates: salt pond mosquitoes (*Opifex fuscus*) were present in the small brackish rock pools in the upper splash zone; although garden snails (*Cornu aspersum*) were present in the Bay, none were seen on the islands.

## Discussion

### Whanarua Bay coast

Two indigenous records are worth further comment: 1. the *Olearia paniculata* record must be close to the natural northern limit for this endemic New Zealand shrub – herbarium records north of here, see Australasian Virtual Herbarium website (AVH), are suspected by the author to be from cultivated material, or wrongly identified or have the wrong locality; and 2. the presence of several healthy wild populations of *Chionochloa flavicans* f. *flavicans* on the coastal rocks – a species absent from much of the rocky coastline of the Bay of Plenty and which is seen more commonly in cultivation than in the wild.

### Motu Papaka

The outer island being slightly larger, containing a smaller flora and the same number of naturalised species, is a little at odds with what the author was expecting: a larger flora and fewer naturalised species, being further from the mainland. Perhaps the explanation is that the outer island is in fact more exposed to storms, salt spray and disturbance, limiting the native species and creating open areas aiding the establishment of naturalised species.

A reflection of the relatively unmodified state of the Motu Papaka Islands is that 86% of the vascular flora is indigenous (Table 1), and that only one environmental weed, Kahili ginger, was present. The indigenous flora percentage was high compared with similar-sized islands in the Auckland region which are also nearly connected to the mainland (pers. obs.). Sullivan et al. (2005) showed that there is a correlation between the number of weed species in native forest fragments in northern New Zealand and the distance to the nearest large town. The remoteness of the Papaka Islands from a town has helped to keep the naturalisations low. However, many of the 64 naturalised species and ten species of the plantings around the Whanarua Bay baches do threaten to invade much of the natural vegetation of the Bay, including the Papaka Islands.

Four unusual species for a small island were recorded (based on floras for northern islands of the North Island, pers. obs.): mangeao, *Chionochloa flavicans* f. *flavicans*, *Luzula picta* var. *picta* and *Bulbophyllum pygmaeum*. Although mangeao was not seen in the adjacent forest of the Bay, it was recorded in the Scenic Reserve close by on the south side of the main road (see Hobbs et al. 2011a). The dead mamaku tree ferns were most likely a reflection of a previous drought. Droughts appear to

cause widespread dieback and even death of tree ferns on small islands in the Hauraki Gulf, Auckland (EKC pers. obs.) e.g., on Motuketekete Island (Cameron 2015: fig. 28). The seaweed record from the lower edge of the reef outside the outer Papaka Island of *Lessonia variegata*, a kelp of very exposed coasts, is the only Bay of Plenty record of this kelp on AVH.

A comparison of the vascular plants of the Motu Papaka Islands and an islet off Whangaparaoa Beach (see Fig. 1)

An unnamed stack off south end of Whangaparaoa Beach (at 37° 35' 27" S, 177° 58' 31" E), some 17 km ENE of Motu Papaka Islands, lies 25 m offshore and is connected by an intertidal reef to the mainland. It is 0.05 ha in size and 12 m asl – data from Taylor (1990) based on his visit on 18 April 1987. Taylor recorded 19 vascular plant species including five naturalised species; three of these were not recorded on Papaka Islands, and all three were exotic herbs (see Appendix 2).

The abundance of three indigenous salt-tolerant plants, horokaka/ice plant, ureure/glasswort, taupata, on the three separate islands makes an interesting comparison. All three species were much more common on the unnamed islet (see Table 3). This may be the result of rats chewing on succulent foliage on easily reachable islands that lack free freshwater but are marginal in size to support them. As Taylor (1990: 150) stated for the much smaller islet: “perhaps because of the steep overhanging sides, or because the size of the stack would not support any mammals except brief visitors.” None of these islands/islets have permanent freshwater, apart from the brackish tidal pools of Papaka Islands. Rats are suspected to eat succulent plant material on islands with a water shortage (see Tennyson & Taylor 1999). The higher number of ōi on the small islet means a greater amount of guano which may also affect the growth of these three native plant species.

Note – The Rotorua Botanical Society visited Oruaiti Beach, the next beach south of Whangaparaoa Beach (see above), on 20 Nov 2009 and recorded the habitat and 38 indigenous and 72 naturalised vascular plants along that section of the open coast (Hobbs 2011). The following year, 2 Oct 2010, they visited Whangaparaoa Beach and duneland, recording the habitat as an outstanding dune and swale wetland system (Cashmore 2011) and listed 55 indigenous and 95 naturalised vascular plant species (Hobbs et al. 2011b).

## Conclusions

The vegetation of Whanarua Bay coast has good native plant diversity, lined with large pōhutukawa trees. However, many of the weeds and a few of the cultivated species, especially around the baches, do pose a long-term threat to the wider indigenous vegetation.

Motu Papaka Islands with their dominant indigenous native forest cover, a flora dominated by indigenous species, the presence of some unusual native species for small islands, a single environmental weed species, a nesting petrel population and the lack of recent human disturbance, make them valuable conservation islands. For them to stay this way, mammalian and invertebrate pests and weeds will need to be controlled in the wider landscape.

## Acknowledgements

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**Table 1. Wild vascular plant totals for three coastal areas of eastern Bay of Plenty (Whanarua Bay coast, both Papaka Is. and combined, and an unnamed stack), for the different plant groupings, and native or naturalised status.**

pl = planted species

| Plant group                   | Whanarua Bay coast 1999-2000, excl. Papaka Is. | Papakanui (inner island) | Papakaiti m (outer island) | Papaka Is. (both islands combined) 1999-2000 | Unnamed stack, south end Whangaparaoa Beach, 1987 [= no. species also on Papaka Is.] |
|-------------------------------|------------------------------------------------|--------------------------|----------------------------|----------------------------------------------|--------------------------------------------------------------------------------------|
| Native Ferns & lycopods       | 7                                              | 8                        | 4                          | 9                                            | 1 [1]                                                                                |
| Native conifers               | 1 pl                                           |                          |                            | -                                            | -                                                                                    |
| Native flowering plants       | 65                                             | 62                       | 43                         | 74                                           | 13 [13]                                                                              |
| Naturalised ferns             | 1                                              |                          |                            | -                                            | -                                                                                    |
| Naturalised conifers          | -                                              |                          |                            | -                                            | -                                                                                    |
| Naturalised flowering plants  | 64 + 10 pl                                     | 8                        | 8                          | 14                                           | 5 [2]                                                                                |
| <b>Totals</b>                 | <b>136 + 11 pl</b>                             | <b>70</b>                | <b>51</b>                  | <b>97</b>                                    | <b>19 [16]</b>                                                                       |
| <b>% native of the totals</b> | <b>50%</b>                                     | <b>89%</b>               | <b>84%</b>                 | <b>86%</b>                                   | <b>74%</b>                                                                           |
| <b>Data source</b>            | <b>this article</b>                            | <b>this article</b>      | <b>this article</b>        | <b>this article</b>                          | <b>Taylor 1990</b>                                                                   |

**Table 2. The diameter at 1.3 m (dbh) of the larger trees on Motu Papaka Islands in Sep 1999, see Fig.5 for their locations.\***

| Species                                    | dbh (cm)                                                                | Notes                                                      |
|--------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------|
| Rewarewa (4 = tree no.)                    | R1 (23.0 + 18.5), R2 (64.8 at 50cm), R3 (44.1 + 31.3 + 28.8), R4 (65.6) | Outer island, the smallest branch of R3 was nearly dead    |
| Mangeao (1)                                | M (55.3)                                                                | Outer island, 12m tall, round-headed, leaning over in 2000 |
| Pōhutukawa (excl. the ones on the margins) | P1 (37.1), P2 (49.1), P3 (55.4), P4 (80.1)                              | Inner island, 10-14m tall                                  |
| Rewarewa (3)                               | R5 (57.1), R6 (35.1), R7 (19.6)                                         | Inner island – R5 branches 1.8m above the ground           |
| Pūriri (2)                                 | V1 (13.7), V2 (32.9 + 17.2)                                             | Inner island, to 8m tall                                   |

\*= all measured 28 Sep 1999 with a dbh tape; some trees were multi-stemmed.

**Table 3. Comparison of abundance records for three indigenous salt-tolerant vascular plants on three islands.**

| Plant species and bird burrows | Inner Papaka Id. | Outer Papaka Id. | Unnamed stack, Whangaparaoa Beach |
|--------------------------------|------------------|------------------|-----------------------------------|
| horokaka/ice plant             | local            | -                | abundant                          |
| ureure/glasswort               | local            | -                | common                            |
| taupata                        | occasional       | occasional       | abundant                          |
| bird burrows (ōi?)             | 2                | 20               | 35                                |

## Appendix 1. Vascular species recorded for Whanarua Bay coast (excl. Papaka Is.)

### Key

|                             |                                                            |
|-----------------------------|------------------------------------------------------------|
| a = abundant                | ×1 = only one individual seen, ×2 = two seen               |
| c = common                  | + = present                                                |
| o = occasional              | [ad] = on adjacent stack                                   |
| lc = locally common         | AVH = Australasian Virtual Herbarium (accessed 5 Sep 2022) |
| l = local                   | * = naturalised exotic species                             |
| s = scarce (<5 plants seen) | * <sup>N</sup> = planted native species                    |
|                             | ** = planted exotic species                                |

| Species by plant group                                                              | Māori or common name | Abundance and Notes for east of the stream (west side separately indicated)                                |
|-------------------------------------------------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------|
| <b>Ferns and lycopods (7 + 1 + 0)</b><br>(= Native + naturalised + planted species) |                      |                                                                                                            |
| <i>Asplenium flaccidum</i>                                                          |                      |                                                                                                            |
| <i>Cyathea dealbata</i>                                                             | punga                |                                                                                                            |
| <i>Cyathea medullaris</i>                                                           | mamaku               |                                                                                                            |
| <i>Doodia australis</i>                                                             | rasp fern            | l                                                                                                          |
| <i>Nephrolepis cordifolia</i> *                                                     | tuber ladder fern    | Patch c.15 × 2 m bottom of steep drive                                                                     |
| <i>Phlegmariurus billardierei</i>                                                   |                      | epiphyte both sides of Bay                                                                                 |
| <i>Polystichum wawranum</i>                                                         |                      |                                                                                                            |
| <i>Pteris tremula</i>                                                               |                      |                                                                                                            |
| <b>Conifers (0 + 0 + 1)</b>                                                         |                      |                                                                                                            |
| <i>Podocarpus totara</i> * <sup>N</sup>                                             | totara               | ×1, medium-sized, planted?                                                                                 |
| <b>Dicots (45 + 43 + 5)</b>                                                         |                      |                                                                                                            |
| <i>Acanthus mollis</i> *                                                            | bear's breeches      | l, naturalised by baches and planted                                                                       |
| <i>Alectryon excelsus</i>                                                           | tītoki               |                                                                                                            |
| <i>Arctotheca calendula</i> *                                                       | Cape weed            | lc                                                                                                         |
| <i>Beilschmiedia tawa</i> s.str.                                                    | tawa                 | o; also wide-leaved tawa ( <i>B. tawaroa</i> ) has been recorded 2 km to E (AK239564, Rogan 308, Jan 1999) |
| <i>Bidens pilosa</i> *                                                              | cobblers' pegs       | lc, in open, back of beach                                                                                 |
| <i>Calystegia soldenella</i>                                                        | shore bindweed       |                                                                                                            |
| <i>Calystegia tuguriorum</i>                                                        | native bindweed      |                                                                                                            |
| <i>Centella uniflora</i>                                                            |                      | west side of Bay                                                                                           |
| <i>Coprosma repens</i>                                                              | taupata              |                                                                                                            |
| <i>Coprosma rhamnoides</i>                                                          |                      |                                                                                                            |

|                                              |                        |                                                                                               |
|----------------------------------------------|------------------------|-----------------------------------------------------------------------------------------------|
| <i>Coprosma robusta</i>                      | karamū                 |                                                                                               |
| <i>Coriaria arborea</i>                      | tutu                   |                                                                                               |
| <i>Cornus capitata</i> **                    | strawberry dogwood     | ×1, planted?                                                                                  |
| <i>Corynocarpus laevigatus</i>               | karaka                 |                                                                                               |
| <i>Cotoneaster glaucophyllus</i> *           | cotoneaster            | I, E side, and more on W side of Bay                                                          |
| <i>Cotula australis</i>                      |                        |                                                                                               |
| <i>Crassula multicava</i> *                  | fairly crassula        | single 2 × 2m clump, back of bach                                                             |
| <i>Daucus carota</i> *                       | wild carrot            |                                                                                               |
| <i>Dichondra repens</i> agg.                 | creeping dichondra     | o                                                                                             |
| <i>Didymocheton spectabilis</i>              | kohekohe               | both sides of the Bay                                                                         |
| <i>Disphyma australe</i>                     | horokaka / ice plant   | I, mainly on islets on west side of Bay                                                       |
| <i>Dodonaea viscosa</i>                      | akeake                 | both sides of Bay                                                                             |
| <i>Dysphania ambrosioides</i> *              | Mexican tea            |                                                                                               |
| <i>Entelea arborescens</i>                   | whau                   | o                                                                                             |
| <i>Erythrina ×sykesii</i> **                 | flame tree             | Several, medium-sized trees by stream, planted?                                               |
| <i>Euphorbia peplus</i> *                    | milkweed               |                                                                                               |
| <i>Ficus carica</i> **                       | fig                    | ×1 large plant W side of Bay, planted?                                                        |
| <i>Galium aparine</i> *                      | cleavers               |                                                                                               |
| <i>Geniostoma laevigatum</i>                 | hangehange             |                                                                                               |
| <i>Geranium molle</i> *                      | dove's foot cranesbill | I, by baches                                                                                  |
| <i>Haloragis erecta</i>                      |                        | W side of bay                                                                                 |
| <i>Hedera helix</i> cv. **                   | ivy cultivar           | divided leaf form, single small patch                                                         |
| <i>Helichrysum lanceolatum</i>               |                        | W side of Bay                                                                                 |
| <i>Hoheria populnea</i> agg.                 | houhere / lacebark     |                                                                                               |
| <i>Hydrangea macrophylla</i>                 | hydrangea              | I, planted and partially escaped                                                              |
| <i>Ipomoea indica</i> *                      | blue morning glory     | Two extensive narrow populations (20 m and 100m long and high climbing), and a garden dumping |
| <i>Knightia excelsa</i>                      | rewarewa               |                                                                                               |
| <i>Kunzea robusta</i>                        | kānuka                 |                                                                                               |
| <i>Lantana camara</i> var. <i>aculeata</i> * | lantana                | single clump amongst kikuyu                                                                   |
| <i>Laurelia novae-zelandiae</i>              | pukatea                |                                                                                               |
| <i>Leptecophola juniperina</i>               | mingmingi              |                                                                                               |
| <i>Leptospermum scoparium</i>                | mānuka                 |                                                                                               |
| <i>Leucopogon fascicularis</i>               | mingimingi             |                                                                                               |
| <i>Lotus suaveolens</i> *                    |                        |                                                                                               |
| <i>Lycium ferrocissimum</i> *                | boxthorn               | c.10 plants to 2m tall, on islets, W side of Bay                                              |
| <i>Lysimachia arvensis</i> s.str. *          | scarlet pimpernel      | o                                                                                             |
| <i>Medicago arabica</i> *                    |                        | I, by baches                                                                                  |
| <i>Medicago nigra</i> *                      | bur medick             | I, by baches                                                                                  |
| <i>Melicope ternata</i>                      | whārangi               | both sides of Bay                                                                             |
| <i>Melicytus ramiflorus</i>                  | māhoe                  |                                                                                               |
| <i>Metrosideros excelsa</i>                  | pōhutukawa             |                                                                                               |
| <i>Metrosideros perforata</i>                |                        | I                                                                                             |
| <i>Modiola caroliniana</i> *                 | Turk's-cap             | I, by baches, weedy, shaded areas                                                             |
| <i>Myoporum laetum</i>                       | ngaio                  |                                                                                               |
| <i>Myosotis sylvatica</i> *                  | garden forget-me-not   | c, by baches                                                                                  |

|                                                      |                       |                                                                   |
|------------------------------------------------------|-----------------------|-------------------------------------------------------------------|
| <i>Nasturtium officinale</i> *                       | watercress            | by stream                                                         |
| <i>Olearia furfuracea</i>                            | akepiro               | lc                                                                |
| <i>Olearia paniculata</i>                            |                       | l, headland by Motu Papaka Is.                                    |
| <i>Oxalis incarnata</i> *                            | lilac oxalis          | lc, by baches                                                     |
| <i>Ozothamnus leptophyllus</i>                       | tauhinu               | lc, back of beaches, up to 3 m tall                               |
| <i>Paraserianthes lophantha</i> *                    | brush wattle          | l, near baches                                                    |
| <i>Pelargonium xasperum</i> *                        |                       | patch 2.0 × 1.5m amongst kikuyu at back of beach; also cultivated |
| <i>Peperomia urvilleana</i>                          | peperomia             | c                                                                 |
| <i>Persea americana</i> *                            | avocado               | 4 saplings to 2 m tall                                            |
| <i>Persicaria capitata</i> *                         |                       | l, several clumps                                                 |
| <i>Piper excelsum</i>                                | kawakawa              |                                                                   |
| <i>Pittosporum crassifolium</i>                      | karo                  |                                                                   |
| <i>Plantago major</i> *                              | broad-leaved plantain |                                                                   |
| <i>Prunella vulgaris</i> *                           | selfheal              | lc                                                                |
| <i>Prunus ?persica</i> *                             | ?peach                | 2 wild sterile saplings                                           |
| <i>Pseudopanax arboreus</i>                          | whauwhaupaku          |                                                                   |
| <i>Pseudopanax lessonii</i>                          | houpara               |                                                                   |
| <i>Ranunculus repens</i> *                           | Creeping buttercup    | lc, by stream                                                     |
| <i>Rhaphiolepis bibas</i> *                          | loquat                | Seedlings lc under an 8m-tall tree (pl. ?)                        |
| <i>Rhaphiolepis umbellata</i> **                     | sexton's bride        | ×1, planted                                                       |
| <i>Roldana petasitis</i> *                           | velvet groundsel      | lc, in front of baches                                            |
| <i>Rubus fruticosus</i> agg. *                       | blackberry            | both sides of Bay                                                 |
| <i>Rumex crispus</i> *                               | curled dock           |                                                                   |
| <i>Salix</i> spp. *                                  | willow species        | two taxa, by stream                                               |
| <i>Sison amomum</i> *                                | stone parsley         | o, by baches and stream                                           |
| <i>Solanum nigrum</i> *                              | black nightshade      |                                                                   |
| <i>Sonchus oleraceus</i> *                           | pūhā / sow thistle    |                                                                   |
| <i>Sophora tetraptera</i>                            | kōwhai                |                                                                   |
| <i>Taraxicum officinale</i> agg. *                   | dandelion             |                                                                   |
| <i>Tetragonia ? trigyna</i>                          |                       | W side of Bay (sterile)                                           |
| <i>Trifolium repens</i> *                            | white clover          | both sides of Bay                                                 |
| <i>Tropaeolum majus</i> *                            | garden nasturtium     | c, along back of beach                                            |
| <i>Verbena ? incompta</i> *                          |                       | ×1                                                                |
| <i>Veronica anagallis-aquaticus</i> *                |                       | lc, in flood plain of stream                                      |
| <i>Veronica persica</i> *                            |                       | o, by baches                                                      |
| <i>Vinca major</i> *                                 | periwinkle            | 10 × 10 m, shaded patch by stream                                 |
|                                                      |                       |                                                                   |
| <b>Monocots (14 + 19 + 5)</b>                        |                       |                                                                   |
| <i>Acianthus sinclairii</i>                          |                       | W side of Bay                                                     |
| <i>Agapanthus praecox</i> subsp. <i>orientalis</i> * | agapanthus            |                                                                   |
| <i>Allium triquetrum</i> *                           | onion weed            | l, from a garden dumping                                          |
| <i>Alocasia brisbanensis</i> **                      | elephant's ear        | single clump                                                      |
| <i>Aloe maculata</i> **                              |                       |                                                                   |
| <i>Anthoxanthum odoratum</i> *                       | sweet vernal          |                                                                   |
| <i>Arthropodium cirratum</i>                         | rengarenga            | W side of Bay and above stream                                    |
| <i>Bromus catharticus</i> *                          | prairie grass         | o                                                                 |
| <i>Canna indica</i> cv. **                           |                       | 2 sites, purplish leaves, orange flowers                          |
| <i>Carex divulsa</i> *                               |                       | l                                                                 |

|                                                  |                    |                                                         |
|--------------------------------------------------|--------------------|---------------------------------------------------------|
| <i>Carex virgata</i>                             |                    | W side of Bay                                           |
| <i>Cenchrus clandestinus</i> *                   | kikuyu grass       | lc                                                      |
| <i>Chionochloa flavicans</i> f. <i>flavicans</i> |                    | l, on islet west side of Bay                            |
| <i>Colocasia esculenta</i> **                    | taro               | Single small patch, back of beach in shade, E of baches |
| <i>Cordyline banksii</i>                         |                    | both sides of Bay                                       |
| <i>Cortaderia selloana</i> *                     | pampas grass       | l                                                       |
| <i>Crocasmia ×crocosmiiflora</i> *               | montbretia         |                                                         |
| <i>Cynodon dactylon</i> *                        | Indian doab        | lc, back of beach                                       |
| <i>Cyperus ustulatus</i>                         |                    |                                                         |
| <i>Dactylis glomerata</i> *                      | cocksfoot          |                                                         |
| <i>Dendrobium cunninghamii</i>                   |                    | epiphyte, W side of Bay                                 |
| <i>Earina mucranata</i>                          | bamboo orchid      | NZ bamboo orchid                                        |
| <i>Ehrharta erecta</i> *                         | veldt grass        | a, by baches                                            |
| <i>Freesia laxa</i> *                            |                    | l, wild, and planted c.10m distant                      |
| <i>Hedychium gardnerianum</i> *                  | Kahili ginger      | lc, large infestation E side of Bay                     |
| <i>Lilium formosanum</i> *                       |                    | lc, wild by road access to Bay, at lower end            |
| <i>Lolium arundinaceum</i> *                     | tall fescue        | W side of Bay                                           |
| <i>Machaerina</i> sp.                            |                    | clumps by stream                                        |
| <i>Microlaena stipoides</i>                      | meadow rice grass  | l, swards                                               |
| <i>Phormium tenax</i>                            | harakeke           | both sides of Bay, wild and planted in front of baches  |
| <i>Poa annua</i> *                               | annual poa         |                                                         |
| <i>Pterosylis alobula</i>                        |                    | W side of Bay                                           |
| <i>Rhopalostylis sapida</i>                      | nīkau              |                                                         |
| <i>Ripogonum scandens</i>                        | kareao, supplejack |                                                         |
| <i>Sporobolus africanus</i> *                    | ratstail           | o, exposed sites                                        |
| <i>Tradescantia fluminensis</i> *                | tradescantia       | 10 × 10m patch, in shade, back of beach by baches       |
| <i>Tradescantia zebrina</i> **                   | tradescantia       | Several clumps in bach gardens                          |
| <i>Zantedeschia aethiopica</i> *                 | arum lily          | o, wild by baches                                       |

## Appendix 2. Vascular flora of Motu Papaka islands, and a stack off south end Whangaparaoa Beach.

Data from: Motu Papaka Islands (this article); and stack off Whangaparaoa Beach (Taylor 1989), recorded on 18 Apr 1987.

Abbreviations as for Appendix 1.

| Location and date of recording /<br><br>Plant Group          | Māori or common name | Papaka nui (inner island) 1999-2000 | Papaka iti (outer island) 1999-2000 | stack off Whangaparaoa Beach 1987 | Notes re Papaka Islands |
|--------------------------------------------------------------|----------------------|-------------------------------------|-------------------------------------|-----------------------------------|-------------------------|
| <b>Ferns &amp; Lycopods (9 + 0) (= native + naturalised)</b> |                      |                                     |                                     |                                   |                         |
| <i>Adiantum cunninghamii</i>                                 | huruhuru             | lc                                  |                                     |                                   | In forest               |
| <i>Asplenium oblongifolium</i>                               | huruhuruwhenua       | a                                   |                                     | o                                 | In forest               |

|                                   |                      |      |    |   |                                                                                         |
|-----------------------------------|----------------------|------|----|---|-----------------------------------------------------------------------------------------|
| <i>Cyathea medullaris</i>         | mamaku               | l    | s  |   | 7 dead, to 4m tall (inner); only 1 living, 50cm tall (outer)                            |
| <i>Doodia australis</i>           | rasp fern            |      | l  |   | Open forest                                                                             |
| <i>Lecanopteris pustulata</i>     | kōwaowao             | c    |    |   | Terrestrial in forest and occasional epiphyte                                           |
| <i>Phlegmariurus billardierei</i> |                      | s    |    |   | Young epiphytes on horizontal pōhutukawa branch                                         |
| <i>Psilotum nudum</i>             |                      | s    |    |   | 8 stems to 10 cm tall, 2-3 plants, N side                                               |
| <i>Pteridium esculentum</i>       | rārahu, bracken      | lc   | l  |   |                                                                                         |
| <i>Pyrrosia elaeagnifolia</i>     | leather-leaf fern    | +    | +  |   | Epiphytic and rupestral                                                                 |
|                                   |                      |      |    |   |                                                                                         |
| <b>Dicots (41 + 8)</b>            |                      |      |    |   |                                                                                         |
| <i>Apium prostratum</i>           | native celery        |      | o  | o | Lower coastal slopes, small plants, with <i>Isolepis cernua</i>                         |
| <i>Brachyglottis repanda</i>      | rangiora             | +    | +  |   | Forest margins and understorey                                                          |
| <i>Centella unifolia</i>          |                      | l    |    |   | In forest                                                                               |
| <i>Cirsium vulgare</i> *          | Scotch thistle       | s    | s  |   | Open coastal slopes                                                                     |
| <i>Clematis cunninghamii</i>      | agangākaukiore       | s    |    |   | In forest (juveniles)                                                                   |
| <i>Coprosma repens</i>            | taupata              | o    | o  | a | Forest margins                                                                          |
| <i>Coprosma rhamnoides</i>        | twiggy coprosma      | o    | o  |   | Forest understorey                                                                      |
| <i>Coprosma robusta</i>           | karamū               | o    |    |   | In forest, to 4 m tall                                                                  |
| <i>Corynocarpus laevigatus</i>    | karaka               | o    | o  |   | Mainly as seedlings, to 4m tall (outer island)                                          |
| <i>Crassula sieberiana</i>        |                      | o-lc | lc |   | Bare coastal slopes                                                                     |
| <i>Dichondra repens</i> agg.      | creeping dichondra   | l    | +  |   | Lower bush margin; leaves aging to yellow                                               |
| <i>Didymocheton spectabilis</i>   | kohekohe             | o    | o  |   | ≤ 0.02 m tall                                                                           |
| <i>Disphyma australe</i>          | horokaka / ice plant | l    |    | a | A few small hanging mats on near vertical S-facing slope, otherwise only 2 small plants |
| <i>Euchiton audax</i>             | cudweed              | l    |    |   | Open coastal slope                                                                      |
| <i>Erigeron sumatrensis</i> *     | fleabane             | o    |    |   | Coastal slopes                                                                          |
| <i>Geniostoma ligustrifolium</i>  | hangehange           | c    |    |   | Understorey to 2m tall; starting to flower 26 Sep 1999                                  |
| <i>Haloragis erecta</i>           | toatoa               | o    |    |   | Lower forest margins                                                                    |
| <i>Hebe stricta</i> var.          | korom                | o    | o  | s | Small plants in open                                                                    |

|                                        |                              |      |      |   |                                                                                                                     |
|----------------------------------------|------------------------------|------|------|---|---------------------------------------------------------------------------------------------------------------------|
| <i>stricta</i>                         | iko                          |      |      |   |                                                                                                                     |
| <i>Hedycarya arborea</i>               | porokaiwhiri /<br>pigeonwood |      | lc   |   | Saplings 0.3-6.0 m<br>tall; seedlings<br>frequent                                                                   |
| <i>Hypochaeris radicata</i><br>*       | catsear                      | o    | o    |   | Open, lower coastal<br>slopes                                                                                       |
| <i>Jacobaea vulgaris</i> *             | ragwort                      |      | s    |   | Open coastal slopes                                                                                                 |
| <i>Knightia excelsa</i>                | rewarewa                     | +    | +    |   | Several saplings; and<br>7 trees, tallest c.16m<br>tall – see Figs. 4,5 and<br>Table 2                              |
| <i>Lagenophora pumila</i>              |                              | lc   |      |   | Open coastal slopes                                                                                                 |
| <i>Leontodon saxatilis</i><br>*        | hawkbit                      |      |      | o | Only on unknown<br>stack                                                                                            |
| <i>Leptospermum<br/>scoparium</i>      | mānuka                       |      | s    |   | Margin of island                                                                                                    |
| <i>Leucopogon<br/>fascicularis</i>     | mingimingi                   | ×2   | ×4   |   | shrubs to 5 m tall on<br>outer island; dying on<br>inner island                                                     |
| <i>Litsea calicaris</i>                | mangeao                      |      | ×3   |   | 3 trees: round-headed<br>12 m tall, 55.3 cm dbh<br>and falling over; 5 and<br>7 m tall, both narrow<br>canopy trees |
| <i>Lobelia anceps</i>                  | punakuru                     | l    |      | o | Coastal slope, In a<br>seep at north end                                                                            |
| <i>Lysimachia arvensis</i><br>s.str. * | scarlet pimpernel            |      | o-lc |   | Open coastal slopes,<br>below bush margin                                                                           |
| <i>Medicago nigra</i> *                | bur medick                   |      | o    |   | Open coastal slopes                                                                                                 |
| <i>Melicytus ramiflorus</i>            | māhoe                        | o    |      |   | Canopy tree and<br>saplings                                                                                         |
| <i>Metrosideros<br/>excelsa</i>        | pōhutukawa                   | c    | lc   | o | Common canopy tree,<br>to 14m tall; mainly on<br>the margins; many<br>with thin canopies –<br>possum-browse?        |
| <i>Muehlenbeckia<br/>complexa</i>      | pōhuehue                     |      | l    |   | Coastal slope                                                                                                       |
| <i>Myrsine australis</i>               | māpou                        | +    | o    |   | Reaching the canopy                                                                                                 |
| <i>Olearia furfuracea</i>              | akepiro                      | l    |      |   | Forest margin                                                                                                       |
| <i>Orobanche minor</i> *               | broomrape                    | ×1   |      |   | Forested slope                                                                                                      |
| <i>Oxalis exilis</i>                   |                              |      | l    |   | Gravel slope, SW side                                                                                               |
| <i>Ozothamnus<br/>leptophyllus</i>     | tauhinu                      | [ad] |      |   | c.5 plants on rock<br>stack between the<br>two islands                                                              |
| <i>Peperomia urvilliana</i>            | peperomia                    | c    | lc   |   | Sheltered coastal<br>slopes                                                                                         |
| <i>Pimelea urvilleana</i>              | pinatoro                     |      | s    | s | Lower bush margin, at<br>N end                                                                                      |
| <i>Piper excelsum</i>                  | kawakawa                     | o    |      |   | Understorey shrub;<br>leaves dull                                                                                   |

|                                    |                      |     |      |   |                                                                                     |
|------------------------------------|----------------------|-----|------|---|-------------------------------------------------------------------------------------|
| <i>Pittosporum crassifolium</i>    | karo                 | c   | c    |   | Forest margins, many as small shrubs                                                |
| <i>Pittosporum tenuifolium</i>     | kohuhu               | ×1  | ×4   |   | 5 m tree inner island; 1-7 m trees on outer island reaching the canopy              |
| <i>Plantago coronopus</i> *        | buck's horn plantain |     |      | o | Only on unknown stack                                                               |
| <i>Pseudognaphalium luteoalbum</i> | Jersey cudweed       |     | l    |   | Coastal ledges                                                                      |
| <i>Pseudopanax lessonii</i>        | houpara              | l-a | c    | o | Commonest woody plant, 5-7m tall; a few dead trees on outer island                  |
| <i>Sagina procumbens</i> *         | procumbent pearlwort | l   |      |   | Coastal slope                                                                       |
| <i>Salicornia quinqueflora</i>     | ureure / glasswort   | l   |      | c | Coastal slope, S end island                                                         |
| <i>Samolus repens</i>              | mākoako              |     | l    | a | In coastal cracks in rock, NW corner by small brackish pool                         |
| <i>Senecio bipinnatisectus</i>     | fireweed             |     | l    |   | Open coastal slope                                                                  |
| <i>Senecio lautus</i>              | shore groundsel      |     | o    | o | Shaded coastal slope                                                                |
| <i>Solanum americanum</i>          | pōporo               |     | ×2   |   | Open coastal slope                                                                  |
| <i>Sonchus oleraceus</i> *         | pūhā, sow thistle    |     | o    | o | Open coastal slope                                                                  |
| <i>Trifolium dubium</i> *          | suckling clover      |     | o-lc |   | Bare coastal slope                                                                  |
| <i>Trifolium repens</i> *          | white clover         | l   |      |   | Lower bush margin                                                                   |
| <i>Vitex lucens</i>                | pūriri               | ×2  | ×1   |   | 6 and 8m tall trees inner island; and skinny 6m tree on outer island                |
| <i>Wahlenbergia ?violacea</i>      | harebell             | o   |      |   |                                                                                     |
|                                    |                      |     |      |   |                                                                                     |
| <b>Monocots (28 + 3)</b>           |                      |     |      |   |                                                                                     |
| <i>Acianthus sinclairii</i>        |                      | +   | +    |   | Outer shaded slopes                                                                 |
| <i>Arthropodium cirratum</i>       | rengarenga           | c   |      |   | Coastal slopes                                                                      |
| <i>Astelia solandri</i>            |                      | l   |      |   | Epiphyte and on tree base                                                           |
| <i>Astelia hastata</i>             | kahakaha             | s   |      |   | Epiphyte                                                                            |
| <i>Bulbophyllum pygmaeum</i>       |                      | lc  | +    |   | Patch on vertical rock face (inner island) and epiphytic on rewarewa (both islands) |
| <i>Carex banksiana</i>             |                      | lc  |      |   | Plateau forest                                                                      |
| <i>Carex spinirostris</i>          |                      | lc  |      |   | Plateau forest                                                                      |
| <i>Carex testacea</i>              | speckled sedge       | o   | o    |   | Coastal slopes                                                                      |

|                                                  |                       |      |      |    |                                                                                                                                  |
|--------------------------------------------------|-----------------------|------|------|----|----------------------------------------------------------------------------------------------------------------------------------|
| <i>Carex uncinata</i>                            |                       | lc   |      |    | Plateau forest                                                                                                                   |
| <i>Chionochloa flavicans</i> f. <i>flavicans</i> |                       | l    |      |    | c.6 clumps, cliff-top, SW point, inner island. Also present on W Whanarua coast                                                  |
| <i>Cordyline australis</i>                       | tī                    | ×1   |      |    | ×1, 3.5m tall, 2-trunked, NW end                                                                                                 |
| <i>Dianella nigra</i>                            | tūrutu                | o    |      |    | Plateau forest                                                                                                                   |
| <i>Festuca bromoides</i> *                       | vulpia hair grass     | lc   |      |    | Bare coastal ledges; S side                                                                                                      |
| <i>Ficinia nodosa</i>                            | wīwī                  | c    | c    | c  | Lower fringe of vegetation                                                                                                       |
| <i>Gahnia lacera</i>                             | bamboo sedge          | o-lc | +    |    | In forest and outer houpapa slopes                                                                                               |
| <i>Hedychium gardnerianum</i> *                  | Kahili ginger         | l    |      |    | Single clump with 4 old fruiting stems and 4 smaller plants, S end of inner island. A patch (10 × 30m) on adjacent mainland      |
| <i>Holcus lanatus</i> *                          | Yorkshire fog         |      |      | s  | Only on unknown stack                                                                                                            |
| <i>Isolepis cernua</i>                           | coastal clubrush      | lc   | +    |    | In a seep at N end (inner island), in a gut (outer island)                                                                       |
| <i>Lachnagrostis billardierei</i>                | sand wind grass       |      | s?   |    | Loose flowering head from?                                                                                                       |
| <i>Libertia grandiflora</i>                      |                       | lc   | o    |    | Plateau forest                                                                                                                   |
| <i>Luzula picta</i> var. <i>picta</i>            |                       | s    |      |    | Open rocky slope, S-facing                                                                                                       |
| <i>Microtis</i> sp.                              | onion orchid          | l    |      |    | 2 clumps, bush margin                                                                                                            |
| <i>Oplismenus hirtellus</i>                      | panic grass           | o-lc | o-lc |    | Plateau forest                                                                                                                   |
| <i>Pentapogon crinitus</i>                       | long-hair plume grass | lc   |      |    | Open coastal slopes                                                                                                              |
| <i>Phormium cookianum</i>                        | wharariki             | l    |      |    | Cliff-top at N end                                                                                                               |
| <i>Phormium tenax</i>                            | harakeke              | o    |      |    | Forest and forest margin                                                                                                         |
| <i>Poa anceps</i>                                | broad-leaved poa      | c    |      | c? | Two forms present, erect, narrow-leaved form (more common), and the drooping, wide-leaved form of Northland and Auckland regions |
| <i>Pterostylis banksii</i>                       | tutukiwi              | lc   | lc   |    | Plateau forest                                                                                                                   |
| <i>Rhopalostylis sapida</i>                      | nīkau                 | ×1   |      |    | Fronds to 2m long, no trunk; plateau forest                                                                                      |
| <i>Ripogonum scandens</i>                        | kareao / supplejack   | o    | lc   |    | Plateau forest, reaching the canopy, leaves shiny                                                                                |

|                               |            |   |      |   |                                                                                                                     |
|-------------------------------|------------|---|------|---|---------------------------------------------------------------------------------------------------------------------|
| <i>Rytidosperma</i> sp.       | danthonia  | o |      |   | Lower fringe of vegetation, no fertile plants. The exotic, <i>R. racemosum</i> was present by the baches in the Bay |
| <i>Sporobolus africanus</i> * | ratstail   |   | o-lc | a | In lower fringe of vegetation                                                                                       |
| <i>Thelymitra longifolia</i>  | sun orchid | l | l    |   | In lower fringe of vegetation, leaves to 19 mm across                                                               |

### Appendix 3. The non-vascular flora and birds of the combined Motu Papaka Islands.

Data source and symbols unchanged from Appendix 1.

| Biotic Group                                       | Papaka Islands | Notes re Papaka Islands, including any voucher specimens (AK)                                        |
|----------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------|
| <b>LIVERWORTS (1 + 0)</b> (= native + naturalised) |                |                                                                                                      |
| <i>Lejeunea gracilipes</i>                         | lc             | Covering part of a bank, S-facing slope on inner island. AK 242363                                   |
|                                                    |                |                                                                                                      |
| <b>MOSSES (3 + 0)</b>                              |                |                                                                                                      |
| <i>Leptostomum macrocarpum</i>                     | lc             | Large clumps on bare coastal rock, south end of inner island. AK 244831                              |
| <i>Rhaphididorrhynchium amoenum</i>                | l              | On small log in forest, outer island. AK 241389                                                      |
| <i>Thuidiopsis furfurosa</i>                       | +              |                                                                                                      |
|                                                    |                |                                                                                                      |
| <b>LICHENS (11 + 0)</b>                            |                |                                                                                                      |
| <i>Heteroderma</i> sp.                             | lc             | On S-facing slope among other lichens, inner island. AK 244847                                       |
| <i>Leptogium aucklandicum</i>                      | +              | On N-facing rock under pōhutukawa and houpapa. AK 244840                                             |
| ? <i>Meglospora</i> sp.                            | o              | Gravel slope, base of cliff, W side, inner island. AK 244843                                         |
| <i>Normandina pulchella</i>                        | l              | Tiny epiphyte on <i>Heterodemia</i> and <i>Pannaria</i> spp., coastal slope, inner island. AK 244848 |
| <i>Pannaria</i> sp.                                | +              | On S-facing slope among other lichens, inner island                                                  |
| <i>Parmotrema</i> sp.                              |                | On S-facing slope among other lichens, inner island. AK244845                                        |
| <i>Pseudocyphellaria pickeringii</i>               | lc             | On S-facing slope among other lichens, inner island. AK 244844                                       |
| <i>Ramalina celastri</i>                           | c              | Exposed coastal rock, in the splash zone                                                             |
| <i>Stereocaulon ramulosum</i>                      | lc             | On S-facing slope among other lichens, inner island. AK 244849                                       |
| <i>Sticta babingtonii</i>                          | lc             | On S-facing slope among other lichens, inner island. AK 244846                                       |
| <i>Xanthoria ligulata</i>                          | lc             | On bare rock, upper splash zone; orange in colour                                                    |
|                                                    |                |                                                                                                      |

|                                                                      |      |                                                                                                                                                               |
|----------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Intertidal SEaweeds (from N side of outer Papaka I.) (12 + 0)</b> |      |                                                                                                                                                               |
| <i>Carpophyllum maschalocarpum</i>                                   | l    | Bottom of the exposed intertidal. AK 251056                                                                                                                   |
| <i>Carpophyllum plumosum</i>                                         | la   |                                                                                                                                                               |
| <i>Caulacanthus ustulatus</i>                                        | l    | Small branches among Laurencia. AK251127                                                                                                                      |
| <i>Chondracanthus chapmanii</i>                                      | l    | Small branches among Laurencia. AK 251126                                                                                                                     |
| <i>Dictyota kunthii</i>                                              | l    | Lower intertidal. AK 251060                                                                                                                                   |
| <i>Laurencia</i> sp.                                                 | l    | Turf-forming. Lower exposed intertidal rocks. AK 251061                                                                                                       |
| <i>Lessonia variegata</i>                                            | lc   | Bottom of the exposed intertidal. AK 251054                                                                                                                   |
| <i>Melanthalia abscissa</i>                                          | l    | Bottom of lower intertidal. AK 251059                                                                                                                         |
| <i>Splachnidium rugosum</i>                                          | o    | E Whanarua Bay (AK 239567, Rogan 305, Jan 1999) "occasional in rock pools"                                                                                    |
| <i>Vidalia colensoi</i>                                              | o    | In large clumps at the bottom of the intertidal. AK 251057                                                                                                    |
| <i>Xiphophora chondrophylla</i>                                      | la   | Bottom of exposed intertidal. AK 251055                                                                                                                       |
| <i>Zonaria turneriana</i>                                            | lc   | Lower intertidal, including in rock pools. AK251058                                                                                                           |
|                                                                      |      |                                                                                                                                                               |
| <b>BIRDS (17 + 3)</b>                                                |      |                                                                                                                                                               |
| ōi/grey-faced petrel ?                                               | >20  | >20 burrows and an egg(s) on surface (75 × 44 mm) (outer island). Some 17 km distant, Taylor (1990) recorded 35 ōi burrows on an islet off Whangaparaoa Beach |
| kororā/blue penguin                                                  | ?    | Larger burrow than the ōi ones, on outer island                                                                                                               |
| tākapu/Australasian gannet                                           | +    | Flying close to islands                                                                                                                                       |
| little shag                                                          | +    | On associated reef                                                                                                                                            |
| kāruhiruhi/pied shag                                                 | +    | Up to 5 on associated reef, and roosting in the pōhutukawa on SW coast of Papaka Is.; also small numbers roost 200 m S of the islands in a pōhutukawa         |
| matuku moana/white-faced heron                                       | +    | On associated reef                                                                                                                                            |
| matuku moana/reef heron                                              | 1 pr | On associated reef                                                                                                                                            |
| tōrea pango/variable oystercatcher                                   | 1 pr | On associated reef                                                                                                                                            |
| spur-winged plover                                                   | 1 pr | On associated reefs                                                                                                                                           |
| karoro/black-backed gull                                             | ?    | Old nest either this sp. or a red-billed gull (outer island)                                                                                                  |
| tarāpunga/red-billed gull                                            | +    | Flock of c.10 birds on associated reef; 8 pairs, nesting behaviour on 2 islets, W side of Bay (27 Sep 2000)                                                   |
| kererū/NZ pigeon                                                     | +    | 2-3 together in Whanarua Bay not seen on Papaka Is.                                                                                                           |
| kōtare/kingfisher                                                    | +    | Especially on associated reefs                                                                                                                                |
| warou/welcome swallow                                                | +    |                                                                                                                                                               |
| riroriro/grey warbler                                                | +    |                                                                                                                                                               |
| blackbird *                                                          | c    |                                                                                                                                                               |
| pīwakawaka/fantail                                                   | +    |                                                                                                                                                               |
| tūī                                                                  | +    | Visiting rewarewa flowers                                                                                                                                     |
| korimako/bellbird                                                    | +    | Visiting rewarewa flowers                                                                                                                                     |
| chaffinch *                                                          | +    |                                                                                                                                                               |
| starling *                                                           | +    | In pōhutukawa above cliffs of inner island                                                                                                                    |