

AN ECOLOGICAL SURVEY OF WHATUPOKE ISLAND, HEN AND CHICKENS GROUP

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SUMMARY: The vegetation of Whatupuke Island (240 acres, lat. 35° 54' S., long. 174° 45' E.) is discussed under six headings: (1) Coastal herbs, grasses and shrubs; (2) *Cordyline* forest; (3)–(5) three phases in the succession after burning, with kanuka (*Leptospermum ericoides*) as a major species; and (6) puriri (*Vitex lucens*) — pohutukawa (*Metrosideros excelsa*) forest. Stands of the latter are probably the most mature to be found on the Chicken Islands.

The soils have been classified as related to the northern brown granular loams and clays on the eastern portion (overlying rocks of the Coppermine plutonic series) and as northern yellow-brown earths on the western end (overlying metamorphosed sedimentary rocks).

170 species of vascular plants were found on the island. Of these, 18 were not found on adjacent Coppermine Island, 40 species are added to the list for Coppermine Island, and 22 previous records are not confirmed.

Petrel burrows were found on all soil types provided there was sufficient depth, relatively open vegetative cover and at least a gradual slope.

INTRODUCTION

During the period 24–31 October 1968, a joint Wildlife Service — Ecology Division expedition visited Coppermine and Whatupuke Islands to record the status of as many aspects of the ecosystems of these islands as feasible, prior to possible prospecting for copper. Our project was to map the vegetation and soils of Whatupuke Island and to collect specimens of all its plants. As no voucher specimens were collected for the list published by Atkinson (1968) for Coppermine Island, an attempt was made to collect specimens of all plants growing on that island also. Two full days were spent on Coppermine Island and nearly four days on Whatupuke.

COPPERMINE ISLAND

Since Atkinson had recently published his fairly comprehensive account of the vegetation types on Coppermine Island, work on this island was restricted to the collection of plant specimens. A list of those collected, and those recorded by Atkinson, is given in the appendix. Of the 152 species recorded by him, 22 were not found by our party. However, 40 species were recorded for the first time, giving a total for the present visit

of 170. Parris (1969) added the common plum (*Prunus domestica*) to the list, but this has not been recorded by other parties. One kauri tree (*Agathis australis*) found above Coppermine Bay was 76 cm. in circumference at breast height and was bearing cones.

WHATUPOKE ISLAND

Whatupuke Island, with an area of 240 acres, is the second largest of the Chicken Islands (Fig. 1). With the other Chicken Islands it was declared a scenic reserve in 1920 and landing without written authority was prohibited in 1956.

The coastal slopes are generally very steep and, on the northern face of the main block, extend as a cliff to the summit, 775 ft. high. Away from the coast, slopes are less steep and gentler grades are found in a large basin behind the bay on the south coast.

The island has a long history of Maori occupation, and Mr. K. Peters, Anthropology Department, University of Auckland, suggests (pers. comm.) that the occupation on Whatupuke was more permanent and extensive than on Coppermine Island. The attempts to mine copper in the group last century were apparently confined to

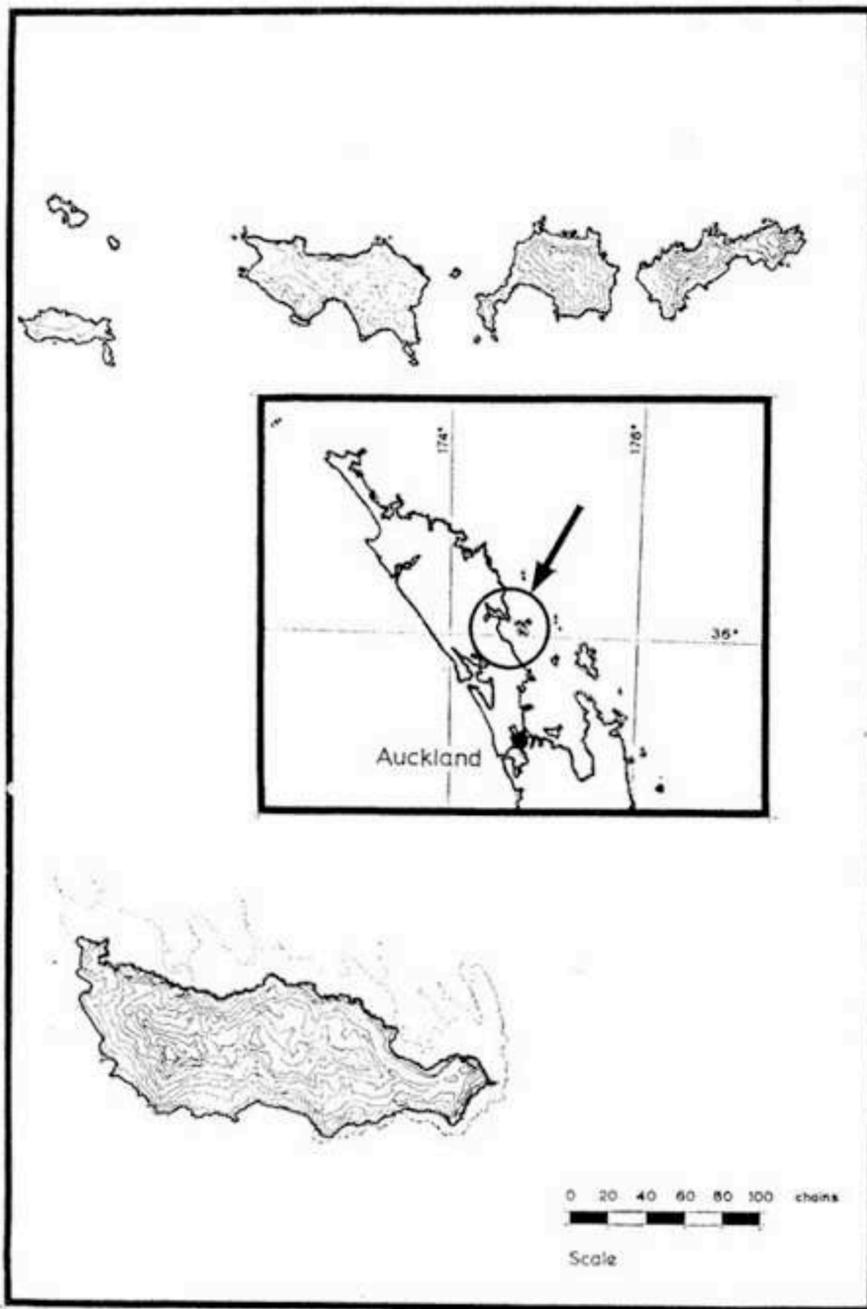


FIGURE 1. *Hen and Chickens Group*. The largest island is Hen (Taranga). Above Hen, from the left, are South-western and North-western, Big (Lady Alice, Marotiri, Motu Muka), Middle (Whatupuke), and Eastern Chicken (Coppermine) Islands.

(del. R. W. H. Simpson)

Coppermine Island; but recent investigations have included the adjacent eastern portion of Whatupuke Island where the rock types are the same.

Burning has had a considerable effect on the vegetation, but this effect is not as marked nor as widespread as on the other Chicken Islands, particularly Marotiri and Coppermine. The main basin supports probably the most mature forest stands to be found on the islands of this group.

To study the soils and vegetation of the island, 40 plots were located as shown in Figure 2. The

vegetation was qualitatively described by strata with particular reference to the state of the canopy and the occurrence of seedlings. At all but the first five plots a soil profile description was made. The frequency of bird burrows and the presence of any land birds were noted.

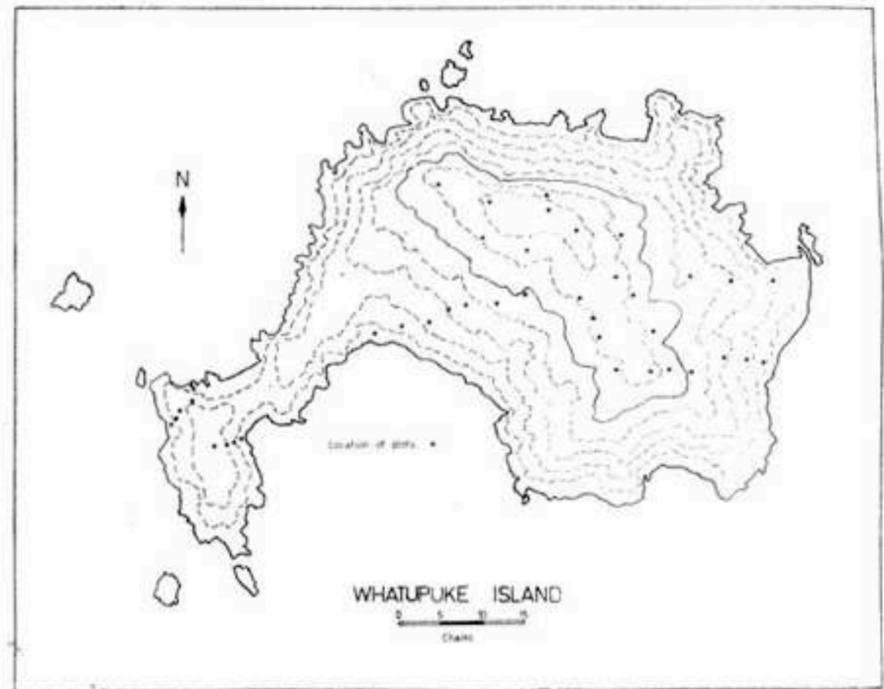


FIGURE 2. *Map of Whatupuke Island showing plot sites. Contours are at 100 ft. intervals.*

FLORA

A list of the plants found on Whatupuke Island is given in the appendix. Of the total of 170 species, 18 were not found on Coppermine Island. Of the total recorded from Coppermine Island 32 species were not found on Whatupuke, although 12 of these were not found on either island during this visit. Parris added five new species to previously published records for the Hen and Chicken Group from Whatupuke. Of these, only two were recorded by our party and neither of the two ferns recorded by Parris for the first time on Whatupuke was found. *Litsaea calicularis* ("one tree") and *Helichrysum glomeratum* were recorded from Whatupuke by Cranwell and Moore (1935) but were not found by members of this expedition. *Hymenophyllum sanguinolentum* was found on a rock tumble to the west of the summit under scattered kanuka 30 ft. high, which was emergent from a mixed canopy at 20 ft. dominated by fivefinger (*Pseudopanax arboreum*), broad-leaved coprosma (*Coprosma macrocarpa*) and mapou (*Myrsine australis*). The presence in the same area of large clumps of *Collospermum* and *Astelia* suggests that the site has been less modified

by fire than its surroundings and that the filmy fern colony is a remnant rather than a recent introduction.

Percy (1956) suggested that the limited running water and the absence of filmy ferns on Marotiri Island (Big Chicken) is indicative of a porous subsoil. On Whatupuke, running water is equally scarce and the subsoils are almost invariably impermeable. However, the nature of the limited occurrence of *H. sanguinolentum* on Whatupuke suggests that its present distribution in the group is a consequence of the widespread burning which has taken place. Under undisturbed conditions, features of the microclimate such as relative humidity probably determine the distribution of filmy ferns.

Jane and Beever (1965) attributed the low numbers of pteridophytes and monocotyledonous plants on Big Chicken to the general lack of ground cover. The higher proportion of both groups of plants on Whatupuke appeared to be associated with the wide range of micro-environment rather than with ground cover.

Plant communities

The vegetation has been divided into six communities:

1. The coastal community, a complex which includes succulents and other herbs, grasses and shrubs.
2. The *Cordyline* community, a basin on the eastern end dominated by cabbage trees (*Cordyline australis*).
- 3-5. Three phases in the succession follow-burning, with kanuka (*Leptospermum ericoides*) as a major species.
6. Puriri (*Vitex lucens*) — pohutukawa (*Metrosideros excelsa*) forest which includes virtually all of the tall forest found on the island and is dominated by one or other or both species.

The six communities are discussed in detail below. The distribution and extent of each is shown in Figure 3.

There appear to be few similarities between the communities found on Whatupuke and those described previously for Coppermine Island or Marotiri Island, apart from that of the coastal cliff and some of the *Leptospermum* communities.

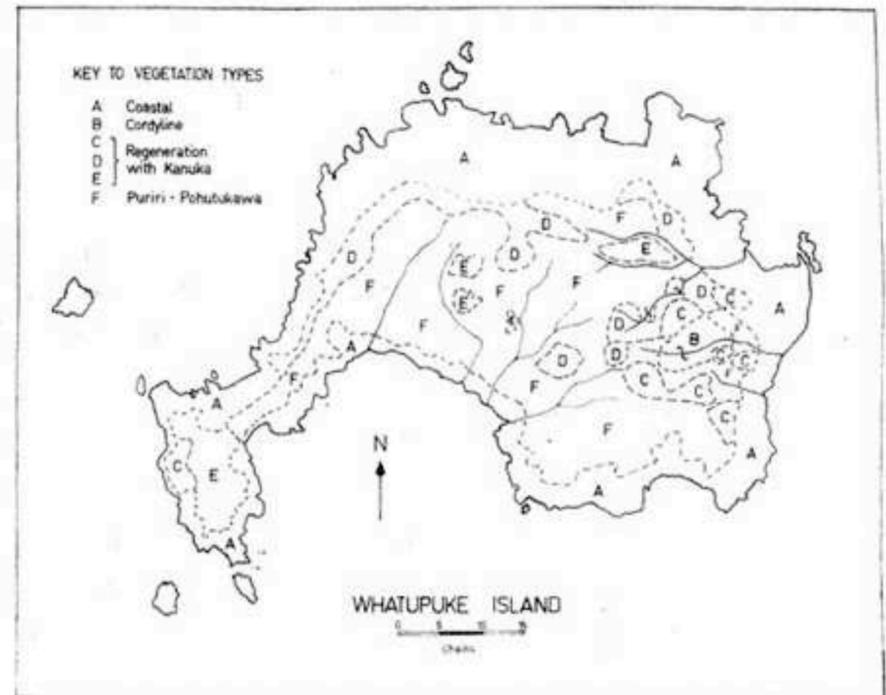


FIGURE 3. *Vegetation of Whatupuke Island.*

On Whatupuke there is no obvious differentiation of the forest with altitude or surface configuration, although some specific preferences were noted.

Coastal: The vegetation on the steep or exposed coastal faces is variable but is generally characterised by a few major species which assume local dominance, such as *Disphyma*, flax (*Phormium tenax*), taupata or pohutukawa scrub. The belt is widest on the high northern face but tapers off to the east and west with only a very narrow strip at the foot of the gentler slopes bordering the bay on the south coast.

Immediately above the coastal rocks and also on rock outcrops above, are succulents, halophytes and a number of other herbs, both native and introduced. Above these, on drier ridges and in eroding gullies, annual grasses and herbs form a sward. On shallow soils on rocky ridges and slopes, flax forms a belt with *Astelia*, sedges, toe-toe (*Cortaderia* sp.), coastal *Asplenium* and a variety of annuals. In sheltered areas there is a scrub cover consisting of taupata, ngaio (*Myoporum laetum*), hymenanthera (*Hymenanthera novae-zelandiae*), karo (*Pittosporum crassifolium*), kanuka and pohutukawa with an occasional stunted broad-leaved coprosma and karaka (*Corynocarpus laevigatus*). The height of the scrub varies from only 1½–2 ft. in exposed positions to about 6 ft. in more sheltered situations. *Hebe stricta* tends to be found in patches of scrub on sheltered sites with deep soils. Renga lily (*Arthro-*

podium cirrhatum) is generally found on rocky seepages. The different zones are often intermingled and vary in extent depending upon the degree of exposure.

Cordyline: This community is located in a mid-slope basin on the eastern end of the island. Trees are about 30 ft. in height and up to 2–3 ft. in diameter at breast height (d.b.h.). Cabbage trees are co-dominant with puriri and pohutukawa at the head of the basin and with kohekohe (*Dysoxylum spectabile*) and karaka nearer the coastal slopes. In the gullies and on the gentler slopes near the lower edge of the basin, stands are virtually pure *Cordyline*. Elsewhere there is a range of broad-leaved species below slightly emergent cabbage trees.

Regeneration with kanuka dominant: On the eastern end of the island are several stands with a complete or near-complete canopy of kanuka between 15–20 ft. high. Where the kanuka gives complete cover, few other species are present. There is a deep coarse litter on the ground with scattered plants of *Doodia* and *Pterostylis banksii* only. Where the canopy is open, an often dense growth of broad-leaved species forms an understorey. The more common species are mapou, mahoe (*Melicactus ramiflorus*), pigwood (*Geniostoma ligustrifolium*), fivefinger and broad-leaved coprosma. In older stands, clumps of *Gahnia* and flax, *Pterostylis trullifolia* and *Acianthus* are present on the floor with the lianes *Parsonsia* and pohuehue (*Muehlenbeckia complexa*) above.

Regeneration with kanuka emergent from a mixed canopy: In patches on the main spurs at the eastern end of the island and in a belt along the ridge above the northern slopes kanuka, with a height of about 30 ft. and approaching 12 in. d.b.h., is emergent above a mixed canopy at about 20 ft. The major species in the canopy are mapou, mahoe, hohera (*Hoheria populnea*), broad-leaved coprosma, fivefinger and pigwood. In the older stands fivefinger and hohera are emergent with kanuka. Kohekohe was also seen in the lower canopy in this community. Usually there is also a shrub layer consisting mainly of *Coprosma rhamnoides*.

Regeneration with kanuka a scattered co-dominant: This community is on the western peninsula and in patches in the main basin. The canopy is generally open at about 30–35 ft. The major

canopy species are: kanuka, puriri or pohutukawa (or both), fivefinger, and kohekohe. Mapou, mahoe, pigwood and broad-leaved coprosma form an understorey at about 15 ft. The ground-storey includes: *Doodia*, *Asplenium lucidum*, *Astelia*, *Carex*, *Uncinia*, *Acianthus* and *Pterostylis trullifolia*. On the upper, south-west facing slopes of the main basin, rewarewas (*Knightia excelsa*) locally take the place of puriri, their conical crowns piercing the canopy.

All the last three stages in the succession are usually present and the boundaries that have been drawn between them are arbitrary. In some instances the different stages merge or intermingle. The area of the last stage on the western peninsula may be stable in its present form because of its proximity to coastal influences. However, most of the other areas appear capable of developing to puriri-pohutukawa forest.

Puriri-pohutukawa forest: This community is found over most of the main basin, on the south-east facing slopes of the neck and on the south-east corner of the island. On the broader slopes there is generally a mixture of puriri and pohutukawa but there is a tendency for puriri to be dominant in the deeper gullies and pohutukawa to be dominant on the ridges.

The depth of the transition zone from the coastal community to the forest varies with the degree of exposure and depth of soil. This zone is usually marked by the presence of kawakawa (*Macropiper excelsum*) and mahoe. This gives way on the slopes and ridges to pohutukawa (ca. 18 in. d.b.h.) which forms a fairly complete canopy at 30–40 ft., with karo as a partial sub-canopy just below and an understorey at 15–20 ft. consisting mainly of karaka but including kawakawa, broad-leaved coprosma, kohekohe and pukaniu (*Meryta sinclairii*). Pukanui is common in the coastal gullies. This type merges rapidly into stands of mixed puriri and pohutukawa about 30 ft. high with a broken sub-canopy of karaka, kohekohe, mahoe and mapou and an understorey of tawapou (*Planchonella novo-zelandica*), karaka, kawakawa, broad-leaved coprosma and pigwood.

Nikau (*Rhopalostylis sapida*) seedlings and tree ferns are common locally on the higher slopes with the tree ferns particularly common in the gullies. Where the canopy is open, a dense sub-

canopy of mapou, kohekohe, karaka, taraire (*Beilschmiedia taraire*), fivefinger and pigeonwood (*Hedycarya arborea*) is usually present.

The most mature stands were seen on some gentle mid-basin slopes. They consist of a complete canopy of puriri (ca. 18–20 in. d.b.h.) and pohutukawa (ca. 24–30 in. d.b.h.) in about equal proportions and about 35–40 ft. high, and at a density of about 30 trees/acre. An occasional kohekohe, tawapou, karaka and broad-leaved maire (*Nestegis apetala*) form a scattered sub-canopy. A few saplings of parapara (*Heimerliodendron brunonianum*), karaka, kawakawa and pukanui were present. There was a deep (5 cm.) litter on the floor with scattered seedlings of pigeonwood, karaka and pukanui and the ferns *Asplenium lucidum*, *A. bulbiferum*, *Doodia* and *Pteris comans*. In a broad gully towards the back of the basin, puriri (ca. 36 in. d.b.h.) forms a dense canopy at 40 ft., with some pohutukawa (ca. 24 in. d.b.h.). Parapara, broad-leaved maire, hohere, karaka and wharangi (*Melicope ternata*) form a scattered subcanopy. The understorey consists of several broad-leaved species, and supplejack (*Rhipogonum scandens*) is present.

SOILS

A preliminary soil survey was attempted using a 1½ in. diameter auger. The following properties were described: depth of topsoil and subsoil, colour, texture and, where possible, structure. The conclusions and correlations based on the data obtained must be regarded as tentative.

The geology of part of the eastern end of Whatupuke Island is discussed briefly by Thompson *et al.* (1967); but a more complete description is given by Small (1969). Most of the eastern half of the island is composed of rocks of the Coppermine plutonic series, mainly medium-grained quartz diorite but with some fine-grained tonalite near the north-eastern corner. The remainder of the island is composed of metamorphosed sedimentary rocks of the Waipapa group; hornblende hornfels occurs near the contact with the plutonics and grades to albite-epidote hornfels away from it. Small's boundary between the hornfels and the plutonics is shown in Figure 4. Andesitic dykes occur at intervals around the coastline.

The better-developed soils on the rolling and hilly land overlying the plutonic rocks usually

consist of about 6 in. of dark greyish-brown silty clay loam of fine granular to nutty structure, overlying about 6 in. of brown to pale brown compact clay loam with reddish mottles; and this lies above yellowish-brown compact clay loam. The better-developed soils on the rolling and hilly land overlying the metamorphosed sedimentary rocks have about 4–6 in. of dark greyish-brown silt loam of less well developed structure, over about 6–8 in. of dark yellowish-brown compact silty clay loam above yellowish-brown compact silty clay loam. Soils of the first kind are found on slopes of up to 25° while those of the second kind are found on slopes of up to 30°.

Soils on the steep-lands are only about 9–18 in. thick, with up to 6 in. of grey-brown sandy silt to silt loam of weakly to moderately developed structure above paler friable sandy silt to silt loam. These are found on the coastal slopes and there is a range of profile development depending upon the degree of stability.

In many of the gullies, topsoils have been eroded and burrowing by petrels has assisted in mixing the remaining soil with rock fragments. Stony soils were found at various locations over the island.

Soil Bureau staff (N.Z. Soil Bureau, 1954), on the basis of a reconnaissance survey, classified the soils of both Coppermine and Whatupuke Islands as skeletal soils. Those on Coppermine belong to the Te Kie set and those on Whatupuke to the Te Ranga set. On the basis of the genetic classification system (N.Z. Soil Bureau, 1968) the soils on Coppermine Island, mainly on plutonic rocks and hypabyssal intrusives, would be classed as steep-land soils related to the northern brown granular loams and clays, and those on Whatupuke Island, mainly on sedimentaries, as steep-land soils related to the northern yellow-brown earths.

Results of the present survey suggest that, in addition to the steepland soils, the soils on rolling and hilly lands may be classified as follows: The heavy, generally finer-structured soils on the eastern end of the island are allied to the northern brown granular loams of the Awapuku set; whereas the not so heavy generally coarser-structured soils farther west fall into the Marua set of the northern yellow-brown earths. The shallower stony or light-textured soils of the coastal faces

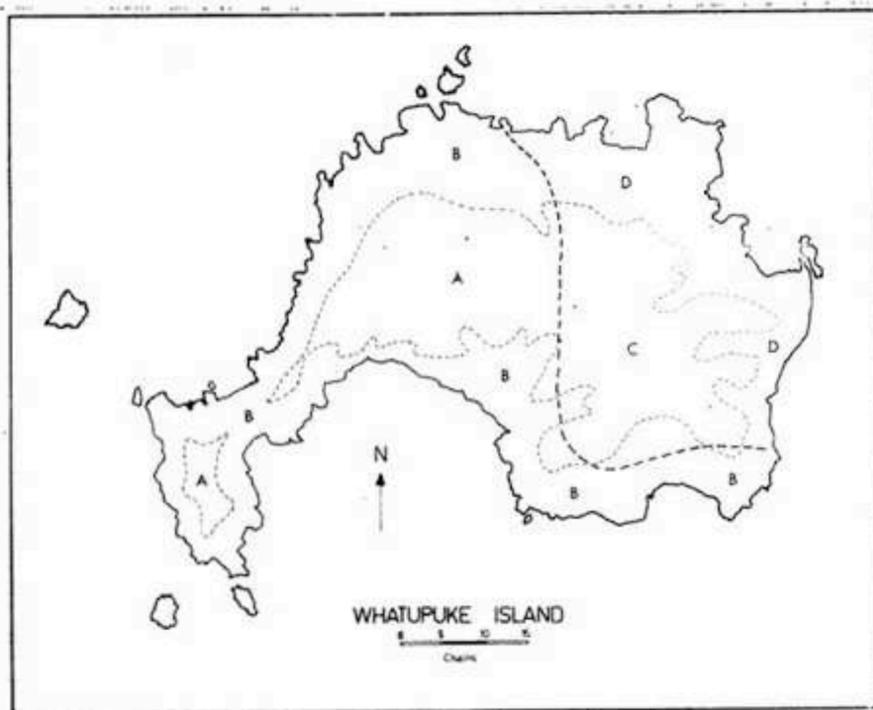


FIGURE 4. Soils of Whatupuke Island.

Northern yellow-brown earths: A: on rolling and hilly lands, *Marua set* (brown silt loam and silty clay loam); B: on steep-lands, *Te Ranga set* (stony silt loams)* C: Northern brown granular loams and clays: on rolling and hilly lands, *Awapuku set* (silty clay loam); D: on steep-lands, *Te Kie set* (stony silt loam and silty clay loam)*.

* includes bare rock faces and shingle slides.

--- Soil boundaries.

----- Boundary between diorite and hornfelsed greywacke (after Small, 1969) and approximate boundary between northern brown granular loams and clays and northern yellow-brown earths.

are classed as Te Kie clay loam and stony loam and Te Ranga clay loam and stony loam respectively. The distribution of the different soils is given in Figure 4. For mapping purposes, the steep-land soils include small areas of true skeletal soils and rock outcrops.

The steep-land soils support species of the coastal plant community, with succulents and annuals on the less-developed and scrub on the more mature. On the sheltered sites these soils may also support some forest species. The deeper heavier soils of the rolling and hilly land support the more extensive kanuka and forest communities. The cabbage tree community appears to be associated with an area of bouldery soils. What appeared to be small charcoal fragments were found at seven sites, in all but one, under kanuka at a depth of about 18 in.

BIRDS

North Island saddlebacks (*Philesturnus carunculatus rufosater*) were liberated on Whatupuke Island in January-February 1964. Sixteen months later adults and juveniles were found to be fairly evenly distributed over the whole island (Merton 1965). By October 1968 the distribution pattern had reverted to that found on Hen Island by Atkinson and Campbell (1966) — most birds were seen and heard about the coastal scrub and forest margin and in the younger mixed kanuka stands, with an occasional pair in the tall forest. Most of the other land birds listed by Merton and Atkinson (1968) for Whatupuke Island were found to have a distribution pattern similar to that of the saddlebacks.

Notes were also taken on the distribution of bird burrows over the island. However, data are insufficient to provide a map of the densities. Merton and Atkinson found that areas densely burrowed by flesh-footed shearwaters (*Puffinus carneipes hullianus*) on Coppermine Island have very friable sandy soils. Atkinson suggested that low numbers of petrel burrows under kanuka on Coppermine Island are probably due to compact soils.

On Whatupuke Island, petrel burrows were recorded at 29 of the 40 plot sites. At 13 of these burrows are prolific. As previously mentioned, no friable sandy soils were recorded on the island. Dense burrowing was recorded on all types of soil at all altitudes. Data for plots where few or no burrows were recorded were examined for possible factors affecting the distribution. Limiting factors appear to be insufficient depth of soil arising from soil loss by erosion, the presence of rocks or both; dense regeneration giving an impenetrable canopy and ground cover; or insufficient slope — burrows were not found on slopes of less than about 5°. Burrows of different species and mixed populations were noted in certain areas but very little is known of the distribution of the various species on the island. More detailed work is needed before specific preferences for soil types or other factors may be ascertained.

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APPENDIX

Plant list for Coppermine and Whatupuke Islands (Hen and Chickens Group)

TREES AND SHRUBS	COPPER-MINE	WHATU-PUKE
<i>Agathis australis</i>	R	
<i>Beilschmiedia tarairi</i>	+	R
<i>B. tawa</i>	+	R
<i>Brachyglottis repanda</i>	+	R
<i>Carmichaelia cunninghamii</i>	+	X
<i>Coprosma areolata</i>	R	R
<i>C. australis</i>	+	R
<i>C. macrocarpa</i>	+	R
<i>C. repens</i>	+	R

TREES AND SHRUBS	COPPER-MINE	WHATU-PUKE
<i>C. rhamnoides</i>	+	R
<i>C. robusta</i>	+	R
<i>C. spathulata</i>	P	
<i>Cordyline australis</i>	+	R
<i>Coriaria arborea</i>	+	R
<i>Corynocarpus laevigatus</i>	+	R
<i>Cyathodes fraseri</i>	+	R
<i>Dysoxylum spectabile</i>	+	R
<i>Elaeocarpus dentatus</i>	R	
<i>Entelea arborescens</i>	+	R
<i>Geniostoma ligustrifolium</i>	+	R
<i>Hebe parviflora</i>	+	R
<i>Hebe stricta</i>	†	
<i>H. stricta</i> var. <i>stricta</i> †	R	R
<i>Hedycarya arborea</i>	+	R
<i>Heimerliodendron brunonianum</i>	+	R
<i>Hoheria populnea</i>	+	R
<i>Hymenanthera novae-zelandiae</i>	+	R
<i>Knightia excelsa</i>	A	R
<i>Leptospermum ericoides</i>	+	R
<i>L. scoparium</i>	+	
<i>Litsaea calicaris</i>		C
<i>Macropiper excelsum</i>	+	R
<i>Melicope ternata</i>	+	R
<i>Melicytus ramiflorus</i>	+	X
<i>Meryta sinclarii</i>	+	R
<i>Metrosideros excelsa</i>	+	R
<i>M. robusta</i>	R	
<i>Myoporum laetum</i>	+	R
<i>Myrsine australis</i>	+	R
<i>M. salicina</i>	R	
<i>Nestegis apetala</i>	+	R
<i>N. lanceolata</i>	A	
<i>Olearia furfuracea</i>	A	X
<i>Paratrophis banksii</i>	A	R
<i>Pimelea prostrata</i>	+	R
<i>Pittosporum crassifolium</i>	+	R
<i>P. umbellatum</i>	A	
<i>Planchonella novo-zelandica</i>	+	R
<i>Pomaderris phyllicifolia</i>	†	
<i>P. phyllicifolia</i> var. <i>ericifolia</i> †	R	
<i>Prunus domestica</i>	P	
<i>Pseudopanax arboreum</i>	+	R
<i>P. lessonii</i>	+	R
<i>P. arboreum</i> × <i>lessonii</i> ?		R
<i>Rhabdothamnus solandri</i>	+	R
<i>Rhopalostylis sapida</i>	+	R
<i>Schefflera digitata</i>	+	R
<i>Solanum aviculare</i>	A	R
<i>Sophora microphylla</i>	+	R
<i>Vitex lucens</i>	+	R

LIANES

<i>Calystegia turguriorum</i>	+	R
<i>Clematis paniculata</i>	+	R
<i>Metrosideros perforata</i>	+	
<i>Muehlenbeckia complexa</i>	+	R
<i>Parsonia heterophylla</i>	+	R
<i>Rhipogonum scandens</i>	+	R
<i>Sicyos angulata</i>	+	R

FERNS

<i>Adiantum aethiopicum</i>		RP
<i>A. cunninghamii</i>	+	R

	COPPER- MINE	WHATU- PUKE		COPPER- MINE	WHATU- PUKE
<i>A. hispidulum</i>	+	R	<i>Microlaena polynoda?</i>	R	
<i>Anarthropteris lanceolata</i>		R	<i>Notodanthonia unarede</i>	A	R
<i>Arthropteris tenella</i>	+	R	<i>Notodanthonia sp.</i>	R	
<i>Asplenium bulbiferum</i>	+	R	<i>Oplismenus undulatifolius</i> †	A	
<i>A. bulbiferum</i> × <i>flaccidum</i> ?		R	<i>O. imbecilis</i>	R	R
<i>A. falcatum</i>	+	R	<i>Parapholis incurva</i>		R
<i>A. flaccidum</i>	+	R	<i>Phalaris minor</i>	R	R
<i>A. lamprophyllum</i>		P	<i>Poa anceps</i>	A	
<i>A. lucidum</i>	+	X	<i>P. anceps</i> "fine head"†	R	
<i>A. obtusatum</i> var. <i>obliquum</i>		R	<i>P. anceps</i> var. <i>densum</i>	R	R
<i>Blechnum aggregatum</i>	A		<i>Sporobolus capensis</i> †	A	
<i>B. capense</i>	R	R	<i>S. africanus</i>	R	
<i>B. filiforme</i>	A	R	<i>Stenotaphrum secundatum</i>		RP
<i>B. membranaceum</i>	R	R	<i>Trisetum sp.</i>	+	
<i>Cheilanthes distans</i>	R	R	<i>Vulpia bromoides</i>	R	R
<i>C. sieberi</i>		R			
<i>Cyathea dealbata</i>	+	R	OTHER HERBACEOUS PLANTS		
<i>C. medullaris</i>	+	R	<i>Acianthus fornicatus</i> var.		
<i>Doodia media</i>	+	R	<i>sinclarii</i>	R	R
<i>Hymenophyllum sanguinolentum</i>		R	<i>Anagallis arvensis</i>	A	R
<i>Lastreopsis velutina</i>	R	R	<i>Angelica rosaeifolia</i>	+	R
<i>Paesia scaberula</i>	R		<i>Apium australe</i>	+	R
<i>Pellaea rotundifolia</i>	A	R	<i>Arthropodium cirrhatum</i>	+	R
<i>Phymatodes diversifolium</i>	+	R	<i>Astelia banksii</i>	+	R
<i>Polystichum richardii</i> †	A		<i>A. solandri</i> ?	R	
<i>P. vestitum</i>		R	<i>Aster sp.</i>	R	
<i>P. vestitum</i> × <i>richardii</i> ?	R		<i>Bidens pilosa</i>	R	R
<i>Pteridium esculentum</i>	+	R	<i>Brassica campestris</i>	+	R
<i>Pteris comans</i>	+	R	<i>Calystegia soldanella</i>		R
<i>P. tremula</i>	+	R	<i>Calystegia sp.</i> (pubescent)		R
<i>Pyrrosia serpens</i>	+	R	<i>Carduus tenuiflorus</i>	R	R
<i>Thelypteris pennigera</i>	A	R	<i>Centaurium erythraea</i>	+	R
<i>Trichomanes endlicherianum</i>		P	<i>Cerastium sp.</i> †	A	
			<i>C. glomeratum</i> †	R	R
SEDGES			<i>Cirsium vulgare</i>	+	R
<i>Carex breviculmis</i>	+	R	<i>Collospermum hastatum</i>	+	R
<i>C. dissita</i>	A		<i>Conyza canadensis</i>	A	
<i>C. lucida</i>	R	R	<i>Cotula australis</i>	R	
<i>C. vacillans</i>	+	R	<i>Crepis capillaris</i>	R?	R
<i>Gahnia lacera</i>	+	R	<i>Daucus glochidiatus</i>		R
<i>Lepidosperma australe</i>	+	R	<i>Dianella intermedia</i>	+	R
<i>Mariscus ustulatus</i>	+	R	<i>Dichondra repens</i>	+	R
<i>Scirpus cernuus</i>	+	R	<i>Disphyma australe</i>	+	R
<i>S. nodosus</i>	+	R	<i>Drosera auriculata</i>	+	
<i>Uncinia uncinata</i>	+	R	<i>Euphorbia glauca</i>		R
			<i>Geranium pilosum</i>	+	R
GRASSES			<i>Gnaphalium collinum</i>	+	
<i>Aira caryophyllea</i>	+	R	<i>G. japonicum</i>	R	R
<i>Anthoxanthum odoratum</i>	A		<i>G. luteo-album</i>	+	R
<i>Avena sp.</i>	R		<i>G. purpureum</i> †	A	
<i>Briza minor</i>	A		<i>G. purpureum</i> (a)†	R	R
<i>Bromus arenarius</i>	R	R	(b)		R
<i>B. diandrus</i>	+	R	<i>Haloragis erecta</i>	+	R
<i>B. mollis</i>	+	R	<i>H. procumbens</i>	R	
<i>Cortaderia toetoe</i> †	A		<i>Helichrysum glomeratum</i>		C
<i>Cortaderia sp.</i> †	R	R	<i>Hydrocotyle elongata</i>	+	
<i>Dactylis glomerata</i>	+		<i>Hypochaeris glabra</i>	R	
<i>Deyeuxia billardieri</i>	A		<i>H. radicata</i>	+	R
<i>Dichelachne crinita</i>	+	R	<i>Ipomoea palmata</i>		P
<i>Echinopogon ovatus</i>	R	R	<i>Lepidium sp.</i> (Introd.)†	A	
<i>Holcus lanatus</i>	+		<i>L. ruderales</i> †	R	R
<i>Lachnagrostis filiformis</i> var.			<i>Linum monogynum</i>	+	R
<i>littoralis</i>	R	R	<i>Lobelia anceps</i>	+	R
<i>Lagurus ovatus</i>		P	<i>Lotus hispidus</i>	A	

	COPPER- MINE	WHATU- PUKE		MINE COPPER-	PUKE WHATU-
<i>L. pedunculatus</i>	R?	R	<i>S. hispidulus</i> var. <i>scaberulus</i>		R
<i>Lycopodium volubile</i>	R		<i>S. lautus</i>	A	X
<i>Microtis unifolia</i>	+	R	<i>S. minimus</i>	R	R
<i>Orobanche minor</i>	+	R	<i>S. quadridentatus</i>	R	R
<i>Oxalis corniculata</i>	+	R	<i>Solanum nigrum?</i>		R
<i>O. corniculata</i> var. <i>microphylla</i>		R	<i>S. nodiflorum</i>	+	
<i>Parietaria debilis</i>	A	X	<i>Sonchus oleraceus</i>	+	R
<i>Pelargonium inodorum</i>	+	R	<i>Stellaria parviflora</i>	+	R
<i>Peperomia urvilleana</i>	+	R	<i>Stellaria media</i>	R	R
<i>Phormium tenax</i>	+	R	<i>Taraxicum officinale</i>	A	
<i>Phytolacca octandra</i>	+	R	<i>Tillaea sieberiana</i>	R	R
<i>Plantago lanceolata</i>	+		<i>Tetragonia trigyna</i>	+	R
<i>P. major</i>	R		<i>Thelymitra longifolia</i>	+	R
<i>Polycarpon tetraphyllum</i>	+	R	<i>Typha muelleri</i>	R	
<i>Pterostylis banksii</i>	+	R	<i>Wahlenbergia gracilis</i>	+	R
<i>P. trullifolia</i>	R	R	<i>W. colensoi</i>		R
<i>P. trullifolia</i> var. <i>alobula</i>		R			
<i>Ranunculus hirtus</i>	+				
<i>Rhgodia triandra</i>	+	R			
<i>Sagina procumbens</i>	R				
<i>Salicornia australis</i>	+	X			
<i>Samolus repens</i>	+	R			
<i>Sarcochilus adversus</i>		R			
<i>Senecio bipinnatisectus</i>	R	R			
<i>S. glomeratus</i>	+				
<i>S. hispidulus</i> †	A				
<i>S. hispidulus</i> var. <i>hispidulus</i> †	R	R			

+=Recorded by Atkinson and by Ritchie & Ritchie.
 A=Recorded by Atkinson.
 R=Recorded by Ritchie & Ritchie; voucher specimens deposited in the herbarium, Botany Division, D.S.I.R. (CHR).
 X=Recorded by Ritchie & Ritchie but no specimens taken.
 P=Recorded by Parris.
 C=Recorded by Cranwell and Moore.
 †=Signifies that probably only the one species is involved.