

THE VEGETATION OF THE ALDERMEN ISLANDS: A REAPPRAISAL

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SUMMARY

The vegetation of the Aldermen Islands has been modified by fires lit by man. Since the first survey in 1925, regeneration from 'meadow' vegetation to scrub and 7m high forest has occurred. Individual islands have been modified to a greater or lesser extent, and therefore possess rather different floras. Middle Island has the richest flora (73 species) and its vegetation may not have been disturbed this century. The total flora of the group consists of 100 species. Although the vegetation has been modified, the islands still form an extremely valuable reserve for rare species and the communities in which these are found.

INTRODUCTION

The vegetational history of the Aldermen Islands since occupation by the Maori has not been well recorded, and conflicting reports have been given. In some accounts (Bell, Sladden and Falla, 1951; Falla, 1953) the indigenous vegetation is indicated to have been extensively modified whereas Cochrane (1962) states that the Aldermen Islands are 'a remnant of primaeval New Zealand'. Moore (1973) provides abundant evidence for a substantial Maori occupation of the Aldermen. Alteration by fires seems to have occurred during the first few decades of this century. Cochrane (1962) notes that dense vegetation on other islands, and at mainland localities, was burned repeatedly after 1830 by Maori birding parties to facilitate access to petrel burrows.

Falla, Sladden, and other workers provide evidence (Internal Affairs Department File 46/29/13) that suggests a steady regeneration of vegetation has taken place since the visit by Sladden and Falla in 1925 (Sladden and Falla, 1927). The last and perhaps the only recorded fire occurred on Hongiora in 1935.

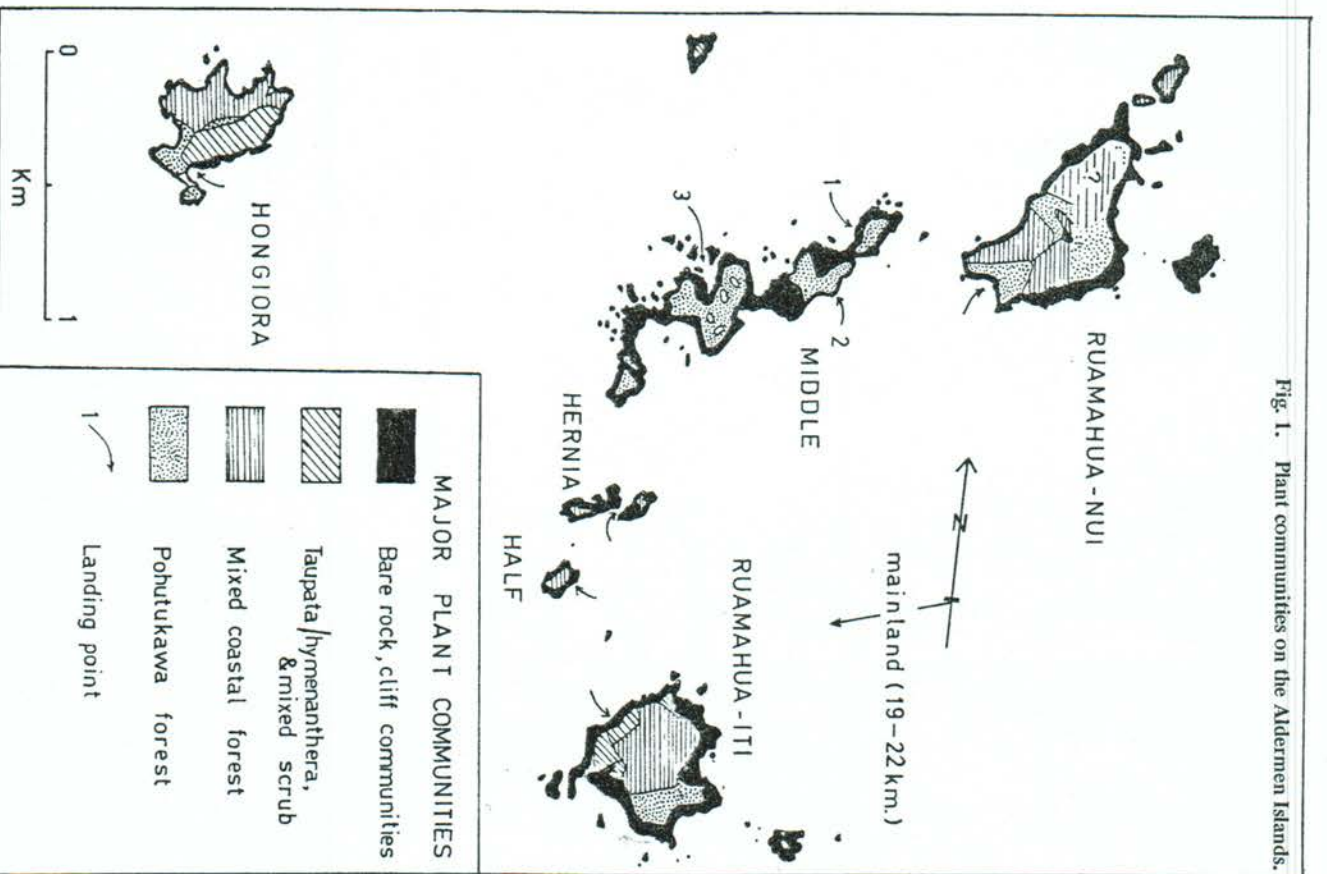
Sladden and Falla (1927) and Cochrane (1962) have published full accounts of the vegetation of the Aldermen Islands, but neither accounts make any allowance for any cultural modification that may have taken place, save for the mention of a few European weeds. The present paper is an attempt to re-describe the vegetation in the light of the unpublished Internal Affairs file and the findings made during the 1972 Field Club scientific camp.

COMMUNITY TYPES

Sladden and Falla (1927) included 'natural meadow' among the plant communities of the Aldermen Islands. They described it as a complex mixture of grasses, small herbs, sedges, manuka (*Leptospermum scoparium*), bracken

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Fig. 1. Plant communities on the Aldermen Islands.



(*Pteridium aquilinum* var. *esculentum*), and flax (*Phormium tenax*), intersected in all directions by tunnels and passages through which the nesting petrels gained access to their burrows. This heterogeneous vegetation (combining characters of grassland and scrubland) was found covering large areas of Ruamahua-iti, Ruamahua-nui, and Hongiora. Smaller areas of meadow were found on these three islands by Cochrane in 1952 (published 1962). The present study shows no appreciable areas of this vegetation still existing on any of the islands. For reasons to be discussed later, the term 'natural meadow' is considered to be unsuitable for the community described by Sladden and Falla (1927) and Cochrane (1962). The only vegetation type now on the islands justifying the term 'meadow' is that in which the grass *Poa anceps* is dominant.

The remaining communities of the above authors are included in coastal forest, coastal scrub, and cliff vegetation. The forest and scrub now appears somewhat changed in composition and has become much more widespread.

Classification of communities in relation to site.

The community types mapped (Fig. 1) are listed below in relation to the sites with which they are associated. On many parts of the islands the communities blend in smooth transition.

Community/Soil Type	Site Type
1. Shore and cliff vegetation/shallow rocky soils, unburrowed.	Shingle above high tide level, cliffs, ledges, and platforms.
2. <i>Poa anceps</i> meadow/burrowed humic friable loam.	Moderately steep slopes.
3. Mixed coastal scrub/burrowed friable, often stony loam.	Moderately steep slopes.
4. Taupata- <i>Hymenanthera</i> scrub/burrowed, friable, often peaty loam.	Stable, level ground on Hongiora.
5. Manuka-mixed scrub/firm loam, unburrowed.	Remnant areas within other scrub and forest communities on moderate slopes.
6. Mahoe forest/burrowed friable loam.	Moderately steep slopes.
7. Karo forest/burrowed friable loam.	Level ground to moderately steep slopes.
8. Pohutukawa forest/friable to firm loam, rock crevices.	Level ground to steep slopes and ledges.
1. Cliff and shore vegetation.	

Limited soil accumulation on shore platforms, cliff ledges, and crevices allows the development of vegetation 0.3m in height. This community is variable in composition but nearly always characterised by carpets of ice plant (*Disphyma australe*), especially on the ledges most exposed to wind and salt spray.

In exposed situations the main species are *Apium australe*, *Lobelia anceps*, *Muehlenbeckia complexa*, *Pinela prostrata*, *Rhagodia triandra*, *Salicornia australis*, *Samolus repens*, *Scirpus nodosus*, *Spergularia media*, *Tetragonia trigyna*, *Tillaea siebertiana*, and the grasses *Deyouzia billiardieri* and *Poa anceps*. A degree of shelter allows renga lily (*Arthropodium cirratum*) and the adventive inkweed (*Phytolacca octandra*) to establish.

Throughout this community are found stunted shrubs of taupata (*Coprosma repens*), *Hymenanthera novae-zelandiae*, karo (*Pitosporum crassifolium*), and pohutukawa (*Metrosideros excelsa*).

2. *Poa anceps* meadow

This community is dominated by the grass *Poa anceps*. It is found growing most vigorously on 30-50° slopes of deep humic loam, with a north-east to westerly aspect. Although the community does not cover large areas it is widespread, and ranges from a few metres above sea level to 150 metres in altitude. Petrel burrows usually riddle the soil, so that progress on foot is difficult.

Other species commonly occurring in this community include *Deyouzia*, *billiardieri*, *Disphyma australe*, *Tetragonia trigyna*, and the fern *Asplenium flaccidum*. In places the sedge *Cyperus usulatus* and pohuehue (*Muehlenbeckia complexa*) form islands or clumps within the community.

3. Mixed coastal scrub

Four shrub species in varying proportions make up the mixed coastal scrub, which is 1-4m in height. Taupata, karo, ngaio (*Myoporum laetum*), and *Hymenanthera novae-zelandiae* may each form up to 50% of the scrub cover. Scattered specimens of *Carnichea williamsii* (Ruamahua-iti only), flax, and *Hebe pubescens*, occur, and in more sheltered areas behind clumps of scrub, poroporo (*Solanum aviculare*), inkweed, and kawakawa (*Macropiper excelsum* var. *maius*) are common. The coastal scrub may be extremely dense, but where it is more open an undergrowth of *Poa* meadow develops and spreads beneath the shrubs.

4. Taupata-*Hymenanthera* scrub.

This most distinctive community is found on Hongiora only; taupata and *Hymenanthera* are co-dominants. The soil is nearly level peaty loam which, though extensively burrowed, has surface areas which seem to be stable and apparently have been undisturbed for at least a year. Apart from the occasional *Asplenium flaccidum* or *A. lucidum*, no understorey exists. All seedlings present showed damage caused by bird movements, so that seedling establishment would appear to be very difficult. The heavily manured soil, where aerated by burrowing, allows vigorous and luxuriant mature taupata-*Hymenanthera* scrub to develop. Single specimens of taupata may reach a very large size; from 2-3m in height, they may each sprawl over an area of 20m². Average specimens of taupata and *Hymenanthera* are 10m² in area. Within the scrub, islands of flax cover small areas. Progress in this scrub involves stepping over prostrate trunks and then into petrel burrows beyond!

5. Manuka-mixed scrub.

Small areas of manuka form a dense 2-4m high scrub. The manuka is intermixed with *Hebe pubescens*, *Geniosoma ligustrifolium*, *Pseudopanax lessonii*, and small trees of *Melicynus*, *Pitosporum*, and *Metrosideros*. Patches of flax and *Carnichea* also occur. Few of the manuka plants are very vigorous, growth apparently being slow, and they form dense thickets of interwoven branches. Cochran (1962) reports prostrate manuka on ridges and cliff crests, but most of the manuka found during this visit is on less exposed areas such as slopes leading up to ridge tops. The closed canopy of the scrub allows few understorey plants. Soil surfaces are stable and have a compact litter layer. No petrel burrows are present.

6-8. Mahoe, karo, and pohutukawa forest.

The greatest area of the islands is covered in coastal forest. Three trees, mahoe (*Melicynus ramiflorus*), karo, and pohutukawa may form either pure forest communities or a mixed forest type. Most of the forest reaches an average height of 7m, and many individual trees of all three species reach a height of 10-12m. In places the canopy may be formed of a mixture of mahoe, karo, pohutukawa, and *Paratrophis banksii*. On Middle Island karaka (*Corynocarpus*

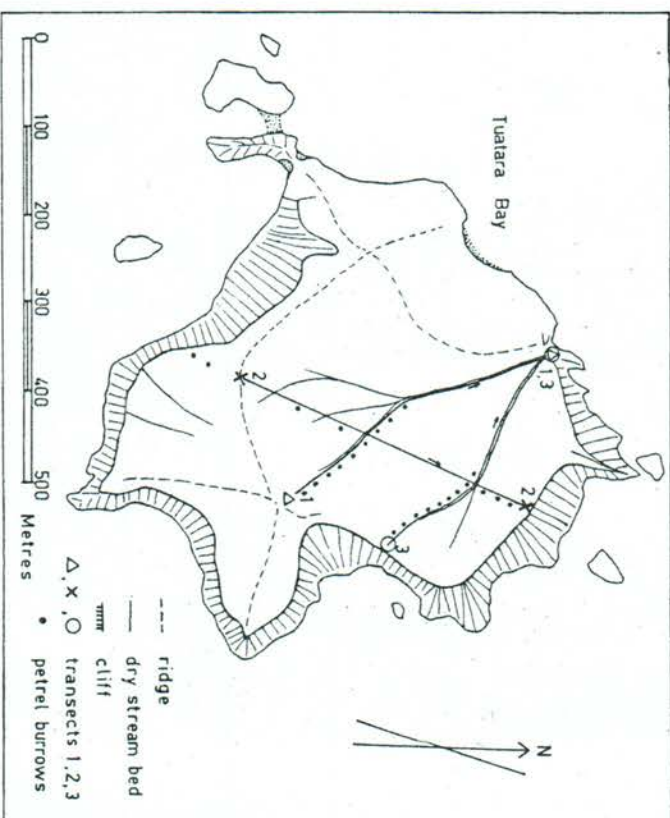


Fig. 2. Transects 1, 2, and 3 on Ruamahua-iti.

laevigatus), parapara (*Heimeriodendron brunonianum*), and tawapou (*Planchonia novozelandica*) contribute to small areas of the canopy.

The degree of cover by the forest canopy varies from 30-100%, from ridges to valleys respectively. The forest averages 60-80% closure; where a tree has fallen the increased light allows a dense ground cover of *Solanum aviculare*, *S. nigrum*, and *Phytolacca octandra*. A number of fallen trees were noted, and these had very shallow root systems.

Forest sub-canopy is similar under each of the three main forest types. Mahoe and karo (but not pohutukawa) may themselves be sub-canopy components. Other sub-canopy plants include *Brachyglottis repanda*, *Macropiper excelsum* var *majus*, *Paratrophis banksii*, *Coprosma ?macrocarpa*, *Geniostoma ligustrifolium*, and *Carnielaella williamsii*.

The forest floor is usually well burrowed and the soil swept clean by the movements of petrels. Burrows are fewer under pohutukawas growing near ridges. Transects 1 and 2 (Fig. 2) show clearly the relationship between the presence of petrel burrows, the degree of canopy closure, and the amount of ground cover. High numbers of petrel burrows correlate with a high degree of canopy closure and a small amount of ground cover, and the converse is also true. The determining factor or factors regarding the presence or absence of petrel burrows is not known, but it seems that a dense forest tree canopy does not interfere with the placement of burrows beneath. Soil throughout the forest is usually friable loam, and litter accumulates only within flat or valley areas covered by mahoe.

Ground cover is sparse, and when present is nearly always the hardy *Asplenium flaccidum* or *A. lucidum*. In very sheltered, shady places occasional plants of *Rhabdanthus solandri* are found; these are the remarkable large-leaved form with leaves up to 8cm in length. This large-leaved form occurs also on other off-shore islands.

It must be noted that the identification of the mahoe is not certain. Some of the voucher specimens taken bear serrations typical of *Melicypus naniflorus*; others possess leaf margins which are closer to *Melicypus macrophyllus*. Some leaves are near obovate and these have serrations similar to those of *M. macrophyllus*. For these reasons both species have been tentatively ascribed to the Aldermen Islands.

* adventive plant.

† present; plant seen in five or fewer places.
m many; plant often present in suitable communities, but occurs in less than half the areas examined.

a abundant; plant of general occurrence in suitable communities.

la plants numerous in localised areas.

N Ruamahua-nui

I Ruamahua-iti.

Ho Hongiora.

M Middle Island.

H Half Island.

He Hernia Island.

Numbers following the abundance ratings show the number of individual plants seen.

SPECIES	COMMON NAME	ABUNDANCE	ISLAND				
			N	I	Ho	M	H
Trees and Shrubs (25)							
<i>Brachyglottis repanda</i>	rangiora	a	+	+	+	+	+
<i>Carnielaella williamsii</i>	native broom	m	+	+	+	+	+
<i>Coprosma repens</i>	taupata	a	+	+	+	+	+
<i>Coprosma ?macrocarpa</i>		a	+	+	+	+	+
<i>Cordylone australis</i>		† (2)					
<i>Corynocarpus laevigatus</i>	cabbage tree	la	+	+	+	+	+
<i>Geniostoma ligustrifolium</i>	karakara	a	+	+	+	+	+
<i>Hebe pubescens</i>	hangehange	a	+	+	+	+	+
<i>Heimeriodendron brunonianum</i>	parapara	la	+				+
<i>Hymenanthera novae-zelandiae</i>	hymenanthera	a	+	+	+	+	+
<i>Leptospermum scoparium</i>	manuka	la	+	+			
<i>Macropiper excelsum</i>							
var. <i>majus</i>	kawakawa	a	+	+	+	+	+
<i>Melicypus naniflorus</i>							
(+ possible <i>Melicypus</i> x <i>Hymenanthera</i> hybrid)	mahoe	a	+	+	+	+	+
<i>Melicypus macrophyllus</i>		m	+	+			
<i>Metrosideros excelsa</i>	pohutukawa	a	+	+	+	+	+
<i>Myoporum laetum</i>	ngao	a	+	+	+	+	+
<i>Myrsine australis</i>	mapou						
<i>Paratrophis banksii</i>	milk tree	m	+	+	+	+	+
<i>Phorumn tenax</i>	N.Z. flax	a	+	+	+	+	+
<i>Pittosporum crassifolium</i>	karo	a	+	+	+	+	+
<i>Planchonella novozelandica</i>	tawapou	+(5)					+
<i>Pomaderris phyllofolia</i>							
var. <i>erectifolia</i>	tauhinu	+				+	
<i>Pseudopanax lessonii</i>	houpara	m				+	+
<i>Rhabdanthus solandri</i>	waiu-a-tua	+(3)				+	+
<i>Solanum aviculare</i>	poroporo	a	+	+	+	+	+
Lianes (3)							
<i>Muehlenbeckia complexa</i>	pohuehue (small-leaved)	a	+	+	+	+	+
<i>Sicyos angulata</i>		+(3)	+	+	+	+	+
<i>Tetragonia trigyna</i>	climbing N.Z. spinach	a				+	+

SPECIES	COMMON NAME	ABUNDANCE	ISLAND				
			N	I	Ho	M	H He
Ferns (9)							
<i>Asplenium bulbiferum</i>	hen and chickens fern	+(1)			+		
<i>A. falcatum</i>		+(1)			+		
<i>A. lucidum</i>		m	+	+	+	+	+
<i>A. flaccidum</i> agg. 3 forms:		a	+	+	+	+	+
(a) erect coastal form							
(b) ?hybrid <i>lucidum</i> x <i>flaccidum</i>							
(c) ?hybrid <i>bulbiferum</i> x <i>flaccidum</i>							
(d) <i>Hypolepis ?nemusfolium</i>		+(1)			+		
<i>Pacsa scaberula</i>	scented fern	la			+		
<i>Phymatodes diversifolium</i>		+			+		
<i>Pteridium aquilinum</i>							
var. <i>esculentum</i>	bracken	la	+	+	+	+	+
<i>Pyrrhosia serpens</i>		m	+	+	+	+	+
Grasses (6)							
<i>Cortaderia ?splendens</i>	toetoe	+(3)			+		+
<i>Deyeuxia billiardieri</i>		m			+		+
<i>Lachnagrostis</i>		+			+		
<i>filiformis</i> agg.		m			+		+
<i>Notodanthonia</i> sp.		m	+	+	+	+	+
<i>Oplismenus imbecilis</i>		a	+	+	+	+	+
<i>Poa anceps</i>							
Other herbaceous monocots (12)							
<i>Arthropodium cirratum</i>	renga lily	m	+	+	+	+	+
<i>Astelja banksii</i>	wharawhara	m	+	+	+	+	+
<i>Carex diuisa</i> *		+			+		
<i>C. ?spinosistris</i>		la			+		+
<i>C. sp.</i>		la			+		+
<i>Cordyline pumilio</i>	te rauiriki	+(1)			+		+
<i>Cyperus ustulatus</i>	coastal cutty grass	a	+	+	+	+	+
<i>Dianella nigra</i>	turutu (blueberry)	m	+	+	+	+	+
<i>Leptocarpus similis</i>	oiioi (jointed rush)	+			+		
<i>Scirpus cernuus</i>		m	+	+	+	+	+
<i>S. nodosus</i>		m	+	+	+	+	+
<i>S. sp.</i>	wiwi	+			+		+

SPECIES	COMMON NAME	ABUNDANCE	ISLAND				
			N	I	Ho	M	H He
Small composites (16)							
<i>Cirsium vulgare</i> *	Scotch thistle	la			+		+
<i>Cotula australis</i> *		la			+		+
<i>Crepis capillaris</i> *	smooth hawks-beard	m			+		+
<i>Erechtites ?arguta</i>		+			+		+
<i>E. atkinsonii</i>		m			+		+
<i>E. sp.</i>		+			+		+
<i>Erigeron floribundus</i> *	broad-leaved fleabane	m			+	+	+
<i>Gnaphalium</i>							
<i>luteo-album</i> agg.							
<i>G. sphaerium</i> *	jersey cudweed	la			+		+
<i>G. spicatum</i> *		+			+		+
<i>Hypochaeris radicata</i> *	catsear	+			+		+
<i>Picris echinoides</i> *	bristly ox-tongue	la			+		+
<i>Senecio hispidulus</i>							
var. <i>hispidulus</i>							
<i>S. laetus</i>		+			+		
<i>Sonchus asper</i> *	shore groundsel	+			+		+
<i>S. oleraceus</i> *	prickly sowthistle	m			+	+	+
	common sowthistle	m			+	+	+
Other herbaceous dicots (29)							
<i>Anagallis arvensis</i> *		+			+		+
<i>Apium australe</i>	native celery	m			+		+
<i>Cerastium glomeratum</i> *		+			+		+
<i>Dichondra repens</i>		m			+	+	+
<i>Dischyma australe</i>	N.Z. iceplant	a			+	+	+
<i>Eupatorium adenophorum</i> *		+			+		+
<i>Halenia erecta</i>		m			+	+	+
<i>Lepidium oleraceum</i>	Cook's scurry grass	+			+		+
<i>Linum monogynum</i>	N.Z. linen flax	+			+		+
<i>Lobelia anceps</i>	shore lobelia	m			+		+
<i>Lotus angustissimus</i> *		+			+		+
<i>Oxalis</i> sp.		+			+		+
<i>Parietaria debilis</i>		la			+		+
<i>Pelargonium inodorum</i>		+			+		+
<i>Peperomia urvilleana</i>		+			+		+
<i>Phytolacca octandra</i> *		la			+		+
<i>Pimelea prostrata</i>	inkweed	a			+		+
<i>Plantago major</i> *	prostrate native daphne	la			+		+
<i>Polycarpon tetraphyllum</i> *	great plantain	+(2)			+		+
<i>Rhagodia triandra</i>		la			+		+
<i>Rumex ?flexuosus</i>	pigweed	a			+		+

SPECIES	COMMON NAME	ABUNDANCE	ISLAND
<i>Salicornia australis</i>	glasswort	a	N I Ho M H He
<i>Samolus repens</i>	sea primrose	m	+ + + + +
<i>Solanum nigrum</i> *	black nightshade	m	+ + + +
<i>S. nodiflorum</i>		a	+ + + +
<i>Spergularia media</i> (= <i>S. marginalia</i> of Allan, 1961)			
<i>Stellaria parviflora</i>	sea spurry	+ la	+ + + +
<i>Tillaea siebertiana</i>		+(1)	+ +
<i>Wahlenbergia</i> sp.	native harebell	la	+ +
Total adventives:			7 12 5 14 1 1
Total species:			50 66 42 73 24 21

VASCULAR FLORA

The nomenclature of the plants listed, excepting grasses, follows Allan (1940, 1961), Clapham, *et al.* (1962), 'Standard Common Names for Weeds in New Zealand' (1969), and Moore and Edgar (1970). Names of grasses follow Chessman (1925), Zotov (1963), and Connor (1971).

Voucher specimens of nearly all species are lodged in the herbarium of the Auckland Institute and Museum.

A total of 100 vascular plants are listed; of these 19% are adventives. *Solanum nigrum* and *Phytolacca octandra* are the adventives most important in contributing to the structure of the vegetation, generally as ground cover or sub-canopy respectively. Out of 81 indigenous species, 38 occur on no more than one or two of the six islands listed.

A significant number of species listed by Cochrane (1962) were not found during the present study, and of these a large proportion are ferns. Cochrane also lists a number of varietal forms not recognised here. Species listed by Cochrane but not found in 1972 are listed below:

Ferns and Bryophytes.

The fern flora of nine species appears small when compared with that of other off-shore islands. Thus Cuvier Island and Red Mercury Island possess more than twice as many fern species (Beever *et al.*, 1969, Lynch *et al.*, 1972). Of the nine species recorded only three are abundant and widespread. These (*Asplenium flaccidum* agg. and *A. lucidum* – both extremely abundant – and *Pyrrosia serpens*) are often epiphytes when growing on the mainland, but are nearly always terrestrial on the Aldermen. It is highly likely that a larger fern flora would be eliminated by summer drought and that only a slight seasonal effect would occur (J.E. Braggins, pers. comm.).

Only three soil-dwelling bryophytes were found. The moss *Thuidopsis fuifurosa*, covering soil on Ruamahua-iti, was unusual in that it contained both antleridial branchlets and young sporophytes. On Hongiora, the otherwise bare soil under scrub (with high petrel population) was sparsely covered by the moss *Bartramia* sp. and the liverwort *Marchantia foliosa*.

RUAMAHUA-ITI

In 1925 (Sladden and Falla, 1927) the vegetation was almost dominated by *Carnichaella williamsii*. In gullies it was found in association with karo, *Paratrophis banksii*, and ngaio scrub growing 3-5 m high. On the scrub outskirts it was associated with flax, and from there spread to 'open meadowland' where it appeared in the form of low, dense-growing bushes. The land sloping downwards to Tuatara Bay (Fig. 2) in the north-west possessed scrub only in gullies and depressions. The greater portion of the vegetation was thus 'natural meadow', and the lesser portion scrub and light forest.

The 'natural meadow' of Sladden and Falla appears to be no longer in existence. It appears to have had the combined characteristics of three of the communities now present: *Poa anceps* meadow, mixed coastal scrub, and mixed manuka scrub.

An unpublished report by Bell, Sladden and Falla (1951) notes marked changes. Not nearly as much 'meadowland' was recorded, and part of the area that was meadow in 1925 had passed through a scrub-bracken association and reverted to a light forest type. Pure stands of mahoe had appeared and the extent of *Carnichaella* had been reduced. Falla briefly summarised this change in 1953.

Cochrane (1962) who visited the island in 1952, does not mention the mahoe forest or the extent of pohutukawa, but notes 4-5 m high karo trees in valleys. Bell, Sladden and Falla (1958, unpublished) note the presence of 10 m high forest in areas where meadow had existed in 1925.

Ruamahua-iti is now largely covered by mahoe, karo, and pohutukawa coastal forest averaging 7 m in height, with individual pohutukawa trees reaching 10-12 m. Considerable sloping areas are covered by taupata-hymenanthera scrub.

Transects.

(a) Method

Three belt transects 30 m wide were laid out. The first followed the north-west trending dry stream bed from the summit (200 m above sea level) directly to the cliff edge (15 m above sea level). The second transect cut across the main valley on a bearing of magnetic north. It began at a ridge high-point 160 m above sea level and ended at 100 m above sea level. Transect 3 began on a ridge (160 m above sea level) to the north of the summit and followed a dry stream to link with the end of Transect 1 (see Fig. 2).

Three observers 10 m apart recorded the vegetation at 20 m intervals. Each observer noted:

- (a) Canopy: 5 nearest trees or shrubs
% canopy closure.
height of canopy.
- (b) Subcanopy: 5 nearest shrubs.
5 nearest trees.
- (c) Ground cover: % ground cover.
rocky or friable; with or without petrel burrows.
- (d) Soil:
- The results for transects 1 and 2 are given in schematic form in Figure 3. Table 1 shows the frequency of the species in the canopy, sub-canopy, and ground cover for transect 3.

(b) Results. Transects 1 and 3.

Both transects were very similar. The vegetation in the valleys is composed of mahoe coastal forest (7-12m), which is taller than is typical for most of the remaining forest on the island (6-8m). Petrel burrows were present at every sampling point of the upper half of the transects, and these were associated with a high % canopy closure and little ground cover.

Canopy: a dense layer of mahoe, karo, and pohutukawa. Mahoe is the usual dominant, but at certain sampling points karo or pohutukawa is dominant. Six other species may form a small proportion of the canopy.

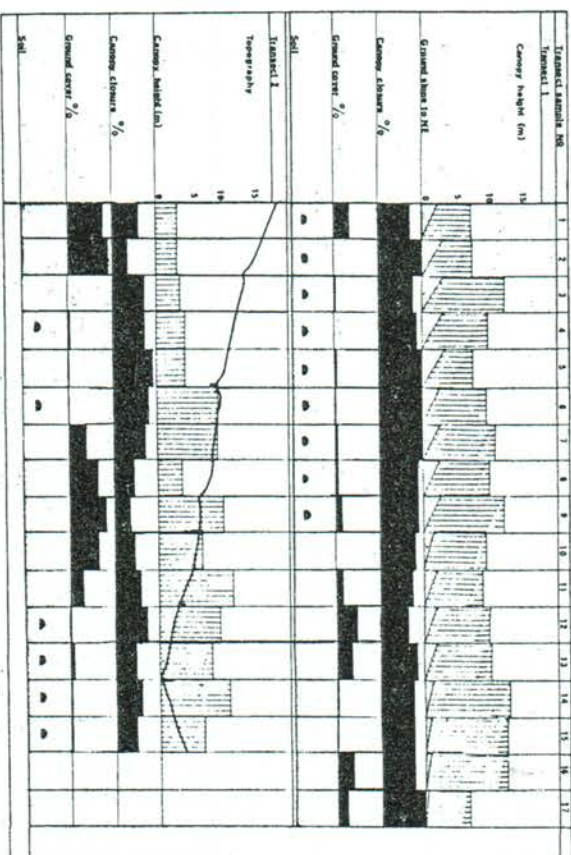


Fig. 3. Schematic presentation of the results from Transects 1 and 2. (Note: Two soil types are distinguished — with and without petrel burrows).

Transect 1: Canopy 43% mahoe, 33% karo, and 15% pohutukawa.

Transect 3: Canopy 55% mahoe, 33% karo, and 7% pohutukawa.

Sub-canopy: present only in the lower half of the transects. Mahoe and kawakawa are co-dominant, and there is a discontinuous distribution of other shrubs (karo, *Coprosma*, *Myrsine*, *Myrsinaceae*, and *Brachyglottis*).

Ground cover: as with the sub-canopy this is significant only in the lower half of the transects. *Asplenium flaccidum*, *A. lucidum*, kawakawa, *Coprosma* sp., and mahoe are all common, but coverage never exceeds 50%.

Transect 2.

Coastal scrub at the top of the transect includes karo, manuka, *Brachyglottis*, and *Carnichea* about 2-3 m in height. This scrub gradually blends into 8-10m high karo forest halfway down the transect. Mixed pohutukawa, karo, and mahoe make up the remainder of the transect. This is equivalent to the 7-12m mixed forest at the mid-points of transects 1 and 3. Despite the abundance of *Carnichea williamsii* noted in earlier reports, it is now found only occasionally in sub-canopy or ground cover of mixed forest.

Again, there are correlations between presence of petrel burrows, canopy closure, and ground cover. Near the top of the transect, the scrub canopy is open, and a dense ground cover of bracken, flax, *Brachyglottis*, *Geniostoma*, and *Carnichea* is present. No burrows are found here. Under the coastal forest at lower levels a similar situation to that found in transects 1 and 3 is found. High numbers of burrows correlate with a high degree of canopy closure and low light penetration.

RUAMAHUA-NUI

Sladden and Falla (1927) reported that the greater portion of this island was meadow, and that only a small area was in scrub and light forest. The vegetation was thus similar to that of Ruamahua-iti apart from the absence of *Carnichea* and the prevalence of mahoe and *Aristotelia serrata*. In 1951, Bell, Sladden and Falla noted that regeneration was 'slower' than on Ruamahua-iti. Considerable areas of *Poa anceps* still remained.

Cochrane (1962) had found in 1952 that the broad central portion of the north-western slopes was largely covered in 'natural meadow'. Coastal scrub, in which mahoe occurred frequently, covered most of the remaining slopes of the island. Coastal forest of pohutukawa, with *Aristotelia*, mahoe, and *Brachyglottis* covered the steep southern slopes. Similar forest 8-10m in height occupied a smaller area at a bay in the north-west.

Blackburn (1958) notes that the island differed from most of the others in not having a predominance of bush, there being only three relatively small areas. Some of the manuka had died with 'blight' and other plants were affected.

Under some of these a growth of *Hebe* and mahoe was replacing the manuka. Today the vegetation of Ruamahua-iti seems little changed from that existing at the time of Cochrane's visit, and it seems still true to say that regeneration is slower on this island. The greater portion that was meadow in 1925 has progressed only to 3-4m high scrub and light forest.

Species Present	SAMPLE NUMBER																	No. of Plants as % of total	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
Canopy																			
<i>Melicytus</i> sp.	-	9	10	4	13	6	15	7	5	7	8	4	6	6	5	2	2	43.0	94
<i>Pittosporum crassifolium</i>	12	4	3	5	2	2	-	5	3	4	4	5	5	7	9	8	7	33.4	94
<i>Metrosideros excelsa</i>	3	2	1	-	-	1	-	1	7	3	3	6	2	1	1	3	3	14.5	82
<i>Coprosma repens</i>	-	-	1	5	-	5	-	1	-	-	-	-	-	-	-	-	-	4.7	24
<i>Hymenanthera novae-zelandiae</i>	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	1	1	2.0	29
<i>Paratrophis banksii</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1	1.2	18
<i>Coprosma ?macrocarpa</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	0.4	6
<i>Pseudopanax lessonii</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.4	6
<i>Brachyglottis repanda</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	0.4	6
SUBCANOPY																			
<i>Melicytus</i> sp.	2	-	2	-	-	-	-	5	8	4	7	2	2	5	7	3	3	31.8	70
<i>Macropiper excelsum</i> var. <i>majus</i>	-	-	-	-	-	-	3	2	2	6	5	4	5	4	4	5	3	27.4	65
<i>Coprosma ?macrocarpa</i>	1	-	-	-	-	-	-	-	-	-	2	5	1	-	3	3	-	9.6	35
<i>Hymenanthera novae-zelandiae</i>	1	-	-	1	-	5	-	-	-	-	-	-	-	-	-	1	6	8.9	29
<i>Brachyglottis repanda</i>	2	-	4	-	-	-	-	2	-	-	-	-	1	-	1	-	-	6.4	29
<i>Paratrophis banksii</i>	-	-	-	-	-	-	-	-	-	-	1	4	3	-	-	-	1	5.7	24
<i>Pittosporum crassifolium</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	3.8	18
<i>Coprosma repens</i>	-	-	2	-	-	1	-	1	-	-	-	-	-	-	-	-	-	2.5	18
<i>Geniostoma ligustrifolium</i>	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.9	12
<i>Pseudopanax lessonii</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1.7	12
<i>Metrosideros excelsa</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	0.6	6

GROUND COVER

<i>Asplenium lucidum</i>	2	1	-	1	1	2	-	3	1	-	1	3	3	2	2	2	1	-	76
<i>Macropiper excelsum</i> var. <i>majus</i>	-	-	-	-	1	2	-	2	1	1	3	3	2	1	2	2	3	-	76
<i>Asplenium flaccidum</i>	2	-	-	-	1	-	1	2	-	-	1	-	1	2	3	1	3	-	59
<i>Coprosma ?macrocarpa</i>	1	-	-	-	-	-	-	2	-	1	1	1	1	2	3	3	2	-	59
<i>Melicytus</i> sp.	1	-	1	1	-	1	-	-	2	-	1	1	-	-	-	1	2	-	53
<i>Paratrophis banksii</i>	-	-	-	-	-	-	-	1	-	-	1	1	1	1	1	1	1	-	47
<i>Phytolacca octandra</i>	-	-	-	2	-	-	-	1	-	1	1	-	-	-	-	-	-	-	23
<i>Phormium tenax</i>	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	18
<i>Carmichaelia williamsii</i>	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	18
<i>Geniostoma ligustrifolium</i>	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	18
<i>Brachyglottis repanda</i>	-	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	18
<i>Coprosma repens</i>	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
<i>Hymenanthera novae-zelandiae</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	12
<i>Solanum nigrum</i>	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	12
<i>Astelia banksii</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
<i>Pteridium aquilinum</i> var. <i>esculentum</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6

Table 1: Data for Transect 3. (Note: Data for ground cover includes only presence or absence of species at the 3 recording stations at each sample point.)

MIDDLE ISLAND

This island is perhaps the most interesting of the group in that it has the largest flora. Unfortunately, unlike the other islands, it now harbours the kioie (*Rattus exulans*). The vegetation remains

This island is perhaps the most interesting of the group in that it has the largest flora. Unfortunately, unlike the other islands, it now harbours the kioie (*Rattus exulans*). The vegetation remains similar to that recorded in earlier papers. Sladden and Falla (1927) found pohutukawa to be the principal growth, and mentioned the interesting occurrence of karaka and parapara. Cochran (1962) commented: "The coastal forest pockets on the 'Middle Island' are very similar to unmodified coastal forest found on the southern and eastern shores of Hauturu or Little Barrier Island (Hamilton and Atkinson, 1961)." Similar remnants occur on Goat Island, Coromandel (Newhook *et al.*, 1971). Table 2 shows the records of coastal forest remnant, and other notable species, since 1925. Cochran states that most of Middle Island was densely covered in 7-12m high pohutukawa forest.

During the present study landings were made on three parts of the island (Fig. 1). The first landing took place on the northern side of the north-east end. Access was gained to the relatively flat plateau via a steep watershed, and a short transect done from the cliff edge in the north-east across to the southwest ridge. Pohutukawa scrub 3-4m high soon gave way to 10-13m high pohutukawa forest.

SPECIES	DATE AND ISLAND				
<i>Entelea arborescens</i>	1925		1952		
	Nui		Nui		
<i>Heimeriodendron brunonianum</i>	1925	1951	1952	1958	1972
	Middle	Middle	Middle	Nui	Middle
					Nui
<i>Planchonella novo-zelandica</i>			1952		1972
			Middle		Middle
			Nui		
<i>Corynocarpus laevigatus</i>	1925	1951	1952		1972
	Middle	Middle	Middle		Middle
<i>Carmichaelia williamsii</i>	1925		1952		1972
	Iti		Iti		Iti
			Middle		Half
			Hongiora		
<i>Rhodothamnus solandri</i>	1925	1951	1952		1972
	Middle	Middle	Middle		Middle
					Iti

Table 2: Records of coastal forest remnant, and other notable species.

A sub-canopy of mahoe, *Coprosma macrocarpa*, karo, and *Pseudopanax lessonii* was present. Ground cover of 10-60% consisted of many species. In some areas the ground was bare and many petrel burrows were present. A small area of 7-10m high *Planchonella novo-zelandica* and *Paratrophis banksii* contributed to the canopy. The transect then tapered out onto a narrow ridge with the *Planchonella* giving way to hymenanthera and ngao, and then finally to *Disphyma* and *Scirpus* sp.

The second landing was made to the south-east, below a 119 m high point (Fig. 1). Forest taller than was found elsewhere grows here on 20-25° slopes. Pohutukawas exceeding 13m, and reaching 17m in height, form a dense canopy under which is a 7 m high sub-canopy of mahoe, *Brachylotus*, *Macropiper*, *Pseudopanax*, and karaka. Over 50 trees of karaka were seen, but *Paratrophis banksii* was rare. *Astelid banksii*, *Asplenium lucidum* and *Rhodothamnus solandri* made up the ground cover.

The third landing, on the north-west side of the mid-section, gave access to the largest area of forest on Middle Island. Again, pohutukawa forest is dominant, but pure stands of mahoe occur. The mahoe forest in valleys is associated with Maori terracing, and on the terraces large piles of leaf litter had accumulated. The only plant of *Myrsine australis* found on the Aldermen grows at the edge of this forest.

At no place on Middle Island did we see any forest type with parapara, karaka, *Paratrophis*, or *Planchonella* dominant to the extent that it could be termed unmodified coastal forest.

HONGIORA

This is the only island in the group on which there is actually a record of alteration by fire. Bell, Sladden and Falla (1951) write of a fire occurring on the north end of Hongiora early in 1935 which burnt for several days. No source for this information is given and no indication of its cause. The area burnt was found in 1951 to be covered by 'a dense growth of fern, shrubs and inkweed 1.3-1.6m in height and 3-4m vigorous young pohutukawas'. They noted that the regeneration had occurred far faster than that on the other islands of the group, and attributed this to a higher soil fertility.

The vegetation on the remainder of the island has changed greatly in the period 1925 to 1951. Bell *et al.* write that 'the meadow lands of 1925 caused by fire years earlier were much reduced in extent'. Blackburn (1958) referring to the earlier authors, suggested that 'the vegetation had matured considerably and the flax and grass areas had been almost completely closed up with bush'. Cochran (1962) makes no mention of any possible changes or modification to the vegetation that may have occurred.

In 1972, the island was circumnavigated before a landing was made. Cliff communities of *Coprosma repens*, *Disphyma australe*, and *Poa anceps* were present on all the cliffs. On the western side pohutukawa grows above the cliffs, and on the northern side, karo forest. Larger specimens of pohutukawa are present on ridges. Karo extends to the eastern and part of the southern side. A landing was made on a rocky platform on the south side (Fig. 1) where water

seeped through jointed rock. Here, due to the seepage, a modified cliff community is present. *Cyperus usulatus*, *Leptocarpus similis*, *Scirpus cernuus*, *S. nodosus*, *Spergularia media*, and grasses grow around the small freshwater pools.

The major part of the southern half of Hongiara is covered with the remarkable taupata/hymenanthera scrub described under community types. On the ridges, large specimens of pohutukawa (6-10 trunks up to 60cm diameter, and 17m in crown diameter) form an emergent canopy up to 15m in height. The northern half is covered with young karo forest (7m), probably established after the 1935 fire. Ground cover throughout the forest is sparse unless the canopy is open. *Phytolacca octandra*, *Solanum aviculare*, and *S. nigrum* form both the ground cover where present, and the 'sub-canopy'.

To the north-east, a small area of karo forest has been blown down in a seaward-facing valley. Giant tangles of *Sicyos angulata* are heaped over the dead trees and progress is rendered almost impossible.

Petrel burrows are present in very high concentrations throughout the island, except under the larger pohutukawas or where a dense ground cover is present. No 'natural meadow' areas are now in existence but flax commonly occurs as patches in any of the communities.

EFFECT OF FAUNA ON THE VEGETATION

Few records have been kept, but birds are certain to be an important factor as agents of seed dispersal. Sladden and Falla (1928) noted 200-300 *Coprosma* seeds in a pellet near the nest of a red-billed gull (*Larus novaezelandiae*) on the Sugarloaf rocks to the north. Red-fronted parakeets (*Cyanoramphus novaezelandiae*) are common and are probably the most important agents of seed distribution. Sladden and Falla (1928) found that seeds of karo and mahoe are eaten before they are mature. Parakeets were observed feeding on flax seeds and small seeds on the ground. In 1972 a bush of *Solanum aviculare* on Hongiara had many of its upper stalks eaten out by parakeets. Starlings (*Sterna vulgaris*) and possibly other species are responsible for the introduction of weed seeds, notably inkweed (Sladden and Falla, 1927; Court, 1973).

Kiore (*Rattus exulans*) are now present on Middle Island (Atkinson, pers. comm.) and these are known to eat leaves and seeds (Bettsworth, 1972).

Nesting petrels (principally the grey-faced petrel, *Pterodroma macropus*) affect the vegetation in four main ways:

- (a) Damage to canopy foliage when the birds land; many new shoots e.g. those of taupata, are broken when the birds crash through the canopy.
- (b) Many seedlings are damaged as the petrels flutter and scabble their way up or down slopes.
- (c) Burrowing activities possibly aerate the soil, and loam has a high turnover rate where burrowing is most intense. The soil may be made more prone to drying out during droughts.
- (d) The soil has added to it large amounts of guano rich in nitrogenous and phosphate-containing material.

DISCUSSION

The vegetation of the Aldermen Islands has evidently been drastically disturbed by fire, although the islands are now mostly covered in coastal forest.

It is unfortunate that there are no good records of the history of the islands from the mid-nineteenth century to 1925, as most of the vegetation appears to have regenerated following fires which have occurred in this period.

Individual islands of the group have been altered to a greater or lesser extent, and the islands may be arranged in an approximate order of increasing damage sustained.

The modification of the flora and vegetation on Middle Island appears to have been less severe than that of the other islands. The patches of tawapu, parapara, and karaka are possibly regenerating remnants of an original forest community. The pohutukawa forest now dominant is probably fire induced, but is of much greater age than that on the other islands. Maori occupation probably involved clearing and cutting of forest, resulting in regeneration to the patches of mahoe forest now present. Middle Island possesses the largest flora of the islands in the group.

Similar vegetation types occur in Ruamahua-iti and Ruamahua-nui, but those of Ruamahua-nui appear to be at a younger stage. It is probable that the apparent slower regeneration on Ruamahua-nui is due to more recent burning. In 1925 the 'natural meadow' on both islands could have been of different age. A time lapse of 10-20 years may be necessary for the transition to scrub/light forest.

Hongiara, because of its different topography, is not strictly comparable with the others in the group. The recorded fire of 1935, and the subsequent rapid regeneration of karo and pohutukawa forest, suggests that the whole island has suffered modification during this century (save for the larger pohutukawa trees on the ridges).

The small Hernia and Half Islands may retain their original plant cover. Karo forest is dominant and there is good seedling establishment. *Carrichaelia williamsii* grows on Half Island, but no trees of *Paratrophis banksii* were found.

No grazing has occurred on any of the islands; this is important since browsing mammals would have imposed severe stress on both the flora and fauna. A great danger to the island group now lies in the possible introduction of European rat species. Further fires should be prevented.

The Aldermen Islands, although the vegetation has been modified as shown, are an extremely valuable reserve for rare species of the New Zealand flora, and the plant communities in which they are found.

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