

A BOTANICAL SURVEY OF SOME OFFSHORE ISLANDS OF THE COROMANDEL PENINSULA

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SUMMARY

A botanical survey of some bush-covered islands near Coromandel, New Zealand, has been made, including quantitative studies in mature coastal forest. Large trees of some uncommon species have been recorded - *Heimerliodendron brunonianum*, *Planchonella novo-zelandica*, and *Paratrophis banksii* - with prolific regeneration of the first two. Brief vegetation descriptions and initial species lists for six islands have been included.

INTRODUCTION

Prompted by the possibility that some of the bush-covered islands off the west coast of the Coromandel Peninsula, east of Auckland, New Zealand, might be subdivided, a series of visits has been made to the islands to ascertain the nature of the vegetation. On the first, necessarily short, visit to Motuoruhi (Goat Island) some affinities were noticed to the flora of the Hen and Chickens Islands. Checks showed that there appear to be no botanical descriptions of these Coromandel islands, so following a further reconnaissance in October 1970, a 7-day visit was made in December 1970.

A base camp was set up on Goat Island, one of the larger, bush-clad islands of the group, 4½ miles from Coromandel township. Quantitative studies were made of the two patches of mature coastal forest on the island, subjective observations were made of the other main plant communities and a species list compiled.

Other islands studied were Motukahaua (Happy Jack Is.), Motukaramarama (Bush Is.), Moturua (Rabbit Is.), Motumorirau (Pauls Is.), and Motukakarikitahi (Rat Is.) (See Fig. 1). As only short visits were possible, reports on these islands are confined to initial species lists and an assessment of the main communities and dominants. Opportunity did not permit landings on the remainder, which, apart from rocky islets include an important gannet/spotted shag colony almost devoid of vegetation, Double Is. (Motuwi) which appears to be similar to Rabbit Is., and the two largest islands, at the southern end of the chain, which are largely under grazed pasture.

The islands show a wide variety of andesitic breccias and lavas (Hayward, 1971); - they have steep cliffs, and some are flat-topped, others ridged.

Grid references from N.Z. Topographical Map N39 are given for each island.

GOAT ISLAND (MOTUORUHI) [N39/905743]

(See fig. 2)

Goat Is., one of the larger islands of the group, only 4½ miles from Coromandel, was more closely studied than any of the other islands. It has areas of mature coastal forest with strong affinity to that of the Hen and Chickens, an interesting series of stages in regeneration, and was more suitable for establishment of a

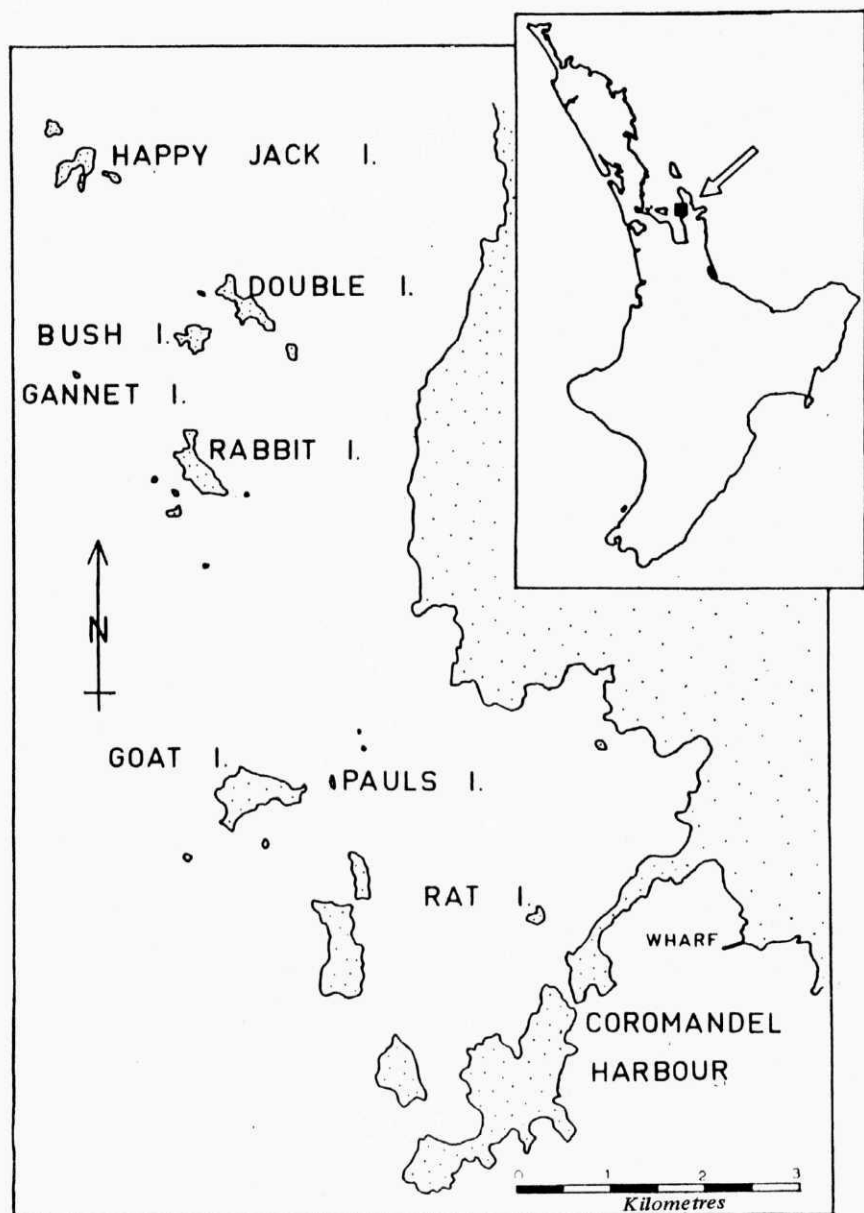


FIG. 1. Location of offshore islands, Coromandel.

base camp than the other islands. It is approximately $\frac{3}{4}$ mile long by $\frac{1}{4}$ mile wide, and up to 555 feet high, sloping steeply on the northern side of the main east-west ridge, and less steeply with secondary ridges on the southern side.

Three minor watercourses were found on the island. Two behind Camp Bay stopped short before reaching the beach, and were dry when visited during October and December, while that in Stream Gully had a few small pools.

No special attention was paid to animal life on the island. Brown skinks, probably *Leiopisma* sp., abounded on the pebble beaches. One Little Blue Penguin was found, but numerous cries were heard during darkness, suggesting the presence of several others returning ashore. The island does not seem to be a major nesting habitat for seabirds. Weasels were seen twice near the camp site but no evidence was found of rats or other mammals. Goats and pigs seem to have been successfully eradicated from the island. Although old rootings were seen in several parts of the island, numbers cannot have been high for several years judging by the prolific seedling regeneration in most plant communities.

The vegetation falls into three main communities :

- 1 Cliff and shoreline.
- 2 Low forest.
- 3 Mature coastal forest.

1 Cliff and shoreline.

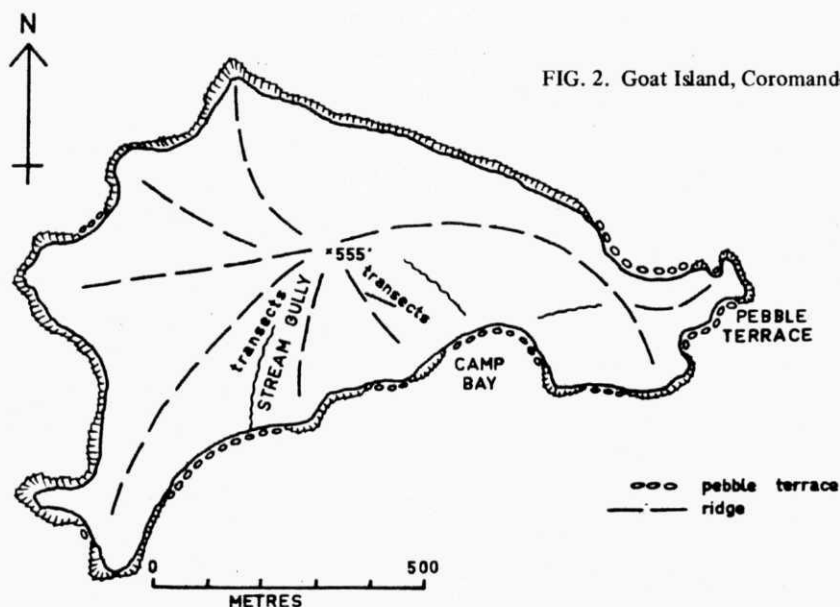
On the steep northern slopes of the island, windswept *Leptospermum scoparium* with *Metrosideros excelsa* (pohutukawa) forms the dominant vegetation, particularly at the higher levels, but the lower slopes are fairly bare and unstable. *Myoporum laetum*, *Phormium tenax* (flax) and large *Coriaria arborea* occur frequently with other shrubs such as *Myrsine australis*, *Pseudopanax lessonii*, *Macropiper excelsum* var. *majus*, *Coprosma robusta*, *Carmichaelia aligera*, *Cyathodes fasciculata*, *Olearia furfuracea* and *Cortaderia* sp. present but less common. The associated ground cover includes the hardy ferns found elsewhere on the island, with several grasses and other adventives. On the lower slopes very occasional shrubs and several adventives together with a few native coastal plants such as *Plagianthus divaricatus* are present, but they are apparently unable to maintain a continuous cover except near the shoreline, where leguminous weeds are rampant.

The southern coast has two wide, curved bays each backed by flat or gently sloping land, between cliffs, some near vertical and almost bare, others sloping and able to support vegetation. The south-western headland and some of the higher slopes about the western bay have a flax-dominated cover which includes a few small shrubs and herbs. In other places there is *M. excelsa* with small herbaceous plants such as *Arthropodium cirratum*, *Centaurium umbellatum*, *Anagallis arvensis*, *Dichondra repens*, *Disphyma australe*, *Asplenium flaccidum*, assorted grasses, and occasional small shrubs such as *Hebe pubescens*, *Pimelea prostrata*, *Hymenanthera novae-zelandiae*, *Pseudopanax lessonii*.

The pebble beaches of the bays are mainly bordered by flax but in some places this border is lacking, and only a few low coastal plants such as *Plagianthus*

and *Muehlenbeckia complexa* separate the low forest from the beach. Low shrubs such as these, with a variety of adventive weeds and grasses and a few strand plants such as *Salicornia australis*, *D. australe* and *Calystegia soldanella* grow at the top of the beach below the flax.

At the south-eastern end of the island, a new, sloping pebble beach, probably somewhat mobile in heavy storms, has built up in front of an old, stable pebble beach. The top of the new barrier is above the level of the old beach, closing off behind it a low-level terrace probably not much above Mean High Water. On this an open-canopied, low coastal forest has established among the pebbles. The age of the front barrier was not determined, but it is probable that storms at high spring tide could inundate the area. A variety of tall shrubs and trees form a very broken canopy, sometimes represented by isolated trees, which is of variable



height, and except in the case of pohutukawa, is rarely over 10 feet high. The dominants are pohutukawa, *Myrsine*, *Myoporum*, *Coprosma robusta*, *Pseudopanax lessonii*, *Brachyglottis repanda*, *Leptospermum*, *Melicytus ramiflorus*, *Macropiper*, and flax. Beneath these is a sparse understorey of low shrubs such as *Cyathodes*, *Pittosporum crassifolium*, *Muehlenbeckia*, *Hebe pubescens*, a few ferns such as *Asplenium flaccidum*, *Pteris tremula*, *Pteridium aquilinum* var. *esculentum* (bracken), *Pyrrosia serpens*, *Phymatodes diversifolium*, clumps of *Gahnia lacera* and terrestrial *Astelia banksii*, and a vareity of weeds and grasses including *Oplismenus undulatifolius*, *Dichondra*, *Orobanche minor*, *Erigeron floribundus*, legumes and Compositae.

2. Low forest.

The low forest behind Camp Bay beach extends in tongues towards the ridge. It is about 20 feet in height with a closed canopy of even height except for a few emergents, and shows mixed dominance. The plants dominant locally or in combinations with other species are *Myrsine*, *Melicytus*, *Dysoxylum spectabile*, *Geniostoma ligustrifolium*, *Corynocarpus laevigatus* and *Coprosma* spp. Those occurring less frequently, both in and just below the canopy, are *Myoporum*, *Macropiper*, *Brachyglottis*, *Entelea arborescens*, *Metrosideros*, *Pseudopanax lessonii*, *Neopanax arboreum*, *Melicope ternata*, *Leptospermum ericoides*, *Heimerliodendron brunonianum*, and *Pittosporum crassifolium*, the last two occurring fairly locally, with the *Pittosporum* on the beach fringe. The understorey includes young trees and seedlings of most of the canopy species, with the notable addition of *Planchonella novo-zelandica* and *Beilschmiedia tarairi*. *Planchonella*, *Corynocarpus* and *Heimerliodendron* seedlings are especially plentiful towards the western end of Camp Bay, where the low forest merges with mature coastal forest. The ground cover is variable throughout the area, probably dependent on the nature of the overhead canopy. Hardy ferns such as bracken, *Doodia media*, *Asplenium lucidum*, *Phymatodes diversifolium*, *Adiantum cunninghami* and *Pteris tremula* occur quite frequently, along with *Oplismenus*, *Carex* spp., and occasional weeds such as *Solanum nigrum* and *Haloragis erecta*. However, much of the ground under the forest is devoid of vegetation. *Hebe*, *Gahnia* and *Muehlenbeckia* are quite plentiful near the coastal fringe, where there is a little more light than under most of the forest. Large, rambling canes of *Ripogonum scandens* are woven through the forest canopy in some areas, displaying hanging clusters of ripe fruit at the time of the survey. *Clematis paniculata* is also present.

An extensive gap in the canopy just behind the beach probably marks an area regenerating after fire. It is characterised by large clumps of *Gahnia* and flax with a variety of shrubs and young canopy species, such as *L. scoparium*, *L. ericoides*, *Entelea*, *Melicytus*, *Brachyglottis*, *Fuchsia excorticata*, *Coriaria*, *Carmichaelia aligera*, *Metrosideros*, *Coprosma rhamnoides*, *Cyathea medullaris* and *Neopanax*, all mostly less than 10 ft. in height.

The ground cover includes sedges, ferns such as bracken, *Pteris tremula*, *Asplenium lucidum* and an abundance of weeds both native and adventive, such as *Eupatorium adenophorum* (fireweed), *Phytolacca octandra*, *Haloragis erecta*, *Erigeron floribundus*, *Senecio atkinsoniae*, *Gnaphalium spicatum*, *Solanum nigrum*, *Anagallis*, *Holcus lanatus*, *Wahlenbergia gracilis*, *Melilotus* spp. and *Oplismenus*.

On the eastern portion of the ridge behind the bay a *Leptospermum* association occurs, which is probably the youngest stage of regeneration on the island. The *Leptospermum* forms a closed canopy 10 to 12 ft. tall, with occasional shrubs and ferns beneath. The main understorey plants are *Gahnia*, *Coprosma robusta*, fireweed, *Brachyglottis*, *Hebe*, *Geniostoma*, *Pseudopanax*, *Myrsine*, *Melicytus*, with occasional *Cyathodes fasciculata*, *Coprosma rhamnoides* and *Olearia furfuracea*. Ground cover includes *Doodia*, *Dichondra*, *Oplismenus*, *Haloragis* and a few sparsely distributed adventives, mainly *Hypochoeris radicata*,

but also *Senecio atkinsoniae*, *Geranium* and *Cirsium vulgare*.

On, and near the ridge top directly behind the bay, the *Leptospermum* is taller and other species are present in the canopy, mainly *Myrsine*, *Coprosma* and *Carmichaelia* with an understorey including sedges, *Geniostoma*, *Hebe*, fireweed and bracken which is mainly old and dead. This probably represents a transitional stage between the young regeneration on the eastern part of the ridge and the older forest of the flat. Massive pig rooting, obviously quite old, is evident in this area.

Near the top of this ridge is a belt of pohutukawa emergent over an association similar to that further down the slope, consisting of *Melicytus*, *Dysoxylum* and *Macropiper*, with a few, relatively old, *Leptospermum*. The floor is fairly open, the sparse cover being mainly *Doodia*, *Asplenium lucidum* and a few seedlings of shrub species.

The summit, and the ridges on the southern side, support *Leptospermum* associations of various ages and heights, ranging from windswept communities approximately 4 ft. high to tall *L. ericoides* dominated forest about 20 ft. in height, with emergent pohutukawa and frequently a sub-canopy of *Myrsine*. The more frequently occurring shrub species of other low forest areas described are present to a limited extent throughout, particularly *Myrsine*, but also *Pseudopanax* and *Melicytus*. In a few areas there are dense stands of almost pure *Myrsine*.

3. Mature coastal forest.

Although the dense canopy is mixed the main dominants in the two areas of mature forest are *Dysoxylum spectabile* and *Beilschmiedia tarairi*, *Dysoxylum* occurring mainly on the ridges and *Beilschmiedia* dominating the valleys. *M. excelsa*, *Planchonella*, *Melicytus*, *Myrsine* and *Macropiper* are also important components of the canopy, with *Cyathea dealbata* and *C. medullaris* occurring locally, whilst some species, notably *Corynocarpus laevigatus* and *Heimeriodendron* are confined to the coastal fringe.

Most of the species found in the canopy of the low forest are present to some extent as understorey members of the mature forest. A notable additional species is *Rhabdotheramnus solandri*, which is locally abundant. Ground cover species are also similar in the two areas, although density is lower in the mature forest, probably as a result of the low light intensity beneath the dense canopy.

Semi-quantitative surveys were made of these two patches of mature coastal forest to enable calculations to be made of the density and frequency of the canopy trees.

METHODS

Four adjacent belt transects were sampled by stationing four persons about 30 ft. apart in a horizontal line across the community. The five canopy trees nearest to each observer were then listed. The process was repeated at intervals of 10 paces downhill to the lower limit of each community. The girth at breast height was also recorded for unusually large or interesting trees.

In the process almost every canopy tree was recorded, thus a direct estimate of the density of each species could be calculated. Frequency values were calculated from the number of sites in which each species occurred. The results are recorded in Tables 1, 2 and 3.

TABLE 1: Transect data, Mature Coastal Forest, Stream Gully, Goat Island.

SPECIES PRESENT	No. recorded at each level (Horizontal totals for 4 stations).																				
	Level:																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
<i>Dysoxylum spectabile</i>	1	2	3	7	6	6	5	5	3	1	5	5	3	6	6	3	3	5	3	6	4
<i>Beilschmiedia tarairi</i>	1	2	4	7	7	9	10	12	10	7	10	9	12	9	3	7	15	7	7		
<i>Myrsine australis</i>	6	3	1	1		1	2			3	3	3									
<i>Meliccytus ramiflorus</i>													2	1		3	1	4		3	3
<i>Geniostoma ligustrifolium</i>			3	5	1		1		2	1	1	2	1	2							
<i>Metrosideros excelsa</i>	2	2	1	2	1		1	1				1	1								2
<i>Knighia excelsa</i>		1	1			1	1		2					1							
<i>Cyathea dealbata</i>	11	11	12	4	6	2	5		2	3		1									
<i>Cyathea medullaris</i>					1	2		4	2		1										
<i>Planchonella novo-zelandica</i>												1					4	3	1	1	1
<i>Corynocarpus laevigatus</i>																1	2	1	1	1	3
<i>Coprosma</i> spp.													1	1							
<i>Macropiper excelsum</i> var. <i>majus</i>																2	2			1	
<i>Neopanax arboreum</i>										1										1	
<i>Pseudopanax hybrid</i>																1					
<i>Brachyglottis repanda</i>																1	1				

N.B. At level 17 one station not recorded - too steep.

TABLE 2: Transect data, Mature Coastal Forest, West end of Camp Bay, Goat Island.

SPECIES PRESENT	No. recorded at each level (Horizontal totals for 4 stations).																						
	Level:																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
<i>Dysoxylum spectabile</i>	3	4	9	10	8	8	4	7	7	5	5	2		4		7	7	3	3	4	5	9	1
<i>Beilschmiedia tarairi</i>	13	11	8	5	2	4	7	2	2	2	1					2			3	3	1		
<i>Myrsine australis</i>	2	1	1	3	3	4	2	2	2	2	1					6	2	1					
<i>Meliccytus ramiflorus</i>		1	1		2		1	1	2	6	4	7	9	6	1		3	7	1	5	8	4	2
<i>Geniostoma ligustrifolium</i>																	1		1				
<i>Metrosideros excelsa</i>		2	1					1	2	1		3			1	3	2		1				
<i>Knighia excelsa</i>	1																						
<i>Planchonella novo-zelandica</i>				1	1	1	2										1	1	3	1			
<i>Corynocarpus laevigatus</i>																1					4	7	
<i>Coprosma</i> spp.					1														2	2	1	1	3
<i>Macropiper excelsum</i> var. <i>majus</i>		1					1		1	2		3	3	2			2	2	3	5	4	3	4
<i>Leptospermum ericoides</i>					3	3	1	6	3	2	5	4	4	7	1	1							
<i>Rhopalostylis sapida</i>		1																					
<i>Pseudopanax lessonii</i>							1						1										
<i>Brachyglottis repanda</i>								1				1	1		1		1	1	2			1	
<i>Elaeocarpus dentatus</i>	1																						
<i>Melicope ternata</i>							1	1					2	1				2	1				
<i>Coriaria arborea</i>															1								
<i>Cordyline australis</i>											2												
<i>Olearia furfuracea</i>																	1						
<i>Vitex lucens</i>																		1					
<i>Heimerliodendron brunonianum</i>																					1		
<i>Myoporum laetum</i>																							2

N.B. At level 15 only 1 station sampled. Forest gave way to *Leptospermum* scrub.

Table 3: Goat Island Transect data - Frequency and Density.

Area Sampled:	Stream Gully (15½ acres)		Camp Bay (17 acres)	
Species	Density (No. per acre)	Freq. %	Density (No. per acre)	Freq. %
<i>Dysoxylum spectabile</i>	51.9	100	60.5	91.3
<i>Beilschmiedia tarairi</i>	87.3	90.5	34.9	65.2
<i>Myrsine australis</i>	13.6	42.8	16.8	60.8
<i>Melicytus ramiflorus</i>	10.0	33.3	37.6	82.6
<i>Geniostoma ligustrifolium</i>	11.2	47.6	1.1	8.7
<i>Metrosideros excelsa</i>	8.3	47.6	9.0	39.0
<i>Knightia excelsa</i>	4.1	28.6	0.5	4.3
<i>Cyathea dealbata</i>	33.6	47.6	-	-
<i>Cyathea medullaris</i>	5.9	28.6	-	-
<i>Planchonella novo-zelandica</i>	6.5	28.6	5.8	34.8
<i>Corynocarpus laevigatus</i>	5.3	28.6	6.9	17.4
<i>Coprosma</i> spp.	1.2	9.5	5.3	26.0
<i>Macropiper excelsum</i> var. <i>majus</i>	2.9	14.3	19.1	60.9
<i>Neopanax arboreum</i>	1.2	9.5	-	-
<i>Pseudopanax</i> spp.	0.6	4.8	1.1	8.7
<i>Brachyglottis repanda</i>	1.2	9.6	4.8	34.8
<i>Leptospermum ericoides</i>	-	-	21.2	52.1
<i>Rhopalostylis sapida</i>	-	-	0.5	4.3
<i>Elaeocarpus dentatus</i>	-	-	0.5	4.3
<i>Melicope ternata</i>	-	-	4.2	26.0
<i>Coriaria arborea</i>	-	-	1.6	8.7
<i>Cordyline australis</i>	-	-	1.1	4.3
<i>Olearia furfuracea</i>	-	-	0.5	4.3
<i>Vitex lucens</i>	-	-	0.5	4.3
<i>Heimerliodendron brunonianum</i>	-	-	0.5	4.3
<i>Myoporum laetum</i>	-	-	0.5	4.3

COMMENTS ON THE TRANSECT DATA

At level 15, at the western end of Camp Bay, a belt of *Leptospermum* scrub was encountered, probably representing regeneration after fire. The transects were therefore shifted westward to continue in typical coastal forest. Sampling then continued to the level of the beach. Data from both subsamples has been pooled. From the tables it is seen that *Beilschmiedia* has a much more disjunct distribution in Camp Bay than in Stream Gully.

Both the frequency and density data (Table 3) show that *Dysoxylum* and *Beilschmiedia* are the most abundant and most widespread of the canopy trees present. In Stream Gully *Beilschmiedia* has a considerably higher density (87.3 stems per acre) than *Dysoxylum*, but the latter is more widely distributed, having a frequency of 100%, compared with 90.5% for *Beilschmiedia*. This is borne out by the visual observation that *Beilschmiedia* appears in definite clumps.

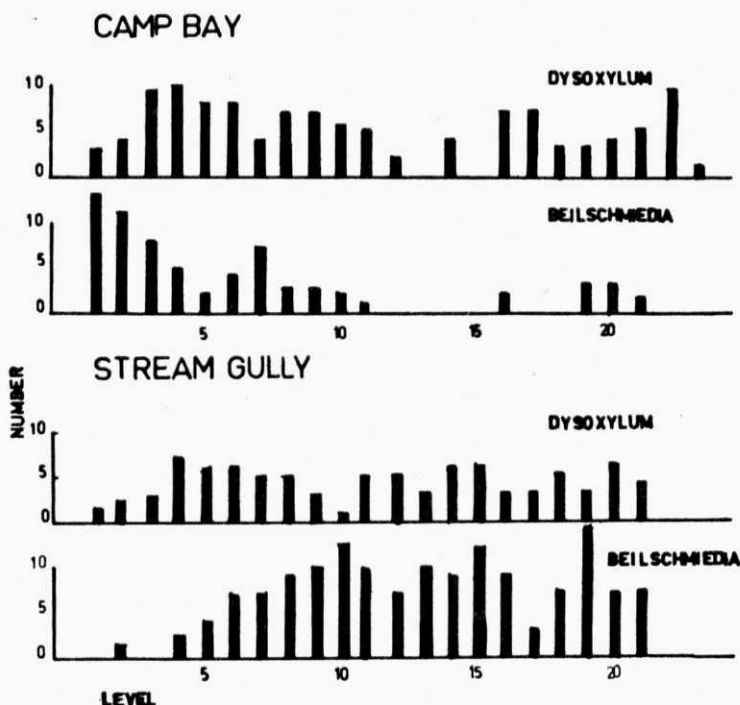


FIG. 3. Histogram showing distribution of dominants from upper to lower level of transects in mature coastal forest, Goat Island.

Beilschmiedia is less abundant both in density and frequency. The histogram (fig.3) indicates the distribution of the two major species from the highest level (level 1) to the lowest level in each of the transect sites.

Some specimens of the two dominants are very large, with the girths, at breast height, of some of the larger *Dysoxylum* in the sampled area being from 5 ft. to 6 ft. 3 in. In the Stream Gully forest several *Beilschmiedia* have girths of 5 to 6 ft.; whilst in Camp Bay there are several even larger; 8 specimens, within the transect area having girths from 7 to 13 ft.

Only one *Vitex lucens* is present, a very large, four stemmed tree with girths, 6 ft. 6 in., 3 ft. 6 in., 3 ft. 6 in. and 2 ft. 3 in.; this occurs in the Camp Bay forest. For some reason there is no seedling regeneration by this species. One mature *Paratrophis banksii* is present near Camp Bay beach.

Large *Metrosideros excelsa* are scattered throughout, and although the numbers are not high, the spreading crowns make a significant contribution to the canopy. Girths of 12 ft. and 13 ft. are recorded from Stream Gully and 10 ft., 11 ft. 6 in, 13 ft., and 19 ft., from Camp Bay.

An unusual and important feature is the abundance of *Planchonella*, of which there are many large, healthy specimens (girths of 2 to 4 ft. are frequent and several up to 7 ft. 5 in. were recorded) with abundant seedling regeneration.

Corynocarpus is restricted to the coastal zone, being completely absent from the upper two-thirds of the sample areas. There is, however, vigorous seedling regeneration, spreading into the low forest.

Although *Leptospermum ericoides* is absent from the canopy of the Stream Gully forest, 40 trees, some approximately 3 ft. in girth, were recorded in the Camp Bay transects. It is not evenly distributed, however, 28 of the trees being distributed on part of one vertical transect, where its co-dominant is *Melicytus*, with pohutukawa and *Myrsine* also represented. Thus it apparently forms part of a belt of advanced marginal regeneration which is not equivalent in composition to the main forest canopy. Nevertheless there are some large residual trees scattered throughout the main forest canopy.

Melicytus ramiflorus is an important contributor to the physiognomy of the forest interior with substantial trees of considerable height, up to approximately 50 ft.

Myrsine australis is likewise represented by several large trees especially in the upper horizontal levels of the transects.

Macropiper excelsum var. *majus*, the off-shore island form, appears occasionally in the canopy and more frequently as a sub-canopy member, in both areas. It is more important in the Camp Bay forest where it performs a similar role to *Melicytus*.

Elaeocarpus dentatus, as with *Vitex*, is represented apparently by only one large specimen. Inexplicably, there is again no seedling regeneration.

Cyathea dealbata is important in the upper Stream Gully slopes, but tree ferns are not an important component in the Camp Bay area, perhaps reflecting habitat differences such as aspect.

Two very large *Heimerliodendron brunonianum* (parapara), one recorded in the transects (level 21), are situated just behind the beach at the west end of Camp Bay. These trees, both about 40 ft. high, are multi-stemmed. One, which is 11 ft. 1 in. in girth just above ground level, has a main stem with a girth of 6 ft. 6 in. at breast height, while the other (in the transect, see Table 2) has two stems with girths of 10 ft. 4 in., and 5 ft. 9 in. respectively. The double-stemmed tree has a crown spread of 45 ft. and casts a shade so dense that the only plant growth beneath it is a profusion of its own seedlings and saplings, with *Corynocarpus* seedlings near the margin of the crown overhang. Similarly, extensive seedling development with saplings up to 12 ft. in height is present in the heavy shade cast under the slightly smaller tree 25 ft. high, further along the beach in the low forest.

Counts of parapara seedlings in the cotyledon stage were made in 6 quadrats, each of 1 metre square, under the large, double-stemmed tree. Data is given in Table 4. Quadrats 5 and 6, sampled at the edge of the canopy, had fewer seedlings than those in the full shade of the canopy (quadrats 1-4) which averaged 417/m². A count of larger seedlings and saplings up to 16 feet high showed that there were more than 250 plants over 1 year old below the 45 foot diameter crown of this tree.

There are fewer secondary species in the area sampled in Stream Gully than in the forest at the west end of Camp Bay. While this might indicate greater

maturity of the Stream Gully community there are, however, larger specimens of *Beilschmiedia* and pohutukawa in the west Camp Bay forest. The minor differences in composition of the two areas, therefore, possibly merely reflect differences in aspect, slope and other environmental factors.

TABLE 4 : Counts of *Heimerliodendron* seedlings in the cotyledon stage
(A) under large, double-stemmed tree in transect (level 21) and
(B) under medium sized tree in low coastal forest, Camp Bay.

	Quadrat No.	No. of seedlings	Location
A:	1	451	Under main canopy.
	2	400	Under main canopy.
	3	330	Under main canopy.
	4	487	Under main canopy.
	5	120	Near edge of canopy.
	6	260	Near edge of canopy.
B:	7	200	Under smaller tree.
	8	254	Under smaller tree.

HAPPY JACK ISLAND (MOTUKAHAUA) [N39/878847]

This is the most distant (9.5 miles) from Coromandel of the islands studied, and is 'U'-shaped with a broad base to the north and two narrow, steeply ridged arms flanking a deep, sheltered inlet known as Elephant Cove. The ridge, which rises to over 200 feet high, is broken on the eastern flank by a narrow strand connecting a small headland with the main part of the island.

On cliffs at the end of the western headland, bracken is predominant, but further north *Phormium tenax*, associated with small shrubs and a few *Metrosideros excelsa*, grows on the steep slopes. At the sheltered head of the cove and around the east headland, large *M. excelsa* shade the cliff-faces, with a few shrubs and herbs such as *Astelia*, *Asplenium* spp., *Doodia*, *Dichondra*, and various grasses clinging to the ledge and stable slopes. A canopy of *M. excelsa* also covers the top of the east headland. The island's outer cliffs are bare and rapidly eroding.

Above the cliff, most of the central cirque-like area, sloping down gently from outer to inner cliff, and towards a central valley, is covered by low *Leptospermum* scrub varying from 3 to 8 feet in height. This is windswept and forms a dense, closed canopy with very sparse ground cover, chiefly *Doodia*, *Haloragis procumbens*, *Hebe pubescens*, bracken, lichen (especially *Cladia* sp.)

mosses and a few adventives. A few isolated *M. excelsa* and flax are evident among the *Leptospermum*.

Burrows and fresh droppings of rabbits were of such a frequency as to warrant extermination measures. Almost certainly this would result in an improvement of the ground cover which is notably sparse even where light and other factors seem favourable.

RABBIT ISLAND (MOTURUA) [N39/897795]

This is a long, narrow island, approximately $\frac{3}{4}$ mile in length and steeply sloping on each side from a central ridge, 100 ft to over 250 ft high. It is 7 miles from Coromandel township.

The cliffs are extremely crumbly, and in some places only a few tenacious *M. excelsa* survive. A sparse ground cover of grasses and herbs such as *Anagallis* and *Astelia* is present where ground stability permits. On some slopes this is supplemented by *Cortaderia* sp. and clumps of *Gahnia lacera*, with occasional *Phormium* and *Leptospermum scoparium*. On less steep areas behind the beach near the centre and north-western end of the island there is a dense *Leptospermum* scrub cover including *Geniostoma*, *Myrsine*, *Coprosma robusta*, *Melicytus*, *Pomaderris phyllicifolia*, with occasional emergent *M. excelsa*. Ground cover is almost non-existent. A tangled mass of *Muehlenbeckia* fringes the beach in this area.

As on Happy Jack Is., rabbit droppings are frequent and the animals must certainly aid erosion and cause damage to the vegetation.

BUSH ISLAND (MOTUKARAMARAMA) [N39/897817]

Bush Island, located 8 miles from Coromandel, is a small island approximately $\frac{1}{4}$ mile across, and is inaccessible from most sides because of the steep cliff faces above the rocky shoreline. However two steep slopes at the south-eastern side lead from the coast to a saddle with a flattish summit on either side more than 200 feet high.

The steep slopes are characteristically dominated by *Metrosideros*, *Dysoxylum*, *Planchonella*, and probably occasional *Corynocarpus*, of which a large number of seedlings were found. There are several large *Planchonella*, including one triple-trunked tree with girths of 5 ft. 10 in., 3 ft. and 2 ft. The subdominants are *Pseudopanax lessonii*, *Macropiper*, *Melicytus*, and *Melicope ternata*. There is apparently no *Myrsine* present on these steep slopes, although it is common elsewhere on the island. Although there is much open ground beneath the canopy on these slopes, *Peperomia urvilleana* is quite common, and the sparse ground cover includes *Asplenium* spp., *Doodia*, young *Melicope*, seedlings of *Melicytus*, *P. lessonii*, *Macropiper*, and *Corynocarpus*.

The flatter ground carries a dense-canopied forest, 20-30 ft. high, dominated by *Melicytus* and *P. lessonii*, with large, emergent pohutukawa, some of which support epiphytic *Collospermum hastatum* and *Earina mucronata*, and including *Myrsine*, *Melicope*, and a few large *Coprosma robusta* in the canopy. There are several trees of unusually large size, for example one *Melicytus* 3 ft. 5 in. in girth

at breast height and another with a multiple trunk and a girth of 5 ft. 9 in. at its base; *P. lessonii* up to 3 ft. 7 in. in girth; *Leptospermum ericoides* with girth, 3 ft. 11 in.; and an *Entelea arborescens* 3 ft. 6 in. in girth.

In contrast to its rarity (a solitary record) on Goat Island, *Paratrophis banksii* occurs quite frequently on the less steep areas, with saplings and several large trees present, (girth measurements up to 5 ft. 9 in.), one bearing abundant green fruit at the time of the survey. The understorey contains *Melicope*, *Myrsine*, *Macropiper*, *Paratrophis* saplings, rare *L. ericoides*, and occasional *Entelea* approximately 15 feet high. A *Parsonia heterophylla* with a stem almost 2 in. in diameter and with some very large, broad leaves, makes a noteworthy spectacle.

The ground cover on the flat saddle includes seedlings of the tree species listed, except for *Leptospermum* and pohutukawa. Seedlings of *Entelea* only occur in canopy gaps. Sedges occur frequently, as do hardy ferns such as *Doodia*, *Asplenium* spp., and *Adiantum hispidulum*; *Geniostoma*, with some other ferns and a few herbs, occur infrequently. A dense grove of *Phytolacca*, growing with *Asplenium lucidum*, is present in a canopy gap caused by the fall of a large *Melicytus*.

One of the gannet colonies on the island was inspected. It is surrounded by trees and shrubs about 10 ft. high and is bordered by *Coprosma repens*, *Hymenanchera novae-zelandiae*, *Solanum aviculare*, and *Phytolacca*.

At the southern end of the island there is a rocky outcrop which has a low, herbaceous ground cover except for occasional pohutukawa, *Leptospermum*, *Hebe pubescens*, and one *Pseudopanax lessonii*. The ground cover includes *Pomaderris phyllicifolia*, *Astelia banksii*, a variety of grasses and adventive weed species, a few small hardy ferns, and native orchids.

Vegetation fringing the rocky shoreline is characterized by pohutukawa, *Pittosporum crassifolium*, *Coprosma repens* and *Arthropodium cirratum*.

Despite the rich nature of the mature coastal forest, there is apparently no *Beilschmiedia tarairi* on the island, although species with which it is a codominant in some areas of Goat Island are present in considerable numbers.

PAULS ISLAND (MOTUMORIRAU) [N39/919744]

This is a small, rocky outcrop a few hundred yards to the east of Goat Is., and 4.2 miles from Coromandel. It rises very steeply on all sides to a narrow ridge about 60 ft. in height.

The vegetation is mainly low growing, with the following scattered dominants: large pohutukawa; *Pittosporum crassifolium* and *Pseudopanax* up to 15 ft. in height. The shrubs and herbs are fairly typical of exposed coastal habitats, and include *Hymenanchera novae-zelandiae*, *Coprosma repens*, *Phormium*, *Arthropodium*, *Muehlenbeckia*, *Asplenium flaccidum*, and *Dichondra*. There are two *Avicennia resinifera* plants growing amongst consolidated shell deposits in cracks of the rock platform.

RAT ISLAND (MOTUKAKARIKITAHI)[N39/935721]

This is a small, roughly circular, steep-sided island rising to almost 200 feet, 2 miles from Coromandel township.

Two vegetation types are evident. One side is covered with low scrub characterized by *Phormium*, *Leptospermum*, and *Hebe*. On the more sheltered side, facing the Peninsula, it is bush-covered, with pohutukawa a major component of the canopy, several *Sophora tetraptera*, and one large, conspicuous *Planchonella* with 7 ft. 3 in. girth, the only mature specimen of the species seen on the island. *Pseudopanax*, *Macropiper*, *Pittosporum*, *Heimerliodendron*, one *Paratrophis* (fruiting), and *Gahnia* are present, together with a ground cover including a few ferns, sedges, grasses and adventive weed species. There is also an extensive thicket of *Parsonsia heterophylla* with large leaves up to 2.5 x 2.3 inches. Of particular interest is the *Sicyos angulata* which hangs in festoons over rocks and trees adjacent to the shore on the southern side of the island.

DISCUSSION

The vegetation of the islands is in general rather young with remnants of mature forest on Goat Island and Bush Island and a small remnant on Rat Island. Within the forest a few trees are of greater age than the others and could be remnants of an even earlier vegetation.

Many stages of succession are represented by the younger communities of the islands, the older regenerating stands probably dating back to just before or after the start of European occupation of the adjacent coast. Because of the terrain very few parts of the islands would have been cultivated before regeneration occurred. An exception could have been the flat behind Camp Bay on Goat Island. No obvious Pa sites were seen but a rock mound behind Camp Bay could have been a burial site.

The distribution of *Beilschmiedia tarairi* is interesting. Its apparent absence from Bush Island conforms to the absence or rarity of canopy trees of the species on islands other than Hen, northwards from Mayor Island. In contrast, *B. tarairi* is a major dominant in the mature forest on Goat Island as it is on the mainland of the Coromandel Peninsula.

Vitex lucens, characteristically one of the major dominant species in mixed coastal forest of other offshore islands, is remarkable not only for its absence on most of these Coromandel Islands, but for its presence on Goat as an apparently solitary specimen. This tree is of large size and fruiting, but no young trees or seedlings were seen on any of our visits.

Dysoxylum spectabile is a major dominant and sub-dominant on Goat Island and Bush Island as on many islands of other groups. Some trees have reached a large size, as have trees of *Metrosideros excelsa*, the other major dominant in the mature coastal forest, where it occurs as scattered, isolated trees with widely spreading, emergent crowns rather than as a member of a mixed canopy of uniform height.

Atkinson (1968) lists *Heimerliodendron brunonianum*, *Planchonella novo-zelandica*, and *Paratrophis banksii* amongst the plants on Coppermine

Island which are rare and mainly or wholly restricted to offshore islands.

Planchonella is well represented by several large trees on Goat and Bush Islands and by one large tree on Rat Island, with vigorous regeneration of seedlings and saplings. Two of the three trees of *Heimerliodendron* on Goat Island must be amongst the largest extant specimens of this plant. Regeneration is locally vigorous on Goat Island and sparse on Rat Island. No sign was seen of this species on the other islands of the group. Mature trees of *Paratrophis banksii* are rare on Goat Island but quite plentiful on Bush Island where regeneration is abundant.

Another rare plant almost confined to offshore islands, *Sicyos angulata*, grows vigorously by the shore on Rat Island.

The form of kawakawa on these islands is *Macropiper excelsum* var. *majus*, characteristic of islands from Mayor Island northwards. *Melicytus ramiflorus* was notable for the size of its leaves. The only *Hebe* species recorded was *H. pubescens*, which is probably restricted to the Coromandel Peninsula. *Asplenium lucidum* varies in form, but frequently approaches *A. obtusatum* in frond shape, as recorded from several coastal localities. The hair-like scales on leaf axis and pinnae are a distinguishing characteristic, however (Martin, 1938).

Quite apart from the aesthetic desirability of preserving their vegetative cover, there are strong botanical grounds for maintaining the islands of the northern part of the group as reserves. As such, they would give protection to fine examples of rare trees, and would illustrate, in a manner impossible on the mainland, almost undamaged mature coastal forest and several stages in its regeneration. The islands should be kept free from introduced mammals; it is urgent that rabbits be eradicated from the islands on which they occur.

LIST OF VASCULAR PLANTS

For the six Coromandel Islands described in this article.

Only initial species lists are given for five of the islands, to which short visits were made. A fuller list is given for Goat Is.

Nomenclature follows Allan (1961) for psilopsids, ferns, and dicotyledons; Moore and Edgar (1970) for monocotyledons except grasses; Cheeseman (1925) for grasses, or Zotov (1963) where revisions have been made; Allan (1940) or other available literature for adventives.

Adventives are marked*

Species present on islands other than Goat Is. but not found on Goat Is. are marked †.

1. Plant species list for GOAT ISLAND.

PSILOPSIDS

Tmesipteris tannensis

FERNS

Adiantum cunninghamii
A. hispidulum
Asplenium bulbiferum var. *laxum* ?
A. falcatum
A. flaccidum
A. hookerianum
A. lucidum
Blechnum capense
B. filiforme
B. lanceolatum
Ctenitis decomposita
Cyathea dealbata
C. medullaris
Doodia media
Hymenophyllum sanguinolentum
Hypolepis tenuifolia
Lindsaea linearis
Lygodium articulatum
Phymatodes diversifolium
P. scandens
Polystichum richardii
Pteridium aquilinum var. *esculentum*
Pteris comans
P. tremula
Pyrrosia serpens

MONOCOTYLEDONS

Astelia banksii
Arthropodium cirratum
Collospermum hastatum
Cordyline australis

Dianella nigra
Earina mucronata
Microtis unifolia
Phormium tenax
Pterostylis banksii
Rhopalostylis sapida
Ripogonum scandens
Thelymitra sp.

Sedges

Carex breviculmis †
C. flagellifera
C. solandri
C. spirostris
Cyperus ustulatus
Gahnia lacera
Lepidosperma laterale
Morelotia affinis
Schoenus tendo
Scirpus nodosus
Uncinia uncinata

Grasses

Aira multiculmis
 * *Avena fatua*
 * *Briza minor*
Cortaderia sp.
Deyeuxia billardieri
Dichelachne crinita
Echinopogon ovatus
 * *Holcus lanatus*
Notodanthonia penicillata
N. gracilis
Oplismenus undulatifolius
 * *Pennisetum clandestinum*

Poa anceps

- * *Sporobolus africanus* (ex *capensis*)
- * *Vulpia bromoides*

DICOTYLEDONOUS

TREES, SHRUBS and LIANES

Beilschmiedia tarairi
Brachyglottis repanda
Carmichaelia aligera
Clematis paniculata
Clematis sp.
Coprosma arborea
C. australis (*macrocarpa* ?)
C. lucida
C. repens
C. rhamnoides
C. robusta
Coriaria arborea
Corynocarpus laevigatus
Cyathodes fasciculata
Dysoxylum spectabile
Entelea arborescens
Eleaocarpus dentatus
Fuchsia excorticata
Geniostoma ligustrifolium
Hebe pubescens
Heimerliodendron brunonianum
Hymenanthera novae-zelandiae
Knightia excelsa
Leptospermum ericoides
L. scoparium
Macropiper excelsum var. *majus*
Melicope ternata
Melicytus ramiflorus
Metrosideros excelsa
M. perforata
Muehlenbeckia complexa
Myrsine australis
Myoporum laetum
Neopanax arboreum
Olearia furfuracea
Paratrophis banksii
Parsonia heterophylla
Pittosporum crassifolium
Planchonella novo-zelandica
Plagianthus divaricatus
Pomaderris phyllicifolia var. *ericifolia*

- * *Prunus* sp.
- Pseudopanax crassifolium*
- P. lessonii*
- P. crassifolium* x *lessonii* hybrid
- Quintinia serrata*
- Rhabdothamnus solandri*
- Rubus cissoides*
- Vitex lucens*

HERBACEOUS DICOTYLEDONS

- * *Anagallis arvensis*
- Apium australe*
- Calystegia soldanella*
- * *Centaureum umbellatum*
- * *Cirsium lanceolatum*
- * *Crepis capillaris*
- Dichondra repens*
- Disphyma australe*
- Erechtites scaberula*
- * *Erigeron floribundus*
- * *Eupatorium adenophorum*
- * *Euphorbia pepus*
- Geranium pilosum*
- Gnaphalium luteo-album*
- * *G. spicatum*
- Haloragis erecta*
- H. procumbens*
- * *Hypochaeris radicata*
- * *Kickxia elatine*
- * *Leontodon* sp.
- * *Linum gallicum*
- L. monogynum*
- Lobelia anceps*
- * *Lotus angustissimus*
- * *Medicago polymorpha*
- * *Melilotus indica*
- * *M. officinalis*
- Nertera depressa*
- * *Orobanche minor*
- Oxalis corniculata*
- Pelargonium inodorum*
- Peperomia urvilleana*
- * *Phytolacca octandra*
- * *Physalis peruviana*
- Pimelea prostrata*
- * *Polycarpon tetraphyllum*
- * *Ranunculus sardous*
- * *Sagina procumbens*
- Salicornia australis*
- * *Senecio atkinsoniae*
- Senecio lautus*
- Solanum nigrum*
- * *Sonchus oleraceus*
- * *Trifolium dubium*
- * *Vicia angustifolia*
- * *V. tetrasperma*
- Wahlenbergia gracilis*

2. Initial plant species list for HAPPY JACK ISLAND

FERNS

- Asplenium flaccidum*
Asplenium lucidum
Blechnum capense
† *B. membranaceum*
† *Cheilanthes sieberi*
Doodia media
Phymatodes diversifolium
Pteridium aquilinum var. *esculentum*

MONOCOTYLEDONS

- † *Acianthus sinclairii*
Astelia banksii
Phormium tenax
Thelymitra longifolia

Sedges

- Carex breviculmis*
C. flagellifera
Scirpus nodosus

Grasses

- Deyeuxia billardieri*
Notodanthonia sp.
†* *Poa trivialis*

DICOTYLEDONOUS
TREES, SHRUBS and LIANES

- † *Cassinia retorta*
Hebe pubescens
Leptospermum scoparium
Metrosideros excelsa
Myrsine australis
Olearia furfuracea
Pomaderris phyllicifolia var. *ericifolia*

† *Solanum aviculare*
HERBACEOUS DICOTYLEDONS

- * *Centaurium umbellatum*
†* *Cirsium vulgare*
† *Cyathodes fraseri*
Dichondra repens
Haloragis procumbens
† *Lagenophora pumila*
Lobelia anceps
Oxalis corniculata
* *Phytolacca octandra*
* *Sagina procumbens*
Senecio lautus
Solanum nigrum
* *Sonchus oleraceus*
Wahlenbergia gracilis

3. Initial plant species list for RABBIT ISLAND

FERNS

- Asplenium falcatum*
A. flaccidum
A. lucidum
† *Cheilanthes sieberi*

MONOCOTYLEDONS

- Astelia banksii*
Phormium tenax

Sedges

- Gahnia lacera*
Scirpus nodosus

Grasses

- Cortaderia* sp.
Notodanthonia penicillata
* *Sporobolus africanus* (ex *capensis*)
* *Vulpia bromoides*

DICOTYLEDONOUS
TREES, SHRUBS and LIANES

- † *Cassinia retorta*
Clematis sp.
Coprosma repens
C. robusta
Gentostoma ligustrifolium
Leptospermum scoparium
Meliccytus ramiflorus
Metrosideros excelsa
Muehlenbeckia complexa
Myrsine australis
Pomaderris phyllicifolia
var. *ericifolia*

HERBACEOUS DICOTYLEDONS

- * *Anagallis arvensis*
* *Centaurium umbellatum*
† *Cyathodes fraseri*
Dichondra repens
† *Hydrocotyle moschata*
* *Hypochaeris radicata*
* *Melilotus* sp.
Oxalis corniculata
† *Wahlenbergia colensoi*

4. Initial species list for BUSH ISLAND

FERNS

- Adiantum hispidulum*
Asplenium ?bulbiferum var. *laxum*
† *A. flabellifolium*
A. flaccidum
A. lucidum
† *Cheilanthes distans*
† *C. sieberi*
† *Ctenitis velutina*
Doodia media
† *Pellaea rotundifolia*
Phymatodes diversifolium
Pteris tremula
Pyrrosia serpens

MONOCOTYLEDONS

- Astelia banksii*
Arthropodium cirratum
Collospermum hastatum
† *Earina mucronata*
Microtis unifolia
Thelymitra sp.

Sedges

- Carex* sp.
Gahnia lacera
Scirpus nodosus

Grasses

- Aira caryophyllea*
Avena sp.
†* *Anthoxanthum odoratum*
†* *Dactylis glomerata*
Dichelachne crinita
Oplismenus undulatifolius

5. Initial plant species list for PAULS ISLAND

FERNS

- Asplenium flaccidum*
A. lucidum
† *Cheilanthes sieberi*
Pteridium aquilinum var. *esculentum*
Pyrrosia serpens

MONOCOTYLEDONS

- Arthropodium cirratum*
Phormium tenax

*DICOTYLEDONOUS
TREES, SHRUBS and LIANES*

- Coprosma repens*
C. robusta
Corynocarpus laevigatus
Dysoxylum spectabile
Geniostoma ligustrifolium
Entelea arborescens
Hebe pubescens
Hymenanthera novae-zelandiae
Leptospermum ericoides
L. scoparium
Macropiper excelsum var. *majus*
Melicope ternata
Melicytus ramiflorus
Metrosideros excelsa
† *Muehlenbeckia australis*
Myrsine australis
Paratrophis banksii
Parsonsia heterophylla
Pittosporum crassifolium
Planchonella novo-zelandica
Pomaderris phyllicifolia
var. *ericifolia*
Pseudopanax lessonii
† *Solanum aviculare*

HERBACEOUS DICOTYLEDONS

- Anagallis arvensis*
* *Centaurium umbellatum*
† *Erechtites quadridentata*
* *Erigeron floribundus*
Geranium pilosum
Gnaphalium sp.
* *Hypochaeris radicata*
* *Orobanche minor*
† *Parietaria debilis*
Peperomia urvilleana
* *Phytolacca octandra*
* *Polygonum tetraphylla*
* *Silene gallica*
* *Sonchus oleraceus*

Sedges

- Scirpus nodosus*

Grasses

- † *Aira caryophyllea*
Avena sp.
* *Briza minor*
Cortaderia sp.
Deyeuxia billardieri
Dichelachne crinita
Poa anceps

- * *Sporobolus africanus*
- † *Stipa teretifolia*

DICOTYLEDONOUS

TREES, SHRUBS and LIANES

- † *Avicennia resinifera*
- Charmichaelia aligera*
- Coprosma repens*
- Hebe pubescens*
- Hymenanthera novae-zelandiae*
- Metrosideros excelsa*
- Muehlenbeckia complexa*
- Pittosporum crassifolium*
- Pseudopanax lessonii*

HERBACEOUS DICOTYLEDONS

- * *Anagallis arvensis*
- * *Centaurium umbellatum*
- Dichondra repens*
- Disphyma australe*
- * *Erigeron floribundus*
- Gnaphalium* sp.
- * *Hypochaeris radicata*
- Linum monogynum*
- * *Orobancha minor*
- Pimelea prostrata*
- * *Polycarpon tetraphyllum*
- Salicornia australis*
- * *Senecio atkinsoniae*
- Senecio lautus*
- †* *Silene gallica*
- * *Sonchus oleraceus*

6. Initial plant species list for RAT ISLAND

FERNS

- Adiantum hispidulum*

MONOCOTYLEDONS

- Astelia banksii*
- Phormium cookianum* ?
- P. tenax*

Sedges

- Carex spirostris*
- Gahnia lacera*

Grasses

- † *Agropyron scabrum*
- †* *Anthoxanthum odoratum*
- Dichelachne crinita*
- † *D. saurea*
- Poa anceps*

DICOTYLEDONOUS

TREES, SHRUBS and LIANES

- Clematis* sp.
- Coprosma lucida*
- C. repens*
- Hebe pubescens*
- Heimerliodendron brunonianum*
- Leptospermum scoparium*
- Macropiper excelsum* var. *majus*
- Metrosideros excelsa*
- Paratrophis banksii*
- Parsonsia heterophylla*
- Pittosporum crassifolium*
- Planchonella novo-zelandica*
- Pseudopanax lessonii*

- † *Sicyos angulata*
- † *Solanum aviculare*
- † *Sophora tetraptera*

HERBACEOUS DICOTYLEDONS

- Erechtites scaberula*
- * *Erigeron floribundus*
- Geranium pilosum*
- * *Hypochaeris radicata*
- * *Orobancha minor*
- †* *Veronica plebeja*

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