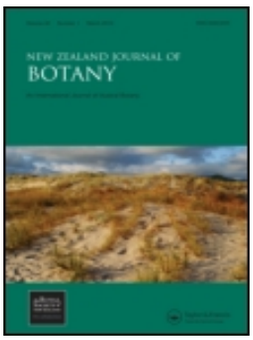

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Botanical features of Motutapu, Motuihe, and Motukorea, Hauraki Gulf, New Zealand

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Abstract An outline of the vegetation and flora is given for three islands which have been farmed for over a century. Motutapu, the largest, is predominantly pasture with extensive riparian swamps, degenerate relics of native forest, and very minor areas of scrubland (flora: 139 native, 206 exotic). Motuihe is grassy with small patches of native forest (flora: 96 native, 124 exotic). Motukorea is almost entirely grass-covered (flora: 55 native, 85 exotic).

Keywords Motutapu Island; Motuihe Island; Motukorea Island; forest; swamp; scrubland; pasture; flora; dynamics

INTRODUCTION

Motutapu (1508 ha), Motuihe (180 ha), and Motukorea or Browns Island (60 ha) are farmed islands lying within 10 km of Auckland City (Fig. 1) and forming part of the Hauraki Gulf Maritime Park. All were occupied by Maoris who left evidence of their occupation in their earthworks, and were at least partly responsible for modifying the natural vegetation. After European settlement began in the Auckland region in the late 1830s the islands passed from Maori ownership and were farmed as well as being used for military purposes, health purposes, and public pleasure.

The natural vegetation on all islands has been seriously depleted. This paper treats Motutapu in some detail and gives a general account of Motuihe and Motukorea. The vegetation of Tiritiri Island (Esler 1978), *c.* 15 km away; is in a less degraded state and makes a very useful comparison.

Climate

Climatological records are not kept on these islands but data for Albert Park in Auckland City (NZ Meteorological Service 1966, 1973a, 1973b) are relevant. Rainfall averages 1268 mm per annum. January is the driest month with 64 mm. About twice this amount falls in each of the winter months. Normal temperatures range from 10.8°c in July to 19.8°c in February. There are very few frosts. Sunshine hours are 2102 annually, 49% of the possible number. Strong winds are not common, the strongest are from the north-east but west and south-west directions predominate.

Wild mammals

Records of the introduction of the rock wallaby (*Petrogale penicillata*) to Motutapu are confused but it is probable that some were released in the 1870s. Wodzicki & Flux (1967) noted that rock wallabies "... are very agile and can climb as high as 12 ft on sloping trees, but feed mainly on grassy clearings above the cliffs". These authors recorded the shooting of 517 wallabies in 1965 as part of the total toll. The extreme state of depletion of the vegetation noted on Kawau Island through wallaby feeding has not yet been reached on Motutapu.

Liberations of the opossum (*Trichosurus vulpecula*) were made around Auckland in the 1870s and it is likely that some reached Motutapu at about this time. The presence of the causeway between Motutapu and Rangitoto allows movement of opossums and wallabies between these two islands.

The Norway rat (*Rattus norvegicus*) has been seen on Motutapu but the population levels and effects are not known. Rabbits (*Oryctolagus cuniculus*) occur on some parts of the island.

There are rabbits on some parts of Motuihe and throughout in high numbers on Motukorea until March 1979. It is likely that at least one species of rat is present on these islands but there are no wallabies or opossums.

Comments are given in this paper on some apparent effects of wallabies and opossums on the Motutapu vegetation.

MOTUTAPU

History

All of Motutapu is farmed except for small areas fenced off to aid management of pastures and livestock, and to protect plantings of trees and shrubs. The island, part of the Hauraki Gulf Maritime Park, provides public recreation space on the coast and along the walkway between Islington Bay and Home Bay. Profit from the farm contributes to the income of the park.

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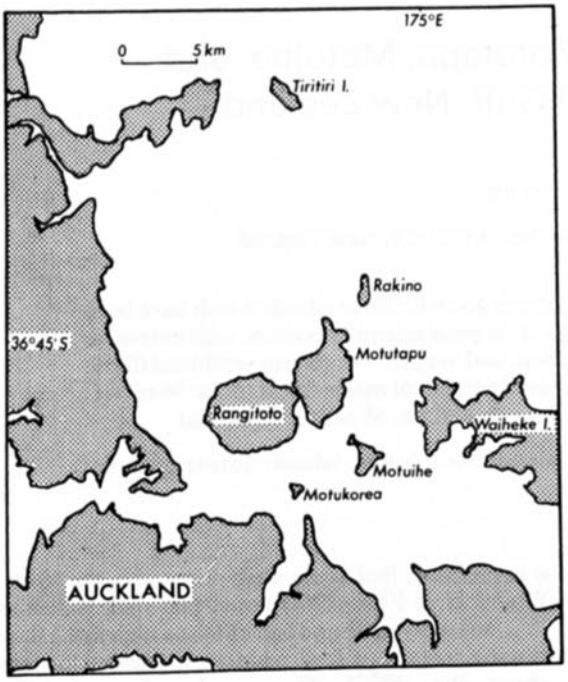

Fig. 1 Location map of Motutapu, Motuihe, and Motukorea.

Maori occupation before and after the Rangitoto ash eruption in about 1200 AD is indicated by archaeological work documented in *Records of the Auckland Institute and Museum* (see Davison 1970). The island was farmed privately from the early 1850s until it was taken over for defence purposes in World War II and managed by the Department of Lands and Survey.

Physical features

Motutapu is 7.8 km long and has a maximum width of 3.8 km (Fig. 2). The island has been eroded by the sea on all sides, the slopes on the greywacke which composes most of the island being moderately steep but not rocky except on the few precipitous parts. The sandstone of the Waitemata Group, overlying the submerged greywacke in the south-west, forms cliffs bounding Islington Bay and Gardiner Gap. These cliffs probably formed before the volcanic cone of Rangitoto Island emerged and have been protected since by Rangitoto, particularly near the causeway where the two islands join. The undulating interior of the island reaches over 100 m in 9 places. Very regular slump terraces are prominent on the sandstone. Ash which erupted from Rangitoto about 1200 AD mantles most of the island. It is up to a metre deep in parts but considerably less in the north and south. Ash has washed from the slopes into the gullies where it is retained in the very lengthy swamps which fill most stream beds from source to outlet.

An account by Grant-Mackie (1960) outlines the geology of the inner islands of the Hauraki Gulf, and Brothers & Golson (1959) relate a stratigraphic section near Administration Bay to geology and archaeology.

Vegetation

D'Urville, sailing down the Rangitoto Channel in 1827, commented that, in comparison with the mainland, Rakino, Motutapu, and Rangitoto were "well wooded" (Smith 1909). Farming was already under way when T. Kirk visited Motutapu and reported (Kirk 1879) that over half of the island was "laid down in excellent grass", most of the remainder being in manuka (*Leptospermum scoparium*) or in fernland. He added "Nothing in the shape of arboreal vegetation is to be found, except on sloping places on the cliffs, and in one or two bays" where there were magnificent pohutukawa (*Metrosideros excelsa*) and a few tawapou (*Planchonella novo-zelandica*) and karaka (*Corynocarpus laevigatus*). Most of the native vegetation, he said, was littoral (coastal) or ericetal (heath-like). He catalogued over 240 species of flowering plants and ferns, about 45 of these being naturalised plants mainly associated with agriculture.

Atkinson (1960), mapping the forest on islands of the inner gulf, marked six forest remnants on Motutapu corresponding to the very degenerate groups of trees persisting there today. Considering the apparent absence of carbonised wood beneath the 1200 AD Rangitoto ash shower, he wondered if there were already clearings on Motutapu at that time. There are still too few stratigraphic sections examined to be conclusive. The few that have been exposed are mainly on Maori occupation sites where there would at least be local clearings.

R. C. Cooper (see Scott 1970) identified pohutukawa, karaka, and tawapou from leaf fragments gathered from below the Rangitoto ash.

Taylor (1960) considered that a buried podzolic soil near Islington Bay may indicate that kauri grew there before the ash shower.

The scenery of the present is dominated by pastoral farming in a maritime setting. Clumps of pohutukawa and other trees are relics of the past but they have not yet been subdued in the landscape by ornamental plantings and tree shelter belts. Extensive swamps in the valley floors may not have changed much in a century, but coastal plants, other than pohutukawa, are no longer a feature of the island.

Grassland

At least some of the grassland had its origin in Maori times. Cultivation kept some of the land clear of forest, and it is likely that other land was cleared for defence reasons and to facilitate movement. Felling for firewood, and unconfined burns probably

Fig. 2 Motutapu. Aerial photos SN 3229 A1 & A2. *Photo:* Department of Lands and Survey, New Zealand

accounted for the loss of much woody vegetation. Grassland of danthonia (*Notodanthonia* spp.), *Microlaena stipoides*, and possibly *Poa anceps* may have developed in limited areas, particularly where there was trampling.

Pastures

With the introduction of grazing animals, possibly in the 1840s, grassland would have been easier to maintain. Pastoral farming on a large scale probably began in the 1950s. It is recorded (McLintock 1966, Vol. 1, p. 870) that Robert Graham bought Motutapu in 1857 and Motuihe in 1858. Two decades later when T. Kirk reported that over half was in excellent grass, scrub would have been cleared and seed mixtures sown. Seed mixtures in those times included many pasture species, and some impurities. These plants, and the self-introductions, could account for the 45 naturalised species noted by Kirk.

The pastures vary in quality, mainly with variations in soil fertility. The best pastures contain perennial ryegrass (*Lolium perenne*), cocksfoot (*Dactylis glomerata*), sweet vernal (*Anthoxanthum odoratum*) and, in winter and spring, *Poa trivialis*. The main legumes are white clover (*Trifolium repens*), suckling clover (*T. dubium*) and, more locally, subterranean clover (*T. subterraneum*). The major weeds are thistles, important because they cover a large area, and apple of Sodom (*Solanum sodomeum*), important because of the difficulty in keeping it under control. Variegated thistle (*Silybum marianum*) is the most troublesome thistle and is hand grubbed each year to keep it in check. In places it forms extensive pure stands. Isolated plants frequently have a rosette spanning a metre or more. Winged thistle (*Carduus tenuiflorus*) and slender winged thistle (*C. pycnocephalus*) are more numerous but have a shorter life and can be grazed close to the plant because the basal leaves wither early. In the 1977–78 summer aphids hastened the loss of the lower leaves of winged thistle and destroyed many seedlings but were less effective on slender winged thistle. Scotch thistle (*Cirsium vulgare*) is widespread and fairly plentiful but not of major significance. Barley grass (*Hordeum murinum*) is quite troublesome, but there appear to be only minor amounts of another barley grass, *H. leporinum*, which grows mainly on ungrazed shores.

Pastures on the poorer soils have these features — a wide range of species (*c.* 60); no tendency for a few species to dominate; small quantities of ryegrass, cocksfoot, *Poa trivialis*, and white clover; more *Bromus mollis*, *Lotus subbiflorus*, and *L. angustissimus*.

The less important species fall into three broad categories — plants with a rosette form (at least in early life), diffuse annuals, grasses. The principal rosette plant is narrow-leaved plantain (*Plantago lanceolata*) and is probably quite a significant part of the diet of grazing animals. Other plants with this form are catsear (*Hypochaeris radicata*), hawksbeard (*Crepis capillaris*), dovesfoot (*Geranium molle*), fiddle dock (*Rumex pulcher*), and, more locally, prickly sow thistle (*Sonchus asper*) and storksbill (*Erodium cicutarium*). Among the diffuse annuals are field madder (*Sherardia arvensis*), small-flowered buttercup (*Ranunculus parviflorus*), suckling clover, clustered clover (*Trifolium glomeratum*), and lesser suckling clover (*T. micranthum*). In some places subterranean clover is prominent. Three grasses are fairly widespread — *Poa annua*, sweet vernal, and Yorkshire fog (*Holcus lanatus*). Among those with more restricted distribution are paspalum (*Paspalum dilatatum*), *Microlaena stipoides*, ratstail (*Sporobolus africanus*), and buffalo grass (*Stenotaphrum secundatum*).

The thistles, apple of Sodom, and barley grass grow on the poorer soils but there is less tendency for the winged thistles to form extensive stands.

Ungrazed grassland

Most of the ungrazed grassland is on coastal slopes. Three localities illustrate the types of grassland to be found on these slopes.

(1) At Islington Bay grassland occupies much of the sandstone slopes facing the south-west. Other features of the area are scattered pohutukawa trees; patches of *Rhamnus alaternus* with some kohekohe (*Dysoxylum spectabile*), bracken (*Pteridium aquilinum*), *Muehlenbeckia complexa*, and pampas (*Cortaderia selloana*); also extensive plantings of trees and shrubs which have not yet become prominent. Towards Emu Point the slopes steepen and the grass cover becomes thinner.

In ungrazed grassland such as this it is usual for a few species to assume dominance, particularly those such as cocksfoot which are tall and erect. However, at Islington Bay there is enough broken ground and unstable soil to promote a wide range of grasses and other species. On parts with a good depth of soil, cocksfoot is the main species and there are appreciable quantities of perennial ryegrass, tall fescue (*Festuca arundinacea*), Yorkshire fog, sweet vernal, *Poa trivialis*, and paspalum. The thinner soils support *Microlaena stipoides*, *Notodanthonia racemosa*, *Bothriochoa macra*, and ratstail. On eroding parts *Vulpia bromoides*, *Bromus diandrus*, and *B. mollis* are seasonally more plentiful. On the unstable soil grows most of the oxtongue (*Picris echioides*), *Lotus* spp., yellow flax (*Linum trigynum*), sow thistle, and the vetches *Vicia sativa* and *V. tetrasperma*. The grass-like introduced sedges, *Carex divisa* and *C. divulsa*, are locally plentiful.

(2) The greywacke coast just north of Home Bay faces north-east and the grassland is typical for this habitat. There are large patches of *Bothriochloa macra* in almost pure stands, growing among the

scattered pohutukawa trees on moderate slopes. In other places, completing the grassy cover, are cocksfoot and *Microlaena stipoides*, with *Bromus diandrus* taking advantage of the minor eroding gaps in the sward.

(3) Above the eastern portion of Waikalabubu Bay the slumping hillside of uncertain geological origin facing the north and north-west is covered with short turf. There is a range of habitats from the very driest with *Notodanthonia racemosa*, to minor wet areas with creeping bent (*Agrostis stolonifera*). On the intermediate habitats grow perennial ryegrass, *Poa trivialis*, cocksfoot, ratstail, white clover, narrow-leaved plantain, and a few annuals on the exposed soil. The foot of the slope backs the beach and wind has blown some sand up the slope. At the upper limit of the sand there is a band composed of *Bromus diandrus*, *B. mollis*, Indian doab (*Cynodon dactylon*), ratstail, a barley grass (*Hordeum leporinum*), and catsear. Below this is a band of *Bromus diandrus* and hawkbit (*Leontodon taraxacoides*) passing abruptly to a pure stand of *Carex pumila* on the beach.

There are some plants, not well represented in these three samples, which are common elsewhere in the ungrazed grasslands. They are narrow-leaved plantain, cut-leaved geranium (*Geranium dissectum*), dovesfoot, cleavers (*Galium aparine*), Australian flax (*Linus marginale*), small-flowered buttercup, and hedge parsley (*Torilis arvensis*). *Agropyron scabrum* and bidibidi (*Acaena novae-zelandiae*) are two native plants (apart from some characteristic coastal plants) which are confined to this habitat. There are a few large patches of kikuyu grass (*Pennisetum clandestinum*). It is not restricted by ecological constraints and will reach many other parts of the island and many other habitats.

Some grassland away from the coast is enclosed by fences to protect plantings of trees. Grassland in these places consists of cocksfoot, *Microlaena stipoides*, tall fescue, and much cleavers and hedge parsley.

Wetlands

Wetlands are a prominent feature. They occupy the full extent of many streams and total *c.* 29 km in length — far exceeding the 20 km of coastline. Most of these alluvial wetlands are 10–40 m wide. They are mostly north of the Islington Bay–Home Bay Road, the southern streams being less impeded.

Three features have favoured the formation of these wetlands:

(1) The gentle grade of the streams (mostly 1 in 15–1 in 50).

(2) The free erosion of the non-coherent Rangitoto ash, particularly soon after the ash eruption, and after scrub fires when pastures were being established.

(3) The efficiency of some swamp plants in trapping silt. Their effect is demonstrated by comparing the swampy stream beds with sections of the stream shaded by trees and shrubs where the stream bed is narrow, channelled, and eroded down to bedrock.

The wetlands have a range of habitats determined by the position of the water table. Open water occurs where there has been artificial ponding for domestic and farm water supplies. At the other end of the scale, there is moist soil where the swamp meets pasture. In intermediate habitats rafted plant material forms quaking swamps in small areas. Plants with narrow limits of tolerance form patches where the habitat suits them. Others are more widely distributed but usually most obvious where the habitat is optimal. Precise ecological limits are difficult to define because of (1) the versatility of species, (2) competition between species, and (3) seasonal changes of the habitat. Fig. 3 is an attempt to place the major species in their approximate positions on the moisture gradient.

In open water the two pond weeds *Potamogeton cheesemanii* and *P. crispus* are rooted, submerged species, whereas *Lemna minor* and *Azolla rubra* are floating species. In the optimum habitat for raupo (*Typha orientalis*) water is not limiting in summer and the swamp is undisturbed by cattle. In a creek reaching the coast between Billy Goat Point and Waikalabubu Bay the swamp has been fenced for many years. The raupo here is 3 m tall and almost impenetrable. It forms a pure colony except for the pink-flowered form of *Calystegia sepium* twining through it. Nearby is a quaking swamp. Here the plants have formed a raft capable of holding a person's weight. The plants here are typical of the undisturbed swamps which do not dry out in summer. The main plants are *Scirpus lacustris*, *Eleocharis acuta*, *Scirpus prolifer*, *Isachne australis*, *Epilobium pallidiflorum*, *Polygonum* sp., and the wetland exotic grasses — creeping bent, Yorkshire fog, and *Poa trivialis*.

Swamps which are trampled and grazed by cattle are a little different in composition. Some species are reduced in quantity, but few are eliminated altogether. The effects are not all adverse. Plants with rapid vegetative spread, or which can seed freely on to the mud, are at an advantage. Disturbance also prevents the loss of vigour which can result through accumulated shoot material and reduced opportunity to colonise fresh ground. *Scirpus prolifer*, *Juncus articulatus*, floating sweet-grass (*Glyceria declinata*), water cress (*Nasturtium officinale*), starwort (*Callitriche stagnalis*), and *Scirpus chlorostachyus* are more plentiful where swamps are grazed. Raupo is shorter and less dense in grazed swamps but there may not be less *Scirpus medianus*, *Isachne australis*, and *Eleocharis acuta*. *Epilobium pallidiflorum* is less plentiful here.

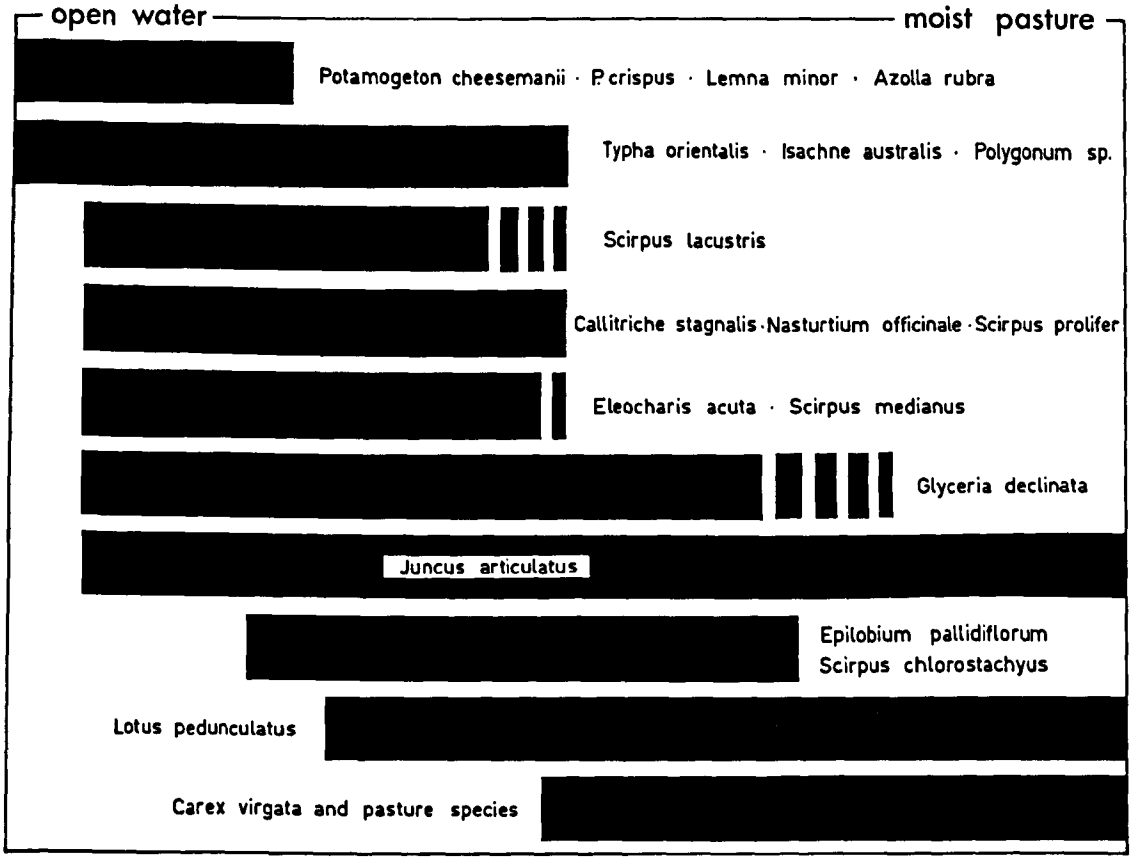

Fig. 3 Generalised plan of position of plants along the moisture gradient in Motutapu wetland.

This perpetually wet habitat seems to mark the limit of tolerance of some very versatile pasture plants — *Lotus pedunculatus*, tall fescue, Yorkshire fog, and *Poa trivialis*. Their optimum requirements are met on the edges of the swamps where wetland gives way to pasture. This is the prime habitat also for pennyroyal (*Mentha pulegium*), creeping buttercup (*Ranunculus repens*), and *Juncus articulatus*. Where there is severe pugging by cattle a mosaic of habitats is created from water-filled hollows to well-drained mounds which are colonised by a wide range of species not normally associated with wetlands.

Forest

The patches of native trees are almost too small to be regarded as forest, and most are on the brink of extinction. In a natural forest some tree species tolerate coastal conditions if they have protected margins and a sloping, well-formed windroof to carry the salt-laden wind over the canopy. However, on Motutapu there is no understorey, no protective margins and, generally, there is a broken canopy. As a tree in a group succumbs to exposure, browsing by opossums, or debarking by cattle, others become progressively more exposed and more prone to windthrow. Pohutukawa survives longer because it has a greater natural life span and tolerance of exposure, but many are being killed by opossums. There is inadequate reproduction to maintain the forest relics because few seedlings survive browsing by farm livestock, wallabies, and opossums. Rank grass too is hostile to seedling establishment.

Contrary to Kirk's statement concerning the absence of arboreal vegetation except pohutukawa, tawapou, and karaka, I believe that there must have been patches of forest a century ago, though perhaps not mature. At the same time, it is clear from the paucity of large trees, large vines and epiphytes, that these stands of trees are not direct relics of some old forest.

In these remnants pohutukawa, tawapou, karaka, kohekohe, rewarewa (*Knightia excelsa*), mangeao (*Litsea calicaris*), taraire (*Beilschmiedia tarairi*), and tawa (*B. tawa*) are well represented. In addition there is totara (*Podocarpus totara*), ngaio (*Myoporum laetum*), mahoe (*Melicytus ramiflorus*), puriri (*Vitex lucens*), and kowhai (*Sophora micro-*

phylla). There are also forest shrubs in small numbers — rangiora (*Brachyglottis repanda*), whau (*Entelea arborescens*), hangehange (*Geniostoma ligustrifolium*), pigeonwood (*Hedycarya arborea*), kawakawa (*Macropiper excelsum*), wharangi (*Melicope ternata*), houpara (*Pseudopanax lessonii*), mapou (*Myrsine australis*), kohuhu (*Pittosporum tenuifolium*), the vine *Parsonia heterophylla*, and some ferns.

The largest remnant of forest, consisting of mixed dominants, is in Bush Creek. It is in two sections each with a more or less continuous canopy and with scattered trees nearby. The tree species in the region are taraire, kohekohe, mangeao, tawa, totara, ngaio, tawapou, pohutukawa, and kowhai. There are a few smaller plants such as whau, wharangi, mapou, pigeonwood, cabbage tree, kohuhu, rangiora, hangehange, coastal karamu (*Coprosma macrocarpa*), kanuka (*Leptospermum ericoides*), and the tree fern *Cyathea medullaris*. It is the only place on the island where more than about four or five tree species grow together, and the only recorded localities for rangiora, kohuhu, pigeonwood, *Adiantum cunninghamii*, and an orchid *Drymoanthus adversus*. This epiphytic orchid appears to be the only orchid on the island, and is a species seen infrequently on the mainland.

The small patches of trees in other places consist of a few individuals of a few species, mostly a combination of two or more of the following — pohutukawa, kohekohe, mangeao, rewarewa, and karaka. Some patches contain tawapou in small numbers but, oddly, there is a pure stand of over 50 trees of tawapou on the coast just north of Station Bay. The only species on Motutapu able to persist in isolation from other trees is pohutukawa.

Pohutukawa stands are in the final stages of degeneration. However, the original composition and the phases of degeneration can be reconstructed because there are examples around Auckland. Pohutukawa on the coast usually grows in pure stands, less commonly with tawapou. It is usual for there to be an understorey of karo (*Pittosporum crassifolium*), houpara, coastal karamu, and kawakawa. These usually stand above a set of ground plants which can tolerate much wind-borne salt. The most important among them are *Astelia banksii*, flax (*Phormium tenax*), *Gahnia lacera*, the grass *Poa anceps*, and the ferns *Asplenium lucidum* and *Polystichum richardii*. When farm animals gain access, the low plants disappear first and later the shrubs. The number and quantity remaining at any one time is an index of the phase of degeneration. When nothing remains except pohutukawa, as on most parts of Motutapu, the end is in sight. Some pohutukawa trees are toppled by the wind but this loss is insignificant compared with the toll taken by opossums. There is some regeneration on the sandstone slopes, but on the greywacke I saw only about six young plants. These were on the steep headwall of a slip where animals could not reach them.

On the unstable sandstone cliffs pohutukawa behaves differently from the firm-rooted plants on the greywacke. Seeds are shed on to the sandstone in vast numbers in May and many seedlings take root before the summer. Most of these are later carried down the slope by the mass erosion and perish when quite young. It is only when the older plants become undermined that the full extent of their root system is evident. Often some roots will hold as the plant topples. The plant then changes its direction of growth and starts a new life in a different posture. In Gardiner Gap a tree carried enough substrate with it to survive on the shore, then produced a new tree from the prostrate trunk. Another apparently slid bodily and landed upright still attached to a set of sandstone strata which exactly matched the strata at the cliff top.

Several forest species find refuge along Home Bay Creek. There appear to be no wallabies in this area and few opossums. The sheltered situation and the exclusion of farm stock are also conducive to forest regeneration. Species which continue to maintain their numbers here are kohekohe, whau, mangeao, kawakawa, mahoe, *Carex ochrosaccus*, *Dianella nigra*, *Asplenium flaccidum* subsp. *flaccidum*, silver tree fern (*Cyathea dealbata*), and mamaku (*Cyathea medullaris*).

Scrubland

Aggregations of shrubs and small trees which have not been planted are referred to here as scrubland. It totals not more than a hectare or so. There is a patch of manuka (*Leptospermum scoparium*) near the centre of the island, some in eastern catchments, another in Administration Bay, some broad-leaved shrubs on a steep hillside in Gardiner Gap, and a very mixed community along the Home Bay Stream.

The manuka stand near the centre of the island is moribund. The plants are mature, even-aged, and have an open canopy 3–5 m high with pasture beneath. The few stands in the east are in a similar condition.

There is a small patch of scrubland on a scarp a few hundred metres west of the YMCA camp, composed of manuka, tutu (*Coriaria arborea*), karamu, and *Cassinia retorta*.

In Gardiner Gap there is an irregular sequence of communities ranging from a thin cover of shrubs to poorly-developed forest. On the more exposed outer parts of the bay the cliffs are undermined by the sea, and the sandstone is continually slipping into the sea. The colonists are mosses and herbaceous exotic plants such as fleabane (*Erigeron floribundus*) and narrow-leaved plantain, together with grasses and legumes. These are followed in the succession by Mexican devil (*Eupatorium adenophorum*),

Rhamnus, and koromiko (*Hebe stricta*). Communities develop no further than this, but inside the bay slipping is less frequent and the shrubs make a denser stand. Nearer the causeway they are joined by coastal karamu, houpara, kawakawa, and some trees — pohutukawa, karaka, mangeao, and kohekohe.

The scrubland along the Home Bay Stream is a collection of some of the exotic aggressive shrubs which are well known around Auckland, together with some native species. About the mid reaches of the stream there is bracken, gorse (*Ulex europaeus*), hawthorn (*Crataegus monogyna*), and blackberry (*Rubus fruticosus*) invading the ungrazed grassland. However, the main community is composed of brush wattle (*Albizia lophantha*) and woolly nightshade (*Solanum mauritianum*) with smaller amounts of mahoe and kawakawa. The brush wattle grows to *c.* 10 m in height and 10 cm in diameter, then the weak root system loses its hold of the non-coherent topsoil and the tree topples. Kawakawa grows through the fallen tree, and a little later mahoe pushes into the canopy. In this way the brush wattle is slowly being replaced. There is not enough light for woolly nightshade seedlings to establish and eventually it gives way too. At the junction of the streams near the Home Bay Road the community is basically the same except that this appears to have been a degenerate relic of native vegetation invaded by brush wattle, woolly nightshade, and privet (*Ligustrum sinense*). Additional taller native species noted here are karaka, mangeao, and kohekohe together with tree fern (*Cyathea medullaris*) and *Muehlenbeckia australis*. Ferns are more plentiful in this gully than elsewhere on the island. The most prominent ferns (apart from bracken and tree ferns) are *Pteris tremula, Athyrium australe, A. japonicum, Doodia media, Adiantum hispidulum, Thelypteris pennigera, Blechnum capense,* and *Asplenium flaccidum* subsp. *flaccidum*.

Coastal vegetation

Except for scattered pohutukawa trees, the coastal slopes of Motutapu show little sign of ever having had communities of coastal plants. On most of the greywacke the slopes are not too steep to exclude rock wallabies, but in a very few unbrowsed places there are some relics from coastal forest — *Astelia banksii*, renga lily (*Arthropodium cirratum*), *Poa anceps, Peperomia urvilleana*, taupata (*Coprosma repens*), houpara, and the ferns *Asplenium lucidum, A. flaccidum* subsp. *haurakiense, Polystichum richardii, Pyrrosia serpens,* and *Phymatodes diversifolium*.

The steepest parts of the sandstone are too unstable to support a permanent population of plants, and the easier slopes have little other than pohutukawa to give them a coastal aspect.

The rocky shore provides a place for a varied native flora in small quantities and subordinate to the many versatile exotics such as the annual grasses (*Aira, Briza, Bromus, Parapholis, Vulpia*), perennial grasses (cocksfoot, sweet vernal, perennial ryegrass, Yorkshire fog), and herbs (*Polycarpon, Sagina, Vicia, Galium, Anagallis, Sonchus,* and *Crepis*). Only *Parapholis incurva* is a regular coastal species. In the upper zone there are small quantities of New Zealand ice plant (*Disphyma australe*), shore groundsel (*Senecio lautus*), *Scleranthus biflorus, Tillaea sieberiana,* and *Oxalis exilis*. A little lower down in moist clefts are *Lobelia anceps*, New Zealand celery (*Apium australe*), *Scirpus cernuus, Selliera radicans,* and shore buttercup (*Ranunculus acaulis*). On the rocks at a lower level grow glasswort (*Salicornia australis*), *Stipa teretifolia,* and *Samolus repens*. The exotic sedge *Carex divisa* is prominent on the shore, but not confined to this level.

The gravel at the foot of some of the eastern coastal slopes, reached infrequently by the tides, provides a habitat for orache (*Atriplex hastata*), *Agrostis semi-verticillata,* clustered dock (*Rumex conglomeratus*), and many other plants of disturbed soils.

On the sandy beaches in the west and north native species are holding a place in a habitat where the native flora had only a few species to stretch over several ecological zones. On the dry sand reached only by the highest tides the sea rockets (*Cakile maritima* and *C. edentula*) and saltwort (*Salsola kali*) grow where no native plant grew previously. However, if there is a freshwater seepage at this level there are no challengers to the native *Carex pumila*. At a higher level, and on dry sand, spinifex (*Spinifex hirsutus*) has to compete with several exotics because there are not large quantities of mobile sand to create an optimum habitat for spinifex. In this zone spinifex and sand convolvulus (*Calystegia soldanella*) are often replaced by Indian doab, harestail (*Lagurus ovatus*), *Bromus diandrus,* catsear, and hawkbit. The sand above this is usually thinner and more stable. Here grow cocksfoot, *Scirpus nodosus,* and ratstail, sometimes with a range of annual legumes of the genera *Lotus* and *Medicago*.

Salt flats reached by the highest tides are limited to a small sheltered area in Islington Bay. *Samolus repens* and *Cotula coronopifolia* are plentiful and there is some *Selliera radicans, Scirpus cernuus,* glasswort, *Triglochin striatum,* and buckshorn plantain (*Plantago coronopus*). Nearby grow *Juncus maritimus, Stipa teretifolia, Deyeuxia billardieri,* and shore ribbonwood (*Plagianthus divaricatus*), all in small quantities. *Leptocarpus similis,* a plant characteristic of this situation, was not seen here but occurs in a few other places on the

Table 1 Numbers of species in abundance rankings.

Abundance ranking	Number of species Native	Exotic
Abundant	3	17
Numerous	12	39
Few	124	151
Total	139	207

island on wet coastal rocks. Mangroves grow along the shore in mud covered daily by sea water.

Plants of disturbed soil

Soil is exposed mainly in erosion scars around the coast and in places where there is intensified trampling by livestock in gateways, around water troughs, and on the margins of roads and ponds. The habitat, though limited in area, is occupied by *c.* 30 species of exotic plants, mostly annuals which can be found in similar situations almost anywhere in the temperate zones of the world.

A group of species have their peak of germination in the spring and early summer, and are dead by winter. In this class are *Amaranthus* (three species), fathen (*Chenopodium album*), nettle-leaved fathen (*C. murale*), and *Portulaca oleracea*. The other annuals, and by far the most numerous plants, germinate mainly in the autumn and winter but seedlings may appear at almost any time if the ground is sufficiently moist. Plants in this class are the grasses *Poa annua, Bromus mollis, B. diandrus*, and shivery grass (*Briza minor*); the legumes — black, bur, and spotted bur medicks (*Medicago lupulina, M. polymorpha, M. arabica*), *Lotus subbiflorus* and *L. angustissimus;* and others such as fleabane (*Erigeron floribundus*), cleavers, fumitory (*Fumaria muralis*), two mallows (*Malva nicaeensis, M. sylvestris*), oxtongue (*Picris echioides*), small-flowered buttercup, twin cress (*Coronopus didymus*), chickweed (*Stellaria media*), and thistles, but mainly sow thistle (*Sonchus oleraceus*).

Some features of the Motutapu flora

Most plant communities and regions in New Zealand have many individuals of a few species and few individuals of many species. This holds for the Motutapu flora also. The Motutapu plants are ranked in Table 1 into three categories depending on whether individuals of a species are abundant, numerous, or few.

Abundance rankings for species on Motuihe and Motukorea are on file at Botany Division, DSIR, Christchurch.

Status of native plants

The most abundant native plants are *Microlaena stipoides, Notodanthonia racemosa*, and *Scirpus prolifer*. Those classed as numerous are *Metrosideros excelsa, Beilschmiedia tarairi, Callitriche stagnalis, Corynocarpus laevigatus, Dysoxylum spectabile, Knightia excelsa, Leptospermum scoparium, Litsea calicaris, Planchonella novozealandica, Polygonum* sp., *Isachne australis, Typha orientalis*, and *Pteridium aquilinum*.

Table 2 Numbers of native species in communities and vulnerability classes.

Community	Status of native species and number in each class: threatened	stable	persisting	Total
Forest and scrubland	35	6	26	67
Coastal vegetation	0	3	23	26
Wetland	0	20	4	24
Open country	2	3	9	14
Various	3	4	1	8
Total	40	36	63	139

Some reasons for the large quantities of these are: (1) minimal disturbance (*Microlaena, Notodanthonia, Typha*), (2) tolerance of disturbance (*Callitriche, Polygonum, Scirpus*), and (3) longevity (the trees, particularly pohutukawa).

The Motutapu plants can be placed into three categories of vulnerability (Table 2). In the first group are plants which cannot continue to exist in the present environment. The second group contains plants facing minimal disturbance (or benefiting from it). They form relatively stable communities and maintain good numbers of individuals. Plants of the third group are persistent plants likely to maintain a hold in low numbers.

An analysis of communities on this basis gives an indication of the place of native plants in the future if present conditions remain. In the table below species are placed in their predominant community. Some of the uncommon species exist as individuals away from their characteristic community but in the analysis they have been placed in the community in which they would normally grow. Some species are not specific to any community and are recorded as "various". These are *Dichondra repens, Epilobium nummularifolium, Lobelia anceps, Oxalis exilis, Cordyline australis, Cyperus ustulatus, Phymatodes diversifolium* and *Pyrrosia serpens*. The open country habitat includes grassland and rocky places which do not have characteristic coastal species. No forest species are included under the heading of coastal vegetation.

About 40 species are threatened with extinction, most of them at the end of the life period of the existing plants. Thirty-two of these are forest plants; 28 are trees and shrubs. In about two decades there

will be few native trees near the coast except pohutukawa. It will remain longer because of the natural life period and tolerance of isolation, but many are being killed by opossums.

Population levels of most wetland species are fairly stable. The habitat of floating and submerged plants is not changing significantly. *Typha orientalis* and *Scirpus lacustris* are little affected because they grow in water and are less accessible to cattle. There is no threat to *Scirpus prolifer* which appears to benefit from the disturbance, and it appears that *Isachne australis, Eleocharis acuta,* and *Scirpus medianus* are not declining markedly. The conflict between native and exotic species increases towards the edge of the swamp where there are fewer adapted native species and the habitat suits many exotics. The pasture rushes which grow on the margins may not have declined in numbers. Rushes of this nature were probably not a major part of any vegetation in New Zealand before farming began.

A greater degree of stability has been reached on the coast because the habitat has not changed greatly. The plants that have withstood or escaped a century of browsing by wallabies are likely to remain.

It is unfortunate that we do not have the list of *c.* 200 native plants catalogued by Kirk a century ago. There are now *c.* 55 species fewer. A comparison of the present flora with the 190 existing species on Tiritiri Island gives an indication of which plants are more vulnerable. It is likely that Motutapu and Tiritiri had about the same range of species, but Motutapu has *c.* 50 fewer native species and *c.* 50 more exotics. The swing is probably related to the more intensive farming on Motutapu and the presence of wallabies. Comparative numbers on a community basis for Motutapu are followed by Tiritiri figures in brackets — forest and scrubland 67 (96), coastal communities 26 (31), wetland 24 (24), open country 14 (27), and various 8 (12).

When the floras of the two islands are compared, forest and scrubland have the greatest differences in composition. Missing from Motutapu but present in the Tiritiri forest and scrubland flora are eight ferns and six other low plants —*Asplenium bulbiferum, A. falcatum, A. filiforme, A. membranaceum, Dicksonia squarrosa, Phytmatodes scandens, Pteris comans, P. macilenta, Solanum nodiflorum, Carex lambertiana, Carex solandri, Cordyline pumilio, Scirpus inundatus,* and *Uncinia banksii.* Among the shrubs and vines are *Clematis paniculata, Coprosma areolata, C. lucida, C. rhamnoides, Hymenanthera novae-zelandiae, Paratrophis microphylla,* and *Ripogonum scandens.* The difference in the tree floras is minor with only two species missing from Motutapu — *Elaeocarpus dentatus* and *Beilschmiedia* sp. (tawaroa).

It is likely that only very few species have been lost from wetlands. Wetlands are much more extensive on Motutapu and a larger wetland flora could be expected. However, both islands have a similar range of species in this habitat. Small differences are brought about by Motutapu having ponds which support *Potamogeton cheesemanii, Azolla rubra,* and *Lemna minor;* also muddy swamps where *Scirpus prolifer* can flourish. Tiritiri has *Baumea rubiginosa* and *Ranunculus rivularis* which could have been expected on Motutapu, and *Ranunculus urvilleanus* which is now uncommon in Auckland and Northland.

The flora of obligate coastal species is nearly the same for both islands. However, a few species which grow predominantly on the coast of Tiritiri were not recorded on Motutapu, e.g., *Parietaria debilis* and *Linum monogynum.* The coast of Motutapu appears to provide suitable places for *Microtis* spp., *Thelymitra longifolia,* and *Wahlenbergia gracilis,* but these habitats coincide with the range of the wallabies.

Status of exotic plants

The most plentiful wild exotic plants are *Carduus pycnocephalus, C. tenuiflorus, Crepis capillaris, Hypochaeris radicata, Nasturtium officinale, Plantago lanceolata, Sherardia arvensis, Trifolium dubium, T. repens, Anthoxanthum odoratum, Briza minor, Bromus diandrus, Cynodon dactylon, Dactylis glomerata, Glyceria declinata, Holcus lanatus,* and *Lolium perenne.*

A feature of the exotic flora of New Zealand is the high proportion of annuals — mostly opportunists taking advantage of situations which offer little competition. Over half the exotics on Motutapu are of this nature. In Table 3 plants are grouped into their predominant habitat on Motutapu. The figures for grassland exclude plants which grow there principally because of the bare ground that results from disturbance of turf.

Annual plants make up to 67% of the exotic flora of Motutapu, but only 4 or 5% of the natives are short-lived species. The natives are wide-ranging species — *Lemna minor, Senecio hispidulus, S. lautus* and *Scirpus chlorostachyus* (which is doubtfully native).

Only 15% of the exotics are woody compared with 30% of the natives. The woody exotics are predominantly cultivated plants which have become weeds.

MOTUIHE

History

It seems that W. T. Fairburn purchased Motuihe from the Maori owners in 1839. Among the many later owners was Robert Graham who also farmed Motutapu in 1858. It passed to the Crown in 1872.

Table 3 Numbers of exotic species in communities and life span classes.

Habitat	Number of exotic species in each class			Total
	Annuals	Biennials & short-lived perennials	Perennials	
Disturbed ground	92	2	13	107
Grassland	5	1	31	37
Shade (mainly with woody plants)	5	0	18	23
Wetland	2	1	15	18
Coastal (mainly shore species)	7	0	5	12
Various (plants without specific habitats)	0	2	8	10
Total	111	6	90	207

For many years after 1873, when a ship brought smallpox into Auckland Harbour, Motuihe was a quarantine station. It was an internment camp for Germans in World War I, became a health camp in 1929, and a domain under the jurisdiction of Auckland City Council in 1930. During World War II, and for many years after, the island was used as a base for training naval personnel. Motuihe was made a domain again in 1963, and in 1968 it became part of the Hauraki Gulf Maritime Park which came into being that year.

Physical features

The island (Fig. 4) is composed of two major types of rocks (Schofield 1958). In the south the island has a greywacke base. The coastal slopes here are fairly steep but there are no cliffs. In other parts of the island the softer Waitemata sandstone has been eroded by the sea and much of the coast is cliff-bound, except at the neck where a saddle separates the main part of the island from the north-western headland. Parnell grit forms wave platforms and outcrops in some places.

Sandy beaches stretch over a quarter of the way around the island. Except for South East Beach, these are backed by cliffs. Away from the shore the topography is gently undulating. Creeks run in narrow beds and are not deeply entrenched, except in the south.

Vegetation

The first reference to the plant cover of Motuihe seems to be a brief account by T. Kirk in 1879. He wrote "Motuihi contains about 460 acres, more than half of which is pasturage. The open, uncleared portion is chiefly covered with manuka or fern, the patches of large arboreal vegetation are to be found on the slopes, the most important member being the pohutukawa, which attains great dimensions. On a charming miniature sandy beach, *Dichelachne stipoides, Pimelea arenaria, Paspalum distichum,* and *Sicyos angulatus* are plentiful. The last-named has not been observed on any other of these islands."

Since that time nearly all the scrubland has given way to good pasture. Relics of forest persist west and east of the trig, mainly on greywacke. Pohutukawa forms a coastal fringe in many other places and clumps of pohutukawa and puriri are an attractive feature of the farmland.

The largest forested tract lies west of the trig (Figs 4 & 5). It is an area which was probably cleared of woody vegetation except for numerous large pohutukawa trees. Among the pohutukawa trees there is now vegetation in the nature of scrubland consisting of scattered small trees (mahoe, karaka, and kohekohe), shrubs (manuka, kanuka, mapou, gorse, and *Rhamnus*), and New Zealand flax. There is rough pasture in the more open parts. Although a stock-proof fence bounds this vegetation, cattle have been given access at times. The unfenced remnant close to Bald Knob has mostly large pohutukawa and puriri trees.

Two large gullies draining on to South East Beach are heavily forested with taraire, the principal component, but with local dominance of kohekohe. There are also a few puriri and karaka trees. Most of the taraire have stems with diameters of 30–40 cm and are apparently not old, probably having established last century. The ground beneath the trees almost lacks vegetation. This is caused mainly by the trampling and browsing by farm animals but it is common for dense stands of taraire elsewhere in New Zealand to have little undergrowth because of the close canopy and the very heavy litter fall.

The pohutukawa stands fringing much of the island have been grossly modified, the degree indicated by the number of associated species which have persisted. Normally pohutukawa would have these species growing with it — *Astelia banksii*, karo, houpara, kawakawa, *Gahnia lacera,* and coastal karamu. In many places these are absent, their place being taken by grasses where grazing animals have access and by *Rhamnus* and gorse where they have been excluded. These two shrubs have now occupied the less steep, eroding sites above the cliffs where pohutukawa seedlings would

Fig. 4 Motuihe photographed on 4 January 1958 from the north-west. (Buildings in the foreground have been demolished). *Photo:* Whites Aviation

have established. Consequently, natural spread of pohutukawa has almost ceased. The larger trees which are becoming undermined by erosion are not being replaced naturally. Some which have been dislodged are still rooted into the bank where the tree rests on its "elbows" on the sandy beach or sprawls down the cliff. There are some good examples of these on Ocean Beach.

The steeper parts of the cliff faces almost lack vegetation because erosion is too active to allow taupata, New Zealand ice plant, and shore groundsel to take root. Consequently these plants are very poorly represented in the island's flora. Where Parnell grit outcrops on the cliffs, the face is more convex and offers a potential foothold for native plants but *Rhamnus*, gorse, and Aleppo pine (*Pinus halepensis*) establish first. However, it matters little what the vegetation is because it eventually slides off with the soil it is rooted in.

The sandy beaches have little of their natural cover remaining. Where the beaches are backed by cliffs, vegetation has little chance to establish because the highest tides reach to the base of the cliffs. South East Beach has an accumulation of sand a metre or so above the high tide-mark. There is enough moving sand in some places for spinifex to grow but it is not a thriving species. The more stable sand behind it is occupied by exotic annuals such as King Island melilot, hawksbeard, harestail and *Bromus diandrus*. At a higher level there are the perennial grasses — cocksfoot, ryegrass, ratstail, Indian doab, paspalum, and buffalo grass, the latter growing down to the high-tide mark in some places. About the strand line sand convolvulus and orache are common and there are a few plants of *Salsola*.

Pastures are of good quality. The major components are perennial ryegrass, Yorkshire fog, white clover, narrow-leaved plantain, and fiddle dock. Paspalum is dominant in a few places. *Notodanthonia* spp., *Microlaena stipoides*, and *Bothriochloa* grow in the dry grassy slopes on the coast. Indian doab, buffalo grass, *Bromus mollis*, and some others occur mainly near the shore. Barley grass is of some importance as a weed and in wetter places pennyroyal is prominent.

There are several larger weeds of some significance. Although there are some large patches of variegated thistle, it is not as widespread as slender winged thistle. Winged thistle, Scotch thistle and

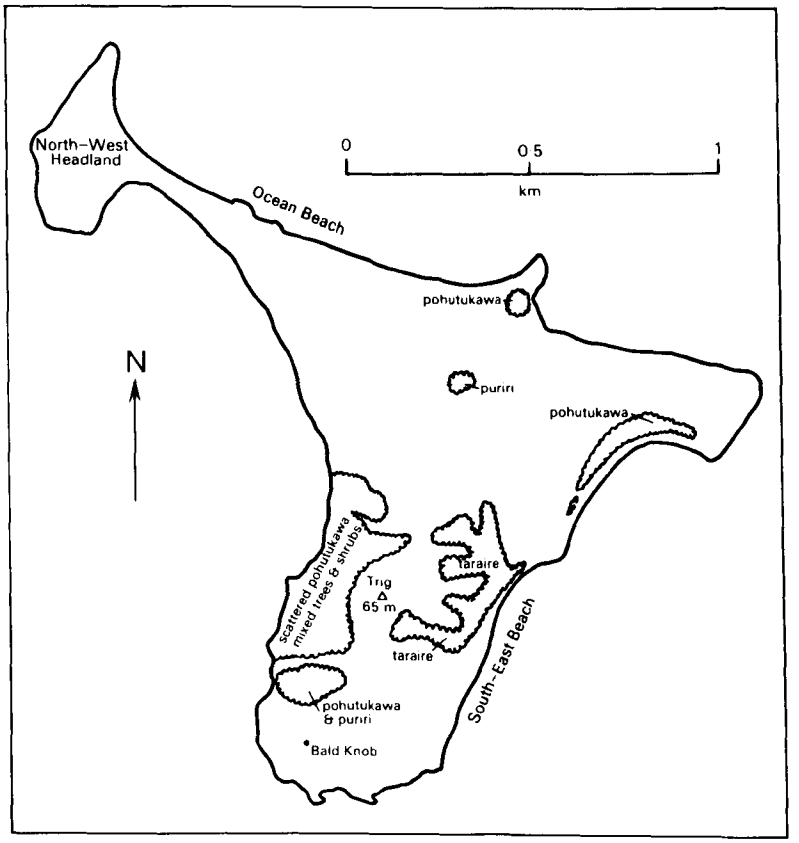

Fig. 5 Motuihe showing localities and forest.

Californian thistle (*Cirsium arvense*) appear to be of less importance. Apple of Sodom is very troublesome. It is mostly on the parts of the coast fenced off from the farm. There is little gorse on the farmland but it is plentiful on the steeper parts where control is not practicable. Woolly nightshade has increased markedly in these gorse patches in the last few years. Inkweed persists around trees on the farmland. Rough pasture which is grazed less intensively occurs in limited amounts on the fenced-out portions along the coast and in the open forest west of the trig. There are habitats here for plants which have less chance of survival in the managed pastures, e.g., *Bothriochloa, Microlaena stipoides, Notodanthonia* spp., and many of the grasses and weeds of disturbed soil.

MOTUKOREA

History

Three pa sites and stone walls are evidence of Maori occupation which lasted till some time after 1827. John Logan Campbell and William Brown bought the island and lived there for a short period in 1840. In 1906 the Devonport Steam Ferry Company took ownership, erected a wharf, and the island was used for picnics and the grazing of race horses.

Motukorea came into the news again in 1946 when purchased by the Auckland Metropolitan Drainage Board as part of a plan for the disposal of sewage from the city. Public outcry caused the scheme to be abandoned and in 1954 Sir Ernest Davis bought Motukorea and presented it to Auckland City. Now under the control of the Hauraki Gulf Maritime Park Board the island is a public reserve.

Physical features

Motukorea is a volcano with an intact cone and crater and several smaller breached craters nearby (Fig. 6). A lava sheet which is most extensive on the southern side of the island is partly covered by sand and gravel extending from a narrow fringing beach. On the northern side a tuff deposit has been eroded by the sea to form steep cliffs and an embayment with a sandy beach. There are no streams but there is a small seepage in the lava at the foot of the main cone.

Vegetation

Samuel Marsden (see Elder 1932) recorded the growing of kumara and taro on Motukorea in 1820. The same year Cruise (1824) noted "The ground was good and under cultivation . . . an immense number of people received us upon landing".

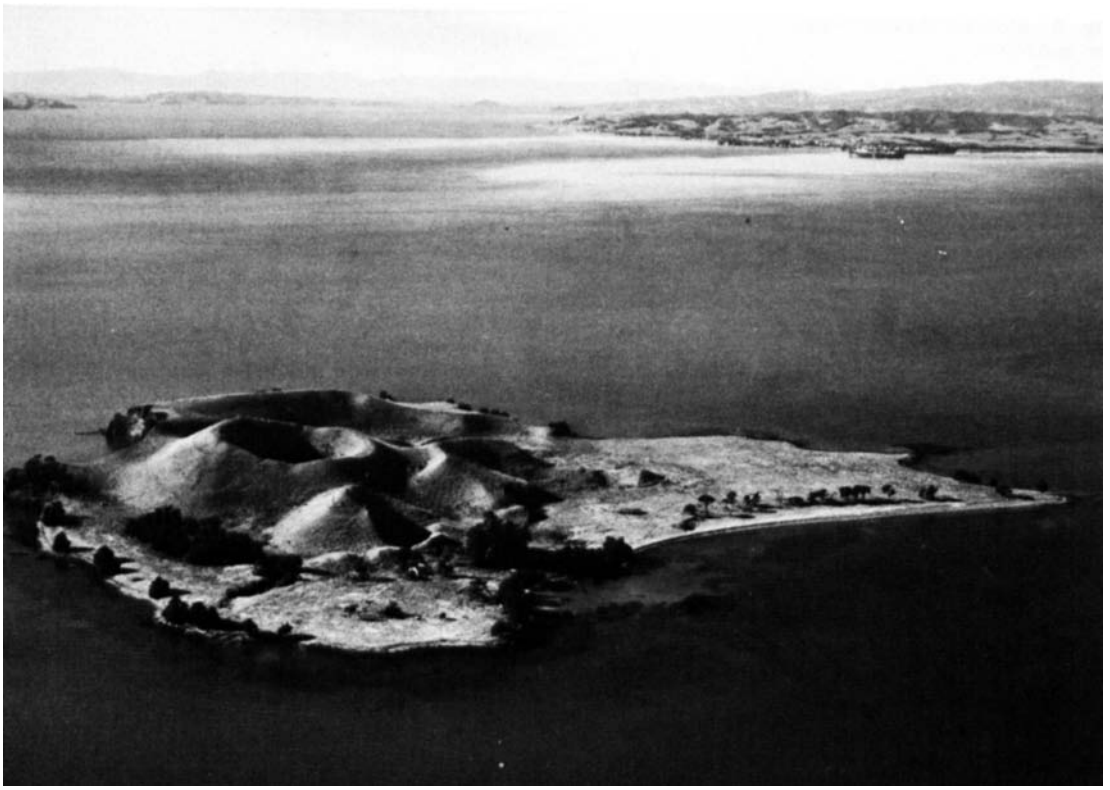

Fig. 6 Motukorea photographed on 8 June 1959 from the west. *Photo:* Whites Aviation

In 1827 D'Urville (see Smith 1909) anchored nearby and sent a boat ashore for firewood. He commented "Its summit is in the form of a crater, and the scoria found at its base attests that its origin is equally volcanic, although it is today almost entirely with a thick carpet of very green herbs, . . . The yawl brought two loads of wood which where easily obtained from Koreha Island".

Campbell (1881) stated that in 1840 "There were long lines of stone walls here and there, and the usual six-foot-high fern which was replaced by a short, dry-looking grass — a sure sign that the land had been cropped for many and many a year, so as to have completely eradicated the fern. The sides of the hill were so thickly covered with scoria that the fern was comparatively stunted growth." He made several references to "brushwood". Presumably this was manuka or kanuka.

At the present day nearly all the island is grassy. Some native trees cling to the steep outer slopes of the tuff deposit and many exotic trees have been planted.

The pasture is of quite good quality and infested with relatively few aggressive weeds, other than apple of Sodom. Perennial ryegrass and Yorkshire fog are prominent on the flats but on the slopes *Microlaena* and Indian doab become more prominent, with appreciable amounts of tall oatgrass (*Arrhenatherum elatius*), cocksfoot, sweet vernal, prairie grass, and paspalum. On the flat near the farm buildings there is a single patch of kikuyu grass. Annual plants are more plentiful in the droughty pastures on the sand and gravel on the flats. These are mainly grasses and legumes — vulpia hairgrass, barley grass, *Bromus diandrus*, *B. mollis*, subterranean clover, and suckling clover. Other plants there are storksbill, dovesfoot and chickweed.

The coastal cliff vegetation on the tuff consists of pohutukawa with houpara, ngaio, whau, mahoe, coastal karamu, kawakawa, *Astelia banksii*, *Muehlenbeckia complexa*, and a single cabbage tree. Woolly nightshade, *Rhamnus*, moth plant (*Araujia hortorum*), and smilax (*Asparagus asparagoides*) occur there too but there is no pampas in this habitat or anywhere else on the island.

On the sandy beach which forms an embayment in the tuff small amounts of spinifex, *Muehlenbeckia complexa*, sand convolvulus, and *Scirpus nodosus* represent the native flora. On the loose sand the main plants are orache, *Salsola*, King Island melilot, *Bromus diandrus*, and hawksbeard. At the boundary

Table 4 Numbers of native and exotic species on the islands.

	Native species	Exotic species	Total
Motutapu	139	207	346
Motuihe	96	124	220
Motukorea	55	85	140

of the pasture and the sand on the beach allseed, *Portulaca oleracea*, scarlet pimpernel, twin cress, and several other annuals are common.

A natural trench 10 m or so wide near the farm buildings forms a seepage area where most of the moisture-loving plants of the island find a foothold. Plants which are fairly prominent here are creeping buttercup, water pepper, *Carex virgata*, loosestrife, and pennyroyal. The less wet margins trampled by farm animals are a habitat for *Amaranthus lividus*, *Paspalum paspalodes*, clustered dock, curled dock, creeping mallow, and broadleaved plantain. A few native trees grow along the margins.

FLORA OF MOTUTAPU, MOTUIHE, AND MOTUKOREA

The number of species growing in the wild state varies with the area of the island and the number of different communities on each (Table 4).

In the following species list the records for Motutapu are indicated by *T*. Where species also occur on Motuihe *(H)* or Motukorea *(K)* the habitats are similar to those on Motutapu unless otherwise indicated.

On Motuihe and Motukorea the habitat or community in which a species grows is generally similar to that on Motutapu unless otherwise stated.

An asterisk indicates exotic species.

Gymnosperms

**Cupressus macrocarpa* Hartw. Macrocarpa *T* Naturalised to a limited extent near a former habitation at Emu Bay.

**Pinus halepensis* Mill. Aleppo pine *H* Naturalised on cliffs.

Podocarpus totara G. Benn. ex D. Don Totara *T* A few trees grow in Bush Creek.

Dicotyledons

Acaena novae-zelandiae Kirk Bidibidi *T* Several patches in ungrazed grassland and is locally prominent on an erosion scarp and Islington Bay. *H* Rough pasture in open forest.

**Achillea millefolium* L. Yarrow *T* Occasional in pastures and ungrazed grassland.

**Albizia lophantha* (Pers.) Benth. Brush wattle *T* Thoroughly naturalised in scrubland in Home Bay Creek. The trees topple when they are *c.* 10 m high and their place is taken by kawakawa and mahoe. The seeds give an unpleasant taste to domestic water drawn from this stream. Brush wattle also grows on slopes above Gardiner Gap and at Administration Bay.

**Amaranthus deflexus* L. *T* Grows in disturbed soil. *H* paths.

**Amaranthus lividus* L. *T* Grows in soil disturbed by cattle. *HK*.

**Amaranthus powellii* S. Wats. *T* Grows in disturbed soil. *H*

**Anagallis arvensis* L. Scarlet pimpernel *T* Common on disturbed soil. *HK* shore.

**Anthemis cotula* L. Stinking mayweed *T* On roadsides in a few places.

**Aphanes microcarpa* (B. et R.) Rothm. Parsley piert *T* An insignificant but widespread weed of the poorer pastures in winter, spring, and summer.

Apium australe Thouars New Zealand celery *T* Occasional in rock crevices just above the high-tide mark. It appears to be grazed by wallabies. *HK*

**Apium graveolens* L. Celery *T* Plants, apparently of this species, have naturalised where garden refuse has been dumped on the edge of salt flats at Islington Bay.

**Araujia hortorum* Fourn. Moth plant *T* Rampant in scrubland in Home Bay Creek. *H* forest. *K* on trees.

**Armoracia rusticana* G., M., et S. Horse radish *T* Persisting in garden refuse at Home Bay.

**Aster subulatus* Michx. Sea aster *T* Occasional on exposed soil on the coast; a little more plentiful near the salt flats at Islington Bay. *H* shore.

**Atriplex hastata* L. Orache *T* Plentiful at the upper-tide mark on most beaches backed by greywacke rocks; some plants on coastal rocks. *HK*

Avicennia resinifera Forst.f. Mangrove. *T* Occupies a small area near the causeway.

Beilschmiedia taraire (A. Cunn.) Benth. et Hook. Taraire *T* Occurs in most of the larger patches of trees. *H*

Beilschmiedia tawa (A. Cunn.) Benth. et Hook. Tawa *T* A few trees in Home Bay Creek and Bush Creek.

**Bellis perennis* L. Lawn daisy *T* Occasional in pastures in a few places. *H*

Brachyglottis repanda J. R. et G. Forst. Rangiora *T* A few plants out of reach of cattle on a stream bank in forest in Bush Creek. *H* forest.

**Brassica campestris* L. Wild turnip *T* Persists in disturbed soil on an old house site at Emu Bay.

**Cakile edentula* (Bigel.) Hook. Sea rocket *T* On some sandy beaches.

**Cakile maritima* Scop. Sea rocket *T* On some sandy beaches.

Callitriche muelleri Sond. *H* creeks.

Callitriche stagnalis Scop. Starwort *T* Common on wet mud and floating on fresh water. *H* creeks. *K* seepage.

Calystegia sepium (L.) R.Br. Convolvulus *T* Pink-flowered plants grow in swamps with raupo; some on ungrazed hillsides. *H* wet places.

Calystegia soldanella (L.) R.Br. Sand convolvulus *T* On some sandy beaches, occasionally extending up hillsides for a short distance. *HK*

Calystegia tuguriorum (Forst.f.) R.Br. ex Hook.f. Forest convolvulus *T* Locally plentiful on ungrazed sandstone slopes at Islington Bay and in scrubland in Home Bay Creek. *K* on trees.

**Capsella bursa-pastoris* (L.) Med. Shepherd's purse *T* Occasional in disturbed soil.

**Carduus pycnocephalus* L. Slender winged thistle *T* Plentiful in pastures throughout; some on ungrazed grassland on the coast. *HK*

**Carduus tenuiflorus* Curt. Winged thistle *T* Plentiful in all pastures, forming pure colonies on some ridge tops; some in ungrazed grassland on the coast. *H*

Carmichaelia aligera Simpson New Zealand broom *T* A few plants grow on sandstone slopes at Gardiner Gap and on greywacke slopes near the sea. *H* forest.

**Carpobrotus edulis* (L.) Bolus Ice plant *T* Patches on the sand and nearby slope at Islington Bay.

Cassinia retorta A. Cunn. ex DC. *T* A few plants on ungrazed grassy slopes near the sea.

Centaurium erythraea Raf. Centaury *T* Occasional on disturbed soil near the coast. *H*

Cerastium glomeratum Thuill. Annual mouse-ear chickweed *T* Occasional in poor pasture and on ungrazed grassy slopes. *K*

Chenopodium album agg. Fathen *T* In disturbed soil in a few places. *H*

Chenopodium murale L. Nettle-leaved fathen *T* In disturbed soil in a few places. *HK*

Chenopodium ambrosioides L. Mexican tea *T* Occasional on the causeway and along the coasts, mainly in the west.

Cirsium arvense (L.) Scop. Californian thistle *T* Patches in pastures and ungrazed grassland in several places. *H* shore.

Cirsium vulgare (Savi) Ten. Scotch thistle *T* Widespread in pastures but not very troublesome. *HK*

Conium maculatum L. Hemlock *T* Large patches in a few places in pasture near the coast between Home Bay and Station Bay.

Coprosma macrocarpa Cheesem. Coastal karamu *T* Small quantities with other shrubs on coastal slopes; one plant in Bush Creek. *HK*

Coprosma repens A. Rich. Taupata *T* Occasional on coastal rocks out of reach of wallabies. *H*

Coprosma robusta Raoul Karamu *T* Mainly on sandstone slopes. It is one of the few native shrubs which is increasing in this area.

Coriaria arborea Lindsay Tutu *T* A few plants on scarps on coastal slopes and some ungrazed parts inland. *H* forest.

Coronopus didymus (L.) Sm. Twin cress *T* Plentiful on tracks, in pastures, on disturbed soil and some sandy beaches. *HK*

Coronopus squamatus (Forsk.) Asch. Wart cress *T* A few plants in gravel on road margins.

Corynocarpus laevigatus J. R. et G. Forst. Karaka *T* In most patches of trees; possibly ranking next to pohutukawa in abundance. *HK*

Cotoneaster glaucophylla Franch. var. *serotina* (Hutch.) Stapf. *H* with trees.

Cotula australis (Sieb.) Hook. f. *T* A few plants in open situations, mainly in gravel on roadsides, and on coastal rocks.

Cotula coronopifolia L. *T* Plentiful on salt flats at Islington Bay.

Crataegus monogyna Jacq. Hawthorn *T* Small patches in many places, and will spread further if not checked. *H*

Crepis capillaris (L.) Wallr. Hawksbeard *T* Plentiful in ungrazed coastal grassland; some in poor pastures and some in sand. *HK* pasture, shore.

Cucurbita pepo L. Pumpkin *T* Seedlings established on the beach at Waikalabubu Bay in the summer of 1977-78. It is not unusual to find cucurbits from water-borne seeds in this habitat, but they do not reach maturity.

Cyathodes fasciculata (Forst. f.) Allan and *C. juniperina* (J. R. et G. Forst.) Druce Mingimingi and prickly mingimingi *T* Infrequent with trees and shrubs near the coast.

Dichondra repens J. R. et G. Forst. Mercury Bay weed *T* On coastal rocks and coastal slopes in a few places, most frequently under pohutukawa trees. *HK*

Disphyma australe N. E. Brown New Zealand ice plant *T* On coastal rocks in a few places inaccessible to wallabies. *HK*

Duchesnea indica (Andr.) Focke Indian strawberry *T* Some in pastures near Bush Creek.

Dysoxylum spectabile (Forst. f.) Hook. f. Kohekohe *T* Occurs in many of the larger groups of trees but is diminishing because of damage by opossums and wind. *H*

Elaeagnus pungens Thunb. *H* forest.

Entelea arborescens R.Br. Whau *T* Many plants in scrubland in Home Bay Creek, a few near the shore at Islington Bay and some in forest at Bush Creek. *HK*

Emex australis Steinh. *T* Grows around houses at Home Bay.

Epilobium nummularifolium R. Cunn. ex A. Cunn. Creeping willowherb A few plants on a steep stream bank at Emu Bay. *K* cliffs.

Epilobium pallidiflorum Sol. ex A. Cunn. Swamp willowherb *T* Locally abundant in ungrazed swamps; a few plants in other swamps.

Epilobium rotundifolium Forst. f. Willowherb *T* Occasional on stream banks near Emu Bay.

Erigeron floribundus (HBK.) Sch.-Bip. Fleabane *T* Occasional on disturbed ground. It seems likely that this species is kept in check on the coast by wallabies. *HK*

Erigeron mucronatus DC. Mexican daisy *T* A garden escape well established on eroding sandstone slopes.

Erodium cicutarium (L.) L'Hérit Storksbill *T* Plentiful in pasture at Billy Goat Point; some at the causeway in mown grass and in a few other places. *K*

Erodium moschatum (L.) L'Hérit Musky storksbill *T* Plentiful in pastures in many places; some at the causeway.

Euonymus japonicus L. *HK* with trees.

Eupatorium adenophorum Spreng. Mexican devil *T* Plentiful on eroding sandstone at Gardiner Gap; some in patches in a few other places. It was growing on Rangitoto before 1933 (Allan 1933) and attempts were made to keep it in check there.

Euphorbia glauca Forst. f. *K* cliffs.

Euphorbia peplus L. Spurge *T* Some in open disturbed places but mostly on unstable soil under trees. *H*

Ficus carica L. Fig *T* Two large trees in Administration Bay and some with seedlings at Islington Bay.

Foeniculum vulgare L. Fennel *T* A few plants on the site of a former house at Islington Bay.

Fumaria muralis Sond. Fumitory *T* Occasional on disturbed soil about habitations.

Galium aparine L. Cleavers *T* Occasional in pastures, on disturbed ground, under trees and in ungrazed places. *HK*

Galium parisiense L. Slender bedstraw *T* Occasional on bare soil near the shore. It is not eaten by wallabies.

Geniostoma ligustrifolium A. Cunn. Hangehange *T* A few plants under trees along some creeks. *HK*

Geranium (unnamed) *H* in rough pasture in open forest.

Geranium dissectum L. Cut-leaved geranium *T* Occasional on disturbed soil and in ungrazed grassland. *H*

Geranium homeanum Turcz. *T* A few plants in grassy places on the coasts and along the banks of some creeks. *H* ungrazed places.

Geranium molle L. Dovesfoot *T* Some in poor pasture and ungrazed grassland. *HK* pasture, shore.

Geranium purpureum Vill. *K* rocks.

Geranium solanderi Carolin *T* A few plants in pasture near Bush Creek.

Gnaphalium simplicicaule Willd. ex Spreng. *H* open forest.

Gnaphalium spicatum Lam. Cudweed *T* Occasional in pastures. It is surprising that only one species of *Gnaphalium* was recorded on Motutapu.

Griselinia lucida Forst.f. Shining broadleaf *T* On a greywacke outcrop at Islington Bay and on native trees on sandstone nearby.

Haloragis erecta (Banks ex Murr.) Eichl. *T* Occasional in open places on the margins of forest and scrubland; some in ungrazed places on the coast. *K* shore.

Hebe macrocarpa (Vahl) Ckn. et Allan Koromiko *T* A few plants at Islington Bay: some planted there also.

Hebe stricta (Benth.) L. B. Moore Koromiko *T* Mainly on eroding sandstone at Gardiner Gap. *H* shore. *K* cliffs.

Hedycarya arborea J. R. et G. Forst. Pigeonwood *T* One plant noted in Bush Creek. *H* forest.

Hypericum japonicum Thunb. Swamp St Johns wort *T* Grows on wet exposed soil in a few places, mainly on pond margins.

**Hypochaeris radicata* L. Catsear *T* Common in pasture and ungrazed grassland. *HK*

Knightia excelsa R.Br. Rewarewa *T* A few plants in most of the larger clumps of trees. *H*

**Lactuca virosa* L. Acrid lettuce *T* On beaches in a few places.

Lagenifera pumila (Forst.f.) Cheesem. *T* Grows near Station Bay under tawapou trees.

**Lamium purpureum* L. Red dead nettle *T* Noted on a trampled pond margin; probably also in gardens.

**Lapsana communis* L. Nipplewort *T* Occasional on disturbed soil at Home Bay.

**Leontodon taraxacoides* (Vill.) Mérat Hawkbit *T* Many on sandy beaches and coastal slopes. *HK* pasture, shore.

Leptospermum ericoides A. Rich. Kanuka *T* Some in Bush Creek. The few plants at Emu Point and Islington Bay may have been planted. They do not resemble the local kanuka and may have come from a nursery. *H* forest.

Leptospermum scoparium J. R. et G. Forst. Manuka *T* Locally plentiful in patches of scrubland. The plants are mostly degenerate but there is minor invasion of pasture along a stream near the centre of the island. *H* forest.

**Ligustrum sinense* Lour. Privet *T* Plentiful in parts of the scrubland along Home Bay Creek. Some has been planted at Islington Bay.

**Linum marginale* A. Cunn. Australian flax *T* Plentiful in ungrazed grassland; some in poor pasture. *K* pasture.

**Linum trigynum* L. Yellow flax *T* Common on ungrazed coastal slopes around Station Bay and Islington Bay.

Litsea calicaris (A. Cunn.) Benth. et Hook.f. ex Kirk Mangeao *T* Occurs in most of the larger groups of trees. It is unusual to see so much mangeao close to Auckland. *H* forest.

Lobelia anceps Linn.f. *T* Occasional on coastal rocks; some in scrubland along Home Bay Creek. *HK* shore.

**Lotus angustissimus* L. *T* Occasional on ungrazed coastal slopes; some in poor pastures. *H* disturbed soil.

**Lotus pedunculatus* Cav. *T* Plentiful in most swamps; some in moist pastures. *H* pasture.

**Lotus subbiflorus* Lag. *T* Frequent in ungrazed places near the coast; some in poor pastures.

**Lycium ferocissimum* Miers Boxthorn *T* A few plants on a rocky outcrop in Waikalabubu Bay. *K* cliffs.

**Lythrum hyssopifolia* L. Loosestrife *T* A few plants in moist disturbed soils. *K* seepage.

Macropiper excelsum (Forst.f.) Miq. Kawakawa *T* Plentiful in scrubland in Home Bay Creek; elsewhere mainly with pohutukawa trees out of reach of farm animals. *H* forest. *K* with trees.

**Malva neglecta* Wallr. Dwarf mallow *T* Occasional on disturbed soil.

**Malva nicaeensis* All. French mallow *T* Plentiful in trampled places, particularly around gateways and water troughs. *HK* trampled places, shore.

**Malva parviflora* L. Small-flowered mallow *T* Occasional on disturbed soil.

**Malva sylvestris* L. Large-flowered mallow *T* Locally plentiful around water troughs in the south.

**Matricaria matricarioides* (Less.) Port. Rayless chamomile *T* Appears to be confined to trampled soil on the causeway.

**Medicago arabica* (L.) Huds. Spotted bur medick *T* Locally plentiful on beaches and disturbed places near the coast. *HK*

**Medicago lupulina* L. Black medick *T* Mainly on road margins at Administration Bay. *HK* shore.

**Medicago polymorpha* L. Bur medick *T* Locally plentiful on beaches and disturbed places near the coast. *H*

Melicope ternata J. R. et G. Forst. Wharangi *T* A few plants in Bush Creek. *H* forest. *K* with trees.

Melicytus ramiflorus J. R. et G. Forst. Mahoe *T* Plentiful in scrubland in Home Bay Creek; some in Bush Creek, but only small quantities along the coast, mainly on the sandstone. *H* forest. *K* with trees.

**Melilotus indica* (L.) All. King Island melilot *T* Plentiful with the bur medicks on beaches. *HK*

**Mentha pulegium* L. Pennyroyal *T* Many in wet places on the edges of swamps and ponds. *H* pasture. *K* seepage.

Metrosideros excelsa Sol. ex Gaertn. Pohutukawa *T* The most conspicuous tree species on the island. It is most plentiful near the coast, the primary habitat of the species. Inadequate reproduction and rapid demise of mature trees could deprive Motutapu of one of its major landscape features. *H* forest, shore. *K* cliffs.

**Modiola caroliniana* (L.) Don Creeping mallow *T* Occasional in ungrazed places, mainly near the coast. *HK*

Muehlenbeckia australis (Forst.f.) Meissn. *T* Common along Home Bay Creek in scrubland; a few with trees in other places. *H* forest. *K* with trees.

Muehlenbeckia complexa (A. Cunn.) Meissn. *T* Some on shores and coastal slopes. *H* forest, shore. *K* with pohutukawa.

Myoporum laetum Forst.f. Ngaio *T* A few plants at Islington Bay, in Bush Creek and along the east coast. *H* forest. *K* cliffs.

**Myosotis arvensis* (L.) Hill Field forget-me-not *T* Occasional on disturbed soil.

**Myosotis caespitosa* K. F. Schultz Water forget-me-not *T* Occasional in grazed swamps.

**Myosotis discolor* Pers. Grass forget-me-not *T* Numerous widely-scattered plants in ungrazed grassland, poor pastures and open ground.

**Myosotis sylvatica* Hoffm. Garden forget-me-not *T* A garden escape locally plentiful near the shore at Gardiner Gap, also under trees in Home Bay Creek.

Myrsine australis (A. Rich.) Allan Mapou *T* Occasional on slopes with other trees; some in Bush Creek. *H* forest. *K* cliffs.

**Nasturtium officinale* R.Br. Water cress *T* Plentiful in grazed swamps and on mud in creeks. *H* creeks.

**Olea europaea* L. Olive *H* forest, *K* cliffs.

**Orobanche minor* Sm. Broomrape *T* Mainly on ungrazed coastal slopes. *H*

**Osteospermum moniliferum* L. Bone-seed *K* on cliffs.

Oxalis corniculata var. *crassifolia* (A. Cunn.) Hook.f. *T* Occasional on upper beach levels and on slopes near the shore.

Oxalis exilis A. Cunn. *T* Occasional in pastures and ungrazed places. *HK*

**Oxalis latifolia* HBK. *K* disturbed soil.

**Oxalis pes-caprae* L. *T* A few plants in Islington Bay as garden outcasts and a few on shores elsewhere, probably having been carried there by the sea. *HK*

Parsonsia heterophylla A. Cunn. *T* One plant noted in Bush Creek. *H* forest.

Peperomia urvilleana A. Rich. *T* On coastal rocks in a few places out of reach of wallabies. *H* forest, *K* cliffs.

**Physalis peruviana* L. Cape gooseberry *T* Occasional on the coast near trees; some in scrubland in Home Bay Creek. *H* forest.

**Phytolacca octandra* L. Inkweed *T* Many in pastures and ungrazed places. *HK*

**Picris echioides* L. Oxtongue *T* In many ungrazed places near the shore, particularly where there has been recent soil movement. *HK* shore, disturbed soil.

Pittosporum crassifolium Banks et Sol. ex A. Cunn. Karo *T* A few plants persist in ungrazed places in the west. *H* with pohutukawa.

Pittosporum tenuifolium Sol. ex Gaertn. Kohuhu *T* One plant in Bush Creek.

Plagianthus divaricatus J. R. et G. Forst. Shore ribbonwood *T* A few at Islington Bay at the high-tide mark.

Planchonella novo-zelandica (F. Muell.) Allan Tawapou *T* Many trees on the east coast with pohutukawa and other trees and forming a pure stand near Station Bay. *H* forest.

**Plantago coronopus* L. Buckshorn plantain *T* Locally plentiful on salt flats at Islington Bay.

**Plantago lanceolata* L. Narrow-leaved plantain *T* Plentiful in ungrazed grassland and poor pasture. *HK*

**Plantago major* L. Broadleaved plantain *T* Some in pastures at Emu Bay. *HK* disturbed soil.

**Polycarpon tetraphyllum* L. Allseed *T* On road margins in gravel and on coastal rocks, mainly in the north. *HK* shore.

**Polygala myrtifolia* L. *H* ungrazed places.

**Polygonum aviculare* agg. Wireweed *T* A few plants on road margins.

**Polygonum hydropiper* L. Water pepper *T* Occasional on wet ground in the west. *K* seepage.

Polygonum sp. *T* This plant, probably a native, grows in wet situations throughout.

**Portulaca oleracea* L. *T* Forms patches on disturbed soil in pastures and grows also on coastal rocks. *HK*

Potamogeton cheesemanii A. Benn. Pondweed *T* Grows in still fresh water.

**Potamogeton crispus* L. Curled pondweed *T* Grows in the same habitat as *P. cheesemanii* but is not so widely distributed.

**Prunella vulgaris* L. Selfheal *T* Occasional in ungrazed places. *H*

**Prunus cerasifera* Ehrh. Plum *T* A minor garden escape at Home Bay.

**Prunus persica* Batsch Peach *K* cliffs.

Pseudopanax arboreus (Murr.) Philipson Five-finger *T* A few plants growing naturally on the sandstone; some apparently planted in other places.

Pseudopanax lessonii (DC.) C. Koch Houpara *T* A few plants growing out of reach of wallabies on the greywacke; more on the sandstone where wallabies are less numerous. *HK* with pohutukawa.

Ranunculus acaulis Banks et Sol. ex DC. Shore buttercup *T* Occasional in crevices on wet rocks on the shore at Station Bay and nearby.

Ranunculus hirtus Banks et Sol. ex DC. Forest buttercup *T* A few plants in scrubland along Home Bay Creek.

**Ranunculus parviflorus* L. Small-flowered buttercup *T* Numerous in spring, particularly where farm animals have disturbed the soil.

**Ranunculus repens* L. Creeping buttercup *T* On many swamp margins. *K* seepage.

**Ranunculus sardous* Crantz Hairy buttercup *T* Occasional on roadsides, pond margins, and in poor pastures at Emu Bay. *H* pasture.

**Raphanus maritimus* Sm. Sea radish *T* Occasional on shores at Islington Bay and on the west coast.

Rhagodia triandra (Forst.f.) Aellen *T* Occasional on coastal rocks in the north.

**Rhamnus alaternus* L. *T* This Mediterranean shrub is likely to spread well beyond the sandstone slopes where it is now abundant. A few plants grow on the coasts in other places. *H* ungrazed places. *K* cliffs.

**Rosa rubiginosa* L. Sweet briar *H* pasture.

Rubus cissoides A. Cunn. Lawyer *H* forest.

**Rubus fruticosus* agg. Blackberry *T* Plentiful on the edge of scrubland in Home Bay Creek; a few plants at Emu Bay. *K* pasture.

**Rumex brownii* Campd. Hooked dock *T* Occasional on ungrazed coastal slopes, a typical habitat for this species in New Zealand. *H* shore.

**Rumex conglomeratus* Murr. Clustered dock *T* Occasional in moist situations on the margins of swamps and ponds, and in seepages on the shore. It can grow almost completely submerged in ponds. *HK* wet places.

**Rumex crispus* L. Curled dock *T* A few plants noted on shores. *H* shore. *K* seepage.

**Rumex obtusifolius* L. Broad-leaved dock *T* A few plants grow on the edge of the salt flats at Islington Bay. *H* moist places.

**Rumex pulcher* L. Fiddle dock *T* Many in poor pastures and in ungrazed grassy places; a few on shores. *HK*

**Sagina ciliata* Fr. Pearlwort *T* Occasional on rocks near the shore.

**Sagina procumbens* L. Pearlwort *T* Occasional near the coast on rocks and in grassland.

Salicornia australis Sol. ex Benth. Glasswort *T* Numerous plants on the salt flats at Islington Bay and a few on coastal rocks in other places. It appears to be grazed by wallabies. *HK* shore.

**Salix fragilis* L. Crack willow *T* Naturalised along the creek at Emu Bay.

**Salsola kali* L. Saltwort *T* Occasional on some sandy beaches within reach of the tides. *HK*

Samolus repens (J. R. et G. Forst.) Pers. Marsh pimpernel *T* Many on salt flats at Islington Bay; occasional on shores in other places, mainly in seepage with *Selliera radicans*. Unlike *Selliera*, it can grow on dry rocks. *HK* shore.

Scleranthus biflorus (J. R. et G. Forst.) Hook.f. *T* A few plants on coastal rocks.

Selliera radicans Cav. *T* Grows with *Samolus* on the salt flats and in seepages along the rocky shore.

**Senecio bipinnatisectus* Belcher (*Erechtites atkinsoniae*) Australian fireweed *T* Occasional in scrubland. *H* with pohutukawa.

**Senecio cruentus* DC. Garden cineraria *T* Grows under pohutukawa trees in two places on the east coast.

Senecio hispidulus A. Rich. (*Erechtites scaberula*) Fireweed *T* A few plants in open situations, mainly on the coast. *HK* shore.

**Senecio jacobaea* L. Ragwort *T* Occasional in a forest remnant near Station Bay.

Senecio kirkii Hook.f. ex Kirk Kohurangi *H* forest.

Senecio lautus Willd. Shore groundsel *T* Occasional on coastal rocks. Its distribution suggests that it is eaten by wallabies. *H* shore, *K* cliffs.

**Senecio spathulatus* A. Rich. Gravel groundsel *T* A few plants on beaches and road margins.

**Senecio vulgaris* L. Groundsel *T* A few plants persist on the site of a demolished house at Emu Bay. It is probably in other gardens too. *H* disturbed soil. *K* shore.

**Sherardia arvensis* L. Field madder *T* Plentiful in pastures in spring and summer. *HK*

**Silene gallica* L. Catchfly *T* Plentiful in winter and spring on disturbed ground on coastal slopes and beaches. *H*

**Silybum marianum* (L.) Gaertn. Variegated thistle *T* Widespread in pastures. In the 1977–78 summer the greatest concentrations were about the middle of the island on the eastern side. *H*

**Sisymbrium officinale* (L.) Scop. Hedge mustard *T* Occasional on disturbed soil. *HK*

Solanum aviculare Forst.f. Poroporo *H* forest.

**Solanum mauritianum* Scop. Woolly nightshade *T* Plentiful in scrubland in Home Bay Creek; also in many other places, mainly with trees and other shrubs. *HK* with trees.

**Solanum nigrum* agg. Black nightshade *T* A few plants under trees and on disturbed soil. *HK*

Solanum nodiflorum Jacquin *HK* with trees.

**Solanum pseudocapsicum* L. Jerusalem cherry *H* with trees.

**Solanum sodomeum* L. Apple of Sodom *T* Widespread. The most troublesome woody weed in pastures. Much money and effort has been spent trying to keep it in check. *HK*

**Soliva valdiviana* Phil. Onehunga weed *H* lawns and road margins.

**Sonchus asper* (L.) Hill Prickly sow thistle *T* Many plants on disturbed soil and on some beaches. In some poor pastures it grows in a very stunted form. *HK*

**Sonchus oleraceus* L. Sow thistle *T* Frequent on ungrazed coastal slopes, in pastures, on disturbed soils, and beaches. *HK*

Sophora microphylla Ait. Kowhai *T* Numerous plants with other trees on the coast and a short distance inland. *H*

**Spergula arvensis* L. Spurrey *T* Occasional on disturbed soil.

**Spergularia rubra* (L.) Presl Sand spurrey *T* Occasional plants in gravel on road margins.

**Stellaria graminea* L. Bog stitchwort *T* Patches in the ungrazed swamp in Home Bay Creek.

**Stellaria media* (L.) Vill. Chickweed *T* Plentiful in disturbed soil; frequent in pastures where animals have broken the turf. *HK*

**Taraxacum officinale* Weber ex Wiggers Dandelion *T* Occasional in poor pasture. *HK* pasture, disturbed soil.

Tillaea sieberiana Schultz *T* An uncommon inhabitant of rocks along the coast. *K*

**Torilis arvensis* (Huds.) Link Hedge parsley *T* Plentiful in many places in ungrazed grassland.

**Trifolium dubium* Sibth. Suckling clover *T* Plentiful in grassy places. *HK*

**Trifolium fragiferum* L. Strawberry clover *T* In pastures in a few places. H

**Trifolium glomeratum* L. Clustered clover *T* Occasional in poor pastures and in gravel on roadsides.

**Trifolium micranthum* Viv. Lesser suckling clover *T* Frequent in pastures in spring and early summer.

**Trifolium repens* L. White clover *T* The main clover in pastures; also in ungrazed grassland. *HK*

**Trifolium resupinatum* L. Reversed clover *T* Locally plentiful on gravel in several localities.

**Trifolium striatum* L. Striated clover *H* grassy places.

**Trifolium subterraneum* L. Subterranean clover *T* Abundant in some pastures in winter and spring. *HK*

**Tropaeolum majus* L. Garden nasturtium *T* There are colonies above the shore in Islington Bay which probably established from garden refuse.

**Ulex europaeus* L. Gorse *T* Troublesome in pastures in many places. *H*

**Urtica urens* L. Nettle *T* A few plants in pastures. *HK*

**Verbascum thapsus* L. Woolly mullein *T* A few plants in ungrazed grassland, in poor pastures in the east, and on a stream bank in Emu Bay. *K* shore.

**Verbena officinalis* L. Vervain *T* A few plants on disturbed soil at Emu Bay.

**Veronica arvensis* L. Speedwell *T* Occasional in poor pastures and on disturbed soil. *H*

**Veronica persica* Poir. Speedwell *T* Occasional in disturbed soil. *K*

**Veronica serpyllifolia* L. Turf speedwell *T* Frequent in pastures, occasional in ungrazed grassland. *H*

**Vicia sativa* L. Vetch *T* Common in ungrazed grassland. *H*

**Vicia tetrasperma* (L.) Schreb. *T* Common in ungrazed grassland. *H*

**Vinca major* L. Periwinkle *T* Large colonies at Home Bay.

Vitex lucens Kirk Puriri *T* A few in forest remnants. *H*

**Xanthium spinosum* L. Bathurst bur *HK* pasture.

Monocotyledons

**Agropogon littoralis* (Sm.) C. E. Hubb. Perennial beard grass *T* A few plants on the shores around Islington Bay.

Agropyron scabrum (Lab.) Beauv. Blue wheat grass *T* A few plants on ungrazed grassy slopes. *K* pasture.

**Agrostis semiverticillata* (Forsk.) Chr. *T* Frequent in damp places on shores. *H*

**Agrostis stolonifera* L. Creeping bent *T* Plentiful on swamp margins and in some damp areas near the shore.

**Agrostis tenuis* Sibth. Browntop *T* On ungrazed coastal slopes in a few places; some in pastures. *H* pasture.

**Aira caryophyllea* L. Hair grass *T* occasional on thin soils near the coast.

**Allium vineale* L. *T* In patches on ungrazed coastal slopes; some on sand at Islington Bay. *H* shore.

**Alocasia macrorrhiza* (L.) G. Don Ape taro, elephant's ear *T* Naturalised in a creek at Emu Bay.

**Ammophila arenaria* (L.) Link Marram grass *T* Established on one beach in the west. *H*

**Anthoxanthum odoratum* L. Sweet vernal *T* A versatile grass which occurs abundantly in all grasslands and on swamp margins. *HK* grassy places.

**Arrhenatherum elatius* (L.) Beauv. Tall oatgrass *HK* rough pasture.

Arthropodium cirratum (Forst.f.) R.Br. Renga lily *T* On coastal rocks in a few places out of reach of wallabies. *K* cliffs.

**Arum italicum* Mill. Italian arum *T* There are patches near habitations, some in scrubland in Home Bay Creek and under trees in several parts of the island. *H* near buildings.

**Asparagus asparagoides* (L.) Wight Smilax *T* Freely naturalised among shrubs on slopes about Islington Bay. *K* with trees on cliffs.

Astelia banksii A. Cunn. *T* On rocks near the shore in a few localities. *HK*

Baumea juncea (R.Br.) Palla *T* In seepages on the coast in a few places.

**Bothriochloa macra* (Steud.) S. T. Blake *T* Plentiful on steep sunny ungrazed coastal slopes, mainly in the west. *H*

**Briza minor* L. Shivery grass *T* Plentiful in spring and early summer wherever there is exposed soil able to be colonised by plants. *H*

**Bromus breviaristatus* (of NZ authors) *HK* disturbed soil.

**Bromus diandrus* Roth *T* Occupies disturbed soil, mostly on coastal slopes. *HK*

**Bromus mollis* L. *T* Plentiful in pastures on the poorer soils; some in ungrazed grassland. *HK*

**Bromus unioloides* (of NZ authors) Prairie grass *T* Occasional in ungrazed grassland. *H* pasture, shore. *K* pasture.

**Canna* × *generalis* L. H. Bailey Canna *T* Escaped from a garden at Emu Bay and is now covering a large area on a stream margin.

**Canna indica* L. Indian shot *T* Thoroughly naturalised around trees at Home Bay.

**Carex divisa* Huds. *T* Forms pure colonies on the shore at Station Bay and Islington Bay.

**Carex divulsa* Stokes *T* Many plants in poor pastures, on swamp margins and on beaches. *HK* pasture.

Carex flagellifera Col. *T* Numerous plants near the shore in many places, mostly associated with pohutukawa trees; some in scrubland along Home Bay Creek. *HK* with pohutukawa.

Carex inversa R.Br. *T* Many plants in grassy places. *H*

Carex lambertiana Boott in Hook.f. *H* forest.

Carex lessoniana Steud. *T* Occasional in swamps and along Home Bay Creek in moist, open scrubland.

Carex ochrosaccus (Cheesem.) Hamlin *T* Occasional in scrubland along Home Bay Creek. *H* forest.

Carex pumila Thunb. Sand sedge *T* Plentiful on several sandy beaches; occasional in coastal seepages on rocks. *H*

Carex spinirostris Col. *T* Plentiful in a stand of tawapou near Station Bay.

Carex testacea Boott in Hook.f. *T* Plentiful under trees near Station Bay; occasional on other parts of the coast.

Carex virgata Boott in Hook.f. *T* Numerous plants on swamp margins. *H* forest, creeks. *K* seepage.

**Catapodium rigidum* (L.) C. E. Hubb. *T* On sand and coastal rocks in a few places.

Cordyline australis (Forst.f.) Endl. Cabbage tree *T* A few in pastures, swamps and scrubland. *K* cliffs.

**Cortaderia jubata* (Lem.) Stapf. Purple pampas *T* Occasional on ungrazed coastal slopes in the west.

**Cortaderia selloana* (Schult.) Asch. et Graeb. Pampas *T* Plentiful on sandstone slopes from Islington Bay to Emu Point and around Administration Bay; scattered plants in many other places. *H* cliffs.

Cortaderia splendens Connor Toetoe *T* Infrequent on steep ungrazed places near the shore. *H* cliffs.

**Crocosmia* × *crocosmiflora* (Lem.) N.E.Br. Montbretia *T* Growing in garden refuse on the edge of the salt flats in Islington Bay. *H* near buildings.

**Cynodon dactylon* (L.) Pers. Indian doab *T* Plentiful on sandy beaches and many coastal slopes; some in ungrazed grassland in Home Bay Creek. *H* shore. *K* pasture, shore.

**Cynosurus cristatus* L. Crested dogstail *T* Occasional in pastures. *H*

**Cyperus brevifolius* (Rottb.) Hassk. *H* wet pasture.

**Cyperus eragrostis* Lam. *T* Occasional on the trampled margins of swamps and other wet places. *HK* wet places.

Cyperus ustulatus A. Rich. *T* Some in swamps and in the shade of pohutukawa trees on beaches. *H* shore, creeks. *K* seepage.

**Dactylis glomerata* L. Cocksfoot *T* Plentiful in grassy places, particularly ungrazed grassland, and at the upper levels of beaches. *HK*

Deyeuxia billardieri Kunth *T* Occasional on the edge of salt flats at Islington Bay. *K* shore.

Dianella nigra Col. Turutu *T* A few plants in scrubland along Home Bay Creek and some on coastal slopes in the west.

Dichelachne crinita (L.f.) Hook.f. Plume grass *H* rough pasture.

Drymoanthus adversus (Hook.f.) Dockrill *T* A single colony on a tree in Bush Creek. This is the only orchid recorded on the island. It is unusual for *Thelymitra longifolia* and *Microtis* spp. to be absent from coastal slopes where there is a suitable habitat for them. Presumably wallabies are responsible.

Earina mucronata Lindl. *H* forest.

Eleocharis acuta R.Br. *T* Plentiful in swamps; some on pond margins and in seepages on the coast.

**Eragrostis brownii* (Kunth) Nees Bay grass *T* Some on salt flats at Islington Bay.

**Festuca arundinacea* Schreb. Tall fescue *T* Plentiful in ungrazed grassland and conspicuous on the upper levels of some sandy beaches. *H*

**Festuca rubra* L. subsp. *rubra* Red fescue *T* Occasional patches in ungrazed grassy places.

Gahnia lacera (A. Rich.) Steud. *T* Many plants with trees and shrubs above Gardiner Gap; a few with pohutukawa trees on the coast. *H* with pohutukawa.

Gahnia xanthocarpa (Hook.f.) Hook.f. *H* forest.

**Gladiolus undulatus* L. Wild gladiolus *T* Spreading from garden refuse at Islington Bay.

**Glyceria declinata* Bréb. Floating sweet grass *T* Plentiful in grazed swamps. Although highly palatable it will not diminish because it is promoted by the puddling of the wet soil while it is being grazed.

**Holcus lanatus* L. Yorkshire fog *T* Plentiful in grassy places and on swamp margins. *HK* pasture.

**Hordeum leporinum* Link Barley grass *T* Occasional on beaches.

**Hordeum murinum* L. Barley grass *T* Plentiful in pastures and some ungrazed open places. *HK* pasture, shore.

**Iris orientalis* Mill. Garden iris *T* Persists from plantings at Islington Bay and Home Bay.

Isachne australis R.Br. *T* Grows in swamps in many places.

**Juncus articulatus* L. Mud rush *T* Plentiful in mud on margins of swamps and ponds.

Juncus australis Hook.f. *T* Occasional in pasture. *H*

**Juncus bufonius* L. Toad rush *T* In trampled wet soil in a few places.

**Juncus effusus* L. Soft rush *T* Occasional in wet pasture. *H*

Juncus gregiflorus L. Johnson *T* Occasional in wet pasture.

Juncus maritimus L. var. *australiensis* Buchen. Salt rush *T* Some on margins of salt flats at Islington Bay.

Juncus pallidus R.Br. Stout rush *T* Isolated plants in ungrazed places on the coast. *H* pasture.

Juncs prismatocarpus R.Br. *T* Occasional in swamps.

Juncus sarophorus L. Johnson *T* A few plants in pasture. *H*

Juncus usitatus L. Johnson *T* Occasional in rough grassy areas. *H* pasture, open forest.

Lachnagrostis filiformis (Forst.f.) Trin. *H* shore.

**Lagurus ovatus* L. Harestail *T* Plentiful on sandy beaches. *H*

Lemna minor L. Duckweed *T* Grows on surface of ponds. *K* water tank.

Leptocarpus similis Edgar *T* A few plants in seepages on the coast.

**Lolium perenne* L. Perennial ryegrass *T* Plentiful in grassy places. *HK*

**Lolium perenne* × *Festuca arundinacea* *T* Numerous plants near the shore at Administration Bay.

Microlaena stipoides (Lab.) R.Br. *T* Plentiful in ungrazed grassland; occasional in pastures on the poorer soils. *H* open forest, pasture. *K* pasture.

Notodanthonia penicillata (Lab.) Zotov *H* rough pasture.

Notodanthonia racemosa (R.Br.) Zotov Danthonia *T* Plentiful in ungrazed grassland. Its tolerance of close cropping by wallabies is demonstrated on Rangitoto and Kawau. Close cropping is less evident on Motutapu because there are good pastures to graze nearby. *H* pasture. *K* cliffs.

Oplismenus imbecillus Beauv. *T* Occasional in forest and scrubland. *H*

**Parapholis incurva* (L.) C. E. Hubb. Sickle grass *T* Plentiful on coastal rocks within reach of splash from the sea. *H*

**Paspalum dilatatum* Poir. Paspalum *T* Plentiful in ungrazed grassland; uncommon in pastures. *HK*

Paspalum distichum L. Coastal paspalum *T* A few patches at the high-tide mark in the region of Station Bay. *K*

**Paspalum paspalodes* (Michx.) Scribn. Mercer grass *T* A few patches near the shores in the west. *H* shore. *K* disturbed soil.

**Pennisetum clandestinum* Hochst. Kikuyu grass *T* Some large patches in ungrazed areas in Administration Bay. *K* pasture.

Phormium tenax Forst. New Zealand flax *T* Occasional in ungrazed places on the rocky coast, on sandstone slopes at Islington Bay, and on wet sand behind a beach at the causeway. *H* forest. *K* cliffs.

Poa anceps Forst. *T* Occasional in scrubland along Home Bay Creek and on the coast with pohutukawa trees. *H* with pohutukawa. *K* cliffs.

**Poa annua* L. *T* Plentiful on disturbed soil, particularly in trampled pastures in winter and spring. *HK*
**Poa pratensis* L. *T* Frequent in ungrazed grassland.
**Poa trivialis* L. *T* Abundant in pastures and on the margins of swamps in winter and spring. *H* pasture.
**Polypogon monspeliensis* (L.) Desf. Beard grass *T* Occasional on salt flats at Islington Bay. *H* shore.
Scirpus cernuus Vahl *T* Plentiful on salt flats at Islington Bay, some on moist coastal rocks near the high tide mark in other places. *H* shore.
Scirpus chlorostachyus Levyns *T* Plentiful on mud in grazed swamps.
Scirpus lacustris L. *T* Occasional in the wettest parts of swamps.
Scirpus medianus Cook *T* Patches in swamps in many places. *H* creeks.
Scirpus nodosus Rottb. *T* Occasional in ungrazed open places near the sea. *HK*
Scirpus prolifer Rottb. *T* The most abundant swamp plant. It thrives where swamps are disturbed by cattle and is probably the only native plant to increase significantly since farming began.
Spinifex hirsutus Lab. Spinifex *T* Many colonies on sandy beaches in the west. *HK*
**Sporobolus africanus* (Poir.) Robyns et Tourn. Ratstail *T* Plentiful in dry ungrazed grassland above sandy beaches; some in poor pastures. *HK* pasture.
**Stenotaphrum secundatum* (Walt.) Kuntze Buffalo grass *T* Many large patches on shores; some in pastures. *HK*
Stipa teretifolia Steud. Coastal needle grass *T* Occasional on greywacke rocks on the shore. *HK* shore.
Triglochin striatum Ruiz et Pav. *T* Occasional on the salt flats at Islington Bay and in seepages on coastal rocks. *H*
Typha orientalis C. B. Presl Raupo *T* Locally plentiful in swamps; less abundant in grazed swamps.
Uncinia uncinata (Linn.f.) Kük *T* Occasional under trees and shrubs along Home Bay Creek.
**Vulpia bromoides* (L.) S. F. Gray Vulpia hair grass *T* Plentiful on unstable soil in ungrazed places in winter, spring, and early summer. *K* pasture.
**Watsonia bulbillifera* Matthews et Bolus *T* A small patch in Islington Bay with garden refuse.
**Zantedeschia aethiopica* (L.) Spreng. Arum *T* Persists in pastures around a former habitation in Emu Bay and in the creek nearby. *H* near buildings.

Ferns

Adiantum cunninghamii Hook. Maidenhair *T* A few plants under trees along Bush Creek. *K* cliffs.
Adiantum hispidulum Swartz Maidenhair *T* Occasional on ungrazed coastal slopes and in scrubland along Home Bay Creek. *H* forest. *K* grassy places.
Asplenium flaccidum Forst.f. Spleenwort *T* The subspecies *flaccidum* grows on trees along Home Bay Creek; subspecies *haurakiense* is infrequent on coastal rocks in the north and west.
Asplenium lucidum Forst.f. Shining spleenwort *T* A few plants with pohutukawa on the coast out of reach of farm animals. *H* forest.
Athyrium australe (R.Br.) Presl *T* Along some creeks in the southern half of the island.
Athyrium japonicum (Thunb.) Cop. *T* Along some creeks in the southern half of the island.
Azolla rubra R.Br. Water fern *T* Grows on ponds. *K* water tank.
Blechnum capense Schlecht. *T* Grows in scrubland along Home Bay Creek and occasionally in swamps. *H* creeks.
Blechnum lanceolatum (R.Br.) Sturm *T* A few plants persist along a stream bank near the causeway.
Cheilanthes distans (R.Br.) Mett. *K* rocks.
Ctenitis decomposita (R.Br.) Cop. *H* forest.
Ctenitis glabella (A. Cunn.) Cop. *H* forest.
Cyathea dealbata (Forst.f.) Swartz Silver tree fern *T* Occasional with trees and shrubs. *H*
Cyathea medullaris (Forst.f.) Swartz Mamaku *T* Occasional with trees and shrubs. *H*
Doodia media R.Br. *T* Frequent in ungrazed grassland on the coast and in scrubland along Home Bay Creek. *H* forest. *K* cliffs, rocks.
Histiopteris incisa (Thunb.) J. Smith *H* forest.
Paesia scaberula (A. Rich.) Kuhn *H* forest.
Pellaea rotundifolia (Forst.f.) Hook. *K* cliffs, rocks.
Phymatodes diversifolium (Willd.) Pic. Ser. Hounds-tongue *T* A few plants on coastal rocks and along Home Bay Creek. *H* forest.
Polystichum richardii (Hook.) J. Smith *K* cliffs.
Pteridium aquilinum (L.) Kuhn Bracken *T* Some large patches on coastal slopes above Islington Bay and in the west; smaller amounts on other coasts and in scrubland along Home Bay Creek. *H* scrubland. *K* pasture, cliffs.
Pteris tremula R.Br. *T* A few plants in scrubland and on coastal slopes. *H* forest.
Pyrrosia serpens (Forst.f.) Ching Leather-leaf fern *T* Occasional on coastal rocks and on trees. *HK*
Thelypteris pennigera (Forst.f.) Allan *T* A few plants in shade along creeks in the southern half of the island. *H* creeks.

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