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The Revegetation of Tiritiri Matangi Island: The Creation of an Open Sanctuary

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INTRODUCTION

Three and a half km off the end of the Whangaparaoa Peninsula, in the Hauraki Gulf, lies Tiritiri Matangi, an island of some 220 ha (Fig. 1). Until recently the island was largely ignored both by potential visitors and the reserves system, its only claim to fame being the lighthouse. In late 1979, myself and John Craig of the Zoology Department put forward proposals to the Hauraki Gulf Maritime Park Board (HGMPB), to revegetate the island and to liberate rare and threatened wildlife. There was then a period of wide consultation by the park board with interest groups both community based and from the scientific establishment. Once the principles involved had been agreed, there remained the problem of finance. Perhaps fortuitously the World Wildlife Fund had been looking for an Auckland project and this coincided with a visit in early 1982 by Sir Peter Scott (international chairman of the World Wildlife Fund council). The outcome was that the World Wildlife Fund adopted the project and sought donations to assist during the setting up phase, to supplement the funding available to the park board. In October 1982 the HGMPB published the Tiritiri Matangi Island Working Plan. This plan established a scheme which was to transform both the management of the island and the island itself. In essence the island was to be converted from its highly modified condition, resulting from centuries of human occupation, back to a state approaching a presumed more natural condition. The long term goals being to provide habitat for rare and endangered wildlife and to allow open access so that the public could more easily view them, hence the concept of an 'open sanctuary'.

I. THE ISLAND HISTORY OF HUMAN ACTIVITY ON THE ISLAND

Tiritiri Matangi was occupied from an early period by the Kawerau tribe, the remains of their settlement being found throughout the island. These include well preserved pa sites, burial grounds, terraces, pits and middens, all of which suggest a long period of stable occupancy. For example there is evidence of settled cultivation, such as the presence of 'Maori onion' *Allium vineale* and soils that give the impression of having been deeply cultivated. However, by the 1830s, Maori occupancy of the island appears to have ended, possibly as a result of Hongi Hika's southward advance. Some members of the Kawerau returned to the island from 1837 to 1856, although during this period (1841) members of another tribe sold the island to the Crown. From the mid-1850s, European settlers started to use the island for grazing. European occupancy 'officially' began in the mid-1860s with the granting of a grazing licence (which eventually covered 202 ha) and the decision to build a lighthouse on the island. The lighthouse began operation in 1865.

It is unclear how much of the island was under grass when European occupancy began, but it was perhaps less than 50%. By 1908, grazing licence records suggest that 'quite one third (outside reserve) is in bush, ti-tree and fern', at least 40 ha had been sown in the years preceding this date. The usual mixtures of

pasture grasses were used, e.g. cocksfoot *Dactylis glomerata*, ryegrass (*Lolium perenne*) and Yorkshire fog (*Holcus lanatus*), although there are also areas of *Paspalum* and species of *Bromus*. These were sown in areas cleared by fire or used to oversow the areas of native *Danthonia* grasslands. In the following years, the proportion of the island under pasture was gradually increased, until 1940 when 92% was pasture, 2% in bracken and scrub, and 6% in coastal forest. After this period grazing intensity declined and the pastures were gradually invaded by bracken and shrubs.

The number and kinds of livestock on the island varied throughout this period. During last century sheep, pigs, goats and rabbits were all abundant at various times. When the Hobbs family took over the lease in 1901, the island was farmed more systematically. Rabbits and 'wild pigs' were eradicated within a few years, although goats (and cats) were present until the 1960s. At its peak stocking in the first half of this century, there were up to 500 sheep and 50 cattle. In 1971 the grazing lease was not renewed and the bulk of the island was incorporated into the Hauraki Gulf Maritime Park. In 1980, the 206 ha of scenic reserve was designated a scientific reserve. The remaining 16 ha of lighthouse reserve was finally incorporated into the park in 1985.

The present-day appearance of the island reflects its past human usage and occupancy. The predominant features are the abandoned pastures, covering the ridge crests and the patches of

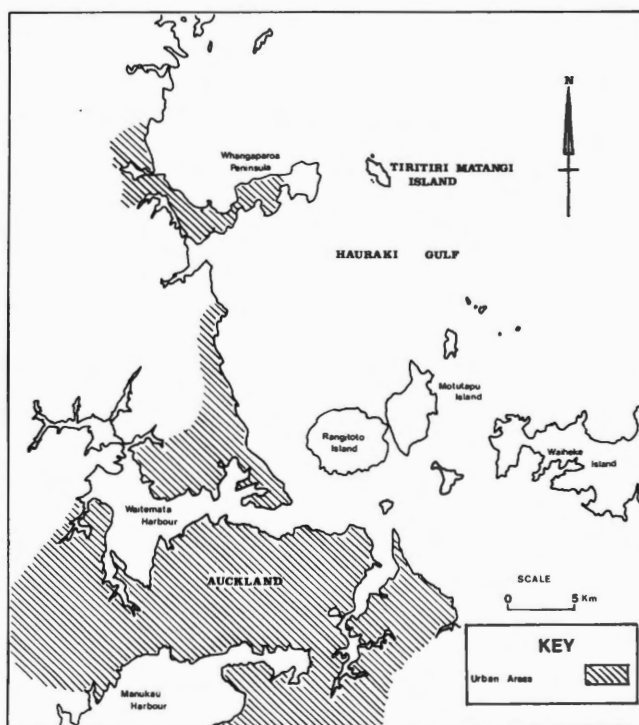


Figure 1. Locality map.

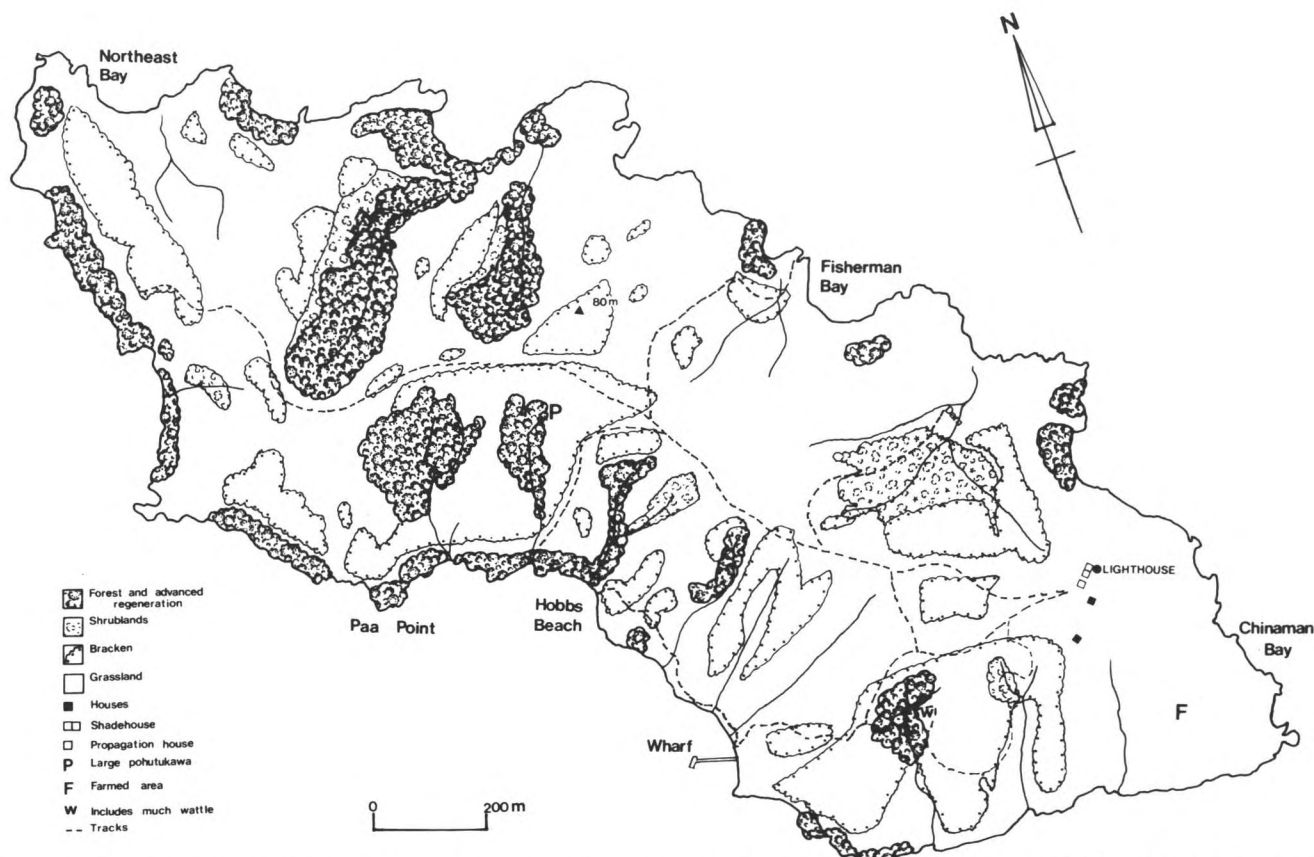


Figure 2. Map of the island to show the approximate extent of the major vegetation classes by the early 1980s. Initial planting is largely complete between Hobbs Beach and the wharf, the lighthouse and Fishermans Bay, together with the intervening areas.

coastal forest in the gullies (varying in size from a few hectares to a few square metres). There is still an actively managed farm associated with the lighthouse.

CLIMATE AND TOPOGRAPHY

The island has a gentle topography with broad ridges sloping away from the main longitudinal ridge (of between 60 and 80m altitude), these ridges mostly end in steep cliffs. The high point of the island (91m) is dominated by the lighthouse. The climate is mild, with temperatures ranging from a mean monthly minimum of 9.2C in July to a mean monthly maximum of 22.6C in February. It has a moderate rainfall of 1,100mm, but as this tends to be concentrated in the autumn and winter periods, summer droughts can be a problem. Consequently, very few of the small streams on the island run all the year. Despite the otherwise moderate climate, the location of the island at the transition between the inner and outer Gulf, means that it experiences the full force of north-easterly cyclonic storms.

The soils of the island are a yellow-brown earth, derived from the upper strata Waitemata series silty-sandstones and siltstones. These soils are free-draining and of high natural fertility, but tend to dry out and crack during summer droughts.

FAUNA AND FLORA

The fauna and flora of Tiritiri Matangi are very interesting despite the long term human occupancy and the drastically re-

duced areas of native habitat (Fig. 2). Some species have persisted which are now absent from the nearby mainland and in microcosm give an idea of what the neighbouring coastal regions were once like. A detailed description of the flora is provided by Esler (1979).

It is assumed that as with all the other islands in the Hauraki Gulf, Tiritiri Matangi originally would have been almost completely forested. At the cessation of grazing the main areas of forest were restricted to a few valleys and the more inaccessible parts of the cliffs. The forests were completely eaten out by stock grazing and the canopy trees were starting to show signs of senescence. If grazing had continued for many more years it is quite likely that the forests would have been completely destroyed, since there was no regeneration to replace the older trees. Thus the incorporation of the island into the Hauraki Gulf Maritime Park was timely. However, it is only now, 14 years later, that we are observing successful seedling establishment. The combined effects of soil compaction and absence of a litter layer to the soil, prevented almost anything from establishing. The canopy trees responded much more quickly, in particular kohekohe (*Dysoxylum spectabile*), which produced many epicormic shoots, which are in some instances, starting to replace the old canopy trunks.

The present day forests are fairly typical of the northern offshore islands and Northland coast. On the exposed cliffs and ridge tops, pohutukawa (*Metrosideros excelsa*) predominates, with on the cliffs, occasional tawapou (*Planchonella costata*) and karo (*Pittosporum crassifolium*). Large pohutukawa often occupy the



Figure 3. One of the forest remnants, showing the huge pohutukawa at the head of the valley; kohekohe and cabbage trees line the valley bottom and lower slopes, with taraire on the upper slopes.

heads of the valleys (the pohutukawa with the largest spread in New Zealand is on the island — 52m), the more sheltered areas having a canopy of kohekohe in the valley bottoms and taraire (*Beilschmiedia tarairi*) on the upper slopes (Fig. 3). Scattered through the canopy are mahoe (*Melicytus ramiflorus*), whau (*Entelia arborescens*), cabbage trees (*Cordyline australis*), pigeon wood (*Hedycarya arborea*), ponga (*Cyathea dealbata*) and mamaku (*Cyathea medullaris*). All the larger areas of forest are fringed by manuka (*Leptospermum scoparium*) and/or kanuka (*Kunzea ericoides*), a number of valleys also having extensive areas under these two shrub species. It is common to find mapou (*Myrsine australis*) growing in these latter communities. A number of other tree species are also found, but just as a few or single individuals, e.g. puriri (*Vitex lucens*), mangeao (*Litsea calicaris*), totara (*Podocarpus totara*), rewarewa (*Knightia excelsa*), hinau (*Elaeocarpus dentatus*), turepo (*Paratrophis microphylla*) and broad-leaf tawa (tawaroa, *Beilschmiedia tawaroa*).

The abandoned pastures that make up the bulk of the vegetation cover are rapidly changing. On the moister south facing slopes, bracken (*Pteridium aquilinum*) has rapidly invaded many of the old pastures, but its advance into the drier areas is much slower. In these areas, where the pasture grasses persist, native grasses are becoming prominent, e.g. *Rytidosperma racemosum*, and in particular *Microlena stipoides*. Invasion of these pastures by native shrub species had been almost non-existent (West 1980) and it was this that stimulated the possibility of the revegetation project.

Some of the animals on the island are of considerable interest and have been subject to detailed research by John Craig and his students. Kiore (the Polynesian rat — *Rattus exulans*) are present in large numbers, particularly in the abandoned pastures. Tui (*Prosthemadera novaeseelandiae*) and bellbird (*Anthornis melanura*) both maintain good populations in the forest; the bellbird being particularly notable as they are essentially extinct on the Auckland/Northland mainland. The grasslands and bracken support pukeko (*Porphyrio porphyrio*) and spotless crane (*Porzana tabuensis*). Red-crowned parakeet (*Cyanoramphus novaeseelandiae*) were released on the island in 1976 and soon became well established throughout all the forested areas. A number of other species regularly visit the island and may breed there, e.g. pigeon (*Hemiphaga novaeseelandiae*), kaka (*Nestor meridionalis serpen-trionalis*), harrier (*Circus approximans*), and morepork (*Ninox*

novaeseelandiae). A wide range of marine birds nest on the island or regularly visit it.

The studies on various of these species and their habitats, together with the success of the unplanned red-crowned parakeet release, was the other stimulus for the open sanctuary concept. The complete absence of introduced predators such as the ship rat (*Rattus rattus*), the Norway rat (*Rattus norvegicus*), mice, possum (*Trichosurus vulpecula*), cats or mustelids was the other factor that would make the introduction of rare species possible.

II. THE REVEGETATION PROJECT INTRODUCTION

The basis of the project was that scientific investigation had shown that natural regeneration and invasion of the pastures by forest, was only occurring very slowly. Effective recolonisation of the abandoned pastures would take many decades due to the very dense grass and bracken growth. In the meantime the island presented a major fire risk and that to let nature take its course could pose considerable problems. At the same time there was increasing public pressure on the other special islands of the Gulf such as the Poor Knights, Hen and Chickens, and Little Barrier island. Much of this pressure stemming from the desire of people to see rare species of animal in a natural environment.

Tiritiri Matangi had of course been highly modified, but despite this it still offered habitat that supported native fauna. Thus it was felt that further intervention in the modified areas, could be justified on the basis of trying to re-create suitable habitat for native fauna. These fauna could then be more readily viewed by the public and would to some extent satisfy the desire to see such species.

Thus the project was born. Our original concept was to try and short-cut the natural regeneration processes, by planting the 'climax' forest species directly. Under natural regeneration it was likely that the pastures would either be firstly invaded by bracken or manuka. In the case of bracken, it forms a very dense, tall (2.5 — 3m) canopy and will occupy the site for several decades. Eventually, the bracken loses 'vigour' and shrub species such as mahoe, cabbage tree and *Coprosma* spp. are able to invade. Under such conditions pohutukawa, will come to dominate the site together with its other associates of kohekohe and taraire. In the case of manuka succession, the same shrub species will occur often with mapou, the development to this stage taking perhaps half the time of the bracken sequence. Kanuka may become dominant, but this is fairly rapidly followed by pohutukawa, kohekohe and taraire. We decided that as both major successional pathways progressed towards a pohutukawa dominated forest that this species should be the major species planted. From some of our studies we knew that pohutukawa seedlings are very resistant to dessication and can survive for several months without being watered. The essential point about the programme being that it had to be low cost and low maintenance. Once the plants were planted there was not going to be any releasing or watering.

SPECIES PROPAGATION

As the intention is to 're-create' a forest with a similar species composition to the existing remnants, the other main species to be used are readily available. The basic planting strategy is to use pohutukawa as the main species, particularly on the exposed ridges and slopes, with taraire and kohekohe as the other principal canopy species. The latter would be planted either in the more sheltered locations or inter-planted with the pohutukawa, once

some shelter has been created. These two species form the canopy in many places, except that our research has shown their seedlings only establish under shaded conditions. Thus more care has to be taken with the selection of suitable sites at this stage in the project. In some respects consideration has had to be given to delaying the large scale production of these species because of their more precise requirements. A range of other species are also being grown, to encompass the variety of canopy species found, i.e. tawaroa, tawapou, karaka, cabbage tree, karo, rewarewa, kanuka and puriri. These species have a variety of requirements their tolerance of exposure being the overriding factor controlling their placement. Shrub species are of course not forgotten and a wide range of these are being grown. However, the selection of these species is as much determined by bird requirements as more strictly botanical criteria. Included here are *Coprosma* spp, mahoe, five finger (*Pseudopanax arboreus*), *P. lessonii*, whau, hangehange (*Geniostoma rupestre*), flax (*Phormium tenax*), and heketara (*Olearia rani*). Careful consideration was given to the 'importation' of species absent from the island, but which might have been expected to have been present, if it were not for human activity. In general 'importation' is avoided in order to maintain the genetic purity of the island, each 'introduced' species being considered on its merits and may only come from a nearby source. To date only a few species have been 'introduced' these include kowhai (*Sophora microphylla*), *Alseuosmia* spp and *Rhabdothamnus solandri*, all of which are considered essential food sources for birds. Additionally, puriri seed has had to be 'imported' because the only tree on the island produces seed of very low viability; puriri being a particularly important nectar source.

THE NURSERY

From the outset it was decided that all propagation is to be carried out on the island to reduce the risk of introducing diseases, minimise transport costs and to grow the plants under conditions that they would be exposed to. The basic facilities required were a propagation house/workshop/office, a glass-house for seed raising, a shade house, standing out area for hardening off and soil mix bins. All of these having been built on site from materials shipped out.

The shade house is two thirds covered with 30% shade cloth

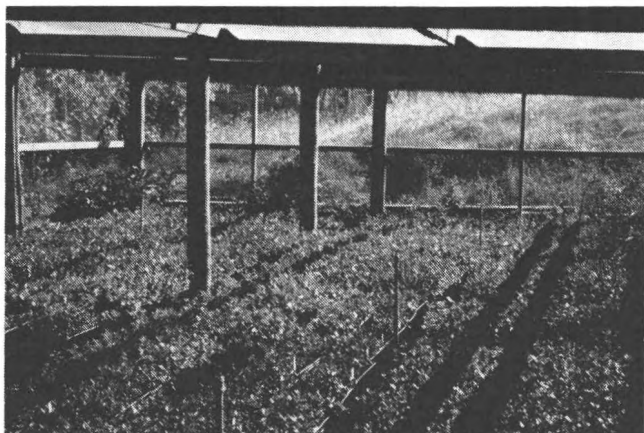


Figure 4. A view inside the shadehouse to show mainly pohutukawa in their root trainers.

under which the pohutukawa grow (Fig. 4); the remainder is 50% shade for the more sensitive species. The standing out area has three zones of shading 70% for taraire, tawaroa and kohekohe, 30% for pohutukawa and 50% for everything else. This area is provided with moveable shade to aid hardening off, although kohekohe, taraire, tawaroa, tawapou and kawakawa (*Macropiper excelsum*) always require shade.

The numbers of plants to be produced were based on estimates of how many plants it would be possible to plant, using volunteer labour, the number of likely boat trips during the planting season (bearing in mind likely cancellations due to bad weather) and the numbers of passengers the hire boats can carry. We estimated that approximately 30,000 plants could be handled in this way per year (a total of 200,000 plants being finally required). From this figure the specifications of the facilities were determined. The other constraint being that the whole programme was to be run initially by two full time staff, with a likely reduction to one, once the project was underway.

The plants are mostly grown in root trainers using a commercial peat-pumice seed raising mix (with 'Osmacote' and 'Terazole'). A bark-pumice mix was experimented with, but it was found that the bark would tend to separate from the roots when the plants were removed from the trainers for planting. The advantages of growing plants in root trainers are considerable. The space occupied is very compact, eg four plants can be grown in the space occupied by a 'book' 19 x 4.5 cm (x 12 cm deep). The amount of soil required is far less than for other methods and it promotes the development of a good root system. The 'books' are supported on wire frames that take ten books. This means that it is very easy to handle large quantities of plants and to easily transport them to sometimes difficult locations. The size and light weight of the plants in these containers also means that almost anyone can carry and plant a surprisingly large number, which became an important consideration for the volunteer groups involved. For most species the Tinus RT-40 size are used, although for some of the larger species RT-45s are better. Not all species are suitable for growing in root trainers, eg taraire, whau and puriri, their roots requiring a larger volume of soil than is provided in root trainers. In these cases the plants are grown in polythene planter bags.

The drawback of root trainers is that because of their low soil volume, a guaranteed water supply is essential. Up until this time roof supply and a small quantity of bore water were all that were available. This became one of the major worries of the programme and it was necessary to completely upgrade the water supply. A new dam has been built in the valley below the lighthouse and additional water storage capacity is now available at the nursery. This comprises 40,000 litres storage which needs to be refilled every two or three days from the dam 85m below. The watering regime essentially being on demand, which usually means every 2-3 days.

A routine pest and diseases spray programme is followed with spraying every fortnight, a Benlate/Lanate mix alternating with other mixes such as Orthene/Ronilan or Ridomil. Relatively few pest and disease problems have been encountered after the early learning period, when damping off and scale insects were troublesome. One disease problem that is still under investigation is an infection of kohekohe, which to date is still unresolved. A high level of hygiene is carefully maintained both through on-site controls and restrictions on the movements of plants and materials to and from the island.

Most plants are only in the nursery for one year, during which time they have put on sufficient growth to allow planting out (e.g.

Fig. 5), although it is possible that tawaroa will need two years. Initially we had expected that many of the plants would need two years in the nursery, but the excellent growing conditions and in particular the good root growth promoted by the trainers has shortened this time. Undoubtedly this has helped with plant hygiene as it means there is little carry over of material between years and that a thorough clean up is possible each year.

PRODUCTION AND PLANTING

In 1984, 28,900 plants were produced and in 1985, 36,300. The bulk of these were pohutukawa the rest being a mixture of tree and shrub species (Table 1). Inevitably the numbers will vary from year to year because of the variability of seed production and growing conditions; although there is never any shortage of pohutukawa seed.

Table 1. Approximate numbers of plants propagated on the project to date.

Species	1984	1985
Pohutukawa	16000	22200
Kohekohe	2000	1500
Manuka	2280	—
Taraire	1570	615
Coprosma spp	1500	1200
Karo	—	4560
Tawapou	150	1300
Mahoe	410	1000
Kawakawa	—	1360
Pseudopanax spp	160	900
Rhabdthamnus	150	480
Cabbage tree	40	600
Karaka	660	—
Kowhai	500	40
Rewarewa	—	500
Whau	210	130
Flax	374	—
Heketara	40	240
Alseuosmia spp	—	180
Hangehange	80	—
Pigeon wood	—	80
Tawaroa	60	—
Puriri	—	56

Planting trips to Tiritiri Matangi have become quite a feature in Auckland during the winter. A very wide range of groups have volunteered their services. These include schools, forest and bird branches, tramping clubs, alpine sports clubs, scouts, service clubs, etc. Over-60s clubs have been particularly helpful with pricking out and help around the nursery. The numbers on any trip may vary considerably ranging from 15 up to 400, although the usual number is between 50 and 100. Irrespective of the size of party, the usual number of trees planted is between 1,000 and 1,400 per trip, with a record of 2,000. In 1984, 43 planting trips were made and by late 1985, 35 trips.

If the area to be planted is in grass then no site preparation is needed, but if the area is under bracken, then it is mown one or two weeks prior to planting. A trial to establish the need for site preparation had shown that other methods such as grubbing or weedkiller had no benefits, and that no preparation or simply mowing were all that were necessary. In either case the trees or shrubs are planted straight into the ground, a teaspoon of 'Osmacote' being placed in the bottom of each hole; a spacing of approx-



Figure 5. Ray Walter with some of the one year old whau ready for planting.

imately 2 m is used. The plant is gently firmed into the ground and grass or bracken pushed back over any bare earth to inhibit weed growth (there are a large number of buried, viable weed seeds in the soil). This is all the 'care' the plants receive. Watering is not possible and 'releasing' not seriously considered. It has been found that the plants survive well, with mortality ranging between 20-50%; the lower part of the range being more typical. The project has perhaps been fortunate with the weather; winter conditions have been mild, even by Auckland's standards and summer rainfall has been more than adequate. The decision not to consider releasing plants has, for an unexpected reason, been shown to have been correct. There have been some strong gales since planting began and a few plants around the nursery were 'released'. These plants were violently whirled around in the 70-80 knot winds and uprooted. Nearby plants that had not been 'released' just bent over with the surrounding grass and survived the storm. One occasional source of mortality is pukeko damage; in some areas pukekos have uprooted quite large numbers of plants, probably out of curiosity. However, overall they are only of minor significance. A more serious problem in some areas, particularly near the lighthouse, is honeysuckle (*Lonicera japonica*). This very aggressive weed has recently spread over some hillslopes and urgent action is necessary to control it. Various control measures are under consideration and it is prov-

ing difficult to find an effective control, that will not at the same time damage the natural systems.

The pattern of planting on the island has been to tackle the more sheltered, moister south-west facing slopes first. Most of these have now been planted and the exposed north-eastern flanks of the island are starting to be afforested. Not all the island is going to be revegetated, the north western end, beyond the major areas of forest, is to be left to naturally regenerate, as is one of the slopes where ongoing research into regeneration is concentrated. This will ensure that a diversity of habitats is maintained and hence a greater diversity of animal life can be supported. The other consideration is the preservation of archaeological sites. It is well known that tree roots destroy archaeological sites and thus special care is being taken to avoid planting up areas of archaeological interest.

WILDLIFE RELEASES

Saddlebacks (*Philesturnus carunculatus*) were released on the island in February 1984 and have flourished. Twenty-four birds were released of which the majority have survived and 18 months later they have almost doubled their numbers. The great success of the saddleback release augurs well for the future. The other species that it is hoped will be considered for release include: stitchbird (*Notiomystus cincta*), particularly when winter nectar supplies are augmented; little spotted kiwi (*Apteryx owenii*) once the area of forest increases, similarly for whitehead (*Mohoua albigilla*). Shoreline species might include shore plover (*Thinornis novaeseelandiae*) and tuatara (*Sphenodon punctatus*). However, the island must remain free of introduced predators.

THE FUTURE

The revegetation programme will continue for a number of years yet, with pohutukawa planting gradually being scaled down in favour of species to be inter-planted. It might be expected that within 5-10 years the planting programme will be completed. A

proper track system is being developed so that visitors can easily traverse the island and view its wildlife, but also so that they can be guided around potentially sensitive areas. In the longer term other aspects of the island will be developed and interpreted. Specifically the archaeological and historical features will become integrated into the project to thus provide an illustration of the continuum of human occupancy and the inter-relationship with the natural environment.

ACKNOWLEDGEMENTS

Special mention must be made of the HGMPB staff on the island — Ray Walter and Mike Cole. They have converted the working plan into practical action and have then developed the scheme further and with great efficiency into the outstanding success it has become. I would also like to thank Ray Walter for the helpful discussions whilst preparing this article. The success of the project is also, of course, due to the full support of the HGMPB, the enthusiasm of its staff and chief ranger, Rex Mossman and the management committee of the island. The conversion of our original ideas into an appropriate management plan format is due to Bob Drey, a planning officer with Lands and Survey. Much of the horticultural advice and in particular the idea of using root trainers, which in many respects made the propagation so efficient, are due to Herwi Scheltus, Director of the Taupo Nursery of Lands and Survey.

My thanks are also due to Anne Murie who prepared the diagrams.

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