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# Matakohe/Limestone Island Scenic Reserve Restoration Plan

Prepared for the

**Friends of Matakohe/Limestone Island Incorporated Society**

By

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Matakohe – Limestone Island from Onerahi foreshore



Lwi planting day, 2000

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## **Executive Summary**

The restoration plan for Matakohe/Limestone Island has been prepared on behalf of the Friends of Matakohe/Limestone Island Society (FOMLI) - a non-profit group dedicated to the restoration and maintenance of the unique natural and cultural heritage values of Matakohe/Limestone Island.

The restoration plan has been developed to assist with the implementation of the key management objective of the Friends of Motu Matakohe/Limestone Island, which is:

***To ensure the effective management and development of Motu Matakohe/Limestone Island in accordance with the Whangarei District Council Management Plan, so that its natural, recreational, historic and cultural features and values can be protected and enhanced to the benefit of the Whangarei District<sup>1</sup>.***

In order to facilitate the achievement of this objective the restoration plan has three primary goals:

1. The re-establishment and maintenance of a diverse range of self sustaining native plant and animal communities<sup>2</sup> typical of the Eastern Northland and Islands Ecological District (refer Appendix 1 for map and description) that may be expected given the bioclimatic conditions and size of the island;
2. The protection of historic sites and features (including the remains of the limestone works and associated quarries and buildings, shipwrecks and Maori gardening and pa sites);
3. The development of the Island as a passive recreational destination with an emphasis on providing opportunities for visitors to experience the unique natural and cultural heritage of the Island.

Secondary goals (in support of the primary goals) are to:

- Build on remnant vegetation and revegetation work already undertaken and establish coastal forest, shoreline, cliff and wetland plant and animal communities typical of that found within the Eastern Northland and Islands Ecological District and similar to those expected to have occurred on the soils and landforms present on Matakohe/Limestone Island, using seed sources on (or as close as possible to Matakohe/Limestone Island);
- Establish self-sustaining populations of threatened native plants and animals of the Eastern Northland and Islands Ecological District and in particular those species that are not able to exist in the presence of introduced predators. Threatened species will not be introduced to the island if there is any chance that they will hybridise with local species;
- Reintroduce and/or encourage colonisation by all native animal species known to have previously occurred on Matakohe/Limestone Island;
- Where it is not possible to introduce a particular plant or animal (e.g. due to extinction), introduce an ecologically similar conspecific<sup>3</sup> or congeneric<sup>4</sup> taxon to restore trophic<sup>5</sup> processes and lost evolutionary potential;
- Prevent re-infestations where possible, and intensively control all exotic plant and animal species which are presently or may in the future, compromise native plant and animal communities being established on the Island;

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<sup>1</sup> Friends of Motu Matakohe/Limestone Island Constitution, 1997, p.1

<sup>2</sup> This includes birds, insects, reptiles, vertebrates

<sup>3</sup> Applied to individuals that belonged to the same species

<sup>4</sup> Applied to individuals that belonged to the same genera

<sup>5</sup> Of or involving the feeding habits or food relationships of different organisms in a food chain.

- Maintain grassland or other suitable groundcover at historic and/or cultural sites to facilitate preservation;
- Provide information to visitors through the use of self guided walks, interpretation and information panels;
- Provide opportunities for community involvement in the restoration and management of the island.

These goals recognise that Matakohe/Limestone Island is presently a heavily modified environment and has been for at least 250 years. As a result, little remains of the original plant and animal communities and so it is necessary to widen the net in terms of the ecological area from which species can be sourced in order to restore a series of ecosystems representative of the Island's soils and landforms.

The goals also formally recognise the significance of Matakohe/Limestone Island as a cultural heritage resource (being the site of the second oldest limeworks in New Zealand as well as its long association with Maori) and the need to integrate both the natural and cultural heritage values of the Island. Collectively these values are also what attracts people to the Island and will if managed proactively, create a significant heritage resource for Northland.

As an Island largely free of mammalian predators, Matakohe/Limestone Island can also act as a refuge for some of New Zealand's most endangered species. Species include kiwi, Northland tusked weta, flax weevils, flax snails and lizards.

Other species may be introduced with a view to establishing self-sustaining populations on the Island, which can then be used as source populations for introductions to other locations. It is recommended that these species be restricted to those that would have been present either on the island or in the Eastern Northland and Islands Ecological District.

Where these introductions do occur they must not jeopardise the survival of resident and restored threatened animals and plants. The species must be able to be removed totally from the Island when other more suitable (mainland or Island) sites become available<sup>6</sup>.

There are eight key tasks required to achieve the integrated management programme for the Island. They are:

- Restore coastal lowland forest communities;
- Attract and reintroduce avian pollinators and seed dispersers;
- Develop the main quarry as a freshwater wetland;
- Weed and predator control;
- Reintroduce vertebrate and invertebrate species common to ecosystems present on the island;
- Preserve and interpret cultural heritage sites and features;
- Provide for recreational use compatible with the Islands key features
- Minimise the threat of fire.

These tasks provide the basis for the operational implementation of the plan and will ensure the restoration and maintenance of an environment that best represents the unique features of Matakohe/Limestone Island.

The re-establishment of coastal forest cover over approximately 50% of the island (refer Map 1) will be undertaken with a planned revegetation programme. This will enable the development of a forest that will become self-sustaining and support the introduction over time of a range of native animals known to occur in this forest type. Predominant canopy species to be planted will be composed of pohutukawa, karaka, kohekohe, puriri, tawapou, rewarewa, coastal maire and titoki.

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<sup>6</sup> Miskelly, 1999, p.v.

To maximise the survival of canopy species and create a diverse forest environment, pioneering species will be planted initially. These include kanuka, manuka, karo, ngaio, karamu and koromiko. These species will also assist with the development of leaf litter and humus for seedlings and insects.

Experimental work with the use of hardy species such as coastal astelia, muehlenbeckia, flax, Euphorbia glauca and Cook's scurvy grass will be undertaken to try and colonise harsh environments present on the Island (e.g. the quarry faces and exposed coastal cliffs).

The revegetation plan will encompass a variety of techniques including:

- interplanting in areas which have already been planted with canopy species and climbers as the forest develops;
- the establishment of new areas for planting through planting "Islands" of trees rather than individual trees to replicate natural processes and to shade out the regrowth of kikuyu and buffalo grass following initial knockdown. Natural corridors between these areas will develop over time with seed fall and may be artificially assisted with the use of herbicide and selected planting;
- assisting naturally regenerating areas through companion planting immediately around these areas to shade out buffalo and kikuyu grass and allow seeds from these areas to germinate. Surrounding planting species would include kanuka, manuka, koromiko and karamu;
- blanket and spot spraying of buffalo and kikuyu grass prior to planting;
- the gradual removal of all Tasmanian ngaio from the Island through planting native species close by and removing the ngaio once the native has established and does not require sheltering;
- the maintenance of open grassland and control of natural regeneration on archaeological and heritage sites;
- the staged removal of the macrocarpa shelter belt and replacement with appropriate native species including pohutukawa and New Zealand ngaio<sup>7</sup>;
- the eventual development of the small quarry west of the Ranger's house as a living collection of threatened native plants of Northland.

Small parts of the Island will be developed as freshwater wetlands. There are presently six constructed ponds in the main quarry, one on the plateau above the limeworks ruins and one close to the singlemen's quarters. On the northern side there are also a number of natural drains. These areas will be progressively planted with wetland species surrounded by overhead canopy cover to provide shade for invertebrates and reduce the buildup of algal growths.

A small natural freshwater wetland has developed on the southern side of the Island and currently supports banded rail. This wetland will be allowed to develop naturally. Planting immediately around the wetland will be of species able to cope with wet conditions such as flax and cabbage trees.

The sandy margins of the southern side of the Island provide an opportunity to extend the natural remnants of saltmarsh ribbonwood associations. These include batchelors button, shore lobelia, sea primrose and glasswort and the introduction of species such as ice plant, and a number of coastal sedge and rush species. The revegetation of this area will then provide an opportunity to increase awareness of the plight of our coastal salt marsh species, particularly within the Northland Region. The marine environment surrounding the island has

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<sup>7</sup> The Reserve Management Plan does provide for the planting of exotics that are not likely to become weeds in this area due to its historic significance.

been the subject of a Kamo High School project to establish a marine reserve within the Whangarei Harbour.

The remainder of the Island (approximately 49%) will be maintained as open grassland (will not be restored as coastal forest). This will provide disturbed habitat necessary for some native species, e.g. lizards, kiwi, protect views out over the harbour and surrounding countryside; provide opportunities for picnicking and protect significant archaeological sites. In some of these areas prostrate creepers such as *muehlenbeckia* may also be appropriate species. *Muehlenbeckia* has already proven to be an excellent pioneering species on the island.

It is proposed that a range of animal species be introduced or attracted to the Island as it develops. Species to be introduced include North Island brown kiwi, robin and tomtit, Northland tussock weta and flax weevils and snails.

The introduction of these species is closely related to the ability of the Island to sustain these species as well as the ability to control animal and plant pest numbers. Understanding the particular requirements of each species to survive in their environment is crucial. A key component of this restoration plan is the identification of the preconditions required before various introductions can occur.

For some species such as nectar and insect feeding birds (e.g. tui, bellbird), preconditions will include a sufficient range of flowering trees and shrubs and good numbers of insects. Grey faced petrels will require artificial burrows and low rat numbers. Lizard and skink species often require a good layer of leaf litter for activities such as foraging. Small areas of habitat for lizards and skinks already exist e.g. remnant coastal forest and dense areas of kanuka/manuka. There is an area of grass/flax mix that has been created that is now suitable for moko skink.

The restoration and maintenance of diverse and self-sustaining invertebrate communities on the Island will require mass translocation techniques rather than a species-by-species approach. It is recommended that the system proposed for introducing some invertebrate species to Mana Island also be used at Matakohe/Limestone Island. Litter samples, decaying timber and malaise trap samples should be collected from appropriate forest types on the mainland and transferred to Matakohe/Limestone Island.

Screening during transfer will check for the presence of injurious adventive<sup>8</sup> species (e.g. wasp eggs and weed seeds), and allow documentation of the species transferred<sup>9</sup>. Screening is absolutely vital, as weeds in Northland forests are rife. Department of Conservation staff can provide the necessary expertise.

As previously identified, the control of plant and animal pests is a key component of the ecological restoration process on the Island. In the case of plant pests, their control is also important in the protection of archaeological sites.

Animal pest control has been a major part of the work undertaken on the Island to date. Possums, cats, rats and mustelids have been eradicated from the Island. However due to the proximity of the Island to the mainland and easy access across mudflats at low tide, rats and mustelids are still occasional visitors to the Island. Continuing control measures are focused on key reinvasion points on the Island and the maintenance of bait stations and tracking tunnels on surrounding Islands and the mainland. To date four weasels, one stoat and seven rats have been killed. The stoat was killed soon after arriving on the island. The weasels were much harder to catch and took days and sometimes weeks to kill after being recorded in the tracking tunnels.

Mice numbers have been targeted with two aerial drops and the maintenance of bait stations. However the lack of any predators to control mice and the difficult terrain combined with

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<sup>8</sup> Not native to and not fully established in a new habitat or environment; locally or temporarily naturalised e.g. an adventive weed.

<sup>9</sup> Miskelly, 1999, p.vii

increasing food supply as a result of forest development has resulted in numbers beginning to rise. FOMLI is committed to the eradication of mice from the island. This would need to be done reasonably soon before the forest cover develops too much more in order to achieve maximum kill and preferably before the intended release of kiwi onto the island in the Spring of 2000.

The eradication of mice will also assist with the re-establishment of some insect species and allow other rarer species to be reintroduced. A re-invasion plan is essential to deal with the possibility of mice coming back onto the island, particularly on driftwood, following flooding in the upper Whangarei Harbour.

Garden snails are a major problem and are having significant impacts on attempts to establish palatable species such as kowhai, kakabeak and rengarenga on the Island. Their numbers will need to be significantly reduced if these species are to establish themselves.

There are over fifty adventive<sup>10</sup> plant species on the Island. Other than kikuyu and buffalo grass none of these species are present in high numbers. Infestations tend to be localised in small areas and the resident ranger has made considerable gains towards controlling many of these species. The weed control programme has established six priorities (refer section 12) according to the invasive nature of each species and its present extent. As well as continuing with this programme, priority needs to be given to continually checking for the establishment of new species.

The ongoing management of Matakohe/Limestone Island is the responsibility of the Friends of Matakohe/Limestone Island Society. This management arrangement has been made possible with an innovative partnership arrangement with the Whangarei District Council who formally administers the Island. The Council has continued to provide a high level of support for the project both in terms of resources and its commitment to the restoration programme.

Much of the success of the restoration project to date has been largely due to the relationships that the Friends have forged with a number of key organisations. These include the Golden Bay Cement Company, which has provided a significant level of sponsorship, the Northland Regional Council, and the Department of Conservation.

In order for the project to succeed longterm, these relationships need to continue along with the continued involvement of iwi and the wider community.

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<sup>10</sup> Not native to and not fully established in a new habitat or environment; locally or temporarily naturalised.

## **1. Introduction**

Matakohe or Limestone Island is the largest Island in the Whangarei Harbour (refer Map 2) and marks the transition between the upper and middle reaches of the harbour. Covering an area of 37.1825 hectares, Matakohe/Limestone Island lays 500 metres south of the Onerahi boat ramp.

In July 1998 the Island was classified as a Scenic Reserve under the Reserves Act 1977 and is known as the Matakohe-Limestone Island Scenic Reserve<sup>11</sup>. The Whangarei District Council administers the Island. The Council has developed a reserve management plan to guide the overall management of the island.

In the management plan (as revised in 1997), the Council acknowledged that because of the Island's unique history, features and potential to become a major open space resource for the community, it should be a focus for broad community participation in its management and development. This could best be implemented by the formation of a group or society of interested people and hence the establishment of the Friends of Motu Matakohe/Limestone Island and its subsequent incorporation in May 1993<sup>12</sup>.

The Council has delegated the responsibility of managing day to day issues, publicity, funding and developing working plans to reflect the intent of the reserve management plan to the Friends. However it continues to maintain an active interest in the work being undertaken on the Island by providing seed funding, administrative and technical support.

The development of the restoration plan has been undertaken with the full support of the Council and is a significant step to implementing the proposals and policies as identified in the Island's management plan.

Limestone Island has a long history of Maori and European occupation. Maori associations with the Island date back to the Ngai-Tahuhu people who were the original settlers of the Whangarei District. Today all that remains is the Pa of Parawhau Te Ihi on the summit of the Island and a series of agricultural lines on the northern side of the Island covering approximately 14 hectares.

European occupation of the Island dates back to the early 1800's when Mr G.D. Browne, the first European trader in the Whangarei District built his home on the Island. The most significant European influence on the Island was the development of the Island for grazing and the establishment of the limeworks and quarries in the late 1800's. The ruins of these works and the quarries stand as testament to the second oldest limeworks in New Zealand.

Historically the Island has been a focus for recreational activities. Recreational use of the Island has increased slowly with most use coming from locals on a casual basis as part of boating or fishing trips in the inner harbour.

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<sup>11</sup> Extract from *N.Z. Gazette*, 27 May 1999, No. 60, p.1434

<sup>12</sup> Matakohe/Limestone Island Management Plan, 1997, section 5.1



## **2. Progress with Restoration**

The interest in formally establishing a restoration programme arose out of an initiative from the local branch of the Royal Forest and Bird Protection Society who formally established FOMLI in 1990. Restoration work was actually begun on the island in 1989 and the first large scale planting of native trees was undertaken in that year. To the end of year 2000, some 45,000<sup>13</sup> native plants of at least 100 species will have been planted with the help of volunteers.

Considerable work has also been done with the control and eradication of a number of animal and plant pests, the development of access tracks across the island, installation of entrance and directional signs, construction of a floating pontoon and replacement of fences.

A series of small wetlands have been artificially created in the base of the main quarry in an effort to establish habitat for native invertebrates and vertebrates. The edges of these ponds have been planted with hardy species such as kowhai, flax, carex species and cabbage trees. Due to the removal of all the topsoil during quarrying operations it has proven very difficult to establish vegetation in this area and experimental work is ongoing.

Breeding success and population sizes of N.Z. Dotterel and Variable Oystercatcher on the northern and southwestern sides of the Island are being monitored annually. Nesting areas for both species are signposted and fenced off prior to each breeding season. In the last four years, one dotterel chick has been fledged each season. Variable Oystercatchers have been more successful, fledging around six chicks each season.

Releases of tree weta began in April 2000 and it is likely that shore skink may also be released in 2001. Approval has also been given through the Department of Conservation's Operation Nest Egg project for the Island to act as a "nursery" for North Island brown kiwi. In July/August 2000, two kiwi chicks (over 1000 grams) will be released onto the island and monitored. They will come from Motuora Island and are from eggs sourced north of Whangarei.

Once the forest has established more and there has been a reduction in the number of invasions from mustelids it is hoped that kiwi will become resident on the Island.

The restoration programme has been substantially boosted by a sponsorship package from the Golden Bay Cement Company. This along with resources from the Whangarei District Council, the Department of Conservation and a number of private sponsors has provided FOMLI with the ability to continue to implement the programme.

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## **3. Restoration Goals**

Ecological restoration plans prepared for other areas around New Zealand generally have as their primary goal the restoration of an environment indicative of what would have been found prior to human contact. This is not possible or indeed appropriate for Matakohe/Limestone Island for three reasons:

- the very high level of modification that has occurred;
- the lack of records of what native flora and fauna would have originally occurred on the Island;
- the significance of the Maori and European cultural sites that remain on the Island.

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<sup>13</sup> Information provided by Page and Reid

Hence the ecological plan for Matakohe/Limestone Island has three primary goals:

- **The re-establishment and maintenance of a diverse range of self sustaining native plant and animal communities<sup>14</sup> typical of the Eastern Northland and Islands Ecological District that may be expected given the bioclimatic conditions and size of the island;**
- **The protection of historic sites (including all Maori sites, the remains of the limestone works and associated quarries and buildings, shipwrecks);**
- **The development of the Island as a passive recreational destination with a focus on providing opportunities for visitors to experience the unique natural and cultural heritage of the Island.**

Secondary goals (in support of the primary goals) are to:

- Build on remnant vegetation and revegetation work already done and establish coastal forest, shoreline, cliff and wetland plant and animal communities typical of that found within the Eastern Northland and Islands Ecological District and similar to those expected to have occurred on the soils and landforms present on Matakohe/Limestone Island, using seed sources on (or as close as possible to Matakohe/Limestone Island);
- Establish self-sustaining populations of threatened native plants and animals of the Northland Region and in particular those species that are not able to exist in the presence of introduced mammals as long as there is no risk of these species hybridising with local species;
- Reintroduce and/or encourage colonisation by all native animal species known to have previously occurred on Matakohe/Limestone Island;
- Where it is not possible to introduce a particular plant or animal (e.g. due to extinction), introduce an ecologically similar conspecific or congeneric taxon to restore trophic processes and lost evolutionary potential;
- Intensively control and prevent re-infestations of exotic plant and animal species which are presently or may in the future, compromise native plant and animal communities being established on the Island;
- Maintain grassland or other suitable groundcover at cultural heritage sites to facilitate site preservation;
- Provide information to visitors through the use of self guided walks, interpretation and information panels;
- Provide opportunities for community involvement in the restoration and management of the Island;

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<sup>14</sup> This includes birds, insects, reptiles, vertebrates

## **4. Revegetation**

### **4.1 CURRENT SITUATION**

The vegetation of Matakohe/Limestone Island has been highly modified as a result of successive periods of human disturbance. What is left is mainly concentrated on the southern side of the Island. This can generally be described as scattered patches of puriri, karaka, and kohekohe and isolated trees of a limited range of species including tawapou, titoki, wharangī and houhere.

The exotic buffalo grass is a dominant groundcover throughout the Island and creates significant challenges for the revegetation programme. However in a number of areas, the native ground cover, *muehlenbeckia* is starting to compete with the buffalo grass. This is particularly evident on the southern side from the ridge top down to the coast. Pohutukawa and saltmarsh ribbonwood are found along the coast along with one parapara tree, which is a unique feature of the Island.

Due to the age of most of these remnants, it is likely that they are remnants of successive forests rather than remnants of original forest.

Approximately 75% of the Island is presently open grassland (i.e. areas that are either not planted or where there is minimal natural regeneration). This includes the area encompassing the limeworks at the southeastern corner, the area immediately in front of the Ranger's compound and some 14 hectares on the northern slopes being the site of Maori gardens in the 1840's. Buffalo grass with some *Paspalum* and *Kikuyu* are the dominant species. *Muehlenbeckia* is also present and flax has been planted in a number of areas.

Of the remaining 25%, about 15% has been planted as part of the revegetation programme. Plantings have concentrated on the establishment of drought tolerant and pioneering species such as manuka, kanuka, ngaio and *coprosma* species. These plantings have had varying levels of success with the most successful and diverse planting being located on the southwestern point of the Island. A 1995 plant survey identified that karamu, manuka, karo, pohutukawa, flax, cabbage tree, houpara, koromiko, akeake and ngaio were performing well<sup>15</sup>.

Exotic species are also present on the Island. Those considered to be of concern are identified in Appendix 13 and are the subject of an ongoing weed control programme (refer section 12). A large Oleander and a small grove of plum trees remain in the ruins of the limeworks. A shelterbelt of *macrocarpa* probably planted to give shelter for the mine manager's house is located on the northern side of the Island. There is also a large oak tree close by.

To aid the restoration programme, Iain Reid<sup>16</sup> has compiled a comprehensive list of native plants to act as a guide for revegetation projects in Northland generally. This list has been edited down so that it is more specific to Matakohe/Limestone Island. It is intended that this edited list (refer Appendix 2) act as the species guide for the restoration programme on the island).

The native flora of Matakohe/Limestone Island currently present is very restricted and is in no way representative of the diversity of species that would have originally been present.

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<sup>15</sup> Reid et al, 1995

<sup>16</sup> FOMLI Committee Member

## 4.2 ORIGINAL PLANT COVER

Due to the extensive modification of the Island over a long period of time little is known about the Island's original vegetation cover. Timber felling for building materials and firewood and clearance for stock grazing resulted in most of the vegetation other than isolated pockets being cleared by the mid 1800's.

Coastal lowland broad-leaved/podocarp<sup>17</sup> forest would probably have dominated much of the Island. The forest canopy is most likely to have contained species such as puriri, karaka, kohekohe, tawapou, and taraire. Pohutukawa, karo, mahoe, mapou and karamu would most probably have been a dominant feature along the coastline with cabbage trees, flax and small coastal natives such as salt marsh ribbonwood and mangrove in more saline areas. Rock outcrops and cliffs were likely to have been dominated by hardy species such as coastal astelia, gahnia species, flax, rengarenga and hebes.

## 4.3 THE ARGUMENT FOR REVEGETATION

Assisted revegetation is necessary on Matakohe/Limestone Island due to the extent of modification to the Island's landscape and the lack of species diversity. With only a limited number and range of species of native plants and trees found to be naturally occurring (refer Table 1 below) as well as many of those being pioneering species, it is unlikely that a self-sustaining forest would develop for a considerable period of time (in excess of 100 years). This is compounded by the lack of seed and pollen dispersing birds and insects to assist with the natural regeneration process. General plant succession is shown in Appendix 20.

Natural regeneration of the forest, scrub and wetland communities on Matakohe/Limestone Island would take many decades, if not centuries, and is unlikely to produce a diverse broad-leaved/podocarp forest such as was likely to have been present originally. Revegetation will also provide habitat for forest, scrub dwelling and wetland species more rapidly than natural regeneration<sup>18</sup>.

**Table 1: Distribution and Abundance of Naturally Occurring Native Tree and Shrub Species Present on Matakohe/Limestone Island in 1999<sup>19</sup>**

Species	Comment
Totara	3 or 4 isolated trees south coast
Titoki	3 or 4 isolated trees south coast
Manawa	Abundant in estuarine wetland/sandspit
Coastal Karamu	Many present under karaka and scattered along coast
Coastal Karamu hybrid	Scattered juveniles along south coast
Shore bindweed	South Coast
Pink bindweed	Scattered around coast
Kawakawa	Scattered under canopy trees on south coast
Karaka	Scattered groves of mature trees and many seedlings on south coast. Good grove around Western point
Kohekohe	5-6 large trees on south coast, seedlings present
Houhere/Lacebark	1 tree above rock outcrop south coast
Manuka	Abundant on south coast and in valleys
Wharangi	6-8 small trees on south coast
Pohutukawa	Many small trees on south coast and two large trees

<sup>17</sup> Podocarp refers to a group of NZ trees belonging to Podocarpaceae family, e.g. totara

<sup>18</sup> Adapted from Miskelly, 1999, pp13-14

<sup>19</sup> Adapted from Reid, 1999

**Table 1: cont.**

Species	Comment
Ngaio	Scattered trees concentrated around Western point
Mapou	Scattered around island
Parapara	1 mature tree on south coast
Saltmarsh Ribbonwood	5-6 trees on south coast
Tawapou	6-8 large trees on south coast, seedlings present
Puriri	Several large trees on south coast and seedlings establishing
Pohuehue/Muehlenbeckia	Widespread on grassland and around coastline
Common Maidenhair	Small patches under shade on south coast
Harsh Shield Fern	Patches in grass on south coast
Trembling brake fern	Patches on south coast
Needlegrass	Patches on south coast
Coastal Cutty Grass	Small patches under shade on south coast
Raupo	Dominant vegetation in wetland behind limestone works ruins
Toatoa	Scattered along south coast
Maakoako/Sea Primrose	Scattered along south coast
Ureure/Glasswort	Scattered along south coast
Remuremu/Selliera	Scattered along south coast
Marsh clubrush	Scattered around island in wetter areas
Sea rush	Saltmarsh on south coast
<i>Suaeda New Zealand</i>	Saltmarsh on south coast
<i>Zoysia sp.</i>	Saltmarsh on south coast

*Note: This table is incomplete, as no detailed survey has ever been undertaken of the native plant species that have naturally established on the island. It is therefore recommended that this be done within the next year while it is still relatively easy to distinguish between planted species and those that have naturally established. Saltmarsh species may also be under-represented in this table.*

In order to restore and maintain diverse self-sustaining native plant and animal communities on Matakohe/Limestone Island it is important to have an understanding of the environment that they need to survive in. Matakohe/Limestone Island's natural landform is the result of the slow weathering of Motatau clays underlain by distinctive limestone parent rock which is generally medium grained crystalline limestone containing sand grains and green sand<sup>20</sup>. The thin layer of clay soils and the hard nature of the limestone combine to create a very hot and dry environment for plants to establish in.

The exception to this soil type is in the area of grassland on the northern side of the Island, which was previously cultivated as Maori gardens. Here the soil is much more friable, water is more readily able to pass through it and it is a better growing medium.

Compounding the poor soils conditions, which extend over much of the Island, is the removal of the original forest cover and the quarrying of lime rock from the Island which has resulted in the establishment of a very harsh growing environment over much of the Island. Some areas, such as the main quarry are completely devoid of topsoil. Other areas have remained for long periods of time without any substantial forest cover. As a result there is little in the way of natural soil fertility through the effects of rotting trees and leaf fall.

In addition the landscape of the Island is such that there are very few valleys and no permanent watercourses. Three small ephemeral<sup>21</sup> streams occur on the western slopes and feed into the foreshore. There are also a number of minor streams (also of an ephemeral nature) which occur along the southwestern slopes and only flow in the wetter months<sup>22</sup>. This lack of readily available water year round as well as the lack of shelter limits both the plant species that can establish as well as the bird and animal species that assist with the development of healthy functioning ecosystems.

<sup>20</sup> Matakohe/Limestone Island Management Plan (Revised 1997), p.11

<sup>21</sup> Seasonal and lasting only for a very short time

<sup>22</sup> Matakohe/Limestone Island Management Plan (Revised 1997), p.11

For these reasons, revegetation efforts will focus initially on those species that are able to:

- survive in these harsh conditions;
- create shelter and improved growing conditions for seeds and other species (partly to aid natural regeneration);
- able to act as attractants for seed dispersing birds.

Once these species have established themselves, a programme of interplanting will begin. This will include some of the canopy species that require shelter to get established such as puriri and tawapou and other species to expand the diversity of the forest such as poroporo and turepo. Further development of the forest will include the introduction of climbers such as clematis, rata and kohia (native passionfruit).

The close proximity of the Island to the mainland and adjacent pockets of coastal lowland forest provides a potential natural revegetation opportunity where seed and pollen of mainland plant species can be dispersed to the Island by wind and also by birds.

The importance of birds as dispersers of the seeds of New Zealand forest plants must not be underestimated. Of the approximately 240 species of woody plants occurring in New Zealand's mainland forests, about 70% have fleshy fruits suited for vertebrate dispersal. Birds undoubtedly disperse the majority of these. Kereru are now virtually the sole dispersers for plants with large fruits (e.g. karaka, puriri) as a result of the decline or extinction of several other avian frugivores<sup>23</sup> (e.g. kokako). They are arguably the most important seed dispersing birds in New Zealand forests, because of their catholic<sup>24</sup> diet, their mobility and their widespread distribution<sup>25</sup>. Currently, a large number of waxeyes feed on the ripe berries of planted karamu, and when the buffalo grass is removed, will be a major vector of this plant species.

Revegetation species need to be indicative of seral<sup>26</sup> species rather than just concentrating on canopy species. This will result in a final canopy, which is natural rather than designed on a botanist's desk and planted in rows. These species need to be hardy and chosen to attract frugivorous birds who once established will distribute the seeds of future canopy trees.

Examples of hardy species would include flax, cabbage tree, Pittosporum spp., poroporo, and Pseudopanax species. Secondary colonisers such as coprosma species and New Zealand ngaio should also be included. These species are typically the first to be found once initial cover has been established by colonising species such as kanuka and manuka.

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<sup>23</sup> feeding primarily on fruit

<sup>24</sup> broad, liberal, comprehensive!

<sup>25</sup> Clout and Hay, 1989, p31

<sup>26</sup> Of or relating to the entire sequence of ecological communities successively occupying an area from the initial stage to the climax

Revegetation efforts will be focused on establishing and maintaining four main plant communities on the Island. These are:

- coastal forest and shrublands;
- freshwater wetlands;
- saltmarsh;
- open grassland.

Active planting of tree and shrub species is planned for the first three of these communities. However the majority of the effort will go into coastal forest and shrubland species as this covers the largest area after open pasture. Areas to be specifically excluded from the main revegetation programme are the areas containing the ruins of the limeworks and the pa and associated gardens (although the damp gullies in this latter area will be planted for erosion control purposes (refer Map 1).

This planting programme will in time create a diverse range of habitats suitable for the local landforms, soils and microclimates on the Island. It will also provide a variety of habitats suitable for the range of plant and animal species that are either resident on the Island or are considered appropriate for introduction.

It is anticipated that the combined effects of the revegetation programme and natural regeneration will result in a mosaic of coastal forest, wetlands and salt marsh. Around 18 hectares will be grasslands, some of which will be reduced over time by natural regeneration and some specimen planting. The only grassland sites where these processes will be actively prevented are on sites considered to have significant heritage values.

#### 4.4 PROGRESS WITH REVEGETATION TO DATE

The emphasis of the revegetation programme is on recreating plant communities appropriate to the Island's location, climate, soils and landforms. It should also ensure that those communities are compatible with the cultural heritage values of the Island.

Nurseries in the Whangarei area grow plants for the Island. Each year growers are invited to tender for the growing of a selected range and number of native species as set by FOMLI. Tender conditions specify that seed or cutting source must be within the Whangarei genetic area to exclude propagation from cultivated plants of unknown origin. Preference is for material from the Whangarei Harbour area.

Mainland seed sources have been the predominant form due to the small seed source that is presently available on Matakohe/Limestone Island. This will continue for sometime yet until the forest becomes more diverse and mature. However it is important that as seed sources (refer Appendix 4 for seed collection guidelines) do develop on the island, that they are used in preference to mainland seed sources. This will increase the percentage survival rate, as island grown trees will become adapted to the specific environments they are growing in. If cuttings are taken they must be from as wide a selection of individual trees of a particular species as possible to ensure that there is sufficient genetic variety.

The majority of plants come out to the island after one year's growth in the nursery. Depending on the species the plants come in a range of sizes from PB2-4, paper pots and root trainers. Standing out or hardening off of plants does occur prior to planting but in the absence of a water system or shade house on the island this is often difficult to do.

It is important that plants grown in sheltered environments such as nurseries away from the final planting area are hardened off on the island for at least 4 weeks prior to planting. A suitable place for a nursery would be in the area in front of the ranger's house. This is a reasonably sheltered and secure area and close to a water supply, which could be pumped down or gravity fed from the tanks above the ranger's cabin.

Herbicides are used to prepare ground prior to planting. Pre-plant spraying is undertaken 2-3 months in advance to planting to allow the buffalo grass to die completely or partially rot down

(as mulch for new plantings). Post plant spraying has recently been introduced and it is recommended that this be adopted as an ongoing practice in areas where the grasses may threaten the survival of young plants. In other areas, such as Tawharanui Regional Park, north of Auckland the experience has been that post plant spraying may need to be undertaken for up to 4-5 years in areas where adventive grasses are present.

Planting generally begins in winter (usually around June) to encourage root growth before summer drought. Initial plantings have been of seral/pioneering species such as kanuka, manuka, flax, cabbage trees, pohutukawa, ngaio, karo and karaka. Significant numbers of coprosma have also been planted to shade out and minimise the re-establishment of grass and weed species.

These species also attract birds and insects and provide shelter, nutrients and suitable microhabitats for the eventual establishment of canopy species. Some interplanting of canopy species has also been undertaken. This has been concentrated around the western point.

Species interplanted include puriri, golden akeake (*Olearia paniculata*) and titoki. However, golden akeake was planted in error in 1989<sup>27</sup>. It is not a species of *Olearia* that would naturally occur in this area (*O. albida*, *O. furfuracea* and *O. rani* considered to be more appropriate) and is expected to disappear naturally as the forest matures.

Saltmarsh ribbonwood has been planted around the southern coast close to the sandspit to supplement existing natural plantings. These plantings are now beginning to provide a natural seed source.

Efforts have also been put into attempting to establish populations of Kowhai ngutukaka (kakabeak sourced from Moturemu Island in the Kaipara Harbour where the species is endangered due to the effects of rats) and rengarenga. However these and many of the initial kowhai planted have been largely unsuccessful due to the high snail numbers on the Island. Localised spreading of snail bait and scrub cutting around plants has resulted in higher success rates in subsequent plantings of these species.

Over 25,000 plants of 100 species have now been planted over approximately 15% of the island between 1989 and 1999. A summary of species planted to date is attached as Appendix 3. This year FOMLI plans to plant around 23,000 trees. 20,000 of these trees will be made up of 5 species (cabbage tree, flax, manuka, taupata and ngaio). These are to be part of a Millennium Planting Day on May 20<sup>th</sup>.

#### 4.5 DETERMINING APPROPRIATE FOREST COMMUNITIES<sup>28</sup>

Plant communities adapt to their local area as a result of a combination of physical parameters. Some of these have been discussed above (refer section 4.3) and include factors such as soil type, slope, aspect, drainage and exposure to wind. Understanding these local conditions and working within their limits is a key component of a successful restoration plan.

Other than that previously described in section 4.3, little detailed information exists on the physical parameters of the Island. The revegetation effort therefore needs to focus on the gathering of information from the experiences of those involved with the planting and management of the Island to date and in the future. The restoration plan therefore needs to be a living document as these experiences cumulatively provide the most realistic basis for planning the restoration of the Island based on actual site factors and anticipated landscape character.

This "research by management" approach has been used successfully in many other restoration projects in New Zealand such as Tiritiri Island and Mapara Mainland Island. In the case of Matakohe/Limestone Island, as it applies to plantings, some will be experimental in nature to determine which species and mixes of species are most appropriate.

<sup>27</sup> Reid, pers. comms, March 2000

<sup>28</sup> Valuable information for this section has been sourced from Wright and Cameron, 1990, p.225

Natural regeneration also needs to be encouraged as much as possible. Preserving natural regeneration on the adjacent mainland as well as on the Island itself will result in the two parts eventually becoming large enough to support and encourage bird movement between the two areas. This can be encouraged through liaison with local landowners, the Whangarei District Council and the Department of Conservation. It could include the provision of incentives for landowners to protect and manage remnant pieces of bush on their properties. Incentives include rating relief, provision of plants, conservation covenants and providing advice and support for animal and plant pest control programmes.

One of the great advantages of natural regeneration as opposed to planned revegetation is that it helps to better understand natural regeneration pathways. The end result will be individual plants that are better suited to their habitat, as they have undergone a strong selection process in order to survive, unlike hand propagated and nurtured plantings.

Due to the low species diversity of Matakohe/Limestone Island, a lot of seed has been sourced from the mainland. This needs to be done with extreme caution as it is recognised botanically that conditions on northern offshore Islands have resulted in many species developing Island forms. Wright and Cameron (1990) identified 5 factors that should be considered:

- The large leaved forms of many mainland plants on northern offshore Islands are well known. An example is *Macropiper f. psittacorum*, which has larger and longer spikes than its mainland form being *Macropiper excelsum* (kawakawa);
- The high genetic variability in many New Zealand plants, combined with the relative infancy of plant taxonomy in New Zealand dictates that caution needs to be taken when moving plant stock to Islands for revegetation or restoration;
- It is important to identify all dioecious<sup>29</sup> plants and determine natural ratios for these species and replicate them as far as possible to minimise alterations to the genetic pool;
- Interspecific<sup>30</sup> hybrids are frequent in some plant genera<sup>31</sup> e.g. *Coprosma*, *Corokia*, *Olearia* (tree daisy), *Pseudopanax* (five finger) and *Melicope* (wharangi) as well as intergeneric<sup>32</sup> hybrids e.g. *Olearia*. Seed rather than cuttings should be taken to maximise genetic variation and seeds should not be collected from sites where hybrids do occur;
- Care must also be taken with revegetation and restoration or rare plant transfers to ensure that closely related taxa<sup>33</sup> which do not naturally overlap are not brought into contact to minimise the chance of hybridisation.

From a practical point of view these issues can be dealt with by a continuation of the present close relationship between FOMLI and botanical staff from the Department of Conservation. FOMLI also need to continue to ensure that contract growers are also aware of these potential risks and take active steps to minimise them.

In addition to these factors, it is also important to limit the geographical area from which native species for the island can be sourced. This minimises the chance of hybridization and maximises the chances of plants being able to establish in an environment they evolved in. For this reason and those mentioned above it is recommended that species to be mass planted should be restricted to those likely to have occurred on the island. These are species, which are found within the Eastern Northland and Islands Ecological District (E.D.). Preference should be given to material that comes from areas that are geographically and

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<sup>29</sup> Having the male and female reproductive organs borne on separate individuals of the same species. In NZ this includes species such as *rimu* and *kahikatea*

<sup>30</sup> Arising or occurring between species

<sup>31</sup> A taxonomic category ranking below a family and above a species and generally consisting of a group of species exhibiting similar characteristics, e.g. *Coprosma*

<sup>32</sup> Arising or occurring between genera

<sup>33</sup> A taxonomic category or group, such as a phylum, order, family, genus, or species

climatically similar to Matakohe/Limestone Island (such as the Whangarei Harbour area currently specified in plant tender conditions).

Establishment of species, which occur outside of the Eastern Northland and Islands E.D., should only occur if there is no chance of hybridization or detrimental affects to existing plant or animal communities. In addition these introductions should only be considered where there is a risk the species may become extinct and it is a species found within the Northland Ecological Region. A suitable area for a rare plant display could be the small quarry to the west of the Manager's house ruins.

Coastal forest and its associated shrublands and open rocky areas (such as cliff and bank edges) will be the predominant vegetation cover on the Island. Appendix 2 identifies those species most likely to be found in coastal lowland forest that would have once clothed Matakohe/Limestone Island. A number of species (e.g. many of the ferns and some of the herbs) will not be readily available in nurseries. Seed or cutting sources of these plants could be sourced from the wild (check with the Department of Conservation for permit requirements) and would make good volunteer projects for people interested in growing specialist plants for the restoration project.

In summary, species considered appropriate for planting on the island are those that are:

- likely to have either occurred on the island;
- are known to occur in the Eastern Northland and Islands Ecological District in either lowland coastal forest, cliffs and shrublands, and in saline and freshwater wetlands;
- able to colonise harsh environments with little or no surface water, salt air and poor or little soil.

#### 4.6 REVEGETATION PLAN

The following revegetation plan is based on:

- Northland Revegetation Species List compiled by Reid (1999);
- Landform constraints (e.g. coastal cliffs, dry conditions);
- The areas identified for revegetation (refer Map 3);
- Past experience with survival of plantings;
- Specific habitat requirements for species such as kahikatea, shore lobelia, Cooks scurvy grass, kohia (NZ native passionfruit);
- Species to create habitat for native plants and animals (to be released and also to encourage natural migration);
- The need to develop and maintain view shafts at key points around the island to provide views down into key features such as historic sites and landmarks around the harbour (refer Map 3).

The plan does not contain all the plants in Appendix 2 and is only an indication of the range of species that could be planted in each area. Inclusions of other species need to be undertaken only when the habitat is available. Some species such as orchids and ferns will require well-developed canopy cover, which will not be available for some time. It is anticipated that these species may be added in subsequent reviews of this ecological plan. Other species will naturally establish from windborne seed or as a result of bird dispersal once suitable conditions develop.

In terms of planting densities it is recommended that the Mana Island revegetation densities be used as a general guide. This plan assumes an initial planting density of 6000 plants/ha followed by interplanting with canopy species at 1000 plants/ha and subcanopy species also at 1000 plants/ha<sup>34</sup>. For Matakohe/Limestone Island, given that approximately 18 out of the total 37 hectares will remain as grassland this means that the remaining 19 hectares will eventually have something in the order of 152,000 trees. Given that around 25,000 trees have been planted to date and that a further 23,000 are planned for planting in the 2000 season this

<sup>34</sup> Miskelly, 1999, p.24

leaves 104,000 trees to be planted. FOMLI has agreed to a target of 10,000 trees per year which will see the planting programme completed in 10-11 years or around 2011.

### **Area A: Coastal Margin Behind Macrocarpa's to Edge of Navigational Beacon Area**

#### Initial Plantings

Pohutukawa, karamu@, flax@, ngaio@, mahoe, karaka, coastal maire, karo, cabbage tree@, akepiro, puriri, wharangi, akeake

#### Subsequent Interplantings

Tawa, kohekohe, rangiora, hangehange@, kawakawa, large-leaved milk tree, corokia, koromiko@, mingimingi, parapara, five-finger, pate, kowhai, bush lawyer, pigeonwood, kanono@, mahoe@, fivefinger@, bracken

#### Plantings once Canopy and Shelter Established

Kidney fern, mangemange, rata, clematis, mokimoki, maidenhair spp.

#### Plantings for Small Quarry (proposed as a conservation garden (refer section 6))

Pomaderris paniculosa spp. novae-zelandiae, Calystegia marginata, Euphorbia glauca, Xeronema, Euphorbia glauca, Colensoa physaloides, Ranunculus urvilleanus, Celmisia adamsii.

#### **Notes for Area A:**

1. This area also includes the dam (shown as wetland on Map 3) and two small gullies with seasonal watercourses and seepage's within it. It is proposed that these areas be planted (refer Section 5 below).
2. The western end of this area bounds onto an area where there are a number of harbour navigational beacons. Plantings done to date that have the potential to restrict the use of these beacons should be removed as soon as possible. Smaller trees may be able to be relocated but larger trees will have to be cut down. The area should be maintained in grass and muehlenbeckia. Any natural regeneration that may pose a threat to these navigational aids is to be removed.
3. Because this area is adjacent to the largest area of open grass and the area where public access is easy, there is a greater fire risk. Species with @ are fleshy and may assist with slowing a fire down. Weeds such as gorse and pampas need to be removed as soon as they establish as they have a high degree of flammability.

### **Area B: Western Point with Established Initial Plantings**

#### Initial/ Established Plantings

Ngaio, karamu, houpara, cabbage tree, puriri, akeake, flax, pohutukawa, manuka, Poor Knights ngaio, Tasmanian ngaio (replace with rewarewa and puriri)<sup>35</sup>, kapuka, Olearia furfuracea, karaka, totara, tawapou, muehlenbeckia, kawakawa.

#### Subsequent Interplantings

Titoki, tawapou, rewarewa, maire tawake, tairaire, kohekohe, turepo, towai, heketara, five-finger, pate, poroporo, ponga, mamaku, wheki logs, rangiora, hangehange, mapou, mangeao, kawakawa, bracken cutty grass.

#### Plantings once Canopy and Shelter Established

Clematis, kohia, rata, native jasmine, maidenhair, mokimoki, waewaekaka, mangemange, bush rice grass.

#### Cliff Bank and Shore Edge Plantings

Natural regeneration should do the majority of the work in this area as is evidenced with the muehlenbeckia cover already present but the area could be enhanced with rengarenga, shore astelia, shore spurge, shore lobelia, flax, coastal tussock and coastal toetoe, cutty grass (*Cyperus ustulatus*).

<sup>35</sup> Should be progressively removed by planting more appropriate species within shelter of Ngaio and then removing Ngaio when other species has developed sufficiently

**Area C: South Coast Sandspit (landward side) to Limeworks and inland to Mine Managers House**

*Initial and/or Established Plantings or Remnants*

Karaka, manuka, parapara, mingimingi, karamu@, karo, tawapou, ngaio@, wharangi, pohutukawa, ngaio gahnia, mapou, coprosma hybrid, puriri, cabbage tree, flax@, koromiko@, hoheria, totara, tutu, titoki, kawakawa, muehlenbeckia, bracken.

*Subsequent Interplantings*

Nikau, kanono, taupata@, rangiora, mapou, taraire, fivefinger, titoki\*, totara\* kauri (restrict kauri to area identified on Map 3), makomako, tawa, tree broom, marbleleaf, kowhai, kakabeak#, rengarenga (once snails under control), koromiko, rewaewa, kahikatea, kawakawa, lemonwood, toru, kohekohe, poroporo, hangehange@, whau, coastal maire, kowhai, poroporo, mingimingi

*Plantings once Canopy and Shelter Established*

Ferns, grasses and sedges, tree fuchsia, hoheria, rata, puka, kapuka, hinau, kakabeak#, kumerahou, tree broom#, nikau, bush lawyer, clematis, native jasmine, kohia, bindweed, native convolulus and muehlenbeckia australis (along coastal edge to prevent nasturtium and ivy re-establishing/spreading,

*Planting for the Dry Plateau above the Limeworks*

Establish as flax fields using species found on the Northland mainland and offshore islands. Initial establishment plantings can be of harakeke.

**Notes for Area C:**

1. The area of young planting on the coastal side of the track near the sandspit needs releasing from bindweed which is beginning to suffocate many of the plantings.
2. The small dry plateau above the Limeworks has the potential to become a haven for invertebrates. The establishment of flax fields in this area would provide habitat for flax weevils and flax snails, bring birds into the area, provide opportunities for local iwi to harvest weaving material and provide an attractive view from the viewing point which is planned for the cliff above this area.
3. Area C also contains one of the larger areas yet to be planted. There are considerable areas of deep buffalo grass as well as patches of nasturtium and ivy that need to be brought under control.
4. It is recommended that plantings be undertaken in dense groups rather than far apart to shade out the regrowth of grasses and other weeds. This would necessitate blanket spraying of the buffalo grass prior to planting. Planting in this manner will also give a much greater sense of achievement and a greater buy-in from the public as they will be able to identify with distinct/identifiable planting areas on the island and observe the success of "their" planting over time. Successful plantings encourage people to come back and do it again and again.
5. Existing bush remnants (refer Map 3) need to be assisted with companion planting to provide cover for seeds to germinate rather than the present situation where they are being out competed by the grass. Companion plantings involve planting other species densely around the remnant. These should be species that will eventually die back and let the species in the remnants come through. Companion planting species include kanuka, manuka, coprosma, flax and mahoe. Under spraying in areas where kanuka/manuka is now dense may also be a useful technique for controlling buffalo grass.
6. A firebreak has been established along the northern edge of the fenceline on the top of the island. This needs to be maintained particularly in the summer months. Species that have a higher tolerance to fire (@) should be interplanted on the southern side of the fence (in with the existing kowhai and kakabeak plantings) and the firebreak should continue to mowed and maintained to its present standard.
6. Species marked with # (tree broom, kakabeak and hibiscus) need to be planted in light wells or on the edges of plantings as they need high light conditions for optimum growth.
7. Species marked with \* (Totara and Titoki) are prone to salt spray so need to be established in areas that are more sheltered from the prevailing winds.
8. Coastal area around limeworks - This area has already been planted with some specimen trees such as pohutukawa. Rather than being densely planted the area should continue to be planted with species that provide an open nature and allow views into the limeworks from the sea. Karo, whau and ngaio are also suitable species.

#### **Area D Dry Eastern end and Steep Cliffs and Quarry Faces**

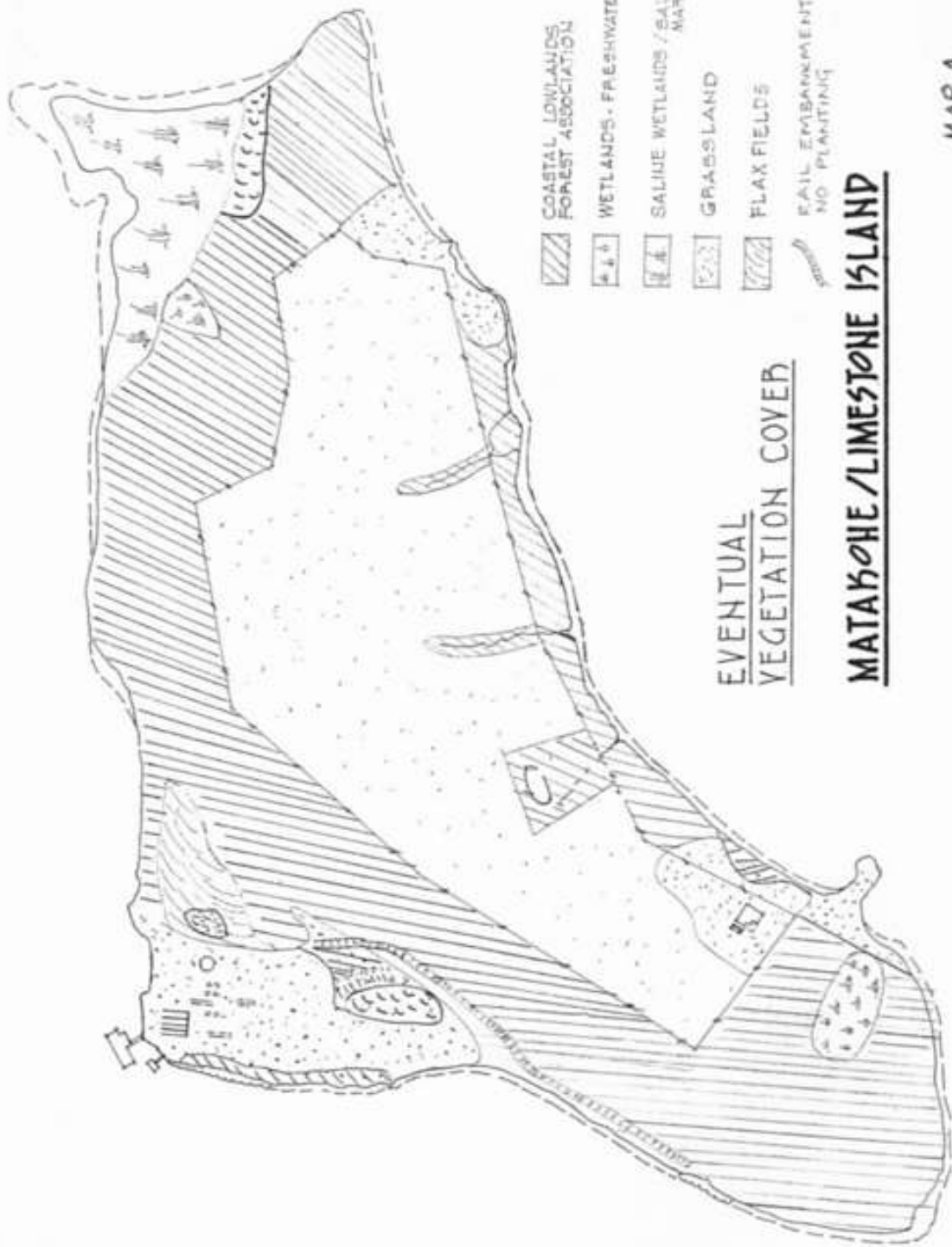
Kiekie (in sheltered areas), pohue\*, powhiwhi, rata\*, muehlenbeckia complexa\*, bush lawyer\*, shield fern, muehlenbeckia australis\*, rasp fern, Eastern Northland and Islands, pinatoro\*, hairy daphne, coastal tussock\*, coastal toetoe\*, rengarenga, shore astelia\*, harakeke\*, turutu, euphorbia glauca\*, Poor Knights lily.

##### **Notes for Area D:**

1. This area contains steep cliffs and the main quarry. These areas pose significant public safety hazards. These hazards can be reduced by undertaking plantings in such a manner so as to have the end result of creating a physical barrier between walking tracks and steep edges. Signs will also need to be installed at key points warning people of the dangers. These may need to include warnings that children under a certain age should be supervised by an adult at all times. Advice on the nature of signage should be obtained from the Whangarei District Council.
2. Suggested species for barrier plantings include coastal astelia, hebe, Poor Knights Lily, coprosma's, flax and muehlenbeckia. Low, dense growing species are favoured over taller species to provide views down into the quarry and out over the island. Professional advice from Whangarei District Council should be sought as to whether temporary fencing should be installed until such time as the barrier plantings become established.
3. Although all of the large wattle trees have been removed from the main quarry, seed will be present in the ground. All seedlings should be removed as they are found and the immediate area of the quarry also checked for signs of wattle spread.
4. Most of the coastal cliffs will naturally regenerate over time but the quarry faces will require planting. These present a particular challenge. Planting out small root trainer size plants of species listed above with an \* may be the best option as at this size they will be easy to fit into cracks and may survive better. Another method for establishing vegetation cover in these areas is hand seeding. Seed of species such as pohutukawa and rengarenga could be collected from around Whangarei harbour and spread around in the wetter months (around mid to late April).

This area also contains the site for the placing of a four-metre high limestone sculpture. The location is above the main quarry and is identified on Map 6. It is intended that the sculpture will be erected on the island later this year. Species to be planted in and around this area need to be low growing species that will not impede the view of the sculpture from the water. These could include hebes, grasses, sedges, turutu, muehlenbeckia and astelia. Existing planted species such as pohutukawa will need to be actively managed so as not to restrict views of the sculpture. Trimming should be undertaken in preference to removal.

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COASTAL LOWLANDS  
FOREST ASSOCIATION

WETLANDS - FRESHWATER

SALINE WETLANDS / SALT  
MARSH

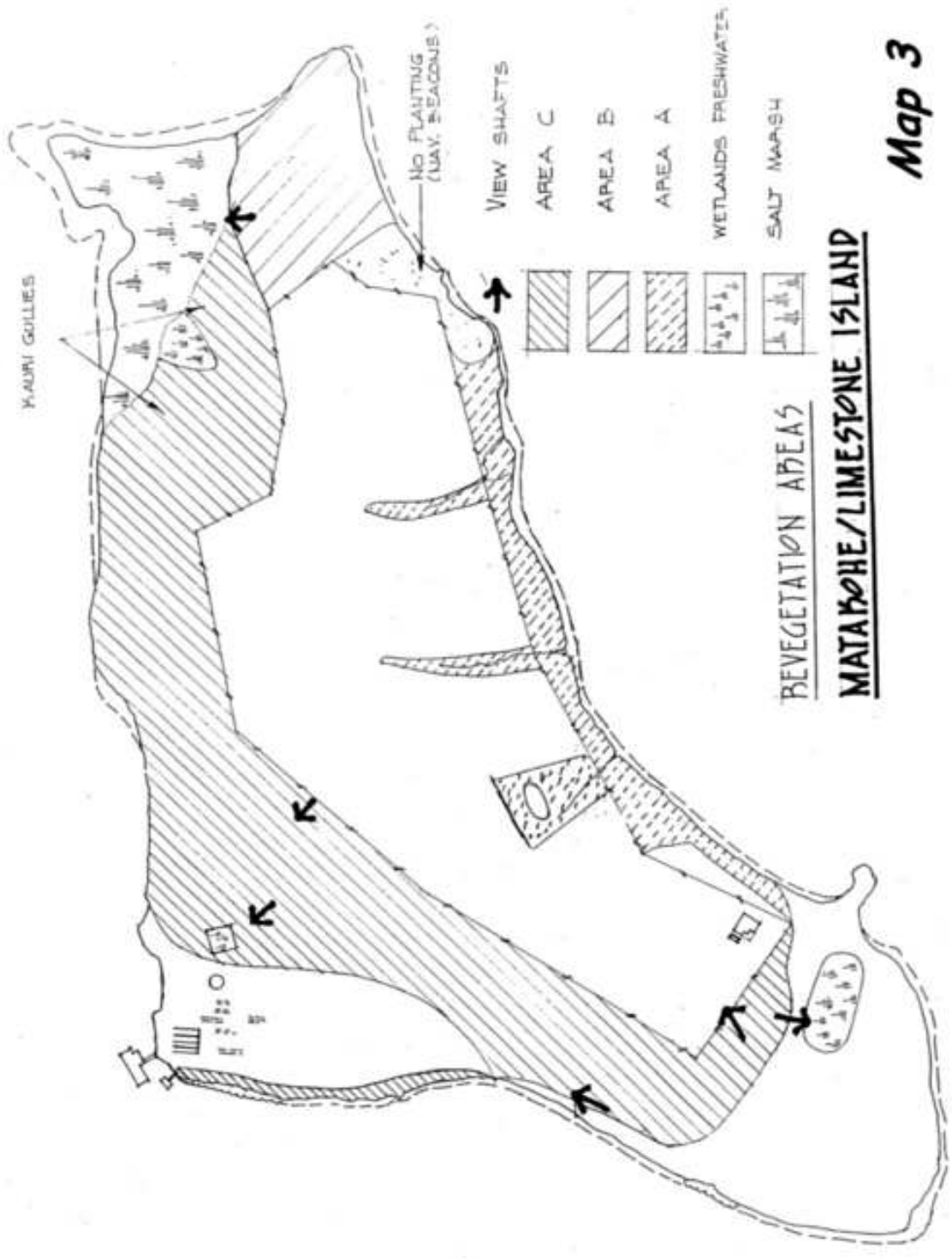
GRASSLAND

FLAX FIELDS

RAIL EMBANKMENT  
NO PLANTING

EVENTUAL  
VEGETATION COVER

MATAKOHE/LIMESTONE ISLAND



**MATAHŌHE/LIMESTONE ISLAND**

**Map 3**

## **5. Restoration of Other Vegetation Communities**

Restoring forest cover to Matakohe/Limestone Island is only part of the ecological sequence required on the island if it is to sustain a representative sample of plants and animals that may once have been present on the island. For example on Mana Island, Cook Strait giant weta have become abundant in rank pasture following the eradication of mice<sup>36</sup>.

Some of the bird species present on the island also reside in non-forest areas. These include banded rail, N.Z. dotterel and variable oystercatcher. A number of plant species on the island such as shore daphne and glasswort only exist in non-forest environments.

### **5.1 CURRENT SITUATION**

There are three non-forest communities presently on Matakohe/Limestone Island:

- The freshwater wetlands (being the artificially constructed waterbodies in the main quarry and at the limeworks ruins, the small wetland on the southern side, the stock dam, two ephemeral streams on the northern side and the pond behind the limeworks ruins);
- the open grasslands (presently including much of the southern and northern sides of the island);
- the saltmarsh on the southwestern end.

The wetlands and in particular, those in the Quarry (known locally as the "Six-pack wetland") are located in harsh environments. All but two of the Six-pack dry up in summer and also have to contend with pH values 8.4 as a result of being located in a limestone quarry with no topsoil. This open rocky area effectively bakes all but the hardiest of plants as it is exposed to the sun and also has minimal natural water. It is intended that as organic material builds up in the ponds over the years, the bottoms will start to seal and hold water for longer periods of time.

The stock dam on the northern side has an irregular water supply. It relies on winter runoff to fill and has no defined channel running into it. At present the dam has a major leak and as a result dried out completely in February 2000.

The pond behind the limeworks is almost entirely covered with raupo and provides habitat for a small colony of Australian bell frogs. An additional artificial wetland has been constructed at the northern end of the limeworks. This is vegetated with raupo and has the potential to provide good habitat for banded rail and spotless crane.

The saltmarsh on the southwestern side of the island already has a good number of species established. These include mangrove, batchelors button, zosteria (eelgrass), and saltmarsh ribbonwood.

The area of grassland is reducing in extent as the forest cover develops. The combined effects of natural regeneration and revegetation will continue this change over time. However the areas that contain the limeworks ruins and the Maori pa site and gardens will continue as grasslands. As well as having historic values these areas will also provide habitat for lizard and weta species and food sources for birds, which have seeds and insects as part of their diet. Natural regeneration needs to be actively discouraged in these areas.

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<sup>36</sup> Miskelly, 1999,p.27

## 5.2 RESTORATION AND MANAGEMENT OF WETLAND AND SALT MARSH COMMUNITIES

The species mix of wetlands is very dependant on physical parameters such as substrate type, water chemistry (salinity, pH, fertility), water depth, and timing and periodicity of submersion and exposure.

The area of the Six-pack wetlands, being located in the base of the quarry will continue to have high pH for many years until plants establish and soil and minerals start to accumulate. This area was once covered with wattle, which have subsequently been removed. Species considered suitable for planting in this area are marked in bold in Appendix 5 and could also include other hardy species such as coastal toetoe and astelia.

It is important to provide shelter around the edges of the ponds. This discourages the growth of algae and slimes in the ponds and also provides shade for any animal species that may be able to establish.

The saltmarsh provides a valuable nesting place for variable oystercatchers and New Zealand dotterel. Other than continuing to plant saltmarsh ribbonwood along the landward edges, it is recommended that this area be left to regenerate naturally.

The future of the stock dam needs to be decided. The recent decision by FOMLI<sup>37</sup> not to graze the island means that this dam is no longer required. Given the problems with holding water in the dam it may be better to let the dam dry out and plant the area up with flax, cabbage tree, kowhai, coprosma species and koromiko.

The pond at the back of the limeworks should be left to naturally evolve over time. As identified above (refer 4.6) it is recommended that the plateau where this pond is located be established as flax fields.

There are also two ephemeral watercourses, which run down to the coast in the large paddock on the northern side of the island. It is proposed that these be vegetated with flax, cabbage trees, kowhai, koromiko, coprosma species, ngaio, sedges and grasses to help stabilise the banks and break up the barren look of this area. The iwi representatives on FOMLI have endorsed this proposal.

These plantings will also provide valuable microhabitats for species such as lizards, flax weevils and weta. However as these areas runs through archaeological sites, approval will need to be gained from the local iwi. It may also require an Authority to Modify from the Historic Places Trust, as the sites are more than 100 years old.

## 5.3 MAINTAINING GRASSLANDS

It is intended that around 18 hectares of the island will be maintained as grasslands. This includes the following areas:

- the limeworks;
- around the Mine Managers house and the ranger's house;
- the pa and garden sites;
- around the navigation markers for harbour approach (refer Map 3).

Management of these areas will be as follows:

### Limeworks\*

- removal of weeds and other plants from within the structures
- mowing and scrub cutting around the structures and along access tracks

### Mine Manager's house and ranger's house

<sup>37</sup> FOMLI Minutes, March 2000

- removal of weeds (this includes oak seedlings)
- mowing of grassed area
- maintenance of the shelterbelt (presently dominated by macrocarpa)

#### Pa and Gardening Sites\*

- mowing and scrub cutting to maintain the present form of the pa
- planting of the two wet gullies in the garden site area (refer Map 3)
- eventual removal of the fence between this area and the coast
- natural regeneration of grass and native groundcover (predominantly muehlenbeckia) in the area of the garden sites

#### Navigation markers

- removal of any trees/shrubs which have the potential to block these markers or reduce their effectiveness
- maintenance of the area around the markers in grass and muehlenbeckia

\*Grazing of these two areas with cattle and sheep was also considered by FOMLI as a means of initial control of the grass. However after consideration of the advantages and disadvantages of using stock to control the grass in these areas, FOMLI have resolved that grazing is not a viable option in the short to medium term<sup>38</sup>.

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## **6. Threatened Plants**

Over 10% of New Zealand plants are recognised as being at risk<sup>39</sup>. Islands that are largely free of mammalian predators such as Matakohe/Limestone Island can act as important refuges for many of these species. Some rare plant species are more likely to survive on islands as a result of the lack of fungal diseases such as phytophthora, which makes it difficult for species such as the native gourd (*Sicyos australis*) to survive on the mainland.

An additional value of Matakohe/Limestone Island is its status as an open sanctuary. This provides opportunities to publicise the plight of threatened plant species to visitors.

There are two categories of threatened plants that could be introduced to Matakohe/Limestone Island:

### **Category One.**

This category contains those species that are indigenous to the Eastern Northland and Islands E.D. and are likely to survive on Matakohe/Limestone Island given its bioclimatic conditions and geology.

The following table of species has been recommended by Lisa Forrester (Department of Conservation, Northland Conservancy, botanist) as being most appropriate for introduction to Matakohe/Limestone Island.

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<sup>38</sup> FOMLI Minutes, March 2000

<sup>39</sup> Wilson and Given, 1989, p.1

**Table 2: Threatened Plants Recommended for Introduction to Matakohe/Limestone Island**

<b>Species</b>	<b>Common Name</b>	<b>Status</b>
<i>Clianthus puniceus</i> var. <i>puniceus</i>	Kowhai ngutukaka (kakabeak)	Presumed locally extinct
<i>Hebe speciosa</i>	Napuka	Endangered
<i>Juncus holoschoenus</i> var. <i>holoschoenus</i>	Angled Fruit Rush	Endangered
<i>Lepidium olearaceum</i> ss.	Cook's Scurvy Grass	Endangered
<i>Rorippa divaricata</i>	Watercress	Endangered
<i>Carmichaelia williamsii</i>	Coastal Tree Broom	Vulnerable
<i>Hibiscus diversifolius</i>	Hibiscus	Vulnerable
<i>Picris burbridgei</i>	Hawkweed	Vulnerable
<i>Senecio scaberulus</i>	Fireweed	Vulnerable
<i>Sicyos australis</i>	Native gourd	Vulnerable
<i>Hibiscus</i> aff. <i>trionum</i>	Bladder Hibiscus	Vulnerable
<i>Austrofestuca littoralis</i>	Sand Tussock	Declining
<i>Colensoa physaloides</i>	Bindweed	Declining
<i>Colensoa marginata</i>	Giant Pratia/Koru	Declining
<i>Euphorbia glauca</i>	NZ Sea Spurge	Declining
<i>Pimelea tomentosa</i>	Native daphne spp.	Declining
<i>Pellaea falcata</i>	Australian Cliff Brake (Fern)	Sparse
<i>Plectranthus parviflorus</i>	Cockspur	Sparse
<i>Senecio marotiri</i>	Shore groundsel	Sparse
<i>S. repangae</i> ssp. <i>Repangae</i>	Shore groundsel	Sparse
<i>Tetragonia tetragonioides</i>	New Zealand Spinach	Sparse
<i>Xeronema callistemon</i> f. <i>bracteosa</i>	Poor Knights Lily	Range restricted
<i>Streblus banksii</i>	Turepo/Large leaf milk tree	Recovering – conservation dependant

### **Category Two**

This category contains those species that are outside of this Ecological District. Introductions of these species are to be limited to one area of the island, which will be designated as a conservation garden. Selection of species to be introduced should meet the following criteria:

- they are species indigenous to the Northland Ecological Region;
- there is no danger of them hybridising or threatening other plant populations on the island;
- there are few other places for them to establish populations where there are no threats to their survival;
- they be introduced to an area of the island designated as a conservation garden (possibly the small quarry on the northern side).

Introductions of threatened species should be undertaken in conjunction with botanists from the Department of Conservation who will also be able to provide advice on the closest source population (or most endangered) and the timing (conditions required) of introductions.

Category Two species are listed separately as Appendix 17.

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## **7. Birds**

Deciding on what native bird species to attract and introduce to Matakohe/Limestone Island is integrally related to the Island's location, its intended vegetation communities, what bird species were likely to have originally been present on the Island and the ability to control the effects of predators on the island.

Limestone Island is also surrounded by a number of islands that are breeding grounds for a range of shorebird species. These include caspian and white-fronted terns, N.Z. dotterel and variable oystercatchers and possibly blue penguins. Dotterel and oystercatcher already breed on the island and it is hoped that, as habitat develops over time and predator numbers decrease (refer section 11), species such as the terns may also breed on the island.

Few records exist as to what species would have existed on the island. However if we assume that the island was originally covered with coastal lowland forest, a range of Northland bush bird species would have been present. These would have included tui, kereru, fantail, silvereve, grey warbler, morepork and possibly kiwi, saddleback and kaka. Shore or cliff nesting species such as kingfisher and petrels may also have been present.

Limestone Island has the potential to be a refuge for a number of native bird species that require habitats free of mammalian predators but this needs to be balanced against other conservation roles of the island such as the establishment of insect populations and populations of rare plants.

It is recommended that an annual avifauna survey be undertaken on the island. This will provide information on breeding success and also assist with determining when habitats are ready for particular species introductions.

### **7.1 CURRENT SITUATION**

A total of 44 bird species have been recorded in and around Matakohe/Limestone Island (refer Appendix 6 for species list). These observations include native and exotic species and have been compiled from N.Z. Wildlife Service surveys<sup>40</sup> and visual observations from Gerry Brackenbury (DoC Northland) and David Wright (Resident Ranger) between 1989-1999. Gerry Brackenbury has combined these observations into one species record. Of the 44 species recorded, 32 were native/indigenous or endemic species.

### **7.2 RE-ESTABLISHING NATIVE BIRD POPULATIONS**

There are two main ways native birds will come to the island – either by natural migration from the mainland and surrounding islands and through translocations or releases. In some instances some species may arrive through a combination of the two.

As stated above, the proximity of the mainland means that some species will naturally migrate to the island. As the forest cover develops and trees and shrubs mature and produce fruit and berries and grow large enough to provide nesting sites, other species will also migrate to the island. These include tui, bellbird and pigeon. This natural migration process can be artificially assisted through the planting of "flag" plant species such as karaka, puriri, karamu and flax. Birds will be initially attracted to the island to feed and over time will establish breeding populations. Some species, including those above as well as silvereve and fantails will come and go seasonally, following food sources from place to place.

Natural migration will also see the establishment of breeding populations of blackbirds and thrushes. Starlings already breed on the island. In the absence of native fructivores, blackbirds, thrushes and starlings will play a significant role in dispersing seeds of both native shrubs and weed species<sup>41</sup>. Kingfisher, pipit and pukeko are also present and it is likely that they have always been present on the island.

<sup>40</sup> Parrish, 1985

<sup>41</sup> Miskelly, 1999, p110

Other bird species such as blue penguins and petrels which are known to frequent the Whangarei Harbour and cliffs may be encouraged to breed on the island with the establishment of nesting boxes and artificial burrows. Six nesting boxes have already been established on the island for penguins. Nesting boxes can also be used for other species such as bellbirds, stitchbirds and saddlebacks.

There are a number of native species that could potentially be released onto the island. Care needs to be taken that species introduced do not hybridise with resident species, e.g. Poor Knights bellbirds are to be conserved solely on the Poor Knights as there is a high risk of hybridisation elsewhere<sup>42</sup>. All releases of native species onto the island will require legal approval from the Department of Conservation. Department staff can also provide advice on where species should be sourced from and when introductions will be able to occur. Local iwi will be consulted early in the process.

Suggested guidelines for assessing the merits of introducing animal (or plant) species to Matakohe/Limestone Island are attached as Appendix 7.

Wherever possible, species should be limited to those that would have naturally occurred in the types of habitats (Northland coastal lowland forest, scrub and cliff communities, and freshwater and saline wetlands) that are present and will eventually establish on Matakohe/Limestone Island. Departures from this limitation should only be undertaken in exceptional circumstances, which include:

- where there is no threat to the native plant and animal species present on the island; AND
- the release species either has nowhere else to be released; OR
- where the species is only coming to the island for a short period of time (i.e. being held until such time as its intended permanent release site becomes available).

Care also needs to be taken to ensure that there are sufficient natural resources on the island to sustain releases of native species when they occur. Primarily these relate to the availability of food species (plants and animals) at the right times of the year and the availability of suitable places for roosting and nesting that are not likely to be vulnerable to predators. The availability of year round water supply is also vital for most bird species.

The small size of the island also precludes the release of species such as kakapo, kokako and stitchbird – species that either have very specific feeding preferences or who require large areas of mature forest to maintain self-sustaining populations. The island's size also needs to be taken into account when considering the range of species that it can sustain. It makes sense to introduce a small range of species that are known to be able to survive in small areas rather than a wider range, which may include species that require larger areas and could potentially displace smaller less dominant species.

Introductions of species such as saddleback which are very hard on insect populations and weka which are known to prey on young and eggs of other native species such as kiwi, reptiles, invertebrates and sea birds need to be carefully considered. Small populations of these species may be able to be established when the forest biomass has built up to sufficient levels to sustain their feeding habits and all other species (including insects) are well established. It is recommended that weka not be established on Matakohe/Limestone Island and that efforts be concentrated on other species (see 7.5).

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<sup>42</sup> Miskelly, 1999, p.45

### 7.3 HABITAT CREATION

Six species of native birds and four species of exotic birds are currently breeding on Matakohe/Limestone Island. Of the six native species, three are shore or coastal birds (N.Z. dotterel, variable oystercatcher and kingfisher), two are small pasture/bush birds (silveryeye and pipit) with the other species being pukeko. Two additional native species may also be breeding. These are banded rail and grey warbler.

The fact that these species are breeding provides evidence that the island is already providing a range of suitable habitats for native and exotic birds to breed. Suitable habitat (as long as mustelid numbers are kept low) is also available for North Island brown kiwi planned for release in late 2000.

As the forest develops more species are likely to naturally migrate to the island and establish resident populations. These include fantail, tui, morepork and possibly bellbird, kakariki and kereru.

Releases of other species will not be possible until there is sufficient forest habitat to support them. This includes good year round supplies of fruits, flowers, seeds, nesting and roosting sites and insect populations. Species that fall into this category are kakariki, saddleback, robin, whitehead, stitchbird, bellbird, tui and kereru. Insect communities should therefore be allowed some lead in time to build in numbers prior to the release of these species. This is assuming mice have been eradicated from the island.

Due to the dry nature of the island the establishment of a system of small watering stations (refer Appendix 8) would be a worthwhile project to provide access to more regular water supplies.

However as stated previously the small size of the island may mean that some of these species may breed on the island but not remain on the island year round and may even establish populations on the mainland. These include bellbird and kereru.

The construction of artificial breeding aids for species such as kiwi, morepork, penguins and petrels will also assist with establishing suitable habitat. These include nesting boxes for penguins (a number of which are already on the island) and burrows for petrels.

### 7.4 ACTION PLAN

Assuming that the revegetation process is completed within the next 15-20 years, the forest cover continues to establish at present rates, mice are eradicated and other predators are kept at current levels or lower the following programme of introductions should be possible:

**Table 3: Programme of Native Bird Releases and Natural Migrations to Matakohe/Limestone Island**

Self sustaining population	Timing	Method <sup>43</sup>	Source/Comment
North Island Brown Kiwi	May 2000	Assisted	From Motuora Island, dependant on stoat numbers, close liaison with Operation Nest Egg
Blue Penguin	1999 ongoing	Natural	Nesting boxes installed, monitor stoat numbers
Tui	2001 ongoing	Natural	Continue planting favoured species

<sup>43</sup> Assisted = human assisted release, Natural = natural migration

**Table 3 (cont.)**

<b>Self sustaining population</b>	<b>Timing</b>	<b>Method<sup>44</sup></b>	<b>Source/Comment</b>
Spotless crane	< 5 years	Natural	Greater Whangarei Harbour
Takahe	< 5 years ?	Assisted	Takahe Recovery Group
North Island Robin	< 5 years	Assisted	After insect populations are at a level where they can sustain bird predation, rats need to be 0 or very low
North Island Tomtit	< 5 years	Assisted	After insect populations are at a level where they can sustain bird predation
Fernbird	5-10 years	Assisted and/or Natural	Small population at Takahiwai
Rifleman	5-10 years	Assisted	Present in Warawara Forest, Hokianga
Bellbird	5-10 years	Assisted and/or Natural	Continue planting favoured species, liaison with DoC over which subspecies and location of source birds
Kereru	5-10 years	Natural	Continue planting favoured species, may be closer to 10 years and may not stay all year round
Kakariki	5-10 years	Assisted	Continue planting favoured species, liaison with DoC over which subspecies and location of source birds, island may only hold 1 subspecies due to small size
Grey- Faced Petrel	5-10 years	Natural	Construction of burrows in cliffs between Onerahi – limeworks, use of call tapes, introduce chicks
Whitehead	10+ years	Assisted	After insect populations are at a level where they can sustain bird predation, rats need to be 0 or very low
Morepork	10+ years	Natural	May not stay all year round, mainly eat insects, some lizards and birds
Saddleback	15+ years	Assisted	After insect populations are at a level where they can sustain bird predation, rats need to be 0 or very low
Stitchbird	15+ years	Assisted	Continue planting favoured species, liaison with DoC over which subspecies and location of source birds, may not stay all year round

<sup>44</sup> Assisted = human assisted release, Natural = natural migration

## 7.5 RECREATING AN AVIFAUNAL COMMUNITY FOR MATAKOHE/LIMESTONE ISLAND<sup>45</sup>

It is considered that the following species should be released onto and/or where possible encouraged to naturally migrate and establish on Matakohe/Limestone Island:

### **North Island Brown Kiwi (*Apteryx australis mantelli*)**<sup>46</sup>

Sub fossil and Maori midden remains indicate that brown kiwi were widespread throughout mainland New Zealand in pre-European times. Since 1900, their range has contracted markedly and many populations have become fragmented and isolated, while others have become locally extinct. Many populations are not self-sustaining because adult mortality (from dogs, pigs, possum traps and natural causes) exceeds breeding productivity, which is low because possums, mustelids and cats eat eggs or young chicks.

Diet is mainly invertebrates but includes some fallen fruits and occasional leaves. Main prey species include earthworms, larvae of beetles, cicadas and moths, spiders, othopterans (wetas and crickets) and centipedes, with the proportions varying from place to place and with season. Most are taken from the soil, rotting logs or the surface.

Limestone Island has been identified as one of two trial sites to establish island creches for North Island brown kiwi chicks. As part of Operation Nest Egg the Department of Conservation plans to release sub-adults over 1200 grams onto the island. Birds of this size will be released due to the ease at which mustelids can get over to the island.

In recognition of the fact that one of the kiwi's main predators, the stoat, can easily swim across to the island, pre-release control work has been undertaken. This has included the maintenance of 30 fenn traps (in kiwi proof tunnels) and at least six months of stoat monitoring. To date one young female stoat has been trapped along with four weasels.

Providing the prerelease conditions are met the first release is planned for July/August 2000 when eight sub adults from Motuora Island will be introduced to Bream Head and two to Matakohe/Limestone Island<sup>47</sup>. However the timing of this release needs to be carefully considered if an aerial drop for mice eradication is approved (refer section 11.2).

Operation Nest Egg considers that there are a number of advantages with involving Matakohe/Limestone Island in this trial. These include its accessibility for monitoring, the potential to raise a larger number of chicks, the presence of the Resident Ranger. In addition the open nature of the island will make the capture of chicks easier using a combination nighttime spotting and daytime location with trained dogs. If this trial is successful, it is hoped that a small breeding population may be established to supplement the collection of eggs from the forests around the Whangarei area.

### **Grey-faced Petrel (*Pterodroma gouldi*)**

Also known as the Oi or northern muttonbird, mainland colonies of this species are declining from predation by rats, cats, dogs, mustelids and humans and some island populations have been ravaged by introduced predators or interference to breeding birds from rabbits. Many island populations however have benefited from the recent eradication of rats, cats and rabbits.

Diet is mainly squid, with some fish and crustaceans. Most prey is taken at night while sitting on the surface of the sea or dipping from the air.

Petrels may naturally come back to Matakohe/Limestone Island. However due to the time that this many take their return to the island could also be assisted. Burrows could be artificially established at Matakohe/Limestone Island along the cliff edges between Onerahi and the limeworks ruins. Chicks could be translocated from thriving populations. Call tapes may also

<sup>45</sup> Descriptions of species characteristics have been sourced from Heather and Robertson, 1996

<sup>46</sup> Information sourced from Colbourne

<sup>47</sup> Brackenbury G., (DoC Northland), pers. comms.

be used periodically to attract birds to the burrows at the beginning of the breeding season, which starts, with the return of the adults in March. Chick translocations would need to be done prior to the chicks orienting themselves to their environment, as they tend to return to their nesting burrows to breed. Oi are long-lived and it may take up to 7 years before they come back to breed.

**Red-Crowned Parakeet (*Cyanoramphus novaeselandiae*) and Yellow-Crowned Parakeet (*Cyanoramphus auriceps*)**

Parakeets or Kakariki were once widely distributed throughout the North and South Islands. The introduction of feral cats, ship rats and stoats lead to mainland populations becoming rare. They are particularly susceptible to mammalian predators (especially cats, stoats and ship rats) because they often feed on the ground and nest in holes close to the ground.

Favoured nesting areas also include holes in branches and trunks of trees, particularly dying trees, but they also use crevices in cliffs or among rocks, burrows in the ground or densely matted vegetation.

Kakariki are mainly herbivorous and their diet varies seasonally and includes seeds of many kinds (particularly flax, beech, sedges, grasses, tussocks and muehlenbeckia), fruits (particularly coprosma, ngaio and solanum), flower buds, flowers, nectar, leaves, shoots; also invertebrates and carrion. They often feed on the ground rather than in the canopy.

Kakariki may naturally establish on the island as the forest and scrublands develop. They could also be released onto the island from captive or wild populations. Captive populations of red crowned have been successfully liberated on Cuvier, Tiritiri Matangi and Whale Islands after the removal of their main predators.

Releases from wild populations would need to come from the east coast of Northland or its offshore islands as the birds would be feeding on the same sorts of foods found in Northland coastal lowland forests and scrublands.

Due to the small size of the island it would be unwise to release both red and yellow crowned kakariki as they are known to hybridise. Advice should be sought from the Department of Conservation as to which sub- species is most suitable for release onto Matakohe/Limestone Island.

However it has been suggested by Richard Parrish (DoC Northland) that because they are such strong fliers that it would be difficult to confine kakariki to the island. Furthermore he recommends that it would be best to let kakariki naturally establish rather than translocating them. Establishing feeding stations with sugar water may also be a useful way of encouraging birds to stay and/return to the island.

**North Island Saddleback (*Philesturnus rufusater*)**

The North Island saddleback or Tieke had similar distribution patterns throughout New Zealand as the kakariki. They declined during the 1800s after the spread of Norway rats and feral cats, and by 1870 they had largely gone from north of the Waikato.

The decline accelerated late in the century as ship rats and mustelids spread, and they had gone from the rest of the North Island and all but one offshore island by 1910. Since 1964, they have been successfully transferred to nine islands.

Diet is mainly invertebrates, but in season they also take a wider variety of fruits and nectar. They take invertebrates from the forest floor to the canopy. On the forest floor, they rummage in the litter and dig into rotting logs with their strong, chisel-shaped bills. On trunks and branches they examine crevices and look for insects. Their feeding is vigorous and noisy. Large insects such as wetas are held with one foot and pulled apart with the bill.

Limestone Island could be suitable habitat for saddlebacks once the forest has developed to a stage where there are tree holes, tree fern crowns and dense epiphytes and there is sufficient

variety of fruits and nectar. Their vigorous and thorough ground foraging habits combined with the high percentage of their diet that is invertebrates means that releases of saddlebacks to islands the size of Matakohe/Limestone Island need to be very carefully considered.

Releases should only be undertaken when sufficient self-sustaining populations of invertebrate's species have built up and sufficient ground cover is available for insects to hide in. It is therefore recommended that releases of insects be made a higher priority than the releases of saddlebacks and that saddleback releases not be considered for at least 10-15 years. This will allow insect species to expand and maintain self-sustaining populations and prove that the island can be largely maintained as predator free.

Sources of release birds could be from any of the northern islands including Little Barrier, Tiritiri Matangi and the Hen and Chickens.

#### **North Island Robin (*Petroica australis longpipes*)**

North Island Robin or Toutouwai like the kakariki and saddleback were also once found throughout the mainland. Apart from strong populations on Little Barrier and Kapiti Islands, they are now restricted to a band across the central North Island from Taranaki (but not Mt Taranaki) to the Bay of Plenty and Te Urewera National Park. In the 1990's they were successfully introduced to a number of other locations including Mokoia Island, Moturua Island and Wenderholm Regional Park.

Diet is mainly invertebrates, supplemented with small fruits in summer and autumn. Prey species include earthworms, spiders, amphipods, beetles, moths and caterpillars, weta, cicadas, stick insects, snails and slugs. Most are caught on the forest floor. Robins often perch on a low branch, supplejack or trunk of a sapling, scanning the ground before flying down to grab their prey.

Limestone Island will eventually be able to provide suitable habitat for North Island robin releases. Insect species would need to be allowed to build to self-sustaining levels prior to robin releases. Robins could conceivably be introduced much earlier than saddlebacks as they are less invasive in their predation of insects<sup>48</sup>. Robins are a good species for conservation advocacy as they can often be found on tracks and track edges or down on the forest floor and can be induced to come near by clearing a patch of leaf litter and then sitting quietly by.

#### **Tomtit (*Petroica macrocephala*)**

Tomtit also known as Pied Tit has five subspecies. It is toitoi or the North Island tomtit that could potentially be released at Matakohe/Limestone Island. Toitoi are widespread and locally common from Kaitaia to Cape Palliser, although they are rare between Whangarei and the southern Waikato and in a number of other areas. Moderate numbers are found on a number of offshore islands including the Hen and Chickens and Little Barrier.

Tomtits are found in mature native forest, especially open beech forest, in second growth manuka/kanuka scrub and can also be found in older stands of exotic plantations. Diet is mainly invertebrates supplemented with small fruits in autumn and winter. Main prey species taken are spiders, beetles, caterpillars, moths, wetas, earthworms, flies and wasps.

#### **Whitehead (*Mohoua albicilla*)**

Whitehead or Popokatea are another species with limited distribution. Widespread at the time of European settlement they are now widely but patchily distributed in native forests, some older exotic plantations and older stands of scrub on the mainland south of a line from Te Aroha to Mt Pirongia. They remain abundant on Little Barrier and Kapiti Islands and have been successfully introduced to Tiritiri Matangi and Mokoia Islands.

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<sup>48</sup> Parrish, R.; (DoC Northland), comments on draft plan, Feb 2000

Diet is mainly invertebrates but includes some fruit. Prey species include spiders, beetles, caterpillars and moths, gleaned from leaves, twigs and branches in the canopy and understorey. They feed on invertebrates dislodged by other feeding birds, and occasionally on insects under loose bark on trunks and large branches. They rarely feed on the ground and also eat some fruit of native shrubs, especially mahoe, matipo, coprosma and hangehange.

Limestone Island would provide suitable habitat for whiteheads within the next 5-10 years. As with other species, pre-planning work would need to include establishing a good variety of food sources and ensuring that insect populations were at a level where they could remain self sustaining in the presence of avian prey species. Birds could possibly be sourced from Little Barrier or Tiritiri Matangi Island.

**Bellbird (*Anthorinis melanura*)**

Bellbird or Korimako are present and often common in forest and scrub areas on the North, South, Stewart, Auckland Islands and many offshore islands. There are four sub species, two of which are confined to Northland. *A.M.obscura* is confined to the Three Kings and *oneho* only breeds on the Poor Knights but occasionally visits the nearby mainland of eastern Northland as do birds from the Hen and Chickens and Little Barrier Islands.

Diet is mainly nectar from many native and introduced plants, and in late summer and autumn, when flowers are not common they take fruit. They also eat many insects and spiders by gleaning trunks, branches and leaves, also by hawking. Females take more insects and less nectar than males. The chicks are almost entirely fed insects.

Bellbirds may naturally colonise Matakohe/Limestone Island if there are mainland populations within close proximity to the island. In winter, males have been recorded flying to eastern Northland, e.g. to Tutukaka from the Poor Knights and from the Hen and Chickens to Whangarei Heads. However females seldom fly to the mainland, and so Bellbirds have not re-established.

Like kakariki, bellbirds could establish themselves within the next 5-10 years as the forest matures. The planting of flag species such as *Pittosporum umbellatum*, puriri, flax and kowhai and the establishment of pohutukawa will also assist with attracting bellbird to the island. The establishment of feeding stations as previously mentioned with kakariki may also be useful here. The existence of predators does not appear to be as much of an issue with bellbirds as they survive elsewhere in the presence of mammalian predators.

**Stitchbird (*Notiomystis cincta*)**

Also known as hihi, stitchbird are a relative of the tui and bellbird. Once widespread throughout the North Island (they have never been reported in the South Island) and on offshore islands such as Great Barrier, Little Barrier and Kapiti they declined rapidly in the later 1800's and by 1885 had vanished from the mainland. It is likely that this decline was due to a combination of avian disease and the spread of tree climbing ship rats, stoats and feral cats.

Diet is a wide variety of nectar and fruits whenever available, also invertebrates gleaned from foliage or bark. Normally whenever tui and bellbird are present, stitchbirds tend to feed in the lower strata of the forest, taking low-grade sources of nectar; however when nectar is abundant they feed in the canopy with the other two honeyeaters. *Pittosporum umbellatum* is a particular favourite of stitchbird.

Limestone Island could potentially be a suitable habitat for a small population of stitchbird. Management aims with the stitchbird recovery programme are to establish self- sustaining populations on several islands, in case ship rats or stoats get to Little Barrier.

However because stitchbirds often travel several kilometres in a day between good feeding sites and competition which may exist on a small island like Matakohe/Limestone with bellbird and tui, stitchbird releases if feasible are likely to be at least 15-20 (if ever) years away. The forest on the island would need to establish to a stage where suitable nest holes and food plants were available. Preplanning work should also involve liaison with mainland landowners in the range of flight for stitchbirds regarding provision of food species and habitat.

The need to provide enough variety of nectar and fruit producing plants, especially in the presence of the more aggressive tui and bellbird who dominate the best nectar and fruit sources has been identified as the main reason why many other island releases have not been successful. Source populations for releases could come from Little Barrier Island.

### **Tui (*Prothemadera novaeseelandiae*)**

The tui, New Zealand's most well known honeyeater remains widespread throughout the mainland of the North and South Islands and is also present on many offshore islands. Tui are mainly forest and scrub birds, however outside the breeding season they become partially nomadic and travel to towns and rural gardens in search of good sources of nectar or fruit.

Preferred diet is nectar, supplemented with fruit and invertebrates. When breeding, they often commute 10+ km in a day to visit a prime nectar source, such as a stand of kowhai, fuchsia, rewarewa, flax, pohutukawa or rata. Outside of the breeding season, they will shift 20+ km away to gain regular access to winter flowering species including gum, puriri, kowhai or kahikatea fruit. Insects are also taken during breeding season and include stick insects, cicadas and other large insects. Nestlings are raised initially on a diet of small berries and nectar, and later also on berries and larger insects, spiders and moths.

Tui will naturally migrate to Matakohe/Limestone Island as the forest develops. Enough food exists now from species such as flax, coprosma, pohutukawa and puriri and it is possible that with the increasing development of forest cover that tui may become resident on the island within the next 5 years. Continued planting of flag species such as flax, rata, pohutukawa and puriri at points on the island visible from the mainland may assist with this natural migration process.

### **New Zealand Pigeon (*Hemiphaga novaeseelandiae*)**

The kereru or kukupa as it is often referred to in Northland is most common in Northland, the King Country, Nelson and the West Coast. Kereru favour native lowland forest dominated by podocarps, tawa, taraire and puriri, bush patches on farmland, gardens, and parks of cities. Outside the breeding season birds move long distances to good sources of fruit or foliage.

Although still widespread and locally common, kukupa are now threatened because in many places adult mortality (from illegal hunting, predation, starvation) exceeds breeding productivity, which is low because of loss of eggs and chicks to rats, stoats and possums. Competition for fruit by possums may also reduce breeding attempts.

Kukupua are exclusively herbivorous. Fruits are preferred and in some parts of the country form the total diet. Preferred fruits are miro, tawa, taraire, puriri and pigeonwood; other main fruits are of kahikatea, coprosma, titoki, nikau, karaka, privet, elder and plums. Supplejack and cabbage tree fruits are also eaten but are less preferred. When fruit is in short supply, kereru will eat foliage, especially old leaves of kowhai, tree lucerne, broom and clover, leaves of coprosma, houhere and *Parsonia*. Flowers of kowhai, tree lucerne and broom also form an important seasonal part of kereru diet.

Kukupua like tui will naturally establish on Matakohe/Limestone Island over time. Continued planting of species they prefer will help to encourage kukupa to the island. Natural regeneration is considerably enhanced in the presence of kukupa they play a key ecological role by dispersing the seeds of large fruited trees and shrubs, some of which (e.g. miro, tawa, taraire, puriri and karaka) are too large to be dispersed by other birds.

Ensuring that there is an adequate ongoing food supply for kukupa is also important for their reproduction. The timing of breeding is closely linked to certain fruits being available, they can lay at any time of the year, but also some or all pairs fail to breed in years when fruit is in poor supply. Providing a wide range of plant species that fruit and flower at different times of the year will assist with encouraging kukupa to visit the island.

Kukupua may not establish on the island for some time and the small size of island combined with low adult population numbers on the mainland may mean that kereru do not become resident on the island.

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## 7.6 MANAGING OTHER BIRD SPECIES ON AND AROUND MATAKOHE/ LIMESTONE ISLAND

These are species that are already found on and around Matakohe/Limestone Island. They fall into three main categories:

- Waders and seabirds, e.g. Godwit, terns, knot and spoonbill;
- Pasture birds and small passerines, e.g. paradise shelduck, skylark, goldfinch and house sparrow;
- Birds that pose a threat to native bird species, e.g. harrier, myna, shining cuckoo, black-backed gull, spur winged plover and starling.

Some of these species are playing an active role in the restoration programme. These include blackbird, song thrush and starling, which can play a major role in dispersing seeds of native shrubs (and weeds) in the absence of native fructivores<sup>49</sup>.

Populations of birds in the third category need to be closely monitored. Some species such as harrier only have the potential to cause problems when forest cover is minimal or when shore birds chicks are mobile.

Black-backed gull populations need to be actively monitored and advice sought from the Department of Conservation if they become a threat to species on Matakohe/Limestone Island (refer section 11.2). Black-backed gulls are known predators of shorebird eggs and chicks.

The use of nesting boxes needs to be carefully managed. They should be checked on a regular basis during breeding season for eggs of myna and starling. Their eggs should be removed and destroyed. Careful design of nesting boxes will also minimise predation by these species. Nest boxes with 42mm entrance holes will stop myna's from entering. Care needs to be taken not to have a protrusion out the front of the box that would allow a myna to hang/perch on and peck the nestlings<sup>50</sup>.

The arrival of new species needs to be recorded and information gained from the Department of Conservation on the level of threat posed to native species. Magpies in particular should be actively discouraged from establishing on the island. Another species to keep a look out for are rooks, which have been reported recently in Northland.

As most species of exotic birds in the latter two categories are extremely mobile, they will continue to grow in numbers and recolonise even if the local population dies out or is eradicated. The high costs of attempting to control large populations of most species of introduced birds are not justified by the small conservation gains that would be achieved<sup>51</sup>.

It is important that the Department of Conservation is consulted prior to any control work as there may be alternative measures that could be undertaken and control will often require a permit under the Wildlife Act.

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<sup>49</sup> Miskelly, 1999, p.110

<sup>50</sup> McGlynn M. (Freshwater Consultant), pers. comms.

<sup>51</sup> Adapted from Miskelly, 1999, p.71

## 8. Reptiles

New Zealand reptiles are represented by 2 species of tuatara and the lizards (at least 29 gecko species and 30 skinks). Populations of many New Zealand lizard have shrunk with the lowland forests. All lizard species and tuatara are at risk from introduced predators such as rats, mice stoats, ferrets, cats and even wild pigs. Once abundant on the mainland, about 40% of New Zealand's lizard species and the two tuatara species are now confined to small predator-free islands<sup>52</sup>.

### Tuatara

Tuatara survive on about 30 rat free islands. The southern species is limited to a small island in Cook Strait while the common tuataras (*Sphenodon punctatus*) are divided into a Cook Strait sub-species and a Northern sub-species, the latter located on islands in the Bay of Plenty and the Hauraki Gulf (e.g. Little Barrier, Hen and Chickens)<sup>53</sup>.

### Lizards

New Zealand lizards are divided into geckos and skinks.

### Geckos<sup>54</sup>

Geckos fall into two groups: the grey-brown *Hoplodactylus* genus and the green *Naultinus*. *Hoplodactylus* are night-time hunters, numbering 22 species. By contrast the seven species of *Naultinus* are active by day. Geckos eat mainly invertebrates, but also carrion, nectar and berries. They are plant pollinators and seed dispersers, with flax and pohutakawa their favourite source of pollen. These are particularly valuable roles in small locations such as Matakohe/Limestone Island.

### Skinks<sup>55</sup>

There are two groups of skink: the *Oligosoma* skinks have pointed heads, long toes, are active during the day (except the egg-laying skink) and enjoy resting in the sun. *Cyclodina* have blunter heads, shorter toes, most are active at night and prefer shaded areas.

Due to the small size of Matakohe/Limestone Island, its highly modified nature and the timelag for good forest cover to establish for releases of bird species it is proposed that efforts be concentrated into creating a refuge for endangered northern reptiles and insects. If this is accepted some bird species such as saddleback may not be suitable species to establish on the island. Other bird species that have a high percentage of reptiles or other insects in their diet may need to have their releases delayed until there are sufficient self-sustaining populations of reptiles and insects.

Some reptile species such as Duvaucel's gecko have a reasonable percentage of small lizards and large invertebrates in their diet. The introduction of these lizard species needs to be carefully considered.

## 8.1 CURRENT SITUATION

Limestone Island already provides some habitat for lizard species. This includes the cracks and fissures in the limestone works ruins and coastal cliffs and the presence of large patches of dense ground cover plants such as muehlenbeckia. Rocks along the coast, fruiting and nectar producing plants, clumps of flax and the development of mulch, leaf litter and rotten logs in bush areas also provide good habitat opportunities.

An invertebrate survey undertaken in the spring of 1996 by Northland Polytechnic students found that only copper skinks were present on the island in small numbers. Twelve months

<sup>52</sup> Ministry for the Environment 1997,p.9.100

<sup>53</sup> Ministry for the Environment 1997,p.9.113

<sup>54</sup> Hutchings, 1998, pp.205-206

<sup>55</sup> Hutchings, 1998, p.206

after the removals of rats, a subsequent pit fall trap survey undertaken by Gerry Brackenbury recorded an increase in copper skinks.

## 8.2 HABITAT CREATION

Even though the regeneration of Matakohe/Limestone Island is in its early stages, the habitat for lizards is very good. Copper skinks were able to survive in the presence of cats and rats and their numbers have been increasing since the eradication of both of these predator species. The island by definition has many good areas of limestone rock piles and areas of flax and grass<sup>56</sup>. Natural succession and revegetation will continue to improve habitat potential for forest species over time. Areas of rock piles should be supplemented with plantings of species such as flax, rata, pohutukawa, mahoe, muehlenbeckia and coprosma. Some areas of rock piles should also be left unshaded to provide a range of habitats.

It is crucial that the predator control programme continues. Some species of lizards are rat and mice sensitive and this provides further justification for the continued control of rats coming onto the island and for the eradication of mice. Perhaps more important is that the Department of Conservation<sup>57</sup> is unlikely to approve releases of rarer lizard species while mice are still present on the island.

Although lizards only comprise a small part of mouse diet (some 6% by volume)<sup>58</sup>, new releases and particularly ground dwelling species as opposed to tree dwelling species (because of their low numbers and the high numbers of mice) may be vulnerable to predation. Competition from mice for certain types of food is probably more of a problem. This would be particularly valid for a small island like Matakohe/Limestone Island with high mouse numbers.

Large *Cyclodina* skinks are extremely vulnerable to mammalian predators, and the current distribution of robust, McGregor's and Whitaker's skinks probably reflects sites at which they were able to escape predation either through the absence of mammals or unusual features of their habitat that provided protection from predators<sup>59</sup>. The continuing development of hiding places such as muehlenbeckia mounds will assist with this at Matakohe/Limestone Island. Since the removal of stock from the island, muehlenbeckia has recovered dramatically.

## 8.3 REPTILE SPECIES SUITABLE FOR RELEASE

### **Tuatara**

Tuatara are predators of other reptiles and large invertebrates, and so if tuatara are released onto Matakohe/Limestone Island, liberation's need to be done in a manner which ensures that they do not jeopardise other native species on the island.

It is recommended that efforts be concentrated on lizard and invertebrate species due to the small size of the island and the predatory nature of tuatara. Richard Parrish from the Department of Conservation has suggested that the effects of tuatara on the island could be minimised by maintaining small populations in open-air enclosures. It is recommended that this be further researched by FOMLI. Indications are that a Lotteries Environment and Heritage Grant may be a useful funding source<sup>60</sup>.

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<sup>56</sup> Brackenbury and Ott, 1997, p.3

<sup>57</sup> Brackenbury, pers comms.

<sup>58</sup> King 1998, p.230

<sup>59</sup> Miskelly, 1999, p.83

<sup>60</sup> Craw J., (ex FOMLI cmte), pers. comms.

**Lizards**

Determining which lizard species to release onto Matakohe/Limestone Island is related to the following factors:

- availability of habitat (including the ability to spatially segregate species);
- presence of predators;
- existing species present on the island;
- whether the species to be released are species that are now or would have originally been present in this part of Northland.

**Table 4: Reptile Species to be Considered for Release onto Matakohe/Limestone Island<sup>61</sup>**

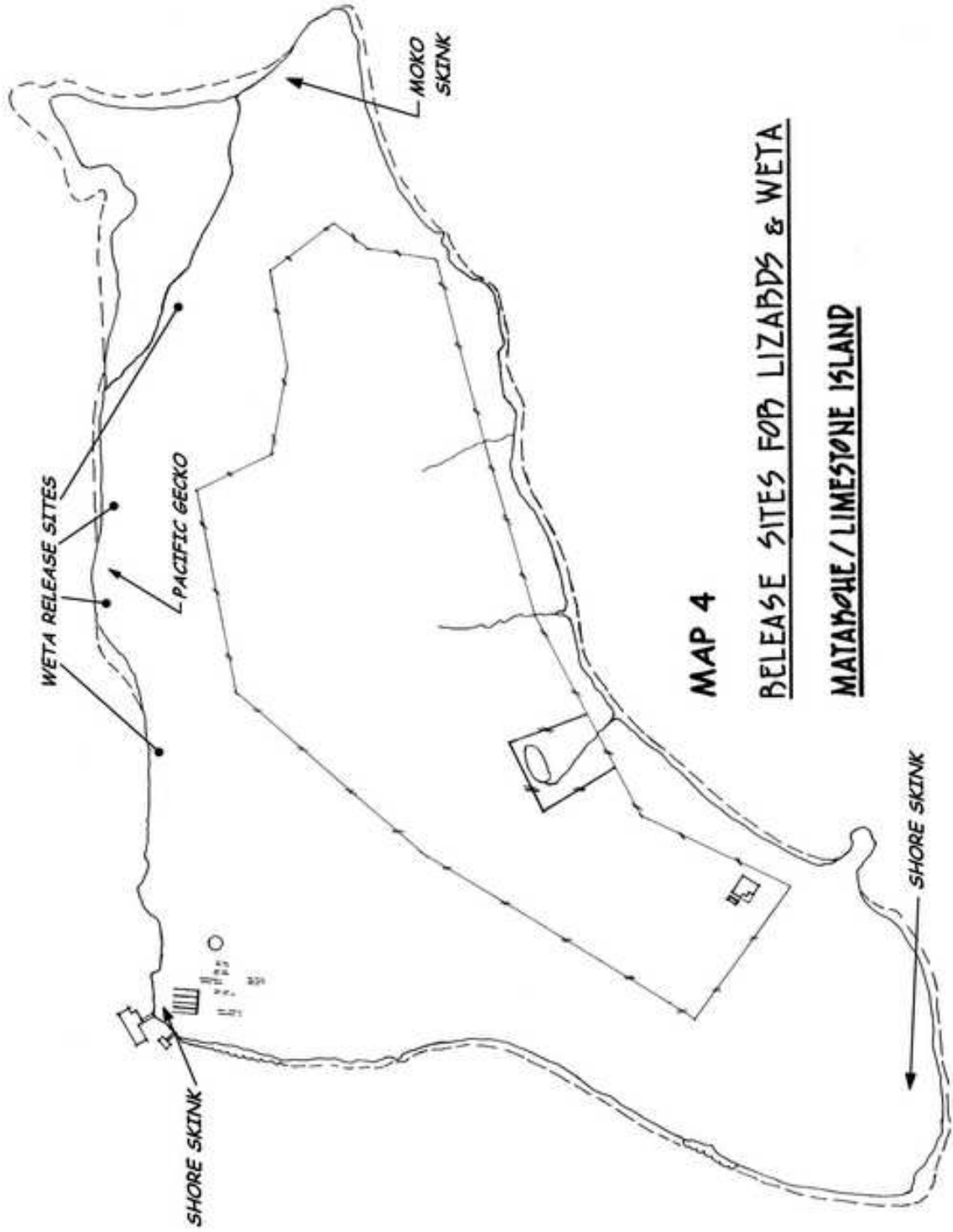
Species	Timing	Source	Release sites (refer Map 4)
<i>O. moco</i> Moko skink #	2001*	Whetupuke Island	dense low cover such as 5-10 yr old plantings, regenerating bush, shrublands. Good habitat exists now in flax/grass
<i>H. pacificus</i> Pacific gecko #	2001*	Lady Alice rockstacks/ Muriwhenua Island	Cliffs and ruins, coastal margins (preferred), established plantings, need spatial separation from common gecko
<i>O. smithi</i> Shore skink #	2001*	Northland mainland	Shoreline with available cover (including tidal detritus and dense grass), driftwood. Good habitat exists now
<i>C. ornata</i> Ornate skink #	*	Northland mainland	Oldest plantings, ponga logs useful for ground cover, requires a stable thermal environment, establishment of this species should indicate likelihood of marbled skink releases
<i>H. maculatus</i> Common gecko #	*	Northland offshore islands	Cliffs and ruins, coastal margins, established heavily vegetated plantings (preferred), need spatial separation from pacific gecko
<i>N. elegans</i> Auckland green gecko @	*	Northland mainland	Needs well established forest and good regeneration or dense low coprosma and muehlenbeckia mounds for shade and shelter, large areas of kanuka/manuka also provide suitable habitat
<i>O. suteri</i> Egg laying skink @	*	Northland offshore islands	??

\* denotes that exact release times are to be determined in consultation with Department of Conservation staff. Target release dates are dependent on a variety of factors including predator levels, available food supplies and the availability of suitable habitat.

Species in Table 4 have been divided into two categories (delineated by # or @). If a selection of species in these two categories were to be introduced to Matakohe/Limestone Island, this would provide a broadly representative sample of northern New Zealand lizard diversity, with:

- All four currently recognised genera represented;
- A range of coastal, grassland and forest species represented;
- Diurnal and nocturnal species represented.

<sup>61</sup> Information in table from Gorman, 1999 and reviewed by Parrish, March 2000



MAP 4

RELEASE SITES FOR LIZARDS & WETA

MATAKŌHE / LIMESTONE ISLAND

The following lizard species are not considered suitable for introduction onto Matakohe/Limestone Island, either because of the risk of population extinction following mammalian predator reinvasion, or due to the lack of suitable habitat:

Robust skink (*C. alani*)  
McGregor's skink (*C. macgregori*)  
Chevron skink (*O. homalonotum*)  
Striped Skink (*O. striatum*)  
Forest gecko (*H. granulatus*) –some habitat will exist but niche can be filled by other nocturnal geckos.

A proposal to transfer lizards to Matakohe/Limestone Island from Lady Alice Island (Hen and Chickens) and the Northland Mainland was prepared by Brackenbury and Ott<sup>62</sup> in January 1997. This proposal is dependent on the removal of mice from the island.

The proposal requested releases of the following species:

- Moko skink (*Oligosoma moco*), which is very rare on the mainland, but is reasonably common on the Hen and Chickens;
- Pacific Gecko (*Hoplodactylus pacificus*) uncommon on the mainland but common on rat-free islets in the Hen and Chickens group;
- Shore skink (*Ologosoma smithi*) which is still present in scattered localities on the mainland.

It is anticipated that this release may be able to occur in 2001.

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## 9. Other Vertebrates

Bats and frogs represent other native vertebrate species. None of these species are considered suitable for release onto Matakohe/Limestone Island. While there is thought to be no suitable habitat on the island for freshwater fish, further investigation/research may show otherwise (see 9.1 below)

### 9.1 CURRENT SITUATION

Other than the species identified in section 8 above, no native vertebrate species have been recorded on Matakohe/Limestone Island. This is due to the highly modified environment and the lack of good permanent wetlands and areas of freshwater including streams and ponds. The constructed ponds in the old quarry ('six-pack') have a high pH. Readings taken in December 1999 recorded pH values of 8.4. Most New Zealand fish and frog species can only survive where pH values are much lower. Mudfish for example are commonly found in water bodies where the pH is 4.0-6.5<sup>63</sup>. Vince Kerr of the Northland Polytechnic is researching habitat requirements of mudfish which, on investigation, might be found in Gerry's Folly (wetland by Singlemen's quarters).

The remaining two water bodies are either almost entirely filled in by deep mud and raupo (the pond above/behind the limeworks ruins) or do not have regular water levels (the stock dam). In addition even if the ponds in the quarry were suitable for fish, their depth and size would severely restrict what species could be established. There are no permanent streams on the island.

Continued planting around the ponds in the quarry may reduce the pH content and provide shade in the long term but due to the lack of topsoil and the depth of the quarry this is unlikely. A visit to the island with Mike McGlynn a Northland based freshwater fauna consultant in December 1999, confirms this opinion.

An introduced species of frog, the Golden Bell frog (*Litoria raniformis*) is known to be present in the quarry ponds. Children from Onerahi have probably released this species. Further

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<sup>62</sup> Department of Conservation, Northland Conservancy

<sup>63</sup> McGlynn, pers. comms.

informal releases of this species should be discouraged although they do provide a food source for some bird species such as white-faced heron. The existing population is not considered to be a threat to the restoration of the island and is worth maintaining as there are very few populations of frogs on the mainland and *Litoria* is becoming an endangered species in its native Australia<sup>64</sup>.

## 9.2 POTENTIAL FOR THE RELEASE OF OTHER VERTEBRATE SPECIES

For the reasons stated above Matakohe/Limestone Island is generally not considered suitable habitat for native freshwater fish and frogs in the medium to long term unless specific artificial habitat in the form of wetlands were created. These would need to have permanent water and pH values that are low enough to sustain landlocked species. Suitable habitat for bats will not be suitable for many decades, as bats require many old hollow trees or trees with loose bark as roost sites<sup>65</sup>.

Mike McGlynn has advised that it would be worthwhile monitoring the wetlands for a 2-3 year period to determine how well they are able to hold water. Inanga (*Galaxias maculatus*) could be a possible fish species in the future if water was more permanent. Introductions of other fish species will only be possible if there is a significant lowering of pH levels.

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## 10. Invertebrates

There are estimated to be 20,000 different species of insects in New Zealand. Of these half are estimated to be beetles with about 5,000 of these being weevils. Of the 20,000 only about half are actually described, i.e. have names. Greater than 90% of our insect fauna is endemic<sup>66</sup> to New Zealand. Habitat destruction and predation are the two major causes of loss of invertebrate species.

Habitat destruction has occurred mainly through the effects of pastoral farming and particularly in relation to the loss of lowland forest and freshwater wetlands. Habitat for invertebrates can be affected in many ways other than complete removal. Stock grazing in forest areas reduces plant diversity and decimates invertebrates in the litter layer. Forest remnants, which appear healthy from above, can be virtual deserts for invertebrates within them.

Insects have also suffered loss through the combined effects of mammalian predators, including mice, rats, mustelids and cats. Mice and kiore are voracious predators of virtually any insect that is big enough for them to see and grab hold of. In addition a range of introduced insect predators, including wasps and ants are also having an effect on our native invertebrates. There are also a number of exotic bird species, which take large numbers of native insects<sup>67</sup>.

Conservation management of invertebrates is severely constrained by both the enormous number of species involved, and the lack of taxonomic, distributional and ecological information compared to vertebrates and vascular flora<sup>68</sup>. Most invertebrate conservation effort has been at a community level, focusing on preserving habitat and reducing the impacts of introduced mammals<sup>69</sup>. Management of invertebrate communities is obviously preferable to a single-species approach, as a suite of species with similar needs can be conserved. Resources spent on habitat protection will conserve far more genotypes than we could ever hope to monitor<sup>70</sup>.

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<sup>64</sup> Brackenbury pers. comms.

<sup>65</sup> Adapted from Miskelly, 1999, p.97

<sup>66</sup> found only in New Zealand

<sup>67</sup> Green, 1995, pp. 1-2

<sup>68</sup> Miskelly, 1999, p.99

<sup>69</sup> Duncan & Johns 1989; Barrat 1994 in Miskelly, 1999, p.99

<sup>70</sup> Hutcheson 1994 in Miskelly, 1999, p.99

## 10.1 CURRENT SITUATION

The extensive modification of the island combined with the relatively small areas of native bush and the effects of predators restricts the range and numbers of species that could potentially be present on the island. The continued presence of mice on the island will also severely limit the potential of the island to both sustain existing invertebrate populations as well as releases of new populations.

One comprehensive invertebrate survey has been undertaken on Matakohe/Limestone Island to date. This was undertaken by two Northland Polytechnic students over a two month period in the spring of 1996 and again in 1997. They trapped 6100 insects in 1996 and 4250 in 1997 (refer Appendix 9 for species list). Dominant taxa were *Amphipoda* (e.g. litter hoppers), *Opiliones* (harvestmen), *Isopoda* (slaters) with a higher number of taxa found on south facing slopes. As this study only used pitfall traps some taxa may not be well represented.

The Department of Conservation has also undertaken a smaller more concentrated survey looking for weta. This survey found no tree weta present but did find a species of cave weta which is presently being identified by Department of Conservation staff. During the survey a number of small species of native land snails were found by Dr Fred Brooks<sup>71</sup>.

## 10.2 RESTORING INVERTEBRATE COMMUNITIES

The potential exists in the future to restore a diverse range of invertebrate communities to Matakohe/Limestone Island. However while mice are present this potential is reduced considerably. A mouse plague on Mana Island in 1989 recorded that 75% of mouse diet was insects, which would otherwise be eaten by birds. If mice were eradicated from the island it would be at least two years before releases of rarer or predator sensitive insect species could be released.<sup>72</sup>

The revegetation programme can also assist with the establishment of suitable habitat for invertebrates. As more and more trees are planted the forest cover will extend over a wider area of the island and so increasing the types of habitat available. In addition specific areas can be planted with species that provide good cover and food such as flax and coprosma.

Land snails are a particularly important part of a diverse invertebrate community. Large numbers of small land snails inhabit any patch of unfired native vegetation in New Zealand. They live in a wide range of habitats: the forest litter, under bark on logs or living trees, in the cavities between loosely packed boulders and on the foliage of understorey plants in the forests<sup>73</sup>. The planned establishment of flax fields around the raupo wetland above the limeworks will provide excellent habitat for snail species.

Invertebrate species considered suitable for the island include flax weevil, stag beetle, darkling beetles (*Mimopeus* spp.), millipedes, giant centipede (*Cormacephalus rubriceps*), tree weta, tusked weta and giant weta and flax and/or kauri snails. Advice received from Department of Conservation entomologist, Chris Green (Auckland Conservancy) is that most of these species need a mouse-free environment.

A number of the species listed also have a number of sub-species and it is important to get advice from the Department of Conservation as to which sub-species is the most appropriate to release on the island as well as when suitable habitats have established on the island. For example the Northland tusked weta appears to be arboreal, often on kanuka, and will need good sized trees but may not do so well in competition with ordinary tree weta. Similarly the giant wetapunga from Little Barrier Island require mature forest which will take a long time<sup>74</sup> (15-10 years or more to develop).

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<sup>71</sup> Brackenbury, pers. comms.

<sup>72</sup> Hutton, 1990, p.15

<sup>73</sup> Climo, 1975, p. 2088

<sup>74</sup> Green, pers, comms,

A proposal to translocate tree weta (*Hemideina thoracica*) from the Northland mainland to Matakohe/Limestone Island was prepared by Gerry Brackenbury in 1999. The translocation is aimed at restoring an important common species to the ecosystem of Matakohe/Limestone Island.

Following a visit to the island in June 1999 with Chris Green (Department of Conservation entomologist) four sites were identified as suitable for the release of tree weta. These sites (refer Map 4 consist of mature trees, mainly puriri that will provide good roosting sites for weta. It is intended that 25 weta of evenly mixed sexes will be released at each of the four sites, making a total release population of 100 weta. Students from Whangarei Boys High School will collect weta and will also assist with the construction of artificial roost boxes and monitor the dispersal of the population over time.

100 tree weta were released in late March 2000. Tree weta are released at this time of the year because they mature from egg in 13-18 months and the adult generally tends to oviposit<sup>75</sup> during autumn-winter. Thus if subadults and adult weta were transferred close to ovipositing season then the greatest number of eggs should be laid in the new habitat, thus maximising the size of the new population. A transfer in autumn would also increase the likelihood of subadult and adult weta being in the best breeding condition with adult females likely to have already mated.

This release if successful will enhance the biodiversity values of the island as well as provide a food source for other animals which may be released or naturally establish on the island. These include morepork, some lizard species and even tuatara.

Given the difficulties of determining when suitable habitats will be available for insect introductions and which species to introduce, it is recommended that FOMLI undertake an annual habitat assessment survey in association with the Department of Conservation. This should be done in conjunction with an invertebrate survey. The results from this combined survey will provide information on the development of habitats suitable for species introductions as well as information on population of invertebrate species which have naturally colonised on the island and those that have been released to date.

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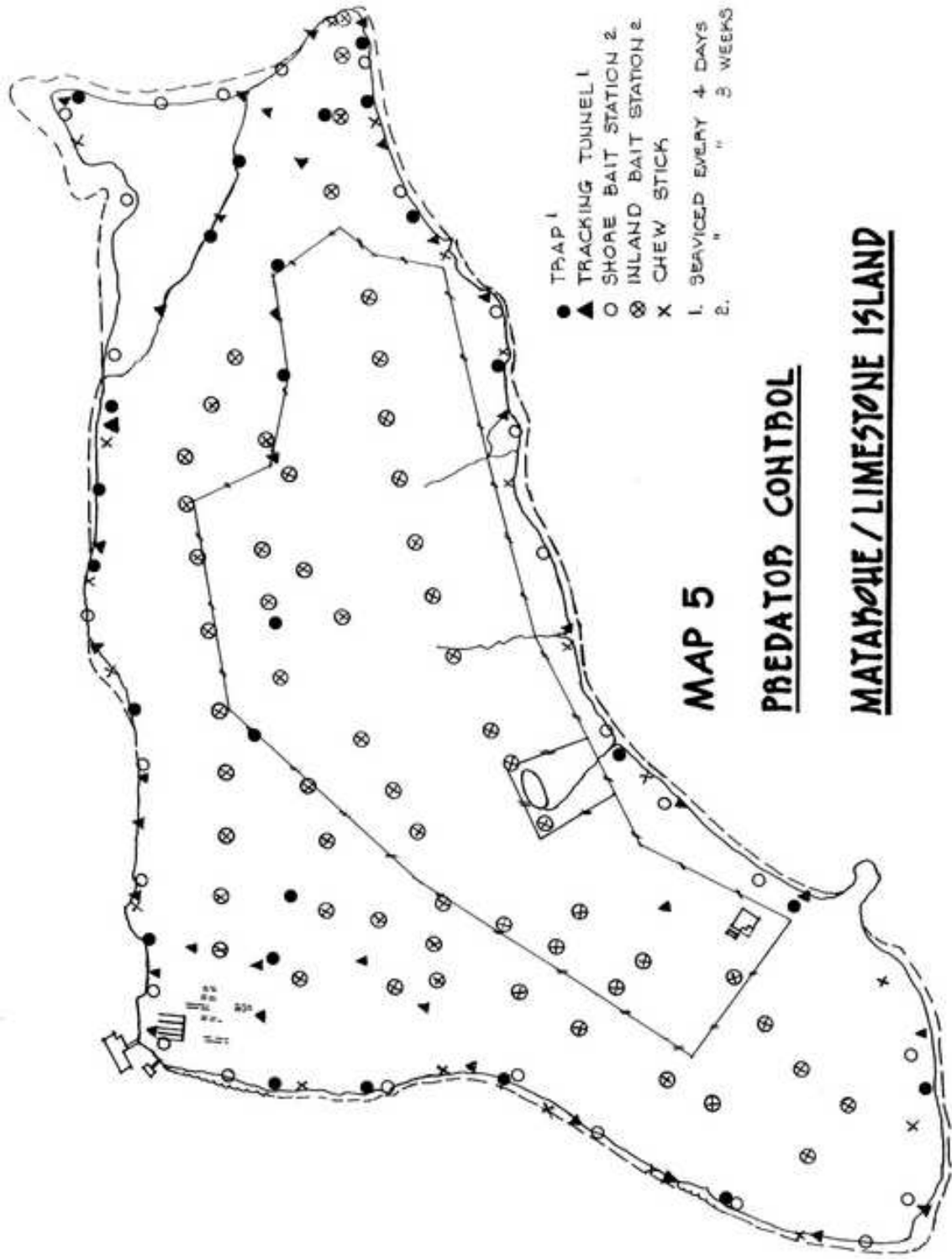
## **11. Control of Animal Pests**

The presence or absence of animal pests and their densities is a significant factor in the evaluation of whether an ecosystem is able to attract and accommodate viable populations of many native plants and animals. Because many of New Zealand's native animal species have evolved without mammalian predators, they are particularly vulnerable to them. Species such as brown teal and kiwi have been virtually eliminated from many mainland areas in Northland as a result of the presence of cats, mustelids and rats. Other species such as kokako, kereru, giant weta, kauri snails and tuatara are increasingly under pressure as a result of the presence of possums and rats.

As a result of the combined effects of predators on the mainland, Island environments are increasingly being looked at as refuges for many native plants and animals. In comparison to the mainland, Island environments are arguably easier to control and even eradicate animal pests from as they are surrounded by water, which can act as a natural barrier for migration and reinvasion.

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<sup>75</sup> To lay eggs, especially by means of an ovipositor



- TRAP 1
  - ▲ TRACKING TUNNEL 1
  - SHORE BAIT STATION 2
  - ⊗ INLAND BAIT STATION 2
  - X CHEW STICK
1. SERVICED EVERY 4 DAYS  
 2. " " 3 WEEKS

**MAP 5**

**PREDATOR CONTROL**

**MATAPOHĒ / LIMESTONE ISLAND**

The cost of animal pest control is not to be underestimated. The time required by people to organise and run operations as well as the cost of equipment and items such as poison are all costs that need to be clearly identified and accurately costed. These costs then need to be balanced against the degree of conservation benefits that will accrue as a result of the control programme.

## 11.1 CURRENT SITUATION

Due to its proximity to the mainland and its ease of access for predators at low tide (as a result of the extensive dry mudflats that are exposed), Matakohe/Limestone Island will always be at risk from predators, particularly mustelids and rats.

Animal pest control, like plant pest control, has been a significant part of the work programme of both the resident ranger and volunteers on Matakohe/Limestone Island. The Northland Regional Council, Whangarei District Council and the Department of Conservation have also played an active role in the provision of advice and equipment.

To date possums, cats rats and mustelids have been successfully eradicated from the Island (between 1988-1997)<sup>76</sup>. Over 250 possums were caught in total<sup>77</sup>. Two cats were also eradicated during this period. Five rats made it back to the island in December 1999 but have all been caught. Since the removal of these species the resulting changes in the vegetation have been significant. Large trees of species such as tawapou and puriri recovered rapidly and are now actively producing fruit and seedlings.

However mustelids (weasels are most common, then stoats, no ferrets have been seen or killed to date<sup>78</sup>) and rats still occasionally make it across to the Island. The closest mainland point to the Island is Onerahi, which is approximately 500m away. Most of the reinvasions appear to be from the mainland at Knight Point, opposite the western point of the island. Unlike the Onerahi gap, which is subject to strong tidal movement even at low tide, the western point gap dries up extensively at low tide with a number of small Islands (Rat and Rabbit) also providing stepping points over to Matakohe/Limestone Island.

Two unsuccessful attempts (during 1997 and 1998) have been made to eradicate mice from the Island. Both were undertaken using aerial baiting techniques. The failure of the drops could include any of the following:

- The last drop was undertaken in August 1998. This is later than the optimum time to spread the bait as weather conditions precluded the bait being dropped in June<sup>79</sup>;
- If bitrex (a compound used to deter dogs from eating the baits) was in any of the baits this has been found to also deter some rats and mice from eating the bait<sup>80</sup> and lead to bait shyness; [Confirmed following the writing of this Plan that bitrex was not in the baits. Jack Crow, pers. comms.]
- Limestone Island is also a difficult environment to effectively cover with one drop. It has steep cliffs and lots of fissures across the Island that are suitable homes for mice.

With no predator species present on the island mice numbers have continued to escalate. As well as natural increase, mice numbers could also increase on the island in times of large floods in the Whangarei Harbour when mice could be washed down on logs and debris. This last form of increase would be more of an issue if mice were eradicated from the island as it would become a reinvasion threat.

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<sup>76</sup> Brackenbury, G. 1999, p.2

<sup>77</sup> Carl Cooper, pers. comms.

<sup>78</sup> Brackenbury, comments on draft restoration plan

<sup>79</sup> Stevenson, R. (Skywork Helicopters), pers. comms.

<sup>80</sup> Ian McFadden, DoC Science and Research), pers. comms.

Black-backed gulls are known to frequent the Island. Eggs are pricked or used in fenn traps and nests are destroyed. No predation of shorebirds by gulls has been recorded to date.

Snails have become an increasing problem (refer section 4.4) as a result of the lack of avian and ground predators (both introduced and native). Some success is being had with the use of snail bait and clearing scrub from around young kowhai and kakabeak (in an area known as Molly's Grove) to make the area too hot and dry for slugs and snails. Consideration should be given to constructing a small enclosure around the perimeter using a mesh size small enough to restrict access into the area by snails. Snails inside the enclosure can then be targeted. Once the trees have established the enclosure can then be removed.

Present animal control efforts (refer Map 5) are concentrated around maintaining a buffer of tracking tunnels and fenn traps around the island and also includes bait stations and tracking tunnels on Rat Island and on the mainland at Onemana Point and the Portland Cement Works. Tracking tunnel sheets are analysed by animal control staff at the Department of Conservation.

## 11.2 ANIMAL PEST CONTROL STRATEGY

### Overview

Because of Matakohe/Limestone Island's close proximity to the mainland, the ideal concept of a pest free Island may be an unachievable goal<sup>81</sup>. However it is conceivable that the Island can be free of the majority of pest species and this should be the goal of the animal pest control strategy. Related objectives to achieve this goal should be:

- to continue to maintain an effective monitoring system which picks up animals on their way over to the Island and soon after they arrive on the Island;
- to eradicate mice;
- to continue snail control efforts;
- to monitor the populations of other potential pest species including magpies and black-back gulls;
- to enlist the services of an island eradication specialist to undertake a review of present control measures (prior to mouse eradication as a programme to do this would be part of the review).

In order to monitor the effectiveness of the animal pest control programme it is important to keep consistent records of work undertaken. This should include how often the bait stations, tracking tunnels and fenn traps are checked by location, dates and locations of any animals caught and bait types used. All these records can be kept using a simple check sheet (refer Appendix 10).

These records are also important for justifying the introductions of native species, some of which will require records of how long since certain predators have been recorded before approval is given. An example is the release of kiwi chicks onto the Island, which requires at least six months of stoat monitoring before chicks are introduced. On detection of stoats up to 60 fenn traps are to be set up until stoats are caught and not detected for the following month<sup>82</sup>.

The maintenance of bait stations and fenn traps on the mainland and islands in between is considered to be a valuable tool in reducing the likelihood of animal pests getting to Matakohe/Limestone Island and should be continued. In addition liaison with mainland landowners (particularly those on the Onemana Point side) should be undertaken to support this programme.

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<sup>81</sup> Graham, p.1

<sup>82</sup> Colbourne, p.6

Tracking tunnels are a valuable source of information about the types of predators that are around. It is important that these continue to be used and that the identification of the prints continues to be done by skilled people. A quick response system needs to be in place following the identification of rat or mustelid prints (refer Appendix 12). Tracking tunnel records need to be filed according to species, location, date and action taken (refer Appendix 10).

The island is currently has a 50m x 100m grid to target rats (refer Map 5) with a combination of tracking tunnels, traps, bait stations and chew sticks which also pick up any sign of mustelids and track mice. Surrounding islands are also monitored. Rabbit Island has two traps and 3 bait stations and Rat Island has two bait stations. Traps and tracking tunnels are serviced every four days and the remainder is serviced every three weeks.

In addition, four tunnel traps and four bait stations are maintained at Onemana Point by the landowner and the Golden Bay Cement Company maintains seven bait stations along the edge of the mangroves in front of the mill.

Accurate monitoring of predator activity for all these locations can be undertaken by using the recording sheet attached as Appendix 10. Sheets must be filled out each time control lines are checked. Completed sheets should be kept in a Monitoring Folder either by the resident ranger or a FOMLI Committee member.

People must be kept away from all toxins and adequate public warnings (in the form of signs, talks to visitors and publications). Every opportunity should be taken to advise the general public of the risks that animal pests pose to the Island. All visitors to the Island should at least see an information sign and if possible be advised of the risks by the resident ranger or tour group leader. Domestic pets need to continue to be excluded from the Island and visitors should be encouraged to check their packs and gear for any signs of rodents.

#### **Mouse Eradication Plan**

Eradication of mice from Matakohe/Limestone Island is essential. The absence of reasonable populations of mustelids and cats combined with the increasing food supply being generated as the forest cover becomes more established means that mice numbers will continue to escalate rapidly. In addition as long as mice are present on the island, mustelids will continue to re-invade from the mainland. Mice are also predators of a number of native insect species, including weta, lizards and beetles.

As a result, re-introductions of some of the more mouse vulnerable species may not be possible while mice are still present and not easily controlled. In addition mice also actively eat seeds and fruit of many native species and will also carry weed seeds and pollen around the island, which in turn impacts in natural regeneration processes.

Mice are considered to be one of the most difficult species to eradicate as they have a very small home range (around 20 metres or less). However with the technology that is available today and the experiences gained from rodent control and eradication programmes on other Islands it is conceivable that mice can be eradicated from the Island. There are a number of options available to do this including bait stations, hand broadcasting and aerial drops.

For reasons of practicality and degree of success it is considered that two aerial drops followed up with a ground based "mop-up" operation is the most cost-effective technique for Matakohe/Limestone Island. A summary of the pros and cons of each of the three techniques is attached as Appendix 11.

To achieve the maximum level of success an aerial operation would need to be carried out in winter (June/July) when natural food supplies are at their lowest. Two drops would be required about 10 days apart using Talon 20 (also known as Pestoff Rodent 20R) applied at 15kg per hectare<sup>83</sup>. Having mainly dry weather for at least two days after each drop would provide optimum weather conditions.

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<sup>83</sup> refer Appendix Eleven for specific bait volume and operation cost details

It is recommended that the aerial drop be considered for June 2000. This would only cause minor delays for the intended introductions of kiwi and lizards (exact timing for introductions after a poison drop would need to be confirmed with Department of Conservation staff). In addition undertaking control while the vegetation cover is reasonably open means that the bait will be more evenly spread across the island.

If this timing is considered acceptable, the following preparatory work would need to be undertaken:

- organising a site visit with an island eradication specialist (Ian McFadden<sup>84</sup>) and developing an accurately costed work programme (includes confirming bait quantities, application rates and pre and post monitoring systems, reinvasion plan) for the duration of the operation (at least 2 years);
- halting the use of talon in bait stations so as to minimise the likelihood of bait shyness. Talon would be reintroduced following the second drop;
- obtaining resource consent and other approvals to drop the bait;
- ordering the bait at least one month in advance;
- booking the helicopter (Skywork Helicopters<sup>85</sup>);
- request Whangarei District Council to close the island to the public while the eradication operation is underway and for a period afterwards to allow poison baits to degrade;
- design and install signage to warn people of the presence of bait and provide some information on the operation;
- Removal of any kiwi chicks on the island as they are prone to taking talon bait (it is suggested that if it is agreed that the control operation go ahead, that the release of kiwi be delayed.

The Society may wish to satisfy itself that aerial drops are the best method of eradication. This can be achieved by investigating other eradication methods. If mice are eradicated, then also to be considered is how to maintain the mouse-free status of the island. As mustelids and rats appear to reinvade from time to time, it is highly likely that this will also be the case with mice.

#### **Mustelid Reinvasion Plan**

Forty fenn traps are currently located on the Island (refer Map 5). In addition, there are also 11 traps on the mainland, 4 at Onemana Point and 7 around the Portland Cement Works land. These are baited with eggs and meat and in combination with the tracking tunnels have proven extremely effective at identifying when mustelids have come on to the Island as well as being successful at catching animals on the mainland.

In the event of mustelids evading the fenn traps for long periods of time (especially when there are vulnerable species on the island such as kiwi) it may be necessary to employ other methods such as specially trained dogs to catch them. The use of dogs has been undertaken on two occasions at Matakohe/Limestone Island. Advice should be sought from the Department of Conservation on appropriate techniques in these circumstances.

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<sup>84</sup> Science and Research Unit, Department of Conservation

<sup>85</sup> Based out of Warkworth, did last drop and has necessary experience and baiting equipment

### **Rat Reinvasion Plan**<sup>86</sup>

The placement of the existing bait stations and tracking tunnels on the Island was the result of the implementation of a Reinvasion Plan for the Island designed by Pete Graham from the Department of Conservation in Whangarei. This plan is attached as Appendix 12. This grid system has been in operation since 1999 and has resulted in 4 rats being identified and caught.

Because Matakohe/Limestone Island is within the swimming distance of rats, reinvasion is inevitable. The chances of reinvasion can be reduced by using toxins in the areas that reinvasion is most likely to originate. By reducing the density of animals in its poisoned buffer zone, dispersal of animals from this area can be greatly reduced.

Graham (1999) has recommended that the following poisoning sequence could be used:

- index rodent numbers with tracking tunnels (where are they, how many);
- fill all stations with 200g of Brodifacoum (Talon) bait;
- after one week re-index rodent populations;
- spot poison areas where rodents are still found in tracking tunnels or where bait take was rapid;
- continue to index rodent populations and pulse feed 200g of Brodifacoum to the stations monthly as the tracking papers dictate.

This is a simple and effective system and needs to be formally accepted as the reinvasion strategy for Matakohe/Limestone Island with one addition. This is to maintain bait stations and tracking tunnels on surrounding islands and on the mainland. Some of these are already in place on Rat Island and around the Portland cement works. Advice should be sought (as part of the predator programme review identified above) as to the effectiveness of mainland control measures currently in place and whether it is necessary to have some control measures at Onerahi.

The need to keep good records is especially important as over a period of time, bait and toxin types may have to be changed to accommodate bait shy rodents. This information can be recorded on the sheet attached as Appendix 10. This sheet can also be used to record results if a rat reinvasion does occur and the Graham plan as identified above needs to be implemented.

### **Snails**

Snails have been identified as a particular problem prohibiting the establishment of some plant species including kowhai and rengarenga. It is suggested that the snail problem will decrease over time as the forest cover increases and provide improved habitat for larger numbers of bird species that will prey on snails such as blackbirds and thrushes.

In the meantime, plant species that are susceptible to snail attack may have to be deleted from planting lists. Alternatively these species could be planted in small numbers in areas where they can be fenced off (e.g. with chicken mesh or similar) or where concentrated snail bait can be laid. Control measures would need to be continued until such time as the plants have grown to a height where they are no longer vulnerable to snail attack.

Caution needs to be taken with the continuing use of poisons such as Mesurool, which may also be poisonous to some native species such as kiwi<sup>87</sup>.

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<sup>86</sup> Information in this section is from Graham

<sup>87</sup> McGlynn, pers. comms.

### **Other Pests**

These include hedgehogs, rabbits, magpies, black-backed gulls, small exotic birds (starlings, mynas etc) and insects such as vespulid wasps. Other than black-backed gulls and starlings, none of these species are resident on the Island at this stage.

Hedgehogs will be able to be picked up in tracking tunnels. Rabbits will be easily identified either through visual observation of animals, burrows or droppings. Visual observation will also identify introduced bird species and wasps will be identified through the presence of nests.

These species should be actively prevented from establishing on the Island. On sighting animals, their location and the date should be recorded and the animal(s) dispensed with. This applies to hedgehogs, rabbits and magpies.

Black-backed gulls populations on nearby islands should also be monitored and control measures undertaken if and when these populations pose a threat to Matakohe/Limestone Island. Advice on appropriate techniques and permits can be sourced from the Department of Conservation. No control work on black-backed gulls can be undertaken without a permit under the Wildlife Act.

Populations of small exotic birds such as mynas and starlings need to be closely monitored. While they can play a valuable role in dispersing fleshy fruits of native plants (in the absence of native fruit eating birds) some species such as starlings also have the potential to disperse mainland weed seed. Monitoring can be done as part of regular bird surveys (refer section 7.5) and also as part of everyday work on the island. If large flocks are found to be establishing on the island control measures may need to be initiated.

On Mana Island, starlings regularly feed on the mainland and return to the Island in the evening to roost<sup>88</sup>. Although this is unlikely to be a problem in the short term on Matakohe/Limestone Island as a result of the lack of good trees to roost in, the numbers of mynas on the Island do need to be monitored on a regular basis.

Mynas and starlings are known to be aggressive predators for nest holes and cavities. Starlings have been recorded doing so during the black robin recovery programme in the South Island and mynas with the establishment of saddleback populations on Tiritiri Island.

Should these species become a problem advice should be sought from the Department of Conservation as there are currently no effective methods for discouraging roosting and nesting by starlings over a large area, although individual nest sites of vulnerable (native) species can be protected<sup>89</sup>.

Exotic insect species such as Argentine ants and vespulid wasps (e.g. German wasp, Common wasp and two species of paper wasp) have the potential to have severe impacts on invertebrates through predation and competition for nectar, and on birds through competition for food and nest sites<sup>90</sup>. Large colonies can also be a public safety hazard.

Worker wasps are sterile. Only a queen can establish a new colony. Queens hibernate during the winter, and seek new nest sites in the spring. Thus the most critical times of the year for wasp colonisation are spring/early summer, when young queens are actively seeking nest sites, and autumn when young queens seek suitable crevices for nesting<sup>91</sup>. Flying wasps can be tracked in early morning or at dusk when other insects such as bees and flies are not flying<sup>92</sup>. Extreme care should be taken when dealing with wasp infestations.

With its proximity to the mainland, the establishment of wasps on Matakohe/Limestone Island is inevitable. Once established on the Island it is unlikely that wasps could be eradicated.

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<sup>88</sup> Miskelly, 1999, p.110

<sup>89</sup> Butler and Merton, 1992 in Miskelly 1999, p.110

<sup>90</sup> Miskelly, 1999, p.111

<sup>91</sup> Miskelly, 1999, p.111

<sup>92</sup> Auckland Regional Council, Wasps

However if the first nest is located before new queens are produced, it may be possible to prevent colonisation. Therefore as soon as wasps are detected on the Island every effort must be made to locate the nest and destroy it immediately. Stocks of wasp poison (e.g. Carbaryl powder) should be held on the Island for this purpose<sup>93</sup>.

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## **12. Control of Plant Pests**

The level of human modification of Matakohe/Limestone Island and its resulting open grassland nature combined with its proximity to the mainland has resulted in the establishment of over 50 adventive<sup>94</sup> weed species on the Island (refer Appendix 13). However many of these species pose no or minimal threat to the conservation values on the Island. This is in large part, due to the success of the weed control programme that has been undertaken to date.

In addition many of the weed species are light loving and short-lived species that will die out as natural succession and the revegetation programme gain momentum. Other than buffalo grass, most weeds on the Island are limited in their distribution and spread and are not the dominant vegetation. They tend to be predominantly located on the south coast and are either small-localised infestations or a number of individual plants in dispersed locations.

Species of greatest concern are those that have the following characteristics:

- Are fully capable of self replication, either by seed, rhizome, stem fragments, spores, corms, or other methods;
- Are capable of forming dense communities or pure associations, excluding most or all other vegetation in the niche that they occupy;
- An effective disposal method that enables them to spread their seeds far and wide; by wind, birds or water;
- Are usually shade tolerant, especially as seedlings, and possess the ability to thrive in a range of ecological niches and environmental conditions<sup>95</sup>.

On Matakohe/Limestone Island weed species present with these characteristics are identified in Table 5 with an asterisk. Species of greatest concern are those that are aggressive colonists and have the potential to dominate coastal forest and shrub communities and/or coastal cliffs. These species are mistflower, convolvulus, Mexican devil, privet, periwinkle, pampas, and Mexican daisy.

In order to maximise the opportunities for natural regeneration of native species and the revegetation programme, ongoing weed control needs to be recognised as a priority work area on the Island. Priority must be given to those species that could potentially dominate coastal forest, shrub, wetland and cliff communities and the eradication of newly established weeds before they have an opportunity to spread.

Localised control of less aggressive species (e.g. ragwort, Italian arum) may be required to assist with the establishment or enhancement of populations of threatened plants on the Island<sup>96</sup>. In addition it is also important to keep good records of all control work done so as to get a better understanding of the techniques that are most effective for each species.

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<sup>93</sup> Miskelly, 1999, p.111

<sup>94</sup> Not native to and not fully established in a new habitat or environment; locally or temporarily naturalised

<sup>95</sup> Craw, 1994, p.32

<sup>96</sup> Adapted from Miskelly, 1999, p.113

## 12.1 CURRENT SITUATION

To date the resident ranger and volunteer groups have put a considerable amount of effort into weed control. This has resulted in the removal of infestations of periwinkle and wattle and a reduction in the extent of many other species including pampas, privet, cotoneaster, blackberry, woolly nightshade, gorse, kikuyu and German ivy.

Control has been concentrated on the use of Glyphosate and Pulse. Blanket spraying appears to be the most effective technique for many species. Larger species such as privet and wattle have been removed with a combination of felling and stump painting.

Considerable success has also been achieved with the control of kikuyu and buffalo grass in areas targeted for revegetation. About 6 weeks prior to planting, individual tree spots are sprayed with Glyphosate. Post plant spraying has also been undertaken in some areas to prevent kikuyu re-establishing.

## 12.2 WEED CONTROL STRATEGY

Compiled by Jack Craw, former plant pest officer for the Northland Regional Council, the strategy divides weed species present on the Island into six priorities based on their ability to affect natural regeneration and/or the revegetation programme and the extent of their distribution. This strategy should be implemented in conjunction with Appendix 14 which identifies the herbicides mixes to be used and the timing of control for each species.

**Table 5: Weed Species Recommended for Eradication or Control on Matakohe/Limestone Island**

### **PRIORITY ONE (eradicate wherever found, immediately if possible)**

Species	Extent	Action to date	Planned action
Periwinkle*	0.5 ha, 2 spots	Sprayed 6 t <sup>97+</sup>	spray 4 tpa <sup>98</sup> until eradicated
Mexican daisy*	2 small spots	Sprayed/pulled 3-4 t	spray 4 tpa until eradicated
Mistflower*	1 plant	Pulled, probably eradicated	Monitor site 4 tpa
Moth Plant*	3-6 vines	Sprayed 2 t	plants sprayed when found.

### **PRIORITY TWO (spray/pull/dig at least once annually until eradicated)**

Species	Extent	Action to date	Planned action
Pampas*	v. sparse	Sprayed/pulled 5 t	spray/pull 2 tpa, monitor
Kikuyu*	2 ha (15+ spots)	Sprayed 4 t+	spray 3 tpa
Elaeagnus*	Small spot	dug out	dig regrowth if appears
Cotoneaster*	Sparse, 8 ha	all sprayed 3 t	spray seedlings 1-2 tpa
Privet*	Sparse, 4 ha	Sprayed 3 t	spray seedlings 1-2 tpa
Mexican Devil*	Dense, 0.5 ha	Sprayed 2 t	spray 2-3 tpa
Woolly Nightshade*	10-15 plants	Sprayed 1 t	spray 2 tpa, pull seedlings
Blackberry*	Dense, 4 ha	Sprayed 3 ha	follow up on 3 ha + new area
Willow (2 spp)	Small spots	Spray/stem inject	spray/ stem inject 1 tpa
Nasturtium*	2 small spots	Nil	Spray 2 tpa
Climbing dock*	1 small spot	Pulled tubers out	Dig 2-3 tpa
German ivy*	3 spots	Sprayed 3 t	spray regrowth 2 tpa
Cape honeyflower*	0.5 ha (2 spots)	Sprayed 2t	spray 2 tpa
Gorse*	Scattered, 2 ha	All sprayed	spray seedlings 1 tpa

<sup>97</sup> t = number of times spraying required

<sup>98</sup> tpa = number of treatments per annum

**Table 5 cont.**

**PRIORITY THREE (spray/dig/pull when convenient, aim to eradicate eventually)**

Species	Extent	Action to date	Planned action
Arum lily	v. sparse	Nil	spray 1 tpa
Italian arum	Scattered	Nil	spray 1 tpa
Radiata pine	4-5 trees	Mostly felled	Firewood, pull seedlings
Dog rose	few plants	Some sprayed	spray 1 tpa
Angels trumpet	2 large trees	Sprayed 1t	spray 1 tpa

**PRIORITY FOUR (spray/pull if interferes with planting)**

Species	Extent	Action to date	Planned action
Australian sedge	Scattered in pasture	Nil	nil in grazed area, reassess if needed
Buffalo grass	All over island	Pre-plant spot spraying	Trial blanket spraying
Shrub wattle <sup>99</sup>	dense 1 ha	Some sprayed/cut	poss. Spray around bluffs
Apple of sodom	v. sparse	Some sprayed	poss. Spray middens
Wattle <sup>100</sup>	small hedge	Cut down/sprayed out	Eventually remove
Australian ngaio <sup>101</sup>	40-50 plants	Nil (planted in error)	Remove as cover establishes
Fennel	dense 1 ha	Some sprayed	spray poss. Pre-plant
Carrot weed	dense 30 ha (seasonally)	Hand pulling around plantings	more hand weeding, poss. some pre-plant spray
Oleander	2 small copses	Nil	spray when convenient

**PRIORITY FIVE (monitor, remove if appears to spread)**

Species	Extent	Action to date	Planned action
Grape	1 vine	Partially dug out	Eventually remove
Oak <sup>102</sup>	1 large tree	Nil	Remove seedlings
Fig	2-4 trees	1 sprayed	Monitor
Feijoa	small hedge	Nil	Monitor
Macrocarpa <sup>103</sup>	12 large trees	Some firewood	Firewood

**PRIORITY SIX (spray/dig/pull on paths etc for aesthetic purposes)** All flatweeds (e.g. dock, dandelion), thistles, etc

Given the level of threat posed by adventive weeds and the level of effort that goes into controlling them, it is important that good records are kept of the work that is done. This does not need to be in any great level of detail and can simply be done by means of a check sheet (refer Appendix 15) which records the species, its location, level of infestation, methods and timing of control and any follow up work that is required. The location of all weed species should be identified on a map and notations made on the map as work is undertaken. A strategy also needs to be in place to deal with the arrival of new species onto the Island. These are likely to occur as a result of one or more of the following:

- Natural arrival mechanisms include by wind and animal (principally birds but can also come in as a component of faecal matter excreted by animal pests) and also by tide (both through high tides and mainland rivers flooding into the harbour);
- Visitors to the island can also inadvertently bring weed seeds in the dirt on the soles of their shoes and in clothing, as well as dropping stones and pips from fruit. This is a common problem on offshore islands around the Hauraki Gulf. Species spread by this means can often be first observed close to access points onto the Island such as wharves and beaches;
- Potting mix containing seeds and often small weed plants. Almost every tree planted on the Island has been planted along with the potting mix it was raised in;

<sup>99</sup> refer section 4.6 regarding useful exotic species

<sup>100</sup> refer section 4.6 regarding useful exotic species

<sup>101</sup> survey required to confirm total number and location

<sup>102</sup> The large oak near the Mine Managers House is considered a heritage tree

<sup>103</sup> refer section 4.6 regarding useful exotic species

- When machinery is brought over from the mainland. Tracks and working parts can often carry weed seeds and fragments. This includes island machinery and equipment when it is taken off for servicing.

Monitoring the Island for the arrival of new weed species needs to be built into the daily routine of the Resident Ranger and also needs to become a part of volunteers coming to the Island to work. Key locations to check are the main access points onto the Island (refer Map 6), the coastline and areas that have been recently planted or cleared of weeds.

Visitors to the Island need to be informed as to the threats that weeds pose to the Island and the means by which they can arrive. In particular visitors that come from farmland or rural areas should check all their gear (shoes, clothing and packs etc) for signs of seeds or flowers. All people bringing planting spades and equipment onto the island should be requested to clean the gear at home prior to coming. Dirty gear should be cleaned on the island prior to use.

This information can be provided through pamphlets, signs on the Island and also at main departure points on the mainland. A waterproof pamphlet holder could be easily installed and maintained where people come off the pontoon and onto the island. This along with a sign would serve as a backup when the resident ranger is unable to meet visitors or is not given any prior warning of their arrival. Commercial boats bringing passengers should be encouraged to advise passengers of threats to the Islands conservation values on the trip over.

Nurseries growing plants for the Island need to ensure that they take all practical steps to avoid weed seeds or plants coming in with potting mix. This includes having proper facilities for storing potting mix, ensuring that plants destined for the Island are not stored close to any weeds which may be in seed or flowering and checking all plants for evidence of weeds prior to dispatch to the Island. Planting tender lists need to continue to specify that soil/potting media must be sterile with no weed seed in the mixture and all plants going to the island should be checked for signs of weeds.

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## **13. Historic Site Management**

### **13.1 HUMAN HISTORY**

Limestone Island has considerable historic significance. No detailed archaeological survey has been done on the island and it is recommended that this be considered a priority before the forest cover develops and obscures some of the sites.

Maori regard the island as a significant place where battles were fought, successive hapu lived and was the source of productive gardens and fishing grounds. Today all that remains is the pa of the Parawhau Te Ihi known as Matakohe which is located on the top of the island and the old cultivation site that can be seen as agricultural lines or drains that follow the hill slope on the northern side of the island.

European use of the island dates back to the 1830's when the first European trader in the Whangarei District, Mr G.D. Brown lived on the island. The pattern of change began in 1832 when his house was destroyed by a Maori war party. Following the end of the Maori land wars, the island went through a period of rapid development.

Land was cleared for farming and the island became one of the major sources of lime rock and lime fertiliser for the Northland Region. The period between 1848 and 1900 saw the development of many facilities to support the quarrying operation, which included the following:

- a long wharf on the southern side of the island;
- a small settlement of some 100 people including a school, hall, mine managers house and store;
- a range of buildings for the processing and storage of the lime – the remains of which are still visible today behind the old wharf.

The merging of the New Zealand Portland Cement Company with the Wilson's Portland Cement Company in 1918 saw the gradual dismantling of most of the installations on Matakohe/Limestone Island. This included many of the houses, most of which were barged over to the Company's new site at Portland.

In 1931, Matakohe/Limestone Island was sold to A.W. Thorburn with the Portland Cement Company retaining the mineral rights. In 1965 the island was sold to the Northland Harbour Board who then leased the land to the Northland District Aero Club for grazing until October 1988.

In 1989, the Golden Bay Cement Company (who had taken over from Portland) relinquished its mining rights to Matakohe/Limestone Island to the Northland Harbour Board. The Board then gifted the island to the Whangarei City Council (as agent for the Whangarei District Council).

In July 1998 the Island was classified as a Scenic Reserve under the Reserves Act 1977 and is known as the Matakohe-Limestone Island Scenic Reserve<sup>104</sup>. The Island is administered by the Whangarei District Council who in turn have an arrangement with the Friends of Matakohe/Limestone Island Society to manage the island on their behalf (refer Section 1). Since 1989 the island has been the focus of a restoration effort aimed at restoring native plant and animal communities.

## 13.2 CURRENT SITUATION

The management of archaeological/historic sites on Matakohe/Limestone Island is guided by Policy 5.2.1 of the Reserve Management Plan, which states:

*That the island is managed in such a way that (a) the Maori pa, agricultural lines, middens and any other identified cultural features of significance to Maori are given the greatest possible protection; and (b) that the industrial ruins, house sites and boat remnants are protected from further degradation to ensure their ongoing visual, historical and educational appeal.*

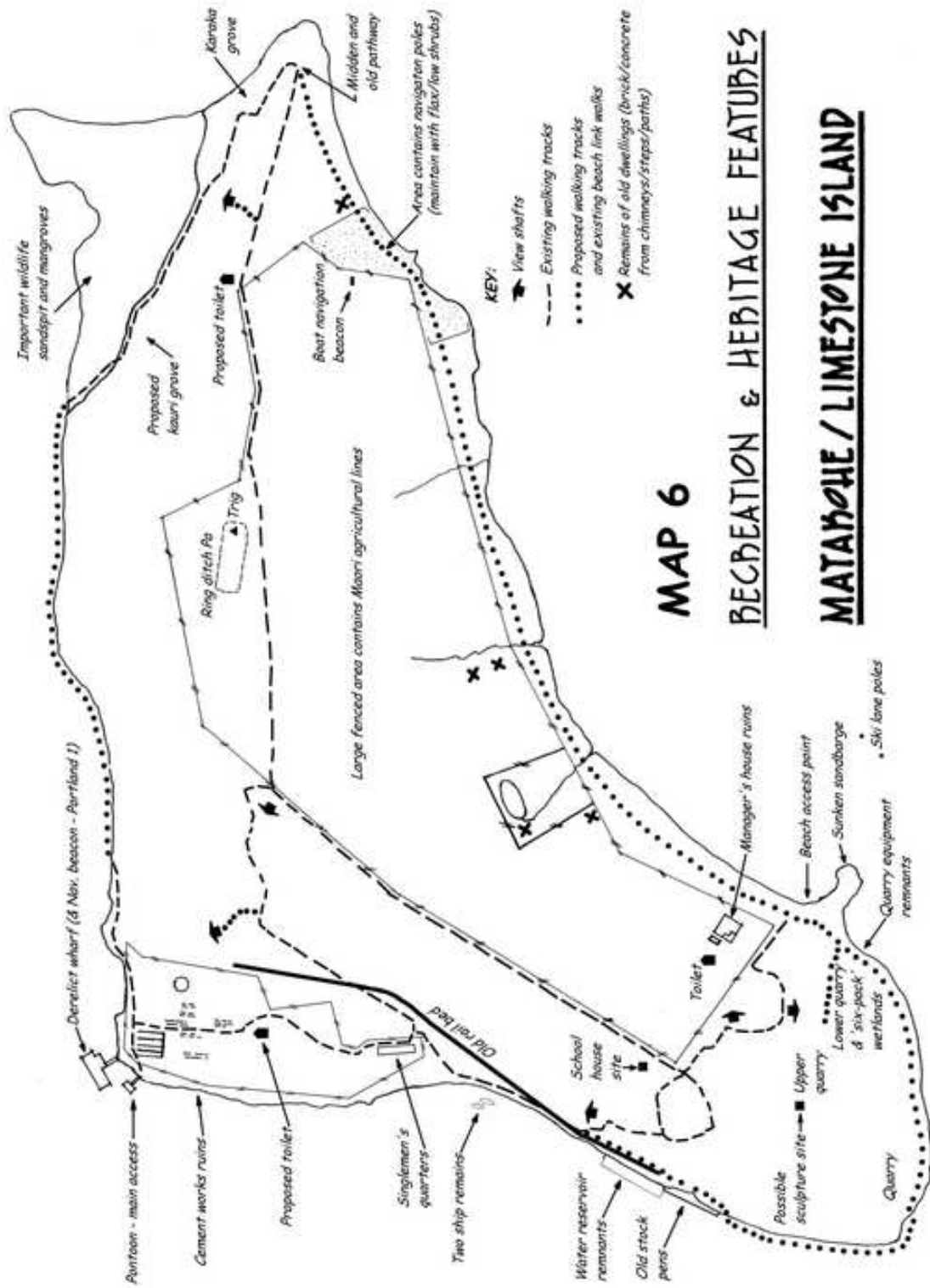
Policy 5.2.2 is also relevant:

*That the local tangata whenua are involved in any decisions or undertakings affecting Maori cultural sites.*

With this in mind, the Society has encouraged tangata whenua to become directly involved in the running of the Society. There are now Maori on the committee of the Society and it is hoped this will ensure appropriate treatment will be given to features on the island that have cultural significance to Maori.

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<sup>104</sup> Extract from N.Z. Gazette, 27 May 1999, No. 60, p.1434



Archaeological/historic sites (refer Map 6) on the island include:

- Early Maori occupation sites (Matakohe pa and gardens)\*;
- Midden sites around the coastline;
- Remains of the Mine Managers house and some of the settlement on the northern side of the island (bricks, concrete, dam, macrocarpa trees)\*;
- Derelict barge and lime grading and loading equipment\*;
- 3 quarry sites;
- animal quarantine yards and the remains of a large water tank nearby;
- remains of at least two ships (the “Tiri” and the “Victoria”) on the eastern coast;
- buildings, kilns, singlemans quarters, the wharf and other buildings associated with the limeworks\*;
- remains of a railway bed behind the limeworks\*.

\* signifies sites that are to remain in grassland (refer section 13.3)

Management of these sites has been minimal. Grassland has been maintained around the limeworks ruins, the area surrounding the Mine Managers house, and the pa and garden areas. Some revegetation work has been undertaken in two of the quarries along with noxious weed and animal control and the Six-pack wetlands have been constructed in the base of the main quarry. In 1991, a Conservation Corps programme, funded by the Ministry of Youth Affairs undertook a variety of historic site maintenance works including cleaning up around the Mine Manager’s house and the Singlemen’s Quarters<sup>105</sup>.

Many of the structures remaining are in an advanced state of deterioration and would require substantial capital investment to restore. As a result it is intended that the management practice of minimal intervention will continue with these sites. The small amount of work that is done will be limited to:

- ensuring that the structures pose no public safety hazard
- controlling the growth of plants in, on and around the structures
- regular mowing.

Structures that may pose a public safety hazard, such as the old concrete wharf could be promoted as demolition projects for specialist volunteer groups, such as the military. Any demolition work should be done in consultation with heritage professionals so that records are kept of what was on the site.

The Mine Managers house is the exception to this minimal maintenance policy. It is currently the subject of a FOMLI project to investigate the options for restoration.

All structures and sites over 100 years old are protected by the Historic Places Act 1993. Any major work such as restoration or demolition must have approval from the Historic Places Trust.

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<sup>105</sup> Brackenbury, G. pers comms,

### 13.3 CONFLICTS BETWEEN ECOLOGICAL RESTORATION AND MANAGEMENT OF HISTORIC SITES

There are several sites on the island where this conflict may occur:

#### **Impact of revegetation on historic sites**

Revegetation and regeneration can obscure and/or disturb archaeological sites. Tall vegetation can hide surface features, while root damage can disturb subsurface features. Digging holes to plant trees also has direct impacts on soil stratification<sup>106</sup>. Seeding native species can also impact on archaeological sites. This is already occurring around the limeworks ruins with species such as pohutukawa and coprosma. Plants found growing in the ruins are being targeted as part of the weed control programme.

All those sites marked with an \* in the list in 13.2 above are to remain in grassland (this includes ground covers such as muehlenbeckia and ferns). Regeneration is to be actively discouraged through the removal of plants as they establish. Care needs to be taken that removal does not damage any features. This may mean in the case of plants in the limestone ruins for example, that they need to be sprayed and left to rot away or cut and painted.

#### **Heritage tree species**

There are a number of species of exotic trees that are connected with the limeworks or the original settlement. These include:

- a large oak and 2 feijoa trees around the Mine Manager's house;
- a shelter belt of macrocarpa in front of the Mine Manager's house;
- various fruit trees including figs at the base of the northern grasslands;
- a large oleander and several plum trees at the limeworks ruins.

Exotic species have the potential to seed into other areas on the island particularly in the absence of significant forest cover. It is recommended that some species be removed and others actively managed to ensure that they do not spread. This way these trees can also provide interim habitat for native plants and animals. The trees need to be aged as they may be protected under the District Plan or by the Historic Places Trust. If this is the case, then some trees may require special permission to be pruned or removed.

Other than the oak, none of these trees appear to be actively seeding or spreading across the island. Oak seedlings are only establishing under the main tree and are part of the weed control programme. It is recommended that the large oak be kept but that all seedlings are removed.

The macrocarpa shelterbelt is gradually being planted in front of with pohutukawa and may eventually be taken out. It is intended that a shade house and nursery may be established inside these trees in the area in front of the Ranger's house. To minimise risks to public safety they should be pruned to remove old, dead and dangerous limbs.

However the management plan provides for the planting of exotic trees and shrubs around the Mine Manager's house for the benefit of nectar-feeding birds. Species used must not be able to spread and become weeds.

The oleander is a very large tree and is probably unique due to its size. Like the oak tree, it should be kept but the area around it should be checked regularly to remove any broken branches capable of sprouting and any seedlings.

The remaining species pose no significant risk to the restoration programme and should be managed so that they do not spread.

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<sup>106</sup> Miskelly, 1999, pp.116-117

### **Access Tracks**

There are presently a number of existing walking and tractor access tracks on the island (refer Map 6). Other than the northern ridge track, part of which was recently relocated away from the pa site, none of these tracks significantly affect heritage values on the island. In the development of new tracks it is important to ensure that they do not adversely affect any heritage (and natural) values on the island.

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## **14. Fire**

**A detailed fire plan exists for Matakohe/Limestone Island. The resident ranger, FOMLI and Whangarei District Council hold copies of this plan. In the event of a fire the procedures as detailed in this plan are to be followed. This section of the Ecological Plan is consistent with the Fire Plan.**

Fire is a considerable risk to Matakohe/Limestone Island until such time as the forest cover establishes itself and the area of open grass and scrublands are considerably reduced. The island's proximity to the mainland, its accessibility to visitors and its wide expanses of combustible vegetation (kikuyu grass and titree) compound this risk.

A fire would spread rapidly across the island, particularly in summer when the island is at its driest. The lack of adequate permanent accessible water supplies on the island also exacerbates the level of risk in terms of fire fighting on the ground.

Even with the eventual establishment of forest cover, half of the island may still remain in grassland. This includes the area around the limeworks ruins, the Maori gardening site and the pa site.

In the event of a fire breaking out, the Matakohe/Limestone Island Fire Plan is to be used as a guiding document. For large fires, a helicopter with a monsoon bucket should be considered an early option. Water can be taken from the sea.

### **14.1 REDUCING THE RISK OF A FIRE OCCURRING OR SPREADING**

Potential fire sources on Matakohe/Limestone Island include cigarette butts, machinery, barbecues, illegal camping, rubbish and bonfires, cooking fires, rescue flares, fuel spills and broken glass. The risk of any of these potential fire sources causing a wild fire can be reduced by a combination of the following management actions:

- Maintain a mown sward at public landing points and maintain fire breaks and all vehicle and walking access tracks;
- Discourage cigarette smoking altogether and if not possible restrict it to the landing beach and pontoons on the beach;
- Meet and inform visitors to the island of fire risks and how they can assist with minimising it;
- Use signage during periods of high fire risk at main entrance points;
- Ban all recreational fires (gas barbecues are permitted) and limit work-related fires (rubbish etc) to periods of low fire risk;
- Establish and maintain basic fire-fighting equipment on the island;
- Ensure all staff and workers on the island know what to do in the event of a fire and undertake regular fire training for staff and workers visiting the island on a regular basis;

- Set up fire fighting equipment next to any planned controlled fire;
- Undertake regular maintenance of machinery and vehicles to reduce the risk of spark discharge or fuel leaks;
- Store fuel, chemicals and other flammable or combustible materials according to label standards and in an industry-approved storage facility
- Restrict public access to and the use of machinery/vehicles to part/all of the island during periods of extreme fire risk;
- Undertake regular patrols of main walking tracks and the coastline during high risk periods and remove any signs of past fires or flammable materials such as glass and other rubbish;
- Fire extinguishers to be carried on quad bike and tractor at all times;
- Over dry periods, the tractor should be hooked up to the spray tank when not in use;
- Fire retardant/additive is to be stored on the island.

## 14.2 FIRE SUPPRESSION

A fire store should be established on the island and all resident staff and regular visitors to the island trained in the use of fire-fighting equipment and who to contact in the event of a fire. This should also include emergency evacuation procedures (refer Island fire plan) in order to ensure that all people on the island are accounted for in the event of a fire.

In the event of a major fire, it is very unlikely that resources on the island will be adequate. Additional resources will be required in the form of personnel and equipment (as this is an island environment this will involve helicopters with monsoon or bambi buckets).

As stated above at least one permanent water source needs to be established and maintained on the island. This could be in the vicinity of the present dam, which is easily accessible by tractor and foot.

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## 15. Public Use and Involvement

Limestone Island is gazetted a Scenic Reserve and as such there are no restrictions on public access to the reserve. However there are restrictions as to what people can do on a Scenic Reserve. These relate to imposing conditions and restrictions as the administering body (being the Whangarei District Council) considers necessary for the protection and well-being of the reserve and for the protection and control of the public using it<sup>107</sup>.

Allowing public use of the reserve must not be in conflict with the principal or primary purposes of Scenic Reserves which is the retention and preservation of the natural or scenic values<sup>108</sup>. These values also include providing for the management and protection of historic, archaeological, geological, biological or other scientific features as long as they are compatible with the primary purpose<sup>109</sup>.

Public use of Matakohe/Limestone Island and involvement in the restoration programme is the key to its success. Since the restoration programme was established in 1989 many people have visited the island, attracted by the restoration project or the historic sites or have been directly involved with some aspect of the restoration project. Educational visits from schools, and other organised groups are also increasing.

<sup>107</sup> Section 19(2)(b) Reserves Act 1977

<sup>108</sup> Section 19(2)(c) Reserves Act 1977

<sup>109</sup> Section 19(2)(d) Reserves Act 1977

## 15.1 ACCESS POLICY

Visitors to the island are encouraged to use either the beach landing in front of the Mine Manager's house on the northern side or the pontoon at the old wharf on the south side. In this way, as many people as possible come past the entrance signs informing people about the island and what they can and cannot do. Commercial boats are restricted to using the pontoon.

However, due to the gentle slope of much of the coastline, people can also access the island at a number of other points along the beaches on the northern and southern sides. Areas known to be popular landing points should be checked regularly for signs of fire, rubbish and other threats such as pip fruit stones and weeds.

Implementation of this restoration plan is considered compatible with recreational use of the island, with the following provisos:

- Camping is not permitted unless it is related to an organised group undertaking work on the island. These groups must have a camping permit and camping is to be restricted to the area around the lime works ruins or in the area of the Mine Manager's House where the ranger can provide additional supervision;
- Open fires are not permitted anywhere on the island at any time of the year, other than for management purposes (e.g. rubbish burning);
- Recreational activities are to be limited to those of a passive nature (i.e. walking, nature watching, planting days, picnics);
- The island may be closed to the public at times of extreme fire risk or predator control work<sup>110</sup>;
- Commercial trips to the island (e.g. ferries etc) should be encouraged to pay a small percentage of each passengers fare towards the restoration programme;
- As revegetation progresses, visitors should be requested to remain on public tracks to reduce trampling of vegetation and soils, disturbance to wildlife and the risk of fire. Smoking should be actively discouraged particularly during the summer months. A designated smoking area, such as the beach/pontoon, may need to be defined;
- Some coastal bird species are vulnerable to disturbance at nesting and roosting sites (e.g. dotterel, oystercatcher) and so access to breeding areas will be limited to management use only;
- If seabird colonies establish (e.g. grey petrel, blue penguin), access to them will be restricted to safe distances to avoid trampling of burrows and disturbance to the birds;
- Releases of fauna, that require minimal disturbance to establish, should be away from high public traffic areas. If considered too close then either the release site or the track should be moved, whichever is the more practical;
- All plants and animals are protected and are not to be removed from the island;
- Visitors are responsible for their own rubbish. A pack it in, pack it out policy applies (this also applies to permitted camping);
- Some areas of the island may be closed off to the public in the future if it is considered that conservation values would be compromised by public access to them.

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<sup>110</sup> This can be imposed by Whangarei District Council as the administering authority.

**Note:** It should be noted that Policy 5.7.3 of the Reserve Management Plan specifies that two camping sites be established with minimal toilet facilities and that a permit system be introduced if the pressure becomes too great in terms of health standards or disturbance to wildlife.

This policy implies camping on a casual basis. It is recommended that this policy be amended to only allow for permitted camping associated with work on the island as identified above or as the Society may deem suitable on a case by case basis.

## 15.2 COMMUNITY INVOLVEMENT IN ISLAND RESTORATION

The Whangarei community as well as the wider community of Northland has already made a substantial contribution to the restoration of Matakohe/Limestone Island through their participation in planting days, construction of wetlands, animal and plant control programmes and through fund raising. There is also considerable interest from the media in the project.

The ongoing support of the community is critical to the project and, as it gains momentum and the forest begins to develop, the range of opportunities for involvement will increase.

Volunteer participation opportunities on Matakohe/Limestone Island include:

- Planting and releasing of trees;
- Seed and cutting collection;
- Plant propagation (threatened and common species), introduction and monitoring;
- Wetland restoration;
- Shorebird monitoring;
- Insect and bird surveys;
- Reptile and insect introductions and monitoring;
- Weed control;
- Installation of signs;
- Track maintenance and construction
- Construction of facilities such as boardwalks, viewing platforms;
- Fundraising.

## 15.3 VISITOR FACILITIES

Limestone Island presently provides a composting toilet at the main landing, entrance signs and a series of walking tracks across the island (refer Map 6). As visitor numbers increase consideration will need to be given to additional facilities. These include toilets (composting or similar design which do not require water or high levels of maintenance), possible additional walking tracks, seats and interpretative signs and walks.

### **Toilets**

It is recommended that consideration be given to the construction of a composting toilet in the area around the pontoon as soon as possible as FOMLI is already experiencing problems with the lack of toilets in this area. This can be to the same design as the toilet near the Mine Manager's House. Construction of a third toilet in the trees at the top of the "ski slope" should also be considered within the next 5 years.

### **Seats**

It is proposed that wooden seats be located at various vantage points around the island (refer Map 6). These could be constructed out of macrocarpa from the island or sponsored by various people (this worked well at North Head Historic Reserve in Auckland). Sponsored seats would be a set price and a standard design. Seats provide a welcome break for people walking the tracks.

### **Additional Walking Tracks**

These are identified on Map 6. The intention is to eventually develop an all tide walk around the base of the island and provide access into the quarry. It is also proposed that a wheelchair accessible track be eventually developed from the northern beach landing along to the small quarry, which is intended as a rare native plant display.

All tracks should be constructed using the principles of minimal maintenance. They should be grassed or of natural materials from on-site and be no more than 1.5 metres wide. Design and maintenance should ensure that they are cross-falld so that water falls off them easily (built with a slight slope towards the low side so as to drain water away naturally as opposed to having culverts and water tables which are labour intensive and trap leaves).

Any steps that are required must be of an equal height that is easy for people to walk up and be maintained in a safe manner. Tracks are to be mowed and maintained on a regular basis. This includes removal of weeds and overhanging vegetation, which may be a public safety hazard.

### **View Shafts**

In order for visitors to enjoy the natural and historic values of Matakohe/Limestone Island it is proposed that revegetation and natural regeneration will be controlled in some areas to provide views over particular features. There are 6 proposed view points (refer Map 3):

- View from walking track looking down into Mine Manager's house;
- View from walking track taking in working men's quarters and main lime works ruins behind (may possibly include a viewing platform with interpretation);
- View from northern ridge down in lime works ruins;
- Panoramic view down Whangarei harbour with lime works ruins in the foreground overlooking the proposed flaxfields;
- Western point of island down over the sandspit and across to Cement Works (may possibly include a viewing platform with interpretation (would be a good place to acknowledge main sponsor);
- View from top of main quarry down into wetlands and up the harbour from Onerahi.

### **Signage and Information**

The following information hierarchy is proposed to supplement the existing entrance and locational signs and information provided about the island:

#### Level One: Entrance Signs

These are located at the two main entrance points on the northern and southern sides of the island. They are routed wood signs with the islands name, logo and basic symbols to identify activities that are permitted/not permitted on the island. Routed wooden signs are easy to construct and maintain and fit in with the landscape. Should these signs need to be replaced for any reason replacements should be the same design and format.

#### Level Two: Information Signs

These fall into two sub categories:

#### **Locational signs**

These identify individual tracks and are placed at the start, end and junctions of tracks. They may also be used to point to the direction of particular features such as the existing sign near the lime works ruins which shows the direction to the pa. These signs, like the entrance signs, should be constructed of wood and routed and mortised into the supporting posts.

#### **Information boards**

These are located at public gathering points. It is intended that there be three of these on the island – at each of the main entrances and one near the trig site. Information includes a map of the island with key features (tracks, toilets etc) and some key information about its history, the planting programme, key sponsors etc). Sponsorship could easily be obtained for these signs. An example of one produced for Tiritiri Matangi is attached as Appendix 16. They would

be constructed of a robust material such as tyvec, which is able to withstand the elements including high UV and vandalism.

*Level Three: Interpretation Signs*

These signs interpret key features on site. They would be composed of similar material to the information signs. Suggestions for locations of these signs include the following areas:

- around key parts of the limeworks ruins;
- the quarries;
- the trig (with information about the restoration programme);
- along tracks interpreting plants (refer Appendix 16 for design);
- near the pa and Maori gardens (with iwi approval);
- at the Mine Manager's house;
- at the base of the sculpture;
- with some of the view shaft lookouts.

Interpretation signs need to be able to tell a simple story with minimal wording and instead making use of pictures, old photos and other graphics. They want to be done in such a manner that they inspire people to want to walk further and learn more about the island. They would be done in the same material and style as the Level Two signs.

Another form of interpretation signage that would be appropriate for the lime works ruins is stenciling. This simply involves the use of letter stencils in an appropriately historic font (e.g. Times Roman) and colour (e.g. black, ochre, and grey) which are stenciled directly onto the side of buildings. This has been done very successfully at North Head Historic Reserve and has the added benefit of being long-lasting and extremely cheap to do and replace.

*Level Four: Signs for Management Purposes*

These signs include those for no fires (standard national triangular sign made of corflute), no dogs signs and signs associated with wildlife (e.g. shorebird nesting areas) and signs where public access needs to be restricted (the Rangers house, dangerous areas such as quarry edges).

Temporary signs such as fire season and shorebird nesting signs can be made from corflute, which as long as it is mounted properly will last a whole season. More permanent signs can be made from the same materials and the same format as Level Two and Three signs.

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## **16. Research and Monitoring**

The restoration of Matakohe/Limestone Island is a long term project and involves the use of a combination of proven techniques as well as the testing of new techniques and the modifying of existing techniques to fit the specific requirements of the island.

In order to test the effectiveness of these techniques and measure the success of the project, it is vital that there is a complementary programme of research and monitoring. A research and monitoring programme can also provide information on how to better manage some of the key features on the island as well as expanding the overall information base for the island.

For example an archaeological survey may uncover plant and animal remains that can provide a better indication of what species were originally present on the island. Pollen and soil sampling can provide information on soil types, which in turn will provide a better guide for the species of trees to plant on the island.

Research and monitoring is also important as an indicator of progress for sponsors who are always keen to see what the contribution they have made has actually achieved.

Research and monitoring does not need to be a time-consuming and expensive exercise. There are plenty of educational institutions (from schools to universities) who would be interested in undertaking short and long term projects on the island. In addition, research and monitoring is another key area of work that volunteers can get involved in.

Research and monitoring can be built into the everyday work and observations of the resident ranger and regular FOMLI visits to the island. It can be as simple as recording a new bird on the island or the growth patterns of individual plant species.

It is important however that all research and monitoring undertaken has a purpose and is robust. The information must be useful and must be in a form that is easy for people to understand. Records of all research and monitoring should be held in one central place and updated on a regular basis.

### **16.1 RESEARCH**

For the purposes of this restoration plan research is defined as pieces of work that are done to find out more about a specific subject. It may be a short piece of work to investigate the feasibility of restoring the Mine Manager's house or a more detailed piece of work, e.g. a survey to identify all mosses and lichens on the island or a review of the success of the animal control programme.

It is suggested that FOMLI develop a list of possible areas where research is needed and rank these in order of priority. The level of skill required to do the work is also important to assess as this will determine whether the work can be done by a school group or a highly skilled person or group. This list can build on work that FOMLI has already done with the development of work project briefs for the main work areas on the island<sup>111</sup>.

For all work undertaken as part of school, university, polytechnic or other educational projects, a copy of the final report should be requested for FOMLI records.

An initial list of research projects for Matakohe/Limestone Island could include:

- investigating the best methods of propagating individual species of plants;
- reviewing the success of animal and plant pest control programmes;
- determining which species grow best in which areas on the island;
- determining relative merits of blanket spraying and spot spraying;
- design of information and interpretation signs;

<sup>111</sup> Kokich, pers. comms.

- establishing a photo inventory of heritage sites and features on the island;
- surveying and recording lichen and moss species present on the island;
- trialing the use of fertiliser in some plantings;
- comparing different planting methods;
- archaeological survey;
- pollen analysis of soils;
- surveying and recording all plant species that naturally occur on the island.

## 16.2 MONITORING

More formalised monitoring and record keeping is needed in a number of key work areas on Matakohe/Limestone Island. These are identified in Table 6 along with methods of monitoring.

**Table 6: Proposed Monitoring Programme for Matakohe/Limestone Island**

<b>Work Area</b>	<b>Why Monitor</b>	<b>Technique</b>	<b>Monitoring Frequency</b>
Revegetation and Restoration of other forest communities	<ul style="list-style-type: none"> <li>• Record of species planted to date</li> <li>• Success of species planted to date</li> <li>• Water levels and pH in 6 pack wetlands for fish and insect introductions</li> </ul>	<ul style="list-style-type: none"> <li>• Database presently being established by FOMLI</li> <li>• Photo points established on the ground in representative habitats</li> <li>• Ruler and spa pool chemical test strips</li> </ul>	<ul style="list-style-type: none"> <li>• Updated after each planting day</li> <li>• Photograph annually</li> <li>• X4 per year until 2003</li> </ul>
Bird Introductions	<ul style="list-style-type: none"> <li>• Record of species on and around the island</li> <li>• Breeding success</li> <li>• Success of new introductions</li> </ul>	<ul style="list-style-type: none"> <li>• Bird surveys to establish abundance</li> <li>• Record breeding success</li> <li>• Species specific surveys</li> </ul>	<ul style="list-style-type: none"> <li>• Annually</li> <li>• Each breeding season</li> <li>• Species specific surveys (longterm)</li> </ul>
Reptiles, invertebrates	<ul style="list-style-type: none"> <li>• Success of new introductions</li> <li>• Success of remnant populations</li> </ul>	<ul style="list-style-type: none"> <li>• Species specific surveys</li> <li>• Species specific surveys</li> </ul>	<ul style="list-style-type: none"> <li>• Species specific surveys (longterm)</li> <li>• Periodic pitfall trapping or other methods (once every few years)</li> </ul>
Animal Pest Control	<ul style="list-style-type: none"> <li>• Success of control and reinvasion programmes</li> </ul>	<ul style="list-style-type: none"> <li>• Tracking tunnels, gnaw sticks, bait stations, visual observations, kills, traps</li> </ul>	<ul style="list-style-type: none"> <li>• Monitoring form (App.10) to be filled out after each line checked, kill made</li> </ul>
Plant Pest Control	<ul style="list-style-type: none"> <li>• Success of control and reinvasion programmes</li> </ul>	<ul style="list-style-type: none"> <li>• Monitoring form (App 15) to be filled out as work undertaken</li> </ul>	<ul style="list-style-type: none"> <li>• as work undertaken and new species found</li> </ul>
Historic Sites	<ul style="list-style-type: none"> <li>• condition reporting</li> </ul>	<ul style="list-style-type: none"> <li>• photo inventory and record sheet for each structure or feature</li> </ul>	<ul style="list-style-type: none"> <li>• updated periodically as changes occur</li> </ul>
Public Use and Involvement	<ul style="list-style-type: none"> <li>• public and sponsor interest</li> </ul>	<ul style="list-style-type: none"> <li>• database of volunteer work groups</li> <li>• visitor satisfaction surveys</li> </ul>	<ul style="list-style-type: none"> <li>• update as work undertaken</li> <li>• every two years</li> </ul>

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## **17. Summary and Action Plan**

### **17.1 KEY TASKS**

There are eight key tasks required to achieve the integrated management programme for Matakohe/Limestone Island:

- Restore coastal lowland forest communities;
- Attract and reintroduce avian pollinators and seed dispersers;
- Develop the main quarry as a freshwater wetland;
- Weed and predator control;
- Reintroduce vertebrate and invertebrate species once-common to ecosystems present on the island;
- Preserve and interpret cultural heritage sites and features;
- Provide for recreational use compatible with the Islands key features;
- Minimise the threat of fire

### **17.2 RECOMMENDATIONS**

Throughout the plan, recommendations have been made to assist with the achievement of various work areas and streamline the work that is undertaken. They are:

#### General

- Plant and animal species to be introduced to the island should be largely restricted to those that are indigenous to the Eastern Northland and Islands Ecological District
- Every effort should be taken to continue to foster community involvement in the restoration and management of Matakohe/Limestone Island
- The Department of Conservation should continue to be consulted on a regular basis for specialist advice on conservation management issues
- Research and monitoring is to be undertaken in all key work areas

#### Revegetation

- Coastal lowland broadleaved forest should be established as the main forest community on the island
- A detailed survey to map and record all native plant species that are naturally occurring on the island should be undertaken within the next year
- As seed sources develop on the island, these should be collected in preference to mainland sources
- A shade house and standing out/hardening off area should be established on the island in the vicinity of the rangers compound
- Blanket spraying of areas to be planted should be undertaken 2-3 months prior to planting dates
- Post plant spraying should be undertaken in areas where grasses may threaten plantings and/or inhibit seed fall
- Joint initiatives between FOMLI, the Department of Conservation and the Whangarei District Council should be explored to assist with the preservation of areas of remnant native bush on the surrounding mainland that could provide seed and animal sources for the island

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- No planting is to be undertaken in a manner that may restrict the use of the harbour navigation beacons
- Existing plantings which do/have the potential to restrict the beacons are to be removed as soon as possible
- Flammable weed species such as pampas and gorse should be regularly controlled in areas of potential fire risk
- Native species that are less flammable (e.g. karamu, ngaio) should be planted in areas of potential fire risk
- A flaxfield should be established on the small dry plateau above the limeworks to provide habitat for species such as flax weevil and flax snail
- Plantings should be undertaken in dense groups rather than regular spacings in order to shade out the regrowth of grasses and other weeds
- Companion planting should be undertaken around the perimeter of existing bush remnants in order to provide cover for seeds to germinate and shade out weeds as above
- Track edges along the top of the quarries should be planted with dense, low growing species to create a physical barrier to prevent people from walking to the quarry edges
- Advice should be sought from the Whangarei District Council as to what public safety precautions may be required along the Quarry edges
- Wattle regrowth is to be monitored in the main quarry area and any seedlings removed as soon as they are found

*Restoration of other vegetation communities*

- The fenced-in area surrounding the stock dam on the northern side should be planted with native species
- The salt marsh area on the southern side should be allowed to regenerate naturally with plantings being restricted to the landward side
- The pond on the plateau behind the limeworks should remain as a raupo wetland
- The sixpack wetlands should continue to be developed as wetland environments with a particular emphasis on creating edge and shelter plantings around each pond
- The two ephemeral watercourses on the northern side of the island should be vegetated with wetland species to assist with habitat creation and erosion control
- Historic sites are to be maintained in grassland and/or native ground covers
- Grazing will not be undertaken in grassland areas in the short to medium term

*Threatened Plants*

- Threatened plant introductions for large scale planting are to be limited to those species indigenous to the Eastern Northland and Islands Ecological District
- A conservation garden should be established for limited introductions of threatened plants from outside the above E.D. but inside the Northland Ecological Region

Birds

- All new introductions of bird species to the island are to be undertaken according to the permit requirements set by the Department of Conservation
- Weka should not be considered for release onto Matakohe/Limestone Island due to the small size of the island and the predatory nature of weka
- Brown kiwi should not be introduced until mice have been eradicated
- Species such as saddleback and robin should not be considered for introduction until the invertebrate population has built up to a level where it can sustain heavy predation by these species
- A comprehensive avifaunal survey should be undertaken on an annual basis
- A system of artificial feeding and water stations should be considered for the island as a way of attracting and retaining key bird species
- Breeding records are to be kept for each species of native and exotic bird
- The arrival of new bird species to the island should be recorded and information provided to the Department of Conservation to determine whether these species pose any threat

Reptiles

- Limestone Island should be developed as a refuge for northern species of reptiles and insects
- Self-sustaining invertebrate communities should be established well in advance of reptile communities
- Lizard releases prior to the eradication of mice should be limited to those species known to survive in the presence of mice
- A range of habitats should be created to provide for the introduction of a diverse range of lizard species
- Tuatara releases should be confined to open air enclosures scattered across the island

Other Vertebrates

- No vertebrate species are to be introduced in the short to medium term
- A monitoring programme should be established to measure the success of the water holding capacity of the six-pack wetland
- Introductions of freshwater fish may not be possible until there is a substantial lowering of pH levels in all wetlands. Further research into freshwater fish habitat requirements is recommended

Invertebrates

- Initial fauna introductions to the island should concentrate on the establishment of a healthy and self sustaining invertebrate community
- Limestone Island should be developed as a key refuge for invertebrates
- Mass collecting techniques should be experimented with as a means to introducing smaller invertebrate species to the island

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- Invertebrate introductions prior to the eradication of mice should be limited to those species that are known to be able to survive in the presence of mice
- Undertake an annual habitat assessment survey in association with the Department of Conservation. This should be done in conjunction with an invertebrate survey.

Control of Animal Pests

- The maintenance of bait stations and fenn traps is to be continued on the mainland surrounding the island and includes liaison with landowners
- All animal pest control and monitoring work undertaken is to be recorded on standard monitoring sheets
- Mice may be eradicated from the island beginning in June 2000
- A review is to be undertaken of the present animal control and monitoring programme as part of the development of the mouse eradication programme
- The present control and monitoring programme on the island is to be continued until the completion of the review
- Other exotic species such as mynas are to be monitored on a regular basis and advice sought from the Department of Conservation as to the level of risk they pose as populations grow
- Evidence of new exotic species on the island that can pose significant conservation threats such as Argentine ants are to be reported immediately to the Department of Conservation

Control of Plant Pests

- All plant pest control and monitoring work undertaken is to be recorded on standard monitoring sheets
- Weed control is to be undertaken according to the Weed Control Strategy
- New weed species found on the island are to be reported, recorded and controlled as soon as practically possible
- A weed map is to be compiled which identifies the location and extent of infestation for each species present on the island
- Both the weed map and control strategy are to be updated as new species are found on the island
- Every practical step is to be taken to prevent the establishment of new weed species on the island

Historic Site Management

- A detailed archaeological survey is to be undertaken on the island within the next two years
- A comprehensive history (both Maori and European) is to be compiled for the island
- Grassland and/or native ground cover is to be maintained around all historic sites
- Historic structures and features are to be maintained in a manner where they are kept weed free and pose no public safety hazard

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- Historic structures and features which may pose a public safety hazard are to be assessed by a heritage specialist and public access to them limited to a safe distance
- Demolition may be considered for some of the more dangerous structures and features
- Exotic tree species with heritage significance are to be managed in such a way that they do not become a weed threat
- Limited exotic plantings of species which do not pose a weed threat are permitted around the Mine Manager's house

Fire

- All practical steps are to be taken to minimise the fire risk
- Basic fire fighting equipment should be established on the island and maintained in working order
- The resident ranger is to be trained to a basic level of fire readiness

Public Use and Involvement

- The island is to continue to be freely accessible to day visitors
- Public use of the island is to be restricted to those activities that do not compromise the natural and heritage values of the island
- Commercial boats are to be restricted to landing people at the pontoon
- Camping is only permitted for groups undertaking work on the island or at the discretion of the Society
- The reserve management plan should be amended to reflect the above recommendation
- Community involvement in the restoration programme is to be actively encouraged
- Consideration should be given to the establishment of a composting toilet near the pontoon
- Wooden seats and view points are to be established in various locations around the island
- An all tide walking track should be established around the base of the island
- All access tracks are to be maintained in a safe manner
- An information hierarchy of signs and pamphlets is to be introduced

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17.3: TIMELINE FOR PERIOD FROM 2000 – 2005

Area of Work	2000	2001	2002	2003	2004	2005	2006 and beyond
<b>Revegetation</b>	<ul style="list-style-type: none"> <li>Planting target 23000 trees</li> <li>Millennium tree planting day</li> <li>Map viable seed sources on island and collect when appropriate</li> <li>Map and record all naturally occurring plant species</li> <li>Remove plantings obstructing navigation beacons</li> <li>Confirm location of sculpture</li> <li>Identify areas to be maintained as viewshafts</li> <li>Continue interplanting in western point bush</li> <li>Confirm total number and location of all Australian/Tasmanian ngaio</li> </ul>	<ul style="list-style-type: none"> <li>Planting target 10,000 trees</li> <li>Establish shade house and standing out area</li> <li>Explore joint initiatives for protection of mainland forest remnants</li> <li>Begin establishment of flaxfield</li> <li>Begin barrier planting along quarry tops</li> <li>Begin removal of Tasmanian Ngaio and replacement with other species</li> <li>Begin interplanting along northern coast</li> <li>Source stock for planting quarry faces</li> <li>Collect seed for companion planting around bush remnants</li> <li>Experimental hand broadcasting of quarry faces with pohutukawa seed</li> </ul>	<ul style="list-style-type: none"> <li>Planting target 10,000 trees</li> <li>Plant ferns and groundcover in Western Point bush</li> <li>Continue with Tasmanian Ngaio replacement programme</li> <li>Begin planting kauri gullies</li> <li>Develop a soil profile map of the island</li> <li>Begin planting quarry faces</li> <li>Collect seed for companion planting around remnants</li> <li>Source species for planting on accessible coastal cliffs</li> </ul>	<ul style="list-style-type: none"> <li>Planting target 10,000 trees</li> <li>Complete Tasmanian Ngaio replacement programme</li> <li>Complete planting of kauri gullies</li> <li>Continue planting quarry faces</li> <li>Begin companion planting around remnants</li> </ul>	<ul style="list-style-type: none"> <li>Planting target 10,000 trees</li> <li>Continue companion planting around remnants</li> <li>Begin planting accessible coastal cliffs</li> </ul>	<ul style="list-style-type: none"> <li>Planting target 10,000 trees</li> <li>Increasing amounts of seed should be being collected from the island by now</li> <li>Continue planting coastal cliffs</li> </ul>	<ul style="list-style-type: none"> <li>Planting target 10,000 trees annually</li> <li>Aim to have at least 30% of the island planted in coastal forest by 2006</li> </ul>
<b>Restoration of other plant communities</b>	<ul style="list-style-type: none"> <li>Plant fenced-in area surrounding stock dam</li> <li>Establish a 6 monthly programme to monitor the water and pH levels in the 6 pack wetlands until 2003</li> </ul>	<ul style="list-style-type: none"> <li>Begin planting of 2 northern watercourse edges</li> <li>Continue planting of saltmarsh edges</li> </ul>	<ul style="list-style-type: none"> <li>Compile a list of mosses and lichens present</li> <li>Review water holding capacity and pH levels in 6 pack wetlands</li> </ul>				
<b>Threatened Plants</b>		<ul style="list-style-type: none"> <li>Identify species that could be grown by volunteers at home for subsequent introduction to the island following mice eradication</li> </ul>	<ul style="list-style-type: none"> <li>Investigate site for conservation garden</li> <li>Identify source seed and plants for conservation garden</li> <li>Begin planting Cat 1 species</li> </ul>	<ul style="list-style-type: none"> <li>Establish conservation garden</li> <li>Continue planting Cat 1 species</li> </ul>	<ul style="list-style-type: none"> <li>Begin planting conservation garden with Cat 2 species</li> </ul>	<ul style="list-style-type: none"> <li>Continue establishment programme for both categories</li> </ul>	<ul style="list-style-type: none"> <li>Continue establishment programme for both categories</li> </ul>
<b>Bird Introductions</b>	<ul style="list-style-type: none"> <li>Initiate annual bird survey</li> </ul>	<ul style="list-style-type: none"> <li>Introduce Operation Nest egg kiwi</li> <li>Tui and kereru may begin to stay on island</li> </ul>		<ul style="list-style-type: none"> <li>Additional kiwi introductions</li> <li>North Island tomtit introduction</li> </ul>	<ul style="list-style-type: none"> <li>Bellbird release possible</li> <li>North Island Robin release possible</li> </ul>	<ul style="list-style-type: none"> <li>Investigate locations for installation of artificial burrows for petrels</li> <li>Kakariki, whitehead, saddleback, stitchbird releases</li> </ul>	<ul style="list-style-type: none"> <li>Construct burrows and experiment with call tapes</li> </ul>
<b>Reptile Introductions</b>		<ul style="list-style-type: none"> <li>Introductions of mouse tolerant lizard species</li> <li>Research options and practicalities of establishing open air tuatara enclosures</li> </ul>	<ul style="list-style-type: none"> <li>Seek funding for tuatara enclosures</li> </ul>	<ul style="list-style-type: none"> <li>Begin introductions of other lizard species</li> <li>Build tuatara enclosure for trial</li> </ul>	<ul style="list-style-type: none"> <li>Trial release of tuatara into enclosures</li> </ul>	<ul style="list-style-type: none"> <li>Build more tuatara enclosures</li> </ul>	<ul style="list-style-type: none"> <li>Release additional tuatara</li> </ul>
<b>Other Vertebrate Introductions</b>			<ul style="list-style-type: none"> <li>Review potential for 6 pack wetlands to hold native fish and frog species</li> </ul>		<ul style="list-style-type: none"> <li>Possible release of inanga into 6 pack wetlands</li> </ul>		
<b>Invertebrate Introductions</b>	<ul style="list-style-type: none"> <li>Research mass collection techniques and identify suitable collecting locations</li> <li>Tree weta released in March 2000</li> </ul>	<ul style="list-style-type: none"> <li>Confirm source locations for larger species of invertebrates</li> <li>Begin introductions of more common species</li> </ul>	<ul style="list-style-type: none"> <li>Begin mass collection introductions to Western Point bush</li> <li>Continue introductions of more common species</li> </ul>	<ul style="list-style-type: none"> <li>Begin introductions of rarer larger species of invertebrates providing mice have been eradicated</li> </ul>			

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17.3 Timeline cont.

Area of Work	2000	2001	2002	2003	2004	2005	2006 and beyond
<b>Animal Pest Control</b>	<ul style="list-style-type: none"> <li>Review animal pest control programme</li> <li>Eradicate mice</li> <li>Initiate use of recording sheets</li> </ul>	<ul style="list-style-type: none"> <li>Mouse mop up control</li> <li>Initiate amended animal pest control programme</li> <li>Continue snail control</li> </ul>	<ul style="list-style-type: none"> <li>Declare mouse free status if appropriate</li> <li>Continue snail control</li> </ul>	<ul style="list-style-type: none"> <li>Maintain island to predator free status and minimise reinvasions</li> <li>Continue snail control</li> </ul>	<ul style="list-style-type: none"> <li>Maintain island to predator free status and minimise reinvasions</li> <li>Snail numbers should be decreasing as forest cover develops</li> </ul>	<ul style="list-style-type: none"> <li>Maintain island to predator free status and minimise reinvasions</li> <li>Review animal pest control and reinvasion programme</li> </ul>	<ul style="list-style-type: none"> <li>Implement amended programme</li> </ul>
<b>Plant Pest Control</b>	<ul style="list-style-type: none"> <li>Initiate use of recording sheets</li> <li>Map all weed infestations present</li> </ul>	<ul style="list-style-type: none"> <li>Continue control as per strategy</li> </ul>	Continue control as per strategy	Continue control as per strategy	Continue control as per strategy	<ul style="list-style-type: none"> <li>Review weed control strategy</li> </ul>	Implement amended programme
<b>Historic Site Management</b>	<ul style="list-style-type: none"> <li>Investigate feasibility of conservation/restoration plan for Mine Manager's house</li> <li>Pa mowing/maintenance</li> </ul>	<ul style="list-style-type: none"> <li>Undertake a comprehensive archaeological survey (includes records of buildings)</li> <li>Liaise with iwi over identification of key sites</li> <li>Seek funding for conservation plan for Mine Manager's house</li> <li>Compile photo inventory of all heritage sites and features on the island</li> <li>Pa mowing/maintenance</li> </ul>	<ul style="list-style-type: none"> <li>Compile comprehensive history of island settlement</li> <li>Conservation plan for Mine Manager's house done</li> <li>Monitor condition of heritage trees</li> <li>Pa mowing/maintenance</li> </ul>	<ul style="list-style-type: none"> <li>Seek sponsorship for restoration of Mine Managers House</li> <li>Pa mowing/maintenance</li> </ul>	<ul style="list-style-type: none"> <li>Begin restoration of Mine Managers house</li> <li>Pa mowing/maintenance</li> </ul>	<ul style="list-style-type: none"> <li>Continue restoration of Mine Managers house</li> <li>Pa mowing/maintenance</li> </ul>	<ul style="list-style-type: none"> <li>Pa mowing/maintenance</li> </ul>
<b>Fire</b>	<ul style="list-style-type: none"> <li>Review fire gear on island</li> <li>Train ranger to Crew Boss standard</li> <li>Establish fire plan for island and backup</li> </ul>	<ul style="list-style-type: none"> <li>Check condition of fire gear prior to summer</li> <li>Refresher training</li> </ul>	<ul style="list-style-type: none"> <li>Check condition of fire gear prior to summer</li> <li>Refresher training</li> </ul>	<ul style="list-style-type: none"> <li>Check condition of fire gear prior to summer</li> <li>Refresher training</li> </ul>	<ul style="list-style-type: none"> <li>Check condition of fire gear prior to summer</li> <li>Refresher training</li> </ul>	<ul style="list-style-type: none"> <li>Check condition of fire gear prior to summer</li> <li>Refresher training</li> </ul>	<ul style="list-style-type: none"> <li>Check condition of fire gear prior to summer</li> <li>Refresher training</li> </ul>
<b>Public Use and Involvement</b>	<ul style="list-style-type: none"> <li>Seek advice from Whangarei District Council as to safety precautions along quarry edges</li> <li>Amend Management Plan re camping</li> <li>Begin introduction of sign hierachy by identifying key areas for information and interpretation and draft some designs</li> <li>Develop information pamphlet for island detailing restoration work and threats, e.g. weeds, fire etc</li> </ul>	<ul style="list-style-type: none"> <li>Realign top quarry edge track away from edge in line with barrier plantings</li> <li>Seek consents and funding for new toilet</li> <li>Begin establishment of all tide walking track</li> <li>Establish information boards at key locations</li> <li>Begin stenciling on buildings</li> <li>Agree on standard wooden seat design and advertise for sponsors</li> </ul>	<ul style="list-style-type: none"> <li>Establish a composting toilet near Pontoon</li> <li>Complete establishment of all tide walking track</li> <li>Complete stenciling on buildings</li> <li>Begin installation of wooden seats</li> </ul>	<ul style="list-style-type: none"> <li>Investigate opportunities for a wheelchair accessible track</li> <li>Establish a self guided walk around the island</li> </ul>	<ul style="list-style-type: none"> <li>Seek funding for wheelchair track</li> <li>Establish a loop track self guided walk around the limeworks and quarries</li> </ul>	<ul style="list-style-type: none"> <li>Install wheelchair track</li> </ul>	
<b>Research and Monitoring</b>	<ul style="list-style-type: none"> <li>Complete establishment of database for planting records</li> <li>Initiate annual bird survey</li> </ul>	<ul style="list-style-type: none"> <li>Install vegetation monitoring plots</li> <li>Initiate annual invertebrate habitat assessment and population survey</li> </ul>				<ul style="list-style-type: none"> <li>Review restoration plan</li> </ul>	<ul style="list-style-type: none"> <li>Implement amended restoration plan</li> <li>Undertake invertebrate survey</li> </ul>

**TIMELINE FOR 2006 AND BEYOND IS INDICATIVE ONLY, AS PLANNED PROGRESS SHOULD BE REVIEWED IN 2005**

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## **Acknowledgements**

The production of this Restoration Plan has been a bigger exercise than I initially envisaged! However it has been made into a challenging and exciting exercise through the tremendous amount of work that has been done on the island to date by David Wright, the Resident Ranger, the Friends of Matakohe/Limestone Island, organisations such as the Department of Conservation, Northland Regional Council and Whangarei District Council and the many volunteers that have assisted with various areas of work on and off the island.

The Golden Bay Cement Company also deserves considerable acknowledgement for without their generous sponsorship package much of the work on the island done on the island to date would not have happened.

The island is a credit to all who have been associated with it and is proof of how effective community participation in conservation projects can be.

In preparing this Plan I would like to acknowledge the following people in particular:

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Mike McGlynn, Nic Gorman.	Environmental Consultants
Roger Stevenson	Skywork Helicopters Limited

The plan has been developed using the Mana Island Ecological Restoration Plan as a working model. This plan was written by Colin Miskelly for the Department of Conservation and is a valuable reference document for those working on Matakohe/Limestone Island.

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