The Rangitoto and Motutapu Pest Eradication - A Feasibility Study

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Te Papa Atawhai

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Executive Summary

The eradication of the seven remaining animal pest species remaining on Rangitoto and Motutapu was announced by the Prime Minister and Minister of Conservation in June 2006. With stoats, cats, hedgehogs, rabbits, mice and two species of rats spread across an area of 3842ha, the proposed project is the most challenging and complex island pest eradication the Department of Conservation (DOC) has ever attempted. To better understand the scale and complexity of the project, a feasibility study was undertaken. This study considered the ecological, economic and social context of the project to allow an informed decision to be made on whether or not to commit resources to further eradication planning. This document outlines the findings of the feasibility study and concludes that while a number of contingencies exist within the project, the proposed eradication is not only feasible, but has many significant benefits.

No single precedent exists on which this project can be modelled and information from a wide range of sources has been required. Previous eradication and control programmes have been reviewed in conjunction with what is known about the behaviour and biology of the target species. In some cases, where information has not been available and could not be inferred, trials have been undertaken. The document has been reviewed by a number of experts both within New Zealand and overseas including DOC's Island Eradication Advisory Group. Consultation has also been undertaken with all of the islands' key stakeholders and communities of interest. Comments from all of these parties have been reflected in the report.

Rangitoto is an iconic Scenic Reserve located just 9km from downtown Auckland City. The island is internationally significant both for its ecology and geology and is an extremely popular visitor destination served by regular ferry services. Motutapu, a Recreation Reserve, is connected to and positioned immediately to the east of Rangitoto. The island, currently managed as a pastoral farm, is noted for its extensive archaeological record but retains a diverse range of habitat types and is the focus of a community-led restoration programme.

In addressing the question, 'can it be done?' particular attention has been paid to mice, ship rats, hedgehogs and rabbits as eradication of these species on the scale of Rangitoto and Motutapu has never been attempted. Preventing reinvasion on such highly accessible and intensively visited islands is also an enormous undertaking. It is accepted, that of all the target species, mice present the greatest risk of failure. However, while a number of mouse eradications around the world have failed, all ten attempts on islands beyond the swimming range of mice that have followed current Departmental best practice have been successful, providing confidence in the method. Rangitoto and Motutapu are a significant step up from previous operations in terms of scale but are also the logical next step to apply current techniques. Despite the unprecedented elements within the project, it is considered that the

key dependencies on which eradication success relies can be met for the species targeted.

Preventing reinvasion is perhaps the most important consideration of the feasibility study and the one that will ultimately determine the fate of the project. Achieving an adequate level of protection for the islands hinges heavily on changing the behaviour of all 100,000 visitors that arrive on an annual basis. Without this any investments made in removing pests will be wasted. Bringing these changes about appears possible but is contingent on a number of commitments and actions that must be put in place by both DOC and its key partners.

The feasibility study also addresses what the project will take to complete and attempts to identify as many of the planning issues as possible to enable the project to be properly sized. It explores the techniques that must be used, the resources that will be required and the timeframe over which they need to be deployed.

While this eradication project is the most challenging and complex to be undertaken by DOC, it also presents a significant opportunity to improve our current understanding of eradication theory and practice. If successful, the project offers outstanding benefits for conservation. The recovery of locally and nationally endangered species, the creation of a stepping stone for wildlife movement between the Hauraki Gulf and the Auckland isthmus, the potential for advocacy and education, and increased recreation and economic opportunities are just some of the likely gains. The study has shown that this project is feasible, but also that there are many significant reasons why it should proceed.


Rangitoto and Motutapu Islands
0 0.5 1 2 Kilometers
N
Billy Goat Point
Rangitoto Island
Rangitoto 260m
Rangitoto 15m
Boulder Bay
Gardiner Cliff
Administration Bay
Sandy Bay
Station Bay
Mullet Bay
Home Bay
Centre Point 115m
Motutapu
Motutapu
Otahuhu Point
Islington Bay
Islington 10m
Islington Jetty
Emu Bay
Emu Point
Emu Rock
Channel
Motuihe
Motuihe I
Rangitoto I
Flax Point
Seafowl rookeries
Wharf
Lava caves
Reservoir
Ilomama Rock
Channel
Motukorea
Browns I
(Motukorea)
Bean Rock
West Bastion Reef
East Bastion Reef
Achilles Point
Ladies Bay
Pipimea Head
Kohimarama Bch
Gower Pt
St. Heliers
West Tamaki Head
Kaneka Bay
Musick Point
Mission Bay
St Heliers
Rakino Channel
Waikalabubu Bay
Three Sisters
Fowlhouse
Greenbush
Te Tumu
Ohinerehia
Pare torotika
Mangoparerua Point
One horahia
Waihoorangatahi Bay
O Runu tumaro
Nga Taikorapa
Department of Conservation
Te Papa Atawbari
New Zealand Government

CONTENTS

1. Site Description and Background Information

1.1 OVERVIEW

Rangitoto is an iconic Scenic Reserve administered by DOC, located 9km from downtown Auckland City within the inner Hauraki Gulf. The island is a popular visitor destination served by regular ferry services and has a small number of baches currently used privately under occupational licenses.

Motutapu, a Recreation Reserve, is positioned immediately to the east of Rangitoto and is physically linked to Rangitoto by a causeway and an area of mudflats on its eastern side, across the Gardiner Gap. The island is noted for its extensive archaeological record representing more than five centuries of Maori settlement and history. Numerous defence installations were built on Motutapu during World War II and most of these still remain. The rolling landscape of the island has been developed as pastoral farmland. An outdoor education camp is run from Administration Bay and a DOC administered campsite is located at Home Bay. DOC operations on Rangitoto and Motutapu are run from a field office on Motutapu. The island is now the focus of a restoration programme that aims to reforest parts of the island.

1.2 PHYSICAL LANDSCAPE

Rangitoto is Auckland's youngest volcano, formed around 600 years ago. The 2311ha island is circular in shape, approximately 5km across, 259m high, and comprised of gently sloping basaltic lava and ash base with a central cinder cone. The island is of international significance for its succession from barren lava and rock to fully vegetated island. It is nationally significant for its lava caves and as the youngest, largest and least weathered basalt volcano in New Zealand.

Motutapu is a relatively low lying island of 1509ha, with a gentle and rolling topography. The island's coastline is dominated by steep coastal cliffs, rocky shore platforms and swampy, steeply backed beaches. It is geologically quite separate and far older than Rangitoto, being composed of basement greywacke laid down 180-120 million years ago, and overlaid with Waitemata group sedimentary rocks. During the eruption of Rangitoto, much of the island was blanketed with volcanic ash.

The two islands are connected by a causeway built during World War II and subsequent to the building of the causeway several hundred metres of mud flats which are exposed at low tide. There are several rock stacks

adjacent to Motutapu and Rangitoto, notably those offshore to the north of Motutapu and to the west of Rangitoto. Some of these are covered and uncovered by the tides.

1.3 CLIMATE

While the mean annual temperature on Rangitoto is a moderate 15.7°C and the mean annual rainfall is 1185mm, local climatic conditions can be extreme. Areas of open basalt can reach temperatures of up to 70°C in summer and with the exception of one small wetland there is no surface water on the island. There is a rainfall gradient across the island increasing from west to east and with altitude. Consequently the wettest parts of the island are the summit and Mackenzie Bay and the driest is Boulder Bay.

The climate of Motutapu is similar to Rangitoto albeit without the extremes. Motutapu lies in the rain shadow of Rangitoto and receives slightly less rainfall. The 1092mm of rainfall the island receives on an annual basis falls mainly between autumn and spring. The mean annual temperature on Motutapu is the same as for Rangitoto.

1.4 PLANTS, ANIMALS AND HABITAT

The ecological significance of Rangitoto is recognised in its status as a separate and entire ecological district. It is unique for its colonising Metrosideros hybrid-dominated forest and shrub land associations growing on basaltic lava and scoria. Hybrids between pohutukawa and northern rata occur in all sorts of combinations, with pohutukawa characteristics usually dominating.

Dominant species associated with the Metrosideros hybrids include puka, mapou, astelia, manuka, akepiro, Hebe stricta var. stricta, and rewarewa. There are more than 200 species of native flowering plants and native ferns. Some show unusual characteristics, for example some plants that are more commonly epiphytes are found on the ground on Rangitoto. These include puka, tree rata, Kirk's daisy, and Collospermum hastatum.

The island has a limited number of forest birds. The insectivorous species, silvereye, grey warbler and fantail are most common. Shining cuckoo are seasonally common. There is a large variety of intertidal and coastal birdlife, and six black-backed gull breeding colonies on the island. A few species of skink are found on the island and 15 species of land snail have been recorded in leaf litter.

Like much of New Zealand, the biological landscape of Motutapu has been culturally determined for many successive generations. The Rangitoto ash shower and subsequent modification by Maori and Europeans has resulted in the clearance of much of the island's original forest cover. The island has been grazed since the 19th century and is largely in pasture.

Pockets of native vegetation still remain in wetlands, small forest patches, and coastal forest. Wetlands are a feature of the island and provide a range of habitats influenced by water level and degree of stock disturbance. Predominant species are raupo (Typha orientalis) and Calystegia soldanella. The few remaining forest remnants are small and scattered. Characteristic species are pohutukawa (Metrosideros excelsia), karaka (Corynocarpus laevigatus), mangeao (Litsea calicaris), tawapou (Pouteria costata), kohekohe (Dysoxylum spectabile), taraire (Beilschmieda taraire), puriri (Vitex lucens), and kowhai (Sophora tetraptera). Pohutukawa is the dominant coastal species, with coastal forest associations of karo (Pittosporum crassifolium), houpara (Pseudopanax lessonii), karamu (Coprosma robusta) and kawakawa (Macropiper excelsum) greatly reduced. These coastal communities have partially recovered as a result of possum and wallaby removal.

The native fauna on Motutapu is relatively depleted as a result of extensive land modification and the effect of introduced predators. Coastal birds are common, but the number of native forest bird species is limited with the insectivorous species of silvereye, grey warbler and fantail being most common. Reptile species present include the egg laying skink (Oligosoma suteri), moko skink (O. moco), copper skink (Cyclodina aenea) and common gecko (Hoplodactylus maculatus).

A major community based restoration programme led by the Motutapu Restoration Trust began in 1993 with the intention of restoring the ecological and historic values of the island. To date more than 400,000 trees have been planted and work has begun on the restoration of historic sites.

1.5 TARGET PEST SPECIES

A programme to eradicate possums and wallabies on Rangitoto and Motutapu was successfully undertaken in the 1990s (Mowbray 2002). However, rats, mice, stoats, rabbits, hedgehogs and feral cats are still present on both islands. Mice have been trapped in most habitats on the islands including areas of open lava on Rangitoto. Trapping indices for mice on Rangitoto as determined by Miller & Miller (1995) were comparatively high (1.6 C100TN-1 to 12 C100TN-1) relative to mainland sites where mice coexist with ship rats suggesting that the broken lava may offer a level of protection from predation or competitive pressure from ship rats. As has been found elsewhere (Innes 2005), mouse population densities on Motutapu appear to be highest in areas with dense ground cover such as rank grassland (Mackay pers. comm.).

Pregnant and/or lactating mice were caught in most months of the year except July although no sampling was completed in August (Miller & Miller 1995) and while breeding appeared to decline markedly from the end of June through to the beginning of September it is possible that some breeding occurs in winter. From stomach analysis, the diet of mice on Rangitoto appears to be dominated by invertebrates throughout the year with fruit and seed forming a less important component (Miller &

Miller 1995). The diet of mice inhabiting grassland habitats on Motutapu is likely to be significantly different.

Ship rats are also present across both islands but appear to be most numerous within or near forested patches (Miller & Miller 1995, pers. obs.). Like mice their diet is dominated by invertebrates, most notably tree weta (Hemideina thoracica). Their diet also includes fruit, seed (karo) and plant material (Miller & Miller 1995). Ship rat abundance declined markedly following the aerial application of 1080 baits for wallaby and possum eradication, but within 12 months, had increased to near pre-poisoning levels.

Norway rats have never been trapped on Rangitoto (Miller & Miller 1995) and have not been detected recently on Motutapu despite intensive and extensive trapping (pers. obs.). Norway rats were recorded on Motutapu in the 1980s (Atkinson 1986; Taylor 1989) but may have disappeared during the wallaby and possum eradication when toxic bait was used extensively on the island (Keeling pers. comm.), or more likely are now simply present at very low densities.

Stoats appear to be more numerous or at least more visible on Rangitoto than Motutapu possibly as a result of lower levels of competition and predation by cats. Cats are present in much higher numbers on Motutapu. Trapping of stoats on Rangitoto resulted in multiple captures at each trap site over a period of weeks (Keeling pers. comm.). A number of stoats have become almost tame at the summit where they survive on discarded food left by the public.

Hedgehogs are common and widely distributed on Motutapu but are rare or absent from much of Rangitoto. Intensive trapping on Rangitoto has yielded very few individuals and only in areas of even and gentle terrain, for example, the ash cone, roads and bach sections. Hedgehogs are found in most habitats on Motutapu but appear to spend most time in open pasture where slugs and other invertebrates are abundant.

While common on Motutapu, cats are rare on Rangitoto and although occasionally seen around the island's baches, have never been trapped there (Keeling pers. comm.). Based on anecdotal observations the number of cats on Motutapu could exceed 100 individuals. When rabbit densities were high, prior to the arrival of rabbit hemorrhagic disease (RHD)[1] , the diet of cats on Motutapu consisted primarily of rabbit. Following the resultant population crash induced by RHD, this was replaced with invertebrates, reptiles, birds and rodents in order of decreasing quantity in samples analysed (Keeling pers. comm.).

Rabbits are present on Rangitoto but like hedgehogs are restricted by terrain. They are present in very low numbers at McKenzie Bay, on the ash cone and in the areas around Rangitoto and Yankee wharves. They are more numerous on Motutapu but are at surprisingly low densities considering the habitat available. It is assumed, based on the findings of other studies, that a combination of predator pressure and RHD is curbing population growth. Recent spotlight surveys show a patchy population distribution with low densities of rabbits even in the most heavily populated areas.

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[1] RHD or RCD is thought to have been intentionally introduced to Motutapu in the 1990's when rabbits were in high numbers on the island.

1.6 HISTORIC AND CULTURAL HERITAGE

Rangitoto features significantly in Maori tradition. An early reference to Rangitoto is as "Nga Pona toru a Peretu" - the three knuckles of Peretu, a local chief. Another early name given to Rangitoto was by the tohunga Taikehu, who named the three peaks "Nga Tuaitara o Taikehu" (the dorsal fins of Taikehu). According to Ngai Tai tradition, Peretu used Rangitoto as a rahui-kaka (parrot reserve).

The Arawa and Tainui canoes arrived at Rangitoto in the 14th century. The commanders in charge of the two canoes, Tamatekapua and Hoturoa, quarrelled and Rangitoto's full traditional name of "Te Rangi i Totongia a Tamatekapua" is traced to "the day that the blood of Tamatekapua was shed". Rangitoto was not generally occupied by Maori because of its rocky terrain and lack of water, and its tapu status because of Tamatekapua's shed blood.

Rangitoto was purchased by the Crown in 1854. The island provided an early source of basalt for building construction in Auckland. The quarries are now closed. The island was designated a public domain in 1890 and became a popular destination for picnickers and day trippers. During the early 1900s the Devonport Borough Council, acting outside its powers, allowed the establishment of camp sites and privately-owned baches on the island. Thirty baches remain on Rangitoto and are held under occupation licences which remain for the life of the present tenants. They have remained largely unmodified since the 1930s.

During the 1920s and 1930s, prisoners built roads, tracks and other facilities, including the tracks presently used on Rangitoto. During World War II Rangitoto was a prohibited area. The summit was used as a radar station and base for harbour defence and fire control for Auckland's coastal defences. A large controlled mine base was built at Islington Bay and defence installations were constructed at other locations around the coast.

The natural character of Motutapu has long been culturally determined. The productivity of the island has attracted successive generations to make it their home and the record they left behind makes Motutapu of prime importance in discovering and understanding the human history of Auckland. The earliest occupation on Motutapu or as it was traditionally known, "Te Motu Tapu a Taikehu" occurred before Rangitoto erupted from the sea, and the archaeological sites preserved on Motutapu beneath the Rangitoto ash are some of the oldest in the country.

The Rangitoto eruption probably destroyed much of the remaining forest, as well as villages and gardens. It also transformed the heavy clay soils on Motutapu into friable loams, well suited to Maori horticulture. Maori settlement and use intensified over 500 years or so until Pakeha arrived.

From 1840 to the late 1940s, the island was farmed under European ownership.

The two main farm settlements were at Emu Bay and Home Bay. With

the introduction of grazing animals, the landscape of Motutapu changed again. Numerous defence installations were built on Motutapu during World War II, including a 6" gun battery and observation post, pill box and searchlight installation, stone sheds, and underground ammunition stores, roads, and barracks at Administration Bay.

Today, most of Motutapu is a pastoral farm with a few hints of its former vegetation and a wealth of historic sites and landscapes. These reflect, layer upon layer, the richness and complexity of human settlement, use and reverence for this island. More than 300 archaeological sites have been recorded and perhaps as many remain unrecorded. There is evidence of undefended settlements, terraced house sites, pits for storage, cooking areas, middens, stone working sites and pa. Of particular significance is the Sunde site, where footprints of humans and dogs have been preserved in solidified layers of Rangitoto ash.

The archaeological landscape is the product of some five centuries of Maori life on the island, overlain with the effects of one and a half centuries of European activity, principally farming, and the military occupation during World War II. In places, some of these activities have destroyed or submerged the Maori sites. In other places, sites ranging from pa and large villages to tiny hamlets are well preserved.

1.7 USE AND ACCESSIBILITY

Rangitoto is a landmark and symbol for Auckland. It is a popular and growing recreation destination, receiving upwards of 100,000 visitors per year. The island is the most easily accessible of the island reserves in the Hauraki Gulf, and there are regular ferry services. A number of tracks provide all year round walking opportunities, with the summit tracks being the most popular. A ring road built by prisoners encircles half of the island and a causeway links Rangitoto to Motutapu. The island's large underground freshwater "lens" reservoir has previously been assessed and rejected as a potential metropolitan water supply. Bee keeping has been carried out on the island since the turn of the 20th century.

Unlike Motutapu, where most of the natural vegetation has been destroyed, Rangitoto has retained its indigenous cover. With the eradication of possums and wallabies, it is now realistic to manage this island in a way which allows indigenous biological processes to predominate, intervening only to the extent of limiting or removing exotic influences. Because of its location and ease of access, and its high visitor carrying capacity, Rangitoto will continue to be a focal place for public recreation and conservation education.

Because of its history and location close to Auckland, Motutapu offers unique opportunities to involve Aucklanders and other New Zealanders in conservation activities, and to increase their understanding and appreciation of heritage values.

At present, much of the island is managed as a farm under a grazing lease. The lease provides for open public access to the island. Pastoral farming

is considered the most appropriate management technique available for managing archaeological sites on the scale of Motutapu. Farmland also contributes to the island's open space character, and facilitates easy access for visitors. The island is a popular boating destination, and receives high recreational use, particularly over the summer period.

The Motutapu Outdoor Education Camp (MOEC) at Administration Bay is operated by the MOEC Trust. It receives over 8000 visitors per year who are predominantly school pupils from Year Seven to Year Thirteen. It is an important outdoor education facility providing opportunities for recreation, education and interpretation of natural and historic values. Most parts of the island are easily accessible by road or track but most recreational activity occurs on the coast.

The majority of island visitors travel by ferry from Auckland and land at Rangitoto Wharf. To get to Motutapu, ferry passengers must currently walk around Rangitoto and across the causeway between the islands, although there are plans to reinstate ferry sailings into Home Bay on Motutapu. The number of visitors to Home Bay is expected to increase following the opening of a visitor centre at the Reid Homestead by the Motutapu Restoration Trust. A small percentage of visitors come by private boat, landing at various points on the island, but mostly at Islington Bay because of its good anchorage. Other anchorages are Mullet, Station and Waikalabubu (Waikarapupu) Bays on the east coast.

Recreational activities on Motutapu include swimming, fishing, kayaking, sailing, walking and sightseeing. There are four main tracks on the island. The Motutapu Farm Walkway links the Islington Bay causeway to Home Bay and is used by between 1000 and 2000 people per year. A track from the Motutapu Outdoor Education Camp (MOEC) in the north of the island receives a much higher level of use, about 7500 visitors per year, many of whom come from the Education Camp.

Home Bay campground, with basic facilities and 50 sites, is used by more than 4000 people per year. Approximately 5000 use Home Bay on a casual day-use basis, and a further 5000 use the causeway and Lynfield Beach.

1.8 INFRASTRUCTURE

Apart from 30 baches built in the 1930s and an information kiosk and toilets at Rangitoto wharf, infrastructure and built development on Rangitoto is limited. There is no reticulated water supply and water is sourced from groundwater bores. There is a network of vehicle and walking tracks around the island. The summit track provides access for pedestrians only and timber boardwalks have been constructed along most of that track, with a deck and viewing platform provided at the summit. A public wharf and amenity area is located on the southern side of the island and is an arrival/departure point for regular passenger ferry services.

There is a boat ramp located on the south-western foreshore, referred to as Yankee Wharf. This is commonly used for the landing of barges for delivery of goods and machinery to both islands. Further north at Islington Bay is a wharf which is the main landing point for DOC and Motutapu Farm boats.

There are a number of existing buildings on Motutapu, ranging from farm buildings, workers accommodation, DOC administration and workshop and storage buildings, and the outdoor education camp at Administration Bay. A network of farm roads traverse the island and connect to Home Bay and Administration Bay. Farming land is separated into paddocks for the grazing of sheep and cattle. An existing grass airstrip is located in an elevated, central position on the island. There is reticulated power serving some of the buildings however there is no reticulated water supply; rather water is sourced from groundwater bores.

2. WHY DO IT?

2.1 OVERVIEW

If successful, the Rangitoto and Motutapu pest eradication offers outstanding benefits for conservation. The recovery of locally and nationally endangered species, the creation of a stepping stone for wildlife movement between the Hauraki Gulf and the Auckland isthmus, enhanced advocacy and education and increased economic opportunities are just some of the likely gains. These benefits and others are expanded on further below.

2.2 THE LEGISLATIVE AND PLANNING BASIS

DOC is the leading central government agency responsible for the conservation of New Zealand's natural and historic heritage. Its legislative mandate is the Conservation Act 1987 and other key statutes such as the National Parks Act 1980 and Reserves Act 1977. Under the Conservation Act its functions relevant to the proposed pest eradication are set out in section 6 as follows:

> Section 6
>
> The functions of the Department are to administer this Act and the enactments specified in Schedule 1 to this Act, and, subject to this Act and those enactments and to the directions (if any) of the Minister,-

(a) To manage for conservation purposes, all land, and all other natural and historic resources, for the time being held under this Act, and all other land and natural and historic resources whose owner agrees with the Minister that they should be managed by the Department:

(ab) To preserve so far as is practicable all indigenous freshwater fisheries, and protect recreational freshwater fisheries and freshwater fish habitats:

(b) To advocate the conservation of natural and historic resources generally:

(c) To promote the benefits to present and future generations of-

(i) The conservation of natural and historic resources generally and the natural and historic resources of New Zealand in particular; and

(e) To the extent that the use of any natural or historic resource for recreation or tourism is not inconsistent with its conservation, to foster the use of natural and historic resources for recreation, and to allow their use for tourism:

Section 17A of the Conservation Act 1987 requires DOC to manage lands under its administration in accordance with its statements of general policy, conservation management strategies and conservation management plans. Policy 4.1 of the Conservation General Policy sets out the specific policies for conservation management strategies in relation to terrestrial habitats and ecosystems as follows:

Policy 4.1

4.1(b) Each conservation management strategy or plan should establish management objectives for indigenous species and their habitats and ecosystems and recreational freshwater fisheries and their habitats, consistent with planned outcomes at places, for the purposes of:

i. Prevention of the loss of indigenous species and the full range of their habitats and ecosystems;

ii. Maintenance of representative examples of the full range of indigenous ecosystems;

iii. Maintenance of populations of indigenous species, habitats and ecosystems with unique or distinctive values;

iv. Recovery of threatened indigenous species (including their genetic integrity and diversity), and restoration of their habitats where necessary;

v. Restoration of threatened indigenous ecosystems where necessary;

vi. Maintenance of the ecological integrity of indigenous ecosystems consistent with the purposes for which the land is held.

All of these statutory provisions give the Minister and DOC the mandate to administer and manage both Rangitoto and Motutapu for the conservation purposes set out in section 6 of the Conservation Act 1987 and sections 17 and 19 of the Reserves Act. In this context there is a statutory mandate to remove exotic fauna from scenic reserves (s19 (2) (a)) in order to preserve and protect indigenous flora and fauna and this is reflected in the Conservation Management Strategy (CMS) for the Auckland Conservancy. As required by the Conservation Act and by Conservation General Policy, the Auckland CMS outlines the strategy for achieving conservation outcomes within the Auckland Conservancy.

Included within the document is identification of key areas for DOC, with both Rangitoto and Motutapu identified as having nationally and internationally significant ecological, heritage and landscape values. A key objective outlined for Rangitoto is the restoration of the island's ecosystem so that indigenous vegetation processes can operate without impediment as much as possible. With regard to Motutapu, the objectives include the protection and enhancement of habitats for threatened species and the reintroduction of native animals. Furthermore, the CMS identifies that there are a range of threats to biodiversity within the Auckland region, including introduced pests, and identifies animal pest eradication as a means to protect threatened habitats.

The proposed pest eradication on Rangitoto and Motutapu can only be seen as consistent with the provisions of the Hauraki Gulf Marine Park Act 2000. Section 7 of the HGMP Act relates to the interrelationship between the Hauraki Gulf, its islands and catchments and the ability of that interrelationship to support the life-supporting capacity of the Hauraki Gulf. Section 8 of the HGMP Act relates to the management of the Hauraki Gulf and requires regulatory authorities to have regard to the national significance of the Hauraki Gulf, its islands and catchments.

The intention of the proposal contributes to wider conservation and restoration objectives for the islands, consistent with the recognition in the HGMP Act that the Gulf, its islands and catchments are matters of national significance. There will be direct benefits to indigenous flora and fauna as a result of the project, which is consistent with objectives relating to the life-supporting capacity of the environment of the Gulf and its islands, and for the social, economic, recreational and cultural well-being of people and communities (section 8).

Section 7 Recognition of the National Significance of Hauraki Gulf

(1) The interrelationship between the Hauraki Gulf, its islands, and catchments and the ability of that interrelationship to sustain the life-supporting capacity of the environment of the Hauraki Gulf and its islands are matters of national significance.

(2) The life-supporting capacity of the environment of the Gulf and its islands includes the capacity -

(c) to maintain the soil, air, water, and ecosystems of the Gulf.

Section 8 Management of Hauraki Gulf

To recognise the national significance of the Hauraki Gulf, its islands, and catchments, the objectives of the management of the Hauraki Gulf, its islands, and catchments are-

(a) the protection and, where appropriate, the enhancement of the life-supporting capacity of the environment of the Hauraki Gulf, its islands, and catchments:

(b) the protection and, where appropriate, the enhancement of the natural, historic, and physical resources of the Hauraki Gulf, its islands, and catchments:

(c) the protection and, where appropriate, the enhancement of those natural, historic, and physical resources (including kaimoana) of the Hauraki Gulf, its islands, and catchments with which tangata whenua have an historic, traditional, cultural, and spiritual relationship:

(d) the protection of the cultural and historic associations of people and communities in and around the Hauraki Gulf with its natural, historic, and physical resources:

(e) the maintenance and, where appropriate, the enhancement of the contribution of the natural, historic, and physical resources of the Hauraki Gulf, its islands, and catchments to the social and economic well-being of the people and communities of the Hauraki Gulf and New Zealand:

(f) the maintenance and, where appropriate, the enhancement of the natural, historic, and physical resources of the Hauraki Gulf, its islands, and catchments, which contribute to the recreation and enjoyment of the Hauraki Gulf for the people and communities of the Hauraki Gulf and New Zealand.

The proposed eradication of animal pests from Rangitoto and Motutapu is also closely aligned with DOC's Strategic Direction as outlined in the Statement of Intent 2008-2011.

The overarching purpose of the Department is to increase the value that New Zealanders attribute to conservation. This leads to enhanced care of New Zealand's unique heritage for people to benefit from and enjoy.

If successful the project will provide an enhanced environment for ecosystem and species protection and the preservation of archaeological sites. It is expected to increase the currently high levels of engagement in conservation both on the islands and elsewhere within the Auckland region, and will provide an improved and more diverse range of recreation and economic opportunities. In doing so the project contributes directly to all seven of the intermediate outcomes (see below), identified in the Statement of Intent as critical steps to achieving DOC's stated outcome that conserving and managing New Zealand's natural, historic and cultural heritage provides increasing benefit to New Zealanders.

1. The ecological integrity of managed sites is maintained or restored.
2. The security of threatened species unique to New Zealand, and most at risk of extinction, is improved.
3. Examples of the full range of New Zealand's ecosystems are conserved.
4. A representative range of historic and cultural heritage is conserved and interpreted.
5. New Zealanders increasingly engage in conservation.
6. New Zealanders have increased opportunities for recreation and outdoor activities.
7. Business opportunities consistent with conservation outcomes are enabled.

In summary the proposal to remove pests from Rangitoto and Motutapu is considered to be a core function of DOC in order to meet its obligations under the Conservation Act, the Conservation General Policy and the Auckland CMS. The proposal is consistent with the HGMP Act, is strongly aligned with DOC's strategic direction and directly contributes to the desired outcomes set out within the Statement of Intent.

2.3 IMPORTANCE OF THE ISLANDS

The reserve status of Rangitoto and Motutapu belies their importance at the national and international level. Rangitoto has outstanding geological and biological values, whereas Motutapu has archaeological and historic values of equivalent importance. The need for a complementary view of natural and historic values of Motutapu has long been recognised and is reflected in the Auckland CMS.

As part of the Auckland Volcanic Field, Rangitoto has been included in the New Zealand tentative list for World Heritage nomination. This is a combined nomination based on cultural and natural values. Rangitoto is the least modified of all volcanoes in the field. Inclusion of the island in the World Heritage proposal highlights the international significance of its biogeographic, geological and biological features.

2.4 SUPPORTING A VISION

The project will contribute directly to the vision articulated in the Auckland CMS by allowing the natural processes of regeneration on Rangitoto to continue unhindered by animal pests and enhancing the restoration potential of Motutapu. The project builds on the successful eradication of possums and wallabies, the replanting of parts of Motutapu and efforts to control weeds on both islands.

It supports the vision of The 'North-West Wildlink' project (www.arc.govt.nz/environment/plants-and-animals/aucklands-natural-environment/north-west-wildlink.cfm), a regional partnership between councils, organisations and the community, which seeks to create a patchwork of natural stepping stones connecting two of the region's biodiversity hotspots – the Hauraki Gulf islands and the Waitakere Ranges. If successful the project will also be a step closer towards realising the vision of a pest free Hauraki Gulf.

2.5 A FOCUSED RESTORATION PROGRAMME

Motutapu and Rangitoto are two of the very few islands for which there is a large body of information available on past flora and fauna. Such a resource is an invaluable guide for restoration efforts. Palynological studies of sediments indicate that Motutapu was once covered in mixed broadleaf/podocarp forest, probably similar to existing forest on Waiheke and the mainland. The particular distribution of forest species is unknown but can be deduced from their current distribution elsewhere.

Some idea of the animal life has been provided by Reg Nichol in his 1988 PhD thesis that included analyses of animal remains from midden sites. The skeletal remains (or sub-fossils) of birds and reptiles under ash showers indicates that Motutapu was at least partially covered with coastal forest inhabited by many of the species today found on Hauturu (Little Barrier Island) (Nichol 1988). Importantly, the remains include two species of lizards, robust and Whitaker's skink, that appear unable to coexist on islands with introduced rats. It is therefore possible that Motutapu was still free of rats or they had only recently arrived when Rangitoto erupted.

The reptile fauna of Motutapu would have been impressive. The largest species were tuatara, which are present as sub-fossil remains on the island. Based on Hauturu and the islands around Motutapu, there would have been at least 11 (perhaps up to 14) species of lizards, including the two present as sub-fossils.

Like Hauturu, the bird fauna probably included at least 20 indigenous forest species, including kaka, kokako and the rare hihi (stitchbird), which is also present on Motutapu in sub-fossil remains. The abundance of some others may be inferred from accounts of the importance of kaka to iwi inhabiting the islands. However, with the abundance of streams and wetlands, Motutapu may also have supported large populations of species such as brown teal, which are rare on Hauturu. There was probably also a diverse fauna of burrowing seabirds. Both native bat species found in northern New Zealand probably inhabited Motutapu.

The volcanic emergence of Rangitoto would have devastated the western and north-western side of Motutapu. However the pattern of ash fall suggests that perhaps half of Motutapu escaped serious damage. Rangitoto is reputed to have been the rahui-kaka preserve of Chief Te Peretu (Fowlds 1951; Nichol 1992). Archaeological evidence and Maori oral

tradition, along with sub-fossil remains from North Island sites (Atkinson & Millener 1991) and present day fauna of forested offshore islands, provide a clear guide to the type of animal community that once lived on Rangitoto and Motutapu.

It is conceivable that until first European contact, the only introduced animals on Motutapu and Rangitoto were dogs, the footprints of which are preserved in the 600 year-old ash on Motutapu. However, following the arrival of European colonists, the history of Motutapu has largely followed that of the adjacent mainland. This has involved the removal of almost all forest for farming, modification and draining of streams and wetlands, and in addition to dogs and stock, the introduction of a further 10 species of mammals. Only rats, mice and hedgehogs appear to have been accidentally introduced. The remaining seven must have been deliberately released for sport (deer and rabbits), curiosity value (possums and wallabies), pest control (stoats), or were abandoned pets (cats).

The first unwelcome mammal arrivals on these islands were probably Norway rats after Cook's visits to New Zealand in the late 18th century. Mice reached New Zealand in the mid 19th century with the first colonists and were followed in the late 19th century by ship rats due to increased trade.

The result has been devastating for native biodiversity. Even bellbirds, that survived on neighbouring islands such as Tiritiri Matangi, have long been absent from Motutapu and Rangitoto. At least two thirds of the avifauna has been destroyed; and now only seven species of native forest birds remain resident. Three species lost from the island, but represented as sub-fossils, are total extinctions. These are New Zealand raven, New Zealand quail and piopio.

Similarly, all bats, tuatara and most lizard species have now gone. Of the species previously recorded, Whitaker's skink is now extinct in the Auckland area and robust skinks, although present locally, are confined to a tiny island in the Mokohinau group. At least four species have survived, however, and up to two others may still be present but have not yet been recorded.

2.6 IMPROVED ECOSYSTEM FUNCTION

Both Rangitoto and Motutapu support rare ecosystems as defined by Williams et al 2007. On Motutapu, threatened ecosystems include ephemeral wetlands, shingle beaches and coastal turf systems. On Rangitoto they include coastal turf systems, seabird guano modified sites, recent lava flows, volcanic boulder fields and basalt caves. However, Motutapu also has ecosystems that are common on the mainland but rare on islands. These include coastal sand beaches, and extensive stream and wetland systems.

On Rangitoto, the harsh environment and young forest has led to the appearance of plants that are unusual because of where they grow, the assemblages that they have formed and the distinctive varieties that

have developed. The attributes of Rangitoto are summarised by Mike Wilcox in "The Natural History of Rangitoto" published in 2007 by the Auckland Botanical Society. Particularly distinctive features include: large populations of the hot rock fern, rare elsewhere in the North Island, perching plants that have taken to growing on the ground; hybrid forms of pohutukawa and rata that have colonised the lava fields; all stages of plant succession – from lichens growing on bare rock to tall forest – demonstrating 600 years of forest development; diverse liverworts, mosses, lichens and filmy ferns; and mangroves growing on basalt and around salt water seepage ponds.

Both Rangitoto and Motutapu are physically complex and have the potential to sustain a diverse array of vegetation and habitat types. Eradication of introduced mammals and sustained weed control would allow the unique processes of regeneration on Rangitoto to continue unhindered while also creating the conditions necessary for reestablishing the foundations of a coastal forest ecosystem on Motutapu. Of particular importance is the restoration of the extensive area of wetland habitat on Motutapu. Freshwater wetlands on Motutapu represent up to 7% of those remaining in the Auckland region. Freshwater wetlands now comprise less than 0.5% of the Auckland region's land cover yet support nearly 30% of its threatened plant species.

2.7 OPPORTUNITIES FOR SPECIES PROTECTION

Predictions of the responses of flora and fauna on Motutapu and Rangitoto without invasive mammals can be made against a backdrop of 70 examples of islands in New Zealand that are now pest free. These island systems respond in four ways, each of which will also proceed on Motutapu and Rangitoto. Research shows that natural responses include the recovery of resident species that have been suppressed by the introduced predators; the reappearance of species suppressed to such low numbers they could not be detected; and the recolonisation of species unable to reestablish previously. Managed responses involve the release or reintroduction of native species that could not previously survive and which may not be able to return without assistance.

One of the more subtle changes on the two islands will be changes in forest condition and composition. These changes have already been instigated by the eradication of possums and wallabies but will be greatly accelerated by the removal of mice, rats and rabbits. Rodents in New Zealand suppress or eliminate at least 20 species of forest plants found on north-eastern islands (Campbell and Atkinson 1999). Many of these species will reappear on Rangitoto and Motutapu, and some such as kohekohe, may become prominent canopy species. Whether these changes will substantially influence the colonisation of lava and succession with forest patches on Rangitoto will be watched with great interest by the scientific community. This will be a unique environment that is able to be studied for the first time without the influence of introduced mammals.

Many species of invertebrates are likely to respond to the removal of rodents, with the most rapid and obvious being native cockroaches, weta, beetles and moths. Studies on other islands have demonstrated that the four species of lizards resident on these islands are all susceptible to rodents. However, all four species can show spectacular recovery when rats are removed. For example, Towns (2002) showed that common geckos in the Mercury Islands doubled in abundance every five years after the removal of rats and rabbits. They now cluster around flax and pohutukawa flowers at night with six or more geckos per flax spike. Moko and shore skinks, which have become extremely abundant on some islands after the removal of rats, should become a prominent feature of the landscape on Rangitoto. Given the results presented by Towns (1996), shore skinks are likely to be seen commonly on the coast and around gull colonies. Moko skinks will thrive on the vegetation islands on Rangitoto and anywhere on Motutapu where there is cover such as flax or rank grass. The work by Towns et al. (2003) indicates that of the four species, Suter's skinks are the most vulnerable to predators. These are large (20cm) skinks that are active at night, and are presently confined to a few refuges where boulder habitats offer protection from predators. They will eventually spread around the coastal platforms and rocky beaches of both islands.

One other species of lizard has not yet been recorded on the two islands but is very likely to be present. This is the ornate skink, which is present on adjacent islands and in Auckland city. These may have succumbed to predators on Rangitoto and Motutapu. However, it is more likely they are so suppressed that they are undetectable, and will reappear when mice, rats and stoats are removed.

Responses of birds to eradications on other islands indicate that a range of ground-nesting birds on the two islands will also benefit from pest removal. These include New Zealand dotterel and oystercatchers around the coast, and pukeko, paradise shelducks and spur-winged plover near wetlands and more open areas. Whether reef herons will also benefit is unknown. A study on Rangitoto published in 1992 by Miller and Anderson found that tui and silvereyes were two native species that rapidly increased in conspicuousness after the aerial drop of baits for possums and wallabies. Without predation of nests by ship rats and stoats, tui should become very abundant, at least seasonally, as they feed on nectar from pohutukawa, rewarewa and kowhai.

Tui are one of five species of highly mobile forest birds that will commute between islands to use seasonally available plant resources. Two other notable examples are kaka and kereru. Both species frequent outer gulf islands and commute into Auckland city. Kaka are known to be highly susceptible to predation by ship rats and stoats, so the removal of these two predators may provide suitable habitat for the establishment of resident populations. Kereru are highly attracted to trees with large fruit, the young foliage of kowhai and to some pasture grasses. They are also vulnerable to predation of eggs and chicks by rats and stoats. Kereru will also have significant impacts on forest composition as they spread or import the seeds of species such as taraire (Beilschmiedia tarairi),

tawapou (Planchonella costata) and kohekohe (Dysoxylum spectabile). Both kaka and kereru could eventually become very abundant on the two islands. Bellbirds are also island-hopping along islands of the inner gulf and may naturally recolonise Motutapu and Rangitoto. Tomtits fly considerable distances and have in the past been recorded as natural colonists on Rangitoto. Two additional species of mobile birds that appear highly vulnerable to predators are spotless crakes and banded rails. Both species could colonise the wetland areas and feed on adjacent farmland on Motutapu, and both may reach the island unassisted.

Another group of birds likely to recolonise, but at a very slow rate, are burrowing seabirds. These are most likely to establish in the coastal fringe along cliff edges. Grey-faced petrels and white-faced storm petrels already occupy the Noises Islands. Other species of the inner gulf include diving petrels, fluttering shearwaters and little blue penguins. All of these are likely to colonise eventually (penguins are already present in small numbers). Like kereru, the seabirds play a vital role in shaping terrestrial ecosystems. They rarely import seeds, but they do import nutrients as guano and provide food and shelter in their burrows for tuatara and many species of lizards. Their importance on New Zealand islands was exemplified in a study by an international research team (Fukami et al. 2006).

The project will also have flow on ecological benefits to the adjacent mainland through the dispersal of wildlife. Tui, bellbird and kereru are all good dispersers and will readily traverse the distance between Rangitoto and the mainland. An increase in the number of these species will bolster mainland restoration projects focused on rehabilitating ecosystems through improved pollination and seed dispersal.

2.8 THREATENED SPECIES RECOVERY

The eradication of the remaining invasive mammals from this combined area of 3842ha will increase the total area within New Zealand that is free of pests by approximately 15%. More importantly, the range of habitats is such, and the area involved so large, the status of many resident or locally extinct threatened species could fundamentally change if successfully managed on these islands. Examples of some of the species that could benefit are provided below. This assessment is not designed to preempt any ongoing restoration planning for the islands and future species translocations must follow the formal process established by DOC.

On Motutapu, the farm operation (assumed here to be principally for protecting historic and archaeological sites) would favour at least three species of threatened native birds that have at various times been proposed for release on the island. These are brown teal, takahe and kiwi. All three species do well in pasture. Motutapu is sufficiently large to support high numbers of all three species to the extent that their status would be substantially improved.

There is little need for ecosystem reconstruction on Rangitoto, but there is great potential for this on Motutapu. Careful restoration of wetland areas will provide extensive habitat for many birds, including fernbird and a range of waterfowl. They may also be inhabited by wetland fish species such as mudfish. Wetlands without the influence of introduced predators are almost unknown in New Zealand.

The extent of replanted forest is at present only about 50ha. However, although small, such forest patches are nonetheless larger than some islands inhabited by the rarer reptiles of northern New Zealand. Species previously recorded on Motutapu such as robust skinks, Whitaker's skinks and tuatara are all capable of inhabiting such areas. Additional species found locally include the large Duvaucel's gecko, Pacific gecko, forest gecko and green gecko. All probably once inhabited Motutapu and would benefit from an environment free of introduced predators.

In the absence of introduced predators, forest bird species such as saddleback, North Island robin, kakariki, whitehead and tomtit should do well in the existing forests on Rangitoto and in forest patches on Motutapu. Although hihi are recorded in sub-fossils, forest habitats on Motutapu and Rangitoto are not suitable for this species and will not be so for many decades. On the other hand, forested habitats and the crevices and lava caves on Rangitoto may be suitable for short-tailed and long-tailed bats.

In coastal areas, the extensive shore platforms may be suitable for shore plover, a species once widespread but now largely confined to the Chatham Islands. Furthermore, the speed and form of recolonisation by seabirds could be enhanced by translocating chicks and using calling stations to attract birds in flight. This would have implications for the nutrient status and productivity of coastal areas for species such as tuatara and robust and Whitaker's skinks.

Through releases on the island, there could be reintroductions of tuatara and at least seven species of lizards. The releases could also include at least five species of forest birds and one species of coastal bird, as well as at least four species of seabird. Furthermore, in farmed areas and wetlands there could be management of up to three species of threatened bird species whose threat status would change in response. A list of the species that may benefit along with their status is given in Appendix 1.

2.9 OPPORTUNITIES FOR ADVOCACY AND EDUCATION

With the eradication of two species of rats from Kapiti Island (1965ha) in 1996, six islands greater than 1000ha have now been cleared of rats and feral cats. Five of these are Nature Reserves with restrictions on public access, and the sixth, Tuhua (or Mayor Island), is iwi owned and a considerable distance offshore. Because of the legal and geographic restrictions to access, there is little capacity for public participation in the restoration of these islands.

Rangitoto and Motutapu differ from these six large islands in many respects. There are currently no restrictions on visitation, they are easily accessible and there is already considerable public interest and involvement in their management. On Motutapu, this began with the launch of the Motutapu Restoration Project in 1993, which coincided with a successful six year campaign from November 1990 to eradicate possums and wallabies from the two islands. These are still the largest successful eradications of these species.

Motutapu and Rangitoto therefore provide a unique opportunity for public involvement. Participation has proven to be one of the best means of improving the value people see in conservation and projects such as the restoration of Tiritiri Matangi have had huge spinoff benefits for the wider Auckland region (Craig & Veseley 2007). The eradication of animal pests on Rangitoto and Motutapu is expected to enhance the profile of restoration efforts and increase current levels of public participation. Greater participation on Rangitoto and Motutapu will lead to increased buy in for their protection. Dispersal of mobile wildlife to the mainland will ensure that the benefits are experienced by a wide audience.

The two islands have already proven their worth as a focal point for education and programmes such as the Motutapu Outdoor Education Camp exemplify this. However, there is a raft of opportunities yet to be explored. One of these, a Centre for Sustainability, has been proposed by the Motutapu Restoration Trust for Home Bay. This initiative would target schools, businesses and the public and would provide hands on experience in conservation and environmental restoration.

2.10 IMPROVED DAY TO DAY MANAGEMENT

Removing animal pests from Rangitoto and Motutapu would provide a range of management benefits for the islands. It would reduce the level of damage currently caused by rodents and rabbits to archaeological sites, accommodation and infrastructure. A common complaint on the island is damage by mice and rats to accommodation and rodents currently consume and contaminate stored food. A number of the pests present are known disease vectors and both human and stock health will be better protected as a result of their removal.

2.11 IMPROVED BIOSECURITY FOR THEHAURAKI GULF ISLANDS

A pest free Rangitoto and Motutapu would improve the level of protection that currently exists for nearby pest free islands. Rakino and the Noises islands are sufficiently close to Motutapu for both stoats and Norway rats to potentially arrive unaided and Motuihe and Browns islands are also within close proximity.

The pest eradication on Rangitoto and Motutapu will raise the profile of key biosecurity messages currently being disseminated to the general public. Once pest free the islands will also simplify these messages as Rangitoto and Motutapu are the last two islands administered by DOC in the inner Hauraki Gulf where pests are still present. The end result will be improved efficiency and effectiveness of advocacy and education programmes that aim to keep pests off islands.

Without mice, rats and other invasive mammals, border control measures against further pest invasions (for example from shipwrecks) will be more effective. Rodent interception sites and indicator stations can be established without being neutralised or interfered with by resident pest species.

2.12 A CONTRIBUTION TO THE KNOWLEDGE BASE

The proposed pest eradication on Rangitoto and Motutapu is the most complex DOC has ever undertaken. Four of the target species present have never before been eradicated from such a large area nor across the type of terrain found on Rangitoto. Not surprisingly, the success of the project is being watched closely by those contemplating larger and more complex projects. The lessons that will arise as a result of this project will contribute to other projects in the same way that this project seeks to build on past experience. This knowledge will be disseminated through project reports and operational debrief and staff working on the project will be able to take their experience elsewhere.

2.13 INCREASED ECONOMIC OPPORTUNITIES

This is currently the subject of an issues and options paper commissioned by the Auckland Area Office. Economic gains from the project are expected not just because of the anticipated increase in visitor numbers but also because of a more diverse range of opportunities. Most island visitors already arrive on a commercial ferry and participate in some commercial activity while on the island.

The potential of both islands as a carbon sink will be improved through increased seedling recruitment and resultant forest diversity. Removal of rabbits could also lead to increased pasture production and a subsequently greater return from Motutapu's farming operation.

2.14 ENHANCED REPUTATION

The project provides DOC with an unmatched opportunity to be recognised as an effective manager of the lands, waters, species, historic places, and roles entrusted to it. DOC is already a world leader in the field of pest eradication and the proposed project, if successful, can

only enhance this reputation. Rangitoto and Motutapu lie on Auckland's front doorstep and any activities on the islands receive intense public attention. The project therefore offers the possibility of demonstrating to a third of New Zealand's population just what can be made possible by the removal of introduced mammalian pests.

3. Can it be done?

3.1 SUMMARY

Five principles must be met to achieve eradication for any given pest species (Parkes 1990, Bomford & O'Brian 1995). These are:

1. All individuals can be put at risk by the eradication technique(s).
2. They can be killed at a rate exceeding their rate of increase at all densities.
3. The probability of the pest reestablishing is manageable to near zero.
4. The project is socially acceptable to the community involved.
5. The benefits of the project outweigh the costs.

It is considered that all principles can be met for the species targeted on Rangitoto and Motutapu. Evidence supporting this conclusion is presented in this chapter alongside the particular challenges faced.

Although no precedents exist for the eradication of ship rats, mice, hedgehogs and rabbits from such a large area, it is believed that all individuals can be put at risk and that they can be killed at a rate faster than their rate of replacement. This assessment is based on the results of other operations and trials completed on Rangitoto and Motutapu. Reducing the risk of reinvasion to near zero is believed to be possible because of the relative isolation of the two islands from potential sources of reinvasion and DOC's relatively good record of keeping pests off islands where biosecurity standards have been implemented and maintained.

From consultation undertaken there is overwhelming community support for the project although one or two individuals have expressing concerns over the proposed technique. A cost, benefit analysis of the project suggests that the project is of enormous value. Even if the project fails to remove one or two of the pest species targeted the project will be a major conservation achievement.

3.2 CAN ALL INDIVIDUALS BE PUT AT RISK BY THE ERADICATION TECHNIQUES?

3.2.1 Proposed Techniques

It is proposed to complete up to three applications of 10mm (2g) Pestoff 20R rodent bait containing brodifacoum at 20ppm between 1 June and 1 November of the chosen year to target rodents. The proposed application rates, listed in Table 1 below, are maximum application rates and may be revised following assessments of rabbit density prior to bait application. Each application of bait will be separated by a minimum of two weeks.

Table 1. Proposed Bait Application Rates

1st Application	2nd Application	3rd Application
30kg/ha	8kg/ha	8kg/ha

Following the last application of bait, monitoring will be undertaken at each point of the proposed 100m x 400m stoat and hedgehog trapping grid for surviving rodents and island invasion contingency measures (including the use of rodent dogs) will be implemented for any detections.

In anticipation of some stoats and hedgehogs surviving, an island wide 100m x 400m trapping grid utilising DOC 200 traps set into wooden tunnels will be established prior to bait application. One month following the first application of bait the trapping grid will be activated and run continuously until no animals have been trapped for a period of six months, after which time the trapping effort will be reduced.

On the same timetable, a network of Victor 1½ hard jaw traps will be deployed along the islands' track and road networks, edge habitats and coastline to target surviving cats. Trap placement will be implemented in such a way that the risk of pull outs is minimised. Cats will also be shot by the rabbit team when spotlighting.

Within two weeks after the second application of bait, a programme targeting surviving rabbits will commence. Trapping, gassing of burrows, the localised use of toxins (most likely carrot with pindone), hunting and dogs will be used to target this species. Shooting will be carried out in such a way that the chances of missing a rabbit is minimised.[2]

Specifically trained predator dogs will be a key element in follow up work targeting all species. Dogs will be required to assist in detecting the presence of surviving pests.

[2] A range of measures will be employed to ensure that all shots find their target. Some of these will include ensuring the target animal is well within range, keeping magazines full at all times and sighting in guns on a daily basis. The location of any animals missed will be marked by GPS and flagging tape and the site will be monitored closely until the animal is killed.

3.2.2 Vulnerability of Target Pest Species

Judging from past experience it is anticipated that all individuals of each target species can be put at risk by the techniques proposed above. An assessment for each species is presented below.

Rats

DOC has been successful in removing rats (Rattus exulans and R. norvegicus) from six islands of more than 1000ha, with the largest over 11,000ha. A private trust recently achieved similar success with ship rats (R. rattus) in a mainland site encircled by a pest proof fence (Maungatautari, 3,154ha). These operations have all employed the aerial application of cereal bait containing brodifacoum to target rats and the success rate has been 100%.

While Rangitoto presents a very different environment to these sites it is anticipated that the likelihood of success will be the same. The 1080 operation targeting wallabies and possums in 1990 markedly reduced ship rat numbers on the island demonstrating that bait is accessible to rats despite the broken lava surface (Miller & Miller 1995). Reasons why this operation failed to eradicate ship rats are more likely associated with the use of an acute toxin, reinvasion from Motutapu where aerial bait spread did not occur, the completion of just a single application of bait and the lack of any overlap in swath. The navigational system used by the helicopters when spreading bait was also rudimentary. The successful eradication of Norway rats, kiore and cats from Tuhua (Mayor Island), which in parts resembles the type of terrain found on Rangitoto, bolsters the conclusion that access to bait by rodents will not be impaired by terrain.

In one of the predator fenced 'cells' at Maungatautari an adult female and several juvenile ship rats apparently survived for more than three months following bait application before being detected and killed. It has been suggested that these rats did not reinvade but survived because they were living in the forest canopy and did not come into contact with bait. If this situation occurred as described, it is improbable that it could be repeated on Rangitoto and Motutapu. The forest canopy on the islands is light with few epiphytes and is unlikely to provide a consistent food resource for ship rats.

The minimum home range size for Norway rats radio tracked on Motuhoropapa Island was 0.8ha (Bramley 1999). Female ship rats tracked at Rotoehu Forest in the North island had smaller home ranges, the smallest being 0.26ha, although these included a three dimensional element (Hooker & Innes 1995). Meeting current DOC best practice for rodent eradication, which includes the use of differential GPS for tracking the flight path of helicopters, will ensure all rat territories on both islands are targeted. The proposed bait application rate and the number of applications will ensure that bait is available to both rat species even in the presence of non-target consumers of bait such as rabbits.

Mice

In contrast to Norway rats, mice have never before been eradicated from such a large area and are considered by the authors to pose the greatest risk of failure. This assessment is based on the species biology and behaviour and the presence of other rodent species on Rangitoto and Motutapu rather than on previous failed eradication attempts (see Table 2) for reasons discussed below. Mice pose a considerable challenge to eradication programmes because of their small home range necessitating a higher level of precision in bait application. They are also more resistant per gram of body weight to toxicants such as brodifacoum (Dubock & Kaukeinen 1978) and when rats are present may initially be excluded access to bait (Sweetapple & Nugent 2005).

It has been suggested, based on recent failed attempts at the predator fenced mainland sites Maungatautari and Tawharanui, that successful eradication of mice on Rangitoto and Motutapu is unlikely. There are difficulties in comparing the proposed operation with results from these sites most importantly because of the increased risk of reinvasion on the mainland. If reinvasion is discounted as the cause of failure at Maungatautari and Tawharanui, the next most likely causal factor may have been the timing of bait application. Application of bait at both Tawharanui and Maungatautari did not commence before the beginning of September and it is probable that both these operations targeted breeding mouse populations that had access to an increasing availability of food. In the North Island, breeding by mice normally ceases in winter but begins again in spring (Ruscoe and Murphy 2005). The ramifications of targeting rodents at this time of the year are unknown, but are very likely to have increased the risk of operational failure.[1]

To estimate probability of achieving successful eradication of mice for Rangitoto and Motutapu it is necessary to make further and perhaps more valid comparisons. For the purposes of this study it was considered appropriate to confine the scope of comparison to operations on islands that have applied DOC best practice techniques and have utilised aerial bait application. Many other eradication attempts have used very different methods, have been carried out in markedly different climates and in some cases have been poorly executed (see Table 2).

Using the same technique as that proposed, DOC has made ten eradication attempts against mice on offshore islands (beyond the swimming range of mice). All 10 operations have been successful, although one which included some hand spreading of bait failed on the first attempt. One of the successes, Enderby Island (710ha) is still the largest successful mouse eradication completed. Rangitoto and Motutapu are a significant step up in terms of scale, but would appear to be the logical next step for applying current methodology.

Forty mice caught on Rangitoto and Motutapu were subjected to a laboratory trial to assess the palatability and efficacy of Pestoff 20R rodent bait containing 20ppm brodifacoum, the proposed bait type. The trial showed that palatability of Pestoff 20R was high and all forty mice died after eating the bait indicating that the proposed bait and toxin will

[3] The chance of weaned mice emerging from a nest after the majority of bait has been consumed or weathered is likely to be significantly greater in spring when mice resume breeding.

be effective. Interestingly, three of the mice included in the trial survived for between 18 and 21 days after ingesting a lethal dose (Morriss 2007). Time to death is likely to be shorter in the wild (Morriss 2007), but it is possible that juvenile mice, still within the nest, could remain insulated from bait for a period of up to three weeks.

Brodifacoum poisoning often causes foetuses to be aborted (Fisher and Fairweather 2006), however from work completed on sheep, it appears that little if any brodifacoum is passed on through lactation (O'Connor 2001). This work confirms that if breeding is suspected bait must be made available to mice for a minimum period, probably three weeks or longer to ensure that juvenile mice emerging from the nest are exposed. For the proposed operation on Rangitoto and Motutapu the application of bait during fine weather, the implementation of a two week minimum period between bait applications, and the addition of a third application of bait will maximise the chance that this requirement is met.

The possibility of mice not having access to bait in rank kikuyu grass has been raised as an issue for mouse eradications. However, house mice (M. musculus) climb readily (Dewsbury 1980) and there is no valid reason why they would not access bait in this habitat type. The vegetation of Browns Island (60ha), where mice were successfully eradicated, was dominated by a dense kikuyu grass sward at the time of the eradication (C. Veitch pers. comm.). A trial to demonstrate how well bait penetrated kikuyu grass sward was carried out on Motutapu in an area of ungrazed pasture. Although the average height of the sward was below 35cm, the trial targeted the worst sites where grass height ranged between 40cm and 65cm. Non-toxic 10mm Pestoff 20R pellets were thrown hard toward the ground to simulate bait falling from a spreader bucket and their penetration into the grass sward measured. On average baits penetrated to 22cm (range 5–39cm, n=25) or to within 31cm (range 15-50cm, n=25) of the ground. This is considered sufficiently close for bait to be detected by mice at ground level and the grazing, mowing or control of rank grass in currently ungrazed areas of Motutapu prior to the eradication operation is considered unnecessary. A high abundance of invertebrates was observed in kikuyu grass sward at Tawharanui (Goldwater 2007) and it is possible that mice stand a better chance of survival in this habitat type because of greater food availability. Carrying out bait application on Rangitoto and Motutapu between 1 June and 31 August will ensure mice are targeted at the time when invertebrate activity is at its lowest. This was not achieved at Tawharanui.

The size of baits has been another focal point of discussion with the argument being that the 10 x 30mm baits are too large to enable mice to readily remove baits for consumption elsewhere or caching. Most dietary items consumed by mice are of a smaller size than the proposed bait, e.g. invertebrates 3-12mm long (Craddock 1997, Wilson et al. 2006) and the size of the proposed bait may reduce the ability of a mouse to move a bait to cover. There is also evidence to suggest that caching of food by mice is uncommon and that food items are normally consumed when out foraging (Schmid-Holmes et al. 2001, Crowcroft 1959). Mice must therefore consume bait at least partially, where it is lying thereby increasing the risk of disturbance before a lethal dose is ingested [4].

[4] A single effective lethal dose for a mouse is approximated as twice the LD50 (0.30 – 0.63mg/kg) which equates to approximately one half of a 2g bait containing brodifacoum at 20ppm.

On Rangitoto and Motutapu, the removal of the majority of competitors and predators within a short time frame after the initial application of bait will eliminate most sources of disturbance. A reduction in disturbance, coupled with behavioural changes following the removal of rats provides confidence that survivors will have access to sufficient bait. Behavioural changes including increased trappability have been observed occurring within three months (Sweetapple and Nugent 2005). Nevertheless it is imperative that bait is available to mice for as long as possible. As discussed above, the proposed delay between applications of at least two weeks will ensure that this is the case.

Evidence from the successful Browns Island (Veitch 2002), Mana (Hook & Todd 1992) and Mokoia (pers. obs.) operations, where mice that survived the poisoning campaign were trapped in post operational monitoring, suggests that in each case a small proportion of the island's mouse population were either not exposed to bait, were exposed but did not consume a lethal dose, or failed to die despite eating bait. Reinvasion must also be considered to be a possibility but is less likely, particularly for Mokoia and Browns Island given the short duration (26 and 19 days respectively) between the completion of the eradication operation and the captures.

While no strong evidence exists for any one of these four possible causes of failure, it is considered that the proposed bait application rate for Rangitoto and Motutapu (up to 4.6 times higher than the Mokoia, Browns Island and Mana operations), will improve the chance that each mouse territory is targeted and that bait remains available to mice even in the presence of other consumers. A higher application rate is especially important given the findings of a study investigating home range and movement of mice on Rangitoto and Motutapu undertaken in April 2008. Too few mice were caught on the open lava of Rangitoto to investigate movement within this environment but radio telemetry and live trapping on Motutapu suggests that home range in rank grass sward may be much smaller (J Mackay pers. comm.) than the average minimum home range sizes of 0.6ha recorded in the Orongorongo Valley (Fitzgerald et al. 1981).

The laboratory trial confirms that Rangitoto and Motutapu mice are not resistant to brodifacoum and also indicates that the prescribed bait is palatable. What it doesn't rule out is the possibility that some mice will consume bait in insufficient quantities to ingest a lethal dose. It is known that individuals within rabbit populations will avoid baits that others find palatable, and this variability in dietary preferences may exist within mouse populations. This is an unknown variable and extremely difficult to demonstrate without undertaking an operation at the scale of that planned.

In light of the evidence from previous failed eradication attempts, over and above aerial bait application, monitoring will be undertaken across the 400 x 100m trapping grid for surviving mice. While the intensity of this monitoring does not fulfil the requirements for a ground based eradication attempt[5] it matches the monitoring implemented on Mokoia, Mana and Browns islands. It has been shown elsewhere that mice may

[5] Establishing and servicing a 25m x 25m grid on Rangitoto and Motutapu would not be financially and logistically feasible.

be more likely to be detected following the removal of rats (Sweetapple and Nugent 2005). The proposed use of rodent specific predator dogs will further increase the sensitivity of this monitoring.

Table 2. The Fate of Mouse Eradication Attempts within New Zealand and Overseas.

Date	Location	Size	Technique Used	Toxin Used	Outcome
	New Zealand				
2007	Adele, Abel Tasman	87	Aerial*	Brodifacoum	Appears to have been successful
2007	Tonga, Abel Tasman	8	Aerial*	Brodifacoum	Appears to have been successful
2007	Fisherman, Abel Tasman	8	Aerial*	Brodifacoum	Appears to have been successful
2007	Pomona, Lake Manapouri	262	Aerial	Brodifacoum	Yet to be confirmed
2007	Rona, Lake Manapouri	60	Aerial	Brodifacoum	Yet to be confirmed
2006	Hokianga, Ohiwa Harbour	8	Bait Stn	Pindone	Failed
2005	Ohinau, Coromandel	46	Aerial*	Brodifacoum	Successful
2005	Blumine, Marlborough	377	Aerial*	Brodifacoum	Successful
2005	Pickersgill, Marlborough	103	Aerial*	Brodifacoum	Successful
2004	Northern Cell, Maungatautari	35	Aerial	Brodifacoum	Successful
2004	Paititi, Rotorua	12.8	Bait Stn	Brodifacoum	Failed
2004	Southern Cell, Maungatautari	65	Aerial	Brodifacoum	Failed
2002	Quail, Lyttleton	81	Bait Stn/Hand Spread	Brodifacoum	Failed
2001	Mokoia, Lake Rotorua	133	Aerial*	Brodifacoum	Successful
1999	Limestone Island, Whangarei	37	Bait Stn	Brodifacoum	Failed
1998	Limestone Island, Whangarei	37	Aerial	Brodifacoum	Failed
1997	Motuihe, Hauraki Gulf	179		Aerial*	Brodifacoum Successful
1997	Mou Tapu, Wanaka	120	?	?	Successful

1997	Limestone Island, Whangarei	37	Aerial	Brodifacoum	Failed
1997	Stevensons Island, Lake Wanaka	65	Bait Stn	Brodifacoum	Not completed
1997	Silver Island, Lake Hawea	25	Bait Stn	Brodifacoum	Not completed
1996	Crusoe Rock, Hauraki Gulf	0.7	Bait Stn/	Brodifacoum Trapping	Successful
1996	Limestone Island, Whangarei	37	Aerial	Brodifacoum	Failed
1996	Mokoia, Lake Rotorua	133	Aerial/Hand	Brodifacoum Spread	Failed
1995	Browns (Motukorea), Hauraki Gulf	58	Aerial*	Brodifacoum	Successful
1995	Mou Waho, Lake Wanaka	140	Aerial/	Brodifacoum Trapping	Successful
1994	Motutapere, West Coromandel	50	Aerial/ Bait Stn	Floucomafen	Successful
1993	Enderby, Sub-Antarctic	710	Aerial*	Brodifacoum	Successful
1993	Te Haupa (Saddle), Hauraki Gulf	6	Bait Stn	Floucomafen	Failed
1992	Moturemu, Kaipara Harbour	5	Bait Stn	Brodifacoum	Successful
1992	Hauturu, Whangamata	10	Bait Stn/	Brodifacoum	Failed Hand Spread
1991	Haulashore , Nelson	6	Bait Stn	Brodifacoum	Failed
1989	Allports, Marlborough	16	Bait Stn	Brodifacoum	Successful
1989	Mana, Wellington	217	Aerial/ Bait Stn	Floucomafen	Successful
1989	Rimariki, Bay of Islands	22	Bait Stn	Bromadialone	Successful
1989	Motutapu, Marlborough	2	Bait Stn	Floucomafen	Successful
1989	Mokoia, Lake Rotorua	133	Bait Stn	Brodifacoum	Failed
1984	Whenuakura, Whitianga	3	Bait Stn	Bromadialone	Unknown
	Rabbit Island, Whangarei	10	?	Brodifacoum	Successful

Overseas					
2005	Tromelin, France	100	Bait Stn/ Hand Spread	Brodifacoum	Failed
2002	Selvagem Grande, Portugal	200	Bait Stn	Brodifacoum	Successful
2002	Île du Château, Kerguelen	250	Aerial	Brodifacoum	Not completed
2001	Surprise Island, France	24	Hand Spread	Bromadialone	Successful
2001	Fajou, France, Guadeloupe	120	Hand Spread	Bromadialone	Failed
2000	Fre´gate, Seychelles	219	Aerial	Brodifacoum	Successful
2000	Denis, Seychelles	143	Aerial	Brodifacoum	Failed
2000	Buck, Carribean	80	Bait Stn	Diphacinone	Failed
1998	White Cay, Exumas-Bahamas	15	Bait Stn	Brodifacoum	Successful
1998	Barrow, Australia	270	Bait Stn	Brodifacoum	Successful
1998	Flat Island, Mauritius	253	Bait Stn	Brodifacoum	Successful
1997	Bridled, Australia (WA)	22	Bait Stn	Pindone	Successful
1997	Beacon, Australia	1.2	Bait Stn	Pindone	Successful
1997	Varanus, Australia (WA)	80	Bait Stn	1080	Failed
1997	St. Paul, France, Sth Atlantic	800	Aerial	Brodifacoum	Failed
1996	Bird Island, Seychelles	101	Bait Stn/ Hand Spread	Brodifacoum	Failed
1996	Curieuse Island, Seychelles	286	Aerial	Brodifacoum	Failed
1995	Île Cocos, Mauritius	15	Bait Stn	Brodifacoum	Successful
1995	Île aux Sables, Mauritius	8	Bait Stn	Brodifacoum	Successful
1994	Rasa, Mexico	60	Bait Stn	Brodifacoum	Successful
1994	Barrow, Australia	270	Bait Stn	Brodifacoum	Successful
1972	Barrow, Australia	270	Bait Stn	Brodifacoum	Successful
1971	Flatey Island, Iceland	50	Bait Stn	Warfarin	Successful

1965	Barrow, Australia	270	Bait Stn	Brodifacoum	Successful

* Operation met DOC best practice

Table 3. Percentage Success of Mouse Eradication Attempts Worldwide.

Total number of mouse eradication attempts where the outcome is known	Percentage success	Total number of eradication attempts that used the proposed method and met DOC best practice	Percentage success
56	63%	10	100%

Table 4. Summary of Completed Eradications for the Pest Species Targeted.

	Successes	Failures	Largest Area (NZ)	Largest Area (World)
Norway rat	33	1	Campbell (11,000ha)	Campbell (11,000ha)
Ship rat	9	0	Maungatautari (3,154ha)	Maungatautari (3,154ha)
Mouse	15	6	Enderby Island (710ha)	Enderby Island (710ha)
Hedgehog	4	0	Maungatautari (3,154ha)	Maungatautari (3,154ha)
Feral cat	10	0	Maungatautari (3,154ha)	Marion (29,000ha)
Stoat	7	0	Maungatautari (3,154ha)	Maungatautari (3,154ha)
Rabbit	19	3	Enderby Island (710ha)	Saint Paul (800ha)

Stoats

Stoats have been eradicated from islands up to 1,525ha through trapping alone and more recently have been eradicated at Maungatautari solely through the aerial application of bait to eradicate rodents. While it is hoped that the Maungatautari experience will be repeated on Rangitoto and Motutapu, this cannot be assumed and a trapping grid must be established to target survivors. Because of the presence of hedgehogs, the proposed trap density of one trap per 4ha is generally greater than that used for previously successful stoat eradications which have implemented trap densities of one trap per 3.7 – 9ha based on the minimum home range size for female stoats (Miller et al. 2001).

Home range estimates for stoats vary according to gender, season, and food availability (Erlinge 1977; Murphy and Dowding 1995; Alterio 1998). Murphy and Dowding (1994) reported an average home range for four male stoats of 206 (SE = 73)ha and for 5 female stoats 124 (SE = 21) ha in a Fiordland beech forest when rodent numbers were low. Based on these figures, the proposed trap network (Appendix 3) exceeds the specifications for a trapping grid aimed at eradicating stoats. It also goes beyond the trap density deployed during recent eradication projects on

Secretary and Resolution islands. The proposed trap density will ensure that every stoat on Rangitoto and Motutapu will encounter a trap.

For stoats, most North Island litters are born between late September and late October. Female stoats may be caught as often as males in summer and autumn but less often in the rest of the year, especially in spring, and pregnant females are extremely difficult to catch (King & Murphy 2005). To ensure all individuals are targeted it is essential that trapping is continued for a period of at least two years as is planned. This precautionary approach is considered prudent given the length of time some previous operations have taken to complete.

Hedgehogs

Similar to stoats, hedgehogs were recently eradicated from Maungatautari largely through aerial poisoning targeting rodents. Only one individual apparently survived and was trapped some time after bait application (P De Monchy pers. comm.). While the late timing of bait application at Maungatautari may have decreased the operation's effectiveness against mice it might have increased the likelihood of successful hedgehog eradication, as all individuals would have been active. Evidence from Maungatautari and Karori Sanctuary suggest that hedgehogs are vulnerable through both primary and secondary poisoning when exposed to Pestoff 20R rodent baits.

A telemetry study to assess over wintering activity of hedgehogs on Motutapu was carried out between May and September 2007. The longest period of inactivity recorded for any one individual of a sample of 20 hedgehogs was 34 nights and this was significantly longer than the average (7.4 nights). Both these figures are conservative as tracking was undertaken only five nights per week. The implementation of a two week minimum period between bait applications and the addition of a third application of bait will increase the chance that all hedgehogs are exposed to the risks of secondary poisoning.

The home ranges of male hedgehogs are typically two-three times larger than females and home ranges of both sexes are larger in spring and summer than in the other two seasons (Jones & Sanders 2005). The average winter minimum home range size for hedgehogs on Motutapu, extrapolated largely from nesting sites, was 11.3ha (Range 1.4 – 70.0ha) which is similar to the home ranges sizes observed elsewhere (Jones & Sanders King 2005). Although the home ranges are considered an underestimate of total range it is possible that some hedgehogs surviving the poisoning campaign will not be exposed to the trapping grid. It is therefore imperative that predator dogs specific to this species are available to cover untrapped territory on both islands. The training of these dogs must be incorporated into project planning.

Cats

Cats have been eradicated from areas much larger than Rangitoto and Motutapu (see Table 4) and because of their large home ranges will be put at risk by the techniques proposed. Evidence from cat eradication

elsewhere, for example, Tuhua, has shown that, like hedgehogs, cats are vulnerable to both primary and secondary poisoning. Only two surviving cats were detected at Maungatautari post bait application and it was thought that these individuals were living on rabbits that had not consumed bait (both were later trapped).

Surviving cats on Rangitoto and Motutapu will be targeted through a trapping programme that will target all cat territories. Cats will also be shot during night work for rabbits. Experiences such as those from Raoul emphasise the need for experienced and skilled staff and conducting trapping in such a way that minimises the risk of a target animal escaping from a trap. The effectiveness of currently registered baits containing 1080 has been variable (Gillies and Fitzgerald 2005) and it is likely that follow up work will focus on trapping. However, new and potentially improved bait types for cats have been developed in Australia (A Cox pers. comm.) and the use of these products will be investigated as part of operational planning.

Rabbits

Based on other operations, it is expected that the proposed application of bait at the specified rates will significantly reduce the islands' rabbit populations but will not eliminate all individuals. Survival rates may also be affected by the density of rabbits on both Rangitoto and Motutapu which is much lower than that recorded on other islands. Food availability, which appears to be high on Motutapu may also affect bait uptake and the consequent survival rate.

It was estimated that between 10 and 20% of rabbits survived aerial poisoning on both Enderby and Motuihe (Torr 2002; P Keeling pers. comm.) where rabbit density was ~35/ha and >100/ha respectively and a rhodamine trial on St Paul Island at 20kg/ha indicated that 92% of the rabbit population consumed bait (Micol & Jouventin 2002). The current density of rabbits on Motutapu appears to be even less than that on Motuihe following the aerial application of 1080 bait (P Keeling pers. comm.), thus even if mortality as a by product of rodent eradication is significantly less, achieving eradication will still be feasible. The surviving density of rabbits is an important element in evaluating whether or not the proposed techniques can kill rabbits faster than they can reproduce (as discussed below).

Follow up techniques, to be implemented systematically, will ensure all individuals are exposed although it is possible this might take up to two years to accomplish. The use of GPS and GIS technology to map search efforts will be critical in ensuring all individual territories are covered.

3.3 CAN PESTS BE KILLED AT A RATE EXCEEDING THEIR RATE OF INCREASE AT ALL DENSITIES?

The population fluctuations observed by Miller & Miller (1995) for ship rats and mice on Rangitoto are typical for non-commensal rodent populations in New Zealand with a peak of abundance (especially of young animals) in autumn and increased mortality through winter. The proposed operation, to occur in winter, will target these species as they are undergoing a population decline and although all three rodent species are capable of breeding during winter (Innes 2005), the chances that mortality can be offset by breeding at this time of the year is low.

Other operations have targeted these species at greatly varying densities both within New Zealand and overseas and have been successful. It can therefore be concluded that if the first principle is passed as is expected then the second will be met accordingly. In saying this, because rodent breeding begins in earnest in spring, to maximise the likelihood of success, bait application should be completed before the beginning of September. This is an achievable objective given existing weather patterns.

Stoats, hedgehogs and cats all have a lower rate of reproduction than rodents and the populations of these species are all expected to be knocked back as a result of the poisoning campaign. Although some survivors may produce offspring it is unlikely that these populations, through breeding, can offset the anticipated levels of mortality caused by secondary poisoning and then trapping. The trapping and dogging programme to be implemented following the bait application will target survivors and pick up any naive juveniles as observed with stoats on Te Kakahu, Anchor and Bauza islands (Golding et al. 2005).

The work completed on the Fiordland islands suggests that eradication of stoats through trapping alone can take a significant period of time. It took two years to remove stoats from Bauza Island (Golding et al. 2005) whereas the Maungatautari and Tawharanui experience indicates that eradication can be achieved solely through a poisoning campaign that targets rodents. For Rangitoto and Motutapu it is assumed there will be some survivors of the poisoning campaign and resources for a sustained trapping programme have been allocated.

From the telemetry study, the first hedgehog litters on Motutapu were found at the beginning of September, corresponding with the onset of breeding observed elsewhere in the north of the North Island (Jones & Sanders 2005). Hedgehogs that survive to breed could produce young that are isolated from both primary and secondary poisoning necessitating the deployment of follow up methods as planned. The use of predator dogs during spring will be critical to eliminating breeding individuals before juveniles are weaned.

Cats will be affected by secondary and possibly primary poisoning but will also be impacted on by the removal of their primary prey. Breeding is likely to be reduced as a consequence, but intense trapping will be required to target surviving individuals and dogs will be required to pinpoint territories.

Rabbits are prolific breeders and are the one species that has demonstrated the potential to breed at a rate exceeding the level of mortality that can be applied through control techniques. For successful eradication, sufficient pressure will be required immediately after the aerial poisoning campaign and will need to be sustained to minimise any chance of breeding by residual rabbit populations. It is believed this can be achieved with a four to six person team applying the proposed techniques and dog and dog handler capacity. GPS and GIS technology will be key to ensuring that no parts of the islands are excluded from searches. Applying the knowledge gained from other operations such as Motuihe and Enderby will ensure this operation is successful and is completed as efficiently as possible.

3.4 IS THE PROBABILITY OF PESTS REESTABLISHING MANAGEABLE TO NEAR ZERO?

3.4.1 Overview

Meeting this principle was perhaps the most important consideration of the feasibility study and the one that will ultimately determine the project's sustainability. Ensuring that Rangitoto and Motutapu are protected in perpetuity from reinvasion is an enormous challenge because of the islands' proximity to such a large population base and the nature of their open access. In the project's favour, Rangitoto and Motutapu are beyond the swimming and dispersal range of all of the target pest species, all of the adjacent islands are pest free, the entirety of the two islands are administered by the Crown, much of the coastline is too rugged for landing and more than 90% of visitors arrive by way of a commercial ferry. The implementation of biosecurity provisions for the islands is also aided enormously by the ferry operation and other approved ventures on the islands being subject to concession agreements with DOC, thus providing an avenue for controlling the flow of the majority of people and stores.

In 1998, the ARC declared the Hauraki Gulf and all of its islands a 'Controlled Area' under the Biosecurity Act 1993, in order to protect the area from the incursion of pests or unwanted organisms. One of the objectives of the Auckland Regional Pest Management Strategy (RPMS) is to develop a Hauraki Gulf Controlled Area Biosecurity Plan. The Biosecurity Act 1993 provides an avenue for enforcing biosecurity measures for those stakeholders not subject to a formal agreement with DOC and will assist in the promotion of awareness about the risks of reinvasion. DOC is working closely with the Auckland Regional Council (ARC) to achieve an adequate level of protection for the islands.

Because the two islands are sufficiently distant from possible sources of reinvasion all of the biosecurity issues for Rangitoto and Motutapu are associated with the flow of people and supplies. These issues are significant on Rangitoto and Motutapu as both islands are open access, multiple use and receive more than 100,000 visitors per annum. The transport of livestock, vehicles, heavy equipment, building supplies and

other resources to support Motutapu's farming operation, concession activities and infrastructure offer numerous pathways for pest invasion.

A number of additional factors amplify the risks including visitors (5-10% of the total) that arrive on their own boats, a campground at Home Bay currently used by up to 4000 people per annum, three wharves and numerous opportunities for landing on Motutapu. The adjacent marine areas are also intensively used for both recreation and commercial use and the Rangitoto Channel is the principal navigation path for overseas and domestic shipping vessels accessing the ports of Auckland.

3.4.2 Biosecurity implementation to date

The Auckland Conservancy Island Biosecurity Plan (Boow & Wilson 2004) was commissioned in 2004 and implemented in 2005. The plan is currently under review with some standards having proved impractical. The plan's intent is to keep the islands administered by the Auckland Conservancy free from the effects of pests. While the implementation of the plan has significantly improved protection for some islands, particularly Little Barrier Island and the Mokohinaus, many of the measures outlined in the plan have not been implemented and for some pest free islands such as Motuihe and Motuora, little progress has been made towards improving their protection. This is reflected in the recommendations made in the two island biosecurity audits of Auckland Conservancy. Both audits recommend that a number of deficiencies be addressed before the plan can be said to have met its objectives.

The biggest challenge to the implementation of biosecurity has been the open sanctuary status of most of the islands in the Hauraki Gulf. Where public access is unrestricted there have been few avenues by which standards can be enforced for all island visitors. Following the gazettal of the Regional Pest Management Strategy 2007, this situation has now changed and the enforcement of biosecurity for all island visitors is now possible. Through the 'Pest Free Islands' initiative led by Auckland Conservancy, significant progress has also been made toward changing internal and external attitudes to biosecurity. Nevertheless, further progress is required prior to the pest eradication on Rangitoto and Motutapu taking place.

Most importantly all visitors to the islands must understand the need for preventing pest reinvasion. They must be aware of the risks and what they can do to minimise them. To this end the project is dependant on the 'Pest Free Islands' public awareness campaign to achieve a high level of awareness within the Auckland commercial and recreational boating community.

3.4.3 The risk of pest reinvasion

The risk of reinvasion varies greatly between the pest species targeted for eradication, with mice and rats the most likely species to stowaway on board a vessel or in stores. Hedgehogs are not considered to be potential stowaways on the International Species Specialist Group (ISSG) website (www.issg.org/database/species/ecology) but possibly arrived on Motutapu in the 1990s in hay transported to the island as stock feed

(P. Keeling pers. comm.). Following the implementation of biosecurity standards (Appendix 3), no stock feed will be permitted to be taken to the island, closing down this pathway for reinvasion. This is considered a reasonable obligation on the island's farming operation given it has become virtually self-supporting in terms of supplementary feed in the last 10 years.

Stoats are also unlikely candidates for stowing away but are the best swimmers of all the target pest species. Fortunately the distances that separate Rangitoto and Motutapu from potential sources of reinvasion are considered to be too great an obstacle for a stoat (see Table 5 below). The absence of stoats on Rakino, Motuihe and Browns islands supports this assessment. These islands all lie within 2km of stoat populations and have been monitored periodically over the last 10 years with no stoat invasions detected (P. Keeling pers.comm.).

Table 5. Swimming Distances for Assessing the Unassisted Reinvasion Risk for Target Species.

Island	Closest source	Greatest swimming populations	Total swimming distance (km)	Stepping stone islands distance (km)
Rakino	Motutapu	1.61	1.61	
Motuihe	Waiheke Motutapu	1.23 1.98	2.32 1.98	Crusoe Rock
Browns Island	Musick Point Rangitoto	1.34 2.58	1.34 2.58	
Post Eradication				
Rangitoto	Takapuna Head	2.99	2.99	
Motutapu Rock	Waiheke	1.98	4.30	Motuihe and Crusoe

Cats are unlikely to be transported inadvertently and are not permitted to be kept as pets on the islands. However, there have been reports of cats being intentionally dumped or having arrived via a recreational boat and escaping onto the island (J Duggan pers.comm.). Regular reinforcement of biosecurity measures amongst the boating community will be critical to minimise future occurrences of this nature. Prosecutions under the Biosecurity Act 1993 may also be required. Rabbits are also unlikely to remain undetected in stores and could not physically cross the gaps presented without assistance. The reinvasion risk posed by this species is considered to be negligible.

No biosecurity provisions presently exist for Rangitoto and Motutapu and an assessment of the frequency of visitation, the range of vessels being used and the diversity of supplies being transported indicates that the current risk of rodent reinvasion is high (see Table 6). The greatest risks

are considered to be associated with the movement of bulk supplies such as building materials or large machinery such as farm trucks and excavators to the island. However, the odd record of mice stowing away in day packs emphasises the risk posed by all movements of people and stores. The high risk of rodents arriving is emphasised by recent incursions of Norway rats onto Motuora, Motuihe and Saddle Island in 2008.

Although no data is available on the frequency of rodents on board boats, commercial and recreational vessels are considered to pose similar levels of risk as a potential vector for rodent reinvasion. Following the implementation of biosecurity standards (Appendix 3) all commercial vessels landing on the islands will maintain a rodent surveillance system. This cannot be achieved for all recreational vessels and minimising the risk of rodents arriving by way of recreational vessels will be wholly dependent on the education, motivation and upskilling of the public.

Table 6. Risk Assessment for the Reinvasion of Rangitoto and Motutapu by Rodents

Operator	No of Visits Per Annum	No of Visitors Per Annum	Materials being Transported	Biosecurity Measures Currently in Place	Risk Assessment
Internal					
DOC	200	500	Groceries, domestic goods, construction materials, vehicles, plant, etc	Pest free vessels Limited use of rodent proof packaging.	High
Concessions					
Motutapu Farms Ltd	200	200	Livestock, roading material, building supplies, farming supplies, vehicles etc	Vessel used for transporting people and groceries is moored on island.	High
MOEC	300	10,000	Groceries, bedding, building materials, vehicles	No controls	High
Fullers	1400	80,000	Day packs, camping gear, bedding, groceries.	Rodent control at departure wharf	High
CE Tours Ltd	10	50	Day packs only	No controls	Low
Heletranz	10	20	Day packs only	No controls	Low
Fergs Kayaks	50	300	Day packs only	Checks of kayak compartments	Low
NZ Walking Co	5	40	Day packs only	No controls	Low

Vodaphone	4	10	Day packs, tools and equipment	No controls	Medium
Overland Tours	10	40	Day packs only	No controls	Low
Skywork	10	20	Spray equipment, fuel, herbicide, strops etc	Checks of helicopters and gear	Low
Carson Challenge	2	200	Groceries, boxes of supplies, day packs	No controls	Medium
Glen Handley	12	24	Bee keeping gear, vehicle, hives etc	No controls	High
C and E Tours Ltd	12	48	Day packs	No controls	Low
Waitemata Honey Ltd	20	40	Day packs, vehicles, bee keeping gear	No controls	High
Community Organisations					
Motutapu Restoration Trust	120	3000	Potting mix, building materials, tools, day packs, groceries, bedding	Most bulk stores travel via the Fleet St store and a DOC pest free vessel. Few other controls	High
Rangitoto bach community	400	1200	Building materials, day packs, groceries, bedding	Some bulk stores travel via the Fleet St store and a DOC pest free vessel. Few other controls	High
Rangitoto Historic Conservation Trust	30	120	Building materials, day packs, groceries, bedding	Most bulk stores travel via the Fleet St store and a DOC pest free vessel. No controls	High
General Public					
Recreational boaties	2500	10000	Day packs, camping gear	No controls	High

3.4.4 Biosecurity measures for Rangitoto and Motutapu

To protect the investment made in removing pests and the long-term gains stemming from it, a commitment to preventing reinvasion will be required from all island users. This expectation is consistent with management objectives for both islands and with the Reserves Act (1977). The classification of Rangitoto as a Scenic Reserve and Motutapu as a Recreation Reserve provides for public freedom of entry and access, subject to conditions that are necessary for the protection and wellbeing of the reserve.

To this end, biosecurity standards (Appendix 3) specific to Rangitoto and

Motutapu have been established and will be implemented prior to the pest eradication proceeding. The intent of these standards is to achieve a high standard of protection for Rangitoto and Motutapu through a mix of voluntary and compulsory standards that apply to all island users. The Rangitoto and Motutapu Biosecurity Plan will not supersede the Auckland Conservancy Island Biosecurity Plan, instead it extends it by broadening the responsibility for biosecurity to external stakeholders.

The standards outlined in the plan have been designed to be as simple as possible to ensure a minimum standard of biosecurity is done well every time rather than a high standard done poorly. To further simplify biosecurity implementation, four island user groups have been identified and a set of standards developed for each of these user groups. These groups are as follows:

- DOC
- Concession Holders, Contractors and Community Groups
- Passenger Ferry Operators
- Transport Operators
- General Public and Campground Users.

In light of the open sanctuary nature of the islands, changing visitor behaviour, so that all visitors take steps to prevent the introduction of pests, will be critical to the project's success. For recreational boat owners this will be achieved only through advocacy and education and Auckland Conservancy's Pest Free Islands Campaign is targeted at this audience. Survey work to obtain baseline data on awareness within this target audience has been undertaken and follow up work is necessary to gauge the effectiveness of the campaign. Consultation with key island users suggests there is a willingness to adopt biosecurity measures, however, this remains to be tested.

A number of advocacy measures specific to Rangitoto and Motutapu will also be required and are incorporated into the biosecurity standards (Appendix 3). These focus on promoting the importance of Rangitoto and Motutapu, raising awareness of the risks of pest invasion and ensuring an understanding of the value of implementing biosecurity. As in the implementation of biosecurity standards all island users will be encouraged, and in the case of concessionaires, required, to educate other users about biosecurity.

Ongoing surveillance is an integral component for all pest free islands administered by DOC and Rangitoto and Motutapu will be no exception. However the size of the islands and the levels of visitor activity will necessitate an increased frequency and intensity of monitoring than is undertaken elsewhere. This has been incorporated into the biosecurity plan, but further work on the specifics of surveillance need to be ironed out. Techniques for detecting and responding to rodent incursions are constantly evolving as more information becomes available but it is intended that when surveillance is implemented on Rangitoto and Motutapu it will meet best practice. It is likely that this surveillance will

incorporate a comprehensive network of rodent tracking tunnels and traps complemented by periodic checks using rodent dog teams. Island staff will be trained in identifying rodent sign and will implement standard island incursion response plans if an incursion is detected. Sustained resourcing for this work is imperative.

In summary, there is no doubt that managing the probability of pests reestablishing on Rangitoto and Motutapu to near zero is possible. The responsible agencies must put in the necessary effort to ensure biosecurity measures are adopted by all island users. It is believed that sufficient resources have been allocated to ensure this is the case for Rangitoto and Motutapu over the lifetime of the project (~3 years) although a full assessment cannot be made until the biosecurity plan has been implemented and the established systems have been audited. Effectiveness of the implementation of biosecurity on Rangitoto and Motutapu is also dependent on the implementation of biosecurity elsewhere, for example, Motuihe and Browns Islands. This is planned to occur prior to the operation commencing. Consequently, the question of feasibility revolves around whether this investment can be sustained permanently.

As funding for government departments cannot be guaranteed for periods longer than three years, an assessment of feasibility rests upon a number of assumptions. These are as follows:

- The biosecurity plan is implemented prior to the eradication taking place and the established systems are tested to ensure they are effective and are adhered to on an ongoing basis.
- Auckland Conservancy implements biosecurity measures on all of the islands it administers and the measures are consistent between islands of the same grouping.
- Auckland Area Office will provide the necessary resources to implement the biosecurity plan and to assist other stakeholders to do the same. Resources will be required on an ongoing basis to maintain systems once established, and for ongoing surveillance on the islands.
- All concessionaires, lessees and stakeholders with a formal agreement are required to implement the stipulated biosecurity provisions. These parties will be audited and any parties that do not meet the standards will be penalised.

3.5 IS THE PROJECT SOCIALLY ACCEPTABLE TO THE COMMUNITY INVOLVED?

Consultation with a wide range of parties about the proposed project has been undertaken since its inception. The project was first announced on Motutapu by the Prime Minister and the Minister of Conservation in June 2006 and this was reported in the NZ Herald the next day. Te Warena Taua spokesperson for Ngai Tai ki Tamaki also attended on this day and iterated his support for the project.

A proactive approach to consultation has been employed since this announcement and consultation was an integral part of the RMA process. All stakeholders in Rangitoto and Motutapu have been identified and approached about the proposed project and the general public has been kept updated through the media, the DOC website, fact sheets and publications such as Regionwide produced by the ARC. All facets of the proposed project have been discussed with stakeholders including the ongoing requirements for biosecurity and the more controversial issues such as the use of toxins. The feedback received has generally been favourable.

Stakeholders in Rangitoto and Motutapu include iwi, concessionaires, the Rangitoto bach community, community trusts, local authorities, other government departments and non-governmental organisations. The Ngai Tai ki Tamaki Tribal Trust, the Ngai Tai ki Te Waka Totara Trust, the Huakina Development Trust, Ngati Paoa, the Ngati Paoa Trust Board, Kawerau a Maki, Ngati Maru and the Hauraki Maori Trust Board and the Ngati Whatua O Orakei Maori Trust Board have been consulted about the project. With one exception, the response from iwi has been positive.

One iwi, Ngati Maru lodged a submission in opposition to the consent application expressing concerns about the aerial application of toxins and the potential impact of the operation on freshwater and marine systems. These concerns appear to have arisen from their past experience with 1080 possum control in the Coromandel. Correspondence with Ngati Maru did not lead to a change of stance on their part and although they did not attend the consent hearing or lodge an appeal they remain opposed to the proposed technique.

Liaison with Pita Turei of Ngai Tai also took place after he raised concerns about access for iwi to the islands and the relationship between the islands and iwi. While the issues of Pita Turei did not relate directly to the project, progress has been made toward resolving his concerns.

Concessionaires are likely to be the party most affected by the project through restrictions on access during bait application and the biosecurity measures to be implemented. Most affected are the Motutapu Outdoor Education Camp (must close for the period 1 June to 1 November) and Motutapu Farms Ltd (must remove stock for the period May to January). The impact the project will have on these stakeholders is recognised and DOC has worked closely with them to ensure their operations are not negatively affected in the longer term. Despite the impacts all concessionaires are supportive of the project. To this end a formal agreement has been finalised between DOC and MOEC and an agreement with MFL is being progressed.

The project will affect the Rangitoto bach community through loss of access to the island during bait application and the implementation of biosecurity measures. Bait will be hand laid in all baches during bait application and water supplies will be disconnected during the period 1 June and 1 November. Despite these impacts, all bach users are supportive of the project and the ongoing commitments to the prevention of reinvasion. Representatives of the bach community will help with placing bait in dwellings to ensure that all covered structures are targeted.

Several community groups have a stake in Rangitoto and Motutapu, the most active of which are the Motutapu Restoration Trust (MRT) and the Rangitoto Island Historic Conservation Trust (RIHCT). These groups will be affected by the loss of access to the islands during bait application. Both groups recognise the huge potential conservation gains that will result as a consequence of the activity and are therefore extremely supportive of the project.

Communication with North Shore City Council (NSCC) has taken place as they have requested regular updates and to be advised when the operation takes place. Although no controlled pesticides are to be used as part of the project, consultation with the Auckland Medical Officer of Health (MOH) has been undertaken and communications are ongoing. Most of the recommendations provided by the MOH have been adopted.

NGOs with an environmental focus were consulted and with one exception are supportive of the project. The exception, Friends of the Earth (FOE), have voiced concerns about the impact of the project on water supplies, non-target species, public health and livestock. Over the last 10 years DOC has consulted with FOE a number of times about the aerial application of brodifacoum including the Kapiti, Little Barrier, Raoul and Macauley island rodent eradications. Despite the lack of adverse effects and the clear benefits that have resulted from these operations, FOE retain their concerns about the aerial application of rodent baits containing brodifacoum. Ongoing dialogue with FOE over the project has resolved a number of their concerns, particularly with regard to non-target native species but they retain concerns about the higher than normal application rate and the length of time the islands will be closed to the public. It is possible these concerns will remain irreconcilable.

From the general public only one opposing submissions was received. Ross Gillespie, a resident from Waiheke Island who spoke to his submission at the consent hearing raised similar concerns to those held by FOE.

A resource consent application was lodged with Auckland Regional Council (ARC) and Auckland City Council (ACC) in September 2007. In total there were 37 submissions received (32 in support, 1 conditional support and 4 in opposition) by the ARC and 26 submissions (24 in support and 2 opposing) by the ACC. A hearing was held in April 2008 and aside from DOC's submission, only four supporting and two opposing submissions were heard. Consent was granted in June 2008 with conditions acceptable to the project. Following granting of the resource consents an appeal was lodged by Ross Gillespie to the Environment Court. This appeal was struck out by the Environment Court because of irregularities with the way it was submitted. The court's decision was not appealed.

Given the depth of consultation undertaken and the feedback received it can be concluded that the project is generally acceptable to the community involved. Opposition has been voiced from a single individual and a NGO opposed to the use of toxins, but otherwise support for the project is overwhelming. Importantly, feedback from island users about the implementation of biosecurity measures has been positive although a commitment to these measures has yet to be tested.

3.6 DO THE BENEFITS OF THE PROJECT OUTWEIGH THE COSTS?

3.6.1 Benefits

Many of the benefits of the eradication of pests from Rangitoto and Motutapu are described in the first section of this report and a summary of these only is provided below. The following beneficial outcomes are anticipated:

Improved Ecosystem Function, Opportunities for Species Protection and Threatened Species Recovery

Eradication of introduced mammals together with sustained weed control will safeguard the unique processes of regeneration on Rangitoto while at the same time creating the conditions necessary for reestablishing the foundations of a coastal forest ecosystem on Motutapu. Importantly it would provide a significant boost to the protection of wetland habitats within the Auckland Region. Motutapu supports up to 7% of the region's remaining freshwater wetlands.

Benefits to the diverse range of ecosystems present on Rangitoto and Motutapu include:

- Increased rates of seedling production leading to shifts in succession of forest communities;
- natural recovery of many species of invertebrates; recovery and spread of four and perhaps up to six resident species of lizards;
- increased abundance of some coastal and wetland birds, and at least two species of forest birds;
- recolonisation by at least two additional species of forest birds and possibly at least two species of wetland birds.

Together with the proposed species reintroduction programme, positive benefits of the eradication would cover the entire forested ecosystems on Motutapu and Rangitoto, species that are present and those that could be reintroduced including 13 species of reptiles, at least 21 (possibly up to 26) species of birds and perhaps two species of bats. The total could exceed 40 species of vertebrates, 24 of which are at present listed as threatened.

Opportunities for Advocacy and Education

Motutapu and Rangitoto provide a significant opportunity to increase the value that New Zealanders attribute to conservation. Pest eradication will increase the profile of the restoration project, leading to increased participation. The dispersal of mobile wildlife to the mainland will provide further avenues for advocacy. Opportunities for island based environmental education programmes will be significantly enhanced.

Improved Day to Day Management

Removing animal pests from Rangitoto and Motutapu will reduce the level of damage currently sustained by rodents and rabbits. Human and stock health is likely to be better protected as a result of the removal of pests.

Improved Biosecurity for the Hauraki Gulf Islands

A pest free Rangitoto and Motutapu would improve the level of protection that currently exists for other pest free islands in the Inner Hauraki Gulf and will improve border control measures against further pest invasions. It will simplify the messages provided to the general public thereby improving biosecurity advocacy programmes.

A Contribution to the Knowledge Base

DOC stands to gain significant new information on the effectiveness of current pest eradication techniques. This information will advise future island eradication programmes.

Increased Economic Opportunities

Economic gains are expected because of an anticipated increase in visitor numbers and a more diverse range of opportunities for tourism and recreation. The islands' potential as a carbon sink will also be improved.

Enhanced Reputation

The project provides DOC with an unmatched opportunity to be recognised as an effective manager of the lands, waters, species, historic places and roles entrusted to it.

3.6.2 Costs

A full analysis of the adverse effects from the proposed aerial bait application targeting rodents can be found in the assessment of environmental effects (AEE) lodged as part of DOC's resource consent application. Consequently some components of the following section such as the impact on non-target species have been abridged.

Economic impacts

The total projected financial cost of the project is $3.4M although this estimate may be reduced if rabbit numbers remain low. Ongoing costs to support the implementation of biosecurity measures will also be required. Over and above existing staff and allocated resources, 0.5 of an FTE and $5,000 per annum for consumables is required on an ongoing basis.

Economic impacts from the proposed activity will affect both MFL and MOEC. Both parties will be required to suspend operations for a significant period. In line with the Code of Practice for the Aerial and Hand Broadcast Application of Pestoff® Rodent Bait 20R for the

Intended Eradication of Rodents from Specified Areas of New Zealand, MFL will be required to de-stock the island for a period of up to eight months to eliminate the risk of contaminating livestock. MOEC, who take bookings up to two years in advance, will be required to suspend the accommodation and education components of their concession for up to five months as the exact timing of bait application and consequent closure of the island cannot be predicted.

The closure of the island for the days during and after bait application will result in the cancellation of ferry sailings and have an economic impact on Fullers Ferries Ltd as well as a number of smaller scale concession holders. The proposed suspension of activities will result in a reduction in revenue for these parties.

Impacts on Non-Target Native Species

No population of native or non-target species present on Rangitoto and Motutapu is considered to be at risk although some individual mortality of NZ dotterel, pukeko, paradise shelduck, black backed gull, morepork, Australasian harrier and some of the introduced bird species is expected. Specific measures, identified to protect NZ dotterel, are expected to eliminate or reduce potential risks to this species as far as is possible.

Impacts on the weed programme

A major weed programme is in place on both Motutapu and Rangitoto to limit the impacts of adventive plant species such as Rhamnus alaternus, moth plant and pine. Following the removal of rodents from Raoul island, improved seed germination and seedling survival was observed in some weed species and the same phenomenon could occur on Rangitoto and Motutapu. The proposed activity could therefore exacerbate the existing weed problem and lead to greater weed control costs in the future.

Potential failure to eradicate one or more of the target species

If this eradication was unsuccessful it would have an impact on DOC's image as an effective manager of the lands, waters, species, historic places and roles entrusted to it. Failure could lead to reluctance to fund other projects within the region. This reinforces the need for careful planning and consideration through every step of the proposed operation.

As with all operations there is a risk of failure to eradicate one or more of the target species present. Given that this is the largest eradication attempt for mice, ship rats, hedgehogs and rabbits, there is a chance that it will fail, even if the other pests are removed. In the event that one or more of these species survive it is likely they will become more abundant with reduced predation and competition.

In the absence of predators, rabbits could increase to levels similar to those found on Motuihe before they were eradicated. Higher numbers of rabbits could result in significant impacts to archaeological sites and pasture production and would hinder the replanting programme on Motutapu.

If mice survive they may become even more abundant, especially on Motutapu where they will thrive in rank pasture. Mice have the potential to alter the species composition of native forest (although this has not yet been quantified) and have been implicated in the reduction of native reptile and invertebrate populations (Ruscoe and Murphy 2005). With the removal of competitors and predators these types of impacts on Rangitoto and Motutapu can be expected to increase. Such a situation would also increase the risk of mice arriving on nearby pest free islands such as Motuihe and Browns.

The survival of hedgehogs would lead to continued impacts on native invertebrates, reptiles and ground nesting birds. Whether or not the level of this impact would change as a result of the eradication of other pest species is unknown.

The survival of ship rats would lead to continued impacts on virtually all aspects of the ecosystems on Rangitoto and Motutapu and would significantly compromise the scope of the planned restoration programme. On the New Zealand mainland, ship rats are regarded as the most pervasive and devastating invasive species alongside possums. Ship rats consume the fruit and seeds of at least 11 species of forest plants and eat weta, beetles, spiders, moths, stick insects and cicadas. They also destroy the eggs and kill chicks of kereru, kokako, robins, fantails and tomtits.

Impacts on Recreation and Public Access

Rangitoto and Motutapu are iconic and popular recreation destinations, together receiving more than 100,000 visitors per year, although visitor numbers tail off significantly during the winter period. The islands will be closed for each of the three applications of bait and for a period of at least five days after each application amounting to a maximum of three weeks over the period 1 June – 1 November in the year of the rodent eradication operation. This will limit public access and restrict recreational use on and immediately around the islands. MOEC and the DOC campground at Home Bay will be closed for the entire pest eradication programme which amounts to up to six months over the winter season.

The cost of, and amount of time to prepare for, a visit to Rangitoto and Motutapu may increase in the future as a result of biosecurity requirements and subsequently have an impact on island visitors, concessionaires and community groups. To minimise these impacts, the proposed standards have been designed to be as simple as possible. They are also in line with those used for the other pest free islands of the inner Hauraki Gulf. Although this approach increases risk it will encourage a minimum standard of biosecurity to be done well every time for all islands rather than a high standard done poorly.

Cultural Impacts

No concerns about wahi tapu sites were identified by iwi during consultation about the proposed pest eradication and no impacts are

anticipated. Shellfish are traditionally collected over the summer months so the closure of the islands to the public during bait application is unlikely to affect traditional food gathering.

3.6.3 The Cost/Benefit Evaluation

Economic Impacts

Apart from the comparatively small ongoing costs of maintaining the islands' pest free status the economic and financial cost of the proposed pest eradication are short term and when measured against the anticipated benefits are considered to be minor. The economic benefits of the project will be ongoing and are expected to eventually outweigh the short term costs.

The impacts of the proposed pest eradication have been fully discussed with all affected parties and all are supportive of the proposed activity. DOC has worked through agreements with MOEC and MFL to find ways of mitigating potential impacts. The low visitor number for the time of year coupled with the very few days on which the island will be closed ensures that the economic impact on other operators such as Fullers is minimised.

Impacts on Non-Target Native Species

Eradication operations utilising the proposed techniques have in all cases led to the long-term recovery of native species and ecosystems and for a number of threatened species it has been the difference between continued survival and extinction. With the exception of weka which has occasionally been a target species, no native species population has been extirpated or its long term survival compromised as a result.

The main threat to native species present on Rangitoto and Motutapu is predation by introduced mammals. There can be little doubt therefore that the eradication of pests from Rangitoto and Motutapu will provide significant long-term benefits for the resident native species.

Impacts on the weed programme

Exclosure plots were established to measure the impacts of rodent removal on Rhamnus alaternus and preliminary results suggest that the impact on this species will be negligible. However other species, currently not targeted, may become a problem. Greater surveillance will be required in the first few years following the removal of pests to detect and react to short term changes in weed populations.

Potential failure of to eradicate one or more of the target species

While there is a risk of failure in any eradication operation the survival of any of the proposed target species is unlikely to present a worse environment for the ecology of Rangitoto and Motutapu. Although the impacts on some native species might increase, many others would not

be affected greatly, and many reintroductions may still be possible. The survival of mice at Tawharanui has had a negative impact on some species but not others and has allowed most bird and reptile reintroductions to proceed as planned.

The likelihood of failure to eradicate one or more of the target species is deemed to be low, if the proposed techniques are implemented as planned. Consequently, the anticipated long term benefits of a successful operation are considered to far outweigh the risk and consequences of failure.

Impacts on Recreation and Public Access

It is considered that the limitations on public access and land and water based recreation on or around the islands will amount to no more than a minor adverse effect on recreational values. This is because of the limited number of days in which the two islands will be closed, the fact that recreational use of the islands and bach occupancy traditionally reduces over winter months and the comprehensive public notification process that DOC will implement prior to the operation proceeding. Furthermore, the significant benefits that will result from the proposal in the longer term, including increased diversity and regeneration of indigenous flora and fauna associated with the eradication of rats and mice, are positive environmental effects and are expected to enhance recreational use and visitor experiences.

Cultural Impacts

As requested during consultation, DOC will advise iwi directly as part of the public notification process about when the operation is taking place to minimise any inconvenience.

Summary

It is concluded that the overall adverse impact of the proposed activity will be minor and that the ensuing benefits outweigh any risks posed by the activity. The costs and impacts of the activity are in most cases short term and inconsequential and the benefits long term and significant. There will be no adverse effects on human health or the wider environment, and no cumulative effects given the one off nature of the proposed activity. Even when the risks and consequences of failure are taken into account, the benefits of the proposed work outweigh the costs.

4. What will it take?

4.1 LEGAL AND PLANNING REQUIREMENTS

The required resource consents from the ACC and ARC have been gained and an appeal that was lodged with the Environment Court has been struck out. As a requirement of the ARC consent a 'Hazardous Substances Management Plan' and an 'Operational Management Plan' is required to be approved by ARC's consent monitoring officer prior to the operation proceeding.

As this proposal does not involve the use of a controlled pesticide, consent from the Medical Officer of Health is not required but notification is necessary. Consultation with the MOH was undertaken prior to the submission of the consent application.

Internal consent to apply toxins for vertebrate pest control on lands administered by DOC must be obtained from the Auckland Conservator prior to bait application. DOC has a standard procedure to apply, assess and grant this consent on behalf of the Environmental Risk Management Authority (ERMA).

4.2 PROJECT TIMING

The project schedule which details the timing of critical elements of the project is outlined in Appendix 3

4.3 TRIALS AND FURTHER RESEARCH

A number of trials were undertaken to answer information gaps that were identified at the outset of the project. The susceptibility of mice from Rangitoto and Motutapu to the proposed bait and toxin was tested along with the bait's palatability. The overwintering activity of hedgehogs was monitored to determine when best to target this species and the impact of pest eradication on weed seed survival and recruitment was assessed. Consultation with stakeholders was also undertaken to provide an indication of whether implementing biosecurity standards would be possible. It is considered that sufficient information is available to establish the feasibility of the project and no further research or trials are recommended.

It was proposed that a non-toxic bait trial utilising a biomarker be undertaken on Rangitoto and Motutapu to test whether all mice can be put at risk by the proposed technique. This trial was not conducted because it could not simulate an actual eradication attempt where

potential competitors and predators were removed over time. If a mouse that had not eaten bait was captured inside the experimental area it would not answer the reasons why it didn't take bait and unless elaborate precautions were taken the trial could not completely control for immigration into the site. It was felt that the results of the Motuihe and Browns Island eradications were a better guide to the likely success on Rangitoto and Motutapu than an in situ trial.

4.4 BIOSECURITY

The level of protection from pest invasion currently afforded to Rangitoto and Motutapu and the other pest free islands in the inner Hauraki Gulf must be improved. The success of the project is contingent on changing the behaviour of all visitors that arrive on a yearly basis so that everyone travelling to the islands takes sufficient steps to prevent pest introduction. Without this change in behaviour any resources invested in removing pests will be wasted. To bring about this change in behaviour the following actions are required.

- The biosecurity and surveillance plan that has been written must be implemented and the systems audited prior to the eradication taking place. This will be critical to ensuring that standards are in place and the level of protection required is present.
- The biosecurity standards outlined in the plan must be incorporated into all concession agreements and formal agreements with key stakeholders. These parties will need to be audited to monitor performance and any parties not meeting the standards must be penalised.
- The key messages for the Pest Free Awareness Campaign run by Auckland Conservancy must reach all recreational boaties and monitoring must be undertaken to determine that this target has been reached.
- The Auckland Area Office will need to provide the necessary resources to implement the above actions and assist stakeholders to implement the required standards. Resources will be required on an ongoing basis to maintain systems and for ongoing surveillance on the islands.

The eradication of pests on Rangitoto and Motutapu should not proceed until it is clear that the probability of pests reinvading Rangitoto and Motutapu has been reduced to near zero. To allow a decision to be made whether or not to proceed before significant resources are committed, the systems outlined in the biosecurity plan must be in place and operational by 1 January in the year that the pest eradication proceeds. These systems must be tested and reworked if they are not effective and a final assessment made by 1 March. The assessment needs to follow the template for reviewing biosecurity practice and test whether the risk of reinvasion has been reduced to near zero. The assessment should be undertaken by DOC staff experienced in island biosecurity from Auckland Conservancy and elsewhere.

Ongoing surveillance for the presence or absence of all target species will be critical to monitoring the pest free status of the islands and responding to incursions as they arise. Techniques for detecting and responding to rodent incursions are constantly evolving as more information becomes available but surveillance on Rangitoto and Motutapu should apply best practice. Surveillance should incorporate a comprehensive network of rodent tracking tunnels and traps and be complemented by periodic checks using rodent dog teams. Island staff need to be trained in identifying rodent sign and must be prepared to implement an incursion response if a pest is detected. Sustained resourcing for this work is imperative.

4.5 OPERATIONAL METHOD

To target all seven pest species on the island a suite of techniques will be required. It is desirable that these techniques are deployed so that each capitalises on the other and that operational efficiencies are maximised. For this reason rodents must be targeted first. The aerial spread of rodent bait containing brodifacoum will remove rodents thereby eliminating an important prey item for both stoats and cats. Any reduction in food availability is expected to increase the vulnerability of these species to the subsequent trapping programme. Cats, stoats and hedgehogs are also vulnerable to secondary and, in some cases, primary poisoning. While not specifically targeted, the rabbit population is expected to be knocked back by the bait drop greatly assisting follow up work on this species.

The trapping programme targeting stoats, cats and hedgehogs will begin hard on the heels of the second bait application as will the follow up programme targeting rabbits to ensure full advantage is made of the rodent eradication. Techniques targeting one species will be used wherever possible to complement others. Trap sets for cats will target stoats and hedgehogs, cats may be targeted while spotlighting for rabbits and sign left by any of the target species will be noted by observers working in the field. When targeting rabbits, passive techniques such as patch poisoning and burrow gassing will be used ahead of more aggressive methods to avoid pushing rabbits into hiding. Dogs will be incorporated into all aspects of the eradication programme to complement the techniques described.

By maximising efficacy of all techniques and capitalising on each the overall time taken to complete the eradication will be reduced as will the quantity of resources required.

4.5.1 Rodent Eradication

Given the combined area of the two islands (3,842 ha), the rodent species targeted and the nature of the terrain, helicopter distribution of bait is the only practical option. To ensure comprehensive coverage of the operational area, bait must be applied along parallel flight lines spaced at between 40m and 50m apart to provide a 50% overlap in swath. Flight

lines for subsequent applications should be flown at approximately 90 degrees to those used for the first drop to minimise the risk of gaps in bait spread. During each application, the coastline of the islands and steep areas will need to be flown a second time using line of sight to guard against gaps at the end of the parallel flight lines.

Application of bait should start as early in the day as possible to ensure there is adequate time to finish spreading, check DGPS printouts and re-fly any gaps before dark. Because of the size of the islands, it is likely that bait spreading at least for the first application will take up to two days. If, for any reason, this or any other bait application is not completed in the prescribed two day period, the untreated area must be flown as soon as possible on the following day. In such a circumstance, the islands would need to remain closed for an extra day with additional public notification undertaken.

Aerial bait spread must cover all parts of the two islands, including sites where buildings are located. For rock stacks identified as potentially harbouring rodents, bait must be applied either from a bucket with the spinner removed or by hand from a helicopter. No areas can be excluded from bait application.

Up to three applications will be required to target rodents. This differs from previous operations for the following reasons:

- The operation targets mice across an area much greater than that attempted previously;
- Multiple target species are present as well as several non-target consumers of bait;
- To ensure mice are exposed to bait for a longer period of time than they have been previously; and
- To give mice that did not access bait during the first application access to bait during the second and third.

The specified rate for the first application also exceeds that recommended by the manufacturer's label and is higher than some other eradication programmes that have targeted rodents for several reasons. Firstly rabbits, present as a non-target species on both islands, are a significant consumer of bait and will compete with rodents for bait. Experience from islands such as Motuihe has shown that even at applications rates of 30 kg/ha and using bait containing a fast acting toxin such as 1080, rabbits can consume bait rapidly. More bait is required on Rangitoto and Motutapu to ensure that bait remains available to rodents. Rabbit numbers will need to be re-evaluated in April, two months before bait application and a final decision on the application rate made.

Secondly, the surface of Rangitoto is extremely broken and fragmented, greatly increasing the surface area of the island that needs to be covered. The home range or territory of the rodent species present may be smaller in this type of terrain and a greater number of baits may be required to ensure that each rodent territory is exposed. Thirdly, recent operations such as Tawharanui and Maungatautari that have targeted multiple species with lower bait application rates have failed to eradicate mice.

Pestoff 20R containing 20 ppm, 0.02 g/kg, brodifacoum is the recommended bait type because it has been used in most successful rodent eradications completed in New Zealand. Up to 176 tonnes will be required. This amount of bait can be produced by the manufacturer but advance warning and a bait supply contract will be required. A 1 April notification is required in the year that the operation proceeds. It is desirable that the bait is shipped in a quantity that can be shipped as one load on board a barge so storage at the factory may be required.

Each application of bait must be separated by at least two weeks to ensure bait is available to rodents for as long a period as possible. On the days of each bait application, baits will also need to be placed by hand in the interiors, roof cavities and sub-floor spaces of all buildings on both islands. Bait must also be placed in any other covered structure including gun emplacements and lava caves. These baits should be checked fortnightly with the bait being replenished as required, until no more bait is taken. The application rate for hand-laying in buildings must be higher than that used for aerial application as the emphasis is on providing easy access to bait for rodents living in these buildings.

As little extra effort is required, it would be beneficial to undertake monitoring across the stoat/hedgehog trapping grid for surviving rodents. Monitoring should utilise traps or tracking tunnels and be complemented by rodent dogs. Island invasion contingency measures including the further use of rodent dogs must be implemented for any sign detected.

Transport and Storage Requirements

To get the bait from ACP in Wanganui to the islands, it will need to be transported by road to Auckland and then shipped to the island. The best transport option is likely to consist of curtain-sider trucks which are rolled onto the deck of a barge in Auckland and then rolled off at Yankee Wharf slipway on Rangitoto. Each truck and trailer can carry up to 22 pallets so eight truck and trailer units will be required, necessitating two barge trips to the island. If a full barge load cannot be delivered on the same day, storage for bait in Auckland will be necessary. A secure warehouse to park trucks would be preferred but if this cannot be found, shipping containers have been used effectively before although this will increase handling effort. Once on the island, a good road network exists but an efficient and rapid system for unloading trucks will be required. Tractors with pallet forks may provide the best means of achieving this.

Once on the island weather tight and rodent resistant storage will be needed for up to several months. Up to 440m2 of floor space will be required to house the 176 tonnes of bait. The best option for storing bait would appear to be the former army bunkers adjacent to the DOC Field Centre on Motutapu. These bunkers are in good condition, are weather proof and can be secured to exclude public access.

Throughout the transport and storage period for bait the risks of contamination must be minimised. As part of this, rodent trapping should be undertaken around storage facilities prior to and during the bait storage period to protect bait from contamination.

The transport of bait to the island must be subject to the biosecurity standards outlined in the biosecurity plan and provision will need to be made for this. This will have ramifications on where and for how long bait is stored and also the time taken prior to loading barges. A consent condition requires that any spillage of bait is swept up and contained. To achieve this, a spill kit will be required on site at all times. Damaged bait that is no longer suitable for application can be stored in plastic drums until such time as it can be removed from Motutapu and disposed of in an approved landfill facility.

Weather

A forecast of less than 15 knots and four fine days (three fine nights) without significant rainfall (less than 6mm) is preferred for bait application. Fine weather is required to maximise the length of time that bait remains palatable. Long range weather forecasts will be required from the Met Service to allow potential weather windows to be accurately predicted.

Bait Loading

On the day of bait application, bait needs to be transported to the Motutapu airstrip and loaded into spreader buckets. Supply of bait to the bucket loading site must be kept ahead of demand so that down time for helicopters is minimised. To achieve this a number of staff will be required and trucks for transporting bait. A mechanism for loading bait spreading buckets is also necessary. It is preferable that this system is mechanical to maximise the efficiency of loading and minimise the number of staff working under helicopters.

Bait Application

Up to four helicopters will be required to simultaneously apply bait to ensure that bait is applied in as short a time as possible, ideally one day. All helicopters used to undertake the work must possess a current Air Service Certificate and the pilots must hold the appropriate chemical rating and have extensive experience in flying with Differential Global Positioning Systems (DGPS). Helicopters must be guided at all times by DGPS. The aerial works contractor must provide spare helicopter capacity to be available at short notice in case of mechanical breakdown.

At the same time as bait is being spread aerially, bait must be placed in all covered structures and caves on both islands. It is essential that all covered structures are targeted to achieve successful eradication. On Rangitoto this must be completed in conjunction with the bach community and on Motutapu in association with concessionaires so that access to all dwellings is guaranteed. Prior consultation with these stakeholders will be required to designate and train representatives of both groups to assist in bait application. DOC staff will assist and supervise these stakeholders to carry out this task.

To ensure that complete coverage is achieved within the days of bait application a team of up to eight people will be required. A comprehensive list of structures will need to be generated and ground truthed before

the operation and a map showing the location of each structure made. A number of system checks will be need to be put in place to provide complete confidence that each structure has been targeted.

DGPS

The DGPS hardware and software used must be interchangeable between helicopters and pilots and at least one ground based person must be familiar with its use and basic fault finding. The DGPS output must be able to be downloaded to disc and a printer and PC to allow immediate and detailed viewing of helicopter flight paths.

The DGPS system will require a fixed base station. This equipment should be installed and tested prior to the commencement of the operation. The summit of Rangitoto is the highest point on the two islands and offers the best potential for line of sight to wherever helicopters may be operating. Back up systems in case of breakdown must be a requirement of the aerial works contractor.

Helicopter Fuel

Up to 30,000 litres of aviation fuel will be required for the operation. At the specified application rates for each application, up to 20,000l will be required for the first bait application and approximately 5000l for each of the second and third. Given the quantities of fuel required and the logistics of transporting this to the islands, a fuel tanker is recommended. The refuelling site should be a minimum distance from the bait loading zone to avoid congestion of helicopters. The fuel tanker will be transported to the island by barge.

Bait Spreading Equipment

All bait spreading buckets must be designed specifically for the application of bait. Buckets should have retractable legs to reduce fragmentation and will need to be calibrated prior to being transported to the islands. Spare parts including a spare bucket must be on site during bait application in case of mechanical breakdown.

4.5.2 Rabbit eradication

All grassed areas of Motutapu should be intensively grazed right up until the point when stock are removed in June to minimise the amount of cover available for rabbits and grazing or spraying rank pasture outside the areas currently grazed should be considered. Clearing up windfalls and other cover prior to the commencement of the eradication programme is also considered necessary. Grass growth is expected to take off in spring and provision should be made for mowing accessible areas. Stock should be returned to the island as soon as the withholding period (up to 60 days) following bait application has expired. On their return, stock must be used expeditiously to complement the rabbit eradication programme.

It is expected, based on other operations that the island's rabbit population will be significantly reduced following bait application for rodents. For successful eradication, sufficient pressure will be required immediately following aerial poisoning and this pressure must be applied at a consistently high level of intensity to ensure the population continues to decline. In saying this, eradication techniques need to be applied in such a way that the possibility of educating rabbits is minimised.

Passive techniques will be required at least in the initial stages to achieve this. Locating sign and patch poisoning these areas should be used as one of these preliminary techniques. Pindone is likely to be the most appropriate toxin for patch poisoning as, the only other registered alternative, 1080 is an acute toxin and therefore more likely to generate bait shyness. Carrot is recommended to be used as bait because it is highly palatable to rabbits and may target individuals that avoided cereal baits. Dogs will be critical to locate sign and active burrows that can then be blocked up and gassed with magnesium phosphide. Care must be taken not to over use dogs to avoid rabbits avoiding areas where dogs have been. The option of trapping must also be considered as a technique although like the other techniques will need to be undertaken with care not to educate individuals.

Hunting with spotlights will be phased in when residual populations are down to just one or two individuals. Shooting must be carried out in such a way that the chances of missing an individual is minimised so as to avoid educating individuals to the technique. Sighting in rifles on a daily basis, ensuring rabbits are well within range and employing good practices when loading ammunition will assist in this. All passive and proactive techniques need to be alternated regularly to avoid rabbits becoming wise to the techniques. GPS and GIS technology will be key to ensuring that no parts of the island are excluded from the area searched.

Working on a conservative area of 100 ha searched per day per person (this will vary greatly depending on the terrain and if a 4WD motorbike or dogs are used) at least four people including two dog handlers each with two dogs, will be required to cover Motutapu and the areas of Rangitoto where rabbits are present inside a period of between five and six days. A 14 day turn around for areas with residual rabbit populations is considered the maximum time interval that should be left between follow ups. Consequently four people and four dogs is considered sufficient to maintain the necessary pressure on the rabbit population while accommodating the down time that will result from weather, leave, and time off the island to freshen staff and dogs. The use of dog handlers from elsewhere to audit progress should be utilised on a regular basis.

4.5.3 Stoat and Hedgehog Eradication

It is likely that stoats and hedgehogs will be affected by the application of bait to target rodents. Based on other operations such as Maungatautari most hedgehogs and stoats may succumb to direct and secondary poisoning, however, this cannot be assumed and a trapping grid will be needed across both islands to target survivors. The trapping grid

must be established and although not set, be open to the target species prior to bait application for rodents. It is considered desirable that traps are pre baited at least once before the rodent eradication to minimise neophobia.

The trapping grid will need to be sufficiently intensive so as to conservatively place a trap in every possible home range of surviving stoats. To achieve this, an island wide 100m x 400m trapping grid utilising DOC 200 traps set into wooden tunnels is proposed. Approximately 1000 trap units will be required, 600 for Rangitoto and 400 for Motutapu. At least eight staff will be required to set up the track and trap network and based on a regime of weekly trap checks and an average of 50 traps checked per person per day, up to four staff will be required to service traps on an ongoing basis.

Hedgehogs have a smaller home range size than stoats and while the dimensions of the proposed trapping grid meet the specifications for stoat eradication they may not for hedgehogs. Consequently predator dogs will be essential to achieving the eradication of this species. Successful eradication of hedgehogs will rely heavily on the abilities, availability and fortitude of the dog handler/s and the recruitment process will need to take this into account.

Bait preferences can vary between the two species but fresh rabbit meat has proven to be successful for both hedgehogs and stoats. Fish and other strong smelling baits work well with hedgehogs but have the potential to deter stoats so should not be used at least in the short term.

The trap network must be run for a minimum of two years to ensure operational success although the frequency of trap checks can be reduced within this time frame. It is proposed that traps checks are initially completed at weekly intervals. Following a six month period of no captures, trap checks will be reduced to once a month.

4.5.4 Cat eradication

A number of cats are also expected to succumb to direct and indirect poisoning as a result of the rodent eradication. However, as for stoats and hedgehogs, resources for follow up work must be allocated to target possible survivors. Rather than a strict trapping grid, trapping should focus on edge habitats including tracks, road networks, bush edges, ecotones and the island's coastline. Cats can also be shot during night work for rabbits. Experiences such as those from Raoul emphasise the need for experienced and skilled staff and conducting trapping in such a way that pull outs are minimised. At least two personnel will be required for cat trapping and cat specific predator dogs will be necessary to locate survivors and their sign.

The effectiveness of currently registered baits containing 1080 has been variable and currently the use of this technique is not recommended. However, new and potentially improved bait types for cats have been developed in Australia and the use of these products should be investigated as part of operational planning.

4.6 STOCK AND FARM MANAGEMENT

The return of stock following bait application is a double edged sword. While it is necessary to graze pasture so that cover for rabbits is minimised, the return of stock may impact on the shooting and trapping operations. These issues were successfully managed on Motuihe and there is no reason why this cannot be repeated on Motutapu. It is imperative that the needs of the eradication take precedence over those of the farming operation and that stock movements are used to support eradication progress. Patch poisoning for rabbits cannot be able to be undertaken where stock are present.

4.7 OPERATIONAL TIMEFRAME

The proposed aerial bait application targeting rodents will take place within the period 1 June to 1 November. This is both an operational and consent requirement. Three applications of bait, each separated by a two week minimum period and each taking 1-2 days to complete will be undertaken. To maximise the likelihood of success it is considered important that all three applications of bait are completed before most rodents commence breeding in spring. Following the last application of bait, monitoring will be undertaken for surviving rodents and island invasion contingency measures implemented for any sign detected.

Timing of the rodent eradication operation for mid to late winter takes advantage of the fact that the target species are under maximum stress through lack of food and cold weather and any breeding is minimal. Winter is also the wettest time of the year so bait breakdown (the cereal based baits break down when wet) is more rapid and non-target species such as reptiles are at their most inactive.

The preference is to undertake aerial baiting in 2009 but consent has been gained for the period up until 1 November 2014 to allow for unforeseen delays. It is hoped that the operation will take place as soon as possible after 1 June 2009. The first drop must occur before 15 August for the eradication to proceed in that year. The ability to do this will depend on suitable weather patterns.

All operational staff and contractors will need to be placed on standby following the arrival of the bait on the island. Following a suitable weather forecast, all operational staff and contractors will travel to the islands in readiness for the bait application proceeding the next day. The same procedure will be followed for the second and third applications.

Follow up work targeting cats, stoats and hedgehogs should commence immediately following the second application of bait to capitalize on mortality resulting from aerial poisoning. The stoat and hedgehog trapping grid must be established prior to bait application. Once activated, trapping of all three target species should continue until no animals have been trapped for a period of six months after which time effort can be reduced. This programme should run for up to two years but provision

must be made to extend this if necessary. Surviving cats will be targeted along the same timeframe.

Within two weeks after the second application of bait a programme targeting surviving rabbits will commence. It is critical that this work begins hard on the heels of the aerial poisoning and that pressure on remaining rabbits remains high to minimise the opportunity for any breeding. The rabbit programme should run for at least two years although provision to extend this period if required should also be made.

Predator dogs will be used immediately for follow up work on hedgehogs, cats and rabbits but will be brought in on an as and when required basis for stoats and rodents. Dogs will be specifically trained to avoid eating rodent bait so that they can be used immediately after bait application.

While eventual success is likely for rabbits, hedgehogs, cats and stoats the prospect of the project dragging on for longer than two years whilst chasing the last few individuals or outbreaks of sign for these species needs to be acknowledged. The eradication of wallabies and possums from Rangitoto and Motutapu took nearly ten years to achieve with the last 10% of animals taking five years to mop up and soaking up more than 50% of the total eradication effort. Any anticipated overruns in terms of the length of the programme need to be signalled early and committed funding found if eradication is going to be achieved.

Regular reviews of progress will be carried out throughout the project's lifetime. Each time the project is reviewed, if overwhelming evidence exists that eradication for any of the target species appears unlikely using all currently available techniques then a decision will be made to cease further work.

4.8 STAFF

4.8.1 Recruitment

Recruitment of a number of staff will be required (see resources required below) and for a number of positions the process must be instigated early. Dog handlers will need to be identified at least a year out and given some surety of employment so that they can make the necessary investments in purchasing, housing and training dogs.

The project needs to secure as many experienced operators as possible and needs to allocate wages accordingly. However, at the same time, a balance needs to be found and it is felt that a mix of experienced with less experienced but keen operators would provide a good balance necessary to sustain an operation that may take two years to complete.

4.8.2 Motivation

For the operation to be as efficient as possible, motivated staff are essential. The recruitment process will aim to select staff who are committed to the project's outcomes and staff will be managed in such

a way as to enhance this commitment. Staff will need to be looked after, given good accommodation, ideally accommodated as separate teams and provided with good direction. Communication flow between team members, team leaders and the project manager will need to be, proactive, regular and consistent. A regular boat run will need to be established to accommodate staff movements to and from the island.

To ensure that traps are checked and that animal sign is followed up on the next day, even on weekends, staff within teams need to be on rotational rosters. Opportunities for increasing the diversity of the work need to be explored and utilised as much as possible. Along these lines it would be desirable that the rabbit team and perhaps members of other teams periodically spend time off site assisting with other control projects elsewhere. These periods will serve to refine skills and refresh staff whose concentration is flagging. The same will be required for predator dogs and their handlers. The effectiveness of predator dogs reduces over time if they are not given time to re-associate with their target pest.

4.9 COMMUNICATIONS

Good communication with coverage across both islands will be required for the eradication programme. VHF radio is likely to be the best means of primary communication between operators on the ground. To achieve good VHF coverage a portable repeater will need to be deployed on the summit of Rangitoto.

4.10 PUBLIC SAFETY AND CONSTRAINTS ON THE OPERATION

As a condition of consent the Department must exclude the public from the islands during, and for the seven days following, each application of bait. Extensive notification will be required to ensure that all commercial and recreational boat owners are informed that the islands are closed. Email communications with ferry and transport operators, coastguard and the harbour master will be required alongside marine radio announcements and boat patrols around the island. 'No Landing' signs will need to be established at all potential landing sites on the islands for these periods.

Following the reopening of the islands to the public all island visitors will need to be informed of the risks posed by the presence of brodifacoum bait and other components of the operation such as the hunting and trapping programme for rabbits and stoats. As a consent condition ferry and charter boat passengers must receive this information prior to their visit. Signage and marine radio broadcasts will need to be in place to alert recreational boat owners.

Public access to and across the islands will be unrestricted outside the periods of bait application and follow up activities including shooting, gassing and trapping pose a risk to public safety and may garner negative public reaction. These issues were dealt with effectively on Motuihe where rabbit eradication work continued for two years with open public access. The hunting of rabbits is generally carried out at night when the public is not present and no hunting will be carried within the Home Bay campground when it is in use. However, remaining risks must be mitigated through good signage, well thought-out placement of traps and cautious hunting techniques. The Home Bay campground may need to be closed for a longer period than is currently planned if risks to the success of the operation are identified.

4.11 PUBLIC NOTIFICATION

A comprehensive public notification and education programme must be implemented to advise the timing of bait application and subsequent island closures and the hazards posed by the activity. Signage on the islands as well as on passenger ferries warning the public of the presence of bait will be required. Signs must remain in place and be maintained in good condition throughout the duration of the bait drop and until monitoring of bait breakdown confirms that no public health risk is present.

In addition to this, public notices will be issued prior to bait application and coastal marine radio channels will be used to notify mariners of the hazards. Passengers booking tickets on Fuller Ferries will need to be alerted to possible cancellation of ferry sailings and following the reopening of the island to the public warned of the hazards prior to their departure from the mainland.

4.12 NON-TARGET SPECIES

New Zealand dotterels are the only native species present on Rangitoto and Motutapu considered at risk from the operation at the population level. The aerial application of baits containing brodifacoum is likely to result in mortality of New Zealand dotterels if measures are not taken to reduce exposure of birds to toxin. A number of measures to mitigate possible impacts have been considered. It is recommended that the dotterels are left in situ, but to reduce their exposure to toxin, sandhopper densities will be reduced in dotterel territories by removing beach-cast seaweed before the operation and removing baits from the high-water area immediately following each drop. NZ dotterel should also be closely monitored before and after bait application.

4.13 RESOURCES REQUIRED

Item	Quantity Required	Comment
Materials		
"Pestoff 20R" rodent bait	Up to 176 tonnes	Bait will be 10mm, 2g approx., Wanganui No.7 cereal bait containing 20 ppm, 0.02 g/kg, brodifacoum)
Carrot	On demand	
Pindone solution	On demand	
Cat baits	On demand	Preferred bait not yet specified but will contain 1080
Magtox	On demand	
DOC 200 traps and wooden tunnels	1000	
Victor 1½'s	200	
Rabbit meat for stoat and hedgehog traps	On demand	Usage will be initially 1000+ pieces per fortnight. However this will reduce over time as the frequency of trap checks is reduced.
Bulk bags	30	For loading spreader buckets
Foil trays	500	For hand baiting buildings
Accommodation		
Blue house accommodation	12 beds	Will sleep up to 12 and will serve as for the stoat and cat teams.
Dusty Lane House	4 beds	Will accommodate the rabbit team
Shearers Quarters	8 beds	Can be used for short term contract staff and possibly from time to time by members of the cat and rabbit team.
Kennels	12 kennels	Will accommodate the required number of predator dogs
Vehicles		
4WD Utes	3	Trap network establishment, Stoat, hedgehog and cat trapping teams
ATV's	4	Rabbit team
Trucks for transporting bait	2	To be sourced from contractor or MFL
Hiab Truck for bait loading	1	To be sourced from contractor
Fuel Tanker	1	To be sourced from contractor
Tractor with pallet forks	1	For shifting bait pallets

Personnel		
Project Manager	1	Already in place
Assistant Project Manager	1	To be appointed
Implementation of biosecurity	1	DOC staff
Establishing the track and trap network	8	To be appointed, temporary DOC employees
Signage	2	DOC staff
Bait loading	8	DOC staff
Media Liaison	1	DOC staff
GIS	1	DOC staff
Coast Patrol	2	DOC staff
Health and Safety	1	DOC staff
Hand laying bait	8	Will consist of DOC staff assisted by reps from RIBCA and MOEC
Staff for stoat and hedgehog trapping	4	To be appointed, temporary DOC employees, will have predator dog capacity
Follow up rabbit work	4-6	To be appointed, temporary DOC employees, will have dog and dog handler capacity
Follow up cat work	2	To be appointed, temporary DOC employees
Reptile monitoring	2	Temp staff
Clearing beaches of seaweed and bait	4	DOC staff
Bait breakdown monitoring	1	DOC staff
Securing MOEC site	2	DOC staff
Operational Contractors		
Bait supply contract	1	ACP
Shipping of bait and other equipment	1	May need multiple trips for bait and bait spreading equipment
Aerial works contractor	1	To be tendered
NZ dotterel monitoring	1	John Dowding
Bird monitoring	1	Sandra Anderson
Rodent predator dog handlers	2	From Sept 2009, as and when required
Stoat predator dog handler	1	From Dec 2009, as and when required

Cat predator dog handler	1	From Dec 2009, as and when required
Rabbit predator dog handler	1	From Sept 2009, as and when required.
Predator dogs		
Rodent dogs	3	Dogs and dog handlers required on an as and when required basis after Sept 2009 for following up detections and for extensive monitoring two years post aerial bait application.
Stoat	2	Dogs and handlers will be required on an as and when required basis for targeting surviving animals. Required from Dec 2009 on an as and when required basis
Cat	2	One handler to be on staff For targeting surviving animals. Required from Dec 2009 on an as and when required basis
Hedgehog	1	One handler to be on staff. For targeting surviving animals. Required from Sep 2009 on a permanent basis
Rabbits	4	One to two handlers to be on staff. Two will be required full time for at least two years. Two will be required on an as and when required basis.

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6. Appendices

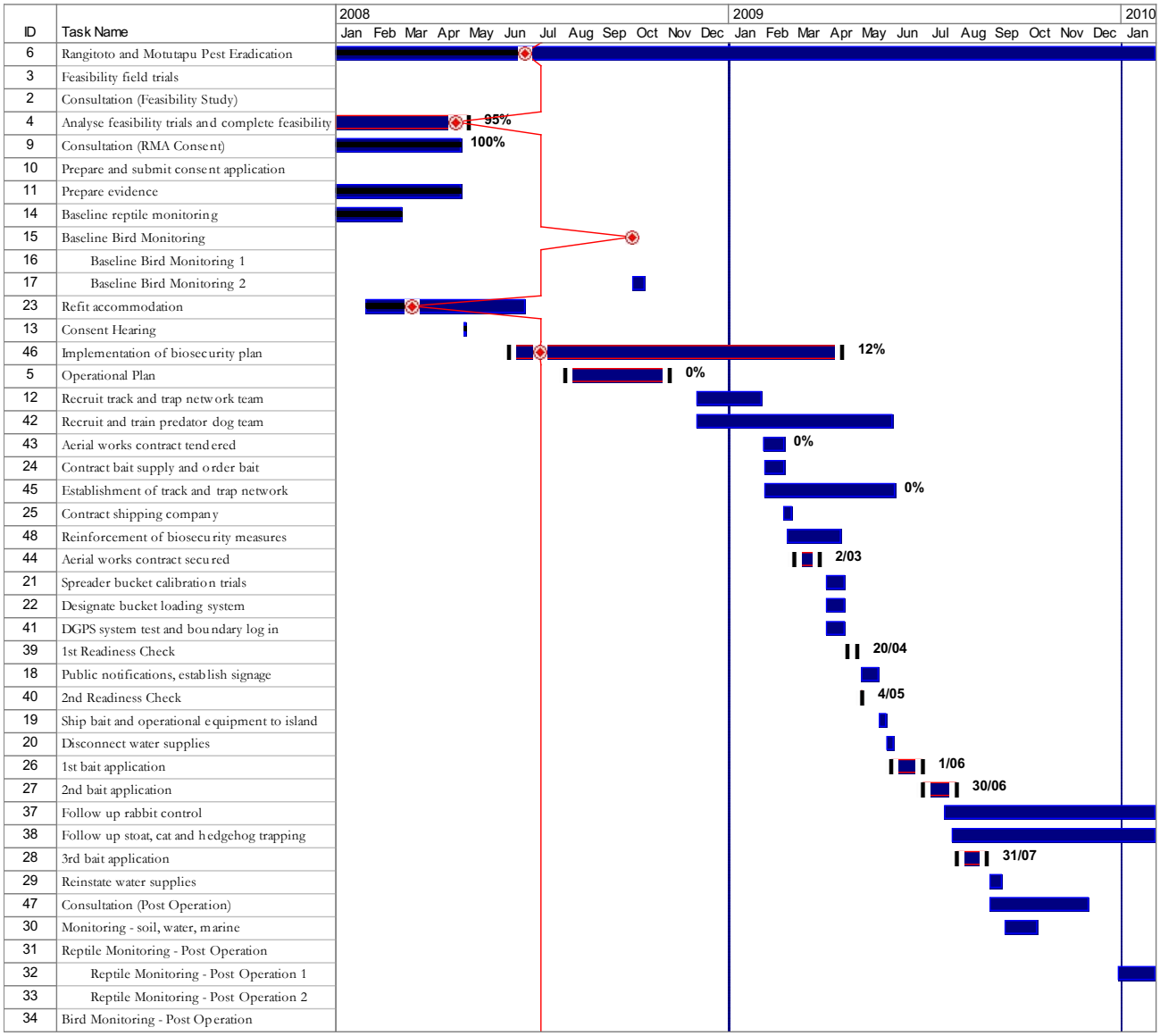
APPENDIX 1. LIST OF NAMES OF SPECIES THAT MAY BENEFIT FROM PEST ERADICATION, WITH THREATENED SPECIES IDENTIFIED IN BOLD FACE AND CURRENT THREAT STATUS IN PARENTHESES*. NOTE THAT INVERTEBRATES HAVE NOT BEEN INCLUDED DUE TO LACK OF INFORMATION.

Maori name	Common name	Scientific name
Plants		
	Coastal cress (NV)	Lepidium flexicaule
Reptiles		
	Auckland green gecko (GD)	Naultinus elegans elegans
	Common gecko	Hoplodactylus maculatus
	Copper skink	Cyclodina aenea
	Duvaucel's gecko (S)	Hoplodactylus duvaucelii
	Forest gecko	Hoplodactylus granulatus
	Moko skink (S)	Oligosoma moco
	Ornate skink (GD)	Cyclodina ornata
	Pacific gecko (GD)	Hoplodactylus pacificus
	Robust skink (RR)	Cyclodina alani
	Shore skink	Oligosoma smithi
	Suter's skink	Oligosoma suteri
Tuatara	**Tuatara (northern) (S)**	Sphenodon punctatus punctatus
	Whitaker's skink (NV)	Cyclodina whitakeri
Sea birds		
Kuaka	Common diving petrel	Pelecanoides u. urinatrix
Oi	Grey-faced petrel	Pterodroma macroptera gouldi
Pakaha	Fluttering shearwater	Puffinus gavia
Takahi-kare-moana	White-faced storm petrel	Pelagodroma marina maoriana
Terrestrial birds		
	Banded rail (S)	Gallirallus phillipensis assimilis
	Bellbird	Anthornis m. melanura

Hihi	**Stitchbird (RR)**	Notiomystis cincta
Kaka	**North Island kaka (NE)**	Nestor meridionalis septentrionalis
Kakariki	**Yellow-crowned kakariki (GD)**	Cyanoramphus auriceps
	Red-crowned kakariki	Cyanoramphus n. novaezelandiae
Kereru	**New Zealand pigeon (GD)**	Hemiphaga novaeseelandiae
Kiwi	**Species to be determined (NC-RR)**	Apteryx sr.
	Northern little blue penguin (GD)	Eudyptula minor iredalei
Matata	**North Island fernbird (S)**	Bowdleria punctata vealeae
	North Island robin	Petroica australis longipes
	Northern New Zealand dotterel (S)	Charadrius obscurus aquilonius
	Paradise shelduck	Tadorna variegata
Pateke	**North Island brown teal (NE)**	Anas chlorotis
Pukeko		Porphyrio porphyrio melanotus
	Oystercatcher (variable)	Haematopus unicolor
	Reef heron (NE)	Egretta sacra sacra
	Spotless crake (S)	Porzana tabuensis plumbea
	Silvereye	Zosterops l. lateralis
	Shore plover (NC)	Thinornis novaeseelandiae
	Spur-winged plover	Vanellus miles novaehollandiae
Takahe	**(NC)**	Porphyrio mantelli
Miromiro	Tomtit (North Island)	Petroica macrocephala
Tui		Prosthemadera n. novaeseelandiae
	Whitehead	Mohoua albicilla
Indigenous mammals		
Pekapeka	**North Island long-tailed bat (NV)**	Chalinolobus tuberculatus
	Northern short-tailed bat (NE)	Mystacina tuberculata auporica

*DOC threat classifications are under review and may change. Descriptors in decreasing level of threat are: NC (nationally critical); NE (nationally endangered); NV (nationally vulnerable); SD (serious decline); GD (gradual decline); S (sparse); RR (range restricted)

APPENDIX 2. PROJECT SCHEDULE



ID	Task Name
6	Rangitoto and Motutapu Pest Eradication
3	Feasibility field trials
2	Consultation (Feasibility Study)
4	Analyse feasibility trials and complete feasibility
9	Consultation (RMA Consent)
10	Prepare and submit consent application
11	Prepare evidence
14	Baseline reptile monitoring
15	Baseline Bird Monitoring
16	Baseline Bird Monitoring 1
17	Baseline Bird Monitoring 2
23	Refit accommodation
13	Consent Hearing
46	Implementation of biosecurity plan
5	Operational Plan
12	Recruit track and trap network team
42	Recruit and train predator dog team
43	Aerial works contract tendered
24	Contract bait supply and order bait
45	Establishment of track and trap network
25	Contract shipping company
48	Reinforcement of biosecurity measures
44	Aerial works contract secured
21	Spreader bucket calibration trials
22	Designate bucket loading system
41	DGPS system test and boundary log in
39	1st Readiness Check
18	Public notifications, establish signage
40	2nd Readiness Check
19	Ship bait and operational equipment to island
20	Disconnect water supplies
26	1st bait application
27	2nd bait application
37	Follow up rabbit control
38	Follow up stoat, cat and hedgehog trapping
28	3rd bait application
29	Reinstate water supplies
47	Consultation (Post Operation)
30	Monitoring - soil, water, marine
31	Reptile Monitoring - Post Operation
32	Reptile Monitoring - Post Operation 1
33	Reptile Monitoring - Post Operation 2
34	Bird Monitoring - Post Operation

APPENDIX 3. BIOSECURITY STANDARDS TO BE ADOPTED FOR RANGITOTO AND MOTUTAPU

Department of Conservation

Unless otherwise specified, the responsibility for ensuring a particular standard is met applies to all DOC staff.

Advocacy and Education

1.1 Interpretive signs will be established at all suitable landing points on Rangitoto and Motutapu. The signs will include key messages about the value of protecting the islands, the importance of biosecurity and instructions on how the risks of pest invasion can be minimised.

Responsibility: Project Manager Rangitoto/Motutapu Pest Eradication, Programme Manager Visitor/Recreation (Ongoing Maintenance)

1.2 DOC will work with the ARC to ensure signage is established at key departure points on the mainland e.g. slipways, marinas etc.

Responsibility: Project Manager Rangitoto/Motutapu Pest Eradication, Technical Support Officer Biosecurity

1.3 Information posted on the DOC website will incorporate key messages promoting the biosecurity standards for Rangitoto and Motutapu. No specific brochures will be produced for Rangitoto and Motutapu. Instead material published for Auckland Conservancy's Pest Free Islands Campaign will be used to promote biosecurity measures for Rangitoto and Motutapu.

Responsibility: Programme Manager, Community Relations

1.4 All opportunities to meet and greet island visitors arriving in their own boats will be used to promote key messages about Rangitoto and Motutapu and biosecurity.

Responsibility: Rangitoto Field Centre Supervisor

1.5 Any island visitor that presents an obvious risk of pest invasion will be first asked for their personal details before being advised to leave the island. Personal details of these visitors will be passed onto the ARC.

Responsibility: Rangitoto Field Centre Supervisor

1.6 All opportunities provided by the media will be used to promote key messages about Rangitoto and Motutapu and biosecurity. National and local newspapers, ARC publications, TV, Radio, Marine Radio will all be used as avenues for key messages where available.

Responsibility: Programme Manager, Community Relations

1.7 Specific proactive advocacy initiatives will be initiated to raise awareness particularly in the early phase of implementing biosecurity for Rangitoto and Motutapu. The use of sniffer dogs, x-ray machines or DOC staff to remind island visitors to check their luggage before boarding are some of the many possibilities.

Responsibility: Project Manager Rangitoto/Motutapu Pest Eradication

Personal Gear

1.8 All luggage must be clean, sealed in rodent-proof packaging and checked for pests at the point of departure from the mainland. Rodent-proof packaging includes sealable day packs and overnight bags, solid boxes that have no holes and are taped closed, sealable plastic bins and barrels, and PVC dry bags. Open bags and unsealed cardboard boxes are not suitable.

1.9 All food must be packed into sealed containers. Food must not be transported in open boxes or supermarket bags.

1.10 All footwear must be clean and free of mud/dirt and seeds. Dirty footwear must be cleaned prior to boarding or cleaned on board before landing.

Operations

1.11 Anyone shipping bulk items to Rangitoto or Motutapu must advise the Ranger, Biosecurity two weeks prior to the intended date of departure. Bulk items include vehicles, building materials, potting mix, tarpaulins, marquees etc.

1.12 All bulk items being shipped by DOC to Rangitoto and Motutapu must be shown to be pest free prior to departure from the mainland. This will be done either through an inspection and quarantine period at the Fleet Street quarantine facility or another method advised by the Ranger, Biosecurity at the Auckland Area Office.

1.13 All bulk items shipped by a third party to Rangitoto and Motutapu will have been shown to be pest free prior to departure from the mainland.

Responsibility: Ranger, Island Biosecurity

1.14 All tools and machinery contaminated by soil e.g. diggers, excavators, trucks, vehicles, spades, shovels, post-hole borers etc must be cleaned and free of all pests, dirt, soil, plant material and seeds before leaving the mainland.

1.15 No plant material including stock feed must be taken to Rangitoto and Motutapu without permission from the Ranger, Island Biosecurity.

1.16 If employing a contractor to carry out services on Rangitoto or Motutapu then the standards for Concession Holders, Community Groups and Contractors apply. Contractors must be forewarned of these standards at least one week prior to their departure to the island.

1.17 All rubbish produced on the island should be disposed of in the following manner:

- Food scraps must be disposed of in an island based composting facility.
- Recyclable rubbish should be cleaned, temporarily stored in island based rodent proof wheelie bins and removed on a fortnightly basis via the MV Hauturu.
- Non recyclable rubbish must be cleaned, temporarily stored in an island based rodent proof skip and removed on a monthly basis via the MV Hauturu or barge.

Responsibility: Rangitoto Field Centre Supervisor

1.18 Anyone chartering a vessel, other than a DOC vessel or Passenger Ferry, for the transport of bulk items or livestock to Rangitoto or Motutapu must advise the Ranger, Island Biosecurity two weeks prior to the intended date of departure.

1.19 Vessels, other than DOC vessels and Passenger Ferries, used for transporting supplies to the island must be shown to be pest free prior to departure from the mainland. If a DOC approved rodent protection programme is not in place, glue boards must be placed onboard the vessel at least seven days prior to departure, and inspected before departure by DOC staff or an operator approved by the Ranger, Island Biosecurity at the Auckland Area Office.

Compliance and Enforcement

1.20 The no dog policy for Rangitoto and Motutapu will be enforced with the only exception being working dogs.

Responsibility: Rangitoto Field Centre Supervisor

1.21 Regular audits of key stakeholder activity will be completed to ensure compliance with the standards outlined in this plan.

Responsibility: Ranger, Island Biosecurity

1.22 An annual audit of DOC activities on Rangitoto and Motutapu will be completed to assess compliance with the above standards.

Responsibility: Ranger, Island Biosecurity

Surveillance

1.23 Tracking tunnels will be established at all access points around the coast and at all permanently occupied dwellings across both Rangitoto and Motutapu. Tracking tunnels will consist of a PhilProof tunnel and base with a long life inked tracking card and rodent lure. A meat based lure for stoats will also be used from time to time.

Responsibility: Ranger, Island Biosecurity

1.24 Tracking tunnels will be complemented by the maintenance of DOC 150's at sites considered to higher risk.

Responsibility: Ranger, Island Biosecurity

1.25 Servicing of tracking tunnels and DOC 150's will be completed by island staff on a monthly basis. Instructions for establishing and maintaining both traps and tracking tunnels will be incorporated into the Rangitoto/Motutapu Island Operations Manual.

Responsibility: Rangitoto Field Centre Supervisor

1.26 Six monthly surveys of Rangitoto and Motutapu with a rodent dog and dog operator will be completed to complement passive surveillance techniques.

Responsibility: Ranger, Island Biosecurity

Incursion Response

1.27 If a pest or weed incursion is suspected, the island ranger must be informed immediately.

1.28 If a pest or weed incursion is reported then the contingency response set out in the Auckland Conservancy Island Biosecurity Plan must be put into place.

Responsibility: Rangitoto Field Centre Supervisor

1.29 A full set of contingency response equipment will be stored at the Rangitoto Field Centre. Sufficient equipment will be on hand to deal with an incursion of the most likely invaders i.e. invertebrates, rodents, stoats and cats. A list of this equipment is provided in the Auckland Conservancy Island Biosecurity Plan.

Responsibility: Ranger, Island Biosecurity

Recruitment and Training

1.30 A ranger responsible for island biosecurity within the Auckland Area will be appointed following the sign off of this plan. This position will be responsible for a number of the standards outlined in this plan.

Responsibility: Auckland Area Manager

1.31 Island staff and representatives from key island stakeholders will be trained in surveillance and response techniques. If no incursions have occurred, a simulated exercise will be completed once a year to maintain an adequate level of skills and experience.

Responsibility: Auckland Area Manager

Review

1.32 This plan will be reviewed on an annual basis with input from stakeholders. If changes need to be made all stakeholders will be advised of the changes following sign off by the Auckland Area Manager.

Responsibility: Auckland Area Manager

Concession Holders/Community Groups/Contractors

Unless otherwise specified, the responsibility for ensuring a particular standard is met applies to all concession holders, community group leaders and contractors.

Advocacy and Education

2.1 At the time of taking bookings or organizing trips, concession holders and community groups must advise potential clients/volunteers of the

following:

- Rangitoto and Motutapu are pest free (or in the process of becoming so).
- Footwear must be clean and free of seeds before boarding.
- Passengers will be asked to check their bags before boarding.

2.2 Information posted on concession holder and community websites and emails must incorporate the following key messages.

- Rangitoto and Motutapu are pest free (or in the process of becoming so).
- Bags must be checked prior to boarding for rodents, insects and other pests.
- Footwear must be checked to ensure it is clean and free of seeds.

Personal Gear

2.3 All luggage must be clean, sealed in rodent-proof packaging and checked for pests at the point of departure from the mainland. Rodent-proof packaging includes sealable day packs and overnight bags, solid boxes that have no holes and are taped closed, sealable plastic bins and barrels, and PVC dry bags. Open bags and unsealed cardboard boxes are not suitable.

2.4 All food must be packed into sealed containers. Food must not be transported in open boxes or supermarket bags.

2.5 All footwear must be clean and free of mud/dirt and seeds. Dirty footwear must be cleaned prior to boarding or cleaned on board before landing.

Operations

2.6 Anyone shipping bulk items to Rangitoto or Motutapu must contact the Ranger, Biosecurity at the Auckland Area Office two weeks prior to the intended date of departure. Bulk items include vehicles, building materials, potting mix, tarpaulins, marquees etc.

2.7 All bulk items being shipped to Rangitoto and Motutapu must be shown to be pest free prior to departure from the mainland. The method of ensuring this standard is met will be advised by the Ranger, Biosecurity at the Auckland Area Office.

2.8 All tools and machinery contaminated by soil e.g. diggers, excavators, trucks, vehicles, spades, shovels, post-hole borers etc must be cleaned and free of all pests, dirt, soil, plant material and seeds before leaving the mainland.

2.9 No plant material including stock feed must be taken to Rangitoto and Motutapu without permission from the Ranger, Island Biosecurity at the Auckland Area Office.

2.10 All rubbish produced on the island should be disposed of in the following manner:

- Food scraps must be disposed of in an island based composting facility.
- Recyclable rubbish should be cleaned, temporarily stored in island based rodent proof wheelie bins and removed on a fortnightly basis via the MV Hauturu.
- Non recyclable rubbish must be cleaned, temporarily stored in an island based rodent proof skip and removed on a monthly basis via the MV Hauturu or barge.

2.11 Anyone chartering a vessel, other than a DOC vessel or Passenger Ferry, for the transport of bulk items or livestock to Rangitoto or Motutapu must contact the Ranger, Island Biosecurity at the Auckland Area Office two weeks prior to the intended date of departure.

2.12 Vessels, other than DOC vessels and Passenger Ferries, used for transporting supplies to the island must be shown to be pest free prior to departure from the mainland. If a DOC approved rodent protection programme is not in place, glue boards must be placed onboard the vessel at least seven days prior to departure, and inspected before departure by DOC staff or an operator approved by the Ranger, Island Biosecurity at the Auckland Area Office.

2.13 Commercial vessels must not occupy a berth at the Rangitoto, Islington Bay or Home Bay wharfs except for the purpose of shipping or unshipping goods, or for embarking or disembarking passengers.

Incursion Response

2.14 If a pest or weed incursion is suspected, the island ranger must be advised immediately.

Passenger Ferry Operators

Unless otherwise specified, the responsibility for ensuring a particular standard is met applies to all passenger ferry operators.

Advocacy and Education

3.1 At the time of booking, ferry passengers intending to travel to Rangitoto or Motutapu must be advised that:

- Rangitoto and Motutapu are pest free (or in the process of becoming so).
- Footwear must be clean and free of seeds before boarding.
- Passengers will be asked to check their bags before boarding.

3.2 At the time of ticketing ferry passengers intending to travel to Rangitoto or Motutapu must be advised of the following:

- Rangitoto and Motutapu are pest free (or in the process of becoming so).
- Bags must be checked prior to boarding for rodents, insects and other pests.
- Footwear must be checked to ensure it is clean and free of seeds.

3.3 All passenger ferry operators taking visitors to Rangitoto and Motutapu must reinforce biosecurity messages with onboard signage and commentary to remind passengers of the pest-free status of the islands and the importance of luggage and footwear checks.

3.4 All passenger ferry operators must incorporate key messages about biosecurity and the pest free status of Rangitoto/Motutapu into any material produced that promotes the islands.

Operations

3.5 Passenger ferry operators must provide a facility where passengers can check their bags and footwear out of the weather.

3.6 Commercial ferry operators must keep a look out for obvious risks such as luggage that is obviously not rodent-proof or dirty footwear worn by passengers. Dirty footwear should be cleaned prior to boarding or cleaned on board before landing.

3.7 Bulk items and supplies e.g. building materials, potting mix, tarpaulins and marquees etc that have not been approved by DOC must not be loaded. The Ranger, Biosecurity at the Auckland Area Office must be contacted if a passenger arrives with unapproved bulk items.

3.8 No rubbish must be left onboard any vessel transporting visitors to and from Rangitoto and Motutapu at the end of each day.

3.9 Passenger ferries must not occupy a berth at the Rangitoto, Islington Bay or Home Bay wharfs except for the purpose of shipping or unshipping goods, or for embarking or disembarking passengers.

Surveillance

3.10 All passenger ferry operators must maintain rodent bait stations on the wharf or jetty where the vessel is moored overnight. Bait stations must be filled with a rat poison approved by the Ranger, Island Biosecurity at the Auckland Area Office. Stations must be checked monthly by commercial operators, old baits replaced and bait take recorded.

3.11 Passenger ferries traveling to and from Rangitoto and Motutapu must maintain DOC approved rodent tracking stations on board. These stations must be checked prior to departure every time a vessel travels to Rangitoto and Motutapu. If rodent sign is detected the following steps must be taken:

- Contact the Ranger, Island Biosecurity at the Auckland Area Office.
- Schedule a rodent free vessel to take over the run.
- In conjunction with DOC, implement a trapping programme to ensure pest free status of the vessel.
- After the trapping programme the pest free status of the vessel must be confirmed by use of a trained rodent dog or tracking tunnels before it can be used to ferry passengers to Rangitoto and Motutapu.

3.12 A log must be kept of all rodent bait station and tracking station servicing outlined above, as well as any biosecurity incidents that occur. A biosecurity incident is any incursion of a pest on to a commercial vessel.

Transport Operators

Unless otherwise specified, the responsibility for ensuring a particular standard is met applies to all passenger ferry operators.

4.1 Commercial vessels traveling to and from Rangitoto and Motutapu on a regular basis must maintain rodent tracking stations on board. These stations must be checked prior to departure every time a vessel travels to Rangitoto and Motutapu. If rodent sign is detected the following steps must be taken:

- Contact the Ranger, Biosecurity at the Auckland Area Office.
- Schedule a rodent free vessel to take over the run.
- In conjunction with DOC, implement a trapping programme to ensure pest free status of the vessel.
- After the trapping programme the pest free status of the vessel must be confirmed by use of tracking tunnels before it can be used to ferry goods or passengers to Rangitoto and Motutapu.

4.2 Any commercial operator shipping materials to and from Rangitoto and Motutapu must maintain rodent stations on the wharf or jetty where the vessel is moored overnight. Bait stations must be filled with a rat poison approved by DOC. Stations must be checked at least monthly by commercial operators, old baits replaced and bait take recorded.

4.3 Bulk goods e.g. vehicles, building materials, roading metal etc that have not been approved by DOC must not be shipped to Rangitoto and Motutapu. The Ranger, Biosecurity at the Auckland Area Office must be contacted if a shipment arrives that is unapproved.

4.4 A log must be kept of all rodent bait station and tracking station servicing outlined above, as well as any biosecurity incidents that occur. A biosecurity incident is any incursion of a pest on to a commercial vessel.

4.5 Commercial vessels must not occupy a berth at wharves or slipways on Rangitoto and Motutapu except for the purpose of shipping or unshipping goods, or for embarking or disembarking passengers. Between dropping off and picking up passengers, vessels must anchor off the island.

4.6 Following the date of implementation of the above standards, regular audits of commercial operators and their compliance with the above conditions will be conducted by DOC.

General Public

Unless otherwise specified, the responsibility for ensuring a particular standard is met applies to all island visitors.

Personal Gear

5.1 All luggage needs to be clean, sealed in rodent proof packaging and checked for pests at the point of departure from the mainland. Rodent proof packaging includes sealable day packs and overnight bags, solid boxes that have no holes and are taped closed, sealable plastic bins and barrels and PVC dry bags. Open bags and unsealed cardboard boxes are not suitable. A good rule of thumb is that if you can push the tip of your little finger through a hole in your box or bag then it is not mouse proof.

5.2 Gear should be checked as close to the time of departure as possible to reduce the risk of a pest stowing away after you have packed. If unsure unpack, re-inspect and repack.

5.3 While unpacking on the island, you will need to check again for signs of rodents, insects, other animals and plants. If you are unsure of a package's contents it must not be taken ashore.

5.4 All footwear needs to be clean and free of seeds. Weeds are a major problem on Rangitoto and Motutapu.

Incursion Response

5.5 If a pest or weed incursion is suspected advise the island ranger immediately.

Bulk Items

5.6 Anyone shipping bulk items to Rangitoto or Motutapu must contact the Ranger, Biosecurity at the Auckland Area Office two weeks prior to the intended date of departure. Bulk items include vehicles, building materials, potting mix, tarpaulins, marquees etc.

5.7 All bulk items being shipped to Rangitoto and Motutapu must be shown to be pest free prior to departure from the mainland. The method of ensuring this standard is met will be advised by the Ranger, Biosecurity at the Auckland Area Office.

Boat Owners

5.8 Anyone traveling in their own vessel should inspect it for rodent sign or insects especially ants before departure.

Responsibility: All boat owners

5.9 Owners of larger vessels should maintain some form of rodent control on board e.g. glue boards, traps or bait stations as a necessary precaution. Check whether your marina has a rodent control programme to reduce the chances of rodents getting on board.

Responsibility: All large boat owners

5.10 Landing on the islands at night is discouraged. Landing at night greatly increases the risk of rodent invasion as rodents are much more active during the hours of darkness.

Responsibility: All boat owners

Campground Users

5.11 In the future those people intending to camp at Home Bay on Motutapu Island will need to book in advance through an online booking system. Failure to book in advance will result in a surcharge being applied.

Responsibility: Project Manager Rangitoto/Motutapu Pest Eradication

5.12 Camping equipment must be opened and inspected for insect and weed pests prior to departure from the mainland.

Responsibility: All campground users