



Kaimai Mamaku
Catchment Forum

A Pest Management Discussion Document:
Towards Thriving
Kaimai Mamaku Forests

May 2018

Prepared for: Kaimai Mamaku Catchments Forum

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Executive Summary

The Kaimai Mamaku Ranges are a taonga - a treasured place, and a connector of two regions, multiple Iwi, Hapū, industry, conservation and recreation groups. The Kaimai Mamaku Catchments Forum (the '**Forum**') was established in 2010 to provide a collaborative approach to improving the health of the Kaimai Mamaku Ranges and their catchments. The Forum developed an "Strategic Plan" in 2014 to guide implementation of Forum outcomes. The priority was to reduce animal pest numbers across the Kaimai Mamaku Forest Park.

The Forum developed and released an 'Operational Plan' in 2017, identifying priority projects for the Forum to focus on over the next five years. Project 1 of the Operational Plan was to develop a 'Pest Animal Management Plan' for the Kaimai Mamaku Ranges.

The 'Pest Animal Management Plan' will guide the allocation of resources to specific actions and allow for long term funding to be sought, towards achieving the Forum's Vision and Objectives. By its very nature, such a Plan would need to be a living document that will respond to change as the Project develops, as new technologies evolve and as both knowledge and capacity grow through 'learning-by-doing'.

The forests and habitats of the Kaimai Mamaku Ranges are home to a richly diverse range of ecological, cultural, social and economic values. Many of these values are now in decline as a result of various conservation threats, leading potentially to large scale ecological collapse. The need to effectively manage key threats in the habitats that still survive is becoming increasingly urgent.

Localised pest animal management at high value sites has occurred over a number of, mostly community driven, project areas. Currently, approximately 5,000ha is under some form of sustained pest management, although this effort is highly fragmented, small in scale and suffers reinvasion of pests from untreated surrounding areas. This makes control efforts more difficult, less effective and expensive. There is a strong desire to see landscape scale pest animal control to extend benefits and support existing projects.

None of the current pest control tools available can, in isolation, achieve the Forum's vision and objectives. Nor can agencies like the Department of Conservation and the regional councils achieve these on their own. Landscape scale pest animal management for the Kaimai Mamaku Ranges will require a "whole-of-region" response, driven by engaged communities, Iwi and industry, and supported by agencies. A wide range of existing or potentially new tools will need to be utilised, depending on the sites to be targeted and the outcomes being sought.

Ultimately, the most appropriate pest animal management programme can only be determined through meaningful engagement and consultation with key stakeholders. Each operational area is different and each set of stakeholders unique. This Discussion Document is a means of informing the required consultation and decision making processes towards a 'Pest Animal Management Plan' that is supported by the Forum and the wider community.

This Discussion Document provides a range of background information and seeks the Forum's response on sixteen key discussion points to help navigate a pathway forward with agencies, Iwi, industry, stakeholders and communities in determining what a 'Pest Animal Management Plan' for the Kaimai Mamaku Ranges might look like. A range of pest animal management scenarios are also presented for consideration. These include: consolidation of existing projects; consolidation and staged expansion; and immediate larger-scale expansion. There will always be a trade-off between budget, the size of the area treated, the methods used and the outcomes achieved. The Forum and its stakeholders will need to weigh up these issues when considering how it wants to proceed, where its priorities lie and how fast expansion might progress.

The Forum may now wish to convene to consider the Discussion Document. That may result in modification of this Document, as the Forum sees fit, before Forum members engage with their own members, or with the groups they represent, for further discussion. These discussions will allow wider Forum membership to make appropriate recommendations to progress the issue of developing an agreed 'Pest Animal Management Plan'.

1 Introduction

The Kaimai Mamaku Ranges are a taonga - a treasured place, and a connector of two regions, multiple Iwi, Hapū, industry, conservation and recreation groups. The Kaimai Mamaku Catchments Forum (the '**Forum**') was established in 2010 to provide a collaborative approach to improving the health of the Kaimai Mamaku Ranges and their catchments. The Forum brings together the multiple kaitiaki, agencies, stakeholders and interest groups, connected by the Kaimai Mamaku Ranges.

The Forum developed a 'Strategic Plan' in 2014 which established biodiversity outcomes for the Kaimai Mamaku Ranges:

- The health of the Kaimai Mamaku Forest Park is restored - bring back the birds.
- The indigenous biodiversity beyond the Kaimai Mamaku Forest Park is enhanced.

To deliver on these biodiversity outcomes, the Forum's priority was the development of a multi-pest control plan to reduce pest numbers across the Kaimai Mamaku Forest Park. The Forum developed and released an 'Operational Plan' in 2017, identifying priority projects for the Forum to focus on over the next five years. Project 1 of the Operational Plan was to develop a 'Pest Animal Management Plan' for the Kaimai Mamaku Ranges, based on robust information and engagement. This Discussion Document is the first step in that process.

1.1 About this Document

This is a Discussion Document to provide information and to help the Forum begin the engagement process with a wide range of its members and stakeholders. The purpose of this Discussion Document is to:

- Inform Forum members so they have a good understanding of the issues involved.
- Enable a robust discussion within the Forum.
- Give Forum members a range of management scenarios to take back to their own members, or the groups they represent, for discussion and input.

Throughout the document there are a series of discussion points that seek feedback. These appear as text-boxes headed "Discussion Point":

Discussion Point: The Forum may wish to consider...

These are simply prompts to seek the Forum's thoughts and feedback on specific issues. Comments on any part of the document or other issues relevant to the wider discussion are invited.

1.2 Scope

The purpose of this Discussion Document is to identify a pathway forward in terms of a landscape scale pest animal management programme for the Kaimai Mamaku Ranges, that has wide support from the Forum and the communities it is drawn from.

The Kaimai Mamaku catchment area is large and covers multiple jurisdictions (two regional councils, four district councils), land tenure (Crown, private and Māori land), community groups, Iwi and Hapū, as well as diverse habitat types (native forest, pasture, forestry, horticulture, urban and lifestyle block environments).

The role of this Discussion Document is two-fold:

1. Community Engagement by:

- Facilitating focused discussion with Iwi/Hapu/Whanau as co-decision makers with Agencies.
- Facilitating focussed discussion with other partner organisations and Forum members.
- Facilitating discussion by Forum members with their communities.

2. Facilitating Animal Pest Management Implementation by:

- Identifying appropriate scenarios for pest animal management within the Kaimai Mamaku Ranges.
- Identifying the amount and type of resourcing, equipment and monitoring needed to carry out the work.
- Supporting funding applications for implementation.

The final agreed Pest Animal Management Plan will guide the allocation of resources to specific actions and allow for long term funding to be sought. One such option is the National Predator Free 2050 Programme, leading ultimately towards a 'Predator Free Kaimai Mamaku'. By its very nature, such a Plan will need to be a living document that will respond to change as the Project develops, as new technologies evolve and as both knowledge and capacity grow through 'learning-by-doing'.

In the context of the Forum's wider Operational Plan, 'Kaimai Mamaku Ranges' includes the Kaimai Range and the Northern Mamaku Plateau (including Opuiaki, Mokaihāhā, Ottawa,

Ōtanewainuku), associated forests and landscapes within catchments that flow into the Waihou basin and to Tauranga Moana (see Map 1 in Appendix 1). This is an area in excess of 80,000ha.

Discussion Point 1: The Forum may wish to consider the landscape scale that the Pest Management Plan should cover. Should it be focused on just the Kaimai Mamaku Forest Park (approximately 37,000ha); all native forest within the catchment; or a larger landscape including private land and other environments, across the whole area of interest to the Forum? Or should the scale of the Project grow as effective pest management is implemented across that landscape?

1.3 Predator Free 2050

Predator Free 2050 Limited (PF2050) is an independent Crown owned company that has been established to help achieve the Government's ambitious goal to rid New Zealand of possums, rats and stoats by 2050. These three introduced predators have been identified as key contributors to the decline of our natural heritage, with 3,000 of our native species classified as threatened or at risk and 800 classified as facing extinction (NZ Threatened Species Strategy, Department of Conservation 2017).

The Crown has set interim goals for completion by 2025 as follows:

- Increase by 1 Million hectares the area of mainland New Zealand where predators are suppressed, through PF2050 projects.
- Demonstrate that predator eradication can be achieved in areas of mainland New Zealand of at least 20,000 hectares without the use of fences.
- Achieve eradication of all mammalian predators from New Zealand's island nature reserves.
- Develop a breakthrough science solution capable of eradicating at least one small mammal predator from the New Zealand mainland.

The criteria that must be met for PF2050 funding are included in Appendix 2.

The exact pathway from pest animal management to 'predator-free' remains a significant challenge. Over the next 10 years, pest animal management could build on a number of successful existing projects to further restrict the impacts of key pests across a wider area of the Kaimai Mamaku landscape. The pathway from sustained pest animal management to Predator Free 2050 will involve a series of incremental steps over a longer time period, as the scale of pest animal management grows and innovation allows for the development and application of new and more effective pest control technologies.

PF2050 is a bold and lofty vision. None of us can imagine what might be possible by 2050. However, right now, the need to limit the damage inflicted by pests on New Zealand's declining biodiversity is urgent. It is no longer appropriate to sit and do nothing. The journey must begin now. This document is a significant step on that journey for the Kaimai Mamaku Ranges.

2 Vision & Objectives

The Vision of the Forum is: "The Kaimai Mamaku thrive; hence we thrive".

The Vision represents the improvement in 'health' of the Kaimai Mamaku Ranges and its catchments to provide for present and future generations. In particular, the Forum seeks to achieve the following objectives:

- Healthy stands of indigenous forests within the Kaimai Mamaku Ranges;
- Abundant native bird species;
- Fewer pest animals and plants;
- People appreciating and treasuring the uniqueness of the Kaimai Mamaku Ranges;
- More people actively involved in the Kaimai Mamaku Ranges; and
- Shared responsibility and greater collective impact.

In terms of funding, there is a further objective specifically related to pest animal management:

- To be investment ready for potential PF2050 funding within 5 years (2023)

Discussion Point 2: The Forum may wish to consider if this Vision and its accompanying objectives provide sufficient guidance for the Pest Animal Management Plan. Are more detailed pest vision and/or objective statements required? If so, what might they be?

Over time, the Vision and Objective statements may develop as the Forum succeeds to: initially consolidate and expand sustained pest animal management linked to the recovery of key biodiversity sites and features; then moves to localised 'zero pest densities' as resources and support grow; then to eradication reflecting the PF2050 vision (as innovation and technology allow). This will be an organic process, guided by stakeholders and available resources (people, funding and technology). Throughout this process, the Forum will serve as an important conduit for sharing information and perspectives, and in informing decisions.

3 Background

3.1 Geology & Landforms

The Kaimai Range and Mamaku Plateau are volcanic landforms, predominantly rhyolite domes and ignimbrite plateaus. The topography of the Kaimai Range is dominated by steep to sheer slopes leading up to broadly-domed or flat-topped ridges. The highest peak is Mt Te Aroha, at 953 m. The Mamaku ignimbrite plateau is punctuated by deeply-incised gorge systems within landforms of otherwise expansive areas of relatively flat terrain.

Between the upper catchments and the Tauranga Harbour to the east, the landscape is dominated by undulating low hills formed by siltstones, sandstones and unconsolidated sediments. On the western side, the Waihou Basin is dominated by alluvial soils on flood plains of the Waihou River in its middle-lower reaches. In its upper reaches the catchment cuts into the Mamaku Plateau ignimbrite or falls steeply from rhyolitic landscapes on the Kaimai Range.

3.2 Land Tenure and Management

The Kaimai Mamaku Ranges contain a complex mix of public, private and Māori land (see Land Use map in Appendix 1), which includes:

- Public conservation land administered by the Department of Conservation (DOC) including Kaimai Mamaku Forest Park and a variety of separate scenic reserves;
- A range of QEII covenants, Nga Whenua Rahui kawenata and covenants established as a condition of resource consents for land subdivision, over many other native habitats on private land;
- Numerous blocks of Māori land in native forest, forestry and/or pasture development, administered by various trusts on behalf of their multiple owners;
- Large tracts of forestry land owned and/or managed by: various Māori trusts, Blakely Pacific (NZ) Ltd, PF Olsen Ltd and Hancock Forest Management (NZ) Ltd;
- A number of upper catchments used for public water supply;
- Private farmland including dry-stock and dairy are significant land-uses around the edges of the main ranges while smaller lifestyle blocks are interspersed throughout;
- Horticulture, particularly the kiwifruit and avocado industries, dominate the mid and lower catchment environments of the Bay of Plenty; and
- The coastal region has extensive, often intensive urban development.

3.3 Natural Values

The Kaimai Mamaku Ranges are situated within the boundaries of five Ecological Districts in the central North Island (Tauranga; Ōtanewainuku; Te Aroha/Waihi; Hinuera; and Tokoroa) reflecting their rich and diverse natural values. Wildland Consultants, in their *Kaimai Catchments State of the Environment Report* (2010), provide a comprehensive forest and habitat inventory of the natural habitats of the area, but perhaps the most poignant description of the natural value of this landscape is as follows:

"The Kaimai Ranges contain the most diverse forests ever encountered by the Forest Research Institute during Watershed (Condition and Trend) Surveys. The northern end of the ranges forms the southernmost extension of the kauri forests of the Coromandel Peninsula. These forests give way in the central and southern ranges to the tawa-dominant forests of the Mamaku Plateau. The ranges also contain the northernmost stands of silver beech and red beech. At mid-low altitudes, the natural forest complexity has been accentuated by the effects of fires and logging. The results of numerical classification of the present survey data revealed that the forest composition varies both altitudinally and geographically". (Dale & James, 1977)

Four major divisions of forest were made, as follows:

- (1) tawa/rewarewa forest of the northern Kaimai;
- (2) kauri/beech/mixed broadleaf forests, also of the northern Kaimai;
- (3) tawa forests of central and southern Kaimai; and
- (4) higher-altitude forests.

These important habitat types are reflected in the formal designation of eight ecological areas and one forest sanctuary, and highlight the high ecological value of the landscape.

3.4 Native Fauna

The forests and habitats of the Kaimai Mamaku Ranges are home to a richly diverse range of native fauna. Many are in decline as a result of various conservation threats and many others have already disappeared - some, forever.

Birds

Bird records for the Kaimai Mamaku Ranges have been collated by Wildland Consultants (2010) from a range of sources. Significant species include:

- Falcon (Karearea) appear to be present throughout.
- Kākā are resident on the Mamaku Plateau and itinerant visitors throughout other areas.

- Kereru are widespread, but evidence suggest breeding success throughout the Kaimai Mamaku Ranges is low, with the obvious exception of sites where intensive possum and predator control is being undertaken.
- Kiwi are thought to be locally extinct or in very low numbers in the main Kaimai Range with a remnant population known on the northern Mamaku Plateau. Kiwi are surviving in higher numbers with active management at Ōtanewainuku.
- Kokako were once widespread but are now limited to management sites. Active pest management and translocations have occurred at Opuiaki and Ōtanewainuku. Kokako disappeared from the Aongatete/Thompson's Track area about 1999/2000.
- Popokatea (whitehead) - Kaimai is the northern limit.
- Rifleman are now common at Aongatete, but only after ongoing pest management.
- Toutouwai (North Island robin) occur in moderate densities throughout Opuiaki and have also recovered with successful pest management at Ōtanewainuku and Aongatete.
- Whio (Blue Duck) survive in the Mangorewa Gorge and some Opuiaki river catchments in very low numbers.

Grey warbler, korimako (bellbird), kotare (king-fisher), miromiro (tomtit), piwakawaka (fantail), ruru (morepork), silvereve and tui can all still be found in varying densities throughout the Kaimai Mamaku Ranges, while long tailed cuckoo and shining cuckoo are seasonal visitors.

Of note are the local (or complete) extinction of:

- Hihi (stitch bird)
- Huia
- Kakapo
- Piopio (New Zealand thrush)
- Red-crowned kākārīki
- Snipe
- Taiko (black petrel)
- Titi (a range of other smaller petrels and shearwaters)
- Tieke (saddleback)
- Weka (there was a failed re-introduction attempt at Aongatete in 2015)
- Yellow-crowned kākārīki

Bats

Long-tailed bats (pekapeka) are widespread on the Kaimai Mamaku Ranges. There are fewer records of the more specialised short-tailed bats but they have been recorded from the Opuiaki Ecological Area, on the Mamaku Plateau at Mamaku Mill in the 1970's and in

2010 from Kaharoa Conservation Area. Roost habitat quality has almost certainly been degraded by loss of emergent rimu and northern rata across the Project area.

Frogs

New Zealand has four species of endemic frogs (*Leiopelma* spp.), all of which are regarded as threatened. Hochstetter's frog is widespread in forested streams throughout the northern two thirds of the Kaimai Range, as far south as Wairere Falls in the west and the Aongatete River in the east. They also occur in the Ottawa forest in the south-eastern section of the Project area but are apparently absent from the ignimbrite country of the Mamaku Plateau.

Lizards

Mainland lizard populations have been severely depleted by introduced predators and some species now occur in forested areas at densities so low that they are virtually undetectable. Three geckos (forest gecko, Pacific gecko, green gecko) and four skinks (copper skink, ornate skink, speckled skink and striped skink) are probably typical of forests throughout the Project area.

Invertebrates

A large number and diverse range of terrestrial invertebrates occur in the Kaimai Mamaku Ranges. Of note are a number of observations of stag beetle at Mt Te Aroha. A number of Carabid beetle species have been collected from the Kaimai Range including an endemic, highly specialised species (wrinkled bark beetle) collected from Te Aroha.

3.5 Water Quality

The forests of the Kaimai Mamaku Ranges play an essential role in containing and filtering runoff from their catchment areas into the Waihou River (to the west) and Tauranga Harbour (to the east), the Kaituna River and Lake Rotorua catchments. Water quality is a critical issue for the Forum and one of its key goals in their Strategic Plan.

When the forest canopy is compromised by heavy possum browsing and the undergrowth eaten out and compacted by grazing; not only does the water rush off the landscape more quickly (causing more erosion and a heavier sediment load), but much less water is able to filter into the aquifers that feed activities downstream (such as farming, industry and for wider communities for uses such as public drinking water, recreation and fisheries). The integrity of the forest is fundamental, not just for controlling sediment run off but also in maintaining and sustaining a continuous healthy water supply.

Retaining healthy, sustainable forest cover will continue to play a vital role in protecting water quality into the future, particularly given the volcanic nature of the geology and the intensity of weather events that can lash the region.

The presence of numerous public water supply catchments (see Water Supply Catchment map in Appendix 1) and the growing demand for clean water within one of the fastest growing regions in New Zealand further increases the importance of healthy, functioning water catchment areas.

3.6 Cultural Values

Iwi Māori are strong advocates for the protection and use of natural resources in a manner that sustains them and future generations by providing for use and development in terms of social, cultural and economic well-being. Māori have strong cultural links to the Kaimai Mamaku Ranges based on centuries of occupation and use. A large number of Iwi, Hapū and Marae connect in different ways across this landscape. There are also strong linkages between the various Iwi, Hapū and Marae via the Kaimai Mamaku Ranges. In broad terms:

- Ngati Ranginui and their Hapū are based in the Bay of Plenty and connect across the central Kaimai Range, south into the northern Mamaku Plateau.
- Ngai Te Rangi and their Hapū are also Bay of Plenty based with strong links to the harbour and across the central and northern parts of the Kaimai Range between Katikati and Athenree.
- Ngati Hinerangi and Ngati Haua are based on the western (Waikato) side of the central Kaimai Range connecting to the central and southern Kaimai, and to the northern Mamaku Plateau.
- In the north, Hauraki Iwi have connections to the northern Kaimai Range and through the Karangahake Gorge.
- In the south, Ngati Raukawa link to the southern Kaimai Range and Mamaku Plateau in the west.
- Hapū of Te Arawa link to the eastern side of the Mamaku Plateau, and up into the southern Kaimai Range and Mangorewa Gorge.

Throughout the Kaimai Mamaku landscape there are culturally important sites such as pa sites, urupa, mahinga kai and other waahi tapu or archaeological features related to historic Māori occupation and use. These cultural features require significant engagement with relevant Iwi and Hapū to determine how pest animal management might interact with such cultural values.

Each of the Iwi and Hapū that connect to the Kaimai Mamaku landscape are at different stages in their negotiations with the Crown over the settlement of historic grievances under

the Treaty of Waitangi. As settlements are reached, the involvement of Iwi and Hapū in management of the Kaimai Mamaku Ranges and their natural resources will increase, better reflecting their traditional relationship with these resources. Outcomes not dissimilar to the Te Urewera settlement and Te Awa Tupua (Whanganui River Claims Settlement) are likely to see a far more hands-on management role by Māori, or at least co-management together with existing land management agencies.

Discussion Point 3: The Forum will need to determine a robust and meaningful process to engage Iwi, Hapū and Marae that connect to the Kaimai Mamaku Ranges. Questions to be considered might be: what are their goals for pest management; how best to proceed with developing a pest management programme; what methods might be used where, when and under what protocols; and how pest management might best utilise the energy, skills and knowledge (Matauranga Maori) of Tangata Whenua.

3.7 Historic Values

The Kaimai Mamaku Ranges have an extensive European history of land clearance, fire, Kauri and other logging, dams, gold mines with associated tramlines and old roading infrastructure. These historic resources form part of the story of the Kaimai Mamaku Ranges and while they often contributed to the decline of the ecological integrity of the area, the access opportunity offered by some of this historic infrastructure may also help manage existing threats.

3.8 Recreational Values

The Kaimai Mamaku Forest Park is serviced by an extensive track system with over 360 km of walking tracks and four huts, providing significant recreational opportunities for day walkers, multi-day trampers and mountain bikers. With multiple road ends and campsites, this extensive infrastructure is well used by visitors based in the large human population centres within a short (1 to 2 hours drive) distance of the area.

The Kaimai Ridgeway Trust has been established to further promote the development of huts and tracks to facilitate recreation in the central Kaimai Range.

The Aongatete Lodge Outdoor Education Camp is an important education facility based within the Kaimai Mamaku Forest Park, catering for large numbers of children and other community groups (~3,000 per annum).

Rivers and streams flowing from the Kaimai Mamaku Ranges provide opportunity for swimming, rafting, kayaking, eeling and trout fishing and are a source of whitebait and other fish species closer to the coast.

The presence of deer and pigs provide further opportunities for both recreation and food gathering.

3.9 Introduced Animals

A range of introduced animal species have colonised the Kaimai Mamaku landscape since European settlement in the 1800's. While the effects of some of these species is limited, localised or relatively benign, some have had (and continue to have) a widespread and significant impact on a range of natural values and processes, including the complete elimination of some indigenous species.

The combination of multiple introduced animal species, together with the impacts of species like wasps, from weeds, logging, fire and fragmentation by human development, is generating a cascade of ecological change across the Kaimai Mamaku Ranges which is gaining momentum and pace as key threats go un-addressed. There is widespread concern that many of these forests are not currently under intensive management, that they are experiencing ongoing ecological collapse, and that significant, critical components (e.g., pollinators, seed dispersers) of the indigenous fauna have already suffered catastrophic population declines.

The need to effectively manage key threats in the habitats that still survive is becoming increasingly urgent, if many of the remaining natural values of the Kaimai Mamaku Ranges are to be retained. So many have already been lost.

Discussion Point 4: How does the Forum tell the story of decline in the Kaimai Mamaku Ranges? As more and more species decline and/or are lost, the interconnected nature of the ecology will see the integrity of these forest ecosystems further destroyed. There is a need to create a sense of urgency to begin to heal the wounds caused by pest animals, before it is too late.

3.9.1 What introduced animals are present?

Possoms

Possoms are opportunistic herbivores, taking a wide variety of leaves, buds, bark, fungi, flowers, fruit and seeds. They are also seasonally omnivorous, eating a variety of invertebrates, predated the nests of many birds and even scavenging meat from dead carcasses.

Possoms are responsible for the decline or removal of favoured food trees and plants from forest ecosystems. They are also a major contributor to the extinction or very low

abundance of many bird species in the forests of the Kaimai Mamaku Ranges through functions of both competition (for food) and direct predation.

Possum numbers probably peaked in the 1980's but continue to be locally abundant around the margins. DOC administers a block system for private commercial possum hunters, and there is ongoing interest in possum hunting linked to fur prices, but this activity is mainly in the northern Kaimai or around the fringes and is not suppressing possum populations to levels that allow for significant biodiversity gains in the wider landscape.

Wherever possums are not actively managed to very low density they have caused significant declines in both forest health and diversity as well as in forest fauna. Possums also impact on horticultural and other values in the productive landscapes surrounding the natural forests.

Ship Rats & Other Rodents

Ship rats first colonised the North Island in the early 1900's, displacing Norway rats and to a lesser degree, kiore - which are now extinct on the North Island mainland. Today, ship rats are the dominant forest rat throughout most of mainland New Zealand. They are widespread, although they are likely to be most abundant in the lower altitude forest habitats which provide a wider range of fruit and seed; and less common in the higher altitude habitats which offer less feeding opportunities and more extreme climatic conditions.

Ship rats are excellent climbers and major predators of forest birds, invertebrates and lizards, as well as significant harvesters of forest fruit and seeds. They can reach high densities in years when environmental conditions result in high forest fruit and seed production. Kokako, kereru, tui, bellbird and robin populations are extremely vulnerable to ship rat predation during rat population peaks, at such times.

While Norway rats are likely to be present along most major rivers and streams, and on the shorelines of lakes or estuaries, they are less common in forest environments. They have a similar impact to ships rats on birds, invertebrates, seeds and fruit.

Mice are also present in the Kaimai Mamaku Ranges but their numbers are restricted by ship rats through a combination of predation and competition. Nevertheless, their numbers could increase dramatically in some habitats if ship rat numbers were to be artificially suppressed (by control operations). In high density, mice have a significant impact on invertebrate, frog and lizard fauna and can harvest large amounts of fruit and seed.

Rodent populations are generally key drivers of other introduced predator populations (e.g., mustelids and cats) – their impacts then ‘spill-over’ to vulnerable and valued species of native fauna.

Mustelids

Ferrets, stoats and weasels were introduced to New Zealand in the late 1800’s to control rabbits. Within a decade, stoats had spread vast distances to colonise the most remote and largest tracts of forest.

Stoats have probably been present in the Kaimai Mamaku landscape for a hundred years or more. While ferrets are likely to occupy farmland adjoining the main ranges, they are less well adapted to a forest environment and are, generally, only occasional visitors to such habitat. However, ferrets have been known to cause serious damage to kiwi populations in some deep bush habitats. The smaller weasel can also thrive in forest and scrub environments. While weasel populations are often suppressed by stoats (through both predation and competition), weasels are relatively common in the Bay of Plenty Region.

Stoats prey primarily on rodents (or rabbits in pasture situations) and their populations fluctuate in a complex relationship with rodent (and rabbit) cycles. However, they are opportunistic ‘spill-over’ predators of a wide range of forest birds, invertebrates and lizards. Stoats therefore, can seriously impact the viability of many vulnerable native species. Their impact in the Kaimai Mamaku Ranges is largely responsible for the decline and/or loss of the more vulnerable native species such as taiko, titi, kiwi, whio, kākā and kākārīki. Their extensive home ranges (~250ha) and large dispersal distances (>10km) mean that stoat control must be implemented over large areas and be ongoing to achieve effective ecological outcomes.

Wild Cats

The history of cats in the Kaimai Mamaku Ranges is unknown. They are likely to occur across most habitats in low density, particularly in habitats closer to human habitation and farmland, or in car park/access areas where dumping of unwanted domestic pets is common. Their primary prey is likely to be rabbits and rodents but, like stoats, they are ‘spill-over’ predators that impact on a range of ground dwelling native birds, invertebrates and lizards. The integration of cat control into any management programme is therefore essential.

Hedgehogs

Hedgehogs occur in varying density in all lower altitude habitats in the Kaimai Mamaku Ranges. As generalist insectivores, they are responsible for a general decline in forest invertebrate fauna and can also predate the eggs and young of some ground nesting birds.

Hedgehogs hibernate during the colder months from June to August. Their overall ecological impact in forest environments is uncertain, relative to possums, rats and stoats.

Goats

Goats occur over a large proportion of the northern and central western Kaimai Range and on the northern Mamaku Plateau. However, effective goat control has been widely implemented for many decades and is still strongly focused in the northern Kaimai and locally, on the northern Mamaku Plateau.

Goats are highly social animals that can breed quickly, adapt to a wide range of habitats and inflict significant damage by browsing preferred species. They can strip the forest understory and bluff systems and restrict vegetation recovery on slip scars. The significant effects on the Kaimai Range were identified and prioritised early on by the New Zealand Forest Service. A significant ongoing investment in goat suppression over many decades, continued since 1987 by the Department of Conservation, is an important strategic advantage for this Project. Goat densities remain low and localised as a result of this effort.

Red Deer

The red deer present in the Kaimai Mamaku Ranges are the result of active liberations and farm escapes over many decades. They are common in the Kaimai Range north of SH29 to Mount Te Aroha and in pine plantations or around the margins of the main native forest areas. They occur in very low numbers north of Thompson's Track and are still colonising the northern Mamaku Plateau, where it is thought mineral deficiency is a limiting factor. A larger herd occupies the Mamaku Plateau to the south.

Red deer are opportunistic and highly adaptable feeders, selectively feeding on a wide range of trees, shrubs, herbs, grasses and litter fall. Red deer colonised the Kaimai Range after goats had caused significant damage, so while they are not the major driver of initial understory changes, the effects of deer browse is helping maintain and exacerbate the initial impacts and effects of goats. Red deer have caused damage to king-fern groves at Aongatete where attempts have been made to protect these with deer exclosures.

The red deer herd is a locally valued hunting resource, particularly in the central Kaimai Range and southern Mamaku Plateau. However, the impacts of the current hunting regime on the resident herd are unknown. The Department of Conservation issues hunting permits for public conservation land, while hunting access in adjoining forests and farmland is managed by land owners. This activity is likely to simply crop an annual harvest from these populations, without reducing base densities.

Fallow Deer

The fallow deer present are also the result of active liberations and farm escapes over more recent decades. Fallow deer are largely grazers and are therefore more restricted to areas around the fringes of the main ranges and in pine plantations.

The fallow deer herd is a locally valued hunting resource, although the impacts of the current hunting regime on the resident herd are unknown. The Department of Conservation issues hunting permits for public conservation land, while hunting access in adjoining private forest and farmland is managed by land owners.

Pigs

Pig numbers vary both seasonally and from habitat to habitat. Pigs are highly nomadic and populations can increase quickly when feed conditions (e.g., fruit crops, soil moisture) allow. When numbers are high, they can have a significant conservation impact through forest understory disturbance, fruit consumption, predation and interference with pest control infrastructure (bait stations, traps, etc).

However, the greatest influence on pig populations is the surrounding forestry and private farmland where wild pigs are a highly prized resource, where hunting pressure is intense, and where there is often active management, usually involving ongoing pig releases.

Across the wider Kaimai Range the overall impact of pigs is comparatively low, being restricted seasonally to lower parts. Pig numbers are higher on the Mamaku Plateau where areas like Mokaihāhā see ongoing problems, but the main Kaimai Range is not recognised as a significant pig hunting destination.

Department of Conservation issue hunting permits for public conservation land while hunting access on adjoining private forest and farmland is managed by land owners.

Wallabies

Dama wallabies were first liberated in the Rotorua Lakes District in 1912. The liberation point was at Lake Okareka. Since then their range has expanded to cover 2,000 km². They currently occupy all suitable habitat east of Rotorua, west of Kawerau and south to the northern tip of the Paeroa Range. A satellite population (separated from the main known distribution) occurs on Mt Ngongotahā and wallabies have been recorded near Mokaihāhā and Galaxy Road in the Mamaku Range but the extent of these populations has yet to be determined.

Dama wallabies are grazers, preferring grasses and other herbs. However, they have adapted well to the podocarp/hardwood forests and scrublands of the central North Island

and thrive up to altitudes of 1000m above sea level. They appear particularly common on and near bush margins and on drier ridge type habitats (e.g., kanuka). Wallabies can have a significant negative impact on the local forest understory.

Keeping breeding colonies of wallabies out of the Kaimai Mamaku Ranges is a priority that needs serious consideration. Their cryptic behavior and natural shyness around pest animal management devices can make them a difficult pest to control once they are well established, especially when possum and rodent densities are high.

Other Threats

In addition to the pest animals mentioned above, there are many other introduced organisms that also threaten the integrity of the Kaimai Mamaku ranges. These include: birds such as rosellas and lorikeets; insects such as wasps; pest fish such as carp; a huge variety of weeds; and pathogens such as fungi and bacteria that cause major issues like Kauri dieback. These other threats might currently be considered outside the scope of this Project. However, as the integrity of the original ecology continues to be undermined by unmanaged pest animal impacts, these other threats have the potential to contribute to even greater decline.

3.9.2 What are the key animal pest threats?

Not all the introduced animal species present are equal in terms of their impacts, and therefore importance to achieving the Vision and Objectives of the Forum. Possum, rats and stoats in particular, are often seen as priority pest species for native biodiversity protection. The focus of PF2050 on these three species reflects this.

Nor are all introduced animals "valued" the same by stakeholders. Species such as possums, rats, stoats and goats are largely considered as pests by the wider community. However, deer and pigs, while being seen as pests by some, are highly valued as a food source by a significant proportion of the community, particularly Māori for whom the Kaimai Mamaku Ranges were once an important 'food-basket'. Venison and pork have replaced more traditional (mainly bird) protein sources in these forests and remain an important food resource for many Iwi, Hapū and Marae. These species also help allow Māori to still connect with the forests within their rohe in a traditional hunter-gatherer context - an important aspect of Māori culture.

The wider deer and pig hunting public also see these species as highly valued. While managing their impacts remains an important part of achieving the Vision and Objectives of the Forum, trying to eliminate them could generate significant conflict which could divide stakeholder opinion and compromise the wider outcomes for more critical pest species.

Discussion Point 5: The Forum will need to determine the key animal pest species/management priorities to be targeted under a Kaimai Mamaku Pest Animal Management Plan, based on potential impacts to natural values and the value placed on some species by people.

3.9.3 What's currently happening to address animal pest impacts?

Apart from comprehensive goat control, the Western Bay of Plenty is one of the few regions in New Zealand which has not been subject to landscape scale pest management. This is partly a result of the absence of Bovine Tuberculosis (TB), a livestock disease that can impact the domestic cattle and deer industries, and for which possums are the primary wildlife transmission vector. Large scale possum control operations to control Bovine TB have been a major driver of landscape scale pest control throughout the country for the past three decades.

Localised pest animal management at high value sites has occurred over a number of, mostly community driven, project areas. Currently, approximately 5,000ha is under some form of sustained pest management, although this effort is highly fragmented. These areas are shown in Map 3 in Appendix 1 and summarised in Table 1 below.

As a result of this fragmented effort and the fact that most of the pest control projects within the Kaimai Mamaku Ranges are relatively small in scale, reinvasion of pests from untreated surrounding areas is a significant issue. This makes control efforts more difficult, less effective and more expensive. While some community groups would like to expand their project areas, the larger their treatment areas become, the harder they are to defend from reinvasion. There is a strong desire to see landscape scale pest control to extend the benefits, support existing projects to allow them to more efficiently expand and to 'connect-up' to reduce the currently fragmented effort.

Forestry companies are major land management agencies with an interest in pest animal management outcomes in the Kaimai Mamaku Ranges, primarily possums and goats. Blakely Pacific NZ Ltd, Hancock Forest Management (NZ) Ltd and PF Olsen Ltd have significant forestry management interests in this landscape on behalf of a range of clients (private, Crown, Māori Trust and overseas investment). All these companies have possum block systems for private (or, on Māori land, Tangata Whenua based) possum trappers to recover a combination of both fur/skins, and possum meat (for the pet-food industry). Pest impact in forestry plantations is at its most severe post-harvest when new trees are planted. When required, additional pest control is often implemented at such times, or private possum trappers are guided to priority areas. Demand for blocks is high but while possum densities are generally held to moderately low levels (5% - %10 RTC) by this activity, these densities are still too high for more sensitive, possum vulnerable species.

Table 1: Pest Control in the Kaimai Mamaku Ranges

Treatment Area	Target Species	Size (ha)	Agency Involved:	Methods Used:	Notes:
Northern Kaimai Goat Control	Goats	13,500	DOC	Ground Hunting with Dogs	Ongoing for almost 5 decades. Deer to be added in future years.
Northern Mamaku Plateau Goat Control	Goats	15,300	DOC, forest companies	Ground Hunting with Dogs	Mostly goat free. Focused on reinvasion from surrounding area.
Total		28,800ha			
Aongatete	Possums, Rats, Stoats	500	Aongatete Trust	Bait Stations, Traps	King fern fenced from deer. Project ongoing since 2005
Karangahake	Possums, Rats, Stoats	?	Project Karangahake	Bait Stations, Traps	Just starting
Mokaihāhā (Core)	Possums, Rats	(870)	Mokaihāhā Trust	Bait Stations, Traps	Ongoing since 2001
Mokaihāhā (Core + Buffer)	Possums, Rats	2,137	DOC	Aerial 1080	Last undertaken in 2015
Opuiaiki (Core)	Stoats only 2016/17 Possums, Rats, Stoats 2017/18	900	DOC	Bait stations	Some recent trapping but largely no control since Sept 2014; kokako declining
Opuiaiki (Canopy)	Possums, Rats, Stoats	(5,600*)	DOC	Aerial 1080	Last undertaken in 2006
Ōtanewainuku	Possums, Rats, Stoats	900 expanding to 1250	Ōtanewainuku Kiwi Trust	Bait Stations, Traps	Ongoing since 2002
Otawa Sanctuary	Rats	350	DOC ("Battle for our Birds")	Self setting Traps	Some previous possum control
Puketoki	Possums, Rats	40	Whakamarama Community Inc.	Bait Stations, Traps	Ongoing since 2004
Te Mania/Lund Road	Possums, Rats, Stoats	165	Lund Road Pest Control Group	Bait Stations, Traps	Ongoing since 2007
The Blade - Whakamarama	Possums, Rats	100	Whakamarama Community Inc.	Bait Stations, Traps	Ongoing since 2015
Wairongomai	Possums, Rats	(975*)		Bait Stations, Traps	Last undertaken in 2003
Waimata	Possums, Rats, Stoats	120?	Waimata Pest Control Group	???	???
Warren Coffey (Karangahake)	Possums, Rats, Stoats	120	Private land owner	Bait Stations, Traps, shooting	Ongoing since 2016
Others?					
Total:		5,332			

* Not included in Total as >10 years ago

4 Strategic Considerations for Pest Control

A summary of potentially useful tools and techniques, and their advantages and disadvantages for operational application in any proposed pest animal management programme follows.

4.1 Key Principles

A number of important principles and considerations must underpin the development of a strategically sound, effective and sustainable management programme.

Management Outcomes

It is not how many pests are killed that is important, but how many remain and what impact those survivors have on the ecological values being protected. Above all else, the desired ecological 'outcomes' should drive the type of management. Management that is not focused on a specified outcome will often result in poorly targeted resources (people, funding, tools). What pests are to be targeted, when, how and why should always be linked to an outcome (for example, 'restoration of specified bird populations'; 'rata regeneration').

Strategic Approach

Eradication of the key animal pest threats is not currently feasible due to ongoing reinvasion from untreated adjoining areas. As PF2050 gains momentum and increasing areas come under management, opportunities to completely remove key pests may evolve over time, especially with the development of new and innovative tools and technologies. However, in the meantime, the only viable management option is for key pest populations to be managed to a level low enough to allow for the protection of specified ecological values. This may be zero density for some highly vulnerable threatened species. This will require intensive, sustained management input. Once started, if management input stops at any time, all gains will be lost within three years. Therefore, sustainable, incremental expansion will need to be a cornerstone of any Pest Animal Management Plan for the Kaimai Mamaku Ranges.

Operational Design

Attempting to create low (or zero) density pest 'islands' within a 'sea of pests' will require a landscape scale pest animal management approach. Working to river gorges, farm edges, or to the edges of other pest control areas will be critical to the long-term success of any management programme.

In developing an effective, sustained pest animal management programme, there is a need to utilise as many geographic and habitat boundaries as possible to minimise pest reinvasion and maximise control efficiency over time. This will require successful collaboration with a

range of neighbouring land owners, land management agencies and communities. The current fragmented approach in the Kaimai Mamaku Ranges is a significant constraint.

Timing

Pest densities fluctuate seasonally and from year to year (especially rodents) with resources such as fruit, seed or prey. Some pests are more vulnerable at certain times of the year, particularly in winter when food supplies become limited and cold weather puts additional pressure on their energy reserves. As a general rule, the June to August period is the most desirable time to control most pests. This ensures spring growth, flowering and breeding (for forest birds) during the September to December period can proceed in the management area, largely free of pest impacts. For pests such as stoats, juvenile dispersal in the December to February period makes this timing critical for management action.

Accessibility

The nature, scale, size and remoteness of the habitat will influence how accessible pests are to various management tools. Steep, rugged and isolated landscapes offer different challenges to flat easy terrain adjoining farmland.

Consideration of perverse effects

There are often complex relationships or interactions between different pest species and different pest and weed species. Controlling one or more pests will provide resources which might result in other problems or pest species. For example:

- When rat numbers are low, mouse populations can thrive with less competition and predation;
- In podocarp broadleaved forests, rats and feral pigs often increase within 1-3 years after possums are controlled.
- Weeds that are suppressed by pests can thrive when pest densities are reduced while those that are bird dispersed can increase their rate and distance of dispersal as the abundance of seed/fruit eating birds increases.

Exclusion of Emerging Threats

A further key principle in pest management is that it is more effective to keep a threat out than to manage its impacts once it becomes established. For a pest animal species like wallaby, this is an important consideration. But there are many other threats for which this principle holds true, especially for weeds and pathogens.

Stakeholder Interests

The choice of appropriate control tools is heavily influenced by stakeholder considerations and other site specific social or cultural values (e.g., hunting, recreational use, waahi tapu, water supply catchments, etc). Meaningful consultation is the only way to identify tools

that are acceptable to stakeholders. A decision support tool (Appendix 3) has been developed on the "Factors that guide methods of pest control and placement of tools at a particular site".

The regional community will need to have an open mind to ensure the right mix of tools are used in the right places to deliver the most effective, efficient and sustainable pest animal management outcomes.

4.2 Control Options

The choice of pest animal management tools is important. There are a range of tools that can be used to limit the impacts of different pest species in natural ecosystems. These include a range of traps, toxins, bait formulations and bait application methods. No single tool is a silver bullet. Each has advantages and disadvantages. When dealing with a range of pest species, in a large complex landscape, this issue becomes even more complicated. Many pest control techniques are pest specific, while others can control multiple pest species. Social dynamics are also an important consideration as identified above in relation to the recreational use of the Kaimai Mamaku and particularly its use for hunting. Social dynamics elevate in influence as projects grow in scale – landscape scale projects are ultimately heavily dependent on getting high levels of social acceptance.

To achieve the best results, it is important to put all target pests within the management site at risk with the method being deployed, either by delivering the control tool to the pests or attracting pests to the tool. Terrain, habitat type and accessibility for management heavily influence operational efficiency, effectiveness and the relative costs of different pest control methods. A further consideration is that the continued use of the same tools over time can result in bait shyness, pesticide resistance (for some chemicals) and/or behavioral changes in surviving pest populations. This results in declining effectiveness of particular tools over time. For example, particularly possums and rats can often start living between devices if these are installed too far apart, allowing them to avoid traps or toxins and keep their populations above damage threshold levels.

A brief description of currently available pest control tools follows. A comparison of these tools is summarised in Table 2.

Trapping

A range of trap options exist, including both leg-hold and kill traps, to manage possums rodents, mustelids and cats. Traps that hold pests without killing them are legally required to be checked within 24 hours of setting and within every 24 hour period thereafter. Leg-hold traps allow the retrieval of possum carcasses for fur recovery. Kill traps do not require

daily checking but must meet specified animal welfare criteria. Smaller traps that are light and portable can be carried by operators over longer distances but many of the larger kill traps are bulky, heavy and much harder to transport. Many traps are single kill devices so once activated, the trap is not functional until the next service - often a period of weeks. Remote sensing technology is developing to improve trap servicing efficiency. Self setting gas operated (GoodNature® A12 & A24) traps also get around this problem. They are light and require far less labour to service (changing lure and gas canisters about every three to six months), but they require significant capital investment to put in place an effective trap infrastructure (approximately one trap per ha). Long life lures have been a limitation but technological advances are supporting improvements in this issue. As scale and access/terrain difficulty increases, traps become less and less feasible and cost effective.

Registered toxins in bait stations

A variety of toxins are registered for use in bait stations. Bait stations rely on attracting pests to a site and encouraging bait consumption, usually through pre-feeding with non-toxic bait. Once there is significant pest activity at a bait station, toxin is applied. Bait station networks can effectively target rodents and possums but must systematically cover the whole treatment area, usually about one bait station/ha (higher density for rats). They require three or four visits to establish, pre-feed (sometimes twice), apply toxin and remove uneaten toxic bait. Access tracks are therefore required in many habitats. Bait station networks can remain at the same site permanently and allow for a mix of bait types and toxins to be used over time, although pest populations can develop between bait stations in some situations. As scale and access/terrain difficulty increases, bait station networks become increasingly more expensive to establish and service.

Ground-based toxin use

A variety of toxins are also registered for ground-based application. Baits are taken to the pests by the operator, who can determine exactly where bait is laid. Operator skill in bait placement is important. Best practice to encourage bait take is achieved through pre-feeding with non-toxic bait for most toxins. This ensures a higher proportion of a pest population is put at risk and reduces the risk of longer term bait shyness but requires at least two visits by operators.

Large amounts of bait can be carried by an operator allowing good coverage of treatment areas, but again, as the scale and access/terrain difficulty increases, operators must walk further and work harder, increasing costs.

Ground laid toxins can also be used in association with aerially applied pre-feed bait.

Shooting

Shooting is an important tool for goats, deer and pigs. Use of indicator and/or bailing dogs can make shooting even more effective. Radio-collared "Judas" animals can also enhance shooting as a management tool. Use of trained professional hunters is important to maximise the removal of the target pest with minimal disturbance. Where pigs are concerned however, bailing dogs can be used to both remove pigs and to scare/push other pigs away from the area where damage is occurring.

Spotlight hunting with rifles can be a valuable possum management technique in open country and particularly along bush edges where possum densities are usually highest, making it a useful supplementary tool in landscape scale possum control programmes. Targeting possum preferred feed species (such as crops, larch and willow) seasonally can yield good results. Infra-red night vision and thermal imaging equipment can also enhance shooting outcomes but shooting as a tool generally has more limited application in dense forests.

Aerial Bait Application

The only toxin registered for widespread aerial application on the mainland is 1080. [Brodifacoum can be applied by aerial means only under a strict code of practise on un-stocked off-shore islands or behind pest proof fenced sanctuaries on the mainland.]

Baits are systemically spread from helicopter sowing buckets at rates of 1 to 2 kg per hectares across a treatment area using GPS satellite navigation. Very large areas of difficult terrain can be treated very cost effectively (\$27 per ha) in a short space of time (up to 20,000ha in a single day), targeting multiple pests (including possums, rodents, stoats, cats and wallabies). Operational areas are pre-fed with non-toxic bait first, approximately 7 - 10 days prior to toxic bait application.

Bait becomes more readily available to non-target species when applied in this way. There is significant public concern around this method based on non-target effects, and a perceived lack of control in terms of bait placement. 'Trickle' boundary-buckets have been developed to allow more targeted delivery. Hand sowing can also be used in conjunction with aerial bait delivery of pre-feed, especially in more sensitive areas. Toxic baits are dyed green to reduce non-target bird mortality. Deer repellents are also available to reduce game animal by-kill but this costs a further \$5.10 per ha. Dogs are highly susceptible to 1080 and dog deaths cause significant public concern. Aerial 1080 has been successfully and safely used within public water supply catchments without incident. The Parliamentary Commissioner for the Environment has endorsed this method of pest management.

Emerging Technologies

While most of the methods and techniques summarised above have been refined and improved over the years, most have been around for decades. With the formulation of a PF2050 vision, the pace at which new animal pest management technologies are developing is rapidly increasing. Over the next decade, it is likely that innovation and technological advancement will transform animal pest management. Organisations such as Zero Invasive Pests (ZIP), the NEXT Foundation and a number of other private organisations are working with PF 2050 Ltd to push new boundaries on issues such as: trap design; alternative toxins; the development of highly attractive long lasting lures; the use of remote sensing for detecting pests or trap triggering; and innovative approaches to reducing or eliminating pest reinvasion in areas where successful pest removal is achieved. The development of gene technologies also offer completely new approaches to pest animal management.

Any 'Pest Animal Management Plan' for the Kaimai Mamaku Ranges will need to maintain an overview of these emerging technologies to ensure the best management tools are always considered in pursuit of achieving the Vision and Objectives of the Forum.

Summary

None of the current pest control tools can, in isolation, achieve the Forum's Vision and Objectives. Nor can agencies like DOC and the regional councils achieve these on their own. Landscape scale pest animal management for the Kaimai Mamaku Ranges will require a "whole-of-region" response driven by engaged communities, Iwi and industry, and supported by agencies. A wide range of existing or potentially new tools will need to be utilised, depending on the sites to be targeted and the outcomes being sought.

Table 2: Comparative Analysis of Pest Control Tools

Method:	Target Pest	Advantages	Disadvantages
Kill traps: Timms, Warrior DOC 200/250	Possums Rats, Stoats, ferrets	Low non-target risks; no daily checking (legal compliance); long life lures evolving; remote sensing technology developing	Heavy & bulky to establish on site; high set-up and operating (labour) costs especially in more remote/difficult terrain; single/double kill before servicing required; carcasses generally rot & not recovered but remain at trap-site
Leg Hold Traps	Possums	Light, portable, effective; carcasses recovered	Non-target risks (kiwi/weka); daily checking (legal compliance); labour intensive (and therefore expensive) in remote sites/difficult terrain
Self Setting Traps (GoodNature®)	Possums (A12) Rats & Mustelids (A24)	Light, portable and effective; very low operational cost; very low non-target risks; safe for use in water catchments; provides continuous control; no daily checking (legal compliance); long life lures & Auto-lure pumps (ALP's) evolving; remote sensing technology developing	Very high set-up cost (\$350/ha); theft due to high price of traps; lure for Stoats needs more development; carcasses not recovered
Registered toxins in bait stations (e.g. 1080, Feratox cyanide, Feracol, Decal, Pindone, Ditrac, RatAbate, brodifacoum)	Possums, Rats Secondary kill of Stoats	Effective multi pest control tool when best practice is applied; low environmental persistence for most toxins; bait station network can be used for a range of toxins and adapted to target rats (reducing risk of bait shyness); low risk to native species; fixed-price tenders can be sought for servicing (\$6 - \$8 per visit); used in water supply catchments	Requires MOH approval where Vertebrate Toxin Agents (e.g. 1080, Feratox cyanide) are used; risks to uncontrolled dogs; requires caution periods excluding taking of game meat for consumption; some anticoagulant toxins persist; high set up costs (\$200/ha); labour intensive (and therefore expensive) to service in remote sites/difficult terrain; some toxins (1080, cyanide, Feracol) require pre-feeding for best results; carcasses not recovered
Ground-based toxin use: cyanide paste, Feratox, cholecalciferol, 1080 either hand laid or in bait bags / removable bait stations	Possums, Rats Secondary kill of Stoats	Effective multi pest control tool when best practice is applied; low environmental persistence for most toxins; bait station network can be used for a range of toxins, and adapted to target rats reducing risk of bait shyness; low risk to native species; fixed-price tenders can be sought; used in water supply catchments; Can utilise aerial pre-feed.	Requires MOH approval where Vertebrate Toxin Agents (e.g. 1080, Feratox cyanide) are used; risks to uncontrolled dogs; requires caution periods excluding taking of game meat for consumption; pre-feeding required for best results; labour intensive (and therefore expensive) in remote sites/difficult terrain; environmental persistence for anticoagulant toxins; carcasses not recovered
Aerial 1080	Possums, Rats Secondary kill of Stoats	Highly effective multi-pest (including possums, rodents, stoats, cats and wallabies) control tool when best practice is applied; low sowing rates (1.5 kg/ha); low environmental persistence; used in drinking water catchments (e.g., Hunua); low risk to native species when best practice is applied; low Cost (\$27/ha); Deer Repellent option significantly reduces unwanted deer by-kill.	Risks to uncontrolled dogs; risk to non-target deer/pigs unless deer repellent used; deer repellent adds to cost; public concerns around aerial application of toxins; overuse can develop bait shy populations - pre-feeding required (once every three years is considered a safe maximum frequency); requires MOH approval; requires caution periods excluding taking of game meat for consumption; carcasses not recovered.
Shooting	Goats, Deer, Pigs, Possums, Rabbits, Hares	Low risk to native species; carcasses recovered; used in water supply catchments; highly effective on goats, deer & pigs in forest especially when dogs and Judas goats are used; useful for possums on forest margins and more open habitats; Infra-red / thermal imaging / night vision technology developing.	Spotlight hunting has limited application in dense forest situations

5 Landscape Scale Pest Animal Management

The urgency of the biodiversity decline in the region is such that there is a pressing need to make change, to be bold and to innovate if pest control is to start making a significant difference. It is essential that the community, through the Forum, has a real understanding of this urgency.

In coming years, current management must be scaled up and expanded by an order of magnitude, from a few thousand hectares of management to tens of thousands of hectares. This scaling up brings a range of opportunities not only for the region's biodiversity but also for its communities, land owners, Iwi and industry. A renewed focus by central and regional government on biodiversity, Predator Free 2050 and the 'Battle for our Birds' will drive potential funding for this change, but the will to seek the necessary change must be driven from and supported by communities.

5.1 Opportunities

There are a range of opportunities to build on the current pest control summarised in Table 1.

5.1.1 Iwi & Hapū

Māori land owners and Tangata Whenua have strong aspirations to become involved in expanding pest animal management programmes across the Kaimai Mamaku Ranges. Their strong cultural connections, knowledge of the forests and commitment to natural resource management for future generations through the concept of Kaitiakitanga make Iwi and Hapū powerful allies in pest management.

The development of Māori social enterprises based on weed and pest management and ecological restoration in a kaitiaki context provides huge opportunity to generate important skills and capacity towards the implementation of pest animal management across the Kaimai Mamaku Ranges.

One Iwi-based proposal, identified during initial discussions, involves the development of a central 'belt' of pest control across the Kaimai Range ("Central Kaimai Pest Belt" proposal), reflecting a traditional Māori trading route known as the 'Wairere Trail'. The presence of old logging tramways and walking tracks in this area provide important access infrastructure upon which a potential pest animal management project might be based. There may also be similar management options to explore with Iwi/Hapū in other areas. Such ventures will need capacity and skill development, but if successful, could in time lay the foundations for significant involvement of Iwi/Hapū-led pest animal management across a much wider landscape. An example training opportunity to support such a programme is included in

Appendix 4. Provision could be made to resource this type of training (see also section 9 Indicative Budget).

Discussion Point 6: The Forum may wish to explore ways in which they can assist Iwi/Hapū to develop the skills and capacity to become key players in pest animal management within the Kaimai Mamaku Ranges as part of their Kaitiaki role.

5.1.2 DOC - Battle for our Birds

Recognising the decline in biodiversity across the country, central government have responded by resourcing DOC to roll out an increasing pest animal management programme known as the "Battle for our Birds". The programme is currently targeting almost 1 Million hectares of forest nationwide for sustained possum, rat and stoat control using primarily aerial 1080 baiting. 350ha of rat control based on self setting traps is currently funded under "Battle for our Birds" at Otawa north of Ōtanewainuku in the Bay of Plenty Region.

Two large operational areas (10,000's ha or more) linking high ranking ecological values - one in the Northern Kaimai and one on the northern Mamaku Plateau at Opuiaki - have been identified for possible funding under "Battle for our Birds". These remain conceptual and have not yet progressed to the operational planning stage. With community support, these could potentially be implemented, creating opportunity for ongoing management of pest populations over large and ecologically important parts of the Kaimai Mamaku Ranges in support of a wider landscape programme.

Discussion Point 7: The Forum should note the opportunities created by potential central government funding of a 'Battle for our Birds' pest management programme within the Kaimai Mamaku Ranges and consider how these could be incorporated to support a wider pest animal management programme. The funding is contingent on community support.

5.1.3 Regional Council Pest Management Initiatives

Regional Councils have a variety of mechanisms to support pest management. Waikato Regional Council have site-led biodiversity projects funded through their Natural Heritage Team from a targeted Biodiversity Rate. They also coordinate contractors to deliver pest management in 'Priority Possum Control Areas' (PPCA's) funded from a targeted Biosecurity Rate. Bay of Plenty Regional Council also fund biodiversity projects at prioritised sites across the region - including pest management.

Mechanisms used by other Councils such as in Taranaki and Hawkes Bay allow for 'Self Help Possum Management Units'. These are now being expanded to include rats, stoats and

cats. 'Self Help' programmes work via councils seeking agreement from a minimum of 75% of land owners within a "Management Unit", then completing an initial possum control knockdown, reducing numbers to below a prescribed threshold (e.g., 5% RTC). Landowners are subsequently required to keep possum numbers below 10% RTC, with technical and other support (bait, traps) from councils. This dual approach has been proven to achieve a greater level of control than would otherwise be achieved by a single landowner on their own.

These mechanisms all recognise that pests do not operate to human land boundaries and that pest control is a wider community issue. Such systems could be considered for some or multiple pests in areas of rateable land within or adjoining parts of the Kaimai Mamaku Ranges, to capitalise on the energy of landowners, supported by the broader (rate-payer) community. They have dual benefits both in terms of increased agricultural productivity as well as recovery and expansion of natural habitats and native species. The result is greater support for landscape scale pest animal management programmes where the whole community shares the responsibility, cost and benefit.

Discussion Point 8: The Forum may wish to consider the opportunities various Regional Council pest management initiatives might play on rateable land within and adjoining the Kaimai Mamaku Ranges. Where considered appropriate, the Forum could enter discussions with Councils in support of such concepts.

5.1.4 Regional Council Catchment Management

Waikato Regional Council is developing pilot 'Local Indigenous Biodiversity Schemes' (LIBS) under its 'Source to Sea' initiative within the Waihou Catchment in the Mangapiko, Rapurapu and Waimakariri sub-catchments. These community-based initiatives aim to encourage biodiversity to flow from the Kaimai Mamaku Ranges out into the agricultural landscape through landowner and Iwi based riparian restoration programmes.

A similar project in the Bay of Plenty at Katikati (the Uretara Estuary Project) undertaken by the community group 'Uretara Estuary Managers', is also underway and is closely connected to the Te Mania/Lund Road Pest Control Group.

As these projects develop further, they will contribute significantly to the Forum's Vision and Objectives, offering opportunities to enhance pest animal management across the wider landscape, to create operational synergies for pest control and to engage stakeholders.

5.1.5 Predator Free Bay of Plenty - Back Yard Trapping Project

Leveraging off the PF2050 momentum that is developing around the country, Bay of Plenty Regional Council together with a wide range of other stakeholders including Tauranga City Council, Western BOP District Council, Envirohub, NZ Landcare Trust and Bay Conservation Alliance, are initiating an urban environment pest programme with the aim of having a rat trap set in every fifth back yard, including Tauranga, Katikati, Ōmokoroa, Te Puna, Te Puke and Maketū. This project will unleash the energy of a very large urban-based human population, helping build capacity and skills that will add another layer to a wider landscape scale pest animal management programme.

5.1.6 Water Supply Catchments

Tauranga City Council ('TCC') has ownership of some 2,500ha of land in the Waiorohi and Tautau stream catchments, comprising more than half the total drinking water supply catchment area of around 4,500ha. These catchments are managed under a Western Bay of Plenty District bylaw, as "Controlled Catchment Areas" and are, part of the Council's moral and legal duty to *"take reasonable steps to contribute to protection of source of drinking water"*. Approximately 90% of the 2,500ha owned by TCC is indigenous forest with about 1,550ha concentrated in one large block in the southern half of the Waiorohi and Tautau catchments. An additional water supply to satisfy the demand from a growing human population is also well advanced in the neighbouring Waiari catchment.

TCC Water Supply Managers have recognised the value of pest animal management for water supply management and catchment protection. They have pro-actively sought to investigate sustained pest animal management programmes for their Waiorohi and Tautau Water Supply Catchments. Progressing these could initiate a further 1,550ha of treatment area that will support neighbouring community programmes at Ōtanewainuku and Otawa. TCC staff need better technical support, guidance and operational assistance to make this happen.

District councils in Western Bay of Plenty and Matamata-Piako also have significant areas of public water supply catchment within the Kaimai Mamaku Ranges (see Map 4 in Appendix 1).

Discussion Point 9: The Forum may wish to explore ways in which they can assist local district council water supply catchment managers to develop acceptable pest animal management programmes within their water catchment areas.

5.1.7 Industry

A wide variety of industries have a stake in a healthy Kaimai Mamaku landscape, including a significant interest in effective pest control. Forestry plantations along with kiwifruit and avocado orchards are large players in the region with influence over large tracts of land. Deer, cattle and dairy farmers also have a strong interest in maintaining low disease vector (possum and mustelid) populations, but livestock farmers generally have an interest in effective pest management.

Indirectly, the Port of Tauranga can be impacted by sediment runoff into the harbour, emphasising the value to such a business of sound catchment management focused on soil and water protection. However, all the industries mentioned above also play a key role in the sustainability of the Port, highlighting the wider commercial synergies within the region when it comes to effective pest management.

Industries may be prepared to contribute directly, play a leadership role with their internal stakeholders or include biodiversity/pest management in the sustainability aspects of their wider marketing programmes.

An example might be the kiwifruit industry which is based on a large number of small orchard holdings of just a few hectares. A handful of self setting traps in each orchard targeting possum, rats and stoats could make an enormous contribution to landscape scale pest control, without putting a major burden on individual orchardists. If Zespri were able to play a leadership role in establishing such a regime, its membership could be encouraged to participate, with technical support from agencies like DOC and regional councils.

Similarly, the forestry sector is comprised of major land management businesses with an interest in pest animal management outcomes in the Kaimai Mamaku Ranges. Their efforts generally keep both possum and goat densities in check, contributing to wider landscape pest reductions. Forestry companies also have Forest Stewardship Council (FSC) Certification or other (e.g., Overseas Investment Office) requirements on many forests that impose environmental and/or biodiversity obligations. These can result in forestry company activity that is highly compatible with the Forum's Vision and Objectives. For example - Blakely Pacific NZ Ltd are currently developing a Biodiversity Plan for their assets, together with DOC, Tangata Whenua and the Kaharoa Kokako Trust. The focus of this work will be in support of kokako management in adjoining reserve areas to create corridors for further kokako population expansion. Plantation forest management therefore, creates important potential synergy within the wider landscape in terms of pest management, to reduce pest densities, create ecological corridors and to support biodiversity.

These industry-based opportunities could play a significant role in an "whole-of-region" approach to pest animal management.

Discussion Point 10: The Forum may wish to consider how it might work with industry to broaden pest animal management across the catchment.

5.1.8 Other User Groups

The NZ Deerstalkers Association have worked closely with the Aongatete Trust to help limit deer impact at that site and provide a huge source of knowledge and potential energy towards pest animal management in the Kaimai Mamaku Ranges. While they do not consider deer and pigs as pests, they have concerns that some forms of pest animal management may limit hunting opportunities. Consideration of such views are an important part of capitalising on the knowledge and energy of such groups as well as expanding the reach of the project into the wider community.

The NZ Deerstalkers Association are an integral part of the Kaimai Ridgeway Trust, who are advocating for new infrastructure that could play a role in providing access for pest control in the "Central Kaimai Pest Belt" proposal.

Local tramping clubs are also a source of energy, skill and knowledge of back country areas.

5.1.9 Ecological Corridors

Landscape scale pest animal management provides an opportunity to create connecting ecological corridors for wildlife such as kokako, kiwi, kereru, kākā and other birds which will transform their survival chances. Wildland Consultants (SOE Report, 2010) have identified a number of ecological corridors that comprise actual or potential ecological linkages between areas of indigenous habitat in the developed urban area and the Kaimai Mamaku Ranges. Four of these corridors extend all the way from the harbour inland to the Kaimai Range and one extends from the harbour inland to the Papamoa Hills. Other opportunities exist to the south to link important management sites like Kaharoa and Otawa/Ōtanewainuku to Opuiaki and the main forest tracts. Forest companies could play an important part in this opportunity.

Establishment and maintenance of such 'predator-free' corridors encapsulate the concept of landscape scale pest animal management in terms of seeing the Vision and Objectives of the Forum being realised, allowing biodiversity to flourish and spill from the Kaimai Mamaku Ranges into surrounding areas.

As pests within the main Kaimai Mamaku Ranges are effectively managed over coming years, corridors and linkages out into the wider landscape and down into the Tauranga Harbour area will become increasingly viable, allowing these to be connected up with the adjoining urban and productive landscapes.

5.2 Constraints

A number of constraints currently restrict effective landscape scale pest animal management in the Kaimai Mamaku Ranges.

5.2.1 Ongoing Reinvasion

The overwhelming message from the many community groups working to manage pest impacts at their project sites is the issue of reinvasion from adjoining areas of untreated habitat. As community projects grow, they are defending increasingly larger boundaries against a "sea of pests". This places added pressure on already stretched infrastructure, capacity and resources. Also, as pest animal management infrastructure is installed further and further from access points and/or into more difficult terrain, fewer (of the often already limited number of) participating members have the time or physical ability to participate, and community groups must rely increasingly on contractors, adding to costs.

While many groups would like to expand, doing so threatens to stretch their project resources to breaking point. Wider landscape scale pest animal management would greatly enhance existing projects, making them more effective and allowing more opportunity for their desired expansion, but this must come with a corresponding sustainable and realistic level of funding.

5.2.2 Technical Support

There is an urgent need for technical support for community groups. Without sound advice on what tools to use, where, when and how, often limited resources can be poorly deployed, leading to ineffective and/or inefficient management of pest impacts. Accessible, accurate, clearly laid out written material, workshops and one-on-one advice will be critical to the success and expansion of existing projects as will be the promotion of best-practice and a consistency of approach using proven tools and technologies.

5.2.3 Public Concerns

Pest animal management can be a very polarising issue in many communities. While most people agree with the need to control pests like possums, rats and stoats, there is less agreement on species like deer, pigs and feral cats.

In addition, there is an increasing concern around animal welfare in terms of how pests are managed. The 'social license' for pest control is changing as animal welfare considerations increase. Pest animal management must take a highly respectful and humane approach to retain that social license.

Communities also have diverse views on pest animal management tools, especially toxins and how they are used. Aerial application of 1080 baits is especially controversial. Communities have genuine fears around the use of toxins and these must be understood, acknowledged and appropriately managed.

5.2.4 Water Supply Catchments

Public water supply catchments are currently sourced from large areas (1,000's of hectares) within the Kaimai Mamaku Ranges for communities in Tauranga, Katikati and Te Aroha.

At present, current policies in many public water supply catchments limit pest animal management techniques to trapping only, to reduce fears (or perceptions) of toxin contamination of public drinking water and to ensure carcasses can be removed from treatment areas. This will increase the cost of management in areas where access and terrain are more difficult.

There is a substantial body of scientific evidence from many areas where pests have been controlled successfully and safely within water supply catchments using a variety of toxins, including aerial 1080 bait application, that indicate this can occur without incident.

5.2.5 Deer & Pig Hunting

Loss of deer and pig hunting opportunity, the risk of toxin residues in game meat (for human consumption) and the risk to hunting dogs form part of public opposition to some pest animal management techniques, particularly around the use of aerial 1080 baiting and some anticoagulant toxins. There is a perception that hunting and pest control (particularly aerial 1080 baiting) are not compatible. However, there is sound, peer reviewed scientific evidence from other parts of the country where pests have been controlled and both deer and pig hunting opportunities have continued to thrive, that demonstrate the two activities are not mutually exclusive. Consideration of game-safe ground control methods on popular/accessible hunting grounds, use of deer repellents, withholding periods, public notification systems, warning signage and operational timing can all be used to help manage this conflict.

5.3 What needs to happen?

5.3.1 Education in the community

There is a need to develop a community education/advocacy programme so that individuals and communities will have a substantial and accurate understanding of the realities involved. There are various components to this:

- The importance of pest animal management to NZ's biodiversity and the health of our catchments and ecosystems. The need is becoming increasingly urgent and if the status quo remains, more will be lost (the 'Why?').
- What needs to be done to make places safe for rare and threatened wildlife (the 'What?').
- The need to engage all stakeholders with a shared vision (the 'Who').
- How we decide what methods to use, where, when and why?
- Best practice in pest animal management, including effective strategies and the responsible use of toxins (the 'How?').

5.3.2 Build local capacity for Pest Animal Management

Scaling up existing management by an order of magnitude in coming years will require a significant investment in human resources. This will include volunteers, but also skilled, fit young professional people whose role it will be to take on areas that are less suitable for communities and volunteers. This will require:

- Building capacity and knowledge by providing appropriate technical support and training.

Discussion Point 11: The Forum may wish to consider how it can ensure community groups get the technical support they need to develop effective, efficient and sustainable pest management programmes. "Pest Management - 101" Workshops are required, but one-on-one advice, guidance and mentoring will also be required on a site-by-site basis.

- The sustainable development of training programmes, social enterprise and employment opportunities, especially for Rangatahi.

Discussion Point 12: The Forum may wish to consider how it can encourage the social enterprise required to enhance and scale up existing pest management programmes and to start new ones.

- Engaging more people in pest animal management whether it is making their backyard pest free, participating in existing community projects or starting new ones.

5.3.3 Determining Key Animal Pests

In association with local communities, there is a need to identify and start the removal of key pest animals that threaten natural values:

- Possums
- Mustelids (mainly stoats)
- Rats
- Goats

Consideration needs to be given to how other pests should be managed:

- Wallaby (stop them establishing). Introduction of surveillance regimes.
- Feral cats?

But also, while recognising their food value, there is a need to minimise the impacts to natural values of:

- Pigs
- Deer

Reiteration of Discussion Point 5: The Forum will need to determine the key animal pest species/management priorities to be targeted under a Kaimai Mamaku Pest Animal Management Plan, based on potential impacts to natural values and the value placed on some species by people.

6 Core principles

The delivery of the Forum's Vision and Objectives will require the Forum and various agencies, stakeholders and industries to follow some key principles:

- **Community led**- to be successful the project must be led by the community and supported by agencies. Trust must be built between all parties as well as a common understanding of the Vision and Objectives.
- **Working together** - a united community are all on the same page - from backyard baiting to larger scale trapping & baiting to landscape scale baiting. A united community extends to the work programmes and contracts undertaken by agencies such as DOC, Iwi and councils, as well as the volunteer community.

- **Coordinating existing pest control activities** - a "whole-of-region" response to form a seamless network across the Kaimai Mamaku Ranges, regardless of land use or tenure. All the people and organisations currently involved in pest animal management have important roles to play and contributions to make, whether these be large or small.
- **Identifying gaps in coverage and opportunities for continuously improving best practice** - devising innovative ways of closing management gaps is key to the overall success of the project. This is likely to include offering landowners advice and subsidised/affordable options for pest control as well as being open to the use of new and/or emerging technologies.
- **Bottom up** - the greatest chance of sustainable success is if all related pest animal management activities are coordinated across the project and grow organically, as more areas are implemented.
- **Being realistic and acknowledging upfront that it's a long game** - implementation needs to be practical, realistic and innovative. There are many proven techniques but the right mix must be agreed, gaps identified and the means to fill these developed - adaptive management and learning-by-doing are vital. It must also be recognised that such work will need to break new ground and some mistakes are inevitable. There is a need to operate in a supportive, transparent and honest environment to learn from such mistakes.
- **Keeping up to date with new innovative strategies and technologies** - this will require agencies to be agile in recognising options and stakeholders to be open minded. Again, adaptive management and 'learning-by-doing' must be a key theme throughout the project.
- **A toolbox of techniques** - to effectively and efficiently target all species, provide flexibility to landowners but always getting smarter as technology, research and knowledge advances, to make it easy for people.
- **Learning from experts** - and the many others around New Zealand who are striving to create predator free communities.

Discussion Point 13: The Forum may wish to consider the appropriateness of these principles and any others that it may wish to see underpin a Kaimai Mamaku Pest Animal Management Programme.

7 Monitoring

Monitoring is a critical part of Pest Animal Management– regardless of the methods or approaches used. Effective pest control is not just simply about killing pests. In fact, it is not how many pests are killed that is important, but how many remain and what impact those survivors have on the ecological values being protected. For ongoing pest management, monitoring forms a vital link in the chain of:

Plan → Monitor → Do → Monitor → Review → Plan → Do → Monitor → Review → etc.

It is therefore, extremely important to regularly monitor and review the results and outcomes achieved, to ensure pest animal management is delivering on its objectives and, most importantly, that management continually improves over time.

The lack of well-planned and robust monitoring is often the downfall of a long-term pest animal management programme. By the time pest managers realise that what they are doing is not achieving their goals, it is often too late. Gains made can be lost again, large amounts of resources have been invested and wasted and stakeholder support has declined.

Two distinct types of monitoring are required:

- **Result monitoring** – measures the results in terms of pest density reductions. Generally, this will involve assessing pest density or relative abundance prior to control (the pest ‘baseline’), after control and then at regular intervals on an ongoing basis over time to guide future needs for management intervention.
- **Outcome monitoring** – measures the ecological outcomes of suppressing the target pests. Generally, this will involve obtaining baseline information on the relative ‘health’ of key indicator biodiversity species being impacted by pests (e.g. specific bird populations like kokako, tui, kereru or indicator trees such as rata), and monitoring changes in the ‘health’ of these species over time (as pest density is sustained at lower or zero levels).

Monitoring is, however, often costly and results may take several years (or even decades) before success can be measured. Careful decisions are required at the project development stage to decide what type of monitoring will give the most useful information to guide management, in the most efficient way. Investment in monitoring is best undertaken prior to actually doing any pest control, as comparisons of pest abundance and ecological impacts before and after control can then be made and communicated with stakeholders. Successful monitoring involves regular planned and timely measurement. Once results are

proven, monitoring intensity can then be reduced (e.g. from annual measurements to once every 3-5 years) or even discontinued entirely.

Monitoring actions must be aligned with management objectives and the expected or desired ecological outcomes. If resources are limited, monitoring tasks should be prioritised with consideration given to what is already known about ecological responses when pest species are managed. For example: rat suppression to <2%RTI results in increased bird populations; or possum control at <5%RTC improves the health of certain palatable tree species. When control targets for a successful ecological outcome are well known, monitoring pest abundance is generally the simplest and most efficient way.

The spill-over of species like tui and Kereru out of management areas and into surrounding landscapes - even urban environments - will create important opportunities for the whole community to start appreciating the gains being made. Outcome monitoring of such changes can therefore become an important marketing tool for pest animal management.

7.1 Previous Monitoring

DOC has had a strong concentration of vegetation monitoring effort in the northern Kaimai catchments; and in selected southern and central Kaimai catchments. These have documented specific rata damage and more general ongoing canopy browse by possums.

Residual Trap Catch Index (RTCI) monitoring of possums throughout the northern Kaimai Range in 2000 returned an average RTC of 17%, although individual trap lines varied from 10% to 33%. Pre- and post-control monitoring of possums and rodents have accompanied regular control operations at Mokaihāhā, Opuiki and Ōtanewainuku.

Most community groups undertake various forms of rat tracking or possum trap catch assessments; and ecological monitoring such as kokako or more general bird surveys. These will provide useful baselines for any wider pest animal management effects.

Currently much of the trapping effort by community groups is also recorded using tools such as the TrapNZ and the DOC "Walk-the-line" APP's or in other (manual) systems. Not all trapping is being recorded and there is inconsistency in data collection that does not allow for a single "big-picture".

7.2 Monitoring Needs

Much of the current pest data for the Kaimai Mamaku Ranges is aging and/or is very site specific. An up-to-date general overview of pest abundance is lacking. It is essential to develop this more detailed understanding about which pests occur in which habitats and

their relative abundance, as part of implementing a wider pest animal management programme.

Landscape scale pest monitoring across the many, varying habitats of the Kaimai Mamaku landscape (e.g., native forest, forestry, riparian habitat, pasture, orchard, etc) is a large task. There are a number of tools to do this. Possums could be monitored using the National Possum Control Agencies (NPCA) %RTCI protocol. This would involve 60 randomly located transects over a large area of mixed habitat. Similar landscape scale rodent monitoring using the %RTI protocol developed by Gillies & Williams (2002) would involve 20+ transects per habitat type.

An alternative approach is to use 'chew card index' (%CCI) transects across the landscape. These are an efficient means of quickly assessing the relative abundance of multiple pest species (rats, stoats, possums, cats, hedgehogs) for a similar cost to %RTI.

'Camera Traps' (a number of game cameras, lured with some food or chemical attractant, deployed simultaneously at random locations across a landscape) also provide indices of abundance. They have the added benefit of acting as surveillance mechanisms to detect new species like wallaby.

Regardless of method used, this pest indexing data would provide a baseline for the task ahead in terms of what levels of pest infestations currently inhabit which parts of the catchment. Such data will allow priorities to be assessed to guide the implementation of pest management.

A general rule is that approximately ten percent of the operational budget will be required for assessing the results (changes to pest densities) and outcomes (improvements in valued resources impacted by pests). Changes to pest densities can be determined from the methods described above (%RTC, %RTI, %CCI, Camera Traps). Outcome monitoring in the Kaimai Mamaku Ranges might focus on valued indicator species impacted by target pests such as:

- Rata or kamahi canopy health/browse levels (good indicator tree species for possum impact);
- Mistletoe size/browse (good indicator plant species for possum impact);
- *Dactyloctenium* (wood rose) flower and seed production (good indicator plant species for both possum and rat impact);
- Robin or kokako density/nesting success (good indicator bird species for rat impact);
- and

- Kiwi or kaka population surveys (indicator bird species for stoat impact - although longer term trends only would be detectable).

The exact tools used for such monitoring will depend on what is being protected, the pests being targeted, where and how.

There is a need to start building a picture of trapping effort on a single recording platform that provides an accurate Kaimai Mamaku pest animal management overview. A decision should be made at project initiation stage as to which platform to use and all project sites encouraged and assisted with training programmes to actively use that platform.

Discussion Point 14: The Forum may wish to consider what its monitoring priorities might be and the value in a pest 'snap-shot' across the wider Kaimai Mamaku landscape to inform future pest priorities. Agencies and individual project sites should be consulted on which trap recording platform best meets the needs of their staff/volunteers and the wider project. A single data collection system is critical.

8 Pest Animal Management Scenarios

Ultimately, the most appropriate pest animal management programme can only be determined through meaningful engagement and consultation with key stakeholders. Each operational area is different and each set of stakeholders unique. This Discussion Document should be viewed as a means of informing the required consultation and decision-making processes.

The ongoing support and enhancement of current and new community driven pest animal management ("core") areas where possums, rats and stoats are the primary target will remain a primary focus of any Kaimai Mamaku pest animal management. Over time, these projects will need to be scaled up and supported by landscape scale control of these species across a much wider management area. Three potential scenarios for this process are outlined below. The areas discussed are shown on the "Current and Proposed Management" map in Appendix 1.

8.1 Scenario 1: Consolidation of Existing Projects

Table 3 identifies a number of core areas currently funded and under (or proposed for) management, projected out to 2023 (5 years). These are largely community driven ground-based possum, rat and stoat suppression projects. They total between 5,000ha and 6,500ha - some 10% of the Kaimai Mamaku forest habitat that is in need of protection. Under this

"Consolidation Scenario", the next five years would see some modest new resourcing going in to support these projects in the following ways:

- improved coordination & networking;
- increased mentoring/technical support (from agencies and other experts);
- skill-sharing and general up-skilling;
- trialling of emerging new technologies (traps, toxin delivery, detection systems); and
- improved monitoring.

By 2023 (within 5 years) under this scenario it is envisaged that the delivery of pest animal management at current sites within the Kaimai Mamaku Ranges will be consistently meeting best practise in terms of both the suppression of target pests and the efficiency of that delivery. It is also envisaged that pest management knowledge and capacity within the region will have increased significantly to start the desired larger scale expansion.

8.2 Scenario 2: Consolidation and Staged Expansion

Under a "Consolidation and Expansion" Scenario, existing sites will be enhanced as above, but additional resourcing will be used to expand the area under management as follows:

- expand existing sites where this is desirable and feasible, utilising landscape features and boundaries wherever possible to reduce reinvasion and enhance efficiency;
- develop an extensive new central 'Kaimai Pest Belt' north of SH29; and
- work with agencies and communities to establish appropriate (and agreed) pest animal management within sensitive areas such as in water-supply catchments, at other culturally/socially important sites and near communities around the margins, in support of the existing community projects above.

By 2023 (within 5 years) under this scenario it is envisaged that the delivery of pest animal management at current sites within the Kaimai Mamaku Ranges will be consistently meeting best practise and that the area under pest animal management would increase, potentially to 16,000ha (about 30% of the habitat that is in need of protection) as follows:

- 6,500ha of community (ground-based) management;
- 5,000ha of ground-based management across a new central 'Kaimai Pest Belt' undertaken by Iwi based contractors; and
- 5,000ha of ground-based management across a range of more sensitive sites undertaken by contractors.

This scenario will also allow for growing pest management knowledge and capacity within the region to start further, larger scale expansion as resourcing and new technologies allow.

8.3 Scenario 3: Immediate Larger-Scale Expansion

A third scenario to be considered might be the utilisation of the Government's expanding 'Battle for our Birds' funding opportunity to develop additional landscape scale pest animal management to connect and enhance the success of existing and proposed sites as above.

This could involve periodic aerial bait applications over the steep, more remote, most rugged and difficult terrain, in support of the ground based work described in both scenarios above. Two aerial-based management blocks totalling some 20,000ha might be considered:

- one in the central and northern Kaimai connecting a range of key ecological sites and community management projects between Aongatete and Te Aroha; and
- one on the northern Mamaku Plateau around Opuiaiki.

Such management would greatly reduce pest reinvasion for existing and proposed ground-based sites. More sensitive and accessible areas adjoining aerial treatment areas would still be treated with traps and/or ground-based toxic bait application by contractors, as required. However, the nature and scale of parts of the Kaimai Mamaku Ranges would make ground control using current technologies difficult, time consuming and more costly.

Scenario 3 could provide for pest animal management over more than 35,000ha (about 65% of the habitat that is in need of protection) by 2023 (within 5 years).

Discussion Point 15: The Forum may wish to consider the appropriateness of the pest animal management scenarios outlined above, taking into consideration issues of scale, timing and projected costs. The Forum may also consider alternative scenarios.

9 Indicative Budgets

The three scenarios above will require very different levels of funding. Table 4 provides some indicative costings for the various management methods.

9.1 Scenario 1: Consolidation of Existing Projects

Scenario 1 is currently largely funded by a range of agencies and charitable donations. The improvements of consolidation could easily be provided through agencies via a small targeted budget of less than \$50,000 (\$10 per ha). Most sites are spending on average \$60-\$70/ha per annum on top of their volunteer labour contributions. While some sites

might need small increases in their project budgets to meet best practise in terms of pest suppression and monitoring, the support outlined would greatly enhance the outcomes of their existing spend.

9.2 Scenario 2: Consolidation and Staged Expansion

Scenario 2 would require a staged increase in funding to develop new pest animal management capacity locally and begin establishment of further ground based control sites. The scale of these sites would be limited by the funding available but based on Table 4 costings, every 1,000ha expansion will cost between \$240,000 and \$350,000 to establish and \$60,000 to \$110,000 per annum to service, depending on the tools used. If an additional 10,000ha comes under ground-based management using existing technologies the costs could exceed \$4 Million over five years. These costs may reduce as new technologies emerge.

9.3 Scenario 3: Immediate Larger-Scale Expansion

Scenario 3 would require more rapid investment of funds - in excess of \$7.5 Million over 5 years to manage pests over 35,000ha. \$6.5 Million of this would need to be new spend but, depending on the methods used, this could be much higher. Government funding under 'Battle for our Birds' or PF2050 is potentially available to support such large-scale expansion (see Section 9.4).

There will always be a trade-off between budget, the size of the area treated, the methods used and the outcomes achieved. The Forum and its stakeholders will need to weigh up these issues when considering how it wants to proceed, where its priorities lie and how fast expansion might progress.

Table 3: Current Kaimai Mamaku Pest Animal Management Programmes with 5 Year Indicative Budget (Currently Funded)

Site:	Method:	Area (ha):	Notes:	Cost Y1	Cost Y2	Cost Y3	Cost Y4	Cost Y5
Aongatete	Traps & Bait Stations	500	Maintain existing	\$20,000 + 500 hrs Volunteer	\$20,000 + 500 hrs Volunteer	\$20,000 + 500 hrs Volunteer	\$20,000 + 500 hrs Volunteer	\$20,000 + 500 hrs Volunteer
Karangahake	Traps & Bait Stations	100	Still establishing, estimates only	\$15,000 + Volunteer	\$7,000 + Volunteer	\$7,000 + Volunteer	\$7,000 + Volunteer	\$7,000 + Volunteer
Mokaihāhā (Core)	Bait Stations	(870)	Maintain (within area below)	\$60,000 Volunteer +	\$60,000 + Volunteer	Volunteer hrs	\$60,000 + Volunteer	\$60,000 + Volunteer
Mokaihāhā (Buffer)	Aerial 1080	2,137	3-year cycles			\$65,000		
Opuia (Core)	Traps & Bait Stations		*Re-establish 900 ha (estimates only)	\$70,000	\$70,000	\$70,000	\$70,000	\$70,000
Ōtanewainuku	Traps & Bait Stations	900	*Expand to 1350, new trapping regime to be installed Y2, 3 yearly toxin pulse	\$75,000 + 4,000 hrs Volunteer	\$435,000 + Volunteer	\$75,000 + 5,000 Volunteer hrs	\$10,000 + 5,000 Volunteer hrs	\$25,000 + 5,000 Volunteer hrs
Ahuwhenua Trust	Traps	55	Maintain (estimate)	~\$1,500	~\$1,500	\$1,500	\$1,500	\$1,500
Otawa Sanctuary	Traps	350	Maintain rats, expand to possums	\$87,000	\$35,000	\$35,000	\$35,000	\$35,000
Puketoki	Traps & Bait Stations	40	Maintain (estimate only)	\$3,000 + Volunteer	\$3,000 + Volunteer	\$3,000 + Volunteer	\$3,000 + Volunteer	\$3,000 + Volunteer
Te Mania/Lund Road	Traps & Bait Stations	165	*Expand to 200	\$15,000 + Volunteer	\$15,000 + Volunteer	\$15,000 + Volunteer	\$15,000 + Volunteer	\$15,000 + Volunteer
Whakamarama (The Blade)	Traps & Bait Stations	100	*Expand to 300	\$10,000 + Volunteer	\$30,000 + Volunteer	\$30,000 + Volunteer	\$30,000 + Volunteer	\$30,000 + Volunteer
Warren Coffey	Traps & Bait Stations	120	Estimate	\$17,000 + Volunteer	\$17,000 + Volunteer	\$17,000 + Volunteer	\$17,000 + Volunteer	\$17,000 + Volunteer
Waimata	Traps & Bait Stations	120	Estimate	\$10,000 + Volunteer	\$10,000 + Volunteer	\$10,000 + Volunteer	\$10,000 + Volunteer	\$10,000 + Volunteer
TOTAL:		~5,000	*Expand to 6,500	\$383,500	\$703,500	\$273,500	\$278,500	\$293,500

Table 4: Cost per Hectare and Indicative Budgets for Various Pest Animal Management Methods/Activities (Not Currently Funded)

Site/Activity:	Method:	\$ Cost:
<ul style="list-style-type: none"> Tech Support Coordination and Networking Skill-Sharing 	<ul style="list-style-type: none"> Agency Staff support Expert Advice Workshops Written material 	\$50,000 per annum
<ul style="list-style-type: none"> "Central Kaimai Pest Belt" Water supply catchments Other sensitive areas Bush margins near communities 	Self setting traps* Bait stations & Trapping #	\$350/ha establishment + \$70/ha servicing \$240/ha establishment + \$110/ha servicing
Training & Capacity building	WINTECH Environmental Management Course (see Appendix 4) or similar	\$10,000 per student/annum over 2 years
<ul style="list-style-type: none"> Mamaku Kaimai Opuaki 	Aerial 1080	\$27/ha (repeated on 3 yearly cycles)
Deer repellent option	Aerial 1080	\$5.10/ha - based on 1.5 kg/ha pre-feed and 1.5 kg/ha toxic bait application rates
Site specific deer & pig management on site by site basis as required	Hunting with dogs, fences, shooting	\$10/ha for contract hunters

* - based on establishing a network of self setting traps for possum (A12 - 1/ha) and rat/stoat (A24 - 1/ha) control, serviced 2 x per annum to replace lure/gas

- based on a bait station network at 100m x 75m spacing in treatment areas with pre-feed and toxic bait application twice per annum in late winter and again late spring, in combination with 1 x self setting stoat trap per 5 bait stations serviced twice per annum to replace lure/gas

9.4 Funding

Many existing community groups are already well resourced by a range of funding streams, although the funding they currently utilise would become far more effective/efficient under an expanded, landscape scale pest animal management programme. There are a variety of resourcing options to support and scale-up new initiatives for this expansion.

Central Government are allocating significant resources to PF2050, but these are linked to specific outcomes (see Appendix 2) and there is a need to develop a clear plan agreed by the community to seek such funding. An agreed Kaimai Mamaku Pest Animal Management Plan, supported by the wider community may assist that application process.

The DOC 'Battle for our Birds' campaign could be expanded into the Kaimai Mamaku Ranges as part of delivering on the goals of the NZ Biodiversity Strategy 2000-2020; the NZ Threatened Species Strategy 2017; and Predator Free 2050. Again, this relies on the community supporting such management action. The discussion generated by this Document may also help determine if and how that opportunity might be realised.

The Ministry for the Environment also has funding through its Freshwater Improvement Fund for wider catchment management. This can include activities such as fencing and pest control.

Waikato and Bay of Plenty Regional Councils both have funding available as part of their biodiversity responsibilities, particularly where projects are community driven. Most community groups involved with pest animal management in the Kaimai Mamaku Ranges source funding through various regional and district councils but also via a range of community or corporate trusts. Most groups appear well able to find significant ongoing funding from these sources. There are wider operational issues, as discussed above, rather than funding issues, that constrain the activities of most groups.

Mechanisms also exist to utilise planning tools such as Regional Pest Management Strategies to develop pest animal management programmes across rateable land. This would require ratepayer engagement and support through submission processes to Regional Pest Management Strategies and Council Long Term Plans.

Various stakeholders have a significant interest in effective pest control. Forestry, kiwifruit and avocado industries in particular are all large players in the Kaimai Mamaku landscape with influence over large tracts of land. They may be prepared to contribute directly, play a leadership role with their internal stakeholders or include biodiversity/pest management in the sustainability aspects of their wider marketing programmes.

Philanthropy is also an increasing source of funds for ecological restoration in New Zealand. Organisations like the NEXT Foundation are active in a number of very large projects similar to the Kaimai Mamaku Project at Abel Tasman and Taranaki. Individuals and families also support such projects.

In the future as Treaty Settlements are finalised, Iwi may develop enterprises which could contribute resources (including people and training opportunities).

Discussion Point 16: The Forum will be influential in many funding opportunities and may have connections itself, to other funding options. How can the Forum best capitalise on these relationships?

10 Where to from here?

The Forum may wish to convene to consider this Discussion Document, and in particular the 16 Discussion Points identified (summarised below). That may result in modification of this Document, as the Forum see fit, before Forum members engage with their own members, or with the groups they represent, for further discussion. These discussions will allow wider Forum membership to make appropriate recommendations to the Forum on how to progress the issue of developing an agreed 'Pest Animal Management Plan' as identified (Project 1) in its 2017 Operational Plan, that has wide community support.

Summary of Discussion Points

1. The Forum may wish to consider the landscape scale that the Pest Animal Management Plan should cover. Should it be focused on just the Kaimai Mamaku Forest Park (approximately 37,000ha); all native forest within the catchment; or a larger landscape including private land and other environments, across the whole area of interest to the Forum? Or should the scale of the Project simply grow as effective pest animal management is implemented across that landscape?
2. The Forum may wish to consider if this Vision and its accompanying Objectives provide sufficient guidance for the Pest Animal Management Plan. Are more detailed Pest Vision and/or Objective statements required? If so, what might they be?
3. The Forum will need to determine a robust process to engage Iwi, Hapū and Marae that connect to the Kaimai Mamaku Ranges. Questions to be considered might be:
 - what are their goals for pest management;
 - how best to proceed with developing a pest management programme;
 - what methods might be used where,
 - when and under what protocols;

- how pest animal management might best utilise the energy, skills and knowledge (Matauranga Maori) of Tangata Whenua.
4. How does the Forum tell the story of decline in the Kaimai Mamaku Ranges to create the sense of urgency needed to begin to heal the wounds caused by animal pests, before it is too late?
 5. The Forum will need to determine the key animal pest species/management priorities to be targeted under a Kaimai Mamaku Pest Animal Management Plan, based on potential impacts to natural values and the value placed on some species by people.
 6. The Forum may wish to explore ways in which they can assist Iwi/ Hapū to develop the skills and capacity to become key players in pest animal management within the Kaimai Mamaku Ranges as part of their Kaitiaki role.
 7. The Forum should note the opportunities created by potential central government funding of a 'Battle for our Birds' pest animal management programme within the Kaimai Mamaku Ranges and consider how it could be incorporated to support a wider management programme. The funding is contingent on community support.
 8. The Forum may wish to consider the opportunities various Regional Council pest management initiatives might play on rateable land within and adjoining the Kaimai Mamaku Ranges. Where considered appropriate, the Forum could enter discussions with Councils in support of such concepts.
 9. The Forum may wish to explore ways in assist local district council water supply catchment managers to develop acceptable pest animal management programmes within their water catchment areas.
 10. The Forum may wish to consider how it might work with industry to broaden pest animal management across the catchment.
 11. The Forum may wish to consider how it can ensure community groups get the technical support they need to develop effective, efficient and sustainable pest animal management programmes. "Pest Animal Management- 101" Workshops are required, but one-on-one advice, guidance and mentoring will also be required on a site-by-site basis.
 12. The Forum may wish to consider how it can encourage the social enterprise required to enhance and scale up existing projects and to start new ones.
 13. The Forum may wish to consider the appropriateness of the core principles and any others that it may wish to see underpin a Kaimai Mamaku Pest Animal Management Plan.
 14. The Forum may wish to consider what its monitoring priorities might be and the value in a pest 'snap-shot' across the wider Kaimai Mamaku landscape to inform future pest priorities. Agencies and individual project sites should be consulted on which trap recording platform best meets the needs of their staff/volunteers and the wider project. A single data collection system is critical.
 15. The Forum may wish to consider the appropriateness of the pest animal management scenarios outlined above, taking into consideration issues of scale, timing and

projected costs. The Forum may also consider alternative scenarios it might wish to pursue.

16. The Forum will be influential in many funding opportunities and may have connections itself, to other funding options. How can the Forum best capitalise on these relationships?

11 Bibliography

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12 Glossary

'Camera Traps' - An array of motion activated game cameras to capture images of animals. The array can involve a large number of game cameras, lured with some food or chemical attractant, deployed simultaneously at random locations across a landscape for a period of days or weeks. Images are downloaded to determine what animal images have been digitally captured. This information can then be used to provide indices of abundance for individual species or used as a surveillance system.

'CCI' - Chew-Card Index. A variation of the RTI (see below) but using corflute 'chew-cards' impregnated with peanut butter or other scented lures (e.g., rabbit paste, fish oil). Randomly located lines of 10 cards set at 50m intervals are left out for three nights and then retrieved to determine which pest species have interacted with the cards by leaving pest-specific tooth marks. This method can be used to index rodent and other smaller animal (stoat, hedgehog, possum, cat) abundance.

'Controlled Pesticides' - Pesticides governed by the Hazardous Substances and New Organisms Act (1996) and for which an 'Approved Handler' license is required for use in New Zealand (e.g., 1080, Cyanide, Phosphorous).

'Effective Pest Animal Management' - sustained pest control activity that reduces pest impacts to below environmental thresholds for vulnerable flora & fauna (e.g., Rat tracking at <2%RTI on 1 October in any given year will result in bird breeding without detectable predation by rats; Possum %RTC of <2% will allow native mistletoe to flower and fruit; Possum %RTC of <5% will allow rata to flower).

'Eradication' - pest eradication occurs when all individuals of a pest species are permanently removed from a management site and the risk of reinvasion is very low to zero. Islands are usually the only place this can currently be achieved due to reinvasion issues on the mainland.

'Forum' - Kaimai Mamaku Catchments Forum.

'MOH' - the local 'Medical Officer of Health' of the local District Health Board, who approves Pest Animal Management programmes using controlled pesticides, subject to conditions.

'PF2050' - Predator Free 2050 Limited is an independent Crown owned company that has been established to help achieve the Government's ambitious goal to rid New Zealand of possums, rats and stoats by 2050.

'Project' - Project 1 of the Kaimai Mamaku Operational Plan 2017 relates to the development of a 'Pest Animal Management Plan' for the Kaimai Mamaku Ranges.

'Remote Sensing' - Remote sensing utilises the cellphone network to notify pest managers when pests have been detected or caught at a device site. This can hugely increase efficiency of detection/pest management networks. The technology is still developing but is an area of considerable opportunity.

'RTCI' - Residual Trap Catch Index of possums as measured by standardised industry method developed by the National Possum Control Agencies (NPCA), involving varying numbers of randomly located 10 trap lines of Victor No.1 leg hold traps, spaced 20m apart (the number of lines depends on the size of the area to be assessed) set to a specified protocol. Traps are opened for three fine nights and checked daily, after which catches are used to determine an index of possum population. The method is specifically used to index possum abundance.

'RTI' - Rodent Tracking Index as measured by a standardised method developed by DOC, involving random lines of 10 tracking tunnels baited with peanut butter, spaced 50m apart (the number of lines depends on the size of the area to be assessed). Tunnels are active for three nights, after which inked cards are retrieved to determine which pest species have interacted with the tunnels by leaving pest specific footprints. This method can be used to index rodent and other smaller animal (stoat, hedgehog) abundance.

'Site-led Management' is term used to describe an environmental management approach where weed and pest management is focused on protecting very high value sites from a full range of threats - not just one or two damaging species (eg., possums or 'Old-man's beard').

'Thermal Imaging' - Thermal imaging detects the heat signature of specific animals allowing their detection/location, even in dense habitat. Current technology is best used at night or early morning when the differential between the ambient temperature of the environment and the heat signature of the animal is highest.

'zero pest densities' is a term used in pest animal management where pest densities are managed at localised sites to (or very near to) zero, but where reinvasion requires ongoing localised efforts to continually remove pests that move back into the treatment area.

Appendix 1: Maps

- Total Area of Interest to the Kaimai Mamaku Catchments Forum
- Land Use
- Current & Proposed Management Areas
- Public Water Supply Catchment Areas

Appendix 2: Criteria for Selecting PF2050 Projects

PF2050 has developed the criteria listed below to evaluate Expressions of Interest.

PF2050, through an Expression of Interest process, wishes to identify regional/local councils, communities, mana whenua, businesses, Non-Government Organisations and/or other entities who have predator eradication initiatives either underway or contemplated, which can contribute toward meeting its interim (2025) goals identified.

The initial focus will be on identifying 'investable' exemplar projects that can be contracted and commenced in early 2018. While emphasis will be given to initiating large scale projects on the mainland, proposals for larger offshore islands which offer transformational biodiversity gains, the opportunity to trial new approaches to predator eradication and/or working with land owners and communities will also be considered.

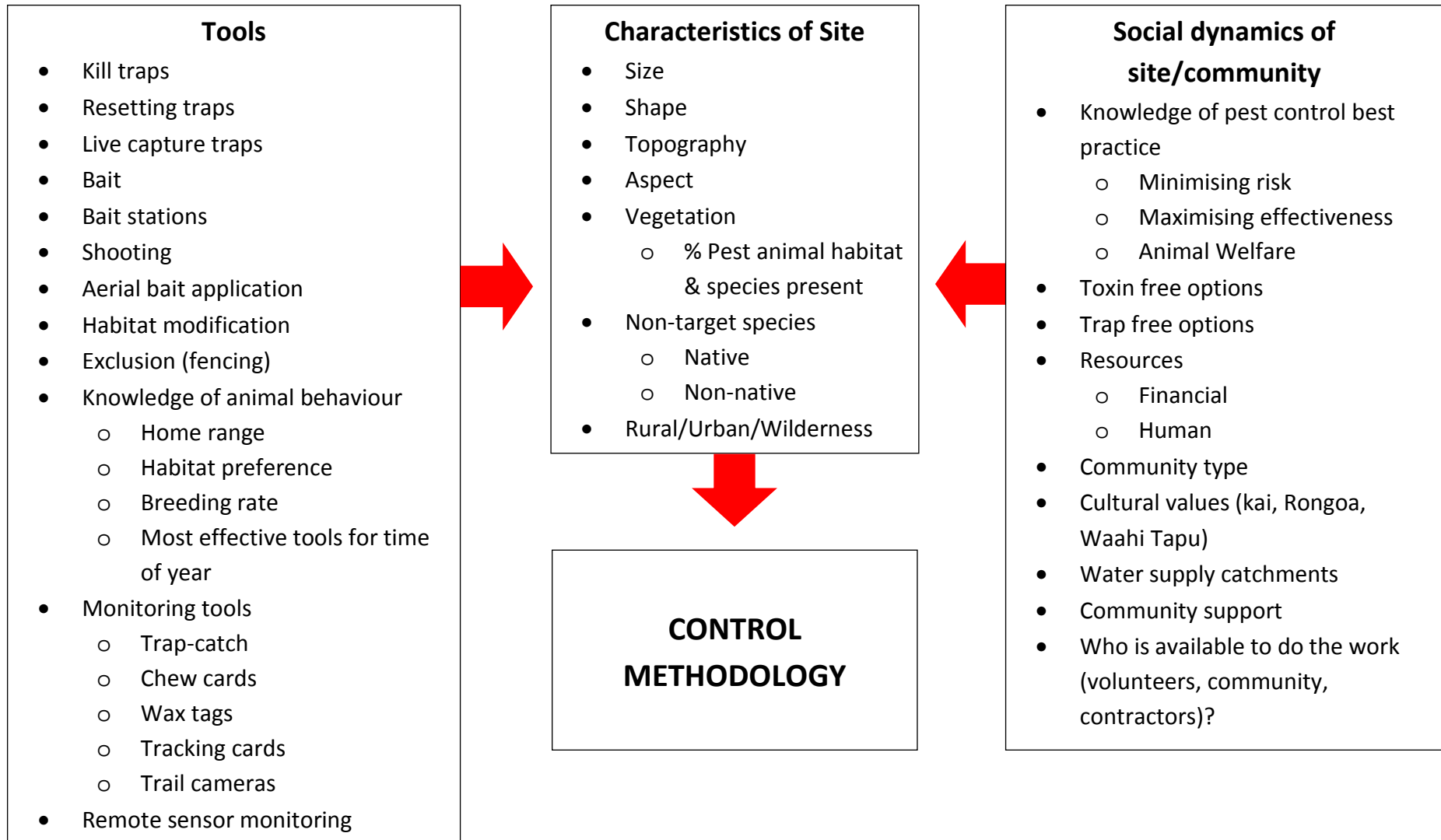
The criteria are:

1. **Scale and geophysical attributes** – the project should be ambitious in scale and seen to be so. While some projects might commence at several thousand hectares, the proposal should indicate why the project exemplifies an approach or behaviour that can be quickly extended or replicated at a larger scale if successful. Geophysical attributes will include “defendability” of the area once predators are suppressed or eliminated. As noted above, proposals for large offshore islands will be considered.
2. **Biodiversity gain** – the project should contribute to substantial biodiversity gains across the land area under consideration. The protection and/or establishment of habitat that will enhance outcomes for New Zealand’s priority endangered species should be identified.
3. **Alignment with PF2050 mission and interim goals** – the proposal should clearly demonstrate alignment to and how it will assist achievement of PF2050 interim (2025) goals.
4. **Timing and measurability of gains** – the proposal should offer credible evidence of the timeframe in which the goals are to be delivered. Specific intermediate milestones that the proponents believe will provide compelling evidence of progress on the plan, and against which they are willing to be measured, should be specified.
5. **Land owner support and participation** – projects should show evidence of collaboration between all relevant landowners and interested parties, i.e. adjoining landowners, Māori, DOC, Local Councils etc. that will ensure multiple land owner support across the target landscape.
6. **Māori partnerships** – where a Māori entity is not the project lead and where applicable, relevant Māori Hapū or Iwi should be involved in the formation of the project and be collaboratively engaged in the ongoing delivery. PF 2050, where

applicable, are seeking projects that have or are proposing to have a strong emphasis on Māori collaboration and partnerships.

7. **Management (expertise and capacity)** – the project management team should have proven experience and capacity given the scale and complexity of the proposal and demonstrate that they have access to the technical resources required to deliver the project.
8. **Funding and level of co-investment** – the proposal should provide sufficient evidence of the sources of funding, proposed or existing, for at least the potential for 2:1 matching funding from parties who are shown to be compatible, have the capacity and are willing to commit cash and other resources to achieving the project goals.
9. **Community support** – the proposal should clearly articulate the degree of local community support for the project and how they will be engaged and their opinions heard in the design and implementation of the plan.
10. **Health & Safety** – the proposal should be able to demonstrate that the participants are aware of their responsibilities under the Health and Safety at Work Act 2015, that the project is committed to ensuring the health and safety of its workers and others affected by the work it carries out.
11. **Alignment with Science Strategy and Research** – opportunities for the proposal to contribute to the advancement of scientific research in the predator free area such as by field trialling and evaluating the effectiveness of a novel technology or combinations of technologies and management systems should be specified.
12. **Sustainability of gains** – the proposal should address the need to secure predator free status for the proposed project area including the basis on which investors can have confidence that future landowners of properties within the project area can be required to maintain the predator free status of that land.
13. **Exit Strategy** – the proposal should address how the project goals and predator free status can be sustained post PF2050 investment.

Appendix 3: Factors influencing the Selection of Pest Control Methods



Appendix 4: Training Example (WINTECH)