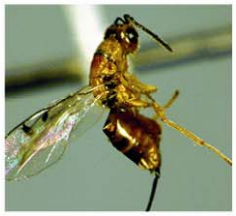
Envirolink Report 912-HBRC138

Wide-scale predator control



Landcare Research
Manaaki Whenua

Envirolink Report 912-HBRC138 Wide-scale predator control

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Project and Client

This report completes requirements of Envirolink Grant 912 – HBRC0138 Wide-Scale Predator Control and was developed following meetings and discussions with Hawke's Bay Regional Council (HBRC), the Department of Conservation (DOC) and the Environment, Conservation and Outdoor Education Trust (ECOED).

Objectives

This Envirolink project proposes to develop a control regime that substantially reduces the costs normally expected for a fragmented landscape predator control programme.. This will be supported by:

- Identifying critical habitat or regionally important sites (DOC/HBRC)
- Identifying and prioritising native species that will benefit from predator control and assessment of threat level and spatial extent. This will assist with prioritisation, where and how to allocate resources
- Identifying and assessing current and future effective predator control options and management regimes that will provide deliverable outcomes

Results

- The DOC Wellington – Hawke's Bay Conservancy has recently conducted an inventory prioritisation process that has identified and ranked areas of biodiversity value (Hawke's Bay Conservation Action Plan, DOCDM-479758). Five high priority sites were identified within the conservancy one of which is the Tutira–Mangaharuru area, which includes Boundary Stream Mainland Island (BSMI).
- The main threats to biodiversity and vulnerable species in the Maungaharuru Trial Zone were identified. Regionally important iconic species include kākā, kiwi, robin, kākāriki and kererū, as well as clematis, mistletoe and herbal remedy plants. There are plans to reintroduce sea birds and kōkako.The main threat to the birds is most likely predation by ferrets, cats, dogs, stoats and rats. Young kiwi can be taken by stoats and cats, but adults remain threatened by dogs and ferrets.
- Predator control is most effectively done with traps and toxins, and a combination of both will likely be most efficient in the fragmented landscape of Hawke's Bay. DOC currently undertakes pest control within BSMI and the surrounding areas. If successful this project will maximise the benefits of this effort by filling in the 'pest control' gaps within the larger project area. The most effective trap and toxin types will vary in accordance with the spatial distribution of the pest species. Rats and stoats are more likely using forested areas while cats and ferrets are more likely to be using the wider landscape.
- The unintentional consequences of implementing a predator control programme have been discussed. The removal of rats may result in an increase in mice and this should be

monitored. Currently the impacts of mice on native biodiversity are unknown. There is no evidence to suggest that removing predators will lead to an increase in rabbits.

- A provisional project area has been identified and landowners approached. Experimental treatments have been assigned to different areas (farms) in the Maungaharuru Project Area based on current pest control practices, and what has been discussed and agreed to for the future with respect to predator control. Experts are satisfied that the treatment areas are large enough for predator removal experiments to deliver results.
- Landcare Research is committed to implementing a biodiversity monitoring plan as part of its Invasive Mammal Impacts programme.

Conclusions

- There is wide-scale enthusiasm and financial support for this project from DOC, HBRC, ECOED, Robertson Trust and Landcare Research that should ensure its success.
- Success of the predator removal will depend in part on an experienced predator trapper assisting in the initial placement of traps/bait stations and on the financial commitment to ongoing control practices.

Recommendations

- Project Area boundaries need to be finalised before the exact number and combination of bait stations and traps can be determined. This will be further influenced by the budget for traps and labour, etc.
- The amount of work undertaken by 'contractors' or project staff needs to be discussed with respect to the initial requirements of project of set-up versus the long-term requirements to assist community groups in undertaking this work.
- The predator trapping regime will be in place by summer 2011/2012. Acquiring and/or making of trap devices and tunnels needs to be actioned if predator removal is to begin in November 2011. The exact numbers of trap types will depend on the final project area but would be in the vicinity of:
    - Leghold traps: 100, and PAPP in tunnels: 100, for initial predator removal
    - DOC200 (rats/stoats): 300, DOC250 (ferrets/stoats): 100, Cat traps: 100, for ongoing predator control. With use of self-setting traps, leghold with remote communication devices, and toxins as appropriate.
- A pest and biodiversity monitoring scheme is to be designed by W. Ruscoe and A. Glen (Invasive Mammal Impacts Programme, Landcare Research) as soon as the project boundaries are finalised and this report accepted.

1 Introduction

This report completes requirements of Envirolink Grant 912 – HBRC0138 Wide-Scale Predator Control and was developed following meetings and discussions with Hawke's Bay Regional Council (HBRC), the Department of Conservation (DOC) and the Environment, Conservation and Outdoor Education Trust (ECOED).

2 Background

Introduced mammalian pests are the most significant threat to indigenous biodiversity on mainland New Zealand. In highly fragmented landscapes native species are further threatened by habitat modification and loss of resources. The impacts of pests may be direct (e.g. predation or herbivory) or indirect (e.g. high rabbit populations sustain large populations of ferrets, which are significant predators of threatened kiwi). Control of animal pests across a large landscape may have the benefit of providing 'buffer zones' thereby reducing reinvasion into core protected areas, significantly improving the outcomes for threatened species and native habitat. Landscape-scale pest control may result in increased security for current threatened species in the core zone and facilitate the dispersal of native species between core zones and into the broader landscape.

Hawke's Bay Regional Council has completed a Wide scale top predator control feasibility forum (November 2009). This was an in-depth discussion on the feasibility of conducting wide scale operations within Hawke's Bay; where they could happen, how they could happen, who may be involved and what sort of measurable outcomes could be obtained. The result was positive, with 16 people from different groups and agencies expressing a keenness to work together and an eagerness to progress the concept further. The HBRC feels that any future work in this area has to be strongly supported by local communities.

In mid-2010 HBRC and Landcare Research were successful in obtaining a second Envirolink grant to progress the Widscale Predator Control thinking including outlining the potential tools and techologies available for effective and relatively cheap pest control that could be undertaken by the local community. This report outlines results of this thinking and was to develop a management plan. HBRC has aligned funding to begin this predator control work.

In November 2010, a business case from the Department of Conservation was accepted by the Roberstson Foundation to fund a major wildlife restoration and community enhancement programme in the Maungaharuru region. The funding and vision of this project correlated well with what was planned by HBRC and Landcare Research. As such, the project initiated by HBRC has now become part of a larger programme. Ken Hunt (DOC) has been appointed the Project Manager for the wider project. A steering committee has been appointed that will balance the objectives of the Widescale Predator Control with the wider Robertson Foundation funded project.

3 Objectives

This Envirolink project proposes to develop a control regime that substantially reduces the costs normally expected for a fragmented landscape predator control programme.. This will be supported by:

- Identifying critical habitat or regionally important sites (DOC/HBRC)
- Identifying and prioritising native species that will benefit from predator control and assessment of threat level and spatial extent. This will assist with prioritisation, where and how to allocate resources
- Identifying and assessing current and future effective predator control options and management regimes that will provide deliverable outcomes

The feasibility of the project was advanced by the successful funding proposal to the Robertson Trust.

4 Results

4.1 Identifying critical habitat or regionally important sites

The DOC Wellington – Hawke's Bay Conservancy has recently conducted an inventory prioritisation process that has identified and ranked areas of biodiversity value (Hawke's Bay Conservation Action Plan, DOCDM-479758). Five high priority sites were identified within the conservancy including the Tutira–Mangaharuru area with includes Boundary Stream Mainland Island (BSMI).

Figure 1 Map of the Hawkes Bay region showing the Tutira/Mangaharuru area (box).

This area also has a strong community group (The Tutira–Maungaharuru Visionary Group (TMVG)) which co-ordinates positive environmental activities for long-term biodiversity gains (e.g. reintroducing blue duck into the Waiau River, having kiwi prevalent in the greater Tutira landscape).

Another area suggested by DOC is the front country of the Kaweka Ranges. This area has significant biodiversity values that are at risk and recreational opportunities that are under-utilised. The area also has a very proactive farming community that is doing a large amount of habitat restoration and biodiversity protection work that would benefit hugely from a collective wide-scale approach.

4.2 Identifying and prioritising native species that will benefit from predator control and assessment of threat level and spatial extent

The main threats to biodiversity and vulnerable species in the Maungaharuru–Tutira zone were identified. Regionally important iconic species include kākā (*Nestor meridionalis*), kiwi (*Apteryx* spp.), robin (*Petroica australis*), kākāriki (*Cyanoramphus auriceps*) and kererū (*Hemiphaga novaeseelandiae*), as well as clematis (*Clematis paniculata*), mistletoe (*Peraxilla* sp.?) and herbal remedy plants. There are plans to reintroduce sea birds, kaka and kākāriki.

The main threat to the birds is most likely predation by ferrets, cats, dogs, stoats and rats. Young kiwi can be taken by stoats and cats, but adults remain threatened by dogs and ferrets. Where predators are controlled, kiwi hatchling survival can be as high as 90%. Predators are a threat to kiwi both in forest and in pasture. Barlow and Norbury (2001) suggested that 50% of a ferret population had to be removed each year to effect a 50% reduction in the long term average population density. Without this level of removal, the increased survival of juvenile ferrets would negate the effectivess of control (Byrom, 2002).

Hole-nesting birds (kaka, kakariki) are susceptible to arboreal predators: cats, stoats and rats. Work in Rotoiti Mainland Island in Nelson Lakes National Park showed that predator control (mainly stoats – 1 Fenn trap per 3-5ha) could increase nest success from 0.2 – 57% and increase the survival of the nesting females. Kakariki are known to feed on the ground making them addtionally threatened by ferrets.

Kōkako survival in other areas has benefited from possum and rat control (Innes et al. 1999). Kererū adults are susceptible to stoats and cats, but their eggs are additionally targeted by rats and possums, leading to nest failure. These birds are more susceptible to predation in forested areas. Clematis, mistletoe and herbal remedy plants are damaged by grazing/browsing animals rather than predators and hence are outside the scope of this project.

The spatial extent of predator control required is governed by both the home range of the birds and the range/foraging distances of predators.

Home ranges:

- Stoats: 40–150 ha
- Ferrets: 20–300 ha. Dispersal distances up to 45 km (mean 6 km)

- Cats: 91–250 ha

These invasive animals are also associated with predation on native invertebrates and lizards, which means other easily monitored non-avian indicator species could be considered.

4.3 Identifying and assessing both current and future effective predator control options and management regimes that will provide deliverable outcomes

The 'project area' is approximately 8000 ha (around 25% of which is forested land managed by DOC and has a large existing network of predator control traps). The remaining area is pasture and scrubland privately owned and managed. Hawke's Bay Regional Council directs pest control activities for the control of bovine Tb. Some rabbit control is done on farmland.

Predator control is most effectively done with traps and toxins, and a combination of both is likely to be the most efficient in the fragmented landscape of Hawke's Bay. DOC currently undertakes pest control within BSMI and the surrounding areas, providing a buffer. If successful this project will maximise the benefits of this effort by filling in the 'pest control' gaps within the larger project area. The most effective trap and toxin types will vary in accordance with the spatial distribution of the pest species. Rats and stoats are more likely using forested areas while cats and ferrets are more likely to be using the wider landscape.

The Animal Health Board also has an interest in the area with bait stations set up with brodifacoum (and Feracol and pindone) for Tb-related possum control. In addition, aerially applied 1080 is scheduled for application in autumn 2011 in the surrounding area.

DOC runs traps for predator control both inside BSMI and outside in the 'buffer zone'. Table 1 illustrates the trapping regimes used.

Table 1 Boundary Stream Mainland Island (BSMI) predator control carried out by the Department of Conservation

BSMI trap-line inventory						
Trap-line location	Code	Trap type	Trap boxes	Traps	Trap sets	Bait type
Internal lines						
Beech Ridge	BR	DOC200	36	72	Double Sets	Egg / Meat
Section Four Walkway	SWW	DOC200	20	40	Double Sets	Egg / Meat
Main Walkway	WW	DOC200	51	102	Double Sets	Egg / Meat
Shine Falls	SF	DOC200	12	24	Double Sets	Egg / Meat
Goat Hill	GH	DOC200	19	38	Double Sets	Egg / Meat
Tumanako Loop Track	TK	DOC200	20	40	Double Sets	Egg / Meat
Te Tatimana / Podocarps	TP	DOC200	29	58	Double Sets	Egg / Meat
Wallow / Cecillies	WC	DOC200	25	50	Double Sets	Egg / Meat
Kiwi	KI	DOC200	26	52	Double Sets	Egg / Meat
Stream Sets Sites	SS	DOC200	10	20	Double Sets	Egg / Meat
Internal line total			**248**	**496**		
Perimeter lines						
Kakabeak perimeter	KP	DOC250	22	22	Single Sets	Egg / Meat
Reserve perimeter	PR	DOC250	208	208	Single Sets	Egg / Meat
Perimeter line total			**230**	**230**		
Buffer lines						
Thomas Bush	TB	DOC250	56	56	Single Sets	Egg / Meat
Woodstock	WS	DOC250	20	20	Single Sets	Egg / Meat
Opouahi	OP	DOC250	20	20	Single Sets	Egg / Meat
Road	RD	DOC250	38	38	Single Sets	Egg / Meat
Tui	TU	DOC250	4	4	Single Sets	Egg / Meat
Rangi Pines	RG	DOC250	33	33	Single Sets	Egg / Meat
Bush Track	BT	DOC250	13	13	Single Sets	Egg / Meat
Naumai Paddock	NP	DOC250	14	14	Single Sets	Egg / Meat
Buffer line total			**198**	**198**		
Cat traps		Belisle	60		Single set	Meat

Estimation of costs:

Mustelid traps – take 50 hours per run = 6.25 days

6 months at fortnightly intervals (October–April) = 6 x 13 = 78 days

6 months at once per month = 6 x 6.25 = 38 days

Provision and preparation of baits (rabbit) = 80 hours

Processing carcasses = 1 day (sexing, aging, etc. of any relatively intact animals caught)

4.3.1 Physical control

Trapping is a widely used method to control mustelids (ferrets and stoats) and cats. Intensive trapping is effective but may be rapidly countered by reinvasion from surrounding areas (Bodey et al. 2011). Trap configuration and spacing varies with the species being protected. Trapping densities typically have been one trap to 10 ha for mustelids, but this can vary according to the terrain. For example, traps could be spaced at a lower density (one per 15–20 ha) in areas dominated by grassland, or at higher densities (one per 3 ha) in areas with continuous forest or a mosaic habitat where there are many contours that mustelids could be active along. For an area of 8200 ha, this equates to at least 410 traps. Trapping from January to April or May is optimal timing for ferrets (Norbury & Efford, unpubl. report).

Trapping sites are best situated in areas most often used by the predators, i.e.

- Stream edges
- Bushland edge
- Fencelines
- Animal runs
- Crossings over watercourses
- Fallen trees
- Along tracks/roads.

The best sites for stoats and rats are where there are converging features like a stream crossing a track at the edge of bush. A change in features is also a good site, e.g. pasture–bush interface. Select sites beneath a tree/shrub canopy cover where possible. Locating natal stoat dens using trained dogs and removing female stoats and young inside (by pellet use and sealing of holes) is a potentially effective control method that may reduce the summer influx of young stoats into an ecosystem.

Although not considered a top predator, various traps will also kill rats. Rat home ranges are generally reported by length. Ship rats (*Rattus rattus*) have an average range length of 100–200 m during the breeding season. Non-breeding ship rats have larger home ranges. Norway rat (*R. norvegicus*) home ranges are 218–916 m in length. At high rat densities, trap or bait station spacing may have to be reduced further to maximise control. Rats prefer areas with water and good food sources. In fragmented landscapes, rat control would be best targeted to habitat features known to be used by rats or that contain threatened species, i.e.

- A particularly heavily fruiting tree that attracts rats
- Stream borders
- Dense vegetation fragments
- Near observed nesting or breeding behaviour in a species you are trying to protect.

Traps available include:

1. Kill traps (do not require daily visits):
    - Snap traps for rats ($7 each + cover)
    - DOC150 and DOC200 for rats and stoats ($30 per trap + double box $20 each) (300 = $24,000)
    - DOC250 for ferrets ($40 per trap + single box $26) (100 = $6,600)
    - Timms traps for cats ($46 per trap) (100 = $4,600)
    - Belisle cat traps (100 = $1,700 + $60 per chimney box) (100 = $,7700)
    - Henry v9.03 self-setting trap for stoats and rats ($160 each) (200 = $32,000)
    - Henry P2.01 for possums (in development)
2. Live traps (require daily visits)
    - Victor leghold traps for possums and cats ($20 each)

Baits for traps are often based on the food source that is available to the target animal. This can be the prey item of highest abundance within an area and can vary from season to season, e.g. rabbit, possum or mouse (Hamilton 2004). Other food items such as eggs (Dilks et al. 1996; Dilks & Lawrence 2000) and commercially mixed baits, fish paste, and pet food have been used in New Zealand. In many cases the choice of type of bait is more for ease of operation and the long-life properties of the bait than for its attractant capabilities (Hamilton 2004).

The development of self-setting traps for predators is continuing. The Henry v9.03 is produced by Goodnature and is currently being tested by DOC. There may be scope to further field-test this product within the project.

4.3.2 Chemical control

Toxins are widely used for vertebrate pest control. Some toxins are relatively species-specific, others environmentally benign (1080), while some can result in secondary poisoning and environmental persistence (brodifacoum). Some toxins can be used by the general public, others by licence holders only, which limits their use within community–volunteer programmes. We list some toxins that may be useful in the Hawke's Bay area for this project.

Cholecalciferol

- 0.8% Feracol paste bait has been used successfully to kill rats and possums.
- FeraCol for Stoats is also available.

Diphacinone

- Ratabate (0.05 g/kg) or PestOff 50D use the first-generation anticoagulant diphacinone for rats. Diphacinone breaks down quickly in the food chain and is far less persistent than brodificoum. First-generation anticoagulants are a multiple-feed toxin. Rats must feed on the poison for at least 5 days and bait stations must not be allowed to become empty during this period to ensure rats ingest sufficient poison to kill them. Overseas, rodents have become resistant to first-generation anticoagulants after poor baiting strategies. Cereal pellets were shown to be more palatable than bait blocks to rats in BSMI
- Pestoff Ferret paste – Diphacinone (0.3 g/kg) used in tunnels at 100 g per application.
- Bait stations can be made of draincoil or PVC pipe (40-mm diam.). These inexpensive bait stations allow rats easy access but limit access by non-targets (e.g. dogs, kiwi), and protect bait from the elements. At least 500-mm lengths of draincoil are used and they are pegged to the ground to prevent disturbance.

New toxin: PAPP

A new poison, para-aminopropiophenone (PAPP), has just been granted registration in New Zealand. This offers an alternative toxin for ground control of stoats and potentially cats. There are restrictions on its use and a requirement for a user licence. Table 2 gives an indication of the likely costs of the toxin; additional costs will include bait matrix (meat), and bait stations (DOC200, wooden submarine and stoat tunnels).

Table 2 Likely cost of para-aminopropiophenone **(**PAPP) for stoat or cat control (in NZ$)

	PAPP Pack Sizes in gms	Dosage gms	Selling Price per Pack	Selling Price per Gm	# of Doses per Pack Size	Cost per Dose
STOATS		0.04				
Syringe	3		39.31	13.10	75	0.52
Smal pottles	9		117.94	13.10	225	0.52
CATS		0.20				
Syringe	3		39.31	13.10	15	2.62
Smal pottles	9		117.94	13.10	45	2.62
Screw on container	100		1,310.40	13.10	500	2.62

PAPP is a farmer-friendly alternative to 1080 and brodifacoum as although it is toxic to dogs, an antidote (BlueHealer[@]) is available. Although 26 mg/kg and upwards was lethal to dogs, a 20-kg dog would have to eat at least 520 mg to succumb. Cats require 20 mg/kg (large male cat may weigh 3 kg = 60 mg per bait) and stoats 37 mg/kg (male stoat 300 g = 12 mg bait) so dogs would have to eat multiple cat baits to receive a lethal dose (Murphy et al. 2007). Using the current formulations (Table 2), a dog would have to eat 2.5 cat baits (or 13 stoat baits) in fast succession to receive a fatal dose.

Notification must be given to all landholders within a 3-km buffer area from the baited area prior to application: between 2 months and 24 hours' prior notice is required. There may be scope to further field-test this product within the project.

4.3.3 Unintentional outcomes of predator control

Where there is effective rat control, one potential ripple effect is for mice to increase in numbers, so consideration of impacts, monitoring and management are needed. Cost-effective control methods for mice are currently unavailable and the biodiversity impacts of mouse population increases have not been researched.

There is some concern within the farming community that lagomorph (rabbits and hares) numbers may increase following ferret control. Recent research by Grant Norbury (Landcare Research, Alexandra) has shown that ferret numbers are influenced by rabbit availability, but that the reverse is not true. Predation, in combination with other factors such as rabbit haemorrhagic disease, may limit recovery of rabbit populations from low levels (Trout & Tittensor 1989; Reddiex et al. 2002). Studies in Australia have shown rabbit populations to recover more quickly from low densiites when predators (foxes and cats or foxes alone) are controlled (Pech et al. 1992) but predators fail to keep rabbits at permanently low numbers. No published studies have provided convincing evidence that New Zealand rabbit populations are regulated by predation alone.

Although rabbits and hares have the potential to impact on sensitive plants such as orchids and dune plants, we would not expect to see an increase in numbers. However, this should be monitored as a demonstration of the lack of top-down regulation (See Project Plan below) and will help allay concerns by landowners in other areas where wide-scale predator control maybe considered.

4.4 Developing a project management plan

4.4.1 Area

Maungaharuru Trial Zone has been selected in the first instance (Figure 2). This area incorporates BSMI and other forested conservation land within a larger pastoral landscape. It is bordered by the Maungaharuru Range on the north-west boundary, Pan Pac pine plantation on the north-east boundary, and Matahorua Rd on the south-east boundary, and lies between 400 and 800 m a.s.l. Currently the borders of the project area are based on farm boundaries and topography. Rivers that prevent the spread of pests offer alternative borders that would help reduce reinvasion of the area.

Stakeholders in this landscape:

- Hawke's Bay Regional Council
- Department of Conservation
- Community groups (MTVG, ECOED, and Guthrie Smith Trust)
- Landholders

- Iwi (Maungaharuru Tangitu, Ngāti Pahauwera, Ngāti Hineuru)

The project area currently encompasses several farms but importantly includes Opouahi, Rangiora and Te Rangi stations. Opouahi Station, while allowing shooting, does not effectively control rabbits, and rabbit populations have been monitored as part of the HBRC Annual Rabbit Night Counts since 1996. Rangiora Station currently manages rabbits with HBRC assistance and presumably the rabbit population in the area is low. Rabbit control costs approximately $80 per hectare of which the HBRC subsidises half. HBRC has plans to include another monitoring line in this area as part of HBRC Annual Rabbit Night Count programme as of 2011. Owners of these holdings have expressed an interest in the wide-scale predator control (WSPC) project and would be amenable to predator control being undertaken on the properties. Te Rangi Station, north of Boundary Stream, may be useful as an experimental control where predators are not removed but are monitored as on the other stations. As such, we have three treatment areas:

- Te Rangi (~1000 ha): Experimental Control
- Rangiora (900 ha): Predator + Rabbit Removal
- Opouahi: Predator Removal.

This provides an (unreplicated) opportunity to test whether doing both predator and rabbit control imparts additional benefit to biodiversity.

Boundary Stream Mainland Island and other DOC-managed forest fragments account for another 1000 ha and a number of pest animals are intensively controlled. The Animal Health Board (AHB) coordinates ground baiting for possums in this area (see Figure 3) and an aerial 1080 control operation is planned on the north-west boundray of the project area. The Department of Conservation also contracts goat shooters in the region. There are also pigs and deer present in Hawke's Bay. They are not considered in this project feasibility assessment but we acknowledge their presence in the ecosystem we plan to manipulate.

A scientifically interesting addition would be a Rabbit-only Removal treatment. Evidence suggests that removing rabbits should induce the top predators to disperse away from the area in search of food and may provide another method of reducing predation in a region. It is acknowledged that is outside the scope of this project.

4.4.2 Current Tb control work within the project area

Currently AHB has bait stations (approximately one per 4 ha) positioned throughout the farmland (Opouahi GS1 & 2, Figure 3) within the project area. While these bait stations currently target possums, there may be potential to utilise them for predator baits. They will be first used in autumn–winter 2011 and be serviced by Colin Pierre (and/or contractors). Each bait station will be a Philproof or Sentry baited with brodifacoum (Pestoff), cholecalciferol, or Pindone (300 g), and placed on trees at 30 cm, or above 2 m where livestock have access. These bait stations (property of AHB) may be available for WSPC use when not being used for possums, and could be effective for rat and stoat baiting programmes.

Sodium fluoroacetate (1080) is a multispecies toxin delivered aerially or in bait stations in a carrot or grain-based bait, or a paste. An AHB aerial-1080 operation is scheduled to occur in

autumn 2011 by EPRO, north-west of the project area (Figure 4). Waitara Valley, surrounding Woodstock Station). This should reduce possum, rat, and perhaps predator numbers in the area, reducing invasion rates to the adjacent part of the project area.

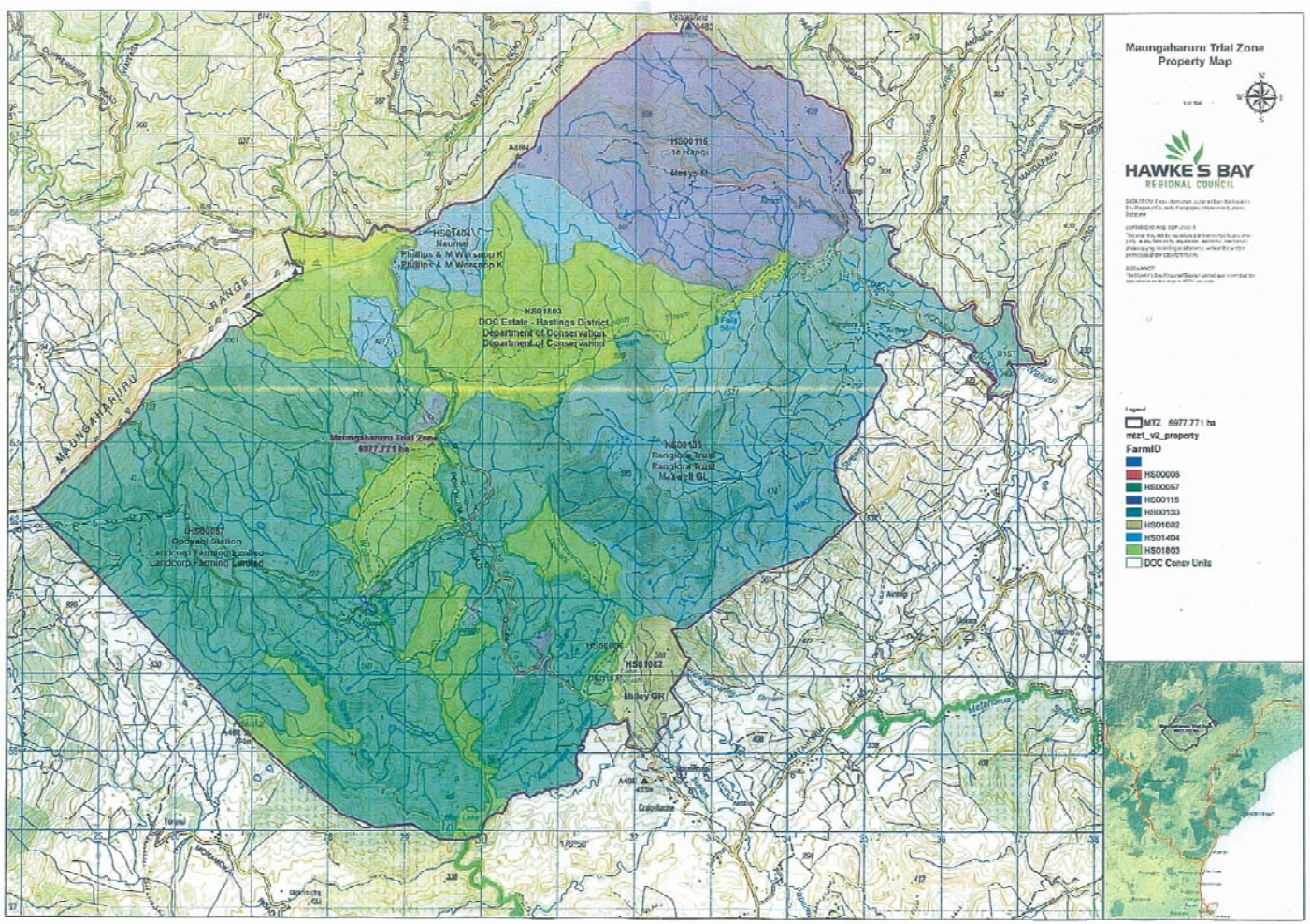

Figure 2 Maungaharuru Trial Zone, incorporating Boundary Stream Mainland Island ; proposed project plan area.

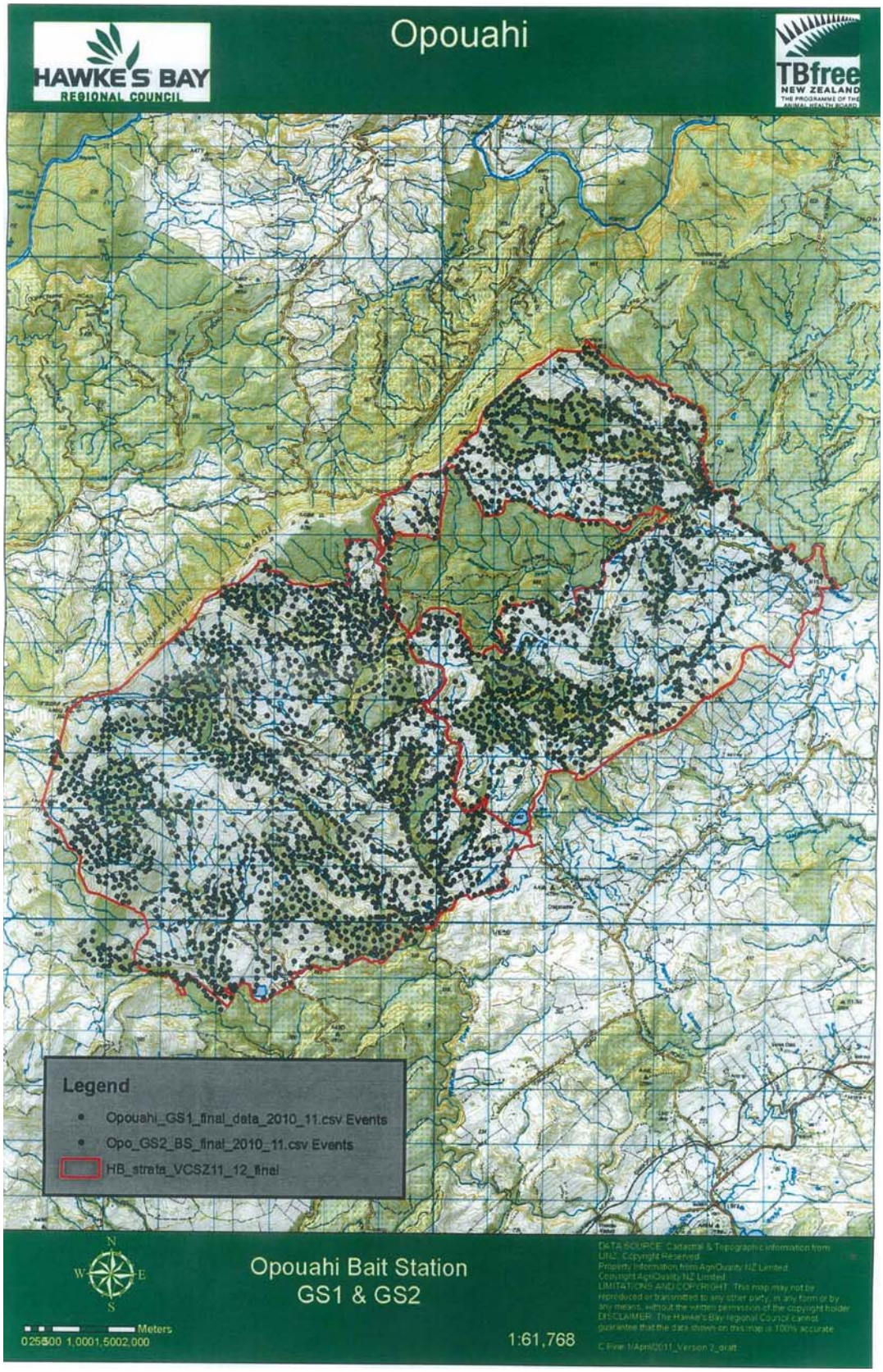

Figure 3 Animal Health Board bait stations on Opouahi farmland in the proposed project plan area (Maungaharuru Trial Zone).

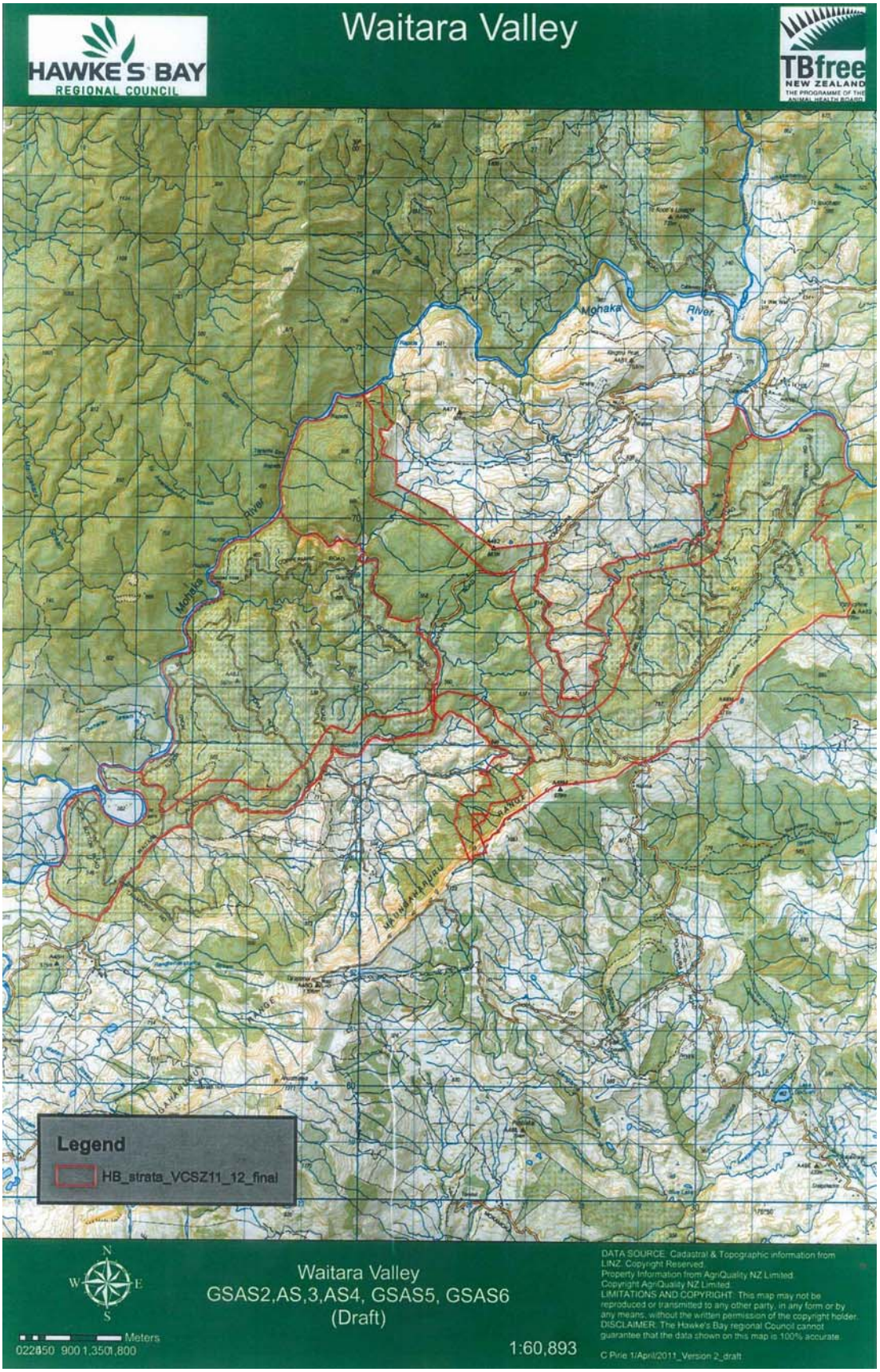

Figure 4 Waitara Valley area planned for aerial-1080 control in autumn 2011 (adjacent to project area).

4.4.3 Measurable outcomes – What indicators?

An indicator is something that you can measure to help answer your monitoring questions. There may be several indicators that could be used to answer a monitoring question. Examples of indicators include:

- Pest trap-catch
- Pest abundance by other monitoring devices
- Bird abundance
- Bird distribution
- Abundance of terrestrial invertebrates
- Seedfall

Indicator species:

- *are relevant to your monitoring questions:* Make sure measuring the indicator will help you answer your monitoring questions.
- *are likely to show change within a useful time frame:* Does the indicator respond in the short term or longer term? Make sure the time frame fits with your project.
- *are able to be measured in a way suited to the skill level of the group undertaking the work and that provides sufficient measurement precision:* An indicator that is difficult to measure precisely should not be used to examine small changes.

As part of the Landcare Research Invasive Mammal Impacts Programme, Drs Roger Pech (Landcare Research) and Clare Veltman (R&D, DOC) have been researching 'threat-defined functional groups' as a means of categorising species. The categories: Bystanders, Compensators, Diminishers, Recolonisers and Beneficiaries describe the response we would a priori expect to see in various taxa. We assign taxa to each group based on previous research results and expert opinion and monitor the impacts of the predator control.

Biodiversity monitoring is currently undertaken in BSMI by DOC. This monitoring has been undertaken for 10 years and therefore provides baseline data with which future comparisons can be made. Monitoring includes:

- Invertebrate pitfall trapping annually (9 lines each with 5 clusters of 4 pitfalls – put out in Dec. and collected 30 days later)
- Weta motel monitoring – lines etc. as above – animals are extracted, sexed, identified and measured
- Vegetation plots – 29 plots including exclosures – initially remeasured 5-yearly – last done 2009
- Mistletoe monitoring – *Alepsis flavida* mostly done every other year. Method has changed recently as they were counting individual plants but that has become impossible as too hard to see where one ends and the other begins now

- 5-minute bird counts (5MBC) done both here and in two 'control' sites annually in autumn (were done both spring and autumn but with increasing numbers of everything and all requiring monitoring, got too hard to keep up)
- Kererū distance sampling annually – same time as 5MBC
- Lizard – artificial covers used in BSMI and two control sites
- Kiwi call counts (BSMI Only) (total of 24 counts done at 6 sites annually for 3 years – last year being the final one in that run – planning next one in 4 years)
- Kiwi chick survival – we have about 10 years' data on that – had just stopped using this method and putting our chicks into crèche at Opouahi but could reinstate if needed
- Kōkako monitoring in spring.

Pest animal monitoring:

- Mustelid tracking – both were done quarterly until 2008 and then changed to 4× over summer
- Rat tracking – quarterly. For successful kōkako population recovery, a tracking tunnel index of less than 5% is suggested (Innes et al. 1999)
- Possums – initially using residual trap-catch (RTC) but have used wax tags for past 4 years. Innes et al. (1999) recommend reducing populations to <1% RTC for successful kōkako population recovery.

Monitoring that would be most informative would be the bird surveys done over a wider area – to see if the wide-scale predator control encourages bird movement into, and survival within, the fragmented landscape. Graham Elliot has offered us the use of DOC bird sound recorders to determine if they would be effective for monitoring birds in the fragmented landscape. Invertebrate and lizard monitoring could be added in small patches of remnant vegetation or along 'corridors' throughout the project area. Landcare Research would be involved in this work as part of the Invasive Mammal Impacts programme.

Monitoring of the targeted pest animals will show whether the control techniques were adequate in reducing the pest populations (relative to the non-controlled area), and identify if 'patches' of pest animals persist requiring additional control. Tracking tunnels are useful for monitoring presence of rats and stoats and sometimes but not always useful to monitor cat and ferret populations. Other devices such as the newly developed 'Chew Track Cards' (Sweetapple & Nugent 2011) could also be used cheaply. Cats are notoriously difficult to monitor so there is potential to study new methodologies here. Bruce Warburton (Landcare Research) is about to embark on a study of the use of remote cameras to monitor pest animals and is interested in working in Hawke's Bay. The use of cameras could also help in describing the effectiveness of various traps and toxin/bait stations for the different species.

5 Conclusions

Project area

The project area includes Boundary Stream Mainland Island, which is considered a high priority area for biodiversity in Hawke's Bay. The 8000 ha (approximately) is considered a large enough area to monitor the effect of predator removal based on similar experimental removals in Central Otago and in considering the pest species movements and home range areas. Based on what pest control is currently undertaken in the region and with the addition of predator control, we are provided with two experimental treatments (−predators +rabbits) and (−predators −rabbits) and a non-treatment area (+predators +rabbits).

Available predator control technology

- DOC200 for rats and stoats ($30 per trap + double box $20 each) (200 = $17,000)
- DOC250 for ferrets and cats ($40 per trap + single box $26) (100 = $5,600)
- Timms traps for cats ($46 per trap) (100 = $4,600)
- Belisle Cat traps (100 = $1,700 + $60 per chimney box) (100 = $7,700)
- Existing toxin: Diphacinone for rats
- New: PAPP bait for stoats
- Future: PAPP for cats and ferrets

Predator control

Trap or bait placement is very important for effective predator control. The specific location of traps, etc. needs to be on recommendation of experienced predator trappers who have trapped the species in question and in the local area (or similar) if possible.

Initial knockdown of predators

Initial use of PAPP for stoats (and cats when available in the future) using DOC200/DOC250 boxes, plastic piping or chimney box. Effective use of PAPP requires pre-baiting. This pre-baiting and then toxin loading could be undertaken initially while the project is being set up and staff/volunteers/contractors are working in the area. This would fulfil the regulatory requirement of having trained people using the toxin.

Live-capture traps (e.g. leghold traps) could also be used when staff are working in the project area every day and are able to visit the traps. Long-term use of live traps will be dependent on the ability of all set traps to be visited daily, or the advancement of technology that would allow remote notification of traps being set off (Al Bramley, Wildtech, pers. comm.).

Ongoing predator control

Toxin could then be replaced with DOC200/250 or Belisle cat traps as appropriate and serviced as required; 2–3-weekly in summer or during animal dispersal periods but less regularly in winter months, and could be undertaken by volunteers. DOC250 traps are rather difficult to use and may require specialist trappers. Timms traps are sometimes preferred due to their ease of use. Station spacing: Forested areas not covered by DOC, 1 station per 3 ha (DOC200/ DOC250) including forest margins, gullies and wetland areas, and 1 trap per 20 ha in the wider lansdscape (DOC250, Belisle).

Use of AHB possum bait stations for rat baiting using diphacinone. A subset of the total traps to be used: those placed in forest/scrub remnants and along forested corridors and drainage channels. Diphacinone does not require specialist handling and could therefore be done in conjunction with trapping or as required. Diphacinone requires Medical Officer of Health notification only.

Adaptive management

The use of independent monitoring of the pest species will allow deficiencies in the removal campaign such as gaps to be identified. The use of remote cameras will hopefully identify the best tools (trap types and baits/lures) for use in this landscape with this suite of pests. As this is a first attempt at wide scale multi-species pest control in a large fragmented landscape the key outcome is to learn from experience in order to maximise efficiencies over time. This will be achieved more quickly within a flexible adaptive framework.

The use of independent monitoring of the pest species will allow deficiencies in the removal campaign such as ‘gaps’ and trap shyness/avoidance to be identified. The use of remote cameras will hopefully identify the best tools (trap types and baits/lures) for use in this landscape with this suite of pests.

We hope to be able to make use of Tom Etherington’s skills in spatial mapping. Tom is a PhD student at the University of Auckland and aligned with Landcare Research. We are hoping that by supplying Tom with trapping data (and biodiversity monitoring data) he can use mathematical methods (circuit theory) to determine the habitat routes that each pest species is most likely to use when travelling through the landscape. This would allow future directing of trapping efforts, to increase efficiency and potentially identify critical habitats in other similar landscapes.

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