Predator workshop 1997

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Introduction

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Effectively managing predation is a major challenge facing New Zealand conservation practitioners. Important advances have been made e.g., eradication of rodents and control of possums to low densities. A key to these successes has been a determination to succeed, innovation and a willingness to adapt to new circumstances.

Central to further advances will be information-sharing between practitioners (who are often isolated). Workshops are one way of achieving this. Moving between projects is another. This workshop is focused on feral cats and stoats (although not solely - there are complex inter-relationships).

We urgently need more effective ways of controlling cats and stoats. This would have major benefits in relation to species recovery and ecosystem restoration objectives.

Demand for participation of this workshop was strong and we couldn't accommodate everyone. Thanks for your concessions. It is important that those of us here pass what we've learned back to those who couldn't attend. I extend a special welcome to non-DOC participants.

This workshop is intended to advance our knowledge about cats and mustelids, and our ability to control their impacts. It is not meant to be a training course. Participants are urged to participate in the department's recently-developed Ecological Management Training Programme for comprehensive training in techniques for managing pest animals and in other disciplines.

Predator management in New Zealand: an overview

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INTRODUCTION

An ecological holocaust has followed the colonisation of the New Zealand archipelago by humans and their associated predatory mammals. In particular, European colonisation of New Zealand over the past 200 years has led to the introduction of many species (Atkinson and Cameron 1993), including cats *(Felis catus)*, stoats *(Mustela erminea)*, ferrets *(M. putorius)*, weasels *(M. nivalis)*, mice *(Mus musculus)*, Norway rats *(Rattus norvegicus)*, and ship rats *(R. rattus)*. Although mammal introductions have now effectively ceased, other alien predators continue to arrive. In the past few decades several species of predatory wasps (e.g., *Vespula*, *Polistes)* have become established, with unknown consequences for the survival of vulnerable native invertebrates.

The tide of predation by alien mammals has now exiled many native animal species to isolated islands, which are either mammal-free or have not been colonised by the full suite of predatory mammals. On the main islands, alien predators continue to contribute to the decline and range contraction of many other species. The best-known examples are native birds. New Zealand has now lost over 40% of its pre-human land bird fauna, and no country has a higher proportion of its surviving avifauna classed as threatened. Of the surviving 287 New Zealand bird species (150 of them endemic), 45 are classed as threatened in the 1996 IUCN Red List . Forty-one of these threatened species are endemic, and several now exist only on mammal-free islands or in dwindling mainland populations. There have been similar, but less well-documented, impacts of introduced predators on other native animals, including reptiles, amphibians, and invertebrates.

RESPONSES

In the face of the devastation caused by alien predators, New Zealand conservationists have had a variety of reactions. The first response, which is still sometimes heard, has been to assume that complete loss of vulnerable native species to alien predators is inevitable. This is the Victorian view of "survival of the fittest": all that can be done for vulnerable species is to record and collect the doomed natives before they disappear. The second response, which started with Richard Henry and prevailed until quite recently, has been to "maroon" the vulnerable species on predator-free islands and to allow the alien predators virtually "free rein" elsewhere. The third response, which dates from only c.20 years ago, has been to progressively eradicate mammalian predators of smaller and smaller size from larger and larger islands (Veitch 1994). The fourth, and most recent, response is to attempt to control alien predators at selected mainland sites, holding them below those levels at which they cause acceptable damage to vulnerable native species.

In New Zealand the conservation of biodiversity is now largely a matter of managing the impacts of invasive species. Predators in New Zealand, unlike most other parts of the world, are mostly alien. The main pest species are mammals, some of which (e.g., stoats, possums) are not a problem anywhere else. However, it must not be forgotten that there are other potentially important alien predators, such as wasps and myna *(Acridotheres tristis),* and that local conservation problems are occasionally caused by native predators.

MANAGEMENT COMPLEXITIES

Predator management is not just a matter of killing animals. It is essential to firstly define the purpose of management, which will often be the recovery or maintenance of a threatened species and/or a natural ecosystem. Monitoring of desired responses should then be a central part of management, not just counting the number of predators killed. Predator managers need to keep abreast of research findings, and be aware of the ecological and behavioural complexities inherent in predator management.

Among these complexities are the facts that predators interact with one another, and respond to changing prey abundance. Species cannot be managed in isolation from one another; an integrated approach to their management is required. Examples of the consequences of interactions between predator species include the numerical responses of stoats to rodent irruptions, and of mice to rat control. Behavioural responses include the example of diet switching by stoats following rodent control (Murphy & Bradfield 1992). Intra-species interactions, such as dominance hierarchies and territoriality, are also significant for predator management strategies.

Other complexities in predator management are that males and females, juveniles and adults, may behave differently from one another, requiring different management strategies. Some predators (e.g., male cats) can operate on a "landscape scale", which may not match the scale of conservation management.

The eradication of predators is a special case in predator management. It is only possible on islands where all individual predators can be put at risk and reinvasion can be prevented. In most situations, predator management implies perpetual control. This effectively amounts to "harvesting" predators and creating consequent population responses of increased fecundity and reduced natural mortality, along with the creation of "dispersal sinks" which may attract juvenile predators.

THE FUTURE

Challenges in predator management include facing issues of animal ethics and toxin accumulation, avoiding non-target kills, and retaining and improving public support. Predator management will need to become increasingly sophisticated in future, if further conservation gains are to be made. There will need to be more focus on integrated predator control (including the planned use of secondary poisoning effects), budgeting for perpetual control , costs, determining the minimal control effort for the desired response, and building and maintaining effective research/management partnerships. In the long term, biological control of predators may hold the best prospect for sustainable management, but for the foreseeable future tie focus will remain on more effective use of existing techniques, supported by sound ecological knowledge.

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Introduction to the Rotoiti Nature Recovery Project St Arnaud's `Mainland Island'

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THE SITE

The project area covers approximately 825 hectares of beech forest on the western slopes of the St Arnaud Range in Nelson Lakes National Park. It has been established as a pilot ecosystem restoration project for beech forest containing honeydew, a habitat that covers large areas of upper South Island.

The site has been chosen to make use of natural features as `island' boundaries and to maximise accessibility to people for advocacy and education. It is bordered to the west by Lake Rotoiti (620 m a.s.l.), to the north-west by the village and tourist community of St Arnaud and adjoining farmland, and to the east by the tops of the St Arnaud Range (to 1780 m), leaving continuous beech forest boundaries to the north-east and south.

The forest is relatively simple in composition, grading from a combination of red/silver/mountain beech at lower altitudes through silver and mountain to pure mountain beech at timberline (c.1440 m). Some areas of reduced drainage include kanuka and mountain cedar. Honeydew, the product of a scale insect (*Ultracoelostoma* spp.) is found on mountain and red beech trees in the lower part of the area (to c.1000 m). It is an important food source for native fauna whose availability is now much reduced by introduced wasps.

PROJECT OBJECTIVES

1. To reduce wasp, rodent, stoat, feral cat, possum and deer populations to sufficiently low levels to allow the recovery of the indigenous ecosystem components (especially kaka, kakariki, tui, bellbird, robin, long-tailed bat, and mistletoes) and ecosystem processes (especially the honeydew energy cycle).
2. To re-introduce recently-depleted species, such as mohua, kiwi and kokako (S.I. sub-species if possible), once the beech forest is sufficiently restored.
3. To advocate for indigenous species conservation and long-term pest control, by providing an accessible example of a functioning honeydew beech forest ecosystem, so a large number of people can experience a beech forest in as near-to-pristine condition as possible.

PROJECT DESIGN

Pest control will be undertaken in the project area from spring 1997. Monitoring of numbers of pest species and selected native species will take place there before and after control (on an ongoing basis), and at the same times in a 'non-treatment' area of equivalent habitat at Lake Rotoroa. The work of project staff will be supplemented by that of a Science & Research Division team focusing specifically on kaka, by researchers from Landcare Research, Nelson who have ongoing studies in the area (wasps, seeding events, kaka), by other scientists we will be encouraging to work here, and by school groups working through an outdoor education lodge.

We aim to build good science into the design, though noting that our primary objective is one of management. For each target pest species we are first defining a control objective, measurable in terms of native components of the ecosystem, then a control and monitoring programme.

KEY TARGET PEST SPECIES/GROUPS AND ACTIVITIES

Wasps

Control will be attempted using Finitron poison in bait stations. Monitoring of wasp numbers will be by Malaise trapping and nest transects; monitoring of benefits of control will be by Malaise trapping (for their invertebrate prey), measuring honeydew and numbers and activity of honey-eating birds. Field trials will be run to support research on baits for aerial use by Landcare, Lincoln.

Rodents

Rat control will be with poison bait stations (as possum below). Experiments are being conducted to determine if mice can be controlled by the same technique. Monitoring of benefits will be through bird counts, vegetation plots and species-specific studies. Beech seed fall will also be measured because of its impact on rodent/predator cycles.

Possums

Possums will be controlled through a bait station (Philproof) operation using 1080 followed by Talon. Monitoring of possums will be through standard trap lines and monitoring of benefits through vegetation plots and studies of tagged trees (mistletoes, cedar, pokaka and others).

Stoats

We are planning to control using Fenn traps and `secondary poisoning', and monitor by radio-tracking and trap catch, but may modify this as a result of the workshop.

Cats

We initially plan to live-trap around boundaries with village/farmland (returning pets to owners) and expect secondary poisoning to account for other animals within the block. We are working with the community on the issue of cats within the village. Monitoring of cats and the benefits of their control needs to be developed.

Deer

Deer currently move through the project area in low numbers. We will do limited shooting and monitor through vegetation plots, exclosures and tagged broadleaf trees.

ADVOCACY PROGRAMME

Activities to date include production of a fact sheet, the project launch by Sir David Attenborough and a programme with Lake Rotoiti School. Programmes with Nelson and Marlborough Colleges and volunteer groups are being developed.

Kiwi Research By Management in Northland

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INTRODUCTION

Some work in the early 1990s suggested that mammalian predators were the prime cause for the dramatic decline of North Island brown kiwi in Northland. This included firstly, observations on the impacts of dogs: of 194 kiwi reported dead in 1990-95 some 70-78% were killed by dogs (and dogs are now a major focus for kiwi public awareness programmes). These data are, however, biased against smaller predators e.g. mustelid predation, for which kiwi remains are less likely to be found (Pierce and Sporle in press). A second set of data suggested that smaller mammals were playing their part in the decline of kiwi. Surveys of kiwi distribution in the 1990s revealed that since the 1970s, kiwi numbers and range had contracted markedly in Northland especially in the south, coinciding with the northward spread and increase in density of possums and ferrets (Miller and Pierce 1995). Detailed work was needed, however, in order to determine the relative impacts of possums and small predators.

STUDY DESIGN

To test for relative impacts of possums and predators, three study areas were selected in 1994 and given different treatments for mammalian pests; a nearby forest patch is used for "Operation Nest Egg" experiments. In 1996, Trounson was added to the study regime, and Katui will be used as an additional control. The treatments of each of the study areas are given in Table 1.

TABLE 1. PEST MANAGEMENT REGIMES IN KIWI STUDY AREAS IN NORTHLAND.

TREATMENT EACH YEAR				
Site (Area)	1994	1995	1996	1997
Rarewarewa (55 ha)	Control	Possum poison	Possum poison	Possum poison
Riponui (44 ha)	Control	Predator trap	Predator trap	Predator trap
Purua (75 ha)	Control	Control	Control	Control
Trounson (450 ha)	-	-	Poison/trap	Poison/trap
Katui (295 ha)	-	-	-	Control

In each study area the following kiwi responses are being measured annually:

• Adult survival:	telemetry
• Egg hatching success:	inspection of nests of telemetered males
• Chick survival and recruitment:	telemetry
• Population structure:	instantaneous samples using trained kiwi dogs
• Trends in call counts:	standard kiwi listening methodology

PEST CONTROL

Rarewarewa possums

Possums have been reduced to low-moderate levels in Rarewarewa (initially with hand-spread pollard and jam 1080, subsequently with talon) in bait stations at 100m intervals around the perimeter and along the ridge system inside. Reinvasion is continuous but possum trap catch has been low especially in 1996-97 (4% in February 1997).Two of four radio tagged cats died of unknown causes soon after the 1080 poisoning. No monitoring of rodents is in place, but is being considered.

Riponui predators

Fenns, victors and conibears are operated throughout and around the perimeter of the reserve, extended in 1996 to adjacent forest and farmland to act as a buffer. 81 double Fenn sets are baited with rabbit (especially in 1995), extended to include samples with plastic eggs/water based duck lure and plastic mesh covers in 1996. Cats are targeted with victors and conibears when sign is observed. Annually 10-20 cats, 10-20 stoats and fewer weasels and ferrets are caught. Peak captures of stoats occur in December-January. Mustelid captures have been highest with wooden covers using plastic egg lure, but more data are needed to test the reality of this.

Trounson possums/predators

Possums and rats are targeted on a 100m poison grid, initially with 1080 in June 1996, subsequently with talon, and aiming for fewer pulses with time. Residual possum and rodent levels are very low (trap catch data c.1-2% for all spp, but higher for mice in April 1997), but with ongoing reinvasion at the edges. Mustelids are targeted along the park perimeter with 110 double Fenn trap sets under wooden tunnels baited with rabbit meat. Cats are also targeted on the perimeter with victor traps and cages baited with rabbit. Since August 1996, 3 cats and mustelids (30 stoats, 12 weasels and 1 ferret) have been killed, with peak captures in December - January. Additional predators have been radio tracked to determine efficacy of the control regime, especially secondary poisoning effects (refer Craig Gillies' summary).

PRELIMINARY RESULTS

Adult survival

Adult survival is high in all study areas. Ten adult deaths have been recorded in 161 bird-years of radio-tracking: mean annual survival = 94%. There is no evidence that any kiwi have been poisoned by 1080 or talon. Four adults were killed in a short period at Rarewarewa and the neighbouring Operation Nest Egg site in spring 1996; a large male ferret was cage-trapped and killed in the area, after which no further adult mortality has been detected (to April 1997).

Hatching success

Hatching success in central Northland is moderate and similar in all areas, but varies significantly between years: 33% in 1994 (n = 53) to 58% in 1996 (n = 53%). Success rate was highest in Trounson in 1996 (90%, n = 20).

Chick survival

Chick survival is low in the controls and significantly higher in the treatment areas (Table 2).

TABLE 2. PRELIMINARY RESULTS ON AVERAGE SURVIVAL OF KIWI CHICKS (TO 17 APRIL 1997).

	1994/95	1995/96	1996/97
Non treatment	3 site 32 days	Purua 0 days	Purua 12+ days
Trapping		Riponui 18 days	Riponui 104+ days
Possum poisoning		Rarewarewa 39 days	Rawerawera 236+ days
Intensive management			Trounson 90+ days

Population structure

Instantaneous sampling using dogs enables an independent check of survival data of radio tagged chicks. These samples reveal good numbers of subadult birds turning up in our study areas, under all treatment and non-treatment regimes, at least in some years. It is unclear why the telemetry data and the data from dogged samples differ unless there is considerable movement of juveniles between forest patches (some radio-telemetry data support this), or some unexplained bias to juvenile mortality caused by our studies.

Call count monitoring

Call counts will enable us to continue monitoring kiwi population trends under different management regimes.

INTERIM CONCLUSIONS

- Predators are the main cause of kiwi mortality in the Northland study areas.
- Dogs and ferrets prey on adults and need to be controlled continuously.
- Stoats prey heavily on chicks each year.
- Predator control by trapping, and better still, poisoning, significantly reduces the mortality rate of chicks.
- More work is needed to find efficient ways of reducing stoat impacts on chicks.

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Kiwi research at Waikaremoana

Darren Peters
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INTRODUCTION

This study at Lake Waikaremoana was started in November 1992

At the time we knew that:

- kiwi were declining in mainland forests,
- surveys had shown that there were few juveniles in mainland forests,
- that predation by introduced mammals seemed to be the main cause of population failure.

AIM

To test whether intensive predator control can enhance juvenile survival and population recovery in kiwi.

STUDY AREA

Part of the margin of the Lake Waikaremoana was selected as the study area because it was hoped that the peninsulas would restrict reinvasion rates once predators were removed, and help prevent young kiwi from dispersing out into nearby areas of unprotected forest.

Partnership approach

Three key acqueves are involved: Tangata Whenua, Manaaki Whenua Landcare Research, and the Department of Conservation.

METHODS

Intensively control predators on one peninsula to determine if this resulted in increased chick survival.

Monitor kiwi on the other peninsula and kiwi elsewhere in the catchment as a control.

Predator control was focused on ferrets, stoats and feral cats which were known to be present in the area.

Kill traps were used because:

1. we wanted to obtain a measure of the number of predators we removed,
2. there was resistance from the local community about the use of poisons.

Traps

- Lake shore and internal trap line spacings are 150 metres. Buffer lines at the neck 25 - 50 metre spacing.
- Traps: Fenn; for stoats and ferrets, i.e., Mark 6 Fenn trap
  Conibears; 8" for cats and ferrets
- Trial tunnel design - for mustelids.
- Trap sets for cats/night spotlighting.

(Traps were concentrated where the highest concentrations of rodents were noted e.g. shore).

6" Conibear were subsequently added to allow for the Conibear/Fenn comparisons.

Baits

Whole egg - doesn't rot, doesn't get eaten by wasps/rats. Supplemented occasionally by a range of meat baits in winter e.g. day old chicks, rabbits, possum (infrequently)

Mammal monitoring

- Tracking tunnels for rodents
- cage traps were used for live capture of mustelids and cats.

The above provided an index of abundance and distribution of these mammals in the catchment each month, this allowed us to assess:

1. the proportion of predators removed from the treatment area,
2. dynamics of the rodent populations.

RESULTS

- the first two years were spent catching and radio-tagging adult kiwi, and measuring chick survival in the catchment before predator control started.
- kill trapping started on Puketukutuku peninsula in May 1995, and has continued ever since.
- slow catch rates initially
- big catch was achieved over the summer of 95/96
- mix of species, including weasels (discovered weasels)
- large by-catch of rats
- egg baits were significantly better than meat or no bait.
- increasing proportion of captures on the saddle as time went on which indicated we'd removed most predators from interior of the treatment area.
- monitoring throughout the following winter of 96/97 suggested that trapping had removed over 90% of the predators from Puketukutuku peninsula. Residual density was estimated at < 2 animals/km^2 and was probably less than 1/km^2.

BENEFITS FOR KIWI

Summer 95-96

- high catch of predators
- or 7 chicks fledged compared to non-treatment area where no chicks fledged

Summer of 96-97

- Low catch of predators.
- No significant benefit for juvenile kiwi (for a while...)
- survival in the treatment area was lower than the non-treatment area!!

LESSONS

While the reasons for many of these results remain unclear, some lessons can be taken:

- predation impacts on young kiwi are always high, but may be even higher still when primary prey are scarce.
- trapping does not remove all stoats from an area, and sometimes may not reduce densities sufficiently to protect young kiwi.
- If kiwi populations are to survive in forests, predation losses must be reduced by 80%.
- kill trapping is not an effective means of indexing stoat abundance. This year for example no captures were made initially yet chicks were being killed.
- cage trapping seems no better than kill trapping - high captures only under certain circumstances (low food abundance).
- this year - need to strengthen our control procedures.
- difacinone in eggs?
- secondary poisoning using bait stations?
- improved lures for traps
- need to understand the basis of the predator/prey system, and the effects of primary prey on secondary prey impacts.

ACKNOWLEDGEMENTS

To construct this tome, great thanks are due to John McLennan, Manaaki Whenua Landcare Research - the principle researcher in this project.

Experimental stoat control North Okarito Forest, West Coast

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INTRODUCTION

Stoats *(Mustela erminea)* have been identified as significant predators of Okarito brown kiwi (OBK, *Apteryx australis australis)* chicks. Mark 4 Fenn traps have been the traditional method for controlling stoats in New Zealand, and have proven to be effective in protecting nesting mohua *(Mohoua ocrocephala)* during stoat irruptions (O'Donnell *et al.* 1992). This method however has not been successful in protecting Okarito brown kiwi chicks from stoat predation (McLennan *et al.* 1996).

If OBK are to be protected *in situ* we need a method that effectively intercepts and kills all stoats within a large area. Research by Eric Spurr (Landcare Research) into the use of hens eggs injected with 1080 poison (sodium monofluoroacetate) offered a promising lead, although the research had been over a limited area. Therefore we began a study in North Okarito forest in 1995 to test whether 1080 injected eggs could be used to control stoats over a large area. Two study grids of 600 ha each were set up in 1995. However the physical effort required to maintain these grids and collect the data was prohibitive. These areas were reduced to 400 ha in 1996.

STUDY SITE

This study was carried out in 2 unlogged 400 hectare blocks in North Okarito forest (NZMS 260-H34,135, H35). One study area was bounded to the south by Okutua Creek, off the end of Oroko Rd (referred to as River grid). The other study area was situated at the end of Jockies Rd (referred to as Loop grid).

North Okarito is a lowland podocarp forest dominated by rimu *(Dacrydium cupressinum).* Other species include miro *(Prumnopitys ferruginea),* Hall's totara *(Podocarpus hallii),* silver pine *(Lagarostrobus colensoi),* kamahi *(Weinmannia racemosa)* and quintinnia *(Quintinia acutifolia).* The forest is gazetted for sustainable yield, and is administered by Timberlands West Coast Ltd (TWC).

METHOD

Two 400 ha (2 x 2 km) grids established in 1995 were used. These consisted of four 1 km^2 blocks (Fig 1) with a basic track marked around the perimeter. Grid lines were called a, b, c, d, and x, y, and z, thus each site had a unique locator.

Tracking tunnels baited with a small cube of meat were placed every 500m, with two in the centre of each square.

A bait station was placed every 100m along the perimeter. Bait stations were made from Novacoil drain pipe and were capped with plastic sewer caps. A hole big enough for a stoat to enter, but not big enough for the egg to be removed ("no eggzit!") was drilled in one end. Two non-toxic eggs (dyed green) were placed in all bait stations. These were revisited once every week where possible. The number of eggs eaten was recorded, and eaten eggs replaced. Uneaten eggs were replaced with fresh eggs about once a month.

Eggs injected with 1 ml of 0.1% 1080 solution were placed in the river grid during November 1996. These were left out for 3 weeks and then replaced with unpoisoned eggs. Prior to poisoning we made several unsuccessful attempts to catch and place radio collars on stoats in this grid.

In Loop grid extensive live trapping was undertaken in January and February of 1997. One female stoat was captured, radio collared and released. Two rats were also caught, collared and released. Poisoned eggs were placed in bait stations and the live traps in this grid in early March.

RESULTS

River grid

Egg take increased over the first six weeks, and then plateaued and remained relatively constant for 8 weeks. Following poisoning egg take dropped rapidly to zero. When non-toxic eggs were reintroduced an average of one egg per week was taken over the following three months. The pattern of occurrence of stoat footprints in the tracking tunnels did not correlate with egg take until after poisoning. At this time footprints and egg take were in the same small area, indicating that only one animal remained or had moved into the area.

We estimate that, prior to poisoning, there were 3 - 4 stoats in the study area. This estimate assumes that stoats eat a maximum of 1 - 2 eggs per day. The number of poisoned eggs eaten supports this, with some stoats eating more than 1 poisoned egg.

Loop grid

The egg take and tracking tunnel index on Loop grid was slower to pick up than on River grid. This may have been due to stoat mortality through a 1080 poison drop over part of the grid 2 months earlier, or a naturally lower density. Both indicators then increased, peaking in November. Unfortunately egg take in November was confounded through interference by keas *(Nestor notabilis)*. Eggs eaten by kea, where they could be identified, were not included in the data set. Keas were eventually dissuaded by injecting eggs with cayenne pepper.

There was a noticeable decline in the number of eggs taken between December and March before the poisoned eggs were placed in the grid. There are several plausible explanations. Stoats may have consumed half eaten eggs left by the kea and become egg shy; some animals may have travelled between the grids (they were 4 km apart) and been poisoned in the river grid; or, there was natural mortality or emigration.

Despite intensive live trapping in both grids we were only able to catch and collar 1 female stoat. After being collared the stoat disappeared out of the grid, and we were only able to obtain contact once. This meant that we could not begin to estimate her home range. She turned up dead 5m from a poison egg tunnel, and 1 km from the original trapping site.

During Poisoning in Loop grid (March) we also placed poisoned eggs in the live traps. One dead male stoat was recovered from these traps.

DISCUSSION

Several years ago stoats were identified as being a significant predator of Okarito brown kiwi chicks. Attempts to protect them with Fenn traps failed, i.e. stoats were caught but it took only one animal to kill a number of chicks. 95% control wasn't good enough. The trap statistics indicated that the stoat population abundance was low (as were ship rats) and probably very mobile, but apart from this we knew nothing about their population dynamics. To date most of the New Zealand research on stoats has focused on their population dynamics and control measures in beech forest.

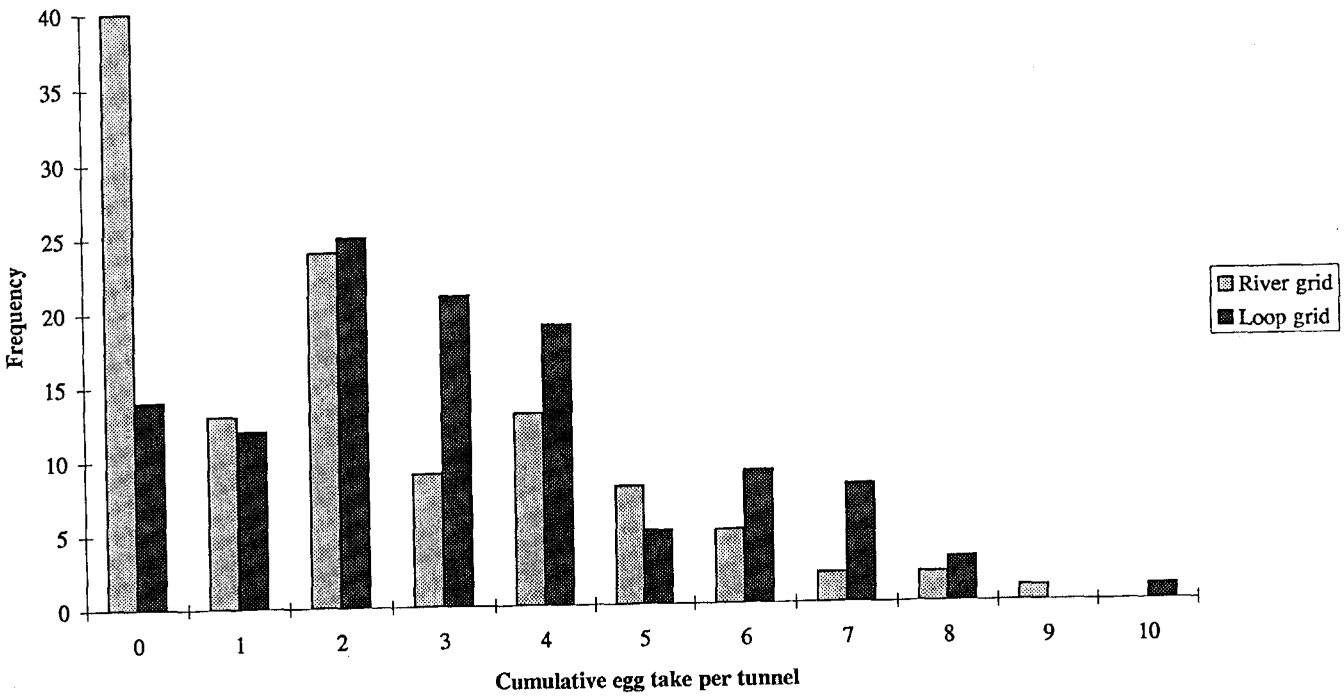

FIGURE 1 GRAPH SHOWING CUMULATIVE EGG TAKE

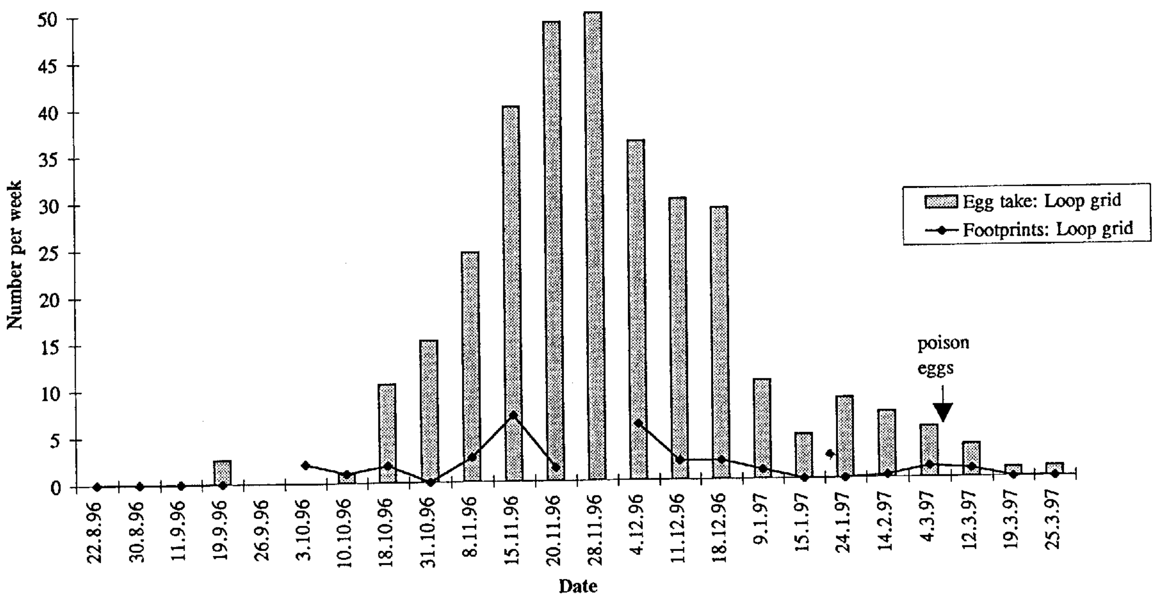

FIGURE 2. GRAPH SHOWING EGG TAKE & STOAT FOOTPRINTS IN THE LOOP GRID.

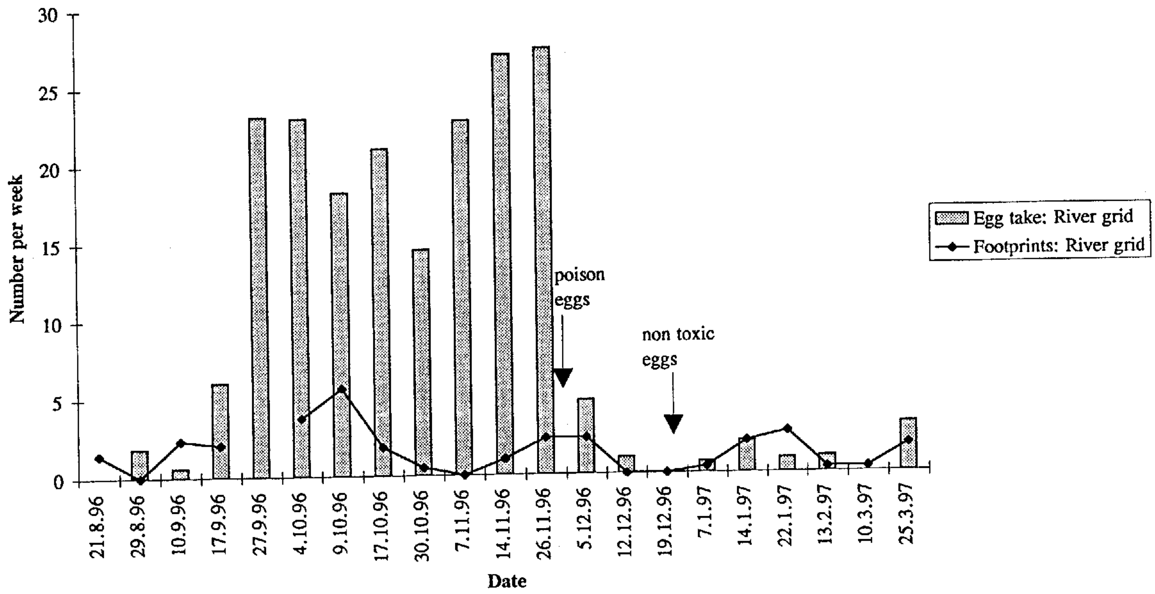

FIGURE 3. GRAPH SHOWING EGG TAKE & STOAT FOOTPRINTS IN THE RIVER GRID.

The original intent was to overlay this programme with the OBK management programme in South Okarito, as research by management (RbM). A change in their objectives to removing all eggs and chicks, and captive rearing, meant that this could not happen. We therefore moved to North Okarito (easier access) and worked to test whether we could control a low number of stoats over a large area. Our results to date indicate that this is possible, although we would have needed to have more luck in the live-capture stakes to confirm this.

Poisoned eggs need to be available to the stoats longer than the three weeks we had them out, and we should have poisoned in October. We suspect that one stoat was left alive in river grid (rather than moving into the grid post-poisoning) but without having transmitters on animals, again we can't confirm this. If it is only one animal, then the egg take and footprint record indicate that it has subsequently roamed over three quarters of the grid (300 ha).

In the next few months we are moving into South Okarito forest, and will be making a concerted effort to live-capture and radio-collar stoats. We need the data on population dynamics, home range, and movements in podocarp forest to develop effective strategies to protect the OBK chicks. We will also be taking the opportunity to test whether an aerial 1080 poisoning operation in September affects stoats in this forest.

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Mohua protection and stoat control research

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BACKGROUND

Mohua (yellowheads *Mohoua ochrocephala)* are a forest passerine found only in South Island beech forests. Originally they were found throughout all forests of the South Island but since European arrival, predation by rats and stoats and competition with other introduced species has dramatically reduced both their distribution and numbers. Mohua populations continue to be adversely affected by predation especially following beech mast years when mouse, rat and stoat numbers irrupt. In our study areas stoats are the major predator of mohua and during a stoat irruption more than 50% of breeding females were killed. Monitoring of the survival of female mohua is a good indication of the effectiveness of stoat control operations.

Following widespread flowering and seeding by South Island beech forests in 1990 a stoat irruption was predicted for the summer of 1990/91. This provided an opportunity to carry out field trials to protect a mohua population. These trials have continued each summer since with differing trap set-ups and baits being used each year. For four summers (1990/91 - 1993/94) we tested a variety of Fenn trap layouts and baits in the Eglinton, Hawdon and Dart Valleys; and during the past three summers we trialed eggs injected with poison (1080 in the Eglinton Valley and Diphacinone in the Dart Valley). In all trials in the Eglinton and Hawdon Valley we used wooden tunnels for traps and poison eggs.

SUMMARY OF RESULTS

Tunnel type

In the Hawdon we compared single entrance tunnels with double ended "run through" tunnels.

In the Eglinton concealed traps, buried in the litter, were compared with exposed traps set on a wooden tunnel base.

In both case there was no statistical difference between the number of stoats caught in each set. Traps set on wooden bases are much easier to set and service, and deteriorate less rapidly. Although single and double ended tunnels caught stoats equally well, double ended tunnels (with two traps) are better as they can catch two stoats between visits.

The following year in the Dart we compared a grid of traps with a perimeter ring of traps. Both layouts caught the same number of stoats but the effectiveness of a ring of traps has not been assessed by monitoring mohua during a stoat irruption year.

Bait type

In different years we tested a variety of baits for Fenn traps. In each case trials compared a standard egg bait which consisted of one whole and one cracked egg with an alternative. We evaluated whole (uncracked only) egg, hard-boiled egg, artificial lure using chemicals extracted from mustelid anal sacs, fresh possum meat, fish flavoured cat food and freshly dead white mice. In all cases the standard egg plus cracked egg caught as many or more stoats. Dead mice were the next best alternate but they are pretty impractical to use when supply and storage are considered.

The standard cracked plus whole egg bait proved most effective and is also the easiest bait to obtain and use. Attractiveness of the bait did not deteriorate noticeably with time - eggs continued to attract stoats and were only replaced when they dried out or became very rotten.

Last summer in the Dart we compared baits of meat, and meat (in the trap) with either live mice or rats in an adjacent cage, when live trapping stoats. Stoats showed no preference for either lure and there appeared to be a slight avoidance of live mice.

Poison trials

The major drawback to using Fenn traps for stoat control is the legal requirement that traps are to be checked daily. We decided to investigate the use of poison for stoat control and contracted Landcare at Lincoln to determine the toxic dose for 1080 and diphacinone. 1080 or a similar fast acting poison would be the best to use as it should kill stoats immediately while diphacinone being an anti-coagulant would take around 10 days.

1080 eggs

In 1994/95 we set up a trial in the Eglinton using hens eggs injected with 0.6 ml of 0.05% 1080 solution.

- We attached radio transmitters to six resident stoats and pre-baited with non-toxic eggs over an intensive grid of 61 tunnels at 100m intervals. Pre-baiting was carried out for two weeks and all radio tagged stoats were eating eggs.
- After the toxic eggs were put out 1 juvenile female died immediately.
  - 5 days later a male died
  - 2 days later another male died.

The two adult females wouldn't eat poison eggs. Neither would they eat fresh (non-toxic) eggs. However, they would readily eat meat and we Fenn trapped them immediately using meat as bait.

We had the 1080 was tested and it proved to be 5.9% not 0.05% as we had requested.

1995/96 was predicted to be another stoat irruption and we set up another trial with 81 poison tunnels in lines to protect 200 ha of mohua habitat. We used eggs injected with 0.5 ml of 0.1% 1080 solution. During the summer we attached transmitters to 26 stoats in and adjacent to this area. These stoats were monitored throughout the summer. Poison eggs were eaten continually but few of the transmittered stoats died. The animals that died were both within the poison grid and well away from it implying that it was not necessarily 1080 that caused most deaths.

We caught some stoats, fed them poison eggs and observed the effect. The first showed no effect after 24 hours (it then escaped), one died soon after eating an egg but another that looked near death had completely recovered by the next day. We carried out further trials using double the 1080 dose (1 ml of 0.1% 1080) and all stoats died within a few hours.

All eggs in the control tunnels were replaced with this higher dose of poison and the egg take dropped immediately.

1996/97 - we carried out another trial using this higher 1080 dose in eggs. Seventeen stoats were caught and had transmitters attached however many died of "natural" causes before any poison eggs were put out. We found that as had happened the previous year poison tunnels were being visited regularly by stoats but eggs were not eaten. When a finger sized hole was poked in the egg they seemed much more acceptable. However, there were no immediate stoat deaths and up to 10 eggs from clusters of tunnels were eaten before the transmittered animal in that area died. It appear that this higher poison dose is not killing animals quickly as happened in the pen trials the previous year. 1080 needs further investigation before it can be accepted as an effective stoat poison.

Diphacinone

1995/96 was predicted to be a stoat irruption summer and it was decided to control stoats in one of the best remaining mohua habitats, the Dart Valley. Due to the high public usage of the area we didn't feel it advisable to use 1080 so used diphacinone instead. Poison lines were set up throughout the valley using 354 egg tunnels in all. Egg take reached its peak in late December/early January but it was around 7-8 weeks before there was a marked fall off in the number of eggs being eaten. Around 800 eggs were taken overall. Although stoats do not die immediately after eating diphacinone we had no known predation of mohua in our monitored areas.

In 1996/97 further field work was carried out to determine how quickly stoats died after eating diphacinone eggs. Overall, 24 stoats were live-trapped and had radio transmitters fitted but many of the earliest trapped animals died before the poison operation commenced. It is likely that most of these animals died of starvation as only one had any body fat.

After the first diphacinone eggs were eaten it was 10 days before the first stoat died and there was a corresponding drop in the occurrence of stoat tracks in tracking tunnels.

WHAT WE HAVE LEARNT FROM THESE POISON TRIALS

1. Eggs appear to be a good lure for stoats but a more palatable long-life bait that can carry poison is needed. We had stoats regularly visiting poison tunnels but not eating the baits and had some radio tagged stoats surviving for more than a month in the presence of 1080 poison eggs.
2. Ensure that any poison used is tested and certified as to its strength. In our first trial we created a bait aversion by the female stoats who could detect the excessively high dose of 1080.
3. When developing new control techniques it 'is vital to monitor the target species. If we hadn't had transmittered stoats we would have assumed that 1080 was working successfully in all trials. Egg take ceased in the first year when there were few stoats; and continued in the second when we would expect a continuing influx of animals during a stoat irruption. However, in both years some transmittered animals were still alive.
4. For continuing management it is important to monitor the species that you are trying to protect to ensure the control operation is effective.

Response of the Eglinton Valley mohua population.

In 1990/91 we had two study areas - one in which we protected mohua against predation and one where we didn't. During that stoat population irruption we lost one breeding female from our "protected" area but 7 from the unprotected area. In subsequent years there was no known predation of adults and the population increased as follows (pairs were counted in spring, therefore females predated in 90/91 summer show up the following spring) years with an* are stoat irruption years:

TABLE 1. POPULATION CHANGES OF MOHUA.

YEAR	DEER FLAT	KNOBS FLAT	TOTAL
1990/91	8 pairs	10 pairs	18 pairs
1991/92	10 pairs 1 male	3 pairs, 7 males	13 pairs, 8 males
1992/93	10 pairs 1 male	11 pairs, 1 male	21 pairs, 2 males
1993/94	17 pairs	14 pairs	31 pairs
1994/95	21 pairs	18 pairs	39 pairs
1995/96	22 pairs	16 pairs	38 pairs
1996/97	5 pairs	6 pairs, 2 males	11 pairs, 2 males

The huge population crash recorded in 1996/97 was not caused by the stoat irruption the previous summer. As a result of the continuing control there has been few stoats present in our study areas over the last three summers. Most of the birds that were missing this summer were alive at the end of the 1996/97 season and it is likely the high death rate of mohua was a result of an unusual and prolonged very cold period in early winter though weather data has yet to be collated.

CONCLUSIONS

Continuing stoat control appears to be having a marked impact on the Eglinton Valley stoat population and has markedly reduced predation on mohua in our study areas. We have few adult stoats resident in the area where we have been carrying out trials each summer although there is regular immigration from both ends of the valley. Establishing a line of bait stations and/or traps along the length of the valley and carrying out control in autumn and again in late winter or spring would probably eliminate most of these remaining animals. The continual re-invasion will need constant monitoring and control.

The use of poisons to kill stoats appears to have good potential as a much less labour intensive method of control. Traps need to be checked often, poison egg stations can easily be left for two weeks between visits if several eggs are placed in each. The big advantage of this method of control is that you can specifically target mustelids and rats and only these animals have access to the poison (whole eggs cannot be removed from the tunnels). Other methods being trialed at present, such as secondary poisoning using Talon, may also adversely affect protected species such as morepork. When using poison egg stations we need to have a quick acting poison that is palatable to rats and stoats. 1080 is the best option at present but its use under the present experimental permit is only valid until February 1998. After this time it has to be registered as a "stoat poison" to be used as such. Further trials are planned this summer to determine if the 1080 dose rate as used at present effectively kills stoats.

Protection of Yellow Eyed Penguins from predators

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INTRODUCTION

Yellow-eyed penguins (YEP) that live on the SE coast of the South Island face two major threats to their continual existence. These threats are predation and habitat destruction. YEP chicks are at risk of predation by ferrets, stoats and cats in a short period generally around mid November to late December in any given year. The impact of predation can be severe with up to 88.5% of chicks in any given habitat being killed by predators (Darby & Seddon 1990).

There has been considerable investigation into the impacts of predation of YEPs, the effectiveness of existing methods and designs into improving the efficiency of protecting YEPs from predation.

Currently, management trapping on the Otago Peninsula is 2 x 10 day periods of trapping using soft jaw victors and Fenns. Any given period of ten days of trapping is extended until there have been three days of no capturing any animals in traps and has lead to a marked reduction in the rate of predation of YEP chicks. This trapping removes between 69-82% of predators present (Ratz *et. al.* 1992).

Secondary poisoning is a method of predator control where normal target prey are poisoned with a slow acting poison (generally an anti coagulant) and relies on the prey being eaten by a predator in the time between consuming the poison and dying. In some cases scavenging of carcasses may also lead to secondary poisoning.

If it is a successful method to protect YEP chicks from predation then it offers a number of advantages over standard trapping in addition to the reduction of costs identified above

We reviewed the costs of protecting YEPs from predation. We reviewed the costs of trapping five sites in the Catlins and separately one on the Otago Peninsula. We then compared the costs of establishing and running a standard trap-line with comparable costs of establishing a secondary poisoning protocol to protect YEP chicks from predation.

The table summarises the costs between the existing method and the use of secondary poisoning. Differences in costs between sites relate to the larger number of sites to be protected in the Catlins and the higher costs of travelling between areas.

The higher costs in the initial year are related to set up costs associated with purchase of traps bait stations, etc.

TABLE 1. EXAMPLES OF THE COSTS TO MANAGE A TRAPPING AND SECONDARY POISONING OPERATION TO PROTECT YEP CHICKS FROM PREDATION.

	TRAPPING		POISONING	
	Otago Pen.	Catlins	Otago Pen.	Catlins
Initial year Total Cost	6132	8353	4988	2962
Cost per Recruit	323	1392	263	494
Subsequent years Total Cost	5132	6028	1614	1362
Cost per Recruit	270	1005	85	227

Some advantages are:

- reduced time commitment to service an area
- lesser frequency of visits
- lesser skill levels

This method was trailed on the Otago Peninsula by Brown and Alterio (1996) in May 1995. They used the following method:

- ferrets, 3 stoats and 3 cats were caught and radio tagged.
- Talon 20P poison was applied in lines at the rate of 7 kg/hectare.
- mouse, rat and hedgehog tracking tunnel rates were used to monitor changes in numbers.
- changes in rabbit numbers were monitored by the erection of barriers in the mouths of burrows.

From this they obtained the following results:

- there was a statistically significant reduction in mouse and hedgehog tracking rates and in the use of rabbit burrows after the poisoning on the poisoned area compared to the non poison or treatment area.
- of radio tagged ferrets and stoats and 2 of 3 radio tagged cats died on the poisoned area shortly after poisoning.

In addition, Brown and Alterio recorded from a diet study that mice were the main prey of ferrets (69%) stoats (83%) and cats (80%).

SPRING 1996

We determined to replicate this study with the following differences:

- we used bait stations that excluded all animals except mice.
- we undertook our work during the YEP breeding season.
- following on from our poisoning trial a standard 10 day trapping session was undertaken.

We used the same treatment (Sandfly Bay) and non treatment areas (Boulder Beach) Figure one as previously. Our bait stations were upturned buckets with a large hole drilled on each side to allow rodent only access to the poison.

We established 18 tracking tunnels of Sandfly Bay and 20 tracking tunnels at Boulder Beach on 14 October 1996. These were baited with meat and peanut butter. The papers were checked and replaced if necessary weekly until 23 December 1996. Cage traps and Edgar traps were used from 10 October until 2 November to catch cats, ferrets and stoats. All caught animals were radio collared. 92 bait stations were established on a 50 metre grid at Sandfly Bay on 6 November 1996. Each one had one cup of Talon 20P placed in it. They were visited approximately each 4 days until 1 December 1996 and additional poison was placed in them and if necessary all the poison was replaced.

RESULTS

We caught and collared six ferrets and stoats. The fate of each one is recorded in Table 2 below:

TABLE 2 THE SPECIES, SEX, LOCATION AND FATE OF LIVE CAPTURED PREDATORS

NO. SPECIES	SEX	BOULDER BEACH	SANDFLY BAY	FATE
06 Stoat	M			Disappeared
16 Stoat	M			Disappeared
79 Ferret	M			Recovered dead
71 Ferret	M			Trapped
77 Ferret	M			Trapped
39 Ferret	M			Collar broke

Mouse tracking rates between Sandfly Bay and Boulder Beach are shown on Figure two.

During the period that bait stations were present, most of the bait was not taken.

A standard kill trapping line was carried out from 4 December 1996 until 15 December 1996. Table three summarises the results of this trapping.

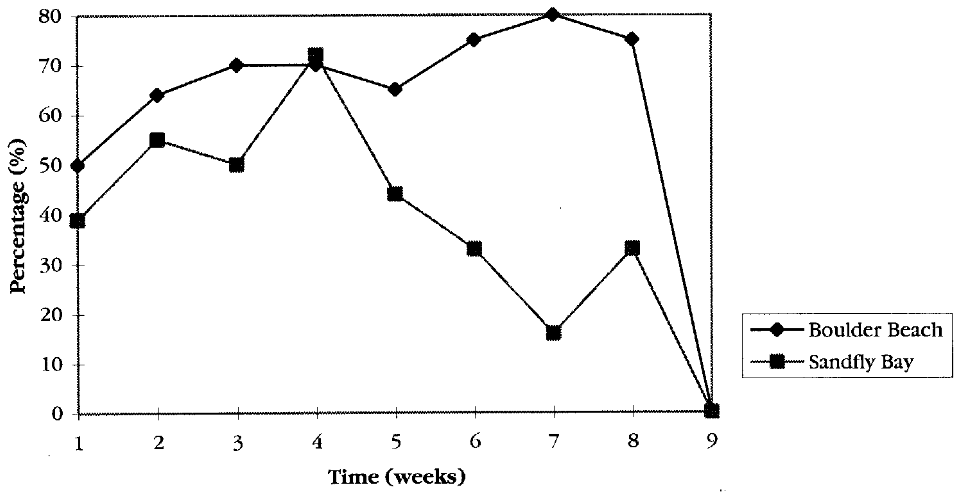

FIGURE 2 CHANGES IN MICE NUMBERS SPRING 1996

TABLE 3. RESULTS OF TRAPPING SANDFLY BAY, BOULDER BEACH DECEMBER 1996

SPECIES	SANDFLY BAY	BOULDER BEACH
Stoats **	2	22
Ferrets Ø	5	3
Cats Ø	1	4
TOTAL	8	29

Note:* $P < 0.05$ ** $P < 0.005$ Using Chi-square Test: Ø N.S.

There was a statistically significant difference in trap success between the treatment and non treatment in the total number of animals trapped and in the number of stoats trapped. There was no significant difference between the trapped areas for either cats or ferrets of for cats and ferrets combined.

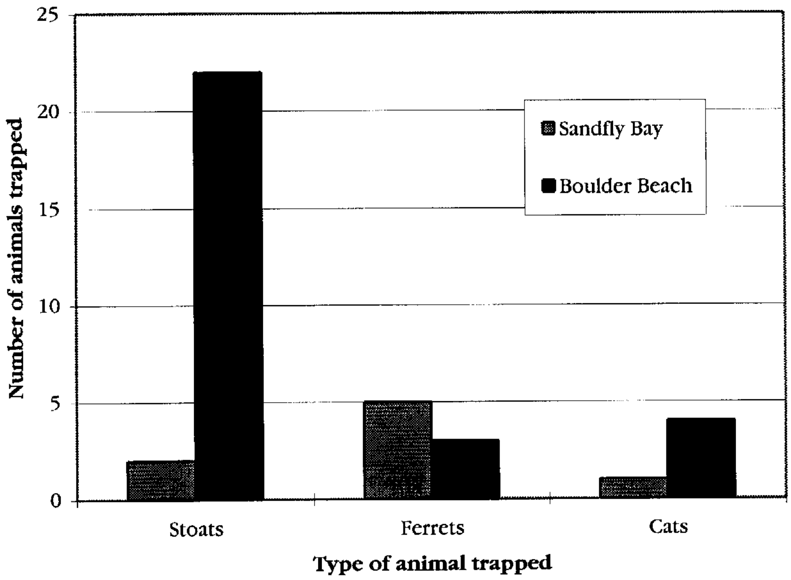

FIGURE 3. RESULTS OF TRAPPING AT BOULDER BEACH & SANDFLY BAY 4 - 15 DECEMBER.

DISCUSSION

The use of bait stations substantially reduced the amount of effort needed to deliver poison to the area Brown and Alterio (1996) used 700 kg of poison. Our trial used less than 50 kg. Although using bait stations reduced the amount of work needed on site, there is still a lot involved in setting out buckets. At Sandfly Bay it took 1.5 days to set out a 2-bait stations. Although this is a reduction on the effort required compared to trapping, it still takes time.

The tracking tunnels were baited with meat so that they could be used to monitor changes in mustelid numbers. No mustelids used the tunnels in either the control or treatment site. Again our ability to effectively monitor changes in mustelid numbers was constrained by current monitoring methodology.

Mouse numbers at the treatment site declined using Talon 20P -bait stations at 50 metre centres can be used to cause a decline in mouse numbers at a time of high productivity for mice.

Our live trapping to be able to radio collar mustelids and cats was extremely disappointing. We caught no females and cats. If we were to repeat such a trial, we would need to initiate live trapping in late August or early September.

The December kill trapping was successful in that it showed that there was a significant difference in the numbers of animals on the treat vs. non treatment site.

All these carcasses have been retained for analysis. The number of radio collared animals is such as to be unable to determine whether secondary poisoning was actually happening. Analysis of the trapped animals may show that these individuals had toxin levels of brodifacoum which if true, means that the timing of the poisoning should be brought forward.

Secondary poisoning continues to show promise as a predator control method. In the case of YEP the timing of the delivery needs considerable finesse. Trial so far have suffered from inadequate monitoring methods and sample sizes. This trial focused on mice as a vector to deliver the poison. Future trials should examine whether other paths e.g., rabbits are more efficient.

ACKNOWLEDGEMENTS

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Karori Wildlife Sanctuary Trust fence trials

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I NTRODUCTION

Karori Wildlife Sanctuary Trust (KWST) proposes to repeat what has already been achieved on many offshore islands: the complete removal of the introduced mammal fauna, followed by ecological restoration. There is one crucial difference though: for the first time ever, this process is to be repeated on the mainland. The area selected is a 250 hectare valley with regenerating natural vegetation, on the outskirts of Wellington City. We are presented with two problems that have not arisen on uninhabited offshore islands: firstly we have far more introduced pests to deal with, secondly we have no natural barrier to prevent reinvasion once the pests have been removed.

We have the option of continued intensive control to maintain low pest populations. This has been very successful in DOC "mainland island" projects (Mapara, Boundary Stream etc.). But this is expensive over a long period of time. The prolonged use of poisons in a semi urban environment creates public and environmental safety issues. Eventually animals will become bait shy: the control will become less effective. Finally, while much can be achieved with pest control, a lot more is possible with predator exclusion.

Instead the plan is to fence the sanctuary perimeter. We need to design a fence that will exclude all introduced mammals. Once those within the sanctuary have been eradicated, we can manage it as an island cut off from all sources of reinvasion, with of course contingency plans to deal with the occasional breach.

Road

The entire fence perimeter will be surrounded by a formed road (4WD track) and an area of managed vegetation (total width ? metres). This is not strictly a component of the fence but worthy of mention as in many respects it strengthens the barrier (although it also adds a few disadvantages). It doesn't allow high vegetation close to the fence, meaning the fence can't be avoided by arboreal species (possums, stoats, ship rats). The road (as bare ground) will act as an additional barrier to the movements of species that prefer vegetation cover (rodents, small mustelids?). On the other hand it will be used as a "highway" by other species (cats, possums). Careful engineering of the road can mitigate drainage problems (encourage water flow to run away from fence). There is a minus and plus for fence security: vandals have easy access to the fenceline, but it also allows ease of inspection and maintenance.

When planning a predator proof fence the most important questions are:

- What are the capabilities of the species targeted for exclusion?
- What are the limitations of the chosen site?

Capabilities of animals targeted will define the minimum requirements for the fence. Site characteristics (length of perimeter, terrain, public access) will decide which of the designs that provide for animal abilities to use, as well as appropriate materials and construction methods.

Many pest fences have been erected around NEW ZEALAND but few/none? are designed for full exclusion. Little controlled research into animal behaviour has gone into the design of these fences - some have been more successful than others.

The Fence Trials

By learning the maximum capabilities of each species we can design a fence that exceeds these capabilities. We have tested the response of various mammals to different designs for the components of the fence. Although we are designing a total exclusion fence, the information we are collecting will be of use to managers targeting just one or a few species. Each component of the fence is a barrier to a different type of animal behaviour. For each type of behaviour there are species that set the benchmark: for example possums are the most skilful climbers. These most able species were selected as the priority for trialing.

The basic design of our fence consists of three components: the wall, hat and skirt. The wall is the basic physical barrier to animal movement, the hat is a barrier against climbing animals, the skirt prevents borrowers from going under the fence. Other fencing projects have incorporated electrified wires. We are not using these because: high running and maintenance costs, electrics are not always a deterrent for some species, public safety issues, and that failure of electric wires in one location will result in failure of the entire fenceline (or length on the same circuit) while a breach at one location of a physical fence represents only a failure at that location. Each component has a number of design options: the objective of the animal trials was to find the best option for each, so that they could be put together to make a fence.

Each of the trials followed the same basic method. Animals were introduced into an enclosure with two parts (divided by a fence). Shelter was provided in one part, food in the other. Animals were given access to the food for long enough to learn where to find it. Then access was taken away, so that to reach the food, animals would have to defeat the component being tested. (Figure 2)

This method provided very strong motivation for animals to cross the fence. This was seen in the behaviour of animals during trials. For example individual possums would make up to 30 attempts to cross the fence hat within 2 or 3 hours, and keep up this level of effort throughout the two nights of trials. We believe that with this level of motivation, the fence has been tested against a much greater effort than it will ever be in the field.

THE WALL

The wall can be either solid, mesh, or a combination; therefore two issues define design of the wall:

- Maximum jumping Height of Target Species
- Minimum Mesh Size

Jumping height

The simplest fence is a solid barrier higher than the jumping height of target species. jumping heights were determined either by placing barriers of certain heights between the animal and its food, or recording scratch marks on a flour coated wall below a suspended bait.

A solid fence 1.5 metres high will exclude all small mammals apart from cats (note small sample sizes and incidental nature of some of these results). The maximum vertical jump height for cats is unknown: we know they can clear 1.5 metres, but no cat ever jumped onto or over the 2.2 metre high fence in the trial enclosure. (Figure 4)

Wind will make a high solid fence impractical at many sites such as KWS. The use of mesh instead, poses a different problem: how small a mesh is required to keep out the target animals.

If trying to exclude all species with a mesh fence, then the critical test is to find what mesh size is a barrier to juvenile (weaning age) mice. We are currently trialing mice against woven wire at apertures of 8 mm, 6 mm and 5 mm. (Table 1)

A full mesh wall that will exclude the smallest targeted species may not be feasible for all projects. We were initially looking at a combination of solid and mesh for the KWS fence wall. The key here is to select a mesh size that the project can afford, and have a solid (tin?) wall extending up to above the maximum jumping height of target animals not excluded by the mesh.

THE HAT

The hat is a barrier projecting outwards from the top of the fence. It needs to be sufficient to prevent any animal that can climb up the fence from going over the top. Key species are the most skilful climbers: possums (cats? ship rats?).

A mesh ladder was placed over the hat so possums could climb over to their food. After two nights the ladder was removed, so that possums would have to beat the hat to cross the fence.

Eight designs have been trialed against possums. Three (wing, small overhang, floppy top) were unsuccessful Two were rejected because of safety or engineering issues (large overhang, drum on outrigger). The drum and 25 cm half hat are the preferred options - why use the 30 cm half hat when the smaller (therefore cheaper) version works just as well?

THE SKIRT

Theory

The idea behind the skirt is that when animals encounter an obstacle (such as the fence wall) that they wish to burrow under, the majority of times they will dig at the base of that obstacle. Incorporating a skirt into the fence design means that animals will encounter a further barrier when they try to dig under the fence. If we can find out how far from the fence wall animals will attempt to dig under, we know how wide to make the skirt.

Methods

In the enclosure used for burrowing trials a tunnel has been cut through the skirt at the base of the fence. Stage one, animals are given a day or two to become familiar with using this tunnel to access food. Stage two, the tunnel is filled so that the animal has to dig through to access food. Stage three, the tunnel is blocked, and then buried. The animal now has no access to the food supply and makes many attempts to try and burrow under the fence. Other behaviour may also be observed at this stage.

We have trialed ship rats and stoats, but have found Norway rats to be the key species. We did not expect the skirt material to make a difference to animal behaviour but since replacing the smooth HDPE plastic skirt with woven wire in the trial enclosure we have seen a change. Both stoats and Norway rats now seem to clear smaller areas when attempting to burrow under the fence. This suggests that the mesh is not as easy to dig on as the smooth plastic surface. Using a permeable mesh skirt also reduces drainage problems that would result from a solid skirt. Though of course the same issues of mesh size that apply to the fence wall also apply here.

Burrowing distance

As expected, by far the majority of burrowing attempts by all species have been right up against the fence, enclosure walls or other obstacles. Only a small proportion have extended more than 200 mm back, and very few more than 400 mm. (Figure 1) Norway rats have on about six occasions (out of 155 attempts) started digging away from a wall, and only four times more than 400 mm (maximum 670 mm). We are confident that virtually all attempts to burrow under the fence will be prevented by a 400 mm skirt.

PROPOSED FENCE DESIGN

The fence design presented now is for the KWS site and for the exclusion of all introduced mammals. Should be stressed that other projects will have other needs, and that a total exclusion fence could be made much simpler without the restrictions and complications placed on us by our site.

Table: issues other than animal behaviour that have influenced the KWS fence design: wind, drainage, public access & urban/rural surroundings (safety and vandalism), length of boundary, terrain, substrate

COMPONENTS:

The wall

Preferred design is a wall of 8 mm WOVEN WIRE. We are still assessing the risk of breach by mice (especially juveniles), but apart from that the material seems ideal. This product is available at smaller apertures but costs will escalate beyond our budget. A further option is to use a combination of different grades of wire with solid components separating mesh that excludes the smallest mammals from mesh which does not. Because of wind resistance we want to minimise the solid area of the fence wall. As woven wire is produced in sheets of 2.2 metres width, it limits fence height, but not to within the known jumping capabilities of cats.

Hat

The 25 cm half hat has been selected over the drum. Expansion and contraction over the length of the drum made it unsuitable. The half hat has lower material costs but construction is more technical. This can be countered by using a set of consistent angles for every change of direction. (A patent has been applied for the hat design and is pending)

Skirt

Extends 400 mm from the fence wall. Well over 95% of burrowing efforts were less than 400 mm from the fence wall. It is likely to be woven wire as this is water permeable. (Figure 3)

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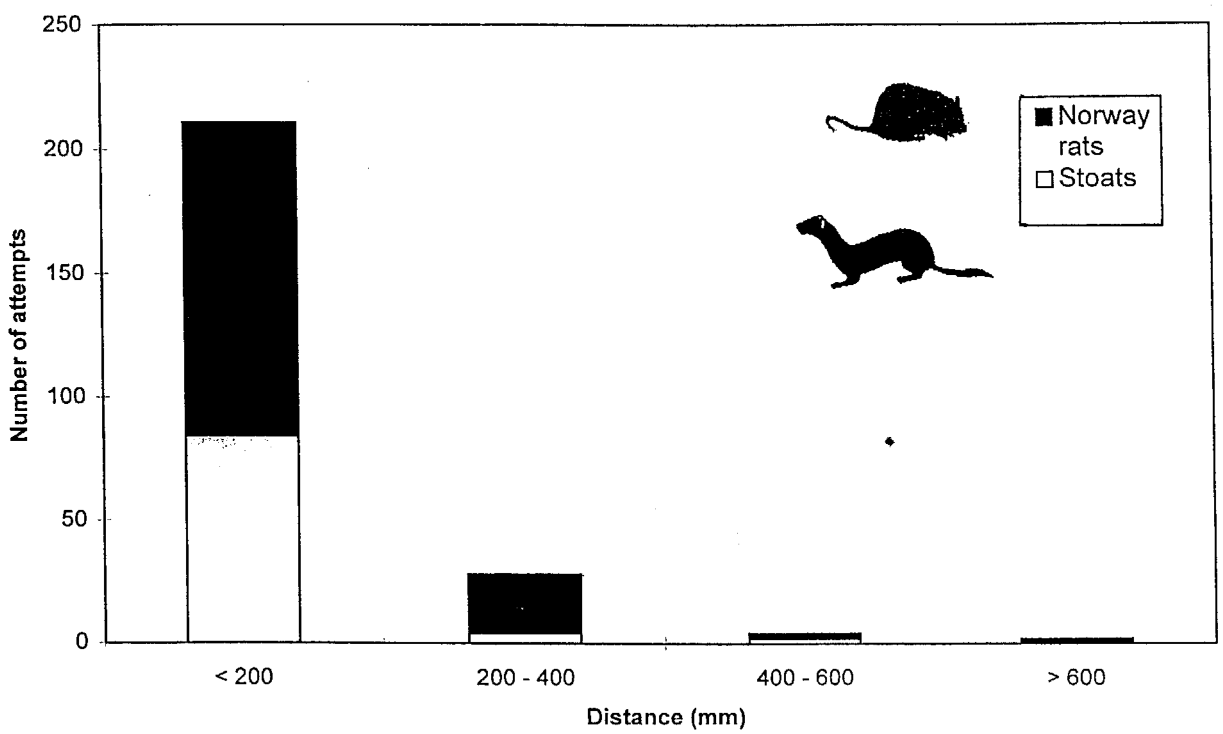


FIGURE 1. DISTANCE OF DIGGING ATTEMPTS FROM FENCE OR WALL.

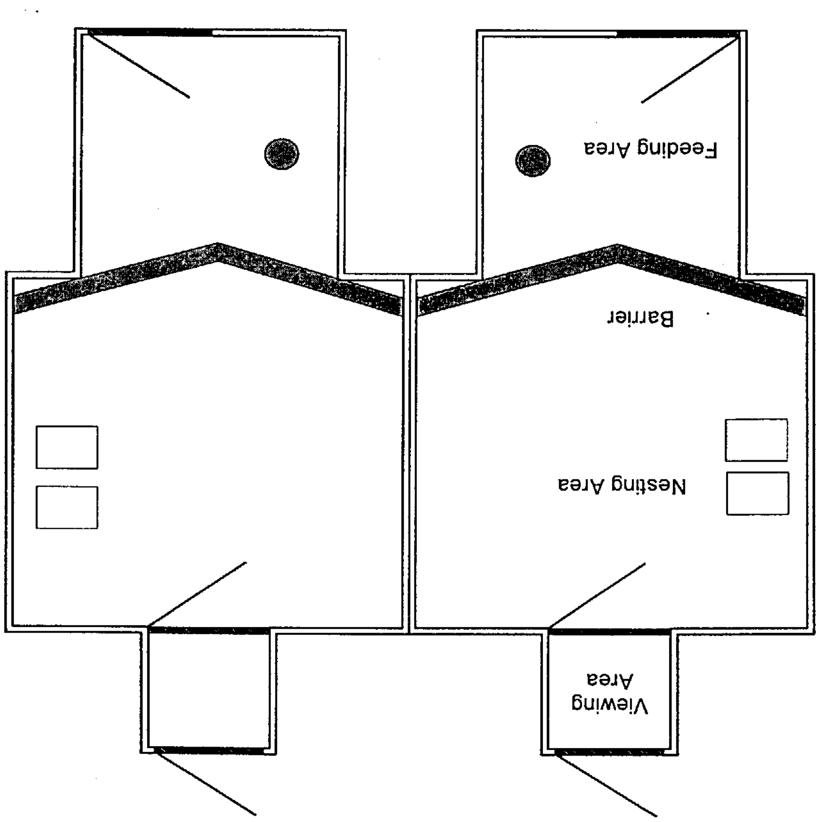


FIGURE 2. FENCE TRIAL ENCLOSURES.

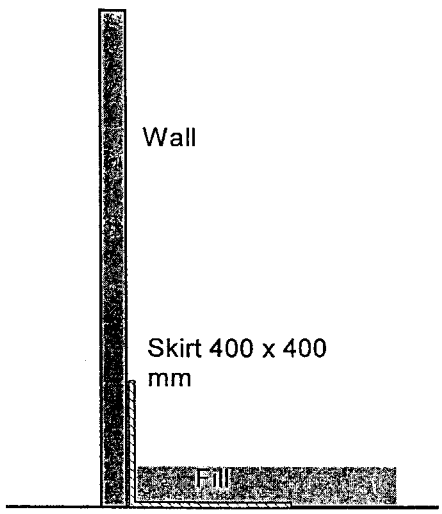


FIGURE 3. THE SKIRT.

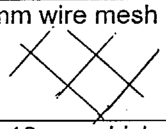
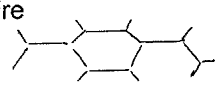
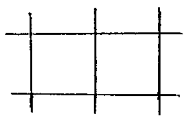
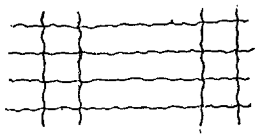
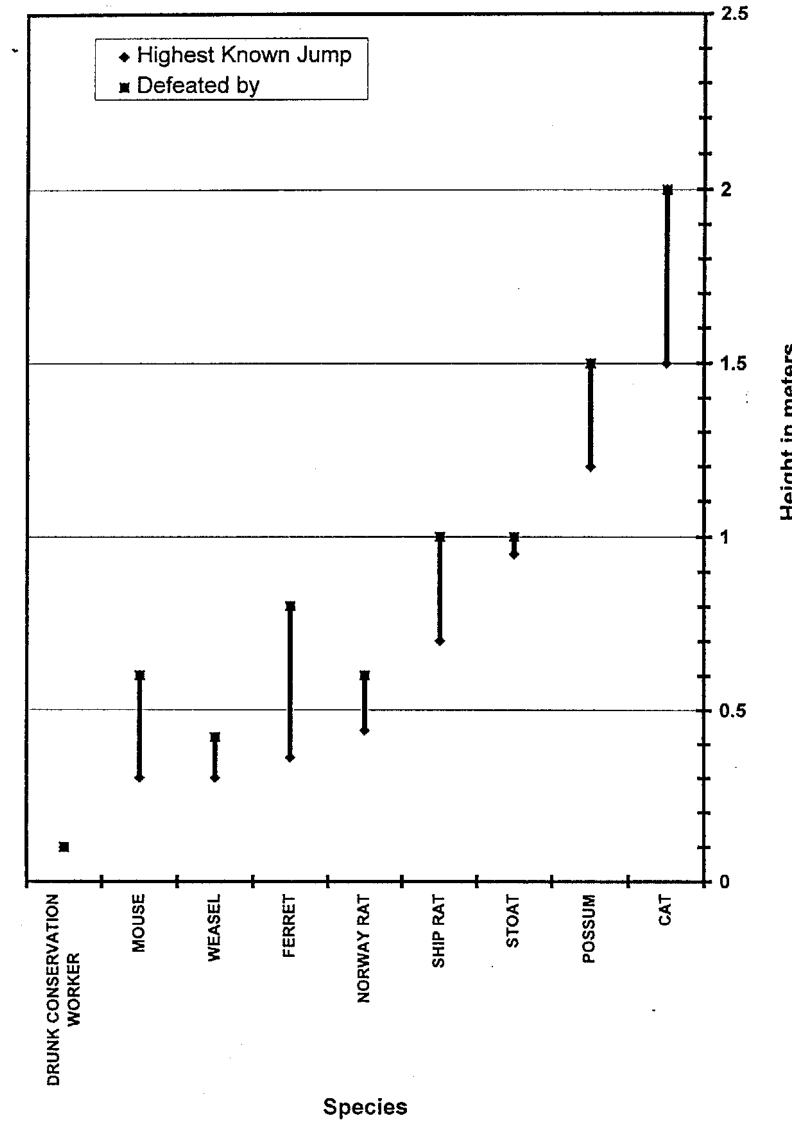
Mesh type and size	Excludes	Doesn't exclude
25 mm wire mesh 	ungulates possums cats adult male stoats	female, young stoats weasels rodents
20 x 13 mm chicken wire 	possums cats ship rats Norway rats adult mice	stoats (bite through) juvenile mice
12 mm weld fab 	possums cats stoats ship rats Norway rats adult mice	juvenile mice
8 mm woven wire 	possums cats stoats ship rats Norway rats adult mice juvenile mice?	juvenile mice?
6 mm woven wire	everything?	

TABLE 1. TYPE & SIZE OF DIFFERENT MESH.

FIGURE 4. PEST MAMMAL JUMPING ABILITIES.



Animal welfare and public perceptions

Peg Loague
National President, Royal New Zealand Society for the Prevention of Cruelty to Animals, PO Box 119, Taupo

"Those who argue at the extremes do so because emotion has overcome reason"

The animal welfare position is now being sought in almost every instance where animals are being handled differently from normal, whether pest or otherwise. Robust justification must be given in every case for interference in any way.

The Kaimanawa horses have been a classic example where much deliberate misinformation has been fed into the public arena. Horse "lovers" love the horses so much they would rather see them starving or going onto the Desert Road, endangering themselves and motorists, than see them culled. "After all, why cull them anyway when you only have to fly over the area and throw out contraceptives!" Common sense is an important ingredient in any debate.

RNZSPCA guards against having their name and reputation used to provide an air of respectability for any operation. Our position and principles must be maintained.

Our first intent is in our name - The Society for the *prevention of cruelty*.

If I had believed the welfare position was not going to be considered, I would not have been here this week, but I understand you want and need to know how to build welfare considerations into the management of pest animals.

In the Principles of Animal Welfare in New Zealand, section 6 addressing Wildlife and the Environment states -

"The RNZSPCA has grave concern for those animals, imported into New Zealand by man and then attaining pest status. While it is accepted that they must be destroyed, this must be done humanely, with as much compassion, dignity and respect as possible. There is no place for hysteria and hatred in the necessary destruction of pest animals."

This indicates our objection to activities like bunny shoots. Our concern is not that something like 25,000 rabbits were shot at the Alexandra shoot this Easter, but rather about the "picnic" atmosphere which seems to pervade the shoot and quite young children attending. Hysteria, rejoicing, excitement, competition all serving to desensitise the participants and their families to the fact that a warm sentient creature must die because man in the past has been careless or thoughtless. In not ensuring that we and our children acknowledge trauma, pain, suffering and fear in each living thing, we lose something of our own sensitivity to life in general.

It is easy to become desensitised. Indeed perhaps some desensitisation is necessary to continue in an unpleasant task, but we need to be aware of it.

From the Pest Summit in 1993 - had our forebears thought ahead to what rabbits and possums could become we might not have had such a problem now. We need to think about the problem cats are threatening to become. However, to stop the killing, we also need to stop the breeding.

Do not blame RSPCAs or SPCAs for the oversupply of kittens and cats. We have strong desexing rules - adult animals are desexed before they leave our care, while those people obtaining a young animal purchase a desexing voucher, usually costing at least half the price of the desexing operation. What about the "free to a good home?" or the child at school who needs homes for a litter before they're drowned?

There is a great need for more education in the schools. While this Society does what it can, there is always room for more.

In Victoria, Australia now, there is legislation controlling cats, where a firm is making large, aviary type cat runs so they are not over confined.

The animal welfare lobby cannot be accused of causing the possum problem by killing the fur trade, because as soon as a price was put on these furs, the animals were farmed - both possums and fetches. Once the market dropped, animals were released into the wild, compounding the problem.

Pest control, particularly stoats and cats, needs to be in place if and when RCD is introduced or their attention will turn to some of our native species.

While some methods of trapping can be acceptable to us, others are not so. It is the humaneness of any trap - or poison - which decides its acceptability.

Various methods of destruction are considered from the same position - if it is rapid and humane, it is acceptable.

Public perceptions must also be considered. A public poisoning programme in an urban area is not considered a good public relations move.

In meandering through a range of topics, I hope I've offered the opportunity to see the welfare concerns we have. We acknowledge the necessity for control of pest animals, but ask that it be as humane as possible, with consideration for the sentience of the animals and as much concern as can be maintained for the operators that they do not become desensitised to the fact that, in spite of its pest status, they are dealing with a living, feeling creature.

DoC Animal Ethics Committee

Don Newman
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BACKGROUND

DOC's Animal Ethics Committee (AEC) was established in August 1987 to ensure that all staff of DOC adhered to the Department's then newly approved Code of Ethical Conduct for the Manipulation of Live Animals. The empowering Animals Protection (Codes of Ethical Conduct) Regulations 1987 required (and still require) that no person shall carry out any work that involves the manipulation of any live animal, unless that work is in accordance with a code of ethical conduct. Codes have no force until approved by the Minister of Agriculture pursuant to section 19A(4) of the Animals Protection Act 1960.

The purpose of DOC's first Code was stated as being "to protect, and to prevent cruelty, to animals" (clause 4). The Code required (clause 15(c)) that all proposals to manipulate animals be approved in advance by the Department's Animal Ethics Committee.

Key definitions under the empowering Act and Regulations are (and remain):

ANIMAL

"Animal means -

a) Any horse, cattle, sheep, pig, goat, dog, cat, mule, or ass, of whatever age or sex and whether in a domestic or wild state.

b) Any bird, whether in a domestic or wild state.

c) Any marine mammal found on, or in the vicinity of, the seashore.

d) Any vertebrate animal that is kept in a state of captivity or is dependent upon man for its care and sustenance.

e) Any animal of a species that is declared by the Minister, by notice in the Gazette, to be a species of animal for the purposes of this Act."

Note: invertebrates are not included. (See section 2 of the Act, and regulation 2 of the Regulations).

MANIPULATION

"Manipulation, in relation to any live animal, means interfering with the normal physiological, behavioural, or anatomical integrity of the animal by deliberately

a) Exposing it to any parasite, micro-organism, drug, chemical, biological product, radiation, electrical stimulation, or environmental condition:

b) Subjecting it to enforced activity, unusual restraint, abnormal nutrition, or surgical intervention:

c) Depriving it of usual care;

but does not include any therapy or prophylaxis (prevention of disease, or control of its spread) necessary or desirable for the welfare of the animal."

(See regulation 2 of the Regulations; "manipulation" is not defined in the Act).

Limited meaning of "manipulation"

Neither the empowering Act, nor the Regulations is concerned with "manipulation" of animals in its widest sense. Both provisions are concerned only with manipulation of live animals in the specialised circumstances of.

(a) research work

(b)experimental work

(c) diagnostic work

(d)toxicity work

(e) potency testing work

(f) work carried out for the purpose of producing antisera or other biological agents

(g) teaching.

(See section 19A of the Act, and regulation 4 of the Regulations).

As an introductory statement to its first Code, DOC stated that the manipulation of live animals, as defined under the Animals Protection Act 1960, will be undertaken by both management and research staff. Consequently, certain clauses, such as 4, were worded in an open-ended way:

> "The purpose of this Code is to protect, and to prevent cruelty to, animals."

whereas, to be consistent with the empowering legislation, clause 4 should have continued:

> ... in the context of the manipulation of live animals for research work, experimental work, etc. ..."

DOC's first Code was, however, approved by the Minister of Agriculture and the Animal Ethics Committee took its approval to mean that they had authority to be involved in decisions entailing all animal manipulations: both for management and research purposes. It was recognised, though, that special emphasis had to be placed on research applications which were required to be dealt with on a case-by-case basis. For instance, consideration of research applications required not only assessment of method, but also matters such as determining if the number of animals to be manipulated was the minimum necessary to provide a scientifically interpretable result. In contrast, for management manipulations, only standard procedures were considered. Once a management manipulation, such as the use of Victor 1.5 soft-catch traps to catch possums, cats and rabbits, had been approved, as far as the Committee was concerned, the technique could be used by any DOC management officer without need for the protocol to be considered further. A list was maintained of animal management manipulations (protocols) the Committee had approved.

For several years this arrangement worked well but a review of the operation of the Code, in relation to the Kaimanawa Horses case, brought to light the fact that the Committee had been exceeding its powers in considering and approving management applications. Under the Regulations, AECs have the legal brief to address ethical issues related to the use of live animals only in relation to the matters specified in section 19A of the Animals Protection Act, and in regulation 4 of the Regulations.

MAF wrote to DOC in 1995 to express its reservations about the apparent DOC decision to use the DOC AEC to address ethical considerations of conservation management. DOC was advised that if this was continued, it must be made clear that Committee members were being consulted as individuals rather than in their formal role as the DOC AEC. In such circumstances the advice of committee members would not be binding on DOC. To resolve this situation, it became clear that DOC's Code required revision to ensure it was consistent with the empowering legislation.

CURRENT SITUATION

The revision of DOC's Code was completed in February of this year and submitted to MAF. The revision was based on a model code developed by the National Animal Ethics Advisory Committee. The model code was adopted in 1994 and is providing a consistent approach to code content and ensures no obligations under the legislation are omitted. I have since learnt the DOC's revised Code is acceptable to MAF and will be sent to the Minister of Agriculture for his final approval.

- The new Code gives authority to the Committee to receive and approve applications to manipulate live animals for research, teaching, or testing purposes only, not management. For DOC this raises the problem of where to draw what is often a very fine line between a manipulation for research, and a manipulation for management. The difficulty is not in determining whether an animal is being manipulated, but in determining when a protocol has research as its primary purpose, or is normal (standard) species management. As a contribution towards developing such guidelines, I offer the following suggestions:
- All investigations approved by GM (STIS) as part of DOC's science planning process

....RESEARCH

- All research-by-management programmes

....RESEARCH

- Standard monitoring/survey programmes (following approved QCM operating procedures)

....MANAGEMENT

The likelihood of arrival of stoats on islands

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INTRODUCTION

Islands are seen as key conservation resources because the presence of water around them is seen as a barrier to invasion of mammalian pest species. Taylor and Tilley (1984) reviewed the situation and determined that islands over 1200 m offshore were stoat free. They also concluded that islands less than 800 m offshore were subject to regular immigration by stoats.

Since that time the 1200 m distance has assumed the status of a rubric - accepted without further testing. A consequence of this is that islands over 1200 m offshore are seen as having a higher conservation value for either marooning species and/or re-introductions.

This paper seeks to document not just the absolute presence and/or absence of stoats on islands, but the frequency with which stoats are recorded on islands, particularly at the upper end of this range.

Figure 1 summarises the distance offshore and probability of arrival. It can be seen that there is a decline in probability of arrival as distance increases.

TABLE 1. SUMMARISES INFORMATION RELATING TO THE DISTANCE OFFSHORE, AREA, AND FREQUENCY OF ARRIVAL OF STOATS ON FOUR ISLANDS.

ISLAND	SIZE (ha)	DISTANCE FROM SHORE <m)	FREQUENCY OF STOAT ARRIVAL [2]	SOURCE
Pigeon Island'	160	1200	3/7	B. Lawrence, K. Springer
Mouwaho'	140	1350	1/16	S. Thorne
Maud Island	309	900	3/8	Crouchley 1994
Adele Island	87	800	2/2	Taylor & Tilley 1984
Moutapu'	117	1650	-	J. Fleming

Notes:
1. Islands in freshwater
2. Calculated as the number of incidents of stoats being observed per year of observations. The number of events rather than total stoats used.

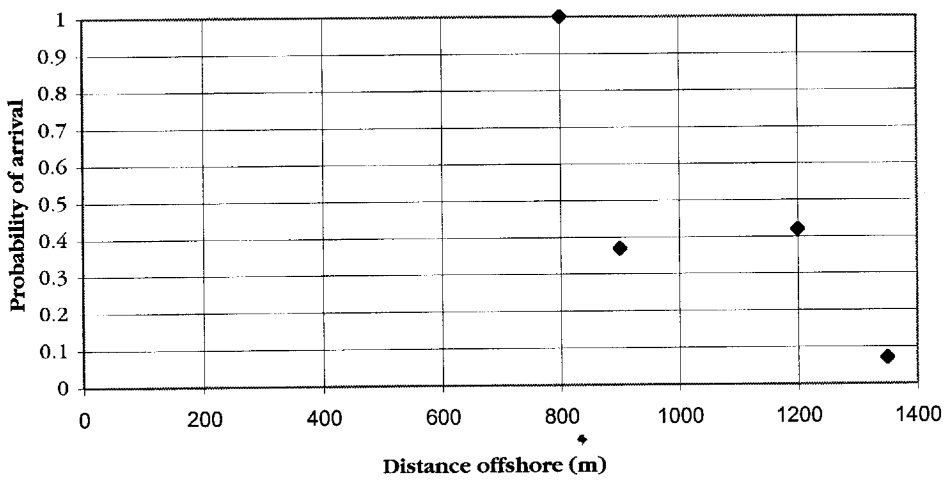

FIGURE 1. FREQUENCY OF STOAT ARRIVAL AS A FUNCTION OF DISTANCE OFF SHORE OF SOME ISLANDS.

An important item in Table One relates to the trapping of stoats on Moutapu in Lake Wanaka. This record questions reliance on 1200 m as absolute criterion for determining whether or not stoats can arrive on islands.

Intuitively, stoats can be expected to swim further in salt water than fresh water because of additional buoyancy, warmer water, use of currents, etc.

Table 2 in (Taken from Taylor & Tilley 1984) summarises their knowledge of frequency of presence on islands of stoats.

TABLE 5. THE ACCESSIBILITY OF 65 NEW ZEALAND ISLANDS (>2 ha IN AREA AND <5000 m OFFSHORE) ON WHICH THE STATUS OF STOATS IS KNOWN.

WATER CROSSING (m)	NUMBER OF ISLANDS	ISLANDS WITH STOATS	% WITH STOATS
0-400	10	10	100.0
401-800	11	11	100.0
801-1200	12	5	
1201-1600	10	0	0.0
1600 +	22	0	0.0

It can be argued that the frequency of arrival or percentage presence on islands with a probability of one is part of the normal annual behaviour of stoats, that, as the distances to islands increases a greater risk is undertaken by any stoat that is driven to make the swim to those islands.

Two of the three arrival events on Pigeon Island have been in the year after a mouse/stoat population eruption in adjacent beech forests.

It may be then that the islands over a certain distance are only subject to stoat arrival when an environmental forcing factor operates to cause an individual to determine that the risks of making the swim are more attractive than the risks of staying put.

On some islands now there are permanent trap lines in place to trap mustelids and rodents when they arrive on an island. If the above arguments hold, then it is apparent that quite different strategies need to be developed to respond to the arrival of stoats.

For example, on an island within the normal behavioural dispersal of stoats then a strategy needs to be in place to intercept stoats at all times. On an island that is further offshore an interception strategy could be of a lower permanent nature but supplemented by more intensive control when other environmental forcing factors come into play. If this strategy is adopted then considerable work is needed to:

a) define much more closely what distances offshore should be used as thresholds for differing strategies; and

b) to determine whether the use of environmental forcing factors are of real value in determining whether in any given year an increased frequency of predator trapping or alternative is necessary on any given island.

A further complicating issue is that the stoat that was discovered in a trap on Pigeon Island in March 1997 was found in a trap at the opposite end of the island to where it is closest to shore.

It is clear that we have no idea how efficient on effective permanent trapping lines are about catching stoats once they arrive on an island. I see an urgent need to undertake experimental work to investigate whether or not permanent trap lines are of any real value in protecting threatened species on islands from invasions by stoats.

Finally the data set that I have presented is inadequate to be able to move forward. It is compromised by having half the islands recorded in it in freshwater. I argue that stoats can be expected to swim farther in salt water than freshwater. The data set relies on a total of 33 years of observations. The data set relies on a descriptive approach to quantifying the arrival of stoats on islands. If we are to resolve this issue I advocate that we need instead to undertake an experimental approach. I would like to see research into defining the maximum range of stoats in both fresh and salt water and also research into determining the efficiency of the permanent trap lines that are already established on islands.

ACKNOWLEDGEMENTS

I wish to acknowledge Ian McFadden for an original idea and Geoff Rogers for his insight in preparing this manuscript.

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Implications of cat control

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INTRODUCTION

New Zealand, Mauritius, Seychelles, Hawaii and a host of other islands have horrendous recent records of extermination of native species resulting from the introduction of cats. Feral cats (Felis catus) are also found throughout the major land masses of the world as an exotic introduced species.

As with any species their abundance is dependent upon the food and shelter that is available to them and which other animals are, in turn, trying to eat them.

On the large land masses the impact of cats on the natural environment is clouded by time, human modifications and other environmental changes. The simpler island ecosystems can be used to demonstrate drastic impacts resulting from cat introductions and remarkable recoveries follow cat removal.

But where does the cat scene of mainland New Zealand fit into this picture?

To begin to answer the question we need to look at the predator/prey situation in a few other large and small ecosystems where cats are a recent introduction.

Great Britain (Figure 1)

The domestic cat reached Great Britain with the Romans. There was already a cat (larger than the domestic cat) there as well as a broad range of native mammals, varying in size from badgers and foxes to mice and voles. The impact of the domestic cat is unknown and it is not now singled out as introduced or a problem. Unfortunately this attitude extends to off shore islands where the cat is the only introduced carnivore and is having the same impact as we see around New Zealand - but this may have happened many centuries ago.

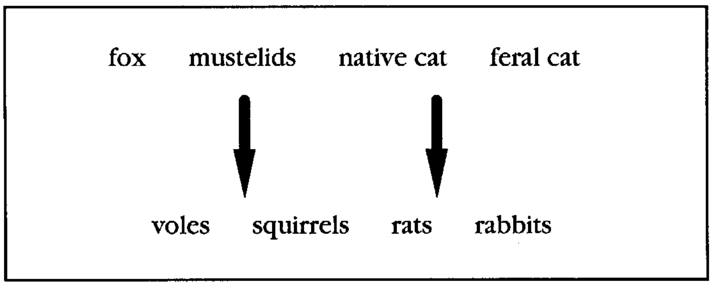

FIGURE 1. A SIMPLISTIC VIEW OF THE PREDATOR/PRREY SUITE OF GREAT BRITAIN. IF FERAL CATS ARE REMOVED THERE MAY BE LITTLE CHANGE TO BALANCE OF PREDATORS & PREY.

North America (Figure 2)

North America probably gained its first domestic cat with the early European settlers but when the first cat became feral is not known. Today there is evidence of feral cat predation on native wildlife despite evolution of the broad range of native species in the presence of an array of natural mammalian predators, such as bears, large cats, canids and mustelids. There is a strong movement to protect cats in the wild from persecution by both conservationists and native higher predators. Groups that want to protect the cats from conservationists say the cats are not causing a problem. Groups that want to protect the cats from native higher predators say all cats should be locked up.

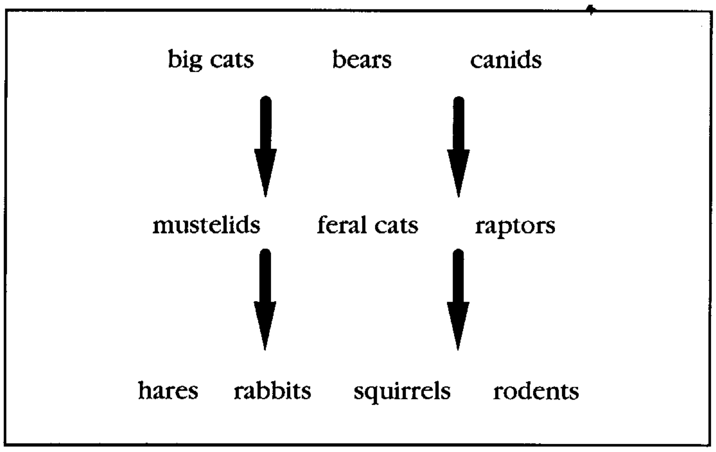

FIGURE 2. A SIMPLISTIC VIEW OF THE PREDATOR/PREY SUITE OF NORTH AMERICA. FERAL CATS MAY OCCUPY A SMALL NICHE WHERE THEY IMPACT ON A FEW NATIVE SPECIES.

Australia (Figure 3)

Australia also gained its first domestic cat with European settlement in the late eighteenth century. The impact of cats as a feral predator of native wildlife was first recognised over 130 years ago but has only recently been accepted as real and detrimental by a majority of interested parties. Now, in some areas, there are rules forcing people to keep their cats at home at night. In Australia there have never been higher mammalian predators that might effectively control cats and the native wildlife evolved in the absence of a significant mammalian predator. In areas, or at times, rabbits and mice may make up the bulk of the cats diet but, more commonly, small native mammals, birds and reptiles are their major food sources. The removal of cats from an area significantly reduces predation of the native animals and allows numbers to increase.

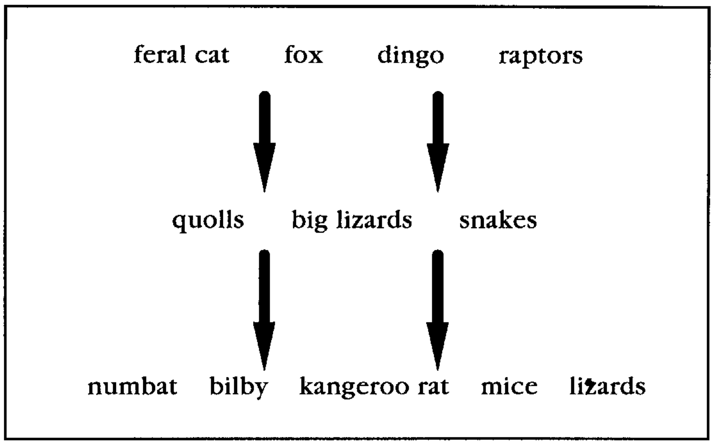

FIGURE 3. A SIMPLISTIC VIEW OF THE [REDATOR/PREY SUITE OF AUSTRALIA. FERAL CATS FILL A SIGNIFICANT VACANT NICHE AT THE TOP OF THE FOOD CHAIN. THEIR REMOVAL BENEFITS MANY NATIVE SPECIES.

New Zealand (Figure 4)

The pattern of cat introduction and recognition of their impact on native species in New Zealand is similar to that in Australia. But here there were also introductions of other predatory and prey animals. While these animals provided food for the cats, they also preyed on native wildlife - a situation that is not replicated in the other countries previously discussed. In most mainland (particularly forested) areas the bird populations that were seriously affected by cats are now gone and the cats depend for food on rats, mice and rabbits where they are abundant. If the cats are removed it is the rat, mouse and rabbit populations that benefit the most. This then results in more rats preying on the remaining birds, more rats and mice as food for stoats and more rabbits as food for ferrets. And all the predators continue to eat birds whenever the opportunity occurs.

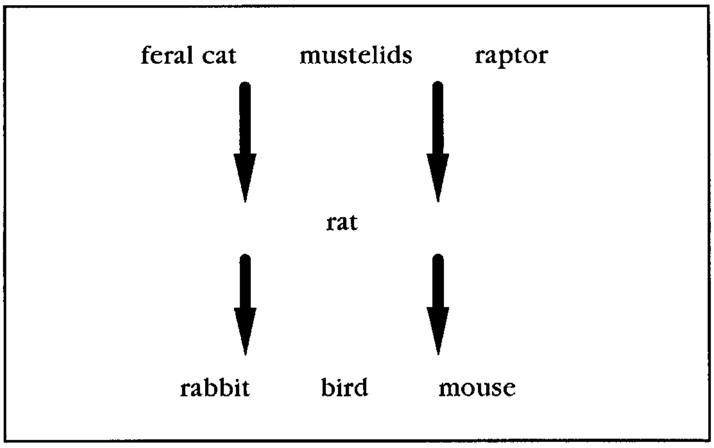

FIGURE 4. A SIMPLISTIC VIEW OF THE PREDATOR/PREY SUITE OF NEW ZEALND. IF CATS ARE REMOVED THE OTHER MAMMALIAN PREDATORS FILL THE SPACE AND BIRDS DO NOT USUALLY BENEFIT.

SUMMARY

The implication of cat control on mainland New Zealand, if it is done as a standalone operation, is that the native wildlife will not benefit or may even suffer. We do have a few examples to prove this point: In the Orongorongo Valley all animals were studied for a number of years, cats were then removed, rat numbers increased; On Raoul Island the diet of the cats was studied and the conclusion was reached that removal of the cats, while not removing rats, would not result in a significant change to bird numbers; On Little Barrier the cats were removed and bird numbers showed an initial change but most have since returned to pre cat eradication abundance due, it is concluded, to rat predation or competition. These situations are examples which are similar to many other parts of New Zealand but there will also be places where a single predator species will be targeting a single prey species.

Usually, however, if predation of native wildlife is seen as a problem then the entire predator suite needs to be controlled. This may be achieved by the very difficult task of actually killing all species or the more strategic approach of control of a key species or an environmental factor.

Development of a cat bait

Mark Wickstrom and Ray Henderson
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BACKGROUND

- Some feral cats are cautious/neophobic, and difficult to bait, especially when prey is abundant.
- Toxic baits tested and/or currently used in Australia and New Zealand include:
  - fresh fish or meat injected with 1080,
  - dried meat with attractant coatings,
  - Dupont/Bait-Tek polymer bait,
  - Applied Biotechnology wet matrix "Pussoff",
  - Animal Control Products fishmeal pellet.
- Problems with the ACP fishmeal pelleted bait:
  - reasonably palatable and efficacious at the pilot stage, less so when scaled up by ACP,
  - quality control problems with bait constituents, lack of stability in the field,
  - DoC and ACP funded studies to develop an improved dry-protein meal pelleted bait containing 1080 for feral cat control.

OBJECTIVES

- Enhance the palatability of the protein meal base.
- Assess the effect of binding agents on palatability and bait durability.
- Minimise oxidation and bio-degradation by bacteria and fungi by addition of antioxidants, bactericides and mould inhibitors.
- Increase field life by incorporation of water repellants that minimise moisture uptake.
- Test the palatability and efficacy of the final formulation containing 1080 in captive cats.

METHODS

- 30 feral cats lived trapped and maintained in individual outdoor pens on a diet of minced horse or beef muscle and organ meat

Palatability of new bait additives and formulation changes systematically tested in a two-choice or randomized block design using Go Cat as the ultimate control.

RESULTS

Development of the protein-meal bait base

- Dried protein sources evaluated included blood meal, whey, whole milk and soy milk powders, lamb milk replacer, cheese, fishmeal, meat meal, and chicken meal; all in various combinations and a range of concentrations.
- The best formulation was determined to consist of 40% chicken meal, 20% milk powder, 15% meat meal and 25% wheat (as a binder) - preferred to Go Cat.

Testing "flavour" additives to further enhance palatability

- Additives evaluated included sugars (dextrose, sucrose and lactose), salt, tuna oil, L-alanine, actinidia, and proprietary cat food flavours (chicken, beef, cream, and ham and chicken).
- Addition of 10% sucrose, 0.5% salt or 0.5% tuna oil significantly enhanced palatability of the base bait, and were therefore incorporated into the final formulation.
- L-alanine, actinidia and the proprietary cat food flavours did not increase consumption.

Evaluation of binding agents to increase bait durability

- 9 different binding agents (lignosulphonates, cellulose gums and metal oxides) used to facilitate agglutination of bait ingredients during pelleting were tested for palatability and effectiveness.
- Baits containing Cial 40 , MaxiBond or Synthemul were equally palatable (no reduction in palatability) and durable.
- Commercial-scale baits may be hard enough without binders (cats reject hard baits).

Evaluation of preservatives to increase stability

- Consumption of the base bait without preservatives declined significantly after only 10 days storage.
- 30 proprietary agents (10 bactericides, 10 fungicides and 10 antioxidants) were evaluated for their effect on bait palatability.
- Most were taste and/or odour-aversive at MIC.
- The combination of a proprietary pet food preservative (Pet Savour - a mixture of organic acids) which inhibits bacterial and fungal growth, and the antioxidants propyl gallate and tertiary butyl hydroquinone was palatable, and should be quite effective.

Evaluation of water repellents to increase field life

- 10 different water-repellents (including fats, waxes and synthetic agents, both surface-coated and mixed into baits and pelleted) were tested for their effect on bait palatability and moisture absorption.
- The best result was achieved with a surface coating of beef tallow (palatability was increased and coated baits absorbed little water on immersion).

Evaluation of effect of pellet size on bait intake

- The consumption of small (0.2 g), medium (1 g) and large (3 g) bait pellets was compared.
- Intake was not related to pellet size.

Evaluation of the palatability and efficacy of the final toxic bait formulation in captive cats

- Water-repellent toxic baits were prepared containing 1080 at 0.1% and a green dye (0.075% Bayer v200).
- Toxic baits were presented in paired trials with non-toxic baits to evaluate the potential for aversion, or alone to determine consumption in a no-choice situation. Cats were also offered half their normal meat ration.
- 80% of cats consumed a lethal dose on the first exposure; recovered cats were not bait-shy.
- Consumption of both toxic and non-toxic bait was reduced in paired trials, probably due to the rapid onset of clinical signs.

WORK IN PROGRESS

Evaluation of self and field life

Palatability to captive feral cats of uncoated and water-repellent non-toxic baits will be re-assessed after storage for 30 days at:

1. 20 C in sealed containers, and
2. 30 C in open containers in a humid environment.

FUTURE RESEARCH

- Studies to compare the palatability and efficacy of the Landcare pelleted 1080 bait with the Dupont/Bait-Tek polymer bait and the Applied Biotechnologies "Pussoff" bait in:
  - pen trials with captive feral cats
  - parallel field trials using bait stations and radio-collared cats with mortality sensors during periods of high and low prey abundance
- Collaborative studies with the 'cat-specific' toxicant being developed at the Victoria Institute in Melbourne

Predator trapping results Mimiwhangata/Puketi

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I NTRODUCTION

Mustelid trapping was undertaken at two sites in Northland where management was aimed atprotecting brown teal populations. Mark 6 fenns were used.

1) Mimiwhangata Farm Park - c.500 ha of coastal pasture with c. 6 km of forest margin and scattered forest remnants. Paired fenn traps were set in wooden double ended covers using primarily fresh rabbit baits replaced weekly. Trapping was undertaken at 40 sites with traps set for 2 weeks/month.

2) Private management operation adjacent to the southern boundary of Puketi forest alluvial river flats with meandering stream with c. 3 km of forest margin and scattered trees. Single traps were set in single - entrance wooden covers ("blind" end blocked off with chicken mesh).

Sets rebaited weekly and checked as often as possible by the landowner.

RESULTS

Mimiwhangata

During the 4 month period November 1996 - February 1997 8 mustelids were caught No adult or juvenile teal were preyed on in this time (or subsequently). 70 juvenile teal were produced by 27 pairs from 31 known breeding attempts. 44% of known ducklings were lost in the first 3 weeks. Summer roost counts at Mimiwhangata increased by 218% over last year, however,counts at another roost site to the south which is not receiving any direct management also increased (by 216%).

Puketi

Following an unsuccessful teal transfer and release in 1995 (all 7 monitored teal were preyed on by cats and mustelids within 1 month of release) and in the virtual absence of any predator control, 8 Transmittered teal were released in July 1996. Most of these birds were males, only 1 bird was recovered dead on the property in November 1996.

A second release in August 1996 of 6 female and 1 male teal resulted in the birds apparently leaving the area. One bird in October 1996 was recovered after being preyed on by a stoat. The one remaining monitorable female produced a brood of 6 ducklings in November 1996 and succeeded in fledging all of them.

Three of the ducklings were transmittered in January 1997. All appeared to have left the area by mid February as the parent birds had become territorial and evicted them from the main pond.

During the capture of the juvenile teal a banded male teal was captured which was not released on the property! Unfortunately poor records mean that we cannot determine the date and release site of this captive-raised bird. It was probably released in either the Bay of Islands or Hokianga Harbour within the last 3 or 4 years. Currently 2 pairs and at least 2 other teal (1 suspected juvenile) are still present on the property. Ten more captive-reared teal were released in April 1997 and predator control will be maintained continuously for a further year until the long term potential of protection management in this area is ascertained.

This programme has been run on a voluntary basis with minimal support from DoC staff. It is hoped that both monitoring and predator control can be undertaken long term by a small team of local volunteers.

Stoat catch rates appear very high. Between November 1996 and February 1997 34 stoats were caught mostly within the 40 ha alluvial area., Up to 5 stoats were caught per week. A significant increase in the rate of catch on the south side of the steam suggests influx from an adjoining forest reserve.

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