Protecting New Zealand dotterels from predators

John Dowding
Dowding Murphy Consultants, PO Box 36-559, Northcote, Auckland 1330

INTRODUCTION

The New Zealand dotterel *(Charadrius obscurus)* is an endemic ground-nesting shorebird. There are two subspecies, one confined to coastal areas of the North island and the other now breeding only on Stewart Island. Introduced mammalian predators have a very large impact on both subspecies but the major impacts are at different stages of the life-cycle, leading to big differences in productivity, adult survival and age structure in the two populations. These differences (summarised in Table 1) mean that management strategies for the two populations need to be somewhat different.

TABLE 1. DIFFERENCES IN THE IMPACT OF PREDATION ON THE TWO SUBSPECIES OF NEW ZEALAND DOTTEREL.

	NORTHERN SUBSPECIES	SOUTHERN SUBSPECIES
Main predators	Cats, stoats, hedgehogs	Cats
Main impact	Predation of eggs and small chicks	Predation of adults, particularly males
Problem results in:		
Typical productivity	Low (0.0-0.3 ch/pr)	High (0.6-0,9 ch/pr)
Adult life expectancy	About 13 years	About 5 years
Adult gender ratio	About 1 male : 1 female	About 1 male : 2 females
Turnover	Lower	High

NORTH ISLAND

The greatest single problem facing the northern subspecies is loss of eggs to predators; evidence to date suggests that cats, stoats and hedgehogs are the main culprits. As a result, productivity at unmanaged sites typically averages 0.0-0.3 chicks fledged per pair. At sites where effective predator control has been carried out for several years (such as Opoutere and Matakana Island), productivity is usually in the range 0.6-1.0 chicks fledged per pair.

However, at some important sites (such as Omaha Spit), there are housing developments with large numbers of people and domestic pets close to dotterel breeding areas. At these sites, killing domestic cats (and even hedgehogs) is likely to have an adverse effect on public support for protection programmes, so other means of reducing predation by cats would be of value.

Exclosures around nests are a possible solution. A prototype `nest cage' which covers the nest completely has been developed and is being trialed. It is proving more difficult than expected to find a mesh size that will allow dotterels access to their nest but exclude all cats. However, the cages are to be trialed at Omaha, where egg survival averages about 6 days, during the 1997-98 season. The advantages of the cages are obvious: they should exclude most cats and possibly hedgehogs. Potential disadvantages are (a) the cages may attract people and result in higher levels of disturbance to incubating birds or vandalism, (b) some birds may not accept cages over their nests (but this has not yet happened in preliminary trials), and (c) mesh size that allows dotterels access will not exclude rats or mustelids. Simple fences with smaller mesh placed around nests are another possibility. The advantage of these would be that smaller predators could be excluded; disadvantages are (a) some animals may climb over them (unless the top is `floppy' or angled outwards) and (b) dotterels would have to fly on and off the nest (which they do not normally).

STEWART ISLAND

The main problem facing the southern subspecies is high adult mortality, probably largely caused by cats, although rats may have some impact. Adult males appear to be more susceptible to predation, probably because they undertake most of the night-time incubation.

In an attempt to protect incubating adults, cat control has been carried out for several years at Table Hill, the single most important breeding site remaining. The programme involves a cordon of bait stations around the breeding area; stations are loaded in August or early September (just before birds begin laying) and baits are replaced at two-week intervals until February.

Combining the four seasons 1992-93 to 1995-96, mortality of adult dotterels at Table Hill averaged 18%; during the same period mortality at other sites (with no cat control) averaged 17%. This suggests that the programme has not been particularly successful in increasing survival of adult dotterels. However, for a number of reasons control was clearly sub-optimal for the first two or three years; baits were sometimes installed too late and were not changed frequently enough.

Trials need to continue to determine whether cat control can improve adult survival. There appear to be `good' and `bad' years for dotterels on Stewart Island, but whether this is related to differences in cat density is not yet known. There have now been two `good' years in a row, with survival and productivity high in cat-control and non-treatment areas alike. Now that the programme is running as planned (baits are installed early and changed frequently), what is really needed is a `bad' year, to see whether dotterel survival can be improved in cat control areas.

POSSIBLE IMPROVEMENTS TO THE PROGRAMME INCLUDE:

- early-season trapping of cats to supplement poisoning,
- trialing new baits in addition to that in current use,
- use of predator exclosures around nests,
- understanding the factors operating during `bad' years might allow us to predict when more intensive or more widespread cat control (or other measures) would be useful,
- a radio-tracking study of cats on Stewart Island to learn about movement patterns, foraging activity and habitat use should help in devising control strategies.

Predator research in Fiordland trialing stoat control tunnels

Jane Maxwell, Simon Torr, Hamish Leary, Greg Coates and Verity Forbes
Southland Conservancy, Department of Conservation, PO Box 743, Invercargill

INTRODUCTION

The goal of this research is to improve the efficiency of future stoat trapping and poisoning operations by determining which of a selection of the currently available tunnel designs is most readily used by stoats, keeping all other factors equal.

METHODS

2 trials-comparing designs of:

1. trap cover designs and
2. of poison egg tunnels.

Location / Timing

2 separate areas of Fiordland National Park -poison line alongside Hollyford Valley Road, 19/1/97 - 9/4/97 (11 weeks), and trapline along Milford Track down the Arthur Valley, start 6/11/96 (20 weeks).

Designs Tested

Poison tunnels:

A: Wooden with floor, open both ends.

B: Aluminium, with floor, open both ends (Simon Torr's).

C: Plastic moulded, with floor, open both ends (Phil Thompson's).

D: Black "novaflow", blind (Okarito "NO EGGZIT" type).

Trap tunnels:

A. Wooden with floor, two traps, open both ends.

B. Wooden with floor, one trap, blind.

C. Lightweight aluminium, no floor, two traps, open both ends (Graeme Loh's).

D. Lightweight aluminium, non floor, one trap, blind (Graeme Loh's).

E. Square weld mesh, no floor, one trap, blind (Ian McFadden's design).

F. Chicken wire, no floor, blind (Tuatapere's modified).

Traps used were mark 4 fenns. The trapping tunnels were baited with hens eggs, and the poison tunnels with poisoned hens eggs.

Experimental Set-up

Poison tunnel experiment - 30 tunnels of each of types A, B and D and 20 of type C, i.e. 110 tunnels.

Trap tunnel experiment - 20 tunnels of each of the six types, i.e.,120 tunnels.

Stationed at 100 m intervals.

Tunnel types spread evenly through lines, e.g. A B C D A B C D etc.

All tunnel types cycled around all sites on the line (important part of experimental design, removes bias from site characteristics attracting stoats unevenly (see Appendix for design).

Poison Eggs

Eggs dyed green, injected with 1 ml 1080 solution, concentration 0.1%, sealed with nail varnish. Two eggs in each tunnel, checked weekly, any missing eggs replaced at each check. All eggs replaced once a month, to ensure toxicity of poison. Entrances of tunnels too small to allow passage of a whole egg, preventing animals from stashing bait elsewhere, rather, the bait must be consumed within the tunnel.

RESULTS

Poison Tunnels

Results are presented in two ways;

I. visits per 100 corrected tunnel nights (CTN),

II. eggs taken per 100 CTN.

The reasoning behind (i) is that it is not yet known how many eggs one stoat may take from a tunnel per visit. If both eggs were gone, we could not tell whether the same stoat took both eggs, or whether two different stoats took each egg. Therefore if either one egg or two disappeared, the result is reported as one visit, and the number of tunnel nights is corrected assuming that tunnel being out of action for half the time between checks. This makes a more conservative measure of preference for any one type, in that even if a tunnel has two eggs taken, it has only as much "advantage" in the stoat popularity stakes over other types as if only one egg was taken. The reasoning behind (ii) is that if we assume that stoats will only take one egg per visit, and that one egg is a lethal meal for a stoat, then each egg taken represents an independent choice by a different stoat, and thus the tunnels which manage to attract two stoats to take an egg each are given full credit. By this system, tunnel nights are not corrected to half the number of nights between checks unless both eggs were taken.

When tested by chi-square, at the a = 0.05 level, the data support the theory that stoats have a preference for one or other type(s) over others.

TABLE 1. HOLLYFORD VALLEY EGG TUNNEL TRIAL, SUMMARY OF CHECKS # 7 TO # 17.

COVERS	VISITS	EGGS	C.T.N.	V/100C.T.N.	E/100C.T.N
WOOD	28	32	2346	**1.19**	**1.36**
AL.	20	27	2380	**0.84**	**1.13**
PLAS.	12	17	1604	**0.75**	**1.06**
NOVA.	4	4	2443	**0.16**	**0.16**
TOTAL	**64**	**80**	**8773**	**0.74**	**0.93**
NIGHTS		**82**			

Trap Covers

TABLE 2. ARTHUR VALLEY TRAP TUNNEL TRIAL, SUMMARY OF CAPTURES AFTER 20 CHECKS TO 4TH APRIL.

TRAPS	C.T.N	STOATS	RATS	S/100CTN	R/100CTN
WOOD 1	2687.5	7	0	0.26	0
WOOD 2	2749	12	1	0.43	0.04
AL. 1	2746	11	1		0.04
AL. 2	2793	11	1	0.39	0.04
SQUARES	2701.5	7	2	0.26	0.07
CHICKEN	2668	8	3	0.3	0.11
TOTAL	**16345**	**56**	**8**	**0.34**	**0.05**

CTN = Corrected tunnel nights
S/1000TN = Stoat captures per 100 corrected tunnel nights
R/1000TN = Rat captures per 100 corrected tunnel nights
When tested by chi-square at the a = 0.05 level, these data provide no evidence for preference of stoats for any trap cover type.

Ease of Use

See through wire tunnels were easy to check for captures. In grassy areas, they could have the potential disadvantage of getting choked with vegetation if used without floors. Wooden ones with easily slid lids and no requirement for anchoring to the ground come ahead of the aluminium trap ones, which require flipping the lid up or getting eyes low enough to see inside, which come ahead of the plastic and aluminium and novaflow types, which all require lifting of the anchor wires to open the lid, then re set-up, which takes a lot more time. Wooden ones on the other hand are heavy to transport, very few can be carried by one person at once.

DISCUSSION

Poison bait tunnels

It would seem from the results that the "no eggzit" black novaflow type of tunnel is a bad choice if you want to kill stoats, and the wooden type is the best, in these trials over seven times the number of animals visited wooden tunnels than novaflow ones. However when choosing a design of tunnel for a poisoning operation, attractiveness to animals is perhaps not the only thing to consider - logistics come into it, especially with remote locations. The weight of the wooden tunnels means that they are good candidates for an area where there is vehicle access, (or just as good, free labour - the wise and brave but warden on the Milford delegated carrying the covers to keen and not-so-weary trampers!). Other than that, either the aluminium or plastic would be better than the novaflow type.

Trap covers

Although the two-ended wooden trap covers came out with the highest capture rate of the types trialled, when tested, the data did not provide sufficient evidence for stoats having any preference for any type(s) over others.

Therefore there is no clear advantage in the tunnel being open both ends (in which case two traps per tunnel are needed) over a blind tunnel which requires only one trap. Catch rates of blind vs two ended tunnels were also compared in North Island podocarp forest at Kaharoa by Hazel Speed over three years of trapping on a line of 70 traps, for six months annually. Her results showed no difference between the two types of set up (Elaine Murphy, pers comm.).

FUTURE WORK

A decision on what to trial next will be influenced by final results from this season and discussion of priorities at this workshop (covers, baits?). Carrying out trials by substituting the original tunnels with alternative types on long term index monitoring lines in other trapping or poisoning programmes has the disadvantage of possibly affecting catch rates on those lines, and thus the capture figures would no longer be comparable between years. This defeats the original purpose of the index line! Thus it is better to set up new lines such as these specifically to run such experiments.

Secondary poisoning research in Westland

Kerry Brown
Ecosystems Consultants, PO Box 6161, Dunedin

INTRODUCTION

Predation is the main cause of ongoing population declines of several native bird species. Brodifacoum offers "multi-predator control" because it is effective at killing a wide range of mammalian pests in one operation. In addition, poisoning with brodifacoum is more cost-effective than trapping. Shyness problems associated with acute poisons and trapping are also avoided because the poison is presented to predators in their prey.

The Department of Conservation is using brodifacoum for predator control. However, before brodifacoum can be used more widely, the ecological costs and benefits of its use need to be determined and the most cost-effective strategies identified.

This research investigated the efficacy of cereal baits containing brodifacoum (Talon 20 P) at killing stoats *(Mustela erminea)* and ship rats *(Rattus rattus)* when mice *(Mus musculus)* were abundant in January and February 1996, and scarce from August to December 1996 in mixed red beech *(Nothofagus fusca)* and silver beech *(N. menziesii)* forest at Maruia, South Island, New Zealand. In addition, two different poisoning regimes were tested for efficacy of predator control and risk of poisoning to South Island robins *(Petroica australis australis)* and moreporks *(Ninox novaeseelandiae novaeseelandiae)* when mice were scarce.

RESULTS

All radio-tagged mustelids resident in the study sites died. Eleven radio-tagged stoats and one weasel *(Mustela nivalis)* died of secondary poisoning after cereal baits were hand broadcast and left exposed on the forest floor at 3 kg/ha when mice were abundant. Five radio-tagged stoats were poisoned after cereal baits were placed in bait feeders on a 100m grid at 0.32 kg/ha, and another five when baits were hand broadcast at 3 kg/ha and left exposed on the forest floor, when mice were scarce. The average time stoats took to die varied between poison operations which suggests that different prey species were important poison sources during each operation. However, variation in sowing rates between poisoning regimes during low mouse abundance may have influenced stoat death rates. Immigrant stoats that were kill-trapped at one poison site two months after poisoning contained high levels of brodifacoum. Ship rats, mice and brushtail possums *(Trichosurus vulpecula)* were also poisoned. Repeated observations of banded and radio-tagged territorial adult robins were used to determine survival from six to eight weeks after poisoning. At least 97% of the robins survived after poison was deployed in bait feeders, whereas a minimum of 52% of the robins survived after poison was hand broadcast, and left exposed on the forest floor. At the non-treatment site at least 86% of the robins survived. This study demonstrated that individual robins are at risk from poisoning when cereal baits containing brodifacoum are hand broadcast and left exposed on the forest floor and therefore, probably from aerial application of such baits. Only three moreporks were monitored through the two different poisoning regimes when mice were scarce, and all three were alive two months after poisoning. This study also identified radio-tagging of robins as a valuable tool for determining risk because it allows direct measures of poisoning.

CONCLUSIONS

Cereal baits containing brodifacoum are effective at killing predators in Nothofagus forests in mast and non-mast years. The most cost-effective predator control strategies need to be determined to maximise protection of native wildlife communities.

Further research is required to determine whether the benefit to bird populations from successful predator control outweighs the loss of some birds by poisoning. Conservation managers must take a wide view of the ecological community impacts when controlling introduced mammalian predators. This research was funded by Timberlands West Coast Limited and the New Zealand Lottery Grants Board and was carried out by Ecosystems Consultants. This research is described in full in two unpublished reports and three scientific papers:

REFERENCES

Alterio, N.; Brown, K. and Moller, H. 1996. Multi-predator control in a South Island *Nothofagus* forest. Ecosystems Consultants Report Number 3, for Timberlands West Coast Limited, Greymouth, New Zealand.

Alterio, N.; Brown, K. P. and Moller, H. (in press) Secondary poisoning of stoats *(Mustela erminea)* and a weasel *(M. nivalis)* in New Zealand *Nothofagus* forest. *Journal of Zoology* London.

Brown, K.; Alterio, N. and Moller, H. 1996. Multi-predator control and assessment of non-target impacts in a South Island *Nothofagus* forest. Ecosystems Consultants Report Number 8, for Timberlands West Coast Limited, Greymouth, New Zealand.

Brown, K.P.; Alterio, N. and Moller, H. (subm.) Multi-predator control at low mouse *(Mus musculus)* abundance in a New Zealand *Nothofagus* forest. Wildlife Research.

Brown, K.P.; Alterio, N. and Moller, H. (subm.) Impact of brodifacoum poisoning operations on robins *(Petroica australis australis)* in a New Zealand *Nothofagus* forest. *Bird Conservation International.*

Secondary poisoning research in the central North Island

Elaine Murphy
Science & Research Division, Department of Conservation, Private Bag 68908, Newton, Auckland

INTRODUCTION

Large-scale poisoning by aerial application or bait stations is used routinely to control brushtail possums and ship rats in New Zealand forests. The two toxins mainly used are sodium monofluoroacetate (1080) and brodifacoum (Talon). For aerial operations, 1080 is incorporated in cereal pellets or applied to carrots. For bait station operations, 1080 is generally used for initial knockdown and then followed by brodifacoum for maintenance (both incorporated into cereal baits). Ship rats are the major prey of both stoats and cats in North Island lowland forests and the indirect effects of the poison operations on these predators are not well understood, although some secondary poisoning of them is known to occur.

At Mapara Wildlife Reserve (1432 ha), possums and rats were controlled by using brodifacoum in bait stations in 1993/94 and in 1994/95. An attempt to control stoats was also made by setting 140 Fenn traps along a 24 km trapline. Very few stoats were caught from October to December in the bait station years (two in one year and three in the next), compared to the previous three years when possums and rats were controlled by aerial 1080 operations (seven, nine and 13 stoats caught respectively). From January to September however, numbers of stoats caught were similar in all years.

To check whether they were eating poisoned prey, 70 mustelids were analysed for residues of brodifacoum. Thirty of 40 stoats, nine of 16 ferrets and ten of 14 weasels caught throughout the year had lethal or sub-lethal levels of brodifacoum in their livers. It could not be determined how many resident predators were being killed by secondary poisoning, or whether re-invasion was so fast that no overall benefit was gained. There was an indication however, that numbers of stoats may be lowered in the first few months after brodifacoum was used in bait stations.

To try and measure the effect of secondary poisoning on predators, a two year field study was set up last October in Pureora Forest by myself and Lloyd Robbins.

OBJECTIVES

1. Measure mammalian predator abundance in relation to control operations undertaken for possums/rats.

2. Measure survival of resident mammalian predators during & after control operations, and determine cause of death if any mortality.
3. Monitor any re-invasion of mammalian predators during & after control operations.
4. Monitor rat and mouse abundance in relation to poison operations and measure recovery rates (Conservancy is doing this).
5. When Talon is used in bait stations, measure brodifacoum levels in rodents during and after the poison operation.

There has been a history of both aerial and bait station control of possums and rats in the Waipapa Ecological Area at Pureora. 1080 was used in bait stations in 1993/94 and 1994/95, 1080 and brodifacoum in 1995/96 (covering an area of about 2,500 ha). A large-scale aerial 1080 carrot operation (covering about 30,000 ha) was undertaken over the North Block of Pureora (including Waipapa) during the winter of 1996. The bait stations at Waipapa were filled with brodifacoum in September 1996 and bait was available continuously until it was removed in April 1997.

Three predator live-trapping lines were set up. One was at Waipapa (Select Loop), one in the pine forest adjacent to Waipapa and one at Waimanoa (non-treatment area). Mustelid tracking tunnel lines were also set up at Waipapa and Waimanoa on the live-trapping lines, to act as a second index and to try to correlate numbers caught in live traps to tracking rates.

RESULTS

At Waipapa, only four weasels, one stoat and one cat were caught in 1,865 trap nights from November to February. In the pine forest adjacent to Waipapa, four weasels, one ferret and one cat were caught in 433 trap nights. At Waimanoa however, nine stoats were caught in only 83 trap nights in February. Tracking tunnel results reflected the live-trapping results; no mustelid prints were detected at Waipapa but 78% of tunnels were tracked at Waimanoa.

The conclusion that could be drawn from these preliminary results is that by using brodifacoum in bait stations, on-going predator control was achieved by secondary poisoning.

Because there was no replication at any of our sites, we added another two tracking tunnel lines to the Waipapa and Waimanoa study areas. We found that the high numbers of stoats caught and tracked at our Waimanoa site was not replicated at two other sites in the same area (see Table 1).

WHAT DOES IT MEAN?

The low numbers of stoats at Waipapa may not be a result of secondary poisoning. It may just be part of a normal fluctuation. King et al. only caught 10 stoats (& five ferrets) in 6,281 trap nights from January 1983 to October 1987 in the same area.

We know very little about stoat demographics in central North Island podocarp forests. We need to undertake long-term monitoring at a number of sites. It is hard to untangle normal fluctuations from those caused by other perturbations, such as secondary poisoning.

IMPORTANT QUESTIONS IN RELATION TO SECONDARY POISONING:

1. Is the proportion of predators killed by secondary poisoning sufficient to confer a benefit to threatened prey species?
2. Does the proportion that die vary with time of year?
3. How is this related to rodent density? (& is this related to bait station spacing and area covered by bait stations?)
4. What is the relationship between surrounding habitat and re-invasion rates?
5. If re-invading stoats die from secondary poisoning, how many days does it take and is this quick enough for very vulnerable species such as kiwi and kaka?
6. If you only poison some of the rodents, to try to secondarily poison predators over longer time periods, will it take an unacceptable time for the predators to die - if they do at all?
7. What are the impacts of the poison on non-target species?

TABLE 1. MUSTELID TRACKING RATES RECORDED AT PUREORA FOREST IN 1997 (TUNNELS BAITED WITH MEAT).

	WAIPAPA (TALON BAITED AREA)			WAIMANOA (NON-TREATMENT AREA)		
Month	Select loop	Line 63	South Hunters	Waimanoa road	Titirau-penga	Gorge road
January (5 nights)	0 % 47 tunnels			78% 36 tunnels		
February (2 nights)	0 %			78		
March (2 nights)			10 %			
April (2 nights) tracks/tunnel	0 % 0/29	3 % 1/32	12% 4/33	52 % 15/29	3 % 1/30	0 0/30

Monitoring the effects of secondary poisoning in predators at Trounson Kauri Park

Craig Gillies
c/o Department of Conservation, Trounson Park Road, RD 9, Dargaville

I NTRODUCTION

Trounson Kauri Park is located South of the Waipoua Forest about 36 km North of Dargaville on Northland's West Coast. The park comprises 450 ha of mixed kauri-podocarp hardwood forest, surrounded by grazed pastureland and bordered by the Waima River on it's Southwestern edge. As part of the Department of Conservation (Northland Conservancy) Trounson Ecosystem Recovery plan, a combination of poisoning and trapping is being employed to upgrade the park to a pest and predator free "mainland island". In June 1996 the Department of Conservation began the possum and rodent control operation at Trounson. The initial phase of the control operation involved 1080 poisoned pellets being put into bait stations set one per hectare, throughout the park. These baits were removed from the stations after about 18 days. The second phase of the operation for possums and rodents involves a continuous Brodifacoum campaign. This began in July 1996 with the bait stations being reloaded every two months since then. Predator control operations began at Trounson in August 1996, this involves perimeter trapping with 108 double Fenn sets (100m to 200m spacing), and 91 softcatch leghold traps (200m spacing) set around the park. Periodic night shooting is also carried out for possums and cats. The aim of this survey (part of a wider study on the diet, ecology and management of predators) was to determine the fate of monitored feral cats *(Felis catus),* stoats *(Mustela erminea)* and Ferrets *(Mustela furo)* throughout these poison operations.

Monitoring was carried out using radio transmittered animals. Live trapping began in January 1996, 17 cage traps and 9 Edgar traps (baited with, rabbit or hare meat) were set around the park. 21 feral cats, 3 stoats, and 1 ferret were captured prior to the June 1080 operation. Radio fixes on the locations of these animals were taken daily where possible, by triangulation from set points around the park. After a time, clear territorial patterns could be discerned, female cats appeared to have discrete territories around 50 ha in size within the park boundaries, whilst the male cats, particularly the larger adults had far greater territories (sometimes overlapping) ranging for several kilometres outside the study area. Two male stoats each had territories of around 40 ha in size whilst the ferret, a young male, occupied about 50 ha, all were within the park boundaries. For three weeks after 1080 was set out in the stations, the resident predators were physically located daily to determine whether they were alive or dead.

RESULTS

All six resident feral cats (plus an additional one found during the routine searches) were dead within 48 hours of the 1080 being put into the stations. One stoat died 9 days after the 1080 operation, it was discovered in a den with a 1080 poisoned rat. The ferret died about 3-4 weeks after the 1080 operation, it was also discovered in a den along with a 1080 poisoned rat. Tissue analysis of skeletal muscle from these animals (except for one cat that could not be recovered as it died within a large kauri stump) all revealed traces of 1080 at various levels. Of the other monitored animals, only 3 cats were known to be near (but not actually in) the park at the time of the operation, these were later shot. The remainder had either died or been excluded from the study for various reasons, prior to the commencement of the 1080 operation.

Concentrated live capture trapping results after the 1080 operation suggested that predator numbers had been greatly reduced, capture rates were very low (when compared to earlier in the year). In August 1996 the Department of Conservation kill trapping programme began, initially capture rates were low, two or three stoats and weasels per month, with no cats or ferrets caught at all. Later however, stoat capture rates in both the kill trapping and live capture regimes increased markedly through December and January, possibly coinciding with the break up and dispersal of natal groups. Cat kill trap capture rates have remained low, until recently, where there has been a marked increase through April 1997, local cat sightings in the area have also increased since previous months. Both live capture and kill trapping results suggest that predator numbers were low immediately after the 1080 operation, but reinvasion began soon after. The trapping results (both live and kill) also elude to the possibility that stoats, and to a lesser degree weasels, may be quicker to exploit a predator free area than cats.

Ongoing monitoring was carried out with a further 3 cats, 5 stoats, and 1 ferret that were captured around the park between July 1996 and January 1997. Two of the cats were actually domestic cats belonging to local farmers, so they could not be used in the survey. The remaining cat dropped it's transmitter several kilometres from the park and it's fate is unknown. The ferret died 3 kilometres from the park, unfortunately it was in an advanced state of decay when recovered so no tissue analysis could be carried out. Of the stoats, 1 was killed in a Department of Conservation fenn trap, one went missing, one was recaptured and died (cause unknown), the remaining two have been freely roaming the park since their capture in January 1997 up to the present (April 1997). Currently these stoats (1 male and 1 female) are utilising territories around 312 ha and 65 ha in size respectively, both tend to be located near the forest margins. Brodifacoum is a cumulative poison and it is possible, over a longer period, these animals may yet succumb to it's effects.

Depending on the state of decay, all predators shot or trapped in the park by Department of Conservation staff since the commencement of the continuous

Brodifacoum campaign in July 1996 are autopsied and their livers sent for analysis. To date, 12 stoat livers, 3 cat livers and 7 weasel livers have been tested for the presence of Brodifacoum. Of these only 2 of the stoat livers, 2 of the cat livers and 3 of the weasel livers have contained Brodifacoum at various levels. The results of these tests and the fact that two stoats are still alive after four months, suggest that the secondary poisoning effect in predators at Trounson is much reduced.

The reduced secondary poisoning effect could be explained by the low numbers of rodents. Rodent sampling carried out bi-monthly since May 1996 at Trounson indicate that mouse and rat numbers were greatly reduced by the 1080 poison operation and are currently still at undetectable levels, probably as a result of the ongoing Brodifacoum campaign, (note; recent rodent indexes at Katui Forest, the non-treatment control site, were also unexpectedly low). The rodent sampling at Trounson will be ongoing, as will the analysis of predator livers for Brodifacoum.

To further assist in the understanding of the mechanisms of secondary poisoning in predators at Trounson, rodent livers will also be tested for Brodifacoum. Potentially more sensitive methods such as tracking tunnels for rodents will be employed in the future. Later in 1997 live capture and radio tagging of predators will be resumed enabling ongoing monitoring, hopefully some of these will be captured from areas neighbouring the study site as well as in the park itself. General observations and a recent "one off" pilot survey suggest that rabbit populations in the pastureland surrounding Trounson Park are much higher than for the same time in 1996. In order to further investigate this, Lagomorph populations at Trounson and at the non-treatment control site will be surveyed regularly. Ongoing diet studies will also assist in understanding the importance of a potential increase in rabbit numbers at a predator control site.

CONCLUSIONS TO DATE

1080 laid in bait stations set at a density of one per hectare to control possums and rodents kills all the resident feral cats through secondary poisoning when there are previously uncontrolled rodents. The results indicate that secondary poisoning may also occur in ferrets and stoats.

The cats are affected very quickly, most of the individuals in this survey were dead within 48 hours of the 1080 being in the stations. Ongoing poisoning with Brodifacoum and resultant low rodent numbers (due to continuous poisoning, "a bad rodent year" or a combination of both) greatly reduces the secondary poisoning effect in predators when compared to the initial control operation.

Predator protection at kakapo nests

Graeme Elliott
National Kakapo Team, Department of Conservation, PO Box 10 420, Wellington

I NTRODUCTION

The only likely predator of kakapo eggs and chicks on Codfish Island is More (Rattus exulans) and our nest protection plans for the first half of 1997 were designed almost entirely for this species.

Nest protection at Codfish Island was designed as a two stage process:

1. Reducing the density of kiore in the area surrounding each kakapo.
2. Frightening any kiore that survived the traps and poison away from the nests.

REDUCING THE DENSITY OF MORE AROUND KAKAPO NESTS

Fifty-six traps and 48 bait stations were placed in a grid around each kakapo nest (see figure 1) within 3 days of the nest being found. It was intended that the bait stations were the primary method of reducing rat numbers, and that the traps, which were confined to an area within 33m of each nest, might catch any rats that were wary of bait stations and also provide a measure of the effectiveness of our poisoning.

Both baits and traps were placed in small (12 x 12 x 30cm) collapsible cages made of welded mesh. Trials on Little Barrier Island during the summer of 1995/6 had shown these cages to be more effective in catching and poisoning kiore than solid tunnels.

Poison baits were 10cm diameter domes of white chocolate laced with brodifacoum with a hole in the middle which enabled them to be pinned to the floor of the cage. Rat traps were "Ezeset" traps and were baited with small chunks of white chocolate or cheese.

During the time that kakapo started nesting rat numbers were rising steeply on Codfish Island. Despite this, our trapping and poisoning regime did reduce the number of rats caught near kakapo nests, though there was still a significant catch of rats at about the time kakapo eggs hatched - the most vulnerable time (see figure 2).

FRIGHTENING KIORE AWAY FROM NESTS

From the day after they were found, the activity at kakapo nests was recorded continuously using a video camera and time-lapse video recorder.

Within a day of the nest being found a small video camera and infra-red light source was inserted into the nest chamber, motion detectors placed at the nest entrance and a cable run back to a video recorder and monitor placed in a tent about 60m from the nest. Activity at the nest was then recorded continuously, and during the night, when female kakapo leave their nests to forage, the nests were more closely monitored by a nest-minder in the tent. Whenever the female kakapo left the nest, the movement detectors sounded an alarm in the tent, and the nest-minder turned on the monitor and watched the chicks or eggs until the female kakapo returned. If rats were observed in the nest while the female. was absent the nest-minder could fire "rat-bangers" in the nest. Rat bangers are small electrically powered detonators that were mounted on the video camera and could be fired at the push of a button mounted on the monitor in the tent.

At the time of writing, no rats had been observed in nests, but rat bangers had been fired in an attempt to frighten a Cooks petrel out of a kakapo nest chamber.

During the course of the breeding season the likelihood of using the rat-bangers was reduced by changes in the management of the nests. Early on in the breeding season we found that some female kakapo left their eggs and chicks for dangerously long periods. We think that this was responsible for the failure of 1 egg and 1 chick, and that it severely checked the growth of another chick. To reduce the ill effects of long periods of absence we started placing small electrically powered heat pads on eggs and chicks soon after the female kakapo left the nest. This necessitated a nest-minder going to the nest soon after the female left, placing the heat pad on the eggs or chicks, staying at the nest and using a radio receiver to detect the females return, and then removing the heat pad before the female arrived back. This meant that for most of the time that the female was away from the nest, a human nest-minder was standing within 2m of the nest and almost certainly discouraging any rats.

Six kakapo nests proved to be a severe field test of the video equipment and heat pads. Both held together, but required constant maintenance. After some initial problems with poor soldering, the cameras and infra-red light sources proved reliable. Two of the monitors malfunctioned and required the replacement of parts which took more than a few days to obtain, and the cabling to the monitors was too light and failed after about a month of continuous use. The video recorders worked almost without fault. Maintaining a power supply proved problematic. We had about 40 36 amphour batteries of which 10 have now failed. We had to run a 5 KVA generator for about 12 hours a day to charge sufficient batteries to keep the nest monitoring going.

With the present state of this equipment a programme such as our requires somebody in the field competent with a soldering iron and multimeter and knowledge of circuitry. If you've got a few staff like that the system works brilliantly.

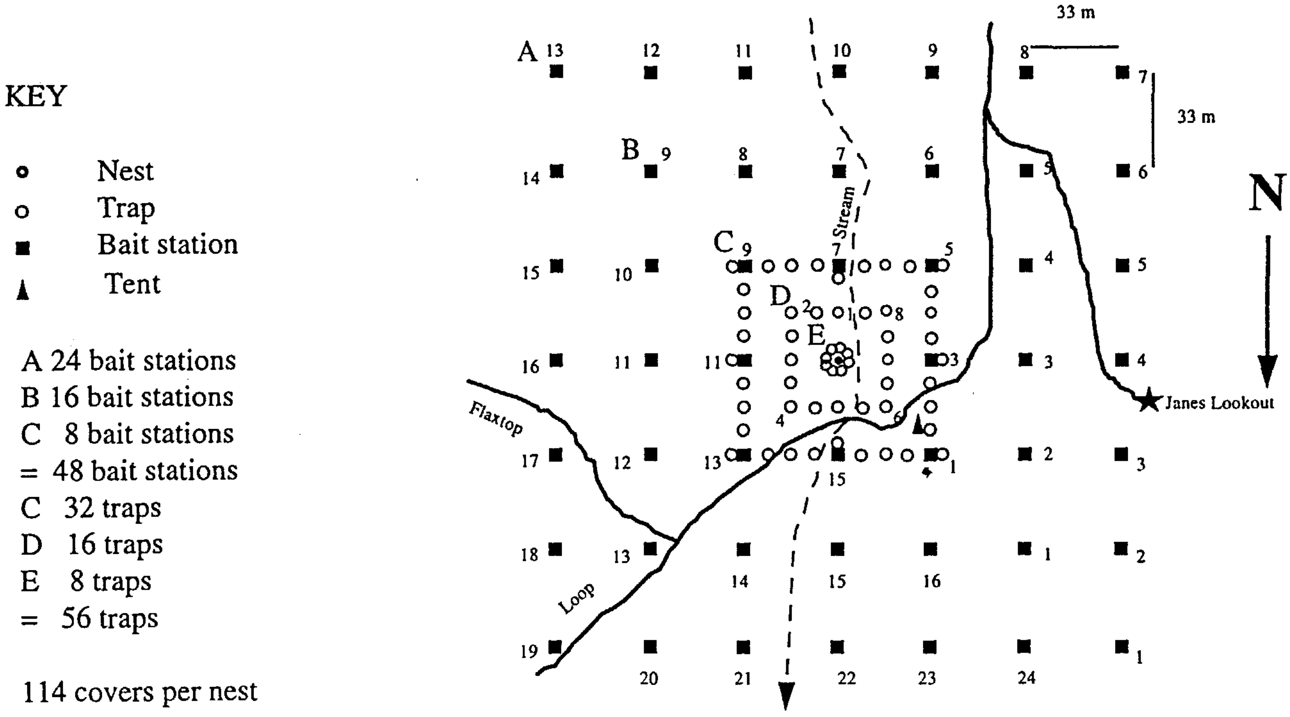

FIGURE 1, THE LAYOUT OF TRAPS & BAIT STATIONS AROUND CYNDY'S NEST.

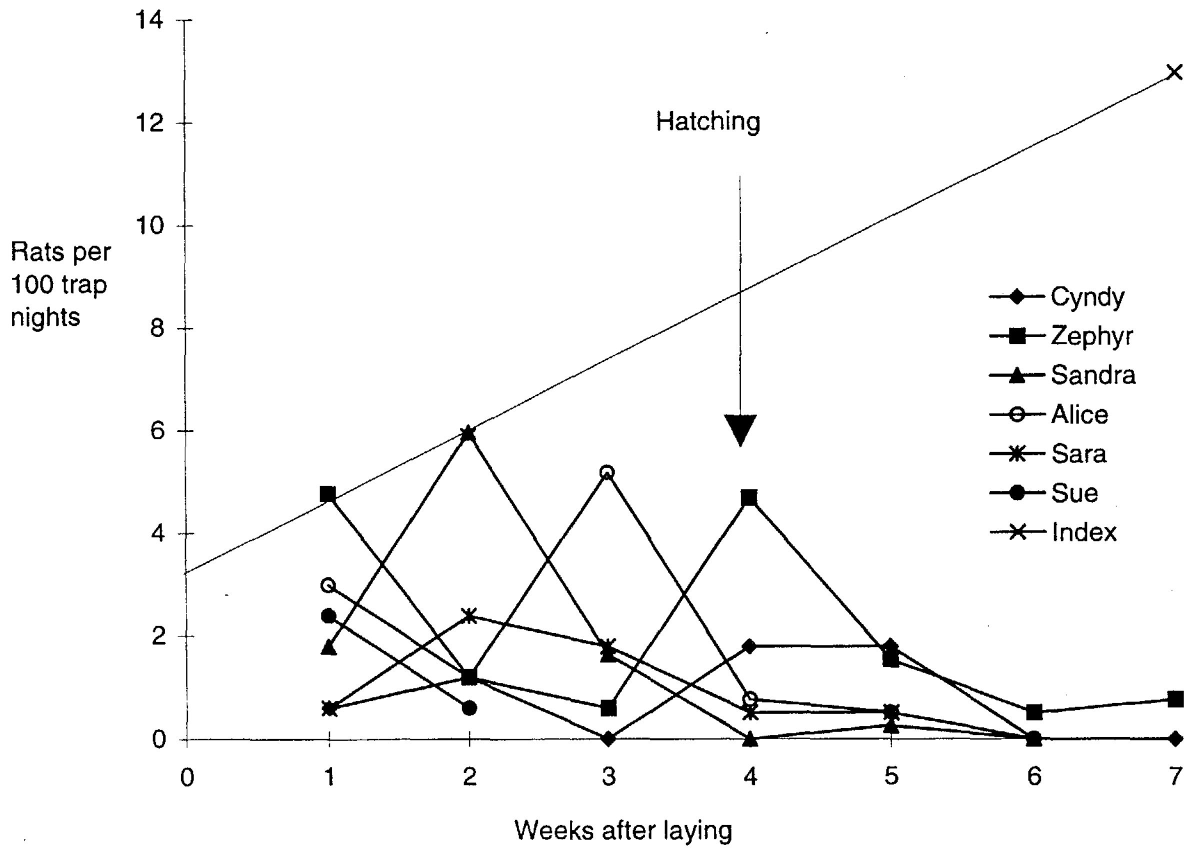

FIGURE 2 RATS TRAPPED AROUND KAKAPO NESTS ON CODFISH ISLAND.
INDEX = CAPTURES ON A RAT TRAPPING INDEX LINE.

Rangitoto and Motutapu possum and wallaby eradication

Simon Mowbray (Presented by Dick Veitch)
Rangitoto Feild Centre, Department of Conservation, Motutapu Island, Private Bag 92039, Auckland

DESCRIPTION

Area:

A) Rangitoto Island is 2300 hectares.

B) Motutapu Island is 1550 hectares.

Physical:

A) Rangitoto Island is a young volcanic island with sparse vegetation, consisting predominantly of Pohutakawa forest.

B) Motutapu Island is currently used for pastoral grazing of beef stock. There are also several areas of indigenous vegetation, including the coastline. Predominant indigenous species are the Pohutakawa.

Wild Animal Control Team

Initially, five hunters were employed for the Wild Animal Control (WAC) team, which was based full-time on Motutapu Island. Throughout the operation the WAC team has consisted of around five to eight people, with a range of experience in pest control.

OPERATION

The Rangitoto-Motutapu eradication operation started in September 1990, with the application of 28 tonnes of 1080 pollard pellets on Rangitoto Island. The Forest Research Institute estimated that this poison drop achieved a 93 percent kill, spread reasonably evenly over both target species.

Motutapu Island was poisoned using cyanide in bait stations in 1990-91-92. This poisoning operation was successful in rapidly reducing both the wallaby and possum population and was supplemented with extensive shooting operations.

From February 1991 Rangitoto Island was gridded at 200 metre intervals and Victor No. 1.5 soft catch traps were set on each grid line. During the wet winter days there was a considerable problem with pullouts from these traps.

Subsequent modifications failed to noticeably improve the performance of the trap set and the decision was made to change to steel jaw Victor No. 1 traps for possums. Victor No. 1.5 and No. 3 traps were used for wallabies. For both species the catch rate increased, with no pullouts. It had proved difficult to trap wallaby on Rangitoto Island, with a lack of suitable sites for traps. Finally, with this new trap configuration we had an effective wallaby trap.

For the 1992-93 season the width between grid lines were reduced from 200 metres to 100 metres, for the second and third sweeps. It was evident during these sweeps that a large number of the possums that were being caught had been caught previously, and had escaped from the soft catch traps. The use of soft catch traps initially is estimated to have extended the operation by several years.

Table 1 and 2 summarise the success of the' operations on Rangitoto and Motutapu Islands, including the number of kills for each trap night and the total kills for both target species. For Motutapu Island the tallies in Table 2 only include the number of bodies picked up on some operations along the cliffs. It is estimated that up to 20 percent of the bodies were not recovered. The main population of wallaby was found in the coastal band of approximately 400 hectares. The density of animals was approximately 19.2 animals per hectare, on a combined species total.

TABLE 1. POSSUM AND WALLABY KILLS ON RANGITOTO ISLAND.

YEAR	POSSUM	WALLABY	TRAP NIGHTS	TRAP NIGHTS PER KILL
1990	17,000**'	8,500		
1990/91	182	10	180,000	937
1991/92	558	6	262,500	464
1992/93	238	19	300,000	1167
1993/94	115	39	375,000	2286
1994/95	17	82	330,000	3333
1995/96	1	32	330,000	10,000
1996/97	0	4	240,000	60,000
Total	1111	193	2,197,500	168,500

Note 1: Estimated by the Forest Research Institute

MONITORING AND FINAL MOP-UP

The monitoring stage of the operation began in at the end of the 1994-95 year. At present the WAC team are completing this monitoring operation, with monitoring lines placed at right angles to the grid lines established in 1990. All of Rangitoto Island has also been checked by the dog team.

Rangitoto Island has been very hard on the dogs. A dog would work well for a short period and then would go completely sour, not wanting to work on Rangitoto Island again. However, if a dog was taken to the mainland it would again work well and with great enthusiasm. Dog turnover has, therefore, been fairly high.

TABLE 2. POSSUM AND WALLABY KILLS ON MOTUTAPU ISLAND [1]

YEAR	POSSUM	WALLABY	METHOD
1990/91	2989	3179	poisoning, shooting
1991/92	660	637	poisoning, shooting, trapping
1992/93	76	156	shooting, trapping, dogs
1993/94	5	4	trapping, shooting, dogs
1994/95	0	0	trapping, dog monitoring
1995/96	0	0	trapping, dog monitoring
1996/97	0	0	trapping, dog monitoring
Total	3920	3768	

1: It is estimated that up to 20 percent of the bodies were not recovered.

At present the WAC team are waiting for an infra-red camera, which will be used from a helicopter to survey Rangitoto Island for surviving target species. The helicopter will be also fitted with a differential global plotting system (DGPS). All infra-red data will be recorded on a video tape and interfaced with DGPS for further reference. Data will be available immediately following each flight. The selected infra-red DGPS system will allow the WAC hunters to return to the sighted location of the target species, with some degree of accuracy. Dogs or traps will be used to catch these animals.

Previous attempts to fly with an infra-red unit failed due to operator error in the use of the navigational systems. The data provided was not complete or accurate and therefore was not able to be used by the WAC team.

TABLE 3. POSSUM AND WALLABY KILLS ON RANGITOTO ISLAND.

YEAR	POSSUM	WALLABY	TRAP NIGHTS	TRAP NIGHTS PER KILL
1990	17,000	8,500		
1990/91	182	10	180,000	937
1991/92	558	6	262,500	464
1992/93	238	19	300,000	1167
1993/94	115	39	375,000	2286
1994/95	17	82	330,000	3333
1995/96	1	32	330,000	10,000
1996/97	0	4	240,000	60,000
Total	1111	193	2,197,500	168,500

1: Estimated by the Forest Research Institute

TABLE 4. POSSUM AND WALLABY KILLS ON MOTUTAPU ISLAND.

YEAR	POSSUM[1]	WALLABY	METHOD
1990/91	2989	3179	poisoning, shooting
1991/92	660	637	poisoning, shooting, trapping
1992/93	76	156	shooting, trapping, dogs
1993/94	5	4	trapping, shooting, dogs
1994/95	0	0	trapping, dog monitoring
1995/96	0	0	trapping, dog monitoring
1996/97	0	0	trapping, dog monitoring
Total	3920	3768	

1: It is estimated that up to 20 percent of the bodies were not recovered.

INFRA RED CAMERA MONITORING

It is believed that the infra-red camera monitoring will greatly assist with identifying the remaining possum and wallaby on both islands. An operator has previously flow half of Rangitoto Island with a helicopter mounted infra-red camera and DGPS. The contractor had fitted the camera to the Hughes 300 helicopter and had leased a DGPS unit for the operation. The operation was conducted over one week and was flown at night. The pilot and camera operator had no previous experience in the use of the DGPS for navigational work, so that the operation was fairly hit and miss.

The information was not sufficient or accurate enough for the WAC team to use. Also, the time delay of three to four weeks in receiving the information meant that it was of limited use to the hunters. A best guess on the location of supposed target species was all that was available. The video tape had stretched and was therefore, was not correlated to the DGPS co-ordinates. The DGPS print out had been converted to the conventional GPS language and followed up with a hand held GPS. This conversion also reduced the accuracy of the target species location. Discrepancies of up to 1.8 kilometres were found from where the sites were marked on the printout supplied and the DGPS information.

Overlaying the flight line printout with the animal location information it was evident that one animal had been over flown and counted 14 times. There were eight supposed possums sighted in one clump of trees which proved later to be a shag rookery.

From this initial operation it has became apparent that the interpretation of infra-red information is critical to the success of an operation. Only operators experienced in the use of DGPS systems should be used for such monitoring operation and the DGPS information should be interfaced onto the video tape to remove any chance of time and location inaccuracies, due to the tape stretching.

Rangitoto Island is a young volcanic island and the exposed lava holds a substantial amount of heat. This has also been a hindrance for the infra-red operation.

Although, the initial operation was not a complete success it showed the potential for infra-red surveying as a monitoring method. At present we are waiting for infra-red camera to become available.

A local operator has had a camera for trial that was fully stabilised but very expensive at NZ $500,000. The operator was offered the chance to survey Rangitoto Island, but could not supply a navigational system capable of recording all flight lines and sightings. Also, cost has been a big hurdle with approximately $2800 per hour being quoted, this was later negotiated lower.

We were given a free trial with the camera and it looked like everything we needed but there was the lack of a navigational system. As the camera was going onto another operation overseas, time run out before a suitable navigation system could be sourced.

These are some problems encountered

1. Availability of suitable systems both infra-red and DGPS that can be integrated.
2. Operator experience in the use of DGPS is the system owner operated or leased and is it capable of on site print outs.
3. Helicopter type, is it suitable for the operation e.g.; cost jet Ranger versus Squirrel, and can it operate effectively in the conditions e.g.; in our original operation the camera was mounted to a Hughes 300 which had great difficulties flying down wind and maintaining the correct speed for survey.
4. Helicopter operators who have the time and equipment to set up for infra-red survey work.
5. Our use of these systems is so far fairly limited but they have shown great potential for the monitoring of a large variety of species.
6. Infra-red monitoring has the potential to be a very cost efficient way of monitoring populations whether it is possums, goats, deer, rabbits etc.

Video monitoring of banded dotterel nests in braided rivers

Mark D. Sanders
Project River Recovery, Department of Conservation, Private Bag, Twizel

INTRODUCTION

The large, braided rivers of Canterbury provide feeding and breeding habitat for many native birds, including wrybills, black fronted terns, black-billed gulls, and black stilts. Strong circumstantial evidence suggests that predation by introduced mammalian carnivores, especially at nests, is a main cause of the decline in range and abundance of birds of braided rivers. However, efforts to reduce the effects of predation are hindered by a lack of direct evidence of predation, and a lack of knowledge about the identity and behaviour of predators at nests. Causes of nest failure other than predation and flooding are poorly understood. Since 1994, Project River Recovery has been using time-lapse infra-red video photography with these aims:

1. To identify the causes of nest failure of braided river birds and, in particular, to identify which predators prey on eggs, chicks and adults.
2. To describe the behaviour of predators at nests of braided river birds.
3. To relate predator sign, especially eggshell remains, to predator species.

METHODS

We monitored nests of banded dotterels in braided rivers. We used this species for three reasons:

1) we considered that it was likely to provide an indication of nest failure rates of more endangered ground-nesting braided river birds;

2) it is abundant enough to ensure good sample sizes, and

3) by studying banded dotterels we avoided imposing the risks of intensive monitoring on more vulnerable species.

We monitored 44 nests between September and December, 1994 - 1996, (Table 1). Two Philips black and white, infra-red sensitive cameras were used in 1994 in the Ohau River, and in the Ohau and Ahuriri Rivers in 1995. In 1996 we used the two Philips cameras plus two Ikegami cameras to film nests in the Ohau River. Cameras were placed 1.5 - 2.5 m from the nest, and were connected by cable to a video recorder and battery placed 50 - 100 m away. To minimise the chances that our scent trails might attract predators, we approached the nest through water if possible, and avoided approaching the nest once the camera was set up.

TABLE 1. SUMMARY OF BANDED DOTTEREL NEST VIDEO-MONITORING 1994-1996.

YEAR	NUMBER OF NESTS VIDEOED	DAYS VIDEOED	NIGHTS VIDEOED	LETHAL EVENTS	NON-LETHAL EVENTS
1994	8	178	178	3	3
1995	13	154	154	6	0
1996	23	229	230	21	36
TOTAL	44	561	562	30	39

RESULTS

The main findings are summarised below. See Table 2 for numbers of various events recorded on video, and Figure 1 for diurnal and seasonal timing of visits to nests by predators.

- Of 26 videoed nest failures, 22 were caused by mammalian predators.
- All predators were mammals - no avian predators were recorded at nests (but chicks weren't monitored).
- All predation occurred between 7 pin and 6 am.
- Usually, predators ate all eggs in a clutch.
- Adult banded dotterels were taken rarely, and only by cats - but ferrets and a stoat also attempted to catch adults.
- Little sign of predation remained by morning - banded dotterels removed eggshell within a few hours. Blowflies and ants were usually present where eggs had been eaten.
- Ferrets and cats were the main predators at the Ohau site.
- of 10 nests preyed upon by ferrets were visited by ferrets on successive nights - sometimes apparently the same ferret, but also by different ferrets.
- The same cat appeared to prey on 4 of the videoed nests (located over a 2 km stretch of riverbed).
- Hedgehogs were the only predators at the Ahuriri site, but only 4 predation events were recorded there.
- Only one stoat predation was recorded. Stoat density is unknown.
- Only one possum was recorded, at an empty nest.
- Eggs were accidentally destroyed by sheep and parent banded dotterels, as well as by predators.
- The brooding adult usually flew before the predators approached close enough to pounce.
- Cats did not eat chicks. Played with them at 1 nest (killed 1), ignored them at another nest.
- Cats did not eat eggs at 2 of 8 nests with eggs.

- Hedgehogs did not eat eggs at 1 of 7 nests with eggs.
- Ferrets rubbed chin on nest - possibly scent marking?
- Ferrets and hedgehogs appeared to locate nest by smell, whereas cats appeared to use vision i.e., went to where the adult flew from.
- Nest failures were usually a result of predation on eggs, but could also be caused by predation on an adult and subsequent nest desertion by the other adult.
- On the other hand, nests that are successful may still have suffered predation. E.g., a cat preyed on 1 parent but the other reared the clutch successfully.

TABLE 2. NUMBER OF BANDED DOTTEREL NESTS AT WHICH VARIOUS EVENTS OCCURRED.

SPECIES	SUCCESSFUL PREDATION			UNSUCCESSFUL ATTACK	VISITED EMPTY NEST	OTHER
	ADULT	CHICKS	CLUTCHES			
1994 Ohau River						
Cat	1	1		1		
Rabbit						1 [a]
Adult banded dotterel						2 [b]
1995 Ahuriri River						
Hedgehog			4			
Sheep						2 [c]
1996 Ohau River						
Ferret			10	4	16	
Cat	2 [d]		6	6[e]	3	1 [f]
Hedgehog			2		2	1 [g]
Stoat			1	1		
Possum					1	
Hare						1 [h]
Total (69)	3	1	23	12	22	8

[a] Sat on nest - no damage.

[b] Egg fell from breast on two occasions (same nest) - one broke, one did not.

[c] Trampled two nests.

[d] Also ate entire clutch of eggs on both occasions (included in clutches column).

[e] At one nest, seven unsuccessful lunges or pounces at the swooping adult.

[f] Appeared to be cat - only eyes visible.

[g] Visited nest with three eggs but didn't eat them.

[h] Ran past - potential to run over a nest and destroy it.

Note: Each separate visit to a nest was counted as one event. Multiple attacks by the same individual predator, on the same night, were counted as one event. Note that when clutches were preyed upon, all eggs were usually eaten. Categories represented by the columns are not necessarily mutually exclusive.

MANAGEMENT IMPLICATIONS

For monitoring nests without videos

1. Early disappearance of entire clutch is usually attributable to predation.
2. No sign does not mean no predation.
3. Blowflies and ants are useful predator sign.
4. Loss of adults suggests cat predation?
5. Dead chicks may have been killed by predators, but not eaten.
6. To see predation at nests, observe at night.
7. A successful nest may still have suffered predation.
8. Provides support for the contention that `rabbit predators' (cats and ferrets) switch to birds after rabbit kills.
9. Validates categorising nests as successes or failures (c.f. counting eggs).

For control

1. Target cats and ferrets?
2. Hedgehogs shouldn't be ignored.
3. Target rogue individuals?
4. Ferrets habit of revisiting nests a weakness?

[1] For further information on storing video information see Appendix 3.

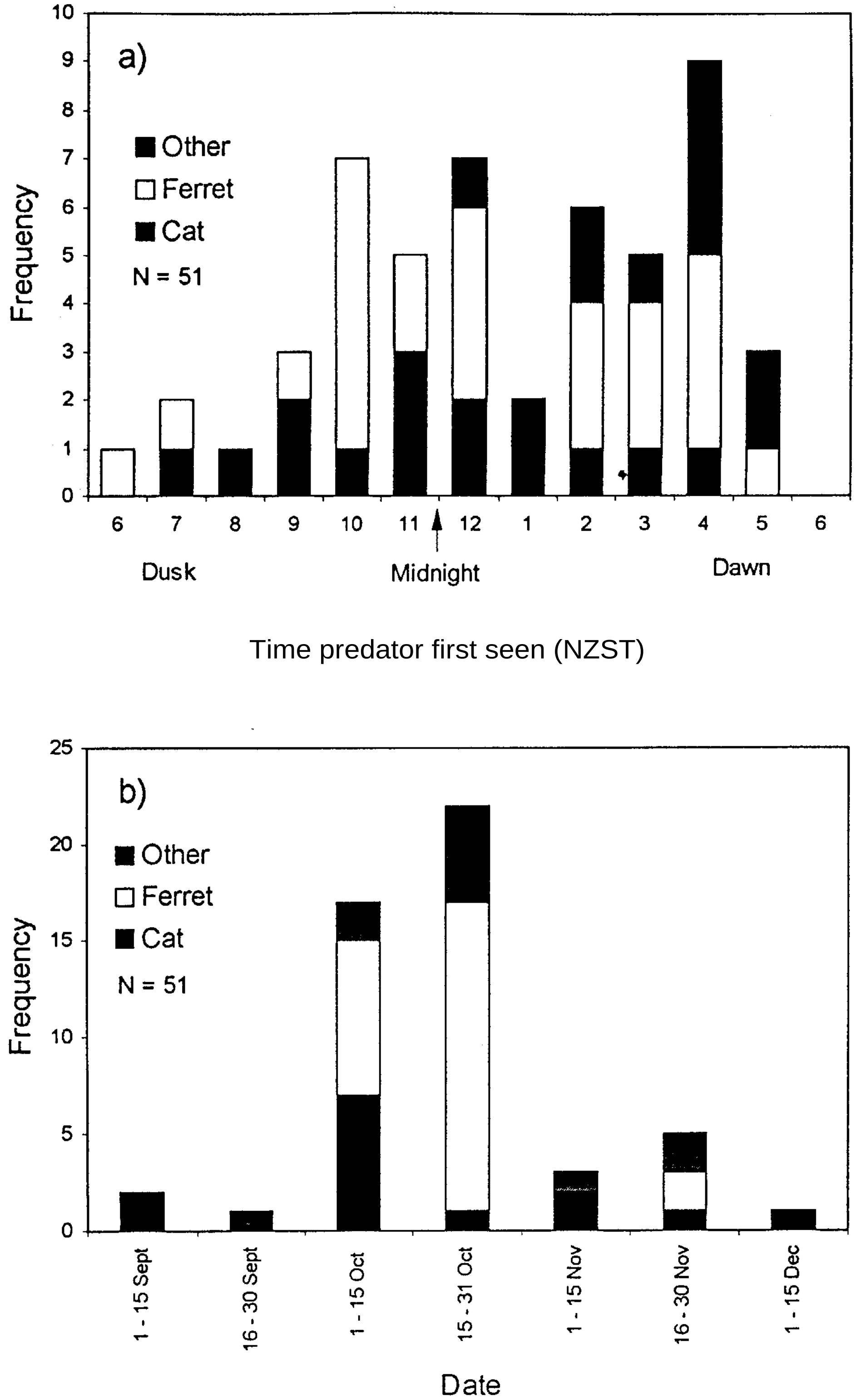

FIGURE 1. DIURNAL (a) AND SEASONAL (b) TIMING OF VISITS BY PREDATORS TO BANDED DOTTEREL NESTS, AS RECORDED BY INFRARED PHOTOGRAPHY .

2 Data are combined from Ohau and Ahuriri River video monitoring, 1994-1996.
'Other' comprised mainly hedgehogs, but also included one stoat and one possum.
Visits by non predators (e.g. sheep) are not included in the figure.

Electronics and Technology

Murray Douglas
Science & Research Division, Department of Conservation, PO Box 10 420, Wellington

Your horizons can be broadened, often only your imagination limits you.

MICRO-CONTROLLERS (computer-in-a-chip)

- Have a micro-processor and memory in them
- Can be programmed, from a computer, with pages of software.
- Program loaded onto the chip which you can't then erase.
- Can be used for simple or complex applications e.g., timers, loggers, intelligent traps.
- Technicians can easily develop systems.
- A special erasable version and a development kit is used.

Advantages

- Use of micro-controllers reduces circuit component count.
- Lowers cost e.g. micro-controller chip $5-10.
- Designs are more flexible to change - often just have to change a few lines of code in software and not the hardware.
- Can run fast (500,000 operations per second),
- or slow, stopping or in bursts to save power.
- Consume hardly any power (mA - mA).
- Crystal controlled clock for precise timing.
- Have input and output lines for input sensing and/or controlling other devices.
- Secure from tampering.

Disadvantages

- Requires moderate time in software development.
- Requires learning a particular assembly language.

INFRA-RED (IR) VIDEO

- IR is in the non-visible light spectrum just beyond your vision - called "Near IR".
- Not visible to predators.

Real-time recorders

- Useful for where rapid changes may be occurring within a brief period.
- E.g., counting bats leaving bat roosts.

- E.g., Sony cams - 8 mm.

Time-lapse recorders

- Used where information is needed over a long time scale.
- E.g., Panasonic VHS, GYYR.
- The number of frames recorded per second must be fast enough to catch the behaviour required to be recorded.
- A limited number of brands and models are available.
- Power hungry, 1.2-1.5 amps.
- Need waterproof housings/ plugs as electronics doesn't like dirt, moisture or salt.
- Can plug in a small DC powered monitor when needed.

12 V DC

- Panasonic is currently the only system available to run off DC direct.
- Systems typically consume 36A/hr per day.
- Time-lapse expands a 3 hour tape time to cover a 24 hour period.
- Records date, time and counter on the tape.

240 AC

- GYYR, longer than 24 hours (i.e., do 72 hours)
- Requires 12V to 240 VAC invertor - c. 90% efficient.
- Need 3 large batteries changed every 72 hours (3 batteries).

CAMERAS

- Charged Coupled Devices (CCD) type.
- Respond to infra-red.
- 12V DC powered.
- Can be run from long cables (twin or coaxial).
- Inexpensive, small, low power.
- New very small cameras (18 mm diameter with LED's) available at higher cost.

LIGHTS

LEDs

- Produce infra-red light.
- Infra-red is not visible to predators.
- Light emitting diodes.
- Cheaper, limited range up to 10 metres e.g., kiwi burrows.

Laser Lights

- Higher power than LEDs.
- Parallel beam goes a lot further.
- Low level laser type.
- Useful for long range (10-30 m).

- More expensive - $1,000
- Output tested & within safe level for kiwi, kokako etc.

Other options?

- Can transmit signal from camera by radio.
- Use UHF and receive signal near recorder.
- Digital technology now available but expensive.

WHERE IS TECHNOLOGY AT?

- VCRs being replaced by digital technology.
- Improved system linkage & versatility.

Digital technology

- Significant recent improvements have occurred in computer based digital systems.
- Reduced size of file size for graphic data using MJPEG compression.
- Reduced cost.
- Improved software flexibility.
- Increased options of input of multiple cameras and output controls.

This system is an indication of the way systems are going in the future with system designed around computers using large but cheap removable hard-disks and read-write compact disk (CO) storage and stacking systems. Improvements in cost, storage capacity and power consumption are expected in near future.

Video and micro-controllers are but two examples of technology that we can use to enhance applications for managing predators.

Where to from here?

Dick Veitch
Auckland Conservancy, Department of Conservation, Private Bag 68908, Auckland

TRAPS, LURES AND BAITS

1. Guidelines are needed to indicate which methods are appropriate or inappropriate for a given situation. These guidelines need to include information on all aspects of trapping although it is recognised that there are knowledge gaps.
2. Each field operation should provide a learning opportunity beyond that of objective of the local project. Baits, lures, trap types and sets can all be tested in the course of field operations. This testing and knowledge gain should not be so complex or large that it detracts from the effectiveness of the operation. All testing should be done in a robust manner to ensure that results are acceptable. When tests are started they must be carried to conclusion, not changed or stopped part way.
3. Staff need more intensive and specialised training opportunities than those provided by short, structured, courses. Training "in-the-field" could be provided by spells of job swapping or sharing. To catch predators effectively we need "trappers" not "trap setters".
4. Mechanisms need to be established to enhance sharing of information between trap and bait station users.
5. Strict standards are needed for monitoring of predator abundance. For monitoring, "trap setters" following exact rules, are better than "trappers".
6. Trap and bait station siting is currently a skill which is totally learned from observation of field experience. Operators still observe that some sets will never catch while others will catch frequently. There needs to be an attempt to quantify and reach conclusions on the different sites and hence enhance future sets.
7. The optimal spacing of traps or bait stations is an area that needs evaluation and development of guidelines. This work needs to be done both for each of the target species and for various habitat types.
8. These predators that are targeted in New Zealand have been regularly hunted in the northern hemisphere for many years. There needs to be a diligent search for information on lures, baits and traps in those countries.
9. Development of baits and lures must continue, particularly for stoats. For each species a variety of baits and lures is needed as not all individuals are attracted to the same baits. Some long-lived baits are needed.

10. The scent of a subordinate species is a lure which has not previously been adequately considered. A lure is needed which can be used as a trail between traps or bait stations. Eggs are proving to be a good visual lure for stoats, are there other visual lures?
11. Multiple strategies need to be available for each predator control operation.

Evening presentations

This section contains brief summaries of the evening presentations, they are not intended as a full proceedings of the talks. More comprehensive accounts of these are available from the individual speaker.

Mammal Tracking papers

Dale Williams
Bay of Plenty Conservancy, Department of Conservation, PO Box 1146, Rotorua

Dale discussed the advantages of tracking tunnels, including the variety of animals that can be monitored (depends on the size of the tunnel), that it is a non destructive sampling technique and tunnels do not require daily inspection. Tracking tunnels can be used in two ways; either as `snapshots', or as a continuos, sample. Both will provide an index of any changes in populations as a result of applied management, such as poisoning. He also outlined the different tracking constructions construction, siting of tunnels, and how to identify small mammals and lizards by their track left on tracking paper.

Tararua Weka Project

Steve Collings

Tararua Weka Trust, PO Box 16 146, Wellington

The Tararua Weka Trust was set up in April 1996 to relocate and protect wekas taken from Kapiti Island to the Tauherenikau valley in the Tararuas. Eighty wekas were caught on Kapiti just before a poison drop commenced, and held in an aviary for 7 weeks before being released. This project was entirely run by volunteers and depended on support from tramping and hunting groups. Despite intensive trapping of stoats, rats and possums, there are few wekas left in the valley, although some may have moved into the next valley. Strong community involvement and support has encouraged Steve to increase the trapping area. He believes that if wekas are bred in the area prior to release they would have a much greater chance of survival

Pitt Island predator fence

Sandy King
Department of Conservation, c/o Chatham Island Field Centre, PO Box 114, Waitangi, Chatham Islands

Pitt Island is 17 km south of the main Chatham Island. Although it does not have rats, it does has feral cats, mice, and pigs. The original plan was to remove all wekas and feral cats from the island, but due to some disagreement between DOC & some local residents eradication has not proceeded. An alternative plan was to fence off the southern portion of the island. Steep cliffs however meant that a suitable fence could not be erected without leaving a gap that would allow predators through. It is now proposed to find a suitable isolated forest habitat and put a ring fence around it. There are still many issues to be resolved, such as the best location, access, ownership, increased DOC staffing levels on Pitt and wider concerns of the community in relation to DOC's roles and policies - all of which will have a bearing on any fence constructed. Sandy is also aware of the possible effects of removing cats from the area and the consequent rise in mouse numbers which would affect invertebrate and ultimately robin populations. If the fence is put up, she would still like to eradicate all feral cats from the island because endemic species that would not be protected by the inland fence, such as the Chatham Island petrel and Chatham Island oyster catcher, would continue to be vulnerable.

Infra red triggered cameras

Barry Lawrence & Graeme Loh
Otago Conservancy, Department of Conservation, PO Box 5244, Dunedin

Barry explained that they were looking for a more efficient and reliable method for indexing stoat density than tracking tunnels. They are relying on an animals curiosity rather than their hunger - which has more variation depending on the time of the year. They developed their own `hot-wired' infra red triggered camera, but they can be bought `off the shelf'. Results so far from early trials show that there are some discrepancies between tunnel and camera results, however these were carried out at a time where hunger and curiosity may not differ much. Ideally the best time to test this would be in a mouse irruption year & post irruption spring. The total information gained from the camera is better than the total information from the tunnel, and it is easy to distinguish what animals had visited. Barry concluded saying that a decision will have to be made whether these cameras have a place in future management for stoat control.

Stoat trapping at Waipapa and Kaharoa

Hazel Speed
Pureora Field Centre, Department of Conservation, Pureora Forest Park, RD 7, Te Kuiti

Hazel outlined different trapping regimes and their respective results, ranging from single/double Fenn sets, to run-through and blind-end tunnels, baited/non-baited etc. The capture of different ages and gender of stoats varied depending on what traps she used (although where double sets were used most stoats missed the first trap but were caught by the second trap). She concluded that there may not be one ideal method to trap stoats, but that stoats may differ in trappability due to age, gender, life experiences and time of year, so a variety of traps, baits, lines may be most appropriate. She also emphasized that new ideas should be properly trialed & not just presumed to be the "best" way to catch stoats. Hazel wants all mustelid trapping to be included as a part of a larger "Research by Management" programme, and to get on with the business of good research and management.

Maud Island Stoat control

Brian Paton
Maud Island Base, Department of Conservation, 13 Mahakipawa Road, Havelock

Closest points of Maud to the mainland are only 900m - 950m, yet since 1991 there has been no known reinvasion of stoats. Wide range of sensitive species protected, including kakapo, takahe, an endemic frog , geckos and Giant weta. There are stoat traps all around the ring road, the peninsula and along the coastline. In the past trapping was focused on trapping around the vulnerable points, but now there are also 40 traps on the adjacent mainland. Double Fenn sets are mainly used. These are checked by boat. They have found that traps on the mainland on the cut tracks and near the batches are not catching many stoats. The best catch areas are along the coastline just above high tide mark on sandy beaches, but not necessarily at the closest points to the island. Undisturbed places catch the most stoats, which also catch a lot of rats which in turn attract stoats. During autumn months they catch the occasional weasel as stoat numbers decrease. Maintaining the trapping regime is time consuming but have concentrated on quality sets without too much variation, and it has been productive.

Mohua protection

Mike Aviss
Nelson/Marlborough Conservancy, Department of Conservation, Private Bag 5, Nelson

Described location and vegetation of Mt. Stokes in the Marlborough Sounds, where there is a stoat trapping regime currently being undertaken to protect breeding mohua. They use an egg in a basket in an open-ended tunnel using a single mark 6 Fenn. 110 traps are in the system, spaced at 100m intervals around the perimeter. They seem to have some sets that consistently catch more stoats. Most of these are near waterways suggesting that the stoats use creeks as access to the area. Although there has been no intensive monitoring of the mohua population, it is definitely increasing (from 7 birds in 1985 to 45-50 birds this season). They also plan to poison possums (justified by the presence of land snails in the area)using bait stations every 150 m along contour lines although these are not baited yet. Now have much more funding than 5 years ago and it has made a huge difference to the mohua population.

Summary of Hurunui mainland island project

Wayne King
Hamner Springs Field Centre, Department of Conservation, PO Box 6, Hamner Springs

Wayne explained the location of the Hurunui project area and described its features. The main objectives are to control mustelids for mohua protection, control possums and to monitor the bird species present. The stoat control regime involves poisoned hen eggs in 198 bait stations each with 4 eggs in them. They pre-fed for 3 weeks with non-toxic eggs and, at the peak of take, they changed to poisoned eggs. They had a very high mouse take, and initially had trouble distinguishing mouse from stoat take. They had 210 presumed stoat takes over 3 months. Monitoring took the form of wooden tunnels with 4 eggs at the end of each tunnel over a 10 day period. This year they also live trapped stoats and put transmitters on them but have had problems with malfunctioning transmitters.(possibly due to high rainfall which meant the stoats were swimming more than usual?) For possum control they used 148 bait stations with 1080 pellets, of which they had high take with many dead possums. Also used altitudinal trap lines for monitoring where the traps are placed on elevated boards to prevent kiwi from being able to access the traps.

Boundary Stream project

Brendon Christensen
Mainland Island project, Napier Field Centre, Department of Conservation, PO Box 644, Napier

Brendon gave some background on the Boundary stream Mainland Island project which was set up in early 1996 and covers approximately 700 ha (including 100 ha of private land. The aim is to protect the native species presently in the area and to allow for successful reintroduction's of appropriate native species into the area. They initially used just Fenn traps for mustelid control but now the regime incorporates poisoned eggs in different sets. Monitoring of mustelids in and out of the control area is by tracking tunnels using rabbit meat as a lure. They are using cage traps to catch cats although they would like to use poison in the future. Hedgehogs are not targeted for control but they are catching significant numbers in Fenn traps. Rats are also being caught in Fenn traps, although they are using talon in bait stations to target rats. In the future they would like to trial different tunnels and bait types.

Northern Urewera mainland island

Peter Shaw
Opotiki Field Centre, Department of Conservation, PO Box 326, Opotiki

Peter introduced the mainland island site, describing its vegetation as predominantly taws forest with emergent rimu. The key native species present include; several species of mistletoe, kokako, kiwi, north island robin, soft jawed kokopu and weta. The non-native species with potential threats to restoration include; red deer, feral goats, possums, stoats, rats and cats. 50% of emerging rata in the canopy had been eaten by possums. Extensive trapping was undertaken and Philproof bait stations established 150 m apart on vertically and horizontally set lines. 34 000 possums were killed in 2500 ha between 1993-96. It is unusual to hear a possum up there now! When possum numbers were controlled the rat population increased and Peter suggested that consequently mustelid numbers increased as a result of this. It was suggested that a good method to test this theory was to analyse stoat stomachs and determine what constituted the main part of their diet during possum control regime.

Protecting brown teal from cats on Great Barrier Island

Dave Barker
Okiwi Field Base, c/- Great Barrier Field Centre, Department of Conservation, Private Bag, Port Fitzroy, Great Barrier Island

Dave outlined the predators/competitors present on Great Barrier Island which threaten the continued survival of brown teal. There are no mustelids or hedgehogs on the island but cats, ship rats, kiore, rabbits, Australasian harriers, paradise ducks and dogs are present. Dave pointed out that he was wanting ideas from workshop participants to how he should go about protecting the brown teal from cats. He suggested trapping half of the Okiwi area where a significant number of teal are concentrated. Responses indicated that cats home ranges probably covered the entire Okiwi area and that trapping half the area would not be productive. It was suggested that further effort should be put into determining the distribution of teak, the incidence of mortality due to predators and the identity of predators before starting any control regime. Apart from cats and other mammals there are also paradise ducks competing for territory and predation by harriers.

Using dogs to indicate predators

Don McKenzie
Northland Conservancy, Department of Conservation, PO Box 842, Whangerei

His idea was formulated and started about a year ago, when he approached the Dog Obedience Club, and its associated member clubs. They have extremely well trained dogs which he feels could be an excellent avenue to pursue in respect of using dogs to find predators. This could be encouraged by competitions which would motivate club members and provide continuity in any program. Other bonuses of working with these clubs are that they are well organised and could provide a valuable service at a low cost, as well as having great advocacy potential.

Summary

Alan Saunders
Threatened Species Unit, Department of Conservation, PO Box 10420, Wellington

In relation to objectives:

1. Identify control approaches and methodologies being applied at mainland sites.

   Through a number of addresses and inputs -> brief summaries of approaches/methodologies for some (not all).

   Probably helpful to many participants - including to organisers in learning more about what's going on.

2. Discuss potential improvements and recommendations.

   Good one-to-one discussions (important) plus this morning's session - had good concrete recommendations.

3. Share information about specific techniques.

   Very good information sharing.

   Could have bought more devices for demonstration and critical review?

4. Advance development of "Best Practice" procedures.

   Field evaluations very helpful. Obvious need for training and technique development in field practices - training and skills sharing.

5. Advise St Arnaud project staff. Tall order to comprehensively address issues in this forum but helpful comments which reinforced Dave Butler's plans in some areas, and raised new issues.

Additional outcomes: Networking - difficult to put performance measures on but very worthwhile.

Good mix of DOC and non-DOC practitioners, indicating the breadth of interst and expertise.

Key conclusions/recommendations will be promoted through various people.

- **Proceedings**

Thank you to all speakers for producing summaries - well done!

Jo will produce proceedings which will be sent to all participants (others can buy them).

- **Speakers**

Well done. Quite a contrast in styles and quality (no doubt reflecting experience). All got their message across.

- **Facilitators**

This morning's effort in particular -good leadership, but also throughout the sessions.

- **Participants**

Excellent participation I didn't notice anyone not contributing. Hopefully everyone got something to take back to their projects.

Maintain the networks. Keep in touch. Don't hesitate to ask for help.

Happy hunting!

Contributions in absentia

The following accounts have been contributed by participants who were invited, but unable to attend the workshop.

Poison-baiting of ferrets

E.B. Spurr
Manaaki Whenua - Landcare Research, Private Bag 69 Lincoln

BACKGROUND

- Ferrets implicated in spread of Tb and predation on wildlife.
- Currently controlled by trapping.
- Fish paste containing 0.015% 1080 or 0.03% diphacinone developed in first year of project (Ogilvie *et al.* 1996) and manufactured by Animal Control Products.

OBJECTIVE

- To determine the efficacy of fish paste containing (a) 1080 and (b) diphacinone in a field trial against ferrets.

METHODS

- Two 200 - 400 ha areas of farmland separated by at least 10 km.
- Fish paste put in bait stations grid with 250-m spacing.
- % mortality of ferrets determined from mortality-sensing radio-transmitters.

RESULTS

1080 area:

- Bait (nominally 0.015%) actually 0.023%.
- Put out on 18 February 1997.
- Eaten from 25% of 47 bait stations,
- but only 2% of bait eaten.
- 5 ferrets in area >14 days before poisoning.

- 4 ferrets died 8-20 days after poisoning.
- Lab analysis confirmed 1080 as cause of death.
- 1 ferret killed by farmer (contained 1080).

Diphacinone area:

- Bait (nominally 0.03%) actually 0.028%.
- Put out on 12 March 1997.
- Eaten from 65% of 74 bait stations.
- 25% of bait eaten.
  - 20 ferrets in area >7 days before poisoning.
  - 1-9 ferrets died 5-18 days after poisoning.
  - Cause of death not yet confirmed.
  - 1 ferret disappeared after poisoning.

IMPLICATIONS

- Poison-baiting a cost-effective alternative to trapping for ferret control.
- Should also reduce stoat, weasel, and rodent populations.
- Method useable by pest control operators and farmers.
- Poison-baiting should reduce incidence of Tb in cattle and predation on wildlife.

RECOMMENDATIONS FOR FUTURE RESEARCH

- Replicate trials (involving farmers, Regional Councils, and DoC?).
- Determine optimum bait station density.
- Determine optimum time of year for poisoning.

ACKNOWLEDGEMENTS

Animal Health Board

Animal Control Products

REFERENCE

Ogilvie, S.C.; Spurr, E.B.; Eason, C.T.; Young, N. 1996. Development of a poison baiting strategy for ferrets. In: Ferrets as vectors of tuberculosis and threats to conservation. *Royal Society of New Zealand Miscellaneous Series 36:* 78-84

Trapping predators in New Zealand (cats and mustelids)

Bruce Warburton
Manaaki Whenua Landcare Research, Private Bag 69, Lincoln

CAPTURE EFFICIENCY

Most predator species occur at low density, have large home ranges, and are innately cautious animals. Several strategies employed by predator trappers worldwide should be evaluated for their ability to increase capture efficiency under NZ field conditions. These strategies include:

Use of lures

Meat baits, or scent lures as developed and used in the Northern Hemisphere, and scented trails. The potential of sound lures should also be investigated.

Masking human scent

Reduce or eliminate human scent around the trap site. Use boiled traps and wear gloves when setting traps.

Overcoming trap recognition/ aversion

Cover traps to overcome innate neophobia or learned aversion.

Use of preferred sites

Identify high use sites, or increase activity around the trap site by using tunnels (field tiles etc).

ANIMAL WELFARE

As a general rule, kill traps are likely to be accepted as more humane than leg-hold traps, but this may not always be the case. It is unknown if the kill traps that are in current use (e.g., Fenn traps for stoats or perhaps the Conibear range of traps for feral cats) would pass the proposed NZ trap standard. It appears that Soft Catch leg-hold traps capture and hold feral cats more effectively than they hold possums, and these traps may be an effective trap option in some situations. The down side of leg-hold traps is that they have to be visited at least once every 24 h, and these visits may further disturb the trap site and decrease the capture efficiency because of the maintenance of human scent.

Because predator populations are usually low density, it is preferable that trap visits are minimised, and that traps are left for several days between visits. This option is not currently permitted under the Animal Protection Act. However, the pending Animal Welfare Act has a provision that the 24 h check can be waived if a trap can be shown to kill rapidly and consistently. Therefore, it is important that those involved in predator trapping identify and select kill traps that are most likely to satisfy this requirement.

NON-TARGET RISKS

Trapping of ferrets in open farmland has often resulted in the inadvertent capture of harrier hawks and other non-targets. Trappers must be aware of the potential risk to non-target species, and ensure that this risk is reduced or eliminated. This could be done by using traps in tunnels and/or using variable entrance diameters to exclude certain species.

TRAP OPTIONS

Many of the species trapped in the Northern Hemisphere are predators. As a consequence, there is a variety of traps from Belgium, Germany, Canada and the USA that should be evaluated for potential use in predator control in NZ.

Tongariro Forest conservation area

Ross Martin
c/- Tongariro/Taupo Conservancy, Department of Conservation, Private Bag, Turangi

BACKGROUND

The Tongariro Forest contains a declining population of North Island brown kiwis. The forest was completely logged over about 20 years ago, which is thought to be the main cause of the tenfold decline in kiwi numbers. No further decline has been detected in the past 5 years, however predation of chicks by stoats prevents recovery of the population. Several lines of Fenn traps were installed (Aug. 1994) in a mostly unlogged part of the forest as a part of a kiwi protection and monitoring program. The original aim of the trapping was to get a feel for the numbers and species of predators present in the forest, and to detect seasonal variations. Stoats are now the main focus or our work as ferrets and weasels seem to have a low presence. Dogs and feral cats are present in the forest and their role in kiwi predation is under investigation.

TRAPLINE OPERATION

The traplines consist of about 150 double or single trapped (Mark IV Fenn) tunnels spaced at 20-50m intervals, covering an area of about 100 ha. They run over a variety of terrains (ridges, flanks, gullies) and habitats (e.g., high canopy forest, scrub, and toi-toi). The traplines are run throughout the year and baits are kept as fresh as possible. Tunnels are all 'half-rounds' constructed from sheets of aluminium or polypropylene plastic. Older tunnels had a diameter of 200mm, however newer tunnels are now 165 mm wide, being the minimum size that allows clean operation of the traps, minimising room for the stoats to jump over or around the traps. Tunnels are placed on well established animal runs (tracks).

TRAPLINE KILLS RESULTS

To date, the traplines have caught 88 stoats, 378 rats, 14 weasels, 1 mouse and 1 ferret from c.94000 tunnel days. Forty four percent of stoat kills were in the traplines' first summer. An aerial 1080 possum control operation across the forest in June 1995 was followed by significantly lower stoat numbers during the : following summer (9 stoats) , however stoat numbers were up this summer (27 stoats). The sex ratio of kills (male:female) was roughly 2:1. Stoat numbers peaked in late November and in late April. Most juveniles caught were females, and adult females were only caught during the summer (after the November spring pulse). Sudden peaks in predator kills coincided with breaks in periods of cold and wet weather (particulary evident in winter).

Tunnels placed on prominent animals runs caught more stoats than tunnels away from runs. Open (high canopy) ridge tops caught more stoats than densely vegetated ridge flanks, and wet gullies caught very few stoats. Stoat foot prints were found along the length of a major forest road which runs along a large dividing ridge feature. Kills were greatest at the points where the trapline intersects with the road.

Prior to November 1996 three baits were trialled. Whole hen eggs, sardine based cat food and egg pulp (whites + yolks mixed together) were tested informally (from analysing 2 years catch data) and formally (in an 8 month structured trial). Both data showed that egg pulp was by far the better bait. Egg pulp and fish were only effective when fresh (no stoats were caught on rotten bait).

Double-trapped tunnels caught proportionally more stoats than single trapped tunnels. This may be due to the differences in tunnel length (600 mm vs. 300 mm respectively). Certainly, the baits stayed fresher and traps stayed cleaner in the drier long tunnels. Residual scent from previous kills and stoat carcasses left in one trap of a 2-trap system, both attracted further kills. Catch records show that 14% of stoats (n=27) were caught facing out of the tunnel, meaning that they avoided the trap on the way in. The use of minimum diameter tunnels seems to have eliminated this, however they have only been in use for a short time.

SUMMARY, RECOMMENDATIONS, AND FUTURE DIRECTIONS

Based on our results, our recommended `best recipe' for trapping is to use double trapped minimum diameter tunnels (600mm long x 165mm) made from black plastic sheeting, using egg pulp for bait (placed in plastic lids). Tunnels should be placed on prominent ridges in high canopy open vegetation and on dry ground. Trapping across the winter could be optimised by limiting trapping to periods of fine weather, and the use of natural stoat scent may increase catches.

Shortly our 100 ha area will be extended to 4-600 ha. In addition, footprint tracking tunnels will be distributed within, at the margins of, and outside of, the control area to provide non-kill based monitoring and to gauge the effectiveness of control in terms of numbers of stoats left after our trap-based control regime. At the same time, wild kiwi chicks will be tagged with radio transmitters to measure trapping effectiveness in terms of species protection. Further, an MSc thesis on habitat use by stoats (within and surrounding the control area) will be undertaken from November 1997.

PROJECT REFERENCES

Keys, J.K.R. & Speedy, CJT 1995. Kiwi Protection & Monitoring in Tongariro Forest 1994-95. Unpublished internal report, DoC- Tongariro/Taupo Conservancy.

Martin, R.D. 1996. Kiwi Protection & Monitoring in Tongariro Forest 1995-96. Unpublished internal report, DoC- Tongariro/Taupo Conservancy

Miles, JRG 1995. Comparative ecology of the Northern brown kiwi in the Tongariro National Park and the Tongariro Forest Park, central North Island. Unpubl. MSc thesis, Massey University.

Speedy, C.J. 1994. Kiwi monitoring - Tongariro Forest Cgnservation Area, June 1994. Internal DoC-Tongariro/Taupo report.

Project diary (trapline records).

CONTACTS

Cam Speedy	Overseeing manager, SCO, T/T Conservancy.
Peter Morton	Project manager, CO, Whakapapa Field Center.
Ross Martin	Kiwi Project field grunt and general dogs body.
Harry Keys	Science advisor, CAS- T/T Conservancy.