

# ECOLOGICAL MANAGEMENT

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# Eradication of Mice from Mou Waho, Lake Wanaka

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## ABSTRACT

The eradication of mice from Mou Waho, an 140-ha island in Lake Wanaka, is described. The use of tracking tunnels to monitor the success of the eradication attempt is discussed. The attempt was successful.

## INTRODUCTION

Mou Waho is a 140-ha island on Lake Wanaka. It is an important island because it is 1.3 km offshore and until recently was free of introduced mammals. The absence of mice was confirmed in August 1992 and again in August 1993 by members of the Highcliff Conservation Corps.

The island is a key site for the alpine weta (*Hemideina maori*) and is one of only two known sites where this animal exists in the absence of mammalian predators. In March 1995 a mouse was observed at the camping area on the northeast end of the island. In May 1995 300 trap nights were completed and eight mice were trapped. Mice were trapped around the camp area and northwards. It was determined to attempt an eradication of mice from this island.

The arrival of mice on this island would lead over time to a decrease in weta abundance on the island. Additionally, populations of other invertebrates and common gecko (*Hoplydactylis maculatus*) would be expected to decline as a result of predation pressure over time. Eradication before an invading species becomes established can prevent these effects from occurring.

Aerial application of anticoagulant poisons for eradication of rodents from islands is now a regularly used tool in New Zealand (see Adams, 1995; Towns *et al.*, 1995) and successful operations have been completed against Norway rats, kiore and ship rats. Generally, post-poison monitoring has been undertaken using snap traps (Towns *et al.* 1995).

For this eradication attempt I used tracking tunnels for post poison monitoring. The use of tracking tunnels gives a longer period of sampling than traps, because tunnels remain active after personnel have left the island and the use of tunnels reduces the workload when spread across the whole island.

## STUDY SITE AND METHODS

Mou Waho (formerly known as Harwich Island) is situated 17 km northwest of Wanaka in Lake Wanaka (GR F39 985 205). The island is rectangular with a NW-SW alignment and steep sides rising 200 metres above the lake. The island is an ice sculptured roche moutonnée with gentle northern scour slopes and steep southern slopes. The island has been grazed in the past and is now covered in regenerating hardwood shrub communities and extensive areas of radiata pine. The island has been previously described in Ward and Munro, (1989).

In September 1995 a track network was established across the island and 31 tracking tunnels were established on the island (Figure 1). The tracking tunnels used the method described in King and Edgar, (1977). Subsequent trips in November 1995 and February 1996 were used to establish the range of mice on the island and to check that tracking tunnels were operating. In February 1996 an audit of the programme was undertaken by Ian McFadden to ensure that the programme was meeting necessary standards.

A resource consent was obtained from the Otago Regional Council for accidental discharge of a contaminant to water and a consent gained from the Medical Officer of Health. Additional consultation was completed with the Otago Fish and Game Council and the Runanganui of Otago.

On 1 May 1996 1.4 tonne of Talon 20P poison was applied to the island by Bell Jet Ranger helicopter at a rate of 10 kg per ha. The spread of poison was calibrated using non-toxic pellets prior to the flight by flying over a predetermined strip for observers to see where the pellets fell. This distance was then measured at 50 m. A GPS was not used for this operation.

Tracking tunnels were checked immediately after the poison operation for a week and then again in July 1996, December 1996 and June 1997. Each of these trips was for a week, during which time tracking tunnels were maintained and 100 Eziset mouse traps with rolled oats and peanut butter lure were set and checked daily.

Immediately after the poison operation ground conditions were observed as very damp with large amounts of dew present throughout the day in the study areas. To investigate whether dew would affect the baits a handful of baits was placed on a sheet of paper. These were then checked daily and softness of the baits was recorded.

Passive indicators of wax candles and soap were placed around the camp site.

## RESULTS

Post operation checks showed no gaps in the distribution of bait on the island. Additional 20P poison was laid by hand around the camp area.

Tracking tunnels showed presence of mice up to 6 days after the operation and then again in one tunnel on the first day of the July 1996 trip. A proportion of tunnels were checked each day while staff were on the island. During a 4-day trip each tunnel would be checked at least twice, some up to four times depending on location.

Figure 2 shows the proportion of tunnels that were checked for the whole of each trip and the proportion of tunnels that had mouse prints in them.

Tracking tunnels extended the time range of monitoring beyond the time spent on the island. However, this time varied. In the December trip ink pads were drying up after 2 days, but in June this was not the case.

FIGURE 1: DIAGRAM OF MOU WAHO SHOWING LOCATION OF TRACKING TUNNELS

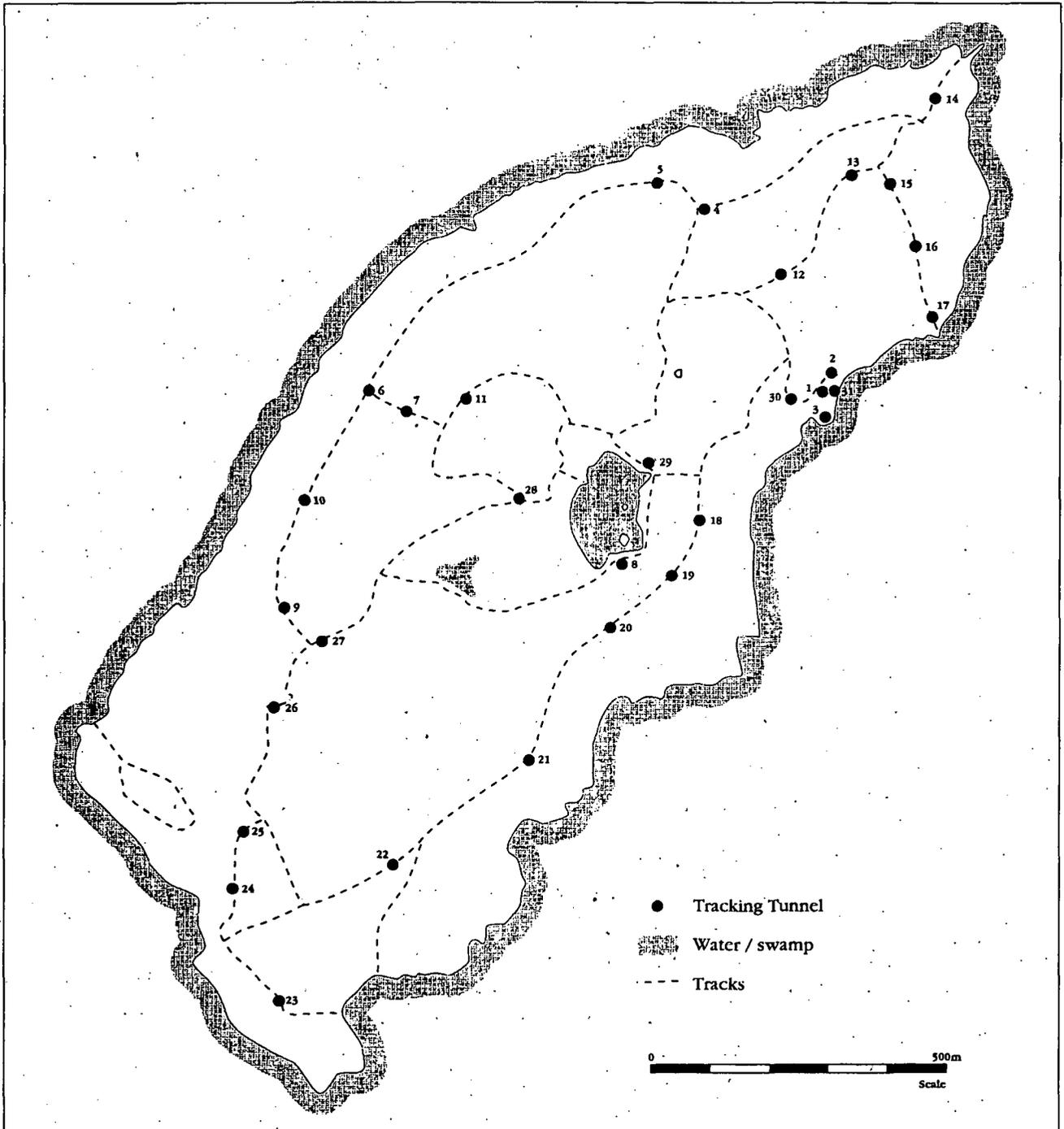
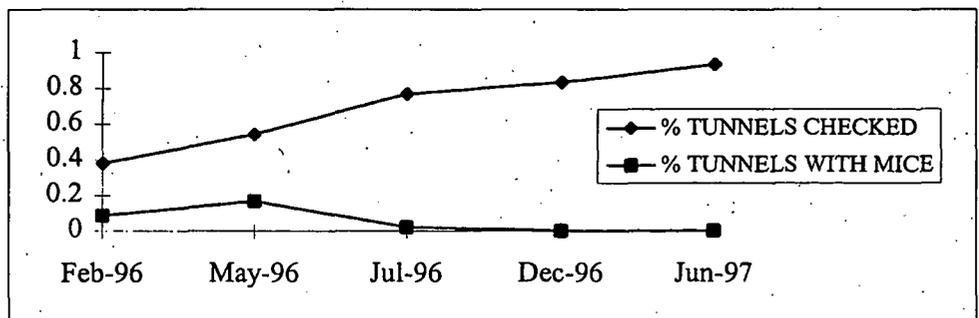


FIGURE 2: PROPORTION OF TUNNELS CHECKED AND PROPORTION WITH MICE PRINTS FEB 96-JUN 97 MOU WAHO



Daily inspections of baits placed on paper around the campsite showed a dramatic deterioration. By the third day baits were crumbly. Baits on the more shady southeast aspect of the island showed similar deterioration. In contrast, baits on the northwest aspect of the island showed very little deterioration, even after a week.

The total corrected trap nights of mouse traps was 881.5 with no mice caught. This is a lot less than in other operations (e.g., Towns *et al.* 1995 trapped for 3500 nights). These trap nights were spread over 2 months, 7 months and 13 months after the poison.

Passive monitoring of baits, wax candles and gnaw sticks were placed in accessible places around the island. All three monitoring methods reported no mice present after July 1996.

## DISCUSSION

The use of tracking tunnels is a departure from previous post-poison monitoring. The use of tunnels gave a third monitoring method and allowed a reduction in effort required for the most labour intensive (i.e., trapping).

The balance of the operation was conducted along similar lines to those outlined by Towns *et al.* 1995 and previous reports. Most other island eradication operations have been carried out to remove rats. Mice have been removed from Mana Island (Hook and Todd, 1992), but that was a ground-based operation. This operation has shown that techniques developed for use against rats can be used against mice. As part of the post-poison monitoring a permanent monitoring system for detecting the arrival of rodents and mustelids has been installed on Mou Waho. This is checked quarterly by staff from the Wanaka Area Office. It is clear from the discussion in Towns *et al.* 1995 that such systems are the first line of defence against reinvasions by mice or invasion by other species. The system established on Mou Waho has already shown its worth because a one-quarter check in May 1998 detected feeding sign-in bait stations around the camping area. A recheck in June showed no further feeding sign.

The amount of dew that was present on shady parts of the island was dramatic and led to early breakdown of baits. Late autumn-early winter is a preferred time for poison operations because of shortage of food. In southern New Zealand this can lead to early bait deterioration because of dew fall.

Clearly, from tracking tunnel records prior to May 1996 mice were not established over the whole island. In such a case, a poison operation over part of the island might have been justified. Such an approach may have been risky because there was no guarantee of exactly where the mice were. For example, on 5 May a mouse was recorded in Tunnel 9, which is on the western side of the island, well beyond any previous recording (see Figure 1). This tunnel had been checked on 4 May with no sign. A partial poison operation would have had no reason to include this part of the island. The only way to be sure was to poison the whole island.

The costs of this operation are set out in Table 1. The total cost per hectare is \$87, which compares with \$181 per hectare for Cuvier Island (Towns *et al.* 1995). Costs are less for Mou Waho because of a reduced sowing rate and easier access.

TABLE 1: COSTS OF MOU WAHO MOUSE ERADICATION 1995/96

ITEM	COST \$
Poison 1.4 tonnes Talon 20P	\$3,875
Helicopter Hire	\$4,273
Field Support, Logistics and Food	\$4,090
<b>Total Cost</b>	<b>\$12,238</b>

## ACKNOWLEDGEMENTS

I wish to thank Dave Murphy, Stu Thorne, John Flemming, Paul Hondelink, Coleen Rowley and Dave Grieve of the Department of Conservation, Wanaka, for their support and commitment on this project. David Blair, Marion Rhodes and the Highcliff Conservation Corps worked hard in the preparation of the island prior to poisoning. Ian McFadden gave advice and checked the operation prior to poisoning. Henrick Moller lent traps for monitoring. Bruce Kyle improved an earlier draft of the report. Joy Taite typed the report.

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# The use of nest boxes for blue penguins (*Eudyptula minor*)

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## ABSTRACT

Some 300 wooden nest boxes have been used for blue penguins in the Oamaru area. Experience suggests that many blue penguins prefer nest boxes to natural nest sites. Reproductive success in nest boxes is high, and the use of tannalised timber appears to present no risk.

## INTRODUCTION

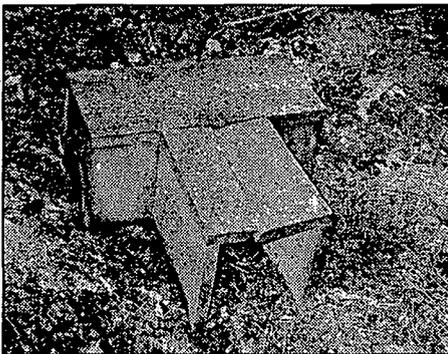


FIGURE 1. "T" TYPE NEST BOX

FIGURE 2. BLUE PENGUIN NEST BOX



Artificial nest boxes for blue penguins (*Eudyptula minor*) were first placed in the Oamaru area by the Waitaki Branch of the Royal Forest and Bird Protection Society, at the suggestion of Euan Kennedy, then working for the New Zealand Wildlife Service. Eighteen boxes were placed at Boatman's Harbour in August 1985, in an attempt to provide nesting sites for penguins displaced by the Oamaru Borough Council's activities in the Oamaru harbour quarry.

The design used for the first nest boxes was obtained by Kennedy during a private visit to Phillip Island Penguin Reserve in Victoria, Australia, during the early 1980s, and it was of the "T" shape design

illustrated in Figure 1.

A small number of boxes of the same design were used in a portion of the Oamaru quarry around the same time after an unsuccessful attempt by the Borough Council to fence penguins out of the area.

After 1987, Kennedy installed a number of nest boxes at Pilots Beach on the Otago Peninsula, after blue penguin habitat there was largely destroyed by the construction of a picnic area.

Kennedy used boxes that were similar to that illustrated in Figure 2, except that they had smaller tunnel entrances and a non-removable lid. The boxes were covered externally in black polythene plastic as a precaution against tannalising chemicals leaching out of saturated timber onto the birds' plumage (E. Kennedy, pers. comm.). The boxes were dug into sloping ground and completely covered with soil, leaving only the entrance visible. Blue penguins promptly occupied

some boxes but little work was carried out at this time on monitoring the boxes and their inhabitants.

In 1989 a number of Kennedy-designed nest boxes were installed at Oamaru creek during a cleanup of an area adjoining a former timber treatment plant.

## DESIGN REFINEMENT

It had been observed that the tunnel entrances to the boxes were too small for large pre-moult blue penguins. The small entrances also made it difficult for staff monitoring the boxes to get their hands inside to determine if penguins were present. It was decided to enlarge the internal size of the entrance to 150 x 150 mm. The development of the Oamaru quarry area as a blue penguin viewing area for tourists necessitated the placement of nest boxes to supplement the existing sites and to replace those under piles of wharf timbers and power poles, which were subsequently removed.

A monitoring programme was established to determine if the quarry penguins were adversely affected by the tourism development. In order to gain easy access to the nests, the front portion of the lid was left exposed and removable. Existing boxes at both sites were modified.

After the first breeding season of weekly monitoring of nest sites at the Quarry and Oamaru creek, it was noted that some boxes, mostly those with two chicks, became very wet and smelly. In an attempt to alleviate this problem two 25 mm ventilation holes were drilled in the sides of the boxes. While this has not eliminated the problem, it does allow the boxes to dry out more rapidly after the departure of the chicks.

## TANALISED TIMBER

In 1990, it was discovered that the Oamaru creek site was extensively contaminated with heavy metals from the former timber treatment plant there. There was concern that the blue penguins nesting in the contaminated soil and sawdust may have elevated levels of the heavy metals. The livers of blue penguins killed by dogs were tested for arsenic and chromium by the Ministry of Agriculture and Fisheries (MAF) Invermay Laboratory.

MAF considered that the arsenic and copper levels were well below that found toxic in other species.

If the penguins nesting on high concentrations of tanalising chemicals did not have elevated levels of heavy metals in their tissues then it was reasonable to assume that the tanalised timber used in the construction of the nest box itself was of no danger.

## REMOVABLE LIDS

While removable lids made the checking of the box and its contents easy; they were not without problems. Securing lids was a problem. Initially screws were used, but the time taken to open and refasten the lids was excessive, and there were problems with corrosion of the screws and warping of the timber.

Lids not securely fastened are prone to being dislodged by the penguins themselves during courtship and territorial defence. Most lids are currently held in place with stoppers (to stop them sliding off) and weighed down with a rock. A small number of boxes have had a one-piece lid fitted. In this way, the entire lid is removed to gain access to the nest. They have not, however, been well received by the monitoring staff who find them difficult to manage.

The use of removable lids means that the top cannot be protected from water infiltration by polythene plastic. This, however, has not proved to be a problem in the relatively dry Oamaru climate.

## PLACEMENT

The optimum placement for nest boxes has proved to be placement into a slope. It is desirable to have the entrance as the lowest point so that any water finding its way into the box can escape.

Boxes should be placed no closer than 2 m apart, as blue penguins will vigorously defend their nest site out to a radius of about 1 metre.

## BREEDING SUCCESS

Blue penguins using nest boxes at Oamaru have achieved reproductive success of up to 70% and fledging rates up to 2.06 per pair. Because of the difficulty of accessing 'natural' nests, no comparable data is available for non-nest box breeders in Oamaru.

It has been noted that several pairs of penguins have moved out of natural sites and into nest boxes, with some natural sites remaining vacant for 3 years now.

In a study of breeding success in at Taiaroa Head, Perriman and McKinlay (1995) observed that the mean number of chicks fledged per pair was  $2.5 \pm 1.35$  (n=10) for pairs using nest boxes compared to  $1.42 \pm 0.96$  (n=52) chicks per pair for pairs using burrows for breeding.

## DISCUSSION

The nest box design in Figure 3 is the result of several modifications of the original design. Its tunnel was designed to allow the bulk of the box to be buried and also to restrict the access of dogs and cats.

Nest boxes are useful where it is desirable to gain easy access to nests for research purposes. They are an effective way of increasing the number of available nest sites in areas where nest sites are at a premium. They may be used to replace existing nests that have been destroyed.

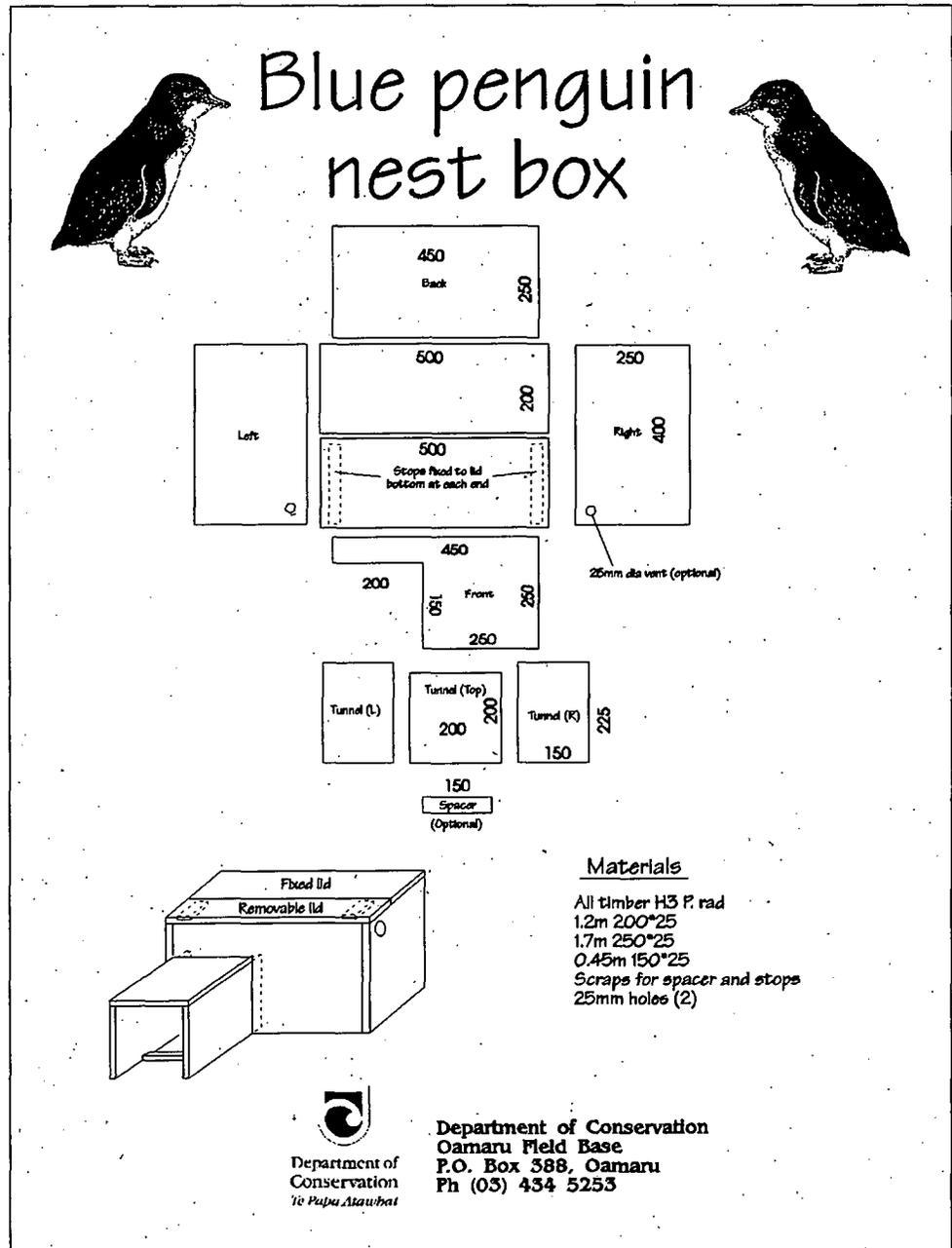
## CONCLUSION

Over 300 nest boxes are now in place in Oamaru, and the majority are occupied. Their use has assisted in the dramatic growth of the Oamaru blue penguin population and enabled many of the nests to be monitored closely with minimal disturbance.

The use of tanalised timber in the construction of the boxes presents no risk to the penguins.

Breeding success in nest boxes is superior to that in 'natural' sites.

FIGURE 3. BLUE PENGUIN NEST BOX PLAN



**ACKNOWLEDGEMENTS**

Thanks must go to Euan Kennedy who provided the initial nest box plans and prompted their placement at Boatman's Harbour.

The Waitaki branch of the Royal Forest and Bird Protection Society has played a significant part in the protection of Oamaru's blue penguins and was able to provide me with much information. Harold Coker was of particular assistance.

Suggestions for design refinement have come from the Oamaru Blue Penguin Colony monitoring team, namely Mandy Home and Tony Hocken, as well as Kevin Pearce, who has overseen the construction of countless boxes.

Finally, thanks to Bruce McKinlay who prompted me to write this and offered critical comment.

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# The quantity and value of existing ecological information in Southland Conservancy, Department of Conservation

**Chris Rance and Carol West**

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## ABSTRACT

A recent file archiving exercise in Southland Conservancy revealed just how much ecological information was buried in files and not readily retrievable. In this paper we describe a method for making the huge amount of previously collected ecological information accessible to conservation staff.

## INTRODUCTION

In 1995 Southland Conservancy identified that a lack of organised information was a limiting factor to good conservation decision-making. Organisations such as DoC often rely mainly on technical personnel with an excellent knowledge of ecosystems and issues built up over time. The loss of institutional and personal memory can put the organisation at risk, particularly after restructuring events.

To address this risk Southland Conservancy embarked on a programme to identify information sources, build databases to organise and sort information, and identify gaps in knowledge. This was to provide a framework for future information collection as well as to improve access to existing information.

The Southland Conservancy Bibliographic database was created to fill this need. This database included library books and reports, science & research publications, the subantarctic islands references database (previously accessed via a card index), individual journal papers and *Transactions of the Royal Society* papers relating to Southland. At this time, the DoC Library was not on-line to conservancy users, and there were no immediate literature search facilities available to conservancies other than out-of-date microfiches.

## QUANTITY OF INFORMATION STORED IN FILES

The quantity of ecological information held within in a national organisation like the DoC is enormous. The filing system includes files from DoC's parent

departments - Wildlife Service, Department of Lands and Survey, and Forest Service. New information is generated every day from within the department and from outside organisations (e.g., Landcare Research, universities). Existing information is in the form of published data (accessible through journal and library sources) and unpublished written data arising from day-to-day inspections, informal survey, and incidental observations. Such 'unpublished' data should be accessible from files, but once files are 'closed' they are often stored in locations that are difficult to access. File contents are not often recorded so searching is very time consuming, and may not be successful.

In Southland Conservancy, as part of a file archiving exercise, the opportunity was taken to identify reports of ecological value from old files. These were photocopied, numbered, and placed in a system called the Resource Inventory (previously a manual report record system with a card index). Over 8000 files were processed with 6000 files sent to National Archives in Dunedin, and relevant ecological reports were placed in the Resource Inventory and entered into the bibliographic computer database. At March 1998 there were over 11,000 references in the system; approximately 2300 of these were Resource Inventory reports which resulted from the file archiving exercise.

From July 1998 a standard operating procedure was introduced to ensure that all newly produced or received reports would go into the database system.

## THE BIBLIOGRAPHIC OR REFERENCES DATABASE

Records have been regularly put into the database to the present day. However, the inputting of library books ceased once the national on-line system was available to staff.

The Access Database fields are:

- Counter - assigns a number to each record
- Title
- Author
- Keywords
- Date of publication
- Document Source - where the publication is from e.g., *Ecological Management* 3.
- Document Location - where the record can be found in the conservancy.

The system was made accessible to most staff in Southland Conservancy in March 1997 through shared g:drive. A user-friendly search facility was created (Appendix 1, 2 and 3) which allows individuals to search for references themselves. The database is regularly updated.

In conjunction with the file archiving exercise, Southland has also committed resources to the library by cataloguing all uncatalogued library items (a recommendation of the STIS Draft Information Management Plan 23/2/98) and bringing into the library system reports being held on files (old and new). During this time, Southland library holdings have increased from 1500 books and reports to over 3000. The books and reports have been catalogued and are now accessible through the national DoCLib computer search facility.

## THE VALUE OF EXISTING INFORMATION

Existing information can only be valuable if it can be easily accessed. A search facility on the database provides the following advantages:

- provides an information baseline for further work
- saves technical staff time manually searching for information
- provides evidence to answer specific questions
- saves similar work being repeated
- provides for informed decision-making
- identifies gaps in knowledge.

The Bibliographic Database is used mainly by technical staff to find literature on certain subjects or locations. It is also used extensively by research staff and students working in Southland, e.g., for producing documents such as World Heritage Status investigation for subantarctic islands. It is also being used extensively to find information to input to other databases, e.g., searches to find information for the Southland Islands database. Increasingly, the Bibliographic Database is being used to fill gaps in other conservancy databases which are at various stages of design.

## OTHER DATABASES IN SOUTHLAND CONSERVANCY

The Bibliographic Database has become an important tool for finding information for input into more specific databases being developed in Southland Conservancy. For example, searching the library system produces 5 reports on Solander Island, whereas the Bibliographic Database produces 39 references, some going back to 1945. The information contained within those reports such as incidence of pest species, plants, birds and other species recorded, or historic sites information can then be input to the 'Islands Database', 'Threatened Species Database', 'Sites Database' or the 'Historic Database'. This provides baseline information which can then be checked and compared by staff visiting sites subsequently.

## DISCUSSION

None of the issues raised in this report are new; these and many others are discussed by Whitehouse (1998). One of the points raised by Whitehouse, which we have alluded to, is that organisations "need to be particularly vigilant when, and after, people leave to ensure that important data or material are not lost". Even when people shift offices within the Conservancy, we swoop on their boxes of 'throwouts' - many a valuable item has been rescued from the tip face.

A key point, from DoC's perspective, must be that all of this information has cost money to collect. It is, therefore, not prudent management to have it buried in old files or piled up in the corners of offices or thrown out during spring-cleans because its custodian is too busy to go through it. It is cost-effective to make this information as accessible as possible. Baseline data are crucial to an organisation like DoC, and the more accessible information is, the easier it is to do our jobs in an accurate and timely fashion.

## CONCLUSIONS

The Bibliographic Database (incorporating many sources of information) provides an essential resource for staff and forms the base information for other databases (sites, threatened species, islands, historic) which are being developed in Southland Conservancy. It also provides a framework into which new information can be placed.

## REFERENCE

Whitehouse, I. 1998: Science database and collection issues: oceans of data, vulnerable collections and terabytes of power. A scoping study prepared for the Ministry of Research Science and Technology. *MoRST report no. 67.*

# The impact of predators on *Powelliphanta marchanti* in Kaimanawa Forest Park

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## ABSTRACT

A survey of predation on *Powelliphanta marchanti* (a New Zealand carnivorous land snail), the extent of the population, and the remeasurement of a permanent monitoring plot, was undertaken early in 1997, in the southern Kaimanawa Ranges. From December 1997 to January 1998 another survey was undertaken to determine the range of the snail population. Results show intense predation by possums, which is probably responsible for a rapid decrease of the snail population. The ratio of live to dead snails decreased substantially, and the proportion of predation ascribed to possums remained constant between surveys. The snail population currently covers less than 2000 ha. These results indicate that the viability of this population is seriously threatened, and that the causal factors of snail population decline will continue to operate. It is recommended that, if a viable *P. marchanti* population is to remain in the southern Kaimanawa Range, possum control is undertaken urgently. Possum control should occur over as much of the snail population's range as possible.

## INTRODUCTION

*Powelliphanta marchanti*, a carnivorous land snail, is found in the central North Island of New Zealand, generally above 900 m altitude. Within the Tongariro/Taupo Conservancy *P. marchanti* is found only in southern Kaimanawa Forest Park, the New Zealand Army training area and adjacent private and Maori land. Meads, Walker and Elliott (1984) described *P. marchanti* as being also found at Mt Taranaki, Lake Waikaremoana, Mangahaururu Range and the central Ruahine Range, where populations are undergoing decline. Recent taxonomic work on *P. marchanti* using gel electrophoresis and morphological analysis shows that the Taranaki, Lake Waikaremoana and Mangahaururu Range *Powelliphanta* do not belong to the same species as the Ruahine and Kaimanawa populations. All populations of *Powelliphanta* are recognised as being vulnerable. The Ruahine and Kaimanawa *P. marchanti* are now reclassified to a category B threatened species from category C (Kath Walker, pers. comm.).

In this study a permanent monitoring plot and traverse were remeasured to determine snail population trends and to make management recommendations for the southern Kaimanawa *P. marchanti* population. The extent of the population was also surveyed and a new monitoring plot established.

## METHODS

This study used Walker's (1994) method for monitoring snail populations. Two basic techniques are used - permanent plots and walk-through traverses. Snails located in a single permanent plot established in 1994 and on a traverse located on a ridge track were counted and then removed during the 1997 survey. These snails, and those removed from the permanent plot, were scattered 5 m south-east of the permanent plot. Additionally, several informal traverses were undertaken over several kilometres south and north-west of the permanent plot in an attempt to find more snails. The maximum diameter of all snails was measured and the method of predation gauged using Walker's (1994) method. The altitude at which snails were found on the permanent traverse was also recorded. The location, habitat, and techniques for measurement are described by Gillingham (1994).

During December 1997 and January 1998 another survey was conducted to determine the range of the snail population. Ridges, gullies and faces were systematically searched for snails. As a result of the discovery of a second core area with a high density of shells during the 1998 survey, a second permanent monitoring plot was established. This plot is located at the summit of a hill 977 m a.m.s.l. near the Rangitikei River/Otamateanu Stream confluence, grid reference 676106 (Ruapehu 260-T20). The plot is situated on an east-facing slope immediately below the summit marked with white permolat strips at the plot's corners. The plot measures 20 m x 25 m (Walker, 1994).

Vegetation in the second plot consists of predominantly 4-5 m high manuka (*Leptospermum scoparium*) with scattered 4-5 m high mountain beech (*Nothofagus solandri* var. *cliffortioides*). The understory consists of *Gaultheria antipoda*, *Cyathodes juniperina*, *Olearia nummularifolia* and *Coprosma* spp. with a limited cover of mosses. In a large number of the quadrants there is very little understory, with only a layer of manuka and beech litter and fallen manuka branches/stems.

Approximately 20 worker hours were spent searching the second plot. All live snails found during this search were at or near the base of manuka stems, totally or partially covered by manuka/beech litter. A light raking motion to disturb the less compacted litter was found to be very effective for snail location.

## RESULTS

During remeasurement of the first permanent plot and traverse in 1997 167 dead snails were found. (The plot was established in 1994.) No live snails were found on the permanent plot or traverse. Only one live snail and two dead snails were found on the haphazard traverses.

During both the 1997 and 1998 surveys faecal pellets of possums and deer were abundant in all areas where snail shells were found. The understory diversity of mountain beech forest vegetation was probably being severely affected by both species.

There was a substantial reduction in the number of live snails found on the 1997 survey (N=1) compared to previous surveys (1994, N=4; 1991, N=6), even with a doubling of search effort in 1997 (Table 1). There was a significant reduction ( $p=0.04$ ,  $\chi^2=6.6$ , d.f.=2.0) in the ratio of live to dead snails found between surveys (1991, 6:100; 1994, 4.3:100; 1997, 0.6:100).

TABLE 1. THE NUMBERS OF SNAILS SHOWING SIGNS THAT THEY WERE CRUSHED BY DEER, PREYED UPON BY BIRDS, POSSUMS OR RATS; WHERE THE MECHANISM FOR DEATH WAS UNKNOWN; AND WHICH WERE FOUND ALIVE FOR THE 1991, 1994 AND 1998 WESTERN AND EASTERN RANGATIKI POPULATIONS. EASTERN SURVEY. RESULTS FOR 1991 ARE ESTIMATED.

YEAR	DEER	POSSUMS	RATS	BIRDS	UNKNOWN	LIVE	TOTAL
1991	6						<100
1994	6	111	8	3	7	4	139
1997	0	131	2	36	0	1	170
1998 (west)	0	251	0	5	0	5	312
1998 (east)	0	160	2	4	0	13	209

Search effort was approximately 10 worker days for the 1991 and 1994 surveys, 20 days for the 1997 survey, 30 for the 1998 western survey, and 8 for the 1998.

There was no significant difference in the proportion of times that possums were identified as being the predators responsible for snail death between the 1994 (80%) and 1997 (77%) surveys ( $p=0.84$ ,  $c^2= 0.04$ ,  $d.f.=1$ ), the 1997 and 1998 surveys ( $p>7.8$ ,  $c^2= 67.6$ ,  $d.f.= 1.0$ ) or between the eastern and western populations in 1998 ( $p>7.8$ ,  $c^2= 46.8$ ,  $d.f.= 1.0$ ).

Snails were mostly found between 1000 and 1200 m altitude. There was a dominance of medium-sized snails. Very few large snails (>45 mm) or small snails (<25 mm) were found.

## DISCUSSION

The most important result of this study is the rapid reduction in the ratio of live to dead snails found on consecutive surveys, even after a substantial increase in search effort. Of particular concern is the rate of decline: even with a doubling of effort in the 1997 survey only one snail was found, after four snails were found only two years previously. More live snails were found in the 1998 survey, but the ratio of live to dead snails did not change significantly between 1997 and 1998. Percentages of live to dead snails found during the 1991 (6%), 1994 (4.3%) and 1997 (0.6%) surveys decreased tenfold. It is unlikely that these differences were due to snails being less conspicuous because weather conditions were suitable for snailing with high humidity and occasional light rain and a damp understorey. It is also unlikely that search effort was less efficient during the 1997 and 1998 surveys because team members had the same level of experience as previous surveys (low) and remained very highly motivated and attentive throughout the survey.

Snails tend to be located on a restricted altitudinal band. This has implications for conservation management: any species with a restricted habitat requirement is more vulnerable to extinction than a more cosmopolitan species. Compounding this, it seems likely that the Kaimanawa *P. marchanti* has a low rate of juvenile survivorship, and is probably an aging population approaching senescence (10-20 years; Kath Walker, pers. comm.).

Possoms were shown to be responsible for most snail deaths. The importance of possum predation remained constant between surveys (80%). Because possums are likely to be opportunistic predators of snails, and are not dependent on snails for food, possum predation will remain constant in the future and will not decrease as the snail population decreases.

The first three surveys of southern Kaimanawa *Powelliphanta* undertaken used search effort quantified on a daily basis and did not accurately record weather and humidity conditions. Because these factors have a substantial impact on the success of finding live snails, field teams recorded search effort, the experience of searchers and relevant weather conditions on a daily basis during the 1998 survey.

Recent work on the taxonomy of *P. marchanti* has shown that only the Ruahine and Kaimanawa populations belong to this species. The Waikaremoana and Mangahaururu populations may belong to *P. traversi* and the Taranaki population is probably an undescribed species. The conservation status of *P. marchanti* has been changed from Category C to Category B threatened species status (Kath Walker, pers. comm.). This means that ensuring the ongoing viability of the Kaimanawa population is a national conservation priority.

The results of this survey show that if possum predation continues at its present rate *P. marchanti* will become extinct in the southern Kaimanawa Range, perhaps within only a few years. On a national scale this population is at a critical point (Kath Walker, pers. comm.) It is therefore recommended that a possum control operation is undertaken urgently over the snail population's range.

Results from the 1998 survey should be used to determine the extent of possum control. Any control operation would have to lower possum densities down to very low levels because only a few possums are required in an area to have a high impact on a *Powelliphanta* population.

Possum control planning will require early negotiations with landowners by the Department of Conservation. Before possum control is undertaken the relative abundance of possums should be indexed, so the effectiveness of control can be determined. This should follow protocols established by Warburton (1996), or perhaps Husheer and Luff (in preparation).

## RECOMMENDATIONS

It is recommended that:

- Funding is obtained for possum control on Department of Conservation estate that Kaimanawa *Powelliphanta marchanti* occupy (2000 ha).
- The New Zealand Army should be encouraged by DOC to control possums on the land that they administer where Kaimanawa *Powelliphanta marchanti* occur.
- Possum abundance is indexed throughout the range of the snail.
- Monitoring plots are measured at least 5-yearly.

## ACKNOWLEDGEMENTS

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The 1997 survey would not have been possible without the assistance of Bill Fleury who arranged access into the Army Training Area and provided helicopter transport in the field. I am indebted to him for his help. The assistance of the New Zealand Army in permitting access to their training area is acknowledged.

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# The benefits of possum control for selected rongoa (medicinal) plants at Rangataua Forest

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## ABSTRACT

Ten rongoa (medicinal) plant species were selected for study by members of the Ngati Rangi iwi. These species were evaluated in the Rangataua Forest at Karioi Rahui for possum, deer, and insect browse following intensive possum control. Additionally, crown density, diameter at breast height, and borer damage were assessed for the trees. The data were collected along two 6-km long by 20-m wide belt transects randomly selected, one in the treated area, and another in a nearby non-treated area for comparison. Results indicated significant differences in possum browse between treated and non-treatment areas for five plant species (*Prumnopitys ferruginea* miro, *Podocarpus hallii* totara, *Aristotelia serrata* makomako, *Coprosma grandifolia* kanono/manono, *Griselinia littoralis*, kapuka). There were insufficient numbers of other five plant species for comparison. There were no consistent patterns of differences for crown density, borer, insect or deer browse. Ten permanent study plots were established on the transects for continued monitoring and to determine forest composition. This study has shown that possum control significantly reduces possum browse on important rongoa plants. This result has important implications for possum control throughout New Zealand.

## INTRODUCTION

The Karioi Rahui is a proposed mainland island project in the Tongariro/Taupo Conservancy of the Department of Conservation (DoC). Mainland islands are experimental areas of comprehensive and sustained control of threats to important biodiversity values. The Rahui has been established in Rangataua forest on the southern side of Mt Ruapehu as a partnership between DoC and the tangata whenua, Ngati Rangi.

Rangataua forest has medicinal plants (rongoa Maori) that are affected by possum browse. Owen and Norton (1995) demonstrated that brushtail possum can severely impact understorey and subcanopy vegetation in beech forests. A recent DoC workshop on possum impacts in beech forests took place in January 1997 (Erikson

*in prep.*) and illustrated the need for continued conservation of beech forests that are damaged by possum.

An opportunity to integrate matauranga maori with western scientific knowledge was enabled by this pilot study, undertaken in conjunction with the Science and Research Division of DoC. Plants identified as important rongoa (medicinal) species by Ngati Rangī were examined in field studies after intensive brushtail possum (*Trichosurus vulpecula*) control had occurred. The chosen plants were possum palatable. Consequently, benefits to an ethnic group can be emphasised when considering the management plan that calls for exotic species control. Such ethnobotanical studies can demonstrate the cultural, economic, and environmental values of conservation management.

Consultation with the Ngati Rangī Trust representatives allowed for a selection of 10 rongoa species for study. Field sampling indicated that only five rongoa species were present in sufficient number for statistical analysis. The rongoa plants that reached at least 3 cm in diameter at breast height were observed for diameter; possum, deer, insect and borer damage; and crown density along a fixed transect through the forest. Sampling took place over a 3-month period beginning in late January 1998 along two randomly located 6-km long permanent transects encompassing plants of interest within a 20-m band. One transect was established in forest that had been treated to control possum 5 months earlier and the other in an adjoining non-treated area.

## OBJECTIVES

The present and continuing objectives of this study are:

1. To identify rongoa plants palatable to possums and deer to use as indicator species;
2. To establish a monitoring system to assess changes in rongoa and forest health indicator plants resulting from pest control;
3. To determine the effectiveness of possum control for survival and regeneration of selected rongoa plant species;
4. To determine the conservation status of selected plant species, the present status of deer and possum browse, and insect and borer damage;
5. To construct permanent transects and plots for long-term, continued research in ecologic status, and vegetation change and composition; and
6. To use the rongoa project to cement relationships with Ngati Rangī.

## STUDY AREA

Rangataua Forest is a 10 000-ha reserve dominated by *Nothofagus* species. Silver (*N. menziesii*), red (*N. fusca*), and at higher levels, mountain (*N. solandri* var. *cliffortioides*) beech dominate a minor podocarp component (estimated at 15-20%, Husheer, 1997) within the lower forest. The forest extends from the main North Island trunk railway line in the south to 1200-m above sea level where, it intergrades with mountain beech forest and tussock lands. A reference map is found in Appendix 1.

An andesite lava flow landform makes up the principle parent material in the eastern half of Rangataua Forest, one of the largest of its kind in New Zealand (Atkinson, 1980). A weakly dissected ringplain forms the rest of the area. Several streams flow through the area from springs and snowmelt from Mount Ruapehu. Between two of these streams, the Omarae and Waitaiki, on the southern edge of the forest are found Lake Rotokura and Dry Lake. These average about 10 ha in size and are a part of Rotokura Ecological Reserve. The upper natural lake, Rotokura, is waahi tapu to Ngati Rangi.

Possums have been controlled in an expanding area east of Omare Stream since 1993 (Appendix 2). An area of 240 ha around Rorokura Lakes has been treated since October 1993. A total of 3100 ha were treated to the end of August 1997, including 1628 ha by aerial application of pollard bait laced with 0.15% by weight 1080 toxin. Trap catch monitoring shows that the possum population has been decreased by 93% in the treatment area. The area to the west of the Omarae Stream has not been treated for possum and provides an ideal control area for treatment evaluation.

## METHODS

Before the data collection component of this project began, DoC staff led by Harry Keys and kaumatua visited the study area to initiate the work and cement ties with Ngati Rangi.

During the experimental design phase Sean Husheer and Harry Keys compiled a list of 30 rongoa plants occurring within the Rahui that are possum palatable. Literature was consulted to determine the palatability and the rongoa status of plants. In January 1998 Ngati Rangi representatives chose 10 of the 30 as indicators for this study. They include:

<i>Prumnopitys ferruginea</i>	miro
<i>Podocarpus hallii</i>	totara
<i>Aristotelia serrata</i>	makomako
<i>Coprosma grandiflora</i>	kanono/manono
<i>Coprosma robusta</i>	karamu
<i>Melicytus ramiflorus</i>	mahoe
<i>Schefflera digitata</i>	pate
<i>Nestegis cunninghamii</i>	maire
<i>Nestegis lanceolata</i>	maire
<i>Pseudopanax arboreus</i>	whauwhaupaku

*Griselinia littoralis* kapuka, and *Fuchsia excorticata* kotukutuku, were also surveyed because of their importance to deer and possum diets.

A continuous transect, referred to as Transect A, was randomly selected on a magnetic bearing of 17 degrees. It is 6.091 km long and begins at point 266 937 on Ohakune Topomap 260 S20. Transect A crosses over Rotokura Lake but the distance measured does not include the lake. Transect B, randomly selected from the west side of Omarae Stream, is 6.43 km long and begins at point 257 963 on Ohakune Topomap 260 S20. It is on a magnetic bearing of 357 degrees. Transects were at best 6 km long in order to include rongoa species that are found in the

altitudinal gradient up to the mountain beech forest. Both transects are mapped in Appendix 1. Transect A traverses through the treatment area and Transect B is through the nontreated (experimental) control area.

Each transect is 20-m wide and all chosen reference plants (rongoa species) that are within 10 m either side of the transect line and have a minimum diameter of 3.0 cm at dbh (135 cm) were indexed. The observer after tagging the tree or stem with a numbered tag allowed the recorder to indicate the position along the transect line (total horizontal distance out from origin of the line) and whether the plant was east or west of the transect line.

Measurements were taken for each overstorey plant using standard field procedures established by Allen (1993), Atkinson (1962), and Payton, *et al* (1997). A detailed description of these measures and standards can be obtained from the field operations manual by Sean Husheer (1998). Data were observed for each tree or stem and included:

1. Diameter  $\geq$  3.0 cm at diameter at breast height (135 cm, overbark), measured to the nearest tenth cm, 1 cm above the numbered tag with a dbh tape.
2. Crown density, using a score card to estimate percentage coverage of upper crown when referenced to a standard, as observed from below standing next to the tree tag.
3. Possum, deer, and insect browse (hedging or damage) on a five-point scale within the categories of: 0 (zero browse), 1 (1-25 % of leaves showing indications of browse), 2 (26-50%), 3 (51-75%), and 4 (76-100%). An X is ascribed if it was not possible to determine severity of browse. Deer browse is only estimated on the foliage that is within the first 2 m above ground.
4. The presence or absence of boring insects (pin hole borers, *Platypus* spp.) on the trunk were observed and recorded.
5. Individual plants were identified as individual trees with one stem, or part of a group of two or more stems arising from the same root mass.

After completion of the transects, 10 (5 for each transect) permanent 20 x 20 m plots were randomly selected along the transect lines and placed on the right (east) of the transect line. All overstorey species within the plots were recorded. The above measurements for overstorey vegetation were also recorded. This plot data will standardise the forest data for reference according to Allen (1993). This will assist in understanding future growth, species composition, and survival data. Permanent plot overstorey data were ordinated using detrended correspondence analysis. This analysis was undertaken to indicate if there might be any consistent difference in permanent plot species overstorey composition between transects and between the plots in the vicinity of Lake Rotokura.

## RESULTS

### Number and size of plants observed

Five of the originally chosen plant species were of sufficient quantity in the survey to allow statistical analysis. There were 1307 rongoa plants tagged and indexed. Of these, 1285 were the five species indicated. They are shown in Table 1 with the number and mean diameter of the tree-size plants observed in each transect.

TABLE 1. FREQUENCY AND MEAN DIAMETER OF STUDY PLANTS ( $\geq 3.0$  cm AT DBH, 135 cm) BY TRANSECT.

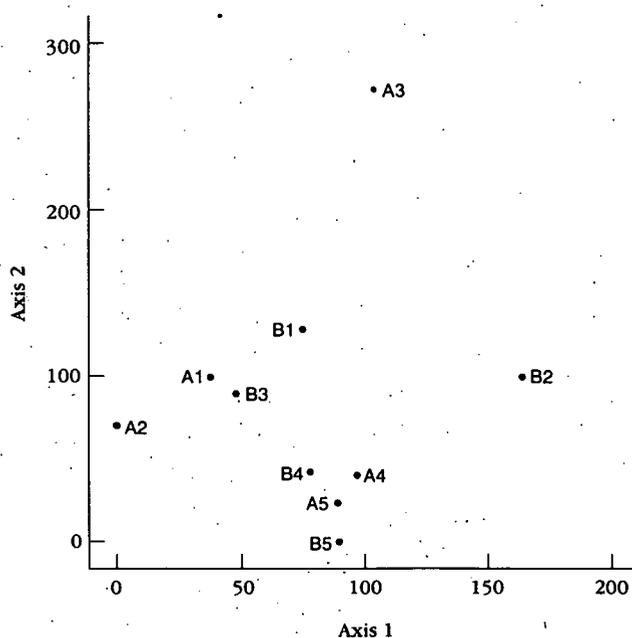
SPECIES	TRANSECT A (TREATMENT)		TRANSECT B (NONTREATMENT)	
	n	diameter cm	n	diameter cm
<i>Prumnopitys ferruginea</i> , miro	625	8.8	145	15.3
<i>Podocarpus hallii</i> , totara	136	7.9	30	8.7
<i>Aristotelia serrata</i> , makomako	101	4.0	125	5.4
<i>Coprosma grandifolia</i> , kanono/manono	8	7.3	14	5.7
<i>Griselinia littoralis</i> , kapuka	45	9.7	56	13.1

Seven other plant species did not occur frequently enough to be analysed (only 22 plants total), but may be important in the future if less common plants are evaluated. Saplings and seedlings of the selected rongoa plants may become part of the data record depending upon criteria for inclusion in future studies. The tally of the seven other species is shown in Appendix 3. A 1997 Recce survey (Husheer, 1997) confirms low incidence of the last seven plant species, except for *Pseudopanax arboreus*, which again may recover after possum control to reach sufficient size for recording. Their absence may suggest browsing pressure within the recent past.

### Were transect lines comparable?

Yes, Figure 1 shows no constant difference in overstorey composition between lines, or between plots in the Rotokura treatment area and other plots. This shows that transects A and B make good treatment and non-treatment areas.

FIGURE 1. A DETRENDED CORRESPONDENCE ANALYSIS ORDINATION OF SPECIES COMPOSITION OF PERMANENT PLOTS.



Plot 1, transect A is A1, plot 2 transect B is B2 and so on.

## Does possum control make a difference?

Yes, in this study possum control appears to make a difference in possum browse damage to medicinal plants of interest. A Kruskal-Wallis test on the five species demonstrated a significant difference between Transect A and B for possum browse for all five species.

TABLE 2. MEAN POSSUM BROWSE SCORE FOR FIVE RONGOA PLANT SPECIES BY TRANSECT.

SPECIES*	TRANSECT A (TREATMENT) SCORE	TRANSECT B (NONTREATMENT)	
		SCORE	p<*
<i>Prumnopitys ferruginea</i> , miro	0.37	0.76	0.001
<i>Podocarpus hallii</i> , totara	0.43	0.72	0.05
<i>Aristotelia serrata</i> , makomako	0.50	0.97	0.001
<i>Coprosma grandifolia</i> , kanono	0.00	0.50	0.05
<i>Griselinia littoralis</i> , kapuka	0.40	1.05	0.001

\*Significance level determined by Kruskal-Wallis nonparametric test statistic.

The mean possum browse score for the treated area (Transect A) is one-half or less than the untreated area. Most of the rongoa species in the treated area had a mean score of 0.5 or less which indicates little or no browse on plants. The possum browse on the same species in the untreated area scored close to 1.0, which signifies up to 25 percent browse on plants.

## Is crown density different for the two transects?

Crown density was significantly different in the two transects in only one case. *Prumnopitys ferruginea*, miro, demonstrated a crown density that was different for the treated versus the nontreated area, as seen in Table 3. Mean crown density was slightly higher (by 5.7%) in the nontreated area. All other species showed no significant difference between crowns in the two areas. A two sample t-test statistic was used to determine significance.

TABLE 3. MEAN CROWN DENSITY FOR FIVE RONGOA PLANT SPECIES BY TRANSECT.

SPECIES	TRANSECT A PERCENT	TRANSECT B	
		PERCENT	p<
<i>Prumnopitys ferruginea</i> , miro	54.1	59.8	0.001
<i>Podocarpus hallii</i> , totara	45.9	51.3	N.S.
<i>Aristotelia serrata</i> , makomako	31.2	35.8	N.S.
<i>Coprosma grandifolia</i> , kanono	35.7	51.2	N.S.
<i>Griselinia littoralis</i> , kapuka	44.4	50.3	N.S.

## Were deer and insect browse scores different for the transects?

Table 4 shows significantly higher deer browse scores for *Prumnopitys ferruginea*, miro, and *Aristotelia serrata*, makomako, for the B (nontreated) Transect, whereas *Podocarpus hallii*, Hall's totara, had a higher deer browse score in Transect A. The last two species demonstrated no statistically significant difference between transects.

TABLE 4. MEAN DEER BROWSE SCORE FOR FIVE RONGOA PLANT SPECIES BY TRANSECT.

SPECIES	TRANSECT A (TREATMENT) SCORE	TRANSECT B (NONTREATMENT)	
		SCORE	p <
<i>Prumnopitys ferruginea</i> , miro	0.93	1.89	0.001
<i>Podocarpus hallii</i> , totara	0.68	0.46	0.05
<i>Aristotelia serrata</i> , makomako	0.22	1.17	0.001
<i>Coprosma grandifolia</i> , kanono	0.00	0.80	N.S.
<i>Griselinia littoralis</i> , kapuka	0.76	1.20	N.S.

Insect browse as seen in Table 5, also demonstrated mixed results. Non significance was indicated for the last two species, and the other three had varied results with a higher score in the B Transect in only two cases, for the first two species shown. Such results are indicative of two similar areas within the same forest.

TABLE 5. MEAN INSECT BROWSE SCORE FOR FIVE RONGOA PLANT SPECIES BY TRANSECT.

SPECIES	TRANSECT A (TREATMENT) SCORE	TRANSECT B (NONTREATMENT)	
		SCORE	p <
<i>Prumnopitys ferruginea</i> , miro	0.91	1.47	0.001
<i>Podocarpus hallii</i> , totara	1.35	1.41	0.05
<i>Aristotelia serrata</i> , makomako	1.76	1.55	0.05
<i>Coprosma grandifolia</i> , kanono	1.62	2.07	N.S.
<i>Griselinia littoralis</i> , kapuka	2.09	2.41	N.S.

## What about borer damage?

Tree stem borer damage (*Platypus* spp.) was minimal for the rongoa species. Only two *Aristotelia serrata*, (one in each transect); six *Griselinia littoralis*, (four in Transect A and two in B); and two *Coprosma grandifolia*, (both in Transect B), showed damage by borers. This represents a total of 10 trees that had borer damage from the 1307 rongoa plants that were observed, less than one percent (0.76%). No statistical difference was demonstrated between the two transects.

## DISCUSSION

The project accomplished all six study objectives.

1. Medicinal plants were identified for use as indicator species.
2. A monitoring system was established that will allow assessment of changes in forest health and the effectiveness of conservation management.
3. Possum control by poison treatment did reduce possum damage to the five plants that were of sufficient number to be monitored. Intensive possum control does make a difference for ensuring survival and growth of selected rongoa plants. Continued monitoring may bring more plants into measurable size for additional success in growth and survival of selected rongoa species.
4. Co-ordinated input and discussion by representatives of the Ngati Rangi Trust helped make this project a positive achievement for local iwi and DoC management.
5. The present status of nearly 2000 tagged plants in the Rangataua Forest is now known for deer, possum, and insect browse; diameter, crown density and borer damage. This includes data from 10 permanent study plots and 2 transects. Such information will also serve as baseline data necessary to accomplish objective 2.
6. The permanent transects and plots that are now in place and marked will be an asset to understanding future vegetative growth, plant survival, species composition, and response to management change of the forest. Those data act as an important management tool for analysing forest changes over time. Ecosystem management within the framework of the mainland island concept requires biological comparisons. This pilot study is a beginning in that direction.

The validity of the conclusions of this study, that possum browse on rongoa plants is reduced by possum control, is strengthened by the similarities of the two transects in species distribution and lack of significant differences in other variables such as insect or deer browse. The principal variable controlled here was possum presence by the introduction of poison control. All selected rongoa plants that were sufficient in number for verifying results showed strong recovery or less possum damage in the treatment area. Comments from field workers data sheets support the study results. Written notations like "saplings on transect (of the rongoa plant) showed recovery from possum damage," and "prolific new growth present on plant," in response to previous damage and now current control, indicate the possum control is making a difference.

A good case is made for protecting rongoa plants by effective possum control management. Continued monitoring is essential to understand the degree and length of effectiveness in maintaining a good rongoa plant resource.

## RECOMMENDATIONS

It is recommended that:

1. Transects are remeasured between January and March 1999.
2. Additional transects are established to monitor less abundant rongoa plants, if resources permit.

3. More permanent plots are established to determine over- and under-storey composition.
4. A study is initiated on low stature, less conspicuous rongoa to monitor the benefits to these species of possum control.

## ACKNOWLEDGEMENTS

We would like to thank staff of the Ohakune Field Centre for providing the support necessary for this field work, especially John Luff and Nigel Hollands who provided logistical information.

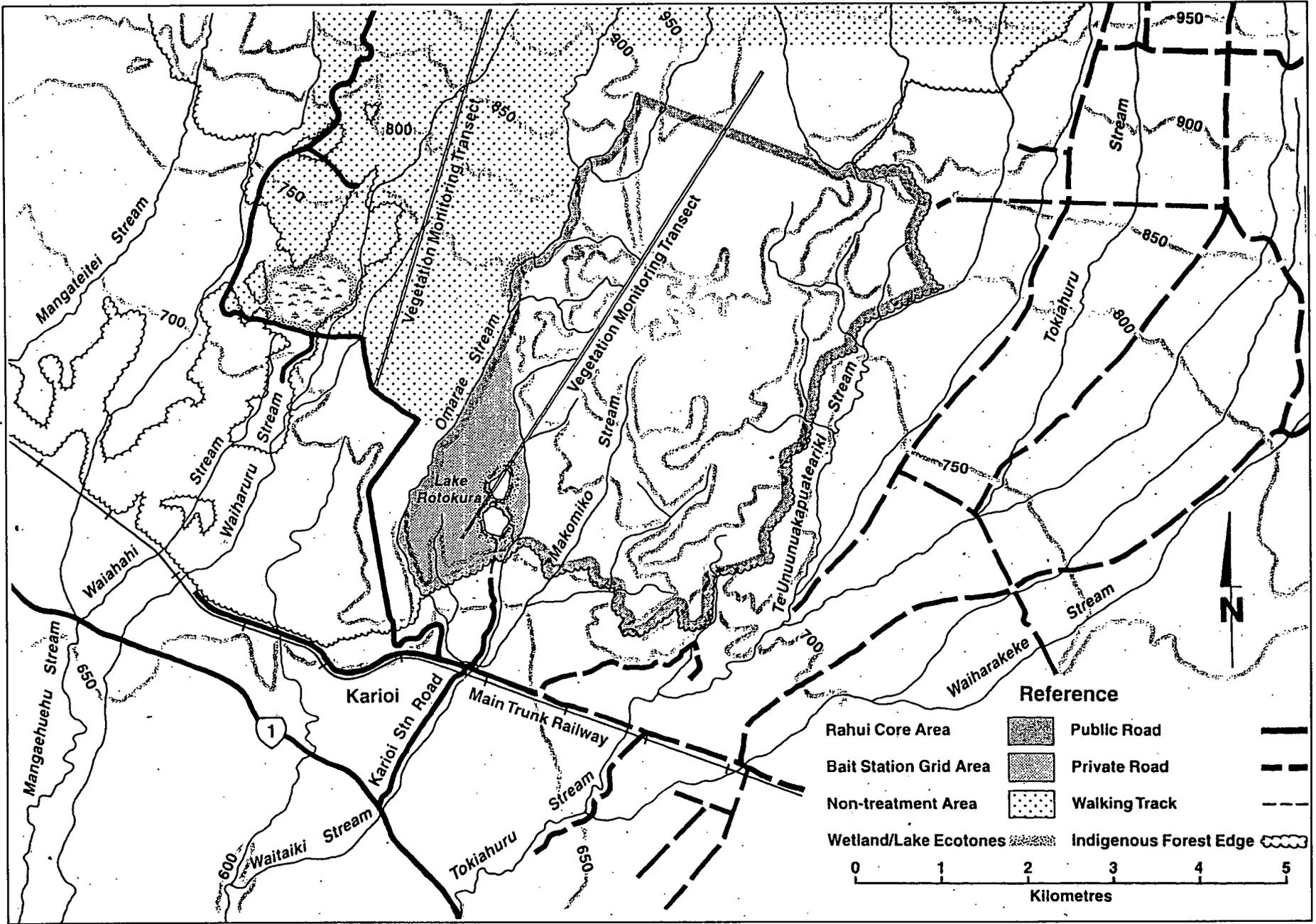
Phillip Simpson commented on a proposal for this work and helped arrange funding for field work. Figure 1 was drafted by staff from the drafting section of the Wanganui Conservancy.

We are grateful for the close co-operation from members of the Ngati Rangī Trust. Their selection of plants of special interest to them was an essential component of this pilot study.

Field workers, many of them volunteers, were particularly enthusiastic and their help made the study possible. They include Cate Ryan, Steve Deverell, and Barbara Martin, whose assistance and comments made this study a success. Others include Susan Katsman, Maikē Neuendorff, Stephanie Krauss, Amy Sayer, Dan Young, Hella Schmidt, Andrea Steede, Marie Anne Decamp, Steven Poelman, and Kris Erickson.

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## APPENDIX 2

### HISTORY OF POSSUM CONTROL TREATMENT IN THE AREA OF THE KARIOI RAHUI

TIMING	LOCATION	AREA (ha)	TREATMENT	PEOPLE	TRAP CATCH
Oct 93-Mar 94	Rotokura Lakes	240	trapping & ground poisoning (cyanide)	TFG	<5% resid.
94/95 summer	Rotokura Lakes	240	trapping & ground poisoning (cyanide)	TFG	<5% resid.
95/96 summer	Rotokura Lakes	240	trapping & ground poisoning (cyanide)	AM/AS	<5% resid.
Oct 96-Aug 97	Rotokura Lakes	240	bait stns (A) (pulse fed brodifacoum)(B)	A Munn	nd
Jan-97	within 2 km of lakes	240	possum trap catch assessment	RW/BG	4%
Mar-97	Rahui core area	1600	possum trap catch assessment	RW/BG	17%
30-Aug-97	Rahui and above	2600	aerial pollard baits (1080) (C)	MH	1.3% resid.
Aug-Dec 97	Rahui streams	200	feratox bait stations (D)	N.Rangi	
Aug-Dec 97	Omarae-Waitaiki	400	bait stns (A) (prefeed then 1080) (E)	N.Rangi	1.3% resid.
Nov 97-Jan 98	Rahui perimeter	line	bait stns @ 100 m (filled with brodifacoum) (B)	N.Rangi	
Jan-June 98	Rahui	"1600"	pulse feed bait stations (brodifacoum)(F)	staff/RW	

A: bait stations every 100 m on grid lines 200 m apart

B: 0.02% w/w active ingredient in 300 g "Pestoff" talon bait

C: 0.15% w/w a.i. in Wanganui #7 cereal baits (spread at 5 kg/ha over lower 1012 ha and 3 kg/ha over higher area of 1616 ha)

D: 100 m spacings on average, filled with 300 g prefeed and 12 toxic "hot pills" with a Victor No. 1 trap between pellet feeders

E: prefeed 1.2 kg non toxic W#7 followed by toxic W#7 as for C in hot spots

F: 0.02% w/w a.i. in 300 g waxed Pestoff talon bait pulse fed monthly

TFG Task Force Green

AM Alan Munn

AS A Smith

RW Ross Wallis

BG Bryan Gascoigne

MH Martine Helicopters Ltd.

### APPENDIX 3

TALLY OF PLANT SPECIES NOT SELECTED FOR STATISTICAL ANALYSIS BECAUSE INCIDENCE WAS TOO LOW.

SPECIES	TRANSECT A	TRANSECT B
<i>Coprosma robusta</i> , karamu	0	0
<i>Meliccytus ramiflorus</i> , mahoe	2	2
<i>Schefflera digitata</i> , pate	0	0
<i>Nestegis cunninghamii</i> , maire	3	4
<i>Nestegis lanceolata</i> , maire	0	0
<i>Pseudopanax arboreus</i> , whauwhaupaku	9	2
<i>Fuchsia excorticata</i> , kotukutuku	0	0

# Scarlet mistletoe *Peraxilla colensoi* surveys in Waitaanga Forest, North Taranaki: a comparison of techniques

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## ABSTRACT

Ground and aerial techniques were used to survey for scarlet mistletoe *Peraxilla colensoi* in silver beech forest on the Waitaanga Plateau. The two techniques are described and compared. For comparative purposes the cost of helicopter time was converted to person-days. The aerial survey by helicopter proved to be four times more efficient than the ground-based survey. The use of helicopters is recommended for future surveys.

## INTRODUCTION

*Peraxilla colensoi* (scarlet mistletoe/korukoru; *sensu de Lange et al.* 1997) was not known on the Waitaanga Plateau at the time of the Protected Natural Areas Programme survey of the North Taranaki Ecological District (Bayfield *et al.* 1991), despite the presence of its principal host species silver beech (*Nothofagus menziesii*). This silver beech stand is a remnant forest, with the next closest population being some 45 km to the south-east in the lower Retaruke Valley (Wardle 1984). DoC has rated *P. colensoi* as a Category B species for management action (Molloy & Davis 1994), and it has an IUCN threat status of Vulnerable (Cameron *et al.* 1995).

In the summer of 1994/95 I initiated an intensive ground search of the Waitaanga Plateau. Four plants of *P. colensoi* were found, all on silver beech. These records for Waitaanga were reported in Barkla and Ogle (1997). Two years later I attempted to find further plants by doing an aerial survey in a helicopter. The aim of this paper is to compare the efficiency of these two techniques.

## METHODS AND RESULTS

### Ground search

I first found and identified *P. colensoi* in the summer of 1993/94 during a specific search for it in South Waitaanga. Subsequently a total of 20 person-days, comprising 10 in 1993/94 and 10 in 1994/95, were spent searching the difficult flat swampy

ground. Searches were conducted primarily in the area in which mature silver beech occurred, i.e. on the plateau and along river banks. The first two mistletoes were found in the same host tree. This tree was used as a starting point from which the search radiated out. Because of the uniformity of the terrain, compass bearings were followed. Different areas were searched each year. The ground was searched for scarlet petals from mistletoe flowers, and trees were searched for plants. Four mistletoes were found over the two seasons of ground searching. This equates to one plant per 5 person-days.

### **Aerial search by helicopter**

A Robertson R22 helicopter was used for the aerial survey in January 1997. The pilot and I were the only spotters. Flying was at tree top level spotting for the crimson flowers. Initially we got our eyes in by using known plants previously located during the ground surveys. I navigated and used a mixture of topographical (gully-by-gully) flying and grid lines. I knew the rough boundaries of the silver beech stands, but used the opportunity to map the boundaries accurately. Six hours of flying was done over 2 days covering some 2400 ha, at a cost of \$2,137.50 (incl. GST).

A differential global positioning system (DGPS) was not available, and a hand-held global positioning system (GPS) did not work well due to interference with reception from the main rotor disc. I did manage to get a fix on one plant located in the middle of the flat area, but relocating the site using GPS under the forest canopy proved difficult.

Localities were plotted on a map, and relocated by ground-based searchers a week later. Fallen petals of the crimson flowers were the best indicator of a plant in a tree. Only one plant located from the air could not be relocated during this ground-based search.

Ultimately 8 new plants were located as a result of this aerial survey: the aerial search revealed 6 previously unknown plants, plus another 2 plants not located during the aerial survey were found in the vicinity of those plants spotted from the air.

The two techniques and the success of each are compared in Table 1.

## **DISCUSSION**

In the aerial survey 8 mistletoes were found in the equivalent of 10 person-days, which equates to 1 every 1.25 days. This is one-quarter of the time it took to find each mistletoe during ground surveys (1 mistletoe per 5 person-days).

Having attempted both ground and aerial surveys in this difficult to search plateau topography, I was pleased with the success rate and efficiency of the aerial survey. The aerial technique will not reveal plants that are hidden by a dense canopy, small plants, or plants without flowers, but it did prove to be four times more efficient than ground-based searches. Inclement weather may prevent flying, in which case a ground survey may have to be conducted.

There appear to be large gaps in the distribution of the mistletoes at Waitaanga, despite a similar search effort throughout the silver beech distribution range. *P. colensoi* appears to have never been common in the North Island (de Lange *et al.* 1997). The follow-up discovery of 2 plants not spotted from the air, but in the

TABLE 1. SEQUENCE OF EVENTS FOR GROUND AND AERIAL SURVEYS, WITH DETAILS ON EFFORT AND SUCCESS RATE OF EACH METHOD (HELICOPTER TIME CONVERTED TO PERSON DAYS BASED ON CURRENT DOC LABOUR RATE OF \$60 PER HOUR, AND 8 HOURS IN A PERSON-DAY - FIGURES PRESENTED IN BRACKETS).

DATE	ACTIVITY	PERSON-DAYS	NO. MISTLETOES	PERSON-DAYS PER MISTLETOE
January '94	ground survey	10	2	5
January 95	ground survey	10	2	5
<b>Total</b>	<b>Ground survey</b>	<b>20</b>	<b>4</b>	<b>5</b>
19/1/97	ground inspection to check that flowering at peak:	1		
20/1/97	4 hrs aerial survey	1 (3)	5	0.8
27/1/97	2 hrs aerial survey	1 (1.5)	1	2.5
30/1/97	ground relocation of plants spotted from air while petals still obvious on ground	2	2 additional	1
<b>Total</b>	<b>Aerial survey</b>	<b>10 #</b>	<b>8</b>	<b>1.25</b>

# half a day added for administration

vicinity of those spotted from the air, indicates that there is a greater chance of finding additional plants in areas where mistletoes are already known. These areas will be worth searching more intensively, both from the air and on foot.

Most helicopters are now fitted with a DGPS, and GPS's now exist which can function under a forest canopy, so the plotting and relocation of mistletoes in the future should be more efficient.

## CONCLUSION

The use of a helicopter to conduct an aerial survey for *P. colensoi* in Waitaanga proved to be highly successful, and I would recommend their use in further mistletoe surveys.

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# Possum woes, mistletoes and environmental impact assessments

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Management actions, no matter how small they seem to be, have environmental implications which need to be considered. This note focuses on the seemingly simple action of banding a silver beech (*Nothofagus menziesii*) host tree to protect a scarlet mistletoe (*Peraxilla colensoi*) from being browsed by possums. The implications of this management action, and the role that simple environmental impact assessment (EIA) techniques could have played in identifying potential problems associated with the tree banding are considered. Parallels are drawn with *Sebaea ovata*, an annual gentian confined to one ephemeral wetland in New Zealand.

Nationally, scarlet mistletoe is rated as vulnerable (Cameron *et al.*, 1995). The Department of Conservation (Molloy & Davis, 1994) rates it as a Category B species. Scarlet mistletoes are uncommon on the Waitaanga Plateau in North Taranaki, with only twelve plants being found during extensive ground and aerial surveys of silver beech stands in the 16,131 ha Waitaanga Conservation Area (Heaphy, 1998).

One of the mistletoes discovered in the summer of 1994/95 grew on a branch only 1.2 cm in diameter. This mistletoe was protected from possums by banding the host tree and trimming overhanging branches (as per Jones, 1993). Within 18 months the mistletoe had doubled in size to approximately 2 m in diameter. There were concerns that the host branch would actually snap under the weight of the mistletoe, which could not be reached in order to trim it. Advice was sought on possible management actions. The survival of the plant became a primary concern, because of the low number of scarlet mistletoes on the Waitaanga Plateau.

The best solution we could come up with was to let the possums do the trimming for us. Our idea was to remove the band from the tree, allowing free access for possums. They hopefully would reduce the mistletoe's weight so that the danger of the branch snapping was diminished. Careful monitoring of browse would be essential, so that the mistletoe wasn't killed as a result of this management regime. With time, the host branch should grow thicker, ensuring that the mistletoe was not lost through the loss of the branch. Once the branch became thicker, possum access could be denied again by banding the tree, to allow flowering and fruit set. An alternative to removing the band was to place a possum into the tree above the band, so that it would have no option but to trim the mistletoe. The possum could then be removed when the mistletoe was reduced to the desired size. We consider it to be highly appropriate to use the major browser of mistletoes to help protect this plant.

This example illustrates the value of the application of environmental impact assessment (EIA) techniques and principles in everyday conservation management actions (e.g., Porter & Brownlie, 1990). EIA principles apply to all levels of activity, not only to large projects or where there's a legal requirement for them. Adoption

of the principles and the application of a simple technique would have highlighted the possible death of this mistletoe because of the simple action of banding the tree to prevent possum access.

This example has a parallel in the management of another threatened plant in the Wanganui Conservancy. The release of rabbit calicivirus disease (RCD) to control rabbits has implications for the only known population in New Zealand of *Sebaea ovata*, an annual gentian growing in ephemeral wetlands at Whitiua Scientific Reserve. Cameron *et al.* (1995) rate it as Critical; Molloy and Davis (1994) as Category A. Invading pasture grasses and rosette weeds are competing with *S. ovata*. Rabbits maintain these weeds at a low level that allows *S. ovata* to establish and grow. Rabbit scratchings in the sandy soil also bare sites where *S. ovata* seedlings may establish. Removal of rabbits will possibly allow the weeds to flourish and out-compete the *S. ovata* (Norbury, 1996).

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